The CEVIS
South West Nova Scotia Case

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1. Introduction

1.1 Purpose and Methodology of the Case Study

This case study is part of the Comparative Evaluations of Innovative Solutions in European Fisheries Management (CEVIS) Project. The last decades have witnessed the rise of innovative fisheries management systems which have been proposed as alternatives for traditional command & control regimes. These include a wide range of alternatives such as participatory governance, rights based approaches, effort controls and various kinds of decision rule systems. The purpose of the CEVIS project was to evaluate these alternative approaches for their usefulness in European fisheries management. We made visits to four places outside of Europe, that A) have fisheries similar to Europe's, B) have implemented innovations that contain various degrees of participatory governance, rights-based, effort-control and decision-rule based systems. These places were Alaska, Maritime Canada, Iceland and New Zealand.

This chapter reports on our visit to the province of Nova Scotia in Canada. We focussed our inquiries mainly on the management of the inshore ground fish fishery but also included other fisheries in our discussions about how the Canadians were structuring their fisheries science institutions. This area attracted us because of several kinds of innovations, the main one being the different ways they combine a rights-based management system built on individual quotas will participatory governance. We began our investigation with a literature review on fisheries management in Nova Scotia and then followed up in February of 2007 with a two week study tour during which we interviewed 20 people: five fisheries scientists, five fishers, five managers and five "others". The latter category included two conservationists, an academic expert in Nova Scotia fisheries, a council member in a fishing village, and a woman who heads a society working to bring together scientists and fishers.

A literature review and a study tour do not create experts in Nova Scotian fisheries. Our job was to learn about what was happening in Nova Scotia while keeping our own problems here in Europe in mind. We were looking for experiences and lessons we could take back with us, and new ideas that might create an "Ah Ha!" experience helping us to look at management issues in a new way. The following report consists of four main sections. We begin with some brief background material on groundfish management in Nova Scotia. Section 2 discusses the recent history and outcomes of rights-based management, with a particular focus on the inshore mobile gear fishery. Sections 3 and 4 focus on two different innovations under the general category of participatory governance. Section 3 looks at the local fisheries co-management initiatives called Community Management Boards (CMB). Here we discuss in particular a combination of innovations that we found very interesting: one of the CMBs has created, in effect, its own transferable rights-based system. Section 4 looks at some of the advances the Canadians have been making in participation in the scientific and decisional aspects of fisheries management.

We conclude with a discussion of the implications of what we learned for Europe. This includes some hypotheses about what kinds of things might work well in particular circumstances and some "best practices", meaning ideas we found in Canada that we feel might be particularly useful in Europe.

1.2 Background to the Case Study Innovations

1.2.1 Changes from Round Fish to Invertebrate Fisheries

The state of fisheries in Atlantic Canada is still very much a result of the collapse of the Northern Cod stock and the depletion of most other groundfish stocks in the late eighties and early nineties. In the early 1980's, Canadian catches of Atlantic groundfish peaked at 775,000 tonnes, gradually declining to 688,000 tonnes by 1988. This decline then continued rapidly, dropping to 418,000 tonnes in 1992, and to 250,000 tonnes in 1993. The 10 principal cod and flatfish stocks went from 500,000 tonnes in 1988 to less than 100,000 tonnes in 1993 (http://www.dfo-mpo.gc.ca/communic/statistics/commercial/landings/sum_e.htm). This means a decline in catch of 90 percent in five years. Following the collapse and a subsequent moratorium imposed on commercial fishing for cod in 1992, industry restructuring and social dislocation in coastal communities across the Atlantic coast led to approximately 40 000 persons out of work (Harris, 1995, cited in Potts, 2003).

Extensive literature exists about the causes of the collapse, evidencing human errors rather than environmental causes. Sinclair et al. (1999) acknowledged that "*failure to meet the objectives was due to deficiencies in the groundfish management system as a whole, rather than to problems with any particular component*". Overfishing and juvenile discarding are considered as the main factors (Hutchings and Myers, 1994; Myers et al., 1997), but errors in stock assessment assumptions and over optimistic forecasts leading to unsustainable TACs have also been advocated as a major reason of the collapse (Walters and Maguire, 1996, Shelton and Lilly, 2000).

Post-moratorium analyses have also underlined the role of over optimistic scientific advice in management. Rice et al. (2003) stated that the observed changes in productivity made the projections of recovery time severely overly optimistic, which consequences are more grievous and lasting than the costs of being overly pessimistic, because re-opening criteria were based on erroneous assumptions on productivity. A slight improvement was observed in the late nineties, leading to partial reopening of the fisheries. As a consequence, the recovery process reversed and main Atlantic stocks were closed again in all areas between Labrador and Gulf of St Lawrence.

More than a decade after the collapse and the moratorium, most groundfish stocks have failed to recover at predicted rates, and are still at very low biomass levels, for the whole Canada Atlantic. Shelton et al (2006) indicate that recent productivity in ground fish is much lower than before, due to increased natural mortality, decreased body growth, and in a few cases, reduced recruitment rates. Continued fishing in directed and bycatch fisheries is also an important factor, and fishing mortality is further delaying recovery.

Although the collapse was not as severe in the Scotia-Fundy area, and thus no moratorium is currently in force, groundfish stocks in areas 4W and 4X are still in poor state with low productivity. Most of the groundfish fishery is found in areas 4X and 5 between Halifax, Nova Scotia and the Canada-U.S. boundary and in the Bay of Fundy. This means that it is shared between the provinces of Nova Scotia and New Brunswick, with the Nova Scotia fleet being much the larger of the two. There were 900 active groundfish licences in 2003, over 700 of these were fixed gear vessels. Approximately 55,000t of groundfish were landed in 2003 with a value of about $90 million (DFO 2004a).

Invertebrate fisheries, on the other hand, have become increasingly important. Frank et al. (2005) argue that the Scotia Shelf ecosystem has experienced a "*trophic cascade*" driven by what they

describe as the "*virtual elimination*" (2005: 1621) of the structural influence of commercial fish species on the ecosystem. One result was a marked increase in the abundance of small pelagic fish and benthic macroinvertebrates. According to the Nova Scotian government the landed value of invertebrate fisheries in 2004 was $ 596 million or 80% of the overall landed value from all species. The major species include lobster, snow crab, shrimp and scallops http://www.gov.ns.ca/fish/marine/sectors/invert.shtml. The value of fish landed in Nova Scotia reached $701 million in 1987 and then declined to $482 million in 1997, however landed values in 1997 were double what they were in 1970. The reason for this is increased landings of high value invertebrate species (Charles et al. 2001).

One main characteristic for these stocks is that the traditional VPA-based methods used for fish cannot be applied to the stock assessment of such species, both because the age determination is almost impossible and because the time-series are not long enough to apply the methods. As a consequence, more ad-hoc methods are used, mostly on a case-by-case basis.

1.2.2 Institutional Changes in Canadian and Nova Scotian Fisheries Management.

In addition to, and to some degree in response to, the ecological changes major changes took place in the early 1990s in the way that Nova Scotian fisheries are managed. These changes are interrelated and driven by a complex mixture of management ideology, the changes in the fishery, and bureaucratic imperatives.

One major change was an accelerated shift to quota management through individual quotas based on historical participation in the fishery. Individual quotas (IQs) and, indeed, individual transferable quotas (ITQs) had existed in Canada for some time. More than half of Atlantic Canada's fisheries have some sort of fishing right or privilege within a quota system. The Bay of Fundy herring seine fishery had IQs boat quotas in 1976 and became an ITQ system in 1983. The offshore ground fishery got Enterprise Allocations, essentially ITQs, in 1982 (Apostle et al. 2002). Our discussion here focuses on two fleets, both of which are based on an individual quota system but structured very differently. The inshore (< 65') mobile ground fish fishery currently managed under an ITQ system. The inshore (< 45') fixed gear fishery, which uses long lines, gillnets and hand lines, is managed through community quotas based on the aggregations of individual quotas. The change was a very difficult one, involving open public protests and demonstrations as well as considerable private anguish.

A second major institutional change in Nova Scotia fisheries management was severe cutbacks in the budget of the Department of Fisheries and Oceans (DFO). In the period leading up to 1999, DFO's budget was cut by a third and they lost a quarter of their staff. The scientific resources have been shifted to include other areas besides fisheries but industry initiatives have been filling the gap (Land and Stephenson 2000). Sinclair et al. (1999) argue that the shift toward co-management was strongly related to a shift in government philosophy towards user fees and cost cutting. Management costs were broadly transferred from government to industry including monitoring and surveillance functions, day-to-day management of the quota system as well as small things such as DFO no longer paying stakeholders' travel and per diem for meetings.

The third major change, which followed directly from the introduction of the individual quota approach was the development of an effective monitoring system. The heart of the system is a privatized "hail in hail out" monitoring system for fish landings. The IQ Committee, which was

charged with the developing the IQ system as described in detail below, and the Groundfish Advisory Committee cooperated with DFO in setting up the monitoring system (Apostle et al. 2002). DFO started to put together a commercial catch monitoring system in the fall of 1990. Their key objective was to develop a system such that one could not move fish from the wharf until it had been weighed and recorded, an important point of this being that the truckers were responsible for the contents of their vehicles. In June of 1992 they created a user-pay system based on a percentage of the landings. DFO was still paying a share of this because non-ITQ species were involved. The monitoring system moved to a fee-for-service approach in 1993 because it faced a financial crisis as a result of quota cutbacks (Apostle et al. 2002). In the fall of 1992 quota cutbacks created financial pressures on the system and some people, especially in eastern Nova Scotia, did not pay their share. In 1996 a new company took over and instituted an "arms-length rule" meaning that the fishing industry now had nothing to do with running the monitoring system (Apostle et al. 2002).

In the current system independent companies collect the data based on a contract they make with the individual fisher. This is a requirement for the fishing license. This kind of system is now ubiquitous across Atlantic Canada. Thirty five companies take care of all the data collection, including an electronic log book system. The role of DFO is policing the system to ensure full compliance but not to be involved directly. There is also a required observer program for larger boats, who must contract with the observers directly. Finally there are obligations for satellite tracking with the industry bearing the costs for installation and transmission. Comments by some of our respondents indicated that the fact that the government is not actually carrying out the monitoring, it was being done by "*normal people*" hired from the fishing communities by the private sector seemed to increase the legitimacy of the system.

A fourth change is the evolution of the legal framework for fisheries management that occurred for the whole of Canada. Canada's original Fisheries Act was passed in 1868 and it still gives the government the basic power to make regulations for "*the proper management and control of seacoast and inland fisheries*" (Haward et al. 2005 p17). In response to the cod crisis, the 1996 Oceans Act gave DFO the role of integrating the activities of marine agencies operating at the federal, provincial, territorial and local levels. The Oceans Act is "*an extraordinary piece of legislation*" (Haward et al. 2005 p17) that commits Canada to integrated, ecosystem-based precautionary management. The Oceans Act expands the role of DFO to integrate all ocean use activities and users rather than simply fisheries only. Emerging pressures from the international community, including FAO Code of Conduct, have lead DFO to develop Objectives-based Fishery Management (OBFM) which provides a broad operational framework for addressing ecosystem and precautionary considerations. A key part of this has been the development of Integrated Fishery Management Plans (IFMP) as operational tools for achieving consistency in management processes since 1995 (Auditor General 1999, cited in Potts, 2003). These are regulatory instruments that set the basis for licensing and regulatory requirements. Finally, the Species at Risk Act came into force in 2003 and has increased the focus on bycatch species. It has evolved into a very restrictive law-driven constraint on fisheries management.

Finally, the last major institutional change in the background of this case study is a general move towards a more participatory approach to fisheries management, albeit a participatory approach firmly under the control of DFO. Both of the fleets we examine closely below have their own industry advisory committee. The community management boards, examined at length below, are perhaps the most ambitious example of a participatory approach to management.

Another aspect of this is the Fisheries Resource Conservation Council (FRCC). This is a stakeholder body with diverse stakeholder membership that considers a wide range of issues. The main focus, however, is on conservation. The FRCC is charged with preparing formal recommendations to the Minister. This body has been through a considerable evolution since its formation. It has become a more open and participatory as indicated by both the number and kinds of spokespeople and it has become a forum for the open discussion of scientific issues (Sinclair et al. 1999). The FRCC and its role in science are discussed below in Section 4.4.2.

The history of the introduction of rights-based management through the IQ Committee, which later became the ITQ Committee, is a good example of the problems and possibilities in this more participatory ethos. The Committee was selected by DFO but only after a survey indicated that fishers, and especially the processors, wanted this approach rather than selection through communities. Sixty percent voted for this approach and DFO agreed to this scheme while expressing reluctance. The system is not a co-operative management scheme but was based on DFO wanting to make a clearer distinction between conservation and allocation and this was a means of transferring some allocation decisions (Apostle et al. 2002). The IQ Committee process worked well internally. It was a fairly homogeneous group, especially in comparison to the old Groundfish Advisory meetings where offshore, mobile and fixed gear reps could not get along. There was also some external hostility (death threats) that the authors believe helped increase the internal legitimacy The ITQ Committee also has real roots in the community and this has limited the ideological assertion of property rights (Apostle et al. 2002).

2 The Right-based System

2.1 A Brief History of the innovation

When the decision was made to introduce an ITQ system, the inshore mobile fleet had the biggest capacity problem in the Scotia-Fundy region. It was four times the size required to harvest its quota at the target fishing mortality rate (F0.1) (Liew 2001). Stock decline in the late 80s led to early closures especially in 1989 and these closures were the immediate catalyst for the Minister of Fisheries and Oceans' action to get an Order-in-Council to create IQs. This decision set aside for later the issue of transferability and the issue of initial allocations (Apostle et al. 2002).

Quota allocation began in February 1990 with a Working Group of representatives from the catching sector and the ground fish industry associations, provincial governments, and DFO. The Working Group was charged with identifying the stocks to include, the operational guidelines including that sharing and appeal system, and monitoring. The Working Group met with fishing communities in the summer of 1990 to explain the programme and hear the views of licence holders. Later in the fall these meetings began to also include discussions of transferability options, limits on quota accumulation and the overall duration of the programme. The programme began on 1 January 1991 (Liew 2001).

Further modifications were carried out by an IQ Management Committee, which was created in late 1991, and later became the ITQ Management Committee. They quickly made some major changes such as making the IQ system permanent and allow permanent transfer, thus creating a true ITQ system. They also expanded the system to include Georges Bank cod and haddock. Working with DFO they designed the self-financed dockside monitoring system described in the previous section

(Apostle et al. 2002). During the summer of 1992 the DFO adopted these recommended changes and also recognized the decision-making authority of the IQ Committee (Apostle et al. 2002).

Vessel owners were given the option of joining the ITQ system, fishing under a competitive quota reserved for fixed gears, or joining a "generalist" category that would also fish under a competitive quota. Of the 455 eligible vessels 325 chose to remain in the ITQ system. The 325 dropped to 213 in three years and estimates at the turn of the century were in the range of 100 give or take 20 (Apostle et al. 2002).

McCay et al. (1996) compare the ITQ systems in Canada for groundfish and in the USA for surf clams and ocean quahogs. The SCOQ system was delayed for years because of struggles between independent and vertically integrated firms. The IQ committee in Nova Scotia came to a decision on how to set up the system and make allocations in less than a year. The use of history in SCOQ was a source of delay because of accusations of cheating by the larger firms. There was less concentration in Nova Scotia. The issue of stratification was important but so were differences in process, in Canada it was controlled by one agency that did not have to convince any co-management type body similar to the US Regional Management Council (Apostle et al. 2002).

In 1993 the Fisheries Resource Conservation Council (FRCC) was created. It was the first formal role for the industry in advising the minister. Soon after its creation the FRCC recommended a mid-year quota cutback. This raised the issue of the durability of fishing rights in a new way as ITQ holders were faced with these cutbacks. Fears emerged in respect to both the legitimacy and the stability of the system. If they could not have a guarantee that the quota would not be cut in the middle of the year then it was really no different from a competitive fishery - there would be a race to fish up the quota before the cutbacks were announced (Apostle et al. 2002).

In 1994 serious consideration was given by the ITQ Committee for allowing quota to be pooled by up to 20 licenses which would allow this group to further rationalize their fishing. This would substantially benefit processors and larger quota holders, but would be open to, and benefit, smaller holders as well. DFO was supportive because the paperwork in handling transfers would be reduced as it would be an internal matter for the pools. Lawyers at the Justice Department, however, pointed out that it might not be possible to enforce an individual stopping fishing after the pool quota was exhausted and they also felt it would be difficult to enforce penalties against a pool that overran its quota. The ITQ Committee then dropped the idea (Apostle et al. 2002).

After this point the structure of the ITQ system for the inshore mobile fleet itself seems to have stabilized and the main issues are treated as settled. This does not mean that there are no serious controversies in the fishery. Perhaps the key current issue is that of “trust agreements” discussed below. These agreements raise serious challenges to the fleet separation policy that severely restricts the transfer of quota between the main fleets as well as to the policy of requiring fishers to be owner operators.

2.2 Structure of the individual access rights

2.2.1 Core Fishers

Since 1976, the overall fishing for all species has been limited through a licensing system. On the order of 2400 fixed gear licences exist, for example, of which about 385 are actually fishing. To acquire a license you have to be a full time fisher but the definition of full time fisher varies. The ownership of fishing quota, fishing licenses and the basic access rights are technically separate

issues in the Nova Scotia inshore (< 65') fleet because being a "core fisher" and a license are not the same thing. The status of the core fisher was created in 1996 and included 700 individuals identified in the mid nineties as being, as one manager put it in an interview, a "*bona fide professional fisher*". The official definition (DFO 1996) reads: "*A Core Enterprise means a fishing unit composed of a fisher (head of enterprise), registered vessel(s) and the licences he holds, and which has been designated as such in 1996 under approved criteria*". The criteria are that the fisher must: "*(a) be the head of an enterprise; (b) hold key licences (or, for some Scotia-Fundy fishers, a vessel-based licence); (c) have an attachment to the fishery; and (d) be dependent on the fishery*". Our DFO respondent told us that what they were "*really deciding was who was really dependent on the industry and who was dabbling at it*". The core designation is not necessarily the same thing as a full-time fisher but the fishers who were prevented from becoming core were the ones who DFO judged were not active enough. Non-core fishers were allowed to keep the licenses they had, but when they die the license dies with them. Any certified professional fisher can become core by buying in an existing core. However, if a fisher transfers between national regions he cannot take it with him, he gets rid of what he has here and enters their fishery according to their rules.

2.2.2 Fleets and Quota Allocation

In Nova Scotia ground fish are allocated to individual fleets as shown in Table One. There is an attempt to make these "sharing arrangements" as stable as possible. The Groundfish Management Plan shown in the table covered two years, the subsequent one covered five. However, shifts or swaps of quota between fleets have take place but they are considered extraordinary actions.

Table One: Nova Scotia Groundfish Fleets and their Allocations – 2000

Gear	Fleet	Management System	Active licences	Cod Allocation in Percentage	Haddock Allocation in Percentage	Pollock Allocation in Percentage
Fixed	< 45"	Community	883*	55	25	28
	45" - 65"	ITQ	20	5	4	1
	> 65"	ITQ	11	1	1	0
Mobile	< 65"	ITQ	131	32	56	23
	65"+	EA (ITQ)	35	7	13	49

Figures are taken from the Scotia-Fundy Groundfish Integrated Management Plan 2000-2002 (DFO 2000).
*Includes 47 active licenses in New Brunswick

The management "systems" in fact are built around these quota allocations. Each fleet has a system for administering their quota (Table Two). Consultative bodies such as the Fixed Gear Committee with representatives from each of the Community Management Boards and the ITQ Committee that represents the inshore mobile fleet exist for each of the fleets. Cross-sectoral consultative bodies also exist, such as the RAPs that address scientific issues (see Section 4.2.3).

2.2.3 Historical Participation and its Problems

We began our interviews using fairly open-ended questions to try to get a sense of what our respondents thought was important before we started asking about what we were thinking was important. It was quite striking that the dominant subject in the early part of nearly all of our interviews was the problems in the early 1990s with the introduction of the IQ system and especially the distribution of the initial IQs. While economic theory might suggest that the best way to allocate IQs, at least from the point of view of society's overall economic welfare, would be to auction them to the highest bidder, political reality has dictated that nearly every such distribution tries, in some fashion, to reproduce the pre-IQ status quo distribution of the resource. The main technique for this is to base the distribution on the "historical participation" of individual fishers in the fishery in question.

As is often the case, in Nova Scotia the argument quickly became what "history" one was going to base the allocation on. IQ systems are almost always introduced in fisheries that have been under other kinds of management systems for a long time and these other management systems have partly determined who was going to have the largest and smallest fishing "histories". In the Nova Scotia case is was the prevailing record keeping system in particular that turned out to be critical. Before 1986 DFO had kept very sparse records of catches in the inshore fleet. So most suggestions about when "history" should begin started at that point. After that there was any number of ways that history could be defined. It could be an average percentage over certain years, but which years? Groups formed around the years that would give them the best allocations. A Shelburne fisher explained how his group wanted a "*straight forward 1986-1993 and nothing else.*" But another group was formed to lobby for 1989-1993 years.

Different gear types had kept different kinds of records. In the 1980s there had actually not been very much control, especially in relation to the smaller boats using fixed gears. Hand lines were particularly hard hit by a lack of records. One respondent explained that many people had been more interested in getting unemployment benefits than in recording fish landings. They would ask their friends to put their fish in the friend's name so they could get unemployment. "*They were cheating the system and cutting their own throats at the same time*". Whole areas were disadvantaged for technical reasons. A man from the port of Digby explained that in his area fish for salt processing was not counted, nor was the fish that they had been selling to the mobile gear fleet.

In the end DFO and the IQ committee managed to get the allocations made in a year through an intense round of meetings and consultation. A number of accommodations were made, and formulas were developed for estimating under recorded catches and distributing them as fairly as they could be. It was a painful experience that still seems to play the role of foundational myth for the current Nova Scotia fisheries management system. Apostle et al. (2002) offer a quote from one fisher describing what these meetings were like that seems an apt summary: Fishers "*were looking at the generated numbers and realizing they were going to end up with 60 tonnes of fish, and realizing they were finished. It was a really tense, tough, emotional time and we did that for a year*".

In the end, however, each fisher had their historical allocation assigned and this allocation became the basis for the new management system. For the mobile fleet and the > 45' fixed gear fleet it became the basis for the individual ITQs. For the < 45' fixed gear fleet the individual allocations were pooled and on that basis the community quotas were identified that would be managed by the Community Management Boards.

2.3 Impacts of the Rights-based System

2.3.1 Enabling the Transition to a More Sustainable Fishery

A central point that one manager in particular wished to make to us was that people tend to conflate everything together. The individual quotas system, the hail-in hail-out monitoring system, the cutbacks in the overall magnitude of the quota driven by the ecological situation, and the transferability of the ITQs are lumped together and called "the ITQ system". His argument was that the huge drops in numbers of active boats, processing plants and the geographical concentration of fishing activity (see Section 2.3.2) were all going to happen anyway if you combined massive quota cuts with effective enforcement. People involved in the fixed gear fishery were seeing large numbers of fish plants being closed down and blaming the ITQ system for this, when in reality it was the quota going down and a number of those plants had been kept alive by black landings and were no longer viable because of the new enforcement system. He pointed out that the same thing, at least as far as operational concentration even if not nearly as much geographical concentration happened under community management boards where no ITQs were in play. What the ITQ did was determine the process by which fishing and processing capacity was reduced, not the reduction itself.

Another of our respondents, a commercial fishing representative, supports this view. He believes that the main reason there was a good deal of reluctant support at the time was that people believed it was the only way to avoid chaos and mass bankruptcies. While he is basically critical of the ITQ system he admits that there *"are a hundred stories"* of fishers consolidate appropriately with money changing hands and people not losing their houses. He suggests that as a mechanism to reduced capacity the ITQ is a good mechanism because it allows fair trading and real value to transfer. A manager suggested to us that the central question that ITQs pose for fishers is what they really want to do with their business. They can decide to have the groundfish be a supplement to what they are doing with lobster or harpooning or do they want to fish for groundfish full time. The sentiment was echoed by many of our respondents, both fishers and managers and both strong supporters of the ITQ idea and those who had many reservations about it. In the late 1980s and early 1990s fishing capacity in Nova Scotia had to be reduced and the ITQ system was the fairest and least painful system for accomplishing that goal.

The process is not over. The smaller and less efficient operations continue to be marginalized. The price of fishing has gone up. Global competition is intense. More and more of the costs of management have been placed on the industry. DFO is requiring increased monitoring and observer coverage. Other government agencies are putting pressure on fishers for "professionalization" meaning more training and required certifications, greater investments in safety precautions, workmen's compensation, and insurance. Meanwhile the groundfish resource is still very small by historical standards.

2.3.2 Geographical and Organizational Concentration

The creation of the Nova Scotia ITQ system case was heavily influenced by the fact that the communities involved were very dependent on fishing (McCay et al. 1996). This led to the requirements that ITQ holders be bona fide fishers and a rule that no one could own more than two percent of the total quota (Apostle et al. 2002). However, Apostle et al. (2002) conclude that concentration of ownership has increased since 1990 in spite of the provisions to avoid this. They base this conclusion on interview data with cross-references of estimates as non-confidential records are not a good indicator because of problems identifying true ownership because of the many routes available for getting around ownership limits. Their interview data identified 19 groups of three or more licenses controlled by a single entity. Within a short time of after the implementation of the ITQ system, Creed et al. (1994), found vertical integration with in the community where they did their field work. Only two or three out of 30 mobile-gear vessels there were not tied to one of the fish plants. They found people who believed that the ITQ system favoured those with capital and fishing rights rather than those who work hard at catching fish.

Table Two summarizes some indicators of concentration. These data should be read keeping in mind concentration was very evident in the 1980s. Indeed there is a dip with some measures going down in the early 90s then back up again (Apostle et al. 2002). There has also been a very clear geographical concentration with a big drop in the cod landed in eastern and central Nova Scotia. These areas accounted for 33% of the cod landings in 1991 but only 4% in 1997 (Apostle et al. 2002). Some of this difference, however, can be attributed to changes in stock distribution.

Table Two: Percentage of Landings Going to..

	1990	1997
The top 12 fishing vessels	13	28
The top 10 fishing ports	57	73
The top 11 fish buyers	39	60

Abstracted from Apostle et al. 2002 pages 61-63

In their ethnographic investigation of the impacts of ITQs on the Scotia-Fundy mobile gear groundfish sector Creed et al. (1994) found significant differences in perceptions of social power and access to resources between ITQ holders and non-holders. One of the social impacts they found through ethnographic studies was that people in communities with significant quota became gatekeepers to the fishery. This changed relationships in ways no one liked, even the gatekeepers themselves. (Apostle et al 2002).

Two other policies that are in place to limit organizational and geographical concentration in Nova Scotia fisheries are the Owner-Operator Policy and the Fleet Separation Policy. Both policies are aimed at separating processing and harvesting (DFO 2004b). Under the owner-operator provision, licence holders who are restricted to using vessels less than 65 feet in length are required to fish their

licences personally. There exist some grandfather provisions for fishers who had previously designated an operator for one or more of their vessels and substitute operators are also allowed when circumstance prevent a fisher from fishing personally. One of the key Canadian policies in respect to the inshore (< 65') fleet is the 1979 "fleet separation policy" The policy restricted corporations from holding any new fishing licences for inshore vessels, while it did allow for corporations, including processors, to maintain licenses held before that time. The fleet separation policy was in place before the ITQ system was introduced.

In 2003 DFO produced a "discussion document" (DFO 2004b) based on interactions with stakeholders on the subject of fisheries policies in Atlantic Canada. These discussions uncovered industry views regarding the owner-operator and fleet separation policies that were highly polarized. The problem from the perspective of the inshore fishers was "trust agreements" which they saw as undermining the fleet separation policy. Trust agreements are a legal agreement which allow a license holder to enter into an agreement with a third party which allows them to control the use of the license. These consultations found wide concerns that the trust agreements were eroding the two policies. There were also proposals to make the owner-operator and fleet separation policies more flexible without limiting the use of trust agreements which provoked widespread opposition. The document argues that DFO might have the power to prevent the separation of the license and the benefit if they do so "for fisheries management reasons" and DFO should have to demonstrate this linkage. The consultations have found opposition to the trust agreements is very strong. Many people believe that DFO should pursue a regulatory solution to reducing or eliminating trust agreements and this debate is still ongoing.

2.3.3 Retirement and Recruitment

The entry and exit of fishers into the fishery is an important area of concern among our respondents in respect to the ITQ system, as well as the Community Management Boards discussed below. Several respondents emphasized that ITQs facilitated the retirement of fishers by providing them with an asset they could sell when leaving the business. This, in fact, was one of the major ideological fault lines in debates over the system. One respondent who was deeply involved in the Community Management boards considered a desire to leave the fishery to be perhaps the main determinate of people's attitudes towards ITQs. This respondent observed that people who are planning to keep on fishing are generally opposed to the ITQs system because their increased costs through taking on debt to buy quota would be greater than their benefits. But those wish to leave fishing say yes because it provides a mechanism for doing this. Another respondent said that he thought it was more common to sell a license in order to buy a license in another fishery than to sell a license in order to retire.

Respondents pointed out, however, that the market for small licenses is currently weak. Transfers in the inshore fishery have traditionally tended to take place between a father and his son or other relative. "*But if you look at the papers there are licenses for sale everywhere*". A young man can become a fisher after two years in terms of being able to qualify as a "professional fisher" to buy a license. Then have to buy a license and it may not be possible to use the license to secure a loan from a bank. The ITQS have not usually been recognized as assets for the purpose of loan collateral but very recently court cases have suggested that the licenses, i.e., the access right itself is an asset in the legal sense. While ITQs have been argued to be a block to a young person getting into the fishery because of the cost of quota, but in Nova Scotia licenses for non-ITQ species (e.g. lobster or crab) are just as expensive. With costs of entry as high as they are and the status of these assets being so

unclear, for many young fishers only real choice they have it to go to the processing plants for a loan. This then ties the new fisher to that plant and is one source of the "trust agreements" discussed in the previous section. Finally, many Nova Scotia young people are choosing to going out west drawn by the oil boom in Alberta. This has implications for both finding future boat owners and finding adequate crew now.

The transfer of licenses on leaving the fishery is an issue with wide resonance. The government is easing the very significant capital gains taxes if a license is transferred from a parent to a child. This was the subject of a large debate in the last election. The resulting legislation allows a tax exemption of 500,000 CAD on all licence transfers and an additional 500,000 CAD if the transfer is to an immediate family member. This is one area that has been a particular challenge for the Community Management Boards, with several respondents saying that retirement is perhaps the most contentious disagreement they fact. People with good catch histories go into a community group, but when the time comes that they want to sell their license to retire the group asserts control of the license of the quota attached to it.

2.3.4 Crew

The ITQs have changed some of the shares systems used through which crew members are paid. Owners of larger firms have placed the cost of ITQ on "the top of the lay" in other words the cost of the quota is considered a cost of fishing and deducted from the crews share of the catch and not only from the share of the ITQ owners (McCay et al. 1996). A respondent from the industry explained that while some inventors in quota are still very concerned with communities and the quality of life others are focussed only on maximizing profit and return to crew members is less today than it was 20 years ago. "*Once people started buying the quotas they had another debt and the less reputable ones would shovel that cost on to the crew members*".

Other factors are at work as well. Changes in skill requirements are one. One respondent who works in the industry told us that even in the 70s a generous portion went to the crew because they took a risk, they had to be skilled and they had to manage the trip. But now fishing has become safer and electronic equipment is reducing the level of skill required. Another fisher explained "*there are four of us in our boat. I used to carry seven. This is because of the lower number of fish we have to catch. I used to fish 7-8 days hard, but now I can't so I only take four. The way they are paid is being changed because you have no fish to catch and you have to buy fish before you come then it has to be paid for*".

Recruiting crew has become very difficult. The smaller firms employing kin have often chosen not to decrease the crew share. The crews in Canada are having to work longer hours and are very unhappy; in some cases they are not getting an increase in pay (McCay et al. 1996). A manager working with the informal ITQ system in Shelburne (see Section 2.6 below) told us "*last summer I think the guys started realizing it was a lot harder to find crew. If they didn't like who they had they used to shift faster… It is particularly hard to get the older more experienced people. I don't think there are a lot of young people who want to go fishing. It is cold hard work.* "A respondent in the mobile fleet told us that because the crew share has decreased it is not so easy to find crew for groundfish now. An important factor here is that there is that the lobster fishery is paying relatively well. His community has responded directly to this problem because "*there are still good young people in [his community]*". "*The community is built on hard workers ... who stayed together and saved money, they adapted to the changes*". The community has bought some ITQs as a community an there are, in fact, more vessels and larger vessels than before the change. This quota they are

buying is from the other villages in the area that are not so organized, another aspect of the geographical concentration discussed above.

2.3.5 Markets, Quality and Price

One claim that was made during the introduction of the ITQ system is that it would improve fish quality because fishers could fish more slowly and time their fishing in relation to the market. Some evidence exists of increases in quality. The prices gotten by the inshore mobile sector of cod and haddock, but not pollock, have converged with those of the fixed gear fleet that traditionally got better prices because of higher quality (Apostle et al. 2002).

Among our respondents, however, even those who are very supportive of the ITQ system expressed some disappointment that the improvement in quality and price has not been as great as they would like. A fisher with a large boat and some processing interests explained that the market is not that well organised in Nova Scotia. Fish buyers in New York and New England are the main driver and this has kept Canadian prices low. He argues that Nova Scotia is hurt by the lack of vertically integration created by the fleet separation and owner-operator policy. This weakens the ability of Canadian firms to resist the influence of the American market and set their own prices. Currently fish from the inshore mobile fleet is sold with little processing, mainly fresh and whole. The large trawlers are able to process the fish onboard. For the inshore fleet the ITQs gave stability and security for the investment. The prices went a little up but not so much. The market structure is such that the reward for quality is not really worth the investment.

Another respondent from the commercial sector agreed that product quality and prices has not improved as much as expected. He argued, however, that the market was constrained by the small number of large companies in the off-shore industry who had blocked attempts to set up port-based auction markets in Canada. *"So a lot of what we do here is controlled by auction markets in the US in Portland and New York where we truck in unprocessed fish".* So while there is some variability in fish quality in the market but the price response has not been enough to generate much change". A third respondent said that the ITQ system did not really help the skippers planning their fisheries and stop the race for the fish because in reality, the owner decides when to go out when the prices are good, whatever the weather.

2.3.6 Fishing Behaviour and Conservation

Evidence for a link between ITQS and stewardship is not readily evident and what is there gives mixed signals (Apostle et al. 2002). People are becoming more concerned with enforcement, as protection of their investments. They did decide to adopt a square mesh net. Creed et al. (1994) also heard reports of increased compliance, even claims that illegal landings had almost disappeared. However, some observer data suggests that discarding, dumping and high grading have increased in the ITQ fleet (Apostle et al. 2002).

Apostle et al. (2002) analyzed violation statistics. The found that ITQ system seems to have had a strong downward impact on both the number violations and the severity of the offences. They report that the inshore mobile fleet recorded 331 violations between 1986 and 1990 before the ITQ system and 74 violations between 1991 and 1995. They also did a random sample of 30 cases, 20 from the first period and 10 from the second, to get an idea of the kinds of cases being brought. They found a marked difference with the violations in the earlier period being considerably more serious in addition to being more frequent (Apostle et al. 2002).

ITQ have raised a couple of questions about their direct implications for conservation. An ITQ is probably perfect in a single-species context, argued one respondent from the fishing industry, but bycatch is the Achilles heel of the ITQ system. In a multi-species context such as Nova Scotia, bycatch makes an ITQ system a "*nightmare*" from a business perspective. A Nova Scotia fisher can be dealing with up to six quota species as well as other species with bycatch restrictions. A fisher has a basket of holdings of quota and catches more of one species and less of another. The economic theory would assume the market would operate and you would buy or sell this quota. But quite quickly it becomes apparent that it is easier to discard the fish you have caught than it is to buy quota to cover it. While there are certainly people on shore who had the quota needed to cover the incidental catch, they will be asking three and four time its market value because they know that the fisher will not be able to catch the target species without some quota for the bycatch. This same observation was confirmed by other respondents from the industry.

ITQs also have an impact on conservation because they lock in a particular management system, including a particular definition of the stock that attaches to the ITQ. One industry member, with the agreement of a scientist, explained how they are caught in a situation now where they are finding that what they thought was one stock is really two stocks with a high degree of mixing. The managers at DFO *"tear their hair when we say this as they have already been subdividing and subdividing"*. It is a downside of an ITQ system that it locks ecological realities into hard institutional boxes. The science is saying that we should split 4X cod, 4X haddock and pollock. But right now fishers own a quota of 4X cod and there is not good way to determine if that quota they own is all eastern or all western or should somehow be divided.

2.4 Conclusion

The benefit of the ITQ system is that it provided a mechanism for removing capacity from the fishery that reduced the inevitable disruption in fishers' lives by providing a transparent system for the reallocation of value. The ITQs smoothed the process by which fishing and processing capacity was reduced, but were not the main engine of the reduction itself. The main engines were much smaller quotas and the introduction of effective enforcement. Most of the unfairness that was experienced stemmed from the initial allocation of individual quota based on the reconstructed historical participation rather than the system developed for trading those individual quotas.

The ITQ system in Nova Scotia has had the same negative impacts that have emerged in other areas where such a system has been implemented. It has intensified the organizational and geographical concentration of the industry that would likely have accompanied capacity reduction however it was carried out. It has shifted more of the burden of reducing excess capacity to crew members than is perhaps fair. Attempts to reduce these negative impacts through the design of the system and closely related policies have not been very effective and remain controversial. The impacts of the system on conservation are both unclear and mixed, but from a legal and institutional perspective it has reduced potentials for adaptive management by locking ecological realities that evolve either naturally or as a result of greater scientific understanding – for example the definitions of particular fish stocks - into hard institutional boxes.

The most interesting aspects of rights-based management in Nova Scotia have emerged in its interplay with the reforms toward greater participation that have taken place, especially in the form of the Community Management Boards. It is to this subject that we now turn.

3 The Community Management Boards

3.1 A brief history of the innovation

The Community Management Boards (CMB) were formed for the management of small vessel fixed gear fleet. The Board's were formed in the wake of organized protests focussed on resistance to the introduction of ITQs. Charles et al. (2005) suggest that this happened because the fixed gear fishers did not like what they saw happening in the inshore mobile fishery after ITQs were introduced.

Many of these fishers were also lobster fishers. Charles et al. (2005) describe the lobster fishery as a *"relatively stable core"* of multi-gear inshore fishery. In Nova Scotia inshore fisheries the lobster fishery is strongly place-based and there is a long history of local management going back at least to the 19th century (Haward et al. 2005). The fishers were used to using effort control for lobster and so there was a lot or resistance when DFO introduced quotas for groundfish in the late 1980s. The fishers wanted trip limits because they saw them as more equitable because larger boats can start fishing earlier in the year and this gives them what was perceived as an unfair advantage under a competitive quota approach. In 1994 when DFO decided not to enforce the trip limits there was conflict and the outcome was the establishment of 18 management units, basically counties, each having a quota. This in turn led to the creation of the Sambro pilot management board and the subsequent allocation of the entire fixed gear quota for cod, haddock and pollock into community quotas (Charles et al. 2005).

The Sambro community, as describe by Loucks (1998), was on the cusp between two quota areas and was competing hard for an area where they had had very high historical participation. They took their complaints to DFO and, once they established this high historical participation, began to negotiate what to do about it. They requested an experiment with a "community quota" allocation. This was approved in the spring of 1995. They ensured the plan would be enforced in a democratic way by designing a Fishing Conservation Harvest Plan that was adopted by fishers through a formal contractual agreement. The contract shifted much of the management responsibility from DFO to the Association.

The fishers understood that they had to demonstrate full compliance if the co-management approach was going to work. This was the first community quota in Atlantic Canada and the first time a group of fishers in Scotia Fundy signed a contract committing themselves to a specific harvesting regime. It required that they hire, for one percent of the catch, one of the independent monitoring companies that were involved in the "hail in hail out" system originally set up to monitor the ITQ fleets. DFO would also do random monitoring and if violations were detected the contract would be cancelled.

One of our respondents was a manager who was involved in these activities from the DFO side. He explained that DFO had become very frustrated trying to develop a single management plan for everyone. They were continually running into problems such as different lobster seasons, differences in tides, one area not wanting to start fishing for pollock until June because they were still fishing for lobster but in danger of losing their quota to other areas if they waited. DFO started to address this by basing management on gear types. They created a gill net group, a long line group and a hand line group. They had the fishers choose which group they would belong to and then we used our data to divide the quota. The system worked more or less well for different groups depending on the fishing history information and other factors. But overall it was not a very satisfactory system.

Then came the Sambro experiment. It was requested by the community but agreed to readily by DFO because of dissatisfactions with the gear group approach. During the first year the other groups ran through their quota while Sambro kept right on going through the year. The shift of responsibility to the group, Loucks (1998) argues, resulted in high community cohesion. The Sambro community purposely under fished their quota by five percent.

The success of this system led to DFO formalizing "community quota regions" throughout Nova Scotia in 1996. After the successful first year, as our manager respondent described the events, in fall of 1995, the rest of the groups got together had their own meeting and invited people from DFO. Two hundred people came and said they wanted to try community management. It was not that easy to arrange. There were a lot of different opinions and the county-based groups put fishers together who did not agree. At one point DFO arranged for independent arbitration. Yarmouth and Shelburne, for example, wanted to be one big group; this was not allowed because DFO wanted to avoid mixing the slower fishers from Yarmouth in with the high liners from Shelburne. They did not want "*piggy backers*". Once the communities finished their negotiations DFO met with them and a final decision was made.

The most contentious area was Shelburne County which is by far the most important area for fixed gear, nearly half of the fixed gear fishing takes place there. Sinclair et al. (1999) describe the complexity of the Shelburne County fishery, with more than 800 fixed-gear < 45' licences. They suggest that the fishers were basically forced to organize. Shelburne County could not come to an agreement and in the end DFO had the divide them into two management boards, Shelburne A and Shelburne B. This arrangement continues to this day.

DFO is very satisfied with the division of responsibilities. "*The boards do a whole bunch of things we did before, we have downloaded responsibilities. We had very little support before in trying to manage fisheries, now they can do their own thing"* explained the manager who had been involved in the process. The boards have the responsibility for defining entitlements on how to harvest the assigned allocation (Peacock and Hansen 2000). The communities have taken a number of approaches, which range from a competitive fishery (by gear type) within an overall community-quota on a per species basis, to an industry-developed and delivered ITQ initiative.

Enforcement is carried out under the CMBs based on the Conservation Harvesting Plans that are the basis of their contracts with DFO. Within communities and/or quota groups it is up to the participants to develop allocation rules and this process has been extremely divisive in some communities, and it is creating tensions among fishers and groups as quota becomes associated with fewer individuals. Some licence-holders see themselves being squeezed out of the fishery. Under an overall competitive quota for the fixed-gear licence holders, all fishers could fish until the global quota was reached. Under community quotas, some groups and/or individuals are being closed down quickly while others are distributing their quota throughout the whole year.

For most of the CMBs the shifting of fishers between boards is not an issue. It is only possible between the two Shelburne A and B without moving to a different county as they are the only ones who have two boards in one county. Shifting never happens within a year. Once a community quota was created, if people want to move between boards the board must approve this decision. They negotiate these things. The boards decide if you are taking any quota with them, so what they take is usually limited, so the new boards are reluctant to take them as they come with no or little quota.

The management boards are all operate differently which was part of the idea of local control. Charles et al. (2005:8) identify the following characteristics are shared by all or most management boards:

> *"1. The boards were established and are run by fish harvesting organizations, and strive for inclusive decision-making processes.*
>
> *2. The boards sub-allocate the community quota among different gear types and devise rules for all licence-holders in the form of a community management plan.*
>
> *3. The management plans are enforced through contractual arrangement between the board, the licence-holders, and the catch monitoring companies.*
>
> *4. Management plans are consistent with basic conservation requirements set out by DFO and each licence holder must follow the conditions of licence as determined by the government.*
>
> *5. Management boards have infractions committees to judge alleged violations of management plans and impose penalties.*
>
> *6. Seasonal adjustments are made to management plans and in a number of cases these adjustments include the sale or trade of unused quota between different management boards.*
>
> *7. Individual licence holders can still choose to fish under a generic management plan devised by DFO for the whole Scotia-Fundy region instead of under a community management plan devised for local conditions".*

The Community Management Boards are organized around previously existing fishermen's associations and are influenced by other place-based networks. Shelburne A for example is made up of three previously existing groups and Shelburne B is made up of five. These groups often reflect the three gear groups of long lines, hand lines and gill nets. The "Fixed Gear Committee" represents all of the boards in meetings with DFO. Each board has three representatives on this committee, one for each gear group, and a CMB is required to present a unified position to the meeting when an issue is decided. Bull (1998) reports that the Fundy Fixed Gear Council, a CMB, has been an initial success because it comprises well defined geographical area, a relatively unified membership and good working links between the three fishers' organizations involved. The Council is organized into three committees by types of gear, an infractions Committee was set up with representatives of the three organizations and a chair but these all rotated secretly so nobody knew who was going to be up to serve.

The significance of the fishing history was a commitment to a particular place not just to an amount of fish that was legally entitled to (Loucks 1998 p57). Haward et al. (2005) argue that the key to Canada's community based approach lies in its reliance on a specific coastal community or logical component of the coastal zone. They also point out that the implementation of community quotas has increased the management role of the already existing regionally-based fishermen's associations.

Davis and Bailey (1996), on the contrary, argue that consideration of how small-boat fishers are rooted in the community is missing. The approach to co-management taken here had entrenched the elite. One of our respondents from the fishing industry, kind of an elite himself, argued that is his experience the government only wants to deal with the bigger local players, they want to deal with one person and have that one person deal with the rest of the industry.

3.2 The CMBs and the Costs of Management

No quantified information exists on the implications of the Community Management Boards for the costs of management. Even if such data did exist the comparison would be between the current system and a counterfactual alternative. Nor is there any data on who is paying what costs, but it is very clear that the overall system relieves DFO of a number of tasks they had previously. We believe it is a reasonable hypothesis that many costs are more cheaply born by community groups than by others.

In comparing the costs of management between the CMBs and the ITQ system a DFO manager said that they have some significant costs dealing with quota transfers within in the mobile fleet. This activity is not necessary for DFO to do on the CMB side because they manage the fisheries internally according to their harvesting plan. Only when quota is shifted between CMBs must DFO must keep track of the exchange. There is not a "*humungous amount*" of this, but enough so that DFO has two or three people involved in keeping these records. Even the CMB that uses individual quotas (Shelburne B) does so internally and this creates no costs for DFO. DFO does have responsibilities for making sure that the harvesting plans are honoured. Most of the information needed for this is developed by the privatized hail-in hail-out monitoring system which also involves little or no costs to DFO When asked if he is sure that DFO's costs for the CMB system are less than that for the ITQ system his response was *"I'm sure it is because it is a lot less paper work"*.

Sinclair et al. (1999), however, are concerned about overall costs. They believe that the strategic decision to use community quotas as an organizational tool to transfer responsibility to the small vessel fixed-gear sector has changed the annual planning process as organizations have evolved, in a somewhat forced fashion, from the bottom up (Sinclair et al. 1999). They further argue that the overall costs of management have risen with the introduction of a more complex institutional structure. The division of responsibilities includes the government licensing and registering vessels, limiting gears, and describing the area to be fished or controlled. Much of this work is carried out through the DFO-administered licence systems and DFO enforcement activities (Peacock and Hansen 2000).

3.3 The CMBs, Sanctions and Compliance

Once a fisher has finished his quota for one species he must stop fishing for groundfish and the same is true for the group quotas in the CMB. This is a major incentive for group organization. As one fisher explained "*some fellow would just go to Georges and catch all the cod they could catch and shut everything down for everyone. We do not want radicals shutting everything down"*. When a group fishes more than its quota this must be corrected, this usually means having to find (buy or trade) quota from somewhere else.

The groups develop strict enforcement mechanisms so that they do not have to stop fishing. In respect to penalties the fishers are tough. In CMBs the penalties, which are normally reductions in quota or time at sea, are harsher than those the government would impose, there is no appeal and the enforcement is quite effective (Peacock and Hansen 2000). People who commit infractions can be put right out of the group. They go into Group X because no one else will take them. This is not common; one respondent from Shelburne B said that he could remember it happening with "*only three or four boats with any significance.*"

Group X is the quota of people who are not affiliated with a CMB. Because DFO created Group X the boards are not forced to accept all fishers. The most serious sanction available to the Community

Management Board is to exclude a fisher so that he must move his IQ into Group X. Group X has almost no management services, it is fished competitively and when the Group X quota is exhausted then the entire group is shut down. This completely unmanaged quota does not last very long and so there is a strong incentive for a fisher to remain within the Board system. As one fisher described it to us *"To belong to no group is not good, nobody wants to touch you, and people do not want you fishing on their boat"*.

When a boat goes over its assigned catch or otherwise breaks a CMB rule they are taken before an infractions committee. One respondent explained how this worked in his CMB. The membership of the infractions committee is different every time it meets and is kept more or less secret. More or less in this context means that it is officially secret but people know who represented their group and the representatives, of course, know who was there. The infractions committee reviews an anonymous file. They begin with warnings for small infractions but sanctions can be serious. The largest sanction has been five years with no contract, which means that the person is forced into Group X. There is an appeals system in that the fisher has a right to take the matter to the Board itself. When they do this they loose their anonymity. His Board has allowed alternatives sanctions, such as a fine instead of lost fishing. Each CMB organizes itself in its own way.

3.4 The Case of Shelburne B

We focused a good deal of our short stay in Nova Scotia on the Shelburne B CMB because it is an interesting example of combining a community approach with a rights-based system. This CMB has chosen to use an internal transferable quota system to solve their allocation problems. This suggests itself as a way to gain the benefits of both community management and ITQs. Community involvement may aid in helping to avoid the quota busting, high grading, and misreporting that are the common problems associated with quota-based fisheries management. Copes and Charles (2004) question the compatibility of the two approaches, however, arguing that community management requires a planned approach and that ITQs cannot contribute to this as markets make decisions in ways that automatically exclude community interests.

The Shelburne B set up, according to two respondents active in its management, gives everyone have some access even if it is only a small share because of their fishing history. The members of the community are able to fish in that community and even people with very little history, and hence small IQs, can collect enough for a summer's work. Another respondent described the benefits of the system this way: *"you go the time of the year you want, if you want to go, you go, and you set the fish aside if you want to go swordfishing. When you want to go you can go, that is how the IQ will make things work for an individual if you are small like we are"*.

The community basis of the system is strongly supported. Our respondents explained that the reason their group has been (mainly) against adopting a full-scale ITQ is because it would harm the smaller communities in the county. They believe that fish would move to the larger ITQ gear and would never come back to their area. The fish will not be landed here or worked on in Shelburne. Another respondent from Shelburne B believes that equity is what fishers really want out of a management system, and it was the inequality under the quota system, a perception rooted in the struggles over "history", that caused so much resistance. In community management you get local enforcement. If he were to go down a dock with, for example, undersized lobster, he would be confronted by fishers with various ways of expressing their anger over an infringement that they see as affecting them personally, *"but if you cheat on a quota you are just cheating the government"*.

While these internal sales are not usually permanent, in Shelburne B fishers can still sell out their licenses and retire. If a fisher decides to stop fishing he can get a reasonable price from the community. These prices, however, are not nearly as high as he would get if their were a official ITQ system. One fisher explained *"If I want to retire I can sell my license and then they [the buyer] would become a part of the group [the CMB]"*.

The swapping system in Shelburne B is entirely internal to the CMB and DFO has nothing to do with it. This is in contrast to the official ITQ system in which DFO bears the costs of recording when quota changes hand. A DFO respondent said *"We could not care less what they do as individuals"*.

The Shelburne situation, including the formation of Shelburne B and the internal ITQ system, has seen a lot of conflict. One fisher said that he see fishers divided into two ideological camps. On the one side are those who want to chase fish wherever they are. They see the others as lazy, and on the other side are those who want to wait for the fish to come closer so they don't steam as far. They say the others are greedy and wasteful. These two attitudes are expressed in their disagreements about management and was, in the opinion of several respondents, an underlying reason for the division of Shelburne into Shelburne A, the lazy group, and Shelburne B, the greedy and wasteful group. While this conflict was very intense ten years ago the groups have settled and seem now to coexist. *"We are not enemies"*. Over the years there has been some movement between the groups. Most of the movement is toward the B side. Some changed simply because they thought the group was working better, but more of the shift was people selling licenses. The B group, being the more business oriented, were simply the more likely to be the purchasers.

A substantial group within Shelburne B would like to move to a full ITQ system. The process that DFO has set up for making such a decision is a demanding one and it does not look like this group has the support to prevail in the near future. The true ITQ groups are also a bit resentful of the Shelburne B system as they have the benefits of ITQs without their costs. These costs being the allocation fee and the more extensive dockside monitoring the DFO requires of the ITQ fleets.

3.5 Conclusion

The Community Management Boards have developed an international reputation as an experiment in fisheries co-management. All of the respondents we interviewed were very supportive, some even quite proud, of the CMB system. Even industry respondents who were not entirely satisfied, such as those that would like a more traditional ITQ approach, considered the CMBs to be as good a deal as they can expect to get at this time. The CMBs seem to have worked particularly well from the perspective of DFO. They have greatly reduced taxpayer costs while giving them effective local institutions for working with the fishing industry.

We found the Shelburne B experiment to be particularly interesting. On the one hand the ITQ impact that leadership in coastal communities fear the most, the loss of a local fisheries base through industry concentration, has not happened. On the other hand, the CMBs that have not allowed the transfer of IQ among members have had problems dealing in a fair way with exits from the fishery. They have also no doubt paid a considerable cost in economic efficiency in comparison to a formal ITQ system, as is evidenced by the lower price that Shelburne quota gets in comparison with the mobile gear quota. On the other hand the Shelburne CMB takes on management costs that are bourn by the Canadian taxpayer in the mobile gear ITQ.

The CMBs are only one of the institutional platforms for fishers' participation in fisheries management in Nova Scotia. They have developed into an important resource that contributes to the

success of other initiatives, such as the individual quotas and the monitoring system. Science is another area in which participatory approaches, facilitated by both the CMBs and other institutions, have been beneficial in Nova Scotia. This is the subject for Section 4.

4 Participatory Approaches to Science and Management decision

4.1 History of Innovation

4.1.1 Increased Industry Participation in Science

The collapse of groundfish stocks and the perceived role of science in it through over optimistic assessment have sharpened the mistrust of the industry to the traditional ways of providing scientific advice to management, and they have demanded the chance to participate in the scientific process. Furthermore, the development of new fisheries almost from zero, with emerging data-poor target species, has weakened the established model-based scientific system, because of the needs of new methods for scientific advice. This has created incentives for industry participation, as the scientific knowledge on biology and abundance for these new species could not been based on historical scientific data, and thus could be more open to industry's empirical knowledge. Finally, the drastic cuts in DFO budget (see Section 1.2.2) have also reduced the possibilities of scientific surveys and analyses. As a consequence, a major trend in Atlantic Canada over the last fifteen years has been towards an increasing participation of industry in the whole scientific advice, and a real educational process of the industry into stock assessment and research.

4.2 Participation in Stock Assessment Processes

4.2.1 Groundfish Stocks

In spite of some flaws in the traditional VPA-based assessment methods revealed by the groundfish stock collapse, these methods are still used for stock assessment and scientific advice to management for most fish stocks. Some alternative indicator-based approaches were tried back in time (see Section 4.5) but have not replaced the existing system. All groundfish stocks are handled in the same way. It has meant that industry participation has been subordinate to that existing scientific system, and has been conditioned to its format and requirement. Potential input from industry should be quantitative and scientifically validated evidence that could fit into the modelling, and potential criticisms from the industry to the scientific hypotheses first required in-depth understanding of the scientific methodology. As such, the participation of industry is formal and controlled.

An initiative jointly created by the industry and DFO scientists was the so-called "sentinel fishery", a survey mostly designed for maintaining information flow during fishery closures, primarily in Atlantic Canada and Gulf of St Lawrence. Sentinel fisheries have succeeded not only in providing crucial information for stock assessments, as a supplement to research vessel surveys, but also in becoming well-established and accepted among fishers, playing an instrumental role in creating a more co-operative atmosphere between scientists and fishers. (Charles, 1998).

Some other initiatives were launched in the nineties by the industry alone, in order to provide alternative surveys that would supplement the scientific surveys used in assessment. A main one is the so-called "ITQ survey" performed by the trawler fleet >45' entitled ITQ in 4X area. DFO used to

have a regular trawl survey, but which could not sample along the shore in shallow waters because of the size of the research vessel. The industry proposed to cover that area and started a systematic survey with scientifically validated protocols in 1996. The costs are fully born by the industry, through some unallocated quotas which are used for science instead of being redistributed to each quota owner. The survey has been added to the scientific survey and is used into stock assessment. "*This is a success story, with willingness and commitment from both parts. The industry makes good and objective job, and the science branch has been willing to modify their methods*" said a fisherman engaged in that survey. Similarly, an industry halibut survey has been in force in ten years. It was initially proposed by scientists but was designed in collaboration between the scientists and the industry. The results of that survey have been quite consistent with scientific findings, giving fishermen confidence in assessment results.

However, including industry-based surveys in the assessment is not always straightforward, if the results differ significantly from scientific findings. A longline fleet also launched a survey, as their perception of stock abundance was the opposite as observed with trawl-based surveys ("*we see cod and few haddock, they see haddock and fewer cod*") said a longline fisherman. The industry survey lasted six years, but was never included in the assessment.

4.2.2 Invertebrate Stocks

The situation is quite different for invertebrate stocks, as usual assessment tools cannot be used. Every single invertebrate species is so unique there has to be a new technique. This has lead to a system with DFO scientists almost full time dedicated to one particular stock over several years. This is changing now, as not all persons leaving are replaced, but this has been the case since invertebrates became major target species. Assessment methods vary from stock to stock, depending on data available and scientist's background, but also on industry demands and funds. A number of scientific studies are paid by the industry, as a source of knowledge for their own goals.

The specificity of invertebrate species is also found in the industry exploiting them. Except for lobster, which is mostly targeted seasonally by a large number of fishermen with other activities year round, most invertebrate stocks have smaller spatial distribution and mobility, and are targeted by a limited number of specialised fishermen forming a rather homogeneous and cohesive group. As a result, the full-time involvement of a DFO scientist on a stock exploited by a limited number of stakeholders often lead to close collaboration and high commitment between the scientist and the industry. These long-lasting relationships strengthen the trust and credibility of science and ease the data collection process.

However, this system leads to two types of issues. First, the scientists may get too accustomed to their routine work, and do not have the chance to compare with methods used on other similar species. This leads to some inconsistencies between stocks, which may not be so problematic ("*we are sort of disjointed and inconsistent according to some, but it is not inconsistency it is specificity to a situation"* advocated a DFO scientist), but still raises some issues regarding science quality and equity. DFO works now towards higher scientific communication across scientists assessing invertebrate stocks, with support from statisticians and modelling experts. "*We are seeing more of this cross stuff, partly because Canada is so big and we need consistency, and industry is complaining that one area is being treated differently from other ones"* explained a DFO Science Branch manager.

The second issue relates to scientific independence and integrity. The high level of embedment with industry creates the risk that industry put pressure to obtain the scientific evidence they want. There have been some good examples, where industry trusted their scientist and followed their recommendation of decreasing catches. These were cases where a real relationship of trust existed "*I said they should cut back, and (…) they said OK. They said you were with us when we went up and this was, importantly, based on my history with this group of people*" said a DFO scientist. But this is not true for all cases, and there are suspicions on scientific manipulation, also acknowledged by the professionals. "*Some places it just does not make sense and we see manipulation"* said a groundfish industry representative. Some industry pay parts of the salary of the scientist involved, and may even be involved in their selection. In such cases, peer scientists do not suggest obvious scientific manipulation, but rather claim over secrecy, lack of transparency and absence of peer-review of scientific results.

4.2.3 Participation in the Regional Advisory Process (RAP)

As most stocks in Scotia-Fundy area are under sole Canadian jurisdiction, their assessment is under the responsibility of DFO and not NAFO, and is conducted within RAP meetings. These meetings have been opened to industry and NGO participants as a way to improve collaboration between industry and science after the groundfish collapse. And indeed, this has facilitated the dialogue with the industry and the improvement and acceptance of scientific results. The industry feel involved, and feel that they have to ("*If you don't ask question they will say whatever they want*" said a fixed gear representative). When they do not agree with scientific findings, they try to come with samples for supporting their hypotheses. The industry is involved in helping to write the evaluation report, and industry's comments and concerns are written down ("*We have to go in with them. They are fair and willing to listen, it does not mean they will change the report, but I don't feel slighted"* said another fixed gear representative). Some communities are also organising local science meetings with DFO scientists prior to the RAP, in order to collect information from fishermen who do not attend the RAP. These open meetings also help the industry to understand the difficulty and complexity of stock assessment, and that uncertainties are inevitable. But it is clear that some mistrust is still there, although less radical than before. Some particular issues occurs with fixed gear industry, as most of the science is based on surveys using mobile gears, which do not accurately catch species such as cusk, pollack, hake and halibut, leading to high uncertainties in assessment.

The major issue of such open science meetings is the risk of distortion because of political issues. The industry may put pressure on the meetings to get the results they want, looking at detailed wording instead of reviewing science and methods. The quality of interaction with industry depends on the level of the stock. *"At one part they were invited to the assessment meeting, they started bringing lawyers and it became a very political discussion"* said a DFO Science Branch manager. "*They are going to change and go back to an invitation only meeting, reenforcing that participation is about bringing scientific inputs. It got to the point where people did not want to chair the meeting as they were afraid of being sued."*

4.2.4 Conclusions

It is clear that the scientific process has dramatically changed over the last fifteen years. A real effort has been made toward transparency and openness for effective governance. The Science Branch has been willing to improve dialogue and communication with the industry, to include their comments and concerns into assessment reports, to include some relevant surveys under certain frames. On the

other side, the industry has been willing to participate at own costs, and has gone through a real educational process to be able to be proficient in collaboration with scientists, as the perception of reality and time frames differ strongly between both worlds "*We were told that we had to do 5 years. 5 years is long time for a fisherman to think ahead, we mostly think one week ahead.*" said a former longline fisherman.

Regular meetings between scientists and industry have created some particular situations of long-lasting and personal relationships with high levels of commitment and trust, especially in invertebrate fisheries. But this cannot be generalised, as it appeared clearly that the own personality of the scientist is a decisive factor in the establishment of such relationships. The industry praises scientists confident with their analyses, and able to explain simply and well about issues.

Participation of industry in the stock assessment process has though not always been straightforward. A degree of mistrust is still present between both worlds, especially when scientific results are based on comprehensive models and with input numbers based on extrapolation of sampling data. This has neither solved all uncertainties in stock assessment results, bringing sometimes more uncertainty in when industry and scientists perceptions of stocks trends go in opposite direction.

In comparison with the previous system which was completely closed to industry participation, the open process risks "*to go way the other way*", with a too large role accorded to the industry. Some uncomfortable situations were observed, with industry putting pressure on science meetings outputs for political reasons, especially when the level of scientific uncertainty is high.

All actors recognised the progress achieved in including fishermen's knowledge and point of view in the scientific advice, although some scepticism remains *"I think it has improved, but on a scale 1-10 it has only improved 1, and it should be 10."* said a fisherman. This process has improved social robustness, by reducing the feeling of industry of being unheard. It has also improved biological robustness, by increasing the feeling of ownership and responsibility for the resource and improving the commitment to scientific advice.

4.3 Participation in other Scientific Work – the FSRS

A notable initiative launched in Nova Scotia in the aftermath of the groundfish collapse was the creation of the Fishermen and Scientists Research Society (FSRS), a voluntary organisation for collaborative research and co-education of fishermen and scientists and the first of its kind in the world. The initiative was initially paid by the government, which also provides continuous office facilities. But it is now an independent non-profit society, which financial support includes industry funds and governmental research grants. FSRS promotes science relevant to the long-term sustainability of the fishery. The Society stays away from controversial management issues, being prohibited by law to engage in lobbying and other management activities. In 2007 it counted 367 active members, mostly fishermen and scientists.

The Society provides a frame for collaborative research. Scientists provide guidance in developing scientific protocols with fishermen; fishermen have a key role in identifying research priorities. Research programs are conducted within self-financed projects dealing with specific scientific issues about various species, and the Society promotes continuity in the projects for insuring suitable time series of data.

The FSRS has played a key role in the educational process of the industry and in the restoration of the credibility of science. Fishermen trust data they collect themselves *"If fishermen are doing the science, they believe it to be true. How can you argue about something you collected.*" explained the FSRS manager. FSRS worked towards increased understanding of the scientific rationale for data collection protocols and increased participation in RAP meetings. It also educated the scientists to give timely feedbacks on their project results. The main success was about helping communication, discussion and dissemination, which helped "*humanising*" each group in the eyes of the others.

However, in spite of these positive initiatives, some of our industry respondents, although part of the educated elite, were little supportive of the FSRS. In particular, its status of non-profit organisation creates a constant chase for grants and funds for maintaining its existence, which precisely distorts its image of non-profitability. Secondly, most of the initiatives are still proposed and piloted by scientists. The FSRS is still perceived by some as a governmental body, which did not necessarily supported industry's own initiatives such as the "ITQ survey".

However, it is clear that in spite of criticisms, the FSRS has existed over fifteen years, surviving the massive DFO cuts in research programs. This longevity is the main proof of success, as the Society would not have survived without support from the industry.

4.4 Industry Involvement in Management Decisions

4.4.1 Harvest Control Rules and Management Plans

Traditionally, management decisions about single stocks TACs were taken based on clear Harvest Control Rules (HCR) such as F0.1. Shelton (2007) showed that the management strategies have however changed over time, including changes in reference points and time-scales. This is due both to an increasingly complex legal framework for fisheries management (see chapter 1.2.2), and to increasing participation of industry in management decisions and scientific understanding. TACs are no longer set based solely on forecasts conducted by scientists, but are now based on a number of considerations, of which stock assessment is a major component.

Management decisions for groundfish are taken as part of the Groundfish Management Plan established for the period 2002-2007. Annual fishing plans are developed in consultation with the fishing industry and are reviewed annually to update quotas and introduce new measures considered appropriate by DFO and the fishing industry, as part of this long-term GMP. Consultations also occur on an ongoing basis to ensure successful implementation of the plan. TACs have been fairly stable over the recent years, reflecting general commitment towards stability and long-term sustainability "*as the crucial starting point for improving relationships with industry, stakeholders and other resource users*" stated fisheries Minister Hearn (http://www.dfo-mpo.gc.ca/media/newsrel/2006/hq-ac07_e.htm).

Shelton (2007) acknowledged that this leads to increased flexibility in the harvest control rules, and weaken the use of the scientific knowledge as decisions are now taken ad-hoc. Indeed, there is a clear reluctance both from the management bodies and from the industry to use clear and pre-agreed harvest control rules, as the final management decision is taken from consensus and negotiation. Precise control rules would remove this negotiation buffer, as HCR does not account for uncertainty. Some situations happened where the industry, the scientists and the managers agreed on some control rules before the assessment, but refused them after the assessment as they would have meant major cutbacks. The final decision process is not always fully clear and transparent. "*Management*

has fisheries roundtable discussions, but I don't see that there is an open process for taking science advice and moving to decisions, which is why these discussions bleed into our science meetings." said a DFO Science Branch manager. Existing lack of consensus across various industry groups undermines the possibilities for real co-management, and the decision power still resides with the Minister of Fisheries and Oceans. *"Co-management was a concept a few years ago, but not now"* deplored a groundfish industry representative. A DFO manager explained that the scientific advice is followed for the most part, but that the management framework has become more complex and more restrictive with law-finding acts requiring drastic decisions.

To improve the transparency of the decision process, The Science Branch is currently trying to introduce simulation-based Management Strategies Evaluations (MSE) (first initiated by IWC 1993) that aim at identifying management strategies robust to various sources of uncertainties. These simulations can be used as a tool to support discussions and negotiations between stakeholders in a quantitative and transparent manner, as alternative scenarios are compared based on a set of plausible hypotheses. First trials were conducted in 2007 on Artic surfclams and ocean quahogs with DFO- and non-DFO scientists as well as members of the fishing industry, DFO managers, and provincial representatives (Boudreau and O'Boyle, 2007). Results were used for providing advice for the 2007 and beyond fisheries. This is still too new to get real feedback on such a process and the immediate feelings about this approach are mixed. *"Many questions industry has are with the whole picture, and if you hear some of their questions then maybe you hear this idea about strategies and decision rules."* said the DFO Science Branch manager. But "*regional management folks were a bit negative, I did not know if this was distaste for formalized management or just that they don't like something new, they do like to be flexible in how they use advice"*.

4.4.2 The FRCC

A particular initiative of increased participation of the industry in the decision process was the creation in 1992 of the Fisheries Resource Conservation Council (FRCC), funded right after the groundfish collapse. The initial mandate (until 2004) of the Council, consisting of industry and academics, was to provide advice to the Minister on conservation issues for the groundfish resources of Atlantic Canada. FRCC was meant as a consumer, not a producer of science. They got DFO peer reviewed science and traditional knowledge, and provided advice based on those two during open and documented meetings. It worked as a "*depoliticised advisory process, providing written public recommendations to the minister, which then should be able to justify publicly why if it doesn't listen to FRCC."* explained a FRCC industry member. Since 2004, the FRCC mandate has changed from annual management advice for groundfish to long-term conservation issues including other key species such as snow crab and lobster, and looking at sustainability issues from ecologic, economic, social and institutional perspective.

In spite of its laudable mandate, some critics were raised about FRCC, mostly because significant conflict of interests problems. *"they kept reappointing these people and you kept seeing obviously manipulated quota allocation.*" said a groundfish industry representative. Needs for consensus can create dangerous *"hostage"* situations if a party brings conflicts of interests in. But it has nevertheless given a real frame for co-management with a legitimate mandate to the industry, and keeps being a major institution in the region.

4.4.3 Conclusion

It is here again clear that some progress have been towards industry participation into the final management decisions using agreed scientific advice. Charles (1998) illustrated how the opening of the scientific process to industry helped reducing uncertainty in cod stock status in area 4X. However, fifteen years of co-management have also shown some limits, as decision will always result from a combination of legal framework and management objectives in one hand, and negotiations on the other hand. A transparent and legitimate decision cannot always be reached from consensus, especially when industry groups are numerous and heterogeneous.

4.5 Indicators and the EBFM

The initial choice of innovation with regards to science in the original CEVIS project was the use alternative tools for providing scientific advice and moving away from the traditional model-based and forecast-based methods. Canada is moving towards integrated management with clear objectives accounting for ecosystem and socio-economic sustainability, and set in agreement ("shared stewardship") with a number of stakeholders. This has naturally led to a growing need of identifying reliable and measurable sustainability indicators systems SIS, using "pressure-state-response"-type frameworks (OECD, 2001), and Canada has gone a decade of development and exploration of these systems.

4.5.1 The Precautionary Approach Framework

Shelton and Rivard (2003) described the history of development of the precautionary approach (PA) since the cod collapsed. Over the 10 years following the collapses, Canada has been engaged in a process of developing a precautionary framework that is consistent with the 1999 United Nation Fisheries Agreement (UNFA). Development of this framework has been given high priority since the concerns raised in 2002-2003 that post moratorium TACs had been unsustainable and were jeopardising stock recovery. The framework adopts a notion of "serious harm" as the definition of a conservation limit reference point. The term "precautionary approach" should be used only to refer to situations that can result in harm that is serious or difficult to reverse. Activities which simply reduced yield were economically inefficient, but could not be interpreted as serious harm. Serious harm is defined as the SSB below which productivity is impaired. In terms of recruitment, impaired productivity is consistent with the notion of "recruitment overfishing", i.e. the SSB level consistent with a marked decrease in recruitment.

In 2007, the PA framework was routinely implemented in a way similar to ICES procedures, on a single-species basis with traffic-light based coloured zones as indicators for management advice.

4.5.2 The Traffic Light Approach

The Traffic Light Approach (TLA) was developed in the Maritimes as a method to incorporate PA and decision rules in fisheries management, following initiatives from Caddy (1998). DFO Maritimes initiated an investigation of the TLA in 1999. It is to be used as part of stock assessment, broadening the approach to include non traditional information. The key appeal of the TLA is a means of visualisation of indicator data as a series of traffic lights categorising indicators in relation to target and limit reference points. The basic TLA includes three steps (Halliday et al., 2001) : (i) uses a multiplicity of indicators of system status; (ii) classifies the current state of each indicator in relation to reference points using a system of green, yellow and red lights; (iii) establishes management rules associated with the number of lights of each category. The TLA was initially

designed for implementing the PA in data poor situations, but was thus adapted to data rich situations. The main interests of the method are the ability to include all new sources of information, and a way to propose a visually pleasing and transparent process for communication and understanding among users. *"You say "this is all the information we have fellows, now you know as much as I do" and we can start talking about all the inconsistencies*" reported a DFO scientist.

In 2007, the TLA was only part of routine stock assessment for the small eastern Scotian Shelf shrimp stock (DFO, 2005), with a summary indicators being a simple average of equally weighted indicators:

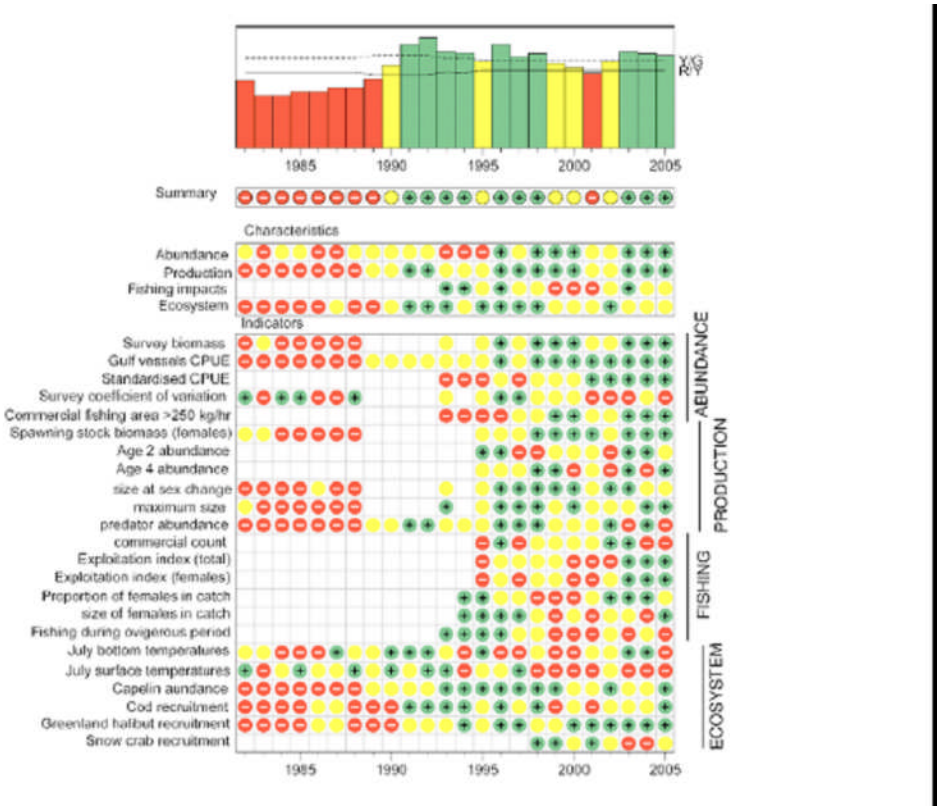

Figure 1. Example of Traffic Light Analysis (DFO, 2005).

The success of the method for a small stock of shrimp was partly explained by the strong relationship of trust between the industry and the scientist. As Koeller (2007) explained, "*the Total Allowable Catch (TAC) exactly tracks my mental integration of the indicators and judgment of how it might affect my patient's health. Surprisingly (or not depending on how one analyses their motives) the stakeholders have always sought and taken my advice on the TAC verbatim, and this has included significant decreases with accompanying economic consequences.*" In that case, the industry trusted the management strategies proposed by the scientist, without arguing of scientific uncertainty for requiring higher quotas.

The traffic light method was applied as a trial basis for some Scotia-Fundy groundfish stocks. As such a complete trust in scientific advice as in the shrimp case is not always existing, it was felt necessary to formalise the method and the harvest control rules that could be applied from it, in a wish to proposing objective and transparent indicator-based management decisions. Main criticisms,

also from industry side, dealt with the too strong simplification of the results, the loss of information and the need for more formal and causal mechanisms, as well as the issue of combining disparate lights into summary lights: *"First is happy with red, the other is happy with green, if you make yellow as a compromise nobody catches anything*" said a fixed gear representative. Furthermore, as industry has gone through a major educational process with regards to stock assessment in the recent years, simplification for communication is no more necessarily a major need. Halliday et al. (2001) conducted a thorough analysis of the technical aspects of the method, including the choices of indicators and reference points, the summarising ("integration") and the establishment of decision rules. The trials made to make the method more quantitative through using fuzzy logic lost its simplicity without solving the issue of integration, and its use did not proceed beyond the pilot stage (Koeller, 2004). As Koeller (2007) noticed, this final product was essentially a compromise between two irreconcilable philosophies, and collapsed under its own complexity.

However, its simplistic approach as taken for shrimp suggests that summary statistics may track "stock health" more comprehensively and usefully than individual indicators, and might be more precautionary than traditional methods (Koeller, 2004). In particular, it accounts for some other parameters than traditionally used in assessment, which could be indicative of stock status, as for example the r productivity parameters (Hutchings and Myers, 1994). And it avoids relating on comprehensive models. *"Fisheries science is not rocket science but it has been mistaken for rocket science and we got a lot of rocket scientists on to the problem*" said the DFO scientist. Furthermore, it is expected that such a traffic light categorising could indeed be applied to any kind of indicators used in PSR-type framework.

In 2007, during our study tour, the method was though gaining a revived interest, and was to be tested on two invertebrate stocks of primary importance, the Gulf snow crab and the Northern shrimp. To which extend this approach will receive commitment and support from a larger industry group as for the eastern Scotian shrimp cannot be answered now, but it would be very informative to follow-up the future development of these cases.

4.5.3 Ecosystem Approach to Fisheries Management (EAFM)

The renewed interest for indicators is related to the ecosystem approach, to which Canada is committed by law. Indeed, Choi et al. (2005) tried to use a similar traffic light approach as a descriptive tool for the Scotian shelf, choosing indicators in collaboration with scientific experts from the various relevant fields but without trying to combine indicators for potential management action. This seemed to work well to track strong dramatic changes, as the Scotian shelf has experienced over recent years, but not so much for weak changes.

Many years of discussion about implementation of the ecosystem-approach in fisheries management have lead to some progress. Influent scientists are acting towards a pragmatic and urgent approach based on current knowledge, rather than on developing comprehensive models trying to include all ecosystem processes. Clearer management objectives have been defined in the frame of Oceans Act. Productivity, Biodiversity and Habitat are the three main Canadian ecosystem objectives. The Management Branch in DFO is formulating one to three priorities under these objectives, as well as associated strategies and performance indicators (Figure 2). For each type of fishery, the level of importance and knowledge is qualitatively assessed (not important, important, unknown), in order to define priorities of action and priorities of research. Progress has been made towards collaboration with other branchs and other departments, with the purpose of formulating integrated assessment and advice. However, the operationalisation of this is not straightforward, as the traditional assessment

cannot easily account for such information. And in most cases, assessment and management meetings are still attended almost uniquely by traditional Fisheries Management science group and industry representatives, with little support from environmentalists and ecosystem scientists.

	Strategies (**performance indicator**)	Managed Activity
		GF HF SF L/CF
Productivity		
Primary Productivity	• Control alteration of **nutrient concentrations** affecting primary production at the base of the food chain by algae	
Community Productivity	• *Manage **trophic level removals** taking into account consumption requirements of higher trophic levels* • *Manage **total removals** taking into account system production capacity*	
Population Productivity	• Keep **fishing mortality** moderate • Allow sufficient **spawning biomass** to escape exploitation • Promote positive **biomass change** when biomass is low • Target **% size/age/sex** of capture to avoid wastage • Limit disturbing **activity in spawning areas/seasons** • Manage **discarded catch** for all harvested species	
Biodiversity		
Species Diversity	• *Control **incidental mortality** for all non-harvested species* • Minimize **change in distribution** of invasive species	
Population Diversity	• Distribute population **component mortality in relation to component biomass**	
Habitat		
	• *Manage **area disturbed** of bottom habitat types* • Limit **amounts of contaminants, toxins and waste** introduced in habitat • Minimize **amount of lost gear** • Control **noise or light level/frequency**	

Figure 2: Steps towards EAFM: Management objectives, performance indicators, and managed activities. Strategies highlighted in blue are those that are considered of high relevance that currently receive attention; Red highlighted strategies are of potentially high relevance but with major uncertainties remaining, and would require additional attention; White strategies are considered of low relevance. (source L. Burke, DFO Management Branch).

5 Best practices –What Might be Useful for Europe?

As a concluding chapter, we intend to consider the example of Nova Scotia from the perspective of our own management issues in Europe. This case study was particularly interesting, because it has gone through many stages ahead of what has happened or could happen in Europe. For example, it gives an interesting insight of what could happen if the cod stocks were to collapse in eastern Atlantic area as well. Furthermore, a similar "cultural shift" towards an integrated and ecosystem-based approach with stakeholders' participation has also emerged in Europe in the most recent years, and interesting lessons might be drawn from the Canadian example. Finally, its size, diversity, complexity and history make it a comparable scale to the EU, probably more than the other case studies of Iceland, Alaska and New Zealand.

We first summarise our main findings in our evaluation of Nova Scotian innovations. Then we focus more in-depth on five "best practices", i.e. five processes which we found were particularly interesting and positive, seen from a practical and field-based perspective and considering how they have developed over their ten to fifteen years of existence.

5.1 Summary – Evaluation of Nova Scotian Innovations

The purpose of CEVIS was to evaluate innovations with regards to four criteria: Cost of management, economic efficiency, biological robustness and social robustness. The literature review and the study tour helped formulating a number of hypotheses for the evaluation of the innovations described in this chapter. These hypotheses were used as the basis of developing the CEVIS research work in Europe. Various processes are identified within each innovation, but not all processes can be evaluated with regards to all four criterias. The findings are summarised in the table below (-) means "decrease" while (+) means "increase" :

Table Three: Evaluation of Innovations by CEVIS Objectives

Innovation Process involved	Costs of Management	Economic Efficiency	Biological Robustness	Social Robustness
1. Right-based management				
facilitating transition to lower capacity	-	+	+	+
fishing rights passed within the community				+
recruitment of crew and crew wage		-		-
fishers retirement				+
reduction of risk of bankrupcies and dislocation		+		
licensing separted from quota ownership				+
flexibility of system to biological reality			-	
management of mixed-fisheries issue			-	
increasing pressure for effective monitoring	-		+	
2. Community control				
community responsible for quota allocation	-			
exclusion of non-cooperating fishers		+	+	+
local stocks exploited by local communities only			+	+
local support to ecosystem approach			+	
3. Role and form of science				
Industry responsible for monitoring	-		+	- / +
industy involvement in science meetings			+	+
industry surveys			+	+
collaborative research			+	+
industry involvement in management decision			+/-	+
scientists commitment with industry			+	

The detailed description and functioning of each process is described in the relevant chapters. It is clear that a number of effects intermingle within each innovation, and some processes may counteract each other. Generally, we found that both community control (innovation 2) and participatory approaches to science (innovation 3) mostly brought positive aspects in. However, some of their effects are still unclear. Especially their practical implementation is not always

straightforward and painless. Nevertheless, both innovations have clearly helped in the sustainability of fisheries activities, both in terms of biological robustness, by increasing industry commitment and trust and thus decreasing cheating, and in terms of social robustness by maintaining fisheries activities in the local communities and increasing the feeling of involvement and ownership of the industry into the scientific and decisional process. The main costs of the participatory approaches are related to their establishment, once functioning institutions are in place they clearly become an important asset for implementing further innovations.

Our analysis of the ITQ system is more mixed, as the ITQ has brought both positive and negative long-term effects. The direct impacts on efficiency are clear in theory and what limited data we have from Nova Scotia (and elsewhere) suggests that ITQs increase efficiency the way they are expected to. The ITQ system has also shown other benefits beyond gains in efficiency. In Nova Scotia the ITQ system helped reducing the number bankruptcies and other forms of dislocation resulting from the required reduction in fishing capacity. A rights-based system using individualized rights increases economic efficiency by granting the individual fishers the ability to decide as an individual when and how to fish their fish. Transferability then increases this gain in efficiency by concentrating the quota in the hands of those who are able to take advantage of it. While for political reasons is these people may be referred to as "better" or "more efficient" fishers, what this means in the real world is concentration in the hands of those who already control other assets that give them the ability to both buy the quota and use it in more flexible ways. Geographical concentration happens for similar reasons as well as because of the comparative advantage given places by ports, markets and processing capacity. The gains are real but so is the concentration. It is difficult to see how organizational concentration could be separated from increases in economic efficiency and attempts to hinder such concentration face myriad problems with both political resistance and people finding direct ways to circumvent the regulations in place to reduce concentration. Geographical concentration is a similar and related phenomenon that is somewhat easier mitigate through policy. Other negative impacts such as placing greater costs on crew members and (as one factor among many) increasing the difficulty for new entrants to the fishery also seem difficult to avoid.

The impact on costs of management of the rights based approached seems entirely dependent on design, the Shelburne example suggests that they can be nearly costless to the public. ITQs have created a complex set of positive and negative impacts with regards to social robustness. The positive effects of ITQs with regards to biological robustness are mixed and quite unclear. Surely, the ITQs have had positive effects because of the increasing pressure for effective monitoring they have implied. But they have not helped with the issues of bycatch they might be expected to help with because it is still often easier to discard fish hand buy quota to be able to keep it.

The main policy question remains how to balance these gains with their costs. The experience in Nova Scotia is that the owner-operator policies and the fleet separation policies are having some effect but they are under increasing pressure both politically and through the proliferation of trust agreements. For us the most interesting thing we came across was the Shelburne B CMB which seems to be pioneering a rights-based approach that balances its advantages and disadvantages in a flexible manner with a great deal of local input from the fishing community.

5.2 The Monitoring System

The arms-length, user pay monitoring system they have designed works very well. The system is able to keep very detailed track of the fish that are landed without any cost to the taxpayer. The fact that the government is not actually carrying out the monitoring seems to increase its acceptance in

the community. The monitoring system also links up very well to both the ITQ system and the CMB system. In both cases local fishers and CMB officers are very interested in keeping a close, real time eye on landings.

5.3 The Community Management Boards

The CMBs have worked very well from the perspective of DFO. They have greatly reduced taxpayer costs while giving them effective local institutions for working with the fishing industry. As they move toward ecosystem-based fisheries management they will be a valuable tool, one DFO manager called them "vital" if they are going to create an effective EBFM. The Nova Scotian CMBs have perhaps realized the practical promise of fisheries "co-management" better than any similar attempt in Western countries. Several aspects of their approach seem to contribute to this effectiveness: they are linked to specific, relatively small geography; they have available effective sanctions including in extreme cases the ability to exclude non-cooperative members; and the use of legal contracts with detailed specifics in the form of the Conservation Harvesting Plans.

5.4 The Informal ITQ System

The Shelburne B system combining the limited transferability of IQs with community control of fisheries also suggests itself as an experimental model for Europe. The pure ITQ system, the CMBs using non-IQ management methods, and the Shelburne B board have all vastly reduced fishing capacity because the main driver for this was tight quotas combined with effective monitoring and enforcement. The pure ITQ system has had the expected negative impacts. It has reduced potentials for adaptive management by locking ecological realities into hard institutional boxes. It has led to geographical concentration of the industry. On the other hand, the CMBs that have not allowed the maintenance and transfer of IQ have had problems dealing in a fair way with exits from the fishery. They have also no doubt paid a considerable cost in economic efficiency in comparison with the ITQ system. The Shelburne B system, because it places strong limits on transferability, is not going to be able to match the pure ITQ system in terms of efficiency. This is clearly reflected in the lower price that Shelburne quota gets in comparison with the ITQ system. But it much less expensive for the taxpayer, makes a strong contribution to maintaining the economic health of a peripheral community, while at the same time dealing effectively with the problem of exit from the fishery.

5.5 Collaborative research and industry participation in management decision

The groundfish collapse has been a traumatic forcing driver, which has though led to positive changes in the ways of providing scientific advice and taking management decisions. The scientific world has been forced to learn from the errors that lead to misleading advice, and has opened its processes to industry participation. Although this collaborative research and co-management is far from being straightforward and error-free, it is clear that increased communication and industry involvement has helped restoring the credibility of science. It has also helped learning to accept uncertainty as inherent to fisheries science and management, and to live with it as a key factor to be accounted for in decisions. Because Europe has not experienced such a large scale collapse jeopardising the existence of a whole region, such changes in mentalities are slower to come up. The established system for scientific advice is fairly rigid, normalised and conservative, and is still providing deterministic advice based on projections and forecasts. Similarly, management decisions are still taken in a centralised way during negotiation between the Commission and fisheries

ministers, without stakeholders participation. Some progresses have been made in that direction with the creation of the RACs (Regional Advisory Councils). But the mandate of these RACs should be extended from the consultative bodies they are now to partners engaged in scientific processes and management decisions. Furthermore, few initiatives of collaborative research have been already launched in the recent years in Europe, dealing with specific industry-based surveys. Such initiatives should be encouraged for improved communication and trust between scientists and fishermen.

5.6 Integrated Fisheries Management Plans

Management decisions for groundfish fisheries in Nova Scotia are not taken within short-term frames with large variations from year to year. Management is decided within Integrated Fisheries Management Plans with emphasis on long-term sustainability, inter-annual stability and commitment to the ecosystem approach. Moving in that direction in European fisheries would remove the pressure from the marathon negotiation of TACs in December, and would insure better stability while relying less on precise assessment. Extensive discussions are currently undertaken in the European Commission to go along those lines, and this should be supported.

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