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Session V: Fishers' Perceptions and Responses in Management Implementation

ICES CM 2005/ V:04

Mind games: Cognitive mapping of fishers' knowledge and perceptions on the impacts of wind farms on fisheries

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Abstract

The development of offshore wind farms around the coasts of England and Wales could make a significant contribution to securing energy supplies for future generations. However, while knowledge of wind farm impacts is developing all the time, there are still some uncertainties about the impacts of wind farms on the environment and specific industries whose activities may be affected by their development. Cognitive mapping was used as a tool in the dialogue between fishers and researchers in a study that investigates the socio-economic impacts and opportunities arising from wind farm developments. Cognitive mapping helped fishers to express their knowledge and perceptions of impacts in a structured way that facilitated a comprehensive and transparent understanding of the issues and concerns of fishers. Specific consideration of possible options to minimise the impacts of developments during construction and operation phases highlight some factors that shape fishers' adaptation to management actions.

Keywords: Wind farm, knowledge, perception, adaptation

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Introduction

Stakeholder participation is an integral part of the changing face of the constitution of fisheries management in Europe. The reformed common fisheries policy, strategies and specific initiatives of independent Governments are demanding so (e.g. Net Benefits, UK Fisheries Science Partnership program). The opportunity for industry to participate in the ICES annual talks on scientific advice together with the creation of partnership bodies such as the North Sea Partnership have paved the way for science and industry to engage and collaborate. More formally, stakeholder participation is embodied in the core principals behind Regional Advisory Councils, giving a decision-making platform from which to develop independent advice on regional management and scientific issues of primary concern to industry. Such issues go beyond traditional fisheries management policies, extending to all aspects of Marine Spatial Planning such as Marine Protected Areas, offshore energy projects and seabed extraction and disposal activities.

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For science and industry to collaborate effectively requires that the knowledge and perceptions from consultations / dialogues can be extracted, synthesised and communicated. In short, the output needs to capture the understanding of both groups and be 'available' for others to understand. It might sound simple and obvious, but problems capturing and translating knowledge to decision-makers is a frequent failing that prevents action being taken when it is needed. To be able extract information, foremost we must listen. By doing so, we adapt our own understanding, and intuitively select and apply appropriate contextual frames that allow us to communicate our own views on issues of common concern. Ineffective synthesis and communication can render otherwise fruitful discussions useless, serving to invite the criticism of only 'paying lip-service'. For instance, how many times have you been to a 'good' discussion, only to see it regurgitated monologue style in the meeting minutes that now languish unremembered? It's what you do with the knowledge that's important.

Cognitive mapping (Tolman 1948, Eden & Ackerman 1998) is a method that can be used to synthesise and communicate the knowledge and perceptions from open discussions. It can be viewed as a process of 'active listening' that outputs qualitative understanding of causes and effects and a semi-quantitative assessment of their certainty/ relative importance. Recognised as a tool to aid decision-making, it is particularly useful where there is a need to clarify alternative and contrasting thought-processes. Unsurprisingly, it does not appear to have been widely applied in fisheries management, perhaps because of the non-collaborative traditions that have prevailed over the past 50 years.

This paper describes the application of cognitive mapping to synthesise and communicate the knowledge from discussions between fishermen and scientists on the impacts of offshore wind farm developments on fishing activities and livelihoods. Based on the specific experiences, benefits, challenges and pitfalls of the method are discussed.

Wind farms background

The development of offshore wind farms around the coasts of England and Wales could make a significant contribution to the UK's commitment to renewable energy, securing energy supplies for future generations. However, the extent of the proposed 'Round 2' wind farms (Figure 1) is likely to conflict with a range of marine users and environmental resources. Responding to concerns already expressed by the fishing industry about possible impacts, Defra commissioned a study to assess the physical and socio-economic impacts that the development of wind farms might have on fishing activities. The purpose of this work is to provide the knowledge necessary to help government make informed decisions on the licensing of new wind farm developments. Specifically, the study provides an important opportunity for fishermen to describe and explain the likely impacts of the construction and operation of wind farms on their activities and livelihoods. Views and suggestions for possible options to alleviate any impacts are also sought. The Centre for Environment Fisheries and Aquaculture Science (CEFAS) and the Sea Fish Industry Authority (Seafish) will conducted face-to-face interviews and postal questionnaires with fishermen during the early summer 2005.

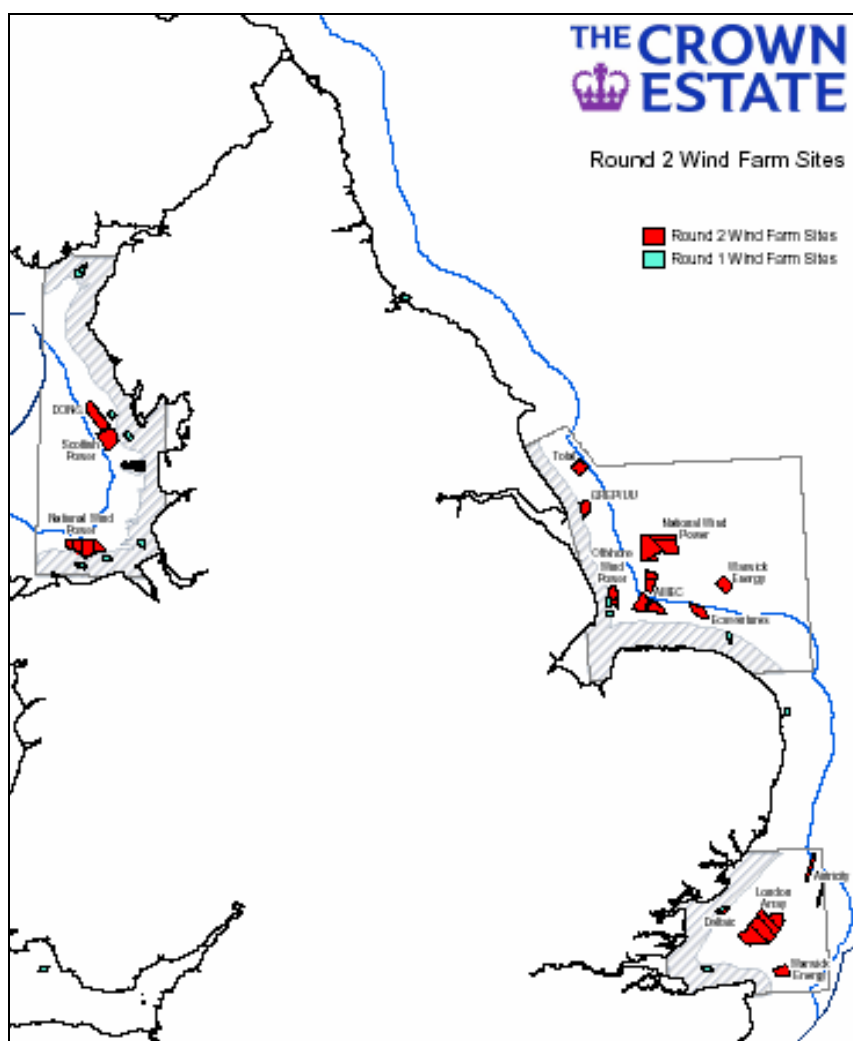


Figure 1. Site leases for proposed ‘Round 2’ wind farms. Note: Before any of the projects can be built, they need to obtain a number of statutory consents: the two key ones are issued under the Food and Environment Protection Act (by Defra) and the Electricity Act (by the DTI). The assessment of the consent applications requires the relevant Government Ministers to consider the impacts of the projects both in regard to any direct effects from the project and any effects arising from interactions with other marine industries.

Methods

Cognitive mapping: rationale and principles

Maps can be viewed as a type of model, which can be used to enhance understanding of systems of many types; for example flow diagrams. Simple maps are often used in this way to develop an understanding of individual or group thoughts as exemplified by Buzan’s mind maps (Buzan & Buzan 1993). The term cognitive map was first used by Tolman in 1948 and has been applied in various ways by various authors (Eden & Ackerman 2001).

The cognitive map has been most intensively developed by Eden and Ackerman within the framework of their SODA (Strategic options development and analysis) method (Eden & Ackerman 1998, 2001; Bryson et al 2004). This is a decision-making method in which cognitive maps are used as a tool for negotiating differences in viewpoints. Specific software can be used to implement and analyse the maps (Decision Explorer; Banxia, 1999).

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Cognitive maps as used by Eden and Ackerman represent a rigorous approach to the use of maps as tools for understanding and negotiation. This is based in the personal construct theory of Kelly (1955) within cognitive psychology. In simple terms this states that individuals strive to make sense of the world using a rational approach in which actions have effects. This leads to the development of a subjective 'construct' of the world as a means to making sense of and managing the world. This construct is a model of the world that is expressed through language and varies from person to person as a consequence of their experiences. To the individual, the construct represent the real world. This construct can be modelled using a language based cognitive map. As such the maps can be seen as approximating the way in which people think. This is supported by considerable empirical evidence that people find the method easy to understand and useful in gaining a better understanding of situations(Eden & Ackerman 1998, 2001; Bryson et al 2004).

In the SODA method, the diversity of viewpoints represented in the maps reflects the different constructs of the individuals. This diversity is seen as a benefit in the same way as the different skills of different team members is viewed. Thus it is a way to explore the richness of the issue. Since they share a common structure, the maps are a facilitative device to assist in understanding and negotiating consensus.

Through discussion, the map is constructed by identifying concepts (or constructs) that are actions or events that can cause other concepts. This forms a directed graph comprising cause-effect nodes and links. For clarity it is usual for the concepts to take the form of pairs of opposite actions, often referred to as the emergent (or positive) and contrasting (or negative) poles. There is also a possibility of negative links where the link causes the contrasting pole rather than the emergent. The map is usually developed with a structure having goals, aims and objectives at the top and issues at the bottom. It is elaborated through a process of discussion, which can begin from goals and work down or from the issues and working up. The developing map is then explored interactively with the interviewee to ensure the model is accurate. This is often done by laddering up and laddering down the map. It is stressed that the map must be 'owned' by the interviewee and not be a product of the facilitators thoughts. Nonetheless they note the move from empathic to negotiative relationship as the facilitator ensures that the map is adequate.

In the SODA method, cognitive maps are developed for individual decision makers and then merged in a group map that encompasses all viewpoints. Eden & Ackerman (1998) note that 'most people do not know for sure what they think about many important matters' and the cognitive map helps to clarify thinking and is also used as a tool to broaden thinking. This stresses the view that these maps are qualitative, and the implications of this need to be understood.

A group map merged from individual maps provides a tool to facilitate group discussion from which a group consensus map that represents the more general views of the group may be drawn. Such group consensus maps are often known as causal maps as they represent general perceptions of cause and effect rather than individual thoughts. More recently the method has been simplified by developing a causal map directly from a group setting rather than through the intermediary of individual cognitive maps (Ackerman & Eden, 2001). This is primarily because of the high cost in time of cognitive mapping.

Quantitative analysis is not normally a part of the use of cognitive mapping. However, the software developed for implementation of the method does have the ability to recognize clusters of concepts which are regarded as 'emerging themes' and which can also be used to collapse the maps to make them easier to understand. The software can also identify tails of models, which are concepts having no causal link. These are typically important starting points or triggering events. Similarly heads can

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be identified as outcomes, goals or conclusions. Busy concepts can also be identified as those with a high level of connectivity according to various algorithms. These can be seen as key concepts in the model. These analyses are used as a basis for understanding the model and discussion rather than for quantitative analysis.

It is also usual to ask participants in mapping sessions to allocate a number (usually 10) of stars to concepts they regard as important. These stars can be allocated as the interviewee sees fit, so that all 10 may be allocated to one concept or each one to 10 different concepts. This can give an assessment of the importance of the various concepts to participants in mapping sessions.

Although quantitative analysis is not normally part of cognitive mapping there would seem to be a potential for such analysis if it was felt to be useful. In general terms if multiple maps (representing multiple viewpoints) are merged into a causal map then it should be possible to record the number of individual maps contributing to the general map. This can be perceived as providing an assessment of the level of agreement on the contribution of that concept or link to the overall model.

Data treatment/ locating fishermen

Two sets of criteria were used to identify from Defra's Fishing Activity Database those boats fishing in the proposed Round 2 wind farm sites. The first identified boats that reported catching fish within the ICES rectangles encompassed by the wind farms areas during the period 2000-2004. This identified mainly those vessels over 10m long since they are obliged to report catches. Vessels under 10m, who do not have a statutory obligation to report catches, were identified using the criteria that either their homeport or administration port occurred in the wind farm areas. It assumes that these smaller vessels generally operate locally. The combined criteria identified a total of 1270 of commercial registered fishing vessels. This did not include charter-angling vessels.

Numerous approaches were implemented to solicit fishermen's participation in the study:

- (i) Invitation letters were sent to the owners of the commercial vessels identified from the database.
- (ii) Announcements of the study, invitation to participate published in the Fishing News (29th April, 6th May and reminder on 10th June). Specific request was made for charter angling interests to participate.
- (iii) Information and invitation to participate on 3 web sites.
- (iv) Detailed information and contact information sent to representatives of 38 fishermen's associations/ co-ops, 6 Sales agencies, 5 Producer organisations, 13 area-based representatives of the National Federation of Sea Anglers, 4 Fishermen's organisations.

To be as flexible as possible in meeting individual circumstances and availability, fishermen were given the option to specify how they wished to be participate in the study, either (i) face-to-face meeting, (ii) postal questionnaires. They were requested to respond to the invitation within 5 weeks.

Response to the 1270 invitation letters was 75 phone calls. Some of these were calls from representatives of fishing associations who wished to meet as a group. A total of 6 group meetings, 8 individual interviews and 44 postal follow-ups were made as a result of following up the 75 calls. Table 1 provides greater detail of the number of meetings and questionnaires that were distributed by each area. Cognitive maps were made for all face-to-face meetings.

Table 1. Postal questionnaires, face-to-face group and individual meetings and questionnaires distributed by area. Numbers in brackets represent the number of questionnaires given out.

| | Greater Wash | Thames | North West | Outside |
|---------------------|--|--|---------------------------------------|---------|
| Postal | 13 | 22 | 3 | 6 |
| Face-to-face | | | | |
| <i>Group</i> | Greater Wash Fishing Industry Group (90) | Thanet Fishermen's Association (30) | Fleetwood Fishermen's Association (3) | |
| | North Norfolk Coast Inshore Fishermen's association & Wells and District Fishermen's association | Whitstable Fishermen's Association (7) | | |
| | Bridlington and Flamborough Fishermen's Association | | | |
| <i>Individual</i> | Lowestoft liners (2) | 8 | uncertain? | |

Cognitive mapping: implementation

In all cases, a brief introduction to the rationale and purpose of the cognitive mapping was given to the participants. In group meetings, two alternative approaches for constructing the maps were tried. In 2 meetings a computer image of the map was projected on to a large white board and was used to construct a single group map. One person operated the computer the other facilitated the discussion. In a 3rd meeting, the group was split in two and separate group maps were constructed using pens and post-it labels as tools. Each facilitator explained the rationale and led their group through the steps to constructing the map (i) brain-storming the cause-effect concepts, (ii) organise concepts in to groups, (ii) connect cause-effects by drawing arrows, (iv) weight importance of concepts using stars. Meetings with individuals were held at the location preferred by the participant. Single cognitive maps were produced directly on a laptop PC viewed by both the interviewer and participant. During these meetings, participants were also asked to complete the full questionnaire.

Our early experiences quickly led us to apply a three-stage approach to the implementation and analysis of mapping process.

- Stage 1: Raw data (Extraction). Map recorded on-site with individual / group. The concepts are written down as stated/ agreed by the participants. Particular wording may represent very specific interests. The participant is the 'owner'.
- Stage 2. Editing and iteration (Synthesis 1) Edited for the purpose of clarification, structural organisation of concepts and ensuring completeness. The main purpose is to get a complete and true reflection of the discussions of the meeting. Concepts that are added or require clarification by the participant are highlighted. This map is 'owned' by the interviewer and is sent back to the participant for their approval. Participants were given two weeks to make and changes. In group cases this can lead to the creation of a consensus map. Any changes are incorporated and sent back again to the participant so they have a final copy.
- Stage 3. Analysis and interpretation (Synthesis 2). Maps collated for analysis of clusters, importance, merging individual and group maps to causal maps. Maps are 'owned' by data analyst.

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Stage 1 represents the extraction of knowledge and perceptions, whilst stage 2 and 3 reflect synthesis of that information. No results for stage 3 analysis are present here.

Results

Opportunities to try both group and individual mapping arose in this study by providing fishermen flexibility in the way that they wished to participate in the study. It allowed us to compare alternative methods for group mapping, compare group maps with individual maps and group maps with merged maps.

Comparison of mapping approaches

Group mapping

In group situations, the facilitator must react to and manage the dynamics of the group and in our experiences, we found ourselves in contrasting situations. In one case, the group was very keen and enthusiastically provided concepts. In this situation, the main task of the facilitator was to keep track of lines of thought, stop and re-open where necessary, prevent stagnation and encourage participation by all members of the group. When a single projected map was used, we found that quieter individuals in the group tended not to contribute.

Another meeting was typified by a greater degree of apathy, participants perhaps having the impression they were there to listen rather than participate. Building a successful map required more leading and examples, prompting of thoughts, cajoling and presenting participants with 'what if?' scenarios. More challenging was a group that at first flatly refused to participate. To engage them in the process required first listening with empathy, breaking down scepticism, developing an understanding in the reasons for undertaking the exercise and providing clarity on what it would provide and how the information would be used. In short, it required developing trust and understanding between the researcher and participants. In this scenario, the post-it method helped provide the much needed closer personal interaction between the facilitator and the participants.

The concepts emerging from group dialogues arose anywhere on the scale from issues to goals. They often came out rapidly, out of sequence and sparked other tangent lines of thought before any particular threads were clearly completed. Although this task was considerably more difficult than guiding individuals through cause-effect it had the benefit of catalysing thoughts through the group and building the confidence to explore areas of thought that as individuals they may not have been prepared to consider. Comfort of the group environment, whether to shout as a group or hide within it, is undoubtedly critical to the dynamics of the discussion and resulting outputs.

The post-it group method seemed to provide the benefit that it engaged individuals more actively in the exercise than when a single map was done on-screen. With on-screen mapping we noticed that as soon as participants had seen that their thoughts and views were being captured, they lost interest in the activity and focussed on the issues. None-the less, the on-screen map was a useful tool to allow the facilitator to summarise and re-iterate themes, thus maintaining direction to the discussions.

In all group cases, it was difficult to achieve complete maps where all cause-effects links were made and thoughts thoroughly fleshed out to exhaustion. Constraints of meeting time and ability to maintain attention were important practical constraints. Considerable skill in facilitation was needed in order to balance these sometimes-conflicting issues and achieve a successful outcome. In our

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experience, it was generally clear when areas of dialogue / the whole meeting was running out of steam, so it is important that the facilitator recognises this natural end and adapts to the situation.

Individual mapping

Of the seven meetings with individual participants, three were held at the Cefas laboratory, three were held at participants' homes and one was held in a local café. All seven meetings were held at times and places chosen by the participants. Two facilitators attended each meeting; this enabled one to guide the discussion and one to operate the computer. To help put them at ease and stimulate initial dialogue from less vocal participants, more background information and examples were given. Once the discussion was underway, ideas were very forthcoming, but as with the group mapping, ideas came rapidly and out of sequence. To maintain focus we tried to introduce times in the discussion where participants could focus on grouping the concepts together and structuring the map on the computer.

There were two main drawbacks to the individual method; it was time consuming and labour intensive. The length of interviews ranged between two and three hours. Most interviews came to a natural close at the end of this time because both the participants and facilitators were nearing the end of their concentration. The participants could have probably contributed new ideas or developed existing ones had the process been less intense and tiring.

The individual method enabled a natural, free flowing and interactive discussion. The participants being in familiar surroundings and being able to take more control helped this in some cases. Participants had the opportunity to personalise the map according to their own situations and opinions. They were able to express personal views and emotional issues without the pressure of a group situation. Involvement did not depend on how shy or outgoing the participant was.

An example map

Both the survey and analysis of maps are ongoing at the present time, thus results presented here are very preliminary. Purely as an example, we present a group map and discuss its main features and information regarding the impact of wind farms on fisheries. Our ongoing analyses include merging of maps from individuals and groups, and expressing the relative importance of concepts and decision paths through quantifying the occurrence of concepts and their links.

The map shown in Figure 2 is in stage 2 of analysis. Some of the concepts have been edited to aid clarity and missing links have been added to complete the decision paths. The map has both a vertical and horizontal structure. Going from bottom to top, the concepts are organised by cause and effect, with final consequences at the top. Clusters of concepts or 'themes' tend to emerge horizontally. For convenience in this map, these have been organised from left to right according to three phases in the lifetime of a wind farm, planning, construction and operation. In this map, no mention is made of the impacts of the decommissioning phase.

Five clusters of concepts denoting themes of issues are highlighted in the example map, (i) views, information & consultation, (ii) physical and (iii) biological effects of construction and operation of a wind farm, (iv) effects on fishing activities and (v) wellbeing and safety.

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Similar themes have been represented (to a greater or lesser extent) in each of the maps we have so far developed with fishermen. As might be expected, the main differences between maps occur because of alternative perspectives associated with different fishing methods.

Some of the important messages that have so far emerged through discussions with fishermen on the impact of wind farms on fishing activities and livelihoods are:

- Belief that no one listens anyway. This belief is rooted in an overwhelming mistrust in consultation processes that is partly influenced by the cumulative experiences of impacts that other offshore developments have had on fishing opportunities and a prevailing view that the energy vs. fishing debate is a lost battle already.
- Consultation is too late in their eyes. Much of the negative attitudes apparent now, would have been avoided if appropriate consultation occurred before Crown Estates published the sites for proposed round 2 wind farms. It seems that the experiences from round 1, where the development of wind farms has progressed through very fast with little consultation, has down-trodden the fishermen's faith that anything they say will be listened to at all.
- Many representatives of fishermen's groups are very well informed and have engaged both government and developers in their concerns on the impact of wind farms.
- Even though fishermen might accept that wind farms are likely to impact their livelihoods and they will have to adapt, it does not change their feelings of despair, disheartenment and being disenfranchised. Uncertainty in what the impacts could be contributes further to this.
- Statements about possible positive impacts of wind farms are rare. For most gear sectors, the impacts appear to be negative.
- The seafaring right of passage ('right to roam') ethos is deeply embedded in the livelihoods of many (particularly) inshore fishermen.
- Fishermen are most focussed on local concerns needing, to draw from their own experiences. It was less common to find them extrapolating more generally on the impact of wind farms to the whole fishing industry and associated shore-based activities and community.
- Fishermen tend to separate the biological effects from the impacts on their ability to operate and many express greater concerns over the unknown ecosystem knock-on effects.

Mitigation and adaptation to management actions

Relating to the information on the impacts of wind farms elucidated through our discussions, fishermen were asked to suggest mitigation and minimisation measures. We experienced on numerous occasions that fishermen found it difficult to provide ideas for mitigation/ minimisation that adequately addressed their own concerns. They often replied in frustration, 'do not build it at all', a response that is largely embedded in the fact that they think construction is already a done deal, and because the many uncertainties make it difficult to know how they might be able to adapt. Given that each of the proposed wind farms sites has a very different ecological and socio-economic environment, establishing appropriate mitigation measures ideally requires that case-by-case evaluations of the impacts that particular wind farms might have on particular fishing activities be conducted. To some degree, this information is a requirement of the developer.

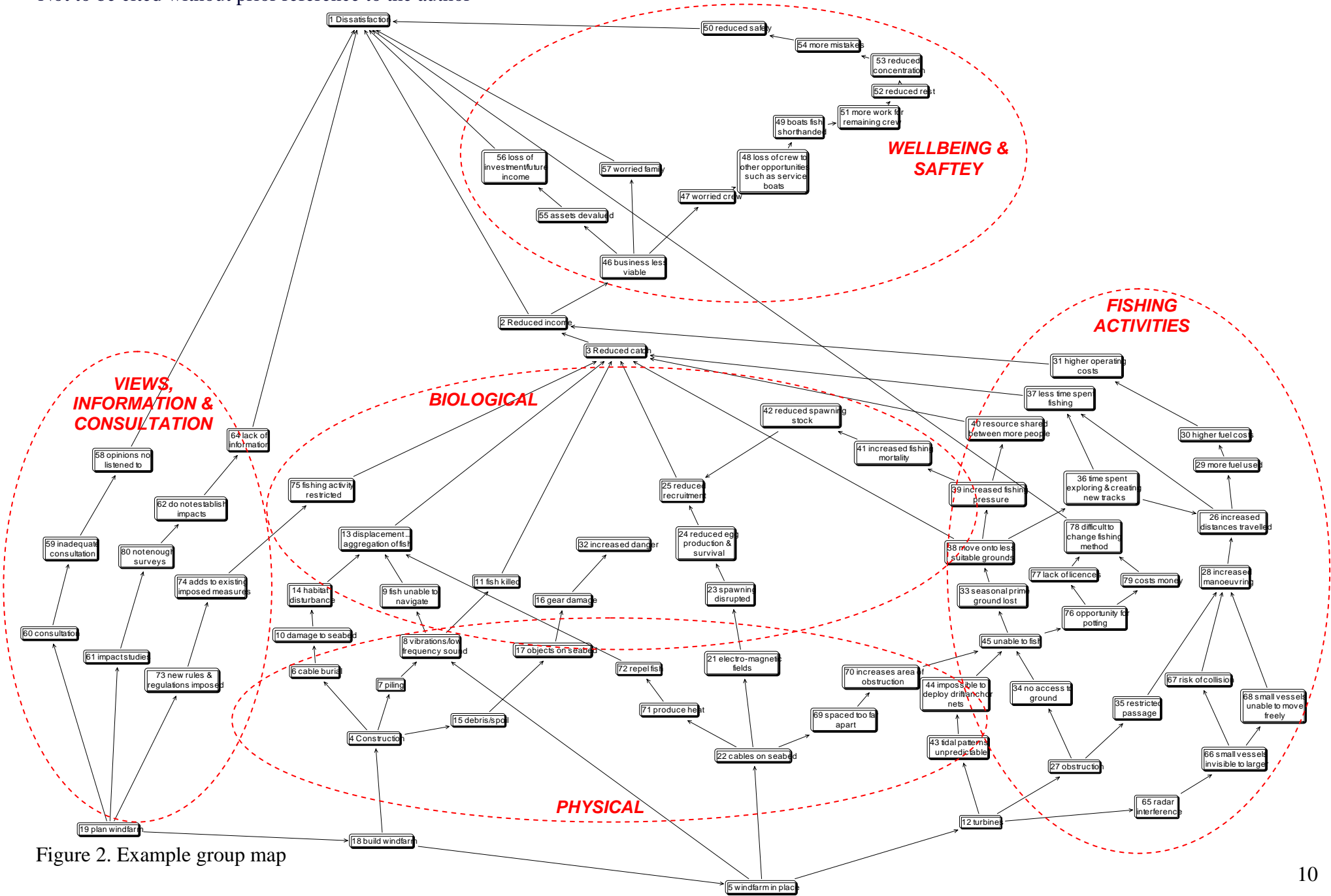


Figure 2. Example group map

Summary and Discussion

Cognitive maps were successfully used to extract and synthesise the views and perceptions of fishermen on the impact of wind farms on their fishing activities and livelihoods. When individual maps are combined from all surveys, the resultant causal maps will help to elucidate the overall views and knowledge of the fishing industry. The easy-to-understand nature of the maps provides a simple, yet effective tool to communicate the information to Defra.

Application of the cognitive mapping approach was not always straightforward, requiring us to adapt the approach to circumstances. Much has been learned through our current experiences and some issues of application remain to be resolved. With the benefit of hindsight we can reflect on how some aspects could be improved, but nonetheless we feel that the resulting maps are a true reflection of the concerns of fishermen over the impacts of wind farms. This is further evidenced by the fact that fishermen who returned maps after checking had few or no additional comments.

Some of the key lessons learned from our experiences in applying cognitive mapping are:

- Whether the map is developed in a group setting or with individuals, the role and skill of the facilitator and his/her interaction with the interviewee is of critical importance. Group mapping exercises required sensitivity to the group size and dynamic, being adaptable to apply a suitable method given the circumstances. i.e. you need several tricks up your sleeve.
- Practical constraints of the environment can play a major role dictating what approach to use. More than one facilitator may be required. Good projection facilities are useful.
- 'Post-its' method suitable where no more than 6-8 participants per interviewer. Offers better personal interaction, particularly when individuals are reticent to get involved.
- On-screen method good where individuals in the group have similar issues and can head toward consensus map. Need good projection facilities.
- Individual maps provide clearer insight on some issues because of the ability to follow single lines of thought. The greater number of maps produced by individual mapping increases the information available for statistical analysis. Group mapping facilitates better chance of agreement on a common causal map, but the group setting has the danger that it does not fully document the thoughts of individuals, being biased to those who are dominant. With groups of different sizes the analysis can be complicated by the need to weight the results of the different groups accordingly.
- Fishermen most often wished to be consulted as a group.
- To ensure ownership of the maps, it is vitally important to explain the methodology to the participants, since even though the method is intuitive; it is not a typical way for people to express their knowledge and thoughts.
- Variability in the approaches/ style of different facilitators complicates the process of coding and merging maps and greatly increases the time this requires. Statistical rigour would be improved if a single person did all of the collection and analysis. We have found however, that the possible impingement on statistical quality is generally offset by the benefits that can be gained through alternative aspects of the maps being explored as a result of different styles of individual facilitators. Contrasting approaches can serve to cancel particular biases of any one individual and provide a more broad and complete description of the subject.
- Since the maps provide a summary of concepts that 'may lead to' other concepts, uncertainty is an inherent feature. Unfortunately, it is not easy to assess how likely each of the links are, and this can be an issue where levels of uncertainty are seen as major areas of interest. Causal maps can be developed into fully quantitative systems dynamics models if this uncertainty is quantified, and the relationship between the concepts determined mathematically.

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During recent years, the approach of European fisheries management has turned in favour of cooperation rather than administration; providing opportunity for managers, scientists and fishermen to work more closely on the common problems they face. From a practical level, doing so requires developing trust between individuals and applying simple communication tools that enable the sharing and understanding of others knowledge, views and perspectives. Cognitive mapping is one such tool.

Because of the many existing uncertainties surrounding the impacts of round 2 wind farms on ecology, navigation and sediment dynamics, it is not clear how fishermen might respond to the presence of wind farms. The impacts they have elucidated in this study are concerns that are perceived to threaten their livelihoods in a very real way. Although resistance and negotiation might be expected to be a fishermen's first line of response to the implementation of round 2 wind farms, it seems that their overwhelming feeling that 'fishermen as a species' are simply not valued, is dispiriting to the extent that it hinders the collective views of fishing industry from emerging fully. This scepticism, unwillingness or lack of interest to participate in the study, means that it is challenging to adequately assess the impacts that round 2 wind farms might have on livelihoods dependent on fishing.

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