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The Atlantic Canadian Groundfishery: Roots of a Collapse

While many explanations have been proposed for the 1990s Atlantic Canadian groundfishery collapse—ranging from "natural causes" to over-fishing and damaging technologies, to failures of fishery management and science—this paper examines the possibility that underlying these, at the roots of the collapse, lie a set of entrenched attitudes that have driven fishery decision making. These attitudes, about the natural world, about management and about how the fishery should function, became influential especially where they prevailed at the institutional level, as the accepted wisdom among the dominant players in government and the fishery. Four sets of conservation-related attitudes are considered, dealing with (1) the extent to which management responsibilities are accepted and shared by fishery regulators and fishers, (2) the "burden of proof" and where it should lie in judging conservation concerns, (3) a view that "conservation can wait", to avoid disrupting catches and fishing activity, and (4) a belief that "the system works", that fundamental change in fishery management is unnecessary. It is noted that a failure to modify attitudes in the fishery may well lead to a situation in which history once again repeats itself.

Introduction

Why did the Atlantic Canadian groundfishery collapse in the early 1990s? The evidence to date suggests that a major part of the blame must be placed on over-fishing. And in attempting to understand why this occurred, a common thread seems to lie at the core: the prevailing *attitudes* in the fishery—attitudes about nature, about management, and about how the fishery should function. This paper pursues the idea that such attitudes may have been driving forces in the fishery collapse—and may lead us to repeat history, if we fail to examine them critically now. Emphasis here is placed not so much on "personal" attitudes, but more on those which became prevalent at the institutional level, as the accepted

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wisdom amongst the dominant players in government and the fishery; it is these which most affected the process of fishery decision making.

Four sets of conservation-related attitudes are considered here, concerning: (1) the appropriate "role of the regulator", and the relation of fishers to the government, (2) the "burden of proof" and where it should lie in judging conservation concerns, (3) the idea that "conservation can wait", to avoid disrupting catches and fishing activity, and (4) the belief that, "the system works", that fundamental change in fishery management is unnecessary. These themes are addressed consecutively in the next four sections. The final section then synthesizes these views and presents some conclusions on changing attitudes toward an emphasis on sustainability in fishery systems.

I. *The Role of the Regulator*

Must fishing fleets be regulated in their harvesting efforts? To what extent? How can regulation best be achieved? Canadian fishery management has struggled with these questions, and is still in search of the answer.

1. *The Spirit of Free Enterprise*

Historically, the world's oceans were viewed as limitless frontiers, containing abundant resources for all. Fishing tended to attract those with a desire for the adventure of the hunt, an entrepreneurial "free enterprise" view of the world, and a dislike of regulations that interfere with the "business of fishing". On the other hand, in modern times, abundant evidence from fisheries worldwide demonstrates that unregulated laissez-faire exploitation is incompatible with long-term sustainability. Indeed, in the absence of management, even extinction can result from an uncontrolled yet economically "rational" pursuit of profit maximization.[1]

Thus, the fishery presents an odd combination: a general acceptance of the need for regulations that limit harvesting activity, and at the same time, a widespread distaste for such controls. Conservation benefits accruing from regulation remain in constant conflict with the freedom sought by fishers to travel the world's oceans in search of fish and profit. (Interestingly, the "free enterprise spirit" did not prevent many in the fishery from accepting government subsidies for vessel construction and purchase of gear. In Atlantic Canada, these ranged from the Fisheries

1. C.W. Clark, *Mathematical Bioeconomics: The Optimal Management of Renewable Resources* 2nd ed. (New York: Wiley-Interscience, 1990).

Loan Board's boat-building subsidies, to the well over $100 million given to the two major offshore companies, Fishery Products International and National Sea Products, in their early-1980s restructuring.[2]

A clear illustration of this conflict between fishery regulation and the "freedom to fish" arose in the 1995 "turbot war" between Canada and Spain, a dispute which centred around the common view of the high seas as a bastion of free enterprise entrepreneurship. The episode began when the European Union (notably Spain), unhappy with the catch allocation of Northwest Atlantic turbot (Greenland Halibut) it had received from the Northwest Atlantic Fisheries Organization (NAFO), unilaterally declared its own higher catch target. Several E.U. vessels set out in search of this catch, fishing just outside Canada's 200-mile limit. Canada viewed this as a threat to conservation, and arrested a Spanish vessel for violating the coastal state's regulations. The European Union responded by calling this action "piracy", arguing that it contravened their freedom to fish the high seas.

After much diplomatic tension, the matter was eventually resolved with a compromise on catch allocations and agreement on management of future harvests. The event drew broad attention to the over-riding need for fishery conservation and regulation, but it is unlikely that entrenched attitudes of free enterprise will soon disappear from the world's fisheries.

2. *Total Control*

At the opposite end of the spectrum from the spirit of free enterprise lay a common attitude of government that, in seeking to conserve and regulate the fishery, it must exercise firm and wide-ranging control over fishers, fishing fleets and processors. In Canada, an extensive regulatory framework was established in an effort to achieve such control, with harvests allocated amongst users (to balance conflicting social, economic, and cultural goals) and over time (to balance present and future needs). This framework typically operated in a "top-down" manner, providing massive power to one individual, the Minister of Fisheries and Oceans, some power to those in the fishery bureaucracy, minimal decision-making power for fishers, and none for Canadians outside the fishery (a point discussed in detail below).

Attempts at total control of the fishery reflect two questionable assumptions about human behaviour: (a) that, in the spirit of Hardin's so-

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2. L.S. Parsons, "Management of Marine Fisheries in Canada" (1993) 225 Canadian Bulletin of Fisheries and Aquatic Sciences 763 (Ottawa: National Research Council of Canada).

called "Tragedy of the Commons"[3], fishers are selfish profit-maximizers, driven to take as much financial benefit from the resource as possible, without regard for conservation, and (b) that fisheries are "controllable" by management agencies, which can force those fisheries to behave in a socially-optimal fashion.

While these assumptions have been seriously challenged in recent years[4], they have had a major impact on fishery thinking. Together, they produced an "us versus them" attitude within fishery management. Assuming that fishers had no interest in conserving fish for the future, regulatory agencies typically took sole responsibility for conservation, and sought to achieve this through controls on the fishers. Thus, Hardin's view of the world became self-fulfilling: with fishers left outside the management decision-making system, they indeed had no other role than that of catching as much fish as possible. Rather than creating social or peer pressure to follow the regulations, pressure *increased* to "beat the system", with those who did so likely to be emulated by others. Under such circumstances, no level of enforcement, however extensive, has been able to prevent illegal fishing, and the potential for building a natural partnership in support of conservation disappears.

Attempts at "total control" over fishers in Atlantic Canada were modified in the 1980s with the development of an extensive consultative system by the Department of Fisheries and Oceans (DFO). Fishery management is further evolving today, as regulatory bodies come to realize that efforts at total control have typically failed to achieve conservation. Indeed, support from fishers may well be a pre-condition for sustainability in any overall management framework.

3. *No Place for the Public*

The above discussion suggests that effective fishery management must satisfy the dual requirements of *regulating the fishing industry* and *involving the fishing industry*. The focus of these requirements on the government's connection with the industry helps to explain why DFO staff deal almost exclusively with those who exploit the fish resource. Indeed, a common theme in DFO is that of "serving" its clients in the fishing industry.

However, the government's principal fishery mandate lies not in serving the resource users, but rather in conservation and wise use of the

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3. G. Hardin, "The Tragedy of the Commons" (1968) 162 Science 1243.
4. For a critique of Hardin, see F. Berkes *et al.* "The Benefits of the Commons" (1989) 340 Nature 91.

fish, a natural asset owned by the Canadian public. While owners of valuable property usually have some say in its management, the attitude of government appears contrary to this. The Canadian public—those who should be viewed as DFO's major "clients"—have been given no role in fishery management, which has been typically restricted to government and industry.

Since a principal role of DFO lies in regulating the use of a public asset, one can make useful comparisons with other government regulatory agencies. For example, both DFO and the Canadian Radio-television and Telecommunications Commission (CRTC) are mandated to protect the public interest by controlling the use of a (renewable) public resource: fish and "airwaves" respectively. To do so, both must regulate the actions of an industry: the fishery and the electronic mass media. Both issue licenses to users, and have the power to withdraw those licenses from anyone violating license conditions. Yet there are major differences in attitude. While the CRTC, charged with "serving the public interest", invites public input on the regulation of an industry, DFO seeks to "serve" clients within the industry, while allowing little public involvement.

Given its primary mandate to conserve public assets, this suggests a clear need for government to adjust the relative importance accorded resource owners and resource users in fishery management. A greater role for the resource owners is needed, while recognizing that, for *pragmatic* reasons, effective fishery management must be designed and implemented with the involvement of those being regulated, the fishing industry.

4. *No Place for the Community*

As noted above, management efforts in a sustainable fishery must serve the public interest by regulating resource harvesting, but must do so in such a way as to encourage fishers and coastal communities to "buy in" to the process. The key to this may lie in "co-management", the creation of suitable institutions in which fishers and communities work with the government to jointly develop and enforce regulations.[5] This implies a broader participation in decision making and a more collective responsibility for fishery sustainability.

The preferred approach in this direction is community-based co-management, involving joint decision making by governments, fishers,

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5. See e.g. F. Berkes, ed., *Common Property Resources: Ecology and Community-Based Sustainable Development* (London: Bellhaven Press, 1989); E.W. Pinkerton, ed., *Co-operative Management of Local Fisheries* (Vancouver: University of British Columbia Press, 1989).

and relevant institutions in coastal communities. This approach promotes efficient management, since the involvement of community institutions (in addition to government and industry interests) maximizes the moral suasion acting in support of conservation. Such an approach already exists informally in parts of the Atlantic lobster fishery.[6] It is also prevalent in agreements between the government and Native peoples across Canada—based on formal sharing of decision making with geographically-based organizations. For example, the "Fisheries Joint Management Committee", comprised equally of Inuit and government members, co-manages fish and marine mammals in part of the Canadian Arctic.[7]

With the proven success of community-based co-management elsewhere in Canadian fisheries, one might imagine that this could provide a useful model for the Atlantic groundfishery. Yet it is an approach which has been essentially ignored in the mid-1990s rush of government to promote co-management (as it "downloads" its responsibilities, and costs, onto resource users).

Instead, DFO has preferred to extend its current approach of "sector-based" management, in which it focuses on segments of the industry, perhaps defined on the basis of vessel size (e.g., offshore vessels over 100 feet in length) and/or gear type (e.g., draggers under 65 feet in length), which compete against one another for a share of the fishery "pie". However, a sector-based model of co-management seems less than ideal in that: (1) it institutionalizes divisions amongst fishers, viewing them not as residents of coastal communities but rather as members of disjoint special interest groups, and (2) it ignores the potential of coastal communities themselves to improve the efficiency of fishery management by increasing the level of moral suasion.

If the federal government indeed sees coastal communities as irrelevant to fishery management, this attitude might reflect a view of the groundfishery as no more than a mass of individuals chasing fish around a large expanse of ocean. In such a world, there may seem to be little scope to incorporate coastal communities, counties, regions or other geographical entities within fishery management. On the other hand, the promotion of sector-based over community-based co-management may be due simply to the government's greater familiarity with the former, or to a disinclination to tackle new challenges with the latter, such as those

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6. See e.g. J. Brownstein & J. Tremblay, "Traditional Property Rights and Cooperative Management in the Canadian Lobster Fishery" (1994) 7:5 The Lobster Newsletter.
7. "Cooperative Management: New Partnerships for Fisheries Management" (November/December 1990) *Pisces* 8.

involved in devising suitable geographical "community" boundaries in the groundfishery. Whatever the reason, it would seem that the community-based approach, with its potentially greater stability and efficiency, is deserving of greater attention from government.

II. *The Burden of Proof*

Uncertainty is pervasive in the fishery. Stock sizes are never known precisely within a given year, much less from one year to the next. Impacts of fishing methods on the resource or on the environment cannot be predicted exactly. Given this uncertainty, decisions must be made by balancing risks. Typically, these involve both a risk of stock and ecological collapse (due to excessive exploitation or environmental damage) and a risk of foregoing economic benefits (if harvests are lower than necessary). The fundamental question is: in considering these risks, should the "burden of proof" favour exploitation or conservation?

1. *The Scientific Method*

Assessments of groundfish stocks over the past decade have often produced misleading results. This may have been due as much to the *assumptions* built into the scientific analysis as to the vagaries of fish behaviour. Some such assumptions worked against conservation, and were difficult to change once established. A "burden of proof" was placed on demonstrating the need for such changes before the DFO scientific structure would act. Three examples are given here of cases where this "burden of proof" in the scientific process led to the setting of TAC quotas at levels which (in retrospect) were excessive.

First, consider the process by which a fish population reproduces. Clearly, if there are no spawning fish, there will be no resulting young fish ("recruitment"); hence, up to a point at least, there must be some positive connection between the number of spawners and the resulting recruitment. However, while this is logical in theory, in practice natural fluctuations in the ocean environment and in the corresponding data available to scientists make it difficult to "prove" the connection. In the absence of such proof, links between fish generations were not incorporated into the groundfish assessment process.[8] Furthermore, although logically there must be a certain number of spawners—a critical "spawning

8. J.A. Hutchings & R.A. Myers, "What Can Be Learned From the Collapse of a Renewable Resource? Atlantic Cod, *Gadus Morhua*, of Newfoundland and Labrador" (1994) 51 Can. J. of Fish and Aquat. Sci. 2126.

stock biomass"—required to maintain the reproductive process, no operational approach was put in place to ensure this.

Second, consider the stock estimation process. In the mid-1980s, scientists began to realize that, year after year, they had been regularly over-estimating the size of many fish stocks. While the cause of this systematic error (known as a "retrospective pattern") is still unclear, the conservation implications were great. Over-estimates of biomasses in turn led to over-estimates of the number of fish that could safely be caught. Hence, supposedly-safe quotas were often too high. Although this problem was identified, its impact could not be "proven" conclusively. As a result, quotas were not adjusted accordingly.

Third, dumping of undesired fish and mis-reporting of actual fish landings have been prevalent practices for years. Hence, more fish have been killed by the fishing fleets than have been reported, a serious problem from a conservation perspective not only in its direct effect on the stocks, but also because it implies poor quality in the data the scientists use to advise on subsequent quota levels. While such practices were well-known for years, the extent of dumping could not be "proven", and hence no systematic adjustments were made to the stock assessments.

In each of these cases, an alternative response would be to err on the side of conservation, creating incentives to minimize nonconservationist activity. For example, one could *assume* a high level of dumping (thereby reducing allowable catches accordingly), unless the level of dumping were proven to be lower.

2. *The Technology Debate*

A controversial issue in the groundfishery concerns the choice amongst harvesting technologies. Of the various methods—trawls (draggers), longlines, handlines, gillnets, fish traps, and so on—which is the best means to catch fish from a long-term conservation perspective, and which from a short-term catch-maximizing perspective? While each technology can pose conservation problems if used improperly, do any have inherent negative features that should lead us to favour one technology over another?

This issue often focuses on the technology most commonly referred to as a threat to conservation, otter trawling (or "dragging"), in which nets are pulled over the ocean bottom.[9] This gear is recognized as a powerful

9. Many fishers believe that dragger technology contributed substantially to the fishery collapse. See e.g. SW Nova Fixed Gear Association, "The Canadian Maritimes Fishery: Let's Fix It" (Shelbourne, Nova Scotia, 1995).

means of catching fish, but also as the source of conservation concerns, particularly due to (a) its impact on the ocean bottom habitat, and (b) its relative unmanageability, given a capability to inflict large-scale impacts on fish stocks within a short period of time. While these are both inherent features of the technology, their effect is hotly debated. With respect to dragging on the ocean bottom, uncertainties in ocean ecology make it difficult to "prove" negative impacts on the food chain and on ocean productivity. In terms of manageability, while the very power of trawling technology implies a potential for intensive and large-scale over-harvesting, it is difficult to prove that such damage is inescapable—some argue that it could be avoided if fishers universally adopted a "conservation ethic".

Where should the burden of proof lie in determining whether one fishing technology is inherently more harmful to conservation than another? A "court of law" perspective would *assume* that no technology is unduly harmful, unless proven more detrimental "beyond a reasonable doubt". This view tends to dominate in the fishery. On the other hand, if the burden of proof is reversed so that decision makers err on the side of conservation[10], the balance of evidence might suggest a shift away from use of the most potentially-damaging technologies. The choice of where one places the burden of proof may well lie at the heart of attitudes connecting fishing technologies and conservation.

III. *Conservation Can Wait*

Conservation compromises have occurred frequently in Atlantic Canadian groundfish management. The desire to maintain catch levels, at the expense of conservation, can be examined at a personal level—where preferences are shaped by the "free enterprise spirit" discussed earlier, combined with a lack of a conservation ethic and a strong focus of each fisher on his/her own income levels. But at the level of the fishery system, the process is more complex. Scientists, managers, politicians and industry all participated in an effort to avoid disrupting the harvesting process, at the cost of failing to meet government's declared conservation goals. For example, of all the TAC quotas set over the 1977–1989 period in the Scotia-Fundy management region—from the Bay of Fundy to the northern tip of Nova Scotia—it has been shown that two-thirds of these

10. For a treatment of the "precautionary approach" in fisheries management, see. S.M. Garcia, "The Precautionary Principle: Its Implications in Capture Fisheries Management" (1994) 22 Ocean and Coastal Management 99.

exceeded the "$F_{0.1}$" level which formed the basis of the government's own management policy.[11]

1. *Avoiding Disruption*

A belief amongst most scientists that groundfish were "resilient" enough to withstand exploitation above target levels, combined with a desire amongst managers and politicians to avoid disrupting the fishery, produced a management process containing certain "stabilizing" features that limited the effectiveness of conservation measures. For example, the so-called "50% rule" was a cornerstone of Atlantic Canadian groundfish management through 1992, one which aimed to smooth out the socioeconomic impacts of downturns in stock abundance.[12] Under this rule, when scientific evidence pointed to the need for large cuts in the quotas, management would reduce the allowable catches slowly, by 50% of the difference each year, rather than taking immediate action to cut quotas to desired levels. For example, if the scientific advice called for a reduction of 10,000 tonnes in what could be caught from one year to the next, the actual reduction would be only 50% of this, namely 5000 tonnes. However, this gradualism did not apply in the opposite direction: if scientific analysis suggested an increase in the allowable harvest, the full increase could be made immediately.

A second, more implicit vehicle to prevent stock declines from disrupting harvesting lies in the attitude toward bycatch, the unintentional harvest of untargetted stocks. While many measures have been introduced over the years to reduce bycatches, it is often simply not possible to harvest one stock without some catch of another. In such cases, if fishing on a relatively healthy stock produces bycatch of a depleted or even endangered stock, the only way to avoid the latter is to close the fishery altogether. Should this occur? The dominant attitude in the fishery holds that it should not. Although bycatches should be minimized, the fishers should not be prevented from catching any stock that can withstand harvesting. This view was clearly expressed in the course of the early-1990s groundfish collapse. For example, in 1993, when the government closed a number of fisheries directing on threatened stocks, harvesting of those stocks continued, in the form of bycatch—so as to avoid disrupting other fisheries.

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11. R.G. Halliday, F.G. Peacock & D.L. Burke, "Development of Management Measures for the Groundfishery in Atlantic Canada: A Case Study of the Nova Scotia Inshore Fleet" (1992) 16 Marine Policy 411.

12. See for example, Canada, *1992 Atlantic Groundfish Management Plan* (Ottawa: Minister of Supply and Services, 1991) at 5.

Even in cases where avoidance of disruption was not built into the groundfish management process, it could be achieved at a later stage in the process. For example, while DFO scientists recommended a total TAC quota of 125,000 tonnes for northern cod in 1990, the Minister's decision for that year was to set the TAC at 197,000 tonnes "following extensive consultations with the industry, the Atlantic Council of Fisheries Ministers and the Special Cabinet Committee on Northern Cod."[13] While this TAC was in keeping with the recommendation of the blue-ribbon Northern Cod Review Panel[14], the decision was certainly controversial—many Newfoundland inshore fishers felt this TAC was so high as to endanger the stock, and sought an injunction to overturn it.[15]

2. *The Annual Business Plan*

Fishing is an unusual economic activity, in that no one can be certain how much of the key ingredient is available in any given year, or what effect this year's production will have on the future availability of fish. In other words, there is a high level of uncertainty in fisheries, and a corresponding need for an "adaptive" approach to fishery management, one which adjusts exploitation levels to match whatever Nature provides.

Such an adaptive management philosophy is well-established in the salmon fisheries of Canada's Pacific coast, where high levels of uncertainty in stock sizes are unavoidable. Not only must harvest patterns change from year to year as stocks vary, but even within a given year, managers adjust fishing activity interactively. Fisheries are opened and closed, sometimes from day to day, as more is learned about the abundance of the stocks.[16] This process requires flexibility on the part of salmon fishers, something that is undoubtedly disliked, yet generally accepted. In recent years, the system has strayed at times from its philosophy of careful catch monitoring and adaptive management[17], but the overall approach remains an example of "living with uncertainty".

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13. Department of Fisheries and Oceans, Press Release, B-HQ-90-003E, "Highlights: 1990 Canadian Atlantic Groundfish Management Plan" (2 January 1990).
14. Canada, *Independent Review of the State of Northern Cod Stock* by L. Harris (Ottawa: Minister of Supply and Services, 1990).
15. R. Gorham, "Group Seeks Injunction to Quash Cod Quotas" *The [Halifax] Chronicle-Herald* (19 January 1990) A3.
16. C.J. Walters, *Adaptive Management of Renewable Resources* (New York: Macmillan, 1986); L.S. Parsons, *supra* note 2.
17. Canada, *Fraser River Sockeye 1994: Problems and Discrepancies* (Ottawa: Canada Communication Group, 1995) (Fraser River Sockeye Public Review Board) (Chair: John A. Fraser).

The groundfishery of Atlantic Canada followed a less flexible approach. While allowable harvest levels (TACs) were typically adjusted from year to year, there was an implicit attitude that the TAC should be fixed, firm, and sacrosanct within the fishing season. On paper, allowance was made for in-season changes to annual catch quotas "as a consequence of major changes in the scientific advice"[18] but the possibility of such changes was severely restricted. For example, a rule that "no adjustments will be made to the TAC in cases where the existing TAC is above the current $F_{0.1}$ value"[19] implied that if DFO had agreed at the start of the season to an excessive TAC quota (above the $F_{0.1}$ target), then no change in that allowable harvest was allowed within the season.

In reality, within-season changes were very rare indeed; not only were they inconvenient to management and industry, they were not thought to be particularly crucial to conservation, given the widespread (although mistaken) belief that the stocks were almost immune to collapse. It was felt that any adjustment to the TAC could be left to next year's fishing plan. Such an attitude allowed the fishing industry to adopt annual business plans, comparable to those in non-resource sectors.

This in-season rigidity in catch quotas may have improved marketing and provided some short-term stability, but it also contributed to overharvesting and led to considerable dislocation when mid-season changes did become necessary. A clear example of this arose in August of 1993, when mounting evidence of the groundfish collapse and concern expressed by many fishers[20], led the Minister to close some fisheries and reduce quotas in others.

Unfortunately, since allowance for such changes was not well-developed in the management scheme, considerable difficulties arose in the quota adjustment process. This was particularly apparent in the individual transferable quota (ITQ) system, which had been promoted by DFO largely through the claim that an ITQ gave each fisher "property rights", firm shares of the TAC that could be caught anytime desired. In developing this system, much less attention was focused on the facts that (a) fish in the sea actually belong to the Canadian public, and (b) conservation of those fish could demand mid-season reductions in quotas. Hence, the ITQ scheme was not built around the idea of "living with uncertainty", and was poorly equipped to assist fishers in equitably sharing the impacts of mid-season changes.

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18. *Supra* note 12 at 6.
19. *Ibid.*
20. Canada, *We Must Stop Chasing Quotas Down to the Last Fish. 1993 Conservation Requirements for Atlantic Groundfish: Report to the Minister of Fisheries and Oceans* (Ottawa: Fisheries Resource Conservation Council, 1993).

IV. *The System Works*

When a fishery collapses, the opportunity could be taken to seriously assess and rectify the root causes, and to radically restructure management systems to correct past deficiencies. Alternatively, the focus might be on business as usual in terms of fishery management, with only minor tinkering. The choice between these will likely bear on the likelihood of future fishery collapses.

1. *Blaming the Ocean*

When the northern cod stock collapsed in the early 1990s, where was blame placed? In initial DFO press releases, no mention was made of human impacts on the resource, nor of problems with the quota-setting system discussed above. Instead, it was stated that "the devastating decline in the stock of northern cod" was due "primarily to ecological factors".[21] Undoubtedly, the connection between fish population dynamics and the environment is a complicated one. Yet the study of past fishery collapses worldwide suggests that while ocean conditions might act as a "trigger" to initiate a stock collapse, the principal underlying cause of the collapse is more likely to be high levels of resource exploitation. The dynamics of collapses are likely highly complex, but the overall sequence of events may be as follows:

(1) During periods in which ocean and environmental conditions are "acceptable" (from the perspective of the fish), fundamentally unsustainable harvest levels may *appear* to be sustainable.

(2) Inevitably, and quite naturally, ocean conditions will deteriorate at some point (again from the viewpoint of the fish), so that heavily-harvested fish populations become subjected to additional stress—environmental conditions that inhibit growth and reproduction.

(3) Faced with intense over-fishing and a "trigger" in the form of an adverse environment, the fishery collapses.

This scenario seems to reflect experience around the world, from the B.C. herring fishery collapse of the 1960s[22] to the Peruvian anchovy collapse, triggered by ocean cooling known as "El Nino" but due fundamentally to massive exploitation.[23]

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21. Department of Fisheries and Oceans, Press Release, NR-HQ-92-58E, "Crosbie Announces First Steps in Northern Cod (2J3KL) Recovery Program" (2 July 1992).

22. Canada, *The Decline and Recovery of Canada's Pacific Herring Stocks* (Fisheries and Marine Technical Report No. 784) by A.S. Hourston (Ottawa: Minister of Supply and Services, 1978).

23. R. Hilborn & C.J. Walters, *Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty* (New York: Chapman and Hall, 1992).

In the case of the Atlantic groundfishery collapse, the jury is still out on impacts of ocean conditions such as temperature, salinity, and ice cover, as well as effects of predation by seals. However, it is of interest to review two "retrospective" analyses of the collapse of the northern cod stock, looking back in time with the benefits of hindsight. Taggart et al. support the 3-step scenario described above. Their study shows that the principal culprit for a 50% decline in the quantity of juvenile cod was "intense fishing" (which reduced the spawning stock as well as the diversity of fish sizes and ages), and that "poor environmental conditions have apparently had an additive effect in further limiting recruitment".[24] Hutchings and Myers take this further, presenting evidence that fishing pressure alone is sufficient to explain the collapse of Northern cod; an appeal to "bad ocean conditions" is simply unnecessary as a part of the explanation.[25] At the very least, the growing evidence suggests that it would be unwise to place too much blame on the ocean in explaining the fishery collapse.

2. *We Have All Sinned*

If the ocean and its inhabitants cannot be blamed for all the fishery's ills, it becomes necessary to look at human impacts. In this regard, a common refrain in government and the fishing industry is that "everyone must share the blame" for the fishery collapse. The implication is that everyone fished illegally, everyone fished in an anti-conservationist manner, and everyone contributed to excessive harvests. Is this a fair assessment, or is the truth more complicated?

Certainly, illegal and nonconservationist fishing practices were widespread—many in the fishing industry now publicly discuss activities they engaged in or witnessed: dumping, mis-reporting, high-grading, illegal gear, trans-shipments, excessive effort, processor collusion, and the like. Yet while such practices were common, there is no evidence that they were universal. Furthermore, there is a question of "scale"; while some illegal actions were of a particularly damaging nature, others were no more than the equivalent of driving a car at 110 kph in a 100 kph zone. A similar argument applies to overall fishery exploitation; while overall harvests were excessive, contributions to these harvests were by no means equal across fishers. Although in the 1980s, many invested

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24. C.T. Taggart *et al.* "Overview of Cod Stocks, Biology, and Environment in the Northwest Atlantic Region of Newfoundland, with Emphasis on Northern Cod" (1994) 198 ICES Marine Science Symposium 140.
25. J.A. Hutchings & R.A. Myers, *supra* note 8.

massively in large and powerful vessels, others constrained themselves to relatively modest investments in new gear and electronics.

It is thus simplistic to claim that "everyone" is to blame; this ignores massive differences amongst fishers, and fails to recognize the possibility that some in the industry have behaved ethically throughout. Indeed, the latter may well have been among those who sounded the unanswered alarm bells of resource decline as their catches fell in the 1980s.

Why has it become commonplace to extend blame to all in the fishery, when in fact some are very little to blame while others are more responsible? Clearly, the spreading of blame distracts attention from the more serious offenders, but it also benefits the management entities which failed to control the operation of these offenders. Furthermore, such an attitude serves to spread the pain of restructuring the fishery. If the spreading of blame to "everyone" is accepted, then the number of fishers can be cut "across the board"; there is no need to penalize some while rewarding those who best lived within their resource means. Unfortunately, however, it is merely dooming the fishery to future conservation crises if we fail to understand the real causes of the collapse, and, in particular, if we place blame in the wrong direction.

3. *Too Many People*

A related refrain in Atlantic Canada's groundfishery is that the principal path to sustainable fishing lies in cutting the number of people in the fishery. The over-capacity issue is often stated simplistically as "too many people chasing too few fish".

Yet the fishery collapse was not in itself due to an excessive number of fishers. From the point of view of the fish, the number of people involved is irrelevant, if catches are kept to a conservationist level. The key factors are catching power and catching methods, not the number of people. (This is clear in the lobster fishery, for example, which has been successful and relatively stable despite the involvement of many thousands of participants.) Indeed, even a powerful fleet does no damage to the stocks if it is tied to the dock. Problems arise only when fishery management is unable to control the killing of fish. Hence, the real problem is the failure of fishery management to predict and control the fishing effort exerted by a fleet with excess capacity.

An example of a mis-guided focus in dealing with over-capacity are use-it-or-lose-it policies, through which the government cancels a fisher's groundfish license if it is not used over a period of time. While the goal of such policies may be to remove "casual" fishers from the fishery, in fact they perversely penalize those who respond to a declining resource by

reducing their impact on the stocks (perhaps by shifting temporarily to other work), and reward those who place the most pressure on the resource. The key to a sustainable fishery lies not in these simplistic efforts to remove people, but rather in careful planning to determine the number of fishers, the types of fishers, and the means to effectively limit overall effort in a re-built fishery.

4. *Fishing by Numbers*

While blame for the groundfish collapse has been placed on "causes" ranging from the ocean to the number of fishers, little attention has been paid to inherent problems in the methods used to manage the fishery. Consider, for example, "quota management", the most fundamental of groundfish management approaches. Quota management in the Atlantic groundfishery was based on a number of steps: estimating the weight (biomass) for each stock, determining an allowable harvest quota (TAC) as a fraction of that biomass, sub-dividing the TAC by sector (defined by gear and boat size), and sub-dividing further into individual fisher quotas in some sectors.

This approach provided, in theory, a firm limit on what can be removed from the ocean. In practice, however, it has been impossible to properly determine quota levels, or to fully enforce these quotas given the ease of cheating.

First, the setting of quotas requires knowledge of the fish biomass, something that (due to the unfortunate habit fish have of living underwater) is never known with certainty. The biomass is estimated through two major sources of assessment information: (1) scientific surveys, using a research vessel which trawls a net in a systematic manner to estimate fish abundances, and (2) commercial fishery "catch rates", the *rate* at which fish are caught, perhaps measured as catch per tow of a net, or per day of fishing. Unfortunately, in at least some cases, both of these approaches produce questionable results. Some scientific surveys are able to cover only a small fraction of the fishable area (often missing inshore areas) and are carried out at only limited times of the year. Meanwhile, commercial fishery data have produced highly misleading results, due to the erroneous assumption that "success" in the fishery, as indicated by high catch rates, is a direct indicator of strong fish stocks. In reality, catch rates (particularly for trawlers) are connected less to how many fish there are and more to the use of electronic gear to *find* the fish, and to changes in the pattern of fishing effort. Even as stocks decline, fishers often are able to find and catch the remaining fish, creating the illusion of a healthy fish stock.

Second, quota management creates inherent incentives to harvest more fish than is allowed in the established quotas. This could be done by (1) exceeding the quota, whether this be a TAC, an allocated share of the TAC for a particular sector of the fleet, or an individual quota, (2) "high-grading" to maximize the *value* of what is reported as caught, typically by dumping lesser-valued fish overboard, and/or (3) dumping prohibited fish (such as that for which the quota has been reached) so as to be able to continue fishing for other stocks. The first of these problems may be largely overcome through independent catch monitoring, but the latter two, taking place at sea, cannot be eliminated (except through the exorbitantly expensive means of placing observers on every vessel).

Incentives for high-grading and dumping can be expected to increase as quotas are subdivided to gear sectors and then to individuals. In the latter case, individual quota or trip limit systems "personalize" the benefits of such actions, so that each individual will wish to take their full quota and to ensure it is comprised of the most valuable fish (particularly when the fisher must pay for the catch quota). While such incentives may be reduced if quotas are transferable (because in theory, one can buy more quota from another fisher to account for extra harvests), they are unlikely to disappear, given the ease of dumping and the economics of quotas. An incentive for dumping will exist in a number of circumstances, such as (a) if the market value of small fish in the catch is less than the cost of quota to account for them, or (b) if the cost of quota for a species of low abundance rises to high levels, because that quota is needed in order to keep operating in a mixed-stock fishery, particularly toward the end of the fishing season.

For example, consider a system of individual transferable quotas (ITQs) in a fishery for two species, say haddock and cod. Toward the end of the fishing season, all fishers may have almost exhausted their quotas for one of the species, say haddock. Then each fisher has an incentive to dump overboard any haddock caught while fishing for cod. As long as this continues, the fisher benefits directly in being able to continue fishing for cod, without violating quota restrictions. On the other hand, under a global quota, if the same fisher were to dump haddock, the quota thereby "saved" would be necessarily shared by the entire fleet, and would therefore keep the fishery open only marginally longer. Thus, dumping would imply sacrificing a valuable haddock catch, while receiving only slight benefits. Hence, under such circumstances, the incentive for dumping under a global (or sector-based) TAC may be less than that under individual quotas.

Not only are quota controls difficult to calculate and to enforce, the anti-conservationist behaviour they induce decreases the quality of data

(and bias that data) in the stock assessment process, thereby tending to produce faulty assessments of stock status and over-estimates of feasible catch levels. While quota management does have its strong points, these various problems suggest that there is at least scope for a critical assessment of such controls as conservation tools. However, little research has been undertaken on alternatives to this groundfishery status quo, and indeed, there persists a dominant view in the fishery, with respect to quota management, that "the system works".

Conclusions

This paper has taken a nonstandard approach to examining the Atlantic Canadian groundfishery fishery collapse, focusing on the role of human attitudes, rather than on possible causes that are perhaps more concrete, such as excessive foreign fishing, predation by seals, cold water, gear technologies, government management, problems with the science, or political factors. This is because underlying many of these considerations lie the attitudes, the philosophical underpinnings, which drive decision making.[26] In particular, this paper has considered four themes:

(1) The role of the regulator. Past attitudes about regulation have ranged from a free enterprise (laissez-faire) view preferred by fishers, to a desire by managers for "total control" over the fishers. Neither perspective seems to promote sustainable fisheries. While these attitudes may still be found in the fishery, the movement is toward more effective approaches. However, in the search for improved management, it will be important to seek greater involvement of the resource owners (the Canadian public) and those dependent on the fishery (the coastal communities).

(2) The burden of proof. In any fishery, there is a need to balance risks—the possibility that overly-conservative management will sacrifice fishery benefits, and the possibility that excessive resource use will result in stock collapse. It is a matter of attitude, indeed of philosophy, as to this desired balance. Where the balance has favoured exploitation over conservation, adoption of a precautionary approach to management ("erring on the side of conservation") may require adjustment of this direction.

(3) Conservation can wait. Various groundfish management measures have acted to postpone or reduce conservation actions, thereby avoiding the consequent disruption of the fishing industry, both

26. A.T. Charles, "Canadian Fisheries: Paradigms and Policy" in D. VanderZwaag, ed., *Canadian Ocean Law and Policy* (Markham: Butterworths, 1992) 3.

between and within fishing seasons. Some of these, such as the "50% rule" and the adoption of quotas above recommended levels, seem to have disappeared from the fishery. These are positive steps toward sustainability.

(4) The system works. If we believe that "the system works" with regard to groundfishery management, then little structural change is needed in the operation of the fishery. Blame for the collapse can be deflected onto non-human factors, such as the ocean and its inhabitants, or spread so widely among fishers that no one takes particular responsibility. Unfortunately, if in fact major changes are needed to "the system", and we ignore the fact, this attitude will destine us to repeat collapses in the future.

Sustainability in fishery systems undoubtedly requires appropriate attitudes, together with appropriate management.[27] One crucial facet of this lies at the "personal" level. It is often said that sustainability will be possible only when a "conservation ethic" develops amongst fishers. Yet, while the search for sustainable fisheries will certainly be aided if individuals behave ethically, staying within the rules set out by society, more is clearly needed.

As noted at the outset, while attitudes are most often viewed as something personal, in fact they exist equally strongly at the larger level of the institution—for example, within government and fishery bodies. Appropriate attitudes are required not just on the part of the individual harvesters but throughout the system: in the scientific process, in the design of management measures, in the structure and operation of the fishery, and within the decision-making bodies. Accordingly, the focus of this paper has been at this institutional level, examining aspects of the "accepted wisdom" amongst the fishery's dominant players, both in government and the industry, on the basis that attitudes at this level most affected the process of fishery decision making.

The key implication arising from an examination of past fishery attitudes is the need for change. However, such change must be translated as well into a change in actions. Even before the groundfish collapse of the 1990s, some movement in this direction was evident. Now, it is crucial that major adjustments in attitude and action come into play *before* the fishery recovers, conservation is forgotten, and the next collapse gathers momentum.

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27. A.T. Charles, "Towards Sustainability: The Fishery Experience" (1994) 11 Ecological Economics 201.

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