Development of Co-management Arrangements for Queensland Fisheries

Stage 1 – Picking the Winners

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The objectives of this study are as follows:

1. Identify the fisheries characteristics required for effectively implementing new co-management arrangements in Queensland fisheries.
2. Identify Queensland fisheries that have the characteristics most amenable to a co-management approach.
3. Identify the tangible incentives for government and industry to adopt a co-management approach in Queensland fisheries.
4. From the relevant fisheries selected, identify the fisheries management processes that could be devolved to industry.

There are a very large number of definitions of co-management in the literature. The FRDC National Working Group for Fisheries Co-management has adopted the following definition (Neville, 2008): "*Fisheries co-management is an arrangement in which responsibilities and obligations for sustainable fisheries management are negotiated, shared and delegated between government, fishers, and other interest groups and stakeholders.*" Co-management can be considered an evolution of fisheries management arrangements in Queensland, rather than a revolution. It can be an approach that builds upon existing achievements in fisheries management and existing industry achievements such as Environmental Management Systems and Codes of Conduct.

From the perspective of fisheries management, co-management has the potential to realise (or at least approach) the ideals of social equity, economic efficiency, and ecological sustainability. It is thought to do away with what is seen as the distant, impersonal, bureaucratic approach of fisheries management and replace it with a partnership approach. It is a form of governance which involves a shift from "top-down" to "bottom-up" management, and of the government sharing responsibility with stakeholders. It is important to emphasis the words shared responsibility when considering co-management. Co-management is not about government delegating all responsibility for a number of core functions, including: 1) Powers to make regulations; 2) Powers to grant the initial authorisation to fish; 3) Compliance, investigation and prosecution powers, and 4) Participation in international and national fisheries management planning exercises.

The range of management roles and processes that can potentially be devolved to industry were identified in this project. These roles and processes include:

- Data collection and data management;
- Improved partnership arrangements that can facilitate fine scale management within a broader management framework;
- Research;
- License issue, renewal, transfers and fee collections;
- EPBC Reporting;
- Maintaining a registrar of operators; and,
- Communication and extension.

This project sought to examine which of Queensland's diverse fisheries are most likely to be ready to adopt modified co-management arrangements in a relatively short time frame. A set of criteria (preconditions) were developed and applied to Queensland fisheries to determine the most likely candidates for adopting new co-management arrangements.

Overall, the key precondition for co-management of a fishery is motivation to enact change. Motivation though by itself is not sufficient as the industry or user group, or business entity must have the capability and capacity to take responsibility certain decision making processes over a period of time, and the delivery of functions/services in a timely and accountable manner. If sufficient motivation for change exists, then two further co-management preconditions need to be considered: 1) The characteristics of the fishery and its management; and 2) Measures of social and human capital in the fishery.

A number of criteria to assess the characteristics of the fishery and measures of social and human capital were developed and applied. Application of the preconditions identified a short list of fisheries potentially suitable for co-management that required further consideration. These short-listed fisheries were the following: Beche de Mer Fishery; Stout Whiting Fishery; Gulf of Carpentaria Finfish Trawl Fishery; Scallop and Deepwater King Prawn sectors of the East Coast Trawl Fishery; Tropical Rock Lobster Fishery; Ocean beach Net Fishery (some zones); Tunnel Net Fishery; and Moreton Bay Trawl Fishery.

While all these fisheries have co-management potential, further review identified that the outstanding candidates at the present time for co-management were the Tropical Rock Lobster Fishery, and the Moreton Bay Trawl Fishery. The latter possibly as part of a wider Moreton Bay co-management approach incorporating the tunnel net fishery. The motivations and outcomes sought from these candidate fisheries were significantly different. The Tropical Rock Lobster Fishery desired to develop an approach to address contentions in the stock assessments that underpinned the setting of the total allowable commercial catch (TACC), in particular the scale of surveying. The Moreton Bay Trawl Fishery has aspirations for implementing real time management as an adaptive approach to manage the take of small prawn and effort distribution in the fishery overall.

2. Acknowledgements

Many industry participants, industry representatives, fisheries manager's and others participated and provided input both formally and informally into this project. In no particular order they are as follows: Randall Owens (GBRMPA), Robert Brock (MBSIA), John Page (MBSIA), Brett Alridge (Kailis), Stephanie Slade (QDPI&F), Andrew Thwaites (QDPI&F), Kellie Williams (MBSIA), Shane Hansford (QDPI&F), David Sterling (MBSIA/QSIA), Ashleigh Hoffmann (QSIA), Keith Hall (Marine Queensland – Charter Fishing Division), Mark Lightowler (QDPI&F), Peter Neville (FRDC Chair), Colin Shelley (QDPI&F), Claire Anderson (QDPI&F), Ted Loveday (Seafood Services Australia), Bridget Kerrigan (QDPI&F) and Tor Hundloe (Bond University).

Morena Mills worked tirelessly in the initial phase of this project, collecting and sifting through the considerable body of literature on co-management and community management.

3. Background

Queensland fisheries are characterised by the diversity of target species and methods, and they are generally small-scale with a relatively large number of operators. Further many occur in areas of high conservation value including the Great Barrier Reef World Heritage Area. Since the early 1990s, all Queensland fisheries moved from a centralised (instructive) to a consultative approach which includes Management Advisory Committees (MACs) to advise on fisheries management planning.

While it is not necessarily new, over the last decade there has been increasing global interest in developing co-management arrangements for the utilisation of common property resources such as fisheries (Jentoft et al., 1998). Co-management has been advocated or implemented for the management of a wide range of natural resources including game and subsistence hunting (e.g. Moller et al., 2004; Mayaka et al., 2005). The theory behind co-management is considered to be grounded in sociobiological concepts such as reciprocal altruism and can be recognised as another form of collaborative behaviour aimed at addressing collective action problems (Schlager and Blomquist, 1996; Plummer and Fennell, 2007).

From the perspective of fisheries management, co-management has the potential to realise (or at least approach) the ideals of social equity, economic efficiency, and ecological sustainability (Pomeroy, 1995). It is thought to do away with what is seen as the distant, impersonal, bureaucratic approach of fisheries management (Jentoft et al., 1998). In many respects, co-management represents evolution rather than revolution of fisheries management practices (Yandle, 2003; 2006).

Co-management returns some responsibility to the community, to the people who have invested their lives and savings in the resource, and to the people who within the context of the local environment understand the resource better than any distant authority (Symes, 2007). Co-management is a democratic process that is synonymous with ‘good governance’ in that it includes the concepts of power sharing, empowerment, and decentralization and encourages governments and citizens to work together to create a sustainable civil society (Pomeroy, 1995; Jentoft, 2004). Fisheries co-management processes must provide a mechanism for industry stakeholder involvement in decision-making, while also providing assurance that precautionary actions will be taken to conserve fish stocks into the future (Cox and Kronlund, 2008).

Co-management is also considered to reduce the government and societal cost of fisheries management. While the costs of designing a co-management regime and the relevant process can be high, Kuderan et al. (2008) identified that the on-going implementation costs are lower for a co-managed fishery as monitoring and cost of monitoring and enforcement are lower, and there is higher compliance with rules and regulations. Since these costs are

encountered on a perpetual basis, this can lead to an overall lower cost of managing the fisheries resources for the society.

The specifics of co-management arrangements are not universally applicable as they depend on the fishery, the people and the place (Pauly, 1997; Imperial and Yandle, 1998). This means that it is important to investigate co-management options that are locally applicable. Further, it is identified that the planning and identification phase for co-management are as important (or more important) than what happens later in the process (Chuenpagdee and Jentoft, 2007). Both these issues are drivers that underpinned the need for this project. It should also be recognised that co-management is not a panacea, and not all fisheries have thrived under the joint management of fishers and managers (Sen and Nielsen, 1996).

The literature contains a myriad of definitions of co-management; some are broad, while some are more specific. Implicit in any relevant definition of co-management is the fishers' right to participate in making decisions about how, when, where, how much and by whom fishing will occur; and the right and role of government to endorse the outcomes of a co-management process (Pinkerton, 2003; Pomeroy and Berkes, 1997). Some examples of definitions include:

"*Ecosystem based management where stakeholders should be engaged in the formulation and implementation of decisions concerning environmental resources*." (Acheson, 2006; Da Silva and Kitts, 2006)

"*A form of self-governance within a legal framework established by the government, where the power to make decisions and implement management plans is shared between users (of the fishery) and the government*." (Jentoft and McKay, 1995)

"*An arrangement where responsibility for resource management is shared between the government and user groups*." (Sen and Nielsen, 1996)

"*Negotiating agreement and sharing decision making between groups or communities of fishermen and various levels of government where different groups are responsible for managing resources.*" (Schumann, 2007)

"*A middle state between pure state management and pure community management, with local stakeholders playing a pivotal role in decision-making, implementation and enforcement.*" (Da Silva, 2004)

"*A form of participatory management in which local community stakeholders share resource management responsibilities with regional or national institutional bodies.*" (Wagner, 1997).

The FRDC National Working Group for Fisheries Co-management has adopted the following definition (Neville, 2008): "*Fisheries co-management is an arrangement in which responsibilities and obligations for sustainable fisheries management are negotiated, shared and delegated between*

government, fishers, and other interest groups and stakeholders." This is the definition utilised in this study.

Co-management is a form of governance which involves a shift from "top-down" to "bottom-up" management, and of the government sharing responsibility with stakeholders (McCay and Jentoft, 1996). At a conceptual level, co-management can be considered a continuum of management arrangements from government-centralised arrangements to self-governance or self management, with a number of steps along the continuum that reflect specific consultative and participatory arrangements. Sen and Nielsen (1996) classified the continuum of co-management approaches according to the roles played by the government and people using the fishery and suggest the following classifications:

> • *Instructive*: There is only minimal exchange of information between the government and users. The government makes the decisions and informs users of them.
> • *Consultative*: Mechanisms exist for government to consult with users but all decisions are taken by government.
> • *Co-operative*: Users and the government co-operate as equal partners.
> • *Advisory*: Users advise the government of decisions they plan to make and the government endorses these decisions.
> • *Informative*: Users have the authority to make decisions and are responsible for informing the government of these decisions.

It is also important to consider that co-management arrangements themselves are not an outcome, but an adaptive process to achieve better management outcomes (Carlsson and Berkes, 2005). The benefits to government and industry of co-management potentially include:

- More cost-effective management,
- Reduced regulatory burden,
- Improved relationships between industry, government and other stakeholders,
- Greater provision and better use of stakeholder knowledge in fisheries management,
- Flexible and adaptable management at appropriate scales including real time management, and
- Increased potential for industry and regional development.

Co-management differs from community-based resource management (CBRM) because the government is also involved in the decision-making process (Sen and Nielsen, 1996). Community-based resource management is almost always locally based whereas co-management may or may not be locally based. Many of the examples in the literature that purport to be examples of co-management are in fact better described as CBRM. Specific examples of this include some artisanal fisheries in Brazil (Da Silva, 2004; Begossi, 2006), Jamaica (Brown and Pomeroy, 1999), Bangladesh (Ahmed et al., 1997; Dey and Prein, 2006), Thailand (Johnson, 2001), Japan (Takahashi

et al., 2006) and Vietnam (Dey and Prein, 2006). While co-management in its strictest sense is more relevant to Queensland fisheries than CRRM and is the major focus of this report, relevant elements and examples of CBRM are also considered in this report.

Co-management has the potential to realize (or at least approach) the ideals of social equity, economic efficiency, and ecological sustainability, fundamentally through seeking to encourage more collaboration and less conflict. It is not simply about more consultation, better administrative efficiency and cost reduction. It is about a fundamental shift in thinking how the objectives of resource security and long term economic use and commercial viability can be achieved.

Co-management can be instigated more or less unilaterally by the community or industry as they bear the burden of governance failure (real or perceived). More usually however, the desire for co-management evolves interactively and informally between government and industry. If relevant other stakeholders may then become involved (Chuenpagdee and Jentoft, 2007).

4. Need

There is growing interest among many Australian fisheries agencies and in particular fishing industry sectors themselves in the development and implementation of co-management arrangements that build upon existing achievements in fisheries management. The need for co-management has also been identified by the Queensland Department of Primary Industries & Fisheries (QDI&F) as a key to the future economic prosperity of the Queensland commercial fishing industry. In Queensland, interest was spurred in part as a result of achievements in the Spencer Gulf Prawn Fishery, in particular the move towards real-time management in that fishery.

While there was strong support from the QPI&F and the commercial fishing industry to move towards co-management, there was limited understanding of what co-management was and how it could benefit fisheries management within the context of Queensland managed fisheries.

5. Project Objectives

The objectives of this study are as follows:

1. Identify the fisheries characteristics required for effectively implementing new co-management arrangements in Queensland fisheries.

2. Identify Queensland fisheries that have the characteristics most amenable to a co-management approach.

3. Identify the tangible incentives for government and industry to adopt a co-management approach in Queensland fisheries.

4. From the relevant fisheries selected, identify the fisheries management processes that could be devolved to industry.

6. Methods

A literature review was undertaken to synthesise international experience with co-management. Information from 63 fisheries was presented and considered, and covered a large variety of fisheries in developed and developing countries.

Queensland managed fishing sectors were defined either with respect to a specific fishery endorsement (e.g. L8 line fishery) or a recognisable sub-sector within an endorsed fishery (e.g. tunnel netting). The fishery sectors and there management was described. Potential conceptual models for co-management were described as was practical considerations for co-management.

In order to identify the most appropriate fisheries for co-management, a rapid assessment approach based on preconditions for co-management drawn from the literature was applied to the fishing sectors identified. Understanding the preconditions prior to co-management implementation assists in evaluating success (Chuenpagdee and Jentoft, 2007).

Overall, the key precondition for co-management of a fishery is **motivation** to enact change by either, or ideally both government and industry. Motivation though by itself is not sufficient as the industry or user group, or business entity must have the capability and capacity to take responsibility certain decision making processes over a period of time, and the delivery of functions/services in a timely and accountable manner. Following from this, if sufficient motivation for change exists, then two further co-management preconditions need to be considered:

1. The characteristics of the fishery and its management (Table 1); and,
2. Measures of social and human capital in the fishery (Table 2).

The following characteristics were developed and applied with significant input from QDPI&F and were as follows:

- Status of Management Planning. If a fishery has undergone a management planning process and a management plan has been in place for a period of time, then this is likely to be advantageous for further developing co-management arrangements. This is because the structure of the fishery may be more optimal after management planning has been completed, and any issues regarding allocations, fishing rights and access arrangements are stabilised. In particular, the level of latent effort is likely to be significantly reduced leaving operators in the fishery with a significant commitment to it. Status of management planning rather than “quality” of management *per se* was chosen as a precondition because the latter is subjective and contentious. One of the frequent outcomes of having completed management planning is a reduction of latent effort in the fishery

through various mechanisms. This can result in the operators remaining in the fishery having a greater commitment to its sustainability.

- Number of Operators. Simply, if there are less operators in a fishery sector it is more likely that communication and negotiation throughout the sector can be more effective.
- Number of Stakeholders with Direct Interest. In theory the development and implementation of new co-management arrangements is easier in a fishery with only one sector with direct interest.
- Nature of the Fishing Right. Motivations among the industry sector for developing and implementing new co-management arrangements are likely to be stronger when the nature of the property right is more secure. This is an extension of the idea that sustainability in general is easier to progress with clear and secure property rights.
- Direct interactions with Other Commercial Fisheries. Co-management arrangements may be more complex if stocks are harvested by more than one commercial fishing sector, particularly if there is spatial overlap between these commercial fishing sectors.
- Area of the Fishery or its Subcomponents. If a fishery occurs over a large spatial area, there is greater probability of local differences in harvesting practices. These local differences can be a driver for co-management arrangements as the industry may desire more flexible management arrangements that consider geographic differences. However, Pomeroy et al. (2001) identifies that a fishery or its sub-components should be restricted to a small number of ports or locations to increase the likelihood of group homogeneity which can be an important practical consideration for co-management.
- Fishery Organisation or Relevant Business Structure. For co-management to be effective, there needs to a relevant fishery organisation or relevant business structure to which responsibilities can be devolved to. There is a need for this structure to be formalised and ideally it should be well established with a track record of competency.

Social and human capital is a key consideration for the development and implementation of co-management arrangements (Pomeroy et al., 2001) and is increasingly been viewed as a key component for fisheries governance and biodiversity conservation. The term social capital is an all-encompassing term for the norms and social networks that facilitate co-operation among individuals and between groups of individuals. In theory, the greater the social capital in a fishery the higher the probability that co-management arrangements can be successfully developed. While broad measures of social capital exist, for example those published by the Australian Bureau of Statistics (ABS) in 2004, there is the opportunity to be more specific in the current instance while still considering the major themes identified by the ABS. Importantly there is also a need to use measures that can be used “off the shelf” rather than those that require the collection of new empirical data.

In terms of developing co-management arrangements, Beem (2007) identifies the importance of “policy entrepreneurs”. These policy entrepreneurs may be in government or industry but that the strength of the ties the advocate has

with the fishing community is the key issue. The concept of a policy entrepreneur is difficult to quantify specifically and for that reason is not explicitly included in the assessment measures for social capital. However, attributes and experiences that a policy entrepreneur is likely to have, or have been exposed to are included.

Assessment measures for social capital used were as follows:

- Member involvement in Fisheries Management Planning. If at least one member of the fishery sector is involved directly in fisheries management planning then they are likely to have a broader understanding of fisheries management and the competing demands placed on fisheries managers, together with at least the beginnings of a cross-sectoral social network.
- Code of Conduct or Environmental Management Systems (EMS). Development of a Code of Conduct or EMS is identified as a very good mechanism to build social capital. In particular it can contribute positively and significantly to the three interrelated pillars of social capital identified and reviewed by Paldam (2000) and Grafton (2005): trust and trust worthiness, civic engagement and co-operation, and social networks.
- Training. Formal vocational training can contribute positively to human capital development and may also contribute to social capital development.
- Linkages with Other Stakeholder Groups. This precondition can be related to EMS development or direct involvement in a fisheries management planning framework. It can however also occur outside these particular processes through other formal and informal mechanisms.
- Research participation. Active participation in research projects can contribute to social capital through network building with research staff.

The characteristics and the associated ranking of the fishery units is to be used as a transparent and flexible screening level approach to determine which fisheries are most likely to be amenable to modified co-management arrangements. It is important to recognise that a “lower” score does not imply that a fishery is not well managed or that a fishery with a higher score is better managed. Further, there is no “threshold” value above which co-management is likely to be successful. Rather, it is a guide for general consideration only.

Application of the preconditions resulted in identification of a number of candidate fisheries and a more detailed investigation of these fisheries with respect to co-management potential was investigated.

Table 1 Characteristics of a Fishery and its Management

ATTRIBUTE	SCORE
Status of Management Planning	
Limited - the fishery has no specific management plan, or management planning for the fishery is in its infancy.	**0**
Recent – the fishery has a management plan that is currently being finalised or has recently been finalised.	**1**
Stable – the fishery has a management plan that has been in place for at least 18 months.	**2**
Number of Operators	
High – the fishery has more than 50 operators.	**0**
Medium – the fishery has between 20 and 50 operators.	**1**
Low – the fishery has less than 20 operators.	**2**
Number of Stakeholders with Direct Interest	
High – a) the harvested species in the fishery has a large or dominant recreational catch or are iconic for the recreational sector, or b) significant interest in the fishery from the conservation sector, or c) significant direct interests by any other sectors or groups.	**0**
Medium – a) the harvested species in the fishery are targeted by recreational fishers but the species are not iconic for the recreational sector and the commercial catch is larger, or b) interest in the fishery from the conservation sector but the fishery is not a priority, or c) direct interests by any other sectors or groups.	**1**
Low – the fishery targets species that are principally captured by the commercial fishing sector with limited direct interest from the conservation sector or any other sectors or groups.	**2**
Nature of the Fishing Right	
Non-tradeable permit – operators are granted an annual non-tradable permit	**0**
Tradeable licence – operators are granted a tradeable licence	**1**
ITQ – operators have a guaranteed proportion of the catch or access (e.g. nights) that is tradeable	**2**
Direct Interaction with Other Commercial Fisheries	
High – targeted stocks in the fishery are also targeted in the region by other commercial fisheries, and/or significant spatial overlap between the operation of the fisheries	**0**
Medium - targeted stocks in the fishery are captured, but not necessarily targeted by other commercial fisheries, and/or limited spatial overlap between the operation of the fisheries	**1**
Low – targeted stocks are rarely captured by other commercial fisheries, and/or little or no spatial overlap between the fisheries	**2**
Area of the Fishery (or its subcomponents)	
Large – the fishery or its subcomponents are based in a large number of major ports and/or over a large geographic area	**0**
Medium – the fishery or its subcomponents are based in two or three main ports and occurs over a moderate geographic area	**1**
Small – the fishery is highly localised	**2**
Fishing Industry Organisation or Relevant Business Structure	
Absent – There is currently no relevant fishing industry organisation or relevant business structure to which responsibilities could be legislatively devolved too.	**0**
Existing & Recent – There is currently a relevant but recently formed fishing industry organisation or relevant business structure to which responsibilities could be devolved too.	**1**
Well Established - There is currently a relevant and well established fishing industry organisation or relevant business structure to which responsibilities could be devolved too.	**2**

Table 2 Measure of Social Capital

ATTRIBUTE	SCORE
Member involvement in Fisheries Management Planning	
Low – The fishery sector or group has no members with direct involvement in fisheries management planning processes (e.g. MACs).	**0**
Medium – The fishery sector or group has some members with limited direct involvement in fisheries management planning processes (e.g. MACs)	**1**
High – The fishery sector or group has some members with significant direct involvement in fisheries management planning processes (e.g. MACs)	**2**
Code of Conduct or Environmental Management Systems	
Low – The fishery sector or group has had little or no involvement in development and implementation of a Code of Conduct or EMS	**0**
Medium – The fishery sector or group is commencing or has recently commenced EMS development or has had only limited experience with a Code of Conduct or EMS	**1**
High – The fishery sector or group has completed or has nearly completed a Code of Conduct or EMS	**2**
Training	
Low – The fishery sector or group has no or very few members that have completed relevant training courses. (e.g. MAC training, EMS training, other relevant training) and no members have completed leadership courses	**0**
Medium - The fishery sector or group have a limited number of participants completed relevant training or courses (e.g. MAC training, EMS training, other relevant training)	**1**
High – Most members of the fishery sector or group have participated in relevant training programs and some have completed relevant leadership courses	**2**
Linkages with other stakeholder groups	
Low – The fishery sector or group has only limited linkages with other stakeholder groups	**0**
Medium – The fishery sector or group has some linkages with key stakeholder groups	**1**
High – The fishery sector or group has well established linkages with the majority of key stakeholder groups.	**2**
Research Participation	
Low – The fishery sector or group has little or no experience in participating in collaborative research projects	**0**
Medium - The fishery sector or group has considerable experience in participating in collaborative research projects, but no experience as a principal or co-investigator.	**1**
High – The fishery sector or group has extensive experience in participating in collaborative research programs including being a principal or co-investigator on at least one project.	**2**

7. Results

International Co-management Experience

There are many international examples of co-management. A comprehensive list of co-management examples from 63 fisheries in developed and developing countries is included in Appendix 1. Many of these examples fall more in to the category of community based management rather than co-management *per se* but where generally relevant they have been included in this report.

Overall, the lists of motivations for pursuing co-management in developing and developed countries were similar (Table 1). In general, a desire for improved sustainability and the reversal of overfishing was the most frequently identified reason in both developing and developed countries. To improve the management of fisheries habitat and/or to stop or reduce pollution were more frequent motivations for pursuing co-management in developing countries in comparison to developed countries. Motivations associated with resolving equity issues and conflict resolution was common to both developed and developing countries.

Table 1 The motivations for pursuing co-management arrangements in international examples.

DEVELOPING COUNTRIES	Number of examples
Improve sustainability, reverse or prevent overfishing	16
Stop or reduce habitat destruction and/or pollution	10
Improve enforcement	5
Resolve stakeholder conflicts	5
Improve interagency cooperation	4
Protect local fishers from outsiders	3
Reduce fishing capacity	2
Reduce social inequities	2
Reduce conflict between fishers and government	1
Reduce gear conflict between fishers	1
Greater control of marketing/production to ensure greater benefits for local fishing communities	1
Manage concentration of fishing effort that resulted from MPA declaration	1
Increase the number of fishers to stimulate more food production for the local community	1
DEVELOPED COUNTRIES	
Improve sustainability, reverse or prevent overfishing	13
Reduce gear conflict between fishers	3
Improve enforcement	3
Reduce bycatch	2
Improve economic returns	2
Increase fishing industry resilience to changes in market	2
Protect local fishers from outsiders	2
Impending catch/effort restrictions	1
Meet external policy requirements (EU)	1
Displacement of small boats by larger boats	1
Unsafe fishing practices	1
Stop or reduce habitat destruction and/or pollution	1
Resolve stakeholder conflicts	1

Four international examples of co-management have been chosen for further discussion here because of their potential relevance to the management of Queensland fisheries. The examples are:

- The Dutch *Biesheuvel system*
- Canadian Atlantic Sea Scallop Fishery
- Maine Lobster Fishery
- New Zealand Rock Lobster Fishery

The Dutch *Biesheuvel* system (Symes et al., 2003)

This system was implemented following severe over-capacity in the groundfish fishery and a failing enforcement regime that could not ensure the integrity of quota arrangements. In response, a government and industry steering committee advised the government to form quota management groups within existing fishing organisations. A quota management group must be formally recognised by the government. Individual quota holders join a quota management group with the incentive being that groups receive an additional 10% allocation of "days at sea" giving operators greater flexibility to utilise their ITQ. Members of a quota management group transfer their right to manage their quota to their group and commit themselves to a fishing plan and other rules. They do however maintain their own right to use their own quota, including leasing arrangements. The executive of the quota management group can impose fines for non-compliance.

The groups are required to provide all information requested by relevant authorities, and in effect, management agencies perform an audit of a group's operations. Since the introduction of the system, offences against the quota regulations have decreased dramatically.

Canadian Atlantic Sea Scallop Fishery (Loucks et al., 2003)

In this scallop fishery, quota holders collaborate closely with government managers and scientists through an informal co-management agreement with the purpose of developing and utilising harvesting strategies to take into account the scallop's highly variable recruitment patterns. The industry finances most of the standard science, monitoring and enforcement costs of the fishery, and also invests heavily in a government research program to determine an accurate and precise estimate of recruitment. This scientific information is used to recommend an annual harvesting strategy (volume, time and area) that evens out the market supply of scallops.

In the fishery, each enterprise or company receives a percentage of the quota and is responsible for specific costs such as dockside monitoring, electronic "at sea" monitoring, and port sampling. The co-management approach is implicated in a significant reduction in the number of fishing vessels from 68 in 1986 to 28 in 1999.

Maine Lobster Fishery (Loucks et al., 2003)

Co-management of the Maine lobster fishery grew out of industry dissatisfaction with State and Federal fisheries management and the desire to focus management at a more local level in a fishery with a large number of operators (approximately 7,000) spread out over a large and heterogeneous geographic area. This dissatisfaction carried with it high enforcement and conservation costs. In 1995, a bill was approved to provide for local zonal management and seven zones were established and management forums (Council's) for each zone were formed. Initially the Councils were given controls rules that were deemed purely local in nature. Rules whose impact

was deemed wider than just the local level were retained at the statewide level. For example, the number of traps fished by each boat in each zone, trap rigging, and time and area closures. Changes in rules were initiated by the Council but required two-thirds approval in a referendum of the license holders.

A striking feature of the approach in this fishery is the speed at which management changes were enacted. In the first year of operation, all seven zones had developed and implemented trap limits. Prior to the initiation of the Councils, this had proven to be a management impasse with ongoing conflict over a long period of time. This is principally because Lacking though when the approach was first developed, was a formal dispute resolution process which was found to be essential for the long term success of the approach.

While the co-management process and its outcomes still remain advisory in nature, embedded within a top-down administrative process, the broad democratic foundations of the councils mean the Commissioner (= Minister) would only overturn a decision in extraordinary circumstances.

New Zealand Rock Lobster Fishery (Yandle, 2006)

Two linked explanations are identified in the case of the New Zealand rock lobster fishery for the emergence of co-management arrangements. A strong tradition among fishers of involvement in fishery management or governance that progressed over decades from an informal to a formal management structure, and the development of perceived property rights in the broader New Zealand fishing industry. For the latter, of importance was a change in the recognition of the ITQ as simply a right to extract a specified tonnage of fish, to a growing embodiment of a more extensive bundle of "rights" (either formally or de facto).

From a legal perspective, the review of the Fisheries Act in 1999 also provided additional impetus with the delegation of certain management responsibilities to "approved service delivery organisations" or CSOs, such as those that are representative of quota holder's. A CSO may carry out routine management activities including research, while the Ministry maintains the role of setting and enforcing minimum management standards, and of auditing CSO activities. Many of the costs of management are thus shifted from the government to the CSO.

A clear message from the New Zealand rock lobster example is that while co-management is a potentially powerful tool, it is not simple to develop and implement. It can be a multi-decade evolutionary process that involves the nurturing of management experience within the industry, and government to respect industry as a partner in management and not just a regulated entity or adversary.

Current Queensland Fisheries Management Arrangements

This section briefly introduces each fishery sector that is discussed in this report. It is not meant to be a comprehensive description of all aspects of a fishery or its management, but provides a general introduction to them and a focus on aspects of direct relevance to co-management.

East Coast Trawl Fishery

The East Coast Trawl Fishery (ECTF) is a large fishery that consists of a number of specific subsectors. The fishery is managed by a complex set of input and output controls including: vessel size and horse power rating, bycatch reduction devices (BRDs), net size, permitted species lists, time and area closures, and effort controls through the allocation of "fishing nights". The fishery is managed under the East Coast Trawl Fishery Plan 1999 and subsequent amendments.

The subsectors included in the analysis are:

- The scallop fishery which operates in central and southern Queensland and targets saucer scallops.
- The banana prawn fishery which operates inshore in a number of ports during daylight hours.
- The Moreton Bay fishery which is a localised small boat fishery targeting a variety of prawn species.
- The Deepwater king prawn fishery which targets large eastern king prawns offshore from Hervey Bay and the southern part of the Swains Reefs.
- The black tiger prawn broodstock fishery which targets broodstock in the Cairns region to support the prawn aquaculture fishery

Beam Trawling

Beam trawling occurs in selected rivers and estuaries from Townsville south to Moreton Bay. The fishery targets a variety of prawn species. The fishery is divided in to five zones and to operate in each zone requires a specific endorsement. The fishery has a history of real and perceived conflict with the recreational fishing sector and in Moreton Bay is also becoming increasingly constrained as a result of coastal development, particularly in the Brisbane and Logan Rivers.

Stout Whiting Fishery

The stout whiting fishery is based in south east Queensland and is limited to only four operators. The fishery commenced in the mid 1990s as a developmental fishery and progressed to a fully fledged fishery. The fishery is

managed by a total allowable catch. There is no recreational fishing interest in the target species.

Spanner Crab Fishery

The spanner crab fishery is an offshore fishery that operates out of ports from Gladstone south to the NSW border. Since the late 1990s, the fishery has been managed by a total allowable commercial catch with individual transferable quotas (ITQs). There is only limited recreational interest in the capture of this species.

Ocean Beach Net Fishery

The Ocean Beach fishery principally targets sea mullet in the winter months from Fraser Island south to the NSW border. The fishery is divided into eight specific zones and an operator requires a specific endorsement to fish in a zone. The number of operators in a zone varies but is generally low (less than 12). Fishing apparatus and its use is highly regulated with a focus on “priority of shot” arrangements that attempt to ensure fair access for all operators. The fishery is highly visible to the general public and in many of the zones there is a history of conflict with recreational fishers.

Gulf of Carpentaria Net Fishery (N3)

The Gulf of Carpentaria inshore net fishery (N3) is mostly based out of Karumba but operators fish throughout most of the inshore areas of the Gulf of Carpentaria. The fishery targets barramundi, blue and king salmon, and also captures a range of other species as by-product. The fishery has a long established regional organisation – the Gulf of Carpentaria Commercial Fishermen’s Association which has been active in management planning for over ten years. The fishery is limited to approximately 90 operators. Due to the remote nature of the fishery enforcement is a challenge and it was recognised by the government early in the management of this fishery that the support and involvement of the industry itself was critical to ensure effective fisheries management.

Tunnel Net fishery

The tunnel net fishery is a sub-sector of the Queensland east coast net fishery (N1). It is currently progressing to a separately endorsed fishery which is likely to have approximately twenty active operators. It is permitted to operate in parts of Moreton Bay and the Great Sandy Straits/Hervey Bay only. The fishery targets a mixed finfish including sea mullet, yellowfin bream and sand whiting. The fishery is not managed by a total allowable catch.

East Coast Tropical Rock Lobster Fishery

The east coast tropical rock lobster fishery is a diver based collection fishery that operates north of Princess Charlotte Bay. There is limited traditional and recreational harvesting of the species – generally restricted to areas adjacent

to townships and major access points. Commencing in 2009, the fishery will be managed under a TACC which is set on a precautionary basis.

Deepwater Finfish Fishery

The Deepwater Finfish Fishery (DFF) targets a range of demersal (bottom dwelling) species, primarily belonging to the families Serranidae, Polyprionidae, Lutjanidae, Lethrinidae and Carangidae in waters deeper than 200 metres. There are 12 licences issued for the fishery and fishing operations remain small scale (only about 100 tonnes landed). The commercial viability of this fishery is uncertain as a result of the implementation of the Representative Areas Program (RAP) in the Great Marine Reef Marine Park and the Queensland State Line Plan.

East Coast Beche de mer Fishery

The east coast beche de mer fishery consists of 18 licences held by three businesses. Harvesting is by hand with the aid of hookah or SCUBA to depths of about 30 metres. The fishery tends to focus north of Townsville to Cape York although it is permitted to occur as far south as Tin Can Bay. The fishery is managed by a total allowable catch and is operating under an industry developed MOU which incorporates a time limited, sector-based rotational zoning scheme. Under the rotational zoning scheme the fishery is divided into 154 zones of approximately 100 to 150 square nautical miles (nm) that can be fished for a maximum of 15 days in any one year. Each area is only allocated for fishing one in every three years.

Aquarium Fish Fishery

The Marine Aquarium Fish Fishery (MAFF) is a harvest fishery that is focussed on a diverse suite of species for the hobbyist. Collecting is usually carried out in shallow water with a mask and snorkel or SCUBA. Operators in the MAFF are permitted to harvest aquarium fish and invertebrates along the entire Queensland east coast in areas that are not closed through general fisheries closures or marine parks zoning. The fishery area also comprises five Special Management Areas (SMAs) that can only be accessed by certain holders of an A1 symbol. These areas are Cairns, Whitsundays, Keppel, Sunshine Coast and Moreton Bay. The remainder of the fishery area is open to both A1 and A2 authority holders. The majority of commercial aquarium fish collecting occurs in coastal and reef waters in northern Queensland. Some recreational harvesting by mask and snorkel also occurs. The number of licensed operators is approximately 50.

East Coast Trochus Fishery

The east coast Trochus fishery is a small scale harvest fishery that occurs in intertidal zone and from reefs when free-diving, using SCUBA or hookah apparatus. There are six fishing authorities issued and a total allowable catch is in place. Mackay is the major port for fishing operations.

Coral Fishery

The coral fish consists of 36 individual operators who are endorsed to take coral and living rock per year for the aquarium industry. DPI&F have developed a *Policy for the management of the Coral Fishery*, that provides a management framework to limit harvest through quotas for particular coral species and categories of corals (e.g. live versus dead). The TAC for coral remains at 200 t but the live coral component is capped at 60 t. Individual authority holders retain their existing quotas (between 1 and 4 t) and any TAC not accounted is allocated proportionally among authority holders based on their existing quotas. Coral harvesters are authorised to take no more than 30% live coral and 70% live rock/coral rubble/ornamental coral from their annual quota.

Worms/Yabbies

The harvesting of worms and yabbies occurs in south-east Queensland to support recreational fishing activities. Worm harvesting is restricted to four seagrass areas in Moreton Bay and limited harvesting also occurs in Hervey Bay. Yabby harvesting occurs at numerous locations throughout south-east Queensland. Both fisheries require very low levels of capital investment.

Conceptual Models of Co-management in Queensland Fisheries

There are two main conceptual approaches to pursuing co-management models in Queensland fisheries. The first approach is based on the existing licence structure which includes a number of endorsements. This approach is the main approach considered in this report. In the context of co-management, the management unit is the endorsed fishery. For example, co-management may focus on the spanner crab fishery which is managed under a specific endorsement. The management unit (the fishery) may operate from a number of ports in different regions. There may be regionally specific differences in harvest methods and in a range of operational practices and constraints. For example, distance to fishing grounds may differ between ports which may influence the size of the vessels and the number of days the fishery can operate. The second approach equates in general terms to regional management whereby the fisheries in a region are considered as a “package” and co-management arrangements are regionally based. These management arrangements address operations in a number of specific fisheries with separate endorsements that operate in the regional area. It is also possible however, to have “regional management” in a fishery without any specific co-management arrangements. For example, the eight endorsed zones of the ocean beach fishery (K1 to K8) are very small regions; however the management processes in these regions do not differ significantly from those in the net fishery, or any other fishery as a whole.

In some instances, there is a general alignment with what is considered from the fisheries perspective as a region and the area in which the endorsed fishery can operate. An example of this is the Gulf of Carpentaria Inshore Net

Fishery which is almost solely based out of Karumba, and its area of operation (albeit large) equates to that of the area of the N3 fishery with similar gear and fairly homogenous operations throughout. In contrast, the East Coast Trawl Fishery (ECTF) which is accessed with a T1 encompasses a large number of ports with high diversity in terms of target species and area specific approaches to harvesting – including those that are regulated and those that are not (e.g. “gentleman’s agreements”). In recognition of these differences in the ECTF, this report divided this fishery into its major sub-sectors based on principal target species (e.g. scallops and banana prawns).

As Neville (2008) discusses, there is no one size fits all approach to co-management, and both approaches discussed (or a mix of them) have merit. Basing co-management arrangements on specific fishing endorsements has the advantage that these endorsements reflect an allocated property right and generally specific management plans that are currently enforced. New administrative arrangements are more likely to be efficiently developed and implemented efficiently. Basing co-management arrangements at the regional level has the advantage that this better considers geographic differences in the fishery, fishing businesses that rely on more than one fishery, and can potentially address specific regional issues.

Preconditions for Co-management of Queensland Fisheries

Application of the preconditions are described in Tables 3 and 4, and the combined scores and a determination of whether sufficient motivation currently exists for co-management is described in Table 5. From Table 5, a total of eight fisheries were chosen for the next stage of investigation: Beche de Mer, stout whiting, Gulf of Carpentaria Inshore Net Fishery (N3), spanner crab fishery, Gulf of Carpentaria Finfish Trawl Fishery, the scallop and deepwater king prawn sectors of the East Coast Trawl Fishery, the tropical rock lobster fishery, some zones of the ocean beach net fishery, the tunnel net sector of the net fishery (Moreton Bay and Hervey Bay) and the Moreton Bay trawl fishery. In including the last two, it was acknowledged that the Moreton Bay Marine Park rezoning plan will have a significant impact on Moreton Bay fisheries, however, sufficient will and unique opportunities as a result of previous work exist in Moreton Bay makes further investigation of these fisheries worthwhile.

Table 3. Characteristics of Fishery Sectors and Their Management

Fishery	Management Planning	No. of operators	No. of stakeholders with direct interest	Nature of the fishing right	Direct interaction with other commercial fisheries	Area of the fishery	Fishing Industry Organisation or Relevant Business Structure	Total Score
Beche de Mer	2	2	2	1	2	1	2	12
Stout Whiting	2	2	2	2	1	2	1	12
Trawl - Broodstock	2	2	1	1	2	2	1	11
GoC Finfish Trawl	1	2	2	1	1	2	2	11
Tropical Rock Lobster	1	2	2	1	2	1	2	11
Trochus	0	2	2	2	2	2	0	10
ECTF – Deepwater King	2	1	1	2	1	2	1	10
Aquarium Fish	1	1	2	1	2	1	2	10
Spanner Crab	2	0	2	2	2	0	1	9
Moreton Bay Trawl	2	0	1	2	0	2	2	9
Deepwater Finfish	1	2	2	1	1	1	0	8
Trawl – Banana Prawns	2	0	1	2	1	1	1	8
Coral harvesting	2	2	1	1	0	2	0	8
ECTF - Scallops	2	0	2	2	0	1	1	8
GoC Inshore Net	2	0	0	1	1	1	2	7
Ocean Beach Net	2	1	0	1	1	2	0	7
Tunnel Net	1	1	0	1	1	2	1	7
Mud Crab	0	0	2	1	2	0	0	7
Worm/yabbies	0	1	1	1	2	2	0	7
Line – RQ	2	0	0	2	2	0	0	6
Beam trawl	2	1	0	1	0	2	0	6
Blue Swimmer Crab	2	0	0	1	0	2	0	5
Line – Spanish Mackerel	1	0	0	2	1	0	0	4

Table 4. Social and Human Capital in a Fishery Sector

Fishery	Involvement in Fisheries Management Planning	EMS or Code of Conduct	Training	Linkages with other stakeholder groups	Research participation	Total Score
GoC Inshore Net	2	2	2	2	2	10
Moreton Bay Trawl	2	2	2	2	2	10
Beche de Mer	2	2	1	1	2	8
Stout Whiting	2	2	0	1	2	7
Tunnel Net	2	2	1	1	1	7
Trawl - Broodstock	1	2	0	2	2	7
GoC Finfish Trawl	2	0	1	1	2	6
ECTF – Deepwater King	1	1	2	1	1	6
Spanner Crab	2	0	1	0	2	5
Trawl – Banana Prawns	2	0	0	1	2	5
Line - RQ	2	0	0	1	2	5
Worms/yabbies	1	0	0	2	2	5
Mud Crab Fishery	2	0	1	1	1	5
ECTF - Scallops	2	0	1	1	1	5
Aquarium Fish	2	0	0	1	2	5
Ocean Beach Net	2	0	0	1	1	4
Line – Spanish Mackerel	2	0	0	1	1	4
Beam Trawl (T5-T9)	0	1	1	1	1	4
Tropical Rock Lobster	1	2	0	0	1	4
Blue Swimmer Crab	1	0	0	0	2	3
Trochus	1	0	0	0	1	2
Deepwater Finfish	1	0	0	0	1	2
Coral harvesting	1	0	0	0	1	2

Table 5. Motivations and Total Precondition Scores

Fishery	Sufficient Motivation (industry)	Sufficient Motivation (fishery's agency)	Characteristics of the fishery & its management	Social & human capital	Total Score
Beche de Mer	**YES**	**YES**	**12**	**8**	**20**
Moreton Bay Trawl	**YES**	**YES**	**9**	**10**	**19**
Stout Whiting	**YES**	**YES**	**12**	**7**	**19**
Trawl - Broodstock	NO	NO	11	7	18
GoC Inshore Net	UNCERTAIN	YES	7	10	17
GoC Finfish Trawl	**YES**	**YES**	**11**	**6**	**17**
ECTF – Deepwater King	**YES**	**YES**	**10**	**6**	**16**
Tropical Rock Lobster	**YES**	**YES**	**11**	**4**	**15**
Aquarium Fish	NO	NO	10	5	15
Spanner Crab	NO	YES	9	5	14
Tunnel Net	**YES**	**CONDITIONAL**	**7**	**7**	**14**
ECTF - Scallops	**YES**	**YES**	**8**	**5**	**13**
ECTF – Banana Prawns	NO	NO	8	5	13
Mud Crab (East coast)	NO	NO	7	5	12
Trochus	NO	NO	10	2	12
Worms/yabbies	NO	NO	7	5	12
Ocean Beach Net	**YES (in part)**	**CONDITIONAL**	**7**	**4**	**11**
Line - RQ	NO	NO	6	5	11
Deepwater Finfish	NO	YES	8	2	10
Coral Harvesting	NO	NO	8	2	10
Beam trawl (T5-T9)	NO	NO	6	4	10
Blue Swimmer Crab	NO	NO	5	3	8
Line – Spanish Mackerel	NO	NO	4	4	8

Co-management for Selected Queensland Fisheries – Practical Considerations

Fisheries management is not a single task with a single tool, but rather a suite of interrelated activities and functions that contribute towards the goal of sustainable fisheries management (however defined). Broadly, the activities and functions can be grouped under the headings of:

- Administration,
- Management planning and policy development,
- Enforcement and compliance,
- Monitoring and assessment,
- Communication and extension, and
- Research and development.

Neville (2008) identifies that co-management is not about government delegating all responsibility for core functions, and this report reaffirms that these core functions include:

- Powers to make regulations,
- Powers to grant the initial authorisation to fish,
- Compliance, investigation and prosecution powers, and
- Participation in international and national fisheries management planning exercises.

The potential range of management roles and processes that can be devolved to industry have been identified. These roles and responsibilities are not necessarily applicable to all fisheries; however a number of them could be integrated into a co-management "package" as there are obvious synergies. These roles and processes include:

- Data collection and data management.
- Improved partnership arrangements that can facilitate fine scale management within a broader management framework.
- Research.
- License issue, renewal, transfers and fee collections.
- EPBC Reporting.
- Maintaining a registrar of operators.
- Communication and extension.

In terms of incentives, much of the initial industry focus both in Queensland and elsewhere has been on financial savings that co-management can potentially deliver. The review of the literature undertaken suggests that co-management probably has limited scope in terms of service delivery to produce anything other than marginal cost savings. At this stage, it is important to continue to consider financial savings in each fishery, but ensure that industry expectations are not unrealistically high.

An incentive for industry taking on roles such as data collection and management is the ability to collect this data at scales more appropriate for industry needs (e.g. input into marine park planning) and to deliver it in a timely fashion. Likewise, devolution of licensing may allow industry to access this information in a more timely fashion. For example, at the time of writing industry organisations could not get up to date information to determine how many tunnel net fishermen are fishing in Moreton Bay.

Another incentive for industry to develop co-management is the desire to develop and implement real-time management. The interest in real-time management stems from the positive experience in the Spencer Gulf Prawn Fishery that many Queensland fishers are aware of. To realise real time management requires the adoption of several of the roles and processes identified above (e.g. data collection, research, communication etc.).

Candidate Fisheries – Further Review

Section 0 of this report identified eight candidate fisheries for further investigation of progressing further co-management options. In this section each of these fisheries are reviewed in more detail in the context of co-management options. On the 19th December 2008, a co-management workshop was held and facilitated by the principal investigator of this project and attended by industry representatives, fisheries managers from the Queensland Department of Primary Industries and Fisheries, and the Great Barrier Reef Marine Park Authority[1].

Beche-de-Mer Fishery

In many respects the beche-de-mer fishery has already progressed to more co-operative management arrangement than most other Queensland fisheries. Facilitated by only two fishing businesses being involved in the fishery, the industry is actively involved in co-operative management through a memorandum of understanding. The fishing businesses undertake research that underpins stock assessment of new species and this research is critical for understanding the spatial distribution of these species. It was identified at the co-management workshop, that it is prudent to allow maturation of the existing management arrangements for the fishery, rather than seek to establish new management arrangements. As such, this report concludes that there is little current benefit in pursuing modified co-management arrangements for this fishery at this point in time.

Stout Whiting Fishery

The stout whiting fishery remains a suitable potential candidate for new co-management arrangements. While there was clear interest from industry and fisheries manager's at the commencement of this project for new co-management arrangements for this fishery, it is currently unclear what

[1] The Chair of the Fisheries Research and Development Corporation – Mr Peter Neville also attended part of this workshop.

tangible positive changes to management of this fishery can be achieved by developing such arrangements. This report recommends that co-management of this fishery should only progress once clear and specific objectives for such an approach are developed jointly by industry and government.

Gulf of Carpentaria Developmental Finfish Trawl

There was initial interest in the implementation of co-management arrangements in this fishery from QDI&F staff in particular, and the fishery itself has characteristics amenable to co-management. At this stage it was deemed appropriate to allow the fishery to transition to a non-developmental fishery, and consider co-management arrangements when a management plan for the fishery is developed.

East Coast Trawl Fishery Sectors – Scallops and Deepwater King Prawn.

The scallop and deepwater king prawn fishery sectors will be considered together. Both sectors have characteristics amenable to co-management, but both would benefit from the perspective of co-management in being specifically endorsed fisheries. This is an easier proposition for the scallop fishery than the eastern king prawn fishery as the stock is not directly shared by other commercial fisheries. In lieu of a specific endorsement for these fisheries, the operators with a long term commitment in these fisheries need to be identified and encouraged to develop a business structure that would allow for progression of co-management. There are potential industry advantages for co-management of the scallop sector in terms of integrating processing and marketing with the catching sector. Overall at this stage, the development of co-management arrangements for these fisheries is premature and should not be progressed before those in other fisheries discussed in this section.

Ocean Beach Net Fishery

There is currently significant uncertainty in several zones of this fishery as a result of the rezoning of the Moreton Bay Marine Park. This fishery has characteristics amenable to co-management and a level of motivation for developing co-management arrangements to address local conflicts was identified early in this project. However, beyond the identified need to address these conflicts there appears to be limited current scope for co-management arrangements where responsibilities are shared between government and industry.

At this stage, to address the salient issue of local conflict in the ocean beach net fishery, the industry should consider as a priority pursuing local area management through discussion and negotiation with local communities. Where this has been undertaken in the past, for example the Bribie island Ocean Beach Net Fishery Zone, it has been successful at mitigating local conflict in the short term. However to achieve long term outcomes, such approaches need to be undertaken on an ongoing basis.

If discussion and negotiation with local communities is undertaken and is successful, then the specific need for, and approaches to, co-management may be elucidated for this fishery, or some zones of this fishery. There are ongoing uncertainties regarding the economic viability of parts of this fishery as a result of the rezoning of the Moreton Bay Marine Park.

East Coast Tropical Rock Lobster

The East Coast Tropical Rock Lobster Fishery is a fishery that is identified as a prime candidate for the development of co-management arrangements. There are two clear and specific tangible drivers for industry and the fisheries management agency (QDPI&F) to develop co-management arrangements whereby industry takes a more active role in research, management and stakeholder negotiation.

The first driver is the implementation by QDPI&F of total allowable commercial catch arrangements which are based on a precautionary stock assessment. The industry considers that the stock assessment significantly underestimates the biomass of the stock and that fisher knowledge, in particular regarding the spatial distribution and dynamics of the stock, has not been adequately considered in stock assessment. Concerns regarding the lack of effective integration of fisher knowledge are well documented in other Australian fisheries (for instance see Baelde, 2001). The industry however, has accepted the burden of proof to provide additional structured data in a form, and at a scale, that can be used to significantly improve the stock assessment.

The advantages of incorporating fisher knowledge in stock assessment and marine resource management in general are clearly documented (e.g. Scholz et al., 2004). The industry seeks guidance from scientists and managers on the specific data collection needs and a partnership for the provision of such data. The industry can provide additional data that can directly aid stock assessment in a cost effective and timely manner.

The second driver is the negotiated expansion of the existing fishing area. The industry desires a southward expansion of the existing area of the fishery, and recognises that the best approach to achieve this is to openly and actively engage with other stakeholders such as recreational fishers. One way to achieve this is within a framework of co-management, and this is the approach the industry desires.

There are some challenges with developing co-management arrangements for this fishery, but these challenges are far from insurmountable. First, there is how to address interaction with the Torres Strait Tropical Rock Lobster Fishery which is managed by AFMA. The preferred approach at this stage is to develop co-management arrangements for the East Coast Fishery while having regard to the operations of the Torres Strait Fishery, and encourage the Torres Strait Fishery to also pursue co-management. This approach means that the East Coast Fishery is taking the lead and that successful co-

management in that fishery is not contingent upon activities of the Torres Strait Fishery.

In addition, how to consider the operation of the fishery in Papua New Guinea is also a challenge. While an approach that involves Papua New Guinea is ideal, fisheries management in Papua New Guinea is rudimentary at best and managing fisheries in that country is a significant long term challenge. At this stage it is not practical to develop joint co-management arrangements with Papua New Guinea.

In terms of moving co-management forward for this fishery, the workshop identified and discussed the need to develop an overall co-management plan led by industry but in collaboration with QDPI&F. There was also clear recognition of the need to include all relevant stakeholders in the development of the co-management plan. The need for relevant training of industry members in fisheries management principles and processes was also identified. The industry has set a timeframe for commencing the development of co-management arrangements for this fishery.

Moreton Bay Trawl Fishery

The Moreton Bay Trawl Fishery has characteristics amenable to co-management. The development and implementation of co-management arrangements in the Moreton Bay Trawl Fishery is an objective of the Moreton Bay Environmental Management System which was developed as part of the FRDC project 2003/062. Representatives of the Moreton Bay Trawl Fishery see co-management as a natural progression from their previous work and have identified real time management as one of the desired outcomes from co-management. The adaptive management of the juvenile prawn stocks in Moreton Bay is one of the desired objectives of real-time management. Representatives of the Moreton Bay Trawl Fishery have previously travelled to Spencer Gulf and have observed the benefits of real-time management in action.

Through the Moreton Bay Seafood Industry Association (MBSIA), the Moreton Bay Trawl Fishery has worked under the banner of Marine Queensland[2] extensively with other stakeholders including recreational and charter fishers. This will be advantageous for the development of co-management arrangements for the fishery.

A potential challenge identified at the commencement of this project for the fishery was the rezoning of the Moreton Bay Marine Park. However, the Moreton Bay fishing representatives consider that co-management is a potential long-term solution to managing the impacts of reduced fishing access as a result of the marine park rezoning and maintaining and potentially enhancing industry profitability. Considering co-management as a solution to effort displacement from marine park rezoning is a positive of way of moving the management of this fishery forward.

[2] Previously known as the Boating Industry Association of Queensland (BIAQ)

Tunnel Net Fishery

The Tunnel Net Fishery is only permissible in parts of Moreton Bay and Tin Can Bay and as already discussed is in the process of being a separately endorsed net fishery. For the Moreton Bay sector of the Tunnel Net Fishery, much of the previous discussions of the Moreton Bay Trawl Fishery are relevant, as both fisheries are included in the Moreton Bay EMS.

With respect to progressing co-management in the Tunnel Net Fishery, a decision would need to be made whether to progress it for the entire fishery, or whether to progress it initially for the Moreton Bay component only. The latter recognises that the Moreton Bay component of the Tunnel Net Fishery through the EMS process, has developed more experience in management processes than the Tin Can Bay component. There is also likely to be efficiencies in developing and implementing co-management of the Tunnel Net Fishery in concert with the Moreton Bay Trawl Fishery. While these two fisheries are disparate in terms of methods and target species, industry members have worked together previously in developing the Moreton Bay EMS.

To clarify the direction of co-management for the Tunnel Net Fishery, dialogue between Moreton Bay and Tin Can Bay tunnel net operators should be undertaken.

8. Discussion

There is considerable interest from fisheries manager's and in particular parts of the commercial fishing industry for developing new co-management arrangements for Queensland fisheries. Queensland has already progressed significantly down a co-management path as a result of the long standing fisheries management framework that includes Management Advisory Committees (MACs). This interest has grown without clear understanding of what co-management is and what it can deliver in practice for Queensland fisheries. This report extends the work of Neville (2008) and provides a more detailed analysis of moving co-management forward in Queensland fisheries. There are lessons however, for Australian fisheries in general.

There is considerable experience internationally in co-management of fisheries from both developed and developing countries. These international experiences identify the following issues that are relevant to Queensland.

- There is no one specific driver for developing new co-management arrangements – but the most frequently encountered drivers were overfishing and sustainability concerns, and lack of effective enforcement.
- There is not a "one size fits all" model for co-management.
- Co-management probably has limited scope in terms of significantly reducing the overall cost of fisheries management.
- Responsibility should only be devolved to industry if the industry has a formal and legally recognised structure such as a relevant industry organisation or structure.
- All industry participants do not have to "sign up" to co-management and agree on aspects of the management regime, but they all need to be afforded a clear opportunity to participate in a transparent and equitable manner.

Given the widespread uncertainty, particularly from industry, regarding what co-management is and what it can achieve, a key issue in progressing it is ensuring that expectations are realistic. This project has provided additional clarification with respect to what co-management is and how it can be applied to Queensland fisheries. It has presented a realistic focus on co-management that should not create expectations that have no chance of being met in practice. It has reinforced that co-management is evolution and not revolution of fisheries management.

Since there is a large number and diversity of Queensland fisheries, it was necessary to develop an approach that will guide the selection of which fisheries have characteristics amenable to modified co-management arrangements. No "off the shelf" approach to select fisheries best suited for co-management was available, and this project identified three preconditions. The first was that their needed to be sufficient motivation from both the industry and the fisheries management agency. While co-management can

not proceed effectively without such motivation, motivation by itself is insufficient. Two other preconditions were identified and a number of characteristics that could be used to rapidly assess these preconditions were identified and applied. These preconditions were an assessment of the characteristics of the fishery and its management and a measure of social and human capital in the fishery.

As long as sufficient motivation exists, it is important to recognise that any one precondition alone does not make the development and implementation of new co-management arrangements more or less likely to be successful. A range of factors need to be considered in parallel and these factors encompass both the attributes of user groups and resources as well the structure of management. Further, the characteristics of the fishery (or fishery sector) and its management reflect a combination of historical, biophysical and contemporary management factors that, in combination, may influence the potential of a fishery to further develop co-management options (Imperial and Yandle, 1998; Beem, 2007).

The application of the preconditions identified a number of fisheries sectors required further consideration for new co-management arrangements. These fishery sectors were:

- Beche-de-Mer Fishery,
- Moreton Bay Trawl Fishery,
- Tunnel Net Fishery,
- Stout Whiting Fishery,
- Gulf of Carpentaria Developmental Finfish Trawl Fishery,
- Ocean Beach Net Fishery,
- East Coast Trawl Fishery Sectors – Scallops and Deepwater King Prawn, and,
- East Coast Tropical Rock Lobster Fishery.

While all these fisheries sectors have potential for the development of new co-management arrangements, two were considered most likely to have a high chance of success in the immediate term. These were the East Coast Tropical Rock Lobster Fishery and the Moreton Bay Fishery, or more specifically the Moreton Bay Trawl Fishery. There are a number of reasons the other fishery sectors that were identified were deemed less suitable. In the case of the Beche de Mer Fishery, current management arrangements had already moved towards down a co-management path and as such it was determined appropriate to let these arrangements mature.

For the Moreton Bay Trawl Fishery there is a clear and specific aspiration for co-management, and that is the development of real-time management to optimise the profitability of the fishery, while minimising environmental impacts. A potential way forward to achieve this has been identified which gives legally binding but flexible approach to managing the temporal and spatial activities of the fisheries and be consistent with other existing fisheries regulations and marine park requirements.

The Queensland Fisheries Regulations can be modified to include a clause where any additional temporal and spatial closures agreed to by the Moreton Bay Seafood Industry Association (MBSIA), or other relevant body agreed to between the Queensland Government and the commercial fishing industry. The decision making processes of the MBSIA (or alternative body) need to allow the equal involvement of all endorsed licence holders in the decision making process. Whether this involvement is exercised by individual endorsement holders or not is a personal matter for them and does not compromise the integrity of the co-management process. The incentive of having a demonstrable and direct say in fisheries management is likely to result in more active involvement in fisheries management by a larger number of endorsement holders than is currently the case.

Given the close working relationship between the trawl sector and other commercial fishing sectors in Moreton Bay, there is scope for co-management for the Moreton Bay Fishery as a whole. However, for the tunnel net fishery, there remain uncertainties regarding the number and identity of the participants.

Based on the observations for the Moreton Bay fishery, a finding was that rather than being an impediment to co-management, the declaration of marine parks may be an incentive to develop co-management arrangements as a solution to managing the concentration of effort and other issues that may result from implementation of a marine park.

With respect to East Coast Tropical Rock Lobster Fishery the fisheries management agency (QDPI&F) are highly supportive of undertaking a more active and participatory approach in the research that underpins the stock assessment. It is a step forward for the fishery when the burden of proof is accepted, and the industry actively desires to contribute monitoring information to the management of the fishery over and above that required by legislation. The details of the approach however, for achieving this are yet to be finalised.

9. Benefits

The benefits from this project are difficult to quantify. Improved fisheries management represents a public good outcome as well as an outcome for the commercial fishing industry.

The fisheries management agencies and sectors of the commercial fishing industry have been able to better tailor their energies and investments in co-management as a result of this project. They have also benefited from “de-mystifying” the concept of co-management which has allowed for realistic consideration of what can be achieved by co-management of Queensland fisheries.

10. Further Development

Further dissemination of the results of this project would benefit from producing a web-based document to complement the one produced from project 2006/068.

11. Planned Outcomes

This project has taken the concept of co-management and pragmatically considered it within the context of Queensland fisheries. The project has utilised the literature to identify what factors that influence the suitability and likely success of co-management models in Queensland fisheries. The project developed and implemented a rigorous and transparent approach for determining which fishing sectors were most appropriate for pursuing new co-management arrangements. The project held a workshop which very clearly reached consensus as to which fisheries were most amenable to co-management.

The project has provided clarity as to what co-management is and what it can achieve. In combination with project 2006/068, it has assisted in identifying which management roles can and cannot be devolved from government to industry.

The outputs have been used to guide the direction of fisheries management in Queensland. The outcomes from the project are yet to be fully utilised as it will take time to implement the outputs. Nonetheless, both the fisheries management agency and sectors of the commercial fishing industry have commenced moving fisheries management in Queensland further towards a partnership model for co-management.

12. Conclusion

Overall, co-management can be considered an evolution of fisheries management arrangements in Queensland, rather than a revolution. It can be an approach that builds upon existing achievements in fisheries management and existing industry achievements such as Environmental Management Systems and Codes of Conduct.

This project has developed and applied a rigorous and transparent approach to identifying the preconditions that make a fishery amenable to developing co-management arrangements. The approaches and preconditions developed are not specific to Queensland and can be applied elsewhere. Initial application of the preconditions identified eight fisheries that required further investigation for their co-management potential. This further investigation, including workshop input from both government and industry representatives, identified that while all ten had potential, the two standout fisheries was the Tropical Rock Lobster Fishery and the Moreton Bay Fishery.

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APPENDIX 1

CO-MANAGEMENT EXAMPLES FROM AROUND THE WORLD

Location	Fishery	Overall Management Regime	Definition of co-management used	Drivers	Lessons	References
Cheasepeake Bay, United States	Blue Crab fishery	Quotas	The term co-management is not used specifically.	Collapse of important fisheries Uncertainty about the status of the blue crabs	The presence of a technical support group (including fisheries experts as well as natural and social scientists) is important to explain science and different interpretations of the status of the Blue crabs Regular meetings and face-to-face interactions between members of different interest groups Meeting focused on specific issues and 'results orientated' Organisation formed responsible for fisheries management included high level decision makers	Beem (2006)
Maine, United States	Lobster fishery	Trap limits, apprentice programs, eligibility criteria to qualify as commercial fisheries. "V-notch" program established, minimum and maximum sizes established Coast divided into seven different areas, fisherman impose rules on themselves, proposed rules enforced by wardens only after they have a 2/3 approval of licence holders of that area, trap limits.		Overexploitation of resource	Co-management caused conflict. Distributional issues between fishermen. Issues involving the number of traps allowed. Representatives of certain areas were trying to benefit personally rather than representing the community. Events occurring at federal level lead local councils to respond to them instead of working to achieve their own goals. Zone councils must be able to effectively communicate between each other, the fishing communities and state bureaucracy. Size of management areas and boundaries central to issues when co-managing fisheries A lot of time, effort and cooperation involved Trap limits lead to a large reduction in the number of traps each fishermen can fish Management rules passed on with the support of the industry Management rules believed to have worked as catches moved to an all time high.	Acheson and Taylor (2001); Acheson (2006)

Maine, Northeast United States	Groundfish	Seasonal quotas and trip quotas, restricted number of days fishing, catch limits, vessel monitoring system, complete closure on cod and yellowtail fishing, liited entry in to the fishery.	Ecosystem based management' where 'stakeholders should be engaged in the formulation and implementation of decisions concerning environmental resources.	Decreasing stocks. Increasing stringent regulations. Reaction to trend - small fishing boats being replaced by large ones. Plan not working as laws were not enforced effectively.	Heterogeneous in terms of both gear and size of boat People in this industry do not interact Developed plan which included mesh size regulations, seasonal and area closures and mesh size regulations, size limits Fishers not worried about conservation issues as do not believe in the future of the industry. Stocks are still depleted.	Da Silva and Kitts (2006); Acheson (2006)
Georges Bank, Northeast, United States	Groundfish	Individuals vessel days-at-sea	Ecosystem based management where stakeholders should be engaged in the formulation and implementation of decisions concerning environmental resources.	Impending effort restrictions which fishermen thought would make their businesses unviable	-	Da Silva and Kitts (2006)
New England, Northeast United States	Red Crab Fishery	TAC, limited number of days at sea	Ecosystem based management where stakeholders should be engaged in the formulation and implementation of decisions concerning environmental resources.	Protecting the crab resource from a and influx of large Pacific Coast Vessels	-	Da Silva and Kitts (2006)
Mountauk, Northeast United States	Tilefish fishery	10 year stock rebuilding schedule, annual total allowable landings, commercial quota divide into full time, part time and incidental categories. Informal arrangement ensure not all fish is landed at the same time	Ecosystem based management' where stakeholders should be engaged in the formulation and implementation of decisions concerning environmental resources	Fishery management plan created by government proposed to reduce landings by 50%.	All member of organisation (Montauk Tilefish Association) use the same facilities and have known each other for year this allowed agreement to be made expeditiously and without the cost of a lawyer Permits of different categories have separate annual quota there is no race for fish – improved quality of product. Members are more actively involved in research projects Improved safety Stable operating environment Balance between cooperation (to achieve greater benefits)and independence (harvesting strategy) had allowed maximum benefits to MTA members	Da Silva and Kitts (2006); Kitts et al. (2007)

Northeast United States	Herring fishery	TAC, no fishing days, limited access to fishery, equipment restrictions in certain areas, gentlemens' agreement on days out of the fishery	Ecosystem based management where stakeholders should be engaged in the formulation and implementation of decisions concerning environmental resources.	Concerns regarding capacity of fishery	-	Da Silva and Kitts (2006)
New Jersey, United States	Hard clam fishery	-	Process which is structured for maximal participation by stakeholders	Declining fishery yield Significant amount of areas closed due to pollution	Lack of participation/enthusiasm of the state Little scientific knowledge of organism may lead to project failure Limited funds and poor communication between stakeholders may lead to project failure. Problems in getting state to see other stakeholders as equals, they avoided direct involvement in the project. Many stakeholders make getting rapid action on critical matters difficult. Even though project may not have fulfilled all expectations, accomplishments such as gained scientific knowledge, ties between stakeholders and improved organisation skills may mean future projects will succeed. Role of scientists should be precisely delineated.	McCay (1988)

Alaska	Groundfish Pollock fisheries	Community Development Quota (CDQ), limited licences, Individual transferable quotas, roe stripping limitations, closed areas, seasonal allocations. Community development Quota communities given a reserve of 7.5% of the total allowable catch of the pollock fishery. Using industry partnership profit will go to starting or supporting commercial seafood activities in Western Alaska.		Gear conflicts. By-catch on non-target species. Fishing effort by some pre-empting that of others.	Organisations given freedom to use CDQ derived funds to attain overall goal in a way which suits it particular objectives i.e. for training, education, jobs and infrastructure development. Program contributing to economic growth (by creating jobs and generating income), local control and fishery sustainability. The CDQ fishery is more efficient in resource utilisation than the open access fishery	Ginter (1995)
British Columbia, Canada	Geoduck clam fishery	Individual Vessel Quota system, limits for recreational users, weight limits for commercial fishers with licences, First nation fishers have harvesting rights with no regulations. Area quota and licensing combined to IVQ		Excess fishing capacity and effort Overfishing Low economic returns Unsafe fishing practices	Workers fear licences are not guaranteed, and fear the unforeseen. Success of the fishery management attributed to 'small spatial scale of management, adoption of co-management arrangements and limited entry schemes into the fishery. Fishery still requires "greater ecological understanding… further co-management arrangements, negotiations with First Nation stakeholders on allocation and equity issues and securing markets outside Asia" Some fisheries experienced periods of decline during TAC quota schemes – shows they do no guarantee biological or economic success. Ecological, economic and socio-cultural concerns must be incorporated in plans.	Khan (2006)

Senja, Northern Norway	Cod fishery	Open access Regulations on type of fishing equipment that can be used	Involves an equal number of both government and fishermen representatives collaborating to create rules on fishing conduct	Conflicts between fisherman groups associated to different fishing gears	Too much time spent resolving conflicts so not much time was left to make management decisions Fisherman groups should involve more than one commonality, for example gear and local community. Communication is essential – however legitimacy of cooperative management also depends on the nature of communication	Soreng (2006)
Baltic Sea, Denmark	Cod fishery	TAC Quota. TAC divided into quarterly quotas (non transferable). Vessel licence, recognition as commercial fishermen.		Management regime cannot protect the stock	Regulations must be perceived as meaningful Immediate actions for non compliance behaviour must be taken Fishers practical knowledge should be integrated with that of biologists Compliance with regulations most likely to be achieved by 'permanently removing fishing capacity rather than increasing costly MCE activities'. Factors influencing fishers compliance/non-compliance behaviour include: (1) economic gains to be obtained, (2) deterrence and sanctions, (3) compatibility between regulations and fishing practices and patterns (4) efficacy of imposed regulation, (5) norms and morals, (6) perception of being part of a decision making process. Decommissioning scheme lead to substantial fleet reduction, so remaining vessels have bigger share in fishing profit.	Neilsen and Matheisen (2003)

Kattegat, Denmark	Demersal and *Nephrops* fishery	TAC divided into quarterly quotas (non transferable), recognition as commercial fishermen. ITQs, Cod and plaice regulated by quota, combined *Nephrops*, sole and cod have mesh and by-catch regulations. Vessel licence numbers, operational rules and management tasks decided upon by the government.	Sharing fisheries management responsibility between government and fishers.	Management regime cannot protect the stock Management system must be within the EU Common Fishery Policy framework	Need to change "management perspectives from fish stocks to ecosystem and fleet perspectives" Large degree of heterogeneity between fishers as demersal fisheries in multi-species, multi-fleet and a mulitwater fishery. Fishing communities should be included as well as other stakeholder groups. Regulations perceived as meaningful Immediate actions for non compliance behaviour must be taken Fishers practical knowledge should be integrated with that of biologists Factors influencing fishers compliance/non-compliance behaviour include: (1) economic gains to be obtained, (2) deterrence and sanctions, (3) compatibility between regulations and fishing practices and patterns (4) efficacy of imposed regulation, (5) norms and morals, (6) perception of being part of a decision making process. Decommissioning scheme lead to substantial fleet reduction, so remaining vessels have bigger share in fishing profit. Need for flexibility to accommodate the specific challenges in specific fisheries , requiring tailor-made solutions to the different types of fishermen. Compliance behaviour is highly influenced by the meaningfulness and efficacy of the imposed regulations.	Nielsen and Matheisen (2003); Christensen and Raakjaer (2006); Nielsen and Christensen (2006).

North Sea, Denmark	Groundfish fishery	By-catch regulation, closed areas		Management regime cannot protect the stock	Regulations perceived as meaningful Immediate actions for non compliance behaviour must be taken Fishers practical knowledge should be integrated with that of biologists. Factors influencing fishers compliance/non-compliance behaviour include: (1) economic gains to be obtained, (2) deterrence and sanctions, (3) compatibility between regulations and fishing practices and patterns (4) efficacy of imposed regulation, (5) norms and morals, (6) perception of being part of a decision making process. Decommissioning scheme lead to substantial fleet reduction, so remaining vessels have bigger share in fishing profit.	Neilsen and Matheisen (2003)
Kattegat, Denmark	Sole and nephrops fishery	Days at sea	Arrangements where responsibility for resource management is shared between the government and user groups	Problems related to discard and misreporting due to quota system Conflict between stakeholders	Implementation process evaluated by user groups and government agencies. Resource boundaries in place – but mixture of boundaries determine co-management arrangement. Socio-cultural homogeneity was important for collaboration between different user groups. Decommissioning scheme lead to substantial fleet reduction, so remaining vessels have bigger share in fishing profit.	Sen and Neilsen (1996)
Denmark	Matjes Herring Fishery	Quotas divided between Denmark, Sweden and Norway	Arrangements where responsibility for resource management is shared between the government and user groups	Seen as a way to increase resiliency of system to changes in market	Success dependant on aspirations and capabilities of user groups Greater participation can occur when governments are avoiding making difficult decisions Implementation process evaluated by user groups and government Resource boundaries in place – but mixture of boundaries determine co-management arrangement. Decommissioning scheme lead to substantial fleet reduction, so remaining vessels have bigger share in fishing profit.	Sen and Neilsen (1996)

Netherlands	Flatfish fishery	Quotas, transferable quotas, days at sea. Individual transferable quotas.	Arrangements where responsibility for resource management is shared between the government and user groups	Overfishing. Fleet overcapacity. Poor relations between fishermen and government.	Implementation process evaluated by user groups and government agencies. Organisational boundaries in place – but mixture of boundaries determine co-management arrangement Decommissioning scheme reduced the fleet size.	Sen and Neilsen (1996)
UK	Purser seine and Freeze trawlers	Restrictive licensing system – Individual vessel quotas		Overfishing Government incentives to get people into industry	Herring fishers adopted more efficient technology (pelagic trawling and purse seining) which in a short time frame resulted in over fishing and the closure of the fishery.	Davidse et al., (1999) Reid (1998)
Chile	Artisanal shell fishery principally for a diverse assemblage of gastropods.	TAC, fishers were limited to specific areas, minimum size limits for loco, declared seasonal closures, ITQ for industrial jack mackerel fishers, exclusive access zone for artisanal fishers, implementation of Management and Extraction Areas and of Marine Protected Areas.	Negotiating agreement and sharing decision making between groups or communities of fishermen and various levels of government. Includes any agreements where different groups are responsible for managing resources.	Shellfish export boom coincided with high levels of unemployment bringing large amount of workers into the industry and devastating certain shellfish stocks and reducing the income for fishers 45,000 registered artisanal fishers Gastropod catch started to be exported attracting many into the industry	Fishers must perceive themselves as 'owners' and that there are economic benefits to 'ownership' Handpicking species in the intertidal zone is considered an informal activity, there is no official estimation of the quantity handpicked, however studies revealed this handpicking are of great ecological importance and cause dramatic change in the community structure of intertidal zones. Fishers organizations must be representative and transparent. Fishers do not oppose regulations but oppose regulations they deem to be unsuccessful Uniting fishers into organisations proved mostly successful Clashes between types of knowledge - scientific and traditional fisher. Small participation of fishers in training classes Limited number of fisherman in management areas unofficially ignored in times of El Niño or droughts for agricultural and pastoral workers for subsistence Problems related to fisherman paying same rent for management areas when the productivity of it differs between areas and in different seasons.	Schumann (2007); Leiva and Castilla, (2001); Meltzof et al. (2002)

Patos Lagoon, Rio Grande do Sul Brazil	Artisanal fisheries	Fishing effort limit, minimum size mesh and other fishing gear restrictions, closed seasons, restricted fishing licences	Partnership among communities, governmental and non-governmental organizations, was established to move fisheries management toward a negotiation-style decision process"	Two sectors of the government were trying to manage Brazilian fisheries - both had different agendas so management was inefficient Overfishing Habitat destruction and pollution	Management boundaries do not coincide with fisheries Common Property rights boundaries. Benefits of defining the boundaries threatened as fishermen afraid others may reap all the benefits. Management plans do not represent the heterogeneity of resources and community patterns of resource use. Input of fishermen were only considered valid after substantial scientific scrutiny – therefore power between scientists and fishermen is not equal Representatives of the fishermen in the forum would not always represent the interest of those in his area. They were often not fishermen, they were middlemen or politicians. Policies accepted which have a negative impact of local small scale fisherman, conflicting with the forums goals Remaining problems: "minimal recognition of local fishers as concerns rules established, and less then optimal participation of fishers in the forum."	Kalikoski et al. (2002); Kalikoski and Satterfield, 2004)
Arraial do Cabo, Rio de Janeiro, Brazil	Artisanal fishery	Biological reserves (marine parks), restrictions on type of gear, vessels , number of crew, days of access.	Sharing of power and responsibility between government and communities, Middle ground between state management and pure community management, with local stakeholders playing a pivotal role in decision-making, implementation and enforcement.	Overfishing. Individuals which form groups (usually from same family) were controlling access days to the fishing grounds	Government agencies not fulfilling jobs in monitoring and enforcement leading to many fisherman not abiding by the rules. Government understaffed and under funded Smaller fisherman feel their job might be threatened by large scale fisherman if they oppose them in votes therefore avoid voting – a more private form of voting then 'show of hands' is required. Marketing increasingly consolidated with decision making Large aging community of fisherman Support of IBAMA (government environmental agency), availability of resources and monitoring and collaboration of fisherman and other community members is vital for system to work.	Da Silva, 2004

Valenca, Bahia, Brazil	Artisanal fishery	Open access, Division of fishing spots between artisanal fishermen	-	Created over time. Evolution of traditional approaches to management.	Fishing spots of artisanal shrimp fishermen remained constant for over 30 years, even though fishing gear has changed Fishing spots are near the fishers residence - "represents a nonoverlapping use of aquatic space to obtain resources" No knowledge of whether fishing practices are sustainable or not as landing data, for example, is not available	Begossi (2006)
Braganca, Para, Brazil	Artisanal fishery of crabs in the mangrove regions	Mangrove resource utilisations prohibited by federal government. However use of resources allowed for locals at local government level	Extractive reserve. where local users have the right to exploit renewable natural resources in a sustainable way through a management plan approved by the federal government	Created to protect local residents resource s from outsiders Resource depletion due to habitat degradation	Social problems complicate matters further. Crab population is highly variable. Mangrove deforestation and degradation continue due to little enforcement of law, and this directly affects crab populations. Conflicts between different stakeholders Conflict between federal and local laws	Glaser and Oliveria (2004)
Costa Rica	Coral Reef fisheries	Unclear	Partnership agreement between the government and the communities.	Conflict between fishermen and government authorities Coastal population growing which was increasing pressure on fisheries resources. Several MPAs established forcing fishermen to concentrate themselves into smaller areas Exploitation of resources by international fleets	As coastal communities change over time, fisheries management must be adaptive. First step for successful co-management strategy involves improving cooperation and coordination between governmental agencies Need to consider in detail the history of local management. Difficulty in determining community - usually described as "territorially fixed, small and homogenous" however a significant part of coastal land was bought by international companies and tourists. Problems related to efficiency of management decisions when two different institutions are managing the natural resources but have different narrow focused perspectives.	Alpizar (2006)

Turks and Caicos Islands, Caribbean	Conch and lobster fishery	Closed seasons, Fishers and owners of the two processing plants meet with representatives from government and 'bid' a price for the lobsters and conch to open the season		Decline in the lobster stock	Strong interrelationship between both fisheries, when the stock of one starts to decline (due to overexploitation) fishers target the other. The lobster is the primary fishery however depending on the stock and price of the lobster, fishermen will allocate effort to fishing conch Those involved in the lobster fishery are generally more knowledgeable (know where to find them) and more skilled (can dive deeper) than conch fishermen – consequently peer pressure influences fishers to become lobster fishermen. Fishermen not getting the maximum return from the fishery as lobsters caught early in the season are juveniles - leads to a rapid decline in the stock An increased amount of pressure is put on the conch fishery due to problems of the lobster fishery Understanding fishers response to biological, economic and regulatory conditions in fisheries is critical to designing management plans	Bene and Tewfik (2001)
Jamaica	Inshore fisheries	Restricted access to those within the community, increased size of mesh, monitored catch, creates a fishery reserve		State intervention turned fishery into a virtual open access regime which to over fishing of the inshore fisheries	Modernisation of equipment have introduced serious disturbances to the system	Brown and Pomeroy (1999)
Eastern Caribbean (Grenadines, St.Lucia and Dominica)	Beach seine fisheries	Allocated space depending on time, gear restrictions and rules imposed by community		Created over time. Evolution of traditional approaches to management.	Modernisation and economic changes have introduced serious disturbances to system	Brown and Pomeroy (1999)
Belize, Caribbean	Lobster and Conch fishery	Restricted access to national fishers, collaborative patrolling to ensure compliance with regulations, participatory decision making of regulatory framework		Artisanal fishermen encouraged to sell their product to the United States, huge profits were made through the export markets and fishers recognised they were being exploited. They organised themselves and took over the production and marketing of lobster.	High export earning strengthen the cooperatives economically. Conflicts between users still present Younger fishermen are leaving their career and moving into better paid tourism jobs - weakening the organisation. Government's lack of resources makes enforcement ineffective.	Brown and Pomeroy (1999)

St Lucia	Sea urchin fisheries	Licences introduced, season closures, size limits.	A form of participatory management in which local community stakeholders share resource management responsibilities with regional or national institutional bodies.	Increase demand for sea urchins in neighbouring towns lead to the harvest of sea urchins to transform from a family based undertaking into a commercial enterprise. Hurricane hit area also leading to the decline of the sea urchins Near depletion of resource lead to ban in sea urchin harvesting while a community based management plan was developed	Decision making is still a top down process Research coordinated by the NGO was mostly undertaken by the community (i.e. a pre harvest survey of the sea urchin population based on which the season is opened) Differences in perception of role of divers between divers and community still exist Conflict between knowledge, divers are keen to learn about areas of fisheries management they are less knowledgeable than the fisheries staff however resent the fact the fisheries staff does not take into consideration their knowledge Management plan should recognise differences between full time and part time divers, taking advantage of the position of the full time divers i.e. for monitoring. In return they should be granted log term fishing licences Training for fishers to manage their own affair was identified as beneficial.	Brown and Pomeroy (1999); Wagner (1997)
Bangladesh	Seasonal floodplain fisheries (stocking rice fields with fish)	Restricted access to land owners and landless who had previously used area for subsistence fishing, restocking of fish. Group approach used (20 households and landless labourers). Landowners comprised of participating (active) and non-participating (passive) persons. Participating landowners received additional share of benefits for their role as a group member, on top of the share they had for their role as a landowner.		Landless had no source of income during the wet season Wild fish harvest from flooded rice fields decreased	More work required to "understand the social and economic viability of these approaches under different socio cultural and institutional arrangements". Methodologies used for measuring water productivity need to be improved (previously based on crop production only) Community based fish culture in rice fields can increase fish production by about 600/kg/ha/year. Social harmony between group prior to establishment of this system was required for its success Selection of fish species and densities important to avoid predation and to achieve greater sizes at harvest Portion of revenue of fish sales reinvested in purchasing fingerlings and maintaining fences	Dey and Prein, 2006

Bangladesh	Inland freshwater fisheries	Direct access rights to fishermen, no leasing of public water bodies to middlemen restocking and voluntary seasonal closures of the fishery	Management functions, rights and responsibilities are shared in a balanced way between government agencies and NGOs. Resource users should be able to interact directly with the government department.	Wanted sustainable fishing practices and greater equity in the distribution of benefits of the fishery. Habitat destroyed due to revenue orientated policies Government leased property rights over water, keeping poor fishing communities to be at the kindness of leaseholders 'water lords'	Fishing community management requires (at least before they organise themselves) strong institutional support. Strong participation of NGO, with more control over the distribution of assets (consequently there is more commitment of the NGO). Good relationship between fishermen and other users of the resource required Fishery more likely to be instructive or consultative if stakeholders cannot organise themselves effectively – nature of user groups play role in determining type of management regim The political culture and social norms of the country may exclude certain types of co-management arrangement and encourage others	Ahmed et al. (1997); Sen and Neilsen (1996)
Philippines	All fisheries	Not specified	Community based coastal resource management initiated by both government agencies and NGOs are defined as ' large-scale development activities with multiple objectives and sites to be achieved over a long time period' and 'specific and time bound set of activities to achieve a given objective within a designated geographic location', and including fishers when developing fisheries management programs	Increased fishing effort through mid 1980s led to over-exploitation of fish stocks and coastal resource degradation.	Government support through leading, legislation, funding and enforcement as well as 'specifying, legitimizing and enforcing security of tenure and property rights to coastal resources' have been key to its success. NGOs and People Organizations have been active in the promotion and implementation of community based resource management and work together and separately with research and academic institutions. Success is dependant on competent staff and communities who are willing and receptive to managing their own lives – factors which are probably not present in every community. Participation of project beneficiaries is vital. Government agencies must be 'capable and willing to work in partnership with fishers and stakeholders'.	Pomeroy and Carlos (1997)

San Vicente, Philippines	All fisheries	Area access restrictions Gear restrictions Ban of compressor rigs and cyanide fishing,. Marine protected areas	Increasing " local user participation in the management process, with the expectation that such participation would lead to more effective solutions to coastal resource management problems and would otherwise improve the institutional structure of governance"	Blast fishing and cyanide used to capture live food fish, but opposed by many in the community due to environmental damage. Encroachment of tourist facilities and resulting problem Increased sediment load due to inappropriate agricultural techniques, residential developments and logging" Illegal commercial fishing on municipal waters Overfishing.	A number of challenges relating to equity and food security for the community were identified Marine protected areas were formed on close to shore, relatively accessible reef s which was partially degraded. These reefs are not used for fishing by the people with motorised boats, but are relied on by poorer people with non-motorised boats. Fishers who use hook and line resent the restrictive nature of MPAs, seeing it as unnecessarily restrictive as they see that only nets and other fishing methods damage the coral reefs. Net fishermen have motorised boats and therefore do not fish in those areas anyway. Prohibited use of seining (still not enforced). However beach seining is a secondary job for many women and children who are economically disadvantaged. Criticism that the fishers were not given enough opportunity to object to managerial decisions and when they objected they did not have a strong enough voice.	Eder (2005)
Capiz, Philippines	Small scale fisheries	Restricted licensing, Bans on commercial vessels in municipal waters. Ban on dynamite and cyanide fishing. Deployment of artificial reefs. Mangrove conservation and rehabilitation plan	Established local government code which "empowers the local people at the local level to participate directly in affairs of the government, including resource management, to enable them to attain their fullest development as a self reliant community	Overfishing Concerns over the use of destructive fishing methods. Habitat degradation (ponds effluents and industrial waste) Illegal construction of pond dikes and mussel culture farms Illegal fishing within the municipal zone	Fishers prepared to accept that the commercial fishermen fish inside the municipal zone as long as it was 3km from the coastline (even though this was already established as illegal under federal law) Enforcement of laws by government was positively correlated with fishers participation Reasons propelling the community to act collectively in nearshore management includes: concern for their children's future, awareness of mangrove rehabilitation and conservation, assessment of the enforcing of banning dynamite and cyanide fishing. Although the local government empowers local to challenge official codes, they rarely do. Younger generations are more willing to assume resource management responsibilities than older ones The radio can be an effective means of communication to the community	Baticados (2004)

Cogtong Bay, Philippines	Small scale fisheries	Areas designated for collective firewood gathering, mangrove use rights restricted to locals, prohibition on selling mangrove firewood outside the town, licences restricted individuals to certain areas where if they cut a tree they had to replant one.	Allows resource users to be involved in the developing rules and enforcing resource management plans, consequently reducing conflicts between the government and the resource users	Conversion of mangrove into fishponds and for the culture of shrimp and milkfish. Mangrove cutting for firewood. No fishers' organisations were operational and national government's resource management functions were fragmented. Overfishing Deterioration of socioeconomic conditions of locals Illegal fishing	Secure mangrove use rights for local fishers through a 25 year contract if fishers cooperated with farm plan, maintained the mangrove and had a "survival of 80% after a year of new or enrichment planting". Had problems of clashing jurisdictions, different sectors of the government had competing aims. One was promoting the creation of fishponds, which was destroying the mangroves while the other was attempting to conserve the mangroves. A law which prohibited the destruction of mangroves for fish ponds was created. Lax enforcement of rules lead to little change in the fish abundance Difficult to manage coastal resources without the sustained cooperation of the government and the resource users to make rules and regulations work. Better chance of working when resource users and government have a shared commitment and take decisive action Co-management depends, in part, on the existence of material and nonmaterial incentives to enter into collaborative arrangements. Involving the "recognition of resource management problems", the "provision of property rights" and "heavy dependence on coastal resources".	Katon et al. (2000)
San Miguel Bay, Philippines	Nearshore fisheries	Multi-gear open access fishery	Arrangements where responsibility for resource management is shared between the government and user groups	Needed for conflict resolution Overfishing	The type of approach influences the type and nature of user group participation in decision making. Residence boundaries in place – but mixture of boundaries determine co-management arrangement.	Sen and Neilsen (1996)
A number of provinces in the Philippines: Calatagan, Batangas, Mabini-Tingloy	Small artisanal fisheries	Gear restrictions (no dynamite fishing). Zonation of area for different fishing methods	Community based resource management (CBRM) is used to describe a rich diversity of real-world initiatives involving the decentralized governance of fishery, marine and other resources.	Coral reef fauna populations decreasing Coastal development impacting access and productivity. Large threat of external boats fishing in those waters	Focus on building strong interpersonal relationships. Threat of external influences possibly made the organization stronger. Program needs to be adaptive to respond to changing circumstances. It is important to study areas of differentiation across community based programs, analysing specificity and detail within program design respond to the specific needs of each community Considered to be successful in increasing fish catch	Lejano and Ocampo-Salvador (2006)

Apo Island Marine Reserve in Dauin and Negros Oriental and Seilong Island Reserve in Dapitan City. Bohol (Mindanao) Sea, Philippines	General	MPA	Community-based management of coastal resources. Achieving resource management and conservation through community-based initiatives, providing the resource users "with a sense of ownership through full participation, cooperation and empowerment of stakeholders".	Overfishing. Concerns over the use of destructive fishing methods. Pollution Conflicting government policies Lack of effective enforcement.	Acceptance of MPAS as people start ed seeing an increase in fishery yield and improvement in biodiversity in the coastal waters. Enforcement of laws within MPAs difficult in some due to lack of enforcement facilities and support from local officials. Some reported enhanced fishery catches in non protected areas. Active involvement of community in the management is vital, including Networking between national government agencies, local government, NGOs and academics necessary. Conflicting laws and responsibilities between agencies with little integration. Researchers and research institutions need to simplify their findings to be understood and used at the community level and make sure they reach communities. Need information and education campaign to increase awareness and support for MPAs and related issues among local people.	Indab and Suarez-Aspilla (2004)
Baan Ao Lom, Thailand	General	Open access with gear restrictions. Fishing boundaries were based on historical	-	Conflict and overexploitation within the fishery. Many villagers forced out of the fishery as a result of job insecurity and low wages.	Age, gender and class differences were reflected by different degrees of interest in the monitoring and enforcing fisheries regulations, i.e. the young seemed uninterested. Collective action reflected lack of dominant authority in the Thai government due to their inability to enforce laws Villagers universally associated the declining catch to push nets and trawlers, making it easy to "vilify a 'common foe'" Meetings were public events - facilitating attendance of individuals which were supposed to be at work Positions attained within the organisation were recognised and respected within the community and among neighbouring communities	Johnson (2001)

Customary Fishing Rights Area, Fiji	Subsistence Fishery	Licences with conditions including: target species, permitted gear, area exclusion and conservation rules	Arrangements where responsibility for resource management is shared between the government and user groups	Conflict between stakeholders.	Socio-cultural boundaries in place – but mixture of boundaries determine co-management arrangement The political culture and social norms of the country may exclude certain types of co-management arrangement and encourage others	Sen and Neilsen (1996)
Mekong River, Kong District, Champasak Province, Laos	Artisanal fisheries	Restrictions of fishing methods all year round and in particular seasons, restrictions in harvesting frogs and certain species of juvenile fish:	Use the term "community based fisheries co-management" where "management systems are centred around communities with users having considerable management decision making power. Although the government participated in the process, it recognises the validity of user tenure over resources". Villages individually establish and enforce regulations for their part of the river.	Increased human exploitation of resource. Habitat disturbance and degradation (i.e. through the building of dams). Mekong River Commission in place to solve trans-boundary problems has failed to resolve issues related to the resource degradation. Fisheries department understaffed and underfunded making monitoring of fisheries in remote areas unrealistic.	Microhabitats and species associated to them protected within established "fisheries conservation zones' determine its success Shows fisheries knowledge is very useful and usually complementary to science Local ecological knowledge is extremely useful for providing researchers with insights into fish stock changes, especially in developing countries where research money is scarce	Baird and Flaherty (2005)
North Coast of Java Indonesia	All fisheries	Ban on trawlers from 1980 to 1982. Extended but the date is not mentioned.	-	Conflicts between commercial and traditional fishermen often lead to violence Excess fishing effort due to overcapacity. Overfishing.	Indonesia has a long tradition of protecting customary rights of small scale fisherman. After two years of the ban to commercial trawling, there was an increased landing of demersal species and small scale fishermen increased their household income by 30%. Government provided subsidies for those commercial trawlers to convert into other types of gear, such as purse seines to harvest pelagic species.	Bailey (1986)

Malacca Sea, Indonesia	All fisheries	Ban on trawlers from 1980 to 1982. Extended but the date is not mentioned.	-	Conflicts between commercial and traditional fishermen often lead to violence. Excess fishing effort due to overcapacity. Trawlers frequently damage the equipment of small scale fishermen, forcing them to abandon those gear types or change fishing ground.	Indonesia has a long tradition of protecting customary rights of small scale fisherman. No increase in small scale fisherman household income Resource continues to be overexploited due to increase in small scale fishers in the area	Bailey (1986)
Vietnam	Seasonal floodplain fisheries (stocking rice fields with fish)	Restricted access to land owners and landless who had previously used area for subsistence fishing, restocking of fish. Group approach used (20 households and landless labourers). Landowners comprised of participating (active) and non participating (passive) persons.		Landless had no source of income during the wet season Wild fish harvest from flooded rice fields decreased	More work required to "understand the social and economic viability of these approaches under different socio cultural and institutional arrangements". Participating landowners received additional share of benefits for their role as a group member, on top of the share they had for their role as a landowner. Methodologies used for measuring water productivity need to be improved (previously based on crop production only) Community based fish culture in rice fields can increase fish production by about 600/kg/ha/year. Social harmony between group prior to establishment of this system was required for its success Portion of revenue of fish sales reinvested in purchasing fingerlings and maintaining fences	Dey and Prein (2006)

Chilba Prefecture, Japan	Abalone fisheries	Access to resources dependent on membership in local cooperative, zones allocated to different fishers organisations. Licences required for helmeted divers, no licences required for breath-holding free divers. Seasonal closures, catch size limits and fishing gear regulations, also have self imposed rules enforced locally by the fishers organisations i.e. restricted diving hours.	Sharing of authority and decision making by communities and government agencies. Allows management efforts to biological, social and economical conditions that vary spatially and over time.	Conflicts between fishermen. Resource decline from 70 metric tons annually to 5 mt tonnes annually in 5 years.	Conservation not valued above short term harvest gains No active efforts to conserve or recover the resource apart from releasing juvenile or seed abalone into their waters Not as interested in the conservation of abalone as most involved have other sources of income (i.e. pension), but still practice it because it is a profitable business. When abalone catches are low they just move into the other fisheries.	Takahashi et al. (2006)
Kanagawa Province, Japan	Summer flounder	Access to resources dependent on membership in local cooperative, licences, closed areas, closed periods, catch size limits and fishing gear regulations, also have self imposed rules enforced locally by the fishers organisations	Sharing of authority and decision making by communities and government agencies.	Summer flounder stock declining	Differences in approaches between older and younger gill-netter organisations, those with younger gill-netters adopted the size limits, those with older fishers didn't Conservation secondary to objectives that concern markets, competition and conflict resolution"	Takahashi et al. (2006)

Akita Prefecture, Japan	Sandfish	TAC. 3 year long fishing suspension. Access to resources dependent on membership in local cooperative. Licences, closed areas, closed periods, catch size limits and fishing gear regulations, also have self imposed rules enforced locally by the fishers organisations.	Sharing of authority and decision making by communities and government agencies"	Decline of sandfish stock From 1000mt (1976) to 74 mt (1984)	Local level management can be meaningfully involved in the management of migratory species. Fishers affected by fishing suspension provided with compensation from prefectural and central governments. Fishery recovered after three year fishing suspension. Due to expensive price of sandfish when the catch rates were low, the preference for sandfish by the public changed. No market for sandfish so prices of the fish dropped drastically. Prefectural scale might be too small for migratory species like the sandfish	Takahashi et al. (2006)
Ibaraki Prefecture, Japan	Hamaguri clams	Access to resources dependent on membership in local cooperative, licences, closed areas, closed periods, catch size limits and fishing gear regulations, also have self imposed rules enforced locally by the fishers organisations--Restricted licences, must have membership in fishers organisations, dredging restricted by time of day, rotation between fishers organisations of access zones, limited access zones	Sharing of authority and decision making by communities and government agencies"	Conflicts over fishing grounds Wanted to stabilize market prices and sustain income from fishing Wanted to achieve resource conservation as well as the social and economic sustainability of commercial fishermen at local level.	Efforts by both fishers and scientists adaptively coped with changes clam biology and economic conditions, scientists helping fishers market their clam as a brand. Advantage to community based resource management is that fishers can apply and modify rules in response to resource and market conditions. Prefectural officials (specialised in fisheries management) and scientists work within their prefecture as advisors to the local fishers' organisations, encouraging them to develop self imposed rules related to conservation and sustainability of marine resources. Type of community based management related to whether fish are mobile or sedentary, population dynamics, culture, demography, politics and economics	Takahashi et al. (2006)
Lake Kariba, Zambia	Artisanal gill-net fishery	Open access	Arrangements where responsibility for resource management is shared between the government and user groups	Falling catches Limited resources for enforcement Poor living conditions of fishers and their families	Type of approach influences the type and nature of user group participation in decision making. The "political, culture and social norms of the country" may exclude certain types of co-management arrangement and encourage others	Sen and Neilsen (1996)

Lake Malombe, Malawi	Lake Malombe fishery		Arrangements where responsibility for resource management is shared between the government and user groups	Overexploitation	Fishery more likely to be instructive or consultative if stakeholders cannot organise themselves effectively – nature of user groups plays a role in determining type of management regime Type of approach influences the type and nature of user group participation in decision making. Physical boundaries in place – but mixture of boundaries determine co-management arrangement	Sen and Neilsen (1996)
Faroe Islands	Wetfish fishery	Open access	Arrangements where responsibility for resource management is shared between the government and user groups	Conserve fishery Aimed to ensure an acceptable income for fishermen Seen as a way to increase resiliency of system to changes in the system	Type of approach influences the type and nature of user group participation in decision making" Greater participation can occur when governments are avoiding making difficult decisions Physical boundaries in place – but mixture of boundaries determine co-management arrangement	Sen and Neilsen (1996)
British Colombia	Sablefish Fishery	Uncertain	None provided	Conserve fishery. Aimed to provide transparency in decision making but without compromising long-term conservation. Formal mechanisms for involving stakeholders in fishery decision-making processes remain undefined.	Management Strategy Evaluation (MSE) was a successful tool for involving stakeholders. Management strategy evaluation (MSE) offers a potential vehicle for addressing both policy and process conflicts in fishery co-management. Stakeholders provided compelling reasons for evaluating practical data-based methods for determining catch limits, as well as more elaborate methods based on modern catch-at-age analysis that use industry-supported fishery monitoring programs.	Cox and Kronlund (2008)

Grenada	Lobster Fishery and Beach Seine Fishery.	Minimum length and weight. No-take moulting lobsters. Hand, loop trap and pot only. No landing lobster not whole. No-take lobsters with eggs. No impaling of lobsters. Closed season (May–August). Trammel nets are prohibited.	None provided	NGO driven initiative aimed at sought to strengthen management relationships between the industry and fisheries authority, enhancing the limited social science capacity of the latter in the process.	Fishery managers need to pay more attention to the social and cultural dimensions of their responsibility. Less emphasis should be placed on technical skills and biological or bio-economic management models. Both fisheries were headed to a consultative co-management approach. Fishers what rules in legislation, but input into designing the rules, but a formal tribunal to determine penalties for non-compliance rather than a magistrate. This tribunal included a fisher as well as other members of the community. Limited capacity (including world view) of the fisheries authority and the public sector as a whole.	McConney and Baldeo (2007)