Pretty Good Governance: Balancing policy drivers and stakeholder interests in developing fisheries ecosystem plans.

By

Thomas Michael Fitzpatrick

PhD Thesis

National University of Ireland, Cork, Ireland.
Department of Geography.

Head of Department: Professor Donald Lyons
Supervisor: Professor Robert Devoy

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TABLE OF CONTENTS

Declaration

The thesis submitted is the candidate's own work and has not been submitted for any other degree, either at University College Cork, or elsewhere.

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Abstract

The central research question that this thesis addresses is whether there is a significant gap between fishery stakeholder values and the principles and policy goals implicit in an Ecosystem Approach to Fisheries Management (EAFM). The implications of such a gap for fisheries governance are explored. Furthermore an assessment is made of what may be practically achievable in the implementation of an EAFM in fisheries in general and in a case study fishery in particular.

The research was mainly focused on a particular case study, the Celtic Sea Herring fishery and its management committee, the Celtic Sea Herring Management Advisory Committee (CSHMAC). The Celtic Sea Herring fishery exhibits many aspects of an EAFM and the fish stock has successfully recovered to healthy levels in the past 5 years. However there are increasing levels of governance related conflict within the fishery which threaten the future sustainability of the stock.

Previous research on EAFM governance has tended to focus either on higher levels of EAFM governance or on individual behaviour but very little research has attempted to link the two spheres or explore the relationship between them. Two main themes within this study aimed to address this gap. The first was what role governance could play in facilitating EAFM implementation. The second theme concerned the degree of convergence between high-level EAFM goals and stakeholder values.

The first method applied was governance benchmarking to analyse systemic risks to EAFM implementation. This found that there are no real EU or national level policies which provide stakeholders or managers with clear targets for EAFM implementation.

The second method applied was the use of cognitive mapping to explore stakeholders understandings of the main ecological, economic and institutional driving forces in the Celtic Sea Herring fishery. The main finding from this was that a long-term outlook can and has been incentivised through a combination of policy drivers and participatory management. However the fundamental principle of EAFM, accounting for ecosystem linkages rather than target stocks was not reflected in stakeholders cognitive maps.

This was confirmed in a prioritisation of stakeholders management priorities using Analytic Hierarchy Process which found that the overriding concern is for protection of target stock status but that wider ecosystem health was not a priority for most management participants.

The conclusion reached is that moving to sustainable fisheries may be a more complex process than envisioned in much of the literature and may consist of two phases. The first phase is a transition to a long-term but still target stock focused approach. This achievable transition is mainly a strategic change, which can be incentivised by policies

and supported by stakeholders. In the Celtic Sea Herring fishery, and an increasing number of global and European fisheries, such transitions have contributed to successful stock recoveries. The second phase however, implementation of an ecosystem approach, may present a greater challenge in terms of governability, as this research highlights some fundamental conflicts between stakeholder perceptions and values and those inherent in an EAFM. This phase may involve the setting aside of fish for non-valued ecosystem elements and will require either a pronounced mind-set and value change or some strong top-down policy incentives in order to succeed. Fisheries governance frameworks will need to carefully explore the most effective balance between such endogenous and exogenous solutions. This finding of low prioritisation of wider ecosystem elements has implications for rights based management within an ecosystem approach, regardless of whether those rights are individual or collective.

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This thesis is dedicated to the memory of my dad, Tommy, who passed on to me his love for fishing and particularly for Herrings so I can blame it all on him!

Acronyms Used

AHP – Analytic Hierarchy Process
CBD – Convention on Biological Diversity
CFP – Common Fisheries Policy
CSHMAC – Celtic Sea Herring Management Advisory Committee
DPSIR – Driver-Pressure-State-Impact-Response
EA – Ecosystem Approach
EAFM – Ecosystem Approach to Fisheries Management
EBM – Ecosystem Based Management
EIA – Environmental Impact Assessment
ESD – Ecologically Sustainable Development
FAO – UN Food & Agriculture Organisation
LAC – Local Advisory Committee
LME – Large Marine Ecosystem
LTMP – Long Term Management Plan
MPA – Marine Protected Area
MCDM – Multi Criteria Decision Making
PES – Payment for Ecological Services
PO – Producers Organisation
RAC – Regional Advisory Council
RBM – Results-Based Management
RFMC – (US) Regional Fisheries Management Council
RSW – Refrigerated Sea Water
SAG – Species Advisory Group
SES – Social Ecological Systems
SSB – Spawning Stock Biomass
TAC – Total Allowable Catch
TCM – Technical Conservation Measure
UNCLOS – United Nations Convention on the Law of the Sea
UNGA – United Nations General Assembly

FIGURES

Tables

Chapter 1 Introduction

1.1. Research Background and problem definition

The central question that this research aims to address is whether there is a gap between stakeholder values and the principles and policy goals implicit in an Ecosystem Approach to Fisheries Management (EAFM). Furthermore the implications of such a gap for fisheries governance are explored. The dissertation concludes with an analysis of what may be practically achievable in the implementation of an EAFM in a case study fishery in particular and fisheries in general.

The author's interest in this research area stems from his experiences working for a fishermen's organisation from 2001 to 2007 where strong reservations about the fisheries governance system under the European Common Fisheries Policy (CFP) were frequently expressed. These reservations included legitimacy and democratic deficit issues with the CFP itself and frustration with the exclusively biological focus of traditional fisheries management. These issues are analysed in detail in Chapter 4, Section 4.2.

During the development of both the Celtic Sea Herring Recovery Plan and the Long Term Management Plan a desire was expressed by a range of participants to broaden the narrow scope of objectives of the plans, which address biomass and fishing mortality levels but no wider economic or social goals. The author experienced first hand the consequences of this narrow focus in the dysfunctional route through which social and economic concerns are introduced to the fisheries governance process via political lobbying activities at Council of Fisheries Ministers in Brussels each December.

Recognition of the complexity and uncertainty inherent in fisheries systems is evidenced in the increasing application in fisheries of multi-disciplinary research frameworks such as co-management theory (Wilson *et al*., 2003), the interactive governance framework (Kooiman, 2005) and Social-Ecological Systems (SES) theory (Charles, 1995, Berkes and Folke, 1998, Ommer *et al*., 2010). Another important theoretical reference point is Rittel and Webber's (1973) characterisation of intractable management issues within complex social-ecological systems as "wicked problems".

In recent debates over what is the most effective solution to these "wicked problems" in fisheries management the EAFM has been dominant (Bavington, 2010; Hilborn, 2011) and the EAFM was embedded as the overarching framework for the 2002 CFP. The principles of an ecosystem approach also included a strong emphasis on stakeholder participation with the potential therein to address fishermen's concerns about legitimacy and democracy. The general responses of fishermen to the EAFM were highly guarded however on the basis that anything with the word ecosystem attached may be driven by an environmentalist agenda. A research interest thus developed in how individual stakeholders perceptions and values would match with the developing EAFM discourse, and whether or not there was a possibility of a more productive and inclusive fisheries governance regime than that previously experienced. Song *et al.*, (2013) also link the spheres of governance and individual perceptions: "*the normative and cognitive concerns of fishery stakeholders are what underpin the overall governance process, guiding, shaping and inspiring decisions and actions*." This interest in both the meta- and micro-governance spheres dictated the choice of methodology ranging from governance benchmarking at the higher level to cognitive mapping at the individual level. The interactions between these methods are described further in Chapter Two with detailed descriptions of specific methods being given in the relevant empirical chapters.

The concepts of the EAFM, participatory fisheries governance and social-ecological systems occur frequently throughout this dissertation. While they are discussed in further detail in Chapters 2 and 3 an introduction to their relevance and meaning is appropriate here.

This research was conducted within a wider project exploring the development of an EAFM in Irish fisheries which reinforced the authors interest in the topic. While understandings of the Ecosystem Approach vary (Yaffee, 1999), often depending on the values held by those doing the defining, an analysis of the literature shows that EAFM is often perceived as a complex systems approach requiring attention to multiple domains (Section 3.2). The FAO emphasises societal-ecological interactions in its definition:

"*An ecosystem approach to fisheries strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries*" (FAO, 2003).

The definition above and an examination of the principles behind it beg the question of whether the term Ecosystem Approach is a misleading one and one of the reasons why debates continue as to its meaning. Perhaps a more informative and less politically divisive term would be the Social-Ecosystem Approach (SEA).

Within this research the more fisheries specific EAFM is generally used and is the main focus rather than the broader more sectorally integrated EA concept. There is some difficulty with this restriction as fisheries are only part of the overall set of impacts on and uses of marine ecosystems. Nevertheless the concept of EAFM as an expansion of traditional fisheries management is useful in terms of defining a pragmatic scope for the research while remaining cognisant that fisheries represent only a partial representation of overall marine resource governance.

Two factors inherent in this social-ecological framing of EAFM also justify an emphasis on participatory governance over the narrower concept of management. The first is the emphasis on diverse societal values and activities which were largely outside the scope of traditional fisheries management. The second is the increased uncertainty inherent in moving from specific stock-focused management to broader ecosystem concerns with limited information. The use of the word governance throughout this dissertation can be taken as shorthand for the following definition which captures well the interactive and participatory nature of the term: "*Governance is the whole of public as well as private interactions taken to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them*" (Kooiman et al, 2005).

Tim Gray, in the final paragraph of his book "Participation in Fisheries Governance" (2005) concluded that: "*Participation, despite its flaws, is an inescapable part of fisheries governance and the link between participation and the ecosystem-based approach, notwithstanding its fragility, is a crucial assumption of fisheries governance".*

This research picks up governance related developments in the ecosystem approach and in particular it explores whether ecosystem-based fisheries management plans, that have the support of local stakeholders, can be developed. Answering the question of what is practically achievable from a governance perspective in implementing an EAFM

is only possible by examining both bottom-up and top-down features of the fishery system and the research themes and questions outlined below explore further associated facets of this primary question. The issues referred to in the sections below on Research Themes 1 and 2 are contextualised and discussed in greater detail particularly in Chapter 3 but also in Chapters 2, 4, 5 and 6.

The Celtic Sea Herring fishery, and specifically its governance arrangements and participants were selected as the main focus of this research. A brief account of how the governance of the Celtic Sea Herring fishery encapsulates this dissertations research issues outlined is given below.

1.1.1. The recent history of the Celtic Sea Herring fishery

In the 2003/2004 season six fishing vessels participated in the Celtic Sea Herring fishery and the Spawning Stock Biomass (SSB) was estimated to be 29,000 tonnes. This was very close to the lowest on record when the stock had previously collapsed and was closed for five years from 1977 to 1982. The 2004 stock was predominantly composed of 1- and 2-year-old fish and the overall feeling within the management advisory forum was that another complete closure of the fishery was a strong possibility. The total first sale value of the fishery was approximately €200,000. This was a disastrous scenario for a fishery, which in earlier years involved over 100 vessels, and seasonally employed over 1500 people in processing factories alone (Molloy, 2006).

Fast-forwarding to 2012, we find that the stock has made an excellent recovery close to historically high levels. The Total Allowable Catch (TAC) has increased by over 300% in 4 years but is constrained by highly precautionary fishing mortality rules prescribed under the Recovery Plan jointly developed and agreed by scientists and industry through the management advisory forum.

Medium-sized fishing vessel steaming in to Cork to land Herring, September, 2011.

Over the same period from 2004 to 2012 the stakeholder-led management forum has persisted and strengthened and attitudinal changes with regard to management objectives have also been evident. Where previously the principal management objective was to maintain an annual TAC of 20,000 tonnes this fixed goal is seldom mentioned now. A more flexible and precautionary approach is evident in the management process and the recently agreed Long Term Management Plan (LTMP). Change is also evident when looking at fisheries management and market interactions. In the 1980s and early 1990s the main market for the fishery was in Japan for roe. However, a general recognition of the negative impact on the stock of fishing for this market meant that in 2011 with Japanese roe prices buoyant again the option of re-opening a roe fishery was unanimously rejected (personal notes from observations of management meeting, 30th August 2011).

A quick roll call of the elements or principles, which are frequently listed in the EAFM toolkit, reveals that many of them are in evidence, at least to some degree, in the recent management approach applied to Celtic Sea Herring. These include:

- A **precautionary** approach to TAC and fishing mortality leading to a recovery of the stock;

- A **participatory** management approach which facilitated agreement of the strategy above;
- Use of **spatial** management and closed areas;
- Broadening the **knowledge-base** through fisheries-science partnerships;
- Market **incentives** towards the use of more sustainable fishing practices.

These successes may also be having a wider ecological benefit as Humpback Whales have been resident in the area during recent winters and have been observed feeding on the renewed supply of Herring (Irish Whale and Dolphin Group, 2011; 2012).

If only fisheries management were this simple! Despite all of these positive factors there are some fundamental problems with the Celtic Sea Herring fishery which represent a threat to future sustainability. Not least is the fact that the fishery has been in managed under a *de facto* open access situation so despite the fact that the stock and TAC have increased so has the number of participating vessels and also conflict between fishers as quota allocations and economic returns at the vessel level have declined. Views on how best to deal with this issue have differed greatly and created threats and tensions between groups of fishermen and between individuals. So a highly successful stock recovery has not thus far been translated into socio-economic benefits. In spite of the brief and simplistic description given, Celtic Sea Herring fisheries management is a complex arena, where ecological, social, economic and political facets interact. It is no different to other fisheries in Europe and globally in this respect.

Inshore Celtic Sea vessel filled with herring caught with drift nets circa 1980.

1.2. Research themes and questions

1.2.1. Research Theme 1 – The role of governance in EAFM implementation

Fisheries governance expands on traditional fisheries management, which has been mainly focused on biological objectives, to include the combined scientific, social, economic and political arrangements affecting or used by multiple actors.

A governance perspective, with its domain-spanning emphasis, is also an alternative viewpoint to prescriptive idealised perceptions of how fisheries management should work and the recurring insistence on panaceas (Degnbol *et al*., 2006). ITQ's, closed areas and co-management have all been promoted as **the** solution to fisheries management problems by various groups.

Hardin's tragedy of the commons paper (1968) and his narrow range of solutions is perhaps the most famous fisheries panacea which despite its flaws is still regularly cited uncritically. Hardin framed the commons problem as being one of open access to a common resource, concluded that overexploitation is inevitable under such circumstances and prescribed two possible solutions, one of strong central government and the other involving the restriction of access and the creation of property rights. However the complex nature of fisheries systems mean that narrowly focused solutions tend to address some aspects successfully while neglecting or exacerbating other problematic aspects (Ostrom, 2007).

There are fisheries scientists who believe that if we look after the fish everything else will fall into place (Lackey, 2004). Evidence however, from fisheries such as Celtic Sea Herring and many others would contradict such a bio-centric viewpoint. This issue relates also to the objectives of fisheries management and how we define success (Hilborn, 2007). If our objectives are to include social and economic factors then governance must be attended to. Khan & Neis (2010) contrast stock recovery with the broader challenge of fishery rebuilding and emphasise the added value of governance over conventional fisheries management: "effective governance is essential for stock recovery and it is even more essential to rebuilding fisheries and to sustaining them once rebuilt".

The research within this theme has a particular emphasis on how governance arrangements can foster or inhibit the assumption of responsibility by industry stakeholders. This link between governance and responsibility was identified in the EU Commission Green Paper on CFP Reform in 2009 as one of the five key problems with the CFP: "*in a mostly top-down approach, which has been the case under the CFP so far, the fishing industry has been given few incentives to behave as a responsible actor accountable for the sustainable use of a public resource*".

1.2.2. Theme 1 Research Questions

1. How have past and present governance arrangements created opportunities for and barriers to EAFM implementation?

2. What can we learn from governance arrangements in fisheries such as Celtic Sea Herring where some success in stock recovery has been made?

3. What balance between top-down and bottom-up drivers best incentivises the assumption of responsibility and EAFM implementation?

4. What further practical governance changes can be made so as to build on the opportunities for EAFM implementation?

These questions are addressed through the development of a governance baseline for Irish fisheries, which essentially is the analysis of Irish fisheries policy over time combined with stakeholder mapping and governance benchmarking. The implications and prospects for results-based-management and a reversal of the burden of proof in three Irish fisheries are analysed also.

The Celtic Sea Herring fishery was selected as a detailed case study as it is the only large scale Irish fishery with a dedicated management forum and also one of the few where a stock recovery has occurred. Although all aspects of the fishery may not be ideal the stock recovery alone makes it an interesting case study in that it bucks the trend of European fisheries of which, according to the 2009 CFP Green Paper, 85% were fished beyond Maximum Sustainable Yield (MSY) (European Commission, 2009). Khan and Neis (2010) state that globally also, examples of stock recovery are few. It is interesting to explore why precautionary management decisions were made in this fishery which

were not possible in others. In this respect this research follows Ray Hilborn's (2007) advice to look to successful fisheries rather than failures if we want to learn how to move forward.

1.2.3. Research Theme 2 – Exploring the gap between high level EAFM policy goals and stakeholder values

A steady flow of high-level policy papers, academic analyses and guides to implementation has been produced in the past 20 years relating to the EAFM. It is, theoretically, the bedrock upon which the EU Common Fisheries Policy has been built since 2002 (European Council Regulation No. 2371/2002). Yet, in interviews, when fishermen were asked what they understood by the ecosystem approach there was generally an awkward silence. Even fishermen's representatives had a very hazy understanding of EAFM. So it would appear that the approach that is being championed by many as the means to deliver sustainable fisheries means essentially nothing to those who will be most impacted by it.

This is not unexpected – a fisherman's job is to catch fish and not to be expert in the fine detail of the latest fisheries management theory. It is arguable that someone doesn't have to understand a management strategy in order to benefit from it. However it does signify a major risk - what is important here is to understand the degree to which fishermen's held beliefs and values are aligned with those inherent in an EAFM. Dubbink and van Vliet (1996) describe three governance levels, the macro-level of state and inter-state bureaucracy, the meso-level of civil and private organisations and the micro-level of individuals. Co-management and interactive governance perspectives emphasise that good governance requires a greater input from the meso- and micro-levels. Grafton *et al.*, (2007), allude to the same issue when they describe the challenge of connecting higher-level ecological goals with day-to-day management decisions as the missing link in fisheries governance.

1.2.4. Theme 2 Research questions:

5. What are the main principles and conceptions of an ecosystem approach?

6. How do a range of stakeholders perceive the functioning of a case study fishery system and what are their management objective priorities for it.

7. Can fisheries stakeholders develop fisheries ecosystem plans that are meaningful for them and that satisfy high level requirements?

8. To what extent is it possible for fisheries stakeholders to assume the burden-of-proof[1] with respect to environmental impacts of fishing?

These are important questions as concepts such as participation, greater assumption of responsibility and stewardship are redundant in the absence of at least some shared values to build on. Research has shown that behaviour will not change where there is no alignment between formal rules and social norms (Rudd, 2004) and that participation under such conditions becomes more about co-opting and manipulating than empowering (Cooke and Kothari, 2001). Adopting a participatory approach is one of the EAFM's most frequently cited principles. Song et al (2013) posit that fisheries governance challenges could be lessened "if stakeholders' values, images, and principles are made explicit, understood, and articulated into the policy and decision-making process".

The research questions under both of these themes are focused on issues which range from high level policy to individual mental models. A criticism of my approach taken here could be that these belong to different spheres which are not relevant to each other. However the gap between these spheres is the interface between the governing system and the system to be governed, which Jentoft and Chuenpagdee call "governability" (2007).

1.3. Chapter Structure

Chapter 2 is a discussion of the overall methodological approach and how it addresses the research questions. The research perspective and the benefits of a mixed-methods

[1] *Reversing the burden-of-proof in the context of fisheries management relates to the idea that fishermen should have to adhere to the same restrictions as other industries and prove that their activities do not cause undue environmental damage. It was proposed as a potential solution both to a lack of industry responsibility and also a micromanagement problem in the EU Commission's Green Paper on CFP reform, 2009.*

approach when dealing with complex and uncertain problems are discussed and the choice of methods used is justified. The combination of traditional social science methods such as participant observation and interviews with the more innovative techniques of governance benchmarking, cognitive mapping and analytic hierarchy process are detailed.

In Chapter 3 the literature on EAFM is reviewed and some of the diverse perceptions of it are discussed. The principles of EAFM and the ways in which it represents a change from conventional fisheries management are summarised from numerous literature sources. The application of EAFM in a number of countries is analysed. In particular the literature on governance elements of EAFM, such as co-management, results-based management and property rights, is examined.

Chapter 4 presents a governance baseline for Irish fisheries. This includes an analysis of Irish fisheries policy and how it is influenced by the Common Fisheries Policy, a discussion of the failure of co-management in Irish inshore fisheries, a stakeholder mapping assessment and a governance benchmarking exercise for three Irish fisheries. The chapter concludes with a summary of significant building blocks and obstacles towards the implementation of fisheries ecosystem plans in an Irish context. This chapter has been accepted for publication in a forthcoming book; "Social issues in sustainable marine fisheries management", to be published in 2013 by Springer.

Chapter 5 develops out of the broader governance approach covered in Chapter 4 and focuses on the individual and group perceptions of stakeholders. It forms an analysis of the cognitive maps of a range of participants in the management of the Celtic Sea Herring fishery. Cognitive maps provide graphical descriptions of unique ways in which individuals view a particular domain (Axelrod, 1976). Cognitive mapping has been shown to be useful in complex resource management situations characterised by high levels of complexity and uncertainty and low levels of data availability (Özesmi and Özesmi, 2004). These maps are analysed at both individual and group level to examine their complexity, the centrality of a variety of drivers of change, and interactions and trade-offs between elements. At an aggregated or group level the cognitive map can be used to expand the knowledge base for management of the system and to assess how the collective mental model relates to the governance strengths and weaknesses identified in Chapter 4. Furthermore from the interviews and maps a suite of objectives

for a fisheries ecosystem plan are identified. These objectives are prioritised in Chapter 6.

Chapter 6 sets out fisheries governance objectives for the Celtic Sea Herring Management Advisory Committee (CSHMAC). This is done through application of the Analytic Hierarchy Process (AHP), which is a multi-criteria decision-making method (Pascoe *et al.*, 2009). The objectives differ from both the existing CSHMAC objectives and those contained in the Long Term Management Plan and Marine Stewardship Council certification commitments, in that they cover all aspects of the management system rather than being focused on a particular facet of it. Additionally, the AHP analysis reveals how stakeholders prioritise the objectives both across and within the socio-economic, governance, biological and ecosystem domains.

Chapter 7 examines potential approaches to reversing the burden of proof under co-management and results-based management (RBM) regimes. Current approaches to reversing the burden of proof in fishery management are discussed, the implications of using *in situ* and *ex situ* indicators, and the potential for RBM to address the major environmental impacts of fishing. The prospects for implementing RBM in three Irish fisheries are assessed.
This chapter was published in 2011 in the ICES Journal of Marine Science (Fitzpatrick *et al*., 2011).

Chapter 8 firstly synthesises the principle research findings under research themes 1 and 2. The theoretical and policy implications of these findings including opportunities for building a stakeholder supported ecosystem approach are discussed. Capacity building recommendations towards the implementation of fisheries ecosystem plans are given. Finally, a description of the term "pretty good governance" is given, in short a pragmatic approach to what is achievable in a fisheries system and how such an approach can achieve more than the designing of idealised governance regimes.

Chapter 2 Methodological Framework

This chapter is a discussion of the overall methodological perspective and approach to the research questions described in the first chapter. More detailed descriptions of the specific methods used are contained in the chapters dealing with empirical data. To a large extent the issues researched were dependent on individual and group preferences and values rather than concrete scientific factors. The benefits of a mixed-methods approach, combining mainly qualitative but also quantitative elements, when dealing with such contested and complex issues are described.

2.1. Research perspective

The author's professional, academic and personal experiences with fisheries have led to the conclusion that there are no simple, universal solutions to fisheries or other natural resource management problems. Existing European management measures and frameworks and many that are still being proposed, usually over-emphasise one panacea or another and do not take into account the inherently complex social and ecological dynamics (Degnbol and McCay, 2007). This issue is discussed in further detail in the literature review (Chapter 3). A Social-Ecological Systems (SES) approach to natural resource management appears to be a more appropriate research framework for real world governance issues as it does not draw arbitrary boundaries between ecological and human domains (Charles, 2001; Olsson *et al*., 2006). SES's have been defined as "integrated complex systems that include social and ecological subsystems in a two-way feedback relationship" (Berkes, 2008). Within this framework clear delineations between social and ecological systems are considered arbitrary and in fisheries the framework is expanded from its previous emphasis on fish stock biology to include social, economic and political factors (Charles, 2001; Khan and Neis, 2010). This framing of natural resource governance issues has methodological implications, or as succinctly put by Glaser et al (2008) "the complexity of social-ecological relations precludes a reductionist approach".

The move to a broader conception of fisheries research implies that the question of "what is valid knowledge in relation to fisheries?" is opened up from a primarily biological and scientific answer. The regular and unproductive disagreements between fishermen and scientists on who is right and who is wrong in relation to the state of fish stocks can be seen as a conflict between two epistemological positions. Most scientists

adopt a positivist position which can be summarised as viewing science as a dispassionate, objective and transparent process and the only valid source of knowledge (Maxwell, 2012). Isaac Newton probably spoke for many scientists when he described rigorously determined scientific findings as being "very nearly true". On the other side of this debate fishermen embody something closer to a position of naive or common sense realism, which holds that all forms of knowledge are valid when constructed through direct experience. The move towards SES approaches and the expansion of valid objects of research provides a way out of such fruitless epistemological conflicts. Scientific versus non-scientific validity conflicts are replaced by a focus on areas of expertise in both arguments (technical assessments in the case of science and operational and behavioural implications in the case of industry), and analysis of how and where they can inform each other.

As much of this thesis was focused on values and perceptions the objective validity of respondents arguments was considered to be less important than how their attitudes and behaviour were affected. Simply put there are no right or wrong answers when discussing preferences, values and politics. This research accommodated subjectivity as it is subjective beliefs rather than objective "truths" which drive individual behaviour. If a respondent held the view that pilchards are juvenile herring or that the fisheries minister has a personal vendetta against him it did not rule him out of the research. What is important is that those perceptions form the respondent's ecological and social reality and his behaviour will be influenced accordingly. In order for a governance system to function well these subjective attitudes and cognitive conflicts have to be understood and accounted for (Adams *et al.*, 2003). By moving beyond conflicts about who is right and who has the most power behind their argument an emphasis on multiple perspectives opens up a space for social and scientific learning to occur through the development and testing of shared models. This approach is evident in the environmental pragmatism movement (Norton, 1991), which looks to move beyond principle-based environmental fundamentalism and towards more practical and fruitful engagement.

2.2. The Researcher as an Insider

In most research which utilises qualitative elements such as participant observation and interviews developing detailed contextual knowledge and gaining the trust of

respondents is an issue for researchers, at least in the initial stages. In this research the author was very much of an insider in that he was well known to all and previously employed by some of the respondents. A number of advantages to conducting insider research when dealing with complex and value-laden subjects have been cited. The researcher may already have the kind of detailed knowledge unavailable to the outsider which is invaluable when it comes to analysis and interpretation and also respondents may talk more freely to someone known to them (Denzin and Lincoln, 2011). However this familiarity raises the issue of subjectivity and the risk of over-rapport between researcher and respondents. While it would be impossible for the author to claim to have a truly objective position in the strictest sense it should not be assumed on the other hand that insider status automatically implies damaging levels of subjectivity. Ratner (2002) has highlighted the role of research reflexivity in mitigating against subjectivity; "subjectivity can bias the researcher and preclude objectively understanding a subject's psychological reality. However, this is not inevitable. In fact, one of the advantages of recognizing subjectivity is to reflect on whether it facilitates or impedes objective comprehension." In any case the concept of the truly objective, unbiased researcher has been questioned and in many cases rejected both in the social sciences (Letherby *et al.*, 2012) and natural sciences (Allen *et al.*, 2001). So an acknowledgement of a level of subjectivity combined with reflection on the possible impact of it, is likely to be a more robust and valid strategy than an assumption of objectivity without any associated checks and balances. The use of a mixed methods approach, as detailed below in Section 2.4 promotes reflexivity as the process of looking at the case and the data from multiple angles "puts the researcher in a frame of mind to regard his or her own material critically" (Maxwell, 2012). Another strategy aimed at combatting the charge of being overly subjective is transparency about the research method, process and results (Hammersley and Gomm, 1997). This allows any interested party to check the validity of the process and the conclusions reached by the researcher.

2.3. Case Study Research

Although much of the research was focussed on a single case study fishery a review of some global examples of EAFM implementation was also conducted. Several Irish fisheries were also analysed for comparative purposes. It was felt that a case study approach was the most appropriate in order to get the level of detail required to understand the complexities of a specific natural resource governance issue.

Case-studies and ethnographic descriptions were the mainstays of early social science research methods (Poteete *et al.*, 2010). During the early twentieth century the desire to emulate the natural sciences created a strong move towards quantitative methods and statistical analysis of large-N data sets. Within this quantitative paradigm the validity of case study research for anything other than exploratory research was questioned. Towards the end of the twentieth century a gradual rehabilitation of the status of the case study commenced, driven in part by a recognition of its ability to describe in detail the links between ecological and social strands in natural resource systems. Additionally the realisation that social science was not producing universal theories or laws of human behaviour has led to a return to methods which explore context and case-based processes more closely (Flyvbjerg, 2006). Maxwell (2004) states that case study research is far more suited than quantitative methods to analysis of "local causality" or "the events and processes that lead to specific outcomes". Specifically he states that large-N surveys rarely have the depth of analysis to access direct information about social, cognitive and political processes which often determine outcomes. This is directly relevant to a number of the research questions. Understanding how individual conceptions of system functioning matched with high level EAFM principles requires a detailed approach suited to a case-study.

Flyvbjerg (2006) claims that case studies can contribute to generalisation if they are atypical cases as they can illustrate solutions or problems that are not apparent in more typical cases. The case-study in this research, the Celtic Sea Herring fishery, fulfilled the criteria of being atypical in a number of respects: it is one of the few European fisheries where the fish stock has comprehensively recovered and where precautionary management decisions were made. It also features a management committee mainly composed of industry stakeholders working in partnership with scientists, which has persisted over many years despite a deteriorating stock trend over most of that time which raises the question of why participation was maintained.

Flyvbjerg also claims that case studies are particularly well suited to acting as "black swans" - to providing the single instance of falsification which can cause a theory or hypothesis to be rejected. This was also relevant to the Celtic Sea Herring case study as it provided an opportunity to test hypotheses about social learning and participation in resource management and about the ecological knowledge of fishermen.

2.4. Research Steps and Methods Applied.

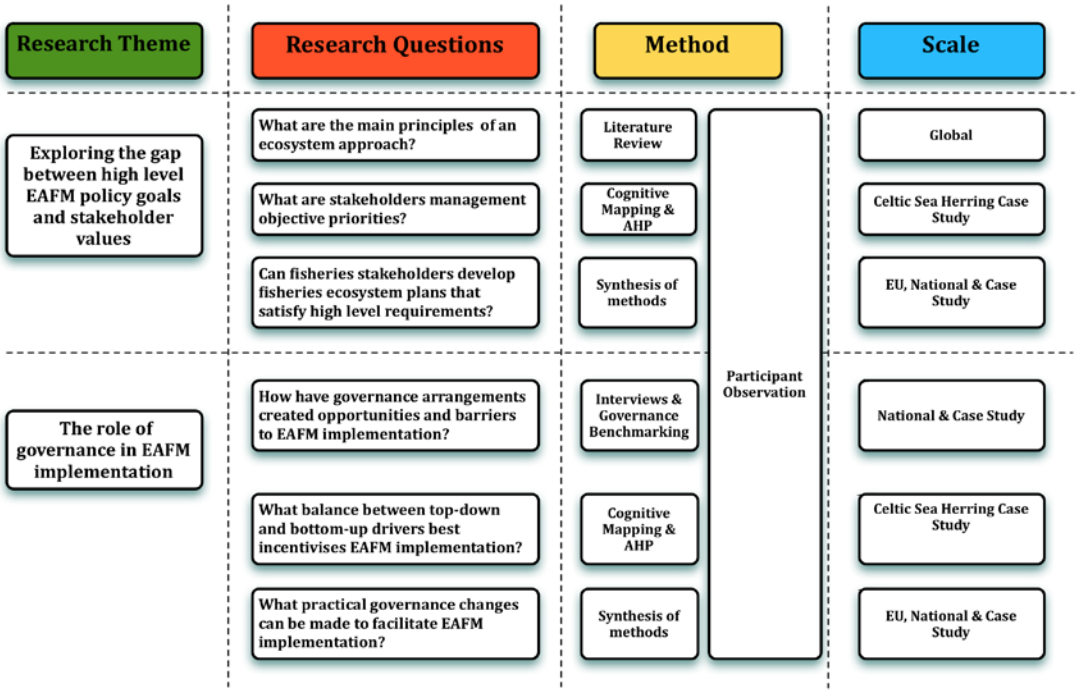
Carlsson & Berkes (2005) outlined a methodological framework for breaking down complex SES into more manageable tasks to facilitate analysis. The 6 steps in Carlsson and Berkes' analytic framework are to:

1. Define the social-ecological system under focus.
2. Map the management tasks to be performed and the problems to be solved.
3. Clarify the participants in management activities and related problem-solving activities.
4. Analyse temporal and spatial linkages.
5. Evaluate capacity-building needs.
6. Prescribe improvements.

Carlsson & Berkes paper was a significant influence on the attempt to develop research questions and a methodological framework which could account for the complexity of the fishery case-study system yet at the same time produce useful results. While their sequence of steps was not slavishly followed their framework was pragmatic and useful.

Figure 2.1 shows the relationship between the methods used, the research themes and questions and the scale to which the analysis was applied. As the research questions involved analyses of both systemic factors (governance) and atomistic elements (values) a variety of methods were required. Multiple methods, some of which could accommodate complexity, but which were less useful in generating practical management outputs, and some which were more reductive but produced practical outputs, were also selected. No single method could address the range of research questions across the range of scales required. The use of mixed methods has been shown to create more robust results in SES analysis as it can mitigate against the shortcomings, constraints or systematic biases of single methods (Poteete, Janssen *et al.*, 2010). Limb and Dwyer (2002) also suggest that methodological triangulation improves the reliability of the data and provides a more rounded picture of the object of research. The methods employed were chosen to complement one another in terms of the research questions they were addressing but to do so by analysis of different governance scales and by provision of a mixture of qualitative, semi-qualitative and quantitative outputs.

Figure 2.1 Research themes and questions, associated methods and relevant scales



The method which underpinned the research at all stages was participant observation. Fisheries sociologist Doug Wilson (2010) suggests that participant observation should be, but frequently is not, the core method for all social science research as it is the basis of social contextual understanding. Prior to conducting this research the author participated professionally in the case study governance forum, the Celtic Sea Herring Management Advisory Committee (CSHMAC), and the role included occasional chairing of forum meetings. During the course of this research that active role was replaced by more detached participant observation. As both a participant and an observer the author attended approximately 60 meetings of the CSHMAC between 2001 and 2012. This participation and observation served more than just to deepen the contextual understanding of the research issues but also allowed the testing of working hypotheses and to ground truth preliminary results obtained against actual behaviour and real world governance processes. Participant observation is the only method which allows the researcher to experience first-hand how political negotiations and power dynamics affect governance processes. Allied with detailed contextual knowledge this becomes a powerful method in ascertaining what are the real drivers of decision-making in a specific fisheries system. Although there is not a separate chapter on the participant observation method it formed an informal but critical method within the research

framework. The research goal was more exploratory than normative i.e. to explore what the perceptions were rather than to change them. Nevertheless the author was conscious of the need to maintain a two-way dialogue with the respondents and made a number of presentations at CSHMAC meetings on preliminary results. This dialogue was motivated by both the need for validation of research objects such as the hierarchy of objectives used in the Analytic Hierarchy Process (AHP) and also by the desire for a communicative rather than an extractive relationship between researcher and respondents.

Interviews with a range of participants in fisheries governance were also an important method at a number of stages of the research. The cognitive mapping method discussed below was based on a form of structured interview technique but semi-structured interviews were also conducted which contributed to Chapter 4 on governance benchmarking and Chapter 7 on results based management and reversing the burden of proof.

A literature review should not just be a box-ticking exercise but should form a critical stage in the methodological framework, outlining current theory within the research field, identifying relevant case studies and the gap which the research project aims to fill (Hart, 2008). The principal aims of the literature review were

a) to construct a baseline against which existing governance arrangements could be assessed, and
b) to derive an inclusive set of EAFM principles which would serve as a reference point against which individual mental models of the SES could be measured.

So the literature review (Chapter 3) formed a critical stage in addressing almost all of the research questions under both the first research theme, exploring the gap between EAFM policy goals and stakeholder values, and the second, analysing the role of governance in EAFM implementation.

Governance benchmarking is a policy analysis tool, which qualitatively evaluates the characteristics of a governance system. It provides a useful high-level stocktake of desirable governance elements and contributes to the understanding necessary to answer the research question on how governance arrangements can facilitate or hinder EAFM implementation. The evaluation within governance benchmarking is done from an external perspective, weighing the formal elements of a governance system against an idealised governance model derived from the literature review. It does not address

the interactions between governance elements nor individual responses to the governance system and the application of other methods was required for such analysis. The governance benchmarking method, process and results are described in detail in Chapter 4.

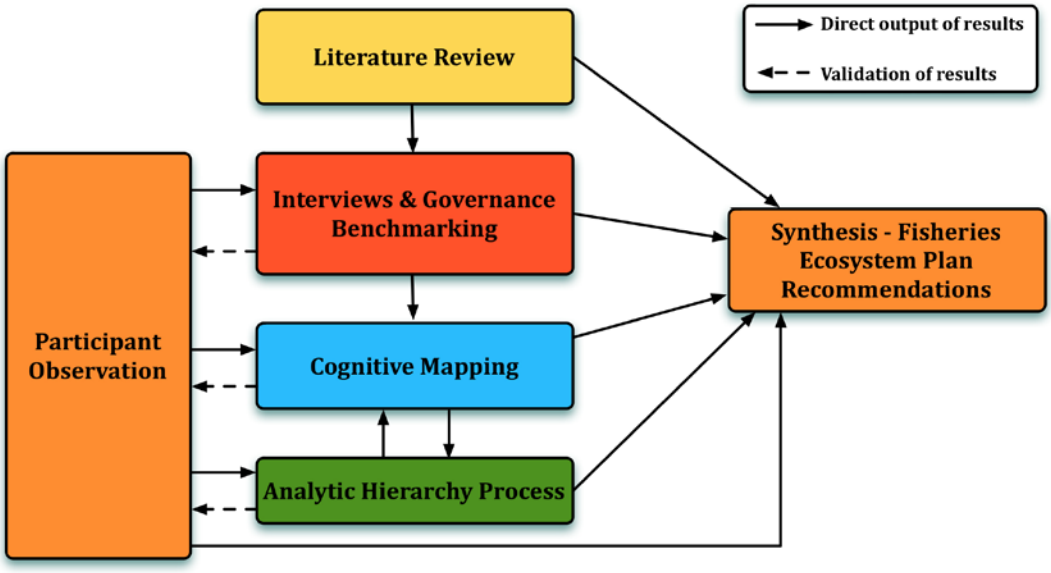
Cognitive mapping was the method within the research framework most capable of capturing the complexity of social ecological systems. The method as applied in this research involved in-person interviews and mental model elicitation sessions with CSHMAC participants. Relevant elements of the fishery system were mapped and the connections between the elements were described and weighted. Individual maps were aggregated together and an increasingly complex group system model was built up. The cognitive mapping method produced a detailed, semi-quantitative dataset integrating system elements across ecological, social, economic and political domains. The difficulty with the method is in distilling practical decision-tools from such complex data and this led to the employment of the AHP method. The application of cognitive mapping is described fully in Chapter 5.

AHP is a multi-criteria decision making (MCDM) tool which involves respondents making a series of relative value judgements to determine their overall preference. Although designed to assist decision-making in complex and data poor situations it is a more reductive approach and unlike cognitive mapping it requires the specification of a limited subset of system elements so that the number of comparative judgements does not become excessive. It was employed to assess what the management objective preferences were for CSHMAC participants. The list of management objectives drawn up was informed by all of the previous phases and also with the close co-operation of the CSHMAC chairman. The preference elicitation is cognitively very simple as only two elements are being compared at a time and this meant that an online survey was a suitable delivery mode. The outputs from the AHP phase were quantitative individual and group preference structures for management objectives for the CSHMAC. Chapter 6 contains a detailed description of the application of the AHP method.

The final methodological step, and that which most closely approaches system modelling, is the iterative use of the group model derived from the cognitive mapping phase to explore the trade-offs which would be required between the management objectives derived from AHP. The results of this exercise and numerous inputs from the other methods employed are synthesised into governance recommendations for a Celtic

Sea Herring Fisheries Ecosystem Plan in the concluding chapter. Figure 2.2 below illustrates the interactions between the research methods used.

Figure 2.2 Sequencing and interactions between the methods used



Chapter 3 Literature review of the EAFM, associated management tools and some global applications.

3.1. Introduction

Whenever fishermen and scientists are in a room together discussion is usually dominated by debates about the adequacy of fisheries science. At a meeting in Dublin airport in November 2009 to discuss the once-a-decade reform of the EU's Common Fisheries Policy (CFP) there was a recurring chorus from the fishermen present – "*We have to eliminate the uncertainty from the stock assessments*". Unfortunately this refrain was completely disconnected from the workshops focus which was the European Commissions Green Paper on CFP Reform (Commission, 2009). The Green Paper identified 5 key issues, all of which were related to governance of European fisheries and none of which touched on the topic of the quality of fisheries science. What should have been the elephant-in-the-room, if it had been allowed to enter the conversation, was the fact that the philosophical and operational foundation of the 2012 CFP would be the ecosystem approach. Moving from traditional single stock fisheries management to the more complex Ecosystem Approach to Fisheries Management (EAFM) has fundamental implications for uncertainty. Far from eliminating uncertainty, the EAFM will require much more sophistication in how it is dealt with.

Another example of how little traction the concept of an EA has gained in fishing industry circles (or to put it another way how wide the gap is between theory and practice) is the draft Long Term Management Plan (LTMP) for Celtic Sea Whitefish. This is a highly complex fishery, with over 100 species making up the catch, high discarding levels and some notable fishery impacts on the ecosystem (Marine Institute, 2011). The LTMP is currently being developed by the NWWRAC, which advises the European Commission, yet the draft plan does not even mention the EAFM.

This thesis aims to explore this contrast between scientific and institutional attitudes to the EAFM and those of the fishing industry. The following literature review explores a range of understandings of what an EAFM means, particularly in relation to its implications for governance. The review contrasts research that has focussed on "*magic bullet*" or panacea solutions with recent calls for "*mixed strategies to cope with multiple uncertainties*" (Grafton *et al.*, 2007). Critiques of the EA and implementation challenges that will have to be faced are also reviewed.

The literature on governance frameworks such as co-management and rights-based management is reviewed with respect to the effect that these approaches may have on EA implementation. Finally Australian and Canadian approaches to the EAFM are reviewed.

The other chapters in the thesis contain some additional review of the literature pertaining to the specific chapter topics.

3.2. What is the ecosystems approach to fisheries management?

An extensive body of literature exists on both the EA and the EAFM and often the practice within the literature is to avoid giving a definition as the approach taken will vary depending on regional, fishery and ecosystem contexts. The Bergen Conference of 2006 on Implementation of EAFM discussed the issue of defining it and concluded that a definition was difficult as EAFM is a tool which changes depending on context and scale, whether that might be a local inshore fishery or a large marine ecosystem.

In order to avoid the problem of the EAFM meaning everything and nothing we can use the definition contained in the 2003 FAO Guide to EAFM (FAO, 2003) as follows:

"An ecosystem approach to fisheries strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries".

A broader definition of the EA (Cortner, 1994) characterises it as *"a management philosophy which focuses on desired states rather than system outputs and which recognizes the need to protect or restore critical ecological components, functions and structures in order to sustain resources in perpetuity"***.**

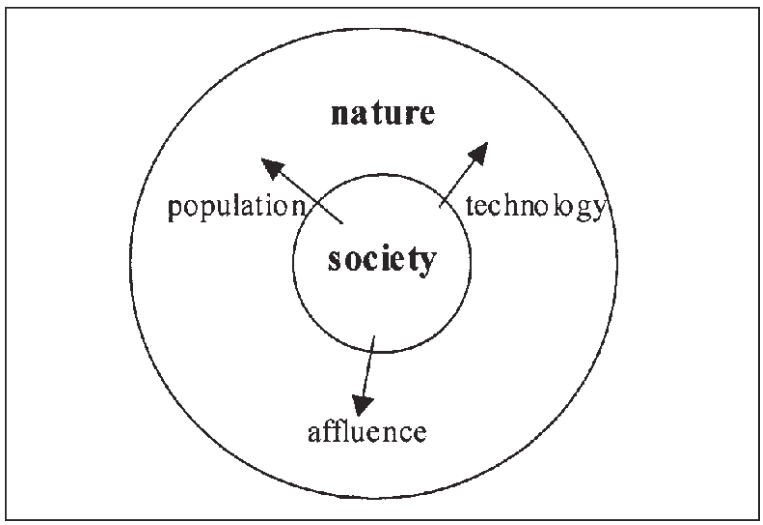
Enduring difficulties in defining, describing and conceptualising the EAFM are evident in the production of recent papers which try to answer the fundamental question of what the EAFM is and also attempt to dispel some EAFM myths (Link, 2002; Murawski, 2007; Morishita, 2008).

The EA is not a particularly concrete concept, it is more like a collection of management approaches and tools whose meaning and application is dependent on the decision makers worldview. The concept of an EA originated with environmental ecologists such as Aldo Leopold in the 1940s and Eugene Odum in the 1970s. So it had ecological conservation values as its starting point. The history or evolution of an EA can be seen as the attempt by ecologists to introduce conservationist values to a system driven by extractive values. In a marine context this "biocentrism vs. anthropocentrism" conflict has been characterised as viewing the sea as a farm vs. viewing the sea as a park (McCay and Wilson, 1997).

Conflicting perceptions of the meaning of the EA are evident in the fact that some definitions do not include any social considerations. For example the Packard Foundation, who fund environmental conservation research, define ecosystem-based management as "*distinct from other management types, because it is determined solely by natural science*" (Chuenpagdee and Bundy., 2005).

The Social Ecological Systems (SES) concept also attempts to accommodate both ecocentric and anthropocentric values. The FAO (2003) consider that humans cannot be considered as external to the ecosystem. Following this theme, Glaser (2006) describes a typology of human-nature mind maps and outlines the management implications of different mental models of society-nature relations. Three mental models described by Glaser, representing different attitudes towards human-nature relations, are: -

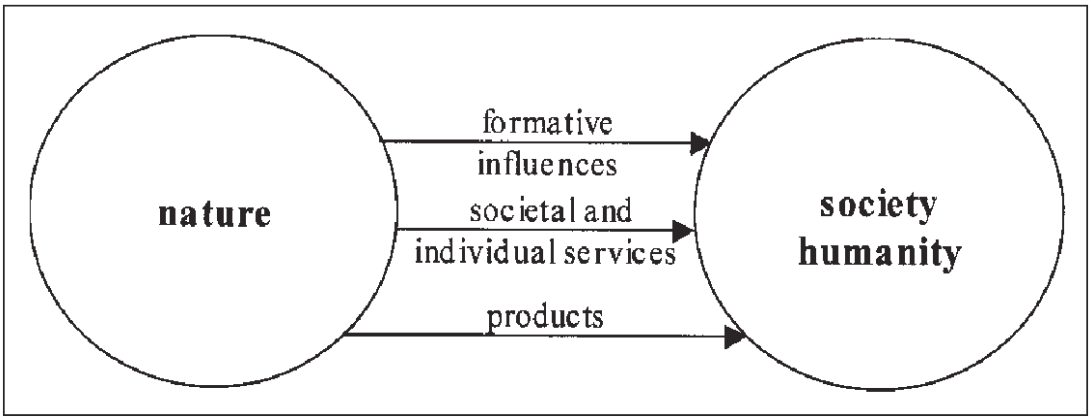
a) The "Pristine Nature and Society with anthropogenic drivers" model.



Source: Glaser (2006).

This is an ecocentric view of society-nature interactions in which anthropogenic impacts on the natural environment are invariably viewed as detrimental. Its main strengths are that it has been the driving force behind attempts to quantify human impacts on ecosystems and analytical concepts and frameworks such as "carrying capacity", "ecological footprint" and "Driver-Pressure-State-Impact-Response (DPSIR)" have all originated within this mental model. Its principal weakness is that the command-and-control management strategies based on this model, although biologically sound, have suffered from low compliance and implementation due to their limited understanding of and accounting for social drivers (Manuel-Navarrete *et al*., 2004).

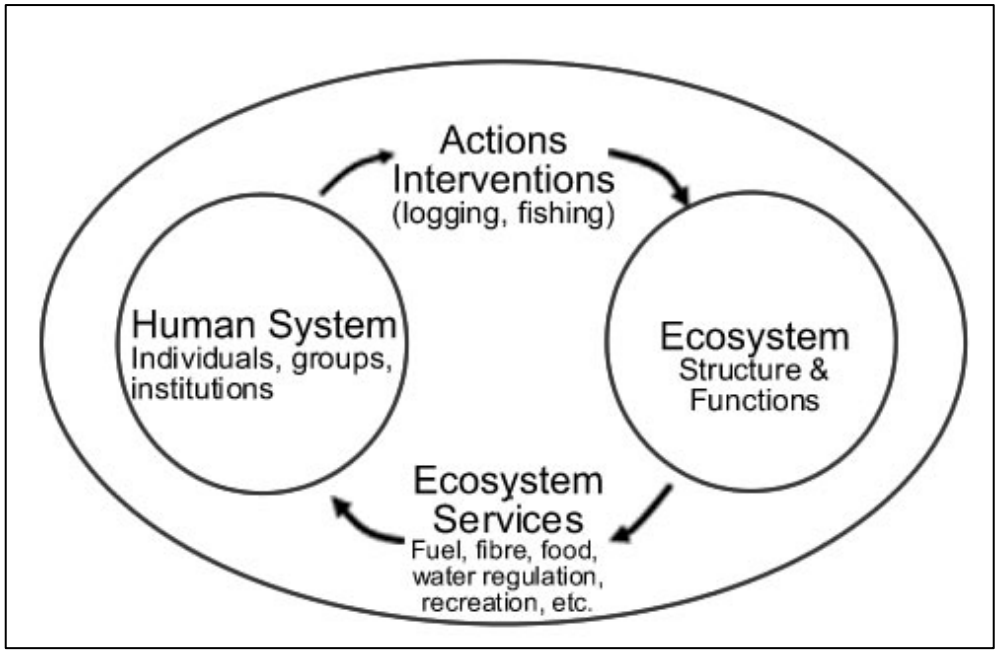
b) The "Nature-for-Humanity" model.



Source: Glaser (2006).

This anthropocentric model views nature as being defined solely in how it provides services for human usage. The main criticism of this model, also called "resourcism" is that it fails to recognise the limits of natural systems and that it produces a dangerously narrow definition of the value of natural resources (Pikitch *et al.*, 2004). It's emphasis on maximising production from resources has been the dominant model of social-natural interactions since the industrial revolution. It is still evident in frameworks such as the much criticised Maximum Sustainable Yield (MSY) approach in fisheries.

c) The Social-Ecological Systems model.



Source: www.resalliance.org.

This model views natural, social and economic spheres as integrated with two-way interactions constantly occurring across scales and sub-systems. It views clear delineations between ecological and social subsystems as arbitrary and artificial. Resilience, or the capacity of a system to absorb change without transformation to an undesirable state (Olsson *et al.*, 2004), is a key conceptual element in this model. Resilience is also focussed on learning to cope with change in dynamic systems rather than attempting to control the system. Another important concept within this framework is that of the adaptive cycle (see Fig. 3.1 below), which originated in ecology but has been adapted and utilised to model general change in social-ecological systems also. Social or institutional learning is the main mechanism through which

the adaptive cycle iterates in social terms. The use of participatory scenario planning in facilitating this social learning has been shown to assist in moving towards more sustainable management orientations (Armitage *et al.*, 2008).

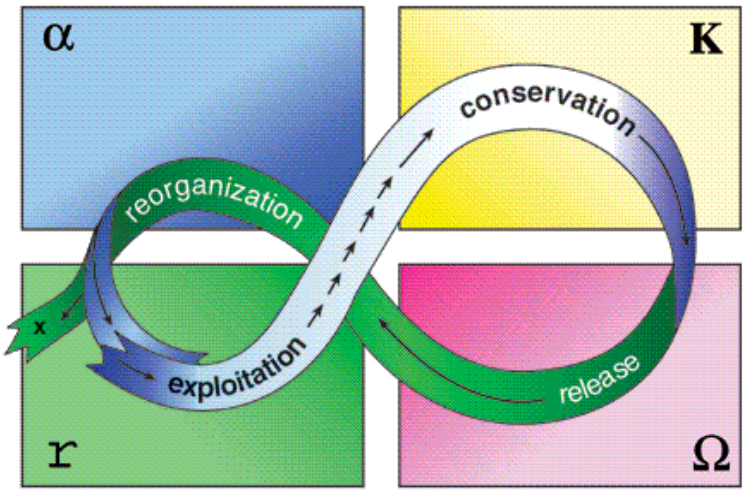


Figure 3.1 Stages in the social-ecological adaptive cycle (Source: www.resalliance.org)

The majority of high level definitions by institutions such as the FAO or the Convention on Biological Diversity (CBD) define the ecosystem approach as a social-ecological system (CBD, 1998; FAO, 2003). Adopting a social-ecological systems orientation does not just imply a new understanding of social- and natural-subsystem interactions but also implies a re-evaluation of how we go about fisheries management. Wilson (2006) notes that a change in primary objective from maximising yield from a given stock to maintaining ecosystem structure and process means a re-conceptualisation of the management problem from prediction and manipulation of individual populations to one which does not attempt to produce particular stock level outcomes but to maintain the circumstances of a healthy system. This ties in very well with Grosskurth and Rotmans definition of sustainability (2005) as "*a systems ability to sustain itself in the long run in a desired state or on a desired trajectory*" but implies a significant shift from single-species management.

Bavington summarises the changes in moving from conventional single species fisheries management to a social-ecological systems oriented ecosystem approach (2010). He identifies the most significant changes as:-

- The move from maximised fish production to desired ecosystem states.

- The move from top-down decision systems with industry lobbying to more participatory management with a greater role for NGOs.
- Managing by adjacent statistical boxes or administrative divisions to managing nested ecosystems at a range of scales
- Associated with this is a move away from sectoral towards area-based management which considers cumulative inter-sectoral impacts on the system.

Criticisms of the EA have emanated from a number of different perspectives. Larkin laments the use of what he calls the "*quasi-religious language of a social crusade*" in terms such as ecosystem, health, ecosystem integrity and the fallacious concept of ecosystem balance (Larkin, 1996). He found that these "*metaphorical*" concepts provided no useful guidance for fisheries managers interested in sustainability, as they were poorly defined if defined at all.

Longhurst (2006) is highly critical of the EA as he feels that it has allowed fisheries science to be hijacked by social scientists and economists with a shift in emphasis away from the only essential element in the system, the fish, "*about which these people know very little*"! For Longhurst this has resulted in approaches lacking in ecological rigour, and with an overemphasis on governance (Longhurst, 2006).

Fishing industry criticism of the EA has shared some of the reservations expressed by biological scientists, such as ambiguous meaning and associated lack of clarity of objectives. The industry solution tends towards increased fishing industry input and greater emphasis on prior agreement of management goals (Morishita, 2008).

Hilborn (2004) criticises ecosystem approaches that over-emphasise difficult if not impossible ecological control combined with equally problematic strong top-down governmental control. He places many of the most influential authors on ecosystem based fisheries management, such as Daniel Pauly and Boris Worm, in this camp. He emphasizes instead a carrot rather than a stick approach which is based on economic incentives and reforming institutions, what he calls a people management approach.

Bavington (2010) also criticises attempts to manage nature as if it were a machine, and claims that this impulse, or "managerialism", has created many of our natural resource problems. He

proposes that an adaptive process, which does not frame natural variations as a problem but instead learns to cope with them, should be adopted.

Kaiser (2005) has criticized the EAFM due to a common overemphasis on what he calls "the red herring of Marine Protected Areas" (MPA's). He considers that the efficacy of MPA's has been strongly overstated due mainly to their effectiveness in limiting fishing mortality in mobile fish species. The MPA issue points to a general problem with panaceas of all kinds which are discussed in detail in the following section.

3.3. Single solution panaceas and a move towards clumsy solutions

Fisheries are complex social-ecological systems and one reason why there have been few successful fishery recoveries despite many attempts is that the approaches taken have often been guided by a kind of tunnel vision with a focus on a single solution (Degnbol and McCay, 2007; Garcia and Charles, 2007). There is however an emerging emphasis in EAFM research which calls for more sophistication in how this problem is tackled (Francis *et al*., 2007).

Degnbol *et al.* (2006) discuss the tendency in fisheries for experts in different disciplines to promote technical solutions or panaceas which principally address their own disciplinary focus. For biologists one favoured solution is Marine Protected Areas despite there being many problems associated with them such as only affording protection to non-migratory species and creating concentration of fishing effort elsewhere (Kaiser, 2005; Suuronen *et al.*, 2010). For economists the solution is often privatisation and ITQs and they discount the well-documented social and environmental problems that may result (Costello *et al.,*, 2008; Arnason, 2012). For social scientists the holy grail is often community-based management despite the scale mismatch with ecosystem boundaries and the potential for ineffective governance that intra-community conflict can create (Berkes, 2004; Kearney *et al*., 2007). The solution proposed by Degnbol *et al.,* is in the adoption of trans-disciplinary research practices and networks at the individual and group level.

A recent and clear example of panacea type thinking was a submission from Green MEPs to the European Parliament (Green MEPs, 2010) where they posed the question "*Is it possible to meet ecological, social and economic challenges with just one approach*?" to which they answered "*We think it is*". Their proposed solution was Rights-Based Management (RBM). The Green MEPs

proposals appear to be quite nuanced and based on novel distributive criteria but research on RBM has shown that it cannot alone address all of the challenges of fisheries management (Wilson *et al.*, 2006). The relationship between property rights and the EA is discussed further in Section 3.9.

Grafton *et al.* (2007) blame governance failures for poor fisheries management performance and advocate the use of benchmarking of the critical governance factors of accountability, responsibility, transparency, incentives, risk management and adaptability. The overall approach in tackling these failings is characterized as one of "*mixed strategies to cope with multiple uncertainties*". This governance benchmarking approach which can quickly and efficiently identify shortcomings in the governance system is very applicable to an Irish context due to the lack of any background studies and limited resources available.

Charles and Young (Charles and Young, 2008) outline an approach which they call robust management to deal with two pervasive problems which managers have to deal with when implementing an EA. These are the "*illusion of certainty*" and the "*fallacy of controllability*". They characterise the approach as a type of risk management which employs a portfolio of tools including property rights, fishermen's ecological knowledge and livelihood diversification to produce a management system which is adaptive, participatory and integrated across marine activity sectors.

Khan and Neis (Khan and Neis, 2010) expand further on these complex social-ecological systems approaches to what they describe as a "*wicked problem*". These are problems which are complex, persistent or reoccurring, often hard to detect and to fix partly because they are linked to broader social issues (Rittel and Webber, 1973). They propose the use of what they call "*clumsy solutions*". These have elements of adaptive management in that they are exploratory and experimental, they include a broad stakeholder range who share information in order to build trust and promote social learning.

Calls for a diversity of participation in fisheries management stem from this requirement for varying perspectives and approaches in order to better understand and address complex problems.

To conclude it can be seen that there are a wide variety of framings of the EAFM. This has been viewed by some as a negative, but equally it may offer a way out of the conflict which has been a ubiquitous characteristic of most fisheries management regimes as it can accommodate diverse values and worldviews, not least resource users such as fishermen who may well have more utilitarian or extractive values than the concept's originators. Additionally, participative forms of management have shown potential in changing attitudes and bridging gaps in values.

3.4. Institutional Milestones in EAFM development

- The United Nations Conference on Human Environment (1972). Principle 2 of the resulting Stockholm Declaration stressed that management should preserve ecosystems for the benefit of present and future generations. The importance of stakeholder participation and subsidiarity were also highlighted.

- The Convention for the Conservation of Antarctic Living Marine Resources (CCAMLR, 1980). This convention represented an early adoption of the EAFM by stressing the protection of entire ecosystems and also the taking of a precautionary approach.

- The United Nations Convention on the Law of the Sea (UNCLOS, 1982) emphasised *inter alia* the necessity for fisheries management to take into account non-target as well as target stocks, inter-species interactions and the preservation of fragile and depleted habitats and ecosystems.

- The Convention on Biological Diversity (CBD, 1992) focused on the conservation of biodiversity and the sustainable use of natural resources. It also recommended the use of Marine Protected Areas (MPAs).

- The Jakarta Mandate on Marine and Coastal Biological Diversity (CBD, 1995) explicitly referred to the ecosystem approach as the framework for action under the CBD.

- The UN Fish Stocks Agreement (United Nations, 1995) strengthened requirements to apply the Precautionary Approach and to protect non-target stocks and ecosystems.

- The Code Of Conduct on Responsible Fisheries (FAO, 1995), although not legally binding, has been highly influential in shaping resultant fisheries policies and contained a number of elements of an EA although it does not mention it explicitly.

- The Convention on Biological Diversity produced a description, principles (the 12 Malawi principles) and operational guidance for an ecosystem approach (CBD, 1998).

- The Reykjavik Declaration on Responsible Fisheries (FAO, 2001) further developed the application of the EAFM. It recognised the necessity to further understand the mutual inter-relationships between fisheries and ecosystems, the inclusion of incentives for sustainable use of ecosystems and the use of MPA's. The Declaration also called on the FAO to develop technical guidelines for an EAFM.

- The Review of the Common Fisheries Policy contained a commitment to the "*progressive implementation of an eco-system based approach to fisheries management*" (European Council, 2002). However the lack of a formal strategy for implementation of the EAFM within the 2002 CFP has been criticised (Sissenwine, 2007).

- The FAO Guidelines on implementing EAFM (2003). These Guidelines sought to move the agenda forward from EAFM theory to practice. They stressed the incremental extension of traditional fisheries management into an EA mode, expanding the range of stakeholders consulted, mitigating conflict through improved stakeholder participation and the setting of clear operational objectives, indicators, reference points, decision rules and evaluation processes. The Guidelines also highlighted challenges to EAFM implementation.

- The Integrated Maritime Policy (IMP) (European Commission, 2007) and the related Marine Strategy Framework Directive (MSFD) (European Council and Parliament, 2008), further consolidated the role of an ecosystem approach within all EU maritime issues and represented a move towards a more integrated cross-sectoral approach rather than a sectoral fisheries focused one.

- A communication from the EU Commission on the role of the CFP in implementing an EAFM (European Commission, 2008) states that the ecosystem approach will form the

overarching principle for fisheries management. The document also stresses the need for the CFP to be linked with the overall integrated objectives contained in the MSFD and highlights areas where the CFP has contributed to the implementation of an EA.

- The outcome of these steps is that the EU is now bound by law, through international commitments and the MSFD to formally implement the EA through the CFP (Frid *et al.*, 2006; Long, 2007). Increased reference is being made in the current CFP reform proposals (European Commission, 2011) to the EAFM but it is impossible to say at the time of writing how well specified the final agreed policy will be in terms of reference points and timelines.

3.5. Principles of the Ecosystem Approach

Table 3.1 summarises the principles of the EA from a number of highly cited policy documents and academic papers. The two most comprehensive sets of principles are those contained in CBD Malawi Principles (CBD, 1998) and those in the FAO guide to EAFM (2003). There is significant overlap between these two documents and they cover all 10 of the principles summarised in Table 3.1.

The FAO (2003) guide contains both a short and long set of EAFM principles. The short list states that EAFM management should embody the following principles:-

- Fisheries should be managed to limit their impact on the ecosystem to the greatest extent possible;
- Ecological relationships between harvested, dependent and associated species should be maintained;
- Management measures should be compatible across the entire distribution of the resource (across jurisdictions and management plans);
- The precautionary approach should be applied because the knowledge on ecosystems is incomplete; and
- Governance should ensure human well-being, ecosystem health and equity.

This summary list of EAFM principles has been used as a foundation on which to build an EAFM by fisheries management institutions in a number of European countries including Norway, Denmark and Ireland.

There is some confusion in the literature about the distinction between principles, high-level policy goals, conceptual objectives and operational objectives. O'Boyle and Jamieson (2006) produced a conceptual map in order to clarify what is intended by different authors using the same terms when discussing EAFM implementation. A number of authors have stressed that success in EAFM will hinge on clarity of definition of principles and early agreement of management objectives (Hilborn, 2004; Morishita, 2008; Berghöfer *et al.*, 2008). It is difficult to reconcile this requirement for clarity with the most commonly cited fundamental principle of EAFM; "*maintenance of ecosystem integrity, function and services*". This principle is a model of vagueness and would require several levels of further specification in order to serve as a useful benchmark for an operational EAFM.

Table 3.1 Principles of an ecosystem approach summarised from literature

Principle	FAO [2]	UNGA [3]	CBD [4]	MSFD [5]	CCAMLR [6]	Australian EBM [7]	ICES [8]	WWF [9]	Costanza *et al.* [10]	Juda [11]
Maintain ecosystem integrity & function	√	√	√	√	√	√	√	√	√	√
Participation	√	√	√	√		√	√	√	√	√
Apply precautionary principle	√	√	√	√	√		√		√	√
Use adaptive management			√	√		√	√	√	√	√
Spatial & management compatibility	√	√	√				√		√	
Sectorally integrated approach	√	√	√				√			√
Complex systems approach	√	√				√		√		
Broad knowledge base		√	√			√				
Use incentives	√								√	√
Subsidiarity			√	√						

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3.6. The Ecosystem Approach and Participatory or Co-Management

Strong participation by stakeholders has been highlighted as a crucial component of an EAFM. Recommendations in the literature include that fisheries management decision-making should involve local users at all stages through formal, transparent and accountable processes (FAO, 1995; Turrell, 2004; Kooiman 2005). Additionally the issue of decentralisation or subsidiarity is linked to participation as it moves decision making power closer to those who interact directly with ecosystems, gives them greater responsibility and requires the development of governance capacity at lower levels (FAO, 2003; Sissenwine, 2007).

Participation was listed in an EU White Paper on European Governance (Commission, 2001) as one of five criteria for good governance, the other four being openness, accountability, effectiveness and coherence. The CFP has as one of its stated principles of good governance "*broad involvement of stakeholders at all stages of the policy from conception to implementation*" (European Council, 2002). The adoption of stakeholder participation as a fundamental element of EAFM echoes a general movement in natural resource management away from top-down approaches and towards community-based or bottom-up development (Kooiman, 2005).

A number of problems have been identified requiring a greater input by stakeholders under an EAFM than with single species top-down management (Berghöfer *et al.*, 2008; Mikalsen and Jentoft, 2008). These include the requirement for additional data and information on fish stocks and other ecological information and the requirement for first hand socio-economic information from a range of stakeholders.

A number of other benefits of participatory management have been cited including an enhanced sense of ownership of and compliance with management regimes, a broader base for management consensus and the development of local solutions to local issues (Berkes, 2004; Kearney, Berkes *et al.*, 2007).

The adoption of an EAFM may have some fundamental consequences for fishing communities and the European Commission, in its recent communication on EAFM and the CFP (EC, 2008), refers to "*short-term contradictions between social objectives and the*

requirement to conduct fisheries within meaningful ecological boundaries". The Commission document concludes that there will as a result be a greater need for a socio-economic framework under EAFM than under previous management regimes (EC, 2008).

One of the key benefits of participation by fishermen in an EAFM context is the potential use of their ecological knowledge (Degnbol, 2002; ICES, 2005). Attitudes towards the usefulness or usability of this knowledge have changed recently and have been characterised by one commentator as a change from *"fishermen's knowledge is of little or dubious value*" to one of "*fishermen's knowledge is of potential value*", (Sota, 2006). Accordingly there have been a number of recent initiatives aimed at giving a greater role to fishermen in both the research and management processes (ICES, 2004; Johnson and van Densen, 2007). Despite this change, barriers to realising this potential of fishermen's knowledge still exist. One significant barrier relates to difficulties with utilising essentially qualitative information in a quantitative process i.e. the analytical assessments generally use to inform fisheries management.. Another category of barriers relates to obstructions to effective communication between fishermen and scientists. These can stem from differences in technical language used, educational differences and perceptions about power all of which may be mitigated through effective participatory processes (Johannes *et al.*, 2000).

Typologies of participation (Arnstein, 1969; Pretty, 1995) and co-management (Sen and Raakjaer Nielsen, 1996; Carlsson and Berkes, 2005) have been developed, all of which loosely range from hierarchical, manipulative or non-participatory modes at one end through various degrees of consultation through to full delegation of power or self-mobilisation at the other end.

3.7. Property Rights Approaches in Fisheries Governance

Few topics in fisheries management are as divisive and controversial as the issue of property rights. The publication of Hardin's "Tragedy of the Commons" paper in 1968 initiated an ideologically driven debate that still continues. Hardin's central thesis was that either central state control or privatisation are the only solutions to the inevitable over-exploitation of common property resources. This conclusion has divided both academics, often along fault-lines between sociologists and economists; and fishermen, mainly along small-scale versus large-scale fault-lines.

Building on Olson's general theory of collective action (1995), published three years before Hardin's work, a number of researchers began to develop theoretical and empirical challenges to Hardin's conclusions. The principal objection is on the basis that Hardin's characterisation of common property was erroneous (Ostrom, 1990; Bromley, 1992; Ostrom, 2003). Ostrom and Bromley have classified property regimes into four types – open access, common property, state property, and private property. It is important to note that these are ideal types and in reality most property regimes are a combination of the characteristics of the ideal types. Hardin's critics claim that he mistakenly conflated open and common property regimes and concluded that common property cannot be sustainably managed. Bromley describes the difference between open access and common property in legal terms as the difference between *res nullius*, a state of no ownership, and *res communis*, a state of communal ownership.

In the late 1980s much empirical evidence emerged from diverse fields, including fisheries, wildlife, forestry, agriculture and irrigation, demonstrating that commons users were not destined to overexploit resources (Feeny *et al.*, 1990). Proponents of private property rights in fisheries have recently been accused of perpetuating Hardin's conceptual confusion regarding open access and common property (Bromley, 2007). Bromley's position is based on the premise that fish within a state's Exclusive Economic Zone (EEZ) are state property (and therefore not *res nullius*) and a fishing skipper does not own the fish until a state official frees him to sell it. This position accords with other legally focused research which asserts that even under a private property approach to fishing rights, such as Individual Transferable Quotas (ITQs), it is not the resource itself but the right to harvest it, (or *usufruct* in legal terms) which is inherent in the right (Stewart, 2004). Kooiman *et al.* argue further that Hardin's reliance on strong government control does not account for new pressures such as globalisation which have in many cases bypassed central governance regimes (Kooiman, 2005).

One particular form of property right, the ITQ, has dominated the research agenda and debate within the field. There are four characteristics of ITQs which define the quality of the right: transferability; exclusivity; security; and durability (Stewart, 2004). Transferability is seen as the key characteristic as it is linked to both maximization of economic efficiency and the social issue of concentration of ownership.

Proponents of private property rights in fisheries have claimed a number of benefits to the approach: greater economic efficiency; fleet rationalisation and fishing capacity reduction; improved stewardship of the resource; and a greater incentive for industry participation in management (Kulmala *et al.*, 2007; Asche *et al.*, 2008; Costello *et al.*, 2008; Leal *et al.*, 2008). A recent European research project, CEVIS, concluded with reference to rights based management that:

- Transferability of a right increased economic efficiency and environmental stewardship.
- Rights are often given in return for increased industry responsibility.
- RBM systems should have a flexible design to maintain stakeholder acceptance but trends over time have generally been towards greater individualisation and transferability.
- Transferability has social costs that are possible but difficult to mitigate.
- Limits to transferability limit economic efficiency.
- Transferability facilitates but does not directly reduce fishing capacity and it can make the process of capacity reduction more humane by offering an alternative to bankruptcy (Hauge and Wilson, 2009).

Conflicts about the application of property rights in fisheries can be classified into 3 categories (Huppert, 2005):-

- disagreements over the meaning and intent of fishing rights,
- disputes over the distribution of rights and associated economic gain, and
- concern for disruptions imposed on people who are dependent on the ‘‘old order’’.

All three types of conflict were evident in responses to a 2009 EU consultation on property rights in fisheries management (Commission, 2009). The responses originated from the fishing industry, academics, scientific institutes, environmental advocacy organisations and the public and raised issues including: social costs due to increased concentration of ownership; threats to the CFP system of “relative stability” which regulates fishing opportunities among member states through trans-national quota transfer; permanency and quality of rights; and ethical issues relating to privatisation of a publicly owned resource.

The social cost of privatising fishing rights, mentioned above both in the CEVIS conclusions and by Huppert, has created more conflict than any other factor (Copes,

1986; Copes and Charles, 2004; Kooiman, 2005; Pinkerton and Edwards, 2009; MRAG, 2009). Problems cited within this discourse include: erosion of coastal community resilience; lack of opportunities for new entrants; ecological costs of ITQs in particular an inherent incentive to discard less valuable fish; poor design of the initial allocation process followed by gradual exclusion of the less wealthy. Opponents of an individualised property rights approach often point to the potential for Community Based Management as a more socially inclusive common property management framework (Copes and Charles, 2004; Kearney *et al.*, 2007).

3.8. Property rights and the ecosystem approach

Section 3.8 showed how there are mainly two competing discourses in relation to property rights and fisheries management, one advocating individualisation based on economic efficiency and the other advocating community based management based on inclusivity and social cohesion. Both camps also make claims that their approach is a better fit to the EA and can provide environmental benefits. The desirability of some kind of secure property right is stressed however in both cases and in the majority of policy documents relating to an EA (FAO, 2003; UNGA, 2006)

Grafton *et al.,* (2005) set out the case that a property rights approach can remedy the situation under command-and-control management systems whereby incentives for fishermen were not aligned with those for sustainability. In so doing a range of environmental benefits could be realised including *inter alia* reduced impacts on the environment, lower discards and promotion of marine reserves. Valdimarsson and Metzner (2005) reached similar conclusions but took a wider view of what constitutes an incentive and differentiated what incentives mean to different stakeholders such as fishermen, scientists or civil society. Costello *et al.,* (2008) conducted a meta-analysis of global fisheries management and concluded that individualised catch shares could halt or reverse the trend towards fishery collapse. A 2008 FAO report (De Young, 2008) found, however, that a broader perspective on incentives than an economically focussed one is required to satisfy the requirements in an EA to maintain human as well as ecosystem well-being.

There are also question marks over the ecological implications of property rights approaches in fisheries. Gibbs (2010) found that the economically rationalist foundation of ITQs treats environmental impacts as an externality and furthermore the

single species focus of most ITQs may make it more difficult to achieve positive wider ecosystem outcomes. Charles and Young (2008) expressed a closely related concern that the tendency for property rights systems to focus on the most profitable species may result in high levels of discards and that distributional changes in fishing opportunities may create a risk of non-compliance. The CEVIS project highlighted the fact that ITQs do not in any way address biodiversity, which would create a potential conflict with an ecosystem approach (Hauge and Wilson, 2009).

3.9. How is the EAFM being implemented globally?

Despite the lack of conceptual clarity the focus of EAFM research has definitely moved on to implementation. The CBD, FAO and others have produced implementation guidelines. The FAO (2003) have prescribed the following steps towards converting policy goals into action

- identifying broad objectives relevant to the fishery (or area) in question;
- further breaking these objectives down into smaller priority issues and sub-issues that can be addressed by management measures;
- setting operational objectives;
- developing indicators and reference points;
- developing decision rules on how the management measures are to be applied;
- monitoring and evaluating performance.

Due to the complexity of the EAFM it is not easy to evaluate how it is being implemented on a global scale. Viewpoints on the degree of implementation in a given area can vary widely, for instance criticism has been levelled at the EU in relation to the degree of EAFM implementation (Blasdale, 2008; Sissenwine, 2007) while the EU Commission itself has defended the degree to which implementation has taken place (Commission, 2008). A recent paper which reviewed the implementation status of Ecosystem Based Management (EBM) in a number of case studies found that marine EBM in practice is in an immature state and accordingly examples of it are few (Ruckelshaus *et al.*, 2008).

In a high profile Nature paper (Pitcher *et al.*, 2009a) it was reported that introduction of EAFM is one of the most poorly implemented elements of the FAO Code of Conduct on Responsible Fisheries in the 53 main fishing countries globally. In relation to European

countries they found that "*the poorer compliance of many EU countries than their governance and resources would indicate is partly as a result of a dysfunctional Common Fisheries Policy*." More significantly the same research team have assessed the implementation success of EAFM in the world's top 33 fishing countries (Pitcher *et al*., 2009b). Success in EAFM implementation was measured against a number of criteria based on adherence to EAFM principles and success in achieving EAFM objectives. Again, criticism was levelled at EU countries, whose scores were described as "*lamentable*".

Sissenwine and Symes (2007) in an overall appraisal of the CFP reported that it has not performed well in EAFM implementation and the EAFM elements that have been introduced, such as habitat protection, have been piecemeal. They recommended an implementation program based on transparency, with systematic evaluation of performance, clear protocols and guidelines.

A number of EU funded research projects have been completed which have as their goal the implementation of EAFM in Europe. One significant project was the European Fisheries Ecosystem Plan (EFEP) project which concluded in 2004 (Hatchard *et al.,* 2003; Paramor *et al.*, 2004). Jake Rice (2008) highlighted the fact that the EFEP North Sea fisheries ecosystem plan was the worlds first. He also placed the EU first in the world in terms of ecosystem indicators arising from research on the INDECO project.

The following two sections look at how EAFM is being implemented in Australia and Canada. This global best-practice scanning exercise is however not geared towards looking for templates to be transplanted in an Irish fisheries context. Building on pre-existing positive governance elements in a given fishery is likely to be a more productive approach (Hilborn, 2007). The EA as operationalised in the Antarctic by CCAMLR has been widely acclaimed (Hirshfield, 2005; Kock, 2007) but it is situated in a radically different governance, social and ecological context than European fisheries. So it would be inappropriate to attempt to apply it as a template but at the same time there may be much we can learn from it and other examples both in terms of governance and scientific approaches.

3.10. Australia's approach to EAFM

3.10.1. General Australian fisheries management legal framework

In 1978 Australia declared its 200-mile EEZ and since then fisheries management has been jointly managed under State and Commonwealth jurisdiction. From 0 to 3 miles offshore Australian fisheries are under State jurisdiction while those from 3 to 200 miles are under Commonwealth jurisdiction (Metzner *et al.*, 2003). Each State has separate fisheries legislation and differing objectives and fisheries which overlap State boundaries are managed by the Commonwealth fishery agencies (Scandol *et al.*, 2005). .

Under the 1999 Environment Protection and Biodiversity Conservation Act all natural resource management must meet the requirements of Ecologically Sustainable Development (ESD) and strategic assessments of all fisheries are mandated under the Act. Essentially this implies that if fisheries cannot demonstrate sustainability then permits cannot be issued which is equivalent to a shifting of the burden of proof from managers to fishermen. The EAFM has been described as the tool to implement ESD in fisheries (Rayns, 2007; Scandol *et al.*, 2005).

Another important policy element in relation to Australia's fisheries management is Australia's Oceans Policy (Environment Australia, 1998) which provided an integrated framework for marine resource management. The Policy includes the use of a hierarchical and inclusive process of objective identification and guidelines for the use of indicators. An example of the development of integrated management initiatives is the North West Shelf Joint Environmental Management program. This process involved the production of 18 technical reports coordinated by CSIRO (Condie, 2008).

3.10.2. Risk Assessment process

A report to the European Parliament on international application of the EAFM (Rice, 2008) described the Australian ecological risk assessment (ERA) framework as their most significant contribution to fisheries management. The ERA process (Smith *et al.*, 1999; Hobday, 2006; Butterworth, 2007; Fletcher, 2008) is a 3 stage hierarchical one which is progressively more demanding dependent on the risk identified at the previous level.

The three stages in the ERA framework are:-

- Level 1 is a largely qualitative scoping phase. This identifies potential hazards from 26 fishing associated activities to 5 ecosystem components: target species, by-catch species; threatened, endangered and protected (TEP) species;

ecological communities; and habitats. It also identifies the scale of the fishery, assesses data availability for further levels and analyses socio-economic factors in the fishery.

- Level 2 is a semi-quantitative assessment of fisheries classified as having potentially serious impacts at Level 1. This assesses the productivity, resilience and vulnerability of each ecosystem component.
- Level 3 is applied if Level 2 analysis indicates a sufficiently high risk. This level involves detailed modelling and scenario testing and is highly focussed, fully quantitative and model-based. Biophysical, economic and management modelling approaches are used.

3.10.3. Ecosystem Modeling

The model used in Australia's ERA process is the Atlantis model which is considered one of the world's most complete ecosystem models (FAO, 2007; Fulton, 2010). Atlantis was used extensively in 2007 to assess ecological and socio-economic outcomes of alternative management strategies for the Southern and Eastern Shark and Scalefish Fishery. The modelling exercise tested management approaches for their effects on:-

- fishing practices and fleet behaviour (such as changes in targeting practices)
- fleet size, structure and gear use
- harvest volumes and catch rates for commercial stocks
- habitats
- the composition and structure of the food web
- profitability and trading of quotas
- public perceptions of the fishery
- recovery of ecological systems.

The process was described as "*one of the few studies ever undertaken to explore alternative management strategies at a whole-of-fishery and whole-of-ecosystem level. It provided managers, industry and other stakeholders with the first sound basis to evaluate integrated rather than piecemeal solutions to complex fishery management problems*" (CSIRO, 2007).

3.10.4. Fisheries Environmental Impact Assessments

Under the 1999 Environment Protection and Biodiversity Conservation Act fisheries require Environmental Impact Assessments (EIAs), which include strong elements of public consultation. Here an ecological risk assessment is embodied within a fishery wide EIA process. Firstly a draft management strategy is prepared with stakeholders and public participation, then an extensive EIA is conducted based on the draft management plan (the New South Wales ocean trawl fishery Environmental Impact Statement was 430 pages long), this is followed by another extensive consultation process and finally a management strategy is published.

This management strategy contains Goals, Objectives, Trigger Points and Management Responses. For illustrative purposes an example is shown below in Table 3.2 from the published New South Wales Ocean Trawl Fishery Management Strategy. The Table shows one of the performance indicators for Goal 3 of the strategy, which refers to conservation of threatened species, populations and ecological communities likely to be impacted by the fishery.

Table 3.2 Performance indicator for NSW Ocean Trawl Fishery Management Strategy goal

GOAL 3. Promote the conservation of threatened species, populations and ecological communities likely to be impacted by the operation of the Ocean Trawl Fishery			
Performance Indicator	**Data and availability**	**Trigger Point**	**Robustness**
Interactions between the fishery and any threatened species, population or ecological community that are likely to threaten the survival of that threatened species, population or ecological community	Data will be obtained and available through catch reporting provided by endorsed OTF fishers, and also by any onboard observer surveys and reports from compliance officers	Any interactions between the fishery and a threatened species, population or ecological community reported by endorsement holders in the fishery or observed during an observer survey that are likely to threaten the survival of that threatened species, population or ecological community, as determined by the Director- General of NSW DPI on advice from relevant threatened species experts	High
Justification/Comments	Currently, little information is available on interactions between the OTF and threatened species. Commercial fishers are required to report a variety of details when an interaction occurs with a threatened species including contact or capture with gear and condition upon release. Every interaction recorded will be referred to the relevant threatened species authority to determine whether the interaction is likely to threaten the survival of a threatened species, population or ecological community. Any such assessment should include consideration of trends in the number or degree of interactions as well as any other cumulative impacts.		

3.10.5. Other recent Australian EAFM developments

The latest development in Australian EAFM has been the introduction of a Commonwealth Fisheries Harvest Strategy Policy in September 2007 (Rayns, 2007; Smith *et al.*, 2008). Under the Harvest Strategy Policy B_{MEY} (the biomass level which would generate the highest sustainable economic yield) replaced B_{MSY} (the biomass level which should produce the maximum sustainable landings) as a reference point. B_{MEY} implies a higher biomass than B_{MSY} and if B_{MEY} is unknown a proxy of $1.2B_{MSY}$ is used.

This policy was inspired by the application of a harvest strategy in the South Eastern Shark and Scalefish fishery, one of Australia's most complex and valuable fisheries. The Harvest Strategy Policy sets very specific levels of acceptable risk with clearly defined reference points.

The economic emphasis in the harvest strategy policy is consistent with an explicit economic efficiency objective in the 1991 Australian Fisheries Management Act (Pascoe *et al.*, 2009) and the recent trend towards increased use of ITQ's (FAO, 2007).

3.10.6. The Australian partnership approach to fisheries management

De Young (FAO, 2007) characterised recent Australian fisheries management as being based on 4 major policy principles which are:-

1. a system of limited entry for all major commercial fisheries;

2. an increasing move from single species to ecosystem based management in line with the principles of ESD;

3. full "cost-recovery" from industry for management and control costs and;

4. a collaborative approach to management.

De Young (2007) also points out that the use of input controls, such as limited entry, is increasingly being augmented with output controls particularly in the form of ITQs to encourage economic efficiency.

Smith *et al.,* (1999) describe the success of Australian fisheries management in general and the development of the management strategy evaluation approach in particular as being facilitated by the partnership approach. They describe this partnership approach as one that involves collaboration in all areas of management including policy design and agreement on objectives, research design and stock assessment, enforcement and operational decision-making. They summarise the underlying rationale of this approach as one where "*the achievement of sustainable fisheries is very much linked to the level of trust and confidence that exists between industry, managers, scientists, and stakeholders*" and "*Whereas sound legislation and policy are essential, there is no substitute for building sound and positive relationships between all those involved*."

Metzner *et al.* (2003) describe the importance of fishery Management Advisory Committees (MAC's) and how the committees balance of industry with non-industry members and the code of practice aimed at limiting self serving actions contribute to successful co-management.

Australia have been a world leader in terms of designating marine reserves and Ruckelshaus *et al.,* (2008), in an assessment of some global examples of implemented ecosystem based management, describe the spatial approach in the Great Barrier Reef Marine Park as a rare case where "*multiple uses and protection of marine biodiversity are addressed directly*". Recently the proportion of no-take zones in the park has increased from 5% to 33% through scientific input and community involvement.

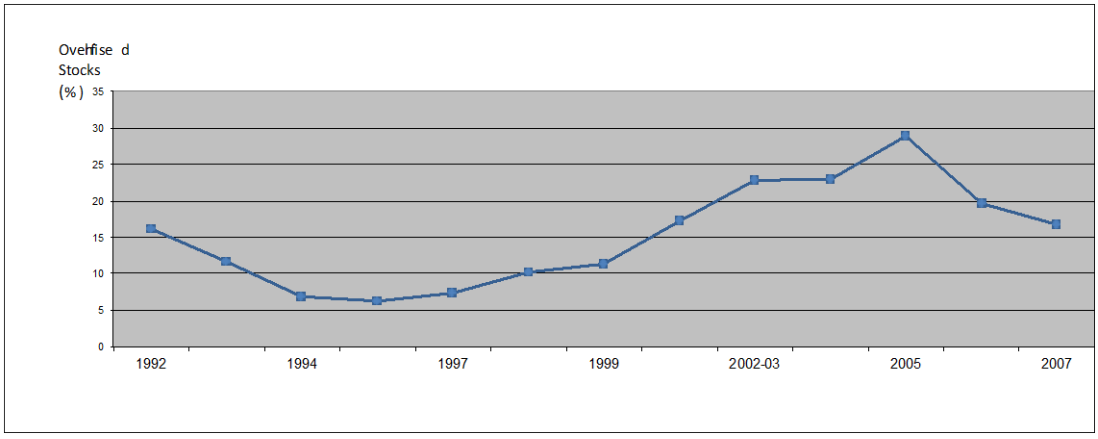
Fernandes *et al.* (2005) described the participatory planning required for this increase in no-take zones as "*the largest participatory planning exercise for any environmental issue in Australia's history*". They describe a 10-step model for a participatory approach which they recommend as being applicable in all cases of MPA designation "*regardless of the level of available data or technical support*".

3.10.7. Australian fisheries management success.

Figure 3.2 below shows the percentage of stocks under Australian commonwealth management classified as overfished from 1992 to 2007 (summarised from Larcombe and Begg, 2008). In contrast to the percentages in Figure 3.2 approximately 85% of EU stocks are claimed to be fished beyond MSY (European Commission, 2009) and over 30% of fish stocks globally (FAO, 2012).

Pitcher *et al.* (2009) in a global EAFM assessment ranked Australia 4th in the world in terms of EAFM implementation and 7th in terms of overall EAFM performance.

Figure 3.2 Percentage of Australian commonwealth managed stocks classified as overfished



3.11. Canada's approach to EAFM

3.11.1. General policy and Governance framework

In a similar fashion to that in Australia the Canadian Federal Fisheries Act of 1985 gives the Fisheries Minister exclusive authority over ocean fisheries while the Provinces have jurisdiction over near-shore fisheries (Loucks *et al.*, 2003). The Provinces objectives

tend to be more community based while the Federal ones tend to be more concerned with economic efficiency.

A very significant issue in terms of Canada's fisheries governance is the integration between sectors required under the Canadian Oceans Act of 1996 (Mageau *et al.*, 2005). The Act specifies a move from a sectoral regime in favour of developing an integrated ocean policy with an emphasis on the need for the protection of marine ecosystems so as to ensure marine biodiversity and productivity (Davis, 2008). Three key principles of the Act are integration, the EA and participatory-based approaches.

The 1996 Oceans Act provides authority to the Minister for Fisheries and Oceans to develop and implement a national strategy for managing estuarine, coastal and marine ecosystems in Canadian waters. According to Juda (2003) the strategy is to be integrated spatially in the context of ecosystems, based on the concepts of sustainable development and concern for future generations, integrated management of human activities in estuaries, coastal waters, and marine waters, and the precautionary approach in which decision-making errs on the side of caution.

The 2004 Oceans Action Plan specifies "maximizing the use and development of oceans technology, establishing a network of marine protected areas, implementing integrated management plans, and enhancing the enforcement of rules governing oceans and fisheries, including rules governing straddling stocks." (Fisheries and Oceans Canada, 2004).

Canada's first Integrated Ocean Management Plan under the Oceans Act was the Eastern Scotian Shelf Integrated Ocean Management Plan (DF0, 2007). According to the Canadian DFO it has been selected for the application of integrated ocean management because it possesses important living and non-living marine resources, significant areas of high biological diversity and productivity, and increasing levels of multiple use and competition for ocean space and resources.

The Plan is a multi year, strategic-level one to provide long term direction and commitment for integrated, ecosystem-based and adaptive management of all marine activities in or affecting the planning area (ESSIM, 2006). There are 3 overarching goals, each with associated objectives and sub-objectives, in the ESSIM plan which are:

- Collaborative governance and integrated management;
- Sustainable Human use;
- Healthy ecosystems;

Rice (2009) describes how a three tiered Canadian approach to implementing EAFM is taking place within the integrated approach of the Oceans Act process. The first of the three tiers is an expert driven qualitative risk assessment process informed by the Australian approach. The second is the creation of a series of advisory documents highlighting the potential for specific fishing activities to threaten vulnerable ecosystem components. The third tier is an annual checklist contained in Canadian Fisheries Management Plans which draws from sources including Canadian legislation and policy, the MSC, the FAO Code of Conduct, and the risk assessments in Tier 1.

Each Fisheries Management Plan is evaluated against the checklist and measures to deal with the consideration are given or reasons why it is not relevant to the particular fishery. Rice (2009) concludes that "*Together these three tools are giving a different and more ecosystem-oriented facet to the management of Canadian fisheries and at the level of individual fisheries management plans, many more ecosystem considerations are being addressed directly*".

Pitcher *et al.* (2009) in a global EAFM assessment ranked Canada 1st in the world in terms of EAFM implementation and 4th in terms of overall EAFM performance.

3.11.2. Co-management and Property rights in the Canadian EAFM

Possibly due to the fact that fishing communities in Canada have a longer social history than in Australia there is a greater emphasis in the literature on community based management. There has been significant criticism of the use of ITQ's by Canadian researchers since the 1980's (Copes, 1986; Finlayson, 1994; Copes and Charles, 2004; Bavington, 2010). This is in part due to the perception that the use of poorly structured ITQ's contributed strongly to the Cod collapse and the subsequent social problems it created. According to Copes (1992) the collapse of cod and other ground-fish came after a decade of widespread misuse of ITQ and IQ systems, with incontrovertible evidence of serious levels of quota busting, high-grading, by-catch waste and data fouling, much of it acknowledged by the Department of Fisheries and Oceans. The national position on property rights was complicated by an internal debate over the question of aboriginal

rights and the allocation of quotas (Copes and Charles, 2004). There are concerns in Canada about the security of the property right. In some valuable fisheries, fishers not initially allocated quota were subsequently given access to fish (Grafton *et al.*, 1998: 138). There is a significant discourse in Canada, which is critical of ITQ's and instead favours the community based management approach (Copes and Charles, 2004; Kearney *et al*, 2007). Wilson and Ulrich-Rescan (2008) describe some interesting developments in Nova-Scotia where hybrid approaches utilising the best elements of community based and ITQ type approaches are combined.

There is a strong emphasis on co-management in Canadian fisheries management (Davis and Bailey, 1996; Davis, 2008; Bavington, 2010). Much of the impetus for this approach originated with the fallout from the Cod collapse in the early 1990s. One of the principal factors within this dynamic was a new emphasis on value for money from Canadian fisheries management and co-management was seen as a way to reduce costs in addition to improving management and deflecting criticism (Bavington, 2010).
Arising from the participative nature of Canadian fisheries management one of the main objectives is for the development of the concept of "shared-stewardship" (Fisheries and Oceans Canada, 2006). However Shelton (2007) interprets the concept of shared-stewardship as meaning that industry viewpoints will be prioritised at the expense of science-based decisions.

Grafton (2007) in an assessment of Canadian fisheries governance recommends that in order to ensure better ecosystem outcomes, better alignment of incentives must be achieved. He recommends three steps to avoid the sort of collapse that Canada experienced with the Newfoundland Cod collapse in the early 1990's and these are to:

a) adopt incentive-based approaches to prevent overcapacity,
b) effectively manage uncertainty and
c) to connect higher-level goals, such as sustainability, with day-to-day decisions in a transparent, accountable, and adaptive way so that operational errors are identified and corrected in a timely manner.

Chapter 4 Governance Benchmarking of Irish fisheries.

4.1. Introduction

The Irish relationship with the EU Common Fisheries Policy (CFP) has always been a troubled one. Irish fishermen's hopes of having a 50 mile national fishery limit established, were dashed in 1978 due to the *realpolitiks* of European negotiations (Irish Times, 18 Feb 1978). The perception at the time and which still resonates amongst fishing communities is that fisheries were a lower priority than agriculture and that Irish politicians and negotiators had a limited appreciation of the potential state benefits of well managed fisheries (McGinley, 1991). This is illustrated in the sending home from Brussels, on the eve of EU negotiations, of the then chief executive of B.I.M. Brendan O Kelly by Foreign Minister Patrick Hillery in 1971 for being too vociferous in defence of Irish fishing rights (Irish Times, 1995).

Ireland is no different to all other EU member states in that many of its fisheries issues are governed by the CFP. However there is still substantial scope for self-determination both in how EU fisheries legislation is interpreted and in how issues such as domestic quota allocation arrangements, licensing policies and inshore fisheries management within the 12-mile limit are defined.

This chapter assesses European and Irish fisheries policy and governance frameworks and how they may deal with the implementation of an ecosystem approach. Participation of the main stakeholder groups in Irish fisheries management is analysed. A detailed description of the main case study fishery for Celtic Sea Herring is given and a benchmarking of governance in that and two other Irish fisheries is described. The chapter concludes with an analysis of the relationship between policy and governance frameworks and the impact of this on implementation of an EA.

The governance analysis in this chapter is based on literature review, interviews with a range of participants in the management of the assessed fisheries and participation in and observation of fisheries governance meetings. The interviewees included inshore fishermen, fishermen operating traditional "dry-hold"[12] vessels, skippers of larger

[12] "Dry-hold" vessels store their Herring catches in the traditional way, mixed with ice in lockers or compartments in the fish hold. Their numbers have decreased rapidly over the past 10 years due to increasing completion from vessels which can store their fish for longer in Refrigerated Sea Water (RSW) tanks.

Refrigerated Sea Water (RSW) vessels, representatives of fishermen's organisations, scientists responsible for the assessment of the stocks, managers of fish processing plants, salesmen for fisheries co-ops, a fisheries protection officer, a director of a responsible fishing certification scheme and a director of a marine environmental NGO. The analysis is also based on the authors observations of approximately 60 meetings of the Celtic Sea Herring Management Advisory Committee (CSHMAC) and also on experience gained while working as an employee of a fishermen's representative organization.

4.2. Policy Analysis

4.2.1. Ireland and the Common Fisheries Policy

The history, structure and problems of the CFP and its attendant problems have been extensively covered in the literature (Wise, 1984; Holden and Garrod, 1996; Daw and Gray, 2005; Sissenwine, 2007; Lutchman *et al.*, 2009; Symes, 2009; Khalilian *et al.*, 2010) and accordingly only those aspects most relevant to an Irish context will be analysed.

The CFP has a number of principal aims including :-

- Regulating fishing activity through the setting of quotas and effort limits based on scientific advice from ICES and allocation of those quotas between member states.
- Promoting sustainable fisheries through the use of technical conservation measures
- Matching seafood supply and demand through the common organization of the market;
- Ensuring that the rules are upheld and applied in a uniform manner across member states;
- Negotiating at central level agreements with non-EU countries for the access of European fleets to fish in their waters.

There are also a number of important principles which have become enshrined within successive iterations of the CFP. The first of these is the principle of “equal access”. There was no interest in a common policy among the original 6 members, France, Italy, Germany, Belgium, the Netherlands and Luxembourg, from 1957 until 1970 as they were predominantly interested in agriculture. In any case, 90% of their fish catches

were taken outside their national fishery limits, which at the time only extended out to three miles (Holden and Garrod, 1996). It was only during accession negotiations with Ireland, the UK, Denmark and Norway that the 2 regulations forming the basis of the CFP were published (Wise, 1984). This was the first time the phrase "*equal conditions of access to and use of the fishing grounds … for all fishing vessels flying the flag of a member state*" was used (EU Regulation 2141/70) and it's last minute introduction was a source of conflict which demonstrably continues to this day. This conflict can be seen in the persistent attitude towards the CFP of some fishermen's organisations such as the Irish Fishermen's Organisation (IFO), and the Fishermen's Association Limited and Save Britain's Fish in the UK. A number of these organisations have formed a loose coalition under the banner 'Reclaim Our Seas Alliance' to lobby for change in the current CFP reform process. One of their explicit goals is ***"That the EU returns control of fisheries policy to the member States"*** (Killybegsonline, 2010).

Another industry submission on the 2009 EU Commission Green Paper on reform of the CFP, from Comhair Iascaire Eireann Teo., (08/07/2009) expresses this feeling unreservedly: *"The Common Fisheries Policy agreed in 1983 has proved to be far from "common" to the participating states. It has severely damaged the Irish fishing industry. It is a fact that our seas, our waters, have contributed vast sums of money to fishing nations of the E.U. over 35 years and more. Verification of these facts can be had from the library of B.I.M., the Revenue Commissioners and the Statistics Office, as supplied to us. It is also a fact that during the Lisbon Treaty debate, our fishing industry was scarcely mentioned"*.

Or even more bluntly, from Pat Murphy of Castletownbere, a still active 81 year old fisherman, who started fishing in 1943, well before a CFP, and whose Green Paper submission states, "*The CFP is the greatest disaster ever imposed on fishermen, the quota system as of now is the greatest disaster of all time*".

The second important CFP principle is "relative stability" and it is also a source of controversy. Relative stability fixes the allocation of TAC's between member states at the levels set in 1983. While it undoubtedly eliminates a significant source of conflict and negotiation between EU fisheries ministers it has been heavily criticised both academically and by industry for its conservatism and inflexibility (Symes, 1995). Any novel management system has to either fit in with the strictures of relative stability or to recommend a dismantling of the CFP (Kraak *et al.*, 2012). The IFO submission on the Green Paper on 17/01/2010, in summing up the negative school of thought, assert that

relative stability and the CFP in general result in negative conservation and social outcomes: *"The green paper clearly out lines some of the fault lines in the relative stability system, lack of flexibility and the discarding of fish. To remain inside a rigid legal system, it has also led to trading in quotas, and days at sea, enabling those with money to keep their fleets fishing at maximum effort. It poses a threat to coastal communities, and does absolutely nothing for conservation or stock recovery. It is discriminatory, the only thing common is the name."*

Dissatisfaction with relative stability is spelt out in this extract from Irelands official response to the CFP reform Green Paper in 2010:
"Irish fishermen – and the wider Irish public - remain deeply aggrieved at the discrepancy between the volume of fish which Ireland contributed to the CFP (through its large and productive 200 mile exclusive economic zone) and the share of fish stocks it has received through the CFP. However, Ireland advocates that adjustments can be made to the present share out (relative stability) of a number of white fish and pelagic stocks so that the future allocation of Community resources is better adjusted to match today's needs and is seen to deliver increased shares of stocks adjacent to shores for coastal Member States through a range of mechanisms including the improved use of swaps".

The principle of subsidiarity is another important element of the CFP, which has implications for national policies. Subsidiarity stresses that decisions are best taken at the lowest possible level and that central decisions must be justified by there being, for example, a trans-national element to the decision. There is some significant incoherence between the principles of equal access and subsidiarity: subsidiarity means that significant discretion should be allowed to Member States within their own waters but equal access means that vessels from other fleets are fishing there and operating under rules set by their own administrations. This has led to conflict between fleets and member states and regular complaints about the lack of a level playing pitch (Cawley *et al.*, 2006). This issue exemplifies the problem that the CFP has always faced in trying to weave together conflicting or incoherent principles in order to satisfy diverse political interests.

The effect of negative attitudes to the CFP can have a wider impact also. In the wake of Ireland's initial rejection of the Lisbon Treaty the Institute of International and European Affairs commissioned a report on the No campaign and highlighted the IFO as one of the influential voices "*The IFO advocated rejection of the Treaty because it said it*

copper-fastened a two-tier approach to regulation across the union's fishing communities. It also argued that Ireland should have secured guarantees on fishing rights and a new quota system when it sought assurances after the 2008 vote. The Chairman of the IFO, Ebbie Sheehan, said fishermen felt they had no influence on decision-making either in Ireland or Europe and wanted that to change" (IIEA, 2010).

4.2.2. The Ecosystem Approach and CFP objectives

The CFP undergoes a process of reform every decade and a new policy is scheduled to be agreed and implemented in 2013. It will have as its guiding philosophy an ecosystem approach (European Commission, 2008; 2009). Under Article 2.1 of the 2002 CFP (European Council, 2002) there is a commitment made to the "progressive implementation of an ecosystem based approach to fisheries management". But that commitment is left unfulfilled as the EA is not mentioned again. The lack of any definition of strategy, goals or indicators for implementation of an EAFM within the 2002 CFP has been widely criticised (Sissenwine, 2007; Lutchman *et al.*, 2009; Symes, 2009). The EU Commission itself, in the 2009 Green Paper (European Commission, 2009) states that "*No priority is set for these objectives and, while direct references are made to adopting a precautionary and an ecosystem approach, it is not clear how this relates to economic and social conditions. There are no clear indicators and yardsticks that could provide more concrete guidance or to help measure policy achievements".* The Commission contradicts itself somewhat as in 2008 it published a defence of the CFP's contribution to EAFM implementation (European Commission, 2008). It is a weak defence which lists *ad hoc* initiatives with a loose connection to an EAFM rather than forming part of a coherent implementation plan.

The lack of clear objectives has long been a fundamental problem of the CFP and it also can be traced to the problems of satisfying divergent or conflicting interests. Symes (1995) has argued that unclear, unfocussed and incoherent objectives are at the root of most European fisheries problems. One very significant issue with which the lack of specific objectives has been linked is the conflating of fisheries science and fisheries management (Holden and Garrod, 1996). Their case is that scientific advice became synonymous with fisheries management as it was the only thing that countries could agree on as political differences precluded them agreeing on objectives. In 1981 the ICES Advisory Committee on Fisheries Management (ACFM) which provides fish stock advice to the European Commission stated that they were only competent to advise on biological objectives and that politicians and administrators should be developing

broader management objectives. When the conservation policy was adopted in 1983 general objectives with no specific criteria or goals were included and the 2002 CFP suffered from the same deficit. It is arguable that biological science is still the main locus of debate, as relative stability rules out arguments about allocations and the continued absence of a focussed set of objectives rule out any meaningful debate on the direction of the CFP. That only leaves a TAC figure and the science underpinning it as the zone for negotiation and debate.

4.2.3. Irish Fisheries Policy

This section is an analysis of Irish fisheries policy and, in particular, to look at indigenous policy development (i.e. Irish policy developed on aspects of fisheries management outside the aegis of the CFP). A literature search on Irish fisheries governance confirms that this has been a neglected area of research. Only a handful of peer–reviewed papers exist which analyse aspects of Irish fisheries policy or governance (Gillmor, 1987; Karlsen, 2001; Bradshaw and Tully, 2004; Fitzpatrick *et al.*, 2011; Foley *et al.*, 2011). This lack of academic analysis may be due to the fact that there is not a great deal of material to analyse. A simple and admittedly unscientific google search on "Irish fisheries policy" or "Ireland's fisheries policy" yields 10 hits or less, as opposed to 51,000 hits for "UK fisheries policy" or 14,300 if you search for "Norwegian fisheries policy" despite the fact that presumably Norwegian fisheries policy and much of the commentary on it are in Norwegian rather than English. There are very few published proceedings of any fisheries meetings with the exception of Dail questions and committee hearings. These however tell us very little of how the real process of fisheries management and fisheries policy interact. Recent public consultations and policy proposals with regard to a strategy for development of the seafood industry and reform of the CFP however do provide some useful subject matter for analysis.

The desire for the development of a clear national fisheries policy has a long history. In the late 1950s and early 1960s there were a number of reports and strategic plans all of which recommended the development of a national fisheries policy. This process culminated in a government White Paper in 1962, the "Programme of Sea Fisheries Development". The principal recommendations in the White Paper included :-

- training programmes for fishermen;
- financial incentives to build vessels up to 65 feet in length;
- the development of 5 major fishery harbours;

- grant aid for fish processors;
- guaranteed prices for fish for fishmeal.

McGinley (1991), in the only published review of Irish fisheries policy described the White Paper as lacking "*vision, projections and ambition*" and as "*a cautious document, aimed at inching the industry forward*".

In 1984 a government appointed Sectoral Consultative Committee produced a report "The development of the Fishing Industry" which found that "*there is at present no clearly articulated national fisheries policy*" (Sectoral Consultative Committee, 1984). The report found that the broad objectives in the State's National Economic Plan did not "*constitute a comprehensive set of explicit policy goals*" and they recommended that a white paper with "*clear cut objectives and policy*" should be published without delay and that those objectives should be reviewed regularly with industry.

The report's ambitious recommendations for industry expansion and modernisation are countered by an equally strong and officially titled "Reservation" from the Department of Finance which states that the recommendations would be very difficult to proceed within the prevailing economic climate.

In the last five years there has again been a period of debate, consultation and drafting of strategy statements and EU policy responses. The Cawley report on the strategic development of the seafood industry and its research counterpart, Sea Change, have set the agenda for the direction marine research and the fishing industry need to travel in (Cawley *et al.*, 2006; Marine Institute, 2006). The current reform of the CFP has prompted numerous official and organisational responses (Department of Agriculture, 2009).

The Cawley Report (2006) followed a strategic review of the Irish seafood industry and it contained a number of recommendations relevant to this paper. These recommendations included the decommissioning of 40% of the Irish whitefish fleet, the establishment of a single representative body for Irish fishermen and the implementation of a devolved Fisheries Management Regime of which one of the proposed elements would be a reformed whitefish quota management system to be managed by a legally incorporated Industry Quota Management Committee.

A number of recommendations explicitly referred to environmental issues including:

- the development of Environmental Management Systems on Irish fishing vessels; the increased awareness in the seafood industry of environmental issues and policy;
- the requirement for the industry to take a stronger conservation role in developing Technical Conservation Measures (TCMs) and to enhance their work within the Regional Advisory Councils (RACs);
- reductions in discarding and use of environmentally unfriendly fishing gear.

Although there are some similarities between the recomendations made in recent strategy statements and those made 50 years ago, which point to a serious national neglect of fisheries policy making, one aspect of the statements has changed greatly. The recommendations in the past, and up until the early 2000s with the last round of grant-aided vessel building, were almost all focussed on technical and infrastructural expansion. The most common theme was a call for greater investment in new vessels capable of fishing and competing offshore and exploiting a valuable state resource. This was the reason why the recommendations in the 1984 report were viewed with reservation by the Department of Finance. The approach now is very much focussed on fishing 'smarter' rather than 'harder', with a recognition that subsidies have to be replaced by adding value and a greatly increased emphasis on conservation and environmental aspects. In that sense, despite the current economic problems, the same barrier to developing a policy that was present in 1984 is not relevant today – the challenges now are more about generating political interest, emerging from the policy shadow of the CFP and developing good governance structures, none of which require large capital investment.

Table 4.1 shows a number of recent Irish fisheries policy and strategy statements, reviewed with respect to how they address the ecosystem approach. The policy statements chosen are a combination of reactive policy proposals, (i.e. where the State is required to respond as in the case of the CFP Green Paper response), and initiatives which arise from an endogenous desire for policy improvement, such as the Cawley report. Harvest 2020 is described by DAFM as "*a strategy to chart the direction of agri-food, forestry and fisheries for the next decade*".

Some of the strategy proposals above are progressive and point to some radical changes from current fisheries management practice. They appear to be well structured from a

co-management and ecosystem approach perspective. Irelands response to the Green Paper proposes significant devolution of rights and responsibilities to industry, greater use of incentives and clearer objectives all to be introduced through industry developed and independently audited spatial fishing plans. The inshore fisheries management framework from 2005 set out a clearly defined co-governance structure, and should have gone a long way to adopting an ecosystem approach in Irish inshore fisheries.

But the issue is that these are still proposals, rather than legally binding policy. The inshore management framework has collapsed (see Section 4.4 below) and similarly many of the proposals in the Cawley report have yet to be implemented. There is also a question about how realistic many of the Green Paper response proposals are given that currently Irish PO's have only a consultative role in quota management and the institutional structures required for devolved- and results-based management will take time to be developed.

Table 4.1 Analysis of Ecosystem Approach governance elements in Irish policy documents

Document	Key ecosystem approach governance issues					
	Ecosystem approach	**Participation**	**Incentives**	**Objectives**	**Responsibility/ Accountability/ Transparency**	**Coastal/Inshore Waters**
Managing Irelands Inshore Fisheries (BIM, 2005)	Detailed explanation of how framework meets EA objectives, in the biological, economic, social & institutional senses.	Strong local committee structure integrated into national and co-ordinating review group for all shellfish species. Framework based as far as possible on a voluntary partnership basis.	Aims to provide *"more secure investment and planning environment for fishermen".* Opportunity for participants to shape management plans.	Non-prescriptive approach whereby environmental, social & economic objectives will be developed locally and nationally through stakeholder led management plans.	Transparency mentioned as a key element of the framework.	
Cawley report (2006)	Ecosystem Approach only mentioned in comments but not the report. The word ecosystem is mentioned once in a very general sense.	Stronger industry role in quota management proposed. Co-management structure of Shellfish Management Framework is mentioned positively.	Opposition to ITQ's expressed. Transferable Vessel Quota system and dedicated quota management body proposed. Significant decommissioning.	Update national objectives to include economic, ecological, social & governance objectives. Objectives will promote transparent decision-making. Clear inshore objectives needed - possible use of community quotas	Transparency mentioned frequently throughout in relation to governance, licensing, objectives and quota management.	Logbook scheme, designated fishing areas & establishment of specific <10m fleet segment proposed. Enhanced Departmental support for shellfish management framework. Access limitation needed.
Sea Change (2007)	EA implementation mentioned as a specific objective. Need for socio-economic inputs.	Science-industry partnership approach required. Shellfish management committees to improve inshore participation.	Long term plans to enhance industry outlook. Decommissioning to reduce overcapacity.	Use of industry knowledge. Enhanced multi-disciplinary approach. Improved reliability of advice. Rebuild stocks. Eliminate discards.	Increased transparency through stakeholder participation in research.	Management plans based on scientific advice developed through Inshore Management Framework.
Ireland's response to the Green paper (2010)	Specific section on EAFM. Stresses governance and working with stakeholders. Principle implementation measure through area based management plans.	Stakeholder involvement stressed throughout. Proposes greater role for RAC's in area based & multi-annual plans. Partnership approach between industry, science and technical experts to solve problems such as discards through Codes of Practice (COP). Greater use of fishermen's knowledge.	Additional quota for vessels and groups implementing and abiding by audited COP's & Plans and responsible fishing schemes. Strong opposition to ITQ's on basis that they would concentrate ownership and have a negative impact on coastal communities.	Objectives to be set by EU Council and then implemented by MS in association with stakeholders. Sub-objectives can be set as part of responsible fishing schemes. Results Based Management (RBM) approach proposed through PO's. Some confusion between multi-annual regional plans & area-based management plans.	Greater industry responsibility addressed through RBM and responsible fishing schemes. Accountability not mentioned. Transparency strongly mentioned re: European control measures, scientific advice and resolving MSY difficulties but not regarding national governance.	Should be reserved for national small scale fleets. Weak proposal for extension of 6/12-mile regime to 10/20 miles with restrictions on permitted activities within these zones. Preferential consideration should be given to island communities. Opposition to differentiated regime for inshore & offshore on basis that offshore would become more industrialised and less connected with coastal communities.
Harvest 2020 (2010)	Not mentioned.	Industry driven Long Term Management Plans and environmentally friendly fishing schemes.		Very high level. Defers to Cawley and Sea Change report on specific objectives.		Implementation of specific Inshore Fisheries Management framework recommended.

4.3. Stakeholders and their participation in Irish fisheries management

Participation of stakeholders in management is a key principle of the ecosystem approach, second only to the maintenance of ecosystem structure and function in terms of citation frequency in the EAFM literature (see Chapter 3). The 2001 EU White Paper on governance (European Commission, 2001) lists participation as one of its 5 key components and states that "The quality, relevance and effectiveness of EU policies depend on ensuring wide participation throughout the policy chain - from conception to implementation".

4.3.1. Key stakeholders in Irish fisheries management

The principle participants in Irish fisheries governance and their key interactions are described below and mapped in Figure 4.1. A more detailed description of many of the stakeholder organisations and their respective interests is given in Appendix 1.

The central institution with responsibility for fisheries management is the **Department of Agriculture, Food and the Marine** (DAFM). As the executive arm of the presiding Minister DAFM has responsibility for *inter alia:* seafood policy and development, fishing vessel licensing, quota management of demersal, pelagic and deep-water fisheries, administering the European Fisheries Fund (EFF) and overseeing fisheries research and development funding through the Marine Institute and Bord Iascaigh Mhara (see below). Potential conflict between development and enforcement roles in DAFM was reduced through the creation of an independent Sea Fisheries Protection Authority (SFPA) in 2006.

The Irish fishing industry is represented in fisheries management discussions mainly by EU recognised **Producer Organisations** (P.O.s). One of the principal justifications for the establishment of P.O.s was more rational quota management. As Ireland has not devolved quota management to the P.O.s, in contrast with many other EU states, their role has become more of a lobbying one. The three main P.O.s formed an umbrella group, the Federation of Irish Fishermen (FIF), which represents the majority of over 12 metre fishing vessels. The IFO are also participants in most fisheries governance fora and represent a greater number of smaller vessels than the P.O.s. Many inshore fishermen are not members of any representative organisation.

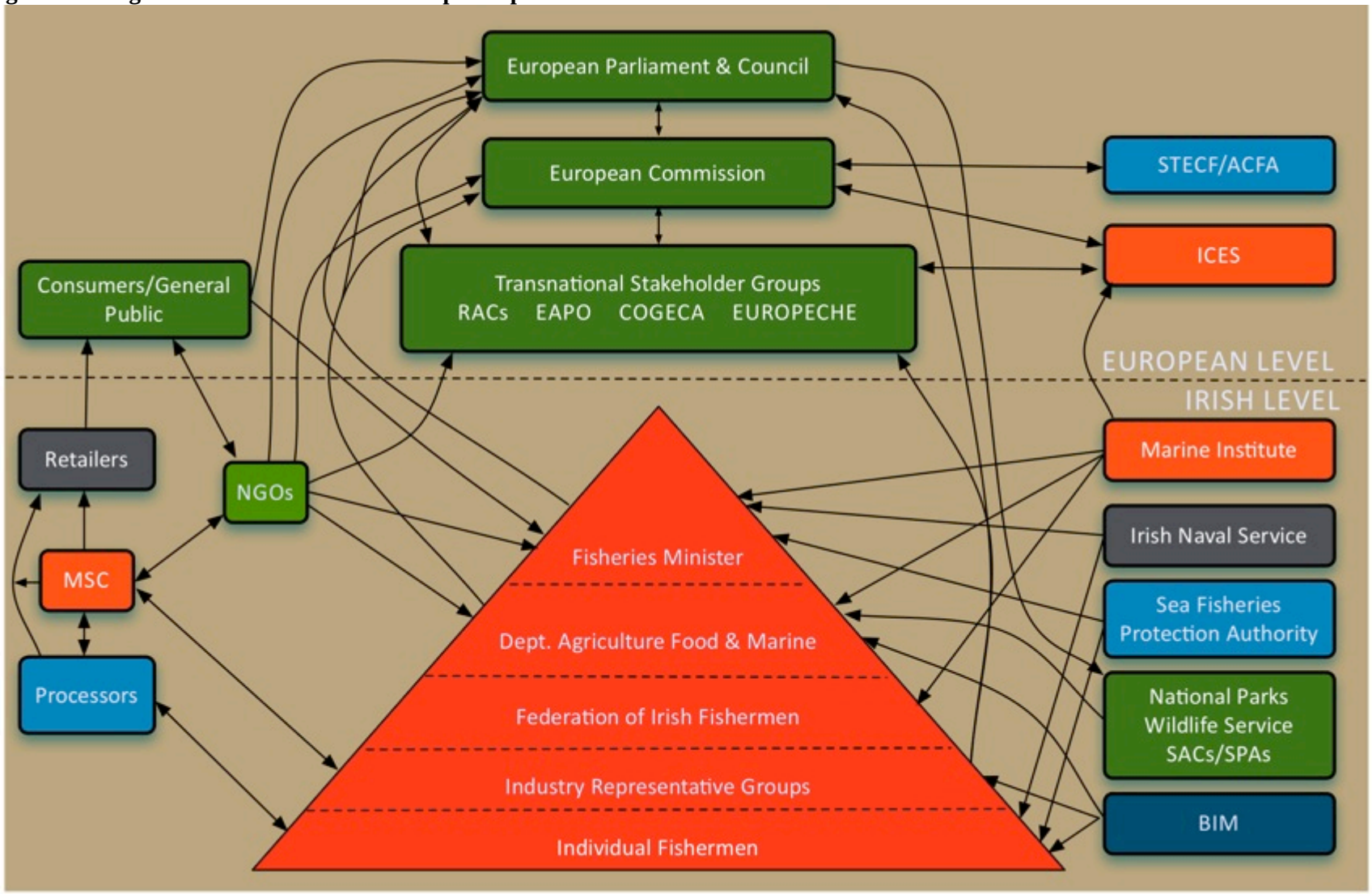
Representative organisations of non-Irish fleets are significant particularly in relation to offshore (outside 12 miles) fisheries. In demersal fisheries the most important stakeholder groups are those representing UK, French and Spanish fleets. In pelagic fisheries the Dutch and UK representative organisations are the most significant. The Belgian beam trawling fleet are also significant in relation to fisheries in ICES area VIIa (Irish Sea) and VIIg (Northern Celtic Sea). These organisations are becoming increasingly consolidated within their own countries in a manner similar to the emergence of the FIF in Ireland.

Other industry organisations with significant roles in fisheries governance are the **fishermen's co-operative associations**, (e.g., Foyle Fishermen's Co-op, Castletownbere Fishermen's Co-op and the Galway and Aran Fishermen's Co-op), and the **Irish Fish Processors and Exporters Association** (IFPEA). Although these organisations often take a complementary position to the P.O.s they tend to be more focused on markets than political issues.

A number of state organisations have a significant role in Irish fisheries governance. The **Marine Institute** (MI) provide the scientific advice relevant to Irish fish stocks and they are also the lead organisation in terms of an implementation of an EAFM. In recent years the Marine Institute has been developing a more collaborative approach and the Irish Fisheries Science Research Partnership (IFSRP) was established in 2008 (Marine Institute, 2008).

Bord Iascaigh Mhara (BIM) are the Irish fisheries development board and their remit is to promote sustainable development and diversification in the Irish seafood industry. They have been involved since 2009 in implementing Environmental Monitoring Systems (EMS) on board fishing vessels and in working with the fishing industry where Habitats Directive requirements and existing fishing operations have been in conflict.

Figure 4.1 Diagram of Irish and EU fisheries participation structure



The **Sea Fisheries Protection Authority** (SFPA) was established in 2007 as an independent body to ensure compliance with EU and Irish legislation governing the seafood industry. It is represented at the majority of fisheries governance meetings but normally restricts its inputs to control related issues.

The **Irish Naval Service** (INS) are charged with the control at sea of fishing activities and also operates the Fishery Monitoring Centre which tracks the activities of vessels using the Vessel Monitoring System (VMS). The INS has very little participation in fisheries management or consultative fora although it did submit a response to the EU Commissions 2011 proposals for CFP reform which focussed on practical difficulties with enforcing complex and confusing fisheries control legislation.

Irish **NGO's** who are participants in fisheries management fora include:

- The Irish Environmental Pillar (IEP), a coalition of several Irish environmental NGO's, who participate mainly in inshore fisheries management debates, particularly those relating to SACs designated under the Habitats Directive
- The Irish Whale and Dolphin Group (IWDG), who participate in the CSHMAC,
- The Irish Seal Sanctuary, who participate in meetings of the North Western Waters Regional Advisory Council.

4.3.2. Participation structure in Irish fisheries governance

There has been criticism in the past of the degree to which management is centrally controlled and of the conflicts between regulators and the industry (All Party Oireachtais Committee Report, 1999; Valatin, 1999; Cawley Report, 2006). A 1999 Parliamentary Committee report on the Department of Communications, Marine and Natural Resources Customer Service to the fishing sector (All Party Oireachtais Committee Report, 1999) noted "*disturbing evidence of a very poor relationship between the industry and the Department*" and recommended *"more decision making and administration to be conducted at local level as the Committee find it hard to believe that there is no executive capacity or decision-making powers in any of our fishing ports"*. Presumably this lack of local executive capacity was construed by the Report's authors as implying a disconnection between fishermen and decision-makers. An EU 4th framework research project described the Irish fisheries management system as opaque and top-down and that "*suspicions remain that a political culture of patronage and*

relying on political connections to obtain services remains largely unchanged" (Valatin, 1999).

During the previous round of CFP reform the Irish National Strategy Review Group on the Common Fisheries Policy, in a submission entitled "Sustainable fisheries through regional management", gave the following rationale for improved stakeholder input - "*There is a lack of communication between those regulating the fisheries and those fishing. If the fishermen or their representatives were made part of the management system and given some responsibility for the fishery, problems such as misreporting and discarding may decrease*." (Irish National Strategy Review Group on the CFP, 2000).

The Cawley Report (2006) highlighted both this conflict and internal conflicts between industry groups in the first two points under the Industrial Relations heading:

"1. A poor working relationship exists between the industry and its policy-makers/ regulators i.e. the Government/Minister, DCMNR and the Naval Service.

2. The industry suffers badly from the lack of a single coherent voice."

Arising from these tensions there have been some attempts at improving communications between state and industry. The Sea Fisheries Consultative Committee (SFCC) was established in the mid-1990s. Membership of the SFCC comprises representatives of the main fishing industry organisations, the fish processing industry, the MI, BIM and DAFM officials. Meetings of the group are held approximately every 2 months and they cover all aspects of EU and domestic fisheries management with a particular emphasis on mainly offshore whitefish and pelagic fisheries and less of a focus on the inshore area. These meetings function mainly as an opportunity for the various parties to express their views, outputs are informal and there are no formal voting or consensus achievement procedures. The function of the SFCC has been described by the Fisheries Minister in quite limited terms as "*a forum for the fishing industry representatives to be advised, and give their views on issues that arise*" (Dail questions, November 6th, 2007). Feedback from SFCC meetings is relayed to the Minister via DAFM officials.

Examples of management devolution as recommended in the All Party Oireachtais Committee Report (1999) are very few. The most significant case of partial management devolution to a local level is the CSHMAC.

One of the most significant aspects of Irish fisheries governance is the comparative lack of NGO involvement relative to many other EU states. Interviews with NGO representatives reveal the perception that this situation reflects a low national level of social interest in environmental issues, and is caused by both a lack of resources available to these organisations and their deliberate exclusion in some cases. However it is an important issue with respect to the implementation of an ecosystem approach. Best practice suggests that broad participation is desirable in order to "*balance diverse societal objectives*", (FAO, 2003). On the other hand there is evidence that conflict and mistrust where there are divergent viewpoints can reduce social learning and decision-making efficiency (Hauge and Wilson, 2009). The extent to which NGO influence is positive overall is certainly a contested and subjective issue and may depend on the degree to which the management forum has an adversarial set-up and the stance of the particular NGO involved, i.e. whether they are negotiators or tend to have fixed positions (Varjopuro *et al.*, 2008).

Regional Advisory Councils

In relation to participation by stakeholders the principal change arising from the 2002 Common Fisheries Policy review was the establishment of Regional Advisory Councils (RACs) which were formally adopted under EU Council Decision 2004/585. The RACs were established in order to address submissions made across the EU by fishing industry representatives both for a regionalisation of the CFP and for improved input from stakeholders. The RACs which have the greatest relevance for Irish fisheries are the North Western Waters RAC, which covers demersal fisheries in the waters around Ireland and the Pelagic RAC.

Fishing industry representatives make up two thirds of the General Assembly and Executive Committee membership of each RAC with the other third being made up by interest groups such as environmental NGO's, consumer groups etc. This has been criticised as creating an imbalance of power particularly for minority interests with lesser resources than well-funded fisheries organisations (Lutchman *et al.*, 2009; Long, 2010).

As specified under EU Council Decision 585/2004 the RAC's have only an advisory role and no real decision-making power has been devolved to them. The EU Commission describe the RAC's role as to "*prepare recommendations and suggestions on fisheries*

aspects in the area they cover and transmit them to the Commission or to the relevant national authorities" and the Commission recently described the RAC's as "*the main mechanism for interaction with stakeholders within the CFP*" (EU Commission 2008).

4.4. Irish Inshore fisheries management

To illustrate some of the problems that can arise even with well designed and well intentioned efforts to improve fisheries governance the recent example of the Shellfish Management Framework is detailed below.

Although it is widely perceived that the majority of Irish fisheries are governed by the CFP, a counter argument can be made. If we use the number of vessels and the employment figures as criteria then it could be argued that the activities of the majority of Irish fishermen are only tangentially or indirectly governed by the CFP. Shellfish fisheries within the 12 nautical mile limit are not generally subject to input or output controls nor are they assessed by ICES (Marine Institute & BIM, 2011). Table 4.2 below shows the number of vessels, employment figures and value of landings for Irish fleet sectors (from Cawley, 2006).

Table 4.2 Profile of Irish Fleet sectors, associated employment and landings value

Sector	**No. of vessels**	**Employment**	**Value** (% of total)
Inshore (<12m)	1,360	2,312	€43m (25%)
Pelagic	23	276	€56m (34%)
Polyvalent* >12m	290	1,880	€66m (41%)
Specific**	158	446	
Beam trawl	13	73	
Total	**1,844**	**4,987**	**€164m**

*Vessels in the Polyvalent sector are typically multi-purpose and target a mix of whitefish, shellfish and pelagic species.
**Vessels in the Specific sector target bivalve molluscs such as mussels, razor clams and scallops mainly using dredges.

It is evident from these figures, and bearing in mind that 100% of the inshore catches are landed in Ireland and that essentially these fisheries fall outside the remit of the CFP, that good governance arrangements for this sector should be a priority. However at present inshore fisheries are essentially unmanaged, with the exception of some local arrangements such as for oysters in Tralee bay, and where required under the EU Habitats Directive, such as the cockle fishery in Dundalk Bay (Marine Institute & BIM, 2011). Also, inshore fisheries are open access and the number of licensed vessels in the inshore sector is increasing annually (Marine Institute & BIM, 2011). As a consequence

total catches of shellfish have declined from 29,000 tonnes to 17,000 tonnes between 2004 and 2010 and there are concerns about stock status for many of the relevant species (Marine Institute & BIM, 2011). The difficulty with implementing governance change within a dysfunctional system influenced by political, social, biological and economic factors is well illustrated in the recent history of attempts at Irish inshore shellfish management.

Following extensive discussions with inshore shellfish fishermen in the early 2000's a management framework for Ireland's inshore shellfisheries was published in 2005 (BIM, 2005). Local Advisory Committees (LAC's), national Species Advisory Group (SAG's) and an Inshore Fisheries Review Group to co-ordinate across the species-based frameworks were established. The framework was designed in consultation with experts from other regions, notably Tasmania, but also the UK and France, and in accordance with best co-management practice. For a period the local and national species groups were operating and a draft lobster management plan and access control scheme was developed and published, (BIM, 2008). This plan proposed authorisation requirements for all those involved in the fishery, limitations on new entrants, regional management and reporting requirements. Similar plans were also being developed for other shellfish fisheries such as crab, shrimp and scallop.

By 2009 it was clear that the management structure was failing and very quickly inshore fisheries management reverted back to its *ad hoc* nature. In an interview with the instigator and principle developer of the management framework the following problems and reasons for the collapse became clear:

- There was a lack of commitment to the process at the top institutional level, which meant that there could be delays of up to a year in scheduling meetings of the national Review Group. This inevitably reduced the capacity of the lower decision-making levels in the framework to make progress on substantive issues such as access.
- This open access situation itself was a barrier to progress. The investments made in purchasing fishing capacity and gear made fishermen reluctant to endorse proposals which they felt would erode the value of their licence in the short-term.
- The requirement for strong top-down leadership from the fisheries department was greater than anticipated. The access and licensing issue was a particular

example of how clear legislative policies and strong departmental engagement are often necessary conditions to guide and incentivise nascent co-management institutions.

- It became apparent that the culture and practice of co-management is something which takes time to adopt. Moving from a situation of essential non-management to co-management in one step was demanding and exceeded the capabilities of the institutional structures present in inshore fisheries. So co-management is not a panacea that can be applied to every situation no matter how well designed the process is, but requires capacity building and time in order to mature.

Figure 4.2 Proposed structure of Species Advisory Group under the Shellfish Management Framework (from BIM, 2005).

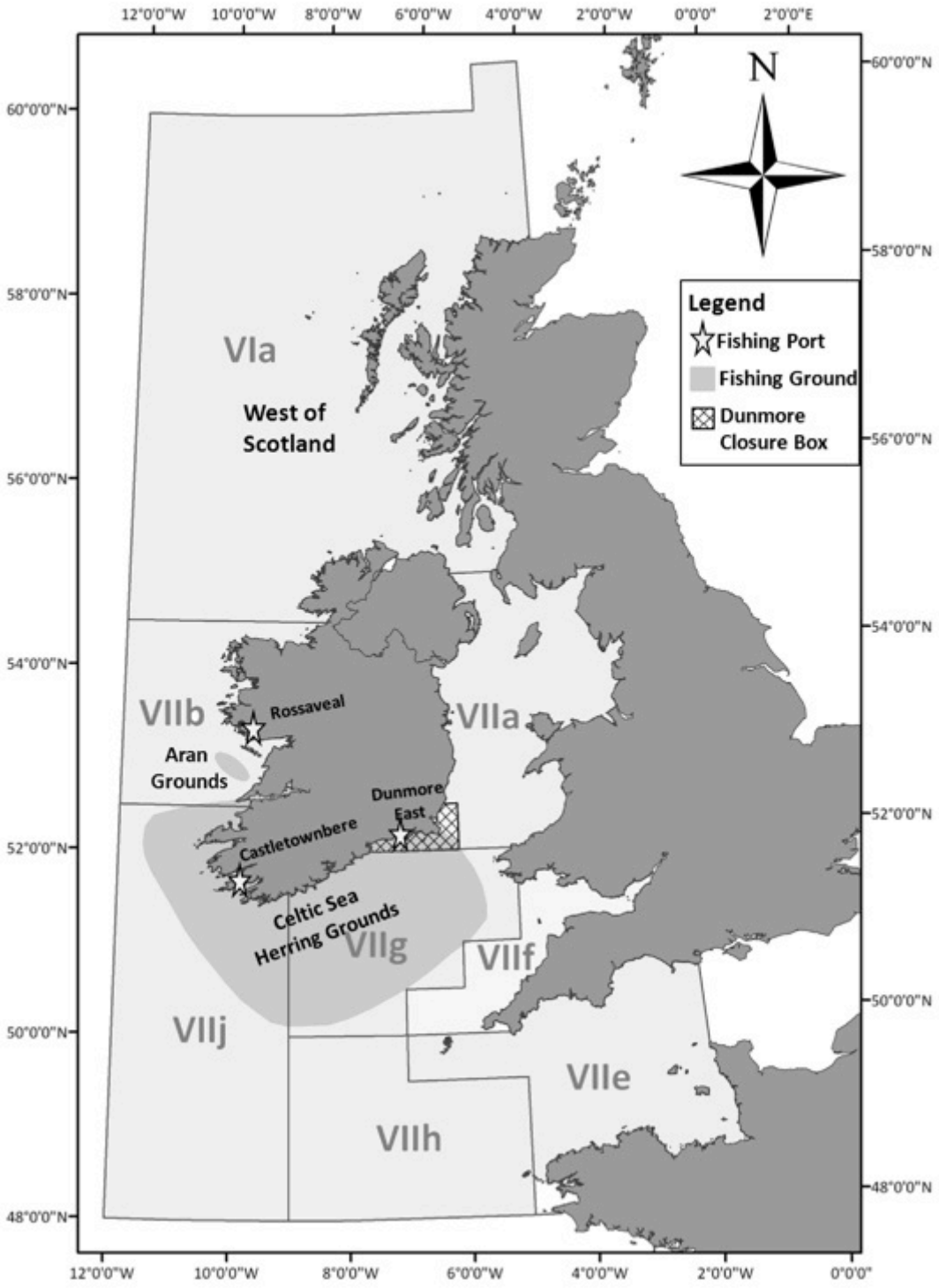
The failure of the management framework means that calls for improved inshore governance are back on the agenda. Recognition of the social and economic benefits of a

well governed inshore fishery are evident in specific recommendations in Irelands Green Paper response and the Cawley report covering extensions of the 6 and 12 mile limits to 10 and 20 miles and the designation of exclusive or priority zones for inshore vessels (Cawley *et al.*, 2006; Department of Agriculture, 2009). The most tangible fisheries recommendation in the Harvest 2020 document is that "the implementation of a specific Inshore Fisheries Management framework should proceed as speedily as possible" (Department of Agriculture, 2010). The fact that 40 years after Ireland entered the CFP it still doesn't have a management framework for the main fisheries sector which is within its exclusive competence is surely more of an indictment of its governance than it is a laudable objective.

4.5. Case Study: the Celtic Sea Herring fishery and its management

The Celtic Sea Herring fishery is a single species pelagic fishery predominantly targeted by Irish fishing vessels off the South coast of Ireland in International Council for the Exploration of the Sea (ICES) areas VIIj, VIIg and the southern part of VIIa (Figure 4.3).

Figure 4.3 Map of ICES areas in Irish waters and Celtic Sea and Aran fishing grounds



The fishery is conducted by a diverse fleet of vessels ranging from under 10m multi-purpose inshore vessels up to modern 50m pelagic vessels equipped with refrigerated seawater tanks. It has traditionally been a very important fishery for both the fleet and processing sectors in the south of Ireland although landings in the last 10 years have been well below their previous peaks and the length of the fishing season has also significantly decreased. The fishery has in recent years been exploited almost entirely by Ireland with small reported catches by other nations. The only other significant players involved in the fishery are Dutch vessels and Dutch owned vessels from France and Germany. It is essentially a single species fishery.

4.5.1. Current management institutions and approaches

The history of the fishery over the past 50 years has been one of an alternating boom and bust cycle. This pattern is shown below in Figure 4.4 which graphs the landings, biomass and fishing mortality trends since 1958 (Marine Institute, 2011). In 2001 the ICES advice for the Celtic Sea Herring stock recommended a cut from the previous year's TAC of 20,000 tonnes to a precautionary level of 6,000 tonnes for 2002. This was mainly based on a poor age profile for the stock which showed an over dependence on juvenile fish. Although eventually the scientific advice for the stock was amended and the TAC was set at 13,000 tonnes stakeholders in the fishery were concerned enough to establish the CSHMAC in 2001. The committee consists of representatives of fishermen, processors, scientists and control authorities. The Committee was established with the overarching goal of sustaining annual catches of 20,000 tonnes and to rebuild the stock if necessary to achieve this. Another strong objective was to improve the partnership between industry and scientists.

In 2005 the Committee was officially recognized as an advisory committee by the Irish fisheries minister and tasked with providing advice to the minister and managers from the fisheries department. Although officially only advisory, following ministerial recognition the committee has found that more of its advice has been accepted and also partnership between industry and science has strengthened. So the management of the fishery could be considered to represent an informal version of co-management.

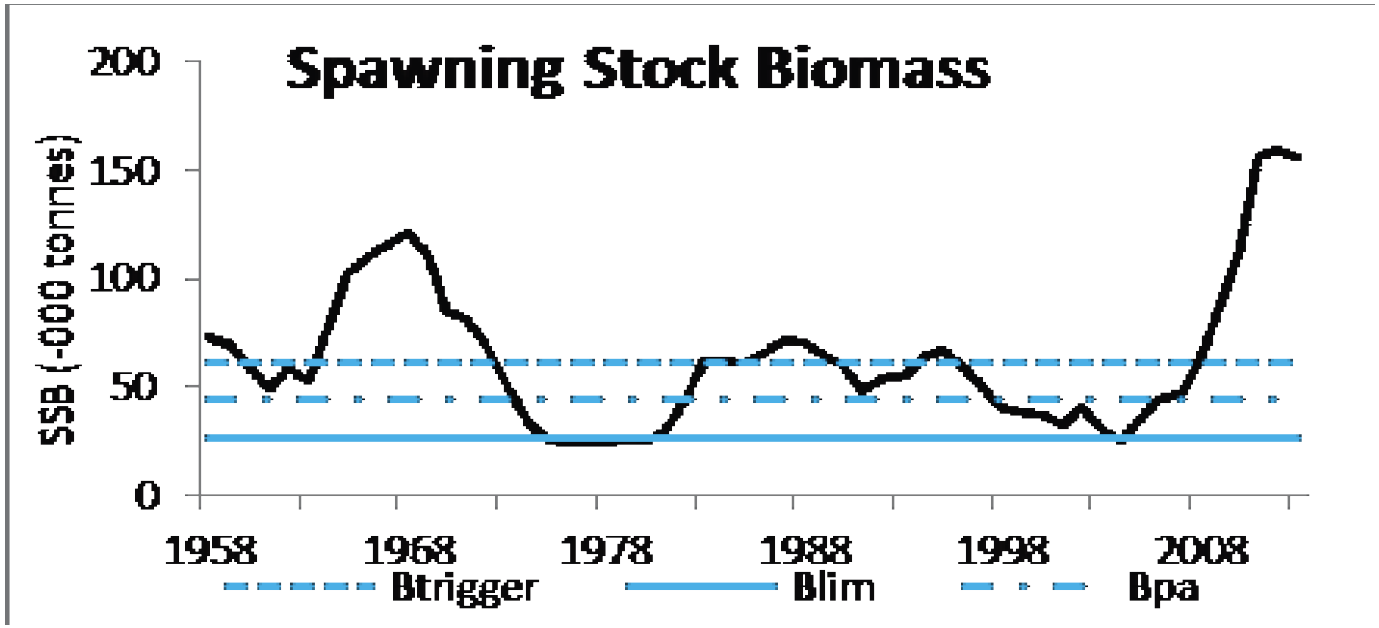
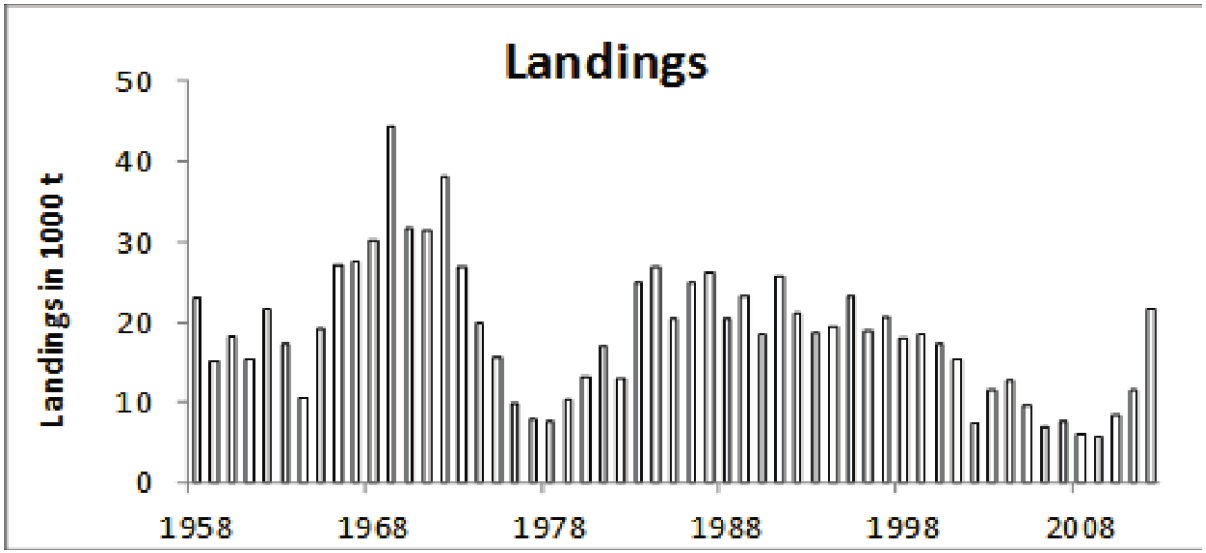
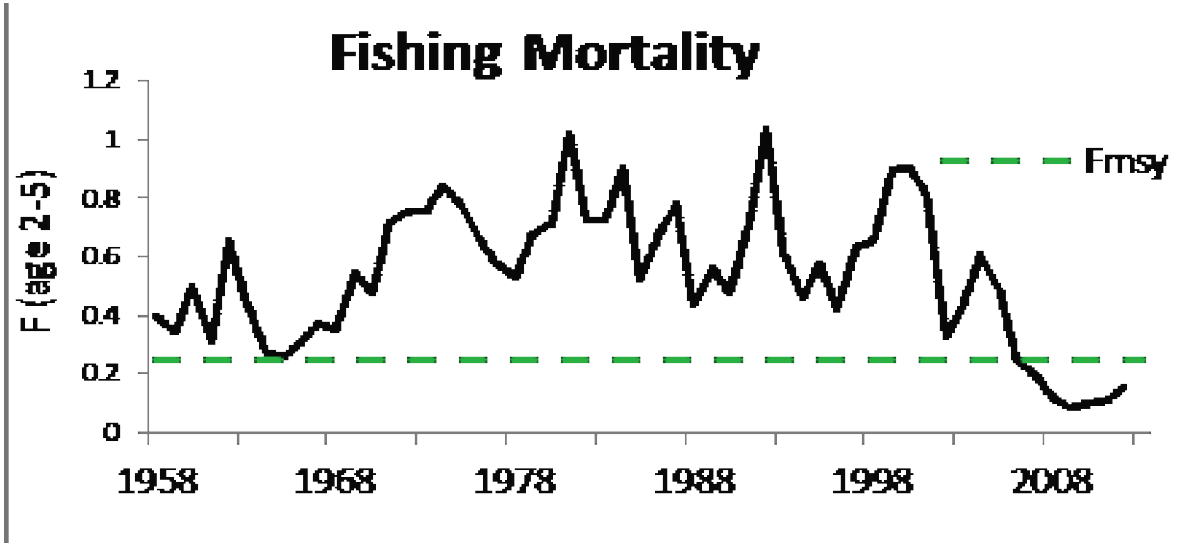


Figure 4.4 Spawning Stock Biomass, Landings and Fishing Mortality in the Celtic Sea Herring Fishery from 1958 to 2013 (Source: ICES, Herring Advisory Working Group Report, June 2013)


Landings
Landings in 1000 t
50
40
30
20
10
0
1958
1968
1978
1988
1998
2008


Fishing Mortality
F (age 2-5)
1.2
1
0.8
0.6
0.4
0.2
0
Fmsy
1958
1968
1978
1988
1998
2008

One of the most significant measures taken was the closure for several years between 2002 and 2006 of a large area off Dunmore East known as the Dunmore Box (hatched area in Figure 4.3) where herring spawning took place and where fishing effort had previously been concentrated. This was aimed at reducing catches of small first time spawning herring. However despite this initiative the TAC continued to decline so in 2007 a rebuilding plan was developed by the CSHMAC in conjunction with scientists from the Marine Institute. The Rebuilding Plan set a very low fishing mortality level, allowed for a small-scale fishery with a guaranteed quota allocation and strengthened the annual closure of the spawning area. The TAC in 2010 was increased by 70% over the 2009 figure and in 2011 increased by a further 30%. In 2011 the rebuilding plan achieved its aim of maintaining SSB above the precautionary biomass level, B_{pa} for the third consecutive year, and the parameters of a Long Term Management Plan (LTMP) have been agreed and await ratification by the European Commission's Scientific, Technical and Economic Committee for Fisheries (STECF). Under the LTMP the target fishing mortality rate is set at its lowest estimated level in the past 50 years, (well below the fishing mortality required to achieve Maximum Sustainable Yield, F_{MSY}) and the spawning area closure is retained.

Another significant development in the fishery within the past decade has been the strengthening of control and enforcement in both legislative and operational terms. These changes have been driven mainly by the introduction of the pelagic weighing regulations and the establishment of an independent fisheries control agency. These factors have increased confidence in the accuracy of the scientific assessment and the Marine Institute in their most recently published advice state that "*under the current management regime the quality of the catch data has improved*" (Marine Institute, 2011).

In 2010 discussions began at the CSHMAC on the benefits and costs of applying for Marine Stewardship Council certification for the fishery. Initially attitudes towards the MSC were quite negatve with the perception that application for it represented dancing to a environmentalist tune (personal notes from observations at CSHMAC meetings). But this tone was moderated over time with greater consideration being given to the fact that failure to have MSc certification in the future may result in the loss of markets for Celtic Sea Herring. The MSC is currently the global leader in certifying fisheries which meet their sustainability criteria. To give a brief account of the MSC certification process it involves assesment by independent consultancies of an applicant fishery against three principles which are:

- Principle 1: Sustainable fish stocks – fishing effort must be at levels which are sustainable over the long term.
- Principle 2: Minimising environmental impact - Fishing operations should be managed to maintain the structure, productivity, function and diversity of the ecosystem on which the fishery depends.
- Principle 3: Effective management - The fishery must meet all local, national and international laws and must have a management system in place to respond to changing circumstances and maintain sustainability.

MSC certification also involves detailed descriptions of chain of custody and traceability requirements to ensure that fish sold under the MSC logo are correctly labelled and there is an open and public process for any interested parties to give their views during the assessment period. The Celtic Sea Herring fishery was certified under the MSC in March 2012 after a number of recommendations were made by the assessment team and addressed by the CSHMAC. Further details on these recommendations are given in Section 6.2.2.

Two pelagic RSW fishing vessels landing Celtic Sea Herring in Cork Harbour.

4.6. Governance benchmarking for three Irish fisheries

Grafton *et al.,* describe "ineffective and inappropriate governance" as the number one cause of negative marine ecosystem outcomes (2007). This is certainly echoed in the top 5 failings of the CFP identified in the European Commissions Green Paper (2009) which were all governance related. Grafton *et al.* suggest that a governance benchmarking exercise can identify underlying causes of unsustainable fishing and steps towards implementing an ecosystem approach. The governance benchmarking assessment below evaluates how current governance arrangements may impact on the implementation of an ecosystem approach in the Celtic Sea Herring and uses two other

fisheries, Aran Ground Nephrops and Celtic Sea mixed demersal fisheries, for comparative purposes.

The *Nephrops* fishery on the Aran Grounds in Area VIIb is a well established fishery that has been exploited since the mid-1970s but has been exclusively an Irish fishery since around 1988. Currently there are 12 large whitefish vessels (> 15m) and another 8 smaller, weather dependent vessels in the fleet. The majority of these vessels fish from the port of Ros a Mhil on the west coast of Ireland. Landings of *Nephrops* from the Aran Grounds in recent years have been around 700-900 tonnes. Currently a single TAC is applied to the overall Area VII *Nephrops* fishery which includes stocks in the Irish Sea, Porcupine Bank, SW Ireland and the Celtic Sea in addition to the Aran Grounds. There is a single target species for the fishery, it operates in a well-defined inshore area and the participating vessels predominantly land into one port and through one co-operative. The major problem in the fishery is discarding of fish and small *Nephrops*, which have been observed as being high.

The mixed demersal fishery in the Celtic Sea area (centred on ICES Areas VIIg and VIIj) is a highly diverse fishery targeting mainly cod, haddock and whiting, involving a large number of vessels from Ireland, France, the UK and Belgium, ranging in size from 10m to 40m and fishing with a variety of gears including otter trawls, beam trawls, gillnets and Scottish seines. Currently the fishery is managed by TAC's and quotas. In addition there is a seasonal closure during Cod spawning of three ICES statistical rectangles in Areas VIIg and VIIf that has been in place since 2005 as well as a range of gear-based TCMs. Discarding is believed to be considerable for all species driven *inter alia* by restrictive TAC's and poor gear selectivity. The current scientific advice for the major whitefish stocks in this area is uncertain. In comparison to the Celtic Sea herring and Aran *Nephrops* fisheries, this is much more problematic with governance arrangements complicated by the mix of target species, fleets, gears and national management structures. There are emerging positive examples of co-operation across fleets in the fishery. The seasonal closure currently in place was the result of a trans-national industry initiative and there are active discussions between industry and scientists, facilitated through the NWWRAC in developing a long-term management plan for whitefish in the area.

The criteria used for governance benchmarking are derived from a number of sources. The primary sources are five key governance principles identified from the literature by Grafton *et al* (2007) which are: accountability, authority and responsibility;

transparency; incentives; risk assessment and management; and adaptability. These are supplemented with principles of the EAFM summarised from literature (see Chapter 3, Table 3.1). The criteria are also inclusive of the principles used in a European Commission White Paper on Good Governance which are: participation, openness, accountability, coherence and effectiveness (European Commission, 2001). These 5 principles are also contained in Article 2 of the current CFP regulation (EC 2371/2002) and the European Commission Green Paper on CFP Reform (2009). Table 2 below gives the list of criteria used and summarises the benchmarking scores for each of the three fisheries.

The scores for each of these criteria given in Table 4.3 were given by the author in consultation with scientists from the Marine Institute with responsibility for the assessement of the relative stocks and the principal scientist on an EAFM research programme. The scores are based on a five point numerical scale as detailed in Table 4.3. For the purpose of summarising and communicating the results of the governance benchmarking exercise the five-point grading system used by Grafton *et al.,* (2007) is used as it provides a simple visual indication of the degree to which the criteria have been operationalised.

Table 4.3 Results of the Governance Benchmarking assessment

Category	Criteria	Benchmark Score		
		Celtic Sea Herring	Aran Nephrops	Celtic Sea Demersal
Objectives	Are there clear **strategic objectives**?	1	1	1
	Are there clear **operational objectives**?	2	1	1
	Has a **long-term management plan** been agreed and implemented?	3	0	1
Responsibility	Is there **accountability** for decisions and outcomes?	2	2	2
	Are there clearly defined roles and **responsibilities**?	2	1	1
	Are **independent** management assessments used?	2	2	2
	Are **social** performance indicators used?	0	0	0
	Are **economic** performance indicators used?	1	1	1
	Are **ecosystem** performance indicators used?	1	1	1
Transparency	Is the decision-making process **transparent** to non-participants**?**	0	0	0
	Is the **research** process **collaborative**?	3	2	3
Participation	Is there a formal or informal **co-management** process?	3	1	1
	Are a broad spectrum of **stakeholders** involved in management?	2	1	1
Incentives	Are there **incentives** to avoid bycatch & habitat damage?	2	0	1
	Is a **rights-based-management** system used?	0	0	0
	Is there strong **enforcement** of the rules?	4	3	3
Adaptive Management	Is **in-season adjustment** to management possible?	1	0	0
	Is there a **real-time** closure option	2	1	1
	Is **fishers tacit knowledge** utilized?	2	2	2
Integration	Is there an **integrated institutional framework**?	1	1	1
	Is there **integration between natural and social sciences**?	2	1	1

Symbol	Meaning
4	Governance element fully in place
3	Governance element mostly satisfied, but not yet fully operationalised
2	Governance element partially satisfied, but further development is required
1	Governance element is not satisfied, but steps towards its development are in place
0	Governance element missing in the fishery

4.6.1. Benchmarking results per category.

Table 4.4 Benchmarking results - Objectives

Objectives	Celtic Sea Herring	Aran Nephrops	Celtic Sea Demersal
Are there clear **strategic objectives**?	1	1	1
Are there clear **operational objectives**?	2	1	1
Has a **long-term management plan** been agreed and implemented?	3	0	1

The importance of strategic objectives and the absence of them from the current CFP has been discussed above in Section 4.2 and in Chapter 3 also. As a result of this absence all three fisheries score poorly on this criterion.

It is obviously difficult to see how operational objectives can be set in the absence of higher level strategic ones and accordingly this criterion scores poorly also. In the Celtic Sea Herring fishery there has been an endogenous attempt to set long-term objectives through the Recovery Plan and the LTMP. However these objectives are narrowly focused on biological targets. The fact that the CSHMAC is advisory rather than a statutory management forum with limited ability to make some significant decisions also makes it difficult to give a higher score on this criterion.

Of the three fisheries assessed here only Celtic Sea Herring has an agreed LTMP. The NWWRAC are currently developing a Long Term Management Plan for Celtic Sea demersal fisheries but it is still a draft and has not been subjected to any scientific assessment as yet. To date there have not been any attempts to develop a management plan for the Aran Nephrops fishery. The Irish Marine Institute Stock Book for 2011 makes the following recommendation: "*There are no explicit management objectives or a management plan for Nephrops stocks in VII. FSS recommends that management objectives be established and that management plans be developed with stakeholders and implemented for fisheries catching Nephrops*." (Marine Institute, 2011).

The difficulty with not having clear policy objectives is illustrated in a recent review of management arrangements for Irish Herring fisheries. This review was instigated in 2011 by the Irish fisheries minister at the request of some industry representatives who were unhappy with existing arrangements. Written submissions from all interested

parties were sought and a Ministerial proposal in response was produced. A public meeting to discuss the issues was organised in January 2012. In terms of consultation the process was fair, all interested parties were given two opportunities to make written submissions and one to give their spoken view at a public meeting. However the problem remains that the Ministers criteria on which to base his decision remain arbitrary. There is no national policy on allocation of fisheries quotas in general nor on pelagic fisheries specifically. However there is an *ad* hoc process of limiting access to pelagic fisheries underway. To date restricted access regimes for Mackerel, Horse Mackerel, Blue Whiting, Boarfish and Herring have been established but in each case the allocation criteria has varied to some degree. Concerns about the basis for the Ministers decision are evident in the fact that at least one fishermen's organisation submitted a request to the Minister asking that he include, with his final decision, an explanation for the criteria used in arriving at it.

Table 4.5 Benchmarking results - Responsibility

Responsibility	Celtic Sea Herring	Aran Nephrops	Celtic Sea Demersal
Is there **accountability** for decisions and outcomes?	2	2	2
Are there clearly defined roles and **responsibilities**?	2	1	1
Are **independent** management assessments used?	2	2	2
Are **social** performance indicators used?	0	0	0
Are **economic** performance indicators used?	1	1	1
Are **ecosystem** performance indicators used?	1	1	1

Interviews with participants in governance indicate that they generally feel that their roles are reasonably well defined but that accountability is very poorly structured which results in the "blame game" being regularly played out between various governance parties. This is symptomatic of a poorly structured governance system which is mirrored at national and European level. The creation of advisory bodies such as the CSHMAC and the RAC's at both levels does little to improve accountability as an advisory group can easily disown negative outcomes by claims that their advice is ignored. Furthermore an advisory committee usually has influence only on certain aspects of the management process. In terms of Schlager and Ostrom's (1992) hierarchy of decision-making, advisory committees operate mainly at the operational level, partly at the collective choice level but critically not at the constitutional level where the most fundamental decisions are taken.

On independent management assessment the fisheries score more highly. ICES evaluate scientific aspects of management, particularly with respect to precaution and periodically ICES Working Groups will nominate a stock for a full benchmark. STECF also assess technical and economic aspects of management decisions and plans. However there is no mandatory requirement, such as exists in the US under the Magnusson-Stevens Act, for a full management strategy evaluation.

The use of indicators with which to monitor the success of management plans is problematic. At present stock status and fishing mortality indicators are used (SSB and F) but from a governance perspective broader reference points and indicators are essential elements. However indicators should be linked to clear objectives and without explicit social, economic and ecosystem objectives the use of indicators is rather pointless, unless perhaps to produce a data set which can act as a baseline to inform the assessment of success relative to some future objective. The use of ecosystem performance indicators should increase rapidly as a range of ecological data is now required under the Data Collection Framework, the Marine Strategy Framework Directive, the Habitats Directive and the Water Framework Directive.

The absence of social indicators reflects the fact that social objectives have been dealt with in an equivocal fashion in European fisheries governance (Symes and Phillipson, 2009). Repeated references to issues such as *"providing a fair standard of living for those who depend on fishing activities"* in the basic CFP regulation (European Council, 2002) are not backed up with any explicit objectives or operational targets. This problem originated in early CFP negotiations where France and Italy had tried in 1960 and again in 1992 to have social objectives included in the CFP, specifically to have funding allocated to alleviate unemployment arising from shrinking fishing fleets but these attempts were unsuccessful due to concerns about increasing the Community budget (Holden and Garrod, 1996).

Table 4.6 Benchmarking results - Transparency

Transparency	Celtic Sea Herring	Aran Nephrops	Celtic Sea Demersal
Is the decision-making process **transparent** to non-participants**?**	0	0	0
Is the **research** process **collaborative**?	3	2	3

There is a highly opaque decision-making process in each of these three fisheries. A member of the general public would have extreme difficulty in getting information on

how operational or strategic decisions were made. Whether management meetings are occurring at local, national or European level very few of the negotiations are subject to public scrutiny. The CSHMAC has recently developed an action plan to address this issue as it was raised during the assessment process for Marine Stewardship Council (MSC) certification.

The collaborative research process scores are better as there is a long-standing relationship between scientists and the CSHMAC and improving levels of collaborative scientific initiatives in relation to Celtic Sea demersal fisheries. Some conflict with industry has set back attempts to build a science-industry partnership in the Aran nephrops fishery but there has been a project attempting to utilise the knowledge of fishers participating in the fishery.

Table 4.7 Benchmarking results - Participation

Participation	Celtic Sea Herring	Aran Nephrops	Celtic Sea Demersal
Is there a formal or informal **co-management** process?	3	1	1
Are a broad spectrum of **stakeholders** involved in management?	2	1	1

If we accept the definition of co-management as "a collaborative and participatory process of regulatory decision-making between representatives of user-groups, government agencies, research institutions, and other stakeholders" (Jentoft, 2003) then none of the three fisheries exhibit what would strictly be classified as a formal co-management structure. However in all but name, which denotes an advisory role, the CSHMAC can be considered as an informal co-management process as the majority of its recommendations are implemented across many aspects of management.

Aran Nephrops and Celtic Sea demersal fisheries are more typical of the general Irish fisheries management framework in that they do not have a dedicated management forum and are centrally managed at a departmental level and through NWWRAC sub-committees. As these fora are advisory or consultative the degree of sharing of rights and responsibilities is quite low.

As discussed in Section 4.3 Irish fisheries governance is quite restrictive in terms of the stakeholder profile while the NWWRAC stakeholder profile is somewhat more inclusive but has still been criticised for privileging industry representatives.

The CSHMAC has recently increased the diversity of participants with the invitation of representatives of environmental NGOs, the fisheries control agency and social science to attend meetings on a regular basis. This expansion was driven in part by governance recommendations arising from the MSC certification process.

Table 4.8 Benchmarking results - Incentives

Incentives	Celtic Sea Herring	Aran Nephrops	Celtic Sea Demersal
Are there **incentives** to avoid bycatch & habitat damage?	2	0	1
Is a **rights-based-management** system used?	0	0	0
Is there strong **enforcement** of the rules?	4	3	3

Economists have emphasised the importance of understanding the role incentives play in fisheries management for many years (Clark and Munro, 1975; Hatcher, 1997; Hatcher and Gordon, 2005). In the past 20 years that emphasis has been expanded to accommodate complex systems theory and in particular the need to embed incentives within an ecosystem approach (Hanna, 1998; Hilborn, Orensanz *et al.*, 2005; Grafton, Arnason *et al.*, 2006; Charles and Young, 2008). Rights-based management has been identified as a key enabling factor for positive economic outcomes in common pool resource management contexts (Ostrom, 1990; Grimur Valdimarsson and Metzner, 2005; Bromley, 2007; Costello, Gaines *et al.*, 2008).

However the emphasis on incentives and rights has not significantly penetrated the governance regime of the three Irish fisheries assessed here with the exception of the control regime. Unsurprisingly this produces a feeling among industry that the governance regime is all stick and no carrot. In all three fisheries there are significant disincentives for conservation actions due to the fact that all three fisheries are in either full or partial open access regimes.

In relation to avoiding bycatch and habitat damage the incentives again are all top-down which fishermen often perceive as a negative. The designation of Special Areas of Conservation under the Habitats Directive, in contrast with the closure of spawning boxes for Herring and Cod in the Celtic Sea, has not received much fishing industry support. This may be due to their permanent nature, dissatisfaction with the designation process or simply because they don't have a perceived benefit for their

target species. A recent announcement by the Fisheries Minister whereby additional quota will be given to fishermen using nets with an approved escape device for young fish in the Celtic Sea demersal fishery may indicate a change in attitude towards the use of incentives to avoid bycatch.

It remains to be seen whether environmental certification can act as a strong driver of change in terms of incentives to avoid environmental damage. The CSHMAC have been requested, as part of the MSC certification process, to develop an environmental impact plan which will address issues such as cetacean bycatch, the use of observers and protection of gravel spawning beds.

Table 4.9 Benchmarking results – Adaptive Management

Adaptive Management	Celtic Sea Herring	Aran Nephrops	Celtic Sea Demersal
Is **in-season adjustment** to management possible?	1	0	0
Is there a **real-time** closure option	2	1	1
Is **fishers tacit knowledge** utilised?	2	2	2

Examples of "active" adaptive management are few due at least in part to practical difficulties in designing management measures as experiments and also in attributing outcomes to measures adopted (Defeo *et al.*, 2007; Walters, 2007). Nevertheless it is widely cited as being a crucial element of an ecosystem approach (Walters, 1997; Olsson, 2006; Armitage *et al.*, 2009). "Passive" adaptive management, which places a different emphasis on the learning aspect of the management process and does not require multiple simultaneous management strategy experiments, is probably a more pragmatic option. It incorporates the idea of addressing uncertainty through learning by doing, and is explicitly iterative. It is sometimes disparagingly described as *ad hoc* management but in fact adaptive management follows a planned and deliberate sequence of monitoring, assessment and design.

Aspects of adaptive management are being implemented in these fisheries: there is a trend towards increased use of real-time measures and fishermen's knowledge. However there are some serious challenges to the application of adaptive management in the three fisheries. These include a persistent desire for stability, predictability and certainty by all stakeholders. Additionally the explicit use of alternative management strategies, evaluation of their consequences and scenarios aimed at addressing uncertainty will require a change of mind-set and additional flexibility which does not necessarily fit with the current development of LTMPs. Such a planned and

experimental approach more than likely requires an institutional maturity which would have to be preceded by a period of co-management capacity building.

Table 4.10 Benchmarking results - Integration

Integration	Celtic Sea Herring	Aran Nephrops	Celtic Sea Demersal
Is there an **integrated institutional framework**?	1	1	1
Is there **integration between natural and social sciences**?	2	1	1

Poor scores on integration within the institutional framework are unsurprising given the disintegrated marine governance structures existing at Irish and European level currently. Despite the fact that there is now an Integrated Maritime Policy (European Communities, 2007) and a Marine Strategy Framework Directive (European Council and Parliament, 2008) both of which cover multiple industrial sectors the degree to which fisheries policy will be integrated particularly within the IMP framework is debatable (Juda, 2007; van Hoof and van Tatenhove, 2009; Rätz *et al.*, 2010; Wakefield, 2010).

At an Irish level the degree of disintegration is a concern. There is an inter-departmental co-ordination committee comprising the assistant secretaries of at least 5 different departments with marine responsibilities. There is some evidence of a move to improve this as a consultation has recently concluded which aims to develop an integrated Irish marine policy.

Juda (1999) states that "social scientists also have an essential role to play in the governance process since ecosystem-based governance addresses human behavior". In comparison particularly with Nordic countries such as Norway and Denmark Irish fisheries research and governance have not until recently included any significant role for social science or economics so integration between natural and social sciences has been almost non-existent. Moves to redress this are being made and current Irish research programs in this field include investigations of governance aspects of the ecosystem approach, of which this paper forms part, economics and socio-economics of Irish fisheries and the collation and use of fishermen's tacit knowledge.

4.6.2. The role of the local management forum in governance and implications for Ecosystem Approach implementation

The governance benchmarking exercise examines how the policy shortcomings discussed in Section 4.2 are manifested in three Irish fisheries. In general the fisheries do not score particularly highly but Celtic Sea Herring does perform better overall. In terms of an average grade across all the criteria examined the Celtic Sea Herring fishery scores a 2, indicating that governance elements are partially satisfied but further development is required. The other two fisheries, Aran Nephrops and Celtic Sea mixed demersal, do less well with an average score of 1, which indicates that governance elements are not satisfied, but steps towards their development are in place. The most significant differences between the fisheries were in relation to the existence of a long-term management plan and also the degree of management participation. In the case of Celtic Sea Herring these two factors are intrinsically linked, as the presence of a dedicated management forum over a number of years created a platform for a strong industry-science partnership which in turn facilitated the development of a long-term management plan.

In total, on ten out of twenty one of the criteria Celtic Sea Herring scored better than either of the other two fisheries. Not all of these improved scores can be attributed to the presence of a co-management process, for instance a higher score for Control and Enforcement just reflects the fact that regulations governing pelagic fisheries are presently more defined and prescriptive than for demersal fisheries. However much of the drive to improve the categories of operational objectives, accountability, broad stakeholder involvement, adaptive management, integration and incentives to avoid bycatch and habitat damage has come through the CSHMAC. It is a strongly held belief among those interviewed for this research that both governance performance and biological stock status for Celtic Sea Herring would be closer to those for the other two fisheries in the absence of a long-standing management forum.

4.7. Conclusions

Three basic modes of fisheries governance have been described (Gray, 2005; Symes, 2006):

a) Top-down or hierarchical governance;

b) Self-governance which involves devolution of responsibility to the individual level (e.g. Individual Transferable Quotas); and

c) Co-governance involving a partnership between the state and user-groups.

Most real world fisheries systems do not correspond exactly with one of these ideal types but instead contain elements of each to a greater or lesser degree. The governance benchmarking exercise outlined here shows that overall Irish fisheries governance can be classified as a hierarchical or top-down system but one that shows a slight trend towards increasing incorporation of co-governance elements. Although the Minister and civil servants consult on the majority of issues with the fishing industry stakeholders are limited to a consultative or advisory role. Executive authority in all cases still rests exclusively with the Minister and his department officials.

A hierarchical system if it functions well is not necessarily negative. However in the case of Irish fisheries the effectiveness of the hierarchical structure is compromised both by weak national policy making capacity and by serious legitimacy problems with the CFP. The first issue, that of weak national policy making capacity, is well illustrated by the lack of a management framework for Irish inshore shellfish fisheries. Given that 73% of vessels on the Irish fleet register are under 12m it is evident that good governance arrangements for the sector should be a priority. In short blaming all of Irelands fisheries problems on the CFP is both inaccurate and disingenuous.

The second issue with the hierarchical governance regime, that of the legitimacy of the CFP, is summarised in the Cawley Report (2006), which concluded that the principal cause of conflict in Irish fisheries was the fact that *"the EU Common Fisheries Policy, which the State is required to implement, is universally unpopular with the fishing industry".* Tom Tyler, an American psychologist working in the field of law and authority, wrote an influential book in 1990 called "Why People Obey the Law". His conclusion was that people obey the law if they believe it's legitimate, not because they fear punishment. This legitimacy problem creates significant challenges for centralised

policy making and governability (Jentoft, 2000; Chuenpagdee and Jentoft, 2007), which strengthens the case for some further devolution or regionalisation.

Specifically in relation to EAFM the lack of policy direction at national level is compounded by shortcomings in the CFP which completely fails to follow up on its commitment to the "progressive implementation of an ecosystem based approach to fisheries management". Simply put there are very few European or Irish fisheries policy drivers assisting interested parties at the fisheries level in EAFM implementation. The Marine Strategy Framework Directive points towards the biological targets which must be achieved but in terms of governance and wider objectives the level of policy guidance is extremely poor.

In terms of policies, national and European factors have combined to contribute to a decision- and policy-making inertia. At national level an opaque licensing process, which facilitated political clientelism and fostered conflict between groups of fishermen, allowed a predominantly unplanned modernisation and expansion to occur while simultaneously the fisheries resource base, mainly under the stewardship of the CFP, shrank. This left Irish fisheries administrators, charged with upholding the CFP, with very little room to manoeuvre and required them to perform an annual loaves-and-fishes miracle with allocated quotas in order to avoid further conflict. The sending home from Brussels of the B.I.M. chief executive in 1971 set an ominous precedent for administrators. The ambiguous political attitude towards fisheries issues is exemplified by the numerous changes to the departmental location of the fisheries section and the fragmentation of the marine portfolio. Such an environment, combined with the fact that much of Irish fisheries policy is dictated at central european level, does not foster bold decisions and policy-making at national level.

To summarise the governance benchmarking assessment the table below lists significant building blocks and obstacles towards the implementation of fisheries ecosystem plans in an Irish context.

Table 4.11 Summary from governance benchmarking of building blocks and obstacles towards ecosystem approach implementation

Building opportunities
Collaborative research initiatives
Increasingly effective control & enforcement
Example of some co-management success with Celtic Sea Herring
Top-down drivers towards development of Long Term Management Plans
Changing incentives and greater industry assumption of responsibility under MSC or other certification schemes
Increasing use of ecosystem indicators required under EU legislation
Obstacles
The lack of policy guidance on targets for EAFM implementation
Opaque management process and decision-making criteria
Lack of clear strategic and operational objectives
Underuse particularly of social and also economic indicators
Participation is purely consultative for most fisheries with little real participation
Stakeholder field is narrow
Underuse of "positive" incentives such as rights based management and incentives to minimise environmental impacts
Absence of an integrated framework
Adaptive management would require both a general mind-set and institutional change

As a qualifier to the usefulness of governance benchmarking approaches the FISHGOVNET research group cautions against approaching governance as a set of idealised performance indicators which are attainable within any system (Kooiman *et al.*, 2005; Chuenpagdee and Jentoft, 2007). They advocate an examination of governability, which involves a detailed assessment of the interactions between the governing system and the system-to-be-governed. This gives a more realistic measure of the capacity of a given social-ecological system to attain good but reachable, rather than ideal but unattainable, governance goals. Achieving MSC certification could be seen as a good example of at least a stepping stone towards such goals. The governability approach recognises that many natural resource management processes are inherently political, are influenced by variable human and financial resource availability and that many governance performance indicators are contestable. This is evidenced in the on-going debate about the benefits of participation in resource management and whether a greatly expanded pool of participants enhances or inhibits the management process (Dubbink and van Vliet, 1996; Mikalsen and Jentoft, 2003; de Vivero *et al.*, 2008). The reality is that the right level of participation, devolution, transparency etc., depends on the case and detailed contextual understanding is required to ensure good governance outcomes. But a governance benchmarking exercise is very useful as an intermediate or scene-setting stage for more detailed analysis (Adrianto *et al.*, 2005).

Dubbink and van Vliet (1996) describe three governance levels, the macro-level of state and inter-state bureaucracy, the meso-level of civil and private organisations and the micro-level of individuals. The co-management and interactive governance perspectives emphasise that good governance requires a greater input from the meso- and micro-levels. Grafton, (2007), in his paper on governance benchmarking, also alludes to the same issue when he describes the challenge of connecting higher-level ecological goals with day-to-day management decisions as the missing link in fisheries governance.

The next three chapters address the challenge of linking these levels with the overall governance baseline presented here by examining:

a) individual perceptions of the drivers and interactions between elements in a case study fishery system (Chapter 5), and
b) how local management group defined objectives compare with the higher-level goals (Chapter 6)
c) the practical implications of the assumption by industry of increased responsibility in the same three fisheries assessed in the governance benchmarking here (Chapter 7).

Chapter 5 Cognitive Mapping of the Celtic Sea Herring fishery and its associated Long Term Management Plan

"*It is possible that ecological interactions only seem easier to model because fish and daphnia do not complain when their interests and behaviour are misrepresented*."

Heemskerk, Wilson and Pavao-Zuckerman, 2003,
Conceptual models as tools for communication across disciplines.

5.1. Introduction

5.1.1. Aim

The principal aim of this chapter is to capture the complexity of CSHMAC participant's mental models of the Celtic Sea Herring fishery, understood as a social-ecological system. The method as applied in this research involved in-person interviews and mental model elicitation sessions. Understanding the mental models of governance participants and actors in a fishery is a critical step in analysing governability (Song et al., 2013), or in this case the relationships between overall governance frameworks and individual perceptions which influence behaviours.

5.1.2. What is mental modeling?

Mental models have been defined as "cognitive structures which enable a person to describe, explain and predict a systems purpose, form, function and state" (Jones et al., 2011). Research on mental models originated in psychological and cognition studies and it is now a trans-disciplinary field which includes inter alia computing and robotics (Jonker et al., 2011), business project planning and decision-making (Sayama et al., 2011), medical science (Lynch and Medin, 2006) and increasingly environmental and resource management (Winz et al., 2011).

The increasing use of a range of mental modelling approaches in natural resource management is due to their suitability in modelling complex problems characterised by high uncertainty (Özesmi and Özesmi, 2004). Mental modelling approaches do not just provide analytical advantages in these circumstances but may also provide normative benefits in promoting systems thinking and social learning through associated participatory modelling aspects. This social learning can be further developed into what Pahl-Wostl (2009) calls triple loop learning with the further development of scenarios based on the elicited group mental models.

Fisheries research, in common with other fields within environmental science, is adopting more of a complex systems approach (Charles, 2001; Kooiman, 2005; Garcia and Charles, 2007). Fisheries, with their persistent and intractable social and ecological problems are models of high uncertainty, high complexity and high stakes systems for which mental modelling approaches are well suited. Degnbol & McCay (2007) describe the perverse consequences of developing management strategies which ignore the kind

of institutional and ecological linkages which mental modelling approaches are adept at describing.

Jones (2011) cites a range of objectives behind the increasing use of mental modelling approaches in natural resource management:

- To improve communication through understanding similarities and differences between stakeholders' understanding of issues;
- To improve overall system understanding by integrating different perspectives;
- To improve decision making through the creation of collective representations of systems;
- To support social learning processes;
- To expand stakeholders' knowledge of a resource and to correct misconceptions.

5.1.3. Cognitive Mapping

The term "cognitive map" has been used with somewhat different meanings in various disciplines. Tolman (1948), the originator of the term used it to describe the navigational capabilities of rats and so imbued the term with a spatial aspect. This spatial interpretation has been followed through by others in the field of geography (Tuan, 1974). In psychology the concept of cognitive maps has been developed as a model of spatial cognition and the neural pathways that thought processes take (Tversky, 2000). Cognitive maps have also been used as subjective representations of knowledge domains which may assist learning, decision-making and negotiation (Eden, 1992) and it is in this sense that the term is used in this thesis. Robert Axelrod (1976) expanded the use of cognitive maps to model political and social decision making. His maps were simple directed graphs showing elements or nodes connected by signed vectors.

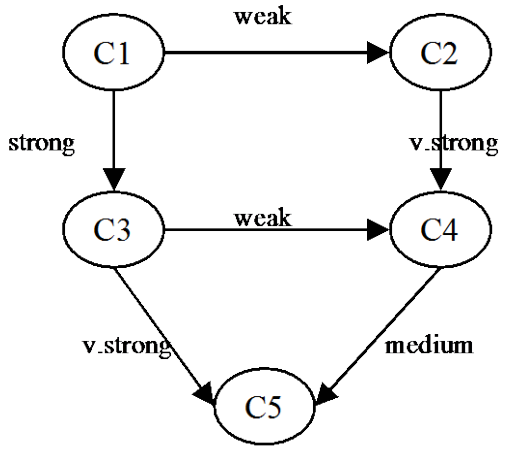
The cognitive mapping technique was further developed by Bart Kosko (1986) who overcame the difficulties of assigning precise numerical weights to causal relationships where little numerical data existed by the use of either fuzzy linguistic terms (small decrease, large increase etc.) or values in the range [-1,1] to express link strengths. The general steps involved in constructing such Fuzzy Cognitive Maps (FCMs) are:

- Identification of important concepts.
- Identification of causal relationships among these concepts.

- Estimation of the strength of the causal relationships.

Figure 5.1 below shows an example of a very simple FCM for illustrative purposes.

Figure 5.1 Fuzzy Cognitive Map with fuzzy linguistic edge labels (Papageorgiou, 2010).



Laukkannen (2010) draws a distinction between two approaches to cognitive mapping which differ in the scope of their analysis. The first approach he calls cognition-oriented where the target phenomena are individuals or groups subjective perceptions or beliefs about a knowledge domain or system and the research goal is descriptive with analysis being limited mainly to the content and structure of the maps. The second approach is system-oriented and the research goal in such approaches is to create a visual and dynamic model of a real system which may be used in a normative sense or to inform management decisions. The choice will be influenced by the research questions and the complexity of the system or knowledge domain being explored. In some cases there may be some crossover with both approaches being taken simultaneously. There are limitations to the use of the FCM method when applied to environmental resource systems. Generally, it does not produce a predictive model of such complex systems but is more suited to problem identification and specification or as a preliminary stage to a full participatory modelling exercise (van Vliet *et al*., 2010). Notwithstanding the useful information that mental models and cognitive maps can elicit they are inherently subjective and frequently incomplete. Additionally, cognition-oriented maps are temporally dynamic in that they represent a snapshot of system understanding which is in reality subject to change over time. The aggregation of individual maps from a diverse group of stakeholders into a group map is designed to mitigate these shortcomings (Özesmi and Özesmi, 2004). This diversity followed by aggregation is one

of the conditions specified by Surowiecki (2004) as an enabling factor in making group perceptions more robust than individual ones.

5.2. Research Questions

The fundamental research question of interest is what a group of stakeholders understand to be the most significant elements influencing a fishery system and which are the most significant interactions between these elements. The approach taken to answer this question has been an inclusive one, *i.e.* not restricted to looking at particular aspects such as ecosystem elements or governance frameworks but rather to examine the interplay between them. The content and structure of the participants cognitive maps would also help to analyse the extent to which the high-level principles of the EAFM are expressed through stakeholders perceptions and values.
The extent to which stakeholders view endogenous or exogenous factors as having a greater influence on the fishery system was also a central research interest (Endogenous here means factors within the control of the CSHMAC or deriving from their actions).

Another related question arises from the debate in the environmental management field about whether a broad set of stakeholders with conflicting opinions make better decisions than a smaller consensual group with more homogenous values. There has been significant research in the field of organisational studies on shared mental models on the assumption that "effective team functioning requires the existence of a shared or team mental model among members of a team" (Langan-Fox *et al*., 2000). So research interests also included whether a shared mental model existed among CSHMAC participants and whether a recent trend in expanding the number of participants would help or hinder group decision-making.

This research also aims to explore whether cognitive maps have further uses additional to those given by Jones *et al*., (2011). These potential additional uses are:

- To bridge the gap between individual behaviour and governance. Cognitive maps highlight individuals perceptions of system functioning and thus may inform policy makers of how stakeholders may respond to policy changes.
- To explore the conditions under which a locally defined and locally legitimate approach to sustainability can emerge.

- To facilitate the development of a broader, systemic management plan covering economic, social and institutional aspects of the case study fishery rather than the current plan with its narrow biological focus.
- To access and analyse the kind of detailed tacit or implicit knowledge held by stakeholders which conventional fisheries science has struggled to both elicit and utilise.

5.3. Method

The mental modelling approach that was used was an open process where respondents were initially presented with the two main elements of the Celtic Sea Herring Long Term Management Plan (LTMP), Spawning Stock Biomass (SSB) and Fishing Mortality (F). and Respondents were then invited to include any other concepts or elements which they felt were significant in the fishery. During piloting of the modelling approach the structured limited concept pool approach using pre-printed elements was quickly dismissed as it was not allowing free expression of respondent's mental maps. The first respondents using this method took a long time to choose elements from the pool and stated that they found the process difficult. Switching to the use of a whiteboard and marker with no restrictions on the concept pool and freehand drawing proved much more productive. Only the two main elements of the LTMP were presented and respondents were free to introduce any other elements. In order to ensure that maps were relatively complete some prompting at a high level was done by the researcher. If for instance there were no economic elements mapped the question was asked "Are there any significant economic factors influencing the fishery system?" but that was as far as the structuring of the maps went. Very few problems with eliciting mental maps were subsequently encountered using this method. The average time for an interview was approximately one hour and fifteen minutes although a number took more than twice that long. The shortest interview took 40 minutes.

All interviews except one were recorded on dictaphone to facilitate later coding, map completion and checking. One interviewee did not consent to the recording but was otherwise very co-operative, and provided copies of relevant correspondence with the fisheries minister.

The mapping approach most closely follows the fuzzy cognitive approach described by Ozesmi and Ozesmi (2004). The four possible linkages between elements were strong positive or negative and weak positive or negative. As described above very little direction was given to respondents in terms of focussing on particular issues as the research goal was to elicit what a respondents main concerns, issues and priorities with the broad fishery system were rather than trying to construct an accurate model of a narrow aspect of the fishery.

Respondents were selected based on their participation in the management forum for the case study fishery. So the sampling strategy was a stratified, non-random one. Of the 17 interviewees 13 were frequent participants at CSHMAC meetings. The four others were chosen on the following basis: one provided advisory services to the committee on environmental certification; one was a fisherman who was working with the Marine Institute in improving the annual Herring acoustic survey; one was a fisherman who does not actively participate in the management of the fishery; and the last was a recently retired fisherman known to have expressed reservations about the committees functioning. Only one of the regular participants at CSHMAC meetings was not interviewed and as two colleagues of his who also operate Herring processing plants were interviewed this is hopefully not a significant omission.

The full breakdown of interviewees is as follows:

- 2 Fishermen involved in the sentinel fishery[13];
- 2 Fishermen operating traditional "dry-hold"[14] vessels;
- 2 Fishermen operating larger Refrigerated Sea Water (RSW) vessels;
- 1 Retired Herring fisherman;
- 1 Fisherman consulting with the Marine Institute;
- 2 Representatives of fishermen's organisations, one of whom is also the CSHMAC Chairman;
- 2 Marine Institute Scientists responsible for the assessment of the stocks;
- 2 Managers of fish processing plants;
- 1 Fisheries protection officer;

[13] The sentinel fishery is reserved for inshore vessels under 15m in length who are given a derogation during part of the Herring season to catch a maximum of 12% of the quota within an area closed to larger vessels in order to protect spawning fish.

[14] "Dry-hold" vessels store their Herring catches in the traditional way, mixed with ice in lockers or compartments in the fish hold. Their numbers have decreased rapidly over the past 10 years due to increasing completion from vessels which can store their fish for longer in Refrigerated Sea Water (RSW) tanks.

- 1 Director of a responsible fishing certification scheme;
- 1 Director of a marine environmental NGO.

Of the 17 cognitive maps produced one was rejected for use in certain analyses as it was not developed in a face-to-face situation due to difficulties with scheduling a meeting. Accordingly the map did not have the same density or complexity as the others. The clear difference between this map and the others produced highlights the necessity for a consistent methodological approach and also is an argument for the face-to-face approach if complexity of the causal maps is considered important to the research.

After the interview the maps were coded into adjacency matrices in MS Excel. Adjacency matrices are a means of representing which nodes in a network or map are connected to each other, the strengths and the sign of those connections. Table 5.1 shows one of the adjacency matrices produced (to facilitate display the matrix with the least number of elements is shown here). Once the adjacency matrix for each interview was created it was emailed to the respondent for validation. A number of minor changes resulted from this process but no fundamental revisions of maps were required.

Once all 17 interviews were completed and coded a list of all terms used was compiled and some recoding of respondent's original terms was required where different terms had been used for what were judged to be identical concepts. To facilitate aggregation and comparison a standard adjacency matrix was created. This was a square matrix including all 136 elements which could accommodate each individual matrix. Initial manual attempts to convert each individual matrix to the standard format proved highly error prone due to the complexity of the matrices. Visual Basic coding was developed with the assistance of a software developer which automated the conversion of the individual to the standard matrix

The Visual Basic coding also allowed for the production of a summary matrix which showed cumulative weights for all linkages. This was done by simple addition of the values in each individual map. This method of producing group matrices has been used by others most notably Özesmi and Özesmi (2004). As each respondents map was unique the resultant group matrix was highly complex and proved difficult to interpret without either some further condensation of elements or by examining sections in isolation. This group matrix and all of its individual component matrices are included in Appendix 1.

In order to interpret the individual and social map dynamics some condensation of elements into higher categories was required. This process is described loosely in Ozesmi and Ozesmi (2004), but in practice it proved challenging. Decisions on which category a node should be placed in can feel arbitrary at times yet can significantly affect the map structure. This condensation or categorisation process was made easier by following the framework for social-ecological systems (SES) analysis developed by Ostrom and others over the past twenty years (2009). This framework was designed to facilitate comparison across different SES's and between scientists of different disciplines by developing a common language with which to describe SES elements.

Another challenging aspect of the categorisation process was the possibility for separate vertices with opposite polarity to cancel each other out when condensed together. This creates the false impression of a lesser weight or zero connection. As my research goal was to analyse perceived linkages between relationships rather than to create an accurate model of the fishery system this masking effect had to be addressed. To overcome this a map was produced with absolute rather than signed values attached to the connections. This facilitated identification of all significant interactions regardless of sign.

A further final condensation into 9 fundamental categories was performed in order to examine the expression of respondent's basic priorities within the map. While this level of condensation undoubtedly obscures the underlying map detail it was useful to examine the relative significance respondents attached to fundamental categories, such as Ecosystem Function, Socio-Economics or Management Measures. At this level of categorisation elements generally fitted intuitively into the fundamental categories and the same problems that were evident with the first condensation stage were not apparent.

No weighting was assigned to any respondent's maps relative to others. In terms of how the fishery system works, in an integrated sense, it was considered that all respondents had expertise relating to different aspects of that system.

Table 5.1 Sample adjacency matrix from individual cognitive map.
The values in the cell represent the strength (strong = 1 or weak = 0.5) and polarity (positive or negative) of the influence of one element on another. The direction of each link can be read by reading across rows, i.e. SSB has a +1 influence on Predators while Predators have an influence of -0.5 on SSB.

	SSB	Predators	Bycatch	Catches	Habitats Directive	Processors	Length of season	CSHMAC	Social learning	MSC	Market Access	Weekly quota	No. Vessels	Science partnership	Broader Participation	Observers	Discards
SSB		1															
Predators	-0.5																
Bycatch		-0.5															
Catches	-1																
Habitats Directive		1		-0.5													
Processors																	
Length of season						0.5											
CSHMAC									1								
Social learning														1	0.5		
MSC											0.5					0.5	
Market Access						0.5											
Weekly quota							-0.5										
No. Vessels							-0.5										
Science partnership																	
Broader Participation																	
Observers			-0.5														-0.5
Discards																	

5.4. Individual Cognitive Maps

5.4.1. Cognitive Map Elements

Table 5.2 shows the number of elements and linkages and the density (the number of linkages drawn relative to the maximum number of linkages possible) for the individual maps. It is evident from the individual maps that the fishery is, in the perception of those involved in its management, a highly complex social-ecological system. This contrasts strongly with the highly reduced pool of elements in the LTMP. The LTMP considers just 3 elements: Spawning Stock Biomass (SSB), fishing mortality (F) and an annual constraint on the percentage positive or negative change in Total Allowable Catch (TAC).

In total across the 17 cognitive maps 136 discrete elements perceived to be significant in the Celtic Sea Herring fishery were mentioned (allowing for some initial recoding where nodes interpreted with near identical meaning were combined). The full list of elements is given in Table 5.3.

Table 5.2 Number of elements, linkages and density per individual respondents cognitive map

Respondent	Number of Elements	Number of Links	Density	Respondent Code
NGO Rep	19	19	0.056	**NGO**
Sentinel Fisherman 1	35	44	0.037	**SF1**
Sentinel Fisherman 2	32	31	0.031	**SF2**
RSW Fisherman 1	30	40	0.046	**RSWF1**
RSW Fisherman 2	26	29	0.045	**RSWF2**
Dry-hold Fisherman 1	40	53	0.034	**DHF1**
Dry-hold Fisherman 2	39	42	0.028	**DHF2**
Dry-hold Fisherman 3	26	32	0.049	**DHF3**
Retired Fisherman	40	44	0.028	**RF**
Processor 1	33	39	0.037	**P1**
Processor 2	42	51	0.030	**P2**
Fishermens Rep 1	20	19	0.050	**R1**
Fishermens Rep 2	42	67	0.039	**R2**
Scientist 1	32	36	0.036	**Sc1**
Scientist 2	17	25	0.092	**Sc2**
Certification Manager	28	36	0.048	**CM**
Fishery Officer	33	45	0.043	**SFPO**

Table 5.3 List of Cognitive Map Elements

Spawning Stock Biomass	Conflict	EU Policy statements	Bycatch
Sub-stocks status	CSHMAC	ICES approach	Spatio-Temporal concentration
Recruitment	Track Record based licence restriction proposal	ICES HAWG	Competitive fishing
Growth rate	Local employment and economy	EU policy	Offshore fishery
Age at Sexual Maturity	Young fishermen	Fisheries Department	Sentinel Fishery
Spatio-Temporal Mobility	Landings outside CS	Fisheries Minister	Polyvalent RSW vessels
Low Water Temp.	Social factors	Ministerial review	Polyvalent vessels
Spawning Bed Health	Economic importance	Strategic Booking In	Dry-hold/traditional vessels
Fresh Water Runoff	State resource	Fishing Mortality	Pelagic RSW vessels
Environmental Conditions	Distribution of benefits	Effort	Foreign Fleets
Prey Availability	Local community	Catches	Mackerel Quota
Dynamic Fish Communities	Food security	Landings	Demersal fisheries
Climate change	Vessel returns	Discards	Pot fisheries
Whales	Viability	Overfishing	Other pelagic fisheries
Seabirds	Technological development/fish quality	Safety/practicality	Other options
Sharks	Catchability	Control equity	Other open access fisheries
Dogfish	Adaptability/ Polyvalency	CFP	Processors
Whiting	Overcapitalisation	Mixed fishmeal rules	Other processing options
Gadoids	Domestic influence	Navy boardings	MSC/certification
Predators	Banks	Observers	Access to market
Other Small Pelagics	Subsidies	Price	Adaptive Management
Ecological issues	Planned decision-making	Demand	Clear Policy
Aggregates	Stewardship	NGO's	Habitats Directive
Aquaculture	Responsibility	Civil Society	Decommissioning
Transparency	Sustainability	Roe fishery	Dunmore Box
Communication	Early opening of season	Scientific certainty	Number of Vessels
Clear Objectives	Length of season	Trust in science	Consensus
Representativeness	Weekly allocation	Survey Regularity & relevance	Culture of compliance
Integration	Weekly regime	Resources	Control regime
Balancing Diverse Interests	Commitment rules	Expanded scientific survey	Social Learning
Deliberation	Effective management	Landings data	Active capacity moratorium
Subsidiarity	Annual TAC fluctuation	CSH acoustic survey	Political clientelism
Inclusiveness	LTMP	Discard trips	
Industry Input	Constraint on TAC change	Scientists	
Participation Incentives	TAC	Industry-Science partnership	

Table 5.4 shows some descriptive statistics for the numbers of nodes and links. The mean number of nodes per map is 31, with a maximum of 42 and a minimum of 17. The number of links between nodes in the individual maps has a mean of 38 and it is striking

to note the difference between the highest and lowest numbers of links per map. The map with the highest number of links (67) is almost four times as complex as the one with the lowest (18).

Table 5.4 Descriptive statistics for numbers of nodes and links

	Number of Nodes	Number of Links
Mean	31.41	37.88
Std. Deviation	7.95	12.16
Minimum	17	18
Maximum	42	67

Interpreting such basic metrics must be done cautiously as the number of nodes can be very much dependent on the interest level of the respondent and the time they are prepared to give to the interview while the number of links is dependent on the skill level and mapping experience of the interviewer and the overall complexity can be dependent on the relationship between the interviewer and respondent (Eden and Ackermann, 1992). A more robust assumption can be made that the elements and relationships drawn and weighted strongly are those that are most significant for the respondent (Langan-Fox *et al*., 2000).

Figures 5.2, 5.3 and 5.4 below show some individual cognitive maps. The variation in complexity is readily apparent from this visual representation.

Figure 5.2 NGO representative's cognitive map of Celtic Sea Herring fishery.
The values represent the strength and sign (strong = 1/-1; weak = 0.5/-0.5) of the influence one element has on another.

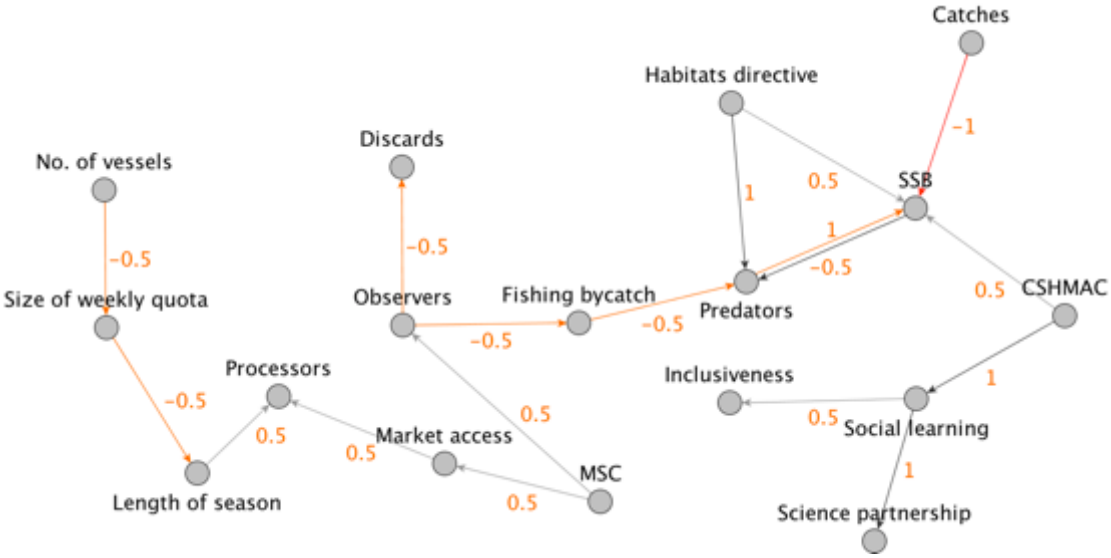


Figure 5.3 Processor's cognitive map of Celtic Sea Herring Fishery
The values represent the strength and sign (strong = 1/-1; weak = 0.5/-0.5) of the influence one element has on another.

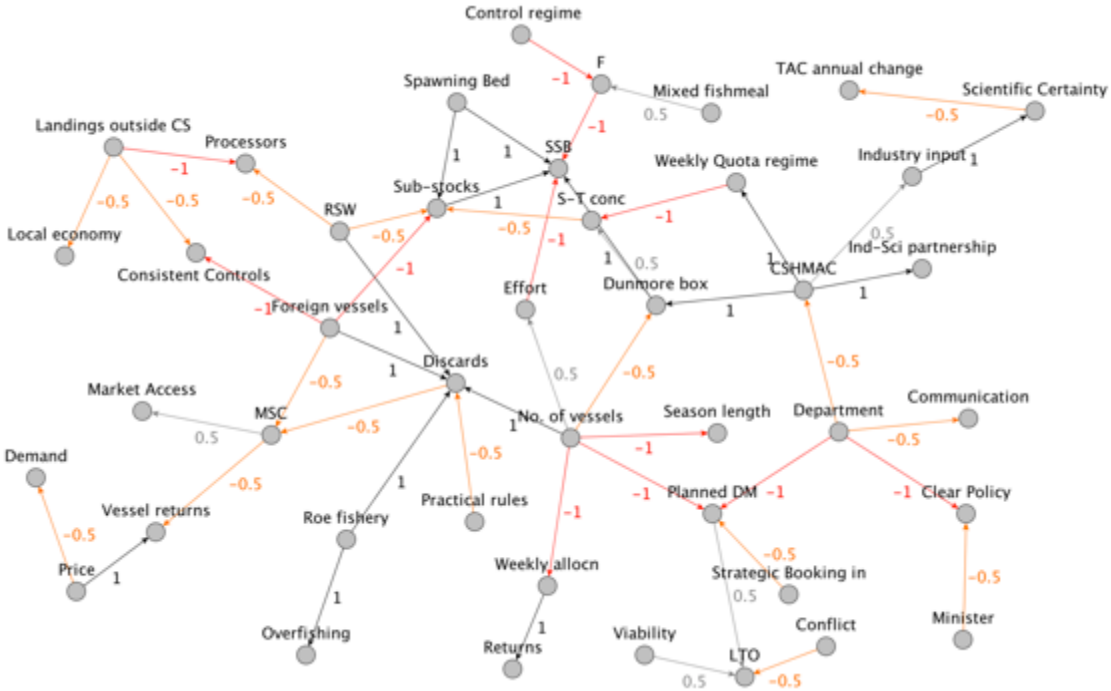
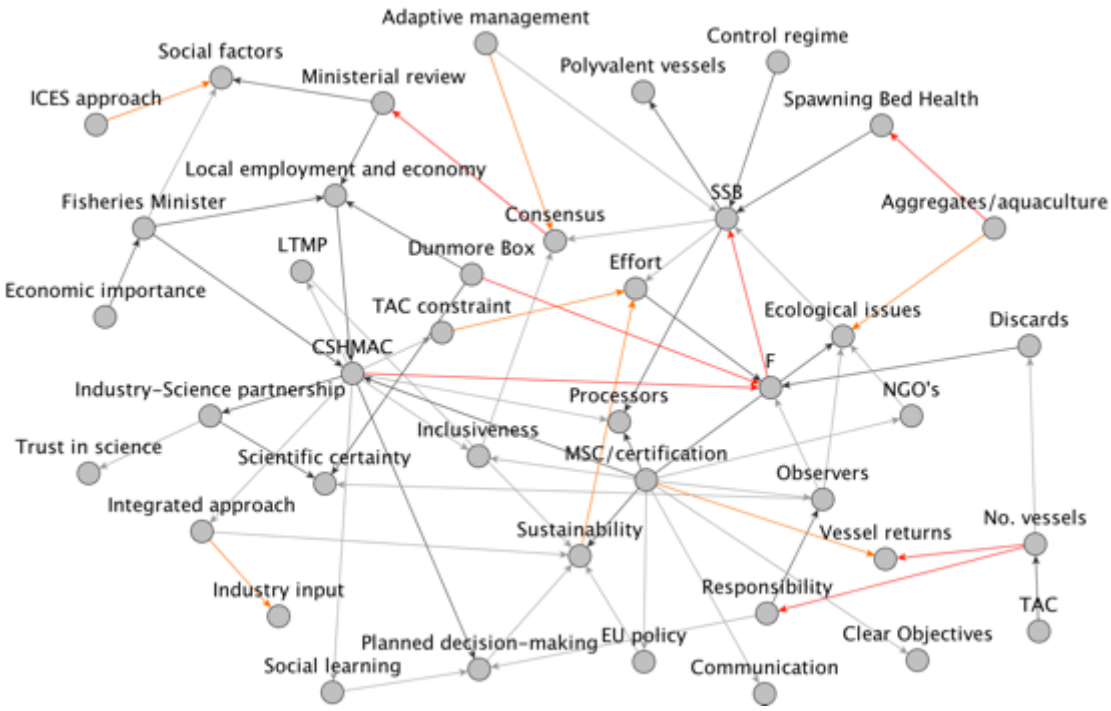


Figure 5.4 Fishermen's Representative cognitive map of Celtic Sea Herring Fishery.
The values represent the strength and sign (strong = 1/-1; weak = 0.5/-0.5) of the influence one element has on another.



5.4.2. Condensation of individual maps.

In order to facilitate analysis and communication of the cognitive maps it was necessary to condense the 136 nodes into 35 higher categorical levels (as described in detail in Setion 5.3). Table 5.5 lists the original elements and the categories they were condensed into in two stages as discussed in Section 3. Comparison between individual matrices was now easier as all respondents maps were translated to a common format using standardised terms.

Table 5.5 Original elements and higher order categories after condensation

1st order category	2nd order category	Original Concepts
Stock	Resource level	SSB
	Sub-stock components	Sub-stocks status
	Stock characteristics	Recruitment Growth rate Age of Sexual Maturity Spatio-Temporal mobility
Ecosystem	System Productivity	Low Water Temp Spawning Beds Fresh Water Environmental conditions Prey availability Dynamic ecosystem Climate change
	Predation & Competition	Whales Gadoids Sharks Seabirds Dogfish Predators Whiting Small Pelagics Ecological links
	Dredging/Aquaculture	Aggregates Aquaculture
Governance	Good Governance	Transparency Communication Clear Objectives Representation Integration Balance diverse Interests Deliberation
	Mgmt Participation	Inclusiveness Industry input Participation Incentive
	Adaptive Mgmt	Social learning Adaptive Management
	Policy guidance	Clear Policy Habitats Directive EU Policy LTMP ICES approach ICES Herring Working Group EU policy
	Minister/Department	Fisheries Department Fisheries Minister Ministerial Review Political clientelism
	CSHMAC	CSHMAC Access Limit Proposal
	Long-Term Outlook	Planned decision-making Stewardship Responsibility Sustainability
	Conflict	Conflict No Consensus
Socio-economic	Socio-Economics	Local employment & economy Young fishermen Landings outside Celtic Sea Social factors Economic importance State resource Distribution of benefits Local community Food security
	Vessel Economics	Vessel returns Viability Technological Development Catchability Adaptability Fish Quality Polyvalency
	Overcapitalisation	Overcapitalisation Domestic Influence Easy Bank Credit EU Subsidies
Management measures	Management measures	Early opening of season Effective Management Length of season Annual TAC change Weekly allocation LTMP Weekly regime TAC constraint Commitment Rules TAC Decommissioning Active Capacity Moratorium
	Dunmore Box	Dunmore Box
	No. of Vessels	No. Vessels
Fishing	Fishing pressures	F Overfishing Effort Bycatch Catches Spatio-TemporalEffort Concentration Landings Competitive Fishing Discards Offshore Fishery
	Sentinel Fishery	Sentinel Fishery
	Polyvalent vessels	Polyvalent RSW vessels Polyvalent vessels Dry-hold vessels Traditional vessels
	Pelagic RSW vessels	Pelagic RSW vessels
	Foreign Fleets	Foreign Fleets
	Mgmt of other fisheries	Mackerel Quota Demersal Fisheries Pot fisheries Other pelagic fisheries Other options Other open access fisheries
	Roe fishery	Roe fishery
Market	Processors	Processors Other Processing Options
	MSC/Certification	MSC/certification
	Market	Access to market Price Demand
	NGO's/Civil society	NGO's Civil Society
Science	Science	Scientific certainty Landings data Trust in Science Acoustic Survey Survey regularity/relevance Discard trips Resources Scientists Expand survey to Smalls
	Industry-Science partnership	Industry-Science partnership
Controls	Controls	Culture of compliance Control Regime Safety & Practicality of Rules Level pitch/Equity CFP Mixed fishmeal loophole Navy Boardings
	Observers	Observers

5.4.3. Centrality

After this condensation process it was possible to analyse which were the most central elements both individually and across the respondents. Centrality is a measure of an elements influence on the map. It is calculated from the number and weight of an elements relationships with its precedents and antecedents in a map. So centrality is composed of indegree (the influences on a node) and outdegree (the influence of the node) components. The freely available MS Excel based fuzzy cognitive mapping software FCMapper[15] (Isak *et al*., 2009) was used to do the calculations .

Table 5.6 shows in descending order the centrality, indegree and outdegree scores for the 10 highest ranked nodes in each case. Indegree and outdegree scores are important to consider separately as they can identify nodes which are variously described in the literature as transmitters and receivers (Özesmi and Özesmi, 2004), heads and tails (Eden, 1992), or means and ends (Laukkanen, 2012). What all of these terms refer to is that nodes with high outdegree scores are strong influencing variables and nodes with strong indegree scores are dependent variables. This can have a bearing on choice of management strategy in that a strong influencing variable may be a useful focus of management effort while a strongly dependent variable may have many different points of input which increases the range of potential management options.

The most central concepts are fishing pressures, management measures, CSHMAC and resource level. There is a significant major gap in centrality scores to the next set of concepts.

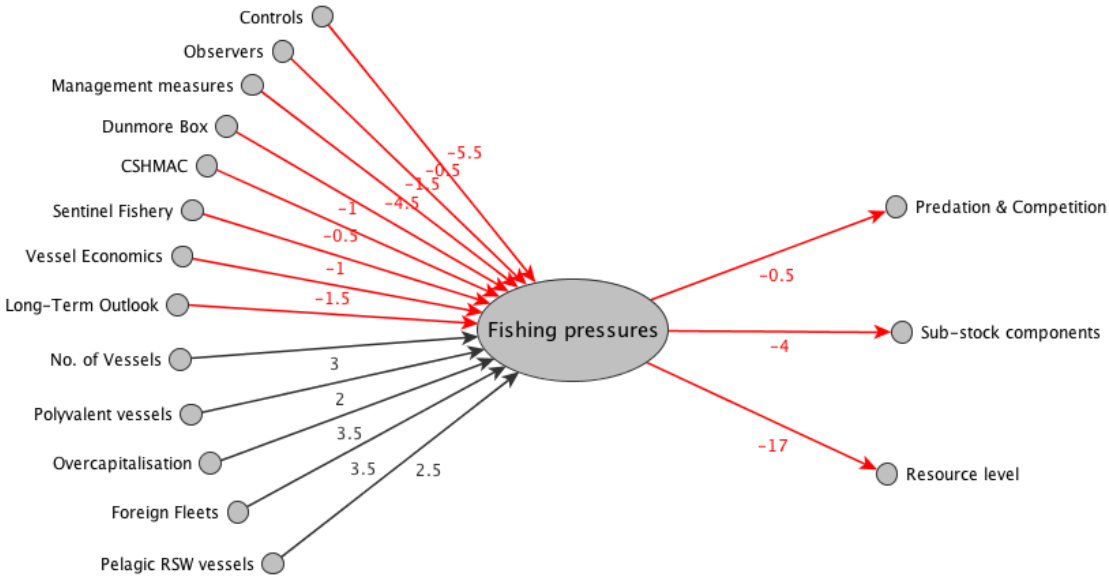
[15] www.fcmappers.net

Table 5.6 Centrality, Indegree and Outdegree for the 10 most central cognitive map nodes

Centrality		Indegree		Outdegree	
Fishing pressures	99	Fishing pressures	67	CSHMAC	52
Management measures	80	Resource level	58	Management measures	41
CSHMAC	78	Management measures	39	Fishing pressures	32
Resource level	76	Long-Term Outlook	32	No. of Vessels	26
Long-Term Outlook	44	CSHMAC	26	Controls	22
Number of Vessels	43	Science	24	Dunmore Box	21
Science	41	Socio-economics	23	Minister/ Department	20
Processors	35	Processors	21	Resource level	18
Socio-economics	32	Vessel Economics	20	MSC/Certification	18
Controls	29	No. of Vessels	17	Science	17

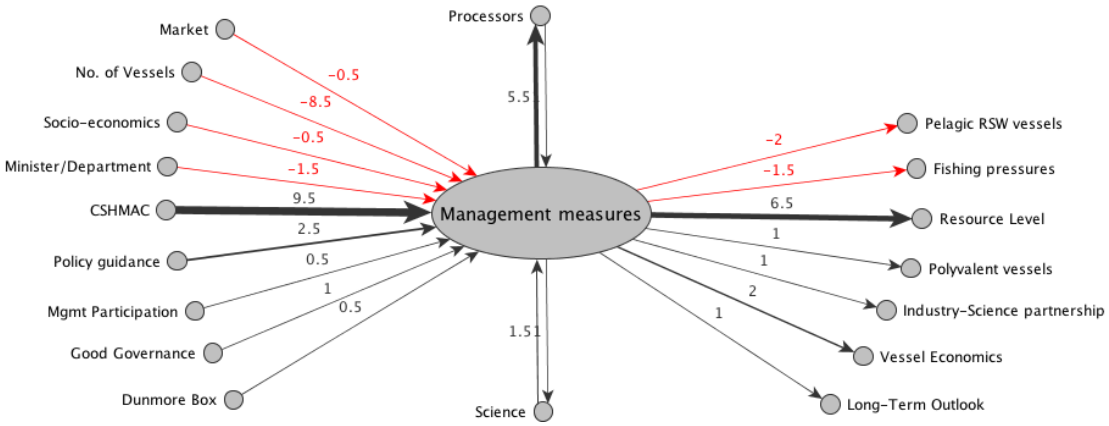
The component vertices for the node "Fishing Pressures" are shown in Figure 5.5. Fishing Pressures is a condensed node comprised of the original terms F (fishing mortality), Fishing Effort, Catches, Landings, Discards, Overfishing, Bycatch, Spatio-Temporal Effort Concentration, Competitive Fishing and Offshore Fishery (see Table 5.5). It has a higher indegree than outdegree score although its negative connection to the Resource Level node is the most significant of any connection on the map. The number of influencing nodes (n = 13) and the high link weights shows that there are many options available to fishery managers to reduce fishing pressures and their associated impact on the resource. These are discussed further in Section 5.5.

Figure 5.5 Indegree and Outdegree components for Fishing Pressures node.
The values are the cumulative strengths of connections summed from the individual maps. Red arrows = negative forcing. Black arrows = positive forcing.



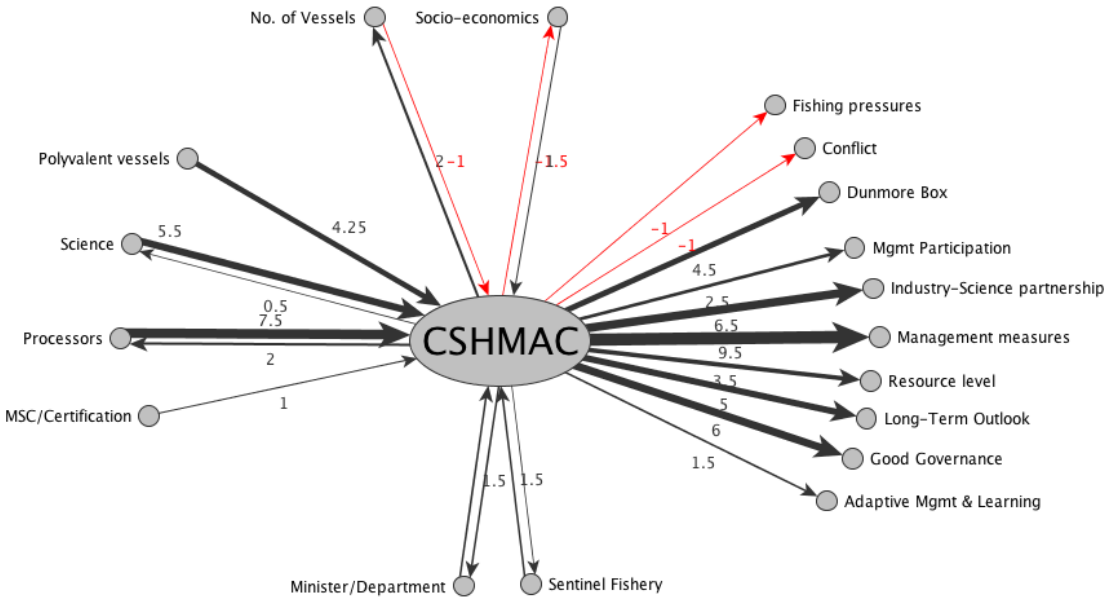
The "Management Measures" node (Figure 5.6) is the second most central node in the group matrix. This node condenses together a range of original concepts mentioned by respondents including season opening time and length, size of weekly quota allocation, CSHMAC rules for commitment to the fishery, LTMP, TAC, TAC constraint and decommissioning (see Table 5.5). Again the range of options for adjusting management measures available to the fishery manager is high with 11 influencing variables and the node also has a strongly perceived direct connection with the resource level.

Figure 5.6 Indegree and Outdegree components for the Management Measures node.
The values are the cumulative strengths of connections summed from the individual maps. Red arrows = negative forcing. Black arrows = positive forcing.



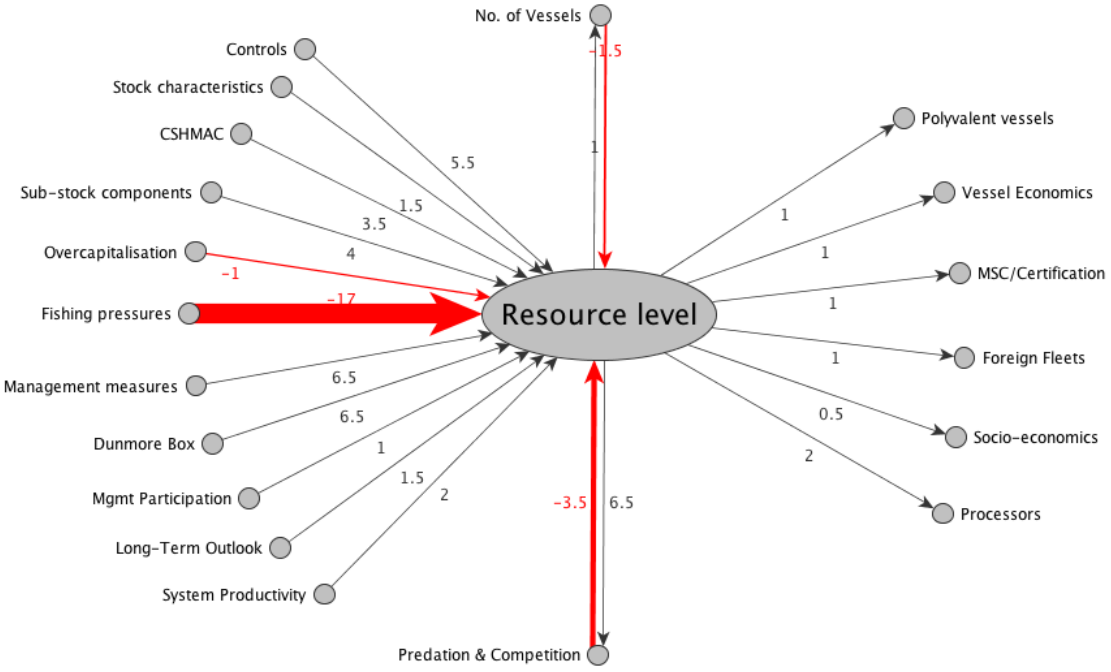
The CSHMAC has the highest outdegree of all nodes meaning it is perceived as the node with the greatest influencing capacity by the respondents (Figure 5.7). This is perhaps not surprising given that respondents were selected mainly on the basis of their involvement with the CSHMAC but it does highlight a belief that management and overall functioning of the fishery system is strongly influenced by the committee. Implications of this are discussed in greater detail in Section 5.5.

Figure 5.7 Indegree and Outdegree components for the CSHMAC node.
The values are the cumulative strengths of connections summed from the individual maps. Red arrows = negative forcing. Black arrows = positive forcing.



The "Resource Level" node ranks fourth in terms of centrality which may be surprising given its obvious and central importance to the fishery (Figure 5.8). Its centrality score is very close to that of Management Measures and CSHMAC so the ranking should be cautiously interpreted. Additionally, its overall centrality score is strongly affected by the perception that it's indegree is much stronger than its outdgree score i.e. it is an end rather than a means. Its score is also affected by the fact that it is a single component node i.e. during the condensation process no other elements were aggregated with it unlike the other high centrality nodes which subsumed a large number of original elements. In any case when respondents had drawn their maps the simple question was asked: "What represents sustainability in this map?" All respondents highlighted the resource level node so its central importance is not in question. Accordingly those nodes most strongly influencing Resource Level are rightly the first focal point in designing management plans for the fishery.

Figure 5.8 Indegree and Outdegree components for the Resource Level node.
The values are the cumulative strengths of connections summed from the individual maps. Red arrows = negative forcing. Black arrows = positive forcing.



5.4.4. Cluster Analysis and differences between individual maps.

Before looking at the overall aggregate map it is necessary to look at the degree of overlap between respondents in their perceptions of the dynamics of the fisheries system expressed through their cognitive maps. There are a number of ways in which to do this.

The first method employed was to use a software package called CMAP16 (Laukkanen, 2012) which was designed for comparative causal map analysis. Each individual matrix is imported to CMAP3 and the conventional graph theory metrics such as centrality, density and complexity can be calculated. CMAP3's most useful function is that it is the only freely available software which can compute the similarities of different causal maps based on the nodes and linkages they have in common.

The C/D (Correspondence/Distance) index is calculated with the formula:

16 http://koti.mbnet.fi/cmap3/

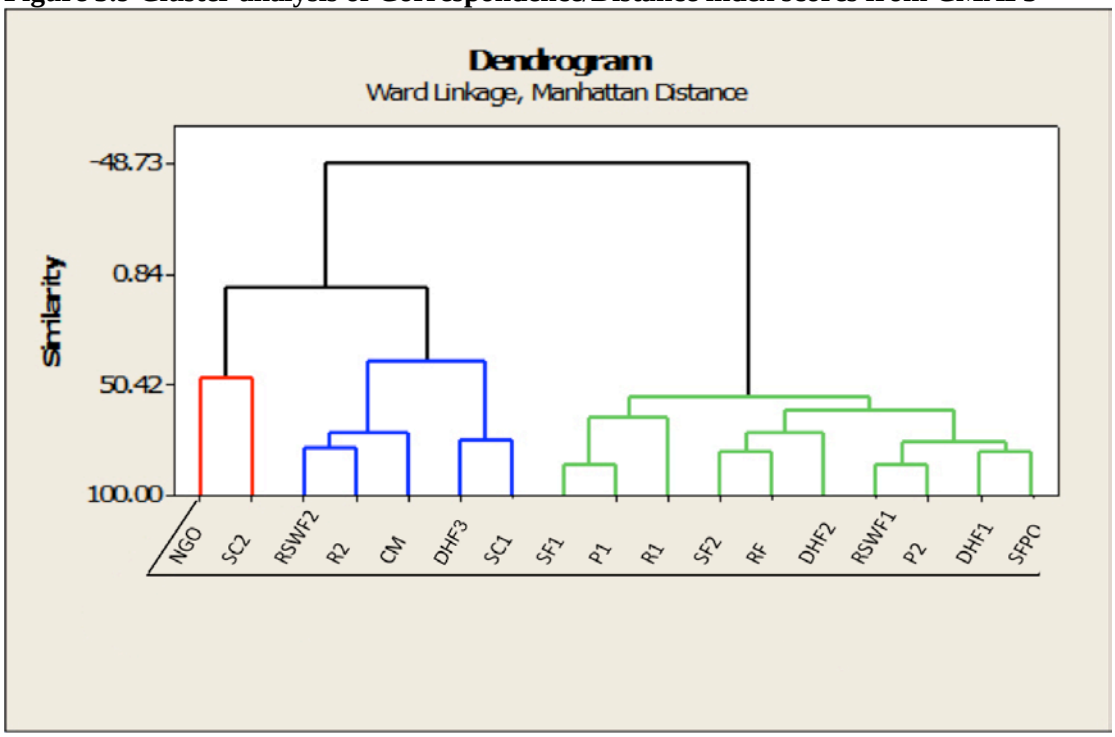
$$C/D\ index = ns / (ns + n_i + n_j)$$

where ns = number of shared nodes and vertices and n_i and n_j the numbers of unique nodes and vertices owned by Respondent$_i$ and/or Respondent$_j$ respectively.

The more nodes and links that are shared by two respondents the closer the value is to 1 and vice versa.

A cluster analysis of the C/D index data performed in Minitab shows the possible existence of three clusters (Figure 5.9). The key to the respondent codes is given again below Fig. 5.9.

Figure 5.9 Cluster analysis of Correspondence/Distance index scores from CMAP3



Respondent Code	Respondent	Respondent Code	Respondent
NGO	NGO Rep	**RF**	Retired Fisherman
SF1	Sentinel Fisherman 1	**P1**	Processor 1
SF2	Sentinel Fisherman 2	**P2**	Processor 2
RSWF1	RSW Fisherman 1	**R1**	Fishermens Rep 1
RSWF2	RSW Fisherman 2	**R2**	Fishermens Rep 2
DHF1	Dry-hold Fisherman 1	**Sc1**	Scientist 1
DHF2	Dry-hold Fisherman 2	**Sc2**	Scientist 2
DHF3	Dry-hold Fisherman 3	**CM**	Certification Manager
SFPO	Fisheries Officer		

When the C/D indices within these three clusters are analysed the results confirm the cluster analysis result. The average C/D index between respondents in the cluster marked in green is 0.63 which indicates quite a high level of internal agreement (A score of 1 indicates that two maps are identical). The C/D indices between this main cluster and any of the other respondents are significantly lower ranging from 0.54 down to 0.39. Another way of looking at this data is to look at how close the individual C/D

scores are to the overall group. The outputs of this are shown in Table 5.7. Again all of the members of the main cluster have the highest average closeness.

Table 5.7 Average Correspondence/Distance ratio scores per respondent.
Cluster 1 is the green cluster in Fig 5.9, Cluster 2 is the blue cluster and Cluster 3 is the red cluster.

Respondent Code	Average C/D score	Cluster
RSWF1	0.587	1
P2	0.574	1
DHF1	0.565	1
SF1	0.564	1
P1	0.562	1
RF	0.559	1
SFPO	0.558	1
SF2	0.534	1
DHF2	0.526	1
R1	0.482	1
CM	0.479	2
Sc1	0.474	2
RSWF2	0.462	2
R2	0.455	2
FC	0.448	2
NGO	0.361	3
Sc2	0.226	3

8 of the 10 respondents in Cluster 1 are regular and long standing participants in the CSHMAC. The other two members of that cluster are fishermen both with over 30 years of Celtic Sea Herring fishing experience. The other cluster is a much more diverse group and only includes one respondent, a scientist, who participates regularly in the CSHMAC.

In order to examine the extent of these potential cognitive differences each respondent's map was further condensed into 9 fundamental categories. The centrality score (measure of a categories influence on the map) for each of these categories are shown in Table 5.8. This second round of aggregation was to reveal patterns in how respondents emphasised certain categories such as ecosystem elements. For most of the respondents the relative importance attached to the categories followed a similar

pattern. The main exception to this however was in relation to the Ecosystem category. Across all respondents, ecosystem elements ranked lowest of the 9 fundamental categories and 3 respondents included no wider ecosystem elements at all. Two respondents, one scientist and one NGO representative, assigned significant weight to ecosystem elements in their maps. These respondents also emphasised the important influence of some top-down policy drivers on the fishery system. The general implications of this are discussed in Section 5 and again in the concluding chapter.

Table 5.8 Fundamental Categories in order of centrality averaged across all respondents

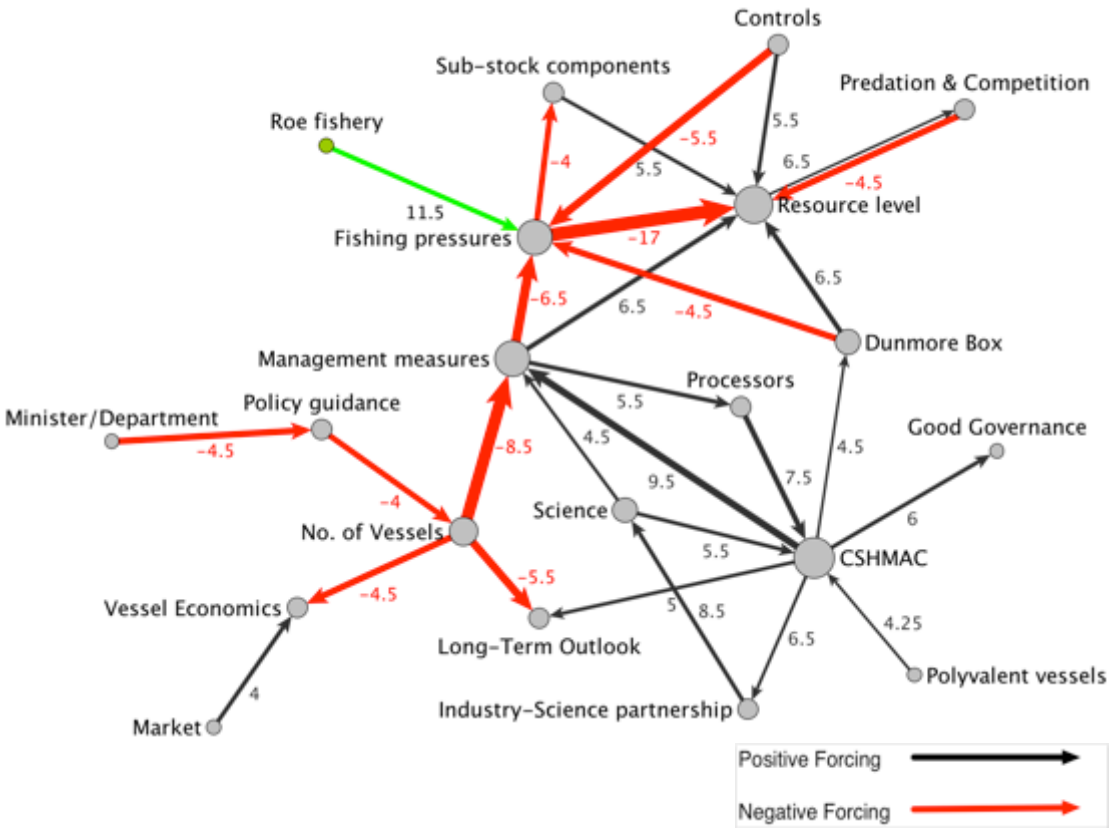
Category	Centrality (%)
Fishing	17
Management Measures	15
Governance	15
Herring Stock	13
Socio-Economics	12
Market	10
Science	7
Controls	6
Ecosystem	5

5.4.5. Aggregate Cognitive Map

As discussed in Section 5.3 an aggregate map was created by combining the 17 individual matrices together. Even allowing for consolidation from 136 to 35 elements this produced a highly complex map which renders it difficult to use as a tool for communication. Figure 5.11 below shows only the connections on the aggregate map with a strength greater than 4 which allows for visual assessment of the most significant interactions in the aggregate map. The most central nodes and their principal interactions are all clearly represented. The size of the node is proportional to its centrality value.

It is important to note that this is not a group or consensus map in that respondents were not brought together in a group session in an attempt to reach a consensus. As such it represents an aggregate of their individual views and reflects the relative contributions of the individual respondents – so minority views are not represented as strongly as those in the majority here. As the principal research goal here was analytical rather than normative, i.e. to explore the overall perception rather than move the group towards a different way of thinking this aggregate model remains useful.

Figure 5.10 Aggregated or Group Cognitive Map showing key interactions.
Only linkages with an aggregate strength > 4 are displayed. Line thickness is proportional to the strength of the linkage.



5.5. *Discussion*

5.5.1. *The status of ecosystem elements in the cognitive maps.*

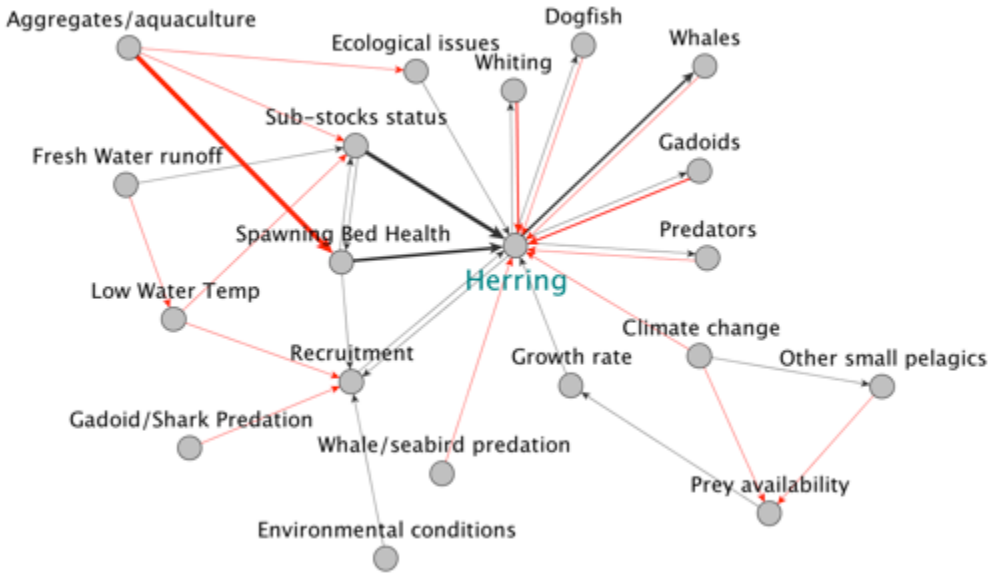
This aspect of the discussion relates closely to the first broad research theme which is to explore the gap, if any, between high level EAFM policy goals and stakeholders values (Chapter 1). Some recent fisheries research has found that fishermen "think more ecologically" than scientists or managers (Berkes and Berkes, 2009; Verweij and van Densen, 2010). Verweij and van Densen found that fishermen tended to emphasise unpredictable environmental fluctuations in determining long-term stock dynamics while environmental NGO's stressed anthropogenic impacts. This research indicates that all parties place fishing impacts as the central influence on the stock. A notable feature of the group map in Figure 5.10 is that ecosystem elements, apart from the direct productivity of the stock, appear to be of little average concern to the respondents. "Predation & Competition" is the only node from the ecosystem category with strong enough connections to be represented. The group map is dominated by management and broader governance elements.

Care must be taken with this interpretation that fishermen are no ecologists. It is to be expected that fishermen and processors involved in targeting and processing Herring will prioritise the stock itself particularly when the overall question being asked refers to sustainability of the Herring fishery rather than the overall integrity and productivity of the Celtic Sea in a general sense. Also some of the ecosystem elements which have previously been regarded as unimportant or problematic by industry participants e.g. cetaceans, are unlikely to figure highly in their priorities.

Additionally, it is the case that a cognitive map is more of a barometer of current concerns than an accurate model of a system over time. Accordingly the possibility that the ministerial review of access arrangements to the fishery temporarily relegated ecosystem aspects to a lower position in the hierarchy than would otherwise be the case can not be discounted. In a more settled management landscape it is possible that ecological elements could be emphasised more strongly.

One of the advantages of the cognitive mapping method is that it can elicit useful information which is included in the underlying matrix but may not feature strongly in the group map as displayed in Figure 5.10. Figure 5.11 below shows a map of biological and ecosystem elements from the underlying aggregated model. Although it is mainly drawn from the views of a small number of the respondents it still serves as a useful ecosystem map with Herring at the centre. In terms of this chapter and the cognitive mapping method the underlying model is certainly more robust due to the inclusion of a broader set of perspectives. This is a point in favour of the argument for including diverse viewpoints in constructing group cognitive maps. It is also relevant to the debate on whether management fora should be broad and inclusive or restricted but efficient.

Figure 5.11 Ecological connections from aggregated Cognitive Map of Celtic Sea Herring fishery.
Red arrows = negative forcing. Black arrows = positive forcing.



An examination of the ecosystem map shows that there are significant linkages expressed between the Herring stock and species which predate on it. Also, the overall productivity of the ecosystem, although mainly viewed through the lens of Herring productivity does throw up some significant observations. The issue of spawning bed health was strongly linked with stock status and this highlights the need for an integrated management structure. There is a strong perception that some past local stock collapses or extirpations were the result of dredge spoil dumping in close proximity to herring spawning beds. The previously important sub-stock at the Daunt Rock close to the mouth of Cork Harbour was mentioned by a number of respondents as having never recovered following the dumping of dredge spoil from the construction of the Jack Lynch Tunnel in Cork Harbour. Another example mentioned by two of the Galway-based respondents was the disappearance of a local spawning bed following dredge spoil dumping from the deepening of the harbour at Ros a Mhil.

Other factors relevant to ecosystem productivity such as water temperature, fresh water runoff, prey availability and climate change were also mentioned as having an impact on the Herring stock. Most of the linkages from these elements were direct impacts on the stock or sub-stock although climate change was linked with changes in Herring prey availability and the abundance of other small pelagic fish also.

The ecosystem productivity category of elements had a very low indegree score which justifiably reflects an understanding that it is largely out of the respondent's control. The one exception to this is the strong perception that managing impacts of other industrial sectors such as aggregate extraction, dredge spoil dumping and aquaculture can positively impact on spawning bed health.

5.5.2. Spatial issues and sub-stock components

The positive role of the Dunmore Box spawning closure in the recent recovery of the Herring stock was strongly emphasised through the cognitive maps. There is a danger however, that viewing the closure as a panacea could create its own problems. A number of fishermen and other respondents expressed concern that the closure was displacing fishing effort and forcing highly mobile technically advanced vessels to focus on smaller sub-stocks as their spawning aggregations peak. Fisheries assessment calculates an appropriate level of fishing mortality across the entire stock and does not make micro-calculations of appropriate F levels for these smaller sub-stock components. There is therefore a risk of extirpation of localised sub-stocks which could reduce the overall resilience of the stock. Research aimed at utilising fishermen's tacit knowledge has revealed a pattern of extinguished local populations of many fish species particularly in coastal areas with diverse habitats and bathymetric features (Wilson, 2006; Bavington, 2010). Interviews with fishermen for this research have revealed similar patterns. The absence of any recovery of western components of the Celtic Sea Herring stock does nothing to contradict this. The danger from this is that resilience to regime shifts have been shown to be linked with response diversity which is eroded by loss of sub-populations (Elmqvist *et al*., 2003). This is important from an EAFM perspective as under a conventional fisheries management approach the stock is assessed as doing well as the meta-population SSB is at a high point. This is an emergent issue from the cognitive mapping exercise which will be addressed in the recommendations for a fisheries ecosystem plan in the concluding chapter.

5.5.3. Insights from the cognitive maps into governance of the Celtic Sea Herring fishery.

This aspect of the discussion is related to the second major research theme - the role of governance in EAFM implementation. In the aggregated cognitive map the positive link from the CSHMAC node to the Management Measures node is the third strongest connection. The CSHMAC node is linked in the maps to the development of a long term outlook, enhancing planning capacity and social learning which can be seen as enabling factors for EAFM implementation. There are also strong internal linkages within the governance node where a forum for participation is seen as creating the space for deliberation which in turn produces more effective management which could be seen as a kind of virtuous circle. So the presence of participation acts in a more influential fashion than just acting as its own reward. The perception is that it promotes the right kind of management. This accords with much Social Ecological Systems research which has emphasised the need for devolved and adaptive management fora in order to find the best fit with complex local environmental and social conditions. There is also a strongly expressed linkage between the CSHMAC and the quality of the science – not just from CSHMAC members but also from other scientists involved and NGO observers.

There were some dissenting voices in how the CSHMAC acts in relation to distributing the benefits of the fishery and it is inaccurate also to say that all participants in the CSHMAC are unanimous in their views on its performance in fostering an EAFM. Both the chief Celtic Sea Herring scientist and the NGO representative emphasised the strongly positive impact of external policy drivers in fostering a long term plan and in protecting marine wildlife respectively. The policy drivers highlighted were European Commission rules incentivising the development of LTMP's (Commission, 2011) and the Habitats Directive's role in ensuring protection of vulnerable species.

Analysis of the individual cognitive maps revealed that there was, to some degree, a core group of CSHMAC participants with a similar mental model of the fishery system. There is an extensive literature on the positive impact of such shared mental models on organisational and decision-making efficiency (Langfield-Smith, 1992; Langan-Fox *et al*., 2000). Thus some of the success of the CSHMAC and its persistence may be due to this factor. (A similar fisheries management committee for the north-west herring fishery in Ireland collapsed due to excessive conflict. Whether the current very poor status of the north-west herring stock and the fact that no Recovery Plan has been agreed can be

linked to the absence of a decision-making forum is uncertain). Some respondents who felt alienated by a majority perspective not matching their own, expressed the view that the committee's achievements have been overstated – but still expressed a link between the committee and good management through their maps. In part driven by the Marine Stewardship Council certification process the CSHMAC has gradually extended the breadth of stakeholders and experts involved. In the past two years NGO and fisheries protection representatives have been invited to participate at all meetings. This broadening of the pool of participants is not unequivocally supported and when drawing the maps there were a small minority of respondents who expressed the view that it would result in a loss of decision-making efficiency and create additional conflict.

The cognitive mapping method itself illustrates some of the beneficial outcomes of including a diversity of perspectives. As discussed above many of the industry based respondents did not include strong ecosystem connections in their maps nor did they recognise any positive significance in top-down or legislative drivers. These poorly represented but undoubtedly significant elements were strongly raised by other respondents from outside of the dominant discourse. Policy or management decisions which aim to tackle complex problems are less likely to succeed where they represent a narrow non-integrated perspective, whether that originates from an industry, scientific or environmental domain.

It is impossible to say at this point whether the core cluster of CSHMAC participants will expand their perspective to accommodate the worldviews and values of the broader group or seek to "close down" (Stirling, 2005) and repress these views. The MSC certification process, which can be seen as rewarding an increased attention to principles of good environmental governance with increased market access, may be an influence. Although the motivation for many CSHMAC participants behind accepting schemes such as the MSC may be purely instrumental to improving economic returns and their values may differ from the MSC schemes principles, there is the possibility of attitudinal change over time. When the MSC was first discussed at CSHMAC meetings it was totally dismissed as representing a "Green" agenda but it was gradually accepted as a market requirement. Whether or not the MSC process has any normative impact on core stakeholder's intrinsic values, which is almost to assume that they need "correcting", the fact that the major economic driver in the fishery has moved from the roe fishery with its negative behavioural incentives to the MSC with its emphasis on principles and good governance is a positive driver for change.

5.5.4. Developing a Long Term Outlook

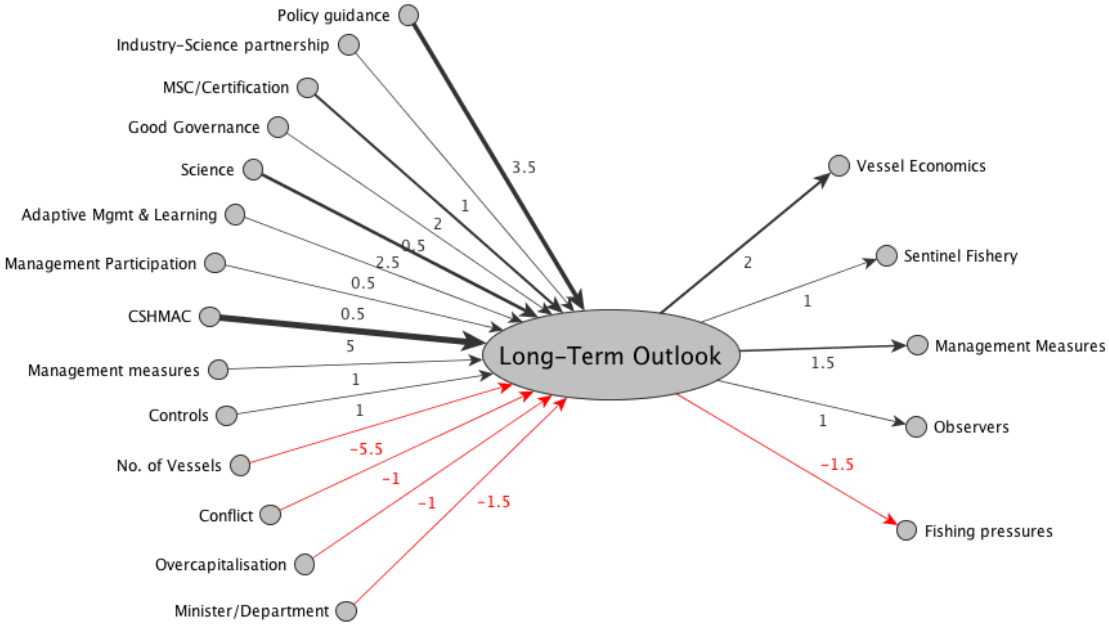
During the mapping interviews a number of general terms philosophically relating to taking a long term view were repeatedly used. These terms included "Planning", "Planned decision-making", "Stewardship", and "Precautionary Management" and were usually related either to the fish stock or to investment decisions by fishermen and processors.

Precaution is a cornerstone of both any risk-averse fisheries management system and of the EAFM. Precaution was not a high priority in the fishery in the past as it suffered two previous collapses which have been acknowledged on numerous occasions by CSHMAC participants as being due to excessive fishing pressures and unsustainable practices such as the roe fishery. This is reflected in the strong negative linkage expressed in the group map between the roe fishery and the stock despite the fact that the roe fishery is not currently practised. The Celtic Sea Herring fishery appears recently to have been successful where many other fisheries have not in transitioning to a precautionary management mode. The Long-Term Outlook node was the fifth most central node and its indegree score was particularly strong. The nodes and connection strengths influencing a Long-Term Outlook can tell us a lot about why these precautionary decisions were possible in the Celtic Sea Herring fishery and not in others (Figure 5.12). This figure shows the linkages between the arena of high-level governance prescriptions and individual perceptions and motivations and is thus of significant interest. Policy documents on the EAFM are replete with vague, non-operationalised stipulations, such as this from the FAO Code of Conduct for Responsible Fisheries: "Long-term management objectives should be translated into management actions" (1995). Figure 13 shows how these recommendations which are predominantly aimed at biological management decisions can be matched or at least incentivised at the individual stakeholder level.

The CSHMAC and Policy Guidance were seen as the most significant facilitators of a long-term outlook. At CSHMAC meetings in the past 2 years a number of examples of a more long term approach being favoured over short term gains have occurred. On one occasion the option to fish for Herring roe for a buoyant Japanese market was unanimously rejected as the incentives for dumping fish would be the same as in the

past with an associated danger of stock collapse. Also during the negotiations with scientists on LTMP development a precautionary fishing mortality level well below that which could be allowed under MSY directives was adopted in order to minimise the risk of destabilising the stock.

Figure 5.12 Indegree and Outdegree components for the Long-Term Outlook node.
The values are the cumulative strengths of connections summed from the individual maps. Red arrows = negative forcing. Black arrows = positive forcing.

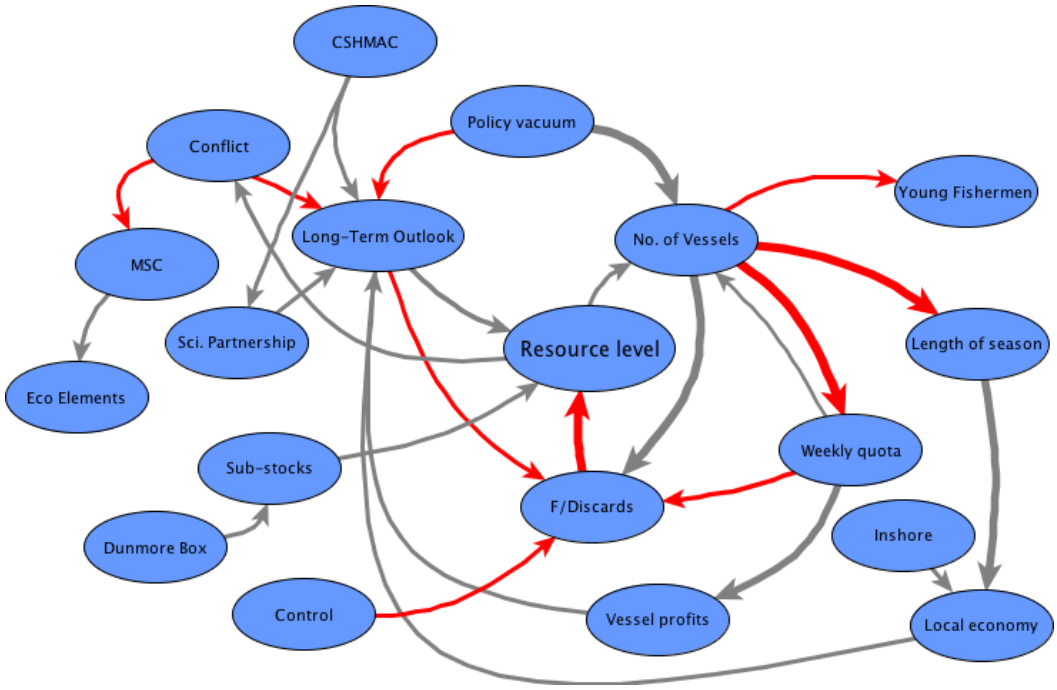


5.5.5. Conflicts & trade-offs

The most significant input militating against the adoption of a long-term outlook was perceived to be the increasing number of vessels. The complex issue of trade-offs and social-ecological feedback loops are well illustrated in consideration of this issue. Figure 5.13 below shows the strongest connections from the aggregated map that are relevant to this issue. There are a number of feedback loops evident in this figure. A strong feedback loop is apparent, where, in the absence of a policy which would restrict the number of vessels, any increase in stock size attracts in new vessels. This increase in vessel numbers has the effect, among others, of increasing discards due to weekly quotas being too low which may have effects on the stock population dynamics. A stock decrease is perceived to have a negative impact on future TACs, on vessel profits and to erode incentives for long-term decision-making. This is illustrative of the classic

common-pool resource problem with free-riding behaviour militating against the taking of long-term or conservation oriented decisions.

Figure 5.13 Feedback loop focused on the number of vessels in the fishery
Red arrows = negative forcing. Grey arrows = positive forcing.



The central factor which is open to manipulation in this case is the number of vessels. Implicit in Figure 5.13 and the perceptions behind it are the expectation that changing from an open-access policy to a restricted access policy based on having an established track-record in the fishery will reduce the number of vessels with associated benefits. This scenario was modelled using FCMapper which can test scenarios using cognitive maps through the changing of initial values of a node or nodes. The particular management scenario explored in this case was to look at what effect the Fisheries Ministers proposed restriction of access to the fishery would have on the overall map and the nodes within it. So to simulate the policy change the initial value of the policy vacuum node was reduced.

Table 5.9 below shows the outputs from FCMapper when running the scenario where the Policy Vacuum node was restricted. A number of strong positive changes were produced by the modelled change in access policy. Resource Level, Vessel Economics, Long-Term Outlook, Inshore Fleet and the Weekly Allocation nodes were all improved by the policy change. The number of vessels and discarding levels were strongly

reduced. However there were also a number of less desirable changes apparent from the scenario output. Conflict was significantly increased while there was also a strongly negative effect on the local employment/economy and Young Fishermen nodes.

Table 5.9 Restricted Access scenario output from FCMapper

Strong Positive Changes	Strong Negative Changes
Resource level	Number of vessels
Vessel Economics	Discards
Long-Term Outlook	Local employment/economy
Inshore fleet	Young fishermen
Weekly allocation	
Conflict	

These model outputs appear to match what would be intuitively expected and point towards some additional strategies that could be implemented in order to address for instance the issue of access for young fishermen. The difficulty with these modelled outputs is that the most significant real outcome in 2012 arising from the Ministers policy decision to restrict access was a 30% increase in the number of participating vessels compared to the 10-year average. This increase appears paradoxical given the new policy limiting access. It was made possible due to the fact that the review process began in October 2010 and did not conclude until June 2012 with the issuing of a new licensing policy by Minister Simon Coveney (DAFM Sea Fishing Boat Licensing Policy 1 of 2012). The announcement of the ministerial review incentivised a strong increase in the numbers of vessels participating in 2010, 2011 and 2012 in order that they would not lose their existing entitlement to fish. The Minister's new policy also set quite a low threshold in terms of defining track record. A threshold level of 5 tonnes of Herring landed in either 2009 or 2010 was set as the requirement to retain a license. Given that the average weekly quota was approximately 40 tonnes this was a very low level which was aimed at including the maximum number of vessels. The CSHMAC had requested that only vessels who had landed 50% of their allocation during three of the previous

five years should qualify. The counterintuitive outcome of this policy review illustrates the difficulty in modelling such a politically complex process.

The process and outcome of this policy change is a challenge to the neat theorising in the literature that by identifying and addressing social-ecological feedbacks we can make the transition to sustainable fisheries (Österblom *et al*., 2011). The reality is much messier and as a complex problem will require complex or "clumsy" solutions (Khan and Neis, 2010). What these solutions could be is discussed further in the concluding chapter.

5.6. Conclusion

From the preceding description and analysis and also the governance benchmarking exercise in Chapter 4 we can identify some opportunities and barriers to the development of an EAFM plan for the Celtic Sea Herring fishery. These will be considered alongside the opportunities and barriers from the governance benchmarking exercise in developing a fisheries ecosystem plan in the concluding chapter.

Opportunities:

- The presence of an inclusive forum for detailed deliberation on management measures is perceived to be strongly linked with the recent recovery of the stock.
- This management forum is highly deliberative and emphasises context and communication in developing tailored management measures which have broad industry support. This management approach is well suited to EAFM implementation.
- The predominant perception of the fishery system is of one where precautionary management decisions are the major influence on the stock level. In addition to engendering a sense of control, ownership and responsibility this allows for the consideration of multiple management options when addressing problems.
- The maturing of the partnership approach between science and industry has built trust and opened up options for co-definition of stock science issues, problem framing and potential further improvements in the biological knowledge base.

- The balancing of top-down and bottom-up drivers is an important success factor and is well expressed in the cognitive maps.
- The evolution of the main market drivers from a roe fishery to MSC certification is a positive factor in facilitating EAFM implementation. The MSC is arguably a far more effective driver towards EAFM adoption currently than the CFP or national policy.
- From a methodological perspective the use of cognitive maps in fisheries research appears to be an effective way of exploring domains of fishermen's tacit knowledge not usually explored in more ecologically driven research.

Barriers:

- The limited expression of wider ecosystem linkages represents a challenge to the emphasis in the literature on maintenance of ecosystem integrity and productivity. Productivity is understood almost entirely to be a stock rather than an ecosystem issue. The AHP exercise in the next chapter elaborates further on how this issue is prioritised.
- The concept of management integration with other industrial sectors is not well expressed for the most part. It is debatable whether this kind of thinking is a cause or a product of the absence of any integrated marine management framework but in any case it represents a risk in that other industrial activities *e.g*. aggregate extraction or dredge spoil dumping could have a strongly negative impact on herring spawning.
- The feedback loop incorporating numbers of vessels, stock size and numerous other factors is an obvious risk factor for sustainability, whether that is defined as ecological, economic or social.
- The issue of spatial heterogeneity in stock structure and the impact of closed areas requires more detailed research. The advent of an offshore fishery in the last decade which presumably catches a mix of fish from different stock components adds weight to this requirement.

Chapter 6 Setting Fisheries Governance Objectives for the Celtic Sea Herring Management Advisory Committee

6.1. Introduction

The necessity for fisheries to have well specified management objectives has been repeatedly stressed in the EAFM literature (Mardle et al., 2002; Hilborn, 2007; Kjaersgaard et al., 2007; Morishita, 2008). The lack of clear objectives has also been highlighted as one of the 5 most significant problems in European fisheries (European Commission, 2009). The Celtic Sea Herring fishery did have a set of objectives which were agreed by its management advisory committee in 2001 and which served it well during the recovery of the stock described in Chapter 4. However this original set of objectives required updating due to changes in the biological, market and governance contexts of the fishery. Coincidentally the research plan for this thesis had originally included an assessment of management objectives for the CSHMAC. The method used in this research was a multi-criteria decision making method, the Analytic Hierarchy Process (AHP). This method and its application, the development of a hierarchy of ecosystem, stock biology, socio-economic and governance objectives, the results and their implications for governance of the Celtic Sea Herring fishery and wider aspects are discussed in detail in this chapter.

6.2. Method

6.2.1. Analytic Hierarchy Process

The AHP, first developed by Saaty (1990), has been used as a multi-criteria decision making (MCDM) method which involves making pair-wise comparisons between alternative objectives or goals to elicit their relative importance to the respondents. It has been used in a wide range of disciplines including engineering, urban planning (Carlsson and Walden, 1995), environmental planning (Herath, 2004; Arnette *et al.*, 2010) and fisheries management (Leung *et al.*, 1998; Soma, 2003; Raakjær Nielsen and Mathiesen, 2006; Pascoe *et al.*, 2009).

In most complex decision-making scenarios there will be a diversity of preferences and weightings for management objectives and strategies. The AHP produces a formal way to break down the problem and to combine the preferences and weightings in a transparent way for a group of stakeholders. The AHP process can be summarized into three main stages:

1. Model the problem as a hierarchy containing the overarching goal, the objectives and sub-objectives, and in some case alternative strategies for achieving the goal.
2. Establish priorities among the elements of the hierarchy by making a series of judgments based on pairwise comparisons of the elements. The comparisons are made with respect to a common property the objectives share – which in this case is their contribution to achievement of a parent fisheries management objective. For example a respondent may say that economic objectives are *x* times more important than ecosystem objectives in contributing to the goal of a viable fishery.
3. Synthesise these judgments to reveal overall priorities for the hierarchy. This combines the respondent's judgements and produces a relative ranking of all high-level objectives and sub-objectives.

Although designed to assist decision-making in complex and data poor situations the AHP and most other MCDM methods have faced criticism for being overly reductionist in the face of the inherent complexity of natural resource governance scenarios (Mendoza and Martins, 2006). A reductive approach is required as a sub-set of elements must be specified in order that the number of comparative judgements does not become excessive. However Mendoza and Martins also describe the benefits of linking hard or quantitative methods (such as AHP) with soft or qualitative methods (such as cognitive mapping). This ensures that the more reductive method is informed by an understanding of the complexity in the given system. This is the approach that was used in this research and many of the objectives in the hierarchy arose during the cognitive mapping phase. This combination of cognitive mapping followed by the use of AHP has not been used previously in a fisheries context.

6.2.2. Development of a Hierarchy of Objectives

The original objectives of the CSHMAC when it was established in 2001 were:

1. To build the stock to a level whereby it can sustain annual catches of 20,000 tonnes.

2. In the event of the stock falling below the level at which these catches can be sustained the Committee will take appropriate rebuilding measures.

3. To introduce measures to prevent landings of small and juvenile herring, including closed areas and/or appropriate time closures.

4. To ensure that all landings of herring should contain at least 50% of individual fish above 23 cm.

5. To maintain, and if necessary expand the spawning box closures in time and area.

6. To ensure that adequate scientific resources are available to assess the state of the stock.

7. To participate in the collection of data and to play an active part in the stock assessment procedure.

These objectives were drafted specifically in response to a stock crisis and a potential closure of the fishery at the time. They are focused on a specific catch target and a set of measures aimed at achieving this. The CSHMAC appears to have achieved it's objectives, as following the implementation of a Recovery Plan in 2006 the stock was officially deemed to have recovered in 2010. During 2010 and 2011 the CSHMAC, along with the Marine Institute scientist responsible for assessment of the stock, developed and agreed the parameters for a Long Term Management Plan (LTMP). This plan includes as parameters; the Spawning Stock Biomass (SSB) level, the level of fishing mortality (F) and an annual constraint on changes in quota. Over the course of this development process some frustration at the limited scope of the plan was evident. This frustration was expressed both by the CSHMAC and the participating scientist. His view was that rather than complicating the LTMP by incorporating too many social and economic factors, that the committee should update their management objectives to reflect these concerns. He had also recommended, as far back as 2006, that the objective for an annual catch of 20,000 tonnes was unrealistic (Minutes of CSHMAC meeting, 9th March 2006). CSHMAC participants have also moved away from a rigid definition of target annual yield and towards a more long term approach to sustainable catch levels (authors observations from CSHMAC meetings attended during drafting of Recovery Plan and LTMP).

The Marine Stewardship Council (MSC) in 2011, as part of their assessment process for Celtic Sea Herring, made the following recommendations which relate to updating objectives (Food Certification International Ltd., 2012):

"Recommendation 1:
Although in performance indicator 1.2.1 (harvest strategy) the fishery scores above 80, a recommendation has been made for the CSHMAC to evaluate its objectives against scientific advice. Specifically, the objective to sustain catches around 20 000 t may be too optimistic and raise unrealistic expectations causing later problems for management.

Recommendation 2:
Although in scoring performance indicator 1.2.3 (information & monitoring) it is accepted that slippage is not thought to be a significant source of mortality in this fishery at the current time, the scientific working group reports having no information on slippage which can be included in its assessment. Slippage is now required to be recorded as part of the code of practice of the Unit of Certification. Therefore, it has been recommended that the fishery supply information on slippage in a form that can be used in the stock assessment.

Recommendation 3:
There are obvious synergies between condition 2 (clearer objectives) and condition 3 (improved communication and transparency) in the context of the work of the CSHMAC. There is therefore obvious scope to address both conditions within the framework of an overall fishery management plan for the stock, which provides the strategic framework and overall context for the proposed long term management plan. Such an exercise could provide an opportunity for the committee to more clearly define it's own role, objectives and operating procedures – in particular in relation to those areas highlighted in condition 2 and 3. At its core should be a commitment to transparency, through providing opportunities for widespread consultation on this strategic document and its subsequent use."
The MSC assessors also scored "Fishery Specific Objectives" as the lowest of 30 sub-criteria in their assessment.

The CSHMAC, in response to the MSC assessment report, developed a client action plan which contained the following commitments:

"*The Celtic Sea Herring Management Advisory Committee will;*

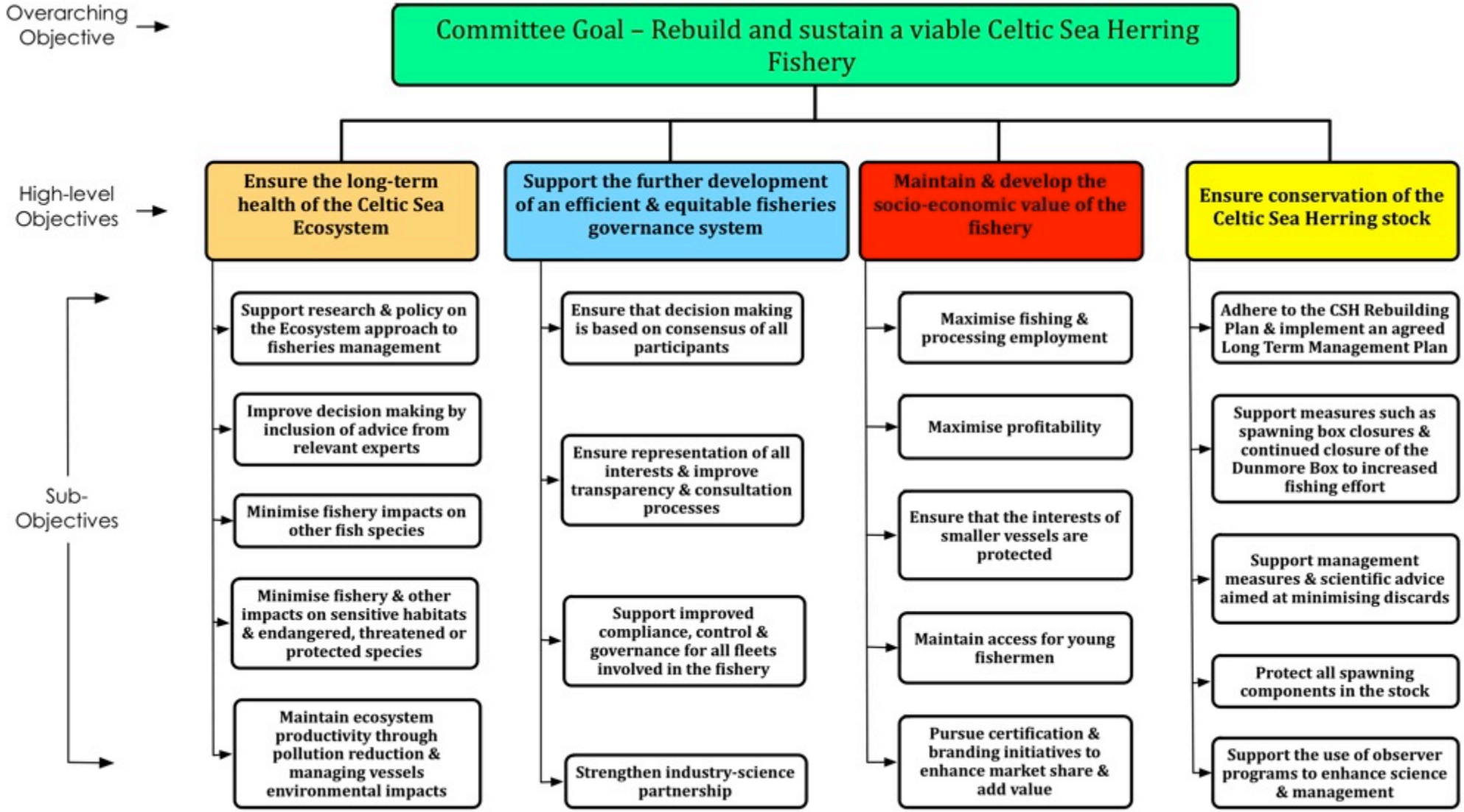
- *Develop short and long term objectives for the Celtic Sea Herring in line with the EAFM. This approach will be consistent with MSC's Principles and will help develop an improved fishery management system.*

- *Develop an Environmental Management Plan for the Celtic Sea Herring Fishery which, tuned by policy, will demonstrate clear and achievable fishery specific environmental management objectives and which will shape management advice through consideration of wider ecosystem elements. Proposals will be sought to help drive this process.*

- *Support an informed and transparent decision making process This process will clearly and transparently demonstrate how environmental targets and objectives guide decision making and overall management advice provided for this fishery. The process will be open to wider stakeholder consultation." (Food Certification International Ltd., 2012)."*

All of the above evidence points to the need for a redrafting of the management objectives for the CSHMAC. Based on objectives expressed during cognitive mapping interviews, the commitments in the LTMP and the MSC action plan the hierarchy of objectives shown below in Figure 6.1 was developed and agreed with the close co-operation of the CSHMAC chairman. The hierarchy also includes socio-economic objectives which were not covered by either the LTMP or MSC environmental plan commitments.

Figure 6.1 CSHMAC Management Objectives Hierarchy



6.2.3. Participants in the AHP survey

The AHP survey is limited to the same set of regular and irregular CSHMAC participants as the cognitive mapping. The decision to base it on this set of stakeholders, although it excludes some decision-makers with an influence on the governance of the fishery at a higher level (DAFM officials and the Fisheries Minister), was a pragmatic one. It was based on the researchers access to individuals and previous lack of involvement at Departmental and Ministerial level in the wider project within which this research was conducted.

All 17 of the participants in the cognitive mapping survey were invited to complete the online AHP survey of which 15 did so. One was eliminated from the analysis due to extremely high inconsistency levels (indicating that the respondent didn't fill out the survey properly or didn't understand how to complete it). This was a response rate of 88%.
Table 6.1 below lists the valid responses and their respondent codes.

Table 6.1 Valid responses to the AHP survey.

Respondent	Respondent Code		Respondent	Respondent Code
NGO Rep	NGO		Processor 1	P1
Sentinel Fisherman 1	SF1		Fishermens Rep 1	R1
RSW Fisherman 1	RSWF1		Fishermens Rep 2	R2
RSW Fisherman 2	RSWF2		Scientist 1	Sc1
Dry-hold Fisherman 1	DHF1		Scientist 2	Sc2
Dry-hold Fisherman 2	DHF2		Certification Manager	CM
Dry-hold Fisherman 3	DHF3		Fishery Officer	SFPO

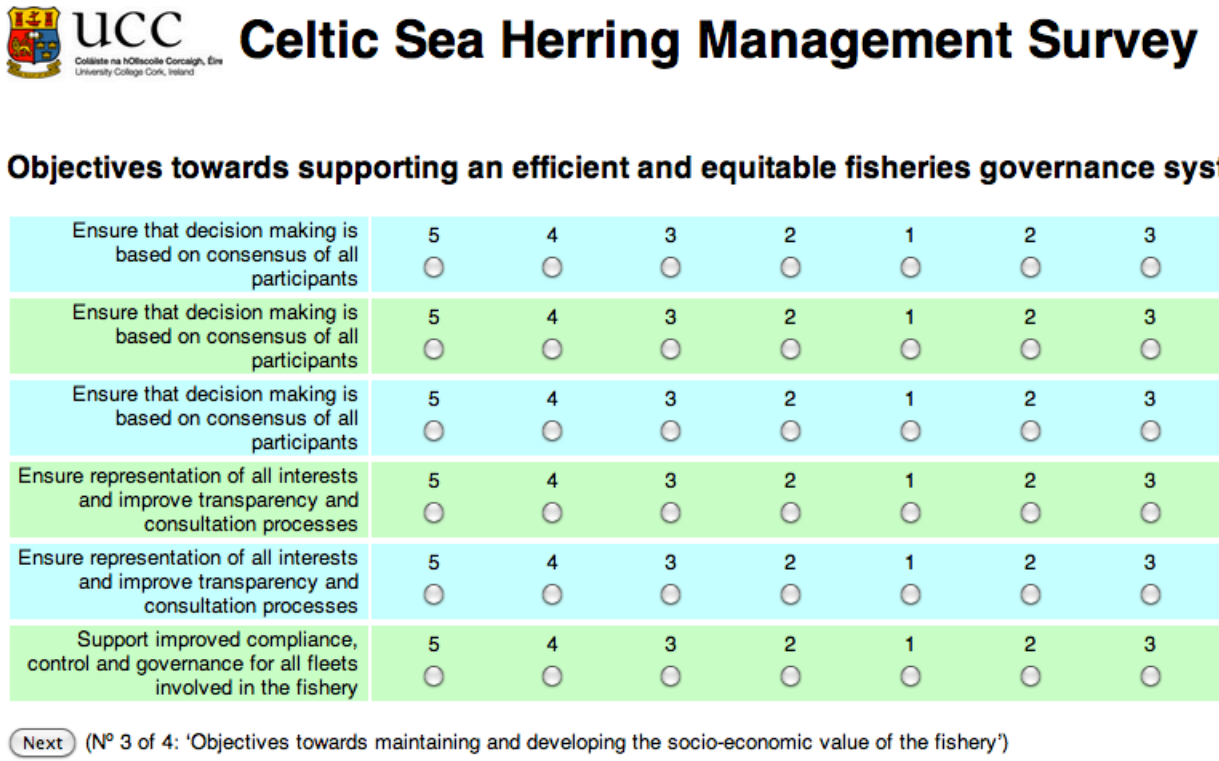
6.2.4. Survey method.

As the preference elicitation using AHP is cognitively quite straightforward, with only two elements being compared at a time, it has been found to be suitable for use either as an online or postal questionnaire survey (Leung *et al.*, 1998). An online survey was set up on the UCC Computer Centre server and the target respondents were emailed an invitation to complete the survey. Figure 6.2 below shows a screen grab of one of the screens in the survey showing a series of pairwise comparisons of

governance related sub-objectives. As stated above, only one of the completed surveys was invalid, so the online method of conducting AHP surveys was successful in this case. Outputs from the online survey were in the form of excel spreadsheets which could be analysed with AHP software. The software used was a freely available Excel based application called AHPCalc [17]. This software calculates the AHP priorities for individuals, internal consistency ratios and group priorities based on the geometric mean.

[17] http://bpmsg.com/wp-content/uploads/2012/10/AHPcalc-version-16.10.12.zip

Figure 6.2 Screen grab from online AHP survey.
Respondents are asked choose a number for each row indicating their relative preference for either the left or right hand objective. Selecting 1 indicates no preference for one objective over the other, 2 indicates moderate preference, 3 indicates a strong preference, 4 a very strong preference and 5 an extreme preference.



UCC
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

Celtic Sea Herring Management Survey

Objectives towards supporting an efficient and equitable fisheries governance system

Ensure that decision making is based on consensus of all participants	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Ensure representation of all interests and improve transparency and consultation processes
Ensure that decision making is based on consensus of all participants	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Support improved compliance, control and governance for all fleets involved in the fishery
Ensure that decision making is based on consensus of all participants	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Strengthen industry-science partnership
Ensure representation of all interests and improve transparency and consultation processes	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Support improved compliance, control and governance for all fleets involved in the fishery
Ensure representation of all interests and improve transparency and consultation processes	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Strengthen industry-science partnership
Support improved compliance, control and governance for all fleets involved in the fishery	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Strengthen industry-science partnership

Next (N° 3 of 4: 'Objectives towards maintaining and developing the socio-economic value of the fishery')

6.3. Results and Analysis

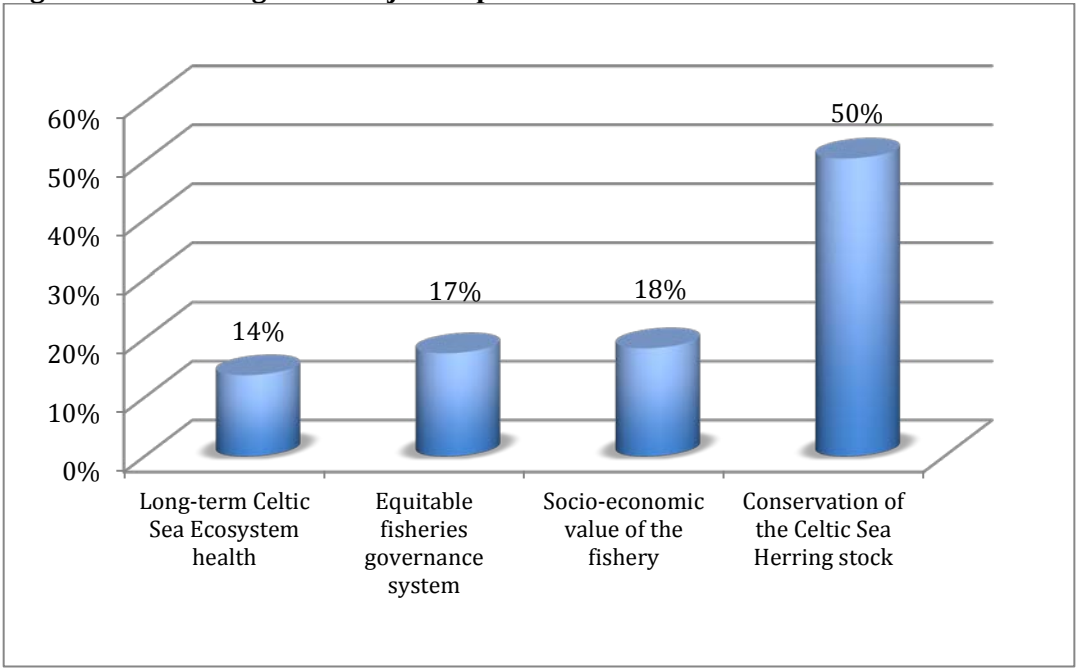
6.3.1. High-level Objectives

There is a clear preference across the group of respondents for conserving the herring stock above all other high-level priorities (Table 6.2 and Figure 6.3). 9 out of 14 respondents had stock conservation as their top priority and all others had it as their second priority. Only one respondent, the NGO representative, had ecosystem health as a clear first priority with one of the scientists and the certification scheme manager splitting first priority evenly between ecosystem health and Herring stock conservation. The three highest priority scores for stock preservation are from fishermen either operating RSW vessels or planning to. A significant proportion of fishermen operating smaller or older vessels did not give stock conservation their highest priority. Two of them had governance as their first priority and one had socio-economic value.

Table 6.2: High-level Objective priorities
(See Table 6.1 for more detailed wording of objectives)

High level Objectives	Ecosystem health	Equitable governance	Socio-economic value	Stock conservation
RSW Fisherman 1	6%	11%	14%	68%
RSW Fisherman 2	11%	10%	12%	67%
Dryhold fisherman 1	14%	11%	17%	59%
Dryhold fisherman 2	12%	60%	9%	19%
Dryhold fisherman 3	14%	38%	19%	30%
Sentinel fisherman 1	13%	16%	49%	22%
Fisheries Rep 1	4%	23%	27%	46%
Fisheries Rep 2	5%	28%	25%	42%
Processor 1	7%	10%	41%	42%
Certification Manager	31%	6%	31%	32%
Scientist 1	43%	6%	6%	44%
Scientist 2	19%	6%	16%	59%
SFPO	8%	60%	12%	20%
NGO	72%	7%	7%	14%
Mean	**14%**	**17%**	**18%**	**50%**

Figure 6.3: Mean high-level objective priorities



K-means cluster analysis (Table 6.3) can help to describe patterns within complex data set such as those produced by the AHP (Arnette *et al.*, 2010). 4 clusters are produced from a k-means cluster analysis using SPSS of the individual priorities for high-level objectives. The dominant cluster (Cluster 3 with 7 members) strongly prioritises Stock preservation over the other factors. The presence of a smaller group prioritising equitable governance is also confirmed while only one respondent strongly prioritised ecosystem health.

Table 6.3: K-means Cluster Analysis for high-level objective priorities

Cluster	1	2	3	4
Ecosystem	11	**72**	19	12
Governance	**53**	7	9	17
Socio-economics	13	7	13	**35**
Stock	23	14	**60**	**37**
No. Members	3	1	7	3

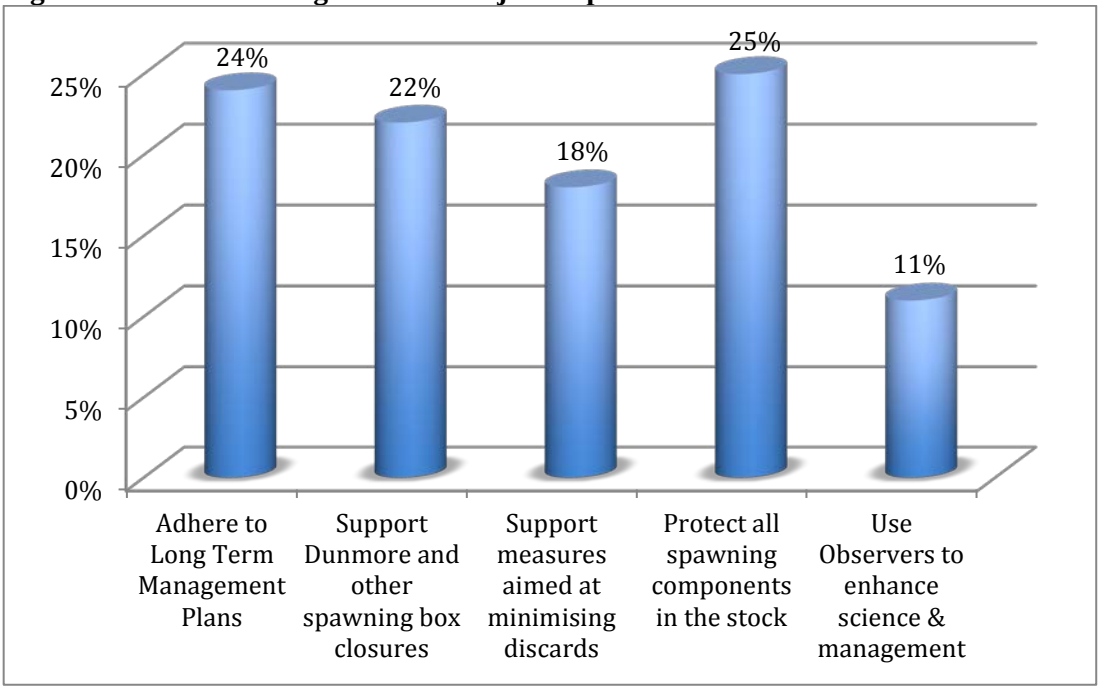
6.3.2. Celtic Sea Herring Stock Sub-Objectives

There is evenly spread support for three of the sub-objectives with respect to preserving the Herring stock (Table 6.4 and Figure 6.4). Protection for all spawning components in the stock, support for the LTMP and continued use of the Dunmore Box are prioritised almost equally. Measures to minimize discards are also strongly supported while the only poorly supported sub-objective is the use of observers. Only three respondents prioritised the use of observers to any significant extent.

Table 6.4: Celtic Sea Herring Stock sub-objective priorities
(See Table 6.1 for more detailed wording of objectives)

Herring stock sub-objectives	Adhere to LTMP	Support spawning box closures	Minimise discards	Protect all spawning components	Enhance science & management with Observers
RSW Fisherman 1	24%	24%	24%	24%	5%
RSW Fisherman 2	7%	13%	9%	66%	6%
Dryhold fisherman 1	56%	15%	11%	8%	10%
Dryhold fisherman 2	19%	30%	19%	20%	12%
Dryhold fisherman 3	27%	13%	13%	19%	27%
Sentinel fisherman 1	11%	58%	7%	16%	9%
Fisheries Rep1	20%	20%	20%	20%	20%
Fisheries Rep2	55%	19%	8%	10%	8%
Processor1	19%	22%	17%	34%	9%
Certification Manager	38%	17%	8%	29%	9%
Scientist 1	29%	11%	29%	25%	7%
Scientist 2	7%	5%	40%	15%	32%
SFPO	11%	12%	29%	22%	26%
NGO	54%	9%	7%	19%	11%
Mean	**24%**	**22%**	**18%**	**25%**	**11%**

Figure 6.4: Mean Herring Stock sub-objective priorities



The even spread of support for the sub-objectives is backed up by the k-means cluster analysis, which shows the largest cluster (Cluster 1 with 6 members) as not prioritising any of the objectives greatly over the others (Table 6.5). Those supporting the use of observers included scientists, fishery officers, fishermen and fishermen's reps but surprisingly not the participating NGO representative. Smaller clusters did prioritise certain sub-objectives, most notably the 4 members of Cluster 2 who clearly prioritised adherence to the LTMP. Two smaller clusters also prioritised protection of sub-stocks and spawning box closures respectively. This demonstrates that there are a range of measures to maintain the Herring stock which have a good level of support within the group.

Table 6.5: K-means Cluster Analysis for Celtic Sea Herring Stock sub-objective priorities

Cluster	1	2	3	4
LTMP	20	51	13	15
Spawning Box	14	15	18	44
Minimise Discards	26	9	13	13
Protect Substocks	21	17	50	18
Use Observers	14	10	8	11
No. Members	6	4	2	2

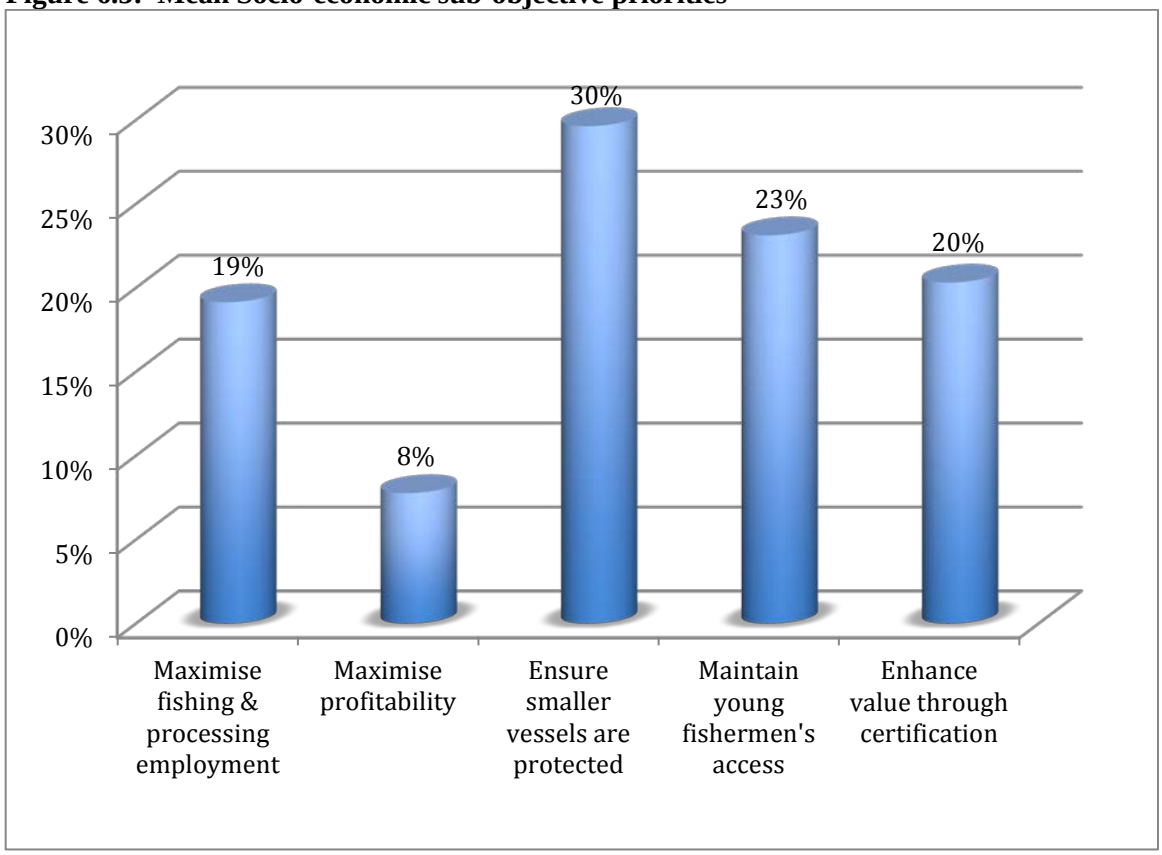
6.3.3. Socio-Economic Sub-Objectives

The strongest preference under the socio-economic sub-objectives category was for protection of smaller vessels but there was also broad support for ensuring access for young fishermen, for certification schemes and for maximizing employment (Table 6.6 and Fig. 6.5). 5 respondents had protection of smaller vessels and 5 had ensuring access for young fishermen as their top priority. The only weakly supported objective was that of maximising profitability. Only one respondent, a representative of a fishermen's organisation, had profit as the main priority. 10 out of 14 respondents had profit as their least priority. This is discussed in more detail in the Discussion section below. Due to the spread of priorities the cluster analysis does not reveal anything new in this category. The lack of extreme or dissenting preferences indicates that in this case it may be possible to develop management measures which would satisfy the majority of participants.

Table 6.6: Socio-economic sub-objective priorities
(See Table 6.1 for more detailed wording of objectives)

Socio-Economic sub-objectives	Maximise fishing & processing employment	Maximise profits	Protect smaller vessels	Maintain young fishermen's access	Enhance value through certification
RSW Fisherman 1	20%	20%	20%	20%	20%
RSW Fisherman 2	28%	2%	29%	15%	27%
Dryhold fisherman 1	10%	7%	54%	17%	11%
Dryhold fisherman 2	25%	9%	27%	29%	10%
Dryhold fisherman 3	5%	4%	42%	42%	7%
Sentinel fisherman 1	25%	23%	45%	3%	3%
Fisheries Rep 1	24%	3%	15%	33%	24%
Fisheries Rep 2	22%	42%	14%	10%	12%
Processor 1	24%	4%	24%	32%	16%
Certification Manager	26%	4%	17%	17%	36%
Scientist 1	24%	3%	24%	24%	24%
Scientist 2	9%	7%	22%	37%	26%
SFPO	8%	22%	29%	16%	25%
NGO	23%	4%	16%	28%	29%
Mean	**19%**	**8%**	**30%**	**23%**	**20%**

Figure 6.5: Mean Socio-economic sub-objective priorities



6.3.4. Governance Sub-Objectives

Three of the four governance sub-objectives are well supported by the group generally (Table 6.7 and Fig 6.6). The objective to ensure consensus in decision-making is the only poorly supported objective. This may be due to a perception that some constructive conflict is good for deliberation but is more likely to reflect a feeling that majority voting can decide contested issues. The strongest support for the consensus objective comes from respondents who have expressed reservations about how their views are treated at CSHMAC meetings. There are also other sources of conflict within this category. The mean priority scores for both improving control and compliance and ensuring representation for all interests mask some strong diversity of views. Support for stronger controls ranges from 12% up to 69% while ensuring representation for all interests ranges from 8% to 42%. This is picked up by the cluster analysis (Table 6.8) which shows that although the main cluster broadly supports all objectives there is a cluster with marked support for stronger compliance. There is also a cluster which very strongly prioritises the strengthening of the industry-science partnership above all the other sub-objectives.

Table 6.7: Governance sub-objective priorities
(See Table 6.1 for more detailed wording of objectives)

Governance sub-objectives	Consensus based decision making	Representation for all interests	Improved control & compliance	Strengthen industry-science partnership
RSW Fisherman 1	8%	8%	23%	61%
RSW Fisherman 2	9%	8%	15%	69%
Dryhold fisherman 1	8%	12%	56%	24%
Dryhold fisherman 2	32%	27%	29%	13%
Dryhold fisherman 3	26%	29%	17%	29%
Sentinel fisherman 1	37%	37%	15%	11%
Fisheries Rep 1	37%	23%	19%	21%
Fisheries Rep 2	14%	17%	21%	48%
Processor 1	9%	10%	69%	13%
Certification Manager	7%	39%	12%	42%
Scientist 1	12%	42%	39%	7%
Scientist 2	2%	33%	33%	33%
SFPO	28%	30%	15%	26%
NGO	12%	23%	50%	16%
Mean	**14%**	**25%**	**30%**	**30%**

Figure 6.6: Mean Governance sub-objective priorities

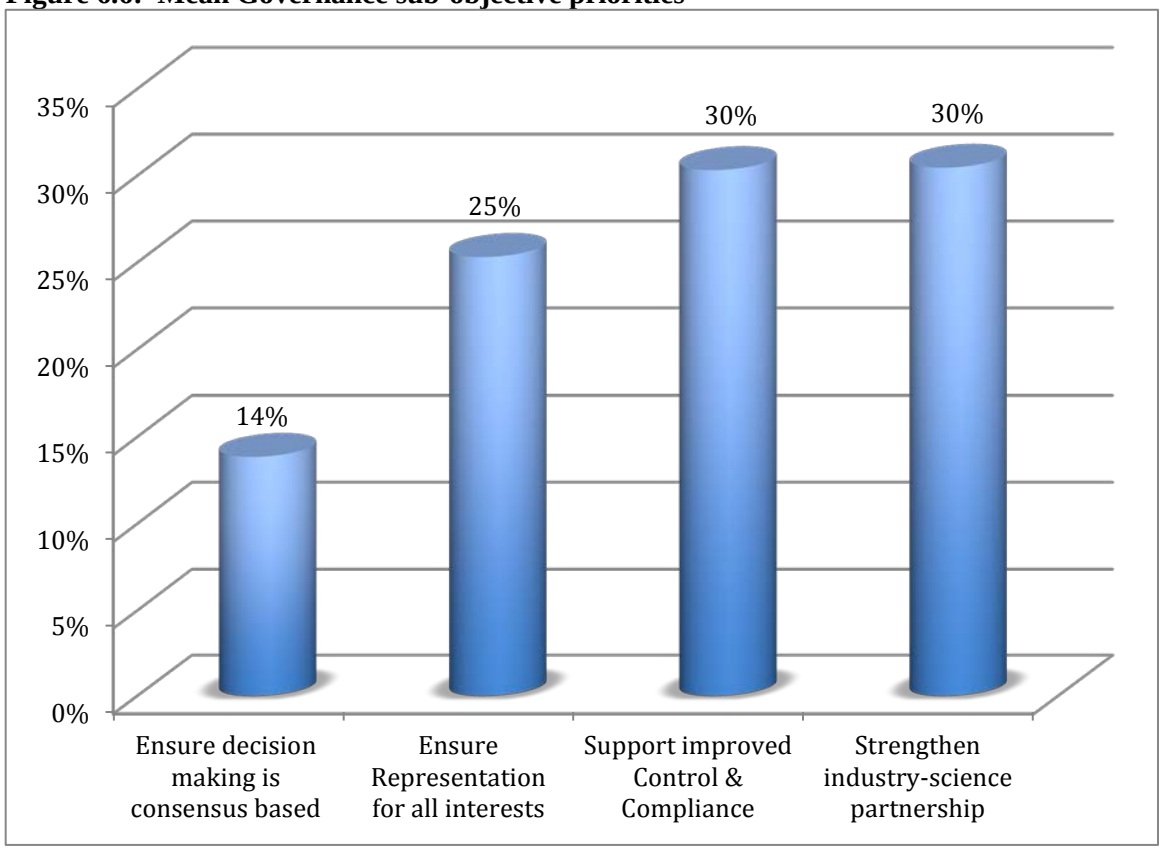


Table 6.8: K-means Cluster Analysis for governance sub-objective priorities

Cluster	1	2	3	4
Consensus	10	7	10	28
Representation	15	**38**	11	31
Compliance	**58**	**36**	20	18
Partnership	18	20	**59**	24
No. Members	3	2	3	6

6.3.5. Ecosystem Sub-Objectives

The most well supported sub-objective contributing towards maintenance of ecosystem health was the use of expert advice to improve decision-making (Table 6.9 & Fig 6.7). Whether this reflects a feeling that ecosystem related issues are somewhat outside the competence of the existing group is not certain. There was fairly even support for the objectives to minimize pollution and environmental impacts and to minimize effects on habitats and vulnerable species. No significant clusters were evident from the k-means analysis.

Table 6.9: Ecosystem sub-objective priorities
(See Table 6.1 for more detailed wording of objectives)

Celtic Sea ecosystem health sub-objectives	Support EAFM research & policies	Improve decision making through expert advice	Minimise impacts on other fish species	Minimise impacts on vulnerable habitats & protected species	Maintain ecosystem productivity by managing vessels environmental impacts
RSW Fisherman 1	25%	34%	15%	11%	15%
RSW Fisherman 2	55%	19%	10%	8%	9%
Dryhold fisherman 1	17%	9%	10%	10%	54%
Dryhold fisherman 2	8%	55%	10%	11%	17%
Dryhold fisherman 3	11%	68%	6%	8%	8%
Sentinel fisherman 1	10%	10%	22%	43%	15%
Fisheries Rep 1	23%	15%	27%	17%	18%
Fisheries Rep 2	14%	43%	14%	14%	14%
Processor 1	10%	36%	25%	16%	13%
Certification Manager	15%	24%	10%	17%	34%
Scientist 1	17%	23%	18%	23%	19%
Scientist 2	8%	28%	11%	29%	23%
SFPO	14%	8%	28%	21%	28%
NGO	5%	8%	12%	52%	22%
Mean	**15%**	**27%**	**16%**	**20%**	**22%**

Figure 6.7: Mean Ecosystem sub-objective priorities

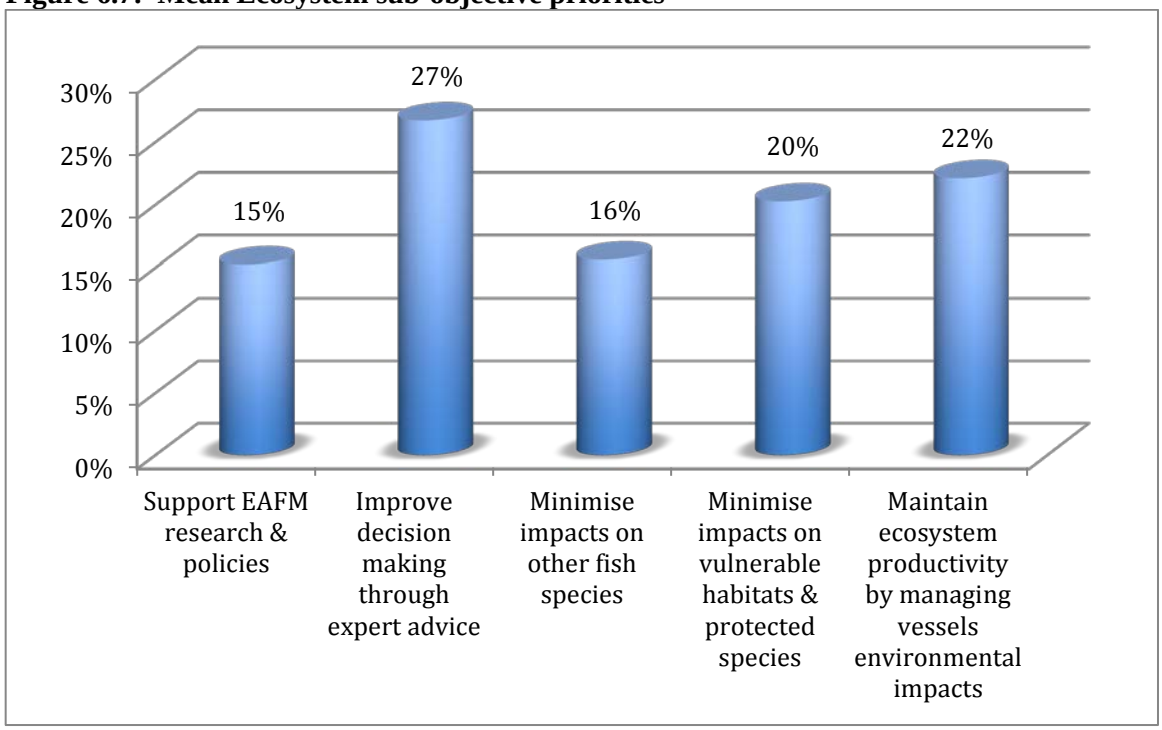


Table 6.10: Overall Management Objective Priorities

Conservation of the Celtic Sea Herring stock	**0.504**
Protect all spawning components in the stock	0.126
Adhere to Long Term Management Plans	0.121
Support Dunmore and other spawning box closures	0.111
Support measures aimed at minimising discards	0.091
Use Observers to enhance science and management	0.055
Socio-economic value of the fishery	**0.183**
Ensure smaller vessels are protected	0.054
Maintain young fishermen's access	0.042
Enhance value through Certification	0.037
Maximise fishing and processing employment	0.035
Maximise Profitability	0.014
Equitable fisheries governance system	**0.175**
Strengthen industry-science partnership	0.053
Support improved control & compliance	0.053
Ensure fair representation, consultation & transparency	0.044
Ensure decision-making is consensus based	0.024
Long-term Celtic Sea Ecosystem health	**0.138**
Improve decision-making through expert advice	0.037
Maintain ecosystem productivity by managing vessel pollution and environmental impacts	0.030
Minimise impacts on vulnerable habitats & protected species	0.028
Minimise impacts on other fish species	0.022
Support EAFM research & policies	0.021

6.4. Discussion and Conclusions

The AHP prioritisation has been useful not just in clarifying what objectives are supported by stakeholders but also the relative importance of those objectives and the degree of support across stakeholders. While some of the objectives have the potential to be conflicting e.g. maximising employment vs. adherence to the LTMP, the relative priority of these objectives is now known and future management measures can be

weighed up in terms of how they satisfy these weightings. This should allow for better design of future management measures and policies related to the fishery.

The AHP results confirm that stock issues are prioritised over any other concerns and that ecosystem matters are not a major priority for the majority of this group. This is a significant finding because the stakeholders priorities are likely to be linked to their actions and the support they will have for future management measures. So measures which allow for further protection and enhancement of the Celtic Sea Herring stock are likely to be strongly supported. Measures, on the other hand, which consider the critical food web role played by herring, and which may require that the needs of other fish, mammal or seabird species are accounted for, may not be well supported. It is important not to overstate this as a lower priority score for an objective does not mean that it is unsupported or rejected but simply that the stakeholder group, at this time, prioritise other objectives more highly. However the fact that the cognitive maps showed that wider ecosystem functioning was not considered as a principal influence on the fishery system adds weight to the AHP finding. This confirms the value of using multiple methods to address research questions. The relative priority afforded to ecosystem issues in this survey of 14% is very much in line with findings from other similar surveys. Leung *et al*., (1998) found that Hawaiian industry stakeholders gave a weighting of 14% to bycatch and protected species, Mardle *et al*., (2004) found that UK fishing groups gave a combined weighting of 13% to non-commercial species and quality of the marine environment while Pascoe *et al*., (2009) found that Australian industry representatives gave a priority of 17% to all environmental objectives.

Socio-economic and governance objectives, although slightly higher priorities than ecosystem health, are also much lower priorities than stock issues. The most curious result is that the "Maximising Profitability" objective ranked lowest of all objectives in this survey. This is significant as it differs from some of the literature which shows that economic concerns rank highly for fishing industry stakeholders. Pascoe *et al.*, (2009) found that economic and stock objectives were of equal concern for Australian fishermen. Mardle *et al.*, (2004) found that stock sustainability issues were ranked slightly higher than concerns about profits. The lack of prioritisation of profits in this survey is an exception which may be due to a number of issues. The wording used in the survey, "Maximise profitability", may have functioned as a disincentive as many respondents could view that as a very narrow objective with some unappealing implications. A different choice of wording, such as "Optimise Profitability", "Optimise

Fishery Value" or "Stabilise income" may have resulted in a higher priority. The fishery is also going through a change in the access regime, which has created a significant increase in conflict, including accusations of CSHMAC participants being motivated by personal greed (Notes from interview with respondent RSW1, October 2011). As a result profit-making motivations may be deliberately downplayed.

When considering the original objectives of the CSHMAC and comparing them with the list in Table 6.10 it can be seen that the original objectives all belong under the Conservation of Herring Stock category. So the new suite of objectives, even though some are not strongly prioritised, at least provide a basis for assessing how EAFM implementation, including social, governance and economic aspects may be addressed. These AHP results indicate that the formal adoption of a similar set of objectives should be possible without significant conflict. The majority of the objectives were broadly supported with very few notable conflicts between individual and group priorities. Such a formal adoption would give a baseline against which future management plans and outcomes could be measured.

In the cognitive mapping chapter the existence of a core group of long-term CSHMAC participants and the relative similarity of their mental models of system functioning was discussed. At the high level objective a comparison between the priorities of the core and non-core groups does reveal some differences (Table 6.11). The greatest divergence between the groups is in the priority given to ecosystem health.
(The core group was made up of 6 fishermen, 2 processors, 1 fishermen's representative and a fisheries officer while the non-core group comprised of an environmental NGO representative, a fisheries certification manager, two scientists, two fishermen and one fishermen's representative.)

Table 6.11: High-level objective weightings for core and non-core CSHMAC participants

High level Objectives	Long-term Celtic Sea Ecosystem health	Equitable fisheries governance system	Socio-economic value of the fishery	Conservation of the Celtic Sea Herring stock
Core CSHMAC group	7%	15%	22%	56%
Non-core group	20%	18%	16%	47%

At the sub-objective level there is very little evidence of significant splits between the core group priorities and those of the non-core group. This is in keeping with the general trend at the sub-objective level where priorities did not appear to be correlated with stakeholder category. The numbers within each category are insufficient to conduct a rigorous statistical analysis. This is significant in that it questions how representative individual fishermen can be of others when discussing specific objectives and points to the need for participation by a diverse group of stakeholders. This is in keeping with the findings of Pascoe *et al*., (2009), who found that within-group coherency decreased with greater specificity of objectives.

6.5. Limits to the use of decision support tools

The use of AHP to develop a hierarchy of objectives and to prioritise their relative weights was initially enthusiastically received and well supported during the survey phase by CSHMAC participants. However the outputs received very little reaction apart from the CSHMAC chairman and one other participant who were keen to use the hierarchy within the ongoing MSC certification process. Most participants however were ambiguous about the usefulness of the exercise. On following up with the participants on why this was so the view was strongly expressed that objectives are usually ignored and that crucial decisions are usually made by negotiation and deliberation between individuals and groups. This viewpoint ignores the fact that the Recovery Plan and LTMP for Celtic Sea Herring have involved tightly specified objectives and targets. But it does illustrate that the political process of decision making is the default mode rather than formal rule-based approaches. This corresponds with previous literature (Carlsson and Walden, 1995) which found that real options chosen did not match those selected through an AHP process. These findings highlight the need for future research to focus on political processes, conflicts and governance structures which can mitigate or constructively redirect conflict.

Another potential disadvantage of the AHP method is that it may not be very robust to strategic response bias i.e. respondents could quite easily give responses that do not reflect their true preferences. This finding does not seem to have been reported in the literature - most critiques are based on technical aspects such as rank reversal rather than the fundamental issue of whether it reflects respondents real priorities. It is

significant as it implies that interpretation of the results must be cautious and should ideally be tested against results from some other method.

The issue of which high level category to place a sub-objective is also a critical and potentially arbitrary one. In this study, enhancement of science and management through the use of observers was placed under the high level objective of stock conservation. As a result the calculated priority for the use of observers was higher than many other sub-objectives although in reality it received very little support so again caution in interpretation is required. These findings concur with those of Triantaphyllou and Mann (1995) who concluded that "*MCDM methods should be used as decision support tools and not as the means for deriving the final answer. To find the truly best solution to a MCDM problem may never be humanly possible. The conclusions of the solution should be taken lightly and used only as indications to what may be the best answer*."

Chapter 7 The burden of proof in co-management and results-based management: the elephant on the deck![1]

7.1. Introduction

The debate about where the burden of proof should be placed in fishery management and what standards it should reach is not new. As far back as 1919, W. F. Thompson wrote, "Proof that seeks to change the way of commerce . . . must be overwhelming" (quoted in Ecosystem Principles Advisory Panel, 1998). Before the widespread application of the precautionary approach, the burden of proof in most fisheries lay with managers who were required to demonstrate that fishing levels were not creating a resource problem. The desire of fishery managers and conservationists *inter alia* to reverse the burden of proof has been expressed repeatedly (Mangel *et al.*, 1996; Dayton, 1998; Agardy, 2000; Gerrodette *et al.*, 2002). The precautionary approach may have shifted the burden of proof somewhat, and its application has led to a feeling commonly expressed by the fishing industry that the onus is on them to provide evidence that is often rejected on the grounds of bias or because it does not match scientific-assessment standards (Charles, 2002). These issues relating to the standard of evidence have a direct implication for any approach seeking to reverse the burden of proof, and some of these are explored here, using discard reduction as an example.

The current debate in European fishery management about reversing the burden of proof can be linked to the 2009 Green Paper on the reform of the Common Fisheries Policy (CFP), (EC, 2009). It proposed co-management, self-management, or results-based management as potential solutions to the problem of increasingly complex and costly micromanagement of fisheries, and suggested that reversing the burden of proof is a necessary element of these approaches, one that would simplify regulation and provide incentives for better provision of information. There is significant support in the literature for the Green Paper's aim of moving away from a traditional top-down management regime, through benefits such as improved legitimacy and compliance, enhanced stewardship, a broader stakeholder and knowledge base, and generally more

[1] A similar version of this paper was published by the author in the ICES Journal of Marine Science (Fitzpatrick *et al.*, 2011). Some material was removed from this chapter to avoid repetition.

robust and resilient management (Jentoft and McCay, 1995; Charles, 2002; Jentoft, 2005; Townsend *et al.*, 2008; Berkes, 2009).

The fishing industry has responded positively to the concept of results-based management. MSC certification could be seen as an example of industry taking on additional responsibility in terms of demonstrating the sustainability of their activities. In submissions made to the CFP reform consultations (Commission of the European Communities, 2010) sustainable fishing plans developed by industry have been proposed by several representative bodies. However, they do not yet contain sufficient detail on what would constitute proof or how audits could verify compliance. One submission addresses the issue as follows: "*One of the key features of the plan will be an obligation to document the vessels' activities in a way that allows for periodic* ***audit.*** *This amounts to reversing the burden of proof*." Clearly more discussion is required on the details of how this could work. Options for addressing the question of how industry can demonstrate satisfactorily that fishing is taking place within sustainable limits in a European, and more specifically Irish, context are discussed here. First, some examples of evolving approaches to reversing the burden of proof are given, in order to provide a context for the following discussion.

7.2. Current approaches to reversing the burden of proof in fishery management

In Australia's prawn fishery in the Spencer Gulf, 39 demersal trawlers are licenced to fish. Their success in maintaining good catch rates has been ascribed to the decision to limit entry from the onset of the fishery in 1968, and also to the strongly collaborative co-management arrangement that exists between fishers, government managers, and scientists (Townsend *et al.*, 2008). Although the Government retains ultimate control, management of the fishery has been delegated to a Fisheries Management Committee since 1995. The management plan for the fishery (Dixon and Sloan, 2007) lists various goals, objectives, and strategies (with associated indicators and limit reference points) across a wide range of factors. One of the four key management goals is to minimize impacts on the ecosystem. There are three objectives linked to this goal, one of which is to minimize fishery impacts on bycatch and byproduct species. A number of strategies are linked to this objective, including *inter alia* limiting fishing effort through restricting the total quantity of gear used, permanently closed areas, and risk assessments to determine the vulnerability of bycatch species to overfishing. The success of impact-

mitigation strategies is assessed through fixed-station trawl surveys conducted by industry vessels three times per year, risk assessments, and dedicated fishery-independent bycatch surveys. The Committee at Sea, consisting of skippers and licence-owners, is also required to report regularly on industry compliance with harvest control rules.

Under a 2010 amendment to fishery legislation (Parliament of Australia, 2010), further delegation of management responsibility to the fishing industry has been mandated. These changes strengthen the ability of fishers to commission and design their own research programmes, while refocusing the role of the Australian fishery management agencies on their auditing function.

On the Canadian Pacific coast, a pilot Commercial Groundfish Integration Plan (CGIPP) was developed jointly by industry and managers, and initiated in 2006. The plan arose as a result of concerns over the status of various species, and in particular rockfish stocks. The CGGIP scheme has a number of guiding principles that are relevant here (Fishery and Oceans Canada, 2009). These are that all groundfish catches, across a complex mix of 60 species, must be accounted for. Also, the plan stated that both at-sea and dockside-monitoring arrangements needed to be revised. This resulted in a requirement for 100% observer coverage and an enhanced dockside-monitoring programme, both jointly funded by Government and industry. At-sea observers record details of fishing activity and gear, catch quantities retained, and discard levels. The at-sea programme allows vessels to choose between carrying an observer or a video-monitoring system. This is supported by a dockside-monitoring programme that combines video records of all landings, of which ~10% are checked against vessel declarations, with random inspections. Discrepancies between the declared catch and the video records can trigger a full inspection, the cost of which is charged to the fisher.

Following an evaluation of the pilot plan, an extension was agreed, and 2010/2011 is the first year of a more permanent integrated plan (Fishery and Oceans Canada, 2010). Although the evaluation indicated that conservation objectives were being achieved, there are some concerns about the sustainability of funding for what is an expensive monitoring programme.

The practical application of reversing the burden of proof is increasing in the context of European fisheries. Many cod stocks are well outside desirable biomass levels and

exploitation rates, and have been for the past decade at least. Despite the introduction of management initiatives that aimed to rebuild stocks by 30% annually (EC, 2004), many have continued to decline. More recently, a new long-term management plan (LTMP) for cod (EC, 2008) has been introduced. It shifted the focus from rebuilding biomass to setting a target fishing mortality. Incorporated within the LTMP are annual reductions in both total allowable catch (TAC) and fishing effort, the extent of which are dependent on stock status and fishing mortality. For cod stocks west of Scotland and in the Irish Sea (ICES Areas VIa and VIIa; Figure 1), this has meant an annual reduction of 25% in both TAC and effort allocations. However, the LTMP offers individual countries the opportunity to implement alternative measures, provided they can demonstrate that equivalent reductions in cod catches are being achieved. Also, where the annual cod catches of a vessel demonstrably do not exceed 1.5% of its total catch, then that vessel may be exempted from the effort-control rules. It is important to emphasize here that the regulation is based on catches (including discards), not only on declared landings. Therefore, it is necessary that total catches be monitored adequately either by on-board observers or remote-sensing equipment, e.g. video cameras. These elements of the LTMP for cod have stimulated national authorities and fishers to adopt measures that minimize cod catches through technical modifications to gears or the application of closed areas. In both cases, individual countries must now provide adequate data to demonstrate that cod catches are below threshold levels, if they are to remain outside the effort control scheme.

A recent year-long trial involving Danish fishing vessels is a good example of how a comprehensive approach to reversing the burden of proof may be taken within the cod LTMP. Based on the assumption that total catches (landings + discards) would be deducted from future fishing quotas, the vessels were fitted with cameras to record any discarding, and in return they received increased quotas (Kindt-Larsen *et al*., 2011). That research found that discard and catch levels could be determined accurately by viewing the electronic-monitoring records onshore. It was also found that the cost of verifying discards in this way was significantly less than that of on-board observers, and that the fishers involved were incentivized actively to avoid areas where there could be much discarding, particularly of juvenile cod.

7.3. In situ and ex situ indicators, and management objectives

Before looking at the types of fishery impacts, which are likely to be audited in a reversal of the burden-of-proof scenario, it is useful to consider two fundamentally different approaches to how they may be measured, and how the choice between them depends on the underlying management objective. In the context of results-based management, the choice of *in situ* (direct observation or monitoring of vessel activities) or *ex situ* (indicators of fish stocks or the wider ecosystem) measures to assess the industry response to a particular goal depends on the overall management or policy objectives, and the agreed tools used to audit the objectives (Lassen *et al.*, 2008). The latter identified four levels of management. At higher levels, objectives covering sustainability, control, and enforcement were deemed as unsuited to reversal of the burden of proof, so these should remain a governmental responsibility. In this context, the information needed for management would generally be *ex situ*, e.g. the state of the stocks or levels of fishing mortality, or in an ecosystem context, impacts on seabed habitats or biodiversity. However, reversal of the burden of proof was considered feasible at the more operational levels of setting acceptable exploitation rates or direct impact assessment. In those cases the more appropriate data would be *in situ*. Examples here might include fishing effort, discards, or bycatches of protected or vulnerable species.

The choice of objectives will, to a considerable extent, determine the choice of metrics, and whether these should be *in situ* or *ex situ*. If the objective is to achieve sustainably exploited stocks, e.g. fishing at MSY, evaluation cannot be at a vessel level but would require *ex situ* metrics, i.e. fish-stock biomass and fishing mortality. If the objective is to manage, for example, fishing effort, this can be evaluated at the vessel level, and would require *in situ* metrics such as can be provided by a vessel monitoring system (VMS).

Discarding is an excellent example of where there is agreement that reduction is desirable, but not on the objectives of that reduction and therefore the choice of *in situ* or *ex situ* metrics. Discarding of commercial fish can be seen simply as an issue of waste, e.g. loss of protein or revenue, or undesirable effects on the stock dynamics, e.g. excess removals leading to increased depletion risk, or it can have wider ecosystem impacts, e.g. in changing the structure of fish communities such as the proportion of large fish (Daan, 2006).

If the objective is to minimize waste, then *in situ* measurements are the most appropriate method because the response of the fleet is measured directly. However, if

the objective is maintaining healthy fish stocks, it should be possible to consider both *in situ* and *ex situ* measures. As with the waste issue, direct monitoring of reduced discarding from vessels allows us to infer an improved state of the stock using standard stock-assessment techniques. Alternatively, the link between reducing discards and better stock health suggests that *ex situ* measures of the latter could possibly be a proxy for demonstrating that discards are indeed falling. However, the concept of a metric to determine discarding is problematic. A key attribute of a useful index (Rice and Rochet, 2005) is that it should be specific to the pressure we are aiming to manage. Fish-stock indicators are responsive to many other pressures, so may be inappropriate for establishing whether or not discarding has reduced.

Finally, if the objective of discard reduction is to achieve a particular ecosystem or fishery objective, such as sustainability, then *ex situ* measures would be the only possible approach. Ecosystem indicators potentially linked to discarding include the large fish indicator (LFI; Greenstreet *et al.*, 2011), a range of biodiversity indices, and the trophic dynamics of the ecosystem – "fishing down the food web" (Pauly *et al*., 1998). There is reasonable evidence of links between many of these indicators and commercial fishing activities, but there is less evidence linking them to discarding on its own. Again, it is likely that a wide range of other external factors will affect many of these indicators, making evaluation of the ecosystem effects of changes in discarding practices difficult.

Both approaches, *in situ* and *ex situ*, have advantages and disadvantages. *In situ* measures are direct, generally at-sea measurements of an activity, and are available almost in real time. The response of the fleet to the policy can be assessed quickly, providing valuable and timely feedback to managers and the fishers. The choice of objectives and monitoring the achievement of those objectives should be relatively straightforward. In a comprehensive system it should also be possible to identify non-compliance at the level of an individual vessel. However, the key disadvantage of the *in situ* approach is that it is likely to be labour-intensive and requires a substantial change in how most fisheries are run. If on-board observers are used, then depending on the precision requirements of a results-based management audit, it is likely that the coverage of the fleet would need to rise considerably. In Irish waters, only ~1% of fishing trips are currently covered by observers. There is also the question of how representative the observed vessels are of the whole fleet (Benoît and Allard, 2009). Ideally then, one would want universal observer cover as applies in the Canadian Pacific groundfish fishery (Townsend *et al*., 2008). Alternatively, new technologies would be

needed to measure discard rates remotely, such as the video-monitoring techniques used in Canada (Townsend *et al*., 2008) and Denmark (Kindt-Larsen *et al.*, 2011).

The main advantage of *ex situ* measures is that their collection is independent of commercial fishing activities, and generally involves alternative data sources such as research surveys or stock assessments. Additionally, the formal inclusion of some of these metrics in the EU Data Collection Framework, the Marine Strategy Framework Directive, and the CFP means that they will be more monitored routinely in future. *Ex situ* metrics target those issues that we most wish to manage, be they at single-stock or ecosystem levels. *In situ* measures tend to address the discarding in and of itself, not the impacts thereof. *Ex situ* metrics are also less invasive of fisher activities, because they can be monitored remotely.

The key disadvantages of the *ex situ* approach are the lack of specificity, and the delay between the activity and quantifying its the impact on the stock or ecosystem. As discussed above, for the most part *ex situ* indicators can be adversely affected by many other factors. For indicators based on stock assessments, these generally depend on the landings in the previous year so would tend to be rather out of date. In some cases, however, more timely stock estimates may be available from fishery-independent surveys. Ecosystem indicators, although often derived from research-vessel surveys, may take some time to respond to changes in fishing pressure, e.g. up to 15 years in the case of the LFI for the North Sea (S. Shepherd pers. comm.). Another disadvantage is that the *ex situ* approach can only operate at the overall fleet level, which has implications for compliance and potential rogue activities by individual vessels.

This leads to the conclusion that in order to monitor the performance of a discard-reduction policy for a given fishery adequately, it is necessary to use *in situ* performance measures that directly observe the level of discarding on individual vessels, not the *ex situ* proxies. This has implications for the tractability of policy objectives in results-based management and the associated audits required to monitor success. The current 1% observer coverage in Irish waters implies a difficult and expensive 100-fold increase to achieve full monitoring. Another important conclusion is the vital need to understand the purpose and objectives of a discard-reduction policy before it is implemented, to decide sensibly between *in situ* or *ex situ* metrics.

7.4. Environmental impacts of fishing and burden-of-proof implications

The main environmental impacts from fishing have been identified in a Quality Status Report as the removal of commercial or other species, and habitat damage and loss (OSPAR, 2010). A similar evaluation was made for Australian fisheries *(*Pascoe *et al*., 2009), where the key environmental pressures were bycatch and habitat damage. The primary objective stated by Pascoe *et al.* (2009) was to minimize environmental impacts. The implications of reversing the burden of proof for each of the more specific impacts noted above are considered below.

7.4.1. Removal of commercial fish and shellfish

In its current form, EU fishery management focuses on the removal of commercial fish species. The declared objective is to exploit stocks at maximum sustainable yield using biomass (*B*) and fishing mortality (*F*) as the main *ex situ* indicators. The scope for results-based management and co-management lies in the way the TACs might be taken (Lassen *et al.*, 2008), as in the proposed sustainable-fishing plans to be developed by industry (EC, 2010). *In situ* indicators would involve on-board monitoring of catches and catch rates. Reversal of the burden of proof would require a monitoring and auditing scheme robust to manipulation by fishers.

7.4.2. Removal of non-commercial fish and shellfish

Essentially this pressure concerns organisms caught while fishing, but then discarded. There is little or no stock information for many of these species, and often a poor understanding of their role in the ecosystem, making the development of robust indicators very difficult. For a few species it may be possible to estimate *B* and *F*, but with the attendant problem that they are also subject to non-fishing factors such as recruitment, growth, natural mortality (including predation), and disease. Therefore, fishing would not be the only factor affecting *B* and *F*, and it would seem likely that only *in situ* indicators, i.e. rates and weights of discards by vessel, would be appropriate.

7.4.3. Habitat damage and loss

Pascoe *et al.* (2009) showed that habitat damage had a broadly similar weighting to bycatch issues across a wide range of stakeholder perceptions. The key problem for the development of objectives, indicators, and management strategy is the difficulty in quantifying the impact of fishing on seabed habitats. There have been many local, usually short-duration, studies aimed at quantifying this impact (Kaiser *et al.*, 2006). Based on these studies, it would be theoretically feasible to develop a range of habitat indicators that could be monitored to evaluate fishing impacts, e.g. on functional epibenthos groupings (de Juan *et al.*, 2009). There are several difficulties in this approach to fishery management. First, as with other *ex situ* indicators, various factors can change the indicator levels. Second, there may again be a considerable delay between the pressure and the indicator response. Most critically, however, it would almost certainly be prohibitively expensive to monitor such indicators routinely and reliably, e.g. using research vessels.

An alternative way to reverse the burden of proof for fishery-related habitat damage would be to use the spatial and temporal pattern of fishing activity as the indicator. If the main objective is to minimize habitat damage, it may not be necessary to know the exact state of these habitats. Fishing-effort data are available via VMS (Lee *et al.*, 2010; Gerritsen and Lordan, 2011), which determine when a vessel is fishing. Model-based approaches linking fishing activity to the benthos (e.g. Hiddink *et al.*, 2006) could then allow the predicted impact of the observed fishing activity on benthic biomass and production to be calculated. This could also include assessments of the sensitivity of particular habitat types to disturbance by fishing (Hiddink *et al.*, 2007). The calculations could potentially be partitioned by gear type, ranging from dredges, through beam and otter trawls, to seines and passive methods. This indicator would be relatively simple to use for management purposes, and it is immediately available. There would be considerable scope for co-management, because there would often be several possible routes to a mutually agreed objective. Given a matrix of habitat and gear types, and an objective of reducing habitat damage, a number of management options (e.g. allow only low-impact gears on sensitive habitats, reduce fishing effort) could be explored using the VMS data and models to predict what each option might achieve in terms of the objective. The burden of proof would require industry to develop fishing plans capable of delivering the objective, and VMS would allow compliance to be demonstrated at the level of an individual vessel. This approach could potentially form part of the pre-

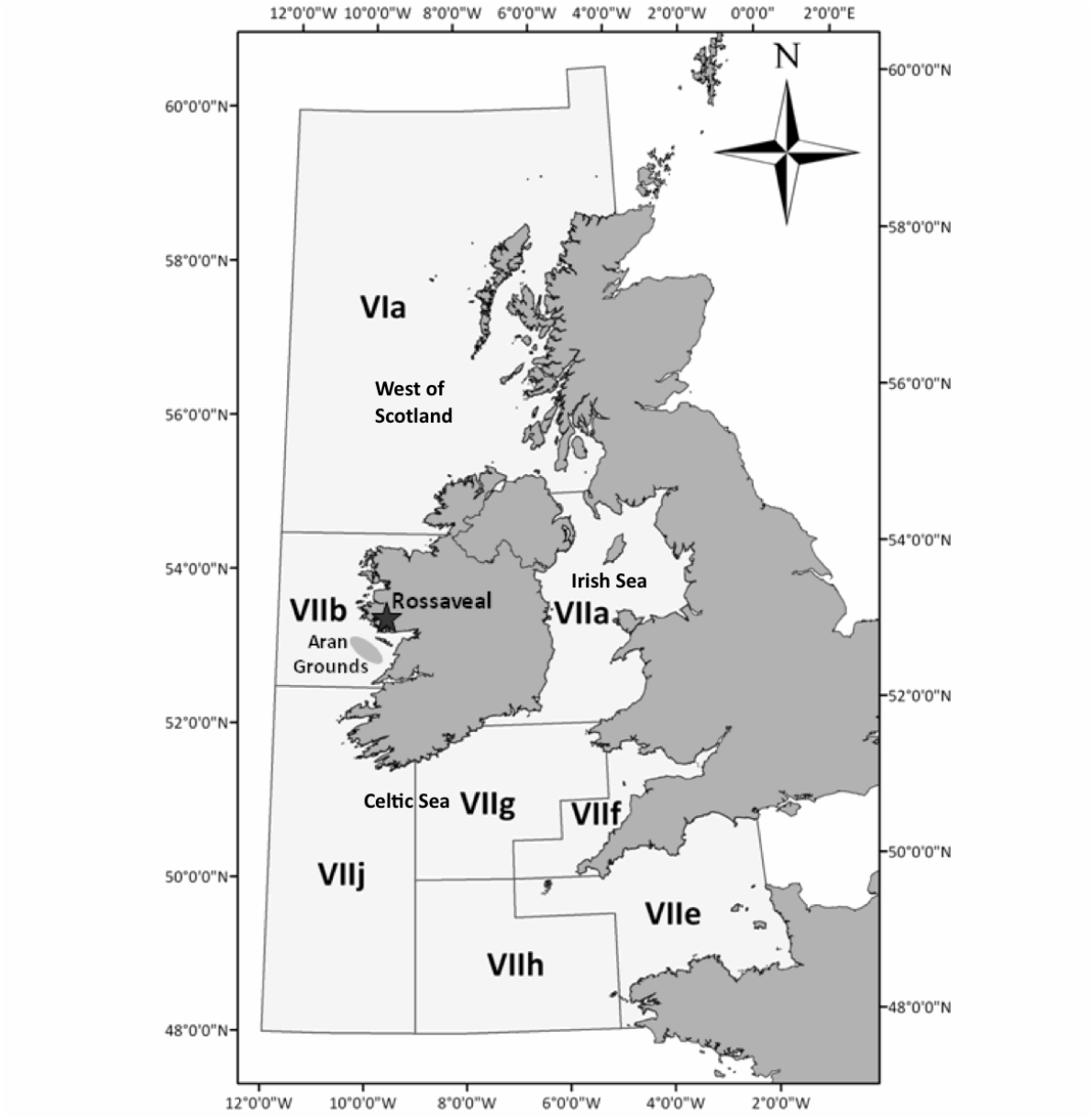
approval process for the industry's proposed sustainable fishery plans in a new CFP. The key to this approach probably lies in all parties being willing to trust the models. However, even that may not be essential, provided they were willing to agree on interpretations. For instance, it would probably be relatively easy for everyone to agree that deploying beam trawls on *Lophelia* beds is more environmentally damaging than fishing crab pots on sand.

7.5. Some Irish fisheries and the potential for reversing the burden of proof

The herring fishery in the Celtic Sea (ICES areas VIIj, VIIg, and VIIa south; Figure 7.1) is already co-managed to a certain degree through the CSHMAC, which has an industry-science partnership structure to facilitate the development of new management measures. As the incentive for discarding or slipping fish has decreased with the decline in the market for herring roe, the main bycatch concerns are accidental catches of protected species, although these are believed to be rare (ICES, 2009a; 2010a). The fishery is currently in the Marine Stewardship Council (MSC) evaluation process, and as part of this, an observer programme is being developed to monitor cetacean bycatch and fish discards. There is also a sentinel fishery that involves small vessels fishing to a limited extent within an otherwise closed spawning area, supplying scientists with valuable samples of the spawning component of the stock.

Therefore, given the strong industry participation in management and research, limited discard problems, and the nascent observer programme, the Celtic Sea herring fishery appears to be an excellent candidate for reversing the burden of proof.

Figure 7.1 Map showing ICES Divisions in Irish waters and relevant fishery areas and grounds



7.5.1. Aran Nephrops fishery

See Chapter 4, Section 4.6 for a description of this fishery.

Compared with Celtic Sea herring, there are more significant discard issues in the Aran *Nephrops* fishery. Nevertheless, the latter could be managed using a results-based approach because of its relatively simple structure, i.e. it has a single target species, is spatially confined, and the vessels are based mainly in one port. The main incentives for reversing the burden of proof in this fishery would be increased autonomy for fishers, who would have more control of their local fishery, a reduced need for top-down micromanagement, and the potential for facilitating certification from a body such as the MSC.

7.5.2. Celtic Sea whitefish

See Chapter 4, Section 4.6 for a description of this fishery.

In comparison with the Celtic Sea herring and Aran *Nephrops*, this is a much more problematic fishery. The potential for implementing results-based management would be influenced by the target species, fleet, gear, and spatial and management structure complexity. There are, however, positive examples of co-management in the fishery. The seasonal closure currently in place was the result of a transnational industry initiative, and there are active discussions between industry and scientists, facilitated through the North Western Waters Regional Advisory Council in developing a long-term management plan for whitefish in the Celtic Sea.

7.6. Conclusions

In the report from a workshop on reversing the burden of proof (Lassen *et al.*, 2008), a hierarchy of objectives was described, and the appropriateness of the approach was assessed. The workshop concluded that reversing of the burden of proof was only appropriate at lower operational levels, but that at higher levels the burden should be a governmental or societal responsibility. Building on that concept and the analysis of the issue presented here, a similar sliding scale is evident as regards the reversibility of the

burden of proof, when moving from the operational level (*in situ* or vessel) to the ecosystem level (*ex situ*). In any situation where an ecosystem impact requires assessment and monitoring, it is difficult to see how the fishing industry alone can deliver a satisfactory demonstration of sustainability. This has obvious consequences for the gradual implementation of an ecosystem approach to fishery management, and begs some questions in relation to terminology. The phrase "reversal of the burden of proof", although having a very specific meaning in legal usage, is misleading in both intent and its applicability in fishery management. It could be more helpfully and accurately substituted with "sharing the burden of proof", or the less ominous but more aspirational "shared demonstration of sustainability".

Discussions with fishers and industry representatives have revealed that at least two factors are important when determining the capacity for a reversal in particular fisheries: (i) the complexity and multispecies nature of the fishery, and (ii) the pre-existing management regime and the extent to which industry is already involved in quota management. Industry representatives felt that because the complexity and capacity for self-management varies greatly between fisheries, results-based management cannot be considered as a universal solution, so its application should be considered on a fishery-by-fishery basis. Additionally, the cost of implementing more-comprehensive observer or electronic-monitoring programmes, and the issue of who would bear that cost burden, are important concerns for the industry. The implications of the above conclusion may be that reversing the burden of proof could be introduced on an incremental and experimental basis, building on progressive fisheries that have already done this to some extent, whether voluntarily or as a result of legislative or market drivers.

The issue of geographic scale is an important consideration in reversing the burden of proof. At too large a scale, particular issues relevant to local fisheries may be missed, with the result that affected fishers may not see any incentive in assuming greater responsibility. At too small a scale, e.g. where national approaches differ markedly within a single fishery, there is more potential for conflicts between fishers and managers. However, such a situation may go some way towards answering questions about industry attitudes towards results-based management compared with the more traditional top-down scenario. Should the implementation of results-based management be at the discretion of individual EU Member States within the new CFP, at the very least an interesting natural experiment in fishery-policy analysis will have been created.

Chapter 8 Conclusion: Balancing policy drivers and stakeholder interests in developing fisheries ecosystem plans.

8.1. Introduction

This study set out to explore what is practically achievable in implementation of an Ecosystem Approach to Fisheries Management (EAFM) through the use of multiple research methods. The research was mainly focused on a particular case study, the Celtic Sea Herring fishery and its management committee, the Celtic Sea Herring Management Advisory Committee (CSHMAC).

Previous research on EAFM governance has tended to focus either on higher levels of EAFM governance or on individual behaviour. The higher level research explored fundamental issues such as what EAFM is and what principles it should embody (Mangel *et al.*, 1996; Costanza *et al.*, 1999) while what little EAFM specific research was conducted at the stakeholder level focussed on attempts to model individual actions in response to policy measures (Wilen *et al.*, 2002; Silvia Salas, 2004; Christensen, 2007). Very little research has attempted to link the two spheres or explore the relationship between them. Two main themes within this study aimed to address this gap in previous research. The first was what role governance could play in facilitating EAFM implementation. The second theme concerned the degree of convergence between high-level EAFM goals and stakeholder values.

This chapter synthesises the empirical findings from the earlier chapters, discusses the theoretical and policy implications of those findings and makes recommendations towards a governance regime which may better facilitate EAFM implementation in future.

8.2. Synthesis of Empirical Findings

The main empirical findings are chapter specific and were summarised within the respective chapters (Chapters 4,5,6 & 7). Due to the large number of research questions and in order to avoid repetition the main body of the synthesis discussion is structured along research theme rather than specific research question lines.

8.2.1. Findings under Research Theme 1: the role of governance in EAFM implementation

Theme 1 Research Questions:

1. How have past and present governance arrangements created opportunities for and barriers to EAFM implementation?

2. What can we learn from governance arrangements in fisheries such as CSH where some success in stock recovery has been made?

3. What balance between top-down and bottom-up drivers best incentivises the assumption of responsibility and EAFM implementation?

4. What further practical governance changes can be made so as to build on the opportunities for EAFM implementation?

A significant finding under Theme 1 was that there was no real policy guidance for managers or local management groups towards implementation of EAFM. This finding emerged firstly from the governance benchmarking exercise and given the emphasis on EAFM in the CFP reform dabates and the legally binding commitment to it in EU legislation it is somewhat surprising to find that there are no functional requirements for Member States or management fora to implement it. The MSFD will require fisheries related indicators of Good Environmental Status to be monitored but as yet only the requirement to fish at MSY levels has been explicitly incorporated into management plans.

As a counterpoint to this the research revealed that EU level policy, requiring the development of LTMPs, was a central factor in incentivising the move from short-term coping to long-term planning horizons in the Celtic Sea Herring fishery. The strengthening of the control regime was also acknowledged by all respondents as having played a critical role in promoting the recovery of the Herring stock.

Opaque management practices, a lack of engagement from the higher national governance levels and a lack of clarity in policies regarding access restrictions and quota entitlements, were found to have a highly negative impact on strategic decision-making by management groups and individual stakeholders.

To balance these top-down drivers the research highlighted some stakeholder led initiatives towards a more sustainable approach. The existence of an established co-management forum and the development through the CSHMAC of a mature science-industry partnership approach were shown to have facilitated the precautionary fishing patterns agreed in the Herring Recovery Plan and LTMP. The cognitive maps illustrated a wide range of potential management measures available to a local management committee which is prepared to put in the deliberative effort required to develop tailored management measures. For example a total of 13 different elements were perceived to impact on fishing pressure. The strongest of these include stronger control measures, spawning box closures, the number of vessels fishing, overcapitalisation, the impact of foreign fleets and the developemnt of a long-term outlook which in turn was found to have a broad range of influencing factors. This knowledge can help a deliberative forum to apply measures in concert with each other and with an understanding of their interactions rather than looking for a single measure to act as a panacea.

The research found evidence of a core group of CSHMAC participants, all of whom were involved in the committee since its inception and who project the dominant mental model of the fishery system. Although the pool of participants in the CSHMAC has been expanded there are very mixed views on this from within the core group due to fears that it could exacerbate conflict and thus hamper CSHMAC efficiency.

8.2.2. Findings under Research Theme 2: Exploring the gap between high level EAFM policy goals and stakeholder values

Theme 2 Research Questions:

5. What are the main principles and understandings of an EAFM?
6. How do a range of stakeholders perceive the functioning of a case study fishery system and what are their management objective priorities for it.
7. Can fisheries stakeholders develop fisheries ecosystem plans that are meaningful for them and that satisfy high level requirements?

8. To what extent is it possible for fisheries stakeholders to assume the burden-of-proof with respect to environmental impacts of fishing?

The most significant finding under Research Theme 2 is that there is significant divergence between stakeholders perceptions and values relating to the wider ecosystem and those implicit in EAFM principles. This is a significant challenge for EAFM implementation. Looking back to Glaser *et al.*'s (2006) typology of societal-nature interactions discussed in Chapter 3 (2006) the stakeholder mental model of the fishery system appears very much to be what is described as a Nature-for-Humanity model. This is an anthropocentric model which views nature as being defined solely in how it provides services for human usage. The main criticism of this model, also called "resourcism", is that in emphasising the maximisation of production it fails to recognise the limits of natural systems and that it produces a dangerously narrow definition of the value of natural resources. The research findings that stakeholders have moved towards a more precautionary, longer-term outlook has not been reflected in a change in mind-set on human-nature relations. Sustainability is narrowly defined in terms of the target stock but does not extend to the ecosystem elements upon which it depends or which depend on it.

Another significant finding, related to the low influence ascribed to environmental factors, is that the dominant perception of stakeholders in the Celtic Sea Herring fishery is of a biologically manageable system, responsive to the levers and measures employed by managers. At present management participants feel that they understand the main driver behind the last stock collapse: the roe fishery and its associated high discard levels; they can identify the main drivers behind the recovery: the spawning box closure, a restrictive control regime and a low TAC; and they see the principle current problem as the number of vessels. This understanding may be linked to the fact that the Herring stock has been increasing for the past few years. It contrasts with views often aired while the stock was declining that environmental factors were significant causes. As a direction for future research it would be interesting to compare if the attitudes to manageability were the same in the context of the fish stock going down.

A stock specific finding of the research was that spatial heterogeneity of Celtic Sea Herring was repeatedly stressed as an important but neglected aspect of management. The recent recovery of the Herring stock and the associated TAC levels have been based

on a healthy eastern component. This is important from an EAFM perspective as under a conventional fisheries management approach the stock is assessed as doing well as the meta-population SSB is at a high point.

A methodological finding was that a multiple methods approach, combining qualitative and quantitative approaches, is suitable and useful for examining and gaining understanding of complex systems such as fisheries. A number of the research findings, particularly the low priority afforded to ecosystem elements, were strengthened in their validity through being confirmed by multiple methods. However the extent to which such complex and political systems can be modelled, particularly in a predictive sense, is debatable. This does not mean that modelling such systems is not useful but it is more useful in an exploratory than predictive sense. This illustrates Elinor Ostrom's (2007) point that it is not possible to make simple predictive models of linked social-ecological systems and to deduce universal solutions or panaceas. The tendency towards unforeseen consequences highlights the necessity for multiple management strategies. Cognitive mapping has proven to be particularly well suited to the identification of a range of management measures which can influence any given system element.

Another finding, tangentially related to methodology, is that there are limits to the usefulness of rational decision-making tools, such as hierarchies of objectives, in a political arena. Deliberation mediated by political negotiation, defined here as the power relationships between people and groups, is the default decision making mode rather than restrictive rule-based processes. Methods such as AHP are useful in generating and focussing debate but the outputs may not be formally adopted.

8.2.3. Summary of research findings

In synthesising across both research themes some significant opportunities and challenges to EAFM implementation are clear.

- Strong policies have incentivised the adoption of a more long-term and precautionary approach
- This has been facilitated by the existence of a participatory management forum
- Conversely a long-term outlook is threatened by a lack of engagement from high-level management coupled with opaque decision-making processes.
- EAFM implementation is very poorly supported by EU and national operational policy.

- The most central principle of EAFM, a holistic view of ecosystem health, is neither reflected in industry stakeholders perceptions nor prioritised by them as a management objective.
- Based on the case study described in this research, bottom-up stakeholder processes can go a long way towards sustainable fisheries management in the single stock sense as the incentives are aligned with their values. However the move to an EAFM, which will, in some cases, require industry stakeholders to set fish aside for ecosystem elements they don't value highly, is a step which will require either a pronounced mind-set and value change or some strong top-down policy incentives in order to succeed.

8.3. Theoretical and Policy Implications

In presenting a case-study of a successful fish stock recovery, which nevertheless exhibits significant problems related to conflicts in values, between stakeholders on the one hand and society and science on the other, this research challenges aspects of current fisheries related social ecological systems theory. A common theme in current theory is that the most significant challenge is in overcoming perverse incentives and moving towards precautionary long-term management (Österblom *et al.*, 2011). A good example of this is Mackinson *et al*., (2011) who claim that "Embracing the move towards an ecosystem-based approach to management, perception and attitudes of researchers and stakeholders have been transformed over the last few years". Another is that stakeholder led co-management or participatory governance is a viable avenue towards EAFM implementation (Gray and Hatchard, 2008). This position is in part dependent on research which demonstrates the wealth of fishermen's ecological knowledge (Prigent *et al.*, 2008; Verweij and van Densen, 2010).

While this research does not refute those findings it does demonstrate that real transition to an EAFM is a more nuanced and phased process, where successful biological recovery through precautionary, long-term management may only be the first stage, which creates a further set of challenges. Governance and associated access and quota management arrangements may be challenged to a greater extent in a successful recovery scenario than was the case when stocks were depleted. Additionally, and critically, wider ecosystem elements may be neither prioritised highly nor understood in great detail. This finding of a lack of ecosystem consideration is significant because even

if a benchmarking exercise shows that EAFM is being implemented its stability is surely less than if attitudes towards ecosystem elements were more positive. It is unstable because as soon as one of the drivers towards EAFM, for example MSC certification, changes or weakens then the process may collapse.

So the possible incentives relevant to this second post-recovery phase need to be considered separately from those relevant to the first phase of transition to long-term thinking. The research emphasis in the second phase should be on whether perceptions and held values related to ecosystem elements and human-nature relations can change through a process of social learning. This could be tested through participatory modelling and scenario building exercises which are focussed on holistic ecosystem issues rather than single stocks. By testing stakeholder assumptions about relationships between target stocks and other elements a broader understanding of ecological complexity may develop.

The low priority given to wider ecosystem processes creates an argument for broader participation in fisheries management. This research has demonstrated that a relatively narrow set of stakeholder values can make the transition to a long-term but stock focused mindset. Further research on the conditions determining whether participation by a broader range of stakeholders is more likely to enhance social learning or exacerbate conflict should also be a focus of future EAFM governance research.

An alternative approach to ensuring that ecosystem issues are accounted for is to provide strong policy supports which are currently weak in European fisheries specific legislation. This research has shown that policy drivers have successfully incentivised industry to adopt a long-term approach. Policies requiring, for example, that harvesting rules must account for their impact on a wider range of ecosystem elements, may incentivise system-wide thinking in the same way.

A feature of the SES perspective is that complex systems are difficult to manage, with non-linear processes and unpredictable outcomes (Bavington, 2010). This research demonstrates that stakeholders may not share that view and are confident that prudent management can maintain a healthy resource. Future research could explore whether attitudes towards the ability of management to manipulate stock levels fluctuates in tandem with stock trends.

The theory that well specified objectives will reduce conflict is challenged to an extent by the finding that political processes and negotiations are ultimately more significant. This prompts a re-evaluation of the extent to which rational multi-criteria decision making methods, such as AHP, may influence real world scenarios. They may be more useful in framing issues and opening up debate. Used in combination with methods such as social network analysis, which are better suited to analysis of power relationships, they may be more revealing of the dynamics of group decision-making.
Additionally future research could focus on what conditions may facilitate the transition from opaque political processes of decision-making to more transparent rule-based modes.

The potential impact of the research outputs in such situations also requires attention. In this case stakeholders may have concerns that results showing that ecosystem elements are not prioritised by the management forum may affect the credibility of an environmental plan, due to be drafted as part of the MSC certification process.

8.4. Recommendations towards the development of a Fisheries Ecosystem Plan for Celtic Sea Herring

The recommended actions given in this section are based on the theoretical and policy implications outlined above, and are intended to contribute towards the implementation of EAFM and the development of a pragmatic Fisheries Ecosystem Plan (FEP). These recommendations are tailored towards the case study fishery and while they may have some general application to other fisheries it is worth bearing in mind Nobel laureate Elinor Ostrom's (2007) warning that poorly designed policy prescriptions in complex systems can cause more harm than good. Additionally the emphasis is on building on existing strengths rather than emulating abstract models of best fisheries governance which should limit the scope for inappropriate prescriptions.

Table 8.1 Authors Recommendations arising from this research towards a Celtic Sea Herring Fishery Ecosystem Plan

Bottom-up capacity building opportunities
Build on stakeholders stock focused priorities and expand spawning box closures westwards to attempt a recovery of all stock components.
Build on positive industry-science partnership to instigate research program on spawning ground locations, stock micro-structure and adaptive management possibilities for network of closed areas.
Invite experts to present on ecosystem role of Herring and develop participatory modelling initiatives to explore this role.
Conduct an integrated valuation of the Herring stock in terms of the wider ecosystem services it provides. This valuation could include indirect use value, options value, bequest value and existence value (Khan and Neis, 2010).
There is some limited scope to broaden the stakeholder base of the CSHMAC in order to accomodate a wider range of perspectives. However a pragmatic approach should be taken to the inclusion of new participants as excessive conflict could destabilise the decision-making forum.
Top-down incentives
Greater engagement, improved communication and more timely responses from higher governance levels, *i.e.* Departmental officials and the Fisheries Minister, are required in order for co-management to function effectively.
Clear policies on fleet structure, access arrangements and quota management are required to de-escalate current levels of competitive and strategic fishing behaviour.
Incentivise ecosystem thinking through the mandatory inclusion of environmental elements in LTMPs. This could take the form of accounting for how MSFD indicators would be affected by agreed harvest strategies.

8.5. Conclusion

The fisheries biologist Ray Hilborn (2010) has described a pragmatic fisheries management goal, Pretty Good Yield, as an alternative to the contentious target of Maximum Sustainable Yield. In terms of fisheries governance a similar approach, aiming at Pretty Good Governance, has much to recommend it. Aspiring to idealised models of fisheries governance, where power is shared equally between all stakeholders and incentives and goals are perfectly aligned, is a laudable objective. But it fails to take account of the complex ecological, social and institutional driving forces that got us to where we currently are. Fisheries sociologist Svein Jentoft (2006) asks the question "If democracy can never be complete, when does it work well enough to produce decisions that are both effective and legitimate in fisheries management?". Answering questions like these are the first step on the way towards achieving Pretty Good Governance.

The case study presented here demonstrates that a lot can change in 10 years and although it may not match anyones mental model of ideal fisheries governance perhaps we should be measuring things at least as much by their accomplishments as by their shortcomings. The alternative is a series of well intentioned but context free prescriptions which are likely to perpetuate the pattern of unintended consequences so often observed in fisheries.

The next step on the way towards Pretty Good Governance in fisheries may lie in addressing the gap between EAFM principles and the attitudes of industry participants in management. A policy based solution is unlikely to cultivate internalisation of these values so should be balanced with attempts at achieving that goal through social learning. Finding out where this balancing point in bridging the policy-stakeholder gap lies will be a significant challenge for future fisheries governance research.

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Appendix 1: Details of cognitive maps

(expressed as adjacency matrices)

NGO cognitive map.

	SSB	Predators	Bycatch	Catches	Habitats Directive	Processors	Length of season	CSHMAC	Social learning	MSC/certification	Access to market	Weekly allocation	No. Vessels	Industry-Science partnership	Inclusiveness	Observers	Discards	LTMP			
SSB		1																			
Predators	-0.5																				
Bycatch		-0.5																			
Catches	-1																				
Habitats Directive		1		-0.5																	
Processors																					
Length of season						0.5															
CSHMAC									1									0.5			
Social learning													1	0.5							
MSC/certification											0.5				0.5						
Access to market						0.5															
Weekly allocation							-0.5														
No. Vessels							-0.5														
Industry-Science partnership																					
Inclusiveness																					
Observers			-0.5													-0.5					
Discards																					
LTMP	0.5																				

Sentinel Fisherman 1

	SSB	Spatio-Temporal mobility	F	TAC	Catchability	Effective management	Dunmore Box	Other open access fisheries	Sentinel Fishery	Polyvalent RSW vessels	Price	Processors	CSHMAC	MSC/certification	Fisheries Department	Fisheries Minister	Commitment rules	Distribution of benefits	Scientific certainty	No. Vessels	Industry input	Planned decision-making	Vessel returns	Clear Policy	Control regime	Responsibility	Other pelagic fisheries	Local employment and economy	Industry-Science partnership	Technological devt/quality	Foreign fleets	Whales	Ecological issues	Effort
SSB				1.00																											1.00			
Spatio-Temporal mobility																		-0.50																
F	-1.00																																	
TAC			1.00																														1.00	
Catchability								0.50																										
Effective management																																		
Dunmore Box			-1.00																															
Other open access fisheries																-0.50																		
Sentinel Fishery												0.50						0.50									1.00							
Polyvalent RSW vessels												1.00																						
Price								0.50											1.00															
Processors																																		
CSHMAC					0.50												-0.50																	
MSC/certification								-0.50	0.50																										
Fisheries Department					-0.25																		-0.25											
Fisheries Minister					-0.25																		-0.25											
Commitment rules											1.00								-0.50															
Distribution of benefits																																		
Scientific certainty																																		
No. Vessels					-0.50									-0.25	-0.25	-0.50					-1.00				-0.50									
Industry input					0.50																													
Planned decision-making																												1.00						
Vessel returns																										0.50								
Clear Policy																1.00																		
Control regime								-0.50																					0.50					
Responsibility																																		
Other pelagic fisheries																																		
Local employment and economy																																		
Industry-Science partnership																		0.50																
Technological devt/quality																						0.50				0.50								
Foreign fleets			0.50																															
Whales	-0.50																																	
Ecological issues								-0.50																										
Effort	-1.00																																	

Sentinel Fisherman 2

	SSB	Roe fishery	Discards	F	Landings	TAC	Decommissioning	Effective management	Dunmore Box	Other options	Sentinel Fishery	Pelagic RSW vessels	Polyvalent RSW vessels	Price	Processors	CSHMAC	Responsibility	Fisheries Minister	Commitment rules	Distribution of benefits	Scientific certainty	No. vessels	Industry input	Planned decision-making	Vessel returns	Clear Policy	Control regime	Overcapitalisation	Local employment and economy	Political clientelism	State resource
SSB																															
Roe fishery			1.00																												
Discards				1.00																											
F	-1.00																														
Landings														-0.50																	
TAC																						0.50									
Decommissioning																						-0.50									
Effective management																															
Dunmore Box				-1.00																											
Other options										-0.50																					
Sentinel Fishery																												1.00			
Pelagic RSW vessels															0.25																
Polyvalent RSW vessels															0.25																
Price																						0.50									
Processors															0.50																
CSHMAC																			-0.50	-0.50											
Responsibility				-0.50																											
Fisheries Minister																			-0.50						-1.00						
Commitment rules																					-0.50										
Distribution of benefits																														1.00	
Scientific certainty								1.00																							
No. vessels																								-1.00							
Industry input																															
Planned decision-making																															
Vessel returns																															
Clear Policy																					-1.00		1.00	1.00						1.00	
Control regime				-1.00						-0.50																					
Overcapitalisation				0.50						-0.50	0.25	0.25				-0.50															
Local employment and economy																															
Political clientelism								-0.50																							
State resource																															

RSW Fisherman 1

	SSB	Sub-stocks status	Spatio-Temporal concentration	Fisheries Department	CSHMAC	Clear Policy	Planned decision-making	Weekly allocation	Dunmore Box	No. Vessels	Foreign Fleets	MSC/certification	Effort	Discards	Roe fishery	Scientific certainty	Conflict	Control regime	Industry-Science partnership	Polyvalent vessels	Processors	Vessel returns	F	Annual TAC fluctuation	Whiting	Local employment and economy	NGO's	Price	Effective Management
SSB										1	1															0.5				
Sub-stocks status	0.5																												
Spatio-Temporal concentration		-0.5																											
Fisheries Department																	1												
CSHMAC	0.5						1		1							1													
Clear Policy										-1																			
Planned decision-making																					1								
Weekly allocation																													
Dunmore Box	1		0.5																			-0.5							
No. Vessels							-1	-1						0.5							-1								
Foreign Fleets	-0.5																-1												
MSC/certification																				0.5						0.5	0.5		
Effort	-0.5																												
Discards	-0.5																												
Roe fishery														1															
Scientific certainty					1		1																-1					1	
Conflict							-0.5																						
Control regime	0.5																												
Industry-Science partnership																1													
Polyvalent vessels					0.5																					0.5			
Processors					1																								
Vessel returns																													
F	-1																												
Annual TAC fluctuation																													
Whiting	-0.5																												
Local employment and economy																													
NGO's																			0.5										
Price																													
Effective Management																													

RSW Fisherman 2

	SSB	Roe fishery	Discards	Demersal fisheries	Gadoids	F	Effective management	CSHMAC	Processors	Control regime	Sub-stocks status	Technological devt/quality	Dry-hold/traditional vessels	Price	Vessel returns	MSC/certification	Length of season	Polyvalent RSW vessels	Scientific certainty	Expand survey to Smalls	Other processing options	Dunmore Box	Representativeness	No. vessels	Weekly allocation
SSB					1																				
Roe fishery			1																						
Discards	-1																								
Demersal fisheries			0.5			-0.5																			
Gadoids	-0.5																								
F	-1																								
Effective management	1																								
CSHMAC							1														1	0.5			
Processors								1																	
Control regime						-0.5																			
Sub-stocks status	0.5																								
Technological devt/quality													-0.5	0.5		0.5									
Dry-hold/traditional vessels								0.5																	
Price												0.5			0.5										
Vessel returns																									
MSC/certification														0.5											
Length of season				-0.5					1								1								
Polyvalent RSW vessels								1																	
Scientific certainty																									
Expand survey to Smalls																		0.5							
Other processing options														0.5											
Dunmore Box						-1																			
Representativeness																									
No. vessels																									
Weekly allocation																-1									

Dry-Hold Fisherman 1

	SSB	Spatio-Temporal mobility	Sub-stocks status	Spawning Bed Health	Fisheries Department	Fisheries Minister	CSHMAC	Clear Policy	Planned decision-making	Weekly regime	Weekly allocation	Dunmore Box	No. vessels	Industry input	Pelagic RSW vessels	Foreign fleets	Price	Effort	Spatio-Temporal concentration	Discards	Mixed fishmeal rules	Roe fishery	Scientific certainty	Conflict	Control regime	Landings outside CS	Industry-Science partnership	Local employment and economy	Length of season	Polyvalent vessels	Processors	Sustainability	F	Whales	Aggregates/aquaculture	Pot fisheries	Whiting	Distribution of benefits	Deliberation/Subsidiarity
SSB																		-0.5															1			1			
Spatio-Temporal mobility																						-0.5																	
Sub-stocks status																																							
Spawning Bed Health																																							
Fisheries Department								-0.5																															-0.5
Fisheries Minister							-0.5																																
CSHMAC	1							1																		1		1		1							0.5	1
Clear Policy								1															-0.5							1									
Planned decision-making																															0.5								
Weekly regime														-0.5															1	1									
Weekly allocation																																							
Dunmore Box	1											-0.5						0.5																					
No. vessels								-0.5			-1																												
Industry input																																							
Pelagic RSW vessels																	1		0.5								-0.5	-0.5	-0.5									
Foreign fleets			-1																1					-0.5														
Price																																							
Effort																																							
Spatio-Temporal concentration			-0.5																																				
Discards																																1							
Mixed fishmeal rules												0.5												-0.5								0.5							
Roe fishery																		0.5	0.5																				
Scientific certainty																																							
Conflict																																							
Control regime	1															1																							
Landings outside CS																										-0.5			-1										
Industry-Science partnership																						1																	
Local employment and economy																																							
Length of season																													1									
Polyvalent vessels																																							
Processors							1																																
Sustainability																					-1												-0.5					
F																																							
Whales																																							
Aggregates/aquaculture				-1																																			
Pot fisheries											0.5																												
Whiting																																							
Distribution of benefits															-0.5																								
Deliberation/Subsidiarity																																							

Dry-Hold Fisherman 2

	SSB	Overcapitalisation	Effort	Sub-stocks status	Offshore fishery	Early opening of seas	Polyvalent RSW vesse	Dry-hold/traditional v	Dunmore Box	Adaptive managemen	Sentinel Fishery	Spatio-Temporal con	Local employment an	Scientific certainty	Industry-Science part	Length of season	Roe fishery	Discards	competitive fishing	Control regime	Level pitch/equity	Navy boardings	Demersal fisheries	Other pelagic fisheries	Planned decision-mak	Clear Policy	No. Vessels	Strategic Booking in	Processors	Fisheries Department	CSHMAC	Distribution of benefits	Deliberation/Subsidia	Vessel returns	Domestic influence (n	Inclusiveness	Price	Weekly allocation
SSB																						0.5															
Overcapitalisation			1																											-0.5							
Effort	-1																																				
Sub-stocks status	0.5																																				
Offshore fishery				-1																																	
Early opening of season				-0.5				-1																													
Polyvalent RSW vessels					1	1																						1								
Dry-hold/traditional vessels																																					
Dunmore Box	0.5										0.5	-0.5																									
Adaptive management																																					
Sentinel Fishery											-0.5																										
Spatio-Temporal concentration	-0.5			-0.5																																	
Local employment and economy																																					
Scientific certainty																																					
Industry-Science partnership													0.5																								
Length of season													0.5									0.5															
Roe fishery																	1																				
Discards	-0.5																																				
competitive fishing																	0.5																				
Control regime	0.5	-0.5															-0.5																				
Level pitch/equity																																					
Navy boardings																			0.5																		
Demersal fisheries																																					
Other pelagic						0.5		-0.5				0.5																										
Planned decision-making																																					
Clear Policy		-0.5																						1		-0.5	-0.5										
No. Vessels																																					
Strategic Booking in																																					
Processors							1	-0.5																														
Fisheries Department																																					
CSHMAC																														-1	1						
Distribution of benefits																																					
Deliberation/Subsidiarity																																					
Vessel returns																																					
Domestic influence (neg)		-0.5																																			
Inclusiveness																														0.5							
Price																																0.5				-0.5	
Weekly allocation																																					

Dry-Hold Fisherman 3

	SSB	Sub-stocks status	Whales	Dogfish	Gadoids	F	Age Maturity	Scientific certainty	Offshore fishery	Effective management	Roe fishery	Discards	Weekly allocation	Overcapitalisation	Control regime	CSHMAC	Deliberation/Subsidiarity	Processors	Length of season	Balancing diverse interests	TR cap proposal	Strategic Booking In	No. Vessels	Young fishermen	Adaptability/Polyvalency	State resource	Distribution of benefits	Price	Vessel returns	Dunmore Box	Decommissioning	Dynamic Fisheries	Inclusiveness	Consensus	Responsibility	Culture of compliance	Level pitch/equity	Industry input	Industry-Science partnership
SSB			0.5	0.5	0.5																																	
Sub-stocks status	0.5																																					
Whales																																					
Dogfish	-0.5																																				
Gadoids	-0.5																																				
F	-1						-0.5																														
Age Maturity																																					
Scientific certainty									0.5	0.5																								0.5				
Offshore fishery																																					
Effective management	1	0.5																																			
Roe fishery												1																									
Discards	-0.5																																				
Weekly allocation						0.5							0.5																									
Overcapitalisation						1						0.5	0.5									-0.5																
Control regime						-0.5																																
CSHMAC																1			1													0.5	-0.5					
Deliberation/Subsidiarity										0.5																												
Processors															1			1																				
Length of season																																					
Balancing diverse interests																																					
TR cap proposal																					0.5	0.5															
Strategic Booking In																																					
No. Vessels																								0.5				-1									
Young fishermen																																					
Adaptability/Polyvalency																																					
State resource																										1											
Distribution of benefits																																					
Price																						0.5															
Vessel returns																																					
Dunmore Box	0.5																					-0.5															
Decommissioning						-0.5																															
Dynamic Fisheries																								1													
Inclusiveness																			0.5																		
Consensus																																					
Responsibility																																					
Culture of compliance																																		0.5			
Level pitch/equity																																			1		
Industry input																																		0.5			
Industry-Science partnership																																		0.5			

Retired Fisherman

	SSB	Spawning Bed Health	Sub-stocks status	Spatio-Temporal mobility	Aggregates/aquaculture	Fresh Water runoff	Low Water Temp	Recruitment	Effective management	Dunmore Box	Discards	Roe fishery	Scientific certainty	Industry-Science partnership	Length of season	Foreign fleets	Price	CSHMAC	No. vessels	F	Overcapitalisation	Dry-hold/traditional vessels	Control regime	Subsidies	Banks
SSB																									
Spawning Bed Health	0.5																								
Sub-stocks status	0.5																								
Spatio-Temporal mobility												-0.5													
Aggregates/aquaculture		-0.5	-0.5																						
Fresh Water runoff			0.5				-0.5																		
Low Water Temp			-0.5					-0.5																	
Recruitment	1																								
Effective management	1																								
Dunmore Box	1											0.5													
Discards																				0.5					
Roe fishery											1														
Scientific certainty									0.5																
Industry-Science partnership												1													
Length of season												0.5								1					
Foreign fleets																				1					
Price																0.5			0.5						
CSHMAC									0.5	0.5			0.5												
No. vessels																									
F	-1		-0.5																						
Overcapitalisation																				0.5		-0.5			
Dry-hold/traditional vessels																									
Control regime																				-0.5					
Subsidies																					0.5				
Banks																					0.5				

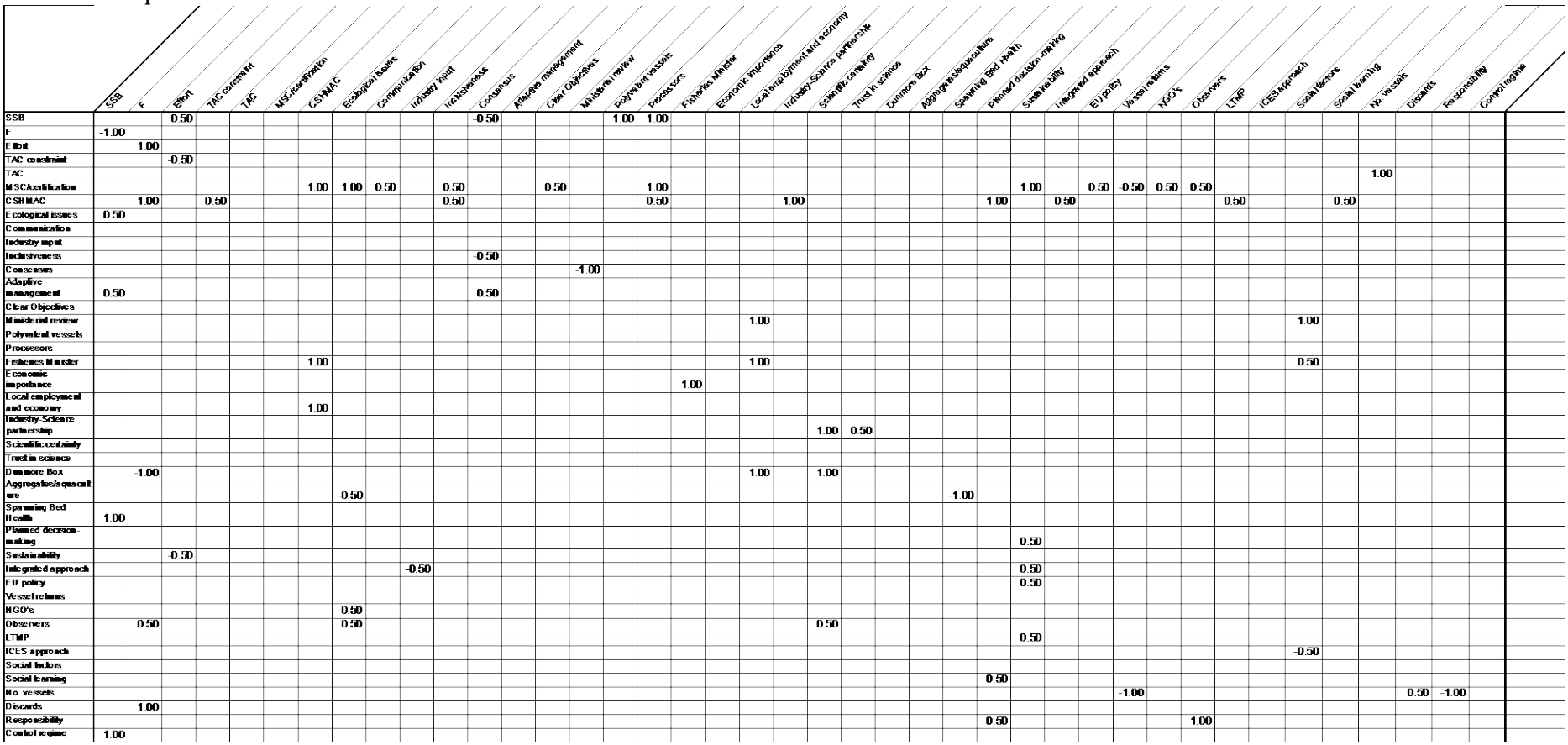
Processor 1

	SSB	Sub-stocks status	Effective management	Dunmore Box	Demersal fisheries	Sentinel Fishery	Polyvalent RSW vessels	Dry-hold/tradition	Processors	Scientists	CSHMAC	MSC/certification	Fisheries Department	Weekly regime	Young fishermen	Scientific certainty	No. vessels	Industry input	Planned decision-making	Vessel returns	Clear Policy	Control regime	Whiting	Stewardship	Climate change	Spatio-Temporal	Local employment	Participation incentives	Deliberation/Subsidiarity	Industry-Science	Other processing options
SSB									1.00																						
Sub-stocks status	0.50																														
Effective management	1.00																														
Dunmore Box	0.50	-0.50																													
Demersal fisheries																															
Sentinel Fishery									0.50																						
Polyvalent RSW vessels									0.50																						
Dry-hold/traditional vessels									0.50																						
Pelagic RSW vessels																															
Processors					0.50	0.50	0.50																		1.00						
Scientists										0.50																					
CSHMAC			1.00						0.50				1.00					0.50	0.50				0.50				1.00		1.00		
MSC/certification																															
Fisheries Department			-0.50							1.00											-1.00										
Weekly regime																								-1.00							
Young fishermen																															
Scientific certainty																															
No. vessels	-1.00									-1.00									-1.00												
Industry input	1.00																														
Planned decision-making																						0.50									
Vessel returns																															
Clear Policy																-1.00															
Control regime	1.00										-0.50																				
Whiting	-0.50																														
Stewardship	0.50																														
Climate change	-0.50																														
Spatio-Temporal concentration		-0.50																													
Local employment and economy																															
Participation incentives																															
Deliberation/Subsidiarity																															
Industry-Science partnership															1.00																
Other processing options									-1.00																						

Processor 2

	SSB	Sub-stocks status	Spawning Bed Health	Communication	Fisheries Department	Fisheries Minister	Clear Policy	CSHMAC	Planned decision-making	Weekly regime	Weekly allocation	Strategic Booking In	Dunmore Box	No. vessels	Pelagic RSW vessels	Foreign Fleets	MSC/certification	Viability	Price	Effort	Spatio-Temporal concentration	Discards	Mixed fishmeal rules	Roe fishery	Scientific certainty	Conflict	Control regime	Safety/practicality	Landings outside CS	Industry-Science partnership	Local employment and economy	Length of season	Overfishing	Processors	Level pitch/equity	Vessel returns	Access to market	Stewardship	Demand	F	Annual TAC fluctuation		
SSB																																										
Sub-stocks status	1.00																																									
Spawning Bed Health	1.00	1.00																																								
Communication																																									
Fisheries Department				-0.50			-1.00	-0.50	-1.00																																	
Fisheries Minister							-0.50																																			
Clear Policy																																									
CSHMAC									1.00			1.00																	1.00													
Planned decision-making																														0.50						0.50						
Weekly regime																					-1.00																					
Weekly allocation																																			1.00							
Strategic Booking In									-0.50																																	
Dunmore Box	1.00																				0.50																					
No. vessels									-1.00		-1.00		-0.50							0.50		1.00									-1.00											
Pelagic RSW vessels		-0.50																				1.00											-0.50									
Foreign Fleets		-1.00													-0.50							1.00												-1.00								
MSC/certification																																			-0.50	0.50						
Viability																																					0.50					
Price																																			1.00			-0.50				
Effort	-1.00																																									
Spatio-Temporal concentration		-0.50																																								
Discards															-0.50																											
Mixed fishmeal rules																																						0.50			
Roe fishery																						1.00										1.00									
Scientific certainty																																								-0.50		
Conflict																																				-0.50					
Control regime																																						-1.00			
Safety/practicality																						-0.50																				
Landings outside CS																														-0.50			-1.00	-0.50							
Industry-Science partnership																							1.00																			
Local employment and economy																																									
Length of season																																									
Overfishing																																									
Processors																																									
Level pitch/equity																																									
Vessel returns																																									
Access to market																																									
Stewardship																																									
Demand																																									
F	-1.00																																								
Annual TAC fluctuation																																									

Fisheries Rep 1



	SSB	F	Effort	TAC constraint	TAC	MSC/certification	CSHMAC	Ecological issues	Communication	Industry input	Inclusiveness	Consensus	Adaptive management	Clear Objectives	Ministerial review	Polyvalent vessels	Processors	Fisheries Minister	Economic importance	Local employment and economy	Industry-Science partnership	Scientific continuity	Trust in science	Dunmore Box	Aggregates/aquaculture	Spawning Bed Health	Planned decision-making	Sustainability	Integrated approach	EU policy	Vessel returns	NGO's	Observers	LTMP	ICES approach	Social factors	Social learning	No. vessels	Discards	Responsibility	Control regime
SSB			0.50									-0.50				1.00	1.00																							
F	-1.00																																							
Effort		1.00																																					
TAC constraint			-0.50																																				
TAC																																				1.00			
MSC/certification							1.00	1.00	0.50		0.50			0.50			1.00										1.00		0.50	-0.50	0.50	0.50								
CSHMAC		-1.00		0.50							0.50						0.50			1.00						1.00		0.50					0.50		0.50					
Ecological issues	0.50																																						
Communication																																							
Industry input																																							
Inclusiveness												-0.50																											
Consensus														-1.00																										
Adaptive management	0.50											0.50																											
Clear Objectives																																							
Ministerial review																			1.00															1.00					
Polyvalent vessels																																							
Processors																																							
Fisheries Minister							1.00												1.00															0.50						
Economic importance																	1.00																							
Local employment and economy							1.00																																	
Industry-Science partnership																					1.00	0.50																		
Scientific continuity																																							
Trust in science																																							
Dunmore Box		-1.00																	1.00		1.00																			
Aggregates/aquaculture								-0.50																	-1.00															
Spawning Bed Health	1.00																																						
Planned decision-making																											0.50												
Sustainability			-0.50																																				
Integrated approach										-0.50																	0.50													
EU policy																											0.50												
Vessel returns																																							
NGO's								0.50																															
Observers		0.50						0.50													0.50																			
LTMP																											0.50												
ICES approach																																		-0.50					
Social factors																										0.50													
Social learning																													-1.00							0.50	-1.00		
No. vessels																																1.00							
Discards		1.00																																					
Responsibility																										0.50					1.00								
Control regime	1.00																																						

Fisheries Rep 2

	SSB	Control regime	Roe fishery	Discards	Weekly allocation	CSHMAC	Processors	Length of season	Vessel returns	Price	No. Vessels	TR cap proposal	F	Dunmore Box	MSC/certification	Access to market	Ministerial review	Pelagic RSW vessels	Fisheries Department	
SSB														1						
Control regime	1			-0.5																
Roe fishery				0.5																
Discards													1							
Weekly allocation				-0.5				-1	1											
CSHMAC					-0.5															
Processors						1														
Length of season							1													
Vessel returns																				
Price									1											
No. Vessels					-1															
TR cap proposal											1									
F	-1																			
Dunmore Box													-1							
MSC/certification															1					
Access to market							1													
Ministerial review						-0.5														
Pelagic RSW vessels																				
Fisheries Department																				

Scientist 1

	SSB	F	Recruitment	Sub-stocks status	Environmental conditions	Aggregates/aquaculture	Spawning Bed Health	Catches	CSHMAC	Weekly allocation	No. vessels	Foreign Fleets	Dunmore Box	Discards	Roe fishery	Scientific certainty	Control regime	Industry-Science partnership	Local employment and economy	Sentinel Fishery	Other small pelagics	Climate change	Gadoid/Shark Predation	Whale/seabird predation	Prey availability	Growth rate	EC Policy statements	LTMP	Stewardship	Active capacity moratorium	Adaptive management
SSB			0.50																											
F	-0.50																													
Recruitment																														
Sub-stocks status							1.00																							
Environmental conditions			0.50																											
Aggregates/aquaculture							-0.50																							
Spawning Bed Health			0.50																											
Catches		1.00																												
CSHMAC																	1.00													
Weekly allocation										0.50			-0.50																	
No. vessels								0.50		-1.00																				
Foreign Fleets				-0.50																										
Dunmore Box		-1.00		-0.50																										
Discards		0.50														-0.50														
Roe fishery													1.00																	
Scientific certainty																														
Control regime							-0.50									0.50														
Industry-Science partnership																											0.50			
Local employment and economy																														
Sentinel Fishery																0.50			0.50											
Other small pelagics																							-0.50							
Climate change																							-0.50							
Gadoid/Shark Predation			-0.50																											
Whale/seabird predation	-0.50																													
Prey availability																								0.50						
Growth rate	0.50																													
EC Policy statements																										1.00				
LTMP																	1.00										0.50			
Stewardship		-0.50																												
Active capacity moratorium										-0.50																				
Adaptive management				0.50								0.50																		

Scientist 2

	SSB	Discards	Polyvalent vessels	Landings	CSH acoustic survey	Landings data	Discard trips	Scientists	Scientific certainty	ICES HAWG	Effective management	CSHMAC	Fisheries Department	Fisheries Minister	Control regime	Dunmore Box	
SSB																	
Discards	-0.50							-0.50									
Polyvalent vessels		0.50		0.50	1.00	1.00	1.00										
Landings	-1.00																
CSH acoustic survey								0.50	1.00								
Landings data												0.50					
Discard trips								1.00									
Scientists									0.50			0.50					
Scientific certainty												1.00					
ICES HAWG											0.50						
Effective management	1.00																
CSHMAC											0.50				1.00		
Fisheries Department								0.50				0.50		0.50			
Fisheries Minister													0.50				
Control regime																	
Dunmore Box	1.00										0.50						

Certification Manager

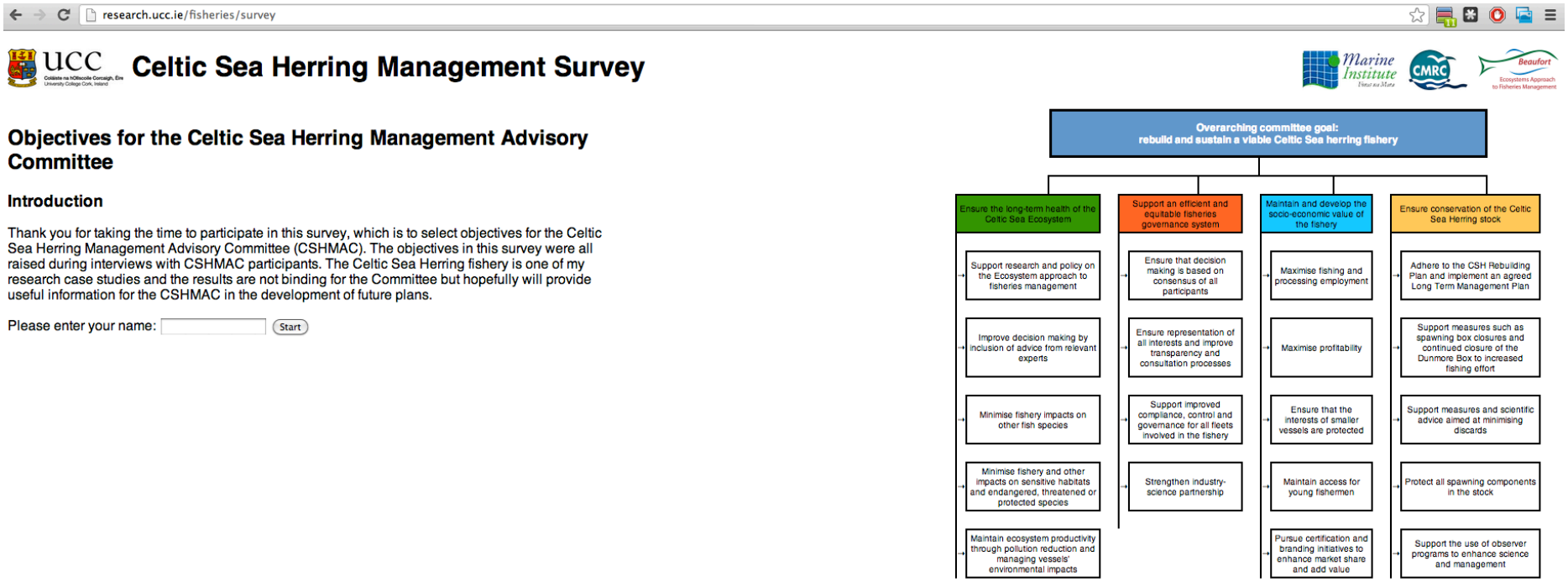
	SSB	F	Roe fishery	Sentinel Fishery	Polyvalent RSW vessels	Dry hold/traditional vessels	Pelagic RSW vessels	Processors	NGO's	Civil Society	Scientists	CSHMAC	Fisheries Minister	Scientific certainty	No. vessels	Weekly regime	Subsidies	Overcapitalisation	MSC/certification	Vessel returns	Control regime	Ecological issues	Responsibility	Conflict	Demand	Transparency	Effective management	
SSB																								1.00			-0.50	
F	-1.00																											
Roe fishery																							-1.00					
Sentinel Fishery												0.50																
Polyvalent RSW vessels												0.50				-0.50												
Dry hold/traditional vessels																												
Pelagic RSW vessels																												
Processors												1.00																
NGO's																					0.50	0.50						
Civil Society																			1.00									
Scientists												0.50																
CSHMAC	1.00															1.00							1.00	-0.50				
Fisheries Minister				0.50																								
Scientific certainty												1.00																
No. vessels	-0.50																											
Weekly regime	1.00				-0.50	0.50	-1.00																					
Subsidies																		0.50										
Overcapitalisation	-1.00																						-0.50					
MSC/certification								1.00												1.00		0.50	1.00		0.50			
Vessel returns																												
Control regime		-1.00																					0.50					
Ecological issues																												
Responsibility	1.00																											
Conflict																												
Demand																							0.50					
Transparency																										-0.50		
Effective management																												

Sea Fisheries Officer

	SSB	Sub-stocks status	Fisheries Department	Fisheries Minister	CSHMAC	Planned decision-making	Weekly allocation	No. Vessels	Pelagic RSW vessels	Foreign Fleets	Price	Discards	Roe fishery	Scientific certainty	Control regime	Safety/practicality	Landings outside CS	Industry-Science partnership	Local employment and economy	Vessel returns	Processors	Sentinel Fishery	Technological devt/quality	Polyvalent vessels	Other small pelagics	Climate change	CFP	Young fishermen	Effective management	Deliberation/Subsidiarity	Other pelagic fisheries	Commitment rules		
SSB																																		
Sub-stocks status																																		
Fisheries Department																														-1				
Fisheries Minister																																		
CSHMAC	1		1	0.5													1				0.5									1		1		
Planned decision-making																					1		0.5											
Weekly allocation											-1																							
No. Vessels							-1																											
Pelagic RSW vessels				0.5												0.5												-0.5						
Foreign Fleets		-0.5												-1				-0.5																
Price								1											0.5															
Discards	-1																																	
Roe fishery												1																						
Scientific certainty					1	1																												
Control regime	0.5										0.5																							
Safety/practicality																																		
Landings outside CS																		-0.5															-0.5	
Industry Science partnership													1																					
Local employment and economy																																		
Vessel returns																																		
Processors					1																													
Sentinel Fishery					0.5	0.5																						0.5						
Technological devt/quality												-1									0.5													
Polyvalent vessels					0.5																							-0.5						
Other small pelagics																					1													
Climate change																								0.5										
CFP															-0.5	0.5																		
Young fishermen																																		
Effective management																																		
Deliberation/Subsidiarity																													1					
Other pelagic fisheries									0.5																									
Commitment rules									-0.5		-0.5																							

Appendix 2: Screens from online AHP survey.

Screen 1: Introduction



Screen 2: Explanation of how survey works

research.ucc.ie/fisheries/survey?sid=0b3c33ba-4a3d-11e2-8b26-b5745c97639a

UCC

Celtic Sea Herring Management Survey

Objectives for the Celtic Sea Herring Management Advisory Committee

How the survey works

The method involves a series of comparisons of the importance of one objective to another. It starts with general objectives (socio-economic, biological, ecosystem and governance) and then more specific ones. A total of 42 preferences have to be made which may be slow initially but will be faster once you have become used to the process. The objectives are shown in Figure 1 which you should consider before making your comparisons.

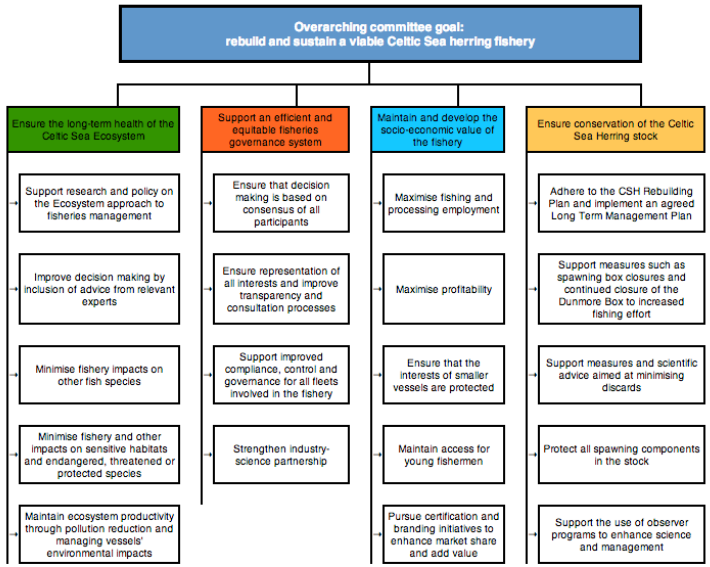
An example is given below of how the preference assessements are made.

- Each row requires you to compare the importance of two different objectives.
- If you think that the two objectives have equal importance, then click on the number 1.
- If you think that the objective on the left is more important, then click on the number on the left of the scale to indicate the strength of your preference.
- Higher numbers reflect greater preferences i.e. 2 = moderate preference, 3 = strong preference, 4 = very strong preference, 5 = extreme preference.
- In most cases both objectives will be important and you may find it difficult to express a preference, but it is important to remember that when choosing one objective as more important you are not saying that the other objective is unimportant, but just that it is not as critical in contributing to the higher objective.
- In the example below the respondent has indicated that the objective "to maximise employment" is strongly more important (choice 3) than the objective "to add value through certification and branding" in contributing to the objective ("Maintain and develop the socio-economic value of the fishery").

	5	4	3	2	1	2	3	4	5	
Maximise fishing and processing employment	○	○	◉	○	○	○	○	○	○	Pursue certification and branding initiatives to enhance market share and add value

1 = no preference, 2 = moderate preference, 3 = strong preference, 4 = very strong preference, 5 = extreme preference

Click button to start: Start



Screen 3: High Level Objective preferences

research.ucc.ie/fisheries/survey?sid=0b3c33ba-4a3d-11e2-8b26-b5745c97639a

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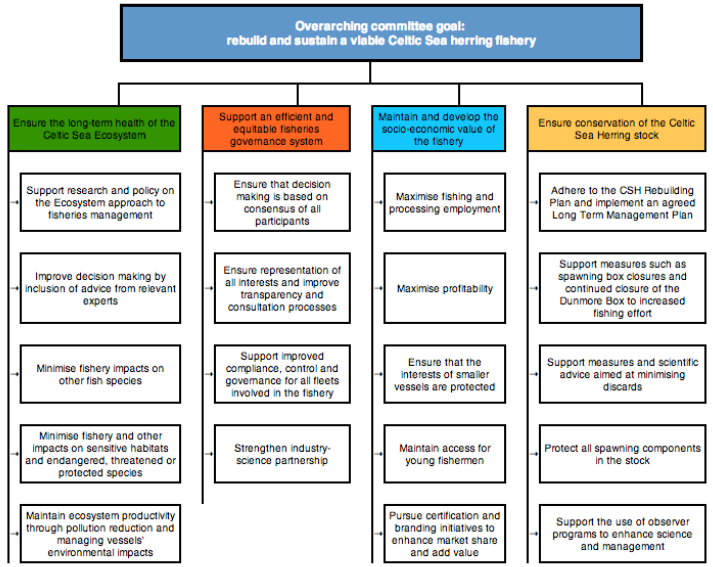
Celtic Sea Herring Management Survey

Marine Institute Feiur na Mara · CMRC · Beaufort Ecosystems Approach to Fisheries Management

Overarching committee goal: rebuild and sustain a viable Celtic Sea herring fishery

	5	4	3	2	1	2	3	4	5	
Ensure the long-term health of the Celtic Sea Ecosystem	○	○	○	○	○	○	○	○	○	Support an efficient and equitable fisheries governance system
Ensure the long-term health of the Celtic Sea Ecosystem	○	○	○	○	○	○	○	○	○	Maintain and develop the socio-economic value of the fishery
Ensure the long-term health of the Celtic Sea Ecosystem	○	○	○	○	○	○	○	○	○	Ensure conservation of the Celtic Sea Herring stock
Support an efficient and equitable fisheries governance system	○	○	○	○	○	○	○	○	○	Maintain and develop the socio-economic value of the fishery
Support an efficient and equitable fisheries governance system	○	○	○	○	○	○	○	○	○	Ensure conservation of the Celtic Sea Herring stock
Maintain and develop the socio-economic value of the fishery	○	○	○	○	○	○	○	○	○	Ensure conservation of the Celtic Sea Herring stock

Next (Nº 1 of 4: 'Objectives towards ensuring the long-term health of the Celtic Sea Ecosystem')



Screen 4: Ecosystem Objective Preferences

research.ucc.ie/fisheries/survey?sid=0b3c33ba-4a3d-11e2-8b26-b5745c97639a&seg=long-term

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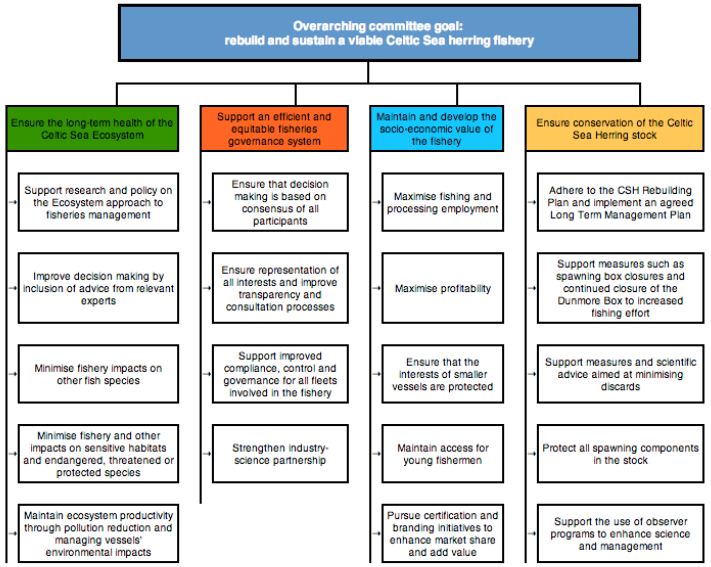
Celtic Sea Herring Management Survey

Marine Institute Muir na Mara | CMRC | Beaufort Ecosystems Approach to Fisheries Management

Objectives towards ensuring the long-term health of the Celtic Sea Ecosystem

	5	4	3	2	1	2	3	4	5	
Support research and policy on the Ecosystem approach to fisheries management	○	○	○	○	○	○	○	○	○	Improve decision making by inclusion of advice from relevant experts
Support research and policy on the Ecosystem approach to fisheries management	○	○	○	○	○	○	○	○	○	Minimise fishery impacts on other fish species
Support research and policy on the Ecosystem approach to fisheries management	○	○	○	○	○	○	○	○	○	Minimise fishery and other impacts on sensitive habitats and endangered, threatened or protected species
Support research and policy on the Ecosystem approach to fisheries management	○	○	○	○	○	○	○	○	○	Maintain ecosystem productivity through pollution reduction and managing vessels' environmental impacts
Improve decision making by inclusion of advice from relevant experts	○	○	○	○	○	○	○	○	○	Minimise fishery impacts on other fish species
Improve decision making by inclusion of advice from relevant experts	○	○	○	○	○	○	○	○	○	Minimise fishery and other impacts on sensitive habitats and endangered, threatened or protected species
Improve decision making by inclusion of advice from relevant experts	○	○	○	○	○	○	○	○	○	Maintain ecosystem productivity through pollution reduction and managing vessels' environmental impacts
Minimise fishery impacts on other fish species	○	○	○	○	○	○	○	○	○	Minimise fishery and other impacts on sensitive habitats and endangered, threatened or protected species
Minimise fishery impacts on other fish species	○	○	○	○	○	○	○	○	○	Maintain ecosystem productivity through pollution reduction and managing vessels' environmental impacts
Minimise fishery and other impacts on sensitive habitats and endangered, threatened or protected species	○	○	○	○	○	○	○	○	○	Maintain ecosystem productivity through pollution reduction and managing vessels' environmental impacts

Next (Nº 2 of 4: 'Objectives towards supporting an efficient and equitable fisheries governance system')



Screen 5: Governance objective preferences

research.ucc.ie/fisheries/survey?sid=0b3c33ba-4a3d-11e2-8b26-b5745c97639a&seg=equitable

UCC Celtic Sea Herring Management Survey

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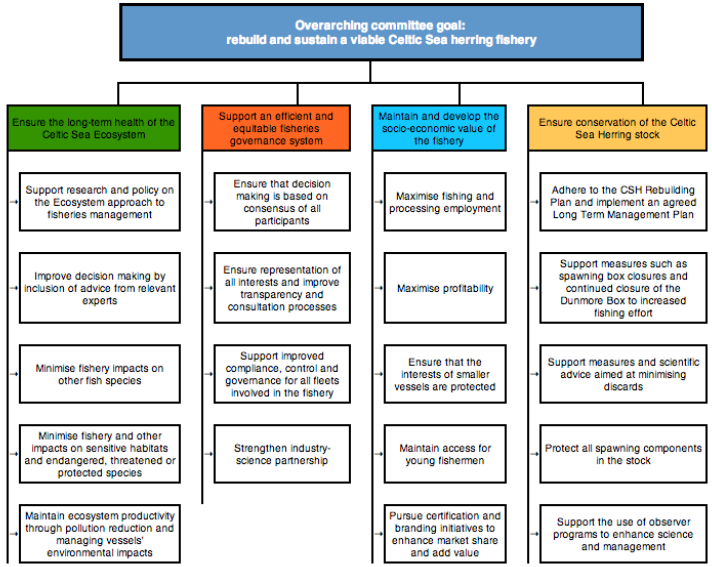
Objectives towards supporting an efficient and equitable fisheries governance system

	5	4	3	2	1	2	3	4	5	
Ensure that decision making is based on consensus of all participants	○	○	○	○	○	○	○	○	○	Ensure representation of all interests and improve transparency and consultation processes
Ensure that decision making is based on consensus of all participants	○	○	○	○	○	○	○	○	○	Support improved compliance, control and governance for all fleets involved in the fishery
Ensure that decision making is based on consensus of all participants	○	○	○	○	○	○	○	○	○	Strengthen industry-science partnership
Ensure representation of all interests and improve transparency and consultation processes	○	○	○	○	○	○	○	○	○	Support improved compliance, control and governance for all fleets involved in the fishery
Ensure representation of all interests and improve transparency and consultation processes	○	○	○	○	○	○	○	○	○	Strengthen industry-science partnership
Support improved compliance, control and governance for all fleets involved in the fishery	○	○	○	○	○	○	○	○	○	Strengthen industry-science partnership

Next (Nº 3 of 4: 'Objectives towards maintaining and developing the socio-economic value of the fishery')



Screen 6: Socio-Economic Objective Preferences

research.ucc.ie/fisheries/survey?sid=0b3c33ba-4a3d-11e2-8b26-b5745c97639a&seg=socio-economic

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Celtic Sea Herring Management Survey

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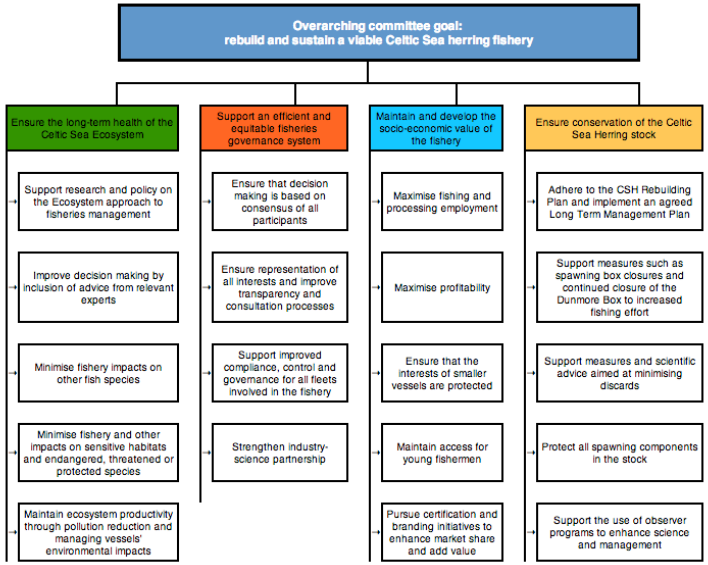
Objectives towards maintaining and developing the socio-economic value of the fishery

	5	4	3	2	1	2	3	4	5	
Maximise fishing and processing employment	○	○	○	○	○	○	○	○	○	Maximise profitability
Maximise fishing and processing employment	○	○	○	○	○	○	○	○	○	Ensure that the interests of smaller vessels are protected
Maximise fishing and processing employment	○	○	○	○	○	○	○	○	○	Maintain access for young fishermen
Maximise fishing and processing employment	○	○	○	○	○	○	○	○	○	Pursue certification and branding initiatives to enhance market share and add value
Maximise profitability	○	○	○	○	○	○	○	○	○	Ensure that the interests of smaller vessels are protected
Maximise profitability	○	○	○	○	○	○	○	○	○	Maintain access for young fishermen
Maximise profitability	○	○	○	○	○	○	○	○	○	Pursue certification and branding initiatives to enhance market share and add value
Ensure that the interests of smaller vessels are protected	○	○	○	○	○	○	○	○	○	Maintain access for young fishermen
Ensure that the interests of smaller vessels are protected	○	○	○	○	○	○	○	○	○	Pursue certification and branding initiatives to enhance market share and add value
Maintain access for young fishermen	○	○	○	○	○	○	○	○	○	Pursue certification and branding initiatives to enhance market share and add value

Next (Nº 4 of 4: 'Objectives towards ensuring conservation of the Celtic Sea Herring stock')



Screen 7: Herring Stock Objective preferences

research.ucc.ie/fisheries/survey?sid=0b3c33ba-4a3d-11e2-8b26-b5745c97639a&seg=conservation

UCC

Celtic Sea Herring Management Survey

Marine Institute | CMRC | Beaufort

Objectives towards ensuring conservation of the Celtic Sea Herring stock

Adhere to the CSH Rebuilding Plan and implement an agreed Long Term Management Plan	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Support measures such as spawning box closures and continued closure of the Dunmore Box to increased fishing effort
Adhere to the CSH Rebuilding Plan and implement an agreed Long Term Management Plan	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Support measures and scientific advice aimed at minimising discards
Adhere to the CSH Rebuilding Plan and implement an agreed Long Term Management Plan	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Protect all spawning components in the stock
Adhere to the CSH Rebuilding Plan and implement an agreed Long Term Management Plan	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Support the use of observer programs to enhance science and management
Support measures such as spawning box closures and continued closure of the Dunmore Box to increased fishing effort	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Support measures and scientific advice aimed at minimising discards
Support measures such as spawning box closures and continued closure of the Dunmore Box to increased fishing effort	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Protect all spawning components in the stock
Support measures such as spawning box closures and continued closure of the Dunmore Box to increased fishing effort	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Support the use of observer programs to enhance science and management
Support measures and scientific advice aimed at minimising discards	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Protect all spawning components in the stock
Support measures and scientific advice aimed at minimising discards	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Support the use of observer programs to enhance science and management
Protect all spawning components in the stock	5 ○	4 ○	3 ○	2 ○	1 ○	2 ○	3 ○	4 ○	5 ○	Support the use of observer programs to enhance science and management

Finish