

17 CO-MANAGEMENT: NAMIBIA'S EXPERIENCE WITH TWO LARGE-SCALE INDUSTRIAL FISHERIES – SARDINE AND ORANGE ROUGHY

*David Boyer and Burger Oelofsen**

Abstract

Namibia has implemented a style of fisheries management that in recent years has often been recommended for large-scale industrial fish stocks. Some sectors of the fishing industry, through representative groups, participate in research, assessment and the management of their fish stocks. The mechanisms that have affected such participation are described for two fisheries: sardine and orange roughy. The biomass of both these stocks have declined to low levels in recent years, which has required some difficult decisions to be made. The role of co-management in the fisheries research and management process and in reducing conflicts is examined. It is concluded that incorporating co-management into the management process can be advantageous, but such a development needs to be implemented with caution.

INTRODUCTION

Co-management

Co-management encompasses various arrangements that formally recognise

* Our colleagues within the Ministry (both in research and management) and the stakeholders of the sardine and orange roughy industries are thanked for often unwittingly providing many of the ideas presented here. Jean-Dominique le Garrec, a company manager from the Namibian orange roughy fishery and member of the Deep Water Fishery Working Group, and Hugo Viljoen, a company manager in the sardine industry and Chairman of the Walvis Bay Fishing Companies, were asked to review and make comment on an earlier version of the manuscript in an attempt to ensure that a balanced account of the developments in co-management in these two fisheries is recorded here. Their comments were extremely useful and they are wholeheartedly thanked. Two anonymous reviewers also provided many useful suggestions and are likewise thanked.

the sharing of fisheries management responsibility and accountability (Jentoft, 1989). It implies that interested parties (usually users) are brought into the management process (including the scientific assessment of the stocks) in some formal way, such that their knowledge and experience can be incorporated into the decision-making process and so that they gain some ownership in the process and hence are more likely to abide by the outcome. However, ultimate responsibility for decision-making regarding rules and management measures often remains with the management authority, especially when dealing with large-scale industrial fisheries. By definition, co-management implies a degree of decentralisation.

Co-management covers a wide range of institutional arrangements used in fisheries management (Figure 1). It is not a management system in itself, but rather establishes an institutional framework in which management can occur (Cunningham and Maguire, 2002). The FAO Technical Guidelines for Responsible Fisheries (Anon, 1997) terms this “*management in partnership*” and states that “*Determining and implementing the actions necessary to enable the management authorities, the fishers and other interested groups, to work towards the identified objectives ...should be done in consultation with all interest groups*”. Indeed a recurring theme throughout this seminal document is that

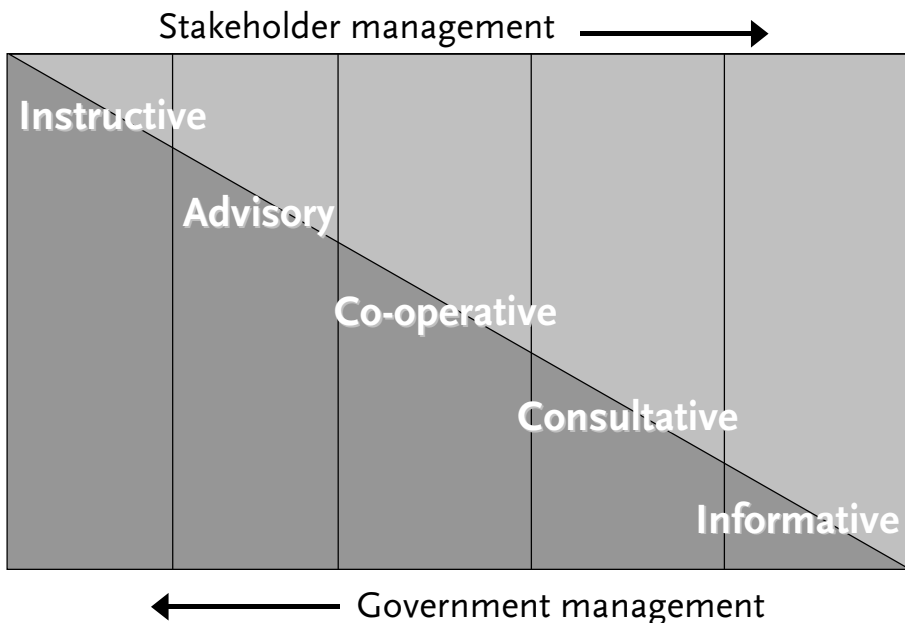


Figure 1. An illustration of the range of institutional arrangements of co-management; from “instructive” whereby government decides on all aspects of management and merely instructs stakeholders, through to “informative” where stakeholders take the decisions and inform government (adapted from Sen and Raakjaer Nielsen, 1996).

the efficient implementation of management measures is often highly dependent on the support gained from the interested parties. The United Nations Convention on the Law of the Sea provides the framework for co-management (Anon, 1983) while the FAO Code of Conduct for Responsible Fisheries (Anon, 1995; 1997) provides the moral obligation to implement such a process. It notes that management authorities should facilitate effective consultative and decision-making processes that enable all legitimate stakeholders to participate in setting objectives, management measures and all other matters that may affect the stakeholder (Articles 6.13, 6.16, 10.1.2, 11.3, 22.3.2).

Co-management has been proposed as one of the key tools for reversing the unsustainable practices that have dominated the world's fisheries during the past decades (FAO, 2002). One of the factors of unsustainability in fisheries is low participation by stakeholders in the management process (Garcia and Staples, 2000), while a recommendation of a recent FAO workshop on *Factors of Unsustainability and Overexploitation in Fisheries* for the reduction of over-fishing practices was to "ensure participation of interested parties at all stages of the management process" (FAO, 2002). A report to US Congress (Anon, 1999) states "ecosystem approaches to management rely on the participation, understanding and support of multiple constituencies. Policies that are developed and implemented with the full participation of all stakeholders, including the interests of future generations, are more likely to be fair and equitable, and to be perceived as such". Wilson *et al.* (1994) believe that the well-documented demise of the Canadian east coast groundfish may have been prevented if the fisheries management system had been based on community government, while Stephenson (1997) argues that timeous management through dialogue with all vested interests would improve the management of the Atlantic herring stocks.

Involving stakeholders in the assessment and management process has been proposed for a wide range of countries and fisheries, e.g. Galicia, Spain (Freire and García-Allut, 2000); Mauritius (Hollup, 2000) and South Africa (Harris *et al.*, 2002). Indeed, some major fishing nations have now incorporated co-management into the management process, e.g. USA, Canada, Norway and Japan (Pomeroy and Berkes, 1998), while others have not so far (Mikalsen and Jentoft, 2001). Namibia's neighbours, South Africa, have recently embraced co-management as part of their new fisheries management policy (Hauck and Sowman, 2001). However this is more to ensure equitable distribution of South Africa's marine resources, than an attempt to improve the sustainability of the resources. In fact, it must be noted that many of the proposed and existing examples of co-management are primarily for small-scale fisheries and not large-scale industrial fisheries as in Namibia's case (Pomeroy and Berkes, 1998; also e.g. Hauck and Sowman, 2001; Pomeroy *et*

al., 2001). Such forms of co-management are often termed “community-based management”.

The few published accounts of co-management available support the contention that bringing stakeholders into the management process yields substantial benefits. Yet reservations are frequently expressed (see Jentoft *et al.*, 1998) as some attempts at co-management have failed (Hanna, 1996), while others note that co-management only works if legal and institutional instruments are implemented to facilitate such an arrangement (OECD, 1997; Pomeroy and Berkes, 1998). However, these case studies are rarely documented, creating a biased record of the success of co-management (pers. comm., J. Rice, Science Advisory Secretariat, DFO, Ottawa, Canada).

This chapter briefly documents the management systems of the orange roughy *Hoplostethus atlanticus* and sardine *Sardinops sagax* fisheries in Namibia, the former having implemented a form of co-management and the latter to a large degree not. We examine why these different approaches have developed and demonstrate that while co-management certainly has a place in large-scale industrial fisheries, it needs to be implemented with caution. In particular we examine the role of co-management in conflict situations (especially during periods of declining catches) and discuss whether co-management is the panacea it is often proclaimed to be or if it is simply another useful management tool.

Namibian fisheries - background

Namibia has a large fishing industry that makes an important contribution to the national economy, both in terms of income and employment. Fishing is the third-largest sector of the Namibian economy, behind agriculture and mining, and the second-fastest-growing industry in the Namibian economy (behind tourism), a growth achieved mainly through product value enhancement. The sector generates more than 10% of GDP, and had an export value of N\$2 900 million for 2000 (N\$1 ≈ US\$10.00 in mid 2002), which makes the fishing sector the second-largest export earner behind mining. Employment in the sector was estimated at about 15 000 persons in 2000, with almost half working at sea.

The Namibian fisheries policy is to utilise the living marine resources on a sustainable basis for the benefit of the nation, and to manage these fisheries based on scientific information and principles. Ultimate responsibility for control measures rests with the state. All activities of the major fisheries are catch controlled, by total allowable catches (TACs) issued as individual non-transferable quotas, in conjunction with effort controls, primarily through limited vessel rights. These rights are issued for seven, ten, fourteen or twenty years dependent on a number of criteria. The longer rights are issued to companies who, *inter alia*, are majority owned by Namibians, employ Na-

mibians, have a proven track record in the industry and have demonstrated a long-term commitment by investing in the fishing sector. See Oelofsen (1999) and Boyer and Hampton (2001) for more details.

Most of the primary research on fisheries resources is conducted by state-run research institutes, primarily the National Marine Information and Research Centre (NatMIRC) within the Directorate of Resource Management of the Ministry of Fisheries and Marine Resources. This research is largely funded by levies on commercial catches and recently has been supported by the use of commercial vessels to assist with resource surveys on hake, horse mackerel, orange roughy and sardine.

Scientific recommendations for the harvesting of all major resources are presented to the Namibian Marine Resources Advisory Council (MRAC) (Figure 2), which makes recommendations to the Minister of Fisheries and Marine Resources after considering socio-economic factors and the industry's perception of the state of the resource. MRAC is a broad-sectored group mandated to provide advice to the Minister on fisheries and fisheries-related matters. This Council consists of representatives of the major fishing industries (although they are appointed for their expertise and experience in the industry and not to represent their own interests), unions, the state conservation Ministry, financial institutions and the local university. The Minister,

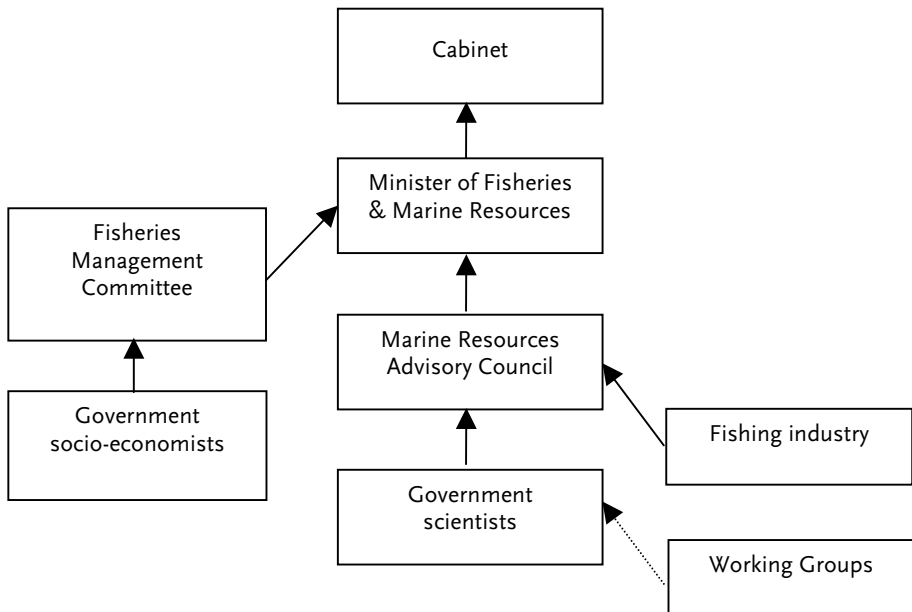


Figure 2. Diagram showing the flow of advice from research to decision-makers. Note that Working Groups do not exist for all fisheries (see text).

after consultation with the Ministerial Fisheries Management Committee and other senior managers within the Ministry (and often the scientists responsible for making recommendations), submits management recommendations to Cabinet for final endorsement.

Prior to Namibian independence in 1990, stakeholders were rarely involved in the management process and to a large extent this continued in the early 1990s. In a number of fisheries the industry was consulted informally, both in setting management objectives and for resource assessments, but this tended to be on an *ad hoc* basis. However, in the middle of the decade, declining abundance indices resulted in reduced TACs in a number of fisheries (Boyer and Hampton, 2001) and brought the state and various sectors of the industry into conflict. The major bone of contention was over the scientific recommendations that tended towards caution, while the industry claimed that the stocks were still healthy and that the scientists were being over-pessimistic. In 1998 the then Minister of Fisheries and Marine Resources, Hifikepunye Pohamba, requested that, where possible, the divergent views of the scientists and industry should be reconciled, such that the decision-makers were presented with an agreed view on the state of each stock. This led to the formal approval for the establishment of working groups for each fishery, in which scientists and industry were represented to jointly conduct research and deliberate on the state and productivity of their respective stocks. To date, working groups have been established for the orange roughy, hake, monk, horse mackerel and rock lobster fisheries, while the other major fisheries (sardine, tuna, crab, recreational and subsistence fisheries) are involved in the management process in less formal ways. The working group for orange roughy was the first such forum established in Namibia and has therefore acted as the testing ground for this process, and subsequently as the model which other working groups have copied.

The two fisheries examined in this chapter, orange roughy and sardine, have both been subject to widely fluctuating catch levels during the past decade (Table 1) and the productivity of both stocks is currently considerably below their long-term potential. Hence the potential for conflict has been ripe. Various papers have investigated the biological and ecological characteristics of these resources in Namibia, and how fishing activities may have impacted on productivity (e.g. Boyer *et al.*, 2001a; Boyer *et al.*, 2001b; Fossen *et al.*, 2001; McAllister and Kirchner, 2001) and this is not dealt with here. The level of co-management that has been introduced into the management of the two species has been rather different. Orange roughy falls between "co-operative" and "consultative" (see Figure 1), with considerable co-operation through a formal working group (Deep Water Fisheries Working Group) established between the Ministry and the industry. In contrast, there is no formal arrangement for the sardine fishing industry to be included in

the research or management process, and it is therefore more a form of “instructive co-management” *sensu* Sen and Raakjaer Nielsen (1996).

Table 1. Catch and TAC levels for the Namibian orange roughy and sardine fisheries since Independence.

Year	Orange roughy		Sardine	
	TAC*	Catch*	TAC	Catch
1990			63 000	89 000
1991			60 000	68 000
1992			80 000	82 000
1993			115 000	115 734
1994		3 315	125 000	116 483
1995		7 284	45 000	** 92 473
1996		13 136	20 000	2 372
1997	12 000	16 675	35 000	32 011
1998	12 000	6 845	65 000	64 000
1999	9 000	2 076	45 000	42 829
2000	1 875	1 209	25 000	26 496
2001	1 875	955	10 000	10 711
2002	2 400	603	0	2 614
2003	2 600		20 000	

* After 1996 the orange roughy fishing year extends from May to April, hence for example 2000 = May 2000 to April 2001. Also note that the TACs were for the quota management areas (QMAs), while the catches include fish taken outside of these areas. The amount caught outside of the QMAs is relatively small in relation to the total catch.

** Note that more than half of the sardine catch in 1995 was taken by Namibian vessels operating in Angolan waters and was therefore outside of the control of the Namibian authorities (see Boyer *et al.*, 2001a).

The following section describes and compares the development of these two different management systems and the Discussion then examines whether co-management has reduced, or helped to alleviate, the conflict situations that have arisen during the past decade.

CO-MANAGEMENT IN THE ORANGE ROUGHY AND SARDINE FISHERIES

The nature of the fisheries

The sardine fishery of Namibia developed into a large-scale industrial fishery more than 50 years ago. Indeed the northern Benguela stock of sardine was

historically one of the major clupeoid stocks of the world, supporting an average annual catch of over 700 000 tonnes throughout the 1960s (Boyer and Hampton, 2001). Since then the stock has declined, and annual catches decreased to around 50 000 tonnes between 1978 and 1989 and were only slightly more in the 1990s. In contrast, the orange roughy fishery developed relatively recently. An experimental licence was granted in 1993 for the exploration of the Namibian shelf-break region for unexploited deepwater resources. Exploration for orange roughy started in 1994 and it was only in late 1995 that several aggregations were discovered, and a viable fishery developed. The orange roughy fishery is a single species fishery operated by three companies with usually three medium-sized stern trawlers. One small processing factory was opened, but due to the low volume (but high product value) of orange roughy, this industry employs considerably fewer people than the other major fisheries sectors.

In comparison, the sardine fishery is considerably more complex. Firstly it is a multi-fishery fleet that in addition to sardine also harvests juvenile horse mackerel *Trachurus capensis*, anchovy *Engraulis capensis* and round herring *Etrumeus whiteheadi*. The fleet is currently reduced to about 12 purse seiners, which are unable to supply sufficient fish for three labour-intensive canneries, as well as for fish reduction plants. Hence, in recent years factory managers have pooled their resources and only one cannery plant has opened each year. Prior to 1996, however, more than 40 purse seiners were operating from five factories employing several thousand people. Thus in comparison with the orange roughy fishery the purse seiner fleet supports numerous jobs for land-based factory workers.

Management strategies

Another difference between the orange roughy and sardine fisheries is that the objectives of the orange roughy fishery have been fairly clear and well understood by all stakeholders, while those of the sardine fishery during the past decade have been somewhat contradictory. While a recovery of the sardine stock is obviously of importance, there have been conflicting aims towards rebuilding the stock. Such a rebuilding strategy implies reducing catches, or even implementing a moratorium, but at the same time the continued operation of the sardine fishery, even at very low levels, is seen as critical to safeguard employment and the prosperity of the harbour town, Walvis Bay. Scientists have recommended a spawner biomass limit reference point of 500 000 tonnes (and a target reference point of 1 000 000 tonnes), but this level is based on a rather poorly defined spawner-stock biomass - recruitment relationship and hence while the concept of such a reference point has been accepted in principle, it has not been applied in practice.

The aim of the orange roughy fishery has been simply to develop a profitable industry based on harvesting at a sustainable level. A management strategy was implemented whereby a 14-year fishing-down phase was to be followed by sustainable fishing once the stock approached the maximum sustainable yield biomass. As is evident from the catches, this strategy was not successful as the abundance of orange roughy on the fishing grounds declined considerably more rapidly than intended (see Boyer *et al.*, 2001b for a discussion of the reasons).

The Deep Water Fisheries Working Group

An unofficial "orange roughy" working group consisting primarily of researchers and senior industry representatives was established in 1995. This forum was established early in the development of the fishery as it was realized that the capacity to sample, monitor and assess the resource was not available within the Directorate of Resource Management.

The primary task of this working group was initially to support and assist the Ministry's researchers in gathering detailed catch data, including length-frequency data, and to provide the means to bring in stock assessment advice, through consultants. Through the working group, government-employed fisheries observers were placed on all orange roughy boats to monitor catches, while annual biomass surveys were conducted from 1997 onwards. The working group also brought in fisheries scientists from other parts of the world (primarily those with expertise in orange roughy fisheries from New Zealand and Australia, but also from South Africa) to provide advice on management and assessment.

The working group functioned informally until late 1997. Until then, only a single company had a licence for orange roughy fishing, but in 1997 four additional licences were issued, although two of the new licensees were only given permission to conduct exploratory fishing (an option which to this day they have still not exercised). The other three were allocated shares in the TAC, although unequal, on the already established fishing grounds, and were given incentives to conduct further exploratory work. This effectively changed the orange roughy fishery from an experimental fishery to a fully commercialised fishery, while still maintaining a strong emphasis on exploration.

With the newly expanded participation in the fishery it was realised that an informal arrangement governing the cooperation between the Ministry and the industry could lead to unnecessary complications and misunderstandings, and therefore the working group was requested to formalise its role in the management process. The working group set itself the role of becoming "*a formal forum for providing guidance and advice on the efficient management of the deep water fisheries of Namibia to the appropriate manage-*

ment authorities". Furthermore the Deep Water Fisheries Working Group (as it was now called) aimed "to ensure the long-term sustainable utilisation of the stocks exploited through proactive research and co-management strategies" and "to promote the rational development of the Namibian deep water fisheries, thereby ensuring that economic and social benefits of the fisheries are optimal and accrue to Namibia". This greatly expanded the role of the working group, which had previously been primarily concerned with research, and it was not until early 2000 that the management authorities finally recognised the Deep Water Fisheries Working Group (DWFVG) in its formal role.

Regardless of this, the Working Group functioned as if it were formally recognised during the intervening period. From its early days in 1995 until present (2003), the Working Group has consisted of senior managers of the various fishing companies involved in the deepwater fishery, senior researchers from the Ministry, plus those researchers directly involved in deepwater research (Figure 3). While nominally part of the group, members of the Ministry's monitoring, control and surveillance Directorate and the Policy, Planning and Economics Directorate rarely participated in meetings, mainly because their role was not clearly defined and most of the deliberations were concerned with stock assessment and related matters.

The Working Group was funded by a jointly managed research fund whereby all concessionaires contributed in proportion to their quota. Major research costs, such as assessment surveys, were shared between industry and the state with both parties contributing vessels. Importantly, consultants were generally co-funded on an equal basis by the industry and the Ministry to promote impartiality.

This form of working group has since been implemented in a number of fisheries in Namibia, but to date not in the sardine fishery.

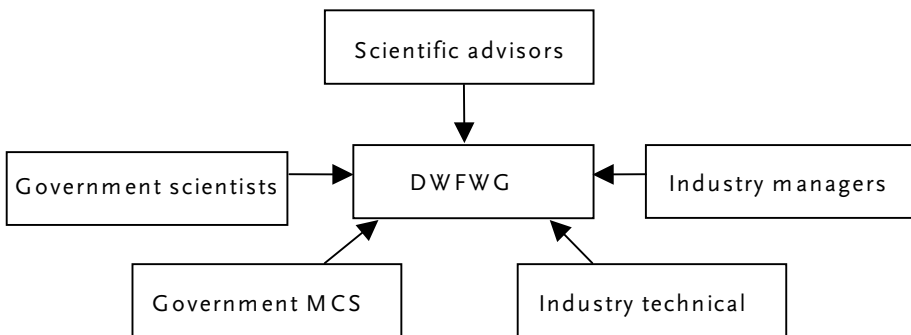


Figure 3. Diagram showing the flow of information within the Deep Water Fisheries Working Group.

Involvement of the industry in research

Both industries have over the past decade or so been involved to some extent in the research conducted on their species. The major difference has been that the research conducted on the sardine stock has been designed and conducted by the government researchers, although often with logistical support from the industry. In contrast, DFWWG guided the setting of priorities for the orange roughy research. This was largely through consultants appointed by the Working Group, and frequently much of the research was conducted by these same consultants.

Throughout the 1990s the sardine scientists made use of fishing vessels to scout for schools of fish during acoustic biomass surveys. In 1997, in an effort to standardise the survey design, this role was formalised whereby between two and four vessels accompanied the research vessel on each survey to find school groups and confirm that fish had not been missed close inshore or outside the area surveyed (Boyer *et al.*, 2001a). In addition, experienced commercial skippers accompanied the research vessel to observe and critique the work of the scientists, although their lack of scientific training (and the inherent complexities of acoustic assessments) often resulted in a poor understanding of the methodology and may even have resulted in reduced confidence (and acceptance) in the results in some cases. Furthermore, the accompanying commercial vessels have often proved difficult to control so that searching effort varies to a certain extent between surveys. The industry, on the other hand, has expressed some frustration when they have proposed changes to the survey strategy and these have been rejected by the scientists. In particular, more flexibility in the survey timing has been viewed as important to the industry to ensure that the stock is surveyed when they believe it to be optimally available.

Since the early days of the surveys, in 1990, scientists have also volunteered to accompany commercial fishing boats to witness any large amounts of sardine that may not have been detected by a survey. More recently, the Ministry has also offered to make the government research vessel available at short notice to assess any such concentrations of sardine that the fleet may find. This was a further move to demonstrate the validity of the survey results, and to counter claims from the industry that the research surveys frequently missed large amounts of fish. While scientists have been called out several times to view concentrations of sardine the amount of fish has been considerably less than that found during surveys, and as a result the research vessel has never been required to make a scientific assessment of such concentrations.

The company that developed the orange roughy industry was managed by a person with a marine biology background and hence this industry was considerably more proactive in research than the sardine industry. In the

early years (1997 and 1998) the orange roughy industry participated in surveys in a rather similar way to the sardine industry, providing commercial trawlers to assist. Initially orange roughy surveys used commercial vessels to conduct target identification trawls for an acoustic research vessel, but since 1999 the commercial vessel also collected acoustic data (Boyer and Hampton, 2001). An important difference was that through the Working Group, outside consultants were appointed to work alongside local researchers to assist and guide this research. Also stock assessment consultants developed and performed most of the stock assessment modelling conducted on this species, while any outside advice obtained for stock assessment of sardine has been entirely funded through the Ministry.

Involvement of stakeholders in the management process

While senior management of the processing and fishing companies of both industries are either formally or informally involved in the management process to some extent, many interest groups are either not consulted or are only included at a late stage. The unions have been represented at some consultative sardine management meetings, but other concerned parties, such as other sectors of the fishing industry, financial institutions and conservation bodies, have not been consulted.

The sardine fishery is characterised by fragmented stakeholders, partially driven by cultural heterogeneity; a consequence of Namibia's political history and the current attempts to redress the racial inequities of the past (Iyambo, this volume). There are several large companies that dominate the industry, but in addition, there are a number of private vessel owners who occasionally act as a unified group, thus increasing their power. These various players are however represented by a unifying group, a fishing association (currently referred to as the Walvis Bay Pelagic Fishing Companies), consisting generally of the fishing company managers and representatives of the small boat-owners. This in effect has become the *de facto* "sardine working group" with whom the Ministry has negotiated. The industry is a major employer and therefore has attracted considerable union attention. As in the orange roughy fishery, however, the unions are given little opportunity to be part of the formal management process. In addition, the fishers themselves, although important stakeholders, are totally reliant on the large companies for their jobs, and throughout much of the 1990s and early 2000s these jobs have not been in abundance. Thus the fishers tend to be deferential to the boat owners and are constrained in their input to the management process.

In contrast to the sardine fishery, the orange roughy fishery consisted of a single company until 1997, and even in more recent years only three companies have participated in the fishery. This has meant that communication within the orange roughy industry has been somewhat simpler and as a re-

sult the orange roughy industry tends to appear as a unified group with similar views and standpoints compared with the rather more diverse views presented by the sardine industry. This greatly facilitated the formation of the DFWFG.

Additionally, the orange roughy fishery was dominated by managers recruited from overseas who had experience in fisheries management and, crucially, fisheries research. In contrast, the sardine industry was in many cases managed by long-serving personnel who had an intimate and detailed understanding of the technical aspects of the fishery, but often lacked specific experience in fisheries management and research. This has hampered the industry's understanding of at least the research methods being used. For example, many participants in the sardine fishery had difficulty understanding the concept of "sampling" a population to determine abundance, and to this day standard acoustic survey methodology is met by some with scepticism because scientists only "see" a fraction of the population and do not "count" every fish. In recent years, some senior managers with an engineering background have been appointed, thus increasing the level of understanding of scientific concepts and management procedures.

Management procedures

The management procedures for both sardine and orange roughy (and indeed most of the commercially harvested marine fish and crustacean species in Namibia) are similar (see Namibian fisheries - Background). However, there are considerable differences in the involvement of the industry in the deliberations on catch levels and other related management measures. In recent years *ad hoc* meetings have been held between the Ministry and the sardine industry prior to management decisions being implemented, which may have far-reaching consequences to the stakeholders. The meetings have taken the form of periodical consultative meetings, where usually some proposed management action is explained to the industry by senior managers of the Ministry, but with limited opportunity for input (Olsen, this volume). Otherwise the industry (and other stakeholders) have no direct input to the management process for sardine.

In contrast, the formal working group that has been established between the Ministry and the orange roughy industry enabled the industry to participate in the management process (see next section). While this working group has been mandated to provide guidance in terms of management strategies, control and surveillance issues and research, the overriding pre-occupation has been in determining stock size, productivity and hence future catch levels. The Working Group was explicitly restricted from making catch recommendations to senior management as this is seen as the function of the Ministry's Directorate of Resource Management. However, the

assessments conducted under the auspices of the Working Group clearly defined optimal catch levels and therefore paved the way for *de facto* TAC recommendations by the Directorate of Resource Management.

Co-management and the orange roughy fishery. - With the development of the orange roughy fishery, and the fact that there was a lack of long term research knowledge to support the fishery due to its newness, co-management was an attractive means of delegating some of these responsibilities to the users. Initially the entire orange roughy fishery consisted of a single company, and therefore establishing formal channels of communication was relatively straightforward. Even after four new companies were given rights in 1997, the industry formed a cohesive unit, which meant that the functioning of the working group was relatively straightforward. In addition, as this was a newly developed fishery, there were clear management goals, while the participants in the working group tended to have a good understanding of management processes and scientific concepts.

The DFWWG therefore offered a structured way for the industry to be involved in the management process, especially at the assessment level.

Orange roughy research, especially in the early days, was dominated by consultants. This ensured that relevant and timeous research was conducted to make an assessment of the abundance and productivity of the stock, although this was not sufficient to prevent the subsequent declines in catches. It also enabled local, less inexperienced scientists the opportunity to learn. However, this also led to the feeling amongst these scientists that they were being used as data collectors, resulting in some resentment towards the more highly paid consultants.

Elaborate attempts were made in the assessments to estimate the abundance of the stocks and to quantify the risks associated with various harvesting levels (McAllister and Kirchner, 2001). One of the greatest difficulties for the Working Group was to formulate optimal catch levels in the face of conflicting interpretations of available data and assessment results, and their implications for resource status (McAllister and Kirchner, 2001). The spawning behaviour of orange roughy was, and still remains, poorly understood, and the dynamics of aggregation formation and dispersion are similarly unknown. Therefore, alternative hypotheses covering a wide range of biological possibilities were necessary in the formulation of the qualitative conceptual models of stock dynamics and behaviour, leading to several possible equally plausible interpretations of the results.

The annual debate on the state of the orange roughy stock and appropriate harvesting levels was generally protracted and difficult, as there were no protocols for setting harvesting levels. This forced an annual debate that was extremely costly and time-consuming for all involved. Some management

procedures elsewhere (e.g. in South Africa, De Oliveira *et al.*, 1998; Johnston and Butterworth, 2000) involve agreeing on pre-defined management decision rules for translating fishery or research data automatically into TACs or some other regulatory measure. Such pre-defined rules negate annual discussions and could be considered for the Namibia orange roughy fishery. However it has to be noted that such a management procedure can only be applied with confidence if the state of the stock and its productivity are well known; hardly the case in this example.

The orange roughy fishery catches averaged more than 10 000 tonnes per annum between 1995 and 1998, but these declined to less than 1 000 tonnes in 2001. This large decline meant that some difficult decisions had to be taken. In theory the Working Group system allowed for this, although in practice it was not without conflict. The industry, through the DFWWG, had considerable comments to make about the interpretation of the data, and in particular any trends in the data. Industry tended to focus on explaining away downward trends or negative perceptions, while high estimates or increases were not questioned. For example, a declining catch per unit of effort (CPUE) or low catch was frequently "accounted for" by the industry as due to operational problems, while increases in CPUE were accepted as a true reflection of the state of the stock. In contrast, scientists were concerned that high estimates or positive trends were in some way biased (upwards) while accepting more negative perceptions of the state of the stock (the industry claims that the scientists were too "green" or conservative). As all parties had equal weight in decisions affecting the outcome of the assessments (in particular, weighting of input data), this tended to downplay any negative signs and probably resulted in more optimistic recommendations than would otherwise have been the case. Finally, in 2000 when consensus could not be reached, the government scientists submitted recommendations to MRAC based on the precautionary view that the stock was considerably lower than assumed by the DFWWG.

Co-management and the sardine fishery. - In contrast to the orange roughy fishery, the sardine fishery has a long history of activity in Namibian waters and hence the management structures that the Namibian government inherited in the early 1990s were relatively well entrenched. The industry was more fragmented than the orange roughy fishery, the understanding of scientific concepts was not as good (with notable exceptions), while management goals have never been clearly defined and were in some cases contradictory. The industry had, and to a large degree still has, no structured involvement in the management process, a process that has been largely instructive in character. Research projects are largely designed independ-

ently of industry and are frequently treated with scepticism by industry, especially when reduced *TACs* are recommended.

During the early years after independence, and until about 1993, the sardine stock was perceived as increasing in size and therefore *TACs* increased similarly. During this period the working relationship between the industry and fisheries authorities was excellent, and the research methodology and results were generally accepted.

As with orange roughy, there was a severe decline in stock abundance during the mid-1990s that required some very difficult decisions. Sardine catches increased between 1992 and 1995, averaging 100 000 tonnes, but from 1992 to 1996 the stock again declined and the lowest annual catch in the history of the fishery was taken in 1996. Recommendations based solely on biological grounds have called for a drastic reduction in catches since 1994 and indeed after 1996 proposed that a long-term closure of the industry would be wise to allow the sardine stock to recover. The labour-intensive nature of the fishery, however, meant that this would have resulted in substantial job losses, with serious social implications. Although there was a small increase in sardine abundance during the last three years of the decade, the stock remained at a worryingly low level and in 2002 a zero *TAC* was set for only the second time in the history of the fishery (the previous time was in 1980).

The industry increasingly questioned the science as the size of the *TAC* declined. With decades of local knowledge, they believed that the sardine had either moved away or were simply not available to the survey technique. The scientists rejected these claims out of hand, with little attempt either to investigate them or even to debate such issues with the industry. Outside consultants were brought in by the industry to question the survey methodology of government scientists, while considerable lobbying of decision-makers, both from the companies and labour unions, occurred. These appeals to the authority to support the beleaguered industry included attempts to discredit the science (and occasionally the scientists themselves). The uncertainties inherent in the surveying and assessment of any fish stock were highlighted and used to undermine the recommendations emanating from this research.

Eventually however, to the dismay of all, including the scientists, the warnings of the government scientists were vindicated as, despite a *TAC* of 20 000 tonnes, catches in 1996 consisted of a paltry 2 000 tonnes of by-catch sardine, almost 10-times lower than the previous lowest catch ever recorded. Good recruitment in 1996 saw the catches rise slightly in the subsequent seasons (Table 1), but in 2002, as noted above, the stock had declined to such a state that even the industry accepted that a complete closure was necessary.

The decline in the sardine abundance created tensions between the controlling authority and the fisheries, especially at the research level where the

natural conservatism inherent in research (and the recommendations emanating from this research) has been viewed by some in the industry as a threat to the continued existence of some of the companies involved in this industry. This conservatism is now more formally acknowledged as part of the precautionary approach (Anon, 1995), which forms a central element of the Namibian fisheries management regime, even though it is yet to be fully implemented.

The industry has necessarily had to be concerned with its own day-to-day survival. As catches have fallen, the financial institutions supporting many of the fishing companies have put further pressure on them to at least meet their financial commitments. Thus, despite apparently incontestable evidence that the resource was in dire straits, the industry was reluctant to accept this, as it would have compromised their own survival.

Indeed, a difference in the basic concepts underlying successful utilisation of fish resources between the fishing industry and scientists has been highlighted during this period and is still to be resolved. The industry contended that overly conservative *TACs* may have pushed companies to bankruptcy and then there would be no fishery once the fish stocks recover. The scientists, whose mandate was restricted to making recommendations based on biological considerations alone, were not permitted to consider socio-economic issues, even if their recommendations, if implemented, would have meant severe hardship for the industry and its employees. The scientists also considered their recommendations as rational, objective and, considering the low level of stock biomass, non-negotiable, although they recognised the uncertainties in their estimates; an apparent contradiction. Obviously a balance between these two opposing views needs to be reached whereby risk up to a permitted level is considered acceptable to ensure the survival of the industry, but beyond that level the survival of the stock takes precedence. Attempts to introduce such concepts, in the form of biological limit and target thresholds, have so far met with little success, partly due to the uncertainties in the precise levels that these should be set at, but also because they would have required the fishery to be closed and thus their implementation was resisted.

It was during this period of conflict that the proposal for closer cooperation between the industry and scientists was developed, largely at the insistence of government managers.

Incorporating fisheries personnel and vessels into research surveys was intended as a mechanism to enhance the acceptance of the research, and to some degree was successful. However, as the people directly involved were skippers of commercial vessels who had spent many years at sea, but often had a poor understanding of the specific concepts used in acoustic surveys, this did little to increase the confidence of the industry in the research re-

sults. Offering to accompany fishers to view any significant aggregations of sardine also deflected some criticism from the researchers, but once again this strategy was probably not utilised as much as it could have been and therefore remained only partially effective in resolving the different perceptions of the state of the sardine stock.

Despite the unprecedented low catch in 1996, frequent deputations were made to decision-makers and the unions mounted public demonstrations, until there was no further question to the state of the stock and a zero TAC was implemented in 2002. Scientists were accused of lacking experience at sea and were therefore said to be unable to find sardine, while the capabilities of the research vessel to detect or catch sardine was questioned. Otherwise the industry simply contradicted the researchers, publicly stating immediately after a survey that there were considerable amounts of fish which scientists had been unable to find.

Throughout this period there was no mechanism to resolve these conflicting impressions of the state of the sardine stock, and scientists and managers from the fishing industry were expected to resolve their differences unaided. This resulted in entrenched positions being formed, and stereotyping of the two sides; industry were perceived by many as irresponsible and solely interested in their own short-term gain, while scientists were seen by the industry as conservationists merely concerned with preserving fish and having little regard for the welfare of fishers and the fishing communities.

In contrast to orange roughy, there was little formal debate over the state of the sardine resource. However, a management procedure is currently being considered for setting sardine catch limits. Such a procedure may benefit the orange roughy, although in fairness it has to be noted that the amount of data available to enable the state of the sardine stock and its productivity to be determined with some confidence is considerably greater than that available for orange roughy.

An area of potential conflict was the control of the catch of juvenile sardine. TAC restrictions on sardine have been the main control measure, but the capture of other purse-seined species, juvenile horse mackerel and anchovy, is also limited if the by-catch of juvenile sardine is considered too high (nominally above 5% by mass). This is one aspect that industry has largely taken responsibility for by controlling the by-catch of juvenile sardine through closure of areas if necessary. The process is monitored by the state to ensure that it is effectively implemented. The limitation of juvenile catches is a particularly sensitive issue because after a number of years of poor recruitment (Boyer *et al.*, 2001a), the rebuilding of the stock was reliant on the survival of juvenile fish. In addition, harvesting juveniles results in a reduced yield (due their small size) and, as they are rendered into low-value fishmeal, a considerable loss of potential income. Since the early 1990s, ef-

forts by the industry to closely monitor the species composition of the catches and to voluntarily ban fishing in any areas where young sardine occur have been encouraged by the Ministry. As a result the industry successfully reduced the catch of juvenile sardine to acceptable limits and has shown that the sardine industry is capable to acting in concert and managing potentially complicated situations. Extending the management brief of the industry into other potentially more difficult issues, such as allowing them to control catch levels within the *TAC*, or even setting *TAC* levels, could be an interesting and worthwhile experiment, although clear and strict monitoring would need to be implemented to ensure that the situation was not abused.

DISCUSSION

Co-management in Namibian fisheries

Fishers are often fishers, at least in part, because the form of lifestyle offers a level of independence rarely found elsewhere. Such people take poorly to top-down controls traditionally found in fisheries management (Jentoft *et al.*, 1998), the type of control system that to a large extent is predominant in Namibia. Co-management seems to offer fishers (or at least the companies controlling the activities of the fishers) the chance to express that independence in a rational and responsible manner, thereby contributing to the successful management of the natural resources that they are reliant on.

The various fishing industries in Namibia have some say over their own activities. In most fisheries they are granted individual catch quotas rather than global quotas and can therefore decide when and where they will make their catches, at least within the season and areas limitation. Such a quota system also reduces the level of competition (at the catch level) with other fishers.

In recent years the Namibian authorities have attempted to incorporate some sectors of the fishing industry into the management process through formal arrangements, partly so that they can contribute to the process, but also to ensure that the industry has a part-ownership of any decisions that may be taken. The Namibian authorities have limited the concept of co-management to a rather narrow range of stakeholders, i.e. the managers of the fishing companies and, occasionally, employees, rather than the more accepted concept of including all who have an interest in the fishery, however indirect (Mikalsen and Jentoft, 2001). Fishers, factory workers, financial institutions, unions, other (competing) fisheries, conservation bodies etc. are either not formally consulted, or are only included very late in the process. On the other hand, the "stakeholders" from the state have been largely lim-

ited to scientists, with little input from managers, policy-makers, or the monitoring, control and surveillance personnel.

The level of co-management that has been introduced into the management process of most of the important commercial fisheries in Namibia is rather limited. This is generally at the instructive level, although there are some aspects where the industry has taken control of a specific set of management decisions that are more normally controlled by the state, such as limiting the sardine by-catch and juvenile catches.

The main mechanism for enabling the industry to participate formally in the management process has been through the establishment of working groups, such as the DFWWG that have been formally mandated to assist with and participate in research and to develop management strategies consistent with the overall goals of each fishery.

Even more ambitious forms of co-management, such as allocating population stewardship rights as proposed by Gavaris (1996), have not been considered, despite their apparent attractiveness. The concept of population stewardship rights recognises that uncaught fish (including unborn fish) have a value. These uncaught fish are referred to as "natural capital" (Rees, 1991). This type of system allows the carry over of fish from one year to the next and allows for an increase in the quota with time due to recruitment and growth (with some reduction due to natural mortality). Thus one way of increasing a concessionaire's quota is to leave unharvested some of the allocated quota, thus increasing the contribution to future generations (= putting fish in the bank and then reaping the interest at some later date). Such a system requires quite detailed knowledge of recruitment, growth and mortality rates, and despite good advances in fisheries science in recent years (Iyambo, 2001) such detailed knowledge is still largely unavailable.

Co-management and institutional change

Co-management by definition implies that a number of parties are involved in the management and utilisation of fish resources. The industry has the opportunity to participate in the management of the resource, but such an opportunity will be more effective if the industry is conversant with fisheries management and research principles. Similarly government scientists also need to have a firm grasp of the fundamentals of managing a large company and in particular the specific problems of utilising a natural resource that is highly variable and unpredictable. Several of the differences highlighted between the Namibian sardine and orange roughy fisheries have been a result of the different levels of understanding of research and fisheries management concepts and the cohesiveness of the industries. The stakeholders of the sardine fishery, and to a lesser extent the orange roughy industry, will need to become more familiar with research and management principles if

they are to participate effectively. As such, relevant awareness needs to be offered in both fisheries science and management to enable industry participants to interact effectively in this process. In addition, the entire industry (management, fishers, factory workers, etc.) needs to be able to act in concert. Indeed, unless an industry can demonstrate a maturity and competence to interact rationally and effectively, trust will soon be lost and their credibility may be reduced.

In addition, co-management implies that all stakeholders have a considerably higher level of responsibility than under a more traditional top-down management system (see also Pomeroy and Berkes, 1998). Short-term fishing strategies that are based on economic profit and are inconsistent with long-term sustainable fishing practices would not be acceptable. In effect this would require stakeholders to focus on the longer-term good of the fishery rather than their own more immediate shorter-term goals.

The Working Group concept resulted in a delegation of conflict resolution to the level of government researchers and fisheries managers. Government research staff are typically not trained or experienced in dealing with such issues, and state research institutions generally have insufficient capacity to handle this role (e.g. Brown and Pomeroy, 1999). If a co-management strategy is to be effective, capacity at the local level needs to be strengthened (Pomeroy and Berkes, 1998). By the same token that industry and other stakeholders need to become familiar with scientific concepts, scientists need to be fully supportive when a co-management strategy is implemented and need to develop an understanding of industrial management.

The Deep Water Fisheries Working Group allowed conflicts to be internalised within the Group, thus preventing more damaging public disputes to develop. Indeed many of the conflicts merely encouraged the proponents to improve their arguments by, for example, acquiring more data or more rigorous testing of their models. As such the Group has acted as a form of peer review, a process that has been sorely missing in sardine research. In contrast, attempts to introduce co-management into the sardine industry were made during a period of conflict, without any mechanisms for conflict resolution being implemented.

Ideally under a co-management style of management, conflicts are successfully resolved at the local level, or issues are solved before they develop into a conflict situation. However, as occurred in both the sardine and orange roughy fisheries during times of declining catches, conflicts that are not timeously resolved can escalate and by the time they reach higher levels within the government are considerably more difficult to resolve.

CONCLUDING REMARKS

Sardine would classify as “instructive” in the classification of institutional arrangements for co-management by Sen and Raakjaer Nielsen (1996) as this fishery is largely managed with a top-down approach, with very little input from stakeholders. In contrast, the orange roughy fishery is more “consultative”, although all final decision-making is still retained by the state. While there may be room for greater involvement of both sectors of the industry in the management process, all stakeholders, including the government, would need to be aware of the implications of such a development.

Co-management tends to divert conflicts resolution to lower levels within the management organisation; in the Namibian situation this tends to be to the research level. Thus in order for co-management to be successfully implemented, the structure at these lower levels needs the additional resources, and also support from higher (management) levels, to be able to undertake this new role. As concluded by numerous other studies, the Namibian experience suggests that involving stakeholders in the research and management tends to lead to better acceptance (a feeling of ownership) of the outcome. However in some cases, for many stakeholders, this may require considerable effort as participants must have a clear understanding of biological concepts, research methods and management strategies.

In summary, Namibia’s experience with co-management suggests that when times are good, the co-management process works well, but then so do most other forms of management. However, when times are poor, conflicts are likely to arise regardless of the management system used. Co-management certainly does not prevent these conflicts, although it may well serve to reduce them by providing a structured forum for discussion and resolution.

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