ANNEX 11

Experience Based Knowledge and Fisheries Management in the Mweru-Luapula System

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1. Introduction

Fisheries social science has historically taken one of three basic approaches to understanding fisheries management, each one stemming from different fundamental models of society (Wilson 2000). The best known begins from an 'atomistic' view of society as the sum of individual interactions. It leads from the "tragedy of the commons" through creating rational institutions that prevent fishers from fishing while externalizing the costs of overfishing onto the other users (Gordon 1954). In this approach the knowledge base is understood as a way to define and monitor the behaviours that need to be controlled by these institutions. When the knowledge base is examined directly, what most people say about nature is understood as a way to further their competitive interests, while government scientists are cast in the role of the disinterested outsiders who present the objective truth. The structural or political economy approach, on the other hand, analyses how management outcomes reflect struggles over profits and other values between different groups such as nations (Peterson 1993), ethnic groups (Bailey 1986), and fishing sectors (Duff and Harrison 1997). Studies of fisheries based in political economy also assumes that claims about science are tactics in a competitive struggle, but often points to the ways that understandings of nature reinforce the ideologies or world views that maintain solidarity among the competing groups.

The third approach comes out of the "embeddedness" view of society (Emirbayer and Goodwin 1994; Granovetter 1985) and is close to the viewpoint that has come to be called 'governance' over the last few years in reference to natural resources. Institutional embeddedness (McCay and Jentoft 1998) examines how larger social contexts, such as cultural understandings, social networks, and polity structures, influence the creation and effectiveness of management institutions. It builds on the atomistic and structural approaches by trying to understand the process of creating effective management institutions in the real world of competing stakeholders. Governance here is much more than just government activity. Governance is the general coordination of social and economic activities by markets and the civil society as well as the government.

The governance perspective transforms the question of the knowledge base and shifts it from the periphery of the analysis to the centre. Rather than simply being a question of supplying management institutions with objective descriptions of the resource the knowledge base becomes the main axis around which the debate among stakeholders revolves. Policy debates are made up of discourses, meaning ways of linking facts, values and interests together in support of a set of actions. But facts are different from values and interests because the possibility of proving or disproving a fact is always there, even if only in principle and not in practice. So there is a difference in what is meant by being right about facts and being right about values and interests (Festinger et al. 1950). This difference matters crucially to institutions because certain institutional mechanisms, particularly those important for managing large scales processes depend on this distinction in order to function (Habermas 1987, Wilson 2003b, Wilson and Delaney 2005). As stakeholders dispute the form of institutions it is facts that they most often draw on and challenge and many of the most important facts are part of the knowledge base for management decisions. Developing the knowledge base for management (particularly biological, ecological

and economic information) is the crucial hinge around which the creation of effective management institutions in the real world of competing stakeholders takes place.

The KNOWFISH project, the results of which we report here for the Lake Mweru-Luapula River system that was the Zambian case, gave this crucial hinge specific form of the multi-disciplinary objective of developing a set of simple indicators for sustainable resource exploitation that would bring together formal research-based knowledge (RBK) and local experienced-based knowledge (EBK). The idea was that such indicators would be useful tools for co-operative fisheries management. Furthermore, it was anticipated from the outset that the process of examining these potential indicators, and the EBK on which they were based, would yield insight into issues around effective governance. The indicators provide a window for examining the cultural understandings, social networks, and polity structures that in which the management institutions are embedded.

2. Basic Hypotheses

2.1 The Characteristics of the Indicators

The governance perspective is built up on the atomistic and the political economy perspectives. The atomistic perspective describes the rational outlines of the problem of resource management and offers general design guidelines for management objectives and institutions (e.g. Ostrom 1990). Here this means suggesting an initial outline of the characteristics of the indicators. They need to be simple, cost effective, reflect an understanding of the resource shared by stakeholders, and be relevant to management objectives (Degnbol and Jarre 2004).

The general, working hypothesis of the KNOWFISH project is that such indicators could be identified using the experience based knowledge (EBK) of the fishers to complement the research based knowledge (RBK) of scientists. To achieve this some preliminary hypotheses about the nature of EBK had to be tested. The first hypothesis was that a body of knowledge exists that can be described as the EBK of Mweru-Luapula system. Then a series of hypotheses were examined about patterns in how this body of knowledge was shared among the different fishing groups. All of these hypotheses, like all hypotheses in good social research, are initial ideas to structure the research and act as a beginning point from which to explore the dynamics of the situation.

2.2 Issues on the Political Economy of Zambian Fisheries Management

The political economy perspective is much more contextual than the atomistic perspective. Rather than following general guidelines what is required is a review of the relevant literature to highlight the issues to be examined. The relevance of these issues to the particular fisheries management situation defines the set of working hypotheses.

The co-management scheme in place in the Mweru-Luapula fisheries is part of the much wider history of community based approaches to development and natural resource management. After a short-lived career as a part of the development establishment in the 1950s and early 1960s, community approaches were crowded out by mega-projects with much greater appeal to powerful

national and international actors (Wilson 2003a). During the 1970s the community approach was reborn as a critical perspective taking two main forms (Vandenberg and Fear 1983). Some authors advocated a truly radical empowerment of local people (Freire 1970) while others focussed on developing "authentic participation" through reforming mainstream development projects with an adaptive, learning-process approach (Korten 1980, Cohen and Uphoff 1977). This reform broke down the division between those who defined the problems, outlined the solutions and carried out the actions. It also brought the question of power within communities to the fore, criticising the papering over of the divisions with in communities that had hidden the ways that community development efforts often reflected the interests of local elites. Authentic participation and action research laid the foundations for what would emerge as a new community development orthodoxy, closely linked to a vast expansion of NGOs. Community participation has become such an orthodoxy that it has become the focus of an excited heterodoxy, note recent books and conferences on the 'Tyranny of Participation'. This new orthodoxy was been adopted in natural resource management through ideas like community based natural resource management (CBNRM) and co-management (Wilson 2003a). Due especially to the NGO movement, participation has indeed become a prerequisite of most development and resource management programmes due to reforms among multilateral, bilateral and national aid agencies.

At the local level, questions related to power and the role of local elites, however, continue to plague development, including co-management and CBNRM programmes. Programmes have to work with someone. Much can be gained by referred to that someone as "the community" In the African situation where states are weak this is often as true for a government agency as it is to an external agency or NGO. African states are highly motivated to enter into arrangements such as co-management because of their own resource limits (Hara and Nielsen 2003) and inability to access sufficient information at the local level (Wilson 2003b). Local elites are the ones who have both the external contacts and who can provide outsiders with legitimate access to the local people. They are usually motivated by access to the outsiders development resources. In the case of fisheries co-management, however, an additional motivation is that the state can convey upon locals a legitimate new role in controlling resources access, particularly in situations where conflicts about such access have arisen (Wilson 2003b).

Two recent research efforts are of particular relevance here in respect to African inland fisheries. The first is work on the role of traditional authorities (TAs) in natural resource management. These various kings, chiefs or headmen are lumped together as 'traditional authorities' while holding offices and performing roles with various pedigrees, both pre-colonial and colonial. In many cases traditional authorities have played a very helpful role in natural resource management. In others they have not. Their actual authority is often contested and the degree to which they are accountable to the people they represent is highly variable. Often such accountability is quite weak and this has led to abuses within a number of decentralized natural resource management programmes (Agrawal and Ribot 1999, Ribot 1998, Ribot 2002). In any case, the role of these authorities seems to be growing in many parts of Africa and it is certainly growing in Zambia and in the particular area of this investigation.

The second research effort raises some profound questions from the intersection of the biological justification and social objectives for fisheries management. Jul-Larsen et al. (2004) point to the

characteristics of the resource and technology using a distinction between the horizontal and vertical intensification of fishing effort (Brox 1990). In respect to aquatic ecosystems that fluctuate naturally, something which characterises many African inland waters including Mweru-Luapula, they argue that horizontal intensification, based on a simple increase in numbers of users, may actually do little or no long-term damage to the resource, in contrast with the much more dangerous vertical intensification based on the introduction of industrial fishing technology. In respect to Lake Mweru they argue:

> Lake Mweru also gives the example of a developing fishery diversifying into targeting successively more components of the fish community. Mesh size in stationary gillnets decreases, while more and more active methods are employed, such as seining (open water and beach). Lastly, fish attraction through lights on the pelagic species Microthrissa (zooplanktivore) or through Fish Aggregating Devices (FAD's) on Alestes macrophthalmus (facultative piscivore/insectivore) develops. The result is a maturing small-scale and subsistence fishery, in which many components of the assemblage are targeted, without any of them disappearing from the fishery, though some species reduce to low stock levels. Thus, the conceived negative image of "fishing down the food webs" is not necessarily ecologically bad, but just represents a fishing pattern.....where the fishery develops to exploit all trophic levels – hunting everything in proportion to the natural P/B ratios. In principle, such a fishing pattern could be much more harmonious for the overall natural mortality pattem than a selective fishery with gear and mesh size regulations (Jul-Larsen et. al 2004:p73)

Hence limits on simple access may unnecessarily restrict the traditional role of aquatic resources as a fall back for poor people suffering for example, a failed agricultural season. On the contrary, they argue that the artisanal fishery will evolve toward a multi-gear fishing pattern that is unselective overall but wherein fishers are able to shift rapidly between targets. Such a fishery, in pulsed systems such as Lake Mweru, "could in principle conserve the ecosystem" (p81) but they add "where operations override the inherent variability by increasing scale and maintaining catch rates at the same level, this will lead to problems" (p81). An effective management system, therefore, is one that is based on monitoring catches, catch rates, fishing effort and water levels and developing indicators based on system variability, the susceptibility of key species to fishing pressure, and the selectivity and scale of fishing operations where the main danger is in increased efficiency and more intensive technology (Jul-Larsen et al. 2004).

They further document that there is considerable reliance in rural Africa on fisheries as just such a fall back resource, emphasizing that people go in and out of the fishery and rejecting the idea that this movement is only in one direction that ends in a fishing "trap" (Panayotou 1982). Limiting the access of certain groups, however, have been shown in many cases to be a key motivator of local participation in co-management programmes where local people are interested in mobilizing state power to limit the access of outsiders, though often this is couched in defining the gears that the outsiders prefer as 'destructive' (Wilson 2003b), a concept that Jul-Larsen et al. (2004) significantly qualify.

These are the two major institutional dimensions that we explored in the Mweru-Luapula case. The first is the roles being played by local elites in fisheries management and the degree to which those roles are being contested. The two hypotheses being a) that the role of TAs in fisheries management is contested and b) that the role of the Department of Fisheries in fisheries management is contested. The second is the degree to which the fisheries management is being driven by an interest in limiting the access of outsiders to the fisheries resource. The main hypothesis being that the active co-management activities in the Mweru-Luapula system are a

reaction to the extensive influx of migratory fishers. Again these hypotheses are merely beginning points for further exploration.

[5]3. Description of Research Area

The Mweru-Luapula fishery is in the northern part of Zambia in Luapula Province on the border between Zambia and the Democratic Republic of Congo (Figure 1). It is divided into two systems: (1) Lake Mweru proper starting from the Luapula River mouth to Luvua River in the north and is approximately 110 km long and 40-50km wide. Its depth varies from 2 m in the south to 27m in the north. Its total area is about 4580 km2 of which 58% belongs to Zambia, (2) Luapula River system stretches from Mambilima Falls to the mouth of Luapula River. Below Mambilima Falls, the River forms an extensive swampy flood plain of about 160 km and 5-18 km wide. This swamp system with its numerous oxbows and lagoons is interlinked with the open waters of lake Mweru. Both systems make up Mweru-Luapula Fishery. There are two main affluent rivers; Luapula River from the south and Kalungwishi River from the east. Luvua River flows out to the north where it joins Zaire River. The fishery is mainly artisanal benefiting more than 500,000 people living along the lake and Luapula valley, with over 250,000 of who are directly involved in fishing either as fishers, workers or processors.

From 1920s, the management of Mweru-Luapula Fishery was mainly based on predominance of biological advice that did not adequately address stochastic impacts and lacked appropriate economic, social, or operational considerations both of governments and fishers. Fisheries management policies have been in favour of fish and have ignored the dynamic responses of fishers to various regulations and changes in the fishery. Such policies have therefore, lacked involvement of key stakeholders and general public in fisheries decision, hence, making fisheries management a baby of the Department of Fisheries (DoF). This factor is critical in failure of modern fisheries management (Hilborn and Walters, 1992).

As a step forward to move away from the government dominated management system, the Zambian Government has since 1991 embarked on promoting the collaborative management system (Co-management) by involving various stakeholders and general public in management of the fisheries resources. The system is being practised in the country's major fisheries.

The co-management arrangements in Mweru-Luapula developed over a number of years mainly through the efforts of the DoF in collaboration with the Dutch bi-lateral aid agency SNV. In 1992, the Department of Fisheries proposed a Conservation and Management Action Plan (CAMAP) in which a participatory approach towards conservation and fisheries management could be achieved (Kapasa1992; Kapasa and van Zwieten 1992). In the same year, a seminar was held with participants drawn from traditional leaders, fishers and the district councils at which the re-introduction of the closed season was recommended (Lubilo et al., 1993) followed by another seminar in 1993 (Mwaba et al., 1994). The concept of Fishing Association (FA) originated from the Democratic Republic of Congo (Zaire), at Pweto in the early 80s (Chongo et al.,1995).The objectives for the formation of the Fishing Association were of three fold:

[5]The material in this section is from Kapasa 2004.

- to control the escalating rampant theft of the fishing gears and registration of fishing gears,
- assisting members in times of difficulties, (sickness, loss of the fishing gears, members and family members' funerals, provision of soft loans to members who have lost nets) and
- to protect the heritage of the fishery through promotion of fish conservation among the members.

A meeting was convened by DoF on 29th October 1995 to form a forum that would coordinate all fisheries related matters such as fish conservation, fish levies, access to fisheries loan facilities, fish marketing, fish licensing and security in general. The objectives of the Nchelenge Fisheries Coordinating Committee (NFCC) were to act as a consultative committee aimed at protecting the Mweru-Luapula fishery and to strengthen the efforts of the Fishing Associations in creating fish conservation awareness among fishers.

In 1996/97 the idea of establishing a pilot co-management project was advanced in Mofwe and Pemba Lagoons. Then, in April 1999 the Department of Fisheries held a series of meetings to sensitize stakeholders to the concept of the collaborative fisheries management. A total of 13 Zone management areas have been demarcated according to chiefdoms and sub-chiefdoms boundary areas in Mweru-Luapula fishery. A total of 78 Village Management Committees (VMCs) have been formed and are operational throughout the fishery. Improvement of fisheries management in a collaborative management system (Co-management) requires more than a subtle modification of the 'status quo' but also a conceptual and organisational change (Kapasa 1999). In Mweru-Luapula fishery the organisational structure of co-management has three levels (Figure 6) starting at:

- Village level: Village Management Committee (VMC) where grass root stakeholders participate in decision making (Figure 5). At this level the village headmen represent the TAs on the committee and include fishers, farmers, business persons and fish traders/marketers.
- Chiefdom or Sub-Chiefdom level: Zonal Management Committee (ZMC). At this level senior chiefs are represented by either a chief or a sub-chief. Other members include; Fisheries Officer, council representative, FA members, and other interest groups
- Fishery level: Fishery Management Board (FMB) at which the 3 senior chiefs are members

This is the co-management system that is currently in place. It has continued to function for several years, in spite of the withdrawal of SNV, which is an important accomplishment in and of itself. The system involves the heavy participation of TAs, indeed it was designed around their jurisdictions. Enforcement is mainly done through the TA structures, VMC patrols will confiscate nets and then go to the Chiefs for confirmation of the confiscation. The lack of formal authority of the VMCs has been a major point of contention between the VMCs and the DoF. The VMCs want to be empowered to make arrests. This is not legally possible in the first instance because the law that will give local management formal authority is still in process. It also raises substantive problems in how to structure co-management because the VMCs are supposed to function as a community presence in fisheries management, not as another arm of the state.

In 2003 one of the District Councils in a District on the lake began to set up a Task Force, a complementary structure to the VMCs that involved resurrecting the Fishing Associations, but which was focussed on more general natural resource management and not just fisheries. The basis was a District umbrella committee that would oversee how people perform and ensure that they conform to the fisheries act. The Task Force approached the Fishing Association to ask them to begin patrolling along the lake shore, just as the VMC do. The DoF response was to encourage this new group to work with the VMC. A local DoF official we interviewed believes that the Task Force was formed behind the backs of the TAs and there is no representation of the TAs. A recent District Superintendent, i.e. the central government's main representative in a District, had been openly opposed to using sub-chiefs in co-management, or otherwise giving them 'official' roles from the perspective of the state. In an interview on Chief told us that the VMCs were afraid to patrol because they did not know about the status of the Task Force. When the VMC is patrolling they had no real guidelines or authority but they believe that the Task Force patrols have been given the authority to make arrests.

4. Research Methods

4.1 Initial Qualitative Interviews

During the case initiation visit in May of 2002 we carried out 13 in-depth interviews approximately one hour in length with groups of 2-5 fishers. These interviews were general experience based knowledge (EBK) interviews involving discussions of area maps and ecological history, important fish species, changes in habitat and other issues raised by our initial ideas about indicators of fishery health. Between May and October the Zambian Department of Fisheries (DoF) prepared detailed transcripts, averaging 15 pages in length, of the tapes of all 13 of these interviews and English translations of 9 of these transcripts. These transcripts provided the raw material for the social evaluation phase.

Discussions between the social and biological project staff, based both on the transcripts and prior knowledge of the fishery, identified the following types indicators for examination:

- Indicators of gear impacts. The idea that there are large differences among the conservation value of different fishing gear is very salient among both the fishers and the DoF staff. Along with a closed season, it is the most commonly referred to concept in discussions of fisheries management. Ideas about gears also figure largely in differences between various groups of fishers.
- Long term decreases in overall yields are an important indicator for both the fishers and for the biologists.
- Changes in species composition seem to be important in two ways. The first is the disappearance of species from the lake and the second is the recent arrival and seemingly rapid growth of the snakehead.
- Changes in the size structure of the fish community are important to the biologists and also figure prominently in fishers' reasoning about gear impacts.
- Water level, particularly in light of the Jul-Larsen et al. (2004) findings.

- Changes in land use and litoral habitat.

4.2 The Consensus Analysis

The main method used for testing the first set of hypotheses was consensus analysis. If a body of EBK exists that fishers have and are able to communicate then fishers working in similar areas will agree in their answers to the questions. As such, agreement is as an indicator of the validity of the observations. A consensus analysis selects a set of twenty or more dichotomous (i.e., having exactly two possible answers) factual questions about the resource based on statements that other fishers made during the initial interviews. The responses to these questions are then tested using statistical procedures to see if the responses fit the "cultural consensus model."

The cultural consensus model means that 1) that respondents agree with each other to a very high degree and that 2) there is only one thing that is exerting any significant influence on their responses. We interpret this one thing as being what they actually see in nature. If the model does not apply it means that something else is having an important influence on their answers. This may be that they are observing different things or that differences in knowledge and skill of the fishers is so great that the EBK is, in fact, more than one basic body of knowledge. If the cultural consensus model does fit the method also produces a correct answer from which a score for each individual fisher can be derived that measures how well that persons answers fit the cultural consensus, something that can be validly interpreted as the degree of that person's personal EBK. This allows us to test a number of hypotheses about variables influencing the amount of EBK that people have.

We began by extracting some 210 simple assertions about the fishery made in the initial interviews. These statements were mainly about fish behaviour, abundance and habitat but we also included 32 statements made about fisher behaviour so that we could get an idea about how reliable these statements were as well. From these 210 assertions we identified two sets of 28 statements to use in the interviews, one set was of statements that were appropriate to the lake area, while the other set was appropriate to the river area. The selection criteria were that the statements were clear enough so that a true or false judgement could easily be made, that if the statements referred to a fish species the referent for that statement would be the same for all the fishers, that the subject of the statement would be familiar to all fishers on the lake or the river. Many of the 210 assertions were applicable to both lake and river, but there were also many that were more relevant to one area than the other. The participation of Zambian biologists who were intimately familiar with the Mweru-Luapula system greatly facilitated this selection. Finally, we negated about a third of the statements, meaning that we turned them to their opposite. This was because of the expectation that the statements made by fishers in the interviews would be agreed to by the vast majority of the fishers and if they were answering "true" to every statement this would set up a pattern that would bias results. We only did negations with those statements which were equally sensible and simple when stated in the opposite way.

Each set of 28 statements was divided into 7 statements about habitat, 7 about fish behaviour, 7 about fish abundance and 7 about fisher behaviour. The equal number were so that we could measure the contribution of each of these types of statements to the overall consensus to see if their were differences in degree of consensus following the different types. In the end two of the

fisher behaviour statements were dropped from the analysis as they were felt after the interviews to not be clear enough.

We used the lake and river consensus interviews to check each other's results. To facilitate this we paired statements from the lake set with those from the river set. This meant that, where ever possible, which as for about 3/4 of the statements, we matched a statement on the lake list with a statement on the river list that was similar in form, complexity and content. For example, if the lake statement said X fish breeds in Y place we looked for a matching river statement that said that W fish breeds in Z place. This was so that we could more reliably compare the results from the two areas with each other.

We administered the river survey to 51 fishers and the lake survey to 38 fishers.

4.3 The Discourse and Analysis and Q Sorts

A discourse analysis takes as its data the extended expressions of the stakeholders about the conflict of interest but it understands those expressions in terms of how they are part of, and are shaped by, an interactive process. In particular, it is interested in the intersection of facts, values and interests in the things that people say about management. Understanding how people link these three things makes a number of contributions. Discourse analysis come out of the embeddedness perspective within social science discussed above in Section 1.

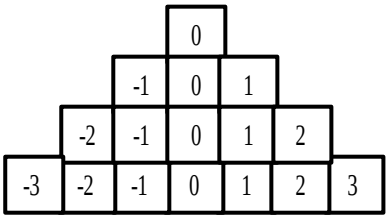
The atomistic and structural approaches both focus on competition and struggle. The main difference being the emphasis on the dynamics of competition between groups versus between individuals. Communications are seen by both as tactics and, in the case of the structural approach, as expressions of ideology or symbolic expressions to maintain group solidarity. The embeddedness perspectives complement this in an important way by viewing society as a shared reality made up of and reproduced by statements that draw on mutual understandings. Here, communications are understood as an interactive process of social construction and analysis describes these mutual understandings. The product of the discourse analysis is a description of the individual discourses, which are sometimes also referred to as discursive themes. Discourses are repeated patterns in which facts, values and interests are linked in the same way by participants in the discourse. Discourses are interpretations and cannot be given precise boundaries and different ways of describing themes can be valid. The only meaningful test is the degree to which stakeholders see the discourse analysis as a coherent picture of their discussions.

Q sorts are a method for identifying individual discourses based on both the content and intensity of agreement and disagreement among respondents. The interviews were done in two steps. First respondents were asked to sort the statements into three piles, agree, disagree and no opinion. Then they were asked to choose the most important statement that they agreed with, then the next most important and so on. This process was repeated with the statements they disagreed with. The final product was an arrangement of the 16 statements as shown in Figure One.

Their proponents (Brown 1087, Dryzek 1987) argue that Q sorts are the least distorting way to attach numbers to people's opinions because the statements are generated by the study population and the interview format allows for a vast number of ways to order the statements. We created one set of Q sort statements related to opinions about nature and the other was related to opinions about management. There was a good deal of overlap between these two subjects. This was

because the nature statements were statements of causal relationships that fishers had mentioned seeing in the fishery and many of these causal statements were related to the impacts of fishing.

The Q sorts are based on the qualitative interviews in two ways. The first is, obviously, because the opinion statements are generated by the interviews. The second is because the statements are selected and organize to represent themes that seem to be common across the interviews based on our intuitive reading of the transcripts. The Q sort allows us to measure how opinions about these themes vary across the population and to compare the relative importance that people give to these themes. Each set of Q sort statements was based on an initial analysis of the themes that emerged from the in-depth interviews. Each set contained four interview themes each one of which was represented by four opinion statements. Once again about a quarter of the statements were negated, changed to mean the opposite of the original statement, so that the general tendency of fishers to agree with each other would not result in too many agreements and too few disagreements. The four themes reflected in the nature Q sort were breeding and technical measures, fish and water, fishing pressure, and environmental interactions. We felt that combination of breeding and technical measures made a plausible theme because the fishers often linked their criticisms of fishing gear to the gears impacts on breeding. The four themes reflect in the management Q sort were authority, management measures, migration, and decision making and knowledge.



A 16 Statement Q Sort

We administered the Q sorts in two phases. The first, in 2003, was to 21 respondents with all but three of these respondents doing both the nature (N=18) and the management (N = 20) sorts. We administered the Q sort interviews mainly to co-management program leadership because the interviews are more challenging for the respondents than the others, requiring both literacy and the ability to make a large number of comparisons, and because we felt that these people are the opinion leaders among the fishers. We were, however, surprised by the facility with which these respondents carried out the Q sorts and we also found initial evidence of an important counter-discourse to the dominant discourse that agreed with the DoF's position among a few fishers who were not involved in the program. In the second phase more interviews were carried out with different kinds of stakeholders including 11 more fishers who were not involved in co-management, 4 fish traders, 4 TAs, and 4 officers of the department of fisheries. Of these 23 respondents 23 completed the management statements and 21 completed the nature statements and 20 completed both.

Analysis of Q sorts are done through a Q factor analysis, hence the name. Q factor analysis groups correlations among respondents, contrasting with R factor analysis which groups correlations among the responses. "Responses" in our analysis is the scores that respondents gave the statements when they ranked them. These groupings are called 'factors' and they are identified by calculating a linear association between respondents from a matrix of their ranks on all statements. This is done for the first factor and then the information[6] associated with that first factor is removed and the process is repeated to identify the second factor. At each step, the factors are calculated in the way that maximises the information they contain. The outcome is a set of factors that have no correlation among themselves. The calculation can be repeated as often as the researcher likes and the researcher's judgement about how many repetitions produces the most coherent outcome determines the number. Q sorting, therefore, should be understood as qualitative research that uses numbers to simplify and summarize the complexities of the discourse. Coherence remains the only meaningful test of the discourse analysis. The 'outcome' is a set of scores for each respondents on the factor, called the loading, and a set of scores for each statement on the factor, called the 'factor score'. Because there is no determined outcome the factors can be "rotated". This means that the factor scores and loadings, which are based on the solution that maximizes the information contained, are used as the basis of a new set of linear combinations. The basic idea is to look for a simple structure that allows the clearest interpretation of the results. We used an approach called varimax that keeps the factor scores uncorrelated while maximizing the differences among factor loadings. In other words the factors reported below as the "rotated solution" have been tuned in such a way that the correlations reported among respondents' scores on the factors have close to the highest absolute values that the data will allow. The rotated analysis emphasizes areas of disagreement.

5. Results of the Consensus Analysis

5.1 The Existence of a Body of Commonly Held EBK

The most basic test of consensus is the ratio between the amount of the information about the agreements and disagreements between the fishers that is explained by the largest single factor and the amount of the information in the second largest factor. These factors represent sources of influence on the amount of agreement between the fishers. What is really being tested here is if there is any other systematic influence on the answers given beyond the observation of nature. We believe that the most important cause of agreement between the fishers is that they are seeing the same things happening around them. The rule of thumb is that if the ratio between the first factor (assumed to be nature) and the second factor (some possibly unknown influence) is not at least three then we cannot assume that there is an agreement about the very basic experience based knowledge we are investigating. This ratio tests of the fit of the consensus model on which the remainder of the results are based.

[6] We are using the term 'information' because it is a clearer term for what is technically 'variance explained' and is measured by the first eigenvalue of the agreement/disagreement matrix.

Table 1 reports these results for both the lake and the river. In both cases this ratio is well above three. For the lake fishers, their common observation of nature accounts for 75 percent of the information found in the agreement matrix, and for river fishers it accounts for 84 percent. From this we can conclude that is a body of commonly held experience based knowledge exists among these fishers. This consensus is, in fact, a very strong. It is also very visible in the non-rotated solution to the Q-sort of causal statements about nature discussed in Table 6 below.

Table 1: Percentage of Information about Agreement between Fishers Explained by the Two Largest Factors

	Explained by Observations of Nature	Explained by the Next Largest Influence	Ratio
Lake	74.5	12.8	5.803
River	83.6	9.1	9.186

The calculation of these results is done through a process which involves both the estimation of the correct answers. For the river we found an average of 85% of the answers correct and for the lake 77% of the answers correct.

5.2 The Distribution of EBK

5.2.1 Influences on Percentage of Correct Answers

A number of hypotheses about influence on the number of correct answers are possible. We examined the following possibilities:

A) that the particular gears fishers use will affect their scores;

B) that the number of different types of gear fishers use will affect their scores;

C) that the amount of experience that fishers have in fishing in general and in this particular fishery will affect their scores.

We did not find any support for C above. Experience in a fishery has been found to be related to this kind of measurement of EBK knowledge in at least one other fishery (Guest 2000), though it was found to be very rapidly acquired. Because we intentionally used simple statements, we may not have fishers with short enough experience in this fishery to detect this relationship if it exists, only five river fishers and four lake fishers in our sample had fished in the area less than three years.

5.2.1.1 The Influence of the Type of Gear Used

Table 2 reports the effects of types of gear. Only gears that have a statistically significant effect the percentage of correct answers are reported. Gill nets, longlines, hooks and lines and a few minor and rare gears were examined and found to have no effect at all.

Table 2: Influence of Type of Gear Used by Fishers on Percent Correct					
	Gear Users		Other Fishers		p
	Mean Percent Correct	N	Mean Percent Correct	N	
Drift Net[7]	90	9	80	79	.01
Kutumpula	89	13	79	75	.00
Traps	84	32	79	56	.04
Seines	74	10	82	78	.03
All			81	88	
The kutumpulas (an active gear used to chase fish into nets) are used by the same people as use the drift nets. All nine of the fishers that use the drift net also use the kutumpula.					

5.2.1.2 The Influence of the Number of Gears

The number of gears used by the respondents varies from one to four, with one fisher using seven gears. Eighty percent of respondents use only one or two gears (Table 3).

Table 3: Number of Gears Used by Respondents			
Number of Gears Used	Frequency	Percent	Mean Percent Correct
1.00	35	40	.78
2.00	35	40	.81
3.00	8	9	.84
4.00	9	10	.87
7.00	1	1	.89
Total	88	100.0	.81

The mean percent correct increases monotonically with the number of gears used. A significant correlation exists between the number of gears a fisher uses and the number of correct answers (Table 4). This raises the question about the degree to which it is the number of gears as such that influences increases the respondents EBK or if it is the particular gears that are used that is the source of influence. One way of investigating this question is shown in Table 4. Table 4 reports this same correlation controlling for the use of the two gears that have the greatest individual impact on correct answers (Table Three). Controlling for the use of traps reduces the correlation between number and gear to .21 and controlling for the use of kutumpula reduces the correlation

[7] We examined the possibility that this result is a statistical artifact from possible circularity arising from the kutumpula users having the highest EBK simply because the agreement among these fishers was so high that they made a disproportionate contribution to determining how higher or lower EBK would be measured by the model. This was not found to be the case.

to an insignificant, but still positive, .13. As Table 4 also shows, trap users and kutumpula users use a higher than average number of gears.

Table 4: Correlation between Number of Gears Owned and Percent Correct			
	Correlation	**p**	**Average Number of Gears**
Without control	**.29**	**0**	**1.95**
Controlling for Traps	**.21**	**.05**	**2.63**
Controlling for Kutumpula	**.13**	**.23**	**3.31**

5.3 Consensus Analysis and Candidate Indicators

Among these abundance statements were statements directly related to the type of information on which some indicators are based. We tested the proportion of these statements answered correctly against all the various gear categories, as well as the number of gears, the number of years fishing in the area, the areas fished in and the number of different areas where the fisher fished. Two statements in the lake area were related to long term changes in overall yields. The mean proportion correct for these two statements is .61 and no other variables were found to have any influence on this mean proportion (Table 5). Four statements in both groups were related to changes in species composition. The mean proportion correct here was .8 and it was also not influenced by any other tested variables (Table 5). Finally, two river statements were related to changes in the size structure of fish. The mean proportion for these two statements was .77 and it was influenced by the use of two gears, kutumpula users answered a higher proportion of these statements correctly while seine net users answered a lower proportion correctly (Table 5).

Table 5: Impacts of Gear Type on Proportion of Right Answers for Some Statements Related to Candidate Indicators			
	Second Set	Third Set	Fourth Set
Gears Used	Two Lake Statements on long term changes in yields	Four Statements in Both Areas on species composition	Two River Statements on size structure
Overall Mean Proportion Correct	.61	.80	.77
Kutumpula N=10	---	-.01	+.16*
Seine Nets N=9	+.06	----	-.17***

6. Results of the Discourse Analysis

6.1 The Dominant Discourse from the Unrotated Solution

Table 6 shows all statements with factor scores around an absolute value of one or greater for the first factor extracted from the nature statements. The scores reported are standard deviations in the distribution of the scores of the statements on the factor. This is a remarkable result in that the difference between the first and second factors (in the unrotated solution) is large enough so that if this were a consensus analysis, which is based on the same statistical idea applied to simple factual statements rather than statements about causal relations, it would reflect a cultural consensus. The consensus reflects fairly clearly the biological basis for the current approach to fisheries management as promoted by the DoF among others. The fact that the interviews were unavoidably carried out in part by DoF personnel may represent some influence on this outcome. However it is one of the hallmarks of the Q methodology that there are a great many possible answers so even if a respondent were motivated to answer in a way they felt would be pleasing to the DoF interviewer they would still be left with a great many choices. It is also true that there exists no pristine EBK uninfluenced by outsiders, all attitudes are developed in discussions and discussions of these matters in Mweru-Luapula has involved NGOs , DoF and other authorities for many years now. While we should be conscious that there are always possible tendencies for DoF's involvement in the research to influence the answers, we do not feel that these tendencies were very strong or that the results are not reliable on that basis.

Table 6: The Dominant Nature Discourse	
This first, non-rotated factor represents 57% of the information about statement scores This is 6.33 times the information represented by the second factor.	
1. A destructive fishing method is one that catches small fish and even eggs	1.80
negative: 2. Destructive fishing methods are not an important cause of the decline in fish	-1.61
negative: 7. The number of fishermen increasing has little to do with the fish becoming fewer	-1.19
negative: 15. One reason for the decrease in fish is that people have started growing crops in places where fish used to settle during the wet season	-1.16
4. The fishing ban protects the fish when they are carrying eggs	1.06
negative: 9. Too little rain is not the reason fish are becoming fewer	-1.04
12. Some fish will leave areas where the water is not clean	.97
11. When it rains a lot the fish go to breed in the weeds then we know that the following year the catches will be very good	.96

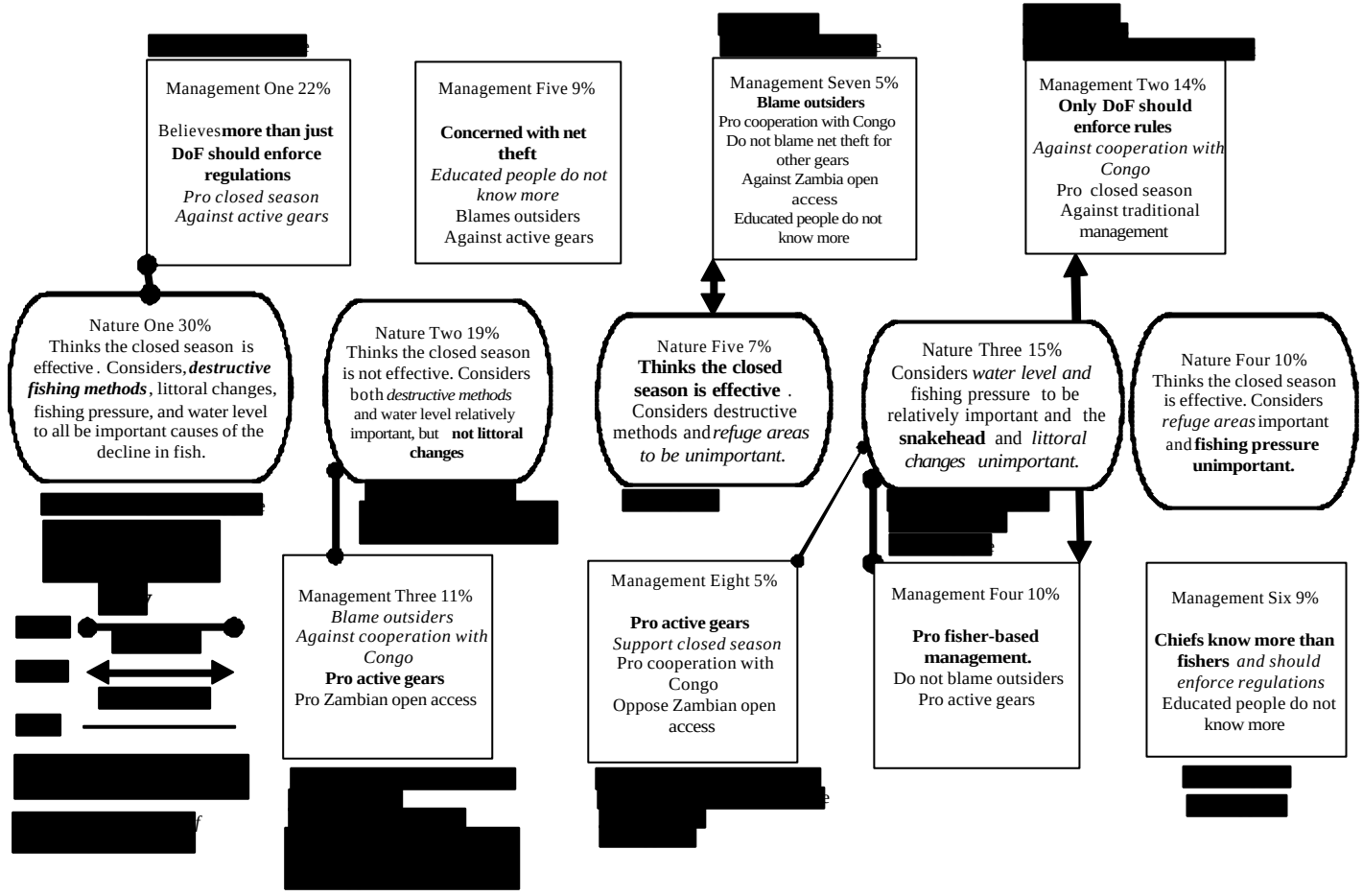
A similar table (Table 7) for the management statements shows the same pattern of strong agreement, but not nearly as dramatic as the one for the nature statements.

Table 7: The Dominant Management Discourse	
Non-rotated solution gives 40% of information, 2.9 times the next factor	
negative: 14. Educated people know much more about the fishery than the fishermen	-1.64
10. The fishing ban is the best way to ensure that we will have fish in the future	1.61
negative: 13. Local traditional fishing regulations are better than those of the Department of fisheries	-1.32
negative: 8. We cannot stop the Congolese from coming to fish here because we also like to go and fish in Congolese waters	-1.25
3.Chiefs and headmen should enforce fishing regulations	1.05

6.2 The Rotated Solution

6.2.1 The Prominent Dimensions of Disagreement

Three prominent dimensions of disagreement emerge in the rotated solution. The first is over the appropriate roles of the DoF, the TAs and the fishers. This is the main difference between the first, second and fourth most important management factors, and the first and fourth factors are



1 The Q Sort Results

also part of two of the three discourse clusters discussed below in Sections 6.2.2 - 6.2.4. The second most important dimension is disagreement over active gears (kutumpulas). While there is a clear consensus that destructive fishing gears are an important culprit in the perceived decline in fish yields there is no consensus about whether or not these active gears are, in fact, destructive. Formal scientific evaluations, in fact, have found no evidence of negative impact of kutumpulas (Kolding et al. 2003). The third dimension is how to relate to outsiders, especially people from the Congo. There are strong feelings about the role of outsiders, whether or not there should be open access for all Zambians and the degree to which Zambians should cooperate with the Congolese.

6.2.2 The Main Discourse

Figure 2 reports the rotated solutions for both the management and nature factors together. The nature factors are all, to some degree, variants of the dominance discourse. This is because after the rotation the factor analysis is no longer tuned around maximizing the total amount of information that factors contain, but rather it is now tuned to displaying areas of disagreement so that the various groups can be discerned.

Management Factor One (MF1) contains 22% of the information about the how respondents scored the management statements. It supports the closed season and is opposed to the use of active gears. Nature Factor One (NF1) now contains 30% of the information about the scoring of the nature statements. NF1 is most concerned with the impact of destructive fishing gears, indeed two statements related to such gears are the two statements that this factor feels most strongly about. NF1 is associated with MF1, meaning there is a significant correlation between a respondent's loading on NF1 and their loading on MF1. This link suggests that the two factors together describe a single discourse. The fact that they both contain considerably more information than the next largest factor means that they are the most popular discourse when disagreement is emphasized in the analysis. Hence, we term it the 'main discourse' within the rotated solution. Active gear fishers are the only identifiable group that disagrees with MF1, meaning that they have a statistically significant lower loading on the factor than the other stakeholders. Active gear fishers also opposed NF1 and here they are joined by trap fishers. Other fishers, however, are significantly more supportive of NF1 than other groups.

6.2.3 The First Opposition Cluster

In Figure 2 two other clusters of opinions and groups holding them can be discerned indicating the existence of two main 'opposition' clusters that contrast with the main discourse. The first cluster is around Nature Factor Two (NF2) and Management Factor Three (MF3). NF2 is similar to NF1, in that the emphasis is still on the importance of destructive fishing methods. This similarity is also seen in a lesser but still present emphasis on the importance of water level. Two beliefs differentiate NF2 from NF1: NF1 thinks the littoral changes are important, where the NF2 does not and NF2 thinks that the closed seasons is ineffective, where NF1 thinks that it is effective.

NF2 is associated with MF3. MF3 is supportive of the use of active gears, its linkage with NF2 indicates that they accept the idea that destructive gears are a critical issue and the disagreement is over whether or not active gears are destructive or not. This interpretation is supported by the qualitative interviews. The other emphasis in MF3 is to blame outsiders for using destructive gear and opposition to cooperation with the Congolese.

Trap fishers, who have the higher than average EBK (Table 2), are the main supporters of the cluster, scoring significantly higher than other fishers on both NF2 and MF3. Active fishers score significantly higher on MF3. Support for the cluster is higher on the river, even controlling for the fact that more traps and active fishers were interviewed in the river area. Cultivation in the littoral area is much more common in the river area than in the lake area. Fishers who use a larger number of different gears are also more supportive. Two particular groups are opposed to MF3. These are fish traders and the TAs.

6.2.4 The Second Opposition Cluster

The second opposition cluster is made up of Nature Factor Three (NF3) and Management Factor Four (MF4). NF3 shares with the main discourse a belief in the importance of water level and the idea that fishing pressure as a relatively important cause of the perceived decline in fish. The emphasis on destructive fishing methods has disappeared. This factor also rejects the idea that the introduced snakehead species is a cause of decline in other fish stocks, as well as the idea that littoral changes are important. This is an issue that is ignored in the dominant discourse and in NF1 and NF2. Fishers that use active gears and fish traders have higher support for NF3 than other fishers, while the TAs are less supportive than other stakeholders.

NF3 is linked to MF4. MF4 is characterized by a strong emphasis on fisher participation in management reflected in high scores on two separate statements related to this idea. It is directly opposed to Management Factor Two (MF2) which believes that only the Department of Fisheries should be enforcing the fisheries rules. MF4 is also supportive of active gears and does not blame outsiders for the introduction of destructive gears. No specific group supports or rejects MF4, but fishers who do not use active or trap gears support MF2.

6.3 The Rankings of Individual Statements

6.3.1 Statements by Means and Variances

Tables 8 and 9 compare the management statements with one another. In Table 8 the statements are ranked in descending order by mean. The higher the statement the greater the agreement among all 43 respondents. Statements at the top and bottom of the table evoke the strongest feelings. In Table 9 statements are ranked by variance, with the most controversial statements at the top and the statements ranked the most similarly at the bottom. Tables 10 and 11 repeat the same information for the nature statements.

Table 8: Management Statements Ordered by Mean Ranking		
Statement	Mean	Variance
The fishing ban is the best way to ensure that we will have fish in the future.	1.44	1.919
Chiefs and headmen should enforce fishing regulations	1	1.857
Fishermen know best which gears should be allowed and which ones banned.	0.84	1.568
Fishermen will accept other fishermen enforcing rules.	0.81	1.155
It is fishermen coming from other places who bring the destructive methods	0.74	1.719
Any Zambian should have the right to come and fish here	0.4	1.626
The council gets a lot of levies but does not assist fishermen.	0.4	1.245
Theft of nets leads to an increase in other fishing methods.	0.37	2.001
Kutumpula should not be allowed in any area of Mweru-Luapula	0.28	2.587
Chiefs know more about the fishery than the fishermen do.	-0.56	2.062
Only the Department of Fisheries should enforce fishing regulations	-0.67	3.034
Because we fish for the same fish we should work together with the Congolese	-0.72	1.682
Local traditional fishing regulations are better than those of the Department of fisheries.	-0.95	1.283
We cannot stop the Congolese from coming to fish here because we also like to go and fish in Congolese waters	-0.98	1.357
Economic problems compel fishermen to engage in active fishing such as kutumpula and manevule	-1.02	2.404
Educated people know much more about the fishery than the fishermen	-1.37	1.573

Table 9: Management Statements Ordered by Variance in Rankings		
Statement	Mean	Variance
Only the Department of Fisheries should enforce fishing regulations	-0.67	3.034
Kutumpula should not be allowed in any area of Mweru-Luapula.	0.28	2.587
Economic problems compel fishermen to engage in active fishing such as kutumpula and manevule	-1.02	2.404
Chiefs know more about the fishery than the fishermen do.	-0.56	2.062
Theft of nets leads to an increase in other fishing methods.	0.37	2.001
The fishing ban is the best way to ensure that we will have fish in the future	1.44	1.919
Chiefs and headmen should enforce fishing regulations	1	1.857
It is fishermen coming from other places who bring the destructive methods	0.74	1.719
Because we fish for the same fish we should work together with the Congolese	-0.72	1.682
Any Zambian should have the right to come and fish here	0.4	1.626
Educated people know much more about the fishery than the fishermen	-1.37	1.573
Fishermen know best which gears should be allowed and which ones banned.	0.84	1.568
We cannot stop the Congolese from coming to fish here because we also like to go and fish in Congolese waters	-0.98	1.357
Local traditional fishing regulations are better than those of the Department of fisheries	-0.95	1.283
The council gets a lot of levies but does not assist fishermen	0.4	1.245
Fishermen will accept other fishermen enforcing rules	0.81	1.155

Table 10: Nature Statements Ordered by Mean Ranking		
Statement	Mean	Variance
A destructive fishing method is one that catches small fish and even eggs.	1.97	1.499
The fishing ban protects the fish when they are carrying eggs.	1.32	2.328
When it rains a lot the fish go to breed in the weeds then we know that the following year the catches will be very good.	1.05	1.074
Fish are becoming fewer because fishermen are using more fishing nets.	0.85	2.131
Some fish will leave areas where the water is not clean.	0.73	1.128
When the vegetation stops the setting of nets this is not a problem because it helps the conservation of fish.	0.7	0.677
When there is little water only small fish are found because the big ones have run away to where there is a lot of water.	0.5	1.282
In the past there were areas where the fish could find refuge from fishermen, but now they have fewer places of refuge and this is why they are decreasing	0.49	1.835
In the 1980's there were red weeds which used to come and would be an indication of good catches. These weeds are now gone.	0.03	0.846
The fish ban has made little difference in the number of fish in the lake.	-0.6	1.477
The gomogomo increasing does not mean the other fish will go down.	-0.83	1.276
The gomogomo is increasing because when it came it found the tiger fish already gone.	-0.9	1.118
One reason for the decrease in fish is that people have started growing crops in places where fish used to settle during the wet season.	-0.95	2.562
Too little rain is not the reason fish are becoming fewer.	-1.23	1.153
The number of fishermen increasing has little to do with the fish becoming fewer.	-1.45	0.818
Destructive fishing methods are not an important cause of the decline in fish.	-1.65	1.464

Table 11: Nature Statements Ordered by Variance in Ranking		
Statement	Mean	Variance
One reason for the decrease in fish is that people have started growing crops in places where fish used to settle during the wet season.	-0.95	2.562
The fishing ban protects the fish when they are carrying eggs.	1.32	2.328
Fish are becoming fewer because fishermen are using more fishing nets.	0.85	2.131
In the past there were areas where the fish could find refuge from fishermen, but now they have fewer places of refuge and this is why they are decreasing	0.49	1.835
A destructive fishing method is one that catches small fish and even eggs.	1.97	1.499
The fish ban has made little difference in the number of fish in the lake.	-0.6	1.477
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When there is little water only small fish are found because the big ones have run away to where there is a lot of water.	0.5	1.282
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In the 1980's there were red weeds which used to come and would be an indication of good catches. These weeds are now gone.	0.03	0.846
The number of fishermen increasing has little to do with the fish becoming fewer.	-1.45	0.818
When the vegetation stops the setting of nets this is not a problem because it helps the conservation of fish.	0.7	0.677

6.3.2 Statements Showing Systematic Differences among Stakeholder Groups

It is also helpful to examine individual statements to get an idea where disagreement of specific statements is the clearest between stakeholder groups. Table 12 lists the statements where a stakeholder group differed from the other stakeholders with statistical significance of .05.

Table12: Statements Showing Systematic Differences among Stakeholders

	Active Gear	Traders	DoF	TA	River
Nature Statements N = 39					
When there is little water only small fish are found because the big ones have run away to where there is a lot of water.		+			
When it rains a lot the fish go to breed in the weeds then we know that the following year the catches will be very good	+				+
Some fish will leave areas where the water is not clean					+
One reason for the decrease in fish is that people have started growing crops in places where fish used to go during the wet season	-				-
Management Statements N = 42					
The council gets a lot of levies but does not assist fishermen					-
Fishermen will accept other fishermen enforcing rules					+
Any Zambian should have the right to come and fish here			-		
Theft of nets leads to an increase in other fishing methods					-
Kutumpula should not be allowed in any area of Mweru-Luapula	-	+			-
Economic problems compel fishermen to engage in active fishing such as kutumpula and manevule				-	
Chiefs know more about the fishery than the fishermen do				+	

Table indicates all differences statistically significant at .05.

7. Discussion

7.1 Evaluation of Hypotheses

A strong consensus on the basic natural processes in the Mweru-Luapula fisheries exists among the fishers. The degree to which this consensus translates into reliable observations, however, is variable. The average fisher gave the correct answer, as defined by the cultural consensus model, an average of 81% of the time (Table 2). So while we can say that fishers responses reflect their observations of nature, using EBK in the development of a knowledge base for management in Mweru-Luapula clearly requires corroboration. Individual fishers observations will be incorrect a fifth of the time. This percentage goes up when a fish uses more gear (Table 4), when a fisher uses trap gear, and most strongly where a fisher uses a kutumpula and drift net (Tables 2 and 5). This linkage between high EBK's and gears is linked to those fishers using more kinds of gear and to using gear which requires ongoing finer judgements and active engagement in fishing.

The structural hypotheses suggested by the literature on natural resource management in Africa (Section 2.2.) were confirmed in the discourse analysis. The roles of TAs, DoF and fishers in management is the most important of the three main dimensions of disagreement that emerged in the Q analysis (Figure 2). It is the main distinction between the first, second and fourth management factor. The role of the DoF is the subject of the single most disputed management statement (Table 9) and the idea that TAs know more about the fishery than fishers is the third most contested statement. The suggestion that TAs should enforce fishing regulations is in the top half of Table 9 and it is also has the second highest mean ranking (Table 8) indicating general agreement and strong feelings. A strong preference for DoF enforcement over TA enforcement, however, is definitive of MF2 (Figure 2).

The role of the TAs in Mweru-Luapula management has mixed implications. On the one hand the TAs have been heavily engaged in the co-management system from the beginning and the programme was structured around their jurisdictions, as discussed in Section 3. The Mweru-Luapula co-management system is still functioning several years after NGO support ended, in contrast with a similar system in the nearby Bangweulu system which became moribund very soon after NGO support was withdrawn. The Bangweulu co-management system intentionally avoided engaging the TAs because, according to an NGO representative we interviewed before they withdrew, they wished to avoid the problems with unaccountable leadership mentioned above in Section 2.2. Given that the TAs are very active in Mweru-Luapula management, that these activities are cited by fishers part of what makes the co-management system legitimate, and the high mean (Table 8) and intermediate variance (Table 9) of the most directly related statement about the TA's role, we must conclude that TA participation is an important factor maintaining the co-management system.

The importance of anti-TA feeling in MF2 (Figure 2), however, indicates that this role is heavily contested. This anti-TA feeling is certainly playing some role in the formation of the Task Force in one of the lake districts. The not yet published results from the KNOWFISH project's formal household survey indicate that the most important component of the TA system in maintaining the co-management system is the support of the local headmen, rather than the support of the chiefs. However the headmen, of course, are part of the same system and answer to the chiefs.

The fact that attitudes towards outsiders is the third main dimension found in the discourse analysis (Figure 2) supports the other structural hypothesis about the importance of attitudes towards outside fishers. Though clearly statements related to outsiders are not as controversial (Table 9) nor as strongly felt (Table 8) as are disagreements about gears and the appropriate roles of various groups in fisheries management. It is interesting that the only group with a distinct attitude toward the statement that "any Zambian should have the right to come and fish here" is DoF personnel who show significantly less support for this than other stakeholders. This suggests that their training may reinforce the assumption that open access always has negative implications for fisheries conservation.

Perhaps the newest and most interesting thing to emerge from the discourse analysis is the second opposition cluster around NF3, MF4 and MF8 (Figure 2). This cluster is the most open to working with the Congo and does not blame outsiders for destructive gear. It is also strongly supportive of fisher-based management believing that fishers will accept other fishers enforcing rules and that fishers know best about what gears should be allowed. It is supportive of the closed season but also would allow the use of active gears. The cluster centres on NF3, which emphasizes water level while considering littoral changes and the snakehead introduction to be unimportant. The cluster draws its main support from the active and trap fishers who have the highest levels of EBK. The emphasis on water level, willingness to work with outsiders and openness toward active gears suggests that this group could be quite supportive of a co-management effort that emphasized the approaches to management suggested by Jul-Larsen et al. (2004). They are, however, opposed to open-access, even for Zambians. Even this, however, may be indicative of a more reflective approach to management.

7.2 The Indicators and the Discourse Analysis

It was clear even from the qualitative interviews that the idea of a simple indicator of ecosystem health was not a very good fit with the way that Zambian fishers view the resource or think about their EBK. Almost all discussions of things that could be seen now that had implications for future fish yields were one sided. The temporal focus of the fishers EBK is on a smaller scale. The only major exception to this was the idea that higher rainfall and water level during the rainy season meant that catches were going to be good. The statement "When it rains a lot the fish go to breed in the weeds then we know that the following year the catches will be very good." received high (Table 10) and non-controversial (Table 11) agreement. Active gear fishers and respondents in the river areas were more supportive of this statement that others were (Table 12). The statement "too little rain is not the reason fish are becoming fewer" also received high (dis)agreement and was just slightly more controversial. The other types of indicators we examined were not so easily directly seen by fishers as tools for evaluating future yields. This does not mean they were not seen as important. Again this is a further indication of possible receptivity among the Mweru-Luapula fishers to a management approach as envisioned by Jul-Larsen et al. (2004).

There is certainly a consensus that here has been a long term decrease in overall yields. This observation is often related to both environmental and fisheries changes but is not in itself seen as a predictor of future yields.

Changes in species composition were not seen as indicative of future changes. The idea that the introduction of the snakehead, an active predator, would have an impact on other fish was agreed to but not strongly (Table 10), and the only place where this statement had any influence on a factor was NF3, where it was seen as unimportant.

Changes in size structure, when this is interpreted as a need to protect spawning and juvenile fish, is seen as very important by the fishers. It is central to the dominant nature discourse (Table 6). It is cited as the main justification for the closed season and impacts on small fish is what makes destructive gears destructive. Even active gears, which do not have exceptionally small mesh sizes, are objected to on the questionable basis that slamming the water or otherwise chasing fish disrupts spawning (Kolding et al. (2003) in a review, found no biological justification for the banning of the kutumpula.) One of the discussions we had in the interviews during the last visit was about the possible benefits of an educational campaign to try to convince people buying fish to refuse to purchase juvenile fish. More than half the people we interviewed were supportive of the idea, and when questions were raised they were about the feasibility of implementing such a programme when the customers are poor and the smaller fish are also the cheaper fish. No one questioned the biological rationale for such a programme.

Finally, there is no consensus on the impacts of changes in habitat and land use. Some fishers were concerned that the fish had no refuge areas. This statement was somewhat controversial (Table 11) but not considered particularly important (Table 10), although it does appear as definitive in the two smallest nature factors. Other related statements received even less emphasis. Two statements about vegetation, one about setting nets and the other about a weed that was supposedly related to catches were considered unimportant (Table 10) by almost everyone (Table 11). The only exception to this was controversy over the growing of crops in littoral areas where fish were breeding. This was the most controversial nature statement (Table 11). Both active fishers and respondents from the river area, where the activities took place, ranked the statement significantly lower than other respondents did. This seems to be a belief held and reproduced by lake fishers about something going on upstream. The river fishers are either cultivating the same kind of land themselves, or their neighbours are doing it.

8. Conclusion

The DoF and other stakeholders in fisheries management in Mweru-Luapula system face a situation of considerable flux in deciding where to go with their co-management program. This flux, however, is not reflected in strong disagreements about the natural system and the way it works. There is a clear consensus on the basics: “destructive” methods are the main problem and what makes a gear destructive is having too much impact on juvenile fish and on spawning; water level is critical; and so is fishing pressure.

While the idea of an indicator is not an immediate fit with the fishers’ view of the resource, it is clearly possible that indicators can be created that will be well understood by fishers. Indicators are something that has to be created in particular management contexts do enable particular management tasks. Hence, they cannot be extracted from the overall discussion and meaningfully evaluated as abstract concepts. How well an indicator fits EBK will be directly related to what

actions the indicator is supposed to be linked to, it is this link that must be a 'fit', not the indicator as such.

Fisheries management in Mweru-Luapula is part of a general social context in Zambia in which unclarity about the appropriate role of the Zambian Government on the one hand and Traditional Authorities on the other characterises many aspects of governance well beyond fisheries and natural resources. The respective roles of DoF, the TAs and the fishers in management is the central ongoing debate in fisheries. The central question remains the downward accountability of the TAs. One key may be the finding that it is really the village headmen, and not the chiefs as such, that are the key to the TAs giving legitimacy to co-management.

Once the co-management law passes it may no longer be necessary to involved Chiefs in day-to-day enforcement and there may be more opportunity for empowerment at the local level. This analysis found a group of fishers who are committed to fisher-based management and who share many attitudes that are congruent the latest biological information on the management of the Mweru-Luapula as represented by Jul-Larsen et al. (2004). They are the group with the highest EBK and who would be a valuable resource for the sort of ecosystem-based monitoring that these authors are promoting. One critical need is to either establish in a convincing way that kutumpulas are actually a problem or to remove the ban. This would make it much easier for these fishers to become active in co-management. Arguably, it was by looking beyond the usual management debates, in which this group would have simply been cast as 'destructive gear users', and focusing on the question of the knowledge base that allowed this possibility to be uncovered.

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10. Appendices

10.1 Appendix One: The Consensus Analysis Statements

Abundance

River

1. Gomo gomo first appeared in the catches in 1998

2. Now we see fewer older fish compared to younger fish than we used to.

3. Gomogomo are increasing in size.

4. The mpumbu have almost disappeared so that we can no longer fish for them.

5. The amabanga have almost disappeared so that we can no longer fish for them.

6. The impata have declined in abundance.

7. The tucenje have increased in abundance.

Lake

1. The catches were particularly low in the 1990's except for 1998 when catches were good.

2. The catches have been getting lower and lower

3. When the gomo gomo first appeared the catches were even higher than they are now.

4. The imikakabala have declined in abundance.

5. Manda is now difficult to catch.

6. The imanda has almost disappeared so that we can no longer fish for them.

7. The makobo have increased in abundance.

Fisher Behavior

8. We don't stop fishing during the ban but we just reduce the number of days instead of fishing daily.

9. The ban on kutumpula is obeyed when the chiefs enforce it.

10.

11.

12.We not go to other areas because there are also fishermen there.

8. When the fishery is closed we mostly catch fish just along the shore of the lake.

9. We do not fish between December and March because it is the closed season.

10.

11.

12. We don't prevent other fishers from fishing here.

13.The type of nets one has also determines the areas in which you are going to fish

14. We catch imbubu between May and September

13. People change the gear they use in accordance with the seasons.

14. We catch gomogomo soon after the closure in May

Habitat

15. Amaba grass became extinct when they were submerged in water but lately they have reemerged.

16. There used to be more areas in the marshes where the fish could hide.

17. The temperature of the water goes up and down but it has not become warmer or cooler over the years.

18. There were poor rains from 1993 up to 1997

19. Fish do not favor dirty water.

20. We are all fishing on the same fish in all parts of the river.

21. In the 1980's there were red weeds which used to come but there are no red weeds these days.

15. The vegetation is becoming more and more grass.

16. When it rains the water spreads around and creates favourable breeding grounds for fish in the grass.

17. The temperature of the water goes up and down but it has not become warmer or cooler over the years.

18. The water reached its lowest level in 1997

19. Fish do not favor dirty water.

20. We are all fishing on the same fish in all parts of the lake.

21. In the 80's we used to have green algae but what is seen now is reddish.

Fish Behavior

River

22. The tucenje breeds in holes in the mud.

23. The red-breasted bream starts to breed at 3 or 4 months old.

24. Monde eats insects, snails and other fish.

25. Ntembwa breeds in shallow water.

26. When there is a flood of water over the grass you never see ifinkanda.

27. Mbubu breed in matafu and also in the marshes.

28. The tucenje wil not deposit eggs in cold water.

Lake

22. The pale breed in the mud or mud with a little sand mixed in.

23. Pale start to lay eggs when they are five to six months old.

24. Ntembwa feed on insects and vegetation.

25. The tucenje breeds in shallow water.

26. Gomogomo are found in the grass and not in the open water.

27. The monde's breeding is done in the depths of the water.

28. When the tucenje spawns it stays and moves with the young ones.

10.2 Appendix Two: The Q-Sort Statements

Nature Statements
Breeding and Technical Measures

1. A destructive fishing method is one that catches small fish and even eggs.

2. Destructive fishing methods are not an important cause of the decline in fish.

3. The fish ban has made little difference in the number of fish in the lake.

4. The fishing ban protects the fish when they are carrying eggs.

Fishing Pressure

5. When the vegetation stops the setting of nets this is not a problem because it helps the conservation of fish.

6. In the past there were areas where the fish could find refuge from fishermen, but now they have fewer places of refuge and this is why they are decreasing

7. The number of fishermen increasing has little to do with the fish becoming fewer.

8. Fish are becoming fewer because fishermen are using more fishing nets.

Fish and Water

9. Too little rain is not the reason fish are becoming fewer.

10. When there is little water only small fish are found because the big ones have run away to where there is a lot of water.

11. When it rains a lot the fish go to breed in the weeds then we know that the following year the catches will be very good.

12. Some fish will leave areas where the water is not clean.

Environmental Interactions

13. The gomogomo increasing does not mean the other fish will go down.

14. The gomogomo is increasing because when it came it found the tiger fish already gone.

15. One reason for the decrease in fish is that people have started growing crops in places where fish used to settle during the wet season.

16. In the 1980's there were red weeds which used to come and would be an indication of good catches. These weeds are now gone.

Management Statements

Authority

1. The council gets a lot of levies but does not assist fishermen.

2. Fishermen will accept other fishermen enforcing rules.

3.Chiefs and headmen should enforce fishing regulations

4. Only the Department of Fisheries should enforce fishing regulations

Migration

5. Any Zambian should have the right to come and fish here

6. It is fishermen coming from other places who bring the destructive me thods.

7. Because we fish for the same fish we should work together with the Congolese

8. We cannot stop the Congolese from coming to fish here because we also like to go and fish in Congolese waters

Measures

9. Theft of nets leads to an increase in other fishing methods.

10. The fishing ban is the best way to ensure that we will have fish in the future.

11. Kutumpula should not be allowed in any area of Mweru-Luapula.

12. Economic problems compel fishermen to engage in active fishing such as kutumpula and manevule

Decision making and Knowledge

13. Local traditional fishing regulations are better than those of the Department of fisheries.

14. Educated people know much more about the fishery than the fishermen

15. Chiefs know more about the fishery than the fishermen do.

16. Fishermen know best which gears should be allowed and which ones banned.

10.3. Appendix Three: Statement Scoring More than |1.0| on Factors

10.3.1 The Five Nature Factors

Nature Factor One

1.72609 1. A destructive fishing method is one that catches small fish and even eggs.
1.44742 15. One reason for the decrease in fish is that people have started growing crops in places where fish used to settle during the wet season.
1.28949 8. Fish are becoming fewer because fishermen are using more fishing nets.
1.12245 4. The fishing ban protects the fish when they are carrying eggs.

-1.11907 3. The fish ban has made little difference in the number of fish in the lake.
-1.27893 9. Too little rain is not the reason fish are becoming fewer.
-1.60894 2. Destructive fishing methods are not an important cause of the decline in fish.

Nature Factor Two

1.63879 1. A destructive fishing method is one that catches small fish and even eggs.
1.35434 3. The fish ban has made little difference in the number of fish in the lake.
1.21816 11. When it rains a lot the fish go to breed in the weeds then we know that the following year the catches will be very good.
1.08277 12. Some fish will leave areas where the water is not clean.

-1.12730 10. When there is little water only small fish are found because the big ones have run away to where there is a lot of water.
-1.84424 15. One reason for the decrease in fish is that people have started growing crops in places where fish used to settle during the wet season.

Nature Factor Three

1.86493 10. When there is little water only small fish are found because the big ones have run away to where there is a lot of water.
1.37559 8. Fish are becoming fewer because fishermen are using more fishing nets.

-1.84360 15. One reason for the decrease in fish is that people have started growing crops in places where fish used to settle during the wet season.
-1.91339 13. The gomogomo increasing does not mean the other fish will go down.

Nature Factor Four

1.52255 6. In the past there were areas where the fish could find refuge from fishermen, but now they have fewer places of refuge and this is why they are decreasing
1.35768 4. The fishing ban protects the fish when they are carrying eggs.

-1.13290 The gomogomo is increasing because when it came it found the tiger fish already gone.
-2.40558 Fish are becoming fewer because fishermen are using more fishing nets.

Nature Factor Five

2.35795 4. The fishing ban protects the fish when they are carrying eggs.
1.02393 16. In the 1980's there were red weeds which used to come and would be an indication of good catches. These weeds are now gone.
1.00403 2. Destructive fishing methods are not an important cause of the decline in fish.

-1.85604 6. In the past there were areas where the fish could find refuge from fishermen, but now they have fewer places of refuge and this is why they are decreasing

10.3.2 The Eight Management Factors

Factor One

1.85872 10. The fishing ban is the best way to ensure that we will have fish in the future.

-1.71856 12. Economic problems compel fishermen to engage in active fishing such as kutumpula and manevule

-2.25404 4. Only the Department of Fisheries should enforce fishing regulations

Factor Two

2.47466 4. Only the Department of Fisheries should enforce fishing regulations

1.12887 10. The fishing ban is the best way to ensure that we will have fish in the future.

-1.49229 13. Local traditional fishing regulations are better than those of the Department of fisheries.

-1.55358 8. We cannot stop the Congolese from coming to fish here because we also like to go and fish in Congolese waters

Factor Three

1.67520 6. It is fishermen coming from other places who bring the destructive methods.

1.26793 12. Economic problems compel fishermen to engage in active fishing such as kutumpula and manevule

1.22004 5. Any Zambian should have the right to come and fish here

-1.53163 7. Because we fish for the same fish we should work together with the Congolese

-1.92938 11. Kutumpula should not be allowed in any area of Mweru-Luapula.

Factor Four

2.10470 16. Fishermen know best which gears should be allowed and which ones banned.

1.30758 12. Economic problems compel fishermen to engage in active fishing such as kutumpula and manevule

1.18183 2. Fishermen will accept other fishermen enforcing rules.

-1.45722 6. It is fishermen coming from other places who bring the destructive methods.

Factor Five

2.57156 9. Theft of nets leads to an increase in other fishing methods.
1.27559 6. It is fishermen coming from other places who bring the destructive methods.
1.01531 11. Kutumpula should not be allowed in any area of Mweru-Luapula.

-1.90989 14. Educated people know much more about the fishery than the fishermen

Factor Six

2.40252 15. Chiefs know more about the fishery than the fishermen do.
2.00604 3.Chiefs and headmen should enforce fishing regulations

-1.19750 14. Educated people know much more about the fishery than the fishermen

Factor Seven

1.64996 6. It is fishermen coming from other places who bring the destructive methods.
1.49527 7. Because we fish for the same fish we should work together with the Congolese
1.24630 8. We cannot stop the Congolese from coming to fish here because we also like to go and fish in Congolese waters

-1.10561 14. Educated people know much more about the fishery than the fishermen
-1.39359 5. Any Zambian should have the right to come and fish here
-1.40428 9. Theft of nets leads to an increase in other fishing methods.

Factor Eight

1.83946 10. The fishing ban is the best way to ensure that we will have fish in the future
1.08276 8. We cannot stop the Congolese from coming to fish here because we also like to go and fish in Congolese waters

-1.03027 5. Any Zambian should have the right to come and fish here
-1.28539 12. Economic problems compel fishermen to engage in active fishing such as kutumpula and manevule
-2.06965 11. Kutumpula should not be allowed in any area of Mweru-Luapula