**SEVENTH FRAMEWORK PROGRAMME**

**Theme 2: Food, Agriculture and Fisheries, and Biotechnology**

# *Deliverable 5.1 A social network analysis of a marine management science-policy community for six case studies.*

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# A social network analysis of six marine management science policy communities

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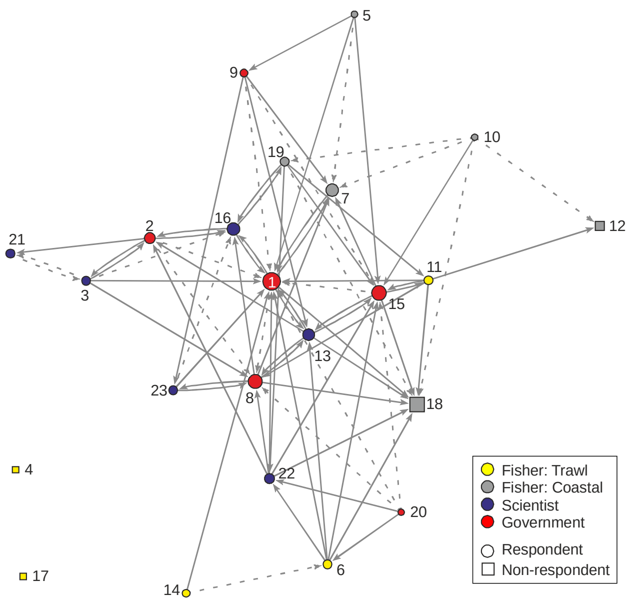
# Executive Summary

What impact does the organization and interactions of the science policy network have on patterns of agreement about biological and economic facts? This is the research question that was at the heart of the JAKFISH deliverable 5.1 "A social network analysis of a marine management science policy community for six case studies". Using social network analysis techniques we assessed the implications of different ways that scientists, managers and other stakeholders organise their common work within an overall fisheries management framework in four EU case studies and two case studies outside the EU. Each case study was carried using a uniform sequential procedure: discourse analysis, survey design, online survey, social network analysis, interpretation of the results in the context of the discourse analysis. The sociograms of the six case studies in this report have been compiled on the basis of network analyses that involve surveys. The number of respondents that have completed the survey is relatively high for all of the case studies (with an exception of the Mediterranean Swordfish case study). Therefore, the sociograms provide a relatively good overview of the most important lines of communication for each case study.

### Baltic Sea - Gulf of Riga herring

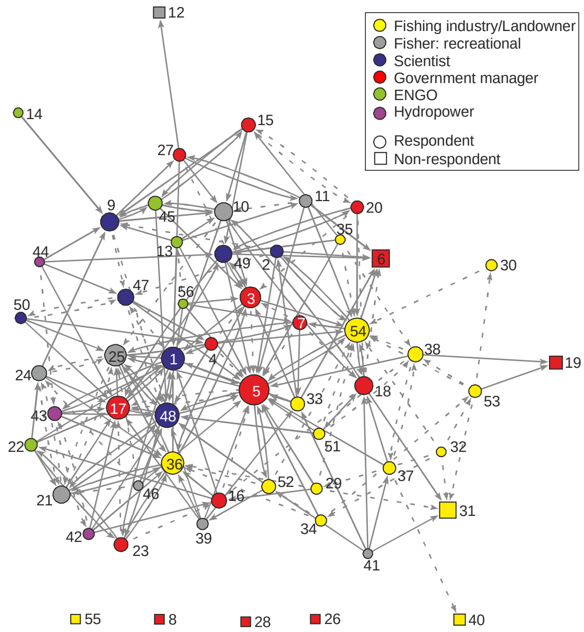
The case study examines fisheries management practices within Estonia, focusing on Gulf of Riga herring. Gulf of Riga herring is a separate population of Baltic herring (Clupea harengus membras) that occurs mainly in the Gulf of Riga, the eastern part of ICES Sub-division 28.




The social network diagram depicts a top-down management system centralized around a few government representatives. The respondents seem to agree more on the management statements than on the factual statements. Network effects are more common on value laden management statements and on importance or harmfulness of statements. The network appear to be negative more frequently than positive, which indicates that the discussion does not necessarily bring about consensus.

The top-down nature of this management system, and the absence of specific structures for stakeholders to participate, is strongly reflected in the results. Only a few actors play an important role in the network (input degree centralisation is 50%), with a key role for the governmental actors.

### Baltic Sea – Salmon management in Finland



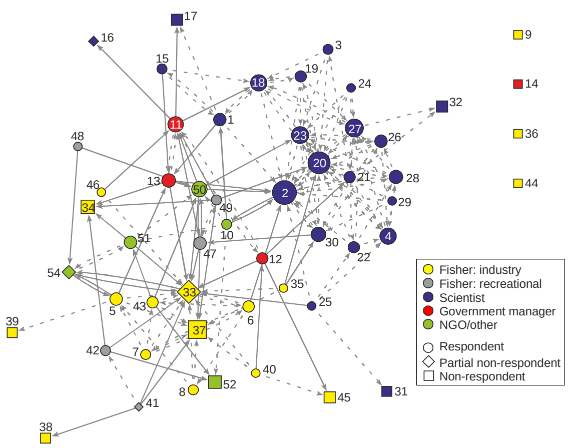

In Finland, Baltic salmon management is a highly conflicted issue that from time to time heats up in Finnish media and in meetings where people with different interests get together.

The actor groups mingle in the discussion network but the industrial fishermen and landowners are a bit on their own, mainly linked to the rest of the network through national and district level government officials.

The opinions and beliefs of the fishing industry and the hydropower representatives most often differ from those of the other groups. The study suggests that persons thinking the same way tend to discuss mostly with each other and that discussion may increase agreement between people. This is also indicated by the positive network effects even though they are sparse. Based on these results it could be assumed that enhancing interaction might bring about increasing agreement among the actor groups.

The regional organisation is clearly visible in the sociogram. The regional networks show discussions among most stakeholders (input degree centralisation is 37%). There is a strong central governmental actor, most likely linked to the national (decision) level. The fishing industry is relatively distant from the core of the network. Recreational fishers seem to be more involved in the network.

### Baltic Sea - Salmon management international




The case study examines Baltic salmon fisheries management practices within the EU. Most of the wild salmon stocks in the Baltic Sea have been depleted during the 20th century, and the remaining ones vary in their status.

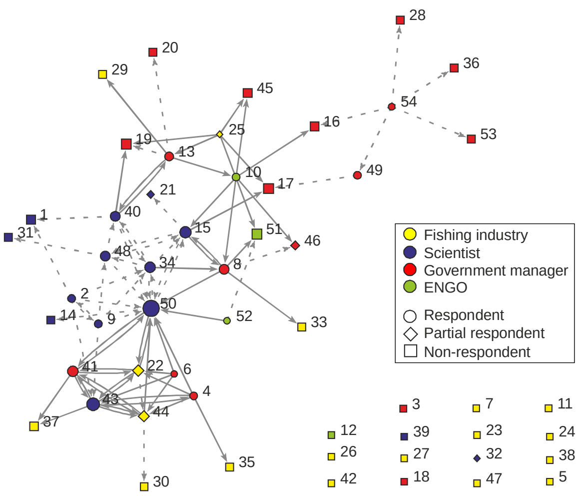
The sociogram shows how the scientists constitute a very dense net of ties between them. Stakeholder groups have fewer ties between them. In the middle there are three managers.

The analysis shows that individual actors agree more on management goals and salience of facts, than the facts themselves and this applies to groups as well. The fishing industry has most frequently positions that markedly differ from the others, both in relation to facts and to values.

The results indicate that agreement between fishing industry and recreational fishers is more usual than agreement between the other groups, and this concerns especially management statements. The fishing industry and the scientists disagree most frequently on facts.

The network shows a high number of interactions between the scientists and an intermediate spread of the discussions over the network (input degree centralization is 29%). The BSRAC and ICES working group meetings play an important organizing role in this network. Communication between stakeholder groups appears to run through only a few actors.

### Mediterranean swordfish




The Mediterranean swordfish fishery is a highly international fishery, with at least 11 countries targeting the stock. Stock assessment results indicate that the Mediterranean swordfish stock is over-exploited

The survey generated a low response rate which is reflected in the network. The network shows a sub network in the top right corner representing interactions between actors in a national setting. One actor (a scientist) appears to be central in the network but many actors are involved in the discussions (input degree centralisation is only 22%). No governmental actors are central in the network. Scientists see each other as important discussion partners. Communication across stakeholder types happen mainly in local or national contexts, rather than at the international level of ICCAT where scientific advice and political decisions are made.

In the network as a whole there was more agreement on the salience of different statements than on the content of the factual and value statements, while the comparison between groups showed that there was higher disagreement on the salience of the statements.

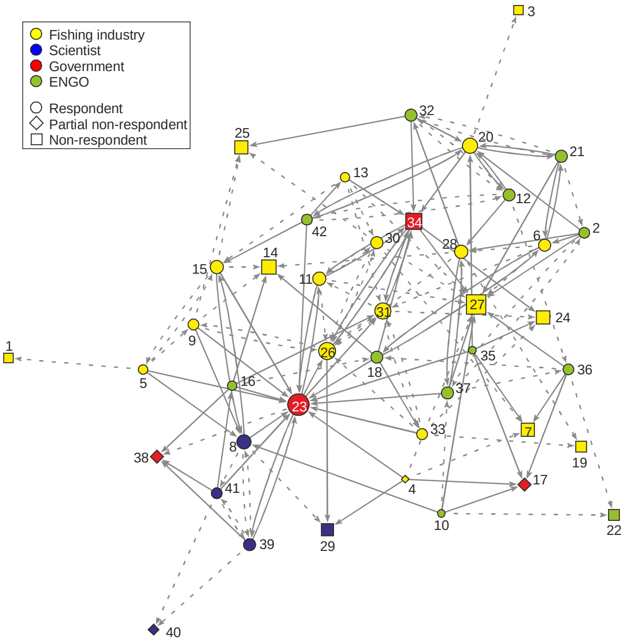
In terms of the relation between communication networks and levels of agreement, we found only negative network effects. We conclude that respondents in this case study tend to have frequent discussion ties with peers of other stakeholder types that have different values or opinions on management goals, and that previous discussions have not brought about consensual opinions among discussion partners.

### United States New England Groundfish fisheries management

The case study examines New England groundfish fishery management practices within the United States. The groundfish fishery is a complex of 19 stocks (12 species) of demersal finfish. U.S. fishermen pursue these stocks in the Gulf of Maine, Georges Bank, and southern New England waters using a variety of gear types.

The discourse selected for this analysis generated a substantial amount of disagreement among different respondents and stakeholder groups.

The NEFMC brings together a diverse group of participants, although the scientists do tend to function more autonomously compared to the other groups. Differences of opinion exist on the management issues (values) which corresponds to the NEFMC being designed to represent the heterogeneous views within the management system. Science advisors frequently hold positions on knowledge that markedly differ from the other groups because they are a more homogeneous group.

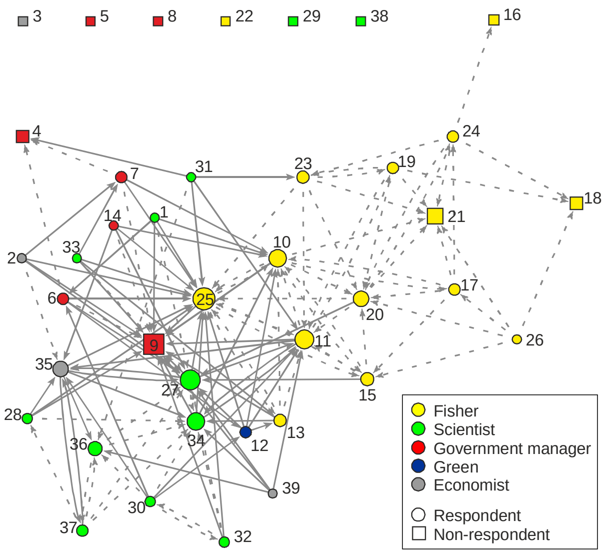



Unfortunately, there are a number of errors in the sociogram in the allocations of individuals to different stakeholder types. This is particularly the case for four of the key respondents who should have been labelled "Scientist". This also has an effect on the network autocorrelation analyses.

**Australian Northern Prawn Fisheries management**

Note: the results in the Australian Northern Prawn Fisheries case study are preliminary because the analysis could not be completed due to illness of the main analyst.

The Australian Northern prawn fishery consists of 52 trawlers from fishing ports between Brisbane and Perth. The Northern prawn fishery has been through a long struggle to reduce overcapacity. The fishery is managed by a multi-purpose co-management arrangement, developed after years of facilitated multi-stakeholder workshops. The management system and legislation places a strong emphasis on a partnership approach among fisheries managers, scientists, and relevant stakeholders. The underlying rationale is that the achievement of sustainable fisheries is very much linked to the level of trust and confidence that exists between industry, managers, scientists, and stakeholders generally.




The discourse selected for this analysis generated a substantial amount of disagreement among different respondents and stakeholder groups.

The network shows frequent discussions within stakeholder groups but a number of respondents appear to be central. This is also reflected in a input degree centralisation of

39%. These central respondents represent each of the stakeholder groups. In the fisheries stakeholder type only a few respondents appear to play an important role, both in internal and external discussions.

NORMAC members who are not also RAG members have significantly more positive opinions on values and interests than respondents who are not affiliated to a management institution. On the knowledge claims, Fishermen and NORMAC members take significantly different positions most often. On the salience of knowledge, experts may have convinced their discussion partners of the importance of knowing the facts correctly.

A separate paper is foreseen to be released in 2012 on this Australian case study. That forthcoming analysis suggests that the Australian network analysis showed that agreement about scientific facts among people who disagreed about values and interests increased when they worked together on management committees. This finding would contradicts the conclusions reached in the analysis above. Therefore, it is important to closely examine the implications of both analyses before final conclusions are drawn.

**Comparison over case studies**

In order to test for interactions between network properties, context and network autocorrelation effect, a multivariate statistical analysis was carried out using a multilevel regression model. All predictors have negative effects, indicating that a higher score on the predictor is associated with more negative autocorrelation and, vice versa. Some key findings:

More heterogeneous networks have more negative autocorrelation (factor: -0.45). When experts discuss matters more with colleagues from other stakeholder groups, their values, interests, opinions, and knowledge are less similar. Consensus within a stakeholder group is higher when the discussion partners are selected within the group. Example of a heterogeneous network is Gulf of Riga herring. Example of a network that is low on heterogeneity is Baltic Salmon International.

Centralized networks have more negative autocorrelation (factor: -0.22). Centralization is associated with discussion links between experts that disagree. This suggests that the central experts in these network are not effectively influencing their peers. Example of a centralized network is the Gulf of Riga herring. Example of a low centralized network is Mediterranean Swordfish and New England Groundfish.

International systems are associated with negative autocorrelation (factor: -0.24). But we should note that the difference is probably mainly driven by the Mediterranean swordfish case. Consensus is probably higher in a national system because experts and issues have a larger shared history.

Management systems with high participation (in decision-making) have negative network autocorrelation (hence more disagreement, factor: -0.17. This difference did not show up in the average scores reported in Table 9.4 because those averages were not corrected for other factors. If we would compare management systems with comparable communication networks (same heterogeneity and centralization) and the same national or international scope, the management systems with high participation will have more negative network autocorrelation, so more disagreement among frequent discussion partners. This result suggests that in a more participatory management system, there is higher disagreement among experts possibly because they result from discussion relations among experts with different values, interests, and knowledge.

Network Heterogeneity and Input Degree Centralization do not fully describe participation. The two measures show some correlation. Input degree centralization appears to be positively related to heterogeneity. This suggests that active stakeholder interaction requires the organizing efforts of a few central actors. If this is so, then the idea of "participation" would need "unpacking" from a network perspective because it shows how different participatory roles are played out in real-life situations where decisions are being made and how leadership and participation are connected.

When experts discuss matters more with colleagues from other stakeholder groups, their values, interests, opinions, and knowledge are less similar. Consensus within a stakeholder group seems to be higher if the most important discussion partners are selected within the group. So more participation (in science, in policy-making) does not (necessarily) mean more agreement on facts or values. Management systems with low participation might show more agreement because stakeholders lack opportunities to discuss controversial ideas. Higher participatory systems may, however, succeed in establishing discussion relations among experts with different values, interests, and knowledge.

The original design of D5.1 was driven by the underlying hypothesis: *who people actually talk to, how frequently they talk to them, and the qualities of those discussions can have an impact on how much they agree on facts when they disagree on values and interests.* This is directly linked to the question of how formal institutions are expressed in actual interactions. It is clearly evident and important that proper forms of communication express controversies over both facts and values and that these two kinds of assertions are tightly related because people interpret facts to defend values.

The edge question that JAKFISH was meant to address follows from this: *given that such controversy is the norm in participatory approaches to management what are the potential tools that can lead to increased agreement on facts by those who disagree on values and interests?* WP4 addressed this question by experimenting with participatory modelling as a method for getting people to focus the conversation on facts and what a "fact" is. WP 5 examined the same question from the broader institutional perspective, i.e. how scientists were dealing with uncertainties in the midst of controversy and the different ways that participation is organized as expressed in the actual interactions of the people involved.

# 1 Introduction

What impact does the organization and interactions of the science policy network have on patterns of agreement about biological and economic facts? This is the research question that was at the heart of this JAKFISH work package.

To answer this question at the institutional level social network analysis techniques were used. The objective was to assess the implications of different ways that scientists, managers and other stakeholders organise their common work within an overall fisheries management framework. The analysis was carried out with people who were actively participating in the existing fisheries management communities. The social network analysis in the EU was carried out for 4 case studies, two national level cases and two international cases. Outside the EU two case studies were selected, one case involving mainly the state level and one the national level policy community (Table 1-1).

Table 1-1 Selected cases studies, selected knowledge objects and level of participation

| **Case study** | **Coordinator** | **Participatory Process** |
|---|---|---|
| Baltic Gulf of Riga herring Estonia (National) | Päivi Haapasaari | • Decision making processes beginning to open to more participation<br>• Fishermen's Organizations<br>• Industry-science collaborative research (small-scale/informal)<br>• Trust in science (in general) |
| Baltic Salmon Finland (National) | Päivi Haapasaari | • Fishermen's and Civic Organizations are active<br>• Decision makers know what stakeholders want |
| Baltic Salmon International (Regional) | Päivi Haapasaari | • Early stage of participatory process<br>• Baltic RAC |
| Mediterranean Swordfish Fishery (International) | Liv Berner | • Relatively little formalized input from industry and ENGO stakeholders. High input from national authorities.<br>• ICCAT |
| USA New England Ground fish Fishery (Regional) | Teresa Johnson | • Highly participatory<br>• Government led co-management through regional fishery management councils<br>• Industry-science collaborative research<br>• Reputation for effective use of science |
| Australia Northern Prawn Fishery (Regional) | Doug Wilson | • Highly participatory<br>• Multipurpose co-management system<br>• Industry-science collaborative research<br>• Reputation for effective use of science and management |

The cases have different levels of participation and this is linked to the level of organization related to the management system. The selected knowledge objects will be elaborated

Social network analysis is a sociological technique based on the analysis of data about relationships between people, such as the frequency and quality of their interpersonal context. Social network analysis allows investigators to get closer to the "real" institutions – i.e. the way people actually interact - as opposed to the "paper" institutions – i.e. the nominal committees or councils people sit on or events they participate it. It has been widely applied in the areas of formal organisations, social movements and in general policy-making contexts (Knoke 1993).

Each case study was carried using a uniform sequential procedure: Case study discourse analysis,  survey design, online Survey, Social Network Analysis, interpretation of the results in the context of the discourse analysis.

## 1.1 How the work was organized

WP5 in JAKFISH was originally coordinated by Doug Wilson (AAU-IFM) who was also responsible for the coordination of task 5.1 (social network analysis) while Ditte Degnbol was responsible for task 5.2 (qualitative analysis of uncertainty).

Unfortunately, Doug Wilson because seriously ill in the beginning of 2011 and was unable to continue his work in the project. This was when task 5.1 was in a critical phase of sending out surveys, carrying out analysis and interpreting results.

David Goldsborough, senior researcher at IMARES (sDLO) was requested to take the role of Doug Wilson in coordinating WP5 and task leading the deliverable 5.1. Unfortunately the analytical approach to WP5 had not been fully documented yet and was tightly linked to the expertise of Doug Wilson. The initial work when David Goldsborough took over consisted of writing up an analytical approach and cleaning up the data that had already been collected. The next step was to find an expert in the field of social network analysis who would be able to carry through the analysis that had been foreseen. After some months of preparatory work, the project team obtained support from Wouter de Nooy (social network analysis) and Jacqueline Tempel (data management) who were both contracted by Aalborg University to work on the JAKFISH deliverable 5.1.

However, the analytical approach that has been carried out in the project was somewhat different from the original method that had not been fully documented. This led to some disagreement on the interpretation of the results that were obtained from the analysis. The case study coordinators who carried out the interviews and developed the questionnaire, disagreed with the type of conclusions that could be drawn from the analytical model. Due to the constrained time available at the end of the project, the project team has not been able to fully resolve the issues, but highlights these issues in the discussion section of this report.

## 1.2 Contents of this report

In this report we describe a social network analysis of a marine management science policy community for six case studies. In Chapter 2 the research design is detailed. Firstly the format of the online survey is described, including how the survey generates so called Q-sorts, and what output is generated. Secondly the selected quantitative social network analysis technique, a network autocorrelation model, is described and modelling choices are justified. Chapter 3 describes the design and the application of the survey and the social network analysis for the six case studies. The results of each Social network analysis is presented per case study. A quantitative comparison of the results of the six case studies is discussed in chapter 4. We conclude with conclusions and some recommendations for further research on social network analysis in fisheries management.

# 2 Research Design

## 2.1 Discourse analysis

Relational data requires more intensive sampling than other methods for gathering social information. The problem, as Burt (1983) has shown, is sampling the ties between people. The amount of relational data lost in sampling is 100-k% of all the relational data, where k is the sample size expressed as a percentage (Burt 1983). For each case it was necessary to get at least the relational information for nearly all the main actors at the national and regional levels. This implied that the range of fisheries management issues examined in each case had to be fairly narrow in order to limit the number of interested stakeholder organisations. To carry out the interviews we started with the major organisational actors in a case and did interviews with their employees involved in management policy (scientists and non-scientists). We then used a snow-ball technique, a standard approach based on generating referrals, to complete the sampling. The qualitative interviews were used to describe the main features of how science is used in developing marine policy in the case, explore how those involved understand the programs, and identify the most salient issues.

For each case study a limited number of salient issues was selected as knowledge items for the further design of the survey. For example in the Australian Northern Prawn case study this was “Bio-economic modelling of the shift from effort control to output control”.

Going from discourse analysis to survey design required carrying out five steps:

- Describe the management system (network plus characteristics)
- Identify the most important people in the network
- Select the main knowledge item and subthemes
- Formulate 16 values statements
- Formulate 16 fact statements

## 2.2 Online Survey

Q sort methodology was used for measuring the opinions and knowledge of individuals in the studied management system.

A formal survey was used to gather data of three types:

- on the frequency and characteristics of respondent’s interactions;
- on their own attitudes and opinions about scientific issues and
- on respondent’s individual characteristics.

The first type of data measured variables as the frequency of interaction between participants, affective strength of the relationship, relative formality of the interaction contexts, and the number of different channels or contexts in which the relationship takes place.

The attitude data was measured using Q sorts (Brown 1986). This technique asks respondents to order statements generated by the qualitative interviews in terms of both agreement and importance and uses principle component analysis to yield rich attitude measures that are more sensitive to the research context than simpler methods are able to yield.

The individual characteristics data included basic data such as people's stakeholder affiliation, their education, organisational membership etc.

Each survey followed the same structure:

- **Part 1** 16 (values) statements on management goals and objectives
- **Part 2** 16 (factual) biological or economical statements
- **Part 3** Social network analysis questions, choose 5 people and answer 9 questions per person

The survey was sent to all people that were identified as being part of the network, so each possible respondent was also mentioned in the survey. The survey was programmed in SurveyXact. SurveyXact is a widely used internet-based system to implement and analyse all forms of surveys.

For each survey the survey program generated one output file containing all of the responses. The  data in this output file was verified, split into a number of smaller datasets and a codebook was produced for each data set. This work was done by Jacqueline Tempel on behalf of Aalborg University.

To understand how the survey works each part is elaborated with an example.

### Part 1 Values statements

Example Baltic Salmon International:

*"All river salmon fishing should be catch and release"*

- *Agree/disagree* 16 statements
- Sort statements
  - Agree with the *most*
  - Agree with the *least*

### Result Part 1

Forced distribution (Q-sort)

Example

Strongly disagree → Strongly agree

| -3 | -2 | -1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|
| 3 | 10 | 4 | 5 | 2 | 11 | 6 |
| | 13 | 9 | 7 | 14 | 12 | |
| | | 8 | 15 | 1 | | |
| | | | 16 | | | |

Each number in the distribution above represents the number of a statement. So the above distribution is a forced distribution showing the answers of one respondent to the 16 values statements. This respondent agrees the most[1] (+3) with statement 6 and disagrees the most (-3) with statement 3. Thus this distribution reflects the subjective view of this respondent on the 16 value statements.

[1] The underlined words are the exact words as used in the survey.

### Part 2 Facts statements

Example Baltic Salmon International:

“Catch below TAC because restrictions sea fishing”

- *True/false* 16 statements
- State certainty
  - *Very sure*
  - *Fairly sure*
  - *Not sure*

### First result Part 2

Distribution.

Example

False → True

| very | fairly | not | | not | fairly | very |
|---|---|---|---|---|---|---|
| -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 3 | 10 | 4 | | 2 | 11 | 6 |
| 13 | | | | 14 | 12 | 5 |
| 8 | | | | 1 | 16 | 7 |
| | | | | | 9 | 15 |

The fact statements are dealt with in two steps: first a distribution is produced based on the first answers to the fact questions. So in the example above the respondent think statement 4 is false but he is not sure about this, and he thinks statement 7 is true and he is very sure about this. In the second step the respondent is asked to rank the statements to produce a forced distribution similar to the procedure from part 1. From the example below we can see that the respondent feels that statement 6 is the most important statement and that statement 3 is the most harmful. The ranking the statements using the concepts most important and most harmful is called the salience of knowledge.

### Second result Part 2

Forced distribution (Q-sort)

Example

False → True

| very | fairly | not | | not | fairly | very |
|---|---|---|---|---|---|---|
| -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 3 | 13 | 10 | 9 | 15 | 5 | 6 |
| | 8 | 4 | 1 | 14 | 7 | |
| | | 2 | 16 | 11 | | |
| | | | 12 | | | |

### Part 3 Social Network Analysis

- Select 5 people from network (some did less and some did more)
- For each person answer 9 questions on professional relationship

## 2.3 Social network analysis

Interactions among stakeholders and exchange of knowledge are deemed important to successful management and policy planning because they help stakeholders to communicate their positions, understand their peers’ point of views, and negotiate deals and compromises.

Social network analysis is a quantitative methodology designed to analyse patterns of interactions and exchange between social actors therefore, social network analysis is increasingly being used in the analysis of environmental planning and natural resource management. Recently, for example, a book by Bodin & Prell (2011) and a special issue appeared on this topic in Ecology and Society (Crona & Hubacek, 2010).

Within the set of techniques for social network analysis, the network autocorrelation model is most appropriate to analyse whether an actor’s opinions and knowledge or behaviour depends on the opinions, knowledge, or behaviour of the actor’s network neighbours: the other actors he or she is linked to (Doreian, 1980) if they do, influence processes may have been at work in the network, so network ties may have been relevant to the distribution of opinions, knowledge, and behaviour

In this section, we describe the network autocorrelation model and we motivate our modelling choices (Leenders, 2002). The network autocorrelation model answers the following question: Can we predict a social actor's characteristics from the same characteristics of its network neighbours? The social network analysis was carried out by W. de Nooy on behalf of Aalborg University

In the cases that we analyse here, the actors are stakeholders in a fishery management process and the relevant characteristics are the stakeholders' opinions about the management goals, their knowledge of economic and biological facts pertaining to the natural resources, and their opinion about the benefits and harms of believing particular economic and biological 'facts'

The network that is hypothesized to be relevant to the opinions and knowledge consists of discussion relations among the actors; each actor is asked to select the five persons from a list with whom he or she discusses management issues regarding the natural resource most frequently; in other words, the salient network is a discussion network

Basically, our network autocorrelation model is a linear regression model with an opinion or knowledge item as the outcome variable and the product of this opinion or knowledge with the discussion network matrix as a predictor variable; in addition, personal characteristics of the actors are included as additional predictors.

We use each survey question on the respondent's opinions and knowledge as a separate outcome variable, so we estimate a model for each opinion and knowledge item; clustering of items turned out to yield scales that were difficult to interpret substantively; in addition, items that clustered into scales sometimes correlate with different predictors and have different network autocorrelation effects, so it is better to evaluate each item separately.

Having the dependent variable weighted by the network matrix as a predictor, we use a dependent variable autocorrelation model rather than a disturbances autocorrelation model; the latter model uses the network matrix as a weight variable for the error term of the regression model.

We prefer the dependent variable autocorrelation model because it assumes that communication ties serve to harmonize the opinions and knowledge of discussion partners: the model supposes that actors change their opinions and knowledge towards (or away from) the opinions and knowledge of their discussion partners; opinions or knowledge converge or diverge due to the network. In contrast, the disturbances model assumes that actors move their opinions and knowledge with changes in the opinions and knowledge of their discussion partners, so the differences remain more or less the same.

Although the two autocorrelation models are technically different and may identify different social processes, we note that we have not found different results in our cases in the instances in which we tested both; the choice of a model, then, is of little relevance in our analyses.

Using direct discussion ties between actors as the salient network, we are assuming that actors are only influenced by their direct contacts; this seems to be the most natural way to operationalize network effects. In social network analysis, however, there is an important alternative positing that a social actor adapts to peers who occupy a network position similar to the actor's position even if there is not a direct tie between them; think of outcasts in a high school class, who may develop similar opinions and behaviour even though they are not friends. In this approach, structural equivalent actors, that is, actors with a similar position in the network, are hypothesized to imitate each other. We acknowledge the alternative but we restrict our model to direct contacts because communication is primarily thought of as a direct exchange of information

Many autocorrelation models normalize the network matrix before it is entered as a predictor in the regression equation and there are many different ways to normalize it (Leenders, 2002). In addition, our survey data allow for several qualifications of the communication ties, e.g. by communication intensity, prestige of the nominated person, or who takes the initiative.

We use the most basic option, simply using the presence (coded 1) versus absence (coded 0) of a discussion tie from one actor to another as binary values in the network matrix. We compared results with the different weighting schemes available from the survey only to find that the simple binary matrix yielded clearer results; we think that this is due to the fact that the basic structure of the network is determined by the simple fact that some actors are linked while other actors are not. The questions about communication intensity, prestige, and initiative-taking were answered only for the 5 linked peers, so they may differentiate a little among the ties with network neighbours but they do not differentiate among the much larger number of peers who were not nominated as the actor's most frequent discussion partners.

In the binary matrix, row-normalization, which is the most popular type of normalization in network autocorrelation models, is inconsequential. Row-normalization divides the tie values by the total number of ties 'emitted' by the actor. Because almost all respondents nominated exactly 5 peers as their most frequent discussion partners, division by the number of nominations does not change the relative size of the tie values, therefore, we decided not to apply this type of normalization.

As a result, our models assume that each actor is equally influenced by all of its frequent communication partners and that each actor is equally likely to be influenced by its network neighbours

Experts who did not fill out the survey complicate the network autocorrelation model. Because we do not know the opinions and knowledge of the non-respondents, we cannot model their relevance to the opinions and knowledge of respondents who nominated non-respondents as frequent discussion partners.

If two respondents mentioned the same non-respondent as a frequent communication partner, we can assess the non-respondent's relevance to the opinions and knowledge of the two respondents indirectly. Two respondents who nominated the same non-respondent as a major discussion partner are likely to entertain more similar opinions and knowledge because both are similar to the non-respondent, therefore, we created an additional network with a tie between two respondents if both nominated at least one non-respondent as one of their five most frequent discussion partners. Again, we use a simple binary line value (1 for a tie, 0 for no tie), so we do not take into account that some pairs of respondents nominated more than one non-respondent as a shared discussion partner. We include this network of indirect ties through non-respondents as a separate predictor in the regression equation to establish the autocorrelation due to shared non-respondents.

In addition to the two network matrices, we include personal characteristics of the actors as predictors in the regression equation. This allows us to separate the effects of the discussion network from the effects of formal institutional differences among the experts, notably their participation in management institutions and their stakeholder type. Note that autocorrelation effects tended to show after controlling for effects of personal characteristics in our analyses. Fishers, for example, tend to have similar opinions and knowledge and network effects usually show only if we control for this similarity.
The personal characteristics are categorical variables, which we grouped if the original number of categories was too high to have a reasonable number of observations. We entered the categorical variables as dummy (1 or 0) variables in the regression model.

The resulting autocorrelation model is summarized by the formula:

$$y = \alpha + \rho_1 W_{direct} y + \rho_2 W_{indirect} y + X\beta + \varepsilon \quad \text{with} \quad \varepsilon \sim N(0, \sigma^2) \qquad (1)$$

with *y* representing an opinion or knowledge item, α representing the constant, $W_{direct}$ the binary direct discussion ties network matrix and $W_{\text{indirect}}$ the binary network matrix of indirect ties via non-respondents, $\rho_1$ and $\rho_2$ the autocorrelation effect parameters, *X* a matrix of personal characteristics and β a vector of regression coefficients, and finally ε a normally distributed error term with zero mean and equal population variances for sets of cases defined by (combinations of) predictor variables.

We report the estimated regression coefficients and the AIC information criterion for the model and the null model (the constant as the only predictor). If the predictor variables help to explain the outcome variable, the model's AIC should be lower than the null model's AIC.

We estimate the models with the lNAM routine in Carter Butts' SNA package available in R using the default BFGS (Broyden, Fletcher, Goldfarb, and Shanno) estimation method (Butts, 2006).

The descriptive network analysis and network visualization is done with the free Pajek software (de Nooy, Mrvar & Batagelj, 2011).

We need to point out two important caveats for the network autocorrelation model.

**Caveat 1: alternative interpretations**
The presence of network autocorrelation effects (significant non-zero estimates of ρ) indicates that the opinion or knowledge of network neighbours is more similar (positive autocorrelation) or more dissimilar (negative autocorrelation) than expected while controlling for the effects of other predictors, such as personal characteristics. It is tempting to interpret this as a network effect: actors influencing their peers opinions and knowledge, hence as a sign that the structure of the discussion network matters to the convergence or divergence of opinions and knowledge.

However, there are several alternative causal interpretations, for example, (1) actors choose each other (establish a network tie) because they have the same opinions/knowledge, and (2) actors are in a similar social context, which causes them to be linked and to have similar opinions and knowledge (Shalizi & Thomas, 2011).

The first alternative interpretation is known as the homophily effect: birds of a feather flock together (McPherson, Smith-Lovin & Cook, 2001). It reverses the causal direction, assuming that similar opinions or behaviour lead to network ties. With cross-sectional data and generally with observational data, it is impossible to distinguish between the network effects and homophily effects explanation.

The second alternative interpretation, can only be ruled out if we control for all relevant manifest and latent personal characteristics that may result in (dis)similar opinions and knowledge. In our analyses, we control only for a few albeit important personal characteristics – affiliation to management institutions and stakeholder type – so we cannot rule out that the autocorrelation effects that we attribute to the network variables are actually due to similarities in personal characteristics that we have not measured.
As a result, we interpret autocorrelation effects with care, keeping in mind that similar opinions and knowledge may be both cause and consequence of communication ties.

**Caveat 2: underestimation of autocorrelation effects**
Recent simulation research has shown that the network autocorrelation model tends to underestimate the autocorrelation effect (Mizruchi & Neuman, 2008). Estimated effects are systematically biased in a negative direction, so true positive effects may be estimated as absent or even as negative effects while truly negative effects turn out to be stronger in the estimates than they really are. However, for low-density networks, such as the ones we are investigating, the bias is less marked and only occurs in the case of positive autocorrelation. In our cases, significant negative and positive autocorrelation effects may be interpreted without special reservations because the negative effects are probably not biased and significant positive effects are probably even stronger than the estimates suggest. We should pay special attention to weak positive effects that are not significant, which may be statistically insignificant because they are underestimated.

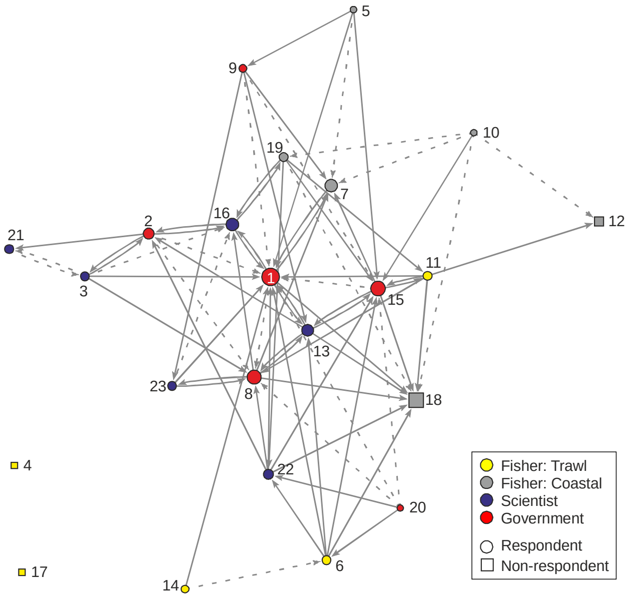
## 2.4 The Case studies

As described in the research design a uniform approach was constructed for dealing with all case studies. And although each case study has its own specific characteristics, the described sequential approach was applied to all cases:

- Baltic Sea - Gulf of Riga herring
- Baltic Sea - Salmon (Finland)
- Baltic Sea - Salmon (International)
- Mediterranean swordfish
- United States New England Groundfish fisheries
- Australian Northern Prawn Fisheries

# 3 Baltic Sea - Gulf of Riga herring

## 3.1 Main findings




The case study examines fisheries management practices within Estonia, focusing on Gulf of Riga herring.

Gulf of Riga herring is a separate population of Baltic herring (Clupea harengus membras) that occurs mainly in the Gulf of Riga, the eastern part of ICES Sub-division 28.

The social network diagram depicts a top-down management system centralized around a few government representatives.

The respondents seem to agree more on the management statements than on the facts.

Network effects are more common on value laden management statements and on importance or harmfulness of statements. The network effect seems however to be negative more frequently than positive, which indicates that the discussion does not necessarily bring about consensus.

Indirect network effects are more frequent than direct network effects suggesting an important role of one of the non-respondents.

## 3.2 Description of the case study

The case study examines fisheries management practices within Estonia, focusing on Gulf of Riga herring. The aim is to investigate how managers, scientists and stakeholders interact behind the formal institutions, and whether and how the interaction influences agreement and disagreement between the groups. The partnership of the University of Tartu and the focus of Baltic herring in two WP4 case studies in JAKFISH contributed in the decision to target herring fishery management in Estonia. The management of Gulf of Riga herring was selected of the three herring fisheries in Estonia (Gulf of Finland herring fishery, Baltic Main Basin herring fishery, and Gulf of Riga herring fishery) because it offered a national level case with two user groups of the fishery. Focusing on the annual decision making related to the trawling ban appeared an interesting and clearly definable case study to examine the biological and value related stakeholder views.

### 3.2.1 Management of Gulf of Riga herring

Gulf of Riga herring is a separate population of Baltic herring (Clupea harengus membras) that is met mainly in the Gulf of Riga, the eastern part of ICES Sub-division 28 (ICES 2011). The abundance and biomass of Gulf of Riga herring has shown, in contrast to the Central Baltic herring, an increasing trend since the late 1980s, mostly due to favourable reproduction conditions (Raid and Kaljuste, 2006; ICES 2011). However, the historical performance of stock assessments has shown an overestimation of spawning stock biomass and an underestimation of fishing mortality since 2000 (ICES 2011), and in the light of the EU policy paper on fisheries management this stock is currently classified under category 3 (Stock outside safe biological limits) (EC 2010). In the stock assessment of 2011, the value of SSB was revised downwards and fishing mortality upwards and as a result a reduction of 21% for the TAC was proposed by the EC (ICES 2011; EC 2011).

The Gulf of Riga herring fishery is divided between Estonia and Latvia, both of which perform two kinds of fishery: trawl fishery and trapnet fishery (ICES 2005; 2011). In Estonia the trapnet fishery constitutes about 70% of the total catches while trawl catches make on average 30%. In Latvia, about 85% are taken by trawls and 15% by trapnets (ICES 2011).

Trawl fishery can in principle be performed all year around, except that in most winters the fishery is stopped or reduced due to ice coverage of the gulf. The trapnet fishery targets exclusively spawning herring, and thus takes place during the spawning period from mid-April to July (ICES 2011).

No explicit management objectives have been defined for the stock (ICES 2011). A number of protection measures limit the number and engine power of trawlers as well as trawling in shallow waters (Fish source 2011). A summer closure from mid-June to mid-September is annually implemented in Estonia, and a 30-day ban on trawling during herring's peak spawning takes place both in Latvia and Estonia in April-June (ICES 2011).

The starting date of the 30-day trawling ban is an issue decided every year, and frequently it rouses arguing both between the Estonian stakeholders, and between Estonia and Latvia. The Estonian and Latvian managers have not been able to agree a simultaneous spring closure, and usually the closure takes place in Estonia earlier than in Latvia. In Estonia, the timing of the closure is decided by the ministry of the Environment based on advice from the scientists that deduce the migration time from hydro meteorological conditions (water temperature, melting of ice, etc.). The period of the trawling ban during the herring spawning migration is the high fishing season of the coastal fishery.

### 3.2.2 Formal science-management system and the role of the stakeholders

Table 3-1 lists the national key players in Estonian fisheries management. The responsibility of the fisheries sector in Estonia is divided between the Ministry of Agriculture and the Ministry of the Environment. The Ministry of Agriculture is responsible for the economic development of fisheries sector, including market organization system, implementing structural and state aid, organizing commercial fishing, administering fishing permits and maintaining records on fishing (http://www.agri.ee/fisheries/; CCB 2004). Ministry of Environment is responsible for exploitation of the fish resources of Estonian waters. It manages and coordinates research, assessment, exploitation, reproduction and protection of fish resources, and makes the main contribution in shaping the national fisheries policy (http://www.envir.ee/67251; CCB 2004).

The scientific knowledge for decision making is produced by the Estonian Marine Institute of the University of Tartu, based on project-specific contracts. This means that the ministry pays an agreed amount of money for the scientific institute for an agreed scientific contribution. The research is resourced by the Ministry of Environment with taxes collected from fishers in licences and catches.

The fishing industry stakeholders are unionized in local and state-wide fishing and producer organizations. The top organization of both trawling fishery companies and regional coastal fisherman unions is the Estonian Fishermen's Association that aims at helping and protecting its members' interests, improving and securing a stable development of the national fishery, and at participating in fisheries management processes (CCB 2004; FAO 2005). The Estonian Association of Fishery, a producer organization, aims at developing domestic fish processing and promoting the competitiveness of fish production on the domestic and foreign markets (CCB 2004; http://www.kalaliit.ee/). Regional and sectored fisherman and producer organizations aim at protecting their members' interests, mediating information, and at influencing in law making processes (CCB 2004). Many of the local fisherman organizations are involved in the Fisheries Local Action Groups (FLAGs), non-profit developing groups of coastal fishing communities funded by the European Fisheries Fund Axis 4 (EFF 2011). The FLAGS were established in 2008/2009, to foster bottom-up socio-economic development in the fisheries areas through adding value to fisheries, diversifying the local economy and raising participation of fishermen (Farnet 2011). The Estonian Fisheries Network is a top organization that comprises the eight FLAGs and a network support unit, and aims at promoting the exchange of knowledge and experience at national and EU level, and at involving beneficiaries and other parties interested in the development of fisheries (Farnet 2011).

The fisherman and producer organizations do not have a formal role in fisheries policy making. Their objective, however, is to influence in management processes both at the national level and at the international level; the Estonian Fishermen's Association represents Estonian fishermen in the Baltic Sea Regional Advisory Council, BSRAC. It has been reported that during a few past years, the stakeholders have been more involved in national policy processes, and it is common today that the ministries encourage proposals from stakeholders (Farnet 2010). The FLAGs have succeeded both in enhancing cooperation at the local level, and in facilitating communication between fishers and the two ministries (Axis 4, 2010).

Table 3-1 The national key players of fisheries management in Estonia (CCB 2004; Interviews 2009; 2010)

| | |
|---|---|
| The Ministry of Environment: | |
| Fishery and Fish resources department | Manages and coordinates research, assessment, exploitation, reproduction and protection of fish resources, and makes the main contribution in shaping the national fisheries policy. |
| Local Environmental Services | Issues fishing permits, collects fishing statistics, and ensures implementation of governmental fishery policy on local level. |

| | |
|---|---|
| The Ministry of Agriculture:<br><br>Department of Fisher Economics<br><br><br>Strategy Department | <br><br>Deals with issues of pisciculture, production, processing and marketing of fish and fish products.<br><br>Organizes marketing environment for fishery, participates in international collaboration and in monitoring the performance of obligations under fishery conventions and international agreements. |
| The Environmental Inspectorate | A domain of the Ministry of Environment, that controls performance of fishery legal acts, inspects fishing harbours and fishing vessels and makes proposals about fishing restrictions or closures if fish resources are endangered. |
| The Estonian Marine Institute (UTartu) | The main academic research institute for fisheries. Besides assessment, monitoring and prediction about resources condition, it gives academic advice about sustainable exploitation and protection of resources and develops international cooperation in marine science area, especially ICES. |
| The Estonian Fishermen's Association | Aggregates fishing enterprises and fishing organizations state-wide, both related to trawling and coastal fishing in Estonia. The objective of the association is to help and protect its members' interests. |
| Regional or sector specific fishermen unions | Objectives are to participate in law making processes, and to forward fishing information to its members and members' proposals to government level. |
| The Fish producer organizations (AEFP) | Aim at securing a stable economic situation in fish production and raising Estonian fish products' ability to compete on the open market. |
| Fisheries Local Action Groups (FLAGs) | Non-profit developing groups of coastal fishing communities funded by the European Fisheries Fund (EFF, Axis 4, est. 2008/2009), aiming at fostering a bottom-up socio-economic development in the fisheries areas through adding value to fisheries, diversifying the local economy and raising participation of fishermen. |
| The Estonian Fisheries Network | EFF's technical assistance (2008-), that comprises the eight FLAGs and a network support unit. Its main task is to promote the exchange of knowledge and experience at national and EU level, involving beneficiaries and other parties interested in the development of fisheries. |

## 3.3 Data collection and methodology

### 3.3.1 Interviews

Seven half-structured thematic interviews were carried out, following the commonly agreed question guideline of WP 5.1. The aim of the interviews was to 1) identify the major institutional actors and key people in those institutions, 2) to examine how science is used in developing marine policy, 3) to hear opinions for improvement in the structuring of science in support for policy with the emphasis on handling uncertainty and the role of communication, 4) identify the most salient issues, and to find a knowledge object for the network analysis, 5) talk through the various conflicting interests and values related to the knowledge object, and 6) talk through the main areas of agreement and disagreement in respect to nature. Through analysing these interviews, the aim was to outline a) a general picture of the policy network, and b) the major discursive themes related to the Gulf of Riga herring management through which facts, values and interests are related.

The interviews covered all the main actor groups dealing with the Gulf of Riga herring fishery: a manager, a scientist, a representative of trawl fishers, a chairman of a fisherman organization, and two coastal fishermen who also had positions in fisherman organizations. In addition, a parliament member of the green party was interviewed that also was a representative of an environmental NGO and a researcher by profession, and thus was well acquainted with the issue. The manager was interviewed twice. The interviews were recorded and transcribed. The interview data provided a good overview of the Gulf of Riga herring management practices, but in addition to that, relevant documents and scientific articles were collated.

### 3.3.2 Discourse analysis

The interviews revealed a fisheries management system that is strictly in the hands of the two Ministries, but also that there is a common will to develop management towards procedures that more involve stakeholders. “Round table” discussions have been a practice for a few years: the Ministry invites both scientists and stakeholders to go through policy issues together. The stakeholders see an improvement taken place during the past few years in terms of participation, but doubt whether their views matter, and whether the views of certain groups matter more than the views of other groups. One stakeholder complained about missing dialogue between managers and stakeholders, and considered fisheries management at the EU level working better than the national management system in this respect.

AXIS 4 (2010) reports of a suspicion towards “cooperative activities” in Estonia, associated with the Soviet times, which has resulted in minimal local level initiative, and further dampened stakeholders’ role in policy processes (Axis 4, 2010). Dividing the fisheries issues into the responsibility of two ministries also is reported to make the processes and rules complicated for fishers (Axis 4, 2010).

Overall, the scientific knowledge base used for policy making seems to be trusted and regarded important by both the managers and the fishermen, but the practice of organizing science for policy based on case specific projects was criticized, e.g. because it causes a lot of paper work and disputing every year. The economic resources available for the scientific management advices are scarce, which is suspected to lead to a poor adequacy or too small scaled scientific contribution; and because non-scientists do not have the ability to evaluate the research it is only the scientists that can define the amplitude of their research in relation to the available money. The interviews also indicated occasionally arising doubts about the impartiality of the project based research, in relation to its funding. Some of the interviewees regarded research conducted by the ICES as more reliable than that of the national research institute.

In the interviews, it came out that a more long-term and stabile funding practice for producing the scientific basis for fisheries management would be preferred, to enable more extensive data collecting and thus to ensure the quality of the scientific work, and also to avoid the recurrent debate around the contracts. A need for an increased transparency of the scientific processes was also revealed, to enable the managers to evaluate the reliability, quality and economic value of a scientific advice, and to help also fishers understand what the results are based on; sometimes the fishermen doubt the results of the research if their own observations do not match with them. The interviewed fishers did not really consider it necessary to understand scientific methods, but convincing about the reliability and validity of research was seen essential.

Some of the fishers are involved in local level collaboration with researchers and through this have a touch on science. They help the scientists collect samples and make observations. This activity is not established or systematic, and not at all official, but rather based on good relationships between very few fishers and few scientists.

The discourse analysis meant classifying the transcribed interviews into themes, and further identifying categories, views, and roles. The formal science-management system, the role of different stakeholders, and science-management debates were analysed. Discursive themes that seemed to be commonly shared within the different actor groups were searched for. Especially issues that seemed to provoke disagreement among the different groups were of interest.

The trawling ban of Gulf of Riga herring implemented annually in the spring formed an appropriate theme for investigating the agreements and disagreements of the actor groups. It was the only issue in relation to Gulf of Riga herring management, that regularly causes debates among actor groups, both related to factual assumptions, and interests of stakeholders.

Three different discursive sub-themes were selected to form a set of 32 statements. Of the statements, 16 were factual (natural or economic) claims, and 16 were related to interests and management, and thus more explicitly value-laden. The sub-themes revolved around: 1) The potential threat caused by trawlers to herring spawning, and the importance of the trawling ban (12 statements); 2) Timing of the trawling ban (15 statements), and 3) Trawling ban in Estonia vs. in Latvia (5 statements). In formulating the statements, both the interviews and literature (scientific articles etc.) were used, and they covered both agreement and disagreement with the views expressed in the discourse. The statements formulated by the researcher were reviewed by the leader of JAKFISH WP5 and two Estonian fisheries scientists.

### 3.3.3 Survey

The interviews produced a chart of the organizations and people that contribute in the discussions related to herring fishery policy making. The chart included 23 people representing the government, scientists, and different kinds of fisherman and producer associations, including FLAGs that seemingly have acquired a strong position in fisheries management. Each interviewed person was shown the chart drawn by the first interviewee, and asked to correct or complement it based on his/her perception on the organizations and persons that should be included. The chart drawn by the first person was not much changed by the others, and this convinced the researcher that all relevant organizations and persons were included. All these persons were included in the group of respondents for the survey. Thus, the p-set included six government officials, six scientists, and eleven representatives of the fisheries sector.

The statements, the initial letter, the distribution email and the survey instructions were translated from English to Estonian by a translation company in Estonia. The translations of the statements were back translated and checked by an Estonian fisheries scientist that also test-used the survey. The survey was distributed on 3rd November 2010. Four reminders were sent, the last one on 21st January.

Of the 23 persons invited to participate in the survey, 19 completed it. All of the non-responders are members of the fishing industry, equally distributed over coastal and trawl fishing industry. Two of the non-respondents, both representing coastal fishing industry, were selected as important discussion partners by the respondents, whereas the two trawl fishers who did not respond, seem to be more peripheral: no one of the respondents selected them. The responders include 6 scientists, 6 government representatives, 4 representatives of coastal fishing industry, and 1 representative of trawl fishing industry. Two of the respondents represent both trawl and coastal fishers, but because too small groups (less than three persons) had to be avoided in the analysis, both of them were typified in the trawler group; this may have an impact on the results.

Two of the non-respondents explained their decision not to respond to the researcher: one of them complained about ambiguous statements, and the other saw the network questions irrelevant because in his/her view, individual people are not responsible for decisions that are taken by institutions/authorities or working groups. One person gave the feedback that the questionnaire was too long and boring, but despite this responded.

## 3.4 Social network analysis

Figure 3-1 is a sociogram of the total network. Circles indicate respondents and squares represent non-respondents; the size of the circle and box shows the number of nominations received while the interior colour of circles and boxes denotes the stakeholder group partition. Dashed lines are discussion ties within stakeholder groups and solid ties indicate discussion between stakeholder groups.

The diagram indicates high network heterogeneity: 75% of the discussion ties are among members of different stakeholder groups, and as a consequence of this, the stakeholder types are not clearly distinguished in the network. However, the scientists tend to be concentrated on the other side than fishers, whereas the managers are in the middle. There is a core consisting of members of all four stakeholder types. The most central persons are the three government managers (1, 15, 8) who seem to discuss with all the other groups; almost everybody in the network is linked at least to one of them. The scientists are situated among the government members and most of their discussion links are with them. The coastal fishers seem to be rather well involved in discussion with the government, and have also straight contacts with scientists. Overall the trawl fishers (yellow vertices) seem to be a bit more peripheral to the discussion network, with the exception of expert 11. S/he represents both trawl and coastal fishers, but was grouped with the trawl fishers for the analysis. S/he is located at the side of the coastal fishing industry in the discussion network.

The descriptive values 'network density' and 'input degree of centralization' were measured. The network density (the proportion of all ties that could be present that actually are) is 0.16, which is low as it indicates that only 16% of all possible discussion ties are present. The input degree of centralization indicating power, stratification, ranking, and inequality in social structures, is 0.50, which gives the impression of relatively much concentrated power: a substantial part of the connections go through few central intermediaries (Introduction to Social Network Methods).

One non-responder (expert 18) received many nominations as a frequent discussion partner; this expert is mainly responsible for the indirect network effects in the statistical models presented below.

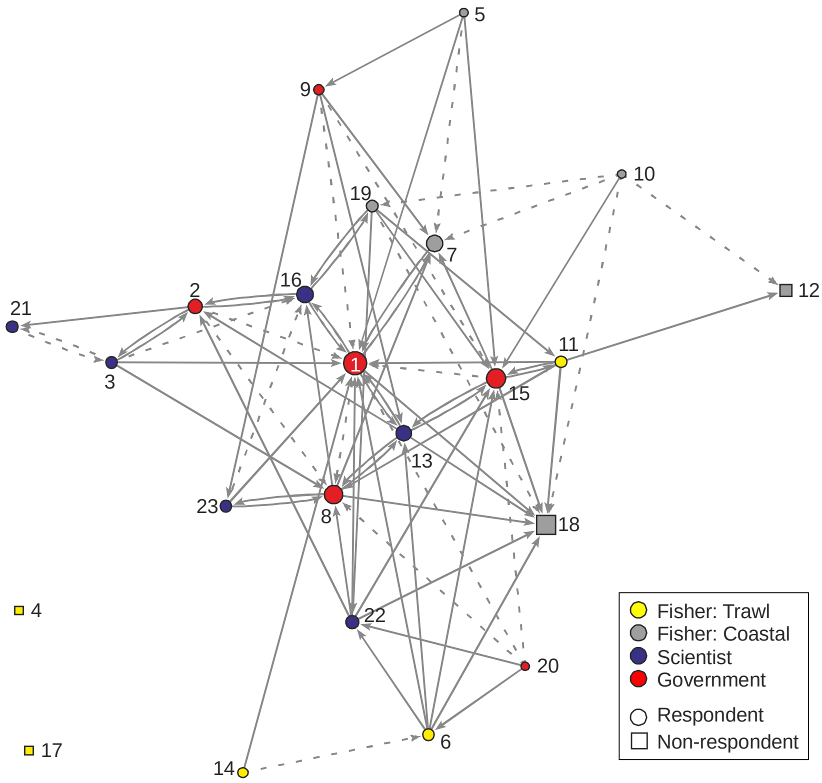



Figure 3-1 Sociogram of the discussion network, @ (vertex size represents indegree, within-group ties are dashed).

## 3.5 Q-sort analysis

### 3.5.1 Overall levels of disagreement in the network

The first part of the q-sort analysis regarded the variation of individual views on statements related to management, and on natural and economic facts and their importance/harmfulness. In the analysis below, the statements are abbreviated; the complete statements presented to the respondents can be found in the appendix.

The output of the analysis shows that some of the management goal statements are more contested than the others, whereas the responses to the knowledge questions and the salience of knowledge show more variation (Table 3, Table 4).

In none of the statements related to management, the distribution of responses varies between the extremes -3 and 3; standard deviations range from .62 to 1.41 (Table 3-2). The widest distribution has the statement 9 and statement 11, where opinions vary between -3 and 2; in the other statements the distribution is narrower.

The management statements that the respondents mostly **disagree** between each other are 2 (Trawling should be allowed during the spawning migration of herring), 3 (Trawling ban is important in ensuring that the coastal fishers can catch their quota), 9 (In timing of the ban, the socio-economic situation of fishers must be taken into account), and 11 (The ministry must have the exclusive right to decide the timing of the ban).

The statements that the respondents most **agree** with each other are 6 (Estonia implements trawling ban too early), 12 (The ban must start later than 20$^{th}$ April), 13 (Scientists, stakeholders and managers should negotiate timing), and 4 (Trawling ban essential).

Table 3-2 Abbreviated survey questions on management goals, (N = 19).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| **The spawning concentrations of the Gulf of Riga herring schools must be protected from trawlers.** | | | | |
| 1. 30-day trawling ban April-May required to avoid decrease prices | -1.32 | -3.00 | 1.00 | 1.16 |
| 2. Trawling allowed during the spawning migration of herring | -1.74 | -3.00 | 1.00 | 1.41 |
| 3. April-May trawling ban ensures coastal fishers can catch their quota | -.05 | -2.00 | 2.00 | 1.31 |
| 4. 30-day trawling ban April-May essential for sustainability stock | 2.58 | 1.00 | 3.00 | .77 |
| 5. Coastal fishery also closed during spring spawning concentrations | -1.32 | -3.00 | .00 | 1.20 |
| **The trawling ban must be implemented just at the right time.** | | | | |
| 6. Estonia usually implements herring trawling ban too early in spring | -1.05 | -2.00 | .00 | .62 |
| 7. After icy winters with poor fishing the ban should be postponed | -.74 | -2.00 | 2.00 | 1.15 |
| 8. The min. of Env. in Estonia has succeeded well in timing the ban | .58 | -1.00 | 3.00 | 1.02 |
| 9. In timing the ban weight of soc-econ. sit. fishers= weight scientific advice | -.47 | -3.00 | 2.00 | 1.31 |
| 10. The trawling season should be closed before the beginning of May | .95 | -1.00 | 2.00 | .85 |
| 11. The ministry must have the exclusive right to decide the timing of the ban | .05 | -3.00 | 2.00 | 1.31 |
| 12. The 30-day ban must start later than the 20th of April | -.16 | -2.00 | 1.00 | .76 |
| 13. Scientists, stakeholders and managers should negotiate timing of the ban | 1.47 | .00 | 3.00 | .77 |
| **Estonia and Latvia cannot reached an agreement on implementing the spring trawling ban concurrently** | | | | |
| 14. Same timing of 30-day trawling ban in Estonia and Latvia | 1.16 | -2.00 | 2.00 | 1.01 |
| 15. Estonia should implement ban later like Latvia does | -1.11 | -2.00 | 2.00 | .99 |

| | | | | |
|---|---|---|---|---|
| 16. May trawling ban in Latvia is too late to protect migrating herring schools | 1.16 | -1.00 | 3.00 | 1.21 |

The fact statements (Table 3-3) indicate more disagreement among respondents: in several statements the distribution is between the extremes -3 and 3, and SD near to 2.00.

The fact statements that the respondents mostly **disagree** between each other are 11 (Earlier ban after ice has melted leads to more successful spawning), 8 (Herring start spawning migration in March or early April), and 1 (Trawlers can scatter the herring schools). Other assumptions that the respondents have very different views are 2 (Trawlers scattering schools leads to lower catches in coastal fishing), 5 (Coastal fishing causes poorer spawning), and 9 (Coastal fishers catch annual quota during spawning time).

There are not any fact statements that would be considerably **agreed**: the statement that awakes the least disagreement is 4 (Trawlers scattering schools leads to poorer spawning performance).

Table 3-3 Abbreviated survey questions on knowledge about biological and economic facts, (N = 19).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| **The spawning concentrations of the Gulf of Riga herring schools must be protected from trawlers.** | | | | |
| 1. Trawlers can scatter the schools migrating to spawning grounds | 1.68 | -3.00 | 3.00 | 1.92 |
| 2. Trawlers scattering schools leads to lower catches in coastal fishing | 1.05 | -3.00 | 3.00 | 1.84 |
| 3. April-May ban contributed strongly to sustainable state population | 1.95 | -2.00 | 3.00 | 1.35 |
| 4. Trawlers scattering schools leads to poorer spawning performance | 2.11 | -1.00 | 3.00 | 1.20 |
| 5. Coastal fishing in spawning grounds causes poorer spawning | .89 | -3.00 | 3.00 | 1.82 |
| 6. Usual trawling season Estonian side: begin October to middle April | 2.11 | -2.00 | 3.00 | 1.15 |
| 9. Coastal fishers catch annual quota during spawning time in spring | 1.84 | -3.00 | 3.00 | 1.83 |
| **The trawling ban must be implemented just at the right time.** | | | | |
| 7. Migration to spawning grounds starts early spring when ice melting | 1.84 | -3.00 | 3.00 | 1.68 |
| 8. Herring start migrating to spawning grounds in March or early April | 1.21 | -3.00 | 3.00 | 1.96 |
| 10. Scientific advice for closing date is based on water temperature | 1.84 | -2.00 | 3.00 | 1.42 |
| 11. Earlier ban after ice has melted leads to more successful spawning | .63 | -3.00 | 3.00 | 2.03 |
| 12. After cold winters herring migrates and spawns later | 1.63 | -3.00 | 3.00 | 1.77 |
| 13. Due to varying climate conditions timing of April-May ban annually | 2.16 | -2.00 | 3.00 | 1.57 |
| 14. Average spawning period two months end of April-beginning of July | 1.79 | -2.00 | 3.00 | 1.55 |
| **Estonia and Latvia cannot reached an agreement on implementing the spring trawling ban concurrently** | | | | |
| 15. Spawning grounds mostly situated on the Estonian side | 1.84 | -2.00 | 3.00 | 1.71 |
| 16. If schools migrate along Latvian coast danger trawler scattering larger | 1.11 | -2.00 | 3.00 | 1.59 |

Some of the fact statements awake more disagreement on their salience (importance/harmfulness) than the others (Table 3-4). In this respect, statements that are found very harmful by some people and very important by the others are e.g. 3 (April-May ban has contributed strongly to sustainable state of the population), 1 (Trawlers can scatter herring schools), and 9 (Coastal fishers catch annual quota during spawning time in spring). In all these statements the distribution of responds is between -3 and 3, and SD above 1.50. In statement 11 (Earlier ban after ice has melted leads to more successful spawning), SD is high (1.76) whereas the distribution range is narrower, between -3 and 2.

Table 3-4 Abbreviated survey questions on the salience (importance/harm) of biological and economic facts, (N = 19).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| **The spawning concentrations of the Gulf of Riga herring schools must be protected from trawlers.** | | | | |
| 1. Trawlers can scatter the schools migrating to spawning grounds | .58 | -3.00 | 3.00 | 1.64 |
| 2. Trawlers scattering schools leads to lower catches in coastal fishing | -.26 | -3.00 | 2.00 | 1.48 |
| 3. April-May ban contributed strongly to sustainable state population | 1.05 | -3.00 | 3.00 | 1.81 |
| 4. Trawlers scattering schools leads to poorer spawning performance | .74 | -2.00 | 3.00 | 1.33 |
| 5. Coastal fishing in spawning grounds causes poorer spawning | -.74 | -3.00 | 1.00 | 1.33 |
| 6. Usual trawling season Estonian side: begin October to middle April | -.95 | -3.00 | 1.00 | 1.08 |
| 9. Coastal fishers catch annual quota during spawning time in spring | .05 | -3.00 | 3.00 | 1.54 |
| **The trawling ban must be implemented just at the right time.** | | | | |
| 7. Migration to spawning grounds starts early spring when ice melting | .00 | -3.00 | 2.00 | 1.41 |
| 8. Herring start migrating to spawning grounds in March or early April | -.26 | -2.00 | 3.00 | 1.41 |
| 10. Scientific advice for closing date is based on water temperature | -.26 | -2.00 | 2.00 | 1.10 |
| 11. Earlier ban after ice has melted leads to more successful spawning | -.89 | -3.00 | 2.00 | 1.76 |
| 12. After cold winters herring migrates and spawns later | .37 | -2.00 | 3.00 | 1.38 |
| 13. Due to varying climate conditions timing of April-May ban annually | 1.11 | -2.00 | 3.00 | 1.52 |
| 14. Average spawning period two months end of April-beginning of July | -.05 | -3.00 | 2.00 | 1.31 |
| **Estonia and Latvia cannot reached an agreement on implementing the spring trawling ban concurrently** | | | | |
| 15. Spawning grounds mostly situated on the Estonian side | .84 | -2.00 | 3.00 | 1.64 |
| 16. If schools migrate along Latvian coast danger trawler scattering larger | -1.32 | -3.00 | 1.00 | 1.16 |

### 3.5.2 Comparing agreement and disagreement levels between groups in the network

The autocorrelation models were used to examine differences and network effects in beliefs and opinions between groups of people belonging to the discussion network, and to test whether respondents agree across the stakeholder types. The investigated stakeholder types were 'Trawl fishers', 'Coastal fishers', 'Scientists', and 'Government'; the last one was used as the reference category in the model. The analysis concentrates on the statistically significant results ($p < .05$ or $p < .01$), but to avoid missing important response patterns falling under the threshold of significance tests, also other results will be referred to.

In the management goals there are three subthemes.

Sub-theme 1: Threat of trawling on spawning (Table 3-5)

- The coastal fishers and trawl fishers agree with each other on statement 1 (30-day trawling ban required to avoid decrease prices) and statement 3 (Trawling ban ensures coastal fishers can catch their quota).

Subtheme 2: Timing of the trawling ban (Table 3-6)

- On statements 9 (Take socio-economic situation into account when deciding timing of trawling ban) and 10 (Close trawling season before May) the coastal fishers take a position that differs from the others.
- Statement 11 (The ministry must have the exclusive right to decide timing) shows that coastal fishers and trawl fishers agree with each other, while differing from the position of government and scientists.

- In statement 12 (Start ban later than 20th April) the coastal fishers together with scientists have a similar position to the issue while the trawl fishers agree with the government.

Sub-theme 3: Trawling ban in Estonia vs. in Latvia (Table 3-5)

- On statement 14 (Same timing of trawling ban in Estonia and Latvia) the coastal fishers display a strong opinion that to some extent differs from the others.
- On statement 16 (Trawling ban in Latvia is too late to protect migrating herring schools) the coastal fishers and trawl fishers again show agreement with each other, whereas the opinion of the scientists is closer to that of the government.

Table 3-5 Network autocorrelation results for **management goals**: spawning concentrations protection and Estonia-Latvia agreement, Riga Herring (N = 19).

| | Item 1 | | Item 3 | | Item 14 | | Item 15 | | Item 16 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | b | p | b | p | b | p | b | P | b | p |
| Constant | -1.85 | 0.003** | -0.43 | 0.449 | 2.21 | 0.000** | -0.86 | 0.196 | 0.54 | 0.250 |
| Coastal Fishing† | 1.62 | 0.005** | 1.67 | 0.038* | -1.64 | 0.000** | -0.52 | 0.345 | -0.93 | 0.036* |
| Trawl Fishing† | 1.86 | 0.003** | 1.15 | 0.098 | -0.29 | 0.553 | 0.98 | 0.142 | -1.22 | 0.006** |
| Scientist† | 0.59 | 0.236 | -0.34 | 0.542 | -0.40 | 0.300 | -0.55 | 0.270 | 0.41 | 0.240 |
| rho(direct) | 0.03 | 0.728 | 0.02 | 0.874 | -0.05 | 0.572 | 0.01 | 0.901 | 0.20 | 0.001** |
| rho(indirect) | 0.02 | 0.475 | -0.01 | 0.945 | -0.09 | 0.028* | 0.01 | 0.778 | -0.04 | 0.254 |

*Note*. * $p < .05$; ** $p < .01$

† Reference category: Government.

Table 3-6 Network autocorrelation results for **management goals**: trawling ban, Riga Herring (N = 19).

| | Item 7 | | Item 9 | | Item 10 | | Item 11 | | Item 12 | | Item 13 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | b | p | b | p | b | p | b | P | b | p | b | p |
| Constant | -2.27 | 0.000** | -1.22 | 0.028* | 0.65 | 0.357 | 0.21 | 0.575 | -0.61 | 0.002** | 1.82 | 0.003** |
| Coastal Fishing† | 0.47 | 0.307 | 1.96 | 0.002** | 1.12 | 0.031* | -1.39 | 0.010* | 0.63 | 0.036* | 0.41 | 0.351 |
| Trawl Fishing† | 0.98 | 0.058 | 0.40 | 0.534 | -0.01 | 0.991 | -1.18 | 0.036* | -0.06 | 0.852 | -0.76 | 0.137 |
| Scientist† | 0.63 | 0.135 | 0.45 | 0.406 | 0.40 | 0.430 | 0.37 | 0.416 | 0.70 | 0.014* | -0.27 | 0.515 |
| rho(direct) | -0.30 | 0.000** | 0.01 | 0.916 | -0.06 | 0.643 | 0.09 | 0.520 | 0.27 | 0.001** | -0.08 | 0.365 |
| rho(indirect) | -0.06 | 0.267 | -0.19 | 0.195 | 0.04 | 0.290 | -0.33 | 0.035 | -0.46 | 0.000** | 0.03 | 0.195 |

*Note*. * $p < .05$; ** $p < .01$

† Reference category: Government.

On the **factual statements** there are three subthemes

In Sub-theme 1 (The spawning concentrations of the Gulf of Riga herring schools must be protected from trawlers) there are no significant results.

Sub-theme 2: Timing of the trawling ban (Table 3-7)

- The coastal fishers and the scientists agree with each other on statement 8 (Herring start migrating in March or early April), whereas the trawl fishers have a belief close to that of the government.
- On statement 10 (Scientific advice based on water temperature), the coastal fishers and the trawl fishers agree with each other; the scientists' belief is closer to the governments' belief.
- The other statements do not show any significant results although

- For item 13 (Due to varying conditions timing to be decided annually) the coastal fishers and the trawl fishers tend agree with each other, whereas the scientists' position is close to that of the government.
- On fact statement 14 (Average spawning period two months end of April-beginning of July), the view of scientists tends to differ from the others' views but is closest to the coastal fishers.

Sub-theme 3: Trawling ban in Estonia vs. in Latvia (Table 3-7)

- Statement 15 (Spawning grounds mostly situated on the Estonian side): the trawl fishers display a position that differs from the others, and mostly from the government.
- The coastal fishers and the scientists agree with each other on statement 16 (If schools migrate along Latvian coast, danger of scattering trawlers bigger); their opinion is much stronger than that of trawl fishers that are closer to the government.

Table 3-7 Network autocorrelation results for **factual knowledge claims**: trawling ban and Estonia-Latvia agreement, Riga Herring (N = 19).

| | Item 8 | | Item 10 | | Item 12 | | Item 13 | | Item 14 | | Item 15 | | Item 16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | b | p | b | p | b | p | b | P | b | p | b | p | b | p |
| Constant | 0.27 | 0.719 | 2.47 | 0.006** | 2.20 | 0.114 | 2.91 | 0.001** | 0.59 | 0.504 | 2.40 | 0.028* | 0.29 | 0.642 |
| Coastal Fishing† | 2.47 | 0.009** | -1.65 | 0.016* | -1.43 | 0.218 | -1.38 | 0.068 | 0.57 | 0.520 | -0.89 | 0.363 | 1.71 | 0.023* |
| Trawl Fishing† | 0.43 | 0.707 | -2.07 | 0.005** | 0.38 | 0.741 | -1.15 | 0.185 | -0.54 | 0.538 | -2.08 | 0.049* | 0.32 | 0.742 |
| Scientist† | 2.07 | 0.047* | 0.48 | 0.410 | 0.62 | 0.595 | 0.20 | 0.752 | 1.71 | 0.014* | 0.58 | 0.472 | 1.83 | 0.011* |
| rho(direct) | -0.01 | 0.937 | -0.01 | 0.836 | -0.04 | 0.691 | 0.03 | 0.667 | 0.08 | 0.343 | 0.00 | 0.990 | 0.09 | 0.408 |
| rho(indirect) | -0.09 | 0.306 | 0.01 | 0.855 | -0.04 | 0.490 | -0.11 | 0.012* | 0.01 | 0.763 | -0.04 | 0.459 | -0.13 | 0.160 |

*Note*. * $p < .05$; ** $p < .01$

† Reference category: Government.

On the salience statements, (importance/harmfulness of knowledge) there are three sub-themes

Sub-theme 1 (Threat of trawling on spawning, Table 3-8) does not show any significant results.

Sub-theme 2 (Timing of the trawling ban, Table 3-9):

- The coastal fishers have a very similar opinion with trawl fishers on the salience of fact statement 10 (Scientific advice for closing date based on water temperature); the scientists seem to agree with the government.
- The coastal fishers and the trawl fishers agree with each other on statement 11 (Earlier ban after ice has melted leads to more successful spawning), whereas the scientists and government tend to take a somewhat opposite position.
- Statement 13 (Due to varying climate conditions timing ban to be decided annually) provokes exactly the same view in both coastal and trawl fishers which is very different from the perception of the government.

Subtheme3 (Trawling ban in Estonia vs. in Latvia, Table 3-8):

- A significant different position is observed for the government on statement 16 (If schools migrate along Latvian coast danger trawler scattering larger)

Table 3-8 Network autocorrelation results for **salience** of knowledge: spawning concentrations protection and Estonia-Latvia agreement, Riga Herring (N = 19).

| | Item 5 | | Item 6 | | Item 15 | | Item 16 | |
|---|---|---|---|---|---|---|---|---|
| | b | p | b | p | B | P | b | p |
| Constant | -0.72 | 0.192 | -1.01 | 0.105 | 0.88 | 0.175 | -1.60 | 0.049* |
| Coastal Fishing† | -0.61 | 0.329 | -0.44 | 0.425 | 0.22 | 0.779 | 1.17 | 0.084 |
| Trawl Fishing† | -0.26 | 0.714 | 0.32 | 0.616 | -0.84 | 0.354 | -0.90 | 0.169 |
| Scientist† | -0.83 | 0.141 | 0.11 | 0.828 | 0.65 | 0.342 | 0.20 | 0.722 |
| rho(direct) | 0.00 | 0.974 | 0.11 | 0.296 | 0.06 | 0.521 | 0.01 | 0.901 |
| rho(indirect) | -0.32 | 0.010* | -0.26 | 0.004** | -0.42 | 0.014* | -0.04 | 0.342 |

*Note*. * $p < .05$; ** $p < .01$

† Reference category: Government.

Table 3-9 Network autocorrelation results for **salience** of knowledge: trawling ban, Riga Herring (N = 19).

| | Item 8 | | Item 10 | | Item 11 | | Item 12 | | Item 13 | | Item 7 | | Item 14 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | b | p | b | p | b | P | b | p | b | p | b | p | b | p |
| Constant | -0.61 | 0.256 | 0.21 | 0.473 | -1.24 | 0.055 | 0.49 | 0.449 | 2.48 | 0.000** | -0.30 | 0.568 | -0.15 | 0.793 |
| Coastal Fishing† | -0.08 | 0.914 | -1.47 | 0.000** | 1.99 | 0.020* | -1.09 | 0.170 | -1.18 | 0.017* | 0.19 | 0.820 | -0.02 | 0.978 |
| Trawl Fishing† | 0.35 | 0.641 | -1.56 | 0.000** | 1.66 | 0.081 | -0.04 | 0.956 | -1.18 | 0.033* | 0.73 | 0.418 | 0.05 | 0.957 |
| Scientist† | 0.34 | 0.573 | 0.04 | 0.922 | -0.66 | 0.385 | 0.32 | 0.634 | -0.25 | 0.512 | 0.33 | 0.674 | 0.02 | 0.979 |
| rho(direct) | -0.01 | 0.954 | -0.12 | 0.213 | -0.09 | 0.320 | 0.12 | 0.277 | -0.05 | 0.411 | 0.13 | 0.324 | -0.05 | 0.717 |
| rho(indirect) | -0.43 | 0.017* | -0.19 | 0.108 | 0.09 | 0.062 | -0.22 | 0.067 | -0.50 | 0.000** | -0.17 | 0.358 | 0.05 | 0.597 |

*Note*. * $p < .05$; ** $p < .01$

† Reference category: Government.

### 3.5.3 Network effects

Significant network effects have been observed in all three analyses (management goals, knowledge claims and salience) but in general the value of network effects has been low (smaller than + or – 0.5), indicating that discussion has only slightly influenced in people's opinions and beliefs.

Negative indirect network effects for management goals have been observed for statement 7 (After icy winters with poor fishing the ban should be postponed), statement 12 (Start ban later than 20th April) and statement 14 (Same timing of trawling ban in Estonia and Latvia). Beside the negative indirect network effect for statement 12 (Start ban later than 20th April) that statement also displays a positive direct network effect meaning that discussion has had twofold influence in views. A positive direct network effects is also observed for statement 16 (Trawling ban in Latvia is too late to protect migrating herring schools).

A negative indirect network effect for knowledge is observed for statement 13 (Due to varying conditions timing to be decided annually).

On the salience of knowledge, negative indirect network effects are observed for statements 5 (Coastal fishing in spawning grounds causes poorer spawning), statement 6 (Usual trawling season is from October to middle April) through a non-respondent , statement 8 (Herring start migrating to spawning grounds in March or early April), statement 13 (Due to varying climate conditions timing ban to be decided annually) through a non-respondent and statement 15 (Spawning grounds mostly situated in the Estonian side). A positive indirect network effect is observed for statement 11 (Earlier ban after ice has melted leads to more successful spawning).

## 3.6 Discussion

The social network diagram depicts a top-down management system centralized around a few government representatives. The network is highly heterogeneous: 75% of the discussion ties are between members of different stakeholder groups. However, the discussion intensity is relatively low.

The government representatives (1, 15, 8) are in the middle of the network interacting with all groups and mediating information between scientists and fishers who tend to be situated on the opposite sides of the network. Some coastal fishers have direct contacts with some of the scientists. The trawl fishers seem more peripheral with the exception of expert 11. One of the coastal fishers (18) is in a very central position, as several persons representing all the other groups have selected him as a frequent discussion partner.

Coastal fishers most frequently display positions that are different from those of the government, but also the trawl fishers differ in relation to several statements. The scientists show a differing position from the government only in relation to a couple of statements. Agreement between coastal fishers and trawl fishers is relatively usual and concern mostly statements related to management and salience of facts in sub-theme 2 (The trawling ban must be implemented just at the right time). The coastal fishers and scientists agree on a few statements.

Overall, the respondents seem to agree more on the management statements than on the facts behind it. The network effects are more common on value laden management statements and on importance or harmfulness of statements. The network effect seems however to be negative more frequently than positive, which indicates that the discussion does not necessarily bring about consensus. Indirect network effects are more frequent than direct network effects suggesting an important role of the non-respondent (18) that was mentioned as a frequent communication partner by several respondents belonging to all stakeholder groups.

As a caveat to these results, we have to remember that two of the respondents who represented both the coastal and trawl fishers were classified in the group of trawl fishers. This may to some extent smooth out differences between these two groups.

## 3.7 Conclusions

The study suggests that the management system in Estonia is in a developing phase from top-down procedures towards enhancing stakeholder involvement; the heterogeneity of the discussion network may reflect the effort of the Fisheries Local Action Groups (FLAGs) and the Estonian Fisheries Network in increasing stakeholder participation. Today, discussion between groups takes place, but a systematic mode of accounting for stakeholder views in decision making seems to be missing. A common will towards participatory practices seems to have emerged, however.

There seems to be a consensus on how to manage the Gulf of Riga herring stocks: e.g. closing the trawling season in the spring is a conventional procedure practically agreed by all. On the other hand, there is some disagreement especially on facts, which can lead to clashing views if uncertainty increases, or if stakes become more critical.

The qualitative study indicated that the procedure of organizing scientific research for management is not adequate, and neither is the transparency of scientific research sufficient to enable an extended peer review. A more stable and long term oriented basis for organizing science for management might be a way to increase both the reliability and the comprehensibility of the scientific processes. This is also a requirement for further involving stakeholders in the policy processes.

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## 3.9 Appendix 1: statements

**Claims of fact**

*The spawning concentrations of the Gulf of Riga herring schools must be protected from trawlers.*

1. Trawlers scatter the herring schools as they migrate to their spawning grounds.
2. The scattering of herring schools by trawlers during the spawning migration leads to lower catches in the coastal fishery.
3. The April-May trawling ban has contributed strongly to the current sustainable state of the Gulf of Riga herring population.
4. The scattering of herring schools by trawlers during the spawning migration leads to poorer spawning performance.
5. The coastal fishers cause poorer spawning performance of herring when they fish in the spawning grounds.
6. The usual trawling season of herring in the Estonian side of the Gulf of Riga is from the beginning of October to the middle of April.
9. The coastal fishers catch their total annual quota during herring's spawning time in the spring.

*The trawling ban must be implemented just at the right time.*

7. The herring schools start their migration to the spawning grounds early in the spring when the ice is melting.
8. The herring start migrating to the spawning grounds in March or early April.
10. The scientific advice for the closing date of the herring trawl fishery is based on water temperature.
11. The earlier the trawling ban is implemented after the ice has melted the more successful the spawning of herring.
12. After cold winters the herring migrates and spawns later than after mild winters.
13. The timing of the trawling ban in April-May must be decided every year because of varying climate conditions.
14. On average the spawning period of the Gulf of Riga herring is two months long – from the end of April to the beginning of July.

*Estonia and Latvia cannot reached an agreement on implementing the spring trawling ban concurrently*

15. The spawning grounds of herring are mostly situated in the Estonian side of the Gulf of Riga.
16. If herring schools migrate to the spawning grounds along the Latvian coast, they are more likely to be scattered by trawlers than if they migrate along the Estonian coast.

**Claims of values / interests**

*The spawning concentrations of the Gulf of Riga herring schools must be protected from trawlers.*

1. The 30-day trawling ban in April-May must be implemented to avoid the decrease of herring prices.
2. Trawling should be allowed to continue during the spawning migration of herring.
3. The one-month trawling ban during herring's spawning migration in April-May is important in ensuring that the coastal fishers get their quota caught.
4. The one-month trawling ban during herring's spawning migration in April-May is essential in ensuring the sustainability of the Gulf of Riga herring stock.
5. Like the trawl fishery, the coastal fishery should also be closed during the spring spawning concentrations of herring.

*The trawling ban must be implemented just at the right time.*

6. Estonia usually implements the herring trawling ban too early in the spring.
7. The trawling ban of herring in the spring must be postponed after cold icy winters when trawlers' fishing possibilities have been poor.
8. The Ministry of Environment in Estonia has succeeded well in determining the timing of the trawling ban in April-May.
9. The socio-economic situation of fishers must be considered as much as the advice of scientists when taking decisions on the timing of the trawling ban during herring's spawning migrations.
10. The trawling season must be closed before the beginning of May.
11. The ministry must have the exclusive right to decide the timing for the trawling ban of herring during the spawning migrations.
12. The 30-day ban on trawling of herring during the spawning migrations must start later than 20th of April.
13. The timing of the trawling ban of herring during the spawning migrations in the spring should be negotiated between scientists, stakeholders and managers.

*Estonia and Latvia cannot reached an agreement on implementing the spring trawling ban concurrently*

14. The 30-day ban on trawling during the spawning migrations of herring in the spring should take place concurrently in Estonia and in Latvia.
15. Estonia should implement the 30-day ban on trawling during herring's spawning migration later, like Latvia does.
16. The trawling ban implemented by Latvia in May is too late to protect the herring schools migrating to their spawning grounds.

## 3.10 Appendix 2: all network autocorrelation results

Table 3-10 **- Network autocorrelation results for factual knowledge, Riga Herring (*N* = 19)**

| | spawning concentrations must be protected from trawlers | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 9 | |
| | b | p | b | p | b | p | b | p | b | p | b | p | b | p |
| constant | 3.03 | 0.032* | 0.31 | 0.721 | 1.28 | 0.175 | 0.94 | 0.308 | 1.04 | 0.287 | 2.01 | 0.042* | 1.91 | 0.137 |
| Coastal Fishing | -0.54 | 0.645 | 2.05 | 0.052 | 0.80 | 0.351 | 0.80 | 0.290 | -0.43 | 0.716 | 0.50 | 0.501 | 1.53 | 0.152 |
| Trawl Fishing | -1.24 | 0.325 | 0.51 | 0.668 | 0.50 | 0.577 | 0.38 | 0.619 | -0.72 | 0.546 | 0.89 | 0.270 | 1.00 | 0.410 |
| Scientist | 0.46 | 0.647 | 1.10 | 0.245 | -0.25 | 0.727 | 0.01 | 0.986 | -1.10 | 0.263 | 0.69 | 0.284 | 0.16 | 0.880 |
| rho(direct) | -0.12 | 0.289 | -0.01 | 0.962 | 0.03 | 0.719 | 0.07 | 0.384 | 0.13 | 0.332 | -0.06 | 0.487 | -0.08 | 0.572 |
| rho(indirect) | -0.01 | 0.829 | -0.02 | 0.758 | 0.03 | 0.380 | 0.03 | 0.186 | -0.03 | 0.666 | 0.01 | 0.581 | -0.03 | 0.590 |

continued

| | trawling ban must be implemented just at the right time | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 | | 8 | | 10 | | 11 | | 12 | | 13 | | 14 | |
| | b | p | b | p | b | p | b | p | b | p | b | p | b | p |
| constant | 1.56 | 0.308 | 0.27 | 0.719 | 2.47 | 0.006** | 0.25 | 0.782 | 2.20 | 0.114 | 2.91 | 0.001** | 0.59 | 0.504 |
| Coastal Fishing | 1.01 | 0.353 | 2.47 | 0.009** | -1.65 | 0.016* | 1.15 | 0.320 | -1.43 | 0.218 | -1.38 | 0.068 | 0.57 | 0.520 |
| Trawl Fishing | 0.67 | 0.560 | 0.43 | 0.707 | -2.07 | 0.005** | 0.62 | 0.617 | 0.38 | 0.741 | -1.15 | 0.185 | -0.54 | 0.538 |
| Scientist | 1.25 | 0.250 | 2.07 | 0.047* | 0.48 | 0.410 | 0.53 | 0.595 | 0.62 | 0.595 | 0.20 | 0.752 | 1.71 | 0.014* |
| rho(direct) | -0.09 | 0.475 | -0.01 | 0.937 | -0.01 | 0.836 | 0.00 | 0.998 | -0.04 | 0.691 | 0.03 | 0.667 | 0.08 | 0.343 |
| rho(indirect) | 0.03 | 0.437 | -0.09 | 0.306 | 0.01 | 0.855 | -0.30 | 0.140 | -0.04 | 0.490 | -0.11 | 0.012* | 0.01 | 0.763 |

continued

| | Estonia and Latvia agreement | | | |
|---|---|---|---|---|
| | 15 | | 16 | |
| | b | p | b | p |
| constant | 2.40 | 0.028* | 0.29 | 0.642 |
| Coastal Fishing | -0.89 | 0.363 | 1.71 | 0.023* |
| Trawl Fishing | -2.08 | 0.049* | 0.32 | 0.742 |
| Scientist | 0.58 | 0.472 | 1.83 | 0.011* |
| rho(direct) | 0.00 | 0.990 | 0.09 | 0.408 |
| rho(indirect) | -0.04 | 0.459 | -0.13 | 0.160 |

Table 3-11 - **Network autocorrelation results for salience of knowledge, Riga Herring (*N* = 19)**

| | spawning concentrations must be protected from trawlers | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 9 | |
| | b | p | b | p | b | p | b | p | b | p | b | p | b | p |
| constant | 0.53 | 0.578 | -0.98 | 0.209 | 1.75 | 0.047* | 0.38 | 0.667 | -0.72 | 0.192 | -1.01 | 0.105 | -0.21 | 0.708 |
| Coastal Fishing | -0.58 | 0.561 | 0.91 | 0.340 | 0.10 | 0.924 | 0.61 | 0.451 | -0.61 | 0.329 | -0.44 | 0.425 | 1.20 | 0.148 |
| Trawl Fishing | -0.09 | 0.931 | 0.81 | 0.393 | 0.57 | 0.632 | 0.03 | 0.971 | -0.26 | 0.714 | 0.32 | 0.616 | 0.56 | 0.512 |
| Scientist | 0.82 | 0.361 | -0.05 | 0.952 | -0.92 | 0.323 | -0.18 | 0.801 | -0.83 | 0.141 | 0.11 | 0.828 | 0.63 | 0.373 |
| rho(direct) | 0.03 | 0.827 | -0.07 | 0.617 | -0.11 | 0.410 | 0.07 | 0.674 | 0.00 | 0.974 | 0.11 | 0.296 | 0.04 | 0.764 |
| rho(indirect) | -0.08 | 0.431 | -0.18 | 0.179 | -0.01 | 0.902 | -0.01 | 0.922 | -0.32 | 0.010* | -0.26 | 0.004** | -0.26 | 0.087 |

continued

| | trawling ban must be implemented just at the right time | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 | | 8 | | 10 | | 11 | | 12 | | 13 | | 14 | |
| | b | p | b | p | b | p | b | p | b | p | b | p | b | p |
| constant | -0.30 | 0.568 | -0.61 | 0.256 | 0.21 | 0.473 | -1.24 | 0.055 | 0.49 | 0.449 | 2.48 | 0.000** | -0.15 | 0.793 |
| Coastal Fishing | 0.19 | 0.820 | -0.08 | 0.914 | -1.47 | 0.000** | 1.99 | 0.020* | -1.09 | 0.170 | -1.18 | 0.017* | -0.02 | 0.978 |
| Trawl Fishing | 0.73 | 0.418 | 0.35 | 0.641 | -1.56 | 0.000** | 1.66 | 0.081 | -0.04 | 0.956 | -1.18 | 0.033* | 0.05 | 0.957 |
| Scientist | 0.33 | 0.674 | 0.34 | 0.573 | 0.04 | 0.922 | -0.66 | 0.385 | 0.32 | 0.634 | -0.25 | 0.512 | 0.02 | 0.979 |
| rho(direct) | 0.13 | 0.324 | -0.01 | 0.954 | -0.12 | 0.213 | -0.09 | 0.320 | 0.12 | 0.277 | -0.05 | 0.411 | -0.05 | 0.717 |
| rho(indirect) | -0.17 | 0.358 | -0.43 | 0.017* | -0.19 | 0.108 | 0.09 | 0.062 | -0.22 | 0.067 | -0.50 | 0.000** | 0.05 | 0.597 |

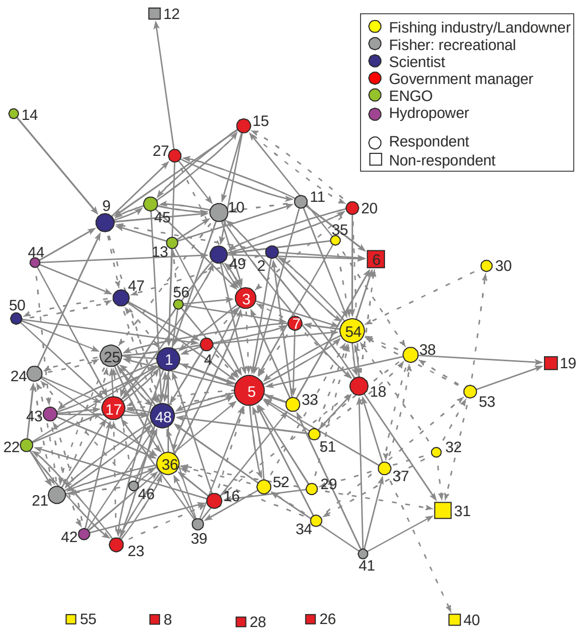
continued

| | Estonia and Latvia agreement | | | |
|---|---|---|---|---|
| | 15 | | 16 | |
| | b | p | b | p |
| constant | 0.88 | 0.175 | -1.60 | 0.049* |
| Coastal Fishing | 0.22 | 0.779 | 1.17 | 0.084 |
| Trawl Fishing | -0.84 | 0.354 | -0.90 | 0.169 |
| Scientist | 0.65 | 0.342 | 0.20 | 0.722 |
| rho(direct) | 0.06 | 0.521 | 0.01 | 0.901 |
| rho(indirect) | -0.42 | 0.014* | -0.04 | 0.342 |

# 4 Baltic Salmon management in Finland

## 4.1 Main findings

The case study examines Baltic salmon fisheries management practices in Finland.




In Finland, Baltic salmon management is a highly conflicted issue that from time to time heats up in Finnish media and in meetings where people with different interests get together.

The actor groups mingle in the discussion network but the industrial fishermen/ landowners are a bit on their own, mainly linked to the rest of the network through national and district level government officials.

The opinions and beliefs of the fishing industry and the hydropower representatives most often differ from those of the other groups. The study suggests that persons thinking the same way tend to discuss mostly with each other and that discussion may increase agreement between people. This is also indicated by the positive network effects even though they are sparse. Based on these results it could be assumed that enhancing interaction might bring about increasing agreement among the actor groups.

## 4.2 Description of the case study

The case study examines Baltic salmon fisheries management practices in Finland. The aim is to investigate how managers, scientists and stakeholders interact behind the formal institutions, and whether and how the interaction influences agreement and disagreement between the groups. Baltic salmon was selected because it offered a case study to examine policy networks both at the national and at the international level, because the researcher had already been involved in several studies concerning Baltic salmon management, had collected data and knew the key actors, and because the salmon case is extremely interesting.

The two Baltic salmon case studies were carried out side by side, and the q-sort statements in both cases were identical. Because these cases concern separate policy networks, they are reported separately.

### 4.2.1 The Baltic salmon fishery

There are two wild salmon rivers in Finland, both situated in the Northern part of the Bothnian Bay: Tornionjoki and Simojoki. Like most salmon stocks in the Baltic Sea, the populations of these rivers depleted during the 20$^{th}$ century (ICES 2011b); the catches were the lowest in the 1980s (ICES 2011b). In 1994-96, an increase in river catches took place and peaked in 1997. Thereafter catches decreased, until a new rise took place in 2008. However, in 2009 the catches again declined, and a similar further drop occurred in 2010 compared to 2009 (ICES 2011b). A concurrent phenomenon during the past few years has been the very low post smolt survival concerning all salmon stocks (ICES 2011a,b).

The decreased natural reproduction and consequent loss in catches has been compensated by supplementary stockings in the wild salmon rivers, and by compensatory releases of reared salmon by the hydropower companies in the river mouths of the dammed rivers Kemijoki, Iijoki and Oulujoki (Karlsson and Karlström 1994, Romakkaniemi 2003). These river mouths form the *terminal fishing areas* established for effective harvesting of the released salmon that due to their restricted access to spawning grounds are not expected to spawn. The mouths of the wild salmon rivers Tornionjoki and Simojoki are located near these terminal fishing areas, which implies that wild salmon may be caught besides reared salmon within these areas. All the diverse salmon stocks mix in the southern Baltic Sea during their feeding, after which they migrate back to the natal rivers to spawn, using different routes (ICES 2011a,b); fishing activities in the feeding area is supposed to pose a threat especially to the weak salmon stocks (ICES 2011a,b). Fin clipping has been introduced in the Baltic Sea to separate wild salmon from released. In Finland, only 10% of released salmon smolt were fin-clipped in 2010 (ICES 2011b).

From 1997 to 2006, restoration of the Baltic salmon stocks was carried out in the framework of the Baltic Salmon Action Plan (SAP). The objective of the plan was through juvenile salmon stocking, habitat restoration and fishery regulations to reach 50% of the potential smolt production capacity in each river by 2010 (IBSFC and HELCOM 1999, Ranke 2002). It has been reported that Simojoki and Tornionjoki have achieved the smolt production target, whereas many weaker rivers have not (ICES 2008). In addition to these two established salmon rivers, the SAP targeted three potential salmon rivers in Finland: Kiiminkijoki, Pyhäjoki and Kuivajoki. In these, salmon stock development has been very slow (ICES 2011b). In 2007, the EU Commission initiated the development of a new long term management plan for Baltic salmon; in 2009 it held a public consultation to get views from stakeholders on how to develop the LTMP (EC 2009a; 2009b). No decision has been taken on the new management plan, so far (ICES 2011a).

In Finland salmon are fished by heterogeneous user groups. Commercial offshore fishers using longlines (14 vessels) target feeding salmon in the Baltic Main Basin, and land their catch mainly to the Danish and to some extent to Swedish harbours; in 2010 the longline catch comprised about 17% of the Finnish commercial catch. Coastal trapnet fishers target salmon on their spawning migration, and this group consists both of commercial fishers and fishers targeting salmon for household use. Recreational fishing is popular in rivers (ICES 2011), and the willingness of local inhabitants to build well-being around fishing tourism in the sparsely populated salmon river areas is strong.

In 2010 Finnish fishermen caught 45 521 salmon (271 t) from the Baltic Sea which was half of the catch of 2009, and the lowest since 1972. Of this, commercial catch was 35 583 (211 t) and recreational catch including river catches was 9938 (60 t). Commercial offshore catches decreased 16%, coastal catches 43% and river catches 49%, from 2009. Since 2005, the total Baltic salmon catch has been below the TAC (Anon. 2009); and e.g. in 2010, Finland used 46,2 % of its quota in the Gulf of Bothnia, and 37,8% in the Gulf of Finland (ICES 2011).

### 4.2.2 The formal science-management system and the role of stakeholders

The Unit for Fisheries Industry of the Ministry of Agriculture and Forestry has the main responsibility for policy making related to the use of fish resources in Finland, based on consultation of the scientists of the Game and Fisheries Research Institute, and relevant stakeholder organizations (www.mmm.fi).

The regional implementation and development tasks of the state administration related to fisheries management is carried out by 15 Centres for Economic Development, Transport and the Environment. In relation to salmon fisheries management, the following centres (situated near the salmon rivers and/or the Baltic Sea area) are relevant: Lapland, North Ostrobothnia, South Ostrobothnia, Southwest Finland, Uusimaa, and Southeast Finland (http://www.ely-keskus.fi/en/frontpage/Sivut/default.aspx).

The Fisheries Research Unit of the Finnish Game and Fisheries Research Institute (FGFRI) produces research data, population estimates and expert services for the management of fisheries, for the use of the Ministry. The Institute is owned by the state and it belongs to the administrative sector of the Ministry of Agriculture and forestry. The institute has 14 research and aquaculture stations that cover the whole country (http://www.rktl.fi/english/).

The fishing industry stakeholders are unionized in local and state-wide fisher organizations. Finnish Fishermen's Association represents Finnish commercial fishers and fishing livelihood at the national level by negotiating fisheries issues with the state representatives and other stakeholders, and mediating information between the administration and fishers. It also is a member of the BSRAC and thus represents Finnish fishermen at the EU level. The association has five regional member associations (http://www.sakl.fi/?page=1000&lang=1).

Federation of Finnish Fisheries Associations is a state-wide association for developing and promoting fishing activities, and it participates fisheries policy processes as consulted by the Ministry. This association is also a member of BSRAC. The federation comprises of 28 regional fisheries centres or fisher associations. These represent 3000 land owner associations, 200 fishing water areas, 150 fisher societies, and 150 other fisher communities (http://www.ahven.net/toiminta-ajatus).

The Finnish Federation for Recreational Fishing promotes recreational fishing through both informing and acting with the recreational fishermen, and through participating in the governmental chain of decision-making. It also is an active participant in the international bodies of recreational fishermen. The Federation constitutes of over 630 local or nationwide recreational fishing, hunting or sports fishing clubs, which have approximately 50 000 members (http://www.vapaa-ajankalastaja.fi/?lang=en).

In addition to the above mentioned, e.g. the Finnish Association for Nature Conservation, WWF, Metsähallitus (a state enterprise administering state-owned land and water areas), and the Hydropower companies acting in the Northern Bothnian Bay rivers frequently contribute to the policy making processes related to Baltic salmon. There are also a few very active NGOs lobbying for the restoration process of the salmon stocks, recreational fishing, and fishing tourism (e.g. NGO Tornio-Muoniojokiseura ry).

## 4.3 Data collection and methodology

### 4.3.1 Interviews and other sources

For the discourse analysis, both previously collected data was used and a few new interviews were carried out. The data used for the study consisted of: 1) Twelve transcribed interviews from 2005-2008 and five from 2009/2010, all revolving around the state and management of Baltic salmon stocks, SAP, a future long-term management plan, scientific knowledge, TAC, and uncertainty; 2) Material collected through three questionnaires (2004, 2008), focusing on the long term management plans for the Baltic salmon stocks (SAP 1997-2006 and the long term plan for the future). One of these questionnaires was carried out in Finland and the other two covered all Baltic Sea countries; 3) Web-pages of different organisations (WWF, The Fisheries Secretariat, Tornio-Muoniojokiseura r.y., Tornionjoki.fi, Finnish Fishermen's association, Baltic Sea Regional Advisory Council, Coalition Clean Baltic, HELCOM, Finnish Federation for Recreational Fishing, European Anglers' Alliance etc.; 4) Documents of ICES, EC, BSRAC, The Ministry of Agriculture and Forestry, Finnish Game and Fisheries Research Institute, etc. related to Baltic salmon and the development of the management plan; e.g. the contributions received by the EC in answer to the consultation of stakeholders in developing the LTMP (http://ec.europa.eu/fisheries/partners/consultations/baltic_salmon/contributions/index_en.htm), and their summary (EC 2009b).

The data covered the views of managers, politicians, fishing industry, landowners and fishermen fishing for household use, recreational fishermen, organizations dealing with regional development, researchers, and environmental NGOs. Thus all the relevant aspects of the research topic were represented.

### 4.3.2 Discourse analysis

In Finland, Baltic salmon management is a highly conflicted issue that from time to time heats up in Finnish media and in meetings where people with different interests get together. The perspective and topic of the discussions varies, but the dispute usually culminates between the sea fisheries and river fisheries, and around the question which of these two is more sustainable in biological, economic and social terms.

Overall, science-management debate in Finland revolves around the high uncertainties related to the state of the different salmon stocks, especially those of rivers Tornionjoki and Simojoki, and much follows the discussion at the EU level. The smolt production, its potential and the target for improving the salmon stocks have been hot topics since the introduction of SAP. Some stakeholders have considered the target (50% of potential) artificial and too high, whereas some of them have seen it too low. During the past years the share of wild salmon in catch in relation to reared salmon has been discussed, as well as the need and possibilities to release caught wild salmon. Reasons for the low number of adult spawners entering the rivers have been debated during the few past years, as well as the low post smolt survival; it was difficult for some stakeholders to believe that the high mortality of young salmon concerned, besides reared salmon, also wild salmon. Some stakeholders have a strong belief that the seals have a major role in reducing salmon in the sea. Especially in the 1990s, reasons for the M74 syndrome causing death of fry were discussed (ICES 2011b; BSRAC 2011).

The international and national regulation of salmon fishing is debated every year at the time when the TACs are set. The state and sustainability of the salmon stocks, and the sustainable quota and fishing effort are discussed. It has been a topic during a few past years whether the catches have declined due to restrictions targeted at commercial fishing, or due to the low status of the salmon stocks. The opening date of the coastal trapnet fishery in the Bothnian Bay is a recurrent topic; the fishery has been regulated by opening date according to zones from the south to the north, from 1990s. The question of unreported catches in the Southern Baltic may be more agreed by the Finnish actors.

In Finland the terminal fishing areas have been discussed since they were established, not only in relation to the salmon of different stocks migrating and caught within them but also in relation to fishing rights. Currently, some people are of the opinion that the compensatory releases should be phased out and replaced by other compensatory measures by the hydropower companies.

Many Finnish individual actors and actor groups contributed the consultation of the EC for developing the new LTMP for Baltic salmon stocks, in 2009. An important topic for the Finnish interest groups is the smolt production objectives for the plan; how ambitious they should be, and whether the same objectives should be set for all rivers. Another question is whether, in addition to or instead of smolt production objectives there should be targets for the number of spawners returning to the rivers. A debate has concerned a global TAC that includes catches from both sea and rivers, versus a TAC only for sea fisheries. Some people see the TACs useless because the catches have been below the quota for years. Overall, different kinds of technical measures (e.g. the drift net ban) are discussed in relation to the new LTMP. Some people would like to ban the mixed stock fishing, and some groups would like to include recreational fisheries in monitoring and control measures.

The discourse analysis meant classifying the transcribed interviews and other data into themes, and further identifying categories, views, and roles. The aim was to find discursive themes that seemed to be commonly shared within the different actor groups. The formal science-management system, the role of different stakeholders, and science-management debates were analysed. Especially issues that seemed to provoke disagreement among the different groups were of interest.

The long term plan for the future management of the Baltic salmon stocks was selected to form the focus of the q sort analysis. The different interest groups – both in Finland and at the EU level - have manifested very different beliefs and opinions on the state of the Baltic salmon stocks and the ways how salmon should be managed and exploited. Thus, this theme was appropriate to investigate the agreements and disagreements between the actor groups, both related to factual assumptions and interests of stakeholders.

Three different discursive sub-themes were selected to form a set of 32 statements. Of them, 16 were factual (natural or economic) claims, and 16 were related to interests and management, and thus more explicitly value-laden. The sub-themes revolved around: 1) Angling in rivers as opposed to fishing at sea (8 statements); 2) Salmon stocks of different origins and of different status mixing in the Baltic Sea (12 statements), and 3) Ring-fencing the commercial fishing despite the long term management plans (12 statements). The statements covered both agreement and disagreement with the views expressed in the discourse. The statements formulated by the researcher were reviewed by the leader of JAKFISH WP5 and a salmon scientist.

### 4.3.3 Survey

The p-set for the survey in Finland included 56 persons that represented the main organizations and stakeholder groups dealing with salmon management: managers, decision makers, scientists, commercial fishers, recreational fishers, environmental NGOs, and hydropower companies. Individual persons were selected based either on their formal role in the management system or their active involvement in meetings and discussion related to salmon management. Ten persons included in the Finland case study overlapped with the sample for the Baltic salmon international case study. Their survey had to be distributed separately, because these persons had to answer two sets of network questions.

The survey had three language options: Finnish, Swedish and English. Thus the statements, the survey instructions, the distribution emails and the initial letter had to be translated. The researcher translated from English to Finnish. A professional translated to Swedish and the researcher checked the translation. The survey was tested by two fisheries scientists and two sociologists, and revised according to their comments.

The “Finland survey” was distributed on 29th October and the “10 person survey” on 3rd November 2010. Four reminders were sent in each, the last one on 21st of January 2011. Out of 56 experts, 47 completed the questionnaire. Non-responders were primarily found among the government (three national level and one district level) and fishing industry/landowner representatives (three). In addition to these, one person representing recreational fishers did not complete the survey. The 47 persons that responded consisted of 7 scientists, 11 government representatives (5 state level, 6 regional level), 6 recreational fishers, 5 representatives of environmental NGOs, 15 representatives or fishing industry/landowners, and 3 representatives of the hydropower companies.

One questionnaire was returned due to unknown address. One respondent emailed and told that s/he felt it tactless to name people and to characterize relationships with them; s/he wanted to know why the questions were so personal, and by whom and why this kind of information was collected. Two people criticized some of the statements and the survey program that did not allow skipping ambiguous statements.

Also positive feedback was received. Two people after receiving the initial letter expressed their interest in responding, and three people were of the opinion that the questionnaire was very good and different from most surveys, which motivated them to respond.

## 4.4 Social network analysis

For the analysis, the respondents were grouped to six stakeholder types: fishing industry/landowners (16), recreational fishing (9), scientists (7), government officials (16), representatives of NGOs (5), and experts dealing with the compensatory releases of reared salmon in hydropower companies (3). Two persons representing fishing industry/landowners were, by mistake, grouped in the stakeholder category of recreational fishers; this must be taken into account in results.

The actor groups mingle in the discussion network (network heterogeneity = 0.69) but the industrial fishermen/ landowners are a bit on their own, mainly linked to the rest of the network through national and district level government officials (note that persons nr 39 and 41 belong to the industry/landowner group, not recreational fishers where they have been by mistake typified) (Figure 1). The government people discuss with all groups, and especially one of them is very central. The fishing industry/landowners discuss mostly within their own group and with government officials, and have very few connections to recreational fishers, scientists and ENGO people. At the national level, the discussion of the industry is very much channelled through one central person, who discusses with the government representatives and with very few scientists (here: with only one scientist). The ENGO people seem to discuss with all groups except the fishing industry/landowners. The recreational fishers discuss with other recreational fishers, with scientists, with government, and to some extent also with industry/landowners and the ENGO people. The scientists discuss mostly with government, recreational fishers and to some extent ENGO, whereas relatively few links are between scientists and industry, and these are concentrated around a few people only.  The hydropower people discuss with local government people, scientists, and to some extent with fishing industry.

The network shows, that besides the discussion at the national level, there also is discussion that occurs at the district level (Figure 2). Here, discussion takes place between local government people (17, 16, 15, 20, 19, 18) and local stakeholders. The scientists mostly discuss at the national level, but two of them (1,48) especially take part in discussion at the district level too. This regional discussion is very much concentrated around a few central persons representing each group.  In the districts, the fishing industry/landowners seem to discuss a bit more with scientists and recreational fishers than at the national level, but not, however, with the ENGO representatives (that mostly operate at the national level). Discussion between scientists and recreational fishers is more frequent than between scientists and industry people.

Non-responders are quite peripheral to the network except for experts 6 and 31 who create some indirect contacts within the network.

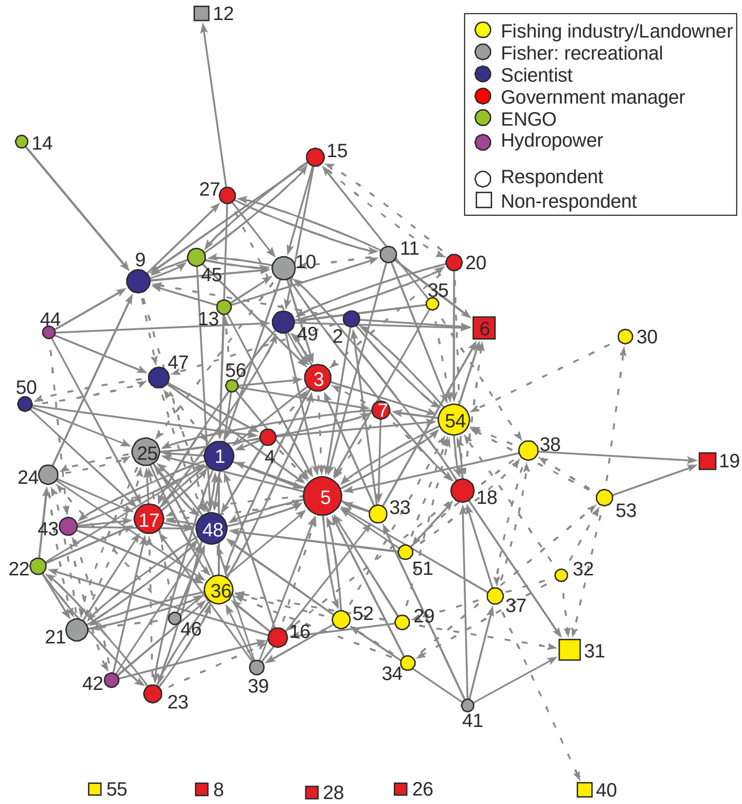



Figure 4-1 Sociogram of the discussion network, Baltic Salmon National (vertex size represents indegree, within-group ties are dashed).

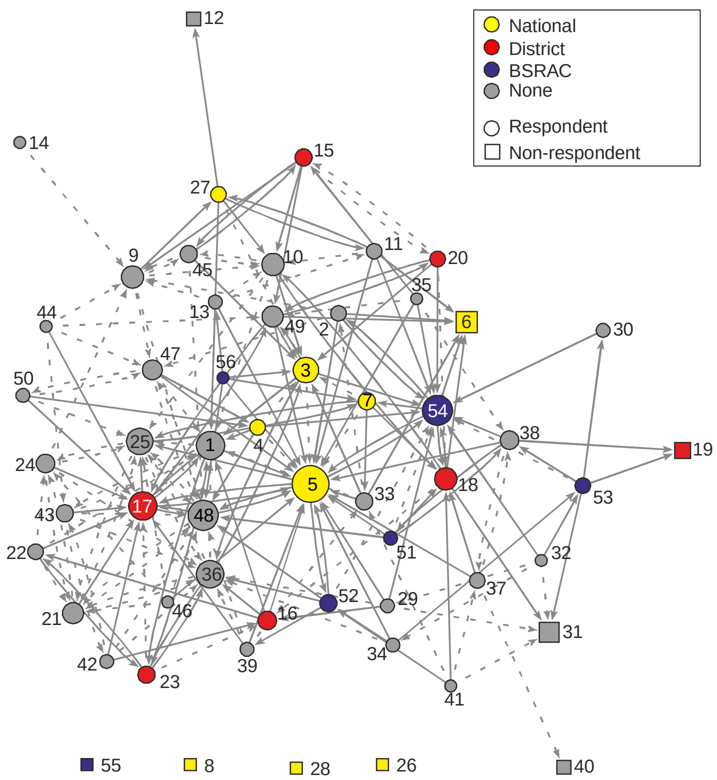



Figure 4-2 Sociogram of the discussion network, Baltic Salmon National (vertex size represents indegree, within-group ties are dashed).

Descriptive values for ‘network density’, ‘input degree of centralization’ and ‘network ‘heterogeneity‘ were measured. The network density (the proportion of all ties that could be present that actually are) is 0.07, which is low as it indicates that only 7 % of all possible ties are present. The heterogeneity of stakeholder types is 0.69 which means that 69% of lines are between members of different stakeholder groups i.e. between fishing industry, recreational fishers, scientists, government managers, NGOs, and the hydropower company representatives. The input degree of centralization indicating power, stratification, ranking and inequality in social structures, is 0.37, which tells us that 37% of the ties in the network go through a few central intermediaries. Thus, despite the very central manager (5) and a few other central persons (54, 36, 48, 1, 17, 3), the information flows are rather dispersed in this network.

## 4.5 Q-sort analysis

### 4.5.1 Overall levels of disagreement in the network

The first part of the q-sort analysis regards the variation of individual views on statements related to natural and economic facts and their importance/harmfulness, and to management. In the analysis below, the statements are abbreviated; the complete statements presented to the respondents can be found in the appendix. Overall, the variation of responses to statements is high, especially regarding fact statements, whereas the statements related to management goals and salience of knowledge display a bit more consensus (narrower ranges).

The most **disagreed** management statement (Table 4-1) is:

- statement 2 (Salmon fishing to shift from sea to river fishing).

The most **agreed** management statements are:

- statement 6 (Overall TAC should be implemented),
- statement 15 (Share national quotas in individual quotas), and
- statement 1 (Further develop recreational fishing and tourism).

Table 4-1 Abbreviated survey questions on management goals, (N = 47).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner.* | | | | |
| 1. Further develop recreational fishing and tourism | .70 | -2.00 | 3.00 | 1.14 |
| 2. Shift from fishing at sea to river fishing | -.38 | -3.00 | 3.00 | 2.26 |
| 3. Recreational fishermen should also report catches | .23 | -3.00 | 3.00 | 1.35 |
| 4. All river salmon fishing should be catch and release | -1.13 | -3.00 | 3.00 | 1.41 |
| *Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole.* | | | | |
| 5. Only reared salmon at river mouths where stocking occurs | -.70 | -3.00 | 3.00 | 1.16 |
| 6. Implement one overall TAC for all sea and river fishing | .04 | -2.00 | 3.00 | 1.10 |
| 7. Only mixed stock fishing if all stocks at sustainable level | .15 | -2.00 | 3.00 | 1.68 |
| 8. All reared salmon must be fin clipped | .43 | -3.00 | 3.00 | 1.61 |
| 9. Besides mandatory release reared salmon add compensation measures | .64 | -3.00 | 3.00 | 1.41 |
| 10. Set target for minimum number of wild spawners for each river | .70 | -2.00 | 3.00 | 1.23 |

| | | | | |
|---|---|---|---|---|
| *Long term objectives for the salmon stocks may not jeopardize the commercial fishing.* | | | | |
| 11. After the driftnet ban no further limit offshore fishing | -1.19 | -3.00 | 3.00 | 1.90 |
| 12. Commercial fishers can catch agreed TAC | -.17 | -3.00 | 3.00 | 1.79 |
| 13. Early summer ban coastal trapnet fishery fundamental protection measure | .32 | -3.00 | 3.00 | 1.48 |
| 14. Only gears that allow live releases of wild salmon permitted | .19 | -2.00 | 3.00 | 1.26 |
| 15. Share national quota in individual quotas professional fishers | -.02 | -2.00 | 2.00 | 1.11 |
| 16. Driftnets ban essential and must continue | .19 | -3.00 | 3.00 | 1.44 |

In relation to fact statements (Table 4-2), the distribution in all except one statement is between -3 and 3. The facts statements with the widest distribution (most disagreement) are:

- statement 8 (Sea fisheries threat weak stocks),
- statement 12 (Current low commercial fishing does not threaten wild stocks), and
- statement 11 (Catch below TAC because of restrictions).

The narrowest distribution (most agreement) are observed in:

- statement 16 (In early summer big wild females migrate first to natal rivers),
- statement 13 (Chance that salmon released from trapnets survive and spawn is small), and
- statement 7 (Each river contains a unique population).

Table 4-2 Abbreviated survey questions on knowledge about biological and economic facts, (*N* = 47).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner.* | | | | |
| 1. Total economic value commercial fishing larger than recreational | -1.02 | -3.00 | 3.00 | 2.21 |
| 2. Only can regulate river fishing in accordance with status each stock | 1.51 | -3.00 | 3.00 | 2.18 |
| 3. Recreational river fishing of big female spawners threatens stocks | -.43 | -3.00 | 3.00 | 2.38 |
| 4. Summer migrators to natal river not same as late summer migrators | .81 | -3.00 | 3.00 | 2.03 |
| *Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole.* | | | | |
| 5. Lower fishing mortality reared salmon more negative impact wild stocks | -.77 | -3.00 | 3.00 | 2.06 |
| 6. Overall Baltic TAC does not protect weak salmon stocks | 1.17 | -3.00 | 3.00 | 2.21 |
| 7. Each salmon river contains a genetically unique population | 2.00 | -3.00 | 3.00 | 1.67 |
| 8. Sea fisheries biggest threat weak stocks | .62 | -3.00 | 3.00 | 2.49 |
| 9. Released reared salmon pose threat to genetic integrity of wild stocks | .21 | -3.00 | 3.00 | 2.35 |
| 10. % caught wild salmon areas intense reared salmon fishing = along coast | .79 | -3.00 | 3.00 | 1.96 |
| *Long term objectives for the salmon stocks may not jeopardize the commercial fishing.* | | | | |
| 11. Catch below TAC because restrictions sea fishing | -.77 | -3.00 | 3.00 | 2.44 |
| 12. Current low commercial fishing effort does not threaten wild stocks | -.87 | -3.00 | 3.00 | 2.46 |
| 13.Chance that salmon released from trapnets survive and spawn is small | -1.60 | -3.00 | 3.00 | 1.62 |
| 14. Smolt production best rivers is at maximum level | -.94 | -3.00 | 3.00 | 2.34 |
| 15. Post-smolt survival only around 10% since 2004 | .94 | -3.00 | 3.00 | 1.83 |
| 16. In early summer big wild females migrate first to natal rivers | 1.81 | -2.00 | 3.00 | 1.56 |

The statements related to the salience( importance or harmfulness of knowledge, Table 4-3) that are most disagreed in terms of the scale of different opinions are:

- statement 8 (Sea fisheries biggest threat to weak stocks), and
- statement 12 (Current low commercial effort does not threaten wild stocks).

Respondents agree most on:

- statement 13 (Probability that salmon released from trapnets small),
- statement 16 (In early summer big wild females migrate first), and
- statement 5 (Lower fishing mortality increase negative impacts of reared on wild).

Table 4-3 Abbreviated survey questions on the importance/harm of biological and economic facts, ($N$ = 47).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner.* | | | | |
| 1. Total economic value commercial fishing larger than recreational | -.83 | -3.00 | 3.00 | 1.76 |
| 2. Only can regulate river fishing in accordance with status each stock | .74 | -3.00 | 3.00 | 1.74 |
| 3. Recreational river fishing of big female spawners threatens stocks | -.26 | -3.00 | 3.00 | 1.39 |
| 4. Summer migrators to natal river not same as late summer migrators | .17 | -2.00 | 2.00 | .99 |
| *Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole.* | | | | |
| 5. Lower fishing mortality reared salmon more negative impact wild stocks | -.47 | -2.00 | 2.00 | .93 |
| 6. Overall Baltic TAC does not protect weak salmon stocks | .43 | -3.00 | 3.00 | 1.63 |
| 7. Each salmon river contains a genetically unique population | 1.23 | .00 | 3.00 | 1.07 |
| 8. Sea fisheries biggest threat weak stocks | .32 | -3.00 | 3.00 | 2.30 |
| 9. Released reared salmon pose threat to genetic integrity of wild stocks | -.06 | -3.00 | 3.00 | 1.36 |
| 10. % caught wild salmon areas intense reared salmon fishing = along coast | .21 | -2.00 | 3.00 | 1.14 |
| *Long term objectives for the salmon stocks may not jeopardize the commercial fishing.* | | | | |
| 11. Catch below TAC because restrictions sea fishing | -.64 | -3.00 | 3.00 | 1.69 |
| 12. Current low commercial fishing effort does not threaten wild stocks | -.70 | -3.00 | 3.00 | 2.16 |
| 13. Chance that salmon released from trapnets survive and spawn is small | -.81 | -2.00 | 1.00 | .77 |
| 14. Smolt production best rivers is at maximum level | -.51 | -3.00 | 3.00 | 1.50 |
| 15. Post-smolt survival only around 10% since 2004 | .51 | -3.00 | 3.00 | 1.28 |
| 16. In early summer big wild females migrate first to natal rivers | .66 | -2.00 | 2.00 | .84 |

## 4.5.2 Comparing agreement and disagreement levels between groups in the network

The autocorrelation models were used to examine network effects and differences in beliefs and opinions between groups (stakeholder types), and to test whether respondents agree across the stakeholder types. Identical stakeholder types with the social network diagram were separated: fishing industry/landowners, recreational fishers, scientists, ENGO representatives, representatives of hydropower companies, and government; the last mentioned was used as the reference category.

Table 4-4 Network autocorrelation results for **management goals** by stakeholder group (N = 47).

| | angling in rivers (as opposed to fishing at sea) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | |
| | b | p | b | p | b | p | b | P |
| Constant | 0.83 | 0.057 | -0.21 | 0.691 | -0.12 | 0.697 | -1.74 | 0.000** |
| Fishing Ind. | -0.65 | 0.148 | -1.09 | 0.120 | 1.65 | 0.000** | 1.20 | 0.019* |
| Fishing Recr. | 0.34 | 0.476 | 1.59 | 0.047* | -0.24 | 0.616 | 0.23 | 0.679 |
| Scientist | -0.19 | 0.700 | -0.07 | 0.926 | -0.13 | 0.794 | 0.46 | 0.431 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ENGO | -0.51 | 0.367 | 1.87 | 0.047* | -0.51 | 0.356 | -0.34 | 0.598 |
| Hydropower | 0.35 | 0.608 | -0.73 | 0.497 | 0.13 | 0.846 | 0.29 | 0.709 |
| rho(direct) | 0.03 | 0.682 | 0.09 | 0.062 | -0.16 | 0.002** | -0.02 | 0.776 |
| rho(indirect) | -0.08 | 0.414 | 0.04 | 0.409 | 0.09 | 0.181 | -0.20 | 0.040* |

Table 4-4 Continued

| | mixing of salmon stocks | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | |
| | b | p | b | p | b | p | b | p | b | p | b | p |
| Constant | -0.62 | 0.076 | -0.34 | 0.248 | -0.08 | 0.851 | 1.06 | 0.007** | 1.21 | 0.012* | 0.46 | 0.203 |
| Fishing Ind. | -0.38 | 0.392 | 0.84 | 0.034* | -0.59 | 0.356 | -0.15 | 0.789 | -0.49 | 0.277 | -0.07 | 0.888 |
| Fishing Recr. | 0.20 | 0.689 | -0.36 | 0.405 | -0.27 | 0.681 | -0.61 | 0.316 | -0.37 | 0.468 | 0.84 | 0.099 |
| Scientist | -0.02 | 0.972 | -0.02 | 0.960 | 0.99 | 0.155 | -1.39 | 0.032* | -0.18 | 0.733 | 0.78 | 0.142 |
| ENGO | 0.17 | 0.760 | 0.40 | 0.434 | 1.35 | 0.083 | -0.83 | 0.233 | 0.87 | 0.137 | 0.82 | 0.163 |
| Hydropower | 1.35 | 0.050 | 2.09 | 0.001** | 1.37 | 0.177 | -3.92 | 0.000** | -3.60 | 0.000** | 0.06 | 0.936 |
| rho(direct) | 0.06 | 0.373 | -0.04 | 0.491 | 0.04 | 0.474 | -0.03 | 0.579 | -0.06 | 0.359 | 0.03 | 0.623 |
| rho(indirect) | -0.03 | 0.646 | -0.04 | 0.736 | -0.01 | 0.889 | 0.06 | 0.318 | 0.04 | 0.544 | 0.45 | 0.000** |

Table 4-4 Continued

| | the protection of commercial fishing | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11 | | 12 | | 13 | | 14 | | 15 | | 16 | |
| | b | p | b | p | b | p | b | P | b | p | b | p |
| Constant | -0.60 | 0.168 | -0.26 | 0.449 | 0.16 | 0.642 | 0.87 | 0.014* | -0.25 | 0.433 | 0.94 | 0.039* |
| Fishing Ind. | 1.26 | 0.020* | 1.17 | 0.014* | -1.06 | 0.021* | -0.82 | 0.093 | 0.44 | 0.298 | -1.27 | 0.019* |
| Fishing Recr. | -0.04 | 0.949 | -0.67 | 0.208 | 1.07 | 0.039* | -0.61 | 0.256 | 0.26 | 0.597 | -1.13 | 0.069 |
| Scientist | -0.47 | 0.431 | -0.34 | 0.529 | 0.71 | 0.177 | -0.98 | 0.086 | 0.80 | 0.124 | -0.40 | 0.534 |
| ENGO | -0.90 | 0.178 | -0.49 | 0.426 | 0.40 | 0.490 | -1.23 | 0.051 | -0.42 | 0.447 | -0.38 | 0.588 |
| Hydropower | 0.69 | 0.394 | 1.11 | 0.125 | 1.72 | 0.018* | -0.93 | 0.220 | -0.41 | 0.541 | -0.07 | 0.934 |
| rho(direct) | 0.14 | 0.000** | 0.14 | 0.000** | 0.02 | 0.690 | -0.06 | 0.413 | -0.04 | 0.510 | -0.04 | 0.476 |
| rho(indirect) | 0.07 | 0.148 | 0.06 | 0.192 | 0.10 | 0.094 | 0.04 | 0.742 | 0.09 | 0.204 | -0.08 | 0.554 |

For the management goals, there are three subthemes

Sub-theme 1: Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner (Table 4-4)

- Statement 2 (Salmon fishing to shift from sea to river): the recreational fishers and ENGOs significantly agree with each other. The fishing industry and hydropower people tend to have an opposite position. The scientists are near to the government's position.
- Statement 3 (Recreational fishermen to report catches): the fishing industry has a significant position that differs from the other stakeholders. Here, the ENGOs have the most opposing position to that of the industry.
- Statement 4 (All river fishing catch and release) shows a significant position for the fishing industry that differs from that of the others.

Sub-theme 2: Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole (Table 4-4)

- Statement 6 (A global TAC to be implemented): the opinion of the hydropower representatives significantly differs from that of the other groups, although the fishing industry tends to somewhat agree with them.
- Statement 8 (Fin clipping program to be introduced): the opinion of the hydropower representatives differs markedly from the governments' opinions; but other groups, especially the scientists tend to agree with them.

- Statement 9 (Other compensatory measures in addition to releases): the hydropower people again have a markedly differing position.

*Sub-theme 3: Long-term objectives for the salmon stocks may not jeopardize the commercial fishing* (Table 4-4)

- Statements 11 (No further limiting of offshore fishing after driftnet ban) and 12 (Commercial fishers must be allowed to catch TAC) display significant values of the fishing industry whereas the other stakeholders tend to have opposite values.
- Statement 13 (Early summer ban fundamental): the fishing industry has a significantly different opinion compared to the recreational fishers and hydropower representatives.
- Statement 16 (Driftnet ban essential) indicates that all the groups tend to agree with each other, but the opinion of the fishing industry is the strongest.

Table 4-5 Network autocorrelation results for **factual knowledge claims** by stakeholder group ($N$ = 47).

| | angling in rivers (as opposed to fishing at sea) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | |
| | b | p | b | p | b | p | b | P |
| constant | -1.06 | 0.020* | 1.75 | 0.006** | -0.32 | 0.585 | 2.46 | 0.000** |
| Fishing Ind. | 2.39 | 0.000** | -0.90 | 0.280 | 1.76 | 0.030* | -0.82 | 0.218 |
| Fishing Recr. | -1.05 | 0.103 | 0.05 | 0.962 | -0.75 | 0.345 | -0.39 | 0.608 |
| Scientist | -0.04 | 0.953 | 0.37 | 0.711 | -0.02 | 0.980 | -1.28 | 0.107 |
| ENGO | -0.68 | 0.360 | -0.07 | 0.949 | -1.28 | 0.159 | -1.29 | 0.163 |
| Hydropower | -0.04 | 0.962 | 0.76 | 0.578 | 1.96 | 0.076 | -5.13 | 0.000** |
| rho(direct) | 0.08 | 0.039* | 0.01 | 0.822 | 0.11 | 0.020* | -0.12 | 0.060 |
| rho(indirect) | 0.02 | 0.727 | -0.18 | 0.135 | -0.01 | 0.912 | 0.05 | 0.592 |

Table 4-5 Continued

| | mixing of salmon stocks | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | |
| | b | p | B | p | b | p | b | p | b | p | b | p |
| Constant | -1.27 | 0.034* | 1.83 | 0.033* | 2.06 | 0.008** | 0.61 | 0.290 | 0.76 | 0.213 | 0.21 | 0.720 |
| Fishing Ind. | 0.82 | 0.322 | -1.82 | 0.025* | 0.07 | 0.909 | -1.99 | 0.010* | 0.09 | 0.914 | -0.09 | 0.897 |
| Fishing Recr. | 1.15 | 0.199 | -0.33 | 0.712 | 0.48 | 0.510 | 1.05 | 0.204 | 1.76 | 0.062 | 0.78 | 0.311 |
| Scientist | 0.61 | 0.529 | -0.37 | 0.704 | 0.91 | 0.227 | -0.04 | 0.960 | 0.48 | 0.624 | 1.63 | 0.048* |
| ENGO | 0.34 | 0.743 | -0.46 | 0.658 | -1.22 | 0.142 | 0.98 | 0.307 | -0.08 | 0.945 | 1.08 | 0.226 |
| Hydropower | -1.61 | 0.211 | -2.18 | 0.085 | 1.25 | 0.216 | -1.75 | 0.124 | -3.78 | 0.004** | -2.51 | 0.020* |
| rho(direct) | -0.04 | 0.600 | 0.00 | 0.961 | -0.02 | 0.693 | 0.10 | 0.030* | -0.01 | 0.862 | 0.06 | 0.282 |
| rho(indirect) | -0.02 | 0.840 | 0.11 | 0.029 | 0.00 | 1.000 | 0.04 | 0.586 | 0.44 | 0.000** | 0.00 | 0.963 |

Table 4-5 Continued

| | the protection of commercial fishing | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11 | | 12 | | 13 | | 14 | | 15 | | 16 | |
| | b | p | B | p | b | p | b | P | b | p | b | p |
| Constant | -0.62 | 0.193 | -0.31 | 0.554 | -2.54 | 0.000** | -0.95 | 0.081 | 1.29 | 0.013* | 0.88 | 0.153 |
| Fishing Ind. | 2.62 | 0.000** | 1.25 | 0.085 | -0.55 | 0.363 | 1.84 | 0.013* | -1.52 | 0.020* | -0.84 | 0.123 |
| Fishing Recr. | -2.29 | 0.001** | -1.47 | 0.054 | 0.28 | 0.681 | -1.38 | 0.072 | -0.21 | 0.774 | -0.35 | 0.563 |
| Scientist | -2.09 | 0.003** | -1.71 | 0.029* | 0.73 | 0.355 | -1.71 | 0.034* | -1.66 | 0.027* | 0.37 | 0.561 |
| ENGO | -2.07 | 0.009** | -1.63 | 0.066 | 0.02 | 0.976 | -0.76 | 0.412 | -0.54 | 0.528 | -0.31 | 0.659 |
| Hydropower | -1.71 | 0.076 | 1.77 | 0.096 | 0.29 | 0.749 | 3.10 | 0.004** | -1.33 | 0.186 | 0.50 | 0.556 |
| rho(direct) | -0.03 | 0.413 | 0.09 | 0.037* | -0.17 | 0.006** | 0.03 | 0.529 | 0.11 | 0.056 | 0.12 | 0.008** |
| rho(indirect) | 0.11 | 0.060 | 0.09 | 0.116 | 0.02 | 0.646 | 0.02 | 0.772 | -0.02 | 0.866 | -0.04 | 0.510 |

Results for the three subthemes in the knowledge statements

Sub-theme 1: Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner (Table 4-5)

- Statement 1 (Economic benefit of commercial fishing higher than that of recreational fishing) displays a markedly different position of the fishing industry; especially the recreational fishers disagree with them. The scientists and hydropower representatives are near to the belief of the government.
- Statement 3 (Recreational river fishery threatens salmon stocks) shows the fishing industry and hydropower representatives agreeing with each other. The recreational fishers and ENGOs have quite an opposite position, whereas the scientists and the government are in the middle.
- Statement 4 (Salmon migrating during early summer differs genetically from those migrating later) shows a very strong differing view of the hydropower representatives from the others.

Sub-theme 2: Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole (Table 4-5)

- Statements 6 (Global TAC does not protect weak stocks) and 8 (Sea fisheries biggest threat to weak stocks) indicate that the fishing industry and the hydropower representatives agree with each other. On statement 8 the recreational fishers and ENGOs have quite an opposite belief.
- Statement 9 (Reared salmon threat wild) shows a differing position for the hydropower representatives; here the recreational fishers tend to disagree with them.
- statement 10 (In outermost parts of terminal areas proportion of wild salmon in catch same as elsewhere by coast): the scientists and the hydropower representatives seem to disagree with each other; the ENGOs and recreational fishers tend to agree with scientists.

Sub-theme 3: Long-term objectives for the salmon stocks may not jeopardize the commercial fishing (Table 4-5)

- Statement 11 (Sea fishing restrictions main reason for catches below TAC ) provokes a strong disagreement between the fishing industry on the one hand, and recreational fishers, scientists, ENGOs, and the hydropower representatives on the other.
- Statement 12 (Current commercial fishing effort no threat to wild salmon) shows that the scientists have a significantly differing position in relation to the statement and the ENGOs and the recreational fishers largely support that reasoning. The fishing industry and the hydropower representatives, on the contrary, both tend to have an opposing position.
- Statement 14 (Smolt production in best rivers would not increase if more salmon entered): the hydropower representatives and fishing industry representatives both significantly agree with each other whereas the scientists significantly disagree with them.

- Statement 15 (Post smolt survival only 10%) shows that the scientists and the fishing industry have a significantly similar view and that also the other stakeholders have a similar direction in their perception.

Table 4-6 Network autocorrelation results for salience (importance, harmfulness) of knowledge claims by stakeholder (N = 47).

| | angling in rivers (as opposed to fishing at sea) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | |
| | b | p | b | p | b | p | b | P |
| constant | -0.93 | 0.012* | 0.77 | 0.111 | -0.71 | 0.035* | 0.44 | 0.113 |
| Fishing Ind. | 2.14 | 0.000** | -0.66 | 0.316 | 1.79 | 0.000** | -0.37 | 0.341 |
| Fishing Recr. | -0.95 | 0.068 | 0.07 | 0.925 | 0.04 | 0.929 | 0.23 | 0.592 |
| Scientist | -0.10 | 0.850 | 0.26 | 0.737 | 0.31 | 0.514 | -0.26 | 0.552 |
| ENGO | -0.64 | 0.293 | 0.71 | 0.422 | -0.47 | 0.374 | 0.08 | 0.876 |
| Hydropower | -0.08 | 0.915 | 0.46 | 0.659 | 1.34 | 0.038* | -0.71 | 0.227 |
| rho(direct) | 0.07 | 0.143 | 0.02 | 0.727 | 0.07 | 0.212 | -0.05 | 0.486 |
| rho(indirect) | -0.02 | 0.811 | -0.22 | 0.143 | -0.02 | 0.800 | 0.44 | 0.000** |

Table 4-6 Continued

| | mixing of salmon stocks | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | |
| | b | p | b | p | b | p | b | p | b | p | b | p |
| Constant | -0.81 | 0.009** | 0.24 | 0.625 | 1.39 | 0.000** | 0.10 | 0.830 | 0.13 | 0.692 | -0.15 | 0.592 |
| Fishing Ind. | 0.37 | 0.313 | -0.96 | 0.092 | -1.10 | 0.002** | -1.73 | 0.008** | -0.65 | 0.156 | -0.21 | 0.594 |
| Fishing Recr. | 0.38 | 0.353 | 0.15 | 0.812 | -0.47 | 0.234 | 1.32 | 0.069 | 1.05 | 0.049* | 0.54 | 0.203 |
| Scientist | 0.35 | 0.439 | 0.70 | 0.281 | 0.51 | 0.216 | 0.51 | 0.477 | 0.16 | 0.785 | 0.94 | 0.040* |
| ENGO | 0.05 | 0.922 | -0.17 | 0.817 | -0.74 | 0.102 | 1.47 | 0.077 | 0.09 | 0.883 | 1.53 | 0.002** |
| Hydropower | -0.38 | 0.504 | -1.06 | 0.223 | 0.77 | 0.158 | -1.31 | 0.178 | -1.82 | 0.011* | -0.42 | 0.481 |
| rho(direct) | -0.06 | 0.351 | 0.09 | 0.091 | 0.02 | 0.621 | 0.12 | 0.010* | -0.02 | 0.774 | 0.10 | 0.025* |
| rho(indirect) | -0.07 | 0.531 | 0.08 | 0.141 | 0.03 | 0.425 | -0.13 | 0.199 | 0.11 | 0.054 | 0.02 | 0.804 |

Table 4-6 Continued

| | the protection of commercial fishing | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11 | | 12 | | 13 | | 14 | | 15 | | 16 | |
| | b | p | b | p | b | p | b | P | b | p | b | p |
| Constant | -0.48 | 0.219 | -0.37 | 0.454 | -1.41 | 0.000** | -0.90 | 0.026* | 1.21 | 0.009** | 0.57 | 0.064 |
| Fishing Ind. | 1.48 | 0.005** | 1.37 | 0.034* | -0.85 | 0.000** | 1.03 | 0.052 | -1.21 | 0.024* | -0.22 | 0.516 |
| Fishing Recr. | -0.74 | 0.187 | -0.56 | 0.431 | -0.40 | 0.125 | -0.36 | 0.546 | -0.02 | 0.969 | -0.18 | 0.623 |
| Scientist | -1.02 | 0.081 | -1.09 | 0.131 | 0.12 | 0.664 | -0.64 | 0.329 | -0.85 | 0.154 | 0.30 | 0.449 |
| ENGO | -1.04 | 0.117 | -1.12 | 0.172 | 0.56 | 0.068 | -0.06 | 0.935 | -0.21 | 0.750 | 0.41 | 0.337 |
| Hydropower | -0.89 | 0.265 | 1.92 | 0.051 | 0.44 | 0.233 | 2.55 | 0.002** | -0.32 | 0.692 | 0.08 | 0.878 |
| rho(direct) | 0.05 | 0.324 | 0.11 | 0.013* | -0.19 | 0.000** | -0.03 | 0.602 | -0.06 | 0.336 | 0.01 | 0.884 |
| rho(indirect) | 0.02 | 0.776 | 0.04 | 0.587 | -0.03 | 0.488 | -0.04 | 0.662 | 0.65 | 0.000** | 0.06 | 0.180 |

Results for the three subthemes for the salience of knowledge statements:

Sub-theme 1: Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner (Table 4-6)

- Statement 1 (The economic benefit of commercial salmon fishing higher than that of recreational fishing) shows that the opinion of the fishing industry markedly differs from those of the others.

- Statement 3 (Recreational fishery threatens salmon stocks): the fishing industry and the hydropower representatives agree with each other. The others are nearer to the government's opinion.

Sub-theme 2: Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole (Table 4-6)

- Statement 7 (Each river contains a genetically unique population): the opinion of the fishing industry differs most from that of the government; the ENGOs and the recreational fishers tend to agree with the fishing industry whereas the scientists and the hydropower tend to agree with the government.
- On the salience of statement 8 (Sea fisheries biggest threat to salmon) the fishing industry and the hydropower people agree with each other, whereas the recreational fishers, scientists, and ENGOs have an opposite position.
- On statement 9 (Reared salmon threaten wild), the recreational fishers and the hydropower people disagree with each other; the fishing industry tends to go along with the hydropower representatives.
- Statement 10 (In the outermost parts of terminal areas proportion of wild salmon in catch same as elsewhere by coast) shows that the scientists and the ENGO people agree with each other; the recreational fishers also tend to agree with them.

Sub-theme 3: Long-term objectives for the salmon stocks may not jeopardize the commercial fishing (Table 4-6)

- Statement 11 (Sea fishing restrictions reason for catches below TAC) provokes a markedly differing position for the fishing industry; the recreational fishers, scientists, ENGOs and the hydropower representatives tend to disagree with them.
- Statement 12 (Current commercial effort not threaten wild stocks) displays a same kind of setting as 11, except that the hydropower representatives agree with the industry.
- Statement 13 (Probability that salmon released from trapnets survive is small) shows that the fishing industry and recreational fishers tend to agree with each other whereas the scientists, ENGOs and the hydropower people have a slightly opposing position. The scientists are nearest to the government.
- In statement 14 (Smolt production of best rivers would not increase if more salmon entered), the hydropower representatives show a markedly differing position that however is sided by the fishing industry.
- In statement 15 (Post smolt survival only 10%) the position of the fishing industry is the strongest, but the others tend to think the same way

### 4.5.3 Network effects

Significant network effects have been observed in all three analyses (management goals, knowledge claims and salience) but in general the value of network effects has been low, indicating that the scarce discussion between groups has only slightly influenced people's opinions and beliefs.

For management goals, positive direct network effects have been observed for statement 2 (Salmon fishing to shift from sea to river), 11 (No further limiting of offshore fishing after driftnet ban) and 12 (Commercial fishers must be allowed to catch TAC). A negative direct network effects has been observed for statement 3 (Recreational fishermen to report catches) and a negative indirect effect for statement 10 (Target for number of wild spawners for each river).

For knowledge claims, a positive direct effect has been observed for statement 1 (Economic benefit of commercial fishing higher than that of recreational fishing), 3 (Recreational river fishery threatens salmon stocks), 13 (Probability that salmon released from trapnets survive is small), 15 (Post smolt survival only 10%) and 16 (Big wild females migrate first). An indirect positive network effects has been observed for statement 11 (Sea fishing restrictions main reason for catches below TAC).

For salience of knowledge claims, a positive direct effect was observed for statement 8 (Sea fisheries biggest threat to weak stocks), 10 (In outermost parts of terminal areas proportion of wild salmon in catch same as elsewhere by coast), 12 (Current commercial fishing effort no threat to wild salmon). Positive indirect effect for statement 4 (Salmon migrating in early summer differ genetically from later migrators) and 15 (Post smolt survival only 10%)

Overall, the network effects are positive more often than negative, which suggests that discussion has increased consensus between people more than caused disagreement. Direct and indirect network effects seem to be almost equally frequent.

## 4.6 Discussion

The discussion network represents a top down management system lead by the government. The network has two levels: the national level centralized around one very central person, and the district level managed by local government representatives. The industrial fishermen/landowners are quite a bit on their own, forming a separate network within the national network, mainly linked to the rest of the network through their own central person and government officials. The other groups seem to mingle more than the industrial fishermen. The partly separate network of the industry is reflected in their differing beliefs and opinions on salmon stocks and management. Discussion density is rather low, except in one of the districts where the density of ties seems to be higher; this is assumed to be the district where the salmon rivers are situated.

Overall, the variation of responses to statements is high, especially regarding fact statements, whereas the statements related to management goals/values and salience of knowledge display a bit more consensus. The mostly disagreed statements comment on the sea fisheries and their impact on the salmon stocks, whereas the mostly agreed statements are related to the salmon stocks and the behaviour of salmon, and do not explicitly threaten either the sea or the river fishery.

The results indicate a very commonly occurring agreement between scientists, ENGOs and recreational fishers versus agreement between fishing industry and hydropower company representatives. Quite commonly the government is situated between these poles; however, the government more often takes the side of the scientists / ENGOs/recreational fishers than that of the fishing industry/hydropower representatives.

Most commonly the fishing industry disagrees with the recreational fishers and the ENGOs, but almost as usual it seems to be that they disagree with scientists; the disagreements seem to concern mostly facts.

The autocorrelation model indicates sparse effects of the discussion network on views of the respondents. These effects consider more often factual statements than management statements or statements related to salience of facts. The network effects are positive much more often than negative, which suggests that discussion has, however, increased consensus between people more than diverged their views.  Direct network effects seem to be more frequent than indirect, which indicates that the most influential people responded in the survey.

## 4.7 Conclusions

The case study demonstrates that Baltic salmon management is a highly debated issue in Finland. Both stakes and uncertainties are high, and there is a deep rooted distrust between those that want to develop the recreational fishing and fishing tourism in the salmon rivers, and those that want to maintain the commercial fishing activities targeting salmon.

The study also indicates that the fishing industry is a bit separate from the rest of the network; the commercial fishers mostly discuss with each other, and not much over their group boundaries. Also their opinions and beliefs most often differ from those of the other groups (except the hydropower representatives). The study thus suggests, that persons thinking the same way tend to discuss mostly with each other, and that discussion may increase agreement between people; this is also indicated by the positive network effects even though they are sparse. Based on these results it could be assumed that enhancing interaction might bring about increasing unanimity among the actor groups.

The results of this study seem to be reliable even though two persons representing fishing industry/landowners were, by mistake, grouped in the stakeholder category of recreational fishers. It is probable that the views of these industry representatives to some extent skew, or smoothen, the results of the recreational fisher group. Despite this the differences between these two groups were notable.

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## 4.9 Appendix: claims of facts and values

**Claims of fact**

*Sub-theme 1: Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner.*

1. Considering all related economic activities, the total economic benefit of commercial salmon fishing in the current situation is higher than the total economic benefit of recreational fishing.
2. It is only in rivers that fishing can be regulated in accordance with the status of each salmon stock.
3. The recreational river fishery threatens salmon stocks because it targets the big female spawners in the rivers.
4. The salmon migrating to a natal river during the early summer differ genetically from those salmon that migrate to the same river later in the summer.

*Sub-theme 2: Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole.*

5. A lower fishing mortality will increase the negative impacts that reared salmon have on wild stocks.
6. A global / overall TAC (a single total allowable catch) that covers all Baltic salmon catches both at sea and in rivers does not protect the weak salmon stocks.
7. Each salmon river contains a genetically unique population.
8. The sea fisheries are the biggest threat to the weak salmon stocks.
9. The large number of reared salmon released in the Baltic Sea and rivers pose a threat to the genetic structure of wild salmon stocks.
10. In the outermost parts of the terminal fishing areas that are established for an intense fishery of reared salmon, the proportion of wild salmon in catches is the same as in other areas along the coast.

*Sub-theme 3: Long term objectives for the salmon stocks may not jeopardize the commercial fishing.*

11. The main reason why the salmon catch has been below the total allowable catch in recent years is restrictions targeted at sea fishing.
12. Currently, the commercial fishing effort targeting salmon is so low that it does not threaten the wild salmon stocks.
13. The probability that salmon released from trapnets will survive and spawn is small.
14. The smolt production of the best Baltic salmon rivers (e.g. River Tornionjoki and River Kalix) is at the level that it would not increase even if more adult salmon entered the rivers.
15. The post-smolt survival of Baltic salmon has been only around 10% since 2004.
16. In the early summer, the big wild females are among the first salmon that migrate to the natal rivers.

**Claims of values/interests**

*Sub-theme 1: Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner.*

1. Recreational fishing in rivers and related fishing tourism must be further developed in the regions of salmon rivers.

2. Salmon fishing should shift from fishing targeting at mixed stocks at sea to river fishing.
3. Recreational fishermen should be required to report catches to the same extent as commercial fishermen.
4. All fishing in rivers should be "catch and release" –fishing.

*Sub-theme 2: Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole.*

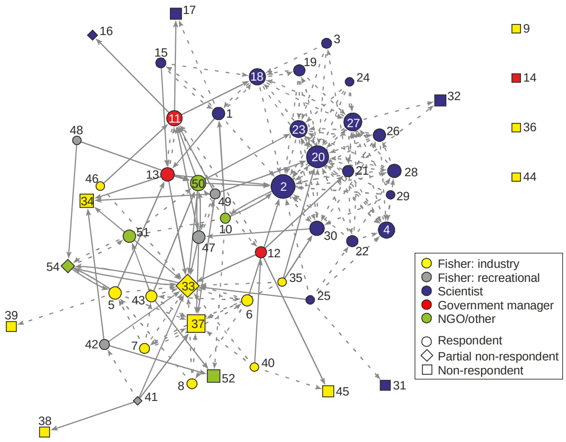
5. Exploitation of reared salmon must be concentrated to the terminal fishing areas established at the river mouths, where stocking occurs.
6. A global / overall TAC (a single total allowable catch) which covers all salmon fishing activities both at sea and in rivers should be implemented for Baltic salmon.
7. Mixed stock fishing in the Baltic Sea and along the coasts should only be allowed if all stocks therein are at a sustainable level.
8. An adipose fin clipping programme considering all hatchery-reared released salmon should be introduced to separate the reared salmon from the wild salmon.
9. The court rulings regarding the mandatory releases of reared salmon by the hydro electric power companies should be updated to include other compensatory measures in addition to compensatory releases.
10. A target for the minimum number of wild spawners must be set for each salmon river.

*Sub-theme 3: Long term objectives for the salmon stocks may not jeopardize the commercial fishing*

11. After the driftnet ban, offshore salmon fishing should not be further limited.
12. The commercial fishers must be allowed to catch the agreed total allowable quotas (TAC).
13. The early summer ban targeted at the coastal trapnet fishery is a fundamental measure to protect wild salmon.
14. Only fishing gears that allow the live releases of wild salmon should be permitted.
15. The national quotas should be shared to professional fishers in the form of individual quotas.
16. The ban on driftnets is essential and must continue.

# 5 Baltic Sea salmon international fisheries and management

## 5.1 Main findings




The case study examines Baltic salmon fisheries management practices within the EU.

Most of the wild salmon stocks in the Baltic Sea have been depleted during the 20th century, and the remaining ones vary in their status.

The sociogram shows how the scientists constitute a very dense net of ties between them. Stakeholder groups have fewer ties between them. In the middle there are three managers.

The low network density rate indicates a very low rate of discussion in the whole network.

The q-sort analysis shows that individual actors agree more on management goals and salience of facts, than the facts themselves and this applies to groups as well. The fishing industry has most frequently positions that markedly differ from the others, both in relation to facts and to values.

The results indicate that agreement between fishing industry and recreational fishers is more usual than agreement between the other groups, and this concerns especially management statements. The fishing industry and the scientists disagree most frequently on facts.

The case study indicates that Baltic salmon management lacks a consensus especially on relevant facts, and that finding common understanding is not advanced by the scarce interaction between the actor groups; the study gives an impression that especially the scientists are very much on their own.

## 5.2 Description of the case study

The case study examines Baltic salmon fisheries management practices within the EU. The aim is to investigate how managers, scientists and stakeholders interact behind the formal institutions, and whether and how the interaction influences agreement and disagreement between the groups. Baltic salmon was selected because it offered a case study to examine policy networks both at the international and at the national level, because the researcher had already been involved in several studies concerning Baltic salmon management, had collected data and knew most of the key actors, and because the salmon case is extremely interesting.

The national case carried out in Finland is reported separately.

### 5.2.1 The Baltic Sea salmon fishery

Most of the wild salmon stocks in the Baltic Sea have been destroyed or depleted during the 20th century, and the remaining ones vary in their status (ICES 2011b). The decreased natural reproduction and consequent loss in catches has been compensated with large scaled releases of reared salmon (Karlsson and Karlström 1994, Romakkaniemi 2003). All the diverse salmon stocks mix in the southern Baltic Sea during their feeding, after which they migrate back to the natal rivers to spawn, using different routes (ICES 2011). During their feeding and spawning migration, the salmon are targeted by several user groups from different Baltic Sea countries: commercial offshore and coastal fishers target salmon in the sea, and recreational fishers both in the sea and in rivers. According to ICES (2011a,b), fisheries on mixed stocks in the sea pose difficulties for management because they cannot target only the stronger stocks but exploit also the weaker ones. The reared salmon, released to be fished, make the dilemma even more complicated.

In 1997, an international treaty, Baltic Salmon Action Plan (SAP), was established to restore the Baltic salmon stocks and to support the management and advisory work related to them until 2010. The objective of the plan was to reach 50% of the potential smolt production capacity in each river by 2010 (IBSFC and HELCOM 1999, Ranke 2002). The most productive rivers have achieved the target whereas the weakest rivers are still far below (ICES 2008). Very low post smolt survival has suppressed the restoration process during a few past years (ICES 2011a,b). The EU Commission has initiated the development of a new management plan for Baltic salmon; in 2009 it held a public consultation to get views from stakeholders on how to develop the new management plan (EC 2009a; 2009b). No decision has been taken so far on the new LTMP (ICES 2011a).

The salmon fishery shared by the Baltic Sea countries has considerably changed during the two last decades, and at the same time the nominal catch has considerably declined (from 5636 t in 1990 to 886 t in 2010) (ICES 2011b). The commercial fisheries have decreased due e.g. to regulations (closed areas, changes in the opening time of fisheries), marketing restrictions owing to high dioxin levels, and increased seal damages in catch and gear (ICES 2011b), whereas the non-commercial fisheries have increased in importance: in 1994 the non-commercial catch was 9,5% of the total nominal catch, whereas in 2010 this share was 23% (ICES 2011b). Driftnet ban implemented in 2008 caused a temporary decreasing of the offshore catch, but the longline fishery has replaced the driftnets and the current offshore harvest rate is approaching the levels of mid-2000s. The total catch has been below TAC since 2005 (Anon. 2009); in 2010 49% of the TAC was utilized (ICES 2011a).

### 5.2.2 Formal science-management system and the role of the stakeholders

The Baltic salmon management follows a formalized procedure involving decision makers, managers, scientists and stakeholders from the countries concerned (Wilson 2009). The main decision making body is the European Council of Ministers, that bases its decisions on proposals prepared by the European Commission's Directorate General for Maritime Affairs and Fisheries (DG MARE)(Wilson 2009). In its proposals, the DG MARE takes into account the scientific advice prepared by ICES and the STECF, and the stakeholder advice from the BSRAC.

The scientific advice is annually produced by the ICES Advisory Committee (ACOM) based on scientific analyses prepared in the ICES Working Group on Baltic Salmon and Trout

(WGBAST) consisting of salmon experts from different Baltic Sea countries. The advisory process includes peer review of the analysis before using it as basis for the advice (Wilson 2009). The WGBAST uses a Bayesian estimation approach (ICES 2011) in its analysis.

The STECF (Scientific, technical and economic committee for fisheries), an own body of DGMARE, receives the ICES advice, reviews it, adds economic information as appropriate, and passes it on to DGMARE. It can be consulted by the Commission on all problems connected with fish resources and the regulation of fishing activities. Its opinion is crucial e.g. in the process of setting annual TACs and quotas (Wilson 2009)

The BSRAC provides political and social advice to the DGMARE (Wilson 2009). The Regional Advisory Council system was set up by the European Council in 2002 (CEC 2002), to bring together divergent stakeholder groups in order to produce a consensus approach to fisheries management problems to help meet management goals. In BSRAC as in the other RACs, 2/3 of the seats of the executive council are occupied by the fishing industry and 1/3 by other stakeholder groups (ENGOs, recreational fisher organizations, consumer organizations etc.) (Wilson 2009; www.bsrac.org). Sometimes in responding to consultations of the EC regarding salmon issues, the groups comprising the BSRAC do not reach a consensus position, but the view of the fisheries sector and the view of the other interest groups are presented separately (e.g. BSRAC 2011a).

## 5.3 Data collection and methodology

### 5.3.1 Interviews and other qualitative data collecting

For the discourse analysis, both previously collected data was used and a few new interviews were carried out. The data used for the study consisted of: 1) Twelve transcribed interviews from 2005-2008 and five from 2009/2010, all revolving around the state and management of Baltic salmon stocks, SAP, a future long-term management plan, scientific knowledge, TAC, and uncertainty; 2) Material collected through three questionnaires (2004, 2008), focusing on the long term management plans for the Baltic salmon stocks (SAP 1997-2006 and the long term plan for the future); 3) Web-pages of different organisations (WWF, The Fisheries Secretariat, Tornio-Muoniojokiseura r.y., Tornionjoki.fi, Finnish Fishermen's association, Baltic Sea Regional Advisory Council, Coalition Clean Baltic, HELCOM, Finnish Federation for Recreational Fishing, European Anglers' Alliance etc.); 4) ICES, EC, BSRAC and other documents related to Baltic salmon and the development of a management plan; e.g. the contributions received by the EC in answer to the consultation of stakeholders in developing the LTMP (http://ec.europa.eu/fisheries/partners/consultations/baltic_salmon/contributions/index_en.htm), and their summary (EC 2009b).

The data covered the views of managers, politicians, fishing industry, landowners and fishermen fishing for household use, recreational fishermen, organizations dealing with regional development, researchers, and environmental NGOs. Thus all the relevant aspects of the research topic were represented.

### 5.3.2 Discourse analysis

From the qualitative data there is an impression of a conflicted management issue with a juxtaposition of opinions and beliefs, and distrust between interest groups. Both stakes and uncertainties are high, and there is constant dispute over to what extent, how, where and by who salmon should be allowed to be fished. Salmon is desired catch for both commercial and recreational fishers that debate about the social and economic value of the fisheries compared to each other. For the inhabitants of the river valleys salmon is a source of increasing the tourist attraction of the regions and through this a means to enhance possibilities for living in sparsely populated regions. The ENGOs stress the importance of preserving the genetic heritage and variability of the salmon stocks, and the aim of the consumer organizations is to promote sustainable consumption of fish resources.

The science-management debates around Baltic salmon stocks concentrate around setting the TACs every year. The main uncertainties and controversies related to the state of the salmon stocks concern the smolt production in relation to the estimated potential capacity, post smolt survival, M74 syndrome, number of spawners in rivers, predation by seals, and unreported catches (ICES 2011b; BSRAC 2011a). A problem highlighted by the scientists is that the EC requests a single TAC for Baltic salmon, whereas the Baltic salmon population consists of several stocks of very different status, that also are assessed river specifically (ICES 2011a,b).

For the past few years discussion has been also revolving around the long term management plan for the near future. An important question has been the smolt production objectives for the plan; how ambitious they should be, and whether the same objectives should be set for all rivers. Another question is whether, in addition to or instead of smolt production objectives there should be targets for the number of spawners returning to the rivers. A debate has concerned a global TAC that includes catches from both sea and rivers, versus a TAC only for sea fisheries. Some people see the TACs useless because the catches have been below the quota for years. The effect of reared released salmon on the genetic diversity of wild salmon has provoked discussion, and it is argued whether releases should be phased out or whether the harvest of reared and wild salmon should be separated. Some people would like to ban the mixed stock fishing. It is discussed to what extent sea trout and salmon mix in catch, to what extent salmon is misreported as trout, and how much this skews the stock assessments. Some groups would like to include recreational fisheries in monitoring and control measures. Overall, different kinds of technical measures (e.g. the drift net ban) are discussed in relation to the new management plan.

The qualitative data also revealed distrust of stakeholders towards the scientific advice and the stock assessment procedures. Besides the uncertainties and their treatment, transforming a stock assessment into a management advice is sometimes questioned, as well as the Bayesian approach (e.g. ICES 2011) used by the WGBAST in the assessments. E.g. year 2011, the estimations of the potential smolt production capacity were criticized by the BSRAC (2011a).

Some interviewees also were of the opinion that the scientists write the stock assessment reports to themselves and not to an extended audience, and emphasized the importance for stakeholders to understand the management advice and the research behind it.

The discourse analysis meant classifying the transcribed interviews and other data into themes, and further identifying categories, views, and roles. The aim was to find discursive themes that seemed to be commonly shared within the different actor groups. The formal science-management system, the role of different stakeholders, and science-management debates were analysed. Especially issues that seemed to provoke disagreement between the different groups were of interest.

The long term plan for the future management of the Baltic salmon stocks was selected to form the focus of the q sort analysis. The different interest groups have manifested very different beliefs and opinions on the state of the Baltic salmon stocks and the ways how salmon should be managed and exploited. Thus, this theme was appropriate to investigate the agreements and disagreements of the actor groups, both related to factual assumptions and interests of stakeholders.

Three different discursive sub-themes were selected to form a set of 32 statements. Of them, 16 were factual (natural or economic) claims, and 16 were related to interests and management, and thus more explicitly value-laden. The sub-themes revolved around: 1) Angling in rivers as opposed to fishing at sea (8 statements); 2) Salmon stocks of different origins and of different status mixing in the Baltic Sea (12 statements), and 3) Ring-fencing the commercial fishing despite the long term management plans (12 statements). The statements covered both agreement and disagreement with the views expressed in the discourse. The statements formulated by the researcher were reviewed by the leader of JAKFISH WP5 and a salmon scientist.

### 5.3.3 Survey

The p-set for the survey (54 persons) focused on the most important organizations influencing in the EU policy processes related to Baltic salmon stocks. The DG MARE, ICES, STECF and BSRAC formed the frames for selecting respondents. From the DGMARE, four persons responsible for the Baltic salmon issues were selected. 22 scientists contributing to the production of the management advice for the Baltic salmon stocks were selected, including three permanent ICES employees, 15 WGBAST members, one ACOM member, one WGBAST reviewer, and two members of STECF. From BSRAC, 27 members were selected: the sample focused on persons that had participated meetings of the BSRAC salmon and trout working group, but to ensure that each Baltic Sea country (except Russia) was represented, the sample was complemented by selecting fishing industry representatives from the Executive Committee. Thus regarding BSRAC, the questionnaire was sent to 17 representatives of fishing industry, 5 recreational fishers, 4 representatives of environmental NGOs, and 1 representative of a consumer organization. In addition to this, a representative of the former IBSFC was included in the sample. Government officials of each relevant member country of the permanent representation of the EC were intended to be included, but had to be left out to keep the sample size reasonable for the q-sorts. Ten persons including in the sample of the EU Baltic salmon case study were also included in the sample of the Baltic salmon Finland case study. These people act in both arenas, and they had to answer two sets of network questions: one regarding the network in Finland and one regarding the international network. Their questionnaire was longer and had to be distributed separately.

The survey was in English, except for the 10 persons that belong both to the EU and the Finland network and that received the survey in English, Finnish and Swedish. The survey was tested by two fisheries scientists and two sociologists, and revised according to their comments. The survey was distributed on 25th October 2010, and the “10 persons survey” on 3rd November 2010. Four reminders were sent in both surveys, the last one on 21st of January 2011.

Of the selected 54 persons, 38 completed the survey. Non-response was particularly high among the members of the fishing industry (47%); partial response occurred in 5 cases and was evenly distributed over all types of stakeholders and management system roles. The 38 respondents that supplied sufficient information to be included in the analysis consisted of 17 BSRAC members, 18 scientists, and 3 DGMARE officials. Of the BSRAC members, 9 were representatives of the fishing industry, 5 represented the recreational fishing community and 3 the environmental or other NGOs.

Of 54 distributed questionnaires, two were returned due to unknown address. One person contacted informing that s/he was not currently involved with salmon management, and pointed at another person in the same organization that intended to respond on behalf of their organization; this person was also included in the sample. Two persons wanted to respond to a manual version of the survey, but this turned out too complicated: the one did not answer at all and the other’s respond was incomplete. Three persons explained their non-responding or leaving the survey incomplete by the following reasons: 1) Naming people and characterizing relationship with them was felt incorrect (1 person), 2) Some of the statements were regarded ambiguous or irrelevant and thus impossible to be answered (2 persons). As the system did not allow skipping any questions these persons left the survey incomplete.

Overall, the survey was received with interest. After sending the initial letter, a few people informed that they were looking forward to receive the questionnaire and to respond. Three persons regretted their delayed respond, and two just emailed to inform of their responding. One person informed about the decision of non-responding of a colleague but promised to respond by him/herself.

## 5.4 Social network analysis

The sociogram (Figure 1) shows how different stakeholder types are distributed in the management network. On the right side there are the scientists with a very dense net of ties between them, and on the left the different stakeholder groups with fewer ties between them. In the middle there are three managers (numbers 11, 12, and 13). Figure 2 confirms the network practically dividing in two parts: on the right side are the scientists all of whom can be affiliated to ICES or STECF, and on the left the stakeholders are members of the BSRAC. The managers are officials of DGMARE. The network is in line with the formal structure of the management system of the EU.

Figure 1 shows that the scientists constitute a separate system with many discussion ties among them, to some extent centralized around a couple of persons. The sociogram proposes that outside their own community, the scientists discuss mostly with DGMARE officials; there are few links between scientists and BSRAC members. The few persons interacting across the borderlines of the groups are situated in the middle of the social network diagram together with managers. In the BSRAC the different stakeholder groups mingle in their discussion network that focuses around two central persons (33 and 37), both representing industry. The yellow nodes clustered around persons 33 and 37 also illustrate that the fishing industry has some more discussion ties among its members.

The two central persons of the BSRAC (33 and 37) are non-/partial responders that receive many nominations as important discussion partners. It is probable that the network of indirect ties via these non-respondents is important in the network autocorrelations models.

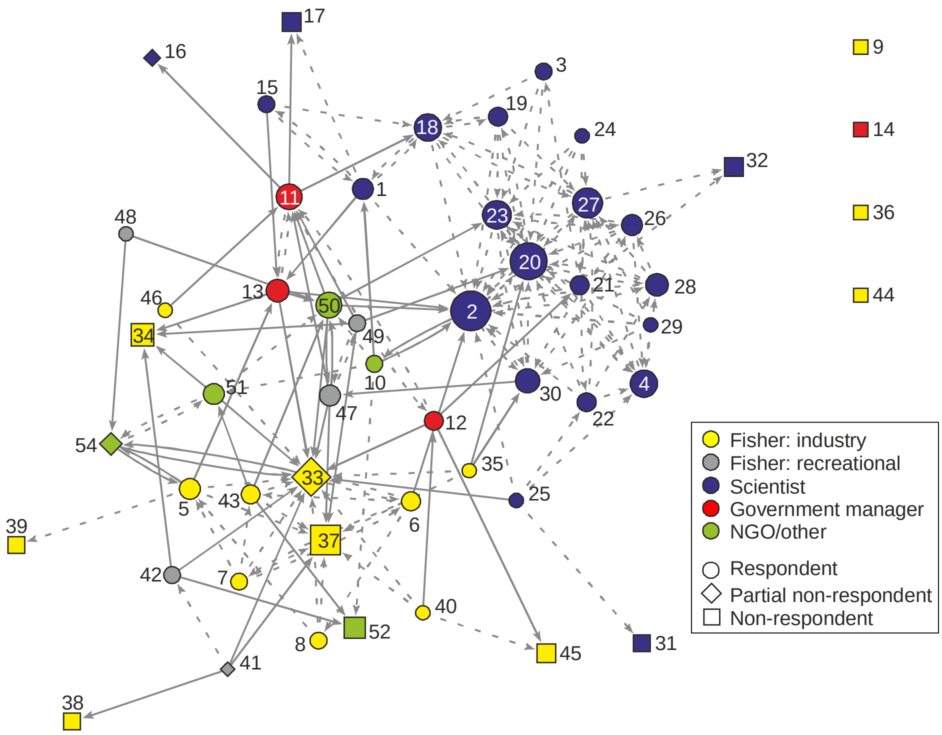



Figure 5-1 Sociogram of the discussion network with **stakeholder type,** Baltic salmon international (vertex size represents indegree, within-group ties are dashed)

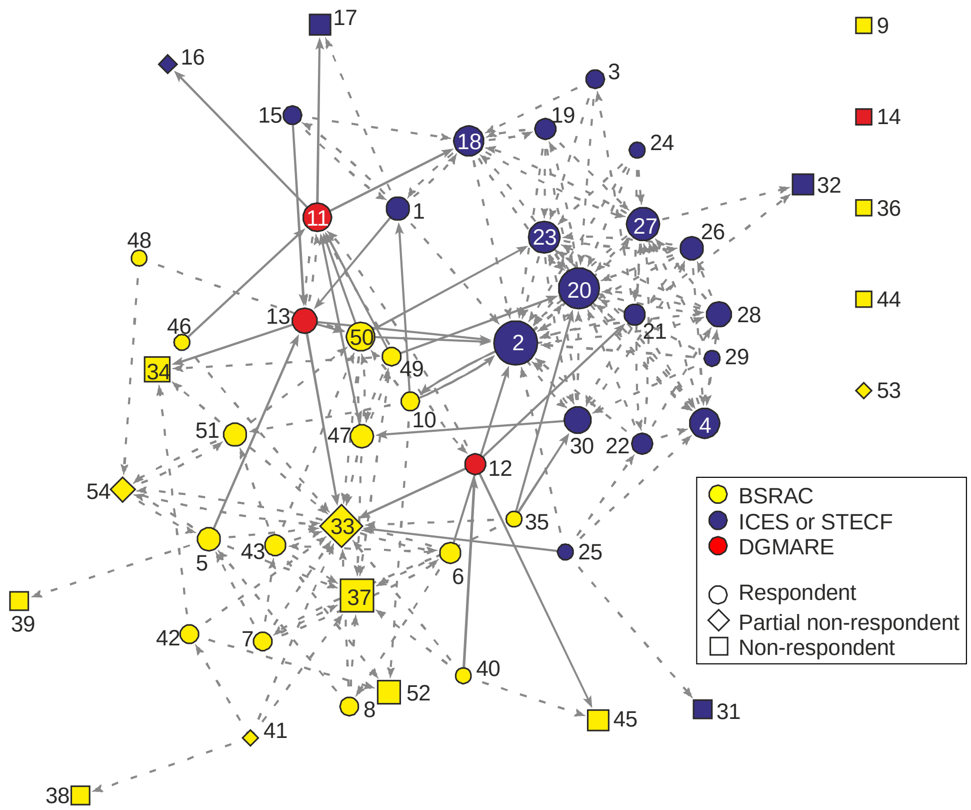



Figure 5-2 Sociogram of the discussion network with **management role,** @ (vertex size represents indegree, within-group ties are dashed).

Descriptive values for ‘network density’, ‘input degree of centralization’ and ‘network ‘heterogeneity‘ were measured. The network density (the proportion of all ties that could be present that actually are) is 0.059 including 170 lines (excluding one loop); this is very low as it indicates that only 5,9% of all possible ties are present. The heterogeneity of stakeholder types is 31,2%, which means that 53 of 170 lines are between members of different stakeholder groups i.e. between fishing industry, recreational fishers, scientists, managers, and NGOs. The network heterogeneity for management roles is 17,1%, i.e. 29 of 170 lines are between people affiliated to BSRAC, ICES or STECF, and DGMARE. As there are only three roles (as compared to five stakeholder types), we should expect an even lower percentage of ties between experts with different roles.  The input degree of centralization indicating power, stratification, ranking and inequality in social structures, is low: 0.286, which gives the impression that information flows are rather much dispersed in this network.

## 5.5 Q-sort analysis

### 5.5.1 Overall level of disagreement in the network

The first part of the q-sort analysis regards the variation of individual views on statements related to management goals (table 1) and to natural and economic facts (table 2) and their salience (importance/harmfulness, table 3). In the analysis below, the statements are abbreviated; the complete statements presented to the respondents can be found in the appendix.

Table 5-1 Abbreviated survey questions on management goals, N = 38).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner.* | | | | |
| 1. Further develop recreational fishing and tourism | .24 | -2.00 | 3.00 | 1.30 |
| 2. Shift from fishing at sea to river fishing | -.03 | -3.00 | 3.00 | 2.09 |
| 3. Recreational fishermen should also report catches | .63 | -2.00 | 3.00 | 1.34 |
| 4. All river salmon fishing should be catch and release | -1.47 | -3.00 | 3.00 | 1.50 |
| *Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole.* | | | | |
| 5. Only reared salmon at river mouths where stocking occurs | -.50 | -3.00 | 2.00 | 1.31 |
| 6. Implement one overall TAC for all sea and river fishing | .16 | -3.00 | 3.00 | 1.46 |
| 7. Only mixed stock fishing if all stocks at sustainable level | .34 | -2.00 | 3.00 | 1.65 |
| 8. All reared salmon must be fin clipped | .47 | -3.00 | 3.00 | 1.47 |
| 9. Besides mandatory release reared salmon add compensation measures | .63 | -1.00 | 3.00 | .94 |
| 10. Set target for minimum number of wild spawners for each river | 1.11 | -1.00 | 3.00 | 1.01 |
| *Long term objectives for the salmon stocks may not jeopardize the commercial fishing.* | | | | |
| 11. After the driftnet ban no further limit offshore fishing | -1.05 | -3.00 | 3.00 | 1.92 |
| 12. Commercial fishers can catch agreed TAC | .00 | -3.00 | 3.00 | 1.66 |
| 13. Early summer ban coastal trapnet fishery fundamental protection measure | -.13 | -3.00 | 3.00 | 1.47 |
| 14. Only gears that allow live releases of wild salmon permitted | -.63 | -2.00 | 1.00 | .85 |
| 15. Share national quota in individual quotas professional fishers | .05 | -2.00 | 2.00 | 1.21 |
| 16. Driftnets ban essential and must continue | .18 | -3.00 | 3.00 | 1.72 |

In half of the management statements the distribution of responses varies between -3 and 3, whereas in the other half it is narrower (Table 5-1 Abbreviated survey questions on management goals, N = 38).Table 5-1). The SD varies substantially indicating that some of the statements are more disagreed than the others.

For the management statements (Table 5-1 Abbreviated survey questions on management goals, N = 38).Table 5-1), the widest deviation is in 2 (Shift from sea fishing to river fishing), and 11 (After the driftnet ban no further limits for offshore fishing).

Narrower distribution are observed for statements 14 (Only gears that allow live releases to be permitted) that has a relatively narrow variation in this context (-2 and 1), 9 (Besides mandatory releases add other compensatory measures), and 10 (Set target for minimum number of wild spawners).

Table 5-2 - Abbreviated survey questions on knowledge about biological and economic "facts", (*N* = 38).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner.* | | | | |
| 1. Total economic value commercial fishing larger than recreational | -.29 | -3.00 | 3.00 | 2.20 |
| 2. Only can regulate river fishing in accordance with status each stock | .32 | -3.00 | 3.00 | 2.54 |
| 3. Recreational river fishing of big female spawners threatens stocks | -.47 | -3.00 | 3.00 | 2.38 |
| 4. Summer migrators to natal river not same as late summer migrators | -.16 | -3.00 | 3.00 | 2.09 |
| *Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole.* | | | | |
| 5. Lower fishing mortality reared salmon more negative impact wild stocks | -.66 | -3.00 | 3.00 | 2.03 |
| 6. Overall Baltic TAC does not protect weak salmon stocks | 1.42 | -3.00 | 3.00 | 2.14 |

| | | | | |
|---|---|---|---|---|
| 7. Each salmon river contains a genetically unique population | 1.24 | -3.00 | 3.00 | 2.22 |
| 8. Sea fisheries biggest threat weak stocks | -.34 | -3.00 | 3.00 | 2.43 |
| 9. Released reared salmon pose threat to genetic integrity of wild stocks | .71 | -3.00 | 3.00 | 2.26 |
| 10. % caught wild salmon areas intense reared salmon fishing = along coast | -.03 | -3.00 | 3.00 | 1.92 |
| *Long term objectives for the salmon stocks may not jeopardize the commercial fishing.* | | | | |
| 11. Catch below TAC because restrictions sea fishing | .16 | -3.00 | 3.00 | 2.49 |
| 12. Current low commercial fishing effort does not threaten wild stocks | -1.21 | -3.00 | 3.00 | 2.41 |
| 13.Chance that salmon released from trapnets survive and spawn is small | -1.13 | -3.00 | 2.00 | 1.95 |
| 14. Smolt production best rivers is at maximum level | -.87 | -3.00 | 3.00 | 2.22 |
| 15. Post-smolt survival only around 10% since 2004 | .63 | -3.00 | 3.00 | 1.91 |
| 16. In early summer big wild females migrate first to natal rivers | 1.66 | -3.00 | 3.00 | 1.48 |

There is much disagreement between individual respondents, especially concerning the fact statements (Table 5-2). In all except one item, the responses to fact statements vary between minimum -3 and maximum 3 and in most of them the standard deviation (SD) is above 2.00.

The widest distributions are related to fact statements 2 (Fishing regulation according to each stock possible only in rivers), 11 (Fishing restrictions main reason for catches below TAC), 8 (Sea fisheries biggest threat to salmon stocks) and 12 (Current low commercial fishing effort no threat to salmon stocks).

The facts that are most agreed on are 16 (In early summer big wild females migrate first) that has variation between -3 and 3 but SD the lowest 1.48, and 13 (Chance that salmon released from trapnets survive is small) that has SD of 1.95 but as the only one a narrower distribution (-3 and 2).

Table 5-3 –Abbreviated survey questions on the salience (importance/harm) of biological and economic facts, ($N$ = 38).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner.* | | | | |
| 1. Total economic value commercial fishing larger than recreational | -.34 | -3.00 | 3.00 | 1.68 |
| 2. Only can regulate river fishing in accordance with status each stock | .16 | -3.00 | 3.00 | 1.98 |
| 3. Recreational river fishing of big female spawners threatens stocks | -.24 | -3.00 | 3.00 | 1.48 |
| 4. Summer migrators to natal river not same as late summer migrators | -.13 | -3.00 | 3.00 | 1.23 |
| *Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole.* | | | | |
| 5. Lower fishing mortality reared salmon more negative impact wild stocks | -.58 | -3.00 | 2.00 | 1.20 |
| 6. Overall Baltic TAC does not protect weak salmon stocks | .97 | -2.00 | 3.00 | 1.42 |
| 7. Each salmon river contains a genetically unique population | .76 | -2.00 | 3.00 | 1.24 |
| 8. Sea fisheries biggest threat weak stocks | -.21 | -3.00 | 3.00 | 2.28 |
| 9. Released reared salmon pose threat to genetic integrity of wild stocks | .26 | -3.00 | 3.00 | 1.45 |
| 10. % caught wild salmon areas intense reared salmon fishing = along coast | -.18 | -2.00 | 3.00 | 1.11 |
| *Long term objectives for the salmon stocks may not jeopardize the commercial fishing.* | | | | |
| 11. Catch below TAC because restrictions sea fishing | .11 | -2.00 | 3.00 | 1.56 |
| 12. Current low commercial fishing effort does not threaten wild stocks | -.97 | -3.00 | 3.00 | 2.16 |
| 13. Chance that salmon released from trapnets survive and spawn is small | -.55 | -3.00 | 2.00 | 1.11 |
| 14. Smolt production best rivers is at maximum level | -.53 | -3.00 | 2.00 | 1.16 |
| 15. Post-smolt survival only around 10% since 2004 | .79 | -2.00 | 3.00 | 1.32 |
| 16. In early summer big wild females migrate first to natal rivers | .68 | -1.00 | 2.00 | .84 |

In half of the salience statements the distribution of responses varies between -3 and 3, whereas in the other half it is narrower (Table 5-3). The SD varies substantially indicating that some of the statements are more disagreed than the others.

Of statements related to salience of knowledge, the most disagreed statements are 8 (Sea fisheries biggest threat to weak stocks), and 12 (Current low commercial fishing effort does not threaten wild stocks) (Table 5-3).

Of statements related to salience of knowledge, the most agreed statement is 16 (In early summer big wild females migrate first to natal rivers; distribution between -1 and 2) (Table 5-3).

### 5.5.2 Comparing agreement and disagreement levels between groups in the network

The network autocorrelation models were used to examine network effects and differences in beliefs and opinions between groups, and to test whether respondents agree across the stakeholder types and management roles. Three stakeholder types (fishing industry, fishing recreational, and scientists) and two management roles (BSRAC, ICES/STECF) were distinguished, as corresponding to the social network diagram.

It should be noted that stakeholder type and management are highly intertwined: for example, all scientists of the sample are members of ICES or STECF and also the government managers and DGMARE officials completely overlap. As a consequence, the effects of stakeholder type and management role in the case of scientists and government managers cannot be distinguished.

Due to collinearity, it is not possible to estimate the effects of BSRAC and government actors in a single model. There are only three government officials among the respondents which have been merged with the three members of NGOs into the reference category.  Because NGOs and the DGMARE (=government) members are not expected to form a coherent group, the views of the two separate groups can no longer be obtained from the analysis.

The analysis concentrates on the statistically significant results (p < .05 or p < .01), but to avoid missing important response patterns falling under the threshold of significance tests, also other results will be referred to.

Table 5-4 Network autocorrelation results for opinions (values) about angling in rivers and salmon stocks, Baltic Salmon International (*N* = 38).

| | Angling in rivers | | | | Salmon stocks | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Item 1 | | Item 3 | | Item 5 | | Item 7 | | Item 9 | | Item 10 | |
| | b | p | b | P | b | p | b | p | b | p | b | p |
| constant | -0.54 | 0.385 | 2.20 | 0.001** | 0.00 | 0.995 | -0.57 | 0.451 | 0.36 | 0.425 | 2.31 | 0.000** |
| BSRAC | -0.25 | 0.770 | -1.98 | 0.020* | 0.93 | 0.328 | 2.95 | 0.008** | -0.43 | 0.504 | 0.46 | 0.450 |
| Fishing industry† | 0.78 | 0.269 | 0.17 | 0.808 | -1.29 | 0.099 | -3.54 | 0.000** | 1.66 | 0.002** | -2.13 | 0.000** |
| Fishing recreat. † | 2.31 | 0.005** | -1.75 | 0.023* | -1.73 | 0.043* | -1.79 | 0.064 | 1.69 | 0.003** | -1.43 | 0.014* |
| Science/ICES/STECF† | 0.82 | 0.230 | -1.52 | 0.021* | -0.31 | 0.665 | 1.50 | 0.081 | 0.02 | 0.967 | -0.77 | 0.105 |
| rho(direct) | 0.08 | 0.334 | -0.02 | 0.751 | 0.10 | 0.169 | -0.01 | 0.798 | 0.04 | 0.604 | -0.03 | 0.627 |
| rho(indirect) | -0.08 | 0.397 | 0.26 | 0.000** | 0.05 | 0.311 | -0.04 | 0.604 | -0.10 | 0.055 | -0.1 | 0.124 |

*Note*. *  *p* < .05;  ** *p* < .01
† Reference category: Government/NGO/Other.

Table 5-5 Network autocorrelation results for opinions (values) about long-term objectives and commercial fishing, Baltic Salmon International (*N* = 38).

| | Item 11 | | Item 12 | | Item 13 | | Item 15 | |
|---|---|---|---|---|---|---|---|---|
| | B | P | b | P | b | p | b | p |
| constant | -0.84 | 0.273 | -0.03 | 0.953 | -0.02 | 0.979 | -0.53 | 0.380 |
| BSRAC | -0.66 | 0.533 | -1.20 | 0.151 | 0.32 | 0.758 | -0.27 | 0.744 |
| Fishing industry† | 2.34 | 0.008** | 3.52 | 0.000** | -1.97 | 0.026* | 1.91 | 0.006** |
| Fishing recreat. † | 1.06 | 0.265 | 0.33 | 0.685 | -0.14 | 0.883 | 1.05 | 0.170 |
| Science/ICES/STECF† | 0.86 | 0.292 | -0.41 | 0.542 | 0.20 | 0.811 | 0.51 | 0.431 |
| rho(direct) | 0.17 | 0.000** | 0.03 | 0.564 | -0.05 | 0.531 | 0.03 | 0.697 |
| rho(indirect) | -0.06 | 0.376 | -0.04 | 0.443 | -0.16 | 0.107 | -0.11 | 0.219 |

*Note*. * $p < .05$; ** $p < .01$
† Reference category: Government/NGO/Other.

In the Management statements there are three subthemes.

Sub-theme 1: Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner (Table 5-4)

- Statement 1 (Further develop recreational fishing and tourism): the opinion of recreational fishers differs markedly from the others
- Statement 3 (Recreational fishermen also should report catches) displays agreement between recreational fishers and scientists.

Sub-theme 2: Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole (Table 5-4)

- Statement 5 (Only reared salmon at river mouths where stocking occurs): the recreational fishers and the fishing industry seem to agree with each other.
- Statement 7 (Only mixed stock fishing if all stocks at sustainable level): the fishing industry has a strong position but the recreational fishers seem to tilt to the same direction; whereas the opinion of the scientists is opposed.
- Statement 9 (Besides mandatory releases add compensatory measures): the industry and the recreational fishers have similar opinions.
- Statement 10 (Set target for minimum number of wild spawners for each river) shows again a statement where both fisher groups tend to agree with each other; the scientists think the same way but not so strongly.

Sub-theme 3: Long-term objectives for the salmon stocks may not jeopardize the commercial fishing (Table 5-5)

The fishing industry shows a strong opinion on

- Statement 11 (After the driftnet ban no further limit offshore fishing): fishing industry shows a strong opinion. Recreational fishers tend to agree, and scientists also but to a lesser extent.
- Statement12 (Commercial fishers must be allowed to catch agreed TAC): fishing industry shows a strong opinion.
- Statement 13 (Early summer ban a fundamental protection measure): fishing industry shows a strong opinion.

- Statement 15 (Share national quota in individual quotas): The fishing industry shows a strong opinion. Recreational fishers tend to agree and so do scientists but less.

Table 5-6 Network autocorrelation results for knowledge about angling in rivers and salmon stocks, Baltic Salmon International (*N* = 38).

| | Angling in rivers | | | | Salmon stocks | | | |
|---|---|---|---|---|---|---|---|---|
| | Item 1 | | Item 3 | | Item 6 | | Item 9 | |
| | b | p | b | P | b | p | b | p |
| Constant | -1.17 | 0.164 | 1.76 | 0.061 | 1.51 | 0.141 | 1.81 | 0.100 |
| BSRAC | 1.07 | 0.365 | -3.24 | 0.016* | -0.47 | 0.738 | 1.93 | 0.223 |
| Fishing industry† | 2.15 | 0.044* | 3.64 | 0.002** | -0.01 | 0.995 | -4.38 | 0.001** |
| Fishing recreat. † | -2.20 | 0.061 | -0.36 | 0.765 | 0.27 | 0.834 | -1.35 | 0.332 |
| Science/ICES/STECF† | 0.59 | 0.522 | -3.77 | 0.002** | -1.04 | 0.351 | -0.87 | 0.472 |
| rho(direct) | 0.08 | 0.192 | -0.05 | 0.566 | 0.15 | 0.006** | -0.10 | 0.161 |
| rho(indirect) | 0.03 | 0.608 | 0.04 | 0.518 | -0.14 | 0.065 | -0.03 | 0.700 |

*Note*. * $p < .05$; ** $p < .01$
† Reference category: Government/NGO/Other.

Table 5-7 Network autocorrelation results for knowledge about long-term objectives and commercial fishing, Baltic Salmon International (*N* = 38).

| | Item 12 | | Item 13 | | Item 14 | | Item 16 | |
|---|---|---|---|---|---|---|---|---|
| | b | p | b | P | b | p | b | p |
| Constant | 0.21 | 0.779 | 0.35 | 0.702 | 0.40 | 0.687 | 0.37 | 0.628 |
| BSRAC | -2.84 | 0.005** | 0.13 | 0.918 | -1.03 | 0.466 | 0.41 | 0.681 |
| Fishing industry† | 4.62 | 0.000** | -3.24 | 0.003** | 1.41 | 0.241 | 0.82 | 0.348 |
| Fishing recreat. † | 0.47 | 0.617 | -1.02 | 0.376 | -1.64 | 0.192 | -0.67 | 0.498 |
| Science/ICES/STECF† | -2.50 | 0.005** | -2.39 | 0.021* | -0.63 | 0.597 | 2.16 | 0.010* |
| rho(direct) | 0.03 | 0.600 | -0.04 | 0.613 | 0.13 | 0.020* | -0.06 | 0.310 |
| rho(indirect) | -0.09 | 0.159 | -0.15 | 0.045* | 0.01 | 0.892 | 0.07 | 0.029 |

*Note*. * $p < .05$; ** $p < .01$
† Reference category: Government/NGO/Other.

In the factual knowledge statements there are three themes

Sub-theme 1: Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner (Table 5-6)

- Statement 1 (Total economic value of commercial fishing higher than that of recreational): the belief of fishing industry opposes that of recreational fishers.
- Statement 3 (Recreational river fishing of big female spawners threatens stocks): the fishing industry and scientists have opposing positions.

Sub-theme 2: Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole (Table 5-6)

- Statement 9 (Released reared salmon pose threat to genetic integrity of wild stocks): the fishing industry shows a differing position.

Sub-theme 3: Long-term objectives for the salmon stocks may not jeopardize the commercial fishing (Table 5-7)

- Statement 12 (Current low commercial fishing effort does not threaten wild stocks) provokes strong opinions for fishing industry and scientists that disagree with each other.

- Statement 13 (Chance that salmon released from trapnet survive and spawn is small): the fishing industry and scientists agree with each other.
- Statement 16 (In early summer big wild females migrate first to natal rivers): the belief of scientists differs from the others' beliefs.

Table 5-8 Network autocorrelation results for salience of knowledge about angling in rivers and salmon stocks, Baltic Salmon International (*N* = 38).

| | Angling in rivers | | | | | | Salmon stocks | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Item 1 | | Item 2 | | Item 3 | | Item 5 | | Item 6 | | Item 7 | | Item 9 | |
| | b | P | b | P | B | p | b | p | b | p | b | p | b | p |
| constant | -2.08 | 0.000** | 1.96 | 0.053 | 0.70 | 0.299 | -1.16 | 0.097 | 1.73 | 0.006** | 0.61 | 0.296 | 1.88 | 0.004** |
| BSRAC | 1.70 | 0.021* | -0.46 | 0.747 | -1.36 | 0.151 | -0.68 | 0.416 | -0.89 | 0.262 | 0.90 | 0.273 | -0.47 | 0.605 |
| Fishing industry† | 2.74 | 0.000** | -2.33 | 0.047* | 1.76 | 0.033* | 1.15 | 0.125 | -1.08 | 0.103 | -1.54 | 0.031* | -2.70 | 0.001** |
| Fishing recreat. † | -1.18 | 0.128 | -2.21 | 0.079 | -0.83 | 0.343 | 1.83 | 0.029* | -0.09 | 0.904 | -1.04 | 0.170 | -0.74 | 0.397 |
| Science/ICES/STECF† | 0.82 | 0.168 | -1.96 | 0.070 | -1.39 | 0.068 | 0.82 | 0.208 | -1.08 | 0.076 | 1.24 | 0.102 | -1.10 | 0.114 |
| rho(direct) | -0.10 | 0.088 | 0.06 | 0.415 | -0.01 | 0.884 | 0.03 | 0.69 | 0.12 | 0.044* | -0.08 | 0.323 | -0.12 | 0.108 |
| rho(indirect) | -0.01 | 0.894 | -0.08 | 0.330 | 0.03 | 0.667 | -0.08 | 0.362 | -0.19 | 0.021* | -0.15 | 0.127 | -0.03 | 0.657 |

*Note*. * $p < .05$; ** $p < .01$
† Reference category: Government/NGO/Other.

Table 5-9 Network autocorrelation results for salience of knowledge about long-term objectives and commercial fishing, Baltic Salmon International (*N* = 38).

| | Item 11 | | Item 12 | | Item 13 | | Item 15 | | Item 16 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | b | p | b | P | b | p | b | p | b | p |
| constant | 1.74 | 0.019* | -0.73 | 0.292 | -0.35 | 0.504 | 0.90 | 0.137 | -0.42 | 0.272 |
| BSRAC | -1.06 | 0.300 | -1.43 | 0.134 | 0.64 | 0.387 | 0.41 | 0.614 | -0.04 | 0.939 |
| Fishing industry† | 0.61 | 0.476 | 4.10 | 0.000** | -1.94 | 0.003** | -1.71 | 0.012* | 0.77 | 0.090 |
| Fishing recreat. † | -1.28 | 0.186 | 1.31 | 0.135 | -0.42 | 0.553 | 0.95 | 0.189 | 1.09 | 0.028* |
| Science/ICES/STECF† | -2.44 | 0.006** | -0.29 | 0.722 | -0.37 | 0.524 | 0.46 | 0.489 | 1.39 | 0.005** |
| rho(direct) | -0.03 | 0.712 | 0.10 | 0.028* | -0.02 | 0.865 | -0.07 | 0.386 | -0.01 | 0.907 |
| rho(indirect) | 0.00 | 0.984 | -0.06 | 0.293 | -0.14 | 0.083 | -0.05 | 0.462 | 0.07 | 0.052* |

*Note*. * $p < .05$; ** $p < .01$
† Reference category: Government/NGO/Other.

On the statements on salience of knowledge there are three subthemes

Sub-theme 1: Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner (Table 5-8)

- Statement 1 (Total economic value of commercial fishing higher than recreational): the opinion of fishing industry differs from the others, and opposes that of recreational fishers.
- Statement 2 (Only can regulate river fishing in accordance with status of stock), indicates agreement between all groups.
- Statement 3 (Recreational river fishing of big female spawners threatens stocks): the fishing industry opposes the scientists and to less extent the recreational fishers also.

Sub-theme 2: Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole (Table 5-8)

- Statement 5 (Lower fishing mortality of reared salmon more negative impact on wild stocks): the opinion of recreational fishers differs from the others, but all groups tend to agree.

- Statement  6 (Overall Baltic TAC does not protect weak stocks): all groups and especially the industry and the scientists agree.
- Statement 7 (Each salmon river contains a genetically unique population) the fishing industry and the recreational fishers agree whereas the scientists disagree.
- Statement 9 (Released reared salmon a threat to wild): the fishing industry has a marked position.

Sub-theme 3: Long-term objectives for the salmon stocks may not jeopardize the commercial fishing (Table 5-9)

- Statement 11 (Catch below TAC because restrictions sea fishing): the scientists have a strong position, that the recreational fishers tend to agree.
- Statement 12 (Current low commercial fishing effort does not threaten wild stocks) displays a very strong opinion of the fishing industry.
- Statement 13 (Chance that salmon released from trapnets survive and spawn is small): the opinion of the fishing industry is strong.
- Statement 15 (Post-smolt survival only around 10 %): the fishing industry has a position that differs from the others, that tend to disagree.
- Statement  16 (In early summer big wild females migrate first) shows that scientists and recreational fishers  agree with each other but that also the fishing industry thinks the same way.

### 5.5.3 Network effects

Significant network effects have been observed in all three analyses (management goals, knowledge claims and salience) but in general the value of network effects has been low, indicating both scarce discussion between groups and low overall impact of it on opinions and beliefs.

Positive indirect network effects for management goals have been observed for statement 3 (Recreational fishermen also should report catches) and positive direct network effects for statement 11 (After the driftnet ban no further limit offshore fishing)

Positive direct network effects for knowledge have been observed for statement 6 (Overall Baltic TAC does not protect weak salmon stocks) and statement 14 (Smolt production at best rivers is at maximum level). A negative indirect network effect has been observed for statement 13 (Early summer ban a fundamental protection measure)

A positive direct network effect and a negative indirect effect for salience has been observed for statement  6 (Overall Baltic TAC does not protect weak stocks). Statement 12(Current low commercial fishing effort does not threaten wild stocks) generated a positive direct network effect and statement  16 (In early summer big wild females migrate first) generated an positive indirect  network effect.

Overall, the network effects are positive more often than negative, which suggests that discussion has to some extent increased consensus between people. Direct and indirect network effects seem to be almost equally frequent. The indirect network effects indicate an important role of the two central non-respondents (33, 37) in the stakeholder community.

## 5.6 Discussion

The social network diagram depicts a formal management system consisting of a homogeneous scientific community (ICES, WGBAST, STECF), a heterogeneous stakeholder organization (BSRAC), and three DGMARE managers situated in the middle. There are a couple of central persons both in the scientists' part and in the stakeholder part of the network, but overall the degree of centralization is low, indicating that information flows are rather dispersed. Neither are the managers very central in the network.

The network density rate (0.059) indicates a very low rate of discussion in the whole network. The densest discussion network is among scientists. Within BSRAC discussion ties are fewer, but there seems to be a cluster consisting of industry members that discuss a bit more with each other than with the other members of BSRAC. People affiliated to BSRAC, ICES/STECF, and DGMARE seem to discuss rarely with each other, and the BSRAC members and scientists mainly via the managers. Especially in the scientific community the contacts to managers and to BSRAC members seem to be in the hands of a few persons, while the other scientists mainly discuss with scientific peers. Fellow citizenship may facilitate straight interaction between persons over the affiliation boundaries.

The q-sort analysis shows that individual actors agree more on management goals and salience of facts, than facts, and this concerns the groups as well. The most disagreed statements explicitly take sides with either of the fisheries, whereas the more agreed statements are more harmless to all groups.

The fishing industry has most frequently positions that markedly differ from the others, both in relation to facts and to values. The recreational fishers show differing opinions on several statements related to management and salience of facts, whereas the scientists differ in their views in relation to a few fact statements and their salience.

The results indicate that agreement between fishing industry and recreational fishers is more usual than agreement between the other groups, and this concerns especially management statements related to sub-theme 2 (salmon stocks of different origins and of different status mixing in the sea). The fishing industry and the scientists, on the other hand, disagree most frequently. They mostly disagree on facts.

The autocorrelation model indicates sparse effects of the discussion network on views of the respondents. These sparse effects, however, seem to consider both values and facts. The network effects are positive more often than negative, which suggests that discussion has increased consensus between people more than diverged their views. Further, direct and indirect network effects seem to be almost equally frequent. The indirect network effects indicate an important role of the two central non-respondents (33, 37) in the stakeholder community.

## 5.7 Conclusions

The case study indicates that Baltic salmon management lacks a consensus especially on relevant facts, and that finding common understanding is not advanced by the scarce interaction between the actor groups; the study gives an impression that especially the scientists are very much on their own.

The BSRAC has undoubtedly meant a considerable step in bringing together the relevant stakeholder groups; the agreement on management issues between the fishing industry and recreational fishers may be a sign of that. But it has probably activated interaction between stakeholders and scientists as well: e.g. in August 2011 a meeting took place between the BSRAC salmon/trout working group and the ICES, to discuss the salmon stock assessment results, the scientific advice and the assessment methodology and data (BSRAC 2011b). It is very probable that this meeting was a step towards improving understanding between scientists and stakeholders. However, such meetings are still occasional and by invitation, instead of taking place regularly on an established forum. It is obvious that straight links between scientists and stakeholders are needed.

## 5.8 References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## 5.9 Appendix

**Claims of fact**

*Sub-theme 1: Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner.*

1. Considering all related economic activities, the total economic benefit of commercial salmon fishing in the current situation is higher than the total economic benefit of recreational fishing.

2. It is only in rivers that fishing can be regulated in accordance with the status of each salmon stock.

3. The recreational river fishery threatens salmon stocks because it targets the big female spawners in the rivers.

4. The salmon migrating to a natal river during the early summer differ genetically from those salmon that migrate to the same river later in the summer.

*Sub-theme 2: Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole.*

5. A lower fishing mortality will increase the negative impacts that reared salmon have on wild stocks.

6. A global / overall TAC (a single total allowable catch) that covers all Baltic salmon catches both at sea and in rivers does not protect the weak salmon stocks.

7. Each salmon river contains a genetically unique population.

8. The sea fisheries are the biggest threat to the weak salmon stocks.

9. The large number of reared salmon released in the Baltic Sea and rivers pose a threat to the genetic structure of wild salmon stocks.

10. In the outermost parts of the terminal fishing areas that are established for an intense fishery of reared salmon, the proportion of wild salmon in catches is the same as in other areas along the coast.

*Sub-theme 3: Long term objectives for the salmon stocks may not jeopardize the commercial fishing.*

11. The main reason why the salmon catch has been below the total allowable catch in recent years is restrictions targeted at sea fishing.

12. Currently, the commercial fishing effort targeting salmon is so low that it does not threaten the wild salmon stocks.

13. The probability that salmon released from trapnets will survive and spawn is small.

14. The smolt production of the best Baltic salmon rivers (e.g. River Tornionjoki and River Kalix) is at the level that it would not increase even if more adult salmon entered the rivers.

15. The post-smolt survival of Baltic salmon has been only around 10% since 2004.

16. In the early summer, the big wild females are among the first salmon that migrate to the natal rivers.

**Claims of values/interests**

*Sub-theme 1: Angling in rivers is the best use of salmon resource from biological and economic viewpoint, and easier to be managed in a stock-specific manner.*

1. Recreational fishing in rivers and related fishing tourism must be further developed in the regions of salmon rivers.

2. Salmon fishing should shift from fishing targeting at mixed stocks at sea to river fishing.

3. Recreational fishermen should be required to report catches to the same extent as commercial fishermen.

4. All fishing in rivers should be “catch and release” –fishing.

*Sub-theme 2: Salmon stocks of different origins and of different status mix in the Baltic Sea, but are managed and exploited as one homogenous whole.*

5. Exploitation of reared salmon must be concentrated to the terminal fishing areas established at the river mouths, where stocking occurs.

6. A global / overall TAC (a single total allowable catch) which covers all salmon fishing activities both at sea and in rivers should be implemented for Baltic salmon.

7. Mixed stock fishing in the Baltic Sea and along the coasts should only be allowed if all stocks therein are at a sustainable level.

8. An adipose fin clipping programme considering all hatchery-reared released salmon should be introduced to separate the reared salmon from the wild salmon.

9. The court rulings regarding the mandatory releases of reared salmon by the hydro electric power companies should be updated to include other compensatory measures in addition to compensatory releases.

10. A target for the minimum number of wild spawners must be set for each salmon river.

*Sub-theme 3: Long term objectives for the salmon stocks may not jeopardize the commercial fishing*

11. After the driftnet ban, offshore salmon fishing should not be further limited.

12. The commercial fishers must be allowed to catch the agreed total allowable quotas (TAC).

13. The early summer ban targeted at the coastal trapnet fishery is a fundamental measure to protect wild salmon.

14. Only fishing gears that allow the live releases of wild salmon should be permitted.

15. The national quotas should be shared to professional fishers in the form of individual quotas.

16. The ban on driftnets is essential and must continue.

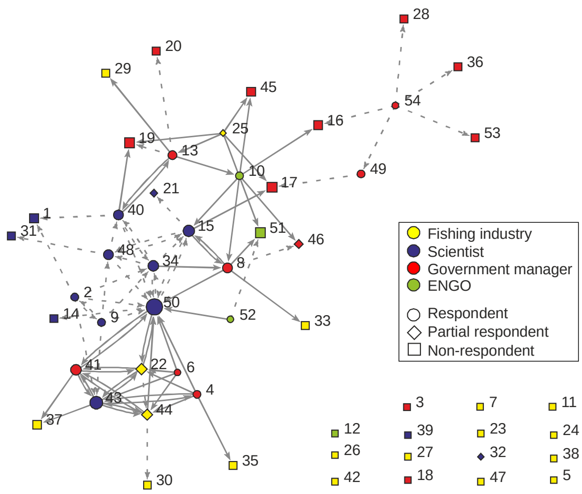
# 6 The Mediterranean swordfish fishery and management

## 6.1 Main findings

The Mediterranean swordfish fishery is a highly international fishery, with at least 11 countries targeting the stock.

Stock assessment results indicate that the Mediterranean swordfish stock is over-exploited

In the Mediterranean swordfish case, communication across stakeholder types happen mainly in local or national contexts, rather than at the international level of ICCAT where scientific advice and political decisions are made.




See figure 1-1: Sociogram of the discussion network with stakeholder type, Mediterranean

In the network as a whole there was more agreement on the salience of different statements than on the content of the factual and value statements, while the comparison between groups showed that there was higher disagreement on the salience of the statements. In the network there was higher agreement on values than on facts.

Overall there seems to be a fair amount of agreement between the stakeholder groups on the different statements. Given that the industry and ENGOs respondents were grouped together in the statistical analysis and used as a reference group, some differences in values or knowledge might have been blurred.

Looking at country affiliation, more disagreement was observed. The Greek stood out as a group, which can be partly attributed to methodological differences in how they were identified as relevant to the network. However, it could also be related to national differences in regulation or fishing practices.

In terms of the relation between communication networks and levels of agreement, we found only negative network effects. Thus we conclude that respondents in this case tend to have frequent discussion ties with peers that have different values or opinions on management goals, and that previous discussions have not brought about consensual opinions among discussion partners.

## 6.2 Description of the case

### 6.2.1 The science-management system and the role of the stakeholders

The Mediterranean swordfish fishery is a highly international fishery, with at least 11 countries targeting the stock. The countries that catch most swordfish in the Mediterranean Sea are Italy, Morocco, Spain and Greece (ICCAT 2010). These countries include both EU member states and countries outside the EU, which are thus answering to different governance regimes. Furthermore these countries have very different amounts of resources available for scientific and management purposes. The fishery has a high number of small-scale coastal fleets with vessels less than 20 m as well as fleets with medium-sized vessels around 24 m.

Management of Mediterranean swordfish lies within the Convention area of the International Commission for the Conservation of Atlantic Tunas (ICCAT). ICCAT receives advice from its advisory board, the Standing Committee of Research and Statistics (SCRS), which bases its advice on regular stock assessments carried out by the Mediterranean swordfish working group.

There is no formal stakeholder involvement at the regional level (ICCAT), and the level of stakeholder involvement at the national level varies between the countries. In some countries, such as Spain, the local fishermen are organized at different levels and represented by a national umbrella-organization. In other countries, such as Greece, the fishermen are mostly small-scale fishers, who are not represented by any organizations. Many of these are seasonal fishers, who supplement the fishing incomes with farming or tourism activities. In general the small scale fishers are not involved in the legislative or scientific decision-making, and at the time of the study there was no formal forum where a broader set of stakeholders could interact. The Mediterranean RAC, which was created in 2008 and became operational in 2009, might become such a forum in the future. At the time when the interviews for this study were carried out, however, several stakeholders informed us that the Med RAC had not yet been dealing with swordfish related issues.

ICCAT is comprised of representatives (administrators and scientists) from the contracting parties, i.e. member states or groups of states such as the EU. These individual states each have their own fishing interests, thus they are also stakeholders in the fishery. Common for the contracting parties are their need to balance their national and international conservation obligations with the wish to protect national socio-economic interests. Amongst the contracting parties there are differences in interest, for example about the best timing of the fishing closure in relation to their national fishing and export interests.

All ICCAT contracting parties with swordfish fishing interests are encouraged to present scientists to the stock assessments, but not all do. Indeed some of the major fishing nations do not send scientific representatives. Some of the scientists participating in the swordfish working group and the SCRS are working directly for government administrations, while others are employed by more independent institutions such as universities.

There are only a few ENGOs engaged in swordfish-related work. These send representatives as observers to scientific and commission meetings in ICCAT.

The only Mediterranean/ICCAT-wide restriction on swordfish fishing currently in place is a two-month fishing closure (Greece has adopted a longer national closure of 4 months), and the prohibition of using driftnets (Morocco was phasing out their driftnet fishing at the time when this study was carried out). Some countries have a national minimum landing size for Mediterranean swordfish.

### 6.2.2 The scientific uncertainties and the management debates

Stock assessment results indicate that the Mediterranean swordfish stock is over-exploited and current spawning stock biomass (SSB) levels are lower (>40%) than those that would support maximum sustainability, but has been stable over the last 15 years. The most recent assessment states that "slight overfishing is taking place" (ICCAT 2010).

There is quite high scientific uncertainty regarding the exploitation pattern, age-length relation and the precise spawning places and timing; Mediterranean swordfish is currently managed as a unique stock, but consists probably of several independent substocks with unknown rate of mixing; also, the stock – recruitment relationship is not well defined, catch misreporting of undersized fish is considered to be a problem and there is a large amount of juveniles in the catches (50 – 70%) (ICCAT 2009 and personal communication with SCRS scientists).

There was general agreement among the people we interviewed, that the Mediterranean swordfish stock is overfished. There was also general agreement that it is important to reduce the high proportion of juveniles in the catches, while there was some disagreement about whether a reduced catch of juveniles will be sufficient for the stock to recover, or whether the spawning population needs also to be protected through further effort or capacity control. There was also some disagreement about the appropriateness of different mitigating factors, intended to reduce the catch of juveniles. The length and timing of the closure was being debated. It was debated whether an ICCAT-wide minimum landing size should be introduced. Finally there was some disagreement among different actors about whether a TAC would be a useful instrument in managing the fishery.

The ICCAT Commission recommended that a more comprehensive long term management plan for the Mediterranean swordfish should be decided by the end of 2010 (ICCAT 2009 [09-04]). Attempts to draft proposals for such a plan, however, have caused much disagreement between different partners in the management system, and so-far no plan has been officially proposed. Generally, however, there was relatively little debate during our fieldwork period, and the debates that stakeholders engaged in were focused mainly on management proposals rather than science.

## 6.3 Data collection and methodology

The questionnaire themes and statements were based on analysis of documents, interviews and observations of scientific and management meetings during the period from October 2009 to December 2010. The documents consisted mainly of scientific reports by SCRS or by individual scientists affiliated with SCRS, as well as reports written by scientists working for environmental NGOs.

Two SCRS annual meetings were observed (2009 and 2010), as well as one swordfish species group meeting (2009) and one Special Meeting of the ICCAT Commission (2010). Furthermore unofficial discussions between managers from different contracting partners were observed.

19 semi-structured interviews were carried out (including 28 people, since 4 of the interviews were carried out with groups of 2-5 people); 2 interviews were carried out by phone, the rest in person. The interviews lasted between 15 minutes and one hour, and most were recorded and transcribed. Apart from the formal interviews numerous informal conversations took place about the relevant themes. The purpose of the interviews, observations and informal conversations was to identify key scientific-policy issues in the

fishery (discursive themes) and to identify relevant respondents for the questionnaire survey.

### 6.3.1 Selection of respondents

A snowball sampling method was used to identify all relevant persons[2]. The majority of interviewees and questionnaire respondents were people involved with ICCAT, i.e. participating in/being present at meetings in either the swordfish working group, the SCRS and/or the ICCAT Commission, since these are the main contexts where organized science-policy discussions related to the fishery take place. Furthermore, interviews were conducted in Crete, Greece (in collaboration with the Greek JAKFISH partner). The purpose of this was to include a number of stakeholders in the study, who were not expected to participate in ICCAT meetings, in order that the survey would reflect the existence and views of stakeholders more marginally placed in the science-policy network. Furthermore, a few respondents suggested by informants were included in the survey, despite them not participating in ICCAT meetings, in order to respect a given organizations' structure of authority.

Choosing the meetings in ICCAT as the basis for the survey had an impact on the network identified for the questionnaire: not all stakeholder types, neither all relevant countries are equally represented in the survey. The meetings favoured access to most of the relevant scientists and managers on a national as well as regional (European) level. However, only a few ENGOs and industry representatives were present at the meetings, and even when asking informants specifically for representatives from these two groups, very few stakeholders were identified. Thus, although we are convinced the network[3] is representative of the people who were active in the scientific/political communication around swordfish fishery in the ICCAT setting, it is not representative in terms of equally covering all interest groups and their potential opinions. This turned out to cause a challenge when carrying out the statistical analysis, as some groups had to be left out of the analysis or grouped together as a reference category.

### 6.3.2 Discourse analysis

Notes from observations, literature and conversations as well as transcribed interviews were sorted according to themes. The discursive themes for the purpose of this survey were identified based on the importance of these issues (according to interviewees and literature), as well as their general suitability for the study: It had to be themes that different types of respondents were likely to understand and have an opinion about. Very technical scientific issues were not suitable, since this might leave out some stakeholders. Furthermore the themes selected had to invoke some kind of uncertainty or disagreement amongst respondents, and this uncertainty or disagreement had to involve some element of what people perceived to be "factual knowledge", since this would be one of the variables tested in the survey (i.e. it could not be issues solely to do with management interests or values). Based on these criteria, an issue such as the illegal use of driftnets by certain actors

[2] During interviews and informal conversations, informants were asked to identify everyone with whom they discussed scientific or policy issues related to the swordfish fishery

[3] „Network" here refers to all the potential respondents, i.e. the people who were asked to fill in the questionnaire and whose names were listed in the network part of the questionnaire.

in the Mediterranean, despite being mentioned by several stakeholders as an important issue, was not included in the survey, because the arguments people made in relation to this theme were mainly of a "value" nature, and there was little disagreement expressed on this issue amongst the people we interviewed. Finally, two overall themes were selected that incorporated a variety of the facts and interests or values expressed in the interviews and literature.

The discursive themes and subthemes were:

1) 'The main problem in the Mediterranean swordfish fishery is the many sexually immature fish in the catches. Management measures must aim at minimizing this'
   a) 'There is a need for a minimum size regulation based on Mediterranean swordfish biology'
   b) 'The closure must be where and when juveniles are most abundant'
   c) 'Juveniles can be avoided by fishing deeper and/or further from the coast'

2) 'Overall fishing mortality must be reduced if Maximum Sustainable Yield is to be reached'
   a) 'Fishing mortality is too high, but a TAC is unnecessary overkill and bad for the fishermen'
   b) 'Some measures aiming at reducing juveniles may actually put the stock under more pressure'

Each of these discursive subthemes was broken down into simple statements of either a value or a factual kind. 32 statements were selected and used for the questionnaire (see Appendix 1), 16 statements expressed a factual claim of biological, geographical or technical nature and 16 statements expressed an opinion about specific management measures. The statements were selected, so that they covered both agreement and disagreement with the discursive themes. The statements were either direct quotes from interviews and literature, or rephrased statements (keeping the meaning, but phrased so that they were sufficiently simple and clear to use in a questionnaire).

The 32 statements were translated into French, Spanish and Greek (the original language being English), they were checked and back-translated by native language speakers with insights into fisheries science. The questionnaire was tested (in all the four language versions) by people involved in the swordfish science-policy network (in order to correct potential misunderstandings or ambiguities).

### 6.3.3 Response rates

This case study has several partial responders of different types. Corrections needed to be applied to the data because two respondents filled out paper versions of the questionnaire incorrectly, and others did not want to fill in the part of the questionnaire related to factual statements. Only 17 people completed the entire questionnaire (31.5%), and non-response is very high (31/54=57%). Non-response is especially high among the members of the fishing industry (83%) and no member of the industry has completed the entire questionnaire. 4 more industry respondents were supposed to fill in a paper version of the questionnaire, but never received it.

When carrying out the statistical analysis, it was found that a minimum number of respondents in each category were required. A sufficient number of responses for this statistical analysis were available only for the respondent types “scientists” and “government managers”, so in the statistical results section we will distinguish between three stakeholder categories: science, government, and “other stakeholders” types.

Another analysis was carried out based on country affiliation. Non-response was high, however, for respondents from all other countries than Greece, so in the statistical analysis we compare the group “Greece” (which includes 6 full responses and 2 partial responses) with a respondent group of “other countries” and “non-affiliated” (i.e. respondents not affiliated with a country).

Different partially overlapping sets of respondents remain for the three sets of questions: we have 19 respondents for the value statements and the fact statements while we have 17 respondents for the statements on the salience of knowledge facts.

### 6.3.4 Categories used in the analysis

For the purpose of the analysis we have grouped respondents into categories. The main categories used in the analysis are the four stakeholder types: Fishing industry; government; scientist and environmental NGO (ENGO). These categories form the basis of the sociograms (Figure 6-1 and Figure 6-2), and to some extent our statistical analysis.

#### Stakeholder types

*The fishing industry* stakeholder type is a heterogeneous group, encompassing local fishermen as well as representatives from fishermen’s organizations, but we assume some shared identification (and thus shared opinions) within the group. However, the industry respondents come from different countries, and some differences in opinions could also be expected.

*The government* stakeholder group includes respondents working for national governments at a local or a national level, as well as respondents working for the European Commission (DG Mare). The national level government representatives were participants in ICCAT meetings, while the local level representatives are part of the Greek local level study and did not participate in ICCAT meetings.

*The scientist* are all people involved in producing advice given by the ICCAT advisory board, SCRS, either as members of the Mediterranean swordfish working group, the general SCRS plenary, or the ICCAT secretariat. The individual scientists were selected on the basis of their relevance to the swordfish fishery science network.

*The ENGOs* are representatives from national as well as international levels of their respective organizations. The ENGO respondents were based in two different countries.

#### Country affiliation groups

We also applied country affiliation as a parameter in the analysis. Country affiliation could potentially have a big influence on opinions about facts and values in the international ICCAT setting. Because the model required a certain number of individuals in each category, however, certain countries had to be grouped together: Thus when discussing the sociogram based on country affiliation we will compare only the Greek and Spanish groups, while the other countries are merged (as “other countries”). In the statistical analysis, only “Greece” had enough responses to stand alone as a country category.

All industry respondents were categorized by country of residence, as were the local and national level government respondents and scientist sent to SCRS as part of contracting party delegations. These respondents were all perceived as having (and observed to have) national interests and/or national level scientific knowledge about the fishery. Furthermore there are a number of respondents who do not represent a country: Respondents representing the European Commission level of the management system and scientist respondents working directly for the ICCAT secretariat were not categorized by country, but grouped as “non-affiliated” in the part of the analysis done by country. The “non-affiliated” group is thus simply a model category, and should not be thought of a as an interest group whose members identify with each other.

We tried grouping the respondents based on role/position scale in the management system, i.e. local, national or EU. Due to insufficient number of respondents in certain groups, however, we could not do a statistical analysis based on this parameter.

## 6.4 Social network analysis

Figure 6-1 is a sociogram of the total network with different colours representing different types of stakeholders; circles indicate respondents and squares represent non-respondents. The size of the circle and box shows the number of nominations received; dashed lines are discussion ties within stakeholder groups and solid lines circles indicate ties between stakeholder groups.

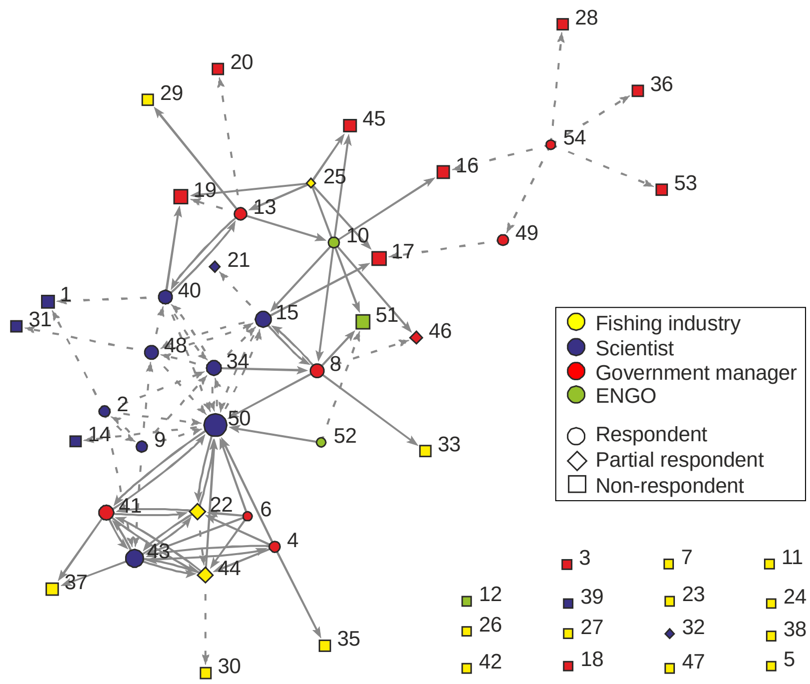



Figure 6-1. Sociogram of the discussion network with stakeholder type, Mediterranean (vertex size represents indegree, within-group ties are dashed).

The sociogram depicts a network where 56% of all discussion ties are between different types of stakeholders: industry representatives, scientists, government representatives and ENGOs. Discussion ties within groups are primarily found among the scientists (blue vertices), who form a rather central cluster in the discussion network. Some of the government managers also cluster in the network –however, it should be noted that several of these managers are non-respondents, thus their potential communication links with other types of stakeholders are not included in the figure. These non-respondents are mainly responsible for any effects of indirect network ties.

The scientists are all part of ICCAT's scientific committee (SCRS), thus it is not surprising that there are many communication ties between them. The cross group communication between scientists and other stakeholder groups happens through a few individual scientists, who talk to government and/or ENGO representatives –most noticeably respondent number 50.

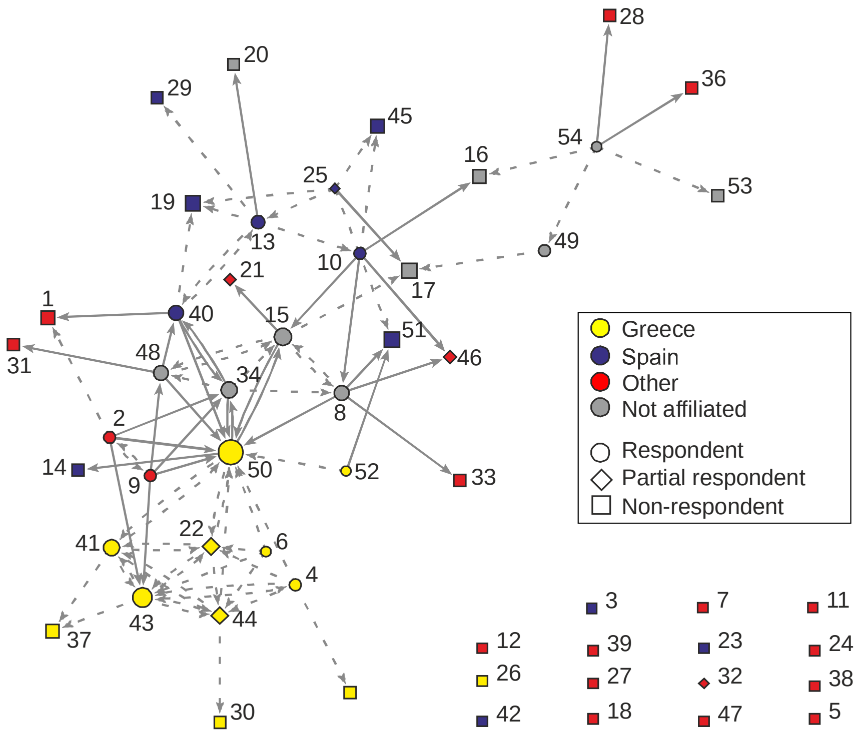



Figure 6-2. Sociogram of the discussion network with nationality, Mediterranean (vertex size represents indegree, within-group ties are dashed).

When applying the attributes of country affiliation (Figure 6-2) we see that two of these scientists with cross group communication ties(15 and 34) are scientists not linked to a specific country. These are scientists with a central SCRS/ICCAT organizational position, rather than national scientific representatives. The other two scientists with cross group communication ties (40 and 50) are "national" scientist communicating mainly with non-scientist stakeholders from their own country.  Had we had a more even representation of respondents from all the countries it is possible that we would have seen the same tendency that the national scientist representatives in SCRS communicate with industry, ENGO and government representatives in their home countries.

There are 3 ENGOs representatives active in the network (2 responders and one non-responder that has been pointed to by 3 other stakeholders). Two ENGO representatives are quite centrally placed, between them communicating with scientist, industry, government and other ENGO representatives alike – i.e. all stakeholder types. The third ENGO appears more peripheral in the network, yet still communicating with the scientific part of the network through a scientist from the same country (Greece), as well as with another ENGO representative from another country (Spain).

15 people are outside the network. These are non-respondents, who were not selected as frequent discussion partner by any of the respondents. As such we can assume that they do not play important roles in the network of people discussing scientific-political issues related to Mediterranean swordfish.

When the respondents are grouped by country affiliation (Figure 6-2), there are few discussion ties cross group boundaries (network heterogeneity = .37). Thus, communication across stakeholder types groups happen –to the extent it does happen – mainly in local or national contexts, rather than at the international/regional level of ICCAT where scientific advice and political decisions are made. This reflects the fact that there is no formal communication channel for stakeholders (other than government representatives and scientists) in the ICCAT management system.

## 6.5 Q-sort analysis

The Q-sort survey asked respondents to rate the extent to which they agreed/disagreed with the statements we had identified through the discourse analysis. We analysed replies in terms of the level of agreement/disagreement in the network overall as well as between different respondent groups. It should be noted that all levels of (dis)agreement are in relation to a) 15 other statements and b) the other groups, thus if a group receives a positive score, it does not necessarily mean that a majority of individuals in the group were positive towards that statement, but on average the group was more positive or less negative than the reference group.

### 6.5.1 Overall levels of disagreement in the network

This part of the study shows the overall level of agreement/disagreement on statements in the science-management network. The tables show how strongly respondents agree/disagree with particular value statements and how sure they are about particular factual statements. Finally we also analyse how much they agree on which facts are important to know or harmful to wrongly believe.

Looking at the network as a whole, there is more agreement on which issues are important to know or harmful to wrongly believe, than on the content of the factual and value statements. Furthermore, there is more overall disagreement on facts than on values.

The spread of opinion is high (maximum from -3 to 3) for 3 of the value statements, for 6 of the factual statements and for 2 of the salience questions.

None of the value statements on management goals (Table 6-1) receive a very high disagreement level (all are below 2), while 4 statements receive a fairly high level of disagreement (1,5 or above): '90cm is an appropriate minimum landing size' (10); 'there should be a spawning sanctuary for Mediterranean swordfish' (16) and 'there is a need to limit licensing for fishing Mediterranean swordfish' (5). Surprisingly, one of the issues about which we observed much and fairly heated debate, namely the expected effects of setting a TAC for Mediterranean swordfish, does not actually show up as highly controversial among the survey respondents. Indeed the statement about the difficulty about rolling back a TAC if the state of the stock should recover, which was one of the argument that some people gave why a TAC is unwanted, receives the highest level of overall network agreement of all the value statements in this case.

While there is quite a lot of disagreement about whether '90 cm is an appropriate minimum landing size' (10), there is a little more agreement that there should be a Mediterranean-wide minimum landing size (6) and about the question whether this potential 'minimum landing size should be based on the length at which 50% of females are sexually mature' (12). Currently several Mediterranean countries have national minimum landing sizes of 90 cm. Previously, the European Union had a minimum landing size of 120 cm, but this regulation was pulled back with the argument that it had been based on Atlantic swordfish biology and thus was not appropriate for Mediterranean swordfish (EC 1999). At present the European Union has no minimum size regulation for their member states.

Table 6-1 Abbreviated survey questions on management goals, Mediterranean (N = 19).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Management measures must aim at minimizing sexually immature fish in catches* | | | | |
| **Need for a minimum size regulation:** | | | | |
| 1. Main problem is catching too many sexually immature fish | 1.32 | -2.00 | 3.00 | 1.38 |
| 6. There should be Mediterranean wide minimum size for swordfish | 1.53 | -1.00 | 3.00 | 1.17 |
| 10. 90 cm appropriate minimum size Mediterranean swordfish | .58 | -3.00 | 3.00 | 1.57 |
| 12. Min. size regulation should be based on length 50% sex. mature female fish | .11 | -3.00 | 2.00 | 1.10 |
| **Closure must be where and when juveniles are most abundant:** | | | | |
| 2. Closure in season when sexually immature fish most abundant | .89 | -2.00 | 3.00 | 1.33 |
| 7. Closure necessary for protecting spawning fish, like for sexually immature fish | .00 | -2.00 | 3.00 | 1.41 |
| 11. The closure can equally well be any time during Aug-Dec | -.53 | -2.00 | 2.00 | 1.22 |
| 13. The closure should be set when it harms the fishermen least | -1.11 | -3.00 | 2.00 | 1.29 |
| 14. Precautionary approach requires closure of > 4 months | -.84 | -3.00 | 2.00 | 1.61 |
| 15. 3 month closure reasonable compromise sci. advice & socio-econ. consid. | .26 | -2.00 | 3.00 | 1.37 |
| 16. There should be spawning sanctuaries for Mediterranean swordfish | -.63 | -3.00 | 2.00 | 1.57 |
| **Juveniles can be avoided by fishing deeper and/or further from the coast:** | | | | |
| 3. Regulation favouring deeper longlining might hurt owners small vessel | -.58 | -3.00 | 3.00 | 1.30 |
| 8. More important to protect larger vessels than small vessels | -1.74 | -3.00 | 2.00 | 1.24 |
| *Overall fishing mortality must be reduced for Maximum Sustainable Yield* | | | | |
| **Fishing mortality is too high, but a TAC is unnecessary overkill:** | | | | |
| 4. It is difficult to roll back a TAC if the state of the stock improves | .26 | -1.00 | 2.00 | .81 |
| 9. A TAC would place too much economic pressure on fishermen | -.53 | -3.00 | 1.00 | 1.26 |
| **Some measures for reducing juveniles may put the stock under pressure:** | | | | |
| 5. Need to limit licensing for fishing Mediterranean swordfish | 1.00 | -3.00 | 3.00 | 1.63 |

When asking respondents whether a particular factual statement about swordfish biology and behaviour is true or false, and how sure they are (Table 6-2), there is more overall disagreement in the network than when asking about values. The general level of disagreement on factual statements is high or fairly high (SD above 1.5) for 10 of the 16 statements, and none of the statements receive a high level of agreement (below 1). The 2 statements on which respondents disagree most are 'benefits from setting a minimum landing size would be eliminated by extra discards' (10) and 'juveniles are most abundant close to the surface' (3). While the first disagreement is not so surprising, since the minimum landing size and potential discards is a politicized issue, the disagreement about the second statement is more surprising, since most of the people interviewed agreed that this was the case. Other statements with fairly high level of disagreement (above 1,75) are: 'At 140 cm 50% of female Mediterranean swordfish are sexually mature' (11), 'spawning peaks in September all over the Mediterranean' (2), 'a placement of spawning sanctuaries would have to be redefined every year' (12), 'with 2 months closure as the only Mediterranean-wide measure MSY will never be reached' (15), 'sexually immature swordfish are most abundant during October-December' (16) and 'deeper set longlines catch larger fish than longlines near the surface' (8).

Table 6-2 Abbreviated survey questions on knowledge about biological and economic facts, Mediterranean (N = 19).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Management measures must aim at minimizing sexually immature fish in catches* | | | | |
| **Need for a minimum size regulation:** | | | | |
| 1. 50-70% of caught Mediterranean swordfish sexually immature | 2.21 | -1.00 | 3.00 | 1.03 |
| 6. Reduction of juvenile catches will improve yield per recruit levels | 1.74 | -1.00 | 3.00 | 1.37 |
| 11. At 140 cm 50% of female Mediterranean swordfish are sexually mature | 1.11 | -3.00 | 3.00 | 1.88 |
| **Closure must be where and when juveniles are most abundant:** | | | | |
| 2. Spawning peaks in September all over the Mediterranean | -1.32 | -3.00 | 2.00 | 1.89 |
| 7. Summer is the season with largest amount of small fish | -1.79 | -3.00 | 2.00 | 1.27 |
| 12. Placement of spawning sanctuaries would have to be redefined every year | -.32 | -3.00 | 3.00 | 1.86 |
| 15. With 2 month closure Med. wide as only measure MSY will never be reached | 1.16 | -3.00 | 3.00 | 1.83 |
| 16. Sexually immature swordfish most abundant during October-December | 1.26 | -2.00 | 3.00 | 1.76 |
| **Juveniles can be avoided by fishing deeper and/or further from the coast:** | | | | |
| 3. Sexually immature swordfish most abundant near surface | .21 | -3.00 | 3.00 | 2.25 |
| 8. Deeper set longlines catch larger fish than longlines near surface | .26 | -2.00 | 3.00 | 1.76 |
| 13. Sexually immature swordfish are most abundant close to the coast | 1.26 | -3.00 | 3.00 | 1.63 |
| *Overall fishing mortality must be reduced for Maximum Sustainable Yield* | | | | |
| **Fishing mortality is too high, but a TAC is unnecessary overkill:** | | | | |
| 4. Annual catch between 11000 t and 16000 t last 20 years | 1.68 | -2.00 | 3.00 | 1.38 |
| 9. Fishing mortality exceeds level needed Maximum Sustainable Yield (MSY) | 2.26 | -1.00 | 3.00 | 1.24 |
| 14. Capacity Med. swordfish fleet exceeds size needed to efficiently extract MSY | 2.11 | -2.00 | 3.00 | 1.41 |
| **Some measures for reducing juveniles may put the stock under pressure:** | | | | |
| 5. Deeply set long line catches more swordfish than one near surface | -1.05 | -3.00 | 2.00 | 1.65 |
| 10. Benefits resulting from setting a minimum size eliminated by extra discards | -.37 | -3.00 | 3.00 | 2.17 |

Table 6-3 Abbreviated survey questions on the salience (importance/harm) of biological and economic facts, Mediterranean (N = 17).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Management measures must aim at minimizing sexually immature fish in catches* | | | | |
| **Need for a minimum size regulation:** | | | | |
| 1. 50-70% of caught Mediterranean swordfish sexually immature | 1.35 | -2.00 | 3.00 | 1.37 |
| 6. Reduction of juvenile catches will improve yield per recruit levels | .76 | -1.00 | 2.00 | 1.15 |
| 11. At 140 cm 50% of female Mediterranean swordfish are sexually mature | .47 | -2.00 | 3.00 | 1.12 |
| **Closure must be where and when juveniles are most abundant:** | | | | |
| 2. Spawning peaks in September all over the Mediterranean | -1.53 | -3.00 | 1.00 | 1.37 |
| 7. Summer is the season with largest amount of small fish | -1.59 | -3.00 | 3.00 | 1.37 |
| 12. Placement of spawning sanctuaries would have to be redefined every year | -1.00 | -3.00 | 1.00 | 1.27 |
| 15. With 2 month closure Med. wide as only measure MSY will never be reached | .29 | -3.00 | 3.00 | 1.57 |

| | | | | |
|---|---|---|---|---|
| 16. Sexually immature swordfish most abundant during October-December | .71 | -2.00 | 3.00 | 1.69 |
| **Juveniles can be avoided by fishing deeper and/or further from the coast:** | | | | |
| 3. Sexually immature swordfish most abundant near surface | -.47 | -3.00 | 2.00 | 1.23 |
| 8. Deeper set longlines catch larger fish than longlines near surface | -.29 | -2.00 | 2.00 | .99 |
| 13. Sexually immature swordfish are most abundant close to the coast | .18 | -1.00 | 2.00 | .95 |
| *Overall fishing mortality must be reduced for Maximum Sustainable Yield* | | | | |
| **Fishing mortality is too high, but a TAC is unnecessary overkill:** | | | | |
| 4. Annual catch between 11000 t and 16000 t last 20 years | .35 | -2.00 | 3.00 | 1.27 |
| 9. Fishing mortality exceeds level needed Maximum Sustainable Yield (MSY) | 1.24 | -1.00 | 3.00 | .97 |
| 14. Capacity Med. swordfish fleet exceeds size needed to efficiently extract MSY | 1.59 | -1.00 | 3.00 | 1.28 |
| **Some measures for reducing juveniles may put the stock under pressure:** | | | | |
| 5. Deeply set long line catches more swordfish than one near surface | -1.12 | -3.00 | .00 | .93 |
| 10. Benefits resulting from setting a minimum size eliminated by extra discards | -.94 | -3.00 | 1.00 | 1.48 |

There is more agreement within the network about the extent to which a given factual statement is important to know (either how important it is to know that this is true; or how harmful it would be if people believed it to be false, see Table 6-3). Respondents particularly agree about the importance/harmfulness of knowledge about abundance of juveniles close to the coast and the possibility of avoiding juveniles by setting longlines deeper ('deeply set long line catches more swordfish than one near surface (5); 'deeper set longlines catch larger fish than longlines near surface (8) and 'sexually immature swordfish are most abundant close to the coast' (13)). The most disagreement about importance or harmfulness of a particular knowledge is generated by the statements that 'with 2 month closure as the only Mediterranean-wide measure MSY will never be reached' (15), on which there is also a very high spread (deviation) in the responses; and that 'sexually immature swordfish are most abundant during October-December' (16).

## 6.5.2 Comparing agreement and disagreement levels between groups in the network

This section compares the level of agreement/disagreement between different interest groups.

### Differences in opinions and beliefs between stakeholder types

There are few statistically significant differences between types of stakeholders both when looking at values (Table 6-4), and with respect to factual statements (Table 6-5). Due to model requirements and low number of individuals in certain groups, industry and ENGO representatives had to be merged in one group. We can thus not see the opinions and beliefs of any of these two category groups, but we can compare the other groups, i.e. scientists and governments in relation to each other, using the (potentially biased) "other stakeholders" group as a reference group.

Comparing the opinion of managers and scientists on value statements (Table 6-4) we find that scientists tend to agree more strongly than other stakeholders that there is a need to limit licensing for fishing Mediterranean swordfish (5) than government representatives.

Scientists and especially government officials on the other hand tend to disagree more than the other stakeholders with the statement that closure should be set when it harms fishermen least (13) and that catching sexually immature fish is the main problem (1).

When comparing answers related to factual knowledge claims (Table 6-5) scientists on average are more sure than other types of stakeholders that sexually immature swordfish are most abundant during October-December´ (16) and that 'reduction of juvenile catches will improve yield per recruit levels' (6). Government officials are more convinced than other groups that 'spawning peaks in September all over the Mediterranean' (2).

## Differences in opinions and beliefs between countries

We wanted to test whether respondents tend to agree more with other respondents from the same country (across stakeholder categories). Due to the low number of individuals in certain groups, all countries except Greece had to be merged. We can thus only look at the Greek in comparison to the "other countries" as well as in comparison with a group we call "non-affiliated", which encompasses the EU and ENGO representatives.

Looking at value opinions (Table 6-4), there is more disagreement between stakeholders when taking country affiliation into account, while there is slightly less disagreement on facts. In comparison with other respondents, the Greek on average agree more strongly than other groups that 'closure should be in the season when sexually immature fish are most abundant' (2), that 'a precautionary approach would require a closure of more than 4 months' (14) and that 'there should be a Mediterranean-wide minimum size for swordfish' (6). As the only Mediterranean country, Greece has a national closure of 4 months, which might explain their standing out on this issue. The Geeks respondents on the other hand disagree more strongly than other groups that 'the closure can equally well be any time during Aug-Dec' (11), and that 'the closure should be set when it harms the fishermen least' (13).

The "non-affiliated" respondents, i.e. ENGO representatives and EU government officials, when looked at as a group, tend to be on the side of the Greek respondents, except with regards to the need to limit licensing for fishing Mediterranean swordfish (5) - the ENGO representatives and EU government officials on average tend to agree much more with this statement than do the Greek respondents.

Table 6-4 Network autocorrelation results for value statements related to management measures, Mediterranean (N = 19). Note that different model run results are placed in the same table. Only groups with the same reference category can be compared.

| | Management measures must aim at minimizing sexually immature fish in catches | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Closure must be where and when juveniles are most abundant | | | | | | | | | | | | | |
| | Item 2 | | Item 7 | | Item 11 | | Item 13 | | Item 14 | | Item 15 | | Item 16 | |
| | b | p | b | p | b | p | b | p | b | p | b | p | b | p |
| constant | 0.77 | 0.347 | 1.03 | 0.277 | -0.73 | 0.319 | 0.39 | 0.457 | -3.08 | 0.010* | -0.35 | 0.687 | 0.27 | 0.815 |
| Scientist† | 1.26 | 0.098 | -1.24 | 0.145 | 0.17 | 0.815 | -1.45 | 0.006** | 1.57 | 0.153 | 0.68 | 0.399 | -1.37 | 0.198 |
| Government† | 0.30 | 0.689 | -1.03 | 0.229 | -0.04 | 0.950 | -1.92 | 0.000** | 1.12 | 0.286 | 1.27 | 0.110 | -0.45 | 0.648 |
| Greece+ | 1.36 | 0.025* | -0.28 | 0.644 | -1.20 | 0.024* | -3.00 | 0000** | 2.42 | 0.001** | 0.27 | 0.660 | 0.79 | 0.272 |
| Non-affiliated+ | 0.46 | 0.534 | -0.49 | 0.536 | -0.14 | 0.821 | -1.03 | 0.024* | 1.30 | 0.149 | -0.78 | 0.269 | -1.24 | 0.148 |
| rho(direct) | -0.27 | 0.006** | -0.01 | 0.931 | -0.25 | 0.039* | -0.22 | 0.015* | 0.06 | 0.718 | -0.01 | 0.929 | 0.08 | 0.420 |
| rho(indirect) | -0.09 | 0.371 | -0.28 | 0.007** | -0.19 | 0.077 | -0.17 | 0000** | -0.08 | 0.475 | -0.20 | 0.072 | -0.09 | 0.435 |

continued

| | Management measures must aim at minimizing sexually immature fish in catches | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Need for a minimum size regulation | | | | | | | | Fishing deeper and/or further from the coast | | | |
| | Item 1 | | Item 6 | | Item 10 | | Item 12 | | Item 3 | | Item 8 | |
| | b | p | b | p | b | p | b | p | b | p | b | p |
| constant | 0.19 | 0.817 | 2.69 | 0000** | -0.37 | 0.693 | 0.18 | 0.792 | -0.34 | 0.678 | -1.44 | 0.102 |
| Scientist† | 1.78 | 0.036* | -0.96 | 0.083 | 0.47 | 0.601 | 0.22 | 0.752 | 0.06 | 0.938 | -0.65 | 0.500 |
| Government† | 1.86 | 0.018* | -0.10 | 0.832 | 1.03 | 0.237 | -0.32 | 0.621 | -0.55 | 0.459 | -0.64 | 0.433 |
| Greece+ | 0.87 | 0.273 | 0.91 | 0.019* | 0.88 | 0.249 | -0.82 | 0.064 | -0.56 | 0.400 | -1.41 | 0.060 |
| Non-affiliated+ | 1.47 | 0.100 | 0.77 | 0.102 | 0.80 | 0.345 | -0.27 | 0.630 | -0.74 | 0.334 | -1.17 | 0.187 |
| rho(direct) | -0.21 | 0.015* | -0.26 | 0.004** | -0.40 | 0.001** | -0.35 | 0.010* | -0.37 | 0.004** | -0.10 | 0.330 |
| rho(indirect) | -0.08 | 0.463 | -0.14 | 0.012* | 0.07 | 0.532 | -0.12 | 0.448 | 0.06 | 0.627 | -0.11 | 0.209 |

continued

| | Overall fishing mortality must be reduced for Maximum Sustainable Yield | | | | | |
|---|---|---|---|---|---|---|
| | TAC is unnecessary overkill | | | | stock under pressure | |
| | Item 4 | | Item 9 | | Item 5 | |
| | b | p | b | p | b | p |
| constant | 1.13 | 0.041* | -1.02 | 0.073 | 1.65 | 0.109 |
| Scientist† | -0.48 | 0.345 | 0.15 | 0.788 | 0.22 | 0.817 |
| Government† | -0.51 | 0.319 | 0.06 | 0.912 | -1.44 | 0.076 |
| Greece+ | -0.62 | 0.108 | 0.46 | 0.247 | -1.01 | 0.123 |
| Non-affiliated+ | -0.34 | 0.492 | -0.81 | 0.105 | 1.56 | 0.033* |
| rho(direct) | -0.27 | 0.101 | -0.25 | 0.003** | 0.00 | 0.969 |
| rho(indirect) | -0.04 | 0.760 | -0.31 | 0000** | -0.11 | 0.233 |

Country groups mainly differ with respect to factual beliefs (Table 6-5) about all three statements concerning fishing location, i.e. whether to fish deeper and/or further from the coast. EU and ENGO representatives, who are not affiliated with a country, tend to be more sure (or less unsure) than all the country-affiliated respondents about the statement that 'sexually immature swordfish are most abundant near the surface' (3). The "non-affiliated" agree more than the Greek respondents that deeper set longlines catch larger fish (8), and together with the Greek respondents they agree more than other nationalities that sexually immature swordfish are most abundant close to the coast (13). In addition, non-affiliated respondents agree more with the statement that 'the capacity of the Mediterranean swordfish fleet exceeds the size needed to efficiently extract MSY' (14) than the Greek respondents.

Table 6-5 Network autocorrelation results for factual statements, Mediterranean (N = 19). Note that different model run results are placed in the same table. Only groups with the same reference category can be compared.

Management measures must aim at minimizing sexually immature fish in catches

| | Closure must be where and when juveniles are most abundant | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Item 2 | | Item 7 | | Item 12 | | Item 15 | | Item 16 | |
| | b | p | b | p | b | p | b | p | b | p |
| constant | -2.63 | 0.037* | -1.89 | 0.062 | -0.19 | 0.876 | 1.21 | 0.274 | 0.15 | 0.913 |
| Scientist† | 0.97 | 0.376 | -0.26 | 0.746 | -0.03 | 0.978 | -0.50 | 0.654 | 2.10 | 0.042* |
| Government† | 2.07 | 0.040* | 0.52 | 0.500 | -0.23 | 0.837 | -0.30 | 0.778 | 0.14 | 0.891 |
| Greece+ | -0.39 | 0.676 | -1.01 | 0.135 | -0.55 | 0.560 | -0.01 | 0.993 | 0.33 | 0.699 |
| Non-affiliated+ | 1.55 | 0.166 | -0.49 | 0.5400 | 0.00 | 0.997 | 1.69 | 0.115 | 0.45 | 0.677 |
| rho(direct) | -0.03 | 0.745 | -0.09 | 0.337 | -0.20 | 0.083 | 0.10 | 0.314 | -0.06 | 0.581 |
| rho(indirect) | 0.15 | 0.378 | 0.03 | 0.854 | -0.04 | 0.835 | -0.28 | 0.077 | 0.19 | 0.289 |

continued

| | Management measures must aim at minimizing sexually immature fish in catches | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Need for a minimum size regulation | | | | | | Fishing deeper and/or further from the coast | | | | | |
| | Item 1 | | Item 6 | | Item 11 | | Item 3 | | Item 8 | | Item 13 | |
| | b | p | b | p | b | p | b | p | B | p | b | p |
| constant | 1.69 | 0.028* | 1.02 | 0.271 | 2.07 | 0.163 | -1.68 | 0.059 | 0.09 | 0.940 | -0.39 | 0.669 |
| Scientist† | 0.55 | 0.393 | 1.71 | 0.039* | 0.57 | 0.589 | 1.52 | 0.080 | -0.60 | 0.578 | 1.37 | 0.134 |
| Government† | -0.22 | 0.705 | 0.33 | 0.661 | 0.25 | 0.826 | 1.52 | 0.089 | 0.75 | 0.462 | 0.10 | 0.911 |
| Greece+ | 0.31 | 0.540 | 0.40 | 0.539 | -0.77 | 0.404 | -1.31 | 0.073 | -0.28 | 0.747 | 1.72 | 0.031* |
| Non-affiliated+ | 0.99 | 0.105 | -0.60 | 0.488 | -0.92 | 0.389 | 3.66 | 0.000** | 1.71 | 0.132 | 2.45 | 0.005** |
| rho(direct) | 0.03 | 0.598 | -0.03 | 0.710 | -0.27 | 0.035* | -0.30 | 0.000** | -0.04 | 0.760 | 0.01 | 0.906 |
| rho(indirect) | -0.11 | 0.429 | 0.01 | 0.933 | 0.19 | 0.193 | -0.24 | 0.103 | -0.03 | 0.867 | -0.15 | 0.306 |

continued

| | Overall fishing mortality must be reduced for Maximum Sustainable Yield | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TAC is unnecessary overkill | | | | | | stock under pressure | | | |
| | Item 4 | | Item 9 | | Item 14 | | Item 5 | | Item 10 | |
| | b | p | b | p | b | p | b | p | B | p |
| constant | 2.50 | 0.005** | 3.15 | 0.002** | 3.16 | 0.007** | -1.10 | 0.309 | -2.45 | 0.091 |
| Scientist† | -0.80 | 0.351 | -0.79 | 0.411 | -0.67 | 0.518 | -1.11 | 0.265 | 1.58 | 0.216 |
| Government† | -2.06 | 0.004** | -0.86 | 0.257 | -0.90 | 0.293 | 0.23 | 0.809 | 1.30 | 0.292 |
| Greece+ | -0.10 | 0.888 | 0.00 | 0.998 | -0.31 | 0.713 | -0.49 | 0.524 | 1.11 | 0.278 |
| Non-affiliated+ | 0.12 | 0.881 | 0.20 | 0.811 | 0.77 | 0.404 | -0.92 | 0.343 | 1.89 | 0.143 |
| rho(direct) | 0.03 | 0.663 | -0.04 | 0.650 | -0.05 | 0.612 | -0.20 | 0.139 | -0.34 | 0.013* |
| rho(indirect) | 0.06 | 0.683 | 0.05 | 0.735 | -0.02 | 0.902 | 0.16 | 0.427 | 0.16 | 0.288 |

Note. * $p < .05$; ** $p < .01$

† Reference category: Other stakeholders.

+ Reference category: Other countries.

Finally we compared the levels of agreement between different types of stakeholders and between stakeholders with different country affiliations with regards to their perceived salience of factual beliefs, that is, how important it is to know that this fact is true, or how harmful it would be to wrongly believe that it is true (Table 6-6).

Here we found higher disagreement both between types of stakeholders and between countries.

Scientists and managers are more convinced than other stakeholders that it is important to correctly know that '50-70% of caught Mediterranean swordfish are sexually immature' (1), that 'reduction of juvenile catches will improve yield per recruit levels' (6), and that 'the benefits resulting from setting a minimum size would be eliminated by extra discards' (10).

Both find it less important than other stakeholders to know (or are more convinced that it is harmful to believe) that a deeply set long line catches more swordfish than one near the surface (5).

Scientists are more likely than managers to find it harmful (or they find it less important to know) that 'deeper set longlines catch larger fish than longlines near the surface' (8) and that ‘sexually immature swordfish are most abundant close to the coast’ (13). Scientists on the other hand find it more important than managers to know that ‘fishing mortality exceeds level needed Maximum Sustainable Yield (MSY)’ (9).

Greek respondents take significantly different positions on the salience of several statements: compared to other groups they consider it more important to know that ‘MSY will never be reached with a 2-month closure as the only Mediterranean- wide measure’ (15), that ‘50% of female Mediterranean swordfish are sexually mature at 140 cm’ (11), and that ‘fishing mortality exceeds the level needed for MSY’ (9). Compared to the non-affiliated respondents, the Greek respondents think that it is more harmful to believe that ‘deeper set longlines catch larger fish than longlines near the surface’ (8).

### 6.5.3 Network effects

Network effects are scarce with regards to factual statements and the salience of factual statements. For factual statements three statistically significant direct negative network effects (rho direct) have been found (statements 11, 3 and 10, Table 6-5), while for salience statements two statistically significant negative direct network effects have been found (statements 3 and 5, Table 6-6) and three negative indirect network effects (rho indirect). On value statements, however, there is a much higher amount of network effects (Table 6-4). When we control for differences in value opinions among types of stakeholders and nationality, statistically significant direct network effects are found for eight out of the sixteen statements. All statistically significant direct and indirect network effects are negative. This means that respondents tend to have frequent discussion ties with peers that have different values or opinions on management goals. Apparently previous discussions have not brought about consensual opinions among discussion partners, if we assume that discussion partner choice has not changed over time.

Table 6-6 Network autocorrelation results for salience of knowledge (importance /potential harmfulness), Mediterranean (N = 17).

| | Management measures must aim at minimizing sexually immature fish in catches<br>Closure must be where and when juveniles are most abundant | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Item 2 | | Item 7 | | Item 12 | | Item 15 | | Item 16 | |
| | b | P | b | p | b | p | b | p | b | p |
| Constant | -2.38 | 0.048* | -0.59 | 0.648 | -1.44 | 0.098 | -0.15 | 0.873 | 0.92 | 0.506 |
| Scientist† | 0.15 | 0.892 | -0.87 | 0.523 | 0.50 | 0.595 | 0.16 | 0.860 | 0.68 | 0.588 |
| Government† | 1.33 | 0.233 | 0.25 | 0.847 | -0.36 | 0.662 | 0.42 | 0.637 | -0.53 | 0.670 |
| Greece+ | -0.22 | 0.827 | -0.81 | 0.457 | 0.24 | 0.676 | 1.51 | 0.013* | 0.52 | 0.579 |
| Non-affiliated+ | 0.69 | 0.440 | -1.08 | 0.235 | -0.76 | 0.307 | 0.45 | 0.515 | -0.28 | 0.803 |
| rho(direct) | -0.05 | 0.628 | 0.00 | 0.995 | -0.08 | 0.529 | 0.03 | 0.771 | -0.11 | 0.366 |
| rho(indirect) | 0.03 | 0.833 | 0.06 | 0.631 | -0.24 | 0.091 | -0.46 | 0.000** | -0.10 | 0.560 |

continued

| | Management measures must aim at minimizing sexually immature fish in catches<br>Need for a minimum size regulation | | | | | | Fishing deeper and/or further from the coast | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Item 1 | | Item 6 | | Item 11 | | Item 3 | | Item 8 | | Item 13 | |
| | b | p | b | p | b | p | b | p | b | p | b | p |
| Constant | -0.31 | 0.723 | -1.01 | 0.202 | 1.13 | 0.107 | -1.54 | 0.028* | -0.42 | 0.530 | 0.31 | 0.686 |
| Scientist† | 2.26 | 0.013* | 2.52 | 0.000** | -0.67 | 0.314 | -0.81 | 0.226 | -0.41 | 0.514 | -0.51 | 0.481 |
| Government† | 1.69 | 0.048* | 1.68 | 0.012* | -0.26 | 0.694 | -0.29 | 0.642 | 0.86 | 0.199 | 0.19 | 0.790 |
| Greece+ | 0.95 | 0.150 | 0.41 | 0.502 | 1.11 | 0.052 | 1.44 | 0.000** | -0.49 | 0.242 | 0.25 | 0.615 |
| Non-affiliated+ | 1.55 | 0.022* | 0.21 | 0.727 | -1.15 | 0.033* | 0.75 | 0.150 | 0.59 | 0.253 | 0.25 | 0.684 |
| rho(direct) | 0.04 | 0.656 | -0.01 | 0.905 | -0.21 | 0.118 | -0.35 | 0.001** | 0.03 | 0.786 | 0.06 | 0.690 |

| rho(indirect) | -0.43 | 0.001** | -0.18 | 0.180 | -0.20 | 0.088 | -0.12 | 0.347 | -0.13 | 0.452 | -0.12 | 0.415 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

continued

| | Overall fishing mortality must be reduced for Maximum Sustainable Yield | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TAC is unnecessary overkill | | | | | | TAC is unnecessary overkill | | | |
| | Item 4 | | Item 9 | | Item 14 | | Item 5 | | Item 10 | |
| | b | p | b | p | b | p | b | p | b | p |
| Constant | 1.88 | 0.031* | 2.07 | 0.000** | 1.71 | 0.086 | -0.77 | 0.186 | -2.97 | 0.002** |
| Scientist† | -0.44 | 0.616 | 0.16 | 0.712 | -0.67 | 0.501 | -1.76 | 0.002** | 1.87 | 0.058 |
| Government† | -1.16 | 0.134 | -0.47 | 0.297 | -0.10 | 0.920 | -1.18 | 0.039* | 2.24 | 0.018* |
| Greece+ | -0.93 | 0.063 | 1.01 | 0.001** | 0.60 | 0.421 | 0.11 | 0.813 | -0.77 | 0.296 |
| Non-affiliated+ | -1.34 | 0.038* | 0.56 | 0.071 | 1.21 | 0.125 | -1.01 | 0.053 | 0.28 | 0.725 |
| rho(direct) | -0.09 | 0.382 | -0.12 | 0.050 | 0.06 | 0.577 | -0.33 | 0.000** | -0.19 | 0.140 |
| rho(indirect) | -0.28 | 0.076 | -0.35 | 0.000** | -0.14 | 0.311 | -0.04 | 0.765 | -0.02 | 0.853 |

Note. * $p < .05$; ** $p < .01$
† Reference category: Other stakeholders.
+ Reference category: Other countries.

## 6.6 Discussion

### 6.6.1 Reflections on the low response rate

The response rate to the survey has been low in this case study. Only 17 people completed the entire questionnaire (31.5%), and non-response is very high (31/54=57%). Non-response was especially high among the members of the fishing industry (83%) and no member of this the industry has completed the entire questionnaire. Apart from the fact that the questionnaire was time consuming, there might be a number of reasons while so many people chose not to respond:

- *Network too wide*: not all respondents might have perceived the identified themes or even the fishery itself as highly relevant to them, and should perhaps not have been included in the survey. Respondents were selected through a snowball sampling method, and we included people who were identified by (potential) interviewees as being relevant. In hindsight some of these were probably identified by their peers due to concerns more related to internal organization structures (command-ways) than by direct relevance to the science-policy discussions within the fishery. For instance several French industry representatives were included in the network, despite France not having a large swordfish fishing interest. However, those people had been pointed out as being relevant by the main French fishing organization, and a few of these respondents did indeed participate in - and had strong opinions on – swordfish related discussions, yet most of the French respondents could probably have been left out of the survey altogether. A few non-respondents are clearly important to the network, as we can see by the number of responders who identified them as communication partners (Figure 6-1 and Figure 6-2).
- *Uncertainty on facts and scale of knowledge*: some respondents did not wish to fill in the part of the questionnaire where they were asked to agree or disagree with a number of factual claims. The statements and discursive themes had been selected on the basis of there being some degree of uncertainty and disagreement about them. This uncertainty, however, seemed to be problematic for some respondents, when it came to rating particular factual statements as either "true" or "false", and might be related to the everyday definition of a fact as something that can be verified, hence people did not want to give the "wrong" answer. The factual statements included figures related to the

stock abundance and catch composition found in the stock assessment reports. One partial respondent noted that due to uncertainties related to the estimation, they could not say whether the specific numbers were “true” or “false”. Furthermore, the stakeholders referred to the fact that there are great variations across the Mediterranean, thus to them it did not make sense to relate to a single average figure of catch composition. To fishermen stakeholders, relevant knowledge is likely to be more related to a local/national scale than to the regional scale at which the SCRS stock assessments operate. This is not an uncommon issue in fishery science (Degnbol & Wilson 2008).

- *Political reasons, organizational structure and institutional tradition for official vs. personal statements*: the questionnaire was constructed on the basis of a network of individuals, and personal responses were thus important. However, several national administrations, part of the European administration and one industry stakeholder organization were concerned with the potential political implications of the survey, and explicitly stated that they needed central clearance to respond. Furthermore, these respondents said that they could only give the official responses of their entire institution. As a result, some responded as a group, while others did not respond at all.

### 6.6.2 Discussions within and between groups in the network

56% of the communication ties between the respondents in this case were between different types of stakeholders. Given that several stakeholder groups were not well-represented in the survey (or in the network), this is actually quite a high number. There were communication clusters within the scientist group and (to a lesser extent) the government group. A separate analysis based on respondents’ roles in the management system, i.e. whether they represented a local, national or EU level was not possible, but looking at our background information on the respondents we can see that a cluster was likely to have formed between the EU-level managers as well. Furthermore, we saw a clear Greek cluster of communication ties. The Greek group was the only one that comprised several people who do not participate in ICCAT level discussions on swordfish. There was also some clustering of Spanish respondents. It is thus likely that had we included more stakeholders from each country, moving beyond the ICCAT context, we would have seen similar clusters of communication. However, for some of the most important Mediterranean fishing nations no stakeholders were identified for the network (neither through observation of ICCAT meetings nor by asking other respondents directly). This thus shows that most of the cross stakeholder type communication, especially with the industry, most likely takes place within countries, and not in any formalized settings. There were only few ENGO representatives identified in the network, however, they generally seemed to be quite centrally placed with communication ties with several other respondent groups. It will be interesting to see whether in the future the Mediterranean RAC can play a more important role in bringing together stakeholders as well as bringing more stakeholder views to the formal discussions on Mediterranean swordfish.

## 6.7 Conclusions

The response rate to the survey in this case study has been low.

The Q-sort analysis showed that in the network as a whole there was more agreement on salience of different statements than on the content of the statements. There was higher agreement on values than on facts.

When comparing groups, on the other hand, we found higher disagreement on the salience of the statements, i.e. which are most important to know or potentially harmful to believe. More disagreement was found between countries than between stakeholder types on values, while for facts and salience there was slightly more disagreement between stakeholder types than between countries.

Overall there seems to be a fair amount of agreement on many of the individual statements. Given that the industry and ENGOs –groups which often have different interests –were grouped together in the statistical analysis and used as a reference group, some differences in values or knowledge might have been blurred. Looking at country affiliation, more disagreement was observed. The Greek stood out as a group, which can be partly attributed to methodological differences in how they were identified as relevant to the network. However, it could also be related to national differences in regulation or fishing practices.

In terms of the relation between communication networks and levels of agreement, we found only negative network effects. Thus we must conclude that respondents in this case tend to have frequent discussion ties with peers that have different values or opinions on management goals, and that previous discussions have not brought about consensual opinions among discussion partners.

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## 6.9 Appendix 1

### Statements of fact

1. Currently, 50-70% of the number of Mediterranean swordfish caught yearly are sexually immature
2. Spawning peaks in September all over the Mediterranean
3. Sexually immature swordfish are most abundant near the surface
4. The total annual catch has been fluctuating between 11000 t and 16000 t over the last 20 years
5. A deeply set long line catches a larger number of swordfish than one set near the surface.
6. A reduction of the volume of juvenile catches would improve yield per recruit levels
7. The season with the largest amount of small fish is the summer
8. Deeper set longlines catch larger fish than do longlines set near the surface
9. Current fishing mortality exceeds the level needed for maximum sustainable yield
10. The increased discards resulting from setting a minimum size eliminate the benefits the minimum size would otherwise have
11. At 140 cm 50% of the female Mediterranean swordfish are sexually mature
12. The placement of spawning sanctuaries would have to be redefined every year if they were to continue to protect spawners
13. Sexually immature swordfish are most abundant close to the coast
14. The current capacity in the Mediterranean swordfish fleet exceeds that needed to most efficiently extract the maximum sustainable yield
15. If a two month closure were the only Mediterranean wide management measure Maximum Sustainable Yield would never be reached.
16. Sexually immature swordfish are most abundant during October-December

### Statements of value

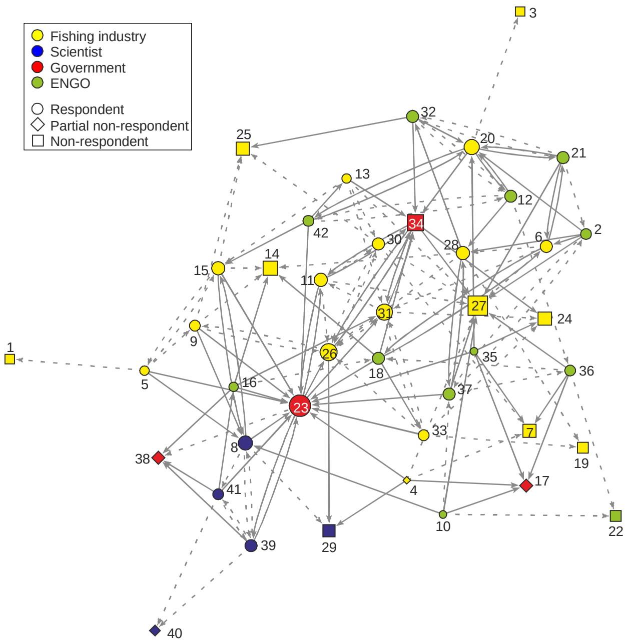
1. The main problem in the fishery is catching too many sexually immature fish.
2. The closure must be placed during the season when sexually immature fish are most abundant
3. Regulation that favours deeper longline fishing might hurt owners of small vessel
4. It is difficult to roll back a TAC if the state of the stock improves
5. There is a need to limit licensing for fishing swordfish in the Mediterranean
6. There should be a Mediterranean wide minimum size for swordfish
7. There ought to be a closure aiming at protecting the spawning fish, not just the sexually immature fish
8. It is more important to protect larger vessels fishing for swordfish than small vessels
9. A TAC would place too much economic pressure on the fishermen
10. 90 cm is an appropriate minimum size for Mediterranean swordfish
11. The closure can equally well be any time during Aug-Dec
12. Minimum size regulations should be based on the length where 50% of the female fish are sexually mature
13. The closure should be set for when it harms the fishermen least
14. A precautionary approach requires a closure of more than 4 months.

15. 3 months closure would be a reasonable compromise between the scientific advice and the socio-economic considerations
16. There should be spawning sanctuaries for Mediterranean swordfish

# 7 New England Groundfish fisheries

**Unfortunately, there are a number of errors in the allocations of individuals to different stakeholder types. This is particularly the case for four of the key respondents who should have been labelled "Scientist". This also has an effect on the network autocorrelation analyses. The analysis presented below is therefore preliminary.**

## 7.1 Main findings




The case study examines New England groundfish fishery management practices within the United States. The groundfish fishery is a complex of 19 stocks (12 species) of demersal finfish. U.S. fishermen pursue these stocks in the Gulf of Maine, Georges Bank, and southern New England waters using a variety of gear types.

The discourse selected for this analysis generated a substantial amount of disagreement among different respondents and stakeholder groups.

The NEFMC brings together a diverse group of participants, although the scientists do tend to function more autonomously compared to the other groups. Differences of opinion exist on the management issues (values) which corresponds to the NEFMC being designed to represent the heterogeneous views within the management system. Science advisors frequently hold positions on knowledge that markedly differ from the other groups because they are a more homogeneous group.

Unfortunately, there are a number of errors in the sociogram in the allocations of individuals to different stakeholder types. This is particularly the case for four of the key respondents who should have been labelled "Scientist". This also has an effect on the network autocorrelation analyses.

## 7.2 Description of the case

The case study examines New England groundfish fishery management practices within the United States. The aim is to investigate how managers, scientists and stakeholders interact behind the formal institutions, and whether and how the interaction influences agreement and disagreement between the groups. New England groundfish was selected because it offered a case study to examine policy networks in a management system known for allowing a high degree of stakeholder participation.

### 7.2.1 The New England groundfish fishery

The groundfish fishery is a complex of 19 stocks (12 species) of demersal finfish. U.S. fishermen pursue these stocks in the Gulf of Maine, Georges Bank, and southern New England waters using a variety of gear types. At the regional level, the New England Fishery Management Council (NEFMC) has managed the fishery since 1977. The stocks experienced significant overfishing through the 1990s, and many remain overfished today. Recent management efforts to reverse these trends have resulted in significant socio-economic impacts on the fleet and fishing communities throughout the New England region, from Maine to North Carolina. Political debate is widespread regarding the biological and social effectiveness of management efforts.

The key management issue is how to reduce fishing morality and rebuild overfished stocks, while to the extent possible, minimizing socioeconomic impacts on fishermen and fishing communities. In attempt to address this, in June 2009, the New England Fishery Management Council (NEFMC) passed Amendment 16 to the Northeast Multispecies Fishery Management Plan (FMP). Amendment 16 created a new system of groundfish catch shares (or sectors), where 19 groups of fishermen have been allocated shares of the total allowable catch (TAC) to harvest as a group (with those not in sectors remaining in a common-pool under more stringent DAS restrictions). This case focuses on efforts to implement this new "catch shares" system, referred to as sectors.

### 7.2.2 The science-management system and the role of the stakeholders

The science/management debate in this case study occurs within the existing fisheries management institutions. The NEFMC is a regional, appointed council of state fishery managers, fishing industry representatives, and other stakeholders that meets about 5-6 times per year. The Council manages federal fisheries from Maine to Connecticut (from 3-200 miles). The 18-member council develops fishery management plans to manage the region's fisheries, according to the provisions in the Magnuson Stevens Fishery Conservation and Management Act. Management must pay attention to 10 National Standards; the most important of these in practice are that conservation measures (1) prevent overfishing while achieving optimum yield and (2) be based upon the best scientific information available.

The Council relies on stakeholder advisory panels and technical (scientific) committees, as well as extensive public comment opportunities. There are approximately 13 council members on Groundfish Oversight Committee, 13 industry advisors (Advisory Panel), at least 8 scientific advisors (Plan Development Team), and 15 independent scientists charged with reviewing the scientific basis of policy-making (Science and Statistical Committee). The SSC sets annual catch limits (ACL) that will not exceed the annual biological catch (ABC), and the Council cannot exceed the ACL set by the SSC. The basis of stock assessment advice are stock assessments compile by the Northeast Fisheries Science Center, and then peer reviewed through the Groundfish Assessment Review Meeting.

## 7.3 Data collection and methodology

### 7.3.1 Interviews and other qualitative data collecting

The discourse analysis was based on 12 interviews with industry members and scientists involved in the fishery management process. In addition, data include observations at NEFMC meetings, June 2009 and June 2010 in Portland, Maine, and the Maine Fishermen's Forum, March 2009 and March 2010 in Rockport, Maine. Key public documents related to the management of groundfish were reviewed including those related o Amendment 13 and Amendment 16, including summaries from public hearings where stakeholders gave public testimonies on their opinions about groundfish management. In addition, other materials and audio files from NEFMC meeting, as well as its science and stakeholder advisory panels, were reviewed. The proceedings and audio files from a fine-scale management workshop attended in April 2009, in York, Maine, were reviewed.

The "network" examined in this case includes individuals most central to the implementation of groundfish sectors: members of the NEFMC Groundfish Oversight Committee (Council members), the Groundfish Advisory Panel (stakeholder panel), and key groundfish science advisors on the SSC and PDT (science advisors), as well as "other participants." Council members include members of the fishing industry, government science and managers, and NGO representatives. Stakeholder advisors include members of the industry and NGOs, the latter including scientists. Science advisors include both academic, NGO, and government scientists. The "other participants" category includes those stakeholders representing, managing, or facilitating the groundfish sectors and the most vocal participants in the process identified in interviews related to groundfish management and catch shares. A total of 42 individuals were identified as key to the network for this case.

### 7.3.2 Discourse analysis

The discourse analysis meant classifying the available data into themes, and further identifying categories, views, and roles. The three broad themes that emerge from interviews in this case study are: "Fishing communities need protection," (2) Spatial/Area management is needed, and (3) Catch shares reduce bycatch and discards." Following this, 32 statements were selected to represent the discourse; 16 were factual in nature (related to the biology or economics) and 16 were value-laden (related to policy preferences). The statements covered both agreement and disagreement. JAKFISH WP5 leader and several local fishery management experts reviewed the statements.

There is significant scientific uncertainty about whether groundfish stocks are more localized than stock assessment and management treats them. If they are more local, the argument is that they must be managed at a more local scale. However, stocks are fairly mobile and there is a bit of uncertainty about how much they move and if they are comprised of distinct subpopulations.

There is disagreement about the behaviour of groundfish and the population structure, or at least the importance of these to the scale of management. Fishery managers have long managed cod, and other groundfish, on a broad scale (large-scale, single species focus). For example, cod is managed and assessed as two separate stocks: Gulf of Maine Cod and Georges Bank Cod. However, Ames (1997, 2004) and others point to the possibility that there are multiple, local stocks and they point to ecological theory to emphasize the importance of fine-scale (spatial and temporal scale) ecological processes. Tagging research conducted in cooperation with fishermen in recent years has added new information about the complexity of Atlantic cod stock structure. It is not clear whether those assessing fish stocks agree or disagree about the importance of this complexity. It is has also been suggested that they do not disagree that fine-scale dynamics matter, but they view that it is sufficient to assess stocks at large scales for the purposes of management. Related to this are legal mandates that require that fish stocks be managed as units throughout their range.

There is some disagreement about the status of the stocks produced through stock assessments. Some stakeholders suggest that the science is sound, while others suggest there are problems with the data used in the assessments. In the past there have also been concerns about the models used in management (although this may not be relevant to the debate about area management) and the fisheries-independent survey that provides input data into stock assessment models. Over the last decade, significant investment has been made in funding industry-science cooperative research projects aimed to improve assessments and management (as well as build trust and communication between scientists, industry, and managers).

There is some disagreement about the impact of catch shares on small-scale communities and whether they are effective (and equitable) tools for fisheries management. There is evidence that catch shares (like ITQs) result in significant impacts to small-scale fishermen and fishing communities in part through rapid consolidation. Because of this, some stakeholder feel there should be put into place some restrictions to protect communities. Often, this means small-scale communities; other groups take this to mean all fishermen should be given some assistance as part of a catch shares system, e.g., temporary increasing catch limits to minimize impacts on fishermen and fishing communities, in part to avoid shutting down the fishery due to “weak stocks” that are caught in pursuit of healthy stocks. Some stakeholders argue that catch shares result in more sustainable harvests, but others point to evidence of high grading, discards, and bycatch problems that are often seen with catch shares.

### 7.3.3 Survey

Of the 42 individuals invited to complete the survey, 28 (64%) completed the entire questionnaire. Ten did not respond at all. Three responded partially, that is, they did not answer all questions. Of those, one answered only the knowledge questions, and two answered only the value questions. One individual provided only partial responses in a paper version of the survey, but these data were discarded because they were too incomplete to use in the analysis.

## 7.4 Social network analysis

Figure 7-1 and beyond show sociograms of the total network; circles indicate respondents, diamonds partial respondents, and squares represent non-respondents; the size of the circle, diamond, and box shows the number of nominations received while the interior colour of circles and boxes denotes the role group partition; dashed lines are discussion ties within role groups and solid lines are ties between role groups. Role refers to the participants' formal role in the process, including members of the Council, stakeholder advisory committee, science advisory committee, and other active participants in the management process and discussion but those without a formal role on a committee.  Note that there are a number of errors in the allocations of individuals to different stakeholder types. This is particularly the case for respondent 23 who should have been labelled "Scientist" in Figure 7-1. This also has an effect on the network autocorrelation analyses, but this effect is likely small.

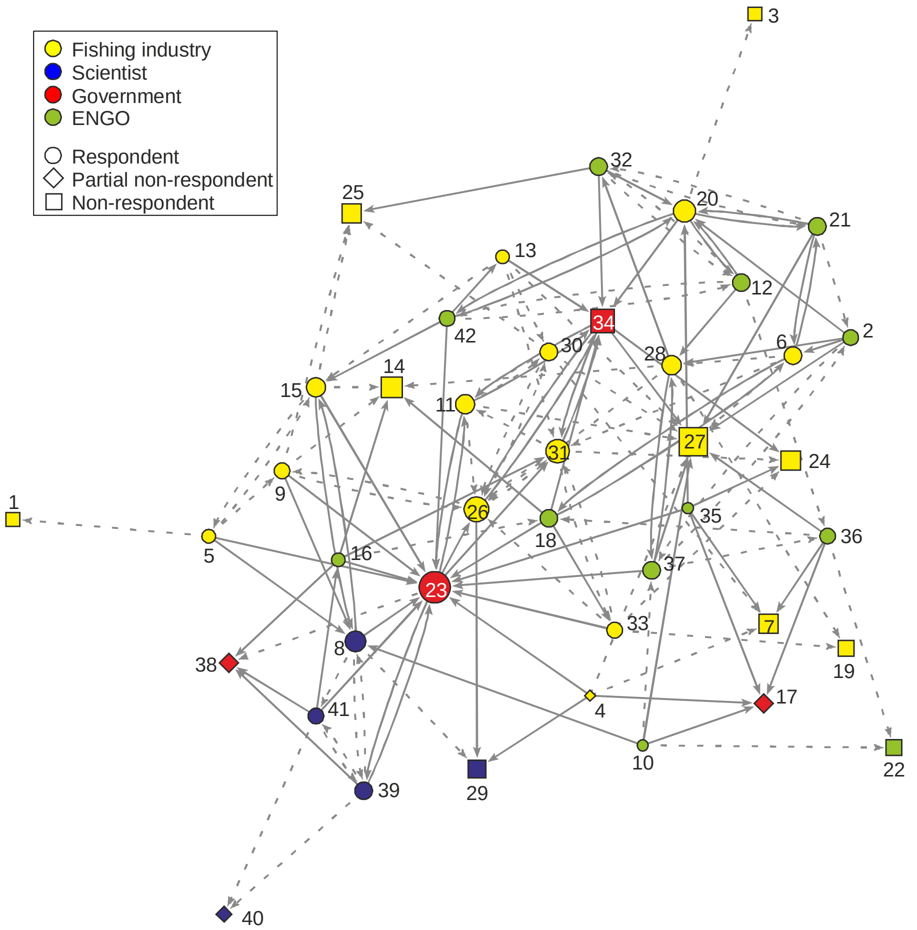



Figure 7-1 Sociogram of the discussion network with **stakeholder type**, New England (vertex size represents indegree, within-group ties are dashed). **NOTE: there are a number of errors in the allocations of individuals to different stakeholder types. This is particularly the case for respondent 23 who should have been labelled "Scientist"**

Individuals cluster in the network to some extent: network heterogeneity with role groups is 0.59 (59% of the lines link experts from different role groups). Science advisors (blue) are clustered at the bottom-left; they are mainly connected to the rest of the network through scientist number 23, who is the most central expert in the network. Other participants (yellow) and stakeholder advisors (green) and Council members (red) are mingled throughout the sociogram.

Non-responders 27 and 34 receive many nominations. They are responsible for many indirect ties between experts.

shows the fields of expertise of the experts. Here the network heterogeneity is .50. One can see that the scientists cluster to the bottom left, and they connect to the rest of the network through scientist 23.

Input degree centralization is 0.24, which is lower than the Australian network. Network density is 0.08.

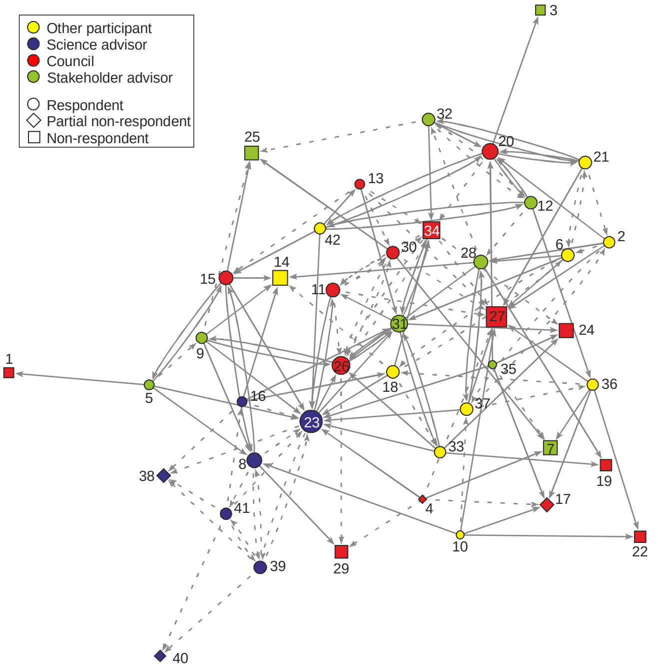



Figure 7-2 Sociogram of the discussion network with formal **role**, New England (vertex size represents indegree, within-group ties are dashed).

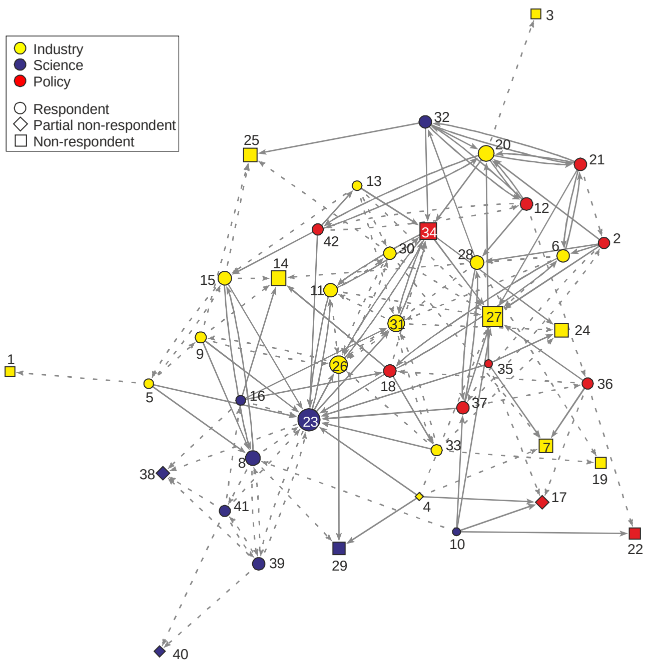



Figure 7-3 Sociogram of the discussion network with **expertise**, New England (vertex size represents indegree, within-group ties are dashed).

## 7.5 Q-sort analysis

### 7.5.1 Overall levels of disagreement in the network

Three broad themes emerged from interviews in this case study: (1) “Fishing communities need protection,” (2) “Spatial/Area management is needed,” and (3) “Catch shares reduce bycatch and discards.” The 16 interest and knowledge items are ordered according to these three categories in the tables below.

Respondents disagree to a large extent on almost all interests and knowledge questions (high standard deviations, Table 7-1 and Table 7-2). Knowledge about cod moving back and forth across stock boundaries (knowledge question 12, $M$ = 2.62, $SD$ = 0.56) is an exception. Almost all respondents are very sure that the do. This applies also to the statements that cod return to the same spawning locations (knowledge question 1, $M$ = 2.10, $SD$ = 0.90).

Table 7-1 Abbreviated survey questions on **values and interests**, New England (N = 28).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Fishing communities need protection* | | | | |
| 2. Increase annual catch limits choke stocks to minimize socio-econ impacts | -.68 | -3.00 | 2.00 | 1.56 |
| 3. Managers should cap amount of individual quota to prevent consolidation | .46 | -3.00 | 3.00 | 1.55 |
| 6. New fishermen should be able to enter the fishery as stocks recover | .46 | -2.00 | 3.00 | 1.32 |
| 9. Allocations should be made solely on historical landings in the fishery | -.89 | -3.00 | 3.00 | 1.66 |
| 11. Amend Magnuson Stevens Act so more flexibility rebuilding overfished stocks | -.21 | -3.00 | 3.00 | 2.33 |
| 12. Industry funded buy back of permits needed to reduce capacity in the fishery | -.50 | -2.00 | 3.00 | 1.23 |
| 13. Permit banks should support small-scale fishermen | .50 | -1.00 | 2.00 | .96 |
| 14. NOAA dedicate more funding for covering the costs of sector management | .04 | -2.00 | 2.00 | 1.10 |
| *Spatial/Area management is needed* | | | | |
| 5. Manage fish stocks as a unit rather than as individual local stocks | .07 | -2.00 | 3.00 | 1.65 |
| 8. To promote stewardship and conservation manage groundfish locally | -.36 | -3.00 | 3.00 | 1.85 |
| 10. Re-designed closed areas to better protect spawning grounds and habitat | .57 | -2.00 | 2.00 | 1.00 |
| 15. All fishing gear capable of catching groundfish prohibited in closed areas | -.29 | -3.00 | 2.00 | 1.18 |
| 16. Manage inshore north-eastern Gulf of Maine as unique ecological area | -.46 | -3.00 | 3.00 | 1.26 |
| *Catch shares reduce bycatch and discards* | | | | |
| 1. Increased at-sea monitoring to ensure fishermen stay within catch limits | 1.32 | -2.00 | 3.00 | 1.66 |
| 4. A zero possession limit for Gulf of Maine winter flounder | -1.21 | -3.00 | 1.00 | 1.03 |
| 7. Discarding of all legal size fish should be prohibited | 1.18 | -1.00 | 3.00 | 1.09 |

Table 7-2Abbreviated survey questions on **knowledge** about biological and economic facts, New England (N = 29).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Fishing communities need protection* | | | | |
| 2. Employment loss is typical when catch shares are introduced | 1.28 | -3.00 | 3.00 | 2.05 |
| 7. Price of fishing permits typically escalates under catch shares systems | 2.14 | -2.00 | 3.00 | 1.33 |
| 8. Catch shares result in fleet consolidation | 2.00 | -2.00 | 3.00 | 1.41 |
| 14. Sectors provide more fisheries flexibility compared to Days at Sea management | 1.76 | -3.00 | 3.00 | 2.17 |
| *Spatial/Area management is needed* | | | | |
| 1. Cod return to the same spawning locations. | 2.10 | -1.00 | 3.00 | .90 |
| 3. Eastern and Western Georges Bank cod stocks are separate stocks | -.24 | -3.00 | 3.00 | 2.17 |
| 5. There are both resident and migratory forms of cod | 1.76 | -3.00 | 3.00 | 1.35 |

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| 6. Eastern Maine coastal current ecologically distinct from rest of the Gulf of Maine | .52 | -3.00 | 3.00 | 1.77 |
| 9. Groundfish stocks are structured as discrete local subpopulations | .31 | -3.00 | 3.00 | 2.21 |
| 11. Georges Bank Closed Area 1 protects haddock because they stay in area | -1.41 | -3.00 | 2.00 | 1.78 |
| 12. Groundfish move back and forth across stock boundaries | 2.62 | 1.00 | 3.00 | .56 |
| 13. Western and Eastern Maine Gulf of Maine cod spawning groups not isolated | 1.14 | -3.00 | 3.00 | 1.92 |
| 15. Eastern Maine groundfish stocks show less recovery than in the region | 1.41 | -3.00 | 3.00 | 1.94 |
| 16. Cod in the Gulf of Maine grow slower than Georges Bank cod | .10 | -3.00 | 3.00 | 2.02 |
| *Catch shares reduce bycatch and discards* | | | | |
| 4. Trip limits create incentives for discarding | 2.72 | -2.00 | 3.00 | 1.00 |
| 10. Incentives to high grade higher in quota managed than in effort managed fisheries | -.14 | -3.00 | 3.00 | 2.25 |

There are also high levels of disagreement for most statements (high SD) on the salience of knowledge (harmful a biological or economic statement might be if viewed incorrectly) (Table 7-3). The statements for which there is more agreement are statement 1 (Cod return to the same spawning locations) and 11 (Georges Bank Closed Area 1 protects haddock because they stay in area). Both had very low standard deviations (Table 1-3). There was most disagreement related to statement 14 (Sectors provide more fisheries flexibility compared to Days at Sea management), followed closely by statement 10 (Incentives to high grade higher in quota managed than in effort managed fisheries) and 2 (Employment loss is typical when catch shares are introduced).

Table 7-3 Abbreviated survey questions on the **salience** (importance/harm) of biological and economic facts, New England (N = 29).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *Fishing communities need protection* | | | | |
| 2. Employment loss is typical when catch shares are introduced | -.17 | -3.00 | 3.00 | 1.77 |
| 7. Price of fishing permits typically escalates under catch shares systems | .66 | -2.00 | 3.00 | 1.23 |
| 8. Catch shares result in fleet consolidation | .59 | -2.00 | 3.00 | 1.35 |
| 14. Sectors provide more fisheries flexibility compared to Days at Sea management | 1.07 | -3.00 | 3.00 | 2.07 |
| *Spatial/Area management is needed* | | | | |
| 1. Cod return to the same spawning locations. | .93 | .00 | 3.00 | .84 |
| 3. Eastern and Western Georges Bank cod stocks are separate stocks | -.86 | -3.00 | 3.00 | 1.48 |
| 5. There are both resident and migratory forms of cod | .07 | -2.00 | 2.00 | 1.00 |
| 6. Eastern Maine coastal current ecologically distinct from rest of the Gulf of Maine | -.41 | -3.00 | 3.00 | 1.21 |
| 9. Groundfish stocks are structured as discrete local subpopulations | -.59 | -3.00 | 3.00 | 1.59 |
| 11. Georges Bank Closed Area 1 protects haddock because they stay in area | -1.41 | -3.00 | 1.00 | .98 |
| 12. Groundfish move back and forth across stock boundaries | .90 | -1.00 | 3.00 | 1.37 |
| 13. Western and Eastern Maine Gulf of Maine cod spawning groups not isolated | -.45 | -3.00 | 2.00 | 1.21 |
| 15. Eastern Maine groundfish stocks show less recovery than in the region | -.10 | -3.00 | 3.00 | 1.35 |
| 16. Cod in the Gulf of Maine grow slower than Georges Bank cod | -.86 | -3.00 | 1.00 | 1.03 |
| *Catch shares reduce bycatch and discards* | | | | |
| 4. Trip limits create incentives for discarding | 1.34 | -2.00 | 3.00 | 1.08 |
| 10. Incentives to high grade higher in quota managed than in effort managed fisheries | -.69 | -3.00 | 3.00 | 1.98 |

## 7.5.2 Comparing agreement and disagreement levels between groups in the network

The network autocorrelation models were used to examine network effects and differences in beliefs and opinions between groups, and to test whether respondents agree across management roles. Four management roles (Council members, science advisors, stakeholder advisors, and other participants) were distinguished, as corresponding to the social network diagram (Figure 7-2).

Table 7-4 Network autocorrelation results for **knowledge**, New England.

| | *Fishing communities need protection* | | | | | | | | *Spatial/Area management is needed* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Item 2 | | Item 7 | | Item 8 | | Item 14 | | Item 1 | | Item 3 | | Item 5 | | Item 6 | |
| | b | p | b | p | b | p | b | p | b | p | b | p | b | p | b | p |
| cons | 2.19 | 0.003 | 2.54 | 0.032 | 2.95 | 0.004 | 1.05 | 0.242 | 1.77 | 0.029 | 0.55 | 0.445 | 1.25 | 0.185 | 1.50 | 0.001 |
| Council | 0.63 | 0.569 | -0.36 | 0.627 | -0.27 | 0.745 | 0.75 | 0.505 | -0.54 | 0.322 | 0.86 | 0.493 | 0.74 | 0.343 | -0.23 | 0.743 |
| Science Adv. | 1.68 | 0.295 | 0.85 | 0.418 | 0.72 | 0.543 | 0.30 | 0.849 | -0.34 | 0.657 | 1.36 | 0.439 | 0.34 | 0.756 | -3.45 | 0.001 |
| Stakeholder Adv. | 0.53 | 0.559 | 0.43 | 0.522 | -0.85 | 0.227 | -0.85 | 0.397 | 0.22 | 0.653 | -0.01 | 0.993 | 0.38 | 0.609 | 0.50 | 0.420 |
| Fishing Industry* | -0.62 | 0.490 | -0.29 | 0.654 | 0.15 | 0.834 | -0.85 | 0.379 | 0.31 | 0.515 | -2.03 | 0.065 | -0.56 | 0.431 | -1.81 | 0.003 |
| Scientist* | -1.11 | 0.535 | -1.44 | 0.274 | -0.81 | 0.565 | -1.13 | 0.539 | 0.00 | 1.000 | -1.56 | 0.434 | -0.27 | 0.836 | 2.64 | 0.020 |
| Government* | 0.00 | 0.999 | -0.22 | 0.873 | 0.09 | 0.953 | 0.41 | 0.808 | 0.57 | 0.574 | -3.41 | 0.064 | 0.07 | 0.956 | -0.16 | 0.877 |
| rho(direct) | -0.07 | 0.370 | 0.03 | 0.678 | -0.03 | 0.731 | 0.10 | 0.199 | 0.03 | 0.631 | -0.05 | 0.589 | 0.11 | 0.200 | 0.10 | *0.064* |
| rho(indirect) | -0.14 | *0.041* | -0.04 | 0.357 | -0.05 | 0.200 | 0.04 | 0.160 | 0.01 | 0.705 | 0.01 | 0.836 | -0.01 | 0.815 | 0.01 | 0.848 |

| | *Spatial/Area management is needed (continued)* | | | | | | | | | | | | *Catch shares reduce bycatch and discards* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Item 9 | | Item 11 | | Item 12 | | Item 13 | | Item 15 | | Item 16 | | Item 4 | | Item 10 | |
| | b | p | b | p | b | p | b | p | b | p | b | p | b | p | b | P |
| cons | 0.78 | 0.329 | -0.59 | 0.474 | 3.70 | 0.000 | 1.22 | 0.155 | 2.36 | 0.003 | -0.34 | 0.579 | 3.55 | 0.000 | -0.60 | 0.402 |
| Council | -1.22 | 0.349 | 1.31 | 0.208 | -0.16 | 0.647 | -0.95 | 0.453 | 3.52 | 0.000 | 0.11 | 0.918 | -1.23 | *0.038* | -0.88 | 0.424 |
| Science Adv. | -0.44 | 0.819 | -0.62 | 0.657 | 0.04 | 0.929 | -0.31 | 0.854 | 0.52 | 0.685 | 2.42 | 0.149 | 0.30 | 0.703 | 3.28 | *0.040* |
| Stakeholder Adv. | -0.44 | 0.697 | -0.11 | 0.898 | -0.18 | 0.542 | -1.02 | 0.314 | 1.09 | 0.182 | 1.06 | 0.252 | 0.18 | 0.717 | 0.99 | 0.292 |
| Fishing Industry* | 0.11 | 0.924 | -1.29 | 0.138 | 0.15 | 0.579 | 0.73 | 0.498 | -3.05 | 0.000 | -0.22 | 0.810 | 0.29 | 0.521 | -0.40 | 0.667 |
| Scientist* | -0.10 | 0.965 | 1.72 | 0.298 | -0.71 | 0.234 | 0.10 | 0.956 | -0.68 | 0.649 | 0.29 | 0.870 | 0.13 | 0.894 | 0.19 | 0.918 |
| Government* | 0.16 | 0.935 | -1.90 | 0.202 | -0.73 | 0.233 | 1.57 | 0.389 | -4.22 | 0.002 | 0.40 | 0.797 | 0.65 | 0.474 | -0.97 | 0.555 |
| rho(direct) | 0.04 | 0.666 | -0.03 | 0.736 | -0.08 | 0.189 | -0.04 | 0.668 | -0.03 | 0.669 | -0.17 | 0.080 | -0.14 | *0.043* | -0.08 | 0.439 |
| rho(indirect) | -0.05 | 0.417 | 0.06 | 0.096 | -0.02 | 0.117 | 0.02 | 0.710 | -0.04 | 0.291 | -0.07 | 0.295 | 0.02 | 0.193 | -0.03 | 0.557 |

*Note*. Italicized results are significant at .05, bold results are significant at .01. Significance of estimates for the constant are not arked.

*) Note: the stakeholder types "Fishing industry", "Scientist" and "Government" are shaded because here are a number of errors in the allocations of individuals to different stakeholder types. This could have some impact on the results of the analysis as presented in the table.

Statement 6 (Eastern Maine coastal current ecologically distinct from rest of the Gulf of Maine): the science advisors strongly disagree with this statement.

Statement 15 (Eastern Maine groundfish stocks show less recovery than in the region): council members agree significantly with this statement.

Statement 4 (Trip limits create incentives for discarding): council members disagree with this statement.

Statement 10 (Incentives to high grade higher in quota managed than in effort managed fisheries): science advisors agree with this statement.

Table 7-5 Network autocorrelation results for values and interests, New England.

| | *Fishing communities need protection* | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Item 2 | | Item 3 | | Item 6 | | Item 9 | | Item 11 | | Item 12 | | Item 13 | | Item 14 | |
| | b | p | b | p | b | p | b | p | b | P | b | p | b | p | b | p |
| cons | -1.21 | 0.051 | 1.44 | 0.002 | 1.37 | 0.011 | -0.87 | 0.097 | -1.79 | 0.003 | -0.64 | 0.239 | 0.9 | 0.026 | -0.13 | 0.709 |
| Council | 0.16 | 0.853 | 0.25 | 0.763 | 0.77 | 0.271 | -1.58 | 0.072 | 0.07 | 0.942 | -0.45 | 0.529 | 0.06 | 0.909 | -1.53 | 0.005 |
| Science Advisor | 1.35 | 0.344 | -0.46 | 0.719 | -2.18 | 0.052 | 0.83 | 0.549 | 1.71 | 0.310 | -1.46 | 0.188 | 0.08 | 0.932 | -0.55 | 0.569 |
| Stakeholder Adv. | 0.42 | 0.584 | -0.02 | 0.970 | 0.21 | 0.727 | -1.33 | 0.062 | 0.95 | 0.284 | -0.26 | 0.654 | -0.45 | 0.336 | 0.21 | 0.641 |
| Fishing Industry* | 1.21 | 0.114 | -1.93 | *0.010* | -1.39 | *0.042* | 1.78 | *0.019* | 1.87 | *0.039* | 0.67 | 0.324 | -0.63 | 0.200 | 0.97 | *0.037* |
| Scientist* | -1.00 | 0.517 | -0.52 | 0.718 | 1.11 | 0.367 | -0.39 | 0.802 | 0.58 | 0.736 | 2.23 | 0.066 | -0.33 | 0.727 | 1.05 | 0.286 |
| Government* | -2.05 | 0.269 | 0.16 | 0.929 | 0.86 | 0.566 | -0.43 | 0.818 | 1.71 | 0.415 | -0.18 | 0.907 | -2.05 | 0.075 | -0.08 | 0.943 |
| rho(direct) | 0.02 | 0.822 | 0.07 | 0.464 | 0.05 | 0.592 | 0.12 | *0.060* | 0.15 | *0.015* | 0.07 | 0.390 | 0.03 | 0.663 | 0.13 | 0.109 |
| rho(indirect) | 0.03 | 0.349 | -0.02 | 0.721 | -0.08 | 0.184 | 0.00 | 0.927 | 0.02 | 0.431 | -0.04 | 0.477 | 0.01 | 0.757 | -0.02 | 0.672 |

| | *Spatial/Area management is needed* | | | | | | | | | | *Catch shares reduce bycatch and discards* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Item 5 | | Item 8 | | Item 10 | | Item 15 | | Item 16 | | Item 1 | | Item 4 | | Item 7 | |
| | B | p | b | p | b | p | b | p | b | p | b | p | b | p | b | p |
| cons | -0.08 | 0.840 | 0.25 | 0.622 | 0.77 | 0.062 | -0.39 | 0.330 | -0.09 | 0.734 | 2.13 | 0.005 | -0.64 | 0.161 | 0.93 | 0.078 |
| Council | -0.69 | 0.325 | -0.16 | 0.872 | 1.01 | *0.043* | 0.04 | 0.950 | 2.06 | 0.000 | -0.55 | 0.497 | 0.00 | 0.997 | 0.90 | 0.073 |
| Science Advisor | 0.50 | 0.654 | -0.94 | 0.568 | 1.93 | *0.017* | 0.45 | 0.655 | -0.86 | 0.249 | -0.19 | 0.882 | -1.75 | *0.037* | 2.03 | *0.015* |
| Stakeholder Adv. | -1.40 | *0.015* | 0.54 | 0.508 | 0.01 | 0.980 | 0.96 | 0.066 | 1.79 | 0.000 | -0.95 | 0.173 | -0.14 | 0.748 | -0.42 | 0.335 |
| Fishing Industry* | 1.34 | *0.032* | -0.45 | 0.614 | -0.60 | 0.143 | -0.27 | 0.600 | -2.20 | 0.000 | -1.34 | 0.058 | 0.29 | 0.514 | -0.25 | 0.554 |
| Scientist* | 0.69 | 0.574 | 0.46 | 0.780 | -0.51 | 0.549 | -1.96 | 0.083 | -1.52 | 0.055 | 1.44 | 0.319 | 0.48 | 0.613 | -2.61 | 0.003 |
| Government* | -0.19 | 0.897 | -1.43 | 0.481 | 0.02 | 0.984 | 0.56 | 0.688 | -0.07 | 0.943 | 0.97 | 0.571 | 2.92 | 0.009 | -1.72 | 0.119 |
| rho(direct) | 0.03 | 0.628 | 0.15 | *0.023* | -0.15 | 0.127 | -0.10 | 0.382 | -0.05 | 0.485 | -0.07 | 0.451 | 0.05 | 0.484 | -0.06 | 0.456 |
| rho(indirect) | -0.19 | 0.004 | -0.01 | 0.907 | -0.02 | 0.673 | -0.02 | 0.745 | 0.03 | 0.482 | 0.04 | 0.261 | 0.04 | 0.144 | 0.04 | 0.090 |

*Note*. Italicized results are significant at .05, bold results are significant at .01. Significance of estimates for the constant are not marked.

*) Note: the stakeholder types "Fishing industry", "Scientist" and "Government" are shaded because here are a number of errors in the allocations of individuals to different stakeholder types. This could have some impact on the results of the analysis as presented in the table.

Statement 14 (NOAA dedicate more funding for covering the costs of sector management): Council members disagree with this statement.

Statement 5 (Manage fish stocks as a unit rather than as individual local stocks): Stakeholder advisors disagree with this.

Statement 10 (Re-designed closed areas to better protect spawning grounds and habitat): Stakeholder and science advisors agree with this statement.

Statement 16 (Manage inshore north-eastern Gulf of Maine as unique ecological area): Council members and stakeholder advisors agree with this.

Statement 4 (A zero possession limit for Gulf of Maine winter flounder): Science advisors disagree with this. Statement 7 (Discarding of all legal size fish should be prohibited): Science advisors agree with this.

Table 7-6 - Network autocorrelation results for salience of knowledge, New England.

| | *Fishing communities need protection* | | | | | | | | *Spatial/Area management is needed* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Item 2 | | Item 7 | | Item 8 | | Item 14 | | Item 1 | | Item 3 | | Item 5 | | Item 6 | |
| | b | p | b | p | b | p | b | p | b | p | b | p | b | p | b | p |
| cons | -0.37 | 0.576 | 1.35 | 0.018 | 1.35 | 0.010 | 0.52 | 0.501 | 1.43 | 0.001 | -0.55 | 0.319 | 0.29 | 0.233 | 0.06 | 0.833 |
| Council | -0.75 | 0.481 | -0.92 | 0.117 | -0.13 | 0.860 | 0.85 | 0.436 | 0.70 | 0.122 | 0.91 | 0.240 | 0.76 | 0.065 | 0.72 | 0.143 |
| Science Adv. | 0.65 | 0.672 | 1.08 | 0.198 | 0.65 | 0.515 | 0.69 | 0.657 | -0.22 | 0.727 | 1.22 | 0.249 | -1.15 | 0.082 | -1.63 | *0.040* |
| Stakeholder Adv. | 0.27 | 0.772 | -0.22 | 0.676 | -0.45 | 0.435 | -0.55 | 0.578 | 0.09 | 0.818 | -0.24 | 0.701 | 1.00 | 0.004 | 1.19 | 0.005 |
| Fishing Industry* | 0.43 | 0.627 | 0.98 | *0.042* | 0.21 | 0.722 | -0.74 | 0.448 | -0.23 | 0.544 | -0.94 | 0.129 | -0.8 | *0.024* | -1.53 | 0.001 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scientist* | -0.26 | 0.880 | -2.70 | 0.009 | -1.43 | 0.219 | -0.63 | 0.727 | 0.60 | 0.419 | -1.86 | 0.131 | -1.00 | 0.160 | -0.81 | 0.366 |
| Government* | 1.42 | 0.362 | -0.35 | 0.721 | -0.20 | 0.865 | 0.39 | 0.809 | -0.27 | 0.695 | -3.56 | 0.002 | -0.32 | 0.590 | -0.23 | 0.752 |
| rho(direct) | 0.00 | 0.959 | -0.08 | 0.343 | -0.02 | 0.759 | 0.02 | 0.803 | -0.11 | 0.149 | -0.19 | 0.036 | -0.26 | 0.002 | -0.06 | 0.488 |
| rho(indirect) | 0.01 | 0.864 | -0.12 | *0.044* | -0.17 | *0.012* | 0.06 | *0.057* | -0.06 | 0.134 | 0.07 | 0.093 | -0.07 | 0.308 | -0.01 | 0.901 |

| | *Spatial/Area management is needed (continued)* | | | | | | | | | | | | *Catch shares reduce bycatch and discards* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Item 9 | | Item 11 | | Item 12 | | Item 13 | | Item 15 | | Item 16 | | Item 4 | | Item 10 | |
| | B | p | b | p | b | p | b | p | b | p | b | p | b | p | b | p |
| cons | 0.02 | 0.972 | -1.34 | 0.043 | 1.23 | 0.017 | -0.92 | 0.073 | -0.37 | 0.262 | -1.21 | 0.031 | 1.73 | 0.002 | -1.59 | 0.030 |
| Council | -1.23 | 0.195 | 0.99 | *0.048* | -0.20 | 0.795 | -0.30 | 0.664 | 2.55 | 0.000 | 0.16 | 0.779 | -1.19 | 0.052 | -1.94 | 0.069 |
| Science Adv. | -1.52 | 0.265 | -0.89 | 0.191 | 0.45 | 0.670 | -0.05 | 0.962 | -0.32 | 0.701 | 0.41 | 0.620 | -0.30 | 0.694 | 0.81 | 0.594 |
| Stakeholder Ad. | -0.39 | 0.623 | -0.52 | 0.238 | -0.36 | 0.572 | -0.02 | 0.970 | 2.01 | 0.000 | 0.19 | 0.703 | -1.02 | *0.038* | -0.22 | 0.809 |
| Fishing Industry* | -0.08 | 0.930 | -0.26 | 0.522 | 1.16 | 0.086 | 0.66 | 0.305 | -1.71 | 0.001 | 0.29 | 0.572 | 0.18 | 0.694 | 1.57 | 0.084 |
| Scientist* | 1.18 | 0.439 | 1.40 | 0.092 | -0.76 | 0.543 | 0.71 | 0.533 | -0.08 | 0.934 | 0.54 | 0.570 | 0.81 | 0.368 | 2.04 | 0.239 |
| Government* | 0.50 | 0.713 | -0.75 | 0.393 | -1.13 | 0.328 | 1.46 | 0.173 | -2.40 | 0.004 | 0.32 | 0.734 | 0.74 | 0.384 | 1.72 | 0.278 |
| rho(direct) | 0.05 | 0.620 | -0.09 | 0.272 | -0.02 | 0.853 | 0.07 | 0.391 | -0.11 | 0.243 | 0.10 | 0.190 | -0.12 | 0.182 | -0.12 | 0.207 |
| rho(indirect) | -0.02 | 0.774 | 0.05 | 0.091 | -0.09 | 0.096 | -0.05 | 0.361 | -0.05 | 0.415 | -0.03 | 0.437 | 0.05 | *0.059* | -0.02 | 0.663 |

*Note*. Italicized results are significant at .05, bold results are significant at .01. Significance of estimates for the constant are not marked.

*) Note: the stakeholder types "Fishing industry", "Scientist" and "Government" are shaded because here are a number of errors in the allocations of individuals to different stakeholder types. This could have some impact on the results of the analysis as presented in the table.

Statement 5 (There are both resident and migratory forms of cod): Stakeholder advisors agree with this statement.

Statement 6 (Eastern Maine coastal current ecologically distinct from rest of the Gulf of Maine): Stakeholder advisors agree with this statement, while science advisors disagree with this statement.

Statement 11 (Eastern Maine coastal current ecologically distinct from rest of the Gulf of Maine): Stakeholder advisors agree with this statement, while science advisors disagree with this statement.

Statement 15 (Eastern Maine groundfish stocks show less recovery than in the region): Stakeholder advisors agree with this statement, while science advisors disagree with this statement.

Statement 4 (Trip limits create incentives for discarding): Stakeholder advisors agree with this statement, while science advisors disagree with this statement.

### 7.5.3 Network effects

Significant network effects have been observed in all three analyses (management goals, knowledge claims and salience) but in general the value of network effects has been low, indicating both scarce discussion between groups and low overall impact of it on opinions and beliefs.

Negative indirect network effects for knowledge have been observed for statement 2 (Employment loss is typical when catch shares are introduced). Positive direct network effects for knowledge have been observed for statement 6 (Eastern Maine coastal current ecologically distinct from rest of the Gulf of Maine) and negative direct effects were observed for statement 4 (Trip limits create incentives for discarding).

Positive direct network effects for management goals have been observed for statements 9 (Allocations should be made solely on historical landings in the fishery), 11 (Amend Magnuson Stevens Act so more flexibility rebuilding overfished stocks), and 8 (To promote stewardship and conservation manage groundfish locally). A negative indirect network effect was observed for statement 5 (Manage fish stocks as a unit rather than as individual local stocks).

A negative direct network effect for salience was observed for statement 5 (There are both resident and migratory forms of cod). Indirect positive network effects were observed for statements 4 (Trip limits create incentives for discarding) and 14 (Sectors provide more fisheries flexibility compared to Days at Sea management), while negative indirect network effects were observed for statements 7 (Price of fishing permits typically escalates under catch shares systems) and 8 (Catch shares result in fleet consolidation).

Overall, the direct network effects on knowledge are equally positive and negative, while direct network effects on values are generally positive. This more likely implies that those who share similar values and management interests are more likely to talk with each other than with those that do not share their same views.

## 7.6 Discussion

The social network diagram depicts a formal management system consisting of a heterogeneous management body (Council), a homogeneous scientific community (science advisors), a slightly less heterogeneous stakeholder panel (stakeholder advisors), and other participants dispersed through the network. There are a couple of central persons, one scientist and one council member, but overall the degree of centralization is low, indicating that information flows are rather dispersed. The network density rate (0.08) indicates a very low rate of discussion in the whole network.

The q-sort analysis shows that individual actors generally have high levels of disagreement on management goals, facts and salience of facts. Respondents tend to agree that cod cross stock boundaries and that they return to the same spawning locations. There is high disagreement (high SD) regarding whether to amend the management law to allow more flexibility rebuilding overfished stocks (#11, Table 7-1), otherwise the level of agreement (or disagreement) is similar across interests/policy statements. There appears to be more disagreement on facts than on management goals, with the exception of the two knowledge statements stated above.

The science advisors and council members frequently hold positions on knowledge that markedly differ from the other groups.  Stakeholder advisory panel does not hold positions on knowledge that differ from other groups. Similarly, the science advisors and council members frequently hold positions on policy that differ significantly from the other groups. Stakeholder advisors do hold views that differ significantly from the other groups on several policy items.

The autocorrelation model indicates sparse effects of the discussion network on views of the respondents. The network effects on knowledge are equally positive and negative, while direct network effects on values are generally positive, indicating that those that engage in discussion do so with those that share similar values and management interests than those that do not share their views.

## 7.7 Conclusions

The case study indicates that the New England groundfish management lacks a consensus especially on relevant facts, but also on values or policy views.

The NEFMC undoubtedly brings together a diverse group of participants, although the scientists do tend to function more autonomously compared to the other groups. It should not be surprising that differences opinion exist on the management issues (values) given these are designed to represent the heterogeneous views within the management system. Science advisors frequently hold positions on knowledge that markedly differ from the other groups because they are a more homogeneous group.

## 7.8 References

Ames, E. P., 1997. Cod and haddock spawning grounds in the Gulf of Maine. 33 pp. Rockland, ME, USA: Island Institute.

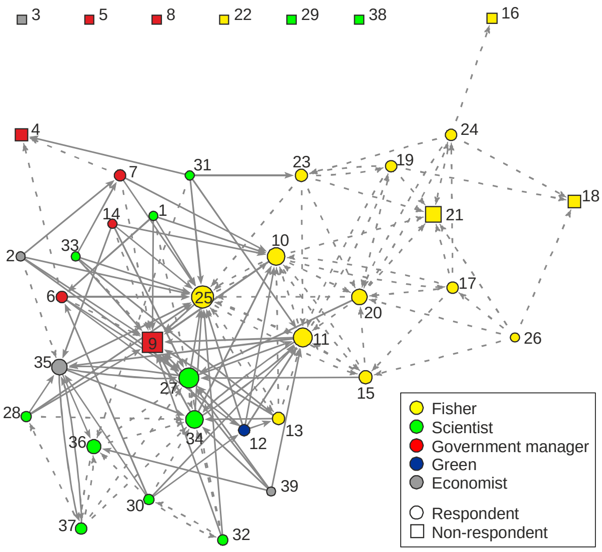
Ames, E. P. 2004. Atlantic Cod Stock Structure in the Gulf of Maine. Fisheries 29: 10-28. http://www.fisheries.org/html/fisheries/F2901/F2901p10-28.pdf

# 8 Australia – Northern Prawn Fisheries

**In the Australian Northern Prawn Fisheries case study, all the case study steps described in section 2 have been applied: discourse analysis, survey design, online survey, social network analysis. However, the last step (interpretation of the results in the context of the discourse analysis) could not be completed within the time frame of the JAKFISH project due to the illness of the case study analyst (Doug Wilson). Therefore, the results described in this section should be considered as preliminary. A separate paper is foreseen to be released in 2012 on this case study.**

## 8.1 Main findings

The Australian Northern prawn fishery consists of 52 trawlers from fishing ports between Brisbane and Perth. The Northern prawn fishery has been through a long struggle to reduce overcapacity. The fishery is managed by a multi-purpose co-management arrangement, developed after years of facilitated multi-stakeholder workshops. The management system and legislation places a strong emphasis on a partnership approach among fisheries managers, scientists, and relevant stakeholders. The underlying rationale is that the achievement of sustainable fisheries is very much linked to the level of trust and confidence that exists between industry, managers, scientists, and stakeholders generally.




The discourse selected for this analysis generated a substantial amount of disagreement among different respondents and stakeholder groups.

The distribution of nominations within the network is quite unequal (Input degree centralization 0.39). Some experts are mentioned by many as their most frequent communication partners while many are not mentioned at all.

NORMAC members who are not also RAG members have significantly more positive opinions on values and interests than respondents who are not affiliated to a management institution. On the knowledge claims, Fishermen and NORMAC members take significantly different positions most often. On the salience of knowledge, experts may have convinced their discussion partners of the importance of knowing the facts correctly.

A separate paper is foreseen to be released in 2012 on this Australian case study. That forthcoming analysis suggests that the Australian network analysis showed that agreement about scientific facts among people who disagreed about values and interests increased when they worked together on management committees. This finding would contradicts the conclusions reached in the analysis above. Therefore, it is important to closely examine the implications of both analyses before final conclusions are drawn.

## 8.2 Description of the case

The Australian Northern prawn fishery consists of 52 trawlers of a length from 14 to 29 metres. The fishing ports reach from Brisbane in the East to Perth in the West. The Northern prawn fishery has been through a long struggle to reduce overcapacity. The fishery is managed by a multi-purpose co-management arrangement, developed after years of facilitated multi-stakeholder workshops. The management is based on maximum economic yield (MEY) and ecosystem considerations (the main problem being by-catch) and is rights based, using transferable effort, but moving to transferable quotas.

The management system and legislation places a strong emphasis on a partnership approach among fisheries managers, scientists, and relevant stakeholders. This partnership involves close consultation, raising awareness of fisheries resource management issues, and a direct input into, and responsibility for, the decision-making process. The underlying rationale is that the achievement of sustainable fisheries is very much linked to the level of trust and confidence that exists between industry, managers, scientists, and stakeholders generally. Whereas sound legislation and policy are essential, there is no substitute for building sound and positive relationships between all those involved.

In the last round of capacity reduction a letter was signed by the different partners that some actors believe committed them to move from transferable effort to transferable quota. This move is supported by most economists and managers, as well as by many natural scientists, but the fishers are split. According to some industry representatives, they only agreed to look at quotas as an option. However, they argue, "live annual crop such as the prawn fishery is not particularly suited to quotas ".

Those actors who are opposed to the switch to quota based management argue that quotas will be set at a precautionary level, which will lower than historical catches, and, they believe, too low. A quota system requires more frequent surveys on spawning and recruitment levels, than does the current effort based system, and such surveys are costly.

Advocates of change to a quota system argue that a quota system (provided that it restricts catch more than the effort system) allows the industry greater operational flexibility, because each participant can plan when and how to take their share. Furthermore, they argue, at the moment fishing levels are set before knowing the actual Catch Per Unit Effort (CPUE) or the stock level, which results in the effort system creating larger inaccuracies than a TAC system would.

## 8.3 Data collection and methodology

39 experts were invited to participate in the survey of which 28 actually filled out the survey.

The experts include several types of stakeholders: fishermen, scientists, government managers, economists and one environmental protection specialist ('Green') . The non-response is remarkably high among government managers: only 3 out of 7 government managers filled out the survey

For the analyses, stakeholders are classified into 3 types: Fisher, Scientist, and Other. One respondent, who is marked as a scientist while having the role of an economic science advisor, is placed in the Other category, which is the reference category in the regression models

About half of the invited experts are a member of one or more management institutions: NORMAC, NPRAG, or RAG. Non-response is slightly lower among members than among non-affiliated experts . To obtain a limited number of categories with sufficient observations, management affiliation is simplified to NORMAC,  RAG or NPRAG and Not-Affiliated (reference category)

The experts include one few females (4 among the respondents)

Unfortunately, the discourse analysis has not been written up yet and will be published in the final paper on this case study.

## 8.4 Social network analysis

Figure 8-1 is a sociogram of the total network. Circles indicate respondents and squares represent non-respondents. The size of the circle and box shows the number of nominations received while the interior colour of circles and boxes denotes the stakeholder group partition. Dashed lines are discussion ties within stakeholder groups and solid are ties lines circles indicate respondents and between stakeholder groups

6 non-respondents have not been mentioned as most important discussion partners, they are isolates in the network. Some non-respondents were chosen as frequent communication partners by many respondents, notably non-respondent 9 (a government manager) and non-respondent 21 (a fisherman). Because these two non-respondents are linked to many respondents, they are mainly responsible for the indirect autocorrelation effects in the model.

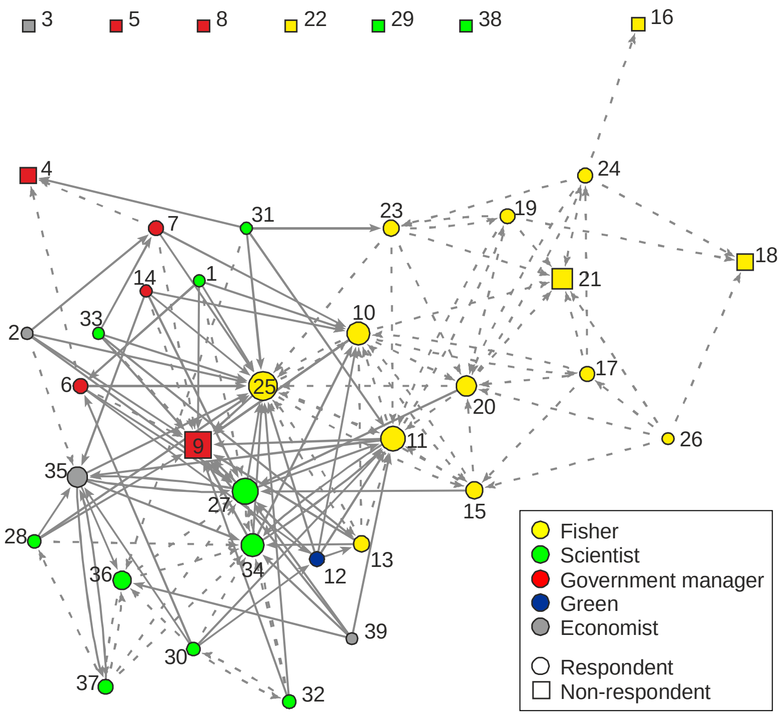



Figure 8-1 Sociogram of the discussion network with **role**, Australia (vertex size represents indegree, within-group ties are dashed).

The network density is .09 (9 percent of all possible lines are present). Input degree centralization is .39, indicating that the distribution of nominations is quite unequal. Some experts are mentioned by many as their most frequent communication partners while many are not mentioned at all. Network heterogeneity, the proportion of links between actors with different personal characteristics, is 0.48 for stakeholder types. Fishermen tend to have other fishermen as their most frequent discussion partners; their discussion network is relatively homogeneous

Network heterogeneity is 0.75 for management institution affiliation, which has about the same number of categories. Therefore, communication tends to be restricted within stakeholder types more than within management institution

## 8.5 Q-sort analysis

### 8.5.1 Overall levels of disagreement in the network

Table 8-1 lists the 16 survey questions that were formulated to cover the main concerns and issues regarding the goals and methods of managing northern prawn fishery. They mainly address perceived advantages and disadvantages of different management regulations (quota, TACs, ITQs) and the restrictions for fishing. This is a discourse that was specifically selected because it was expected to show substantial disagreement within the network.

The variation in responses on each question is rather high. Variation in opinions among the experts is a prerequisite for an network autocorrelation model, so this requirement is fulfilled.

Table 8-1 Survey questions on values and interests, Australia (*N* = 28).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *ITQs will not achieve the rationalization they would achieve in other fisheries* | | | | |
| **Values:** | | | | |
| 4. TACs for common banana prawns based on historical catch will be too restrictive. | .14 | -2.00 | 3.00 | 1.48 |
| 10. The NPF industry is morally obligated to implement ITQs because of its participation in the buyback programme | -.07 | -3.00 | 3.00 | 1.92 |
| 15. Once a prawn has bred there should be no restrictions on a fisherman's ability to catch that prawn. | -.54 | -3.00 | 2.00 | 1.35 |
| **Interests:** | | | | |
| 2. Disagreements about an opening date will not be resolved by implementing a quota system. | .82 | -1.00 | 3.00 | 1.06 |
| 7. Fishermen must be able to catch prawns when they are concentrated. | .93 | .00 | 3.00 | .81 |
| *Increased costs of management and science* | | | | |
| **Values:** | | | | |
| 5. The NPF has already spent a great deal to show that it has reduced by-catch to an acceptable level, under quota that work will have to be repeated at too high a cost. | -1.07 | -3.00 | 3.00 | 1.41 |
| 11. The start up and ongoing costs for both science and management of an output system will be so high they will eliminate the advantages of ITQs | -.11 | -3.00 | 3.00 | 2.23 |
| 16. The quota system requiring more precise prediction from science than the effort system is a significant problem from the point of view of biological sustainability. | -.64 | -3.00 | 2.00 | 1.47 |
| **Interests:** | | | | |
| 3. The input control system unduly reduces the security of the property rights in the NPF fishery. | -.57 | -3.00 | 3.00 | 1.55 |

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| 8. We need a system where we are not constantly renegotiating season start dates | .14 | -2.00 | 2.00 | .93 |
| 12. We need a system where we are not constantly renegotiating because of effort creep. | .43 | -2.00 | 3.00 | 1.45 |
| *Increased operational flexibility* | | | | |
| **Values:** | | | | |
| 1. The TAC must be set low enough so that it will not matter if someone catches their quota as small or large prawns. | -1.07 | -3.00 | 2.00 | 1.27 |
| 6. Fishermen must be able to adjust quickly to different changes in markets, costs or other economic conditions. | 1.57 | .00 | 3.00 | 1.17 |
| 13. The volume of prawns caught will always be the single most important factor for the industry's profitability. | -.64 | -3.00 | 3.00 | 1.81 |
| **Interests:** | | | | |
| 9. Fishermen must be able to catch large prawns when there are still sufficient numbers that operating costs do not become too high. | .61 | -2.00 | 2.00 | 1.03 |
| 14. We need a system that rewards innovations that catch more prawns faster. | .07 | -3.00 | 2.00 | 1.21 |

Table 8-2 describes the knowledge about biological and economic facts concerning prawn fishery. A higher score indicates more confidence in the respondent about his or her knowledge

Table 8-2 Abbreviated survey questions on knowledge about **biological and economic facts**, Australia (*N* = 28).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *ITQs will not achieve the rationalization they would achieve in other fisheries* | | | | |
| 4. Common and red legged banana prawns are easily divided by the north-south line through Peace Point. | .68 | -3.00 | 3.00 | 2.02 |
| 6. At the rate at which the industry fishes the stock down, by week 3 they have taken more than half of the biomass. | .00 | -3.00 | 3.00 | 2.09 |
| 8. It is impossible to model the impact of rainfall on banana prawns because this impact is different in different areas. | -.32 | -3.00 | 3.00 | 2.40 |
| 9. Brown tiger, grooved tiger prawns and endeavour prawns have very different biology and risks of being overfished. | 1.57 | -3.00 | 3.00 | 2.06 |
| 10. With a quota system there is no practical alternative to setting a single combined TAC for the brown tiger, grooved tiger prawns and endeavour prawns. | .64 | -3.00 | 3.00 | 2.42 |
| 15. The very high variability in banana prawn recruitment means that precautionary quotas will be set lower than historical catches. | 1.57 | -3.00 | 3.00 | 1.89 |
| *Increased costs of management and science* | | | | |
| 1. An effort limit can be set without knowing pre- fisheries stock abundance, setting a TAC for a quota system requires monitoring this. | -.46 | -3.00 | 3.00 | 2.62 |
| 5. A quota system will require a very substantial increase in observer coverage of the fishery. | .79 | -3.00 | 3.00 | 2.56 |
| 7. If we stayed with the effort system we could carry out spawning and recruit surveys once every other year while still having sufficient information for management. | -.07 | -3.00 | 3.00 | 2.54 |
| 11. An effort limit can be set without knowing pre- spawning stock abundance, setting a TAC for a quota system requires monitoring this. | .21 | -3.00 | 3.00 | 2.41 |
| *Increased operational flexibility* | | | | |
| 2. Under the effort system the race-to-fish in the banana prawn fishery creates very substantial costs for the industry. | .46 | -3.00 | 3.00 | 2.44 |
| 3. For banana prawns the quota system will result in greater swings in profit than under the effort system. | -.89 | -3.00 | 3.00 | 2.42 |
| 12. A quota system allows the industry greater operational flexibility than the effort regime. | 1.79 | -3.00 | 3.00 | 2.06 |
| 13. When fishing levels are set before knowing the actual CPUE or stock level an effort system will overshoot or undershoot more than a TAC system. | -.79 | -3.00 | 3.00 | 2.17 |

| | | | | |
|---|---|---|---|---|
| 14. Controls on hull size and engine power under the effort regime reduce operator's efficiency. | 2.68 | -2.00 | 3.00 | .98 |
| 16. Under a quota system each participant can plan accordingly when and how to take their share, but only if the TAC restricts catch more than the effort system does. | .64 | -3.00 | 3.00 | 2.36 |

Table 8-3 lists the survey questions that gauge how important (positive score) or harmful (negative score) the respondent thinks that believing a particular statement is to the management of northern prawn fishery. The items have regular distributions except that some knowledge items (notably 9, 12, 14, and 15) are highly negatively skewed

Table 8-3 Survey questions on the **salience** (importance/harm of biological and economic facts), Australia (*N* = 28).

| | Mean | Min | Max | SD |
|---|---|---|---|---|
| *ITQs will not achieve the rationalization they would achieve in other fisheries* | | | | |
| 4. Common and red legged banana prawns are easily divided by the north-south line through Peace Point. | -.21 | -2.00 | 1.00 | .92 |
| 6. At the rate at which the industry fishes the stock down, by week 3 they have taken more than half of the biomass. | -.32 | -3.00 | 2.00 | 1.02 |
| 8. It is impossible to model the impact of rainfall on banana prawns because this impact is different in different areas. | -.25 | -3.00 | 2.00 | 1.04 |
| 9. Brown tiger, grooved tiger prawns and endeavour prawns have very different biology and risks of being overfished. | .71 | -3.00 | 3.00 | 1.67 |
| 10. With a quota system there is no practical alternative to setting a single combined TAC for the brown tiger, grooved tiger prawns and endeavour prawns. | .11 | -2.00 | 3.00 | 1.66 |
| 15. The very high variability in banana prawn recruitment means that precautionary quotas will be set lower than historical catches. | .68 | -3.00 | 2.00 | 1.36 |
| *Increased costs of management and science* | | | | |
| 1. An effort limit can be set without knowing pre- fisheries stock abundance, setting a TAC for a quota system requires monitoring this. | -.61 | -3.00 | 3.00 | 1.69 |
| 5. A quota system will require a very substantial increase in observer coverage of the fishery. | .29 | -3.00 | 3.00 | 2.07 |
| 7. If we stayed with the effort system we could carry out spawning and recruit surveys once every other year while still having sufficient information for management. | -.29 | -3.00 | 2.00 | 1.56 |
| 11. An effort limit can be set without knowing pre- spawning stock abundance, setting a TAC for a quota system requires monitoring this. | -.43 | -3.00 | 2.00 | 1.37 |
| *Increased operational flexibility* | | | | |
| 2. Under the effort system the race-to-fish in the banana prawn fishery creates very substantial costs for the industry. | .00 | -3.00 | 3.00 | 1.66 |
| 3. For banana prawns the quota system will result in greater swings in profit than under the effort system. | -.75 | -3.00 | 3.00 | 1.51 |
| 12. A quota system allows the industry greater operational flexibility than the effort regime. | 1.11 | -3.00 | 3.00 | 1.75 |
| 13. When fishing levels are set before knowing the actual CPUE or stock level an effort system will overshoot or undershoot more than a TAC system. | -1.11 | -3.00 | 1.00 | 1.29 |
| 14. Controls on hull size and engine power under the effort regime reduce operator's efficiency. | .89 | -2.00 | 3.00 | 1.37 |
| 16. Under a quota system each participant can plan accordingly when and how to take their share, but only if the TAC restricts catch more than the effort system does. | .18 | -3.00 | 3.00 | 1.44 |

## 8.5.2 Comparing agreement and disagreement levels between groups in the network

Table 8-4 shows the autocorrelation model for values and interests. Direct discussion relations among respondents seldom have significant effects on opinions about values and interests and if they do, they may be both positive and negative. There is positive direct autocorrelation for item 11, indicating that discussion partners are more similar with respect to their opinion that costs eliminate the advantages of ITQs than respondents that are not frequent communication partners. Autocorrelation is negative in the case of item 16, meaning that discussion partners tend to have less similar opinions on problems associated with the required precision of resource prediction

Positive autocorrelation may result if discussions lead to convergence of opinions. Perhaps, discussing the costs of ITQs may have induced experts to adjust their opinions to their partners. In contrast, negative autocorrelation signifies that discussion partners tend to disagree, which may be understood better if we assume that frequent communication was established in order to discuss and possibly resolve opposite opinions on management goals.

In both models with significant direct autocorrelation, NORMAC members who are not also RAG members have significantly more positive opinions than respondents who are not affiliated to a management institution. NORMAC members think that costs eliminate the advantages of ITQs and that the required prediction precision is a problem. They score exceptionally low on item 10, they are much less inclined to think that the prawn fishing industry is morally obligated to implement ITQs. On this topic, RAG members score significantly high: they are much more convinced that ITQs should be implemented

Indirect autocorrelation via non-respondents occurs 5 out of 16 items. Non-respondents seem to link respondents that share opinions on the need for fishermen to adjust quickly, on cost problems of the quota system, and renegotiation because of effort creep. Similarity between two respondents due to their shared contacts with a non-respondent may mean that the respondents both agree or both disagree with the non-respondent. Therefore, discussion with the non-respondent may have lead to more similar opinions or different opinions have lead to more discussion

Significant negative autocorrelation is found for the opinion that fishermen must be able to catch prawns when they are concentrated and that no restrictions should be applied once prawn has bred. These opinions have marked positions for RAG members and fishermen (resp. con or pro catching concentrated prawns) and for fishermen and scientists (both pro no restrictions after breeding).

Negative indirect autocorrelation may arise from the contacts between the respondents and the non-respondent only if one respondent agrees and the other disagrees with the non-respondent . In this case, it is unlikely that network autocorrelation represents a harmonizing effect of discussion on the opinions of experts. The non-respondent seems to function as a go-between or bridge between experts with opposing views

Personal characteristics matter to the opinions on several items. In addition to the distinctive positions of NORMAC and RAG members mentioned before, fishermen and scientists score significantly different than other stakeholder groups on several items. Fishermen tend to think that TAC should not be set low enough so that it will not matter if someone catches their quota as small or large prawns (item 1). Like the scientists, they think that the effort system does not unduly reduce the security of the property rights (item 3), that the system should not necessarily exclude renegotiation due to effort creep (item 12), and that there should be no restrictions once the prawn has bred (item 15). But in contrast to the scientists, they think that the industry has already spent a great deal to show that it has reduced by-catch (item 5) and that fishermen are not able to adjust quickly to different changes in markets, costs or other economic conditions (item 6)

Table 8-4 Network autocorrelation results for values and interests, Australia.

| | *ITQs will not achieve the rationalization they would achieve in other fisheries* | | | | | | | | | | *Increased costs of management and science* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Values | | | | | | Interests | | | | Values | | | | | |
| | Item4 | | Item10 | | Item15 | | Item2 | | Item7 | | Item5 | | Item11 | | Item16 | |
| | *B* | p | *b* | p | *b* | P | *b* | p | *b* | p | *b* | p | *b* | p | *b* | p |
| Constant | -0.16 | 0.793 | 0.79 | 0.143 | -1.86 | 0.000 | 1.11 | 0.058 | 1.68 | 0.000 | -2.26 | 0.003 | -0.39 | 0.595 | -2.01 | 0.001 |
| NORMAC | 0.07 | 0.921 | -2.26 | 0.001 | -0.02 | 0.968 | 0.67 | 0.143 | -0.44 | 0.182 | -0.65 | 0.291 | 2.55 | 0.004 | 1.39 | 0.009 |
| RAG | -0.14 | 0.835 | *1.46* | *0.028* | 0.15 | 0.762 | -0.62 | 0.142 | *-0.64* | *0.04* | -0.76 | 0.195 | 0.43 | 0.601 | -0.24 | 0.648 |
| Fisher | 0.67 | 0.402 | -0.43 | 0.574 | *1.18* | *0.023* | -0.83 | 0.075 | 0.59 | 0.087 | *1.50* | *0.017* | -0.86 | 0.338 | 0.37 | 0.486 |
| Scientist | 0.03 | 0.969 | -1.12 | 0.123 | *1.4* | *0.015* | 0.24 | 0.638 | 0.57 | 0.144 | 0.90 | 0.191 | 0.41 | 0.674 | 0.57 | 0.344 |
| Female | 0.24 | 0.789 | 0.26 | 0.748 | *-1.51* | *0.019* | 0.91 | 0.102 | -0.15 | 0.715 | -0.34 | 0.664 | 0.53 | 0.62 | 0.49 | 0.474 |
| rho(direct) | 0.05 | 0.647 | 0.01 | 0.885 | 0.07 | 0.418 | -0.07 | 0.469 | -0.11 | 0.147 | -0.15 | 0.135 | *0.14* | *0.046* | -0.32 | 0.000 |
| rho(indirect) | -0.03 | 0.699 | -0.05 | 0.48 | -0.16 | 0.005 | 0.00 | 0.886 | *-0.07* | *0.01* | -0.01 | 0.741 | 0.09 | 0.001 | 0.02 | 0.464 |

| | *Increased costs of management and science* | | | | | | *Increased operational flexibility* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Interests | | | | | | Values | | | | | | Interests | | | |
| | Item3 | | Item8 | | Item12 | | Item1 | | Item6 | | Item13 | | Item9 | | Item14 | |
| | *b* | p | *b* | p | *b* | P | *b* | p | *b* | p | *b* | p | *b* | p | *b* | p |
| Constant | -0.29 | 0.663 | 0.2 | 0.581 | 1.14 | 0.014 | -0.69 | 0.212 | 1.41 | 0.008 | -1.17 | 0.083 | 0.62 | 0.249 | 0.24 | 0.607 |
| NORMAC | -0.32 | 0.634 | -0.65 | 0.118 | -0.66 | 0.195 | 0.78 | 0.154 | 0.44 | 0.26 | -0.73 | 0.298 | 0.35 | 0.508 | -0.44 | 0.411 |
| RAG | -0.73 | 0.224 | 0.64 | 0.103 | 0.33 | 0.482 | -0.9 | 0.066 | 0.03 | 0.929 | -0.12 | 0.858 | 0.22 | 0.642 | 0.52 | 0.305 |
| Fisher | *-1.38* | *0.020* | 0.41 | 0.304 | *-1.04* | *0.037* | *-1.27* | *0.01* | *-1.14* | *0.012* | 2.48 | 0.003 | -0.65 | 0.227 | -0.03 | 0.958 |
| Scientist | *-1.59* | *0.022* | 0.16 | 0.700 | -1.81 | 0.001 | 0.40 | 0.468 | *0.90* | *0.036* | -0.73 | 0.346 | -0.03 | 0.96 | -0.15 | 0.797 |
| Female | 1.20 | 0.112 | -0.46 | 0.323 | -0.72 | 0.245 | 0.55 | 0.364 | 0.44 | 0.351 | -0.30 | 0.730 | -0.18 | 0.766 | -0.95 | 0.162 |
| rho(direct) | -0.12 | 0.167 | -0.20 | 0.089 | -0.09 | 0.325 | -0.08 | 0.406 | -0.06 | 0.296 | -0.10 | 0.200 | 0.05 | 0.643 | -0.22 | 0.089 |
| rho(indirect) | -0.11 | 0.196 | 0.01 | 0.862 | 0.06 | 0.002 | 0.04 | 0.105 | 0.03 | 0.009 | 0.01 | 0.752 | -0.01 | 0.813 | -0.07 | 0.478 |

*Note*. Italicized results are significant at .05, bold results are significant at .01. Significance of estimates for the constant are not marked.

Table 8-5 shows the autocorrelation model for knowledge claims. We find more autocorrelation effects in the case of knowledge issues (for 8 out of 16 items) than opinions about management goals. The effects are more often direct autocorrelation effects (4 out of 16 items) and all significant autocorrelation effects are consistently negative which means that network neighbours have dissimilar knowledge rather than similar knowledge. The network is more likely to be established for exchanging knowledge among experts with different knowledge than that it actually harmonized the knowledge between network neighbours.

Direct discussion links are associated with different knowledge or different levels of confidence in knowing whether a biological or economic ‘fact’ is true or false for the following statements: ‘At the rate at which the industry fishes the stock down, by week 3 they have taken more than half of the biomass’ (item 6), ‘With a quota system there is no practical alternative to setting a single combined TAC for the brown tiger, grooved tiger prawns and endeavour prawns' (item 10), and 'Controls on hull size and engine power under the effort regime reduce operator's efficiency' (item 14)

Indirect autocorrelation via non-respondents appears especially with statement 13: 'When fishing levels are set before knowing the actual CPUE or stock level an effort system will overshoot or undershoot more than a TAC system.'

Fishermen and NORMAC members take significantly different positions most often. They have opposite knowledge on issues 3 'For banana prawns the quota system will result in greater swings in profit than under the effort system' and issue 12 'A quota system allows the industry greater operational flexibility than the effort regime' (NORMAC members are quite sure that the statement is true, fishermen are quite sure that it is false), while issue 8 'It is impossible to model the impact of rainfall on banana prawns because this impact is different in different areas' is surely true according to fishermen but surely untrue to NORMAC members (and scientists)

Table 8-5  Network autocorrelation results for **knowledge**, Australia.

| | *ITQs will not achieve the rationalization they would achieve in other fisheries* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | item 4 | | item 6 | | item 8 | | item 9 | | item 10 | | item 15 | |
| | *b* | p | *b* | P | *b* | P | *b* | p | *b* | p | *b* | p |
| Cons | 1.15 | 0.181 | 2.04 | 0.005 | 0.41 | 0.562 | 1.22 | 0.277 | -0.09 | 0.911 | 0.18 | 0.888 |
| NORMAC | -0.93 | 0.292 | 0.10 | 0.891 | *-2.15* | *0.010* | *2.32* | *0.017* | 1.13 | 0.227 | -0.67 | 0.467 |
| RAG | -1.76 | 0.033 | -0.37 | 0.595 | -1.02 | 0.228 | 1.34 | 0.135 | -2.61 | 0.002 | 0.95 | 0.185 |
| Fisher | -0.33 | 0.707 | *-1.91* | *0.028* | 2.48 | 0.007 | -1.43 | 0.162 | 1.26 | 0.202 | *1.74* | *0.026* |
| Scientist | 0.48 | 0.631 | -1.28 | 0.124 | -2.44 | 0.008 | 0.52 | 0.613 | 0.24 | 0.801 | -0.06 | 0.941 |
| Female | -1.52 | 0.179 | 0.63 | 0.509 | 0.11 | 0.913 | 0.83 | 0.475 | 0.28 | 0.787 | -0.57 | 0.536 |
| rho(direct) | -0.23 | 0.054 | -0.40 | 0.000 | -0.02 | 0.800 | -0.06 | 0.457 | -0.31 | 0.002 | 0.19 | 0.106 |
| rho(indirect) | 0.04 | 0.423 | 0.04 | 0.346 | -0.05 | 0.345 | 0.01 | 0.821 | 0.02 | 0.764 | *-0.08* | *0.03o* |

| | *Increased costs of management and science* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | item 1 | | item 5 | | item 7 | | item 11 | |
| | *b* | p | *b* | p | *b* | P | *b* | p |
| cons | -2.47 | 0.001 | -0.64 | 0.451 | -2.57 | 0.000 | 1.08 | 0.205 |
| NORMAC | *2.04* | *0.025* | 1.04 | 0.303 | 0.21 | 0.822 | 0.22 | 0.815 |
| RAG | 0.74 | 0.418 | -1.00 | 0.269 | 0.24 | 0.773 | -0.98 | 0.328 |
| Fisher | 0.22 | 0.827 | 1.12 | 0.285 | 3.97 | 0.000 | -0.37 | 0.713 |
| Scientist | 0.52 | 0.579 | 1.94 | 0.059 | *1.85* | *0.046* | -1.71 | 0.072 |
| Female | 3.13 | 0.003 | 1.00 | 0.385 | -0.50 | 0.629 | 3.96 | 0.000 |
| rho(direct) | 0.13 | 0.131 | *0.17* | *0.036* | 0.05 | 0.563 | 0.03 | 0.787 |
| rho(indirect) | -0.15 | 0.098 | -0.16 | 0.079 | *-0.16* | *0.036* | -0.12 | 0.078 |

| | *Increased operational flexibility* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | item 2 | | item 3 | | item 12 | | item 13 | | item 14 | | item 16 | |
| | *b* | p | *b* | p | *b* | P | *b* | p | *b* | p | *b* | p |
| cons | 0.41 | 0.666 | -1.43 | 0.077 | 2.50 | 0.007 | -0.21 | 0.825 | 4.86 | 0.000 | 2.15 | 0.036 |
| NORMAC | 1.43 | 0.178 | 2.80 | 0.001 | 2.39 | 0.003 | -0.47 | 0.591 | 0.54 | 0.171 | -1.00 | 0.362 |
| RAG | 3.05 | 0.007 | 0.98 | 0.211 | -0.81 | 0.297 | -0.48 | 0.554 | 0.56 | 0.109 | -0.66 | 0.516 |
| Fisher | -1.53 | 0.168 | -2.56 | 0.005 | -2.38 | 0.003 | -0.98 | 0.296 | -0.10 | 0.79 | -0.09 | 0.945 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scientist | -0.95 | 0.410 | -1.69 | 0.073 | -0.96 | 0.282 | -0.13 | 0.882 | -0.46 | 0.282 | -0.98 | 0.400 |
| Female | -0.32 | 0.806 | 1.46 | 0.151 | 1.09 | 0.272 | -0.19 | 0.847 | 0.19 | 0.678 | 0.05 | 0.969 |
| rho(direct) | -0.20 | 0.076 | -0.06 | 0.346 | -0.09 | 0.253 | 0.13 | 0.154 | -0.20 | 0.000 | -0.13 | 0.217 |
| rho(indirect) | 0.02 | 0.673 | *-0.13* | *0.036* | 0.02 | 0.231 | -0.27 | 0.009 | 0.00 | 0.735 | -0.06 | 0.434 |

*Note*. Italicized results are significant at .05, bold results are significant at .01. Significance of estimates for the constant are not marked.

Table 8-6 contains autocorrelation results for salience of knowledge. Some autocorrelation effects are positive, others are negative. Positive autocorrelation implies that network neighbours tend to have the same opinion on the importance of believing that a true statement is true and a false statement is false. This effect appears with the statement on the need to increase observer coverage of the fishery for a quota system (item 5) and probably also for the statement that that a quota system allows the industry greater operational flexibility than the effort regime (item 12). Here, experts may have convinced their discussion partners of the importance of knowing the facts correctly.

Negative autocorrelation is found for items 3 (‘For banana prawns the quota system will result in greater swings in profit than under the effort system’) and 16 (‘Under a quota system each participant can plan when and how to take their share, but only if the TAC restricts catch more than the effort system does’). Here, communication partners tend to disagree on the importance of knowing the facts correctly

Personal differences are relatively inconsequential to an expert’s scores on the salience of facts. If a particular group deviates significantly in positive or negative direction from the scores of other groups, this is usually for items on which they scored significantly in the knowledge questions. Women score exceptionally on 3 items: 1 ‘An effort limit can be set without knowing pre-fisheries stock abundance, setting a TAC for a quota system requires monitoring this.’ (on average 1.68 points higher than men, so they think it is important to know this fact), 5 ‘A quota system will require a very substantial increase in observer coverage of the fishery’ (on average 3.54 points higher than men), and 8 ‘It is impossible to model the impact of rainfall on banana prawns because this impact is different in different areas’.

Table 8-6 Network autocorrelation results for **salience** of knowledge, Australia.

| | *ITQs will not achieve the rationalization they would achieve in other fisheries* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | item 4 | | item 6 | | item 8 | | item 9 | | item 10 | | item 15 | |
| | *b* | p | *b* | p | *b* | p | *b* | p | *b* | p | *b* | p |
| Cons | -0.47 | 0.207 | -0.23 | 0.608 | -0.36 | 0.372 | 0.10 | 0.867 | -0.28 | 0.677 | 1.14 | 0.103 |
| NORMAC | -0.14 | 0.724 | -0.14 | 0.763 | -0.80 | 0.056 | 1.03 | 0.057 | -0.12 | 0.871 | -0.70 | 0.255 |
| RAG | -0.17 | 0.629 | 0.22 | 0.624 | 0.14 | 0.718 | 1.61 | 0.003 | -0.99 | 0.161 | 0.09 | 0.866 |
| Fisher | -0.10 | 0.799 | 0.25 | 0.614 | *1.10* | *0.019* | *-1.31* | *0.048* | 1.04 | 0.214 | 0.87 | 0.155 |
| Scientist | 0.20 | 0.624 | -0.61 | 0.254 | -0.18 | 0.693 | *1.43* | *0.018* | -0.22 | 0.784 | 0.02 | 0.978 |
| Female | -0.66 | 0.130 | -0.46 | 0.428 | *-1.11* | *0.027* | 0.75 | 0.261 | 0.41 | 0.645 | -1.13 | 0.097 |
| rho(direct) | -0.11 | 0.215 | -0.11 | 0.390 | -0.10 | 0.395 | -0.03 | 0.604 | -0.14 | 0.324 | 0.03 | 0.845 |
| rho(indirect) | -0.16 | 0.089 | -0.01 | 0.820 | -0.04 | 0.431 | -0.01 | 0.820 | -0.08 | 0.482 | -0.12 | 0.102 |

| | *Increased costs of management and science* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | item 1 | | item 5 | | item 7 | | item 11 | |
| | *b* | p | *b* | p | *b* | p | *b* | p |
| Cons | -2.34 | 0.000 | 1.09 | 0.222 | -2.03 | 0.000 | 0.44 | 0.451 |
| NORMAC | 0.80 | 0.218 | 1.29 | 0.205 | 0.02 | 0.969 | -1.03 | 0.122 |
| RAG | 0.41 | 0.489 | -0.67 | 0.496 | 0.64 | 0.181 | 0.16 | 0.779 |
| Fisher | 0.78 | 0.279 | -2.35 | 0.052 | 3.15 | 0.000 | -0.23 | 0.720 |
| Scientist | 0.88 | 0.187 | 0.07 | 0.952 | *1.36* | *0.016* | 1.14 | 0.111 |
| Female | *1.68* | *0.030* | 3.54 | 0.009 | -0.54 | 0.400 | -0.26 | 0.092 |
| rho(direct) | 0.03 | 0.764 | 0.05 | 0.622 | -0.08 | 0.316 | -0.03 | 0.661 |
| rho(indirect) | -0.13 | 0.051 | 0.31 | 0.000 | -0.02 | 0.504 | | |

| | *Increased operational flexibility* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | item 2 | | item 3 | | item 12 | | item 13 | | item 14 | | item 16 | |
| | *B* | p | *b* | p | *b* | p | *b* | p | *b* | p | *b* | p |
| Cons | 0.84 | 0.161 | -1.25 | 0.032 | 1.31 | 0.081 | -0.8 | 0.363 | 1.55 | 0.016 | 0.27 | 0.571 |
| NORMAC | 0.23 | 0.742 | 0.78 | 0.198 | 0.34 | 0.652 | -1.04 | 0.062 | -0.79 | 0.228 | -0.84 | 0.172 |
| RAG | 0.99 | 0.149 | 0.60 | 0.288 | -0.04 | 0.954 | -0.69 | 0.170 | -0.30 | 0.617 | -0.77 | 0.182 |
| Fisher | *-1.92* | *0.010* | -1.31 | 0.052 | -1.37 | 0.077 | -0.29 | 0.598 | 0.21 | 0.762 | 0.63 | 0.362 |
| Scientist | -0.96 | 0.190 | -0.59 | 0.380 | -0.23 | 0.791 | -0.06 | 0.925 | -0.20 | 0.785 | 0.23 | 0.724 |
| Female | -0.87 | 0.294 | 0.24 | 0.741 | -0.18 | 0.845 | -1.00 | 0.117 | -0.83 | 0.304 | -0.99 | 0.163 |
| rho(direct) | -0.01 | 0.932 | 0.01 | 0.949 | -0.06 | 0.547 | 0.02 | 0.825 | -0.16 | 0.179 | *-0.27* | *0.037* |
| rho(indirect) | -0.02 | 0.700 | -0.17 | 0.013 | 0.04 | 0.052 | -0.08 | 0.064 | 0.00 | 0.969 | -0.03 | 0.699 |

*Note*. Italicized results are significant at .05, bold results are significant at .01. Significance of estimates for the constant are not marked.

## 8.6 Discussion

Input degree centralization within this network is 0.39, indicating that the distribution of nominations is quite unequal. Some experts are mentioned by many as their most frequent communication partners while many are not mentioned at all.

Network heterogeneity, the proportion of links between actors with different personal characteristics, is 0.48 for stakeholder types. Fishermen tend to have other fishermen as their most frequent discussion partners; their discussion network is relatively homogeneous.

NORMAC members who are not also RAG members have significantly more positive opinions on values and interests than respondents who are not affiliated to a management institution. NORMAC members think that costs eliminate the advantages of ITQs and that the required prediction precision is a problem. They score exceptionally low on item 10, they are much less inclined to think that the prawn fishing industry is morally obligated to implement ITQs. On this topic, RAG members score significantly high: they are much more convinced that ITQs should be implemented

Indirect autocorrelation via non-respondents occurs 5 out of 16 items. Non-respondents seem to link respondents that share opinions on the need for fishermen to adjust quickly, on cost problems of the quota system, and renegotiation because of effort creep. Similarity between two respondents due to their shared contacts with a non-respondent may mean that the respondents both agree or both disagree with the non-respondent. Therefore, discussion with the non-respondent may have lead to more similar opinions or different opinions have lead to more discussion

On the knowledge claims, Fishermen and NORMAC members take significantly different positions most often. They have opposite knowledge on issues 3 ‘For banana prawns the quota system will result in greater swings in profit than under the effort system’ and issue 12 ‘A quota system allows the industry greater operational flexibility than the effort regime’ (NORMAC members are quite sure that the statement is true, fishermen are quite sure that it is false), while issue 8 ‘It is impossible to model the impact of rainfall on banana prawns because this impact is different in different areas’ is surely true according to fishermen but surely untrue to NORMAC members (and scientists)

On the salience of knowledge, some autocorrelation effects are positive, others are negative. Positive autocorrelation implies that network neighbours tend to have the same opinion on the importance of believing that a true statement is true and a false statement is false. Here, experts may have convinced their discussion partners of the importance of knowing the facts correctly.

In the Australian Northern Prawn Fisheries case study, all the case study steps described in section 2 have been applied: discourse analysis, survey design, online survey, social network analysis. However, the last step (interpretation of the results in the context of the discourse analysis) could not be completed within the time frame of the JAKFISH project due to the illness of the case study analyst (Doug Wilson). Therefore, the results described in this section should be considered as preliminary. A separate paper is foreseen to be released in 2012 on this Australian case study. That forthcoming analysis suggests that the Australian network analysis showed that agreement about scientific facts among people who disagreed about values and interests increased when they worked together on management committees. This finding would contradicts the conclusions reached in the analysis above. Therefore, it is important to closely examine the implications of both analyses before final conclusions are drawn.

## 8.7 Conclusions

The preliminary conclusions drawn from this case study are:

- The distribution of nominations within the network is quite unequal (Input degree centralization 0.39). Some experts are mentioned by many as their most frequent communication partners while many are not mentioned at all.
- Network heterogeneity, the proportion of links between actors with different stakeholder types is 0.48. Fishermen tend to have other fishermen as their most frequent discussion partners; their discussion network is relatively homogeneous.
- NORMAC members who are not also RAG members have significantly more positive opinions on values and interests than respondents who are not affiliated to a management institution.
- Similarity between two respondents due to their shared contacts with a non-respondent may mean that the respondents both agree or both disagree with the non-respondent. Therefore, discussion with non-respondents may have lead to more similar opinions or different opinions have lead to more discussion
- On the knowledge claims, Fishermen and NORMAC members take significantly different positions most often.
- On the salience of knowledge, experts may have convinced their discussion partners of the importance of knowing the facts correctly.

A separate paper is foreseen to be released in 2012 on this Australian case study. That forthcoming analysis suggests that the Australian network analysis showed that agreement about scientific facts among people who disagreed about values and interests increased when they worked together on management committees. This finding would contradicts the conclusions reached in the analysis above. Therefore, it is important to closely examine the implications of both analyses before final conclusions are drawn.

# 9 Case study comparison and analysis

## 9.1 Introduction

In the preceding chapters, we analysed the impact of interactions on the science policy network: to which extent do experts agree or disagree with their most frequent discussion partners on values, interests, and knowledge? We measured agreement and disagreement as positive and negative network autocorrelation effects. Although we cannot be sure that a positive or negative network autocorrelation effect means that the discussions and contacts organized by the management system have caused the experts to agree or disagree, we think that this is likely because bringing together representatives of different stakeholder groups and experts with different roles in the management system is one of the primary activities of a management system.

The six case studies were selected because their management systems differ, notably with respect to the level of participation in the management process that is allowed to stakeholders. The JAKFISH project aims to trace the consequences of different management systems for the ways in which stakeholders participate in the system. We now turn to a comparison among cases, focusing on the extent to which experts agree or disagree with their primary discussion partners, in other words, we now want to understand why we sometimes find agreement (positive network autocorrelation) or disagreement (negative network autocorrelation).

## 9.2 Comparison

Table 9-1 presents an overview of the case studies that have been studied within this subtask of WP5. The networks are described in terms of overall management system characteristics, network heterogeneity, input degree centralization and general properties of the network (Tables 9-2 and 9-3).

**Network heterogeneity** measures the extent to which frequent discussion partners are chosen from another stakeholder group. Higher network heterogeneity means that frequent discussion occurs more between members of different stakeholder groups. Because stakeholder groups tend to have different values, interests, and knowledge, we expect that the discussion among members of different stakeholder groups (network heterogeneity) is likely to witness more disagreement on facts, values and saliency, hence more negative network autocorrelation.

**Input degree centralization.** Higher centralization indicates that contacts concentrate heavily on a small number of key experts. This implies that the other experts are ‘exposed’ to the values, interests, and knowledge of those key experts. This may result in more agreement among discussion partners if the central experts are influential, so their discussion partners adapt to their values, interests, and knowledge. In this case, we expect more positive network autocorrelation among experts because they all adapt to the central experts’ views.

**Network density** signifies the proportion of all ties that could be present in a network. These values partly reflect the level of response to the survey. For example the high response rate in the Gulf of Riga compared to low response rate for the Mediterranean case.

**Participation.** Participation is here interpreted as participation in the decision-making process. Table 9.1 shows the level and type of participation in the WP5.1 case studies.

Table 9-1 Description of participation in the six case studies.

| Case | Specific management system | Level of participation | Type of participation |
|---|---|---|---|
| Australia Northern Prawn | Northern Prawn Fishery Management Advisory Committee (NORMAC); http://www.afma.gov.au/managing-our-fisheries/fisheries-a-to-z-index/northern-prawn-fishery/ | High | Co-manage-ment |
| USA New England Groundfish | New England Fishery Management Council (NEFMC) http://www.nefmc.org/ | High | Co-manage-ment |
| Mediterranean Swordfish | No, only a working group under ICCAT; http://na.oceana.org/sites/default/files/ICCAT_Swordfish_Fact_Sheet_English.pdf | Low | |
| Gulf of Riga herring | No, national authorities decide | Low | |
| Baltic Sea Salmon Finland | No, national authorities decide | Regional participation | |
| Baltic Sea Salmon International | EU through TAC and technical regulation; http://ec.europa.eu/fisheries/partners/consultations/baltic_salmon/280409_presentation02_en.pdf | Increasing | Advisory role |

The measures of network heterogeneity and input degree centralization derived from the Social Network Analysis for each case study are listed in Tables 9.2 and 9.3. The Gulf of Riga herring case has the highest network heterogeneity (interactions with stakeholder from other stakeholder types) and the highest input degree centralization (concentration of interactions on a small number of key experts). The lowest network heterogeneity is observed for the Baltic Salmon International case (31%) which indicates a low level of interaction across different stakeholder types. This is also associated with a relatively low Input degree centralization (29%) which indicates that there are only very few influential experts in the system.

Table 9-2 Overview of WP5.1 case studies characteristics: number of completed surveys, network density, network heterogeneity and input degree centralization.

| Case study | Completed surveys | Network density | Network heterogeneity | Input degree centralization |
|---|---|---|---|---|
| **Gulf of Riga herring** | 83% | 16% | 75% | 50% |
| **Baltic Sea salmon (Finland)** | 84% | 7% | 66% | 37% |

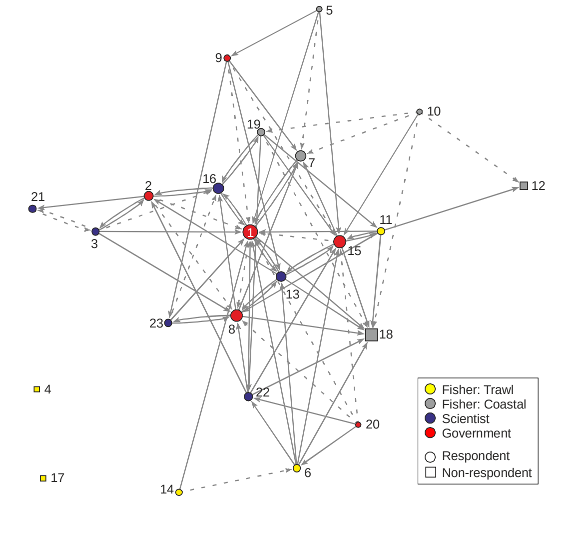
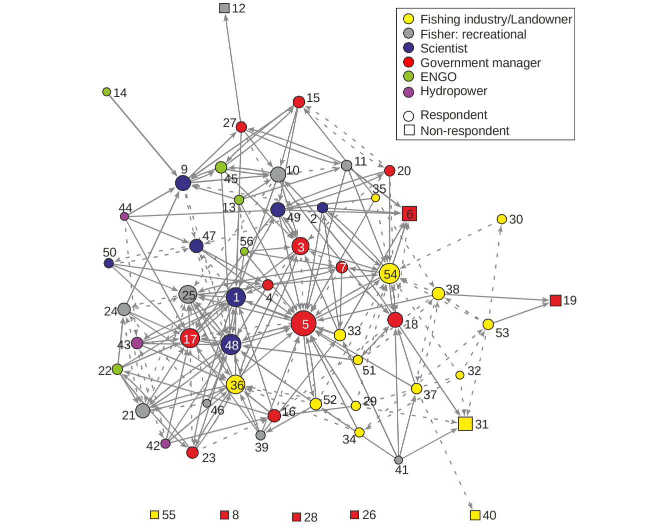
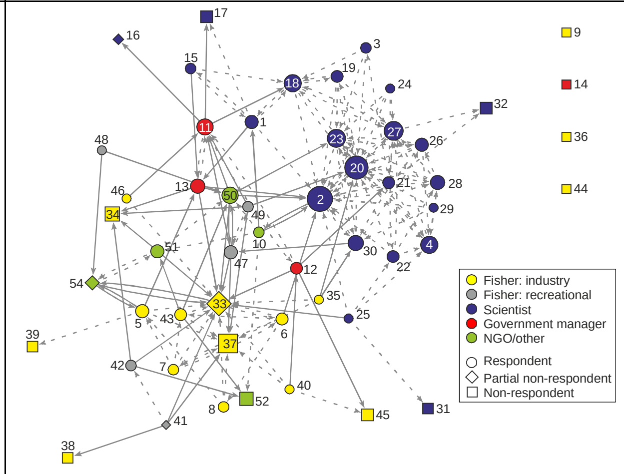
| | | | | |
|---|---|---|---|---|
| **Baltic Sea salmon (international)** | 70% | 6% | 31% | 29% |
| **Mediterranean swordfish** | 31%[4] | 3% | 56% | 22% |
| **US New England Groundfish fisheries** | 64% | 8% | 54% | 24% |
| **Australia Northern Prawn fisheries** | 72% | 9% | 48% | 39% |

The number of respondents that have completed the full survey is relatively high for all of the case studies, with an exception of the Mediterranean Swordfish case. Therefore, the sociograms provide a relatively good overview of the most important lines of communication for each of the case studies.

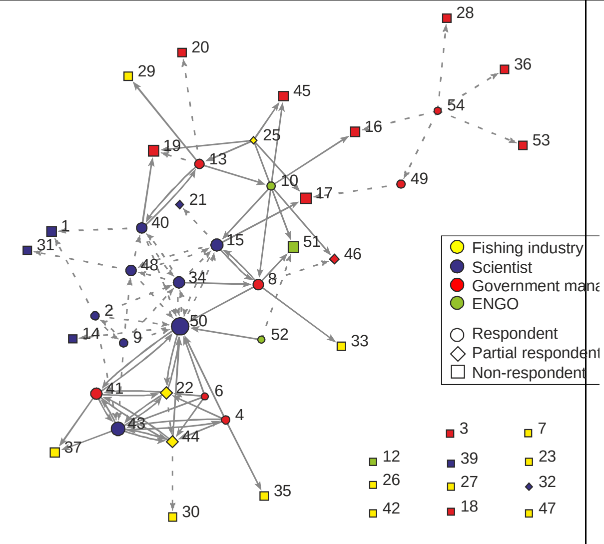
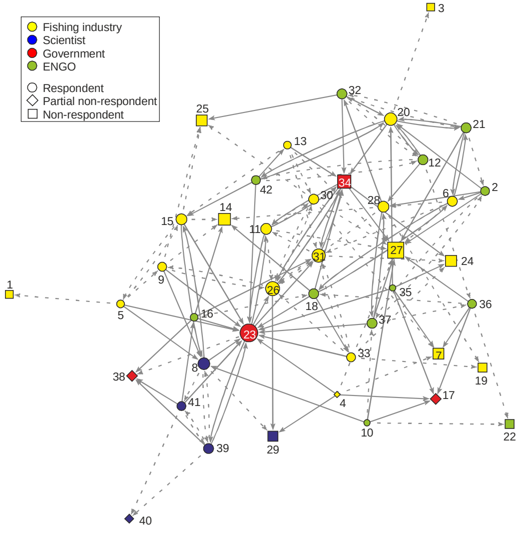
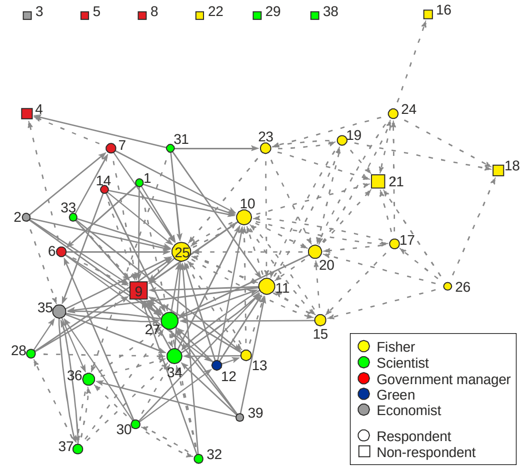
Input degree centralization appears to be positively related to network heterogeneity. This could imply that a few influential central experts can stimulate active stakeholder interaction among different stakeholder groups. If this is so, then the idea of “participation” would need "unpacking" from a network perspective because it shows how different participatory roles are played out in real-life situations where decisions are being made and how leadership and participation are connected.

[4] 57% were partially completed

Table 9-3 Overview of social network analysis case studies

| Case | Gulf of Riga herring | Baltic Sea salmon (Finland) | Baltic Sea salmon (international) |
|---|---|---|---|
| Sociogram |  |  |  |
| Management | Estonia and Latvia are the main exploiting countries. No explicit management objectives have been defined for the stock. Management measures include annual TACs, fleet measures and closed seasons. | The Unit for Fisheries Industry of the Ministry of Agriculture and Forestry has the main responsibility for fisheries policy making. The regional implementation and development tasks for fisheries management is carried out by 15 regional Centres for Economic Development, Transport and the Environment. | Baltic salmon management is carried out at the European level (EC) with national implementation. Main management measures involve TACs. The BSRAC provides a stakeholder forum that generates advice to the EC. ICES and STECF provide scientific advice to the EC. |
| Heterogeneity | 75% | 66% | 31% |
| centralization | 50% | 37% | 29% |
| density | 16% | 7% | 6% |
| Description | The top-down nature of this management system, and the absence of specific structures for stakeholders to participate, is strongly reflected in the results. Only a few actors play an important role in the network (input degree centralisation is 50%), with a key role for the governmental actors i.e. the decision makers. | The regional organisation is clearly visible in the sociogram. The regional networks show discussions among most stakeholders (input degree centralisation is 37%). There is a strong central governmental actor, most likely linked to the national (decision) level. The fishing industry is relatively distant from the core of the network. Recreational fishers seem to be more involved in the network. | This network shows a high number of interactions between the scientists and an intermediate spread of the discussions over the network (input degree centralization is 29%). The BSRAC and ICES working group meetings play an important organizing role in this network. Communication between stakeholder groups appears to run through only a few actors. |

(continued)

| **Case** | Mediterranean swordfish | US New England Groundfish fisheries | Australia Northern Prawn fisheries |
|---|---|---|---|
| Sociogram |   |   |   |
| Management system | highly international fishery with at least 11 countries targeting the stock (EU and non-EU). Management through ICCAT. There is no formal stakeholder involvement at the regional level (ICCAT), and the level of stakeholder involvement at the national level varies between the countries. Management measures: closed seasons and in some countries minimum landing size. | NEFMC is a regional council of state fishery managers, fishing industry representatives and other stakeholders. The Council relies on stakeholder advisory panels, technical (scientific) committees and extensive public comment opportunities. The Science and Statistical Committee sets annual catch limits (ACL) that will not exceed the annual biological catch (ABC) and the Council cannot exceed the ACL set by the SSC. | The fishery is managed by a multi-purpose co-management arrangement, developed after years of facilitated multi-stakeholder workshops. The management system and legislation places a strong emphasis on a partnership approach among fisheries managers, scientists, and relevant stakeholders. |
| heterogeneity | 56% | 54% | 48% |
| centralization | 22% | 24% | 39% |
| density | 3% | 8% | 9% |
| Description | The low response rate is reflected in this network. The network shows a sub network in the top right corner representing interactions between actors in a national setting. One actor (a scientist) appears to be central in the network but many actors are involved in the discussions (input degree centralisation is only 22%). No governmental actors are central in the network. Scientists see each other as important discussion partners. | Most actors take part in the discussions in this network (input degree centralization is 24%) with a relatively high level of discussions between actors in stakeholder groups.<br><br>Unfortunately, there are a number of errors in the sociogram in the allocations of individuals to different stakeholder types. This is particularly the case for four of the key respondents who should have been labelled "Scientist". This also has an effect on the network autocorrelation analyses. Results are therefore preliminary. | The network shows frequent discussions within stakeholder groups but a number of respondents appear to be central. This is also reflected in a input degree centralisation of 39%. These central respondents represent each of the stakeholder groups. For the stakeholder fisheries a only a few respondents appear to play an important role, both in internal and external discussions. |

In each of the six cases and for each of the survey statements, the value for the network autocorrelation effect indicates whether the experts agree (positive network autocorrelation or disagree (negative network autocorrelation) and the extent to which they agree or disagree (the numeric value of the coefficient).

Table 9.4 describes the average network autocorrelation per case study, per domain of the statements (values/interests, factual knowledge, and salience of knowledge), the themes of statements, whether the case study involves one nation or an international system, and whether the level of participation is high or low in the management system. Here we have taken simple arithmetic averages over all statements within a category.

The average direct autocorrelation effect varies among the six case studies, with a neutral autocorrelation for most cases but negative average autocorrelation for the Australian (M = -.07, *SD* = .13) and the Mediterranean case (M = -.12, *SD* = .14). For the Mediterranean swordfish management system, negative network autocorrelation (i.e. disagreement among most frequent discussion partners) is highest for the statements on measures for reducing juvenile catches (M = -.21, *SD* = .14). Positive network autocorrelation (agreement among frequent discussion partners) occurs especially in the Gulf of Riga herring case on the topic of the agreement between Estonia and Latvia.

The two international cases (Mediterranean swordfish and Baltic Salmon International) tend to have more negative network autocorrelation.

Management systems with high participation of stakeholders (Australian Northern Prawn Fisheries and New England ground fish fisheries) do not seem to differ from low-participatory systems with respect to the network autocorrelation effects. Likewise, average (dis)agreement does not vary substantially between value/interests, factual knowledge, and salience of knowledge.

Table 9-4 Average direct network autocorrelation effects by category.

| Category | Mean | SD | N |
|---|---|---|---|
| Case Study | | | |
| 1 Gulf of Riga Herring (GRH) | .00 | .09 | 48 |
| 2 Baltic Salmon National (BSN) | .01 | .08 | 48 |
| 3 Baltic Salmon International (BSI) | .00 | .08 | 48 |
| 4 Mediterranean Swordfish (MSF) | -.12 | .14 | 48 |
| 5 New England Ground fish (NEGF) | -.02 | .10 | 48 |
| 6 Australia Northern Prawn Fisheries (NPF) | -.07 | .13 | 48 |
| | | | |
| *Domain of the statements* | | | |
| 1 Values and interests | -.04 | .13 | 96 |
| 2 Factual knowledge | -.03 | .12 | 96 |
| 3 Salience of knowledge | -.03 | .10 | 96 |
| | | | |
| *Case study and Theme of the statements* | | | |
| <u>1 Gulf of Riga Herring</u> | | | |
| Estonia and Latvia agreement | .05 | .08 | 7 |
| spawning concentrations must be protected from trawlers | .00 | .07 | 19 |
| trawling ban must be implemented just at the right time | -.01 | .11 | 22 |
| <u>2+3 Baltic Salmon International and National</u> | | | |
| Angling in rivers (as opposed to fishing at sea) | -.01 | .08 | 24 |
| Don't jeopardize commercial fishing | .02 | .08 | 36 |
| Mixing of salmon stocks | .01 | .08 | 36 |
| <u>4 Mediterranean Swordfish</u> | | | |
| Closure must be where and when juveniles are most abundant | -.07 | .11 | 17 |
| Fishing mortality is too high but a TAC is unnecessary overkill | -.09 | .12 | 8 |
| Juveniles can be avoided by fishing deeper and/or further from the coast | -.13 | .18 | 8 |
| Need for a minimum size regulation | -.17 | .16 | 10 |
| Some measures for reducing juveniles may put the stock under pressure | -.21 | .14 | 5 |

| Category | Mean | SD | N |
|---|---|---|---|
| 5- New England Groundfish | | | |
| Catch shares reduce bycatch and discards | -.08 | .06 | 7 |
| Fishing communities need protection | .04 | .07 | 16 |
| Spatial/Area management is needed | -.03 | .10 | 25 |
| 6 Australia Northern Prawn Fisheries | | | |
| Increased costs of management and science | -.04 | .15 | 14 |
| Increased operational flexibility | -.08 | .11 | 17 |
| ITQs will not achieve the rationalization they would achieve in other fisheries | -.08 | .14 | 17 |
| | | | |
| *National versus international network* | | | |
| 0 International | -.06 | .13 | 96 |
| 1 National | -.02 | .11 | 192 |
| | | | |
| *Level of participation* | | | |
| 0 Low | -.03 | .12 | 192 |
| 1 High | -.04 | .12 | 96 |

**Importantly, the averages in Table 9.4 do not take into account that specific properties of the communication networks (e.g. centralization, heterogeneity) can also account for differences in direct network autocorrelation effects. They are in fact simply averaging all results in a certain category without taking into account the way the individual statements have been derived and can be compared (or not).**

In order to test for interactions between network properties and network autocorrelation effects of all six case studies, we conducted a multivariate statistical analysis. We used a multilevel regression model to predict the size and sign of the network autocorrelation effects of the statements related to the type of management system (national versus international, high versus low participation) and from two network characteristics: network heterogeneity with respect to stakeholder type and network centralization (see above).

Table 9.5 shows the results of the multivariate statistical analysis. We have analysed 288 statements (6 case studies each including 3 sets of 16 statements) that belong to 17 themes and 6 case studies (bottom rows in Table 9-5).

Table 9-5 Prediction of the direct network autocorrelation effects of statements (N= 288).

| Predictor | b | S.E. |
|---|---|---|
| *Fixed Part* | | |
| Constant | 0.10 | 0.075 |
| Network heterogeneity with respect to stakeholder type | -0.45 | 0.277 |
| Network centralization | -0.22 | 0.349 |
| International (versus national) | -0.24 | 0.126 |
| High participation (versus low participation) | -0.17 | 0.096 |
| | | |
| *Random Part* | | |
| Level: Case | | |
| Constant | 0.00 | 0.001 |
| Level: Theme | | |
| Constant | 0.00 | 0.000 |
| Level: Observation | | |
| Constant | 0.01 | 0.001 |
| | | |
| -2*log likelihood: | -459.11 | |
| Units: Case | 6 | |
| Units: Theme | 17 | |
| Units: Observation | 288 | |

*Note*. Estimated with Restricted Iterative Generalizes Least Squares (RIGLS).
All numerical predictors are centered on their grand mean.

The effects in the random part are nearly zero, which means that there are no clear differences among cases or themes with respect to the network autocorrelation scores. Any differences that exist are captured by the characteristics of the case studies listed as the fixed part of the model. We restrict the interpretation to the fixed effects. Note that the fixed effects are not statistically significant, which means that there is a larger than 5% chance that we may find no effects if we would repeat the research. Here, for the purpose of describing the data, we have interpreted the estimated effects in the fixed part.

All predictors have negative effects, indicating that a higher score on the predictor is associated with more negative autocorrelation and, vice versa. Some key findings:

1. More heterogeneous networks show more negative autocorrelation (factor: -0.45). When experts discuss matters more with colleagues from other stakeholder groups, their values, interests, opinions, and knowledge are less similar and there is less agreement. Example of a heterogeneous network is Gulf of Riga herring. Example of a network that is low on heterogeneity is Baltic Salmon International.
2. Centralized networks have more negative autocorrelation (factor: -0.22). This suggests that the central experts in these networks are not effectively influencing their peers. Example of a centralized network is the Gulf of Riga herring. Example of a low centralized network is Mediterranean Swordfish and New England Groundfish.
3. International systems are associated with negative autocorrelation (factor: -0.24). But we note that the difference is probably mainly driven by the Mediterranean swordfish case. In general, consensus is probably higher in a national system because experts and issues have a larger shared history.
4. Management systems with high participation (in decision-making) have negative network autocorrelation (hence more disagreement, factor: -0.17. This difference did not show up in the average scores reported in Table 9.4 because those averages were not corrected for other factors. If we compared management systems with comparable communication networks (same heterogeneity and centralization) and the same national or international scope, the management systems with high participation would have more negative network autocorrelation, so more disagreement among frequent discussion partners. This result suggests that in a more participatory management system, there can be higher disagreement among experts possibly because they result from discussion relations among experts with different values, interests, and knowledge.

# 10 Discussion

What impact does the organization and interactions of the science policy network have on patterns of agreement on biological and economic facts? This is the research question that was at the heart of the JAKFISH deliverable 5.1 "A social network analysis of a marine management science policy community for six case studies". Using social network analysis techniques we assessed the implications of different ways that scientists, managers and other stakeholders organise their common work within an overall fisheries management framework in four EU case studies and two case studies outside the EU. Each case study was carried using a uniform sequential procedure: discourse analysis, survey design, online survey, social network analysis, interpretation of the results in the context of the discourse analysis. The comparison between case studies was based on the social network analysis using a autocorrelation model and a multivariate statistical (regression) analysis.

**Defining participation**

Although the results presented in this report all deal with participation in some sense, we have not been very explicit in what we mean by *participation*. In the Description of Work we outlined that " JAKFISH addresses how different actors in the marine sector, including fisheries, make use of scientific knowledge, how the roles that scientists play help formulate policies and how governance approaches can be developed which enable policy decisions to address uncertainty and complexity based on research and with the <u>participation</u> of stakeholders.”. There is some ambiguity about the purpose of participation. Is the participation directed at improving the knowledge base for fisheries management or is the participation directed at improving the decision-making process (or even other purposes, see JAKFISH deliverable 2.6.1 on participatory modelling in natural resource management). This unclearness makes it somewhat arbitrary to describe the 'level of participation' in the six fisheries management systems that we studied. Here, we applied the second interpretation: improving decision-making (see Table 9.1) but this was a post-hoc interpretation at the time when the analysis needed to be carried out.

**Does participation lead to disagreement?**

The Social Network Analysis carried out in JAKFISH suggests that participatory decision-making systems tend to create more disagreement between different stakeholder types. Note that this conclusion is based on non-significant results though. This finding may seem unexpected but can be explained. In the following we depict a few examples from other studies that support this finding.

The Dogger Bank analyses in JAKFISH deliverable 5.2 have shown that a whole range of factors influence the amount of disagreement and controversy. At a first glance that analysis confirms the conclusion that more participation generates more disagreement about facts. The qualitative analysis also showed that the level of agreement cannot be solely explained by the properties of the network. An important trigger for the disagreement and controversy in the UK Dogger Bank case, came from the amount of stakes involved for example.

In the CEVIS project (CEVIS 2008a,b) participatory processes in Canada were observed and the conclusion was reached that if only the scientific process is open to stakeholder participation, but not the final decision-making process, then challenging the knowledge claims can block unpopular decisions. The politics then bleeds into scientific discussions through non-agreements on facts. In contrast, the JAKFISH participatory modelling case studies on the Mediterranean Swordfish and the Western Baltic Herring showed that stakeholders' participation not only involved discussion of the model outcomes but also getting a say on which kind of management scenarios might be implemented in the future.

The original design of D5.1 was driven by the underlying hypothesis that agreement on facts depends on *which experts people in a network actually talk to, how frequently they talk to them, and the qualities of those discussions when they disagree on values and interests.* This is directly linked to the question of how formal institutions are expressed in actual interactions. It is evident and important that proper forms of communication express controversies over both facts and values and that these two kinds of assertions are tightly related because people interpret facts to defend values. The crucial question that JAKFISH was meant to address follows from this. *Given that such controversy is the norm in participatory approaches to management, what are the potential tools that can lead to increased agreement on facts by those who disagree on values and interests?* The main part of the project addressed this question by experimenting with participatory modelling as a method for getting people to focus the conversation on facts and what a "fact" is. WP 5 examined the same question from the broader institutional perspective, i.e. how scientists deal with uncertainties in the midst of controversy and the different ways participation is organized, as expressed in the actual interactions of the people involved with each other.

Mediating science, carefully communicating uncertainties and inviting stakeholders for discussion makes stakeholders aware of the potential impacts of management scenarios. Such an awareness can create controversy, not only about values but also about facts. From this perspective, controversy can also be a sign of proper communication, stakeholder involvement and participation, particularly in cases with high stakes.

**Need for a uniform approach**

The subtask 5.1 used six case studies to develop the main research question above. The six cases differed in terms of properties and contexts in which some sort of participation occurred. In order to compare across the case studies, a uniform approach would have been needed and the analytical method should have been written down at the start of the project.

The illness of the coordinator of the subtask in the beginning of 2011, lead to a staff change for task 5.1. As the methods had not been fully documented, additional analytical steps were needed. In addition, the six case studies had carried out their discourse analyses and collected the statements in slightly differing ways, e.g. some focussed on future management issues, others on current issues, some focussed on highly contested topics, others on somewhat contested topics). The way the information had initially been collected in the case studies (before 2011), did thus not fully fit the requirements of the method that was used for final analysis.

This led to some disagreement on the interpretation of the results obtained. The case study coordinators who carried out the interviews and developed the questionnaire, disagreed with the type of conclusions that could be drawn from the analytical model. Due to the constrained time available at the end of the project, the project team has not been able to fully resolve the issues, but highlights these issues in the following paragraphs.

**Discourse analysis and selection of statements**

The discourse analyses in the different case studies were focussed on generating statements to be used in the social network analysis. The selection of relevant discourses and the selection of key statements on values, facts and the salience of facts affected the overall outcome per case study. Selecting a discourse with a high level of disagreement in a case study where there is in general a substantial level of agreement on many other discourses, this would automatically generate the result that the management system triggers a high level of disagreement. Thus the process of carrying out the discourse analysis and selecting statements is critical for the overall interpretation of the results. With the methods used here, it is difficult or even impossible to make these across-case comparisons in a meaningful way.

**Alternative interpretations of network autocorrelation**

The basic premise of the Social Network Analysis is that the presence of positive network autocorrelation indicates that the opinion or knowledge of network neighbours is more similar than expected while controlling for the effects of other predictors such as personal characteristics). This means that the structure of the discussion network can affect the convergence or divergence of opinions and knowledge. However, there are two alternative interpretations:

1. Actors choose each other (establish a network tie) because they have the same opinions/knowledge. This is known as the homophily effect: birds of a feather flock together (McPherson, Smith-Lovin & Cook, 2001). It reverses the causal direction, assuming that similar opinions or behaviour lead to network ties. With cross-sectional data and generally with observational data, it is impossible to distinguish whether the causes are network effects or homophily effects.
2. Actors are in a similar social context, and therefore, they are linked and have similar opinions and knowledge (Shalizi & Thomas, 2011). This can only be ruled out if we control for all relevant manifest and latent personal characteristics that may result in (dis)similar opinions and knowledge. In our analyses, we controlled only for a few important personal characteristics – affiliation to management institutions and stakeholder type – so we cannot rule out that the autocorrelation effects that we attribute to the network variables are actually due to similarities in personal characteristics that we have not measured.

Due to these possible alternative interpretations, the autocorrelation effects in our six networks need to be interpreted with care, keeping in mind that similar opinions and knowledge may be both cause and consequence of communication ties.

**Potential use of Social Network Analysis**

Social network analysis is a quantitative methodology designed to analyse patterns of interactions and exchange between social actors. Social network analysis is increasingly being used in the analysis of environmental planning and natural resource management.

Within the set of techniques for social network analysis, the network autocorrelation model is most appropriate to analyse whether an actor's opinion and knowledge or behaviour depends on the opinions, knowledge or behaviour of the actor's network neighbours: the other actors he or she is linked to (Doreian, 1980). If an actors' view is influenced by network neighbours, then influence processes may have been at work in the network, so network ties may have been relevant to the distribution of opinions, knowledge, and behaviour.

We think that there is great potential in using Social Network Analysis for the analysis of participation in fisheries management. But for this to provide effective answers to the research questions underpinning the JAKFISH project, the research methodology would have needed to be more clearly spelled out at the beginning of the project so that the overall data collection, analysis and interpretation all fall within the same analytical framework. In such a situation we would have been better placed to make cross-case comparisons and to provide more general lessons.

# 11 Conclusions and recommendations

The sociograms of the six case studies in this report have been compiled on the basis of network analyses that involve surveys. The number of respondents that have completed the survey is relatively high for all of the case studies (with an exception of the Mediterranean Swordfish case study). Therefore, the sociograms provide a relatively good overview of the most important lines of communication for each case study.

| | |
|---|---|
| **Gulf of Riga herring** | The top-down nature of this management system, and the absence of specific structures for stakeholders to participate, is strongly reflected in the results. Only a few actors play an important role in the network (input degree centralisation is 50%), with a key role for the governmental actors i.e. the decision makers. |
| **Baltic Sea salmon (Finland)** | The regional organisation is clearly visible in the sociogram. The regional networks show discussions among most stakeholders (input degree centralisation is 37%). There is a strong central governmental actor, most likely linked to the national (decision) level. The fishing industry is relatively distant from the core of the network. Recreational fishers seem to be more involved in the network. |
| **Baltic Sea salmon (international)** | This network shows a high number of interactions between the scientists and an intermediate spread of the discussions over the network (input degree centralization is 29%). The BSRAC and ICES working group meetings play an important organizing role in this network. Communication between stakeholder groups appears to run through only a few actors. |
| **Mediterranean swordfish** | The low response rate is reflected in this network. The network shows a sub network in the top right corner representing interactions between actors in a national setting. One actor (a scientist) appears to be central in the network but many actors are involved in the discussions (input degree centralisation is only 22%). No governmental actors are central in the network. Scientists see each other as important discussion partners. |
| **US New England Groundfish fisheries** | Most actors take part in the discussions in this network (input degree centralization is 24%) with a relatively high level of discussions between actors in stakeholder groups. Unfortunately, there are a number of errors in the sociogram in the allocations of individuals to different stakeholder types. This is particularly the case for four of the key respondents who should have been labelled "Scientist". This also has an effect on the network autocorrelation analyses. |
| **Australia Northern Prawn fisheries** | The network shows frequent discussions within stakeholder groups but a number of respondents appear to be central. This is also reflected in a input degree centralisation of 39%. These central respondents represent each of the stakeholder groups. For the stakeholder fisheries a only a few respondents appear to play an important role, both in internal and external discussions. |

Management systems with a lower level of stakeholder participation (no formal role for stakeholders in decision-making) show less discussion between actors of the same stakeholder type and more discussion with the decision making actors. In those cases only a few actors are actively involved in the discussion.

Management systems with a higher level of stakeholder participation show many discussion items especially across different stakeholder types. In those cases, there is also often disagreement on facts and values.

Network Heterogeneity and Input Degree Centralization do not fully describe participation. The two measures show some correlation. Input degree centralization appears to be positively related to heterogeneity. This suggests that active stakeholder interaction requires the organizing efforts of a few central actors. If this is so, then the idea of "participation" would need "unpacking" from a network perspective because it shows how different participatory roles are played out in real-life situations where decisions are being made and how leadership and participation are connected.

More participation (in science, in policy-making) does not (necessarily) mean more agreement on facts or values. Management systems with low participation might show more agreement because stakeholders lack opportunities to discuss controversial ideas. Higher participatory systems may, however, succeed in establishing discussion relations among experts with different values, interests, and knowledge.

The original design of D5.1 was driven by the underlying hypothesis: *who people actually talk to, how frequently they talk to them, and the qualities of those discussions can have an impact on how much they agree on facts when they disagree on values and interests.* This is directly linked to the question of how formal institutions are expressed in actual interactions. It is clearly evident and important that proper forms of communication express controversies over both facts and values and that these two kinds of assertions are tightly related because people interpret facts to defend values.

The edge question that JAKFISH was meant to address follows from this: *given that such controversy is the norm in participatory approaches to management what are the potential tools that can lead to increased agreement on facts by those who disagree on values and interests?* WP4 addressed this question by experimenting with participatory modelling as a method for getting people to focus the conversation on facts and what a "fact" is. WP 5 examined the same question from the broader institutional perspective, i.e. how scientists were dealing with uncertainties in the midst of controversy and the different ways that participation is organized as expressed in the actual interactions of the people involved.

# 12 Terminology

| | |
|---|---|
| Direct Network Effects | Network effects that are linked to **direct** ties in the network. An direct tie is a link between two experts ( respondents). In this study the assumption is that actors (respondents) are only influenced by their direct contacts so direct network effects refer only to direct ties between respondents. |
| Discourse analysis | Methodology to select topics of interest and to identify people/experts that communicate about these topics. Based on literature and interviews. |
| Indirect Network Effects | Network effects that are linked to **indirect** ties in the network. An indirect tie is a link between a non-respondent and two other respondents. Indirect ties are a way of dealing with non-responders in this study. |
| Input Degree Centralization | Indicator (between 0 and 1) for the distribution of nominations by respondents. A low input degree centralization (.e.g. .35) indicates that a few experts are mentioned by many as their most frequent communication partners while many are not mentioned at all. |
| Network autocorrelation | Network autocorrelation effects indicate whether the opinion or knowledge of network neighbours is more similar (**positive network autocorrelation**) or more dissimilar (**negative network autocorrelation**) than expected while controlling for the effects of other predictors. |
| Network heterogeneity | This measure (between 0 and 1) describes the proportion of links between actors with different personal characteristics. A low heterogeneity (e.g. .45) indicates that the actors tend to discuss with partners with the same characteristics as their most frequent discussion partners. For example fishermen that have many links with other fishermen. A high network heterogeneity (e.g. .75) indicates that the actors tend to discuss with partners with different characteristics as/from their most frequent discussion partners. |
| Participation (low/ high) | How can stakeholders participate in the management system? Do stakeholders have a formal role and position in the management system? We see low participation as participation where the stakeholders are involved in discussions but no formal structure exists for this participation. In contrast, high participation is where stakeholders have a formal role and position in the management system. |
| Q-methodology | Q-methodology was invented by Stephenson in 1935 and aims to account for subjectivity. Carrying out a Q methodological study involves five steps. For this this study we only used the first steps of this approach with emphasis on selection of representative statements and asking selected experts to sort the statements. |
| Q-sorts | Q-sorts are the basis of Q-methodology. With a Q-sort responses to a statement from strongly agree (+3) to strongly disagree (-3) are obtained from individual respondents. |
| Social Network Analysis | Sociological technique based on the analysis of data about relationships between people (frequency and quality of their interpersonal contacts). |

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