

Barbara Neis
Department of Sociology,
Memorial University, St. John's, NF
Canada A1C 5S7
Fax: 709-737-2075
Email: bneis@plato.ucs.mun.ca

Paul Ripley
Department of Sociology,
Memorial University, St. John's, NF
Canada A1C 5S7
Fax: 709-737-2075
Email: pribley@plato.ucs.mun.ca

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Territorialization, the mobilization of bias and the collapse of the northern cod stocks

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Introduction:

The 1990s collapse of several Atlantic Canadian groundfish stocks has had profound ecological, social and economic consequences for the region. The processes responsible for this collapse are only partially understood. Existing research has concentrated primarily on the disappearance of the so-called "northern cod stocks" off the northeast coast of Newfoundland and Labrador (Chantraine, 1993; deYoung and Rose, 1993; Finlayson, 1994; Lear and Parsons, 1993; Hutchings, 1996; Hutchings and Myers, 1994, 1995; Hutchings, Walters and Haedrich, 1997; Martin, 1995; Neis, 1992, 1993; Steele et al., 1992; Steele and Andersen, 1997). Historians and environmentalists have shown how the collapse of the northern cod stocks needs to be seen in a broader context of long term resource degradation associated with expanding commodity relations, industrialization, lack of effective state intervention and regional economic and political dependencies (Cadigan, 1996; 1998; Wright 1996 ; Rogers, 1995). Fisheries scientists have identified a number of technical shortcomings in stock assessment science in the 1980s that contributed to overly optimistic estimates of abundance, made it difficult to interpret data, and marginalized awareness of threats to stock recruitment (Angel et al., 1994; Harris, 1990; Hutchings and Myers, 1994; Hutchings, 1996). Fisheries scientists and social scientists have highlighted the lack of independence of DFO scientists from government, blaming political and bureaucratic interference in government fisheries science for exacerbating the crisis. DFO personnel and managers= intellectual and social distance from fishers and active fisheries, disciplinary divisions within fisheries science and management, and the attitudinal bases

for fisheries science and management have also been implicated (Charles, 1995; Hutchings, Walters and Haedrich, 1997; Maguire, Neis and Sinclair, 1995; Martin, 1992; Neis, 1992; 1993; Neis et al., 1996; Steele et al., 1992; Steele and Andersen, 1997). Finally, a few analysts have combined a critique of the empirical and theoretical basis of northern cod science with an analysis of institutional factors that shaped the design and interpretation of that science, as well as the management initiatives that contributed to overfishing in the 1980s (Finlayson, 1994; Finlayson and McCay, in press).

This paper contributes to our understanding of the collapse of the Atlantic Canadian groundfish stocks by linking the dynamics of sovereignty initiatives and shifting property relations associated with a privatization agenda to the spatial organization of science and management, and the dynamics of knowledge production and control. Our analysis focuses on the northern cod stocks and the period between June 1986 and April 1987. We have selected this period because this was the time when the precision and accuracy of DFO estimates of northern cod stock abundance, the largest Atlantic groundfish stock, were first questioned in an organized, public and sustained fashion, and because scientific and state response to this challenge set the stage for a delayed response to indicators of resource degradation in subsequent years.

This paper builds on Finlayson's (1994) social constructionist analysis of the northern cod collapse as a product of bureaucratically-embedded science and tensions between bureaucratic and scientific rationality, and is informed by evidence of political intervention in DFO groundfish science (Anderson and Steele, 1992; 1997; Hutchings, Haedrich and Walters, 1997). We open with a discussion of the ways processes related to sovereignty claims and developing property relations in the period between 1977 and 1986 interacted with knowledge production and management to create both strong pressures for an expanding Canadian northern cod fishery *and* a context of scientific uncertainty. This background discussion sets the stage for a microanalysis of the dynamics of the first organized challenge to both this expansionism and to the scientific advice on which it was based. We look at the development of this challenge and at scientific, management and political response to it. Like others, we link the marginalization of the challenge to the culture of DFO science (Finlayson, 1994), but also to the spatial construction of fisheries science and management and to a developing privatization policy agenda. Finally, we suggest that this privatization agenda and the conditions under which it was pursued may have augmented the scientific and bureaucratic barriers to public discussions concerning problems with DFO's science and management for northern cod after 1987.

We use the concept of territorialization in our analysis (Vandergeest and Peluso, 1995; Vandergeest, 1996). Territorialization includes initiatives to expand spatial control over resources, the spatial organization of science and management, and initiatives to allocate resources between groups (property relations). In contemporary society, territorialization is largely associated with states and with centralized management on the basis of expert science. Its key written text, modern maps, tend to represent complex realities as sets of homogeneous areas...defined by their borders (Vandergeest, 1996: 160). As a result, territorialization is associated with resource degradation because it inhibits accurate interpretations of biological information and makes it difficult to monitor the dynamics of diverse resource-extraction activities associated with differing property relations, technologies and spatial and temporal scales.

In our analysis of events associated with the onset of the northern cod crisis, we begin with the way various dimensions of territorialization shaped the context for and the form of the initial challenge to northern cod stock assessment science in 1986. The link between this context and our microanalysis of events in 1986-87 is through power relations which acted to mobilize bias against this challenge

and its authors. Mobilization of bias is a dimension in the exercise of power within institutions. It refers to institutional features and knowledge frameworks that tend to admit some issues and agents while excluding others. Within science, it entails the processes by which some alternatives may remain invisible because of the ways data are collected and understood (the spatial aspect of territorialization) and because proponents lack the resources to affect decision making processes or because they are excluded from these processes (property relations and decision-making structures within the Canadian Department of Fisheries and Oceans (DFO) and the industry) (Bachrach and Baratz, 1970; Schrecker, 1984).

Setting the Stage: Population thinking, Sectoral management and Bureaucratic and Industrial Expansion, 1977-1986

Atlantic Canadian groundfish stocks were massively overfished during the 1960s and 1970s. In 1977, the Canadian government extended its sovereignty in the offshore from 12 miles to 200 miles by establishing a 200 mile exclusive economic zone (EEZ) off its coasts. Canada's claims to the fishery resources within 200 miles of its coasts were legitimated by technoutopian assumptions about its ability to develop a scientific and management regime that would ensure management of overfished stocks to allow their rapid recovery (Finlayson, 1994). The extension of the 200 mile EEZ was thus associated with the development of an increasingly elaborate institutional basis for science and management. In contrast to earlier periods, after 1977, this was housed within the federal Department of Fisheries and Oceans (DFO) rather than the Fisheries Research Board, a semi-autonomous scientific research body (Johnstone, 1977). DFO also adopted the Northwest Atlantic Fisheries Organization (NAFO) area structures for dividing up the region's waters. Each year, it would establish Total Allowable Catches (TACs) for most commercial species of groundfish for the different NAFO areas. In most cases, the scientific advice that provided the basis for these TACs came from the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC); in the case of the northern cod stocks, scientific advice came from the NAFO Science Council, in which Canadian scientists participated.

By the 1920s in Europe and somewhat later in North America, population thinking was the dominant paradigm within fisheries science and management. Heincke's 19th century research on herring populations and the subsequent work of Hjort contributed to the acceptance that groups of relatively isolated populations, and not species, were the appropriate unit of research and management within many fisheries, including those for cod (Sinclair and Solemdal 1988:201, 210). Population thinking encouraged the definition of management units taking into consideration the geographic patterns in populations (Sinclair and Solemdal, 1988: 203). Spatial boundaries for scientific data collection and management that violate population thinking enhance scientific uncertainty by making it difficult to pinpoint the factors responsible for fluctuations in fish harvests: are such fluctuations a consequence of fish movements, or of fluctuations in the size of different annual populations, mediated by the effects of fishing?

It is well-known that the misfit between 200 mile EEZs and the population structure of different species has posed major problems for fisheries science and management. These problems have been manifested in international concern regarding straddling stocks and, in the case of Newfoundland, a tendency to blame foreign overfishing for the collapse of the northern cod and other groundfish stocks (McCay and Finlayson, 1995). The boundary for the Atlantic Canadian 200 mile

EEZ did not coincide with underlying fish ecology, and thus violated population thinking in both scientific and management terms. However, this was only one part of a more general problem associated with the spatial construction of offshore areas. Research on the historical development of the boundaries for fisheries areas used as the basis for scientific research (and later management) of fisheries in the Northwest Atlantic, including particularly those off northeast Newfoundland and Labrador where the northern cod stocks are located (2J3KL), has found that these boundaries fit poorly with the population structure of cod, and even more poorly with population structures of the many other commercial groundfish species targeted after World War II (Halliday and Pinhorn, 1990).

From the early 1970s, established areas became the spatial basis for the management of fish stocks through the introduction of area-based quotas or TACs. Stock structure knowledge for a diversity of important commercial species was substantially developed by the mid-1970s, when the NAFO era of regulation developed. This improved knowledge suggested that a simple geographical grid could not capture the complexities of population structure, particularly in the southern part of the ICNAF Statistical Area where species diversity is higher (Halliday and Pinhorn 1990: 40). Despite the fact that the development of the new management regime meant that the potential scientific costs of a shift in boundaries were limited as a result of the reduced usefulness of earlier data (due to a changed sampling regime used for scientific stock surveys and the effect of area management on fishing patterns of the commercial fleet), and despite the requirement for better scientific data in order to meet the needs of the new management regime (Finlayson 1994), area boundaries were not adjusted in an attempt to capture, more effectively, the underlying ecological complexity of groundfish stocks (Halliday and Pinhorn, 1990).

In the case of the northern cod stocks, problems with NAFO boundaries were exacerbated by DFO's success in arguing at NAFO that all of the cod in the huge area covered by NAFO areas 2J3KL should be managed as one stock. As a result, prior to 1987, northern cod estimates were based on abundance estimates for the three areas combined, trends in individual populations were not monitored and there were few controls on the distribution of fishing effort across these populations. Assessments were based on offshore research vessel surveys and catch rates (catch/haul) in the offshore trawler fishery. There were no surveys of coastal areas and there were no reliable data on trends in inshore catch rates. Trends in coastal populations that did not necessarily migrate offshore and trends in inshore fishing effort (men, boats and gear) were unavailable. A similar approach characterized assessments and TACs for other groundfish species.

As with the debate about 19th century Norwegian herring stocks that prompted the development of population thinking (Sinclair and Solemdal, 1988), the spatial organization of scientific data collection and management according to these NAFO areas made it hard to tell whether fluctuations in catches were a consequence of changes in the movement of fish or changes in the overall abundance of particular populations. This ambiguity added to scientific uncertainty and, in combination with the emergent DFO regime for allocating northern cod between sectors, helped shape the original mid-1980s challenge to this regime. We now examine the dynamics of the allocation regime.

In the wake of the extension of the 200 mile limit, Atlantic Canadian fishing effort expanded dramatically in all sectors, from the small-scale, owner-operated inshore fishery to the large scale, offshore corporate fishery. Foreign effort declined but persisted, particularly in areas outside of the 200 mile limit. Expansion was partly encouraged by Canadian sovereigntist goals in relation to northern cod and interactions between these goals and the Northwest Atlantic Fisheries Organization's (NAFO)

regime for science and management. Other factors included optimistic scientific assumptions about the rate of growth of the stock at given levels of fishing pressure, relative open-access within the inshore and nearshore fisheries and a commitment to rationalize and stabilize the fishing industry through an expanding, complex property rights regime.

The northern cod stocks were fished primarily by coastal Newfoundland and Labrador fishers prior to World War II, and by this sector and foreign vessels until 1977. These stocks were fundamentally important to DFO's and industry plans for the Atlantic fishery after 1977. In 1978, a DFO scientist projected that cautious management of the northern cod stocks, symbolized by a commitment to fish them at less than an estimated $F_{0.1}$ (at roughly .16 fishing mortality) to allow for rapid recovery, might result in a TAC approximating 400,000 mt by 1987 and might eventually exceed 500,000 mt (Finlayson, 1994). In association with these optimistic predictions about the fishing potential associated with the northern cod stocks, DFO allocated between 10- and 20,000 mts of northern cod to European countries in return for access to European markets for Canadian goods until 1987 (Blackwood, 1996). Northern cod and other commercial groundfish species were also fished by foreign vessels in areas outside of the 200 mile EEZ.

Within Newfoundland and Labrador, based on historic user rights, the coastal sector was supposed to have first access to the recovering northern cod stocks. Between 1974 and 1980, the number of licensed fishers in Newfoundland increased from 12,792 to 35,080 (McCorquodale 1983: 154). Optimism, weak constraints on entry into the inshore and nearshore fisheries, corporate demand for fish, and large incomes from lucrative inshore fisheries for squid and caplin combined to provide the means and the opportunity for an intensified seasonal, inshore northern cod fishery and expansion of that fishery further offshore and into other seasons (Neis, et al., 1996).

DFO subsidized the development of a Canadian, corporate-owned, offshore, year-round trawler fishery for northern cod and other groundfish species in 2J3KL. The rationale for this included: scientific assumptions that only a portion of the northern cod TAC was accessible to the small boat, inshore sector and, related to this, a Law of the Sea requirement that portions of TACS within 200 mile EEZs that exceeded the capacity of the Canadian fleet to harvest them had to be allocated to other countries (Sanger, 1987: 144). A stock crisis in the Gulf of St. Lawrence, a traditional area of concentration for the offshore companies also encouraged the opening up of new areas to these companies. The original understanding was that offshore companies would have access only to the northern cod that was surplus to the catching capacity of the inshore fishery. For this reason, the inshore sector (which included both small boats and larger owner-operated longliners and draggers) was allocated a set allowance with the remainder of the northern cod TAC initially taking the form of a quota for which offshore companies competed. As further protection to the inshore, northern cod TACs were initially supposed to be underfished by 30,000 mt. This system of allocation meant that any increases to TACs would tend to go to offshore companies and cuts to TACs would come exclusively from the offshore quota.

In the early 1980s, the larger Atlantic Canadian offshore companies almost went bankrupt. In 1982, the federal government stepped in and established the Task Force on the Atlantic Fishery. The Report of the Task Force reiterated the optimistic 1978 estimate that the TAC for northern cod would be roughly 400,000 mt by 1987 (Finlayson, 1994: 7). State intervention in response to the threatened bankruptcies resulted in the amalgamation of the assets of several companies into two large super-companies, National Sea Products (NSP) and Fishery Products International (FPI). FPI was majority owned by the federal and Newfoundland governments but the restructuring agreement that

created it included a commitment to reprivatize once the company became profitable. This goal was achieved in 1986.

As advocated by the Task Force Report, DFO accepted an industry proposal to introduce, on an experimental basis, enterprise allocations (EAs) for the two new companies. Gordon Cummings, then president of NSP, described these allocations as "a swimming inventory," "an amount of fish to which the company in question has quasi-property rights" (Hayes, 1987: 25). In 1984, the enterprise allocation system was revised and extended. This system was supposed to reduce the "race for the fish" created by quota systems, allowing companies to rationalize their investments in fishing and processing, and increasing potential investors' confidence in the companies. One of its side effects was an increased incentive to highgrade or discard smaller, less valuable fish so as to maximize the value of the landings to the draggers and to the company. This appears to have had the effect of increasing fishing mortality and creating problems with scientific estimates of mortality. Around the time of the introduction of corporate enterprise allocations, the commitment to underfish the northern cod TAC by 30,000 mt was abandoned. TACs were set at an estimated $F_{0.1}$ (.20 fishing mortality) (Cashin, 1986).

Restructuring infused new capital and greater industrial and political leverage into the offshore sector of the industry. It encouraged investment in new, more advanced offshore trawlers with better fish-finding abilities and improved ability to fish the northern cod offshore pre-spawning and spawning aggregations. Restructuring gave these companies more political leverage by tying the fate of thousands of jobs in many communities to the success of two companies.

Inshore and nearshore landings of northern cod in the 3K and 3L areas peaked in 1982, and then went into a three season drop of close to 30% (Hayes, 1987: 26). At the same time as stock assessments were suggesting that the northern cod stocks were continuing to recover, the inshore share of the northern cod catches declined from its traditional level of 85-90% of the total and 100% of the Canadian share, to less than 50% of the Canadian catch by 1986. When foreign catches are added, the inshore share was only about 25% of the total catch. In contrast to their historical average of 230,000mt, inshore fisheries landed only 80,000mt out of a Total Allowable Catch of 250,000mt in 1985. Failures in the inshore cod fishery occurred in each year between 1982 and 1988 (Blackwood, 1996: 2). The extent of the shift between inshore and offshore landings was less clear in 1986 than it is today, but what was becoming increasingly clear to inshore fishers was that, as their landings declined, seasons shortened and fish were getting smaller, offshore landings were increasing (Neis, 1992). At the June, 1986 NAFO Science Council meetings on northern cod, the advisory TAC was set at 266,000 mt for the third year in a row. By then, it was recognized that the rapid recovery of the northern cod stocks to a point where a TAC of 400,000 mt was plausible had failed to materialize. This projected TAC had provided part of the rationale for providing a growing share of the northern cod to the offshore companies.

The rapid expansion in offshore northern cod fisheries took place in the context of high levels of scientific uncertainty regarding trends in the abundance of northern cod. This uncertainty was exacerbated by the limited scientific data available, and the misfit between the spatial organization of science and management and the underlying complexity of both fisheries ecology and of the fisheries themselves making it difficult to interpret data on fish population abundance and fishing mortality.

The low inshore and nearshore landings, and small fish in the years leading up to 1986 were all too familiar to those fishers who had observed similar trends during the development of an intensive, foreign, offshore fishery during the 1960s and 1970s. The differences between the two periods were that the offshore vessels were more likely to be Canadian in 1980, and while declining inshore landings

were understood to be a consequence of offshore overfishing and declining stocks during the earlier period, Canadian scientists appeared to be convinced that the northern cod stocks were healthy and growing in the 1980s and that divergent trends in inshore and offshore catches were unrelated. The period between June 1986 and April 1987 was the first point when this orthodoxy was challenged in an organized and somewhat sustained fashion. The following sections present a microanalysis of the period in chronological fashion. We attempt to show how interconnections between the spatial construction of science and management, the processes of scientific knowledge production and control within DFO and the unfolding property regime associated with this period influenced the shape of this challenge, its unfolding and its outcome. The challenge had two components that were weakly linked: a public component spearheaded by the Newfoundland Inshore Fisheries Association (NIFA) and a component that was largely, but not entirely confined within DFO science (Finlayson, 1994; Hutchings et al., 1997).

Inshore vs Offshore and A Sophomore[®] vs Expert: the Mobilization of Bias against Criticisms of Northern Cod Stock Assessments:

When Canadian scientists presented their stock assessments at the Atlantic Groundfish Advisory Committee (AGAC) meetings in July 1986, they advised caution in setting reference TACS. Despite increasing biomass and growth, A recruitment has been slower than anticipated, especially in stocks such as 2J3KL cod[®] (AGAC 1986: 3). A number of indicators, including the A consistent decline in catch rates experienced by the inshore fishery in this stock[®] were challenging the expectations of increasing catch rates prompted by previous scientific advice and producing discontent in inshore fisheries in particular. Discussion at AGAC included calls from Newfoundland Fishermen, Food and Allied Workers Union (NFFAWU) representatives of the inshore industry for a more equitable sharing of northern cod between inshore and offshore fleets to be achieved by cuts to the EA's of the offshore companies. The meeting agreed that a proposal related to the TACS would be developed for submission, along with a DFO- prepared discussion paper on its implications, at the AGAC fall meeting.

NIFA was formed in the fall of 1986. It included inshore fishers, fish processors and processing workers, businessmen, municipalities and rural development associations. Its mandate was to aggressively address the problem of no fish in the northeast coast inshore fishery and relatedly, the 1987 Groundfish Management Plan that would provide the basis for TACS and management of northern cod the following year (NIFA, A An open letter.,[®] 1987). On September 7th, 1986, NIFA held a public meeting where they put forward a Ten Point Plan, A for the preservation of the 2J3KL cod stock complex,[®] that was publicly endorsed by NIFA, the Inshore Fishermen's Improvement Committee, the provincial Minister of Fisheries and by the NFFAWU. Prompted by low inshore landings, particularly in areas 3K and 3L, their Ten Point Plan called for a reduction in the northern cod TAC to 200,000 mt with a 50% cut in the EAs of FPI and NSP, as well as measures to distribute offshore fishing effort more evenly across offshore populations that fuelled inshore fisheries, and measures to control discarding and count discards against catches. There was lukewarm support from FPI for some of the recommendations other than the cut to EAs. NSP President, Gordon Cummings, rejected them completely, arguing that there was no scientific evidence that offshore fishing was negatively affecting inshore catches and their acceptance in the absence of scientific evidence would be

irresponsible, because of their potential social and economic impacts (Moore, 1986).

The co-chairs of NIFA met with Tom Siddon, the federal Minister of Fisheries, in September 1986 and in October they were notified that Siddon had requested a special meeting of the groundfish subcommittee of CAFSAC to discuss the situation in the inshore fisheries along the northeast and Labrador coasts. The Assistant Deputy Ministers of Science and Atlantic Fisheries asked the scientists to answer 18 questions related to the 1986 abundance of the northern cod stocks relative to 1977 (CAFSAC 1986b). The publicly-available document that resulted from this special scientific review, CAFSAC 86/25, suggested that declining inshore landings were a result of changes in cod migration patterns and inshore fishing effort linked to: the possible impact of variable oceanographic conditions on cod migrations; the unconfirmed possibility that large supplies of capelin (the primary prey of cod during the summer season) in the offshore discouraged the cod from migrating onto inshore fishing grounds; and the unconfirmed possibility that inshore fishers were concentrating less fishing effort (fewer boats or fishing less intensively) on cod. 86/25 also acknowledged that there were problems with all of these explanations: DFO had no consistent, reliable data on trends in inshore fishing effort, there had been shifts in capelin biomass offshore between 1985 and 1986; and whereas somewhat low water temperatures might have explained the failure of cod to migrate inshore in 1985, temperatures had returned to normal in 1986.

Issues related to the relationship between inshore and offshore landings were not new, these had been a major source of scientific debate prior to the extension of the 200 mile limit. However, as noted above, the NAFO area system's violation of population thinking made it difficult to distinguish between the movement of fish, and the combined effects on abundance of fishing and natural fluctuations. Despite these problems, the scientists who produced CAFSAC 86/25 were able to draw upon existing tagging and other studies to describe the migration patterns between particular offshore banks and particular inshore areas. This led them to suggest that the cumulative effect of sustained heavy fishing pressure on a few populations, particularly in division 3K, could be disastrous for at least some inshore areas, the offshore fishery, and the stock [population] itself (CAFSAC 1986b: 12). They arrived at rough estimates of the relative distribution of the cod biomass between the different divisions 2J, 3K and 3L advising, in support of one of NIFA's recommendations, that to reduce the risk of overfishing particular populations, offshore cod should be taken equally in all three divisions.

A third possible factor contributing to low inshore landings was a positive bias in stock assessments resulting in higher than anticipated levels of fishing mortality, and static or declining cod abundance in the years leading up to 1986. Participants at the special meeting of CAFSAC in 1986 did not redo the annual NAFO assessment of northern cod completed in June. They were told by the Director of Science Branch in St. John's that the validity of the 1986 assessment was not to be discussed. However, CAFSAC Groundfish Subcommittee Chairman, Jean-Jacques Maguire, indicated in the cover memo accompanying the 18 questions his committee was supposed to answer that the assessment would not be accepted blindly and would be reviewed, with any disagreement with the assessment taken into account (Maguire, 1986). This willingness to question the NAFO assessment appears to have opened the door to at least one scientist, who had been raising serious questions about the assessments at the NAFO meetings, to develop a working document for the special meeting outlining these concerns. Winters' Aide-Memoire on 2J3KL Assessment: Non Gratum Anus Rodentum? documented a pattern of consistent overestimates in previous stock assessments, and included a graph suggesting a strong correlation between expanding offshore catches and declining

inshore catches. Insights from Winters' document were integrated into CAFSAC 86/25. However, although these insights implied the 1986 NAFO stock assessment, like previous assessments, had produced an overly optimistic assessment of cod abundance, the authors concluded that there was no firm basis upon which to disagree with it (CAFSAC 1986a:2).

Winters' Report Ass' document did not become public, and was unknown to NIFA leadership until it was recently accessed under the Access to Information Act. The document was one of the few working papers used in the development of CAFSAC 86/25 that was not upgraded to Research Document status. The reasons for this are unclear, but this failure, and a departmental requirement for public consensus that discouraged public discussion of disagreements between scientists, partly account for NIFA's ignorance of the document. However, Cabot Martin, a NIFA leader, identified the contradictory and inconsistent character of CAFSAC 86/25 (1995:7). It showed, he calculated, that DFO's stock assessments (calculations of the size of the fishable biomass) had been out an average of 107% and, because the analyses improve with the addition of more years of data, over-calculations in earlier years were as high as 220% in 1977. As indicated by Hutchings et al., CAFSAC 86/25 recognized that "the abundance of northern cod from 1977 to 1985 was probably considerably less than had been previously believed and that fishing mortalities had been approximately double the intended, and presumed sustainable, target levels" (1997: 1201). However, the 86/25 authors did not conclude that the estimates of abundance in the 1986 NAFO Stock Status Report should be abandoned. Instead they recommended a number of research initiatives, most of which were not acted upon until several years later (Hutchings et al., 1997).

The NIFA leadership also appears to have been unaware that, by 1986, some CAFSAC scientists had identified a problem with their assessments of a number of *other* Canadian cod stocks similar to that identified by Winters for northern cod. In the minutes for the July 3rd AGAC meeting referred to above, 1986 assessments for cod in Atlantic Canadian zones 3Pn, 4Rs and 4Vn and 4VsW are described as showing increasing or stable biomasses. Because of concerns about the accuracy of the stock assessments, however, the scientific advice was for reduced TACs. AGAC members responded by questioning "the integrity of the biological advice...it was stated that the advice was not consistent with the reality of good catch rates" (AGAC 1986: 5), ignoring the fact that mobile gear and improvements in fishing technology could maintain high catch rates even in the context of declining stocks. Newfoundland assessment scientists, who were part of CAFSAC for other stock work, were aware of this TAC advice, but most adhered to their optimistic assessments and to the NAFO methodology for the northern cod stocks. The CAFSAC experience with the other zones might explain why CAFSAC 86/25 incorporated reference to Winters' cautionary criticisms of the NAFO stock assessments rather than dismissing them and why, in 1987, DFO exercised Canadian territorial rights, bringing the northern cod assessment from NAFO into CAFSAC¹.

In addition to successfully pressuring DFO to examine causes of declining inshore landings, NIFA also financed a review of northern cod science to be conducted by three Memorial University

¹Major tensions between Canada and the European Community (EC) were also growing within NAFO during this period. Beginning in 1986 the European Community began to file objections to the NAFO commission management decisions on a number of stocks including Northern cod and its new member states, Spain and Portugal, fished beyond quotas set for areas outside the 200 mile EEZ. The EC also attacked NAFO's management approach based on $F_{0.1}$ and, as well, sought to have area 3L, which included the rich "Nose" of the Grand Banks outside the 200-mile zone, managed as a separate unit and under NAFO control (Parsons 1993: 274-75).

scientists. This foray was to suggest that low inshore landings might not simply be related to the distribution of northern cod harvests between the inshore and offshore sectors, but to higher than anticipated levels of fishing mortality and a related positive bias in the stock assessments upon which the TACS were based. This was not what NIFA had expected to find and this finding was not popular with most DFO scientists because it questioned the integrity of their science. It was also not popular with the offshore companies or the Canadian Minister of Fisheries. Official responses to NIFA's concerns addressed those that focused on the distribution of offshore effort and monitoring of offshore catches but marginalized concerns about higher than anticipated levels of fishing mortality that had substantial implications for corporate Enterprise Allocations.

The so-called Keats Report, was released shortly after CAFSAC 86/25. It focused on both the relationship between offshore and inshore landings, and the accuracy of the 1986 NAFO stock assessment. The authors drew on existing scientific research to support NIFA's claims that the northern cod stocks were composed of multiple populations and called for separate assessments based on 4 stocks associated with 4 offshore banks (Keats et al., 1986). The Report also highlighted the apparently escalating discard rates on offshore vessels that were not being taken into account in the stock assessments, challenged the NAFO methodology for arriving at estimates of abundance, and its conclusion that northern cod abundance had been consistently overestimated by DFO assessments was the same as that presented in 86/25.

One of the authors of the Keats report remembers that there was excellent cooperation from the working scientists at DFO with their research. While some attempted to convince him that the assessments were fine, he remembers experiencing no hostility. A draft of the Keats Report was presented at the Nov. 29 meeting of AGAC, as was CAFSAC 86/25. The strong reservations about the accuracy of the northern cod assessment expressed in the Keats Report, led to the setting up of a meeting at DFO in St. John's to discuss the technical arguments in the report. This meeting was held on December 9th and the Director of Science, Mac Mercer, introduced the meeting by alluding to the limited resources Keats had at his disposal in comparison to the years of research and the infrastructure available to DFO--in other words, by questioning the evidence and expertise behind the report. George Winters was present at this meeting but intervened on rare occasions, and in a vague fashion. The Proceedings summarize his interventions as emphasizing that the appropriateness of catch rates as an index of biomass has not been treated lightly in NAFO or CAFSAC (Wells, 1986b), a statement that could as easily be interpreted as support for the rigour of the NAFO assessment as an indication that he was, himself, critical of the process. Winters' apparent failure to mention the Rat's Ass document suggests he had been either intimidated or actively gagged by DFO management. Winters had been part of the consultations with DFO scientists that led up to the Keats Report but did not show them the Rat's Ass document. After the release of the Report, he was confronted by DFO management concerning his interaction with its authors. Scientists who were uncritical of the NAFO were not, to our knowledge, subject to the same confrontation.

The Proceedings of the December 9th meeting suggest that discussion focused on the claim in the Keats Report that the 23KL cod biomass has been grossly overestimated and has only increased slightly since 1977 (Wells, 1986b). The same focus is evident in Dick Wells' covering memo that accompanied the copy of the Proceedings he submitted to Eric Dunne, Newfoundland Regional Director-General (Wells, 1986a). In these documents, the challenge to this claim focused primarily on evidence of stock recovery up to 1980 or 1981. Wells argued that, given the range of believed

potential fishing mortalities between 0.2 to 0.4, northern cod biomass had increased from 1977 up until at least 1981, and extrapolations suggested it had increased further by 1985. Pinhorn, another member of the assessment team, said he was confident that the biomass had increased up to 1980--but made no such statement of confidence for after that. Thus comments focused on the evidence for the early years with the claim of overestimation for later years only marginally subject to challenge.

In a letter to the federal Minister of Fisheries, Tom Siddon, the co-chairs of NIFA made clear the Association's position emerging from the Keats report: "... the findings, in general, are quite disturbing in that they show that massive overfishing and a drastic decline in the biomass of 2J3KL cod stock is a distinct probability, contrary to the results from the scientific methodology being used by your officials in stock assessment" (NIFA, 1986b). Keats and some members of NIFA met with Siddon on December 17, 1986. A member of the NIFA team remembers encountering hostility from the Minister: "...we were not even listened to by the Minister, who did not even make an attempt to discuss the problem." On December 24th the Keats Report was forwarded to J. S. Beckett, Chairman of CAFSAC with a request that it be "reviewed in depth" and that detailed comments be sent to the chairman of NIFA (Parsons, 1986). This request for a CAFSAC review of the issues raised by Keats appears to have become integrated into the general 1987 northern cod stock assessment. The CAFSAC comments on Keats were not mailed to NIFA until July 21st, 1987 (Beckett, 1987).

The Newfoundland gadoid assessment group produced a review of the final version of Keats Report in January 1987. In his covering memo to the document summarizing the group's comments, Wells said "In my view the report is, at best, sophomoric" (Wells, 1987b). This supports an observation by a member from the NIFA delegation that credentialism (Keats had not quite received his Ph.D. at the time the report was submitted) was one of the grounds for dismissal of the report and NIFA's associated concerns. A ground for dismissal contained within this the gadoid assessment group review was evidence that "advocacy" had resulted in "distortion" of the facts in some parts of the report (Wells, 1987b). In his general summary of the comments produced for the Regional Director General, Wells concluded that "their arguments are subjective and qualitative. They provide no new data nor do they rework the existing data [they didn't have access to the data]. They are inconsistent in that they accept trends in variable survey data but reject trends in variable commercial catch rate" (Wells, 1987a). He then discusses the evidence for and against the claim that the TAC for 1987 is too high and should be reduced. Wells argues that fishing mortality in 1985 would have had to have been "in excess of .50" for the biomass to have been declining since 1982. But, once again, his conclusions are cautious, partially reflecting the growing awareness within DFO science of the so-called "retrospective problem", i.e. a pattern where estimated $F_{0.1}$ levels set in earlier years were subsequently found to have been consistently too high, with the stock assessments: "On balance it appears that the stock has increased since 1981. The situation will of course become clearer as time goes on." (Wells, 1987a).

The assessment-related "findings" of the Keats report, like those in Winters' document, were not popular with those scientists within DFO and NAFO who had produced and believed in their northern cod stock assessments. They were also unpopular with those higher up the bureaucratic hierarchy, including Tom Siddon, the federal Minister of Fisheries. However, the threat these posed to the status quo was limited. In the case of Winters' "Rat's Ass" document, only a single incident of open confrontation seems to have been associated with the suppression of the document. Departmental requirements for consensus and the departmental process for selecting which documents presented at CAFSAC meetings got upgraded to research documents accomplished most of the work. Because the

Keats Report was an external document and publicly available, mobilization of bias had to take a somewhat different form. The Keats Report got the question of a history of possible overestimates of the abundance of the northern cod stocks into the public arena. In this case, the referee process, with its focus on the credentials of the authors, the degree to which the document provided new data or a new methodology, and the evidentiary basis for particular claims, such as the date after which there had been no increase in abundance appears to have provided the basis for marginalizing the Report and containing the impact of those findings considered most problematic by scientists and others within the bureaucracy. In retrospect, Cabot Martin has suggested that focusing on the Keats Report may have been a strategic error. Instead, NIFA should have concentrated its efforts on confronting DFO with 86/25, its own document.

A privatization policy agenda: another dimension in the mobilization of bias?

The implications of the concerns raised by Keats and Winters might have been (and *were*, two years later) a reassessment of northern cod abundance and recommendations for dramatic cuts to TACs. This would have had major economic, political and social consequences, particularly for Fishery Products International and National Sea Products and their workers, because any reduction in the TACs should have come from their EAs, rather than from the inshore allocation. Like the decision-making structures and organization of science within DFO, the political-economic context of the Atlantic fishery in the mid-1980s appears to have mobilized bias against careful consideration and public disclosure of concerns about the accuracy of the northern cod assessments. This was a context of shifting property relations within Canada as a whole, associated with the federal and provincial commitments to privatization, including the privatization of fish resources in the form of Enterprise Allocations and Individual Quotas, and the privatization of crown corporations and portions of the public sector.

In the fall of 1986, the executive of FPI and the federal and Newfoundland governments were gearing up to reprivatize the newly profitable Fishery Products International. On October 23rd, 1986, FPI sought approval for a bid to privatize operations (Fishery Products... 1986. p. B11). The company was reprivatized on April 15, 1987. NIFA quickly identified the risks the reprivatization of FPI might pose for its challenge to the management of northern cod and the future of the inshore fishery. The bid to reprivatize and the directive to convene the special CAFSAC meeting that resulted in 86/25 virtually coincided. In its written response to notification about the CAFSAC meeting, NIFA asked the federal government to take a broad, comprehensive look at all factors relating to cod stock health and inshore abundance which would, they felt, require years of research. In the interim, they argued, declining inshore catches should be used as a basis for reducing the northern cod EAs the federal government had given the Canadian offshore firms. They argued that a 50% reduction in offshore quotas would not jeopardize the financial health of FPI or National Sea. NIFA also expressed some concern regarding press reports of plans to reprivatize FPI in the near future, suggesting that, if this was happening, the federal government must fully explain to potential purchasers that FPI's northern cod enterprise allocation of 63,000mt would be subject to variance according to the needs of the inshore in any given year (NIFA, 1986a).

NIFA was invited to participate in the annual AGAC meeting of December 6, 1986. At this meeting, it attempted to reach a compromise with the offshore sector by agreeing to support the Minister of Fisheries if he set a TAC of 230,000 mt, about halfway between where the Keats report

had said the TAC should be located, and the 1986 TAC consistent with the scientific advice for fishing at $F_{0.1}$. They were unable to get the agreement of either the Minister or the offshore companies, and the TAC was set at 256,000mt, 10,000 mt below the NAFO recommended TAC but 10,000 mt above the calculated $F_{0.1}$, and a harvesting level where, NIFA claimed, the Canadian offshore trawler fleet [is allowed] to overfish the northern cod by some 70,000 tons or 140 million pounds (NIFA, An open letter., 1987). NIFA challenged the Minister's claim that he had taken into account the Keats Report in setting the 1987 TAC and in support of their claim that the 1987 TAC would constitute overfishing on this scale, NIFA included a graph taken from 86/25 which CAFSAC had prepared, that pointed out the overestimations of $F_{0.1}$ (the primary scientific basis for setting TACs) in previous assessments. NIFA asserted that [i]f DFO knew then, what DFO knows now, in 1985 DFO would have set the northern cod TAC at some 185,000 tons and not the 266,000 tons which they then allocated. There is certainly no sign that the northern cod stocks are more healthy now than in 1985. If DFO now thinks that the TAC for 1985 should have been 185,000, then surely a TAC of 256,000 tons for 1987 can not be justified. (NIFA, An open letter..., 1987: 5).

An important feature of the mobilization of bias during this period, the so-called 50% rule, was applied in setting the northern cod TAC for 1987. The rule was a management measure which allowed the setting of quotas half-way between the current TAC and the estimated $F_{0.1}$ for particular stocks in contexts where cuts to TACs up to and exceeding 50% were recommended. It was developed in 1986 in response to corporate opposition to the advised TAC reductions for some other Atlantic groundfish stocks in the Gulf of St. Lawrence and Scotian Shelf. The TAC levels estimated to maintain fishing at $F_{0.1}$ in 1986 for some of these stocks represented reductions at this level. Notes from an AGAC working group meeting held in Halifax on October 16-17, and obtained through the Access to Information Act, indicate that the reduced $F_{0.1}$ TACs would be unacceptable to industry and would not meet their requirements. As one DFO scientist explains it, the rule was a management-AGAC initiative and science-CAFSAC would have given tacit approval since at that time there was no perceived biological need to make a massive adjustment in the level of fishing. The 50% rule was used in setting the northern cod TAC for 1987, even though no drastic reduction in the TAC had been recommended by scientists. The same rule was later applied again, towards the end of the 1980s, when the advice did shift dramatically.

Steele and Andersen (1997: 23-24) suggest the original management target for northern cod was knowingly sacrificed so that TACs would not be significantly reduced from year to year and that ultimately the northern cod closure was the price paid for stable TACs for industry. It should be noted that industry in this case would primarily include the offshore sector and in some cases, the nearshore sector longliner and 65 foot dragger sectors in areas with individual quotas.

The authors of the NIFA letter made an explicit link between the high TAC set by the minister, 10,000 tons higher they alleged, than that indicated by the scientific calculations ($F_{0.1}$ for the year), the reprivatization of FPI and a potential long term threat to the survival of northern cod. They argued:

...in order to bring the Canadian offshore trawler catches into line with biological realities, he [the minister] might have to cut their catches by some 70,000 tons, or 140 million pounds perhaps affecting FPI privatization plans in some way - a company in which Ottawa is the majority shareholder. ...The rationale [for the high TAC] seems to be that FPI and National Sea need to be cushioned from large quota reductions. However, it is the fish, not the trawlers that need to be cushioned (NIFA, An open

letter...,@1987: 6).

The authors pointed out that DFO scientists appeared to be taking refuge in unsubstantiated theories such as the effects of cold water, in explaining the decline in the inshore fishery and pledged to monitor the proposed sale of FPI to the private sector in 1987, calling for public debate and to monitor the legal status of future FPI demands for northern cod quotas to maintain current profit levels if such quotas can be taken by the inshore sector in the exercise of their historic rights of access.@"

After consultation with FPI and National Sea, DFO agreed to place observers on offshore Canadian vessels, to count all discarded cod against offshore quotas, to increase scientific research on northern cod and to spread the offshore northern cod fisheries equally between areas 2J, 3K and 3L-- several of the demands in NIFA's 10 point plan. These initiatives did not, however, address the more general problem of the history of overly optimistic assessments and ignored scientific evidence that fish in more northerly areas (2J) grow more slowly and should probably be fished more conservatively than those in the more southerly parts of the region (3K).

The federal and provincial shares in FPI were sold to the private sector in April 1987 in the form of 14,160,000 common shares valued at \$177,000,000, representing 88.5% of the common shares outstanding and a share price of \$12.50 (FPI, 1987). By October 1988, the price per share had dropped to \$8.00. On July 9, 1992, one week following the announcement of the northern cod moratorium and a succession of cuts to quotas for other groundfish, the share price for FPI stock was at \$3.15 a share (*Globe and Mail*, 1992).

The Prospectus that announced the public offering of the FPI shares released March 24, 1987, relied heavily on DFO scientific work to present a positive picture of its resource base. Mobilization of bias at the level of science played a role in defining what was "legitimate" knowledge and to be addressed in the prospectus. The prospectus included a DFO figure indicating that the estimated total weight of the northern cod stocks had increased from approximately 0.3 million tons in 1976 to 1.2 million tons in 1985, a four-fold increase. The prospectus noted that DFO claimed to "monitor all aspects of fish harvesting" (FPI, 1987:7) and the management approach of the federal government was presented as "conservative" with problems of overfishing confined to areas outside the 200 mile limit in the post-1977 era (FPI, 1987: 6-7). According to the prospectus, FPI's northern cod enterprise allocations represented its "single most important fish resource, accounting for 31.1% of the Company's total offshore groundfish enterprise allocations" (FPI, 1987: 9). The prospectus referred to the reduction in inshore landings over the previous three years and to fishermen's claims that this reduction was "related to the harvesting activity of the offshore fleet." It also noted inshore fishermen's concerns that the offshore sector harvest was understated due to the unreported discarding of small fish. As did NIFA, FPI used the 1986 scientific review (reported on in 86/25) to support its position, stating that the review did not "conclusively link the reduced harvest by the inshore fleet with offshore harvesting activity and recognized that biological and environmental conditions affected the inshore migration of cod during this period" (FPI, 1987: 9).

The Prospectus contains no reference to the concerns about the accuracy of the stock assessments identified in the Keats Report. It explains (FPI, 1987: 10) that the 1987 Groundfish Management Plan reduced TACs for all groundfish species by 5.6%, including a 10,000 tonne reduction of 2J3KL cod, which entailed a 5,073 tonne reduction in FPI's enterprise allocation from 1986. It describes the requirement that FPI spread its harvesting over the three NAFO areas and indicates some concern about the capacity of FPI to harvest its entire 2J portion. The requirement to

introduce observers is also noted. The Prospectus indicates that the inshore sector was on an allocation but it does not explain that under this system, any cuts to the overall TAC would be removed from the offshore companies' enterprise allocations. There is no specific reference to the management goal of maintaining harvests at $F_{0.1}$ levels until the stocks recover.

The reprivatization of FPI was politically controversial. However, most of the controversy had to do with whether the federal government would use some of the money generated through the sale to help out indebted inshore fishers, and possible impacts the sale might have on local control over the fishery and on the inshore fishery. The reprivatization may have reinforced the bias against close examination of the northern cod stock assessments in the immediate period after 1986. The apparent hostility towards NIFA and particularly the Keats Report on the part of the Minister of Fisheries and upper level bureaucrats could be explained by the influence of this wider political-economic context on attitudes towards challenges to prevailing assumptions about the state of the northern cod stocks.²

In August 1987, the Minister of Fisheries, Tom Siddon, formed the Task Group on Newfoundland Inshore Fisheries to study the decline of the inshore fisheries. NIFA requested the Task Group to extend its mandate to a second phase including public meetings and a review of all aspects of the northern cod problem, including social, economical and historical. It called on the Task Group to recommend more funds for fisheries research and to recommend that the fish stock assessment team of his department be given total autonomy within the federal government structure as is the case with the Marine Institute in Iceland...[to]...ensure that stock assessments are free from political and corporate influence. (NIFA Wants...@ 1987). In its submission to the Task Group, NIFA identified two possible explanations for totally unprecedented declining trends in inshore catches: 1) that the stock is overfished (by trawlers) or that unprecedented ecological factors are preventing an otherwise abundant and healthy stock from coming inshore (NIFA, Brief to...,@ 1987). They argued that the former, and not the latter was the explanation. Scientists involved with the Task Group who found, like Keats and Winters, serious problems with previous stock assessments, encountered significant hostility, not only from some other scientists, but also from Ottawa managers. Like 86/25, the Report of the Task Group is an unequivocal document in which the conclusions of the Executive Summary do not fit well with the data in the appendices which appear to support the findings of the Keats Report (Finlayson, 1994: 40ff).

Based on optimistic stock assessments, the Canadian allocation for 2J3KL cod was set by the Minister of Fisheries at steadily increasing amounts from 155,000mt in 1980 to 250,000mt in 1986 (Task Group, 1993: 124). The 1987 allocation was 247,000mt and in 1988 it reached 266,000mt, largely on the basis of an upward estimate of the strength of the 1980-82 year-classes of fish (Doubleday, 1993: 79). The provisional allocation for 1989 was also set at 266,000mt but was subsequently reduced to 235,000mt following the explosive January 1989 CAFSAC assessment which concluded that previous assessments had, indeed, greatly underestimated fishing mortalities. The $F_{0.1}$

² As recently as 1997, a co-author of the Keats Report inquired if anyone had followed up on the issue of FPI and the Prospectus that was issued during privatisation?...There must be a paper trail that could be followed (confidential communication). We have attempted to follow that trail, but it is no simple matter. Most of the documents directly related to the reprivatization of FPI cannot be accessed using the Access to Information Act because they entail correspondence between the Department of Justice and DFO, and are protected by client privilege. To the extent that references linking TACS and the large companies have been found in memos and advice to the Minister, they take the form of general references to the fact that, if there are going to be cuts, they will have to come primarily from the enterprise allocations of the companies.

value for 1989 was estimated at 125,000mt, so the 1989 TAC of 235,000mt violated even the 50% rule, the application of which would have resulted in a TAC of 195,000mt. The 1990 Canadian allocation was set at 197,000mt and, in 1991, only a year previous to the moratorium, it was 188,000mt. In the years just prior to the moratorium, the estimated above average strength of the 1986 and 1987 year-classes of northern cod was used to defeat a court challenge by NIFA that would have produced an injunction on offshore fishing during the spawning period and to justify higher quotas. Rice (cited in Finlayson, 1994: 83) suggests that the choice of a liberal strategy of heavier fishing with slower stock growth in the 1980s meant more jobs and the cost of a more conservative strategy would have been an unnecessary loss of jobs. This analysis ignores, however, the fact that conservative cuts to the TACS would have affected the offshore, capital intensive sector and might have benefitted the more labour intensive inshore sector. The liberal approach appears to have produced large catches of small fish (in all sectors) and high rates of discarding by the late 1980s and early 1990s followed by the collapse of the stocks and the northern cod moratorium (Myers et al., 1997; Steele and Andersen, 1997).

Conclusion:

Others have visited the 1986-1987 period before us. Finlayson (1994) compared findings from the Keats Report with those from the Task Group in 1987 and the Harris Commission in 1990. In the first two cases, challenges regarding the accuracy of the assessments were publicly rejected, whereas in 1990, their acceptance precipitated the public acknowledgement that the northern cod stocks were in jeopardy. Drawing on a social construction of science perspective, Finlayson argues that the northern cod stock assessments in the 1980s were a result of the combined effects of scientific and managerial technoutopian faith that science based management was working, and the interpretive flexibility associated with imprecise data that permitted scientists with an institutional commitment to this faith to interpret these data as supporting their views. He blames divisions between scientists, scientific resistance to external challenges to its credibility and disputes over intellectual property rights for prolonging scientific commitment to the accuracy of the stock assessments.

Hutchings et al. (1997) compare Winters' Report document with the Keats Report, arguing that these came to similar conclusions. They suggest that these internal and external challenges were summarily dismissed by the DFO scientific establishment because of the stifling effects of scientific investigation created by affiliation with government. Steele and Andersen (1992; 1997) have highlighted this period for its association with the abandonment of the conservationist $F_{0.1}$ management goal and its replacement with the 50% rule, a key factor in the eventual collapse of the northern cod stocks.

Our analysis builds on this research by drawing on new data sources and adding new dimensions. Like these authors, our intent is less to explain fisheries science and policies related to northern cod in the 1980s than to identify the conceptual and institutional processes that interacted to encourage particular outcomes. The paper documents ways in which processes related to sovereignty claims and shifting property regimes in the period (territorialization), interacted with the dynamics of scientific knowledge production and management to shape the expansion of the northern cod fishery prior to 1986, enhance the scientific uncertainty and hence interpretive flexibility available to scientists and managers in a context of challenges, and shape both the type of challenges that developed

in 1986 and containment of those challenges.

We have examined some ways in which the dynamics of the production of scientific knowledge, including dominant paradigms and the institutional basis of science and management, interacted with elements of the political economy of the industry to produce resource degradation. We have linked the dynamics of sovereignty and property relations with knowledge production and control, the spatial organization of science and management, and bureaucratic decision-making in the context of a privatization policy agenda. Our analysis shows that during the period under study, the knowledge claims of some groups, both within and outside of DFO, provided different understandings about what was happening with the northern cod stocks from those held by scientists and managers who dominated decision-making. But institutionalized science, more so than the local knowledge of resource users and the knowledge of external scientists, extends itself culturally to become legitimate knowledge. Conversely, its success as a knowledge system is partly a consequence of its denial of its own social and legitimating aspects (Wright, 1992).

Our examination of territorialization within fisheries focuses attention on the contradictory role of the state in undertaking fisheries control strategies, and the ways in which territoriality has shaped state strategies (Vandergeest and Peluso, 1995). We use the concept territorialization to refer to the processes by which the spatial framework for scientific knowledge and stock assessments related to the northern cod stocks was produced by and interacted with national and international institutions for fisheries management to create a positive bias in stock assessments, enhance scientific uncertainty, to shape the conflicts and ultimately the challenges to science and management that developed in 1986 as well as response to those challenges. Reductionist understandings of both nature and human societies contributed to scientific uncertainty by substituting a simplified spatial model for science and management that masked a more complex ecological reality (Hutchings, Neis and Ripley, 1997), and either oversimplifying or ignoring fisher and fishing industry response to management initiatives and shifting ecological and economic constraints (Maguire, Neis and Sinclair, 1995). Thus, we contribute to the literature on territorialization by including socially constructed scientific knowledge and practice as an important agent.

Institutional structures that embedded science within management, non-transparent scientific and bureaucratic decision-making processes, and a bias within the management regime and within decision-making processes towards one sector of the industry, a bias that appears to have been strengthened in the mid-1980s, combined with the positive bias in stock assessment science to constrain conservation initiatives in the 1980s and ultimately to produce the collapse of the northern cod stocks. The Canadian government was committed to the bottom line of the big companies directly, when both were to some degree state assets, and indirectly after they had reprivatized FPI. Certainly, the inception of the 50% rule suggests a capitulation to these interests and a further slide from a commitment to resource conservation. Management rules such as this and the implementation of three-year management plans in 1991 (Parsons 1993: 385), were aimed at *gradual* reductions in TACs and provided an apparently stable resource base for the corporate sector. In April 1987, the federal government's sale of FPI to the private sector, without fully acknowledging developing concerns about the accuracy of the science that provided the basis for FPI's Enterprise Allocations, may have added a new dimension to the mobilization of bias, so evident in the 50% rule, that set the agenda for responses to challenges to northern cod science and management over the next few years.

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