Now or never

The cost of Canada's cod collapse and disturbing parallels with the UK

A WWF report
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An Excel worksheet with additional statistical analysis is available from the author at macgarvin@modus-vivendi.co.uk

Background note on the author

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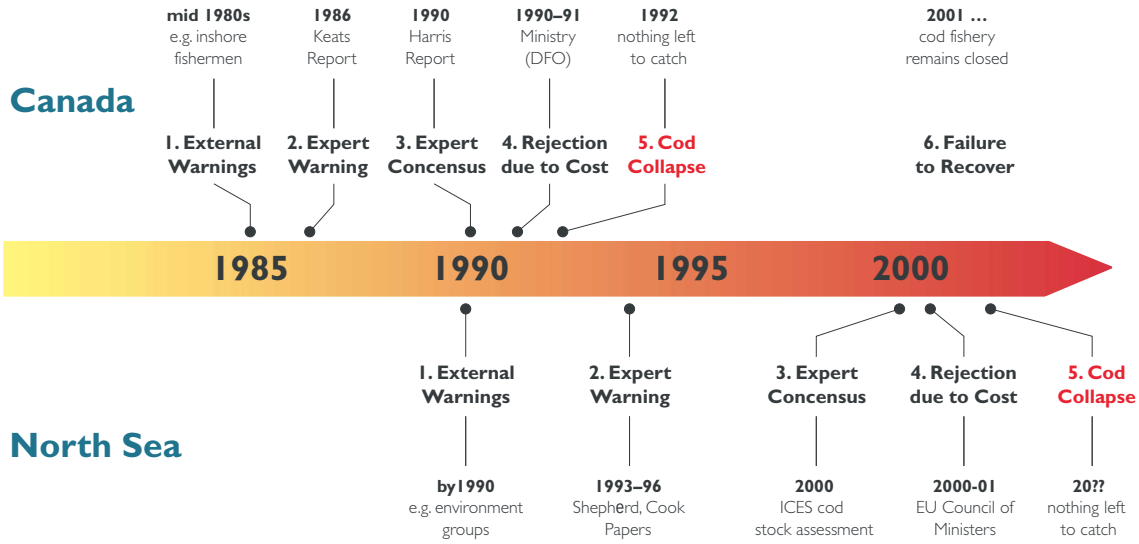
Executive Summary

The parallels in the North Sea with the commercial extinction of Canadian cod are all too clear – or rather they should be, for as yet the drastic action necessary to ensure the survival of fish and the fishing industry has failed to materialise. In 2000, it was confirmed that cod stocks in the North Sea and to the west of Scotland were on the verge of collapse. Other major UK fisheries such as haddock and plaice are now relying on single good breeding years and young fish, and are considered by scientists to be outside "safe biological limits".

This has major consequences for both the marine environment and the fishing industry. The International Council for the Exploration of the Sea (ICES) – the body responsible for providing advice on the state of stocks to European governments – recommended a zero quota for cod in 2000. In the event, cod quotas were about half those of 1999 and about one third of those in 1995. In fact, 1995 was the last time the full quota for cod of 120,000 tonnes was landed. Three years earlier, in 1992, on the other side of the Atlantic, the Newfoundland Northern cod fishery collapsed.



Five steps to disaster. Sequence of events in the Canadian cod collapse and in the North Sea. All but the final Canadian step have been passed in the North Sea.

The collapse of Canadian cod stocks in the early 1990s, and their subsequent failure to recover despite a draconian fishing moratorium, resulted in huge economic, social and environmental losses. Other stocks were also severely depleted. At the time of the collapse there were around 55,000 Atlantic fisheries licence holders, 15,000 of them entitled to fish for cod and similar "groundfish". There were 60,000 people working in the fish processing industry.

Depending on how the calculation is made, at the time of the cod collapse the Canadian industry was three to four times bigger than the present UK industry. Some 30,000 people lost their jobs, including 10,000 fishermen. The cost to the Canadian taxpayer of the collapse of Northern cod

and other Atlantic groundfish has been enormous. The total federal government assistance to fisheries, already generous, grew from around C$150 million in the mid-1980s to some C$700m in the mid-1990s.

The bulk of this expenditure was due to the Atlantic crisis. Assuming that the most pessimistic assumption of a net 30,000 lost jobs among fishers and the processing industry is correct, this amounts to an annual peak expenditure of approximately C$9,000 (around £4,500) per individual. With the optimistic assumption that all these job losses were countered by the then booming shellfish industry, and by importing fish for processing, it still amounts to C$6,500 (£3,250) per individual per year. The potential annual income forgone from a sustainable Canadian cod fishery is probably of the order of a billion Canadian dollars.

The crisis provides a graphic illustration of what is at stake in the seas around the UK. In 2000 there were 15,121 fishermen in the UK, 11,899 of them full-time and most engaged in demersal fisheries. The total value of all demersal landings is around £300m. In 1999 landings of just the major demersal species was worth £196m.

A number of lessons from the Canadian experience can be applied in Europe, and these are considered in detail in the full report. But one main message is fundamental: in policy terms, the repeated putting-off of long-term benefits for short-term gain resulted in costly disasters. We most emphatically have not learned this lesson in Europe.

In order to escape from an otherwise inevitable catastrophe, it is necessary immediately to address not one but two problems in Europe: those facing the fish stocks, and those facing the industry. Between the mid-1960s and 1999, total landings of major fish species by UK vessels in UK ports declined from some 900,000 tonnes to 400,000 tonnes. The value of the landed catch of major fish species, corrected for inflation and in 1999 prices, fell from a peak of some £880m to just £196m in 1999. This massive fall in the value of landings means that the state of the fishing industry has been progressively worsening. For example, in the late 1990s, the average net profit on invested capital for the Scottish demersal fleet – a major component of the UK fleet – was a dismal and unsustainable 0.1 per cent. Since then, increased costs and lower catches mean that the Scottish demersal fleet is predicted to make heavy losses in 2001, ranging from £19,000 to £90,000 per vessel. With all other costs uncontrollable, crew payments have taken a major hit, with pay down to 30 per cent of what was available in 1998. As a result of such changes, the number of full-time UK fishermen, after remaining relatively stable between 1970 and 1990, has fallen from 16,872 in 1990 to just 11,899 in 2000, along with 3,222 part-time jobs.

Financial assistance to the UK fishing industry is among the lowest in the EU. The principal joint EU/national package, the Financial Instrument for Fisheries Guidance (FIFG), between 1994 and 1999 amounted to €850 (£619 at the then current exchange rate) per fishermen, and €322 (£235) per fish processing worker. Significantly higher spenders per fisherman included Belgium (€3,532), Denmark (€2,386), Germany (€3,524), the Netherlands (€1,222), Spain (€2,486) and Sweden (€2,135).

As far as the whole UK population is concerned, €0.26 (19p) was spent on behalf of each of us (ie per capita) on FIFG aid to the fishing industry, and €0.10 (7p) per capita on the processing

industry. Specific national aid to UK fishermen in 1997 amounted to £186 per fisherman, or 6p per capita. This was spent primarily on port infrastructure. FIFG expenditure between 2000 and 2006 has already been fixed, and does not represent a major change in funding. Of course, these figures represent an assessment of how much was spent rather than how wisely – but along with the figures on profits, they illustrate that the UK industry is in no position to absorb major new costs over extended periods.

Fishing industry representatives are aware of the scale of the problem. The Scottish Fishermen's Federation (SFF) regards technical measures as insufficient, and argued for a permanent 20 per cent reduction of demersal fishing capacity, and a further 20 per cent temporary reduction while stocks recover. The SFF requested between £22.5m and £32.5m assistance for decommissioning and temporary lay-ups in 2001, and a further £13m over the following four years for continuing lay-ups – leaving the industry to finance perhaps £50m for buying and passing on quota allocations. The Scottish Executive has so far agreed to provide up to £25m for permanent decommissioning in 2001. This is a significant package. In England and Wales, only £6m has been made available by raiding other budgets – something regarded as "dismal" by the National Federation of Fishermen's Organisations (NFFO). Similar problems exist in Northern Ireland.

Stepping back from the brink

The parallels between the events leading up to the Canadian cod collapse and those in European seas are startling. In Europe we have already passed through the Canadian stages of initial warnings from outsiders, followed by warnings from government advisory scientists, expert consensus, and the rejection of decisive action on the basis of immediate cost. This leaves only the step of final fish stock collapse.

In 1993, the Deputy Director of Fisheries Research at MAFF emphatically warned that the type of measures that were eventually adopted for the recovery plans would not work. Technical measures on their own would be insufficient, and a closure of spawning areas without dealing with the redirection of effort to other areas, or preventing the capture of fish once the area re-opened, would have little effect. He, like others, emphasised the need for significant cuts in fishing effort. But because of the short-term costs, this option was avoided.

Ultimately, governments make the decisions, and have the responsibility to manage fisheries. The buck stops with them, regardless of pressures. Whoever else might be to blame, the British government was clearly warned at an early stage. It is therefore in some degree culpable. By acting in the early 1990s, it could have achieved recovery at far lower costs than it can now. The fishing industry argues that it was prepared to decommission at that time, but that adequate funding was not made available because of Treasury pressure. The blame can be widely spread, but it is the present administration which has the responsibility to pick up what is now a much larger bill.

Thus, while other steps are necessary, the absolute show-stopper on the critical path to fish stock recovery is the availability of finance. An essential step forward is for the Treasury to make it clear that, if the economic case can be made robustly, and the structures put in place to ensure that measures agreed are implemented, it will support appropriate investment. Without additional funds, it is difficult to see how the Department of Environment, Farming and Rural Affairs (DEFRA), in particular, can contribute in any meaningful way to a strategic resolution

of this crisis. As government involvement is clearly essential, this would represent an extraordinary state of affairs.

It may seem strange for a report published by an environmental organisation to be arguing the case for further expenditure on the fishing industry. But, as set out in WWF's 2000 report *Choose or Lose*, such action for fisheries management is the single most effective step that can be taken to restore the marine environment. This includes the implementation of medium- and long-term recovery programmes, as described in *Choose or Lose*, and immediate crisis measures to deal with species such as cod. If not done, the damage caused by fisheries in their struggle to survive will cause immense environmental damage. This is certainly long-term and possibly irreversible, as the failure of Canadian cod stocks to recover amply demonstrates.

We can be certain that in 20 years when people buy fish, dine in restaurants, holiday in small seaside ports, dive in a Marine Protected Area or spend time sea angling, they would be astonished to hear that there was ever a debate about whether financial investment in meaningful fish stock recovery programmes represented good value for money. For an island nation, fishing still has an importance to many that far outweighs its economic value, or the number of people it employs.

RECOMMENDATIONS

• We must act immediately. By the time the Council of Fisheries Ministers meets in December 2001, the Treasury should commit itself to investing in strategic recovery programmes that involve all diminishing fish stocks in the regional seas around the UK.

• Investment in the fishing industry should be allocated after the economic case has been made robustly, and the structures put in place to make sure that measures agreed are implemented. All policies should be subject to a full environmental, economic and social cost benefit analysis.

• The goal of the recovery programmes must be to restore stocks to levels that provide the optimum economic and environmental benefits, for the long-term success of coastal fishing communities and the health of the seas.

WWF's Oceans Recovery Campaign (ORCA) is calling for a network of regeneration areas to enhance and restore fish stocks, including the piloting of Fishing-Free Zones alongside a stronger network of Marine Protected Areas in the UK. In the longer term, WWF wants to see the introduction of an Oceans Act to provide the best legislative support for managing and protecting the marine environment for wildlife and people.

Introduction

In 2000 the quota allocations for the North Sea confirmed that North Sea cod are in a perilous state. The International Council for the Exploration of the Sea (ICES) – the body responsible for providing advice on the state of stocks to European governments – recommended a zero quota. In the event, cod quotas were about half those of 1999 and about one third of those in 1995. In fact, 1995 was the last time the full quota for cod of 120,000 tonnes was landed.

Three years earlier, in 1992, on the other side of the Atlantic, the Newfoundland Northern cod fishery collapsed. The parallels in the North Sea with the commercial extinction of the Canadian cod are all too clear – or rather they should be, for as yet, the drastic action necessary to ensure the survival of fish and the fishing industry has failed to materialise. While recovery plans for the North Sea cod have been instigated, the current measures are so circumscribed that it would be astonishing if the stock does not collapse.

This latest report for WWF-UK's Oceans Recovery Campaign (ORCA) nevertheless illustrates that all is not hopeless, providing radical action is taken now. There are lessons that can be learned from the collapse of Canadian cod, and its failure to recover. North American practices have changed radically in the last decade. This includes wider involvement of other sources of expertise, including fishermen and marine ecologists, and management practices that are more robust to error, such as the use of no-take zones in conjunction with other measures. Shore-side, there is a need to consider how user rights, management institutions and governance systems might be reformed so that they support sustainable fisheries. Such steps must not be restricted to North Sea cod, or even to the other recovery plans, for Irish Sea and west of Scotland cod stocks, and northern hake. Fish stocks in general are severely depleted and require urgent action.

Of the many steps that are needed, the most immediate is to make emergency funds available. The fishing industry, as documented in this report, does not have the reserves to take the pressure off stocks. But with the exception of the Scottish Executive, UK governments have failed to respond even partially to this evident need. It appears that this constraint comes from the Treasury. Given the past history of unjustifiable subsidy, such an attitude is understandable.

But important decisions must not be made on the basis of prejudice. A critical step forward is for the Treasury to make it clear that, if the economic case can be made robustly, and structures are put in place to make sure that measures agreed are implemented, then it will support and facilitate the additional budgetary requirements of recovery programmes.

It may seem strange for a report published by an environmental organisation to be arguing the case for further expenditure on the fishing industry. But, as set out in WWF-UK's 2000 report *Choose or Lose*, the action necessary to restore stocks to levels where much larger catches can be made is the single most effective step that can be taken to restore the marine environment. If not done, the damage caused by fisheries in their struggle to survive will cause immense environmental damage. This is certainly long-term and possibly irreversible, as the failure of Canadian cod stocks to recover amply demonstrates.

The Canadian Experience

BUILD-UP TO CRISIS

The early 1990s collapse of the Canadian Northern cod stocks off the Newfoundland coast, and their subsequent failure to recover despite a draconian fishing moratorium, resulted in huge economic, social and environmental costs[1]. Prior to collapse the industry was about three to four times the current size of that in the UK. In 1987-88 there were 40,000 tax-filing fishermen in Canada, which had fallen to 30,000 by 1994-95. There were 15,000 licence-holders for species such as Atlantic cod. Some 60,000 people were working in the fish processing industry prior to the collapse. Overall, some 30,000 people were estimated to have lost their jobs at the height of the crisis. The effect was cushioned to some degree because it was possible to expand the shellfish fishery, and for processors to switch to imported fish. These are options largely not available in the UK where diversification has already occurred. Subsequent to the collapse, the combination of annual emergency aid and annual income forgone from the lost fishery probably amounted to the order of C$1.75bn (ca. £875m). The crisis provides a graphic illustration of what is at stake in the seas around the UK.

The root causes of the Northern cod collapse go back far beyond the events of the late 1980s and early 1990s. The fishery was once the largest in the world, supporting European fisheries from the Middle Ages. In the century leading up to the 1970s, annual catches had been in the region of 200-300,000 tonnes annually[2]. Despite the vast size of the resource, the Canadian fisheries were plagued by instability and crisis. Indeed, there had been a series of national enquiries dating back to 1887[3]. Many of the fishing grounds lay in international waters, and attempts to control exploitation were ineffective. This became increasingly problematic as fishing technologies improved, and by the 1960s the cod stock was severely over-fished, the catch peaking at 1.5 million tonnes in 1968[1]. Certainly by 1969-70, the Canadian Fisheries Ministry was well aware that there was a need to cut over-capacity within the Canadian fleet to raise profitability for those remaining, and that this would cause major social and political problems[4].

A major goal of Canadian foreign policy at that time was to establish an Exclusive Economic Zone under the United Nations Convention on the Law of the Sea (UNCLOS), extending 200 nautical miles offshore. This would bring much of the cod into Canadian control and exclude the foreign fleets. All the same it was recognised, even before this objective was obtained, that

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[1] OECD (2000). *Transition to Responsible Fisheries. Annex: Government Financial Transfers and Resource Sustainability Case Studies. Canada.* OECD Paris. Available via http://www.ocde.org/agr/fish/docrespfish.htm Accessed 16th February 2001.

[2] DFO (2000). *Northern (2J3KL) Cod.* DFO Science Stock Status Report A2-01 (2000). http://www.dfo-mpo.gc.ca/csas/csas/status/2001/a3-01e.pdf Accessed 24th March 2001.

[3] Lennox O'Reilly Hinds (1995). *Crisis in Canada's Atlantic sea fisheries.* Marine Policy 19, 271–283

[4] Schrank, WE (1995). *Extended fisheries jurisdiction: Origins of the current crisis in Atlantic Canada's fisheries.* Marine Policy 19, 285–299.

the additional stocks for Canadian vessels would not be sufficient to resolve the problem of national over-capacity[4].

When Canada announced in 1976 that it was unilaterally adopting the 200-mile limit the following year, the Federal Minister announced that Canadian catch limits would also "be set back sharply … to allow over-fished stocks to recover". The Newfoundland Fisheries Minister was reported as believing that, in order to gain the prize of building up stocks, "if the quotas have to be reduced, Newfoundland fishermen are prepared to co-operate".

In theory, given the relatively generous social security system for Newfoundland fishermen (for example it provided closed season unemployment benefit), this might have been feasible. Nevertheless, despite repeated internal discussions between federal and Newfoundland governments, it proved impossible to deliver. Cod and total sea-fish landings, and the price of cod, were both rising, encouraging a general inclination to "wait and see". The lure of a booming fishing industry, and little alternative employment, attracted more people into the industry.

Generous government-backed loan schemes continued unabated. Between 1976 and 1980 the number of registered inshore fishermen grew from 13,736 to 33,640 and the number of vessels from 9,517 to 19,594. Net unemployment benefit (a sign of growth of the industry, because fishers were entitled to sign on during the closed season) grew from C$9.7m to C$36.5m, and loans grew from C$12.5m to C$43.8m. The total federal and Newfoundland provincial expenditure for 1980/81, of C$125m, was nearly equal to the value of the entire landed catch. When loans are also taken into account, the entire public financial outlay for the Newfoundland fishery grew from C$211m in 1981/82 to C$409m in 1990/91, immediately prior to the moratorium. On a wider scale, for the entire Canadian Atlantic fishery, the total public outlay between 1981 and 1991 grew from C$505m (ca. £208m at 1981 exchange rates) to C$1bn (ca. £500m at 1991 exchange rates) over the same period, exceeding the C$918m value of the catch in 1991.

There were a number of reasons why the federal and Newfoundland governments were unable to deliver a secure future. Partly it was an unresolved tension over whether the Federal Department of Fisheries and Oceans (DFO)'s goal was "to set and implement policy for the fishery as a viable industry or whether it is to maximise [short term] employment and save non-viable rural communities"[4]. Perhaps more important were the different political goals of the federal government (on balance, trying to slim down the industry and maximise its profitability) and the provincial governments (to pump as much short-term money and employment into the system as possible). Once money had started to flow, the impact on many voters of any attempt to reverse the policy made it very difficult to change.

CRISIS

The crisis might be seen as inexcusable political ineptitude except for one point – the DFO had attempted to put in place what would be regarded, even by many today, as precautionary goals. It set "deliberately conservative" limits on fishing mortality to ca. 20 per cent of the stock, with

the aim of building up the cod[5]. The DFO's published calculations indicated that this was happening, and that the increasing offshore catches by Canadian trawlers were simply a reflection of this healthy situation. In 1988 the DFO claimed a "five fold increase in Northern cod since 1976", and the Department was held in wide regard across the world as an example of how cautious, science-driven, management could turn around a seemingly hopeless situation of an international free-for-all.

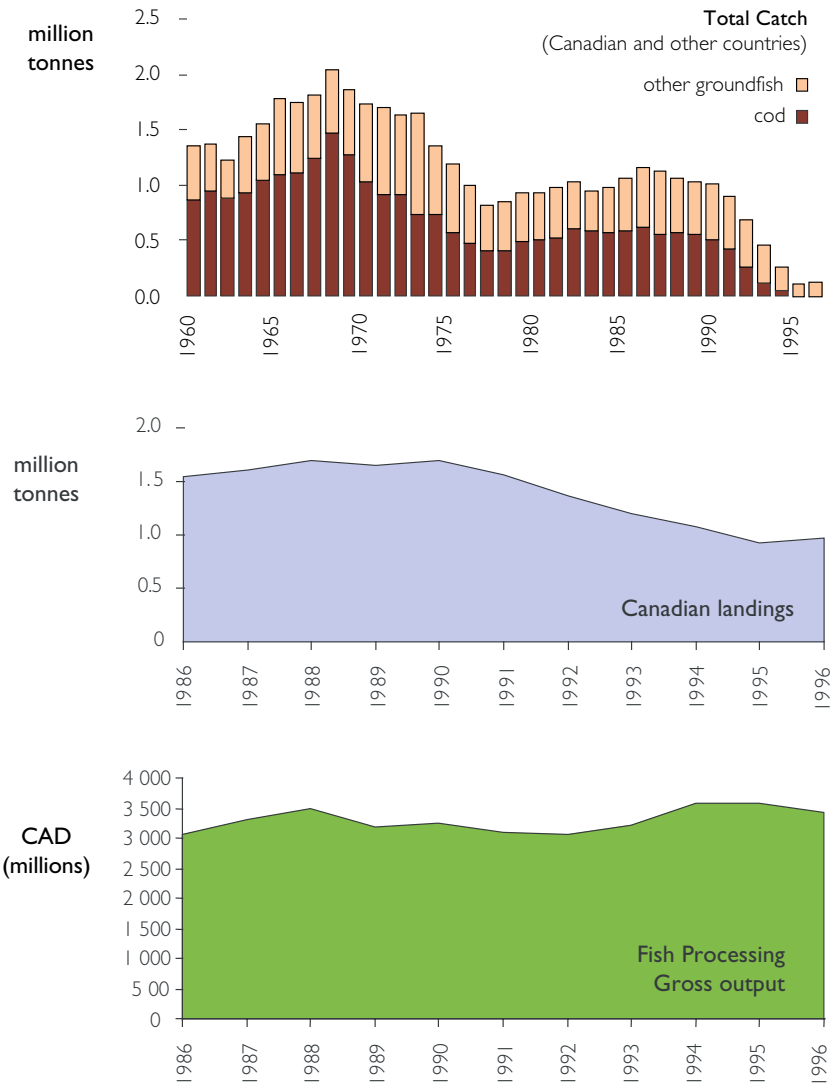

Figure 1. Total tonnage of cod and other groundfish taken from the North-west Atlantic fishery 1960–1996 by all nations (top); total Canadian landings from all fisheries, Pacific and Atlantic (middle); and the gross value of Canadian fish processing. After the cod crash, fish processors turned to imported fish, maintaining gross output. Source: Reference 1.

However, there was a dissenting group – the traditional inshore fishers, who could not reconcile their falling catches with this supposed abundance (although others believe that this was not

[5] Finlayson, A. C. (1994). *Fishing For Truth: A sociological Analysis of Northern Cod Stock Assessments from 1977 to 1990.* Social and Economic Studies No. 52. Institute of Social and Economic Research. Memorial University of Newfoundland, St. Johns. 176 pages.

entirely disinterested, but was part of a campaign for a bigger share of the fish[6]). But their protests were disregarded, so they commissioned what became the Keats Report[7], published in 1986. Keats highlighted the DFO's own (downplayed) retrospective analyses that indicated consistent and severe underestimation of the fishing pressure on the stock since the imposition of Canadian control, with "the result that we have consistently taken from 1.5 to 3 times the [20 per cent of stock] catch since 1977". The DFO dismissed this as "biased pseudo-science written to support a political agenda"[5]. Keats nevertheless gained media attention, forcing the commissioning, by the federal Fisheries Minister, of an official report.

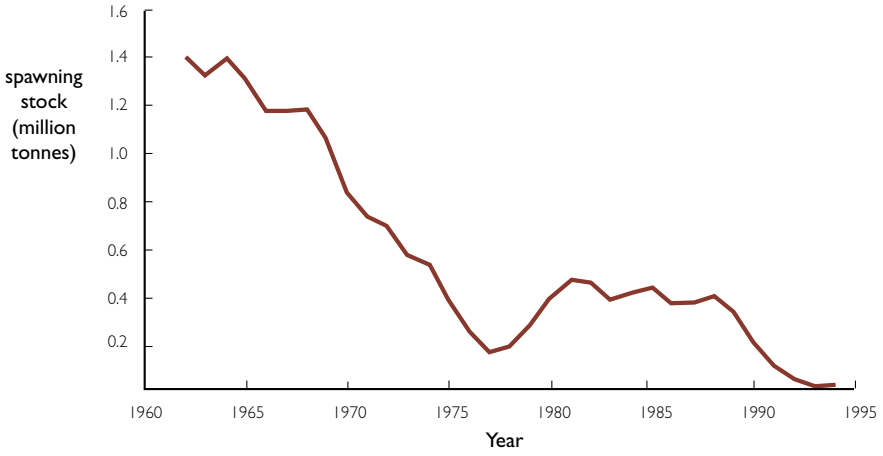

Figure 2. Spawning biomass of Northern cod, as assessed in 2000. In the 1980s the total stock size (ie including immature fish) was approximately double the size of the spawning stock. Cod had increased after the 1977 extension of sovereignty, but this was soon overwhelmed by the growing Canadian fishing effort. Source: Reference 8.

This was the 1988 Alverson Report, which concluded that the stock had increased since 1977, although after 1982 it increased "probably only very slowly"[5]. But it, too, stated that the "fishing mortality actually exerted has been considerably in excess of target mortality" because of the "consistent over-estimation of the current stock size". The technical problem was that for any year, some five subsequent years' data was required before the estimated fishing mortality and stock size estimates for the original year "effectively converged to the correct answer". The shorter this period (ie the closer the year in question was to the "current" year) the more it simply reflected the assumed level of fishing mortality of around 20 per cent. This became a critical flaw where a stock such as Northern cod became so depleted that it depended on the last couple of years' breeding success. Moreover, if a stock goes through a period of sharp decline, the delay in accurate information instils a false sense of assurance. Alverston also demonstrated how sensitive the conclusions about stock size were to the wide range of estimates of possible levels of fishing mortality. However, in their executive summary this was turned on its head: the report stated that the DFO calculations of fishing mortality fell "within the range of estimates supported by the data", albeit at the lower end.

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[6] JJ Maguire, pers. comm. 18/9/01

[7] Keats, D., D. H. Steele & J. M. Green. (1986). *A Review of the Recent Status of the Northern Cod Stock (NAFO Divisions 2J, 3K, and 3L) and the Declining Inshore Fishery.* Report to the Newfoundland Inshore Fisheries Association. Cited in Finlayson 1994.

[8] Shelton, PA and DE Stansbury (2000). *Northern cod recruitment before, during and after collapse.* Canadian Stock Assessment Secretariat Research Document 2000/089. Available via http://www.dfo-mpo.gc.ca/csas/csas/English/Research_Years/2000/2000_089E.htm Accessed 19th March 2001

The official DFO response was that it had been vindicated. However, there was an internal reassessment of how it conducted its stock assessments. The 1989 assessment assumed that fishing mortality was higher, and that the stock was not growing. It recommended that the off-shore catch be virtually halved. If it had been possible to have then demonstrated beyond reasonable doubt what was to come, according to those closely placed to the events it is quite likely that even stricter measures would have been recommended. The problem was that the situation was unprecedented[6]. Even the action that was taken started to have a major impact on the total Canadian landings (see middle graph, Figure 1). This reappraisal was seen as an admission that the DFO had got it wrong all along. It caused serious problems for the administration, which depended on the unquestioned accuracy of the science as an arbiter to conflicting claims to resources. The offshore fishers now felt justified in vigorously contesting the evidence that stocks had fallen.

The Fisheries Minister called a new enquiry, the 1990 Harris Report[9]. Harris also concluded that prior to 1989, fishing mortality was probably more than double that intended, and the stock was little more than half the assumed size, with the result that it had been fished at levels that pointed towards commercial extinction – a conclusion widely reported by the media. It cautiously concluded that the revised DFO 1989 assessment was a better approximation of reality. But also, over many pages, it pointed to major uncertainties, not easily resolved, at every conceivable level. What were (and often still are) "believed to be the best available management theory, data and assessment methodologies will legitimately support claims of stock status ranging from sustainable growth to dangerous decline".

Harris estimated that the Total Allowable Catch (TAC) would have be reduced from 235,000 tonnes in 1989 to ca 125,000 in 1990 in order to bring the TAC into line with the goal of no more that 20 per cent stock removal. But this would also "precipitate social and economic repercussions of a particularly drastic nature". There was also evidence that the cod had since had two good breeding years[6]. Harris suggested a TAC of 190,000 tonnes (ca. 30 per cent removal), although it cautioned that "this may contribute to further decline". The 30 per cent target was adopted, at a loss of C$26m (£12.5m) of landings, C$66.6m (£32m) processed product and the equivalent of some 1,000 jobs. Similar limits were set for 1991-92. But during the 1992 fishing season it became apparent that there was little left to catch. The situation was far worse than even the most pessimistic projections. An emergency moratorium was imposed in July 1992, initially for two years, but since has been indefinitely extended with some very minor exceptions. The stock actually continued to decline in the years after the imposition of the moratorium, which may indicate that the collapse would have occurred whatever action had then been taken[6]. Nevertheless, overall, the evidence for the role of over-fishing in the collapse is compelling.

The cost to the Canadian taxpayer of the collapse of Northern cod and other Atlantic groundfish has been enormous (Figure 3). The total federal government assistance to fisheries, already generous, grew from ca. C$150m in the mid-1980s to ca C$700m in the mid-1990s. The bulk of this expenditure was due to the Atlantic crisis. Assuming that the most pessimistic assumption of a net 30,000 lost jobs among fishers and the processing industry is correct, this amounts to an

[9] Harris, L. (1990). *Independent Review of the State of the Northern Cod Stock.* Communications Directorate, Department of Fisheries and Oceans, Ontario.

annual peak expenditure of ca. C$9,000 (£4,500) per individual. With the optimistic assumption that all of these job losses were absorbed by the booming shellfish landings, and by importing fish for processing, it still amounts to C$6,500 (£3,250) a year.

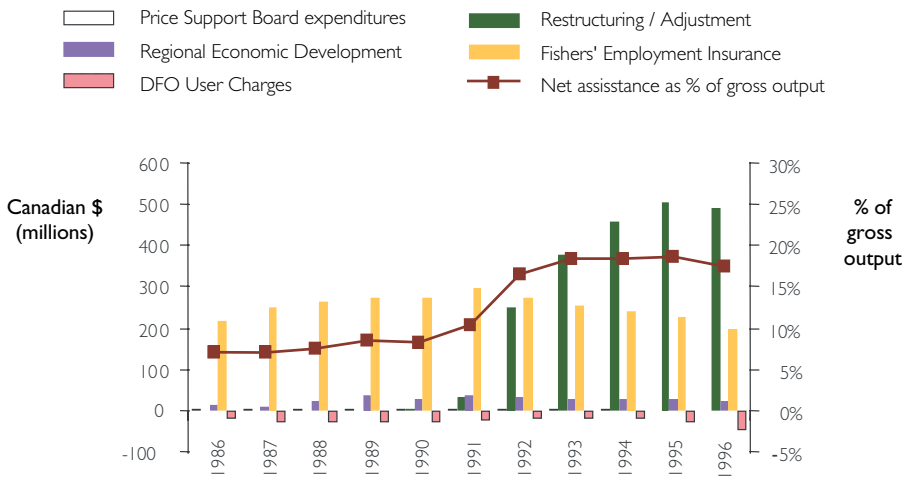

Figure 3 Canadian Federal Government assistance to fisheries, 1986–1996. Source Reference 1.

This expenditure was spread over a number of areas during the 1990s (Figure 4). The three most important were income support, unemployment, benefits and "special adjustment" funds, channelled through a diverse array of emergency programmes introduced at various points. The Atlantic Fisheries Adjustment Programme (AFAP) and the Quebec Federal Fisheries Development Programme (QFFDP) had a total budget of C$637m. This included funds for research, conservation and surveillance activities, income support, job creation for affected fishers and plant workers, and wider economic diversification within and outside the fishery. The Northern Cod Adjustment and Recovery Programme (NCARP) of C$587m and the Atlantic Groundfish Strategy (AGAP) of C$381m, provided income and other support. This included assistance to affected fishers and plant workers, assistance to inshore vessel owners to maintain boats and gear during the fisheries closure, training, and financial incentives for the retirement of fishers, plant workers and fisheries licences. The Atlantic Groundfish Strategy (TAGS), with a fixed budget of C$1.9bn, had a similar mix of measures. This was directed at fishers and plant workers affected by the collapse of the Atlantic groundfishery and included the reduction of catching and processing capacity through licence and human retirement, and supporting changes in occupation and long-term community economic development. The call on funds for TAGS, particularly income support, was so great that these were exhausted in 1998 – a year earlier than intended.

In addition to the ca. C$700m a year being spent on relief as a result of the stock collapses, there was also the forgone income from the groundfish fisheries. In the short term, the landed value of the Atlantic groundfish crash declined from ca. C$400m (£192m) in the early 1990s to perhaps C$150m (£72m) in the mid-1990s (Figure 5). Judged on a longer time scale, the forgone income was substantially larger. Figure 1 shows that the total tonnage of Atlantic groundfish landed in the mid-1990s was of the order of hundreds of thousands of tonnes (116,000 in 1996 and 624,000 in 1990[1]), compared with 2.2 million tonnes in the late 1960s. These earlier catch levels were unsustainable; even so, the potential income forgone from landings by a sustainable fishery could well be of the order of C$1bn (£450m at the 2001 exchange rate) a year.

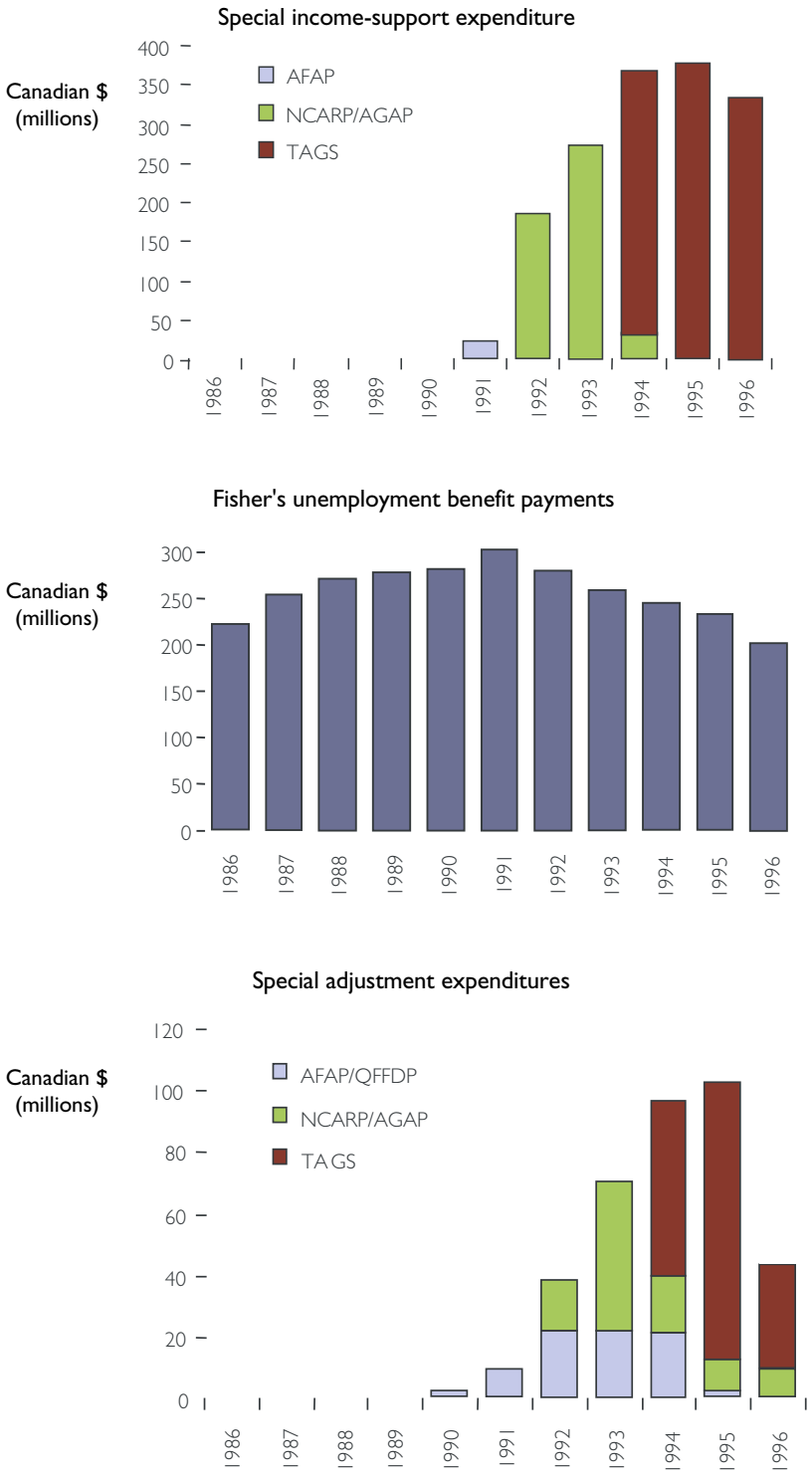

Figure 4. Major sources of Federal expenditure 1986–1996. The special adjustment fund includes training and job creation schemes for fishers and plant workers, economic diversification schemes and buy-back of licences and early retirement. Source: Reference 1.

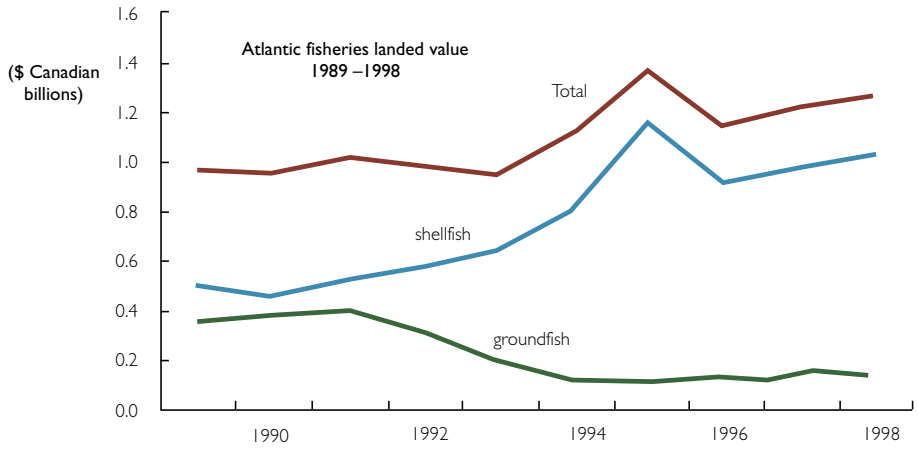

Figure 5. Atlantic fish landed value. The collapse of the groundfish landings was accompanied by an increase in shellfish landings. Source: Reference 10.

However, there was one saving grace for the industry (Figure 5). This was that the fishery for shellfish – particularly crabs and lobsters – had latent potential that had not been exploited while the cod and other groundfish were prolific. This was expanded in the late 1980s and 1990s. The net result was that the total value of landings actually increased during the 1990s, and the total value of processed fin and shellfish held relatively level (bottom graph, Figure 1).

Similarly, the various sources of information on the number of Atlantic fishers and their income shows a mixed story. There is no exact figure for how many fishers were engaged in the Atlantic groundfish fisheries, and how much they earned, so a picture has to be built up from a variety of sources (Figure 6). The total number of fishing licences in the Atlantic fishery was ca. 55,000 throughout 1986-1996. The number of licences for engaging in the Atlantic groundfish fishery was similarly stable, at around 15,000, although it does show a slight fall in 1992-93.

But having a licence is not the same as actively engaging in the fishery; licences may be held onto in the hope of a recovery. There is good information on the number of self-employed fishers actually making tax returns, and the size of their income (Figure 6, lower graph). This suggests a peak of just over 40,000 actively engaged in the late 1980s, falling to ca. 30,000 in 1993. This includes both Atlantic and Pacific coast fishers. According to a Canadian government submission to the OECD,[11] "self-employed fishers constitute the majority of the fishers' population. Fishers' income generally followed the trend of the value of commercial fisheries. The record harvest and favourable price performance in 1987-1988 brought a high income around C$23,000 and after a slight decline between 1989 and 1990 the average income was pushed up again to C$30,000 in 1994-1995 due to the strong performance of the shellfish fisheries. The two peak periods (1987-88 and 1994-95) are contrasted by the large "difference

[10] Anon. (2000). *The Management of Fisheries on Canada's Atlantic Coast: A Discussion Document on Policy Direction and Principles.* Atlantic Fisheries Policy Review, Ottawa. Available via http://www.dfo-mpo.gc.ca/afpr-rppa/linksto_discodoc_e.htm Accessed 19th March 2001.

[11] OECD (2000) *Transition to Responsible Fisheries. Government Financial Transfers and Resource Sustainability: Case Studies*. Canada. OECD Directorate for Food, Agriculture and Fisheries Fisheries Committee. AGR/FI(2000)10/FINAL. Paris. http://www.oecd.org/agr/fish/doc/fi0010fe.pdf Accessed 10th September 2001.

between the tax-filing fisher populations: 40,000 (1987) vs. 30,000 (1994) mainly attributable to the failure of the Atlantic groundfishery in the 1990s".

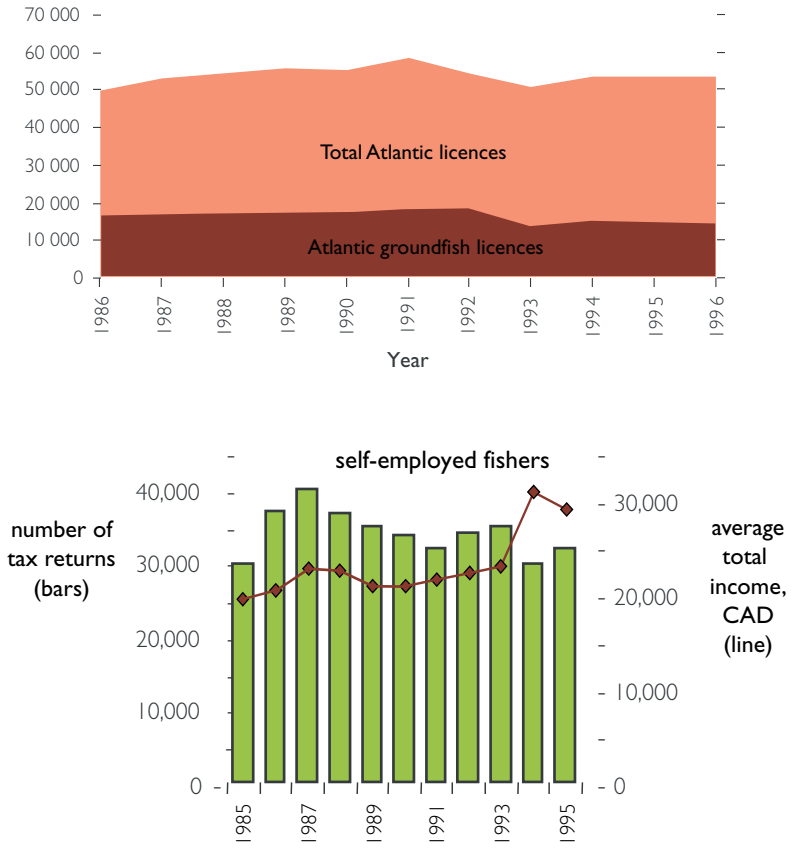

Figure 6: Measures of potential and actual engagement in the Atlantic fishery. The top graph shows the total number of Atlantic fisheries licences held, and those specific to groundfish. Individual fishers can hold more than one licence, and not necessarily be fishing. The lower graph shows the number of self-employed fishermen making tax returns, and the average total income. Source Reference 3.

There have also been similar problems on the west coast relating to the collapse of the Pacific salmon fishery. The Canadian submission states that "it can be safely concluded that, in general, fishers with shellfish licences were faring very well during the 1991-1996 period while those dependent solely on Atlantic groundfish or Pacific salmon would suffer a great deal during the same period. The impact of the resource crisis would be felt more in the processing sector as the majority of the processing jobs have traditionally been related to the groundfish fishery on the Atlantic coast and to the salmon fishery on the Pacific coast".

Taking both the loss of earnings from a sustainable fishery where stocks had not been depleted, and the government crisis funding into account, it seems likely that the total cost of the failure to manage the fishery at its peak was the order of at least C$1.75bn (ca £800m) a year.

AFTERMATH – LESSONS FOR THE UK

Despite the closure, the Northern cod stock failed to rebound, and it was not until 1999 that a small inshore fishery of 9,000 tonnes was permitted, even then with considerable misgivings

from fisheries scientists[12]. Much effort has been spent assessing why the stock collapsed, and why it has failed to recover. Although it may take a long time, if ever, for these lessons to have an effect on the Northern cod, it is essential that they be used for other stocks, including those around the UK.

Some of the research re-emphasises points already understood in principle, if still not given sufficient weight in management; other elements shed new light on why stocks may not recover, or recover only slowly, once a stock has fallen below a critical threshold.

Of the better understood aspects, the principal cause of the collapse is well established. The stock had been heavily depleted due to overfishing prior to the extension of jurisdiction in 1977. It fell from nearly 3m tonnes in the early 1960s to about 0.5m tonnes in 1977 (see Figure 1). Following the extension of jurisdiction, the stock at first partially recovered as a result of smaller catches, strong recruitment, and faster growth of the fish. This was reversed as exploitation by the expanding Canadian fleet increased, and weaker cod recruitment and lower individual growth rates occurred[8]. The re-opening of the fishery on Northern Cod in 1999, with the setting of a 9,000 TAC, led to the remarkable comment by the official Canadian Stock Assessment Secretariat (CSAS) that this had an "unquantifiable (but large) risk of something bad happening to the remnant of the stock concentrated in the inshore. Clearly the precautionary approach has had very limited penetration in the setting of TACs on cod stocks in Atlantic Canada in this early post-moratorium period" [12]. The stock assessment in 2000 reported that the level of fishing mortality was again well above the 20 per cent target rate, "and this is unacceptable under a precautionary approach".

Physical and biological events may have contributed, but it is very unlikely that they alone would have caused a collapse had the stocks not been depleted. Physical events can have important consequences, particularly between spawning and recruitment. Currents can take larvae out of favourable sites for growth, and low temperatures can lead to slower development. This appears to be important for coastal populations of Newfoundland cod[13] as elsewhere. In turn, this may interact with the biology and ecology of the system, for example because the vulnerable planktonic larval phases are left open to predation for longer. Biological and ecosystem factors can also exert effects by other routes.

In the southern Gulf of St Lawrence, at least, cod stocks reached very low levels in the 1970s, but subsequently staged a recovery, despite the continuation of fishing. Then, in the 1990s, they were again depleted to very low levels but failed to recover[14, 15]. This was despite a fishing

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[12] Shelton, PA (2000). *The development of precautionary and biological limit reference points for the 3Ps cod stock.* Canadian Stock Assessment Secretariat Document 2000/075. http://www.dfo-mpo.gc.ca/csas/csas/English/Research_Years/2000/2000_075e.htm Accessed 24 March 2001.

[13] Bradbury, IR, GL Lawson, D Robichaud,, GA Rose & PVR Snelgrove. *Success and failure of Atlatnic cod,* Gadus morhua*: a case study from coastal Newfoundland.* Canadian Stock Assessment Secretariat Document 2000/087. http://www.dfo-mpo.gc.ca/csas/csas/English/Research_Years/2000/2000_022e.htm Accessed 24 March 2001.

[14] Swain, DP, & GA Chouinard (2000). *Background information on the southern Gulf of St Lawrence cod stock for the Fisheries Oceanography Committee workshop on the cod recruitment dilemma.* Canadian

moratorium imposed in 1993 (separate from that imposed on the Northern cod) and a level of survival of larval phases, and recruitment of young fish to the stock, that was either average or higher than average. It has been argued in scientific literature that during this later period the very low growth rates of young fish and abnormally high levels of mortality, other than fishing, prevented a recovery. In particular the rapid recovery in the 1970s was strongly correlated with low levels of herring and mackerel (which are predators of young cod-fish, and which had collapsed at that time due to over-fishing). During the 1990s, stocks of herring were at high levels compared with the 1970s[16]. There was little correlation between cod survival and climatic fluctuations or seal abundance. Indeed, the researchers warned that a seal cull could have unpredictable effects on the cod recovery, as they are also important predators of herring[17]. For Northern cod, an apparently strong 1994 year class also did not come through to the adult stock, and there is some concern regarding the decline of capelin, a fish that is a principal source of food.

The main hope is that there are now hints that the stock is very slowly rebuilding[2]. The estimates of spawning stock increasing from 10,000 tonnes in 1994 to 30,000 tonnes in 1999, although these are a shadow of previous total stock abundance (in excess of 1m tonnes in the 1980s preceding the crash[2]), and spawning biomass (i.e. mature fish, in excess of 400,000 tonnes[8] [see Figure 1]).

Other aspects of the biology of cod are now receiving greater attention. Of these, one of the most important is the increasing appreciation that supposedly single "stocks" of cod and other species are actually divided into more or less discrete sub-populations (metapopulations) inhabiting individual bays and offshore areas, with their own characteristic locations and migration patterns. Rather than the overall population being reduced to low densities and subsequently recovering uniformly, low overall levels appear be the result of the extirpation of sub-populations, which then depend on adjacent populations becoming sufficiently abundant for there to be "spill-over" and re-colonisation. This is important, not least because sub-populations tend to aggregate, so that local densities of the survivors remain high (and can be located by the fisheries). This may partly explain the paradox that fishermen report good catches when general fisheries surveys report low average densities of fish. Of the north-west Atlantic "stock", only five of 11 historic spawning areas are occupied, and re-colonisation appears to be very slow. Indeed, it is not generally appreciated that localities that were decimated by international fleets

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Stock Assessment Secretariat Document 2000/142. http://www.dfo-mpo.gc.ca/csas/csas/English/Research_Years/2000/2000_142E.htm Accessed 24 March 2001.

[15] Chouinard, GA, L Currie, A Dinclair, G Poirier & D Swain. *Assessment of cod in the southern Gulf of St. Lawrence.* Canadian Stock Assessment Secretariat 2000/019. http://www.dfo-mpo.gc.ca/csas/csas/English/Research_Years/2000/2000_019e.htm Accessed 24 March 2001.

[16] DFO (2000). *Southern Gulf of St. Lawrence Herring.* DFO Science Stock Status Report B3-01 (2000). http://www.dfo-mpo.gc.ca/csas/csas/status/2000/b3-01e.pdf Accessed 24 March 2001.

[17] Swain, DP, AF Sinclair, GA Chouinard & KF Drinkwater (2000). *Ecosystem effects on pre-recruit survival of cod in the southern Gulf of St. Lawrence.* Canadian Stock Assessment Secretariat Document 2000/147. http://www.dfo-mpo.gc.ca/csas/csas/English/Research_Years/2000/2000_147E.htm Accessed 24th March 2001.

between 1965 and 1969 (the Saglek, Nain and Makkovik-Harrison Banks off northern Labrador) have never been re-occupied[18].

New approaches to management are emerging in the aftermath of the cod collapse. There is a wide-ranging discussion among economists and other disciplines about alternative approaches to industry structures, such as the allocation of user rights, management institutions and governance systems[19, 20]. Although not a major theme of this report, undoubtedly changes will need to be considered here if past mistakes are not to be repeated. At the policy level, an important 2000 DFO discussion document about the future of the Atlantic fisheries[10] suggests the distancing of DFO management from taking decisions on the behalf of interest groups, the latter instead being given greater rights, but also the burden of responsibility to establish sustainable fisheries. At the practical level, as the limitations of computer modelling to determine stock sizes and safe levels of fishing have been increasingly exposed, there has been a move towards a wider interpretation of what a precautionary approach implies, and a wider involvement of other disciplines such as ecology. North America, particularly the US with its 1996 Magnuson-Stevens Fisheries Management Act, is perhaps most advanced in this process, which has "fundamentally changed" fisheries management[21].

Fishing-Free Zones

There is a growing appreciation that a precautionary approach does not simply mean incorporating a greater margin of error into computer stock models and theories. There needs to be a wider approach to management, particularly the creation of Fishing-Free Zones and other types of fish refuges, that are robust to management uncertainties, error and difficulties with implementation[22, 23, 24, 25, 26, 27, 28, 29, 31].

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[18] Kent Smedbol, R & JS Wroblewski (2000). *Metapopulation theory and northern cod population structure: interdependency of subpopulations in recovery of a groundfish population.* Canadian Stock Assessment Secretariat Document 2000/087. http://www.dfo-mpo.gc.ca/csas/csas/English/Research_Years/2000/2000_087e.htm Accessed 24 March 2001.

[19] Hatcher, A. & K Robinson (1999a). *The Definition and Allocation of Use Rights in European Fisheries.* EU FAIR Concerted Action on Economics and the Common Fisheries Policy: perspectives for the future economic management of Europe's Fisheries. Centre for the Economics and Management of Aquatic Resources. University of Portsmouth, UK.

[20] Hatcher, A. & K Robinson (1999b). *Management Institutions and Governance Systems in European Fisheries.* EU FAIR Concerted Action on Economics and the Common Fisheries Policy: perspectives for the future economic management of Europe's Fisheries. Centre for the Economics and Management of Aquatic Resources. University of Portsmouth, UK.

[21] Darcy GH, Matlock GC (1999). *Application of the precautionary approach in the national standard guidelines for conservation and management of fisheries in the United States.* ICES Journal of Marine Science 56: 853-859.

[22] Coleman, F. & J Travis (2000). *Preface*. Bulletin of Marine Science 66, 525.

[23] Conover, DO, J Travis & FC Coleman (2000). *Essential Fish Habitat and Marine Reserves: An Introduction to the Second Mote Symposium in Fisheries Ecology.* Bulletin of Marine Science 66, 527–534.

[24] Sumaila UR (1998). *Protected marine reserves as fisheries management tools: a bioeconomic analysis.* Fisheries Research 37, 287–296.

This "second generation" precautionary approach seems to be most advanced in the area to the south of the Northern cod, on the Georges Banks, administered by the US[30]. Here closed areas, in conjunction with other measures, can have a remarkable effect both in terms of environmental protection and increasing the stocks available to harvest. The results follow the theoretical expectations of the strengths and weaknesses of Fishing-Free Zones, which have the greatest positive effect where some areas are permanently closed, or closed for a long time, and where the population is sedentary. They have progressively less effect where large numbers of fish move in and out of the area, or where there are seasonal closures and the fish remain aggregated in the area when the fishery reopens.

A relatively small area of the Georges Bank is completely protected as a "Habitat Area of Particular Concern", with much larger areas designated as "Essential Fish Habitat", both under the 1996 Magnuson-Stevens Act. Taken together, the area covered is 17,000 sq km, about one third of the Bank. For sedentary species such as scallops, completely protected areas experienced a 14-fold increase in biomass between 1994 and 1998, encouraging interest among the industry in a fallowing or "area-rotation" scheme. For yellowtail (flatfish), which are relatively sedentary, there has also been a considerable increase in spawning stock in the protected area and there is some evidence of an increase in more mobile haddock and cod. This cannot exclusively be the result of the closed areas, but rather the net result of these and other more traditional approaches that are also being applied, and perhaps also changes in oceanographic conditions.

As a result, there is now growing interest in the role that Fishing-Free Zones may have in assisting the recovery of Northern cod[31]. Attempts to model the impact of different approaches suggest that rebuilding the stock by closed areas alone is impracticable, requiring the closure of 80 per cent of the area. The authors of the research considered that this would quite likely trigger heavy investment in gear and exploitation of the remaining areas, which would defeat the purpose. But if used in conjunction with other approaches, such as temporary closure to trawls and gill netting, then depending on location, a closure of 20 per cent of the home-range of

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[25] Sumalia, UR, S Guénette, J Alder & R Chuenpagdee (2000). *Addressing ecosystem effects of fishing using marine protected areas.* ICES Journal of Marine Science 57, 752–760.

[26] Rosenberg A, TE Bigford, S Leathery, RL Hill and K Bickers (2000). *Ecosystem approaches to fisheries management through essential fish habitat.* Bulletin of Marine Science 66, 535–542.

[27] Pitcher, TJ, R Watson, N Haggan, S Guénette, R Kennish, UR Sumaila, D Cook, K Wilson & A Leung (2000). *Marine reserves and the restoration of fisheries and marine ecosystems in the South China Sea.* Bulletin of Marine Science 66, 543–566.

[28] Bohnsack, JA (2000). *A comparison of the short-term impacts of no-take marine reserves and minimum size limits.* Bulletin of Marine Science 66, 635–650.

[29] Dayton, PK, E Sala, MJ Tegner & S Thrush (2000). *Marine Reserves: Parks, baselines, and fisheries enhancement.* Bulletin of Marine Science 66, 617–634.

[30] Murawski, SA, R Brown, H-L Lai, PJ Rago & L Hendrickson (2000). *Large-scale closed areas as a fisheries-management tool in temperate marine systems: The Georges Bank experience.* Bulletin of Marine Science 66, 775–798.

[31] Guénette, S. TJ Pitcher and CJ Walters (2000). *The Potential of Marine Reserves for the Management of Northern Cod in Newfoundland.* Bulletin of Marine Science 66, 831–852.

the Northern cod is predicted to accelerate the recovery rate significantly. In effect, this is restoring the natural refuges that existed in earlier decades because fishing was physically impossible in certain areas.

These are encouraging developments. Of course, some caution is needed – these are predictions, not observed facts. The more mobile a species is, the less certain are the consequences of fixed closed areas, and the greater the area that has to be incorporated. Also, for both the Georges Bank and northern Cod, it is evident that means will have to be found to make it possible for the industry to survive short-term reduction in yields, and without redirecting effort on other stocks.

The UK experience

While the UK experience does not exactly parallel Canada's in all its details, the same broad sequence of events is evident. Rather than an over-optimistic expansion following the exclusion of other fleets, the UK fleet was itself expelled from distant waters in the 1970s. But the net result was the same: it increased domestic pressure on local fishing grounds. In both cases problems arose from faulty technical assessments. In the early 1970s an exceptionally good run in the recruitment of North Sea cod, haddock and their relatives – the so-called "gadoid outburst" – resulted in a mistaken assumption that such stocks were capable of sustaining much greater fishing pressure than actually the case. More recently it has become apparent that the same technical problem contributing to the Canadian collapse – that of the systematic overestimation of stock size and the underestimation of fishing pressure – has occurred on this side of the Atlantic.

There has been increasing awareness of a growing threat to North Sea cod and other stocks for at least a decade. By 1996 a senior UK government scientist had warned of a serious risk that the North Sea cod stock would collapse, justifying "decisive action". By 2000 the International Council for the Exploration of the Sea (ICES) – the body responsible for providing scientific advice to the European Commission and European governments – had indicated that only a zero direct catch of cod in 2001 was compatible with government guidelines regarding the application of a precautionary approach.

These events can be considered equivalent to the vigorous but rejected protestations of the state of Northern cod in Canada in the late 1980s and early 1990s. The reason for the rejection of this advice was also the same as in Canada, that of immediate economic cost. A proposal from the European Commission for short-term assistance to allow the reduction of fishing effort was rejected by national governments. Instead, only the temporary closure of spawning grounds and a limited set of technical restrictions were implemented. As long ago as 1993, the then senior stock assessment scientist at the UK Ministry of Agriculture Food and Fisheries (MAFF) had warned that technical measures more stringent than those actually applied in 2001, and closures of spawning stock areas of the form adopted in 2001 were unlikely to be effective unless combined with significant effort reduction. Fishermen's organisations have accepted the need for significant permanent and temporary effort reduction. The Scottish Fishermen's Federation (SFF) proposed a 40 per cent reduction during 2001, while acknowledging that it would be "unreasonable" to expect taxpayers to make substantial investments without assurance that the programmes would work, and that steps were taken to prevent any re-occurrence. Assistance has been provided by the Scottish Executive, although falling short of the amounts requested by SFF.

Similar arguments made south of the border by the National Federation of Fishermen's Organisation, and from Northern Ireland, have met with less success. Therefore, given the steps that have been said by scientists, fishermen and environmental groups to be necessary, and the deficiencies in the actual measures compared with this advice, we have to face the prospect that North Sea cod will now collapse. Similar questions hang over the fate of the other two cod stocks subject to recovery plans, off the west of Scotland and in the Irish Sea.

BUILD UP TO CRISIS

In order to escape from an otherwise inevitable catastrophe, it will be necessary to addressed not one but two problems: those facing the fish stocks, and those facing the industry. Strategic long-term recovery programmes are required to resolve what has been a long build-up to crisis.

Problems facing the Stocks

Prior to exploitation, North Sea fish stocks, like those of Canada, would have been of a size almost incomprehensible now. In recent times, stocks of cod and haddock in the North Sea, and Irish Sea cod, have been far smaller and under growing pressure since the 1960s[32] (Figure 7-9). During the late 1960s, the North Sea cod spawning stock was at its largest, around 250,000 tonnes – a level far smaller than the 1-1.5 million tonne spawning stock of Canadian cod in the same period (see Figure 2). During the 1960s landings grew, and they reached a peak of 350,000 tonnes in 1973, made up of spawning and immature fish. This was unsustainable, and the stock begun to decline, as did the catches.

Like cod, spawning stocks of North Sea haddock reached their highest level in recent times in the early 1970s, when they were estimated to be around 900,000 tonnes (Figure 8). This period, the so-called "gadoid outburst", was an exceptional time of bumper years of young cod-fish (cod, haddock, whiting and saithe). But with landings of haddock in 1970 being in excess of 900,000 tonnes, they were rapidly fished out. Although the spawning stock and landings subsequently showed considerable variation, by the late 1990s the spawning stock of North Sea haddock was little more than 100,000 tonnes.

Certainly by 1990[33], those working with environmental groups were expressing concerns, pointing out that the spawning stock of cod had reached the lowest level in 30 years, the number of immature fish caught was increasing; and the landings in 1987 were the lowest for 20 years. Similarly, the proportion of haddock being caught were the largest then on record. Few cod or haddock survived beyond one or two years of spawning age, when under natural circumstances they would live and breed for one or two decades.

During the 1990s the stock assessments carried out by ICES expressed increasing concern about the level of catches[34]. The UK government, whose fishing industry was most dependent on North Sea cod and haddock, was warned in 1993 by its own advisers that levels of exploitation of cod were unsustainable[35]. A further significant development came in 1996 when Robin Cook, a senior scientist advising the UK government, warned that fishing mortality on North Sea cod was so high "that stock collapse is likely". The exploitation rate for cod was "not sustainable and… a reduction of fishing mortality of at least 30 per cent is required". He said that it was

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[32] CEC (2000). *Green Paper on the future of the Common Fisheries Policy. European Commission COM (2001)135. Annex: Report on the state of the resources and their expected development.* Brussels**.**

[33] See e.g. MacGarvin, M. (1990). *The North Sea.* (First volume in the series Greenpeace: The Seas of Europe) 144 pages. Collins and Brown, London.

[34] Compilation of ICES advise from 1990 communicated by R Cook, 19/9/01

[35] Shepherd, J. (1993). *Why Fisheries need to be managed, and why technical conservation measures on their own are not enough.* Laboratory Leaflet 71. Ministry of Agriculture, Fisheries and Food Directorate of Fisheries Research. http://www.cefas.co.uk/publications/lableaflet71.pdf Accessed 10th September 2001.

almost certainly necessary to reduce fishing effort by more than this as there would "inevitably be compensating behaviour by the fleet". However, the rate of decline was sufficient to require "decisive action"[36].

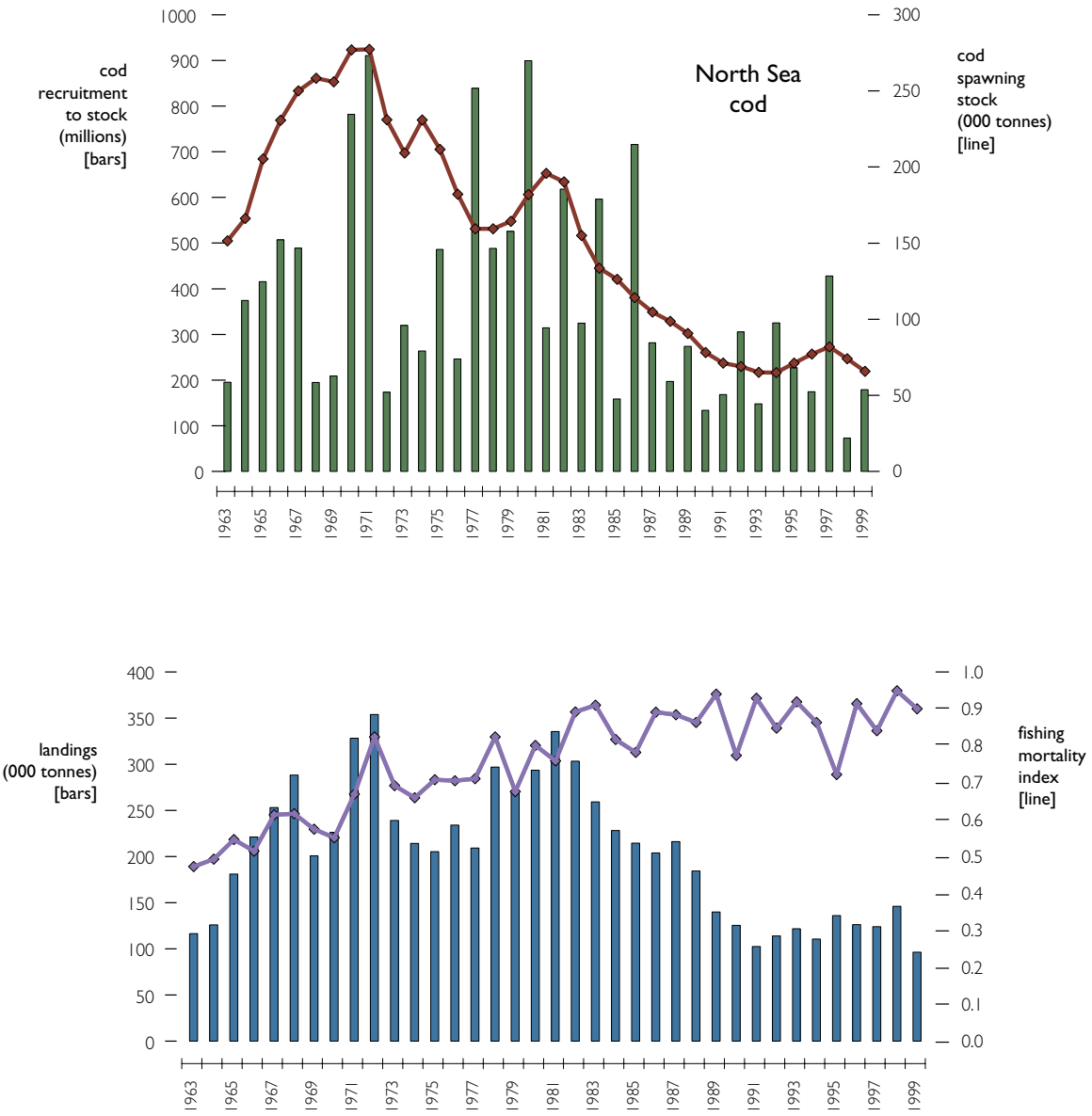

Figure 7. North Sea cod spawning stock and recruitment (top graph), and landings and fishing mortality (bottom graph). Source: Reference 32.

For North Sea haddock, Cook stated that, according to the scientific analysis, the risk of collapse was *"moderate"*. Nevertheless *"it would be dangerous to conclude that the present*

[36] Cook, R. (1996). *North Sea Roundfish.* Marine Laboratory, Aberdeen. Published in Fisken og Havet 1. Seminar Report: The Precautionary Approach to North Sea Fisheries Management. Havforskngsinstituttet, Bergen / Norwegian Ministry of Fisheries, Oslo. See also Cook, R.M., A. Sinclair, G. Stefansson, (1997). *Potential collapse of North Sea cod stocks.* Nature, 385:521-522.

fishing mortality rate is 'safe' particularly in view of the low levels that the stock has been observed to reach". Assessed in isolation from other stocks, a 20% reduction in mortality would be *"desirable"* and *"prudent"*. However, as haddock swims with cod (and saithe, a late maturing cod-fish which, along with cod, *"is much more vulnerable to heavy exploitation"*), a greater reduction of mortality to protected the more vulnerable species *"seems sensible"*, and was likely to improve the *"spawning stock and yield for haddock"*.

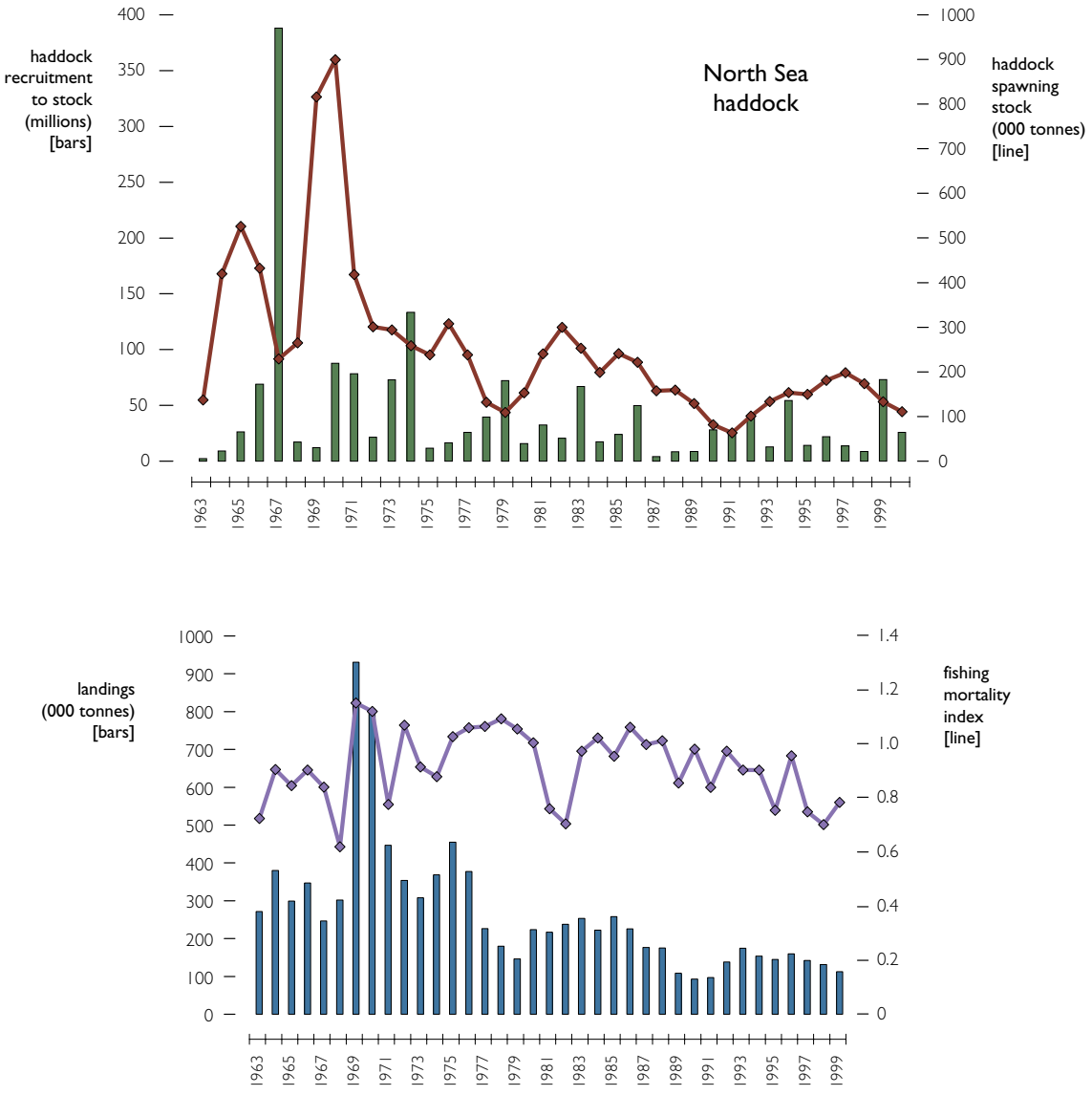

Figure 8. North Sea haddock spawning stock and recruitment (top graph), and landings and fishing mortality (bottom graph). Source: Reference 32.

The prospects for a recovery programme for cod received a fillip in 1997 when, in relative terms, there was an exceptional year of recruitment of young "1996 year class" cod to the stock. The political circumstances for taking advantage of this chance event did not exist, however, and these were again rapidly fished out.

By 2000 the ICES formal analysis of the state of the North Sea, Skaggerak and eastern English Channel stocks – the consensus opinion of the senior government scientists from those countries fishing cod – was couched in exceptional and unambiguous terms[37]. The 1997 year class of young cod was "the poorest on record" while those in 1998 and 1999 were also "relatively poor". The 2000 year class was "not large". The "relatively strong 1996 year class appears to have been heavily exploited and its potential to contribute further to significant recovery of the stock is low". Fishing mortality had been underestimated, and stock size over-estimated. ICES drew an explicit parallel with the Canadian collapse, noting that the same error there had resulted in "over-optimistic decisions on the management of these stocks before they collapsed".

Since 1987 the levels of cod catches agreed by governments had generally exceeded the advice of ICES, although in practice it had generally proved impossible to catch even the level advised by the body. Clearly the stock was in deep trouble. Most remarkable of all, the ICES assessment contained a table of the options for catches facing ministers, shading out those inconsistent with the (technically very specific) precautionary approach that had been agreed by governments. The only option left unshaded was for zero catches. Their formal advice was that "fishing mortality on cod should be reduced to the lowest possible level in 2001. A rebuilding plan should be developed and implemented in order to rebuild SSB [spawning stock biomass]… The necessary reduction in fishing mortality on cod cannot be achieved by a reduction in TAC [Total allowable catches] alone. The rebuilding plan should include provisions to deter directed fishing, reduce by-catches of cod in fisheries for other species to the lowest practical levels, and to deter discarding and mis-reporting of cod in all fisheries".

In the case of North Sea haddock, ICES advised that the stock was "outside safe biological limits" below which there is judged to be an increasing risk of stock collapse. To restore the stock, ICES judged that landings in 2001 should be no more than 60,000 tonnes, with an additional 123,000 tonnes allowed for discards[38]. However, this advice was "extremely sensitive" to the survival and growth of the strong 1999 year class. This had "already suffered substantial mortality due to discarding in 2000", and "the indications are that fish of the 1999 year class are relatively slow growing. Discard rates… are very high and may even increase when the growth rate is reduced. Any measures which reduce the capture of juveniles will assist in the recovery of the stock and make better use of the resource". ICES also recalled how the "1996 year class of cod presented an opportunity to rebuild the SSB of North Sea cod. However, that potential was not realised, due to discarding and excessive fishing mortality. Without effective management, the strong 1999 year class of haddock may suffer the same fate and if so, would only increase the SSB for a short while". It also tabulated how, in recent years, the total allowable catches for North Sea haddock had exceeded its advice, and that the level of catches exceeded those agreed by governments.

While attention has focused on North Sea cod, the smaller Irish Sea cod stock was also in deep trouble. Landings had increased from around 6,000 to 10,000 tonnes between the late 1960s and

[37] ICES (2000). ACFM Section 3.5.2. *Cod in Sub-area IV (North Sea), Division VIId (English Channel) and Division IIIa (Skagerrak).* ICES, Copenhagen.

[38] ICES (2000). ACFM Section 3.5.3. *Haddock in Sub-area IV (North Sea) and Division IIIa (Skagerrak – Kattegat).* ICES, Copenhagen.

late 1980s. But in the 1990s, the spawning stock declined dramatically and catches fell. In the late 1990s, governments had consistently set catch limits above the level advised by ICES, but between 1996 and 1999 it proved impossible to catch the ceiling it proposed. The stock was outside safe biological limits, according to ICES, and the prospects for good recruitment appeared to be low. It recommended a zero catch for 2000. In the event, a catch of 2,100 tonnes was set, accompanied by a recovery plan. This closed fisheries in the spawning areas between mid-February and the end of April. ICES recommended that these measures should be repeated in 2001, action strengthened to protect juveniles, and reduce cod by-catch and discarding from other fisheries. There was evidence that the closure in 2000 had displaced fishing effort to the west of Scotland, and ICES further recommended that future measures should "not encourage a diversion of effort to other vulnerable stocks".

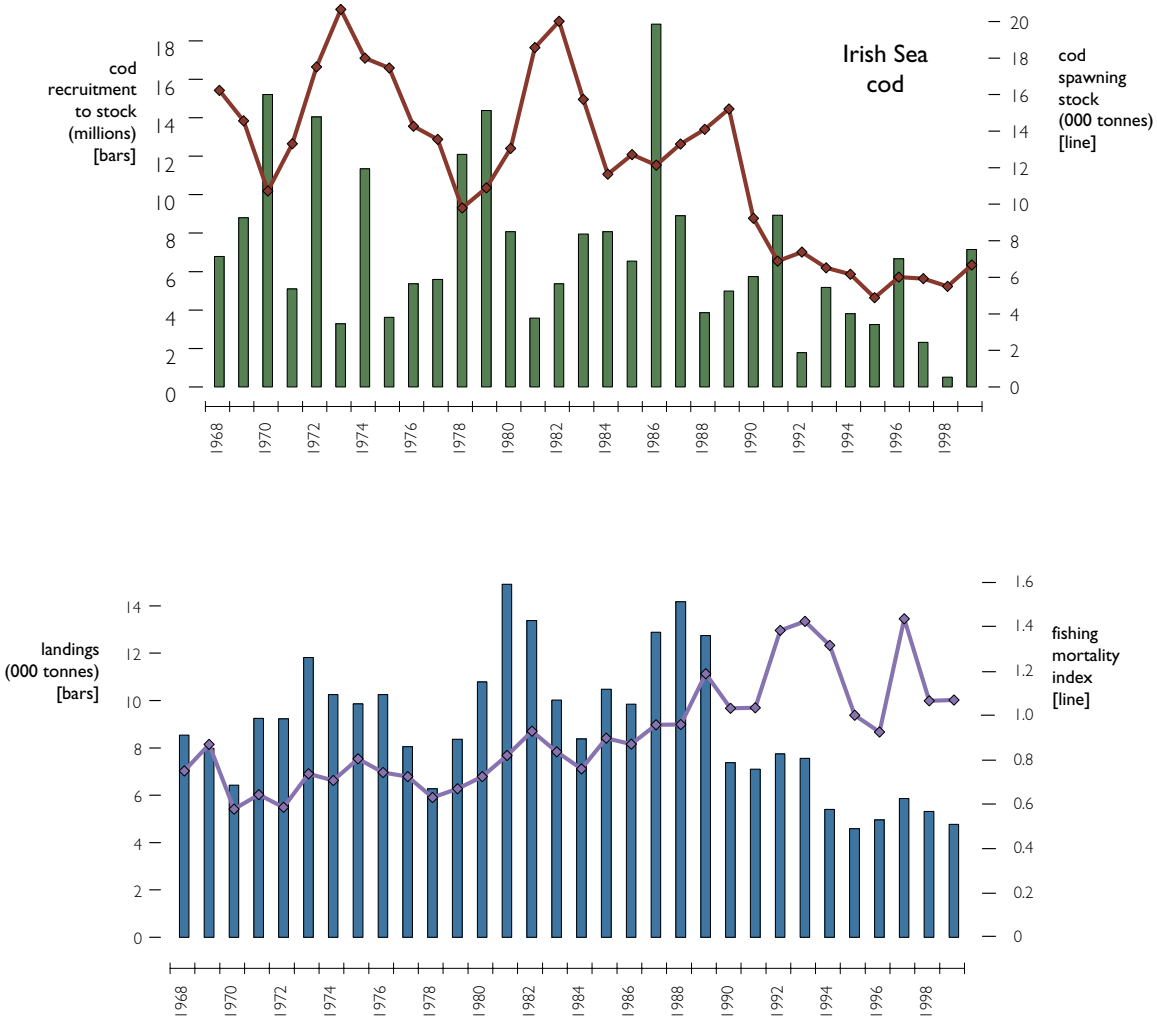

Figure 9. Irish Sea cod spawning stock and recruitment (top graph), and landings and fishing mortality (bottom graph). Source: Reference 32.

Finally, while attention has naturally been focused on those species on the brink of collapse, the fact should not be overlooked that many other stocks are in trouble, with some below "safe biological limits" such as North Sea whiting, saithe and plaice. It is also important to recall that the concept of success has come to be judged by whether or not stocks are maintained above such safe biological limits. The rational requirement is for stocks to be restored to far higher levels, providing much greater sustainable economic, social and environmental benefits. The

adequacy of the response of governments to this scientific advice, including recovery programmes for North Sea and Irish Sea cod, is assessed in the later sections of this report. But first it turns to the other side of the equation – the build-up to crisis in the fishing industry.

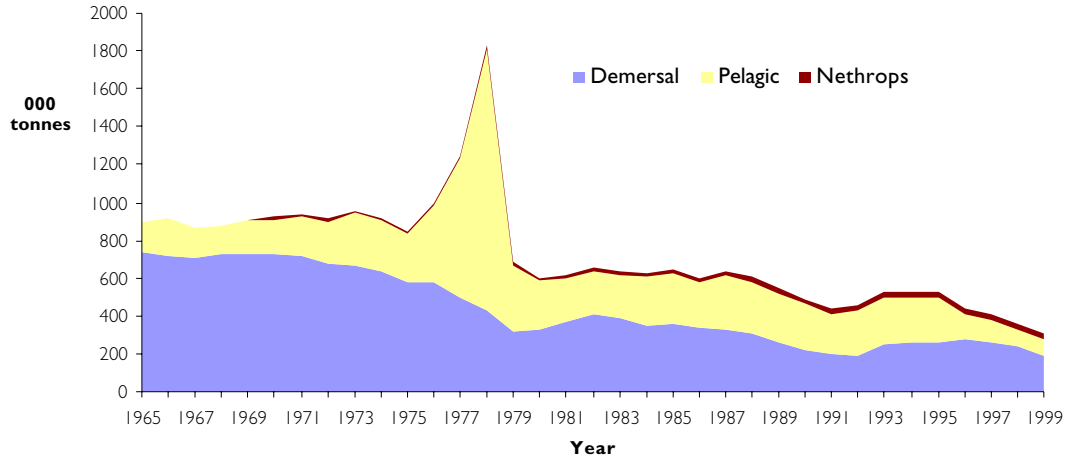

Figure 10. UK Fleet landings of major species into England, Wales, Scotland and Northern Ireland from 1965 to 1999. The peak is due to the inclusion of sprats, for a brief period, as an individual "important species" in the official statistics. Because total landings of all species are inconsistently reported, it was not possible to clarify whether this was due to a real increase in landings or a statistical artefact. Source: MAFF / DEFRA / Scottish Office /Scottish Executive Sea Fisheries Statistics annual publications, 1969-1999.See Excel worksheet for additional information.

Problems facing the industry

The decline of landings of major species by UK vessels into UK ports is shown in Figure 10. At the outset it is important to be aware that these statistics are exactly what they say they are. There are also foreign landings into UK ports, and some UK vessels – those targeting herring, for example – will land significant amounts in other countries, where they can get better prices. Also, in the 1960s and 1970s, significant landings, for example of cod, would have come from distant waters. Finally, because of differences over time concerning how total catches were reported in government statistical compilations, the values here have been summed for only the most important species, where reporting was more consistent. Nevertheless the data presented here are of the most important part of UK landings, and the most important part of UK fleet catches.

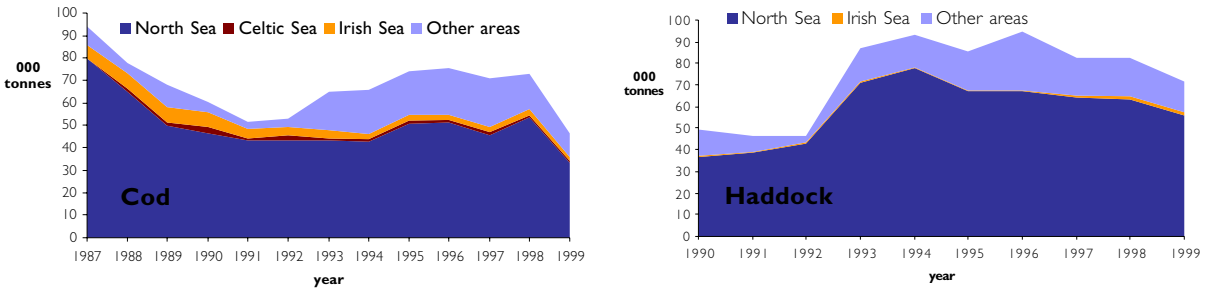

Figure 11 Amount and sources of cod and haddock landed in UK ports by UK fleets. Source: as Figure 10.

Between the mid 1960s and 1999, total landings of major demersal (whitefish such as cod, haddock, whiting, plaice etc., known as "groundfish" in Canadian parlance) and pelagic (herring, mackerel and sprats) species declined from around 900,000 tonnes to 400,000 tonnes. The recent dependency of the UK industry on catches of cod and haddock from seas adjacent to the UK is apparent from Figure 11, and this is also true of many other species.

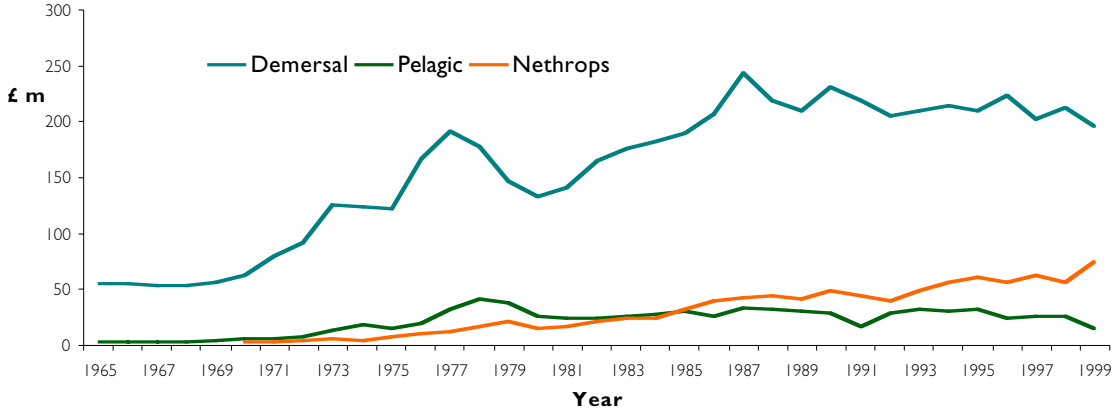

Figure 12. Value of UK catches of major species landed by the UK fleet 1965–1999, unadjusted for inflation. Source: see Figure 10

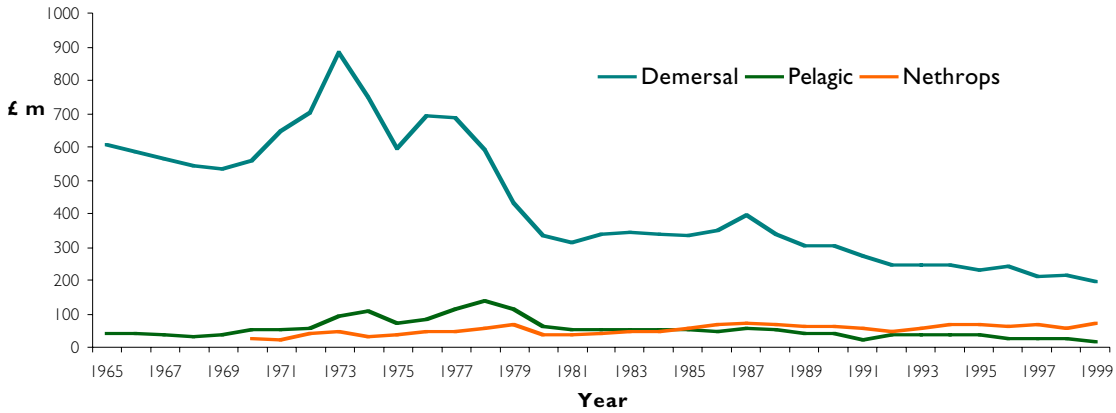

Figure 13. Value of UK catches of major species landed by the UK fleet, adjusted for general inflation using the Retail Prices Index headline rate. Figures expressed in 1999 equivalent values. Source: see Figure 10, RPI values from UK National Statistics Office Statbase.

Of course, it is not so much the volume of landed fish that is important to the industry, but its value. At first sight (Figure 12) it appears that the industry has not done so badly, despite the fall in catches. This is how the information is presented in official statistics. But inflation has been a hugely important factor. When corrected, using the Retail Price Index (RPI) headline inflation rate, the scale of the contraction of the industry becomes apparent (Figure 13). By this measure, and in 1999 prices, catches of the major demersal species peaked in 1973 at £880m compared with just £196m in 1999. In 1999 herring and mackerel landings were worth £14.7m, with an additional £74.3m coming from nephrops (Dublin prawn or scampi). The total value of all demersal species landed in 1999 (ie not just the major species) was £280m, that from all pelagics was £17.8m, and that for all shellfish was £166m. In 2000, the total value of demersal

catches was £302.3m, that from pelagics £78.5m, with £169.5m coming from shellfish, making a total of £550.3m[39].

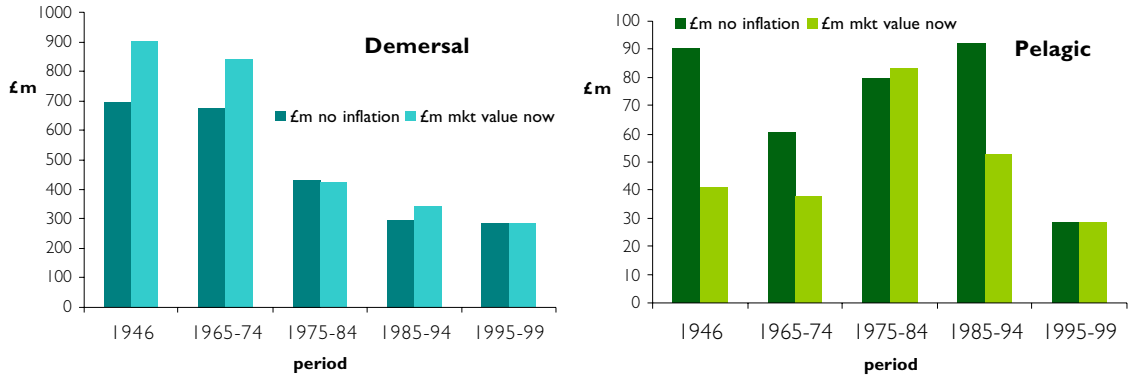

Figure 14. Total major demersal and pelagic landings for 1945, and mean annual values for periods between 1965 and 1999. The left hand column shows prices obtained at the time, adjusted to constant 1999 values using the RPI headline indicator rate of inflation. The right hand column shows the value if the tonnage of fish landed could be sold at 1999 market prices. Source: see Figure 13.

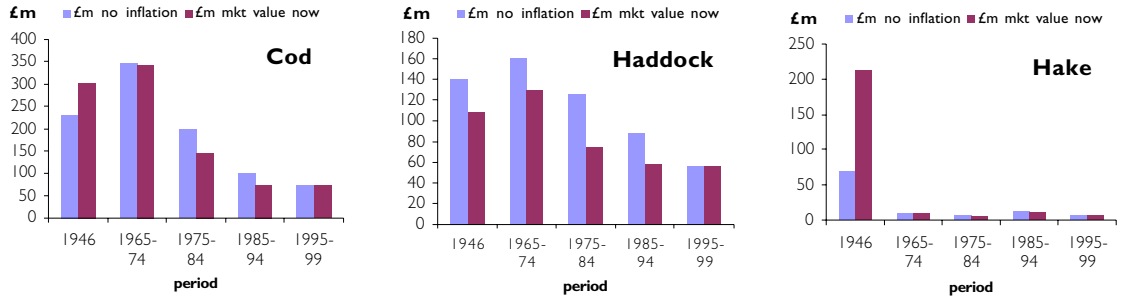

Figure 15 Landings of cod, haddock and hake by UK vessels into UK ports, adjusted for RPI inflation (normalised to 1999 values), and for value if the fish landed could be sold at 1999 market prices. Source: See Figure 13. Equivalent data for other species included in Excel worksheet.

Indeed, the adjustment of historic catches for inflation may be an underestimate of the potential value forgone. The RPI is just a general measure of inflation, but the value of fish can actually outstrip the RPI. Another way of assessing the potential value is to gauge what historic landings would have been worth if they could be sold at current prices. This is done in Figure 14, where both the RPI corrected values, and the value of landings expressed in terms of 1999 market value, are shown. While the RPI corrected total value of major demersal landings between 1965 and 1974 (and for the single year of 1945) was just under £700m, when the volume of landings during the various periods are calculated in terms of 1999 market value, the sum is closer to £900m. This is illustrated most remarkably for hake, which is now a far more valuable species than it was in the 1940s (Figure 15).

Of course, there are caveats and complications with such comparisons. Many areas where fish were caught in the post-war years are no longer available to the UK fleet. On the other hand a

[39] DEFRA (2001) *UK Sea Fisheries Statistics.* Downloadable via http://www.defra.gov.uk/fish/fishstat/default.htm Accessed 4th September 2001.

successful recovery programme could significantly boost the stocks available adjacent to the UK, even compared with historic levels. Current market prices are high because stocks are scarce; whether these values could be at least partially realised following a successful recovery programme might partially depend on the rather gloomy prospect that the rest of the world's fish stocks remain in deep trouble. Nevertheless, it does suggest the potential for a considerable return from investing in recovery programmes, and certainly drives home the current plight of the industry.

	WoS Nephrops Trawl	North Sea Nephrops Trawl	NS & WoS Trawl <24m,<300kW	NS & WoS Trawl <24m,>300kW	NS & WoS Trawl >24m
Total Income					
1998	£202,119	£128,094	£312,217	£494,291	£698,773
2001	£177,095	£108,982	£171,574	£249,627	£355,310
%	-12%	-15%	-45%	-49%	-49%
Fuel & Oil					
1998	£23,385	£17,801	£22,666	£40,445	£55,001
2001	£52,510	£38,761	£50,063	£92,093	£120,889
%	125%	118%	121%	128%	120%
Fishing Expenses					
1998	£46,990	£38,950	£94,808	£136,958	£205,466
2001	£74,785	£58,317	£98,948	£155,302	£222,633
%	59%	50%	4%	13%	8%
Crew Share					
1998	£55,293	£42,518	£117,591	£180,560	£229,205
2001	£51,155	£25,332	£36,313	£47,163	£66,339
%	-7%	-40%	-69%	-74%	-71%
Owner Expenses					
1998	£30,322	£40,755	£66,858	£126,804	£141,164
2001	£35,495	£42,072	£69,609	£136,017	£141,219
%	17%	3%	4%	7%	0%
Total Expenses					
1998	£132,606	£122,224	£279,257	£444,323	£575,835
2001	£161,435	£125,721	£204,870	£338,481	£430,191
%	22%	3%	-27%	-24%	-25%
Balance					
1998	£69,513	£5,871	£32,960	£49,968	£122,938
2001	£15,660	-£16,740	-£33,296	-£88,854	-£74,881
%	-77%	-385%	-201%	-278%	-161%

Table 1: Comparison between 1998 and 2001 of the total income, expenditure and balance of Scottish West of Scotland (WoS) and North Sea (NS) fleets targeting nethrops and demersal stocks. Source: Reference 41.

The fall in real value of landings means that the state of the fishing industry has been progressively worsening. The situation in many important sectors is now critical. One of the background documents to the European Commission's 2001 Green Paper on the future of the Common Fisheries Policy includes a review of the current state of profitability of EU fishing fleets[40]. Generally it found that the industry was in poor health. Of the two UK fleets reviewed, the average net profit on invested capital between 1994 and 1999 for the Scottish nephrops sector was 12.4 per cent, one of the better performers in the EU. But for the Scottish demersal fleet, targeting species such as haddock and cod, it was a dismal and unsustainable 0.1 per cent. Since that time, increases in the price of fuel have caused a further deterioration, as the report

[40] Commission of the European Community (2001). Green Paper on the Future of the Common Fisheries Policy. COM(2001) 135. Volume 2b *Report on the Economic and Social Situation of Coastal Regions.* Brussels**.** Available at http://www.intrafish.com/laws-and-regulations/greenCFP/volume2b_en.pdf Accessed 10th September 2001.

makes clear. The extent of that deterioration is apparent in a detailed analysis undertaken by SeaFish, comparing the typical returns from the Scottish nephrops and demersal vessels in 1998 with that projected for 2001 (Table 1)[41]. With the exception of nephrops trawlers operating west of Scotland, all vessels are predicted to make heavy losses in 2001, ranging from ca. £17,000 to £90,000. With all other costs largely uncontrollable, it is the crew payments and the return to the vessel owner that take the strain, with the cash available to pay the crew often down to just 30 per cent of what was available in 1998.

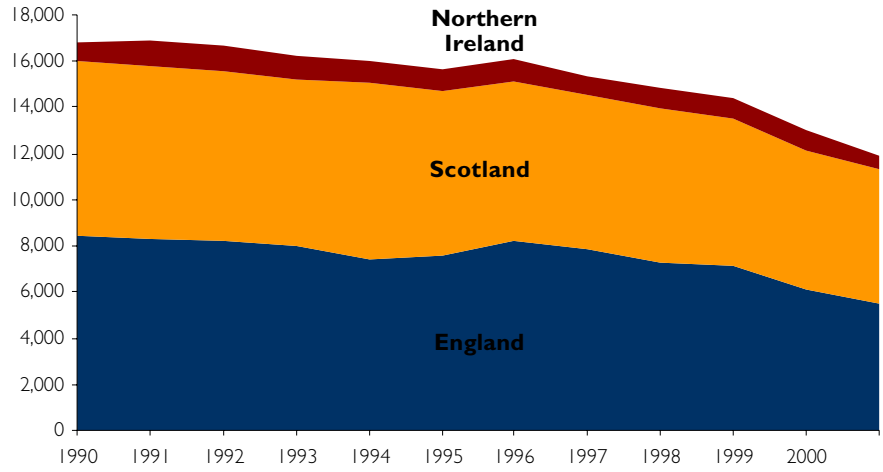

Figure 16. Full- and part-time employment in fisheries, 1990–2000. Source: See Figure 10. Comparative data for all EU countries included in Excel worksheet.

Unsurprisingly, given the state of profitability of the industry, employment has taken a sharp turn for the worse during the 1990s. In 1938 and 1948, full-time fishing employment in the UK was just under 40,000. There was then a subsequent period of decline, to 17,480 jobs in 1970, followed by a period of relative stability, with employment in 1990 being 16,872. But since 1990 there has been an accelerating decline in jobs, to just 11,899 full-time jobs (along with 3,222 part-time jobs) in 2000 (Figure 16).

The other important element to the story is the scale of aid to the industry. Tables 2 and 3 show an OECD global assessment of the total value of aid, in its various forms, to fisheries in 1996–97[42]. According to this assessment, Canada – in the wake of its disaster – spent US$509m in 1996, or an astonishing 46 per cent of the values of all landings. In 1997 it spent $405m, 25 per cent of the landings value. The UK spent $115m (€9 m, £74 m[43]), 12 per cent of the landed value in 1996, and $128m (€113 m, £78 m[44]) in 1997, 13 per cent of the value of the catch, compared with the EU average of 12 per cent and 15 per cent respectively.

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[41] Seafish Industry Authority's Costs and Earnings Model, cited in SFF (2001) *Stock Recovery Programme: Restraining Effort and Reducing Capacity.* Aberdeen. http://www.sff.co.uk/Rebuild.html Accessed 10th September 2001.

[42] Source: 1996; OECD (2000). *Transition to Responsible Fisheries: Economic and Policy Implications.* Table 2 p. 132 http://www.oecd.org/publications/e-book/5300021e.pdf For 1997; cited in reference 40.

[43] Average monthly 1996 exchange rate

[44] Average monthly 1997 exchange rate

1996, $ million	Direct Payments (A)	Cost Reducing Transfers (B)	General Services (C)	TOTAL Transfers (D)	Total landed Value (TL)	(A+B)/TL immediate aid as % catch	D/TL all aid as % catch value
Australia		5	5	10	156	3%	7%
Canada	**217**	**11**	**97**	**326**	**709**	**32%**	**46%**
EU	**274**	**254**	**472**	**1,000**	**6,061**	**9%**	**17%**
Belgium		*2*	*1*	*3*	*66*	*3%*	*5%*
Denmark	*8*		*47*	*55*	*336*	*2%*	*16%*
Finland	*2*	*1*	*15*	*19*	*20*	*16%*	*94%*
France	*16*	*10*	*76*	*102*	*554*	*5%*	*18%*
Germany	*12*	*3*	*39*	*54*	*134*	*11%*	*40%*
Greece	*9*		*28*	*36*	*282*	*3%*	*13%*
Ireland	*3*	*2*	*67*	*88*	*148*	*3%*	*59%*
Italy	*65*	*3*	*36*	*103*	*1,240*	*5%*	*8%*
Netherlands	*3*		*24*	*26*	*320*	*1%*	*8%*
Portugal	*23*		*24*	*47*	*230*	*10%*	*21%*
Spain	*110*	*26*	*28*	*164*	*2,003*	*7%*	*8%*
Sweden	*12*		*28*	*40*	*90*	*13%*	*44%*
UK	***10***	***4***	***60***	***74***	***635***	***2%***	***12%***
Iceland		14	12	26	561	3%	5%
Japan	18	17	2,005	2,040	9,038	0%	23%
Korea	13	42	181	236	3,156	2%	7%
Mexico			9	9	651	0%	1%
New Zealand			10	10	304	0%	3%
Norway	4	38	69	111	860	5%	13%
Poland			5	5	138	0%	4%
Turkey			18	19	136	0%	14%
United States	11	124	426	561	2,333	6%	24%
OECD TOTAL	**449**	**474**	**3,109**	**4,032**	**24,350**	**4%**	**17%**

Table 2 Comparison of national aid to fisheries made available in 1996 in US$ million. Total for EU includes payments to external countries for EU access. Source: Reference 42. (NB equivalent values in euro and pounds Stirling are included in the Excel worksheet)

However, as for the raw data on catch values, this only tells part of the story. For a better insight, it is also important to know how large the industry is in each country; in other words, how much was spent per fisher. Indeed, the health of the stocks and related expenditure has an importance to nations and people beyond that of the industry – for example its value to tourism, for recreational fisheries, for protection of the environment, and indeed the general willingness of the nation to see fishing continue. So it is also illuminating to determine how much is spent per capita in each country, while the proportion of GDP spent is also of interest. Of course, how far such expenditure assists meeting these wider objectives depends on how it is spent, so distinguishing between types of expenditure (such as decommissioning versus fleet modernisation) is also important.

This is done in Tables 4 and 5, which show total expenditure in each EU fishing nation on the most important package of joint EU and national aid, the Financial Instrument for Fisheries Guidance (FIFG). The Excel spreadsheet accompanying this report includes further details and analysis.

1997, $ million	Direct Payments (A)	Cost Reducing Transfers (B)	General Services (C)	TOTAL Transfers (D)	Total landed Value (TL)	(A+B)/TL immediate aid as % catch	D/TL all aid as % catch value
Australia	5	7	11	23	259	5%	9%
Canada	**252**	**18**	**135**	**405**	**1,621**	**17%**	**25%**
EU	**366**	**358**	**710**	**1,434**	**9,324**	**8%**	**15%**
Belgium		*3*	*2*	*5*	*99*	*3%*	*5%*
Denmark	*20*		*62*	*82*	*521*	*4%*	*16%*
Finland	*3*	*2*	*21*	*26*	*29*	*17%*	*90%*
France	*22*	*14*	*104*	*140*	*756*	*5%*	*19%*
Germany	*8*	*3*	*52*	*63*	*194*	*6%*	*32%*
Greece	*12*		*38*	*50*	*387*	*3%*	*13%*
Ireland	*5*	*3*	*96*	*104*	*220*	*4%*	*47%*
Italy	*24*	*5*	*64*	*93*	*1,749*	*2%*	*5%*
Netherlands	*4*		*32*	*36*	*466*	*1%*	*8%*
Portugal	*32*		*34*	*66*	*319*	*10%*	*21%*
Spain	*205*	*81*	*59*	*345*	*3443*	*8%*	*10%*
Sweden	*9*		*45*	*54*	*129*	*7%*	*42%*
UK	***23***	***4***	***101***	***128***	***1,012***	***3%***	***13%***
Iceland		18	18	36	877	2%	4%
Japan	25	22	2,899	2,946	14,117	0%	21%
Korea	30	59	253	342	4,929	2%	7%
Mexico			17	17	1,017	0%	2%
New Zealand			17	17	475	0%	4%
Norway	3	62	98	163	1,343	5%	12%
Poland			8	8	215	0%	4%
Turkey		1	27	28	212	0%	13%
United States	21	194	662	877	3,644	6%	24%
OECD TOTAL	**702**	**740**	**4,56**	**6298**	**38,032**	**4%**	**17%**

Table 3 Comparison of national aid to fisheries made available in 1997, in US$ million. Source: Reference 40. (NB equivalent values in euro and pounds Stirling are included in the Excel worksheet)

Between 1994 and 1999, annual FIFG expenditure in the UK on both the fishing and processing industries amounted to €22.84m (£16.65m[45]), €14.49m (£10.57m) from the EU and €8.34m (£6.08m) from the UK government. In terms of expenditure on individuals (and apportioning the different types of expenditure appropriately between the fishing and processing industries), in the UK in 1997-98 this amounted to €850 (£619) per fisherman, and €322 (£235) per processing industry worker. This is among the lowest in the EU. Significantly higher spenders per fisherman included Belgium (€3,532), Denmark (€2,386), Germany (€3,524), the Netherlands (€1,222), Spain (€2,486) and Sweden (€2,135). So far as the whole population is concerned, in the UK €0.26 (19 pence) was spent on our behalf per person on FIFG aid to the fishing industry, and €0.10 (7 pence) on the processing industry. This is also among the lowest proportions in the EU.

[45] Based on the average monthly exchange rate of £0.73 to €1.0 between 1994–1999.

€ euro	Total funds, €m			per fisher, €			per capita, €			% of GDP		
	EU	National	TOTAL	EU	National	TOTAL	EU	National	TOTAL	EU	National	TOTAL
Belgium	1.23	1.40	2.63	1,650	1,880	3,530	0.11	0.13	0.24	0.0006	0.0006	0.0012
Denmark	9.38	5.80	15.2	1,470	912	2,390	1.77	1.10	2.87	0.0060	0.0037	0.0097
Finland	1.31	1.08	2.39	445	366	810	0.25	0.21	0.46	0.0011	0.0009	0.0021
France	7.91	7.73	15.6	413	404	817	0.13	0.13	0.27	0.0006	0.0006	0.0012
Germany	7.37	2.96	10.3	2,510	1,010	3,524	0.09	0.04	0.13	0.0004	0.0002	0.0005
Greece	7.62	2.44	10.0	185	59.1	244	0.72	0.23	0.96	0.0070	0.0022	0.0093
Ireland	3.69	1.91	5.60	587	304	892	1.00	0.52	1.51	0.0049	0.0025	0.0074
Italy	15.3	11.5	26.7	353	265	617	0.27	0.20	0.46	0.0014	0.0011	0.0025
Netherlands	1.31	1.83	3.14	509	713	1,220	0.08	0.12	0.20	0.0004	0.0005	0.0009
Portugal	17.6	4.61	22.2	648	169	817	1.77	0.46	2.23	0.0105	0.0027	0.0132
Spain	118	51.7	170	1,723	757	2,490	3.00	1.31	4.31	0.0227	0.0099	0.0326
Sweden	2.96	1.59	4.55	1,390	746	2,130	0.33	0.18	0.51	0.0014	0.0007	0.0021
UK	**8.65**	**6.52**	**15.2**	**484**	**365**	**850**	**0.15**	**0.11**	**0.26**	**0.0007**	**0.0005**	**0.0012**
EU - 15	**202**	**101**	**303**	**840**	**419**	**1,260**	**0.54**	**0.27**	**0.81**	**0.0026**	**0.0013**	**0.0040**

Table 4 EU and national expenditure on FIFG, 1994–1999, expressed in euros, rounded to three significant figures. Source: Reference 40. Breakdown into types of expenditure (decommissioning, renewal and modernisation etc) and data on processing industry (included in Excel worksheet).

The other element is purely national aid to the fishing industry. In 1997, according to an EU submission to the OECD[46], the UK spent the third highest amount, €11.3m (£7.7m or £436 per fisherman[47]), after Italy (€20.6m) and France (€15.4m). However, the largest portion of this is defined as "Regional Aid", for which much lower values, or none at all, are given by other countries. It is not clear what proportion of the UK figure can really be considered as aid relevant to the fishing industry. If this is excluded, then UK national aid was a more modest €4.8m (£3.3m; £186 per fisherman, or 6 pence per capita), spent primarily on port infrastructure.

Again, it is important to emphasise that this is an assessment of how much was spent, not how wisely or sustainably it was spent. Fisheries Minister Elliot Morley has pointed out the absurdity of "what happened in this country in the 1980s, when an awful lot of money was made available to the United Kingdom fleet for modernisation and building. That led to significantly increased capacity, and we then spent the 1990s using public money to decommission the fleet"[48]. As described in last year's WWF report *Choose or Lose*, in future it is important that expenditure be justified as the best option in terms of concrete returns in economic, social and environmental benefits. But for something that is so important culturally to the UK, and for which we have considerable international responsibility, we are not spending a great deal on ensuring that both fish and fisheries have a sustainable future. Providing that there are guarantees that the money would be wisely spent, it is likely that many would be willing to invest more.

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[46] OECD (2000) *Transition to Responsible Fisheries. Government Financial Transfers and Resource Sustainability: Case Studies*. European Community. Table 9. OECD Directorate for Food, Agriculture and Fisheries Fisheries Committee. AGR/FI(2000)10/FINAL. Paris. http://www.oecd.org/agr/fish/doc/fi0010fe.pdf Accessed 10th September 2001.

[47] Based on the average monthly exchange rate of £0.69 to €1.0 during 1997.

[48] Hansard 25.6.01. Column 487. *Adjournment Debate*. http://www.parliament.the-stationery-office.co.uk/pa/cm200102/cmhansrd/cm010625/debtext/10625-33.htm#10625-33_spmin0

£ Stirling	Total funds, £m			per fisher, £			per capita, £			% of GDP		
	EU	National	TOTAL	EU	National	TOTAL	EU	National	TOTAL	EU	National	TOTAL
Belgium	0.90	1.02	1.92	1,200	1,370	2,580	0.08	0.09	0.18	0.0004	0.0005	0.0009
Denmark	6.84	4.23	11.07	1,070	665	1,740	1.29	0.80	2.09	0.0044	0.0027	0.0071
Finland	0.96	0.79	1.74	324	267	591	0.19	0.15	0.34	0.0008	0.0007	0.0015
France	5.77	5.64	11.40	301	295	596	0.10	0.10	0.19	0.0004	0.0004	0.0009
Germany	5.38	2.16	7.53	1,830	736	2,570	0.07	0.03	0.09	0.0003	0.0001	0.0004
Greece	5.55	1.78	7.33	135	43.1	178	0.53	0.17	0.70	0.0051	0.0016	0.0068
Ireland	2.69	1.39	4.08	428	223	650	0.73	0.38	1.10	0.0035	0.0018	0.0054
Italy	11.1	8.36	19.5	257	193	450	0.19	0.15	0.34	0.0011	0.0008	0.0018
Netherlands	0.96	1.34	2.29	371	520	891	0.06	0.09	0.15	0.0003	0.0004	0.0007
Portugal	12.8	3.36	16.2	472	123	596	1.29	0.34	1.63	0.0076	0.0020	0.0096
Spain	86.1	37.7	124	1,260	552	1,810	2.19	0.96	3.15	0.0165	0.0072	0.0238
Sweden	2.16	1.16	3.32	1,013	544	1,557	0.24	0.13	0.37	0.0010	0.0005	0.0015
UK	**6.31**	**4.75**	**11.1**	**353**	**266**	**619**	**0.11**	**0.08**	**0.19**	**0.0005**	**0.0004**	**0.0009**
EU - 15	**148**	**73. 7**	**221**	**612**	**306**	**918**	**0.39**	**0.20**	**0.59**	**0.0019**	**0.0010**	**0.0029**

Table 5 EU and national expenditure on FIFG, 1994–1999, expressed in pounds Stirling, using the average monthly exchange rate 1994–1999. Source: see Table 4.

NORTH SEA COD RECOVERY PLAN

The North Sea cod recovery plan, as outlined by EU governments in December 2000, could be considered remarkable. As in the Irish Sea the year before, it was agreed to ban all fishing specifically for cod over what are believed to be the main spawning grounds for 10 weeks, from mid-February 2001 to the end of April. The initial reaction ranged from enthusiasm to reluctant acceptance. However, as time passed and the details of the plan were filled in, the limits to what governments are prepared to do, and the consequences of such decisions, have become more apparent. In particular, it would have been prudent to pay attention to the experience from the introduction of the Irish Sea cod recovery programme, which resulted in increased pressure on other species, and on other areas[49].

ICES' advice regarding cessation of cod fishing was not followed. Rather, the total quota was cut to 48,600 tonnes, a reduction of 40 per cent from the 81,000 tonnes in 2000. Then, midway through 2001, further decisions were announced, mainly concerning technical measures such as the mesh size of the nets. Until the end of 2002[50], the use of 110mm diamond mesh nets, with a 90mm square mesh panel, would continue in the EU area of the North Sea, "as we have at the present time". From then on it would be increased to120mm. The nephrops fishery mesh size was set at 80mm, "which is already applied in many cases". There were similar decisions on a number of more specialised fisheries. Norway disagreed, believing that this would be

[49] House of Commons Select Committee on Agriculture (2001). *Memorandum submitted by the Chief Executive, Anglo-North Irish Fish Producers Organisation Ltd. Select Committee on Agriculture Appendices to the Minutes of Evidence. Appendix 12.* http://www.parliament.the-stationery-office.co.uk/pa/cm200001/cmselect/cmagric/404/10509a14.htm Accessed 10th September 2001.

[50] Reference 48

ineffective, so 135mm mesh nets will be required for cod fisheries in the Norwegian part of the North Sea. As Elliot Morley pointed out,[48] "there is, of course, logic in going for a bigger mesh size in a cod fishery. Indeed, in the cod fisheries in Norwegian, Faroese and Icelandic waters, a 135mm mesh size is not unusual". In effect, the mesh size adopted for the rescue plan is smaller than that considered necessary elsewhere for stocks not under imminent threat of collapse.

Fishing targeted at haddock, whiting, plaice, sole, lemon sole, skate, ray, angler or monkfish could be landed providing there was no more than 25 per cent of cod in the catch. It was argued[48] that while "25 per cent is tough for the industry, it is certainly more manageable than the 15 per cent originally suggested" by the European Commission. Otherwise, the argument ran, catches with over 15 per cent by-catch would still be caught, but be dumped at sea, serving no useful purpose.

ON THE BRINK

The reason why governments did not follow their scientists' advice is couched in terms of economics. But it is economics based on the shortest of time frames, and with no willingness to address the need for short-term investment to achieve longer term gains. If attitudes remain unchanged, this may well have sealed the fate of North Sea cod, and in turn the remaining demersal stocks, unless we are very, very lucky.

The principal reason, as explained by Elliot Morley[51], for not following stricter measures is that the fishery in the North Sea contains mixed species. Greater restrictions on cod by-catch will have a major impact on other fisheries, such as for whiting. But this only makes sense with hand-to-mouth economics. In 2000 whiting was worth £614 per tonne. Cod was worth £1,364 per tonne. This huge difference in value is long-term: the scarcity of cod might have had a minor positive effect on cod prices, but the larger cod available as the result of a successful recovery programme might also be expected to attract a premium. Nobody in their right mind would justify sacrificing a cod fishery for a whiting fishery on the basis of economics, other than under the most desperate pressure of short-term needs.

Of course, it is true that the fishing industry lobbied hard for such limitations on the recovery programme. This should come as no surprise. Regardless of how we got into this situation, it is evident from both the Commission's Green Paper and the SeaFish analysis presented earlier, that fishermen now have little means at their disposal to get the pressure off the stocks to the degree required. Prior experience means that few have any faith that governments will provide more than token assistance, so they press for as much as they can for short-term survival. As already described, depending on whether one includes just the major species or all demersal fish, the income from the UK catch is currently £200m-300m. Convincing recovery programmes will mean a substantial shortfall of this for a number of years, even though one might reasonably expect subsequent landings to be at least double current values.

Obviously there are costs that are not incurred when the boats are in harbour, such as fuel. Even so, there is a huge gap between the costs of taking significant pressure off the stocks, and the funding available. As elaborated earlier, the annual UK FIFG budget was around £16.7m, or

[51] Reference 48

some £600 per fisherman. National UK funding was largely irrelevant, mainly going to infrastructural projects such as port improvements. Moreover, the FIFG budget for 2000-2006 was fixed back in 1999. The amounts available are difficult to assess fully, because part of the funding now comes out of generic regional aid, but it is safe to say that they do not amount to a substantial change in funding levels[52].

According to the Scottish Fishermen's Federation (SFF), the European Commission had in fact proposed that money should be made available for "effort limitation", such as short-term lay-ups[53]. But national governments who would foot the bill rejected this option outright as too expensive. Separately, WWF Scotland had argued that such short-term payments might be justifiable, providing they were tied into a recovery programme, where the stream of predicted short-term costs and medium- to long-term benefits (economic, social and environmental) were fully and credibly worked out for all to see. However, there can be problems with effort limitation such as "technological creep" (the use of more efficient equipment that increases catches during the reduced time at sea). The cost of temporary effort limitation can also be more expensive and less effective compared with permanent decommissioning.

The failure to set the cod recovery programme in a wider context, coupled with lack of funding, has also had the entirely predictable effect of diverting pressure onto other stocks. This resulted in enormous pressure being placed, for example, on haddock, and was exactly the result ICES feared regarding pressure on the 1999 year class of immature haddock. The nature of the Scottish Executive's response to the voluntary cessation of fishing of these stocks by the Scottish fleet, coupled with a demand for compensation for tie-ups, was unfortunate. The tie-ups, rather than being rejected, could and should have been evaluated as part of a wider package.

The SFF has accepted that action is required to address the major over-capacity in the Scottish demersal fleet[53]. It is clear that the industry cannot fund the retirement of vessels from its own resources. But the SFF also accepts that "it would be unreasonable to expect taxpayers to make the substantial investment required without some reassurance that the scheme is likely to succeed and that measures are in place to prevent a recurrence of the current crisis". It has argued that a permanent reduction of capacity by 20 per cent is required to bring landings from the recovered stock up from the projected 139 tonnes demersal landings per vessel in 2001 to 211 tonnes in 1998, the last fully profitable year.

The SFF has also argued that a further 20 per cent reduction will be required while the stocks are recovering over a projected five-year period. But, it said, this capacity would be needed when the stocks had recovered, so this should be met by temporary lay-ups. The SFF concluded

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[52] Total EU FIFG expenditure between 2000 and 2006 is set at €1.1 billion plus an uncertain amount from general Objective 1 structural funding (Berlin European Council 24 and 25 March 1999. *Presidency Conclusions*. Europarl website at http://www.europarl.eu.int/summits/ber1_en.htm#E Accessed 9th September 2001). Total FIFG expenditure over 1994–99 was €2.7 billion. FIFG funds available to the UK during 2000–2006, outside Objective 1 funding, amounts to €121 million, compared to €137 million in total over 1994–1996.

[53] SFF (2001) *Stock Recovery Programme: Restraining Effort and Reducing Capacity.* Aberdeen. http://www.sff.co.uk/Rebuild.html Accessed 10th September 2001.

that the total cost would be £95m. Of this, the permanent decommissioning would cost between £22.5m and £32.5m in the first year (depending on whether scrapping of the vessels was required), of which £7.2m would be for temporary lay-ups. Some £13m would be required over the following four years for temporary lay-ups, leaving the industry to persuade financiers to facilitate the transfer of £50m of quota allocations. In the event, the Scottish Executive has agreed to provide up to £25m for permanent decommissioning in 2001, although it will not cover the cost of scrapping vessels. The response in future years is undecided, although the Scottish Executive is consulting on the future of the Scottish fishing industry[54].

In Northern Ireland, many fishermen have reluctantly accepted that decommissioning will occur[55]. Yet although the government indicated in 1999 that funds would be available for decommissioning, in May 2001 they had still to materialise. Moreover, the Anglo-North Irish Fish Producers' Organisation (ANIFPO) had wanted the quota entitlement of decommissioned vessels to go to the producer organisations so that these could be withheld to the benefit of other fishermen and the stock. Although originally assured by the Department of Agriculture and Rural Development (DARD) that this would happen, it has since been announced that these will be available on the open market. DARD apparently backtracked because "protocol must be observed between the various other UK Fisheries Departments" which did not favour this option. As a result, ANIFPO now fears that pressure will not be reduced on the stocks, and that the quota entitlement will be sold abroad and lost from Northern Ireland.

South of the Scottish border, a much lower amount – £6m – of additional funding has been found for decommissioning by raiding other budgets. This was denounced as "pathetic" by the National Federation of Fishermen's Organisations (NFFO), the umbrella group representing English and Welsh fishermen[56]. Regarding the problem of displaced fishing effort, the UK government has responded that this "is partly in the hands of the industry itself, which well knows the impact of diversion and concentration on particular areas"[57]. The difficulty comes where the industry needs similar restraint from its creditors. Nevertheless, Elliot Morley has also said[48] "My mind is not closed to any approach, but I remain to be persuaded that the large sum of money that would be involved in a tie-up represents good value for money, or that the policy would have the effect we want. It might be regarded as a short-term solution to a long-term problem. There are several points on which we still need to be convinced".

The onus now rests on all interest groups to justify, in robust detail, not just only short-term tie-ups may be appropriate, but also how wider short-term expenditure may be justifiable in terms of longer and broader environmental, social and economic benefits. But this is not just something for those outside government to respond to: governments also have to demonstrate why their short-term and narrow approach will not simply waste tax-payers' money, but will also make stock collapse – with all its costs and opportunity forgone – inevitable.

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[54] Scottish Executive. Scottish Fish Industry Project. http://www.scotland.gov.uk/fisheries/sfip/default.asp Accessed 9th September 2001.

[55] Reference 49

[56] NFFO (2001) Press Release: Fishermen "Unimpressed" By Government Aid Package 3rd April. http://www.nffo.org.uk/press/press01/pr010403.html Accessed 10 September 2001.

[57] Reference 48.

Stepping back from the Brink

The parallels between the events leading to the Canadian cod collapse, and those in European seas, are startling (See Figure 17). In Europe we have already passed through the Canadian stages of initial warnings from outsiders, followed by warnings from government advisory scientists, expert consensus, and the rejection of decisive action on the basis of immediate cost.

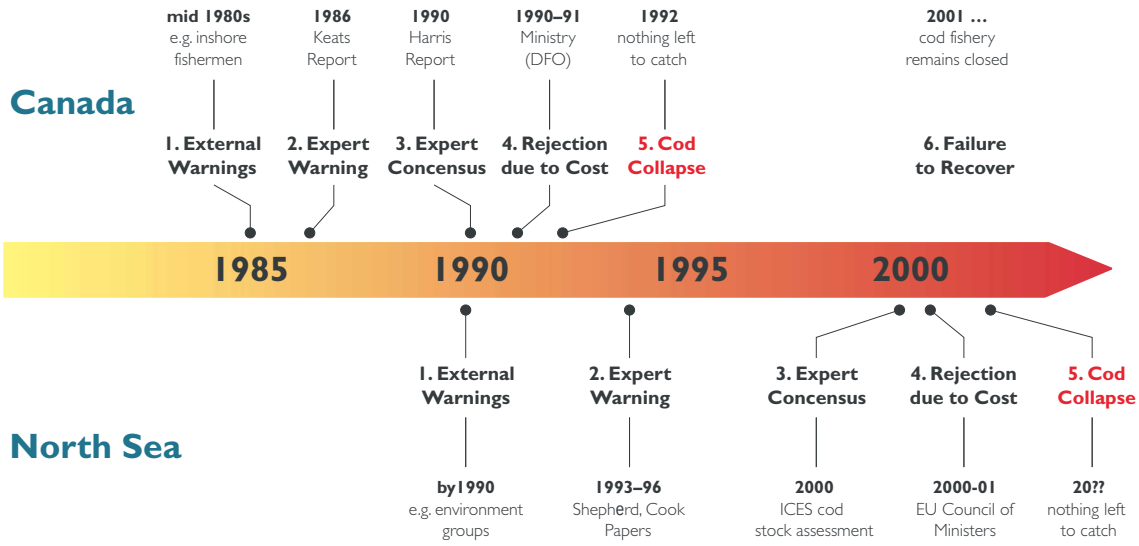

Figure 17. Five steps to disaster. Sequence of events in the Canadian cod collapse and in the North Sea. All but the final Canadian step to collapse have been passed in the North Sea.

There are no easy options left. The restrictions on spawning areas have been discussed in terms of "until 2002", with discussions then about whether further restrictions might be necessary. But the probability is that this is no period of short-term belt tightening, to be muddled through by individual fishermen as best they can. The North Sea cod spawning stock, and the likely levels of recruitment, are already lower than those of the late 1990s (See Figure 7).

Even if the maximum restraint is shown, we are now in the hands of fate. Unless we are very lucky, we are waiting for the chance event of possibly two good breeding years to bring us up to the very poor stock levels of the mid-1990s that inspired Robin Cook's comments on the need for "drastic action". That will still leave us well short of the levels where the highest economic returns, commensurate with environmental goals, can be reached. The probability is that we are in for the long haul of at least five, and perhaps ten, years. Governments need to plan how they are going to assist the survival of the industry during this period. As the SFF has pointed out, placing the emphasis on technical measures alone, as the recovery programme does, is insufficient[53].

Indeed, the reason why the concentration on technical measures such as mesh size is extremely rash has already been outlined in a remarkably prescient document written by John Shepherd. This was published by MAFF in 1993, when he was Deputy Director of Fisheries Research, responsible for advising the UK government on stock management. It is still available on the

CEFAS website[58], and is essential if provocative reading. It is short and lucidly expressed, yet touches on more issues that can be covered here. But the title, *Why Fisheries need to be managed, and why technical conservation measures on their own are not enough*, speaks for itself: it directly challenges the current Recovery Plan strategy, based on 110mm mesh size, perhaps increasing to 120mm after 2002.

Shepherd states that, because cod are late maturing fish, with mesh sizes of ca. 100mm "it is little short of miraculous that the stock continues to produce sufficient young recruits to replenish itself from such a reduced spawning population". That miracle has evidently come to an end. He continues: "Even with a 120mm mesh size, modest increases of fishing effort above the current (1990) level [effort subsequently grew] could push the stock below the minimum tolerable level [elsewhere explained as "only above which does the stock have a better than even chance of producing enough recruits to maintain its size"]. To be reasonably sure of staying at a sustainable (although small) level of stock size, even if effort were to increase substantially, would require a mesh size of at least 140mm, To reach the desirable level of stock size [20 per cent of the unfished stock, Shepherd states, is "widely considered to be a minimum desirable level", cf. the Canadian section of this report] at current levels of fishing would require a mesh size of at least 160mm, and to be confident of reaching the desirable level even if fishing effort was to increase substantially would require a mesh size of 180mm or more". He was not actually advocating that this should be done: rather, he was making the point that technical measures have to be accompanied by effort limitation. "This means catching fewer fish, and thus, at least in the short term, probably a reduction in fishermen's earnings. The uncomfortable fact is that a conservation measure which avoids any short-term loss is most unlikely to be effective. If it doesn't hurt, it won't work".

Unfortunately the levels in 2001 are so low that it is not a matter of the measures hurting: without short-term investment the fishery faces annihilation. Shepherd also made the point that closure of spawning areas could be helpful, but only if steps were taken to prevent effort and catches from simply being displaced elsewhere, or to later in the year – both of which have happened. Even if catches of juvenile fish outside the spawning areas were prevented, Shepherd continued, if the spawning stock were caught later in the year, the net result would be a one-off boost to the spawning stock. "In the first year of implementation, more fish get a chance to spawn than they did previously. After that, however, the numbers being caught between one spawning season and the next would be just the same, and the effect is at best just the same as delaying the age of capture by a few months".

Ultimately, governments make the decisions and have the responsibility to manage. The buck stops with them, regardless of the pressures. Whoever else might be to blame, governments were clearly warned at an early stage; they are in some degree culpable. By acting in the early 1990s they could have achieved recovery at far lower cost than now. The UK fishing industry argues that it was prepared to decommission at that time, but that the funding was not made available due to Treasury pressure.

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[58] Shepherd, J. (1993). *Why Fisheries need to be managed, and why technical conservation measures on their own are not enough.* Laboratory Leaflet 71. Ministry of Agriculture, Fisheries and Food Directorate of Fisheries Research. http://www.cefas.co.uk/publications/lableaflet71.pdf Accessed 10th September 2001.

As described in the Canadian section, it will be important to learn from North American experience (and indeed elsewhere). It will also be necessary to diversify the way in which we deal with the biological and ecological aspects. This includes taking greater account of ecological knowledge as well as stock modelling, and making use of combinations of management measures that are less sensitive to error, such as no-take zones. Shore-side, it will also be important to have an open mind to alternative approaches, for example to the allocation of user rights and different management practices.

However, the absolute show-stopper for the moment is the availability of finance. The reportedly leaked letter[59] from ex-Agriculture Minister Nick Brown to the Chief Secretary of the Treasury, that he was "holding the line" against decommissioning grants, if correct, is disturbing An essential step is for the Treasury to make it clear that, if the economic case can be made robustly, and the structures put in place to make sure that measures agreed are implemented, then it will support investment in a recovery programme and provide the additional funds. The industry is now so small – its output is some 0.1 per cent of UK GDP – that the short-term investment is affordable. Given past experience, a natural if uninformed prejudice against further spending is understandable. If so, it must change. Without additional funds, it is difficult to see how DEFRA, in particular, can contribute in any meaningful way to a strategic resolution of this crisis. As government involvement is clearly essential, this would represent an extraordinary state of affairs.

A deliberately understated assessment can be made of the historical value of just the major demersal species, corrected for inflation (Figure 13) and allowing for the loss of distant water fisheries. This suggests that a successful recovery programme could be worth at least £400m a year, compared with the £196m realised in 1999. There is also the added value from fish processing, not to mention indirect positive effects such as on tourism and recreational sea fishing. By contrast, if policy remains unchanged, we not only forgo these benefits, but we also face the real prospect of the loss of North Sea cod, which alone was still worth £40m in 1999. Many other economic, social and environmental costs will come with such a collapse. As the Canadian experience shows, these can be substantial and long-term.

We can be certain that in 20 years time when people buy fish, dine in restaurants, holiday in small seaside ports, dive in a Marine Protected Area or spend time sea angling, they would be astonished to hear that there was ever a debate about whether such a recovery programme represented good value for money. For an island nation, fishing still has an importance to many that far outweighs its economic value, or the number of people that it employs – something apparent even from the current extent of media coverage. John Donne's "any man's death diminishes me, because I am involved in Mankind" is apposite. The death of large sections of the industry, and the damage that it will inevitably cause to the natural environment in its final struggle to survive, will diminish us all.

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[59] Salmond, A (2001) Hansard, 2 May 2001, Col 254H, citing the Glasgow Herald 27 March 2001. http://www.parliament.the-stationery-office.co.uk/pa/cm200001/cmhansrd/cm010502/halltext/10502h02.htm#10502h02_spmin0 Accessed 10th September 2001.

RECOMMENDATIONS

• We must act immediately. By the time the Council of Fisheries Ministers meets in December 2001, the Treasury should commit itself to investing in strategic recovery programmes that involve all diminishing fish stocks in the regional seas around the UK.

• Investment in the fishing industry should be allocated after the economic case has been made robustly, and the structures put in place to make sure that measures agreed are implemented. All policies should be subject to a full environmental, economic and social cost benefit analysis.

• The goal of the recovery programmes must be to restore stocks to levels that provide the optimum economic and environmental benefits, for the long-term success of coastal fishing communities and the health of the seas.