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Fisheries management in Atlantic Canada

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ABSTRACT

This paper provides an overview of fisheries in Atlantic Canada and examines in detail the two most important and widespread sectors, groundfish and lobsters, highlighting initiatives undertaken in the wake of the collapse of the groundfish stocks in the early 1990s. Two key features contributed to this collapse: over-reliance on quota management and an adversarial relationship between fishers and government. Among the new initiatives detailed in the paper are co-management, community quotas 'Conservation Harvesting Plans' and the Fisheries Resource Conservation Council. © *1997 Elsevier Science Ltd.*

1. INTRODUCTION

The fisheries of Atlantic Canada provide an insightful contrast: on the one hand, they hold a special historic, cultural and socioeconomic place in the life of Atlantic Canada, whereas on the other hand, the early 1990s collapse of the groundfishery has become the most prominent global case study of failure in fishery management. The paper explores the current state and future directions of Atlantic Canada's commercial fisheries—their structure, operation, management and policy debates, as well as the role of the federal Department of Fisheries and Oceans (DFO). The focus lies on what are traditionally the two important and widespread fisheries in Atlantic Canada—groundfish and lobster.

2. AN OVERVIEW OF CANADA'S ATLANTIC FISHERIES

Atlantic Canada has an impressive recent history of fish harvesting. The total catch of all species in 1995 was 629 621 tonnes, whereas the landed

value of that harvest was $1324 million,[1] up from $1123 million in 1994, with values in the $600 million range over the first half of the 1980s growing to around $1000 million in the late 1980s at current prices.[2,3]

Atlantic fisheries dominate Canada's commercial harvest, with roughly 70–80% of the total harvest and the total value. Whereas nationally, fish production contributes around 1% of employment and gross national product (GNP), the impact in Atlantic Canada is more substantial; in Newfoundland, for example, fisheries have accounted for over half of all employment in commodity producing industry. Indeed, when one combines the regional economic role with its social, cultural and historical grounding, the overall political importance of commercial fisheries in Atlantic Canada tends to far exceed any economic indicators. This situation is made even more pronounced by the relatively large number of federal politicians based in fishery dependent constituencies, and the complex mix of five provinces along with the federal government in fishery debates.

2.1. Species diversity

The major species harvested in the Atlantic Canadian fishery can be placed into three groupings:

Groundfish species (particularly cod, haddock, redfish, pollock, halibut and various catfishes) have historically provided about two-thirds of the total harvest by weight, and 40% or more of the landed value, but this contribution has decreased greatly since the collapse or serious decline in many groundfish stocks in the early 1990s. In 1995, groundfish harvests produced only 8% of the total Atlantic Canadian landed value.[1]

Shellfish (including lobster, crab, shrimp and scallops) have collectively grown in importance over recent years, both in relation to groundfish and in absolute terms, with remarkable increases in abundance and market price for lobster and crab. In 1995, shellfish comprised 85% of the total landed value,[1] with the traditionally important lobster fisheries throughout much of Atlantic Canada matched in value by the very lucrative and more recently developed crab fishery in the Gulf of St. Lawrence.

Pelagics (including herring, mackerel, capelin, eels, skate, salmon, tuna and swordfish), while a smaller component of the Atlantic Canadian fishery, are very significant in localised areas. For example, herring is of importance in the Bay of Fundy and the Gulf of St. Lawrence. Capelin is a traditional catch in Newfoundland. Tuna and swordfish are important along the

Atlantic coast of Nova Scotia. Salmon, which was once caught widely in commercial fisheries, is now primarily harvested in Native and sport fisheries, where it plays a major role.

These three groupings constitute most of the Atlantic catch, although there are also harvests of marine plants (such as rockweed), seals (in Newfoundland) and other species. The diversity of Canada's Atlantic fisheries is perhaps exemplified best by the fact that as world attention focused on the early 1990s collapse of the groundfishery, the landed value of harvests in Atlantic Canada grew to record highs.

2.2. Geographical diversity

Organisation of Atlantic Canadian fisheries is influenced by political boundaries between the five provinces touching on the Atlantic (Newfoundland, Nova Scotia, New Brunswick, Prince Edward Island and Quebec) and by natural boundaries between the three principal ecological zones (the Grand Banks area, the Gulf of St. Lawrence, and the Scotian Shelf and Bay of Fundy).

On a provincial basis, 38% of the 1995 landed value generated in Atlantic Canada is attributed to Nova Scotia, 26% to Newfoundland, 15% to New Brunswick, 13% to Quebec and 8% to Prince Edward Island.[1] Newfoundland historically has been highly dependent on groundfish, which has typically comprised 80% of the catch by weight, compared with 50–60% in Nova Scotia, and 30% in New Brunswick and Prince Edward Island.[3] However, some provinces are more diversified in their harvests. For example, one report[3] notes that in New Brunswick, pelagics comprised two-thirds of the catch by weight, whereas shellfish comprised nearly 80% of the landed value (rising to 88% in 1995[1]).

Fisheries are not managed within provincial boundaries, but neither are they based on ecological zones. For example in the groundfishery, the Northwest Atlantic Fisheries Organisation (NAFO) areas are used; in some cases, there are similarities in oceanographic and fish stock conditions within a given ecological zone (e.g. between the southern and northern Gulf of St. Lawrence, respectively), whereas in other cases, there can be substantial differences (e.g. on the Scotian Shelf off Nova Scotia where the cod stock at the eastern end is very depleted, whereas that to the west is relatively healthy).

2.3. Diversity in industrial structure

In the Atlantic Canadian fishery, commercial fishers tend to be characterised principally by the fish species that they harvest and the size

of their vessels. The stocks that can be fished depend on what licences are held, as well as the home region of the fisher. Some fisheries, particularly for shellfish, tend to be very homogeneous, using similar gear within a given fishing area, and indeed across areas. Others, notably the groundfishery, have an amazing variety of gear types and vessel sizes, which both create conflict and complicate management.

Fishers live in over 1000 fishing communities along the often isolated coastline. There is a variety of gear-based and community-based organisations, as well as unions and cooperatives, although many fishers are unorganised. The processing sector, however, is relatively well organised, and is closely involved in most policy debates. Historically, many coastal communities have relied on the local processing plant as a key source of employment, and many inshore fishers rely on processors as an outlet for their catches. The entire offshore component of the groundfish fishery is dominated by processors. Whereas provinces have jurisdiction over processors, the federal government has taken a significant role in the past.

2.4. Diversity in fishery management

Whereas the provinces have responsibility for any land-based fishery activity, including fish processing (as noted above) and aquaculture, the national government has responsibility for management of Canada's ocean fisheries and in particular for conservation of ocean resources. This takes place within three Department of Fisheries and Oceans administrative regions: 'Maritimes' (fisheries off the coasts of Nova Scotia, New Brunswick and Prince Edward Island), 'Laurentian' (Quebec fisheries) and 'Newfoundland' (including most fisheries off Newfoundland and Labrador). One clear difficulty with these regions is the compromise that they reflect between political boundaries and ecological zones. For example, it would be natural for fisheries in the Gulf of St. Lawrence to be managed together as an ecological system, but responsibility for fish stocks in that ecological zone is divided among DFO's regions. Despite efforts at coordination, this has led to ongoing complaints from the industry that those harvesting the same fish stock in the middle of the Gulf may be subject to different rules, depending on the administrative region in which they happen to live.

Differences in methodology and 'style' of management among Atlantic Canada's fisheries also can be traced to philosophical, historical and biological considerations. For example, lobster fishery management reflects several realities: lobster are relatively non-migratory; historically, lobstering has been closely tied to local coastal communities; and in terms of

stock assessment, an inability to determine the age of lobsters has prevented the application of complex modelling tools. Each of these factors contrasts with the groundfish fishery, which exploits more migratory species, tends to operate more independently of communities, and has been the subject of highly technical stock assessment procedures. As a result, the character of management has differed dramatically in these two fisheries.

3. THE GROUNDFISH FISHERY

3.1. Context

Discussions of the groundfishery in Atlantic Canada must be viewed in light of recent events, particularly the two major collapses that the fishery has suffered in the second half of the 20th century. The first occurred in the early and mid-1970s, driven largely by heavy fishing pressure by foreign vessels that continued up to 1977. With more conservative management and some luck (in the form of strong year classes recruiting to the fishery), groundfish stocks re-built in the late 1970s and early 1980s. However, Canadian stock assessment and management measures proved incapable of monitoring and controlling fishing pressure.

The second collapse, in the late 1980s and early 1990s, arose from very high levels of domestic (and, in some cases, foreign) fishing mortality, compounded by the onset of less favourable environmental conditions. In 1992, the federal government closed the 'Northern cod' fishery in NAFO area 2J3KL, a fishery that had been one of the world's largest and of enormous importance to the Canadian province of Newfoundland and Labrador. Whereas many inshore fishers had been expressing alarm for years about the decline that they perceived in this stock, it was a failure of the corporate 'offshore' trawler fishery to find fish that led the government to end harvesting. Strong shock waves resulted from the closure, as those in Newfoundland came to realise that the mainstay of their fishery was apparently gone. A 2-year moratorium was declared on harvesting, one that has been extended indefinitely as the stock has failed to recover. Subsequently, fisheries have been closed for most cod stocks and a considerable number of other stocks throughout most of Atlantic Canada, although some of these fisheries have re-opened in 1997.

Historically, groundfish resources in Atlantic Canada have been among the most plentiful in the world. Cod was the species most attractive to fishers arriving in the region centuries ago, and remained, until recently, the mainstay of the groundfishery. However, with many cod fisheries

closed over the past 3–4 years, the species composition in the groundfish catch has changed dramatically. For example, in 1995, more redfish was caught than cod, and the value of the Greenland halibut catch exceeded that of cod.[1] Many other species play more localised roles. For example, haddock and pollock are important along the Scotian Shelf of Nova Scotia, redfish and white hake likewise in the Gulf of St. Lawrence. Greenland halibut is a major species off Newfoundland and Labrador, where a lumpfish fishery also operates. Some species also have particular relevance to specific gear types; for example, redfish to otter trawlers, and halibut to hook-and-line fishers.

The groundfish fleet is heterogeneous, involving vessels ranging from under 35 feet to well over 100 feet in length, and involving several different gear types, in two principal groupings: fixed gear (including gillnets, longlines, handlines, traps and weirs) and mobile gear (particularly otter trawls, as well as Danish and Scottish seines).

In recent years, gear conflicts between fixed and mobile gear sectors have emerged strongly in the groundfishery, but the more traditional dichotomy is between 'inshore' and 'offshore' fisheries. As their names suggest, these fisheries originally were defined on the basis of how far from shore fishing took place, with inshore fishers operating relatively close to their home port, whereas offshore vessels range throughout the Atlantic region. Bureaucratically, the size of the vessel is the determining factor, with 100 feet in length as the nominal dividing point. There are many other differences: the inshore fishery is tied to coastal communities, whereas the offshore is connected with companies. The inshore is relatively labour-intensive, whereas the offshore is more capital intensive. Inshore fishing vessels number in the thousands, whereas those offshore can be counted in dozens. Indeed, the offshore fishery is dominated by two large corporations, National Sea Products and Fishery Products International.

However, since 1977, the dichotomy between the 'true inshore' groundfish fleet of vessels under 35 feet in length and the offshore became blurred with the development of a new 'nearshore' fleet of powerful mid-sized vessels 35–65 feet in length.[4] This fleet, which grew primarily in the wake of Extended Fisheries Jurisdiction, operates under inshore regulations but has the capability to fish in offshore areas, and seems qualitatively different from the 'true' inshore fleet.

fishing) and closed areas and closed seasons (to protect spawning and/or nursery grounds).

With the collapse of Atlantic Canada's groundfishery in the early 1990s, criticism grew over the state of the scientific and management system. The perspective presented here is that this failure can be largely attributed to an over-reliance on quota management and its process of setting and sub-dividing the TAC, and an adversarial relationship between government and fishers, which created an environment in which fishers operated illegally, dumped and discarded fish, and grossly misreported catches. These two problem areas, and recent changes to address them, are discussed in detail here.

3.2.1. Quota management

Quota management is the cornerstone of groundfish regulation in Atlantic Canada. Indeed, in the 1970s, Canada was a world leader in introducing quota management to the groundfishery. The process has involved estimating the biomass for each stock through complex modelling, determining an allowable harvest quota (Total Allowable Catch, TAC) as a fraction of that biomass, sub-dividing the TAC by sector (based on gear and/or boat size), and in some sectors further sub-dividing it into individual fisher quotas (ITQs). In particular, government has been heavily promoting ITQs in the groundfishery. Yet, whereas quota controls have the apparent benefit of setting a firm limit on what can be removed from the ocean, the reality is that a reliance on quotas has led not to a sustainable groundfishery, but to stock collapse.

Quota setting requires knowledge of the fish biomass. However, the two major sources of assessment information both proved faulty. Research vessel surveys could not capture the spatial diversity of the stocks, covering only a small fraction of the fishable area, usually in offshore areas. However, commercial fishery catch rates proved misleading, since it was assumed that success in fishing (as indicated by high catch rates) was a direct indicator of strong fish stocks. This neglected the reality that even as stocks declined, fishers were able to find and catch the remaining fish. In other words, good catch rates created the illusion of a healthy stock. This was aggravated by a failure of stock assessments to account consistently for technological change that boosted the catching power of the fleets, such as introduction of the 'turbo-trawl' in the Gulf of St. Lawrence groundfishery.

Second, quota management created inherent incentives to kill more fish than allowed under established quotas (whether a global or an individual quota). Catch monitoring can deal with this at dockside, but anti-conservationist behaviour also can take place at sea, through 'highgrading'

to maximise the *value* of what is reported as caught, typically by dumping lesser-valued fish overboard and/or dumping or discarding prohibited fish (such as that for which the quota has been reached) so as to be able to continue fishing for other stocks.

No remedy for these problems has yet been found, except through the expensive means of placing observers on every vessel. Furthermore, incentives for high grading and dumping increase as quotas are sub-divided to gear sectors and then to individuals. Under a simple global quota, high grading or dumping presents direct costs to the fisher, as lost income, but provides few advantages to the fisher, except where hold capacity is a limiting factor, since any benefits would be necessarily shared by the entire fleet. However, under an individual quota system, the fisher's direct cost of highgrading or dumping remains the same, but the benefits of such actions are 'personalised', accruing directly to the fisher rather than being shared. Thus, there is evidence now of extensive dumping and discarding in the offshore fleet under 'enterprise allocations', a form of individual company quota.[5]

A third less well recognised problem with quota management, particularly in the Atlantic groundfishery, is the illusion of certainty that it creates. Quantities of fish are allocated to the various players, and once this has been done, industry is led to view their piece of the pie as unalterable. Although in theory, in-season changes to annual TACs were possible 'as a consequence of major changes in the scientific advice',[6] in reality, such changes were very rare. In the balance between adaptability to respond to new knowledge about stock status, and the rigidity of 'annual business plans', the choice was clearly with the latter. This was particularly apparent with the groundfishery's individual transferable quota (ITQ) system, which was ill-equipped to deal with mid-season reductions in quotas during the groundfish collapse.

Finally, not only are the above shortcomings of quota management serious in their own right, they are compounded through the interaction between them: the anti-conservationist behaviour and misreporting induced by the existence of quotas distorts and biases the catch data that are so crucial in the stock assessment process. This resulted in faulty assessments of stock status, and overestimates of feasible catch levels.

3.2.2. Consultation versus co-management

Historically, fishery management in Canada was based on a polarised view of the world, in line with Hardin's 'Tragedy of the Commons':[7] fishers were seen as selfish profit maximisers, versus regulators as protectors of the resource. This perspective, although flawed,[8] actually became self-fulfilling; when fishers in Atlantic Canada were excluded from management

decision-making, their incentive to conserve resources was diminished. Under such circumstances, no level of enforcement, however extensive, was able to prevent illegal fishing and over-harvesting.

To deal with this, DFO shifted to a consultative model, in which government discussed management measures with the industry prior to implementation. However, consultations did not equate to decision-making power, and as a result, in most cases, fishers still did not 'buy into' government imposed regulations. This was clear in the Atlantic Canadian groundfishery, where evidence has mounted of extensive dumping and highgrading of fish, as well as under- and misreporting of catches, in the 1980s. There was also a perception among inshore fishers that the consultative mechanism, which operated on a centralised Atlantic wide basis, favoured the larger-scale players in groundfishery, who also operated Atlantic wide.

The next step in the evolution of fishery management lies in recognising that effective management requires the close involvement of those being regulated, the fishing industry. To achieve this, 'co-management' is needed, involving the creation of suitable institutions in which stakeholders and government work together to develop and enforce regulations jointly.[9,10] The federal government is now promoting a form of co-management in the groundfishery, in conjunction with rapid reductions in government spending on fishery management, and increasing licence fees charged to fishers. Unfortunately, the government vision of co-management has two flaws. It lacks an understanding of the potential of 'community based co-management' to increase the efficiency of management by involving relevant coastal community institutions alongside governments and fishers, and to maximise the moral persuasion acting in support of conservation. Indeed, this flaw reflects a long-standing lack of attention by DFO to participation by coastal communities in the fishery. Instead, the government's approach is sector-based, perpetuating the division of the fishery into competing groups defined by gear type and vessel size. It also fails to recognise that, since the government's principal mandate is conservation of fish resources, a natural asset owned by the public, the resource owners deserve some involvement in management of Atlantic Canadian fisheries. Instead, DFO has focused on 'serving' its 'clients' in the industry.

3.2.3. Innovations in groundfish management

In the wake of groundfish closures, the Minister of Fisheries and Oceans altered the management process for the groundfishery, beginning in 1993. While, many changes were made at that time and subsequently, the key elements of these can be captured through an examination of two

examples: a new advisory body, the Fisheries Resource Conservation Council (FRCC), and a more participatory process for creating fishing plans, referred to as Conservation Harvesting Plans.

The FRCC represents a tentative step toward co-management and partnership between industry and government. It is composed of 15 individuals from the fishing industry and universities (including the author) appointed by the Minister of Fisheries and Oceans, together with provincial delegates and federal fisheries staff as *ex-officio* members.

Creation of the FRCC led to key changes in fishery decision-making processes, as they pertain to the groundfishery. In the past, government scientists, through a structure known as the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC), published advice on groundfish conservation measures, notably a set of recommended TACs. This advice was then debated by selected members of the fishing industry in an Atlantic Groundfish Advisory Committee (AGAC); a second round of advice went from that forum to the Minister of Fisheries and Oceans for a final decision. In 1993, both CAFSAC and AGAC were dissolved. Now, scientists provide information rather than advice and, in contrast to the AGAC process, this scientific information is combined by the FRCC with input from public consultative hearings, at which any stakeholder (fisher, fishery organisation, or general public) can make a presentation. The results of the FRCC deliberations are provided in public recommendations to the Minister, who then makes decisions on TACs and other conservation measures.

Two months after its initiation, in August 1993, the FRCC responded to a request from the Minister with an emergency report[11] for closures of many groundfish fisheries (in addition to the 2J3KL cod stock) and quota reductions in others. All of the recommendations were accepted and implemented, as were most of those in subsequent reports, suggesting that the FRCC was a quasi-decision-making body. However, in some instances, the Minister went beyond FRCC recommendations, reducing quotas further or even closing additional fisheries; this may signal the importance the government places on conservation, and/or a desire by Ministers to place a personal stamp on the fishery.

The FRCC also has the mandate to advise the government on fishery research priorities. It has emphasised adoption of a multidisciplinary, systems oriented approach for fishery research, with five elements:

1. an ecosystem approach to fisheries management;
2. a multidisciplinary team approach in addressing fishery research questions, recognising that fishery science involves more than the natural sciences;

3. studies of fishing as a system, striving to better understand the relationship between fish (resource) and fishing (fishing practices, gear technology, capacity analysis, etc.);
4. a more effective role in fishery science for those with practical experience and knowledge in the fishery; and
5. better integration and coordination in the government fishery research establishment, including links between government and the fishing industry.[12]

Once the Minister of Fisheries and Oceans announces catch quotas (TACs) and other conservation measures for the groundfishery, the TAC is divided into allocations for each sector of the fishery. These sectors are defined in terms of location, gear type and vessel size category, e.g. vessels using mobile gear, of 45–65 feet in length, fishing in NAFO area 4X. However, any given sector cannot harvest its allocation until a final step takes place; the development by that sector of a 'Conservation Harvesting Plan' (CHP), a detailed set of agreed management measures.

The CHP is an important new element of the groundfishery that moves the fishery in the direction of co-management. Previously, DFO developed fishing plans for each sector, after nominal consultations with the industry, and as a result there was little acceptance of the plans. Now, the process is different. FRCC recommendations outline broad guidelines for the CHP, and DFO may provide more precise requirements, but the onus is placed on each sector of the fishery to determine if and how it can fish within allowable limits. With this responsibility comes the flexibility to develop management measures that best suit the fishers of that sector. However, as a safeguard, DFO fishery managers must agree that the CHP will meet conservation requirements before a CHP is approved and fishing is allowed.

The CHP has been a vehicle for innovation. Typically, in addition to noting the sector's total available catch quota and allowable fishing gear (e.g. mesh or hook sizes), the CHP also incorporates new arrangements for at-sea and dockside catch monitoring, 'small fish protocols' to close the fishery temporarily if undersized fish are being caught, and so on. Also, it appears that the shortcomings of the quota management system, described earlier, may be dealt with to some extent in the CHP process. It is recognised that with great overcapacity in the fleets, setting a quota in the absence of effort limitation can lead to extensive dumping, discarding and highgrading, as well as more chance that a quota erroneously set too high will be caught, thereby damaging the stock. Thus, the FRCC has recommended the use of effort controls in addition to quotas, and DFO is beginning to insist that such measures be built into CHPs. Such dual

controls provide a double check that conservation is ensured, but again, how exactly to implement them is left to fishers in each sector, depending on what is most appropriate in that sector. It should be noted that overcapacity, a recurring theme in Atlantic Canada, is not a matter for CHPs. Instead, there have been under-funded unsuccessful attempts at buyback programmes. In the absence of substantial capacity reduction measures, attention must turn to ensuring that the realisation of this capacity, effort at sea, is suitably controlled.

4. THE ATLANTIC CANADIAN LOBSTER FISHERY

4.1. Context

Whereas, internationally, one hears much about the collapse of groundfish in Atlantic Canada, it must be realised that neither the fisheries themselves, nor fishery management in the region, is homogeneous. Groundfish and lobster dominate Atlantic Canada's fisheries, but the structure, operation and management approaches used in these two major fisheries are dramatically different. The lobster fisheries of Atlantic Canada have been heavily studied by social scientists, interested in the community-based and self-regulatory aspects of these fisheries, but in scientific terms, they are relatively understudied, compared to groundfisheries in the same areas. Of most interest is the absence from the lobster fishery of the two major problems in the groundfishery described above: a reliance on quota management and a lack of acceptance by fishers of the management system. Whereas this fishery has its own problems, it provides a relatively successful model for an alternative approach to fishery management in Atlantic Canada.

Whereas lobsters are present throughout most of Atlantic Canada, there is great variation in catches between areas, with the greatest production in southwest Nova Scotia and the southern Gulf of St. Lawrence. In the first half of the 1990s, landings averaged 16 500 tonnes in the Scotian Shelf and Bay of Fundy (including southwest Nova Scotia), 19 800 tonnes in the southern Gulf of St. Lawrence, 3400 tonnes in Quebec and 2800 tonnes in Newfoundland.

Whereas considerable information exists about some aspects of lobster biology, Pringle and Burke[13] note that 'little is known of their natural diet', 'lobster mortality rates are difficult to obtain', in most cases, 'lobster stock-recruit relationships are not known', and 'few direct measurements of lobster density are available'. Although differential catches between areas suggest variations in abundance, the inability of science to determine the

age of individual lobsters means that demographic information cannot be obtained systematically. These various sources of uncertainty in the science of lobsters have prevented the quantitative modelling common in the groundfishery, and have interesting implications for lobster fishery management.

The inshore lobster fishing fleet is structurally quite uniform, involving the same general configuration of vessels and gear throughout the region. There are approximately 12 000 lobster licences active in Atlantic Canada, with the fishery providing seasonal employment to over 32 000 people.[14] In recent years, the price of lobster has been high, as has the abundance; these factors have made the lobster fishery 'the most valuable individual fishery on the Atlantic coast by a considerable margin'.[14] Indeed, it has been noted that lobstering is 'the backbone of the inshore fishery in Nova Scotia, New Brunswick, Prince Edward Island and parts of Quebec', providing in most areas 'the base for a mixed fishery supplemented with groundfish, herring and other species'.[13] Specifically, of those fishers in the Maritimes with a lobster licence, lobster catches constitute from 60% to over 80% of the fisher's total landed value.

There is also a small offshore fishery, which started in 1971 and has eight licensed vessels, ranging in length from 60 feet to 141 feet, with an average length of 107 feet.[15] Since 1985, the offshore fishery has been managed through quota controls (total allowable catches) and individual enterprise allocations, an approach diametrically opposite to that in place for the inshore sector.

The lobster fishery in Atlantic Canada has an interesting history, but one that is relatively more recent compared with the groundfishery. The early development of the fishery was to serve a market for canned lobster, with the first cannery in Atlantic Canada being established in 1845. By 1900, there were 760 such canneries;[16] this number subsequently decreased (to 191 in 1939 and 23 in 1978), as more of the catch was exported live. Meanwhile, as the fishery developed in the late 1800s, catch levels declined steadily over several decades, reflecting a fishing down of the original population. For the following 60 years from the mid-1910s to the mid-1970s, catches remained remarkably stable. Subsequently, catches began rising dramatically, perhaps in response to environmental conditions, reaching a peak in the early 1990s before falling somewhat since then.

4.2. Lobster fishery management

The inshore lobster fishery generally operates on a limited geographical scale, and thus issues in this fishery tend to be discussed locally. In the early 1980s, a management structure was put in place, based on dividing the region into small-scale Lobster Fishing Areas (LFAs), each of which

has an Advisory Committee including elected fishers and processors, as well as government officials, including a biologist, an economist and a local manager.[13] Each LFA has its own management plan, adjusted for local conditions.

In contrast to the focus on quota management in the groundfishery, lobster fishing is regulated largely through input controls: limited entry licensing (so that only licensed fishers can participate), limits on the amount of gear (number of traps) per fisher, and limits on the fishing season. With effort-based, rather than quota-controlled management, there is no inherent drive among fishers to catch a pre-set TAC. There are also biologically oriented controls, designed to keep the size and/or maturity of individuals in the harvest to desired levels, including closed areas and size limits. The latter are regulated through a minimum 'carapace size' (a minimum size below which the lobster must be returned to the water) and, more recently, through measures to limit the maximum size of lobster caught, using a designated 'hoop size'.

Again in contrast to the groundfishery, the above management measures tend to be more adaptive, with adjustments made in an attempt to fine tune them from year to year. This adaptive approach also reflects the fact that, in the absence of quantitative knowledge of the lobster resource and of model-based stock assessment, lobster fishery management is more guided by 'rules of thumb', such as year on year stability through effort controls and common-sense biological restrictions, such as not harvesting egg-carrying females.

Despite regular disagreements between participants in the lobster fishery, there is remarkable acceptance of the LFA-based management system, a form of established co-management, with fishers, scientists and managers working together. Notably, fishers praise the efforts of 'their' DFO scientists, and lobby the government for more research within their fishery. Overall, there is a sense of contentment with the structure of the system, both on the part of lobster fishers, who know that they have access to a reasonable living from lobster, and on the part of government scientists and managers, who receive relatively little complaint from the industry. Indeed, there is an awareness within the inshore industry of the need to protect the strong points of their management system:

> We wish to emphasize that it is the total package of measures that makes the lobster fishery work and not any single measure in isolation. The long-term success of the lobster fishery, based on effort and biological controls, stands in stark contrast to the apparent failure of quota managed fisheries.[17]

> We are particularly concerned that DFO's loss of will to manage the fishery and apparent desire to off-load management issues to the 'industry' threatens our elaborate lobster regulatory regime.[18]

The lobster fishery has avoided the problems of quota management, developed a broadly supported management structure and already incorporated the innovations described for the groundfishery above. Nevertheless, there are conservation concerns in the fishery. Catches have been declining in recent years, from historic highs in the late 1980s and early 1990s; some view this as part of a natural cycle, whereas others are concerned about the possibility of a pending stock collapse.

A report by the FRCC, '*A Conservation Framework for Atlantic Lobster*'[14] highlighted several problem areas. First, despite effort controls, actual fishing effort increased dramatically in the lobster fisheries. This occurred because of a lack of full enforcement of current controls (such as trap limits), due to expansion of uncontrolled elements of effort (such as the time that each lobster trap 'soaks' in the ocean, the number of trap hauls made), and due to technological change (notably introduction of larger and sturdier metal traps to replace the traditional wooden design). Secondly, this increase in effort has generated very high exploitation rates (up to 85%), which, combined with the fact that harvests are largely immature, implies low egg production and possible recruitment overfishing. Thirdly, whereas LFAs have proven to be useful as a co-management approach, they are too small geographically to serve conservation needs; in other words, synchronised conservation measures need to be implemented in combinations of LFAs.

In light of these concerns, the FRCC recommended that local level co-management through LFAs be complemented with a set of broader 'Lobster Production Areas' within which conservation measures can be better determined. Furthermore, a set of approaches were provided to aid fishers in developing management measures to increase egg production and reduce exploitation rates in their fisheries. The key point here is that these proposals, which have been well received in the fishery, build on rather than drastically alter the existing lobster fishery management arrangements. The system has generally worked well, and no one wishes to change it more than necessary.

5. NEW DIRECTIONS IN ATLANTIC CANADIAN FISHERIES MANAGEMENT

In the aftermath of the groundfish collapse, there has been ongoing discussion in Atlantic Canada on creating the 'fishery of the future'. This

paper has focused on several management innovations in the fishery, notably co-management, effort controls and new conservation institutions such as the Fisheries Resource Conservation Council. In this final section, we provide a brief overview of some other positive directions that may help in forging a more sustainable 'fishery of the future'.

5.1. The Fisheries Act, co-management and administrative sanctions

Canada's Fisheries Act is a comprehensive and powerful legislation that served the country well since 1868. The Act gives government strong powers to 'make all and every such regulation or regulations as may be found necessary and expedient for the better management and regulation of the Fisheries...' (from the United Canada's Act, 1859[16]) as well as to control pollution of the marine environment. In 1996, the federal government introduced legislation to 'streamline and modernise' the Act (Bill C-62). If passed by Parliament this would establish a mechanism for government to 'enter into a fisheries management agreement with any organisation that, in the opinion of the Minister, is representative of a class of persons or [licence] holders'. This essentially provides a legislative vehicle for co-management in the commercial fishery, as well as arrangements with Native fishers and others. The new Act also reinforces a recent development in fishery enforcement, the administrative sanction process. An initiative to avoid lengthy and uncertain legal cases for non-criminal fishery offences, this involves a quick administrative hearing for a fisher charged with an offence. Penalties are lower than in court, but 'conviction' is more likely.

5.2. The Oceans Act, marine protected areas and integrated coastal zone management

Managing Atlantic Canada's commercial fisheries will be increasingly complicated by interactions with sport fisheries, Native fisheries, aquaculture and non-fishery activity along the coast. A number of initiatives have been undertaken in the mid-1990s to bring a more integrated approach to ocean management. The Oceans Act provides government with the enabling legislation to manage multiple and conflicting ocean uses. One of the Act's provisions is the capability to declare marine protected areas (MPAs), whether as a fishery conservation tool or to protect endangered species or habitats; these MPAs may be as simple as traditional closed areas in fisheries, or they may be permanent no-take zones. Integrated coastal zone management is still embryonic in Atlantic Canada, although both provincial and federal governments are in

the midst of formulating strategies and pilot projects. From a fishery management perspective, a fascinating aspect of these initiatives is that they are often seen as threatening by fishers, who are accustomed to discussing only fishery matters with government, without dealing with other issues and without having other players involved.

5.3. The precautionary approach

Whereas the precautionary approach is a relatively new concept, the idea behind it—erring on the side of caution—has long been (at least theoretically) part of fishery management. However, the collapse of the Atlantic Canadian groundfishery has been attributed in part to a wide variety of anti-conservationist actions, by government and industry, that do not reflect this perspective.[19] For example, a recent study of groundfish management[20] showed that of all the catch quotas set in a particular region over the 1977–1989 period, two-thirds exceeded the levels set in the government's policy. Now, attempts are being made to explicitly implement the precautionary approach. This is reflected in recent TACs set for George's Bank groundfish, which were based on a 'risk analysis' and chosen to provide a low risk of stock decline.

5.4. Community quotas

Whereas community level management is already in place in much of the lobster fishery, groundfish fishers in parts of Atlantic Canada have developed their own version of this, the 'community quota'. Once an overall TAC has been sub-divided into sector allocations (by gear and vessel size), some sectors have chosen to allocate their global quota on a community basis, dividing up the coastline into self-identified sections (often on a county-by-county basis) so that the available harvest can be managed locally. This approach, pioneered in the small community of Sambro (near Halifax, Nova Scotia) has since spread throughout the small boat, fixed gear fishery in the Scotian Shelf and Bay of Fundy areas.

5.5. Cooperative fisher–scientist research

Several years ago, Nova Scotian inshore fishers and government scientists initiated the '*Fishermen and Scientists Research Society*' to promote cooperative scientific research efforts, as well as to educate fishers on stock assessment and other scientific activities. More recently, so-called 'sentinel fisheries', have been established throughout much of Atlantic Canada to monitor stock status through low-level fishing activity designed by

government scientists and carried out by fishers. These various endeavours have had a remarkable impact in forging a new found positive interaction between fishers and scientists.

These various positive initiatives, together with others outlined earlier in the paper, reflect the fact that fishery management in Atlantic Canada is in a state of flux. Motivated in part by the groundfish collapse, and in part by the changing role of government, this has led to widespread re-thinking of the directions for fishery management. Some of this is ideological (such as debates over community-based versus market-based approaches), whereas some is more technical and institutional. There is a need both to understand the past, and to learn from fishery experiences elsewhere in the world, if the search for a 'sustainable fishery of the future' is to be successful.[21] This is one of the key challenges facing Atlantic Canadian fisheries.

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