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Discussion Paper

Factory Freezer Trawlers

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Canada

DISCUSSION PAPER ON FACTORY FREEZER TRAWLERS

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DISCUSSION PAPER ON FACTORY FREEZER TRAWLER

SECTION A - PURPOSE

The purpose of this discussion paper is to assess the implications of introducing factory freezer trawler technology into the Atlantic coast offshore groundfish fishery. There have been several requests in recent years for factory freezer trawlers but the current policy does not permit their use. At present the offshore fishery uses wetfish trawlers and some freezer trawlers.

Wetfish trawlers are offshore vessels in excess of 100 feet in length that preserve their catch for up to two weeks by storage in crushed ice. Freezer trawlers are larger vessels capable of freezing the catch on board; they are usually equipped with vertical plate freezers and heading and gutting machines, fish are typically headed and gutted, then frozen in large blocks to be thawed and filleted later. Factory freezer trawlers are similar to freezer trawlers, except that the catch is usually filleted at sea and either frozen in final product form or frozen in block to be reprocessed on shore.

Rather than focussing on the details of any individual application, this paper outlines the key economic and social considerations related to the introduction of Factory freezer Trawlers as a broad policy issue and concludes with an analysis of the various options open to Government.

SECTION B - BACKGROUND

1. Current Structure of the Offshore Fleet:

The total catch of the Atlantic groundfish fishery was 720,000 t in 1984. The fishery is historically divided into inshore and offshore. The inshore/midshore fleet (vessels less than 100 feet) generally operates independent of fish processors. This fleet of approximately 16,000 vessels is primarily seasonal and accounted for 60% of groundfish landings in 1984.

The Atlantic offshore groundfish fleet includes 145 active licenced trawlers. Fishery Products International and National Sea Products own 114 trawlers while the remaining 31 trawlers are operated by smaller companies. These vessels harvested 300,000 t of groundfish in 1984, on a year round basis. The offshore fleet is primarily based on the east and south coast of Newfoundland, Cape Breton and south western Nova Scotia. The offshore fleet works on a basis of enterprise allocation, i.e. each company is assigned its own quotas. Approximately 10,900 individuals are employed directly in the offshore groundfish fishery; 2,100 trawlermen and 8,800 plant workers.

Much of the current offshore fleet is aged and will require replacement within the next 5 years. Financial difficulties in recent years have severely inhibited the ability of companies to replace vessels. This postponement has forced many companies into a situation where they must acquire vessels now. Because of this and changing markets some companies have examined more closely other alternatives such as used factory freezer trawlers which are available for reasonable prices.

2. History of Factory Freezer Trawlers:

Factory freezer trawlers first appeared in the Atlantic coast groundfish fishery in the early 1950's. Britain first employed this technology to access distant water fisheries. By the mid-1960's, most European nations fishing the North Atlantic were using factory freezer trawlers. With open access to all fish stocks beyond the 12 mile limit, this technology enabled the European countries to exploit these groundfish stocks. It was a choice dictated by the distance to the fishing grounds. In contrast, the Canadian offshore fleet developed on the basis of wetfish trawlers operating in close proximity of fishing grounds.

Foreign factory trawlers continued to fish without reserve until Canada, the U.S. and other countries imposed 200 mile exclusive fishing zones. Foreign allocations within the Canadian zone have decreased since 1977 while the Canadian share has increased. Some foreign countries continue to use factory trawlers to harvest their allocations within the Canadian zone.

3. Canadian Experience with Factory Freezer Trawlers:

The Atlantic Canadian experience with factory freezer trawler technology is limited to the experimental six month charter of the "Friedrich Busse", a West German vessel, in 1977. The charter was co-sponsored by National Sea Products and the Department of Fisheries and Oceans. While the experiment was successful in many ways, the viability of such technology in the domestic fishery was unclear. The vessel was used primarily to harvest non-traditional species (mainly squid) as well as minor amounts of traditional species. The lack of certainty of availability of the squid resource and the untested performance of the vessel on a 12 month basis cast doubt in the minds of some observers. Following the experiment, National Sea Products requested a licence for a factory freezer trawler. The request was rejected primarily because the company requested an additional groundfish licence to operate the vessel. The additional licence would have aggravated the over capacity problems of the offshore fleet and contributed to even more uneconomic harvesting of the groundfish resource.

On the Pacific coast, in 1979, a factory freezer trawler, the Callistratus, owned by B.C. fishermen was licenced to fish for underutilized species, specifically hake and dogfish. The vessel produced headed and gutted hake as well as blocks of frozen hake fillets. From the outset of operations, financial difficulties were encountered as the markets for hake products became depressed. The vessel was finally tied up in 1981 due to the absence of markets for its product. The vessel was purchased by DFO and is being converted to operate as a research vessel.

4. Current Policy on Processing at Sea:

As a result of the 1977 experiment and subsequent request by National Sea, the Minister of Fisheries and Oceans began to examine more closely the factory trawler technology. This examination resulted in a policy statement on the use of factory freezer trawlers in the Atlantic fishery. The statement announced in 1979 by then Minister, the Honorable James McGrath was part of a much broader licencing and replacement policy which was aimed at controlling the size and improving the viability of the offshore fleet. The policy had four major parts:

i) no new additions to the fleet,

ii) maximum replacement of offshore vessels greater than 100' LOA was set at 125% of existing length, this was later amended in June, 1981 and restricted to foot-for-foot replacement.

iii) no replacement vessel in excess of 200 feet, and

iv) no factory freezer trawlers in the traditional groundfish sector.

One of the main concerns was the loss of onshore employment. This policy was subsequently reaffirmed by later Ministers.

5. Current Applications for Factory Freezer Trawler licences:

Earlier it was noted that following the 1977 experiment with the "Friedrich Busse", National Sea Products made application for a factory freezer trawler. This application was turned down primarily because the company was requesting an additional groundfish licence. There have been other requests since then. In 1979, Ocean Harvesters of Newfoundland in conjunction with Nordsee of West Germany requested the use of a factory trawler. The application was part of a comprehensive plan for superport facilities and a fish distribution centre for Harbour Grace. The request for a factory freezer trawler was not pursued when other major aspects of the plan failed to materialize. In 1981, National Sea again made application to utilize factory trawler technology. This time the company did not seek an additional licence, but rather was willing to relinquish two or three wetfish trawler licences. The application was again turned down (December 1981) on the basis that enterprise allocations were being introduced in 1982. It was felt that a decision on the use of factory trawlers without knowledge of the full effect of enterprise allocations would be premature.

Last year, Ocean Harvesters and Nordsee again made application to use factory freezer trawlers. This time the request centered around the Resource Short Plant Program. After thorough discussions with industry about the future of RSP Program, the request was rejected in favour of other approaches to managing this program. The main concern with the Nordsee proposal was that it would not achieve the maximum utilization of shore-based processing capacity intended by the RSPP.

More recently, the Torngat Coop has given notice to DFO that it intends to make an application to acquire a factory freezer trawler under a joint venture arrangement with a Greenland company with financing to be arranged through the Native Development Fund. They propose a fishing plan of northern shrimp and northern groundfish. While the company has a northern shrimp allocation, it has no enterprise allocation for groundfish.

6. Deregulation of the Fisheries:

The present government was elected on a platform which includes reducing regulatory complexity facing Canadian industry. Policies are to allow as much freedom and flexibility as possible for business to achieve international competitiveness. In February, 1985, the

Ministerial Task Force of Program Review under the chairmanship of the Deputy Prime Minister, the Honourable Erik Nielsen, established a Joint Study Team on Regulatory Programs. One of the "sub" teams was assigned to review the fisheries sector and report on its observations and advice concerning the efficiency, appropriateness and adequacy of the regulatory system as a whole. One of the facets of their study is the impact of regulations on the introduction of technology. The team will be reporting shortly.

7. <u>Task Force on Atlantic Fisheries:</u>

The issue of factory freezer trawlers centres very much on the harvesting of northern cod. The Task Force on Atlantic Fisheries (1983) did not examine the issue of factory freezer technology in detail except to indicate as part of their recommendations on Enterprise Allocations that a company should be free to choose the appropriate technologies to harvest its quotas. The Task Force did examine alternate technologies to harvest, in particular, Northern Cod. An overriding concern noted throughout the Report of the Task Force was the excess processing capacity that existed in the groundfish sector, particularly among seasonal plants. Thus rather than looking at technologies such as Factory Trawlers which would in essence displace more onshore processing capacity, the Task Force instead focussed on initiatives to more fully utilize this excess capacity on a year round basis and, as such, reduce the seasonality of the groundfish industry.

The first option involved using offshore vessels to harvest a portion of the Northern Cod stock for delivery to resource short plants during the winter months. The second option was freezing fish from the "glut" periods for processing during "shoulder" spring and fall periods. The third option involved the use of Scandinavian type longliners to harvest Northern Cod. This later technology centered around the development of a middle distance fleet (between the inshore seasonal vessels and the large offshore trawlers). It was also based on the premise that those adjacent to the resource should have the first right of access.

The Resource Short Plant Program has been implemented. As a result, a significant number of plants are now achieving an improved utilization of capacity during the traditional "off season" months.

The latter two options have been tried on an experimental basis. Both have been evaluated but the results are, as yet, inconclusive.

SECTION C - POLICY ISSUES

1. Enterprise Allocations:

Prior to 1982, the offshore groundfish fleet fished competitively on a quota basis. Over a period of years, this led to considerable imbalance between the catch and the fleet's capacity to harvest fish. As a result, unit costs increased and considerable regulation was imposed to ensure an orderly harvesting of the resource. It led as well to an uneven distribution of landings throughout the year and hampered companies in planning their activities.

In 1982, enterprise allocations were introduced. This essentially gave each company a share of the overall groundfish resource (based mainly on past performance). This has given companies the basis, over the long term, to match their harvesting and processing capacities and to coordinate both to projected market requirements. The result has been that companies have left a considerable portion of their enterprise allocation in the water in each of the past three years. The allocations have been unutilized not because of harvesting difficulties, but because of market requirements, of restructuring activities within these companies and a strike of trawlermen in Newfoundland. This is, however, the concept within which enterprise allocations are designed to work; companies make their own decisions on when, where and how much of particular species to harvest. This concept also implies that companies be free to determine the size and configuration of their fleets and the appropriate technologies for harvesting their quotas.

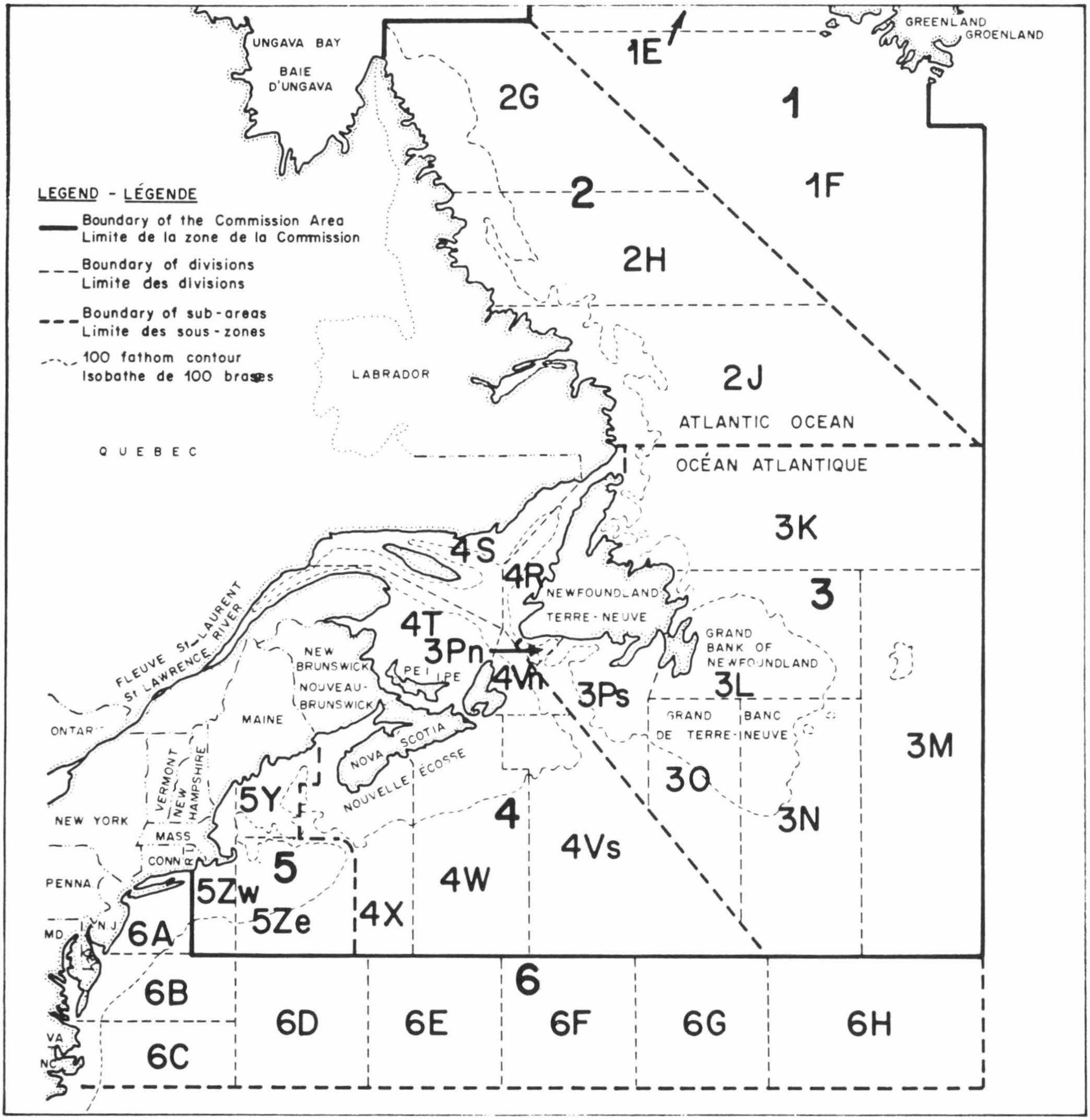
The introduction of enterprise allocations has had an impact on the quality of offshore landings. Prior to enterprise allocations, the northern cod fishery posed unique problems for the offshore companies. High catch rates coupled with competitive fishing resulted in glut and poor quality landings leading to early closure of the fishery. With the introduction of EA's, and other measures such as boxing at sea, these problems have been lessened.

It should be noted that a Federal Provincial Working Group is currently working on refinements to the EA system which will be based on companies leasing quotas and will include a mechanism or formula for the periodic redistribution of underutilized quota among offshore companies.

2. Resource Forecast for Key Stocks:

As outlined in the previous section Enterprise Allocations were in 1982, introduced to the offshore fleet in which has allowed offshore firms to better plan their harvesting, processing and long term investment activities. However, the success of the EA system, and the potential introduction of Factory Freezer Trawlers will depend very much on the continued stability and productivity of certain key stocks.

i) 2 J & 3 KL cod
ii) 2 & 3 K redfish
iii) 3 LN redfish
iv) 3 O redfish
v) 2 & 3 KL Greenland halibut.



CARTE (UNIQUEMENT POUR FINS D'ILLUSTRATION) INDIQUANT LES DIVISIONS DE LA COMMISSION INTERNATIONALE DES PÊCHERIES DE L'ATLANTIQUE NORD-OUEST ET LA LIMITE DES ZONES DE PÊCHES CANADIENNES SUR LA COTE DE L'ATLANTIQUE.

MAP (FOR ILLUSTRATION ONLY) SHOWING ICNAF (INTERNATIONAL COMMISSION FOR THE NORTH-WEST ATLANTIC FISHERIES) DIVISIONS AND LIMIT OF CANADIAN FISHERIES ZONES ON THE ATLANTIC COAST.

The 2 J & 3 KL cod is the largest cod stock on the Atlantic coast and is the mainstay of both the Newfoundland inshore fishery and the offshore groundfish sector. This cod stock is fully utilized by all offshore companies with enterprise allocations. In recent years, inshore catches have been a little less than the reserved allowance. Lower annual stock recruitment and growth rates, in recent years, have retarded the growth of this stock and TAC's have not increased to the extent forecast in the late 1970's and early 1980's. The most recent scientific evidence suggests that the current TAC (266,000 t) could remain unchanged for several more years and the originally forecast 1990 TAC of 336,000t may be optimistic.

2 GHJ & 3 K, 3 LN, 3 O Redfish stocks are in reasonably good health and TAC's are expected to remain at 35,000 t for 2 & 3 K, 20,000 t for 3 LN and 25,000 t for 3 O. However, 2 & 3K may be more fragile than other stocks and thus may not withstand a great deal of more effort. Exploitation levels for each stock has been low in recent years. The 2 & 3 K redfish stock has been, in various areas, infested with parasites. This has made fishing unprofitable. Last year, some companies were successful in locating pockets of parasite free redfish.

The 2 & 3 KL Greenland halibut (turbot) stocks are in a very healthy state. Recruitment has been strong and catch levels have been low. The northern stock, NAFO area 2 is an offshore fishery (both domestic and foreign) while the southern fishery (3 KL) is shared between domestic inshore gillnet and offshore fleets. Recent scientific studies suggest that a TAC of 75,000 t would be conservative and could be split between 2 GH (20,000 t) and 2 J & 3 KL (55,000 t). It is worth noting that Canada currently allocates 11,500 t of Greenland halibut to foreign countries and reserves a portion of the domestic allocation for the resource short plant program.

3. Comparative Analysis of Harvesting and Processing Costs

In Appendix A comparative economic analysis of the various technologies available to the offshore fleet shows that factory freezer trawlers are at least as profitable as either wetfish or freezer trawlers. Under the assumptions used in the analysis regarding stocks, area of operation, catch rates and product mix factory freezer trawlers are shown to operate more profitably than the other two technologies.

It should be noted, however, that while the operating costs of wetfish and freezer trawlers are well documented, the costs of operating FFTs are less well known because these vessels have not been operating as part of the Canadian fleet.

The key factors that affect viability are catch rates, species mix, harvesting and processing costs. The profitability of all technologies is greater if used vessels rather than new vessels are purchased. Viability of all technologies is sensitive to the mix of species harvested.

4. Quality and Marketing:

The Canadian fishing industry is highly export dependent. Efforts by Canadian industry to capture new markets especially the North American market face numerous difficulties. Trade barriers (tariff and non-tariff) increasingly impede market access. Some experts argue that there is a growing trend for U.S. buyers to prefer frozen-at-sea products not only because of its quality but because of the consistency which can be achieved.

To address properly the market implications of introducing factory freezer trawlers in the domestic fishery, two questions must be posed; (1) is there a real difference in the quality and consistency which can be achieved by factory freezer trawlers compared to more traditional technologies? Then, regardless of real differences (ii) is there a perceived difference in quality and consistency by buyers which confers a competitive advantage to the users of factory freezer trawlers?

In the U.S. market future growth of seafood consumption will likely depend on the availability of high quality frozen fillets. Of the annual frozen groundfish fillet consumption of approximately 350 million pounds, premium fillets account for 90-100 million pounds with an estimated 20-25 million pounds currently supplied by factory freezer trawlers. The growing perception among U.S. buyers is that frozen-at-sea fillets provide the high standards required for this market segment. It is generally perceived that factory freezer trawlers provide "consistently high quality products" by seafood buyers and consumers throughout the world. To the extent that this perception translates into real demand, suppliers of frozen-at-sea fillets appear to have a competitive edge in the growing premium quality market. On the other hand, other technologies can provide a high quality product and it is important that we avoid creating negative perceptions regarding the product, say, of wetfish trawlers.

In terms of other market opportunities for frozen-at-sea products, Canada could increase its market share in the H&G redfish market in Japan. There also appears to be a large market for H&G cod in the U.K. Other opportunities exist (e.g. U.S.S.R., G.D.R., Egypt etc.) for bulk frozen-at-sea cod and redfish. These markets require only freezer trawlers not factory trawlers. Experiments are also underway to develop suitable inshore/midshore caught products for these markets.

For the premium cod fillet market in the U.S., wetfish, freezer or factory freezer trawlers can meet the required standard. Approximately, 75% of the premium fillet market is currently supplied by non frozen-at-sea product. Although not directly dependent upon the type of vessel used in harvesting the high quality market it does require the highest standards of quality, workmanship and manufacturing practices throughout the system. Once a fish is caught, quality deterioration begins and freezing-at-sea (by either freezer and factory freezer trawlers) arrests this process very soon after harvesting. Product from freezer trawlers, if it is to be filleted rather than sold headed-and-gutted, must be thawed for further processing on shore.

One factor that may influence the quality of product from a factory freezer trawler is the high catch rates required, particularly, in 2J 3KL cod. It is noted in Appendix B that catch rates in excess of 45 t per day may result in the bruising of fish from excessive weight when landed and may also increase the delay between harvesting and bleeding and gutting the fish.

A delay of one hour or more will result in a deterioration in quality. The projected catch rates for 2J 3KL cod are 74 t per day. Such a large catch rate will almost certainly require stringent handling and processing if top quality is to be maintained.

5. Use of Factory Freezer Trawlers by Canada's Competitors:

Closely related to the questions in the foregoing section is whether Canada's major competitors are or will be using factory freezer trawlers to out-compete Canadian industry in key export markets. Factory freezer trawlers have been an integral part of foreign fishing fleets for many years. Essentially, they have been used to exploit fishing grounds around the world to serve home markets. Distant fishing necessitated the use of factory freezer trawlers. However, with the extension of jurisdictions to 200 miles, many countries operating fleets of factory freezer trawlers suffered a significant loss of access to traditional fishing grounds, thus creating a world surplus of such vessels.

Factory freezer trawlers have recently been introduced by nations which harvest more accessible domestic fishing zones. Wetfish trawlers are being converted to operate with processing equipment at sea while smaller factory freezer trawlers are being introduced by countries such as Iceland and the United States. The smaller vessel size is directly a result of improved technology such as more compact and energy efficient refrigeration systems and refined processing equipment. Our major competitors in the U.S. market, the Norwegians, the Icelanders and the Americans themselves use freezing-at-sea to produce high quality products.

In the United States, nine vessels operating out of Alaska will process at sea approximately 25 million pounds of cod. These vessels are participating in the newly expanded Alaskan groundfishery that has been characterized by high catch rates and an absence of a nearby shore based processing industry and were once participating in the now collapsed king crab fishery. U.S. companies on the east coast (in response to a lack of capacity to process and market loligo and illex squid) are planning to introduce factory freezer trawlers in 1985-86, initially to harvest squid and flatfish, which are underutilized species in the U.S. fishery. Onshore processing facilities are being added in New Jersey to produce finished products from the catches of this new fleet of vessels. The majority of vessels operating in the U.S. fleet are smaller in length than the traditional factory freezer trawlers used by countries such as West Germany.

Iceland introduced its first factory freezer trawler in April, 1982. Seven vessels now in operation are converted wetfish trawlers and two are specially designed vessels which stay out for less than 20 days per trip. Iceland is planning to add four more similar vessels over the next few years to its fleet. The growth of this fleet in Iceland has been attributed to growing demand for frozen-at-sea products in the U.S. market by independent vessel operators. Also a number of vessels in the fleet are apparently individually owned, (i.e. not vertically integrated with land based processing operations); thus converting to factory freezer trawlers allows these harvesting operations to sever their dependence on shore based processing operations and increase their margins. As well, it has been reported that even integrated companies are moving to factory freezer trawlers because Icelandic processing industry has had a problem recruiting labour. Foreign workers have been imported to work in fish plants (approximately 300 per year). It is difficult to assess the relative importance of these factors without further in-depth analysis.

The Norwegians, according to Lloyd's Register of Shipping, operated eleven factory freezer trawlers in 1984. Originally these vessels were built to fish stocks off Greenland and Labrador. As stocks became less accessible, these vessels changed fishing grounds to the coast of continental Europe and the Barents Sea. The role of factory freezer trawlers in the Norwegian fleet has been publicly debated over the last 15 years. In many ways it resembles the themes discussed in the Canadian context: quotas, catch rates, impacts on employment and market potentials.

Denmark according to Lloyd's, has only one factory freezer trawler which is operated out of the Faroe Islands. Their vessel fleet plans for the future are unknown at the present time. In the U.S. market, the Danes are supplying a high quality cod block comprised of whole fillets. Danish onshore processing techniques have enabled them to produce good quality blocks for commodity markets for their inshore caught fish. In other words they appear to be marketing effectively consistent good quality products without the "frozen-at-sea" perceptual advantage.

It is interesting to note that Iceland and the United States which have begun using factory freezer trawlers in recent years have chosen either to convert wetfish trawlers or to build new vessels, smaller in length than those utilized by the West Germans.

6. Net Employment Impact of Introducing FFTs:

Replacement of wetfish trawlers with factory freezer trawlers would normally result in a net loss of shore-based employment. Employment adjustment would be caused by the replacement of existing onshore processing jobs with on vessel processing jobs.

A factory trawler harvesting 12,000 t of currently harvested groundfish would displace approximately 170 person years of employment in a modern, efficient onshore plant and a further 45 person years on wetfish trawlers. A factory freezer trawler, in turn, will create 70 person years of employment. The net loss would be 145 person years of employment.

Should the government permit factory freezer trawlers the number that might be acquired and the consequent employment impact is uncertain. If, for example, there were four (4) factory freezer trawlers in the domestic fleet, the employment impact would depend upon the utilization of enterprise allocations. If the total catch of these factory trawlers displaced catch currently harvested by wetfish trawlers and processed onshore the employment displacement would be, based on the above estimates, 680 person years of onshore and 180 person years on wetfish trawlers. Four factory trawlers would generate 280 person years of employment. The net displacement would be 580 person years.

On the other hand, if factory trawlers harvested, for example, 50% of their catch from currently unutilized enterprise allocations, then the estimated displacement would be 340 person years onshore and 90 person years on wetfish trawlers. Four factory trawlers would create 280 person years of employment. The net displacement would be 150 person years. The extent to which factory freezer trawlers catch unutilized enterprise allocations would reduce the negative employment impact. This is a key factor in the equation.

In 1984 over 150,000 metric tonnes of offshore groundfish were left unutilized. This included 38.1% of FPI's allocation, 28.5% of National Sea Products Ltd and 27.5% of the Independent Offshore Group. (It should be noted that the companies were in the midst of restructuring and that there was a strike of offshore trawlermen in Newfoundland).

7. Community Implications of Introducing Factory Freezer Trawlers

A factory freezer trawler can be viewed as a floating processing plant. Many onshore plants have an annual throughput of between 10,000 t and 12,000 t of raw material which is equivalent to the throughput of an factory freezer trawler. As well many onshore plants of this size are aged and more labour intensive than a modern mechanized plant. The total inplant employment ranges between 220-250 person years and most are the primary economic base for that community. Factory freezer trawlers would conceivably replace these outdated facilities rather newer plants. Many of these older plants are the main base for employment in many communities. Hence, in in some cases, depending on the community such losses could remove its economic base entirely.

The impact of factory freezer trawlers may be viewed in the broader context of technological change in the Canadian fishing industry. Compared to our competitors, Canada's shore-based processing industry makes relatively little use of the latest industrial technology in fish processing. However, the industry is increasing its use of mechanization in processing. To become more competitive, increased mechanization will result in the loss of processing employment as plants continue to substitute capital for labour.

8. Changing Social/Work Patterns Associated with Factory Freezer Trawlers:

Social changes and labour force composition changes would occur if the new technologies are introduced. Crews working on factory freezer trawlers would remain at sea for long periods of time, up to 60 days, and would have more time in longer stretches onshore. The composition of the workforce associated with factory freezer trawlers compared to onshore processing may shift from older to younger and from predominately female to male, although the overall effect on the industry requires further examination, particularly the impact on the female labour component and the associated impact on household income (i.e. wives incomes are an important supplementary income particularly as it generally allows eligibility for UIC payments during winter months). The salaries and wages associated with factory freezer trawlers likely will be significantly higher than those associated with the wetfish trawler/onshore processing system.

Another issue associated with the introduction of new technologies relates to crewing of the vessels. Collective agreements would have to be negotiated and it is argued that foreign workers will have to be hired until Canadian workers could be trained in specialized areas such as mates, engineers and processing equipment mechanics.

9. Provincial Perspectives:

The issue of whether or not to allow factory freezer trawlers in the Atlantic groundfish fishery will be viewed differently by different provinces. The focus is offshore and likely would affect Newfoundland and Nova Scotia more than other eastern provinces. However, other provincial governments will undoubtedly express concern to maintain and protect inshore fisheries. Also, it should be noted that some provinces (Quebec, New Brunswick and P.E.I.) have questioned the enterprise allocation system and demanded a reallocation formula so that the unutilized allocations of offshore companies based in Nova Scotia and Newfoundland can be used to create shore-based employment in their provinces. Some of the concerns with respect to the inshore appear to be unfounded. With the acceptance of enterprise allocations, a company receiving approval to operate a factory freezer trawler would have to do so within its current allocations. Some smaller offshore companies may wish to form partnerships to ensure an adequate allocation for factory freezer trawlers. The acceptance of enterprise allocations by the offshore companies should ensure maintenance and protection of the inshore fleets.

Enterprise Allocations coupled with existing measures (TAC, seasons, etc.) to protect the resource and licensing restrictions that control the overall capacity of the remaining fleets should make the issue of factory freezer trawlers a question of economic efficiency for particular companies. The major impact would be the displacement of existing onshore employment and processing capacity at a time when existing processing industry is already over-capitalized.

The Newfoundland government has publicly stated its opposition to the introduction of factory freezer trawlers in the Northern Cod fishery. In the Agreement of September 26, 1983 between the Government of Canada and the Government of Newfoundland and Labrador concerning the Restructuring of the Newfoundland fishery, clause number twelve states "factory trawlers will not be permitted to harvest northern cod". Some parties have questioned the validity of an agreement that impact on provinces which were not party to the agreement. It has further been argued that the Government of Canada cannot, by agreement, legally restrict its regulatory authority under section 34 of the Fisheries Act.

10. <u>International Implications</u>:

Introduction of factory freezer trawlers in the domestic groundfish fishery would also have important international implications which will require close scrutiny.

During the past few years domestic fishing companies have left some of their enterprise allocations unutilized. The rationale of these companies is that species such as redfish, turbot and hake cannot be harvested profitably with wetfish trawlers. These species require freezing-at-sea. Some companies will argue that the use of factory freezer trawlers will enable them to better utilize their enterprise allocations and thus weaken the argument of foreign countries for access to the unutilized enterprise allocations.

While it is true that factory freezer trawlers will permit a greater utilization of enterprise allocations for species such as redfish and turbot, freezer trawlers would also achieve the same end. As well, the argument made by many provincial governments is that a more balanced re-allocation of unutilized EA's among offshore companies would weaken the claim that Canada has considerable quota beyond it's requirements.

11. Other Implications for Industry and Government

Companies wishing to acquire factory freezer trawler technology will argue that factory trawlers are not intended to compete with the existing industry groundfish production but rather to give Canadian companies better access to market segments that are not presently, serviced by Canada or where Canada will otherwise become less competitive.

Therefore, the decision on (if the current policy is changed) how many factory trawlers should be permitted should be based on realistic estimates of the potential market penetration. This will serve to protect the remaining segment of the domestic offshore groundfish industry (i.e. smaller offshore operators who can't afford these trawlers), and the inshore supplied seasonal groundfish operators.

One word of caution needs to be expressed. If a limited number of factory trawlers are successful and the particular companies involved can penetrate the premium quality U.S. market for cod, then these companies will likely take advantage of the the image of "frozen at sea" products to enhance their entire product lines. This may provide a marketing advantage over other companies who would undoubtedly react negatively to a new factory freezer trawlers policy. National Sea has asked the federal government to enter a joint public relations campaign to promote factory freezer trawlers. In addition, companies with small enterprise allocations may pressure governments to obtain a larger allocation (i.e. redistribute currently underutilized quota) so it can take advantage of factory freezer trawlers.

The government has established a new agency, Investment Canada with a mandate to encourage and facilitate investment. Foreign fishing firms which may be interested in investing in the Canadian fishing industry, and which could provide marketing and management benefits to Canadian industry, currently operate fleets of distant water vessels including factory freezer trawlers. It is likely that these companies would want to include factory freezer trawlers as part of their investment proposals in the Canadian industry.

SECTION D - POLICY OPTIONS

There are several options open to government. The choices range: (a) to continue the current ban on processing at sea; (b) to permit factory trawlers with restrictions on the number, on the areas of operation , and/or quotas and/or species; and, (c) to permit factory trawlers without restrictions (other than those the enterprise allocation program imposes). These options have been reviewed in terms of the effect on: (i) resource base, (ii) economic viability, (iii) employment, (iv) marketing, (v) anticipated provincial positions and, (vi) international implications.

(a) Continue Current Restriction on Processing at Sea:

Continuation of the prohibition of processing at sea would not affect the resource base nor impact on resource management operations. The economic viability of the offshore sector, however, may be negatively affected. In general, employment levels may remain constant. It is possible that marketing opportunities could be lost as premium frozen at sea fillet markets increase in the U.S. market. The industry, however, can and does now use freezer trawlers to access the markets for headed and gutted groundfish products. A Province seeing lost benefits to its' industry would protest this option. Provinces that see factory freezer trawlers as a threat to processing jobs would be supportive of this option. International implications would be minimal; the utilization of quotas of redfish and turbot do not depend solely on the introduction of Factory Freezer Trawlers.

(b) Permit Processing at Sea with Restrictions:

Factory freezer trawlers could be licenced with a restriction on number of boats, species, quotas, and areas of operation. For instance, the overall number of factory freezer trawlers could be restricted to a specific number. Moreover, each vessel could be restricted as to its annual harvest of traditional species (eg. 6000 t of northern cod) and the rest of its fishing plan made up of underutilized species/quotas (redfish/turbot) in certain NAFO areas.

To the extent that unutilized enterprise allocations are fished this option may have some implications for a fuller utilization of the resource base. For traditional species, assuming companies operate within their enterprise allocation, no effect on the resource would occur. For non-traditional species such as squid there may be no impact; as for capelin and mackerel, primarily inshore fisheries, difficulties may occur with market displacement of current landings of the inshore fleet. The Economic viability of industry could improve with the operation of factory freezer trawlers to the extent that new markets are accessed or the Canadian position in traditional markets protected.

There would be arguments that the level of success of such ventures was being restricted due to limitations imposed on areas fished or species caught. Some onshore processing jobs would be displaced but it would be less than if all traditional species (cod) were harvested.

Should a factory freezer trawler be restricted from fishing in an area such as the Gulf, or restricted from fishing Northern cod, numerous federal provincial implications would arise. Newfoundland would likely oppose the operation of any factory freezer trawler in the northern cod fishery. Quebec, New Brunswick and Prince Edward Island would be opposed as they are now to any trawler operations in the Gulf.

(c) Permit Factory Freezer Trawlers without Restrictions:

This option would see the licencing of factory freezer trawlers without restrictions except those now normally applying through the enterprise allocation system. The resource base would be more fully utilized if factory freezer trawlers focussed part of their fishing plan on underutilized quotas; however, with no restrictions companies could well choose to harvest only their traditional species/quotas. Without restrictions, industry would more easily be able to adapt to changing marketing conditions and thus maximize any potential for viability. The net employment impact would be negative but this would be lessened to the extent the factory freezer trawler harvested under utilized quotas. Depending on how many factory trawlers were introduced and the extent to which unutilized enterprise allocations were harvested, there could be a major negative impact on employment and community viability.

Federal-provincial implications would be significant especially if trawlers were to operate in the Gulf and/or catch Northern cod. Foreign investment and government deregulation would be seen to be encouraged.

SECTION E - CONCLUSIONS

The foregoing has outlined the background and policy questions which are necessary to focus the issue of the introduction of factory freezer trawler technology into the Atlantic coast groundfish fishery.

Tentative conclusions are summarized below.

1. There is an adequate resource base within current enterprise allocations to enable the use of domestic factory freezer trawlers. Unutilized enterprise allocations of redfish and turbot could be harvested to serve the headed and gutted market in Japan and Europe. To serve the U.S. premium cod fillet market northern Cod will be required.

2. Based on the best available information, and dependent on related assumptions, economic analysis shows that factory trawlers would operate more profitably, than wetfish trawlers or freezer trawlers and their associated onshore based processing plants.

3. At the present time there exists a few used West German factory freezer trawlers available at low prices and as such could be a good addition to the fleet of any firm which can acquire one.

4. Other major fishing countries are using factory freezer trawler technology; for example Iceland and the United States are using smaller factory freezer vessels than those utilized by the West Germans. The reasons for the increased usage of factory trawlers are varied and have dictated the role that this technology has in each country.

5. Replacement of wetfish trawlers with factory freezer trawlers would normally result in a net loss of shore-based employment. The net loss will be lessened depending upon the amount of unutilized enterprise allocations harvested by a factory freezer trawler.

6. A change in policy will likely result in applications for more factory freezer trawlers. Depending on the number of factory freezer trawlers licenced and their fishing plans, plant closures may occur. Depending on the communities in question, such closures could remove the economic base of these communities entirely.

7. There will be other socio-economic changes associated with the introduction of factory freezer trawlers. Longer trips at sea will likely result in shifts from a predominantly female to male workforce, more time off in larger blocks, and higher than average incomes (in comparison to onshore processing). The current pattern of women holding processing jobs to supplement family incomes and gain eligibility to unemployment insurance benefits in the off season would change; the extent to which would be dictated by the number of factory freezer trawlers employed in the fleet.

8. Marketing implications are difficult to quantify. The major growth segment in the U.S. market is in the premium frozen fillet market. It is generally perceived by major U.S. seafood buyers that freezing at sea provides "consistently high quality products" resulting in a growing preference for products frozen at sea.

9. Market opportunities exists in Japan, Europe and other countries for headed and gutted frozen at sea products (turbot, redfish). These products can be supplied by freezer trawlers; it does not require the use of factory freezer trawlers. Some of Canada's competitors are using factory freezer trawlers to supply these markets.

10. From a quality perspective premium quality groundfish products can be produced from any harvesting technologies provided that stringent handling and processing controls are applied. The high catch rates, particularly in the 2J3KL cod fishery, may result in lower than premium quality products due to bruising of fish from excess weight when landed and the necessity of processing product quickly.

APPENDIX A

COMPARATIVE ECONOMIC ANALYSIS OF DIFFERENT VESSEL TECHNOLOGIES IN THE OFFSHORE FLEET

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PAGE

1. Purpose

The purpose of this Appendix is to determine the comparative economic viability of factory freezer, freezer and wetfish trawlers in the Atlantic groundfish industry. The financial performance of each technology is evaluated in a common framework of stated assumptions.

2. Background

Factory freezer trawlers are used mainly to harvest groundfish species. Their potential application is therefore mainly in the Atlantic industry. At present, the Atlantic offshore groundfish fleet includes 145 active licenced trawlers owned by Fishery Products International, National Sea Products Ltd. and smaller independent companies organized as the Independent Offshore Group. Approximately 300,000 tonnes of groundfish are harvested year round by these Canadian offshore vessels. In this capital intensive, vertically-integrated part of the industry, the owners of vessels have operational control of harvesting, processing and marketing operations.

The offshore fleet is primarily based in Newfoundland and Nova Scotia. In Newfoundland, the home ports of offshore vessels are on the south coast and the Burin, Bonavista and Avalon Peninsulas. In Nova Scotia, trawlers are based in Cape Breton and southwestern Nova Scotia. Approximately 10,900 people are employed directly in the Atlantic offshore groundfishery; 2,100 trawlermen and 8,800 plant workers.

3. Structure of the Analysis

The comparative viability analysis is based on the assumption that the fleet and processing operations for each technology are designed to harvest 20,000 tonnes (t) of groundfish per year comprised of 13,720 t of cod, 5,460 t of redfish and 820 t of turbot. The level of 20,000 tonnes was chosen to be consistent with the harvesting level used in previous departmental analysis. The composition of the catch reflects the expected performance of a typical factory trawler.

It is assumed that no additional enterprise allocations would be made available for the acquisition of new or used vessels. Therefore, acquisition of the vessels evaluated in this analysis would displace existing fleet capacity within the offshore fleet.

4. Vessel Description and Acquisition Costs

A summary description of the physical and cost characteristics of each vessel technology used in the analysis is provided in Table 1.

With respect to the data in Table 1, sea days are the total days spent at sea both steaming and fishing. The variation in sea days among the technologies reflect the typical trip schedules that would be used for each vessel. Wetfish trawlers on the average complete twenty-six 10 day trips per year. Recent experience with freezer trawlers indicates a schedule of nine 34 day trips, while it is assumed that factory trawlers typically would make 6 trips per year of 40-60 days' duration. The different number of trips for each technology is a result of the time lost in steaming to and from port, the time required for refits and the contractual arrangements for crewing.

The capital costs of new vessels displayed in table 1 ($8 million for wetfish trawlers, $13 million for freezer trawlers and $20 million for factory freezer trawlers) are based on industry's best approximation of current construction costs built offshore and exclude tariff costs in accordance with current government policy.

TABLE 1
PHYSICAL & CAPITAL COST CHARACTERISTICS OF ATLANTIC FISHING VESSELS

	Wetfish Trawler Lunenburg	Wetfish Trawler St.John's	Freezer Trawler	Factory Freezer Trawler
Length (m)	54	54	76	92
Sea days	260	234	286	320
Fishing days	150	191	219	264
New Vessel Cost (M$)	8	8	13	20

5. Vessel Deployment Plans

The fishing plan of a factory trawler is based on data pertaining to fishing effort and catch rates of class 7 stern trawlers operating in the Canadian zone and reported in the FLASH system. The numbers, countries and general characteristics of stern trawlers are described in Table 2 for 1983 and 1984. Most vessels are very similar in terms of length and gross tonnage with the exception of vessels from the Federal Republic of Germany (FRG) which are approximately 30% larger by tonnage. Due to data constraints it has been necessary to exclude FRG vessels from the class 7 group in some of the subsequent analysis.

TABLE 2
CLASS 7 STERN TRAWLERS*

Country		No. of Vessels	LDA (m)	GRT
Cuba	- 1983	10	107	2635
	- 1984	8	104	2635
FGR	- 1983	13	91	3176
	- 1984	10	90	3096
France	- 1983	3	91	2428
	- 1984	3	91	2428
GDR	- 1983	-	-	-
	- 1984	3	87	2513
Italy	- 1983	1	73	2023
	- 1984	-	-	-
Japan	- 1983	1	85	2538
	- 1984	1	80	2155
Poland	- 1983	4	85	2510
	- 1984	3	81	2449
USSR	- 1983	31	94	2349
	- 1984	34	83	2424
		Total (without FRG)		
	- 1983	50	89	2421
	- 1984	52	87	2458

*Greater than 2000 gross registered tonnage.

A. Steaming Distances

The following port-to-ground steaming times are assumed for all vessels on a round trip basis. To simplify analysis, the distances are denoted for central locations on the major fishing grounds.

	Fishing Grounds	
Port	2+3KL	3LNO
Lunenburg	6.0 days	4.0 days
St. John's	2.0 days	1.0 days

B. Effective Fishing Time

Analysis of Class 7 stern trawler operations indicates the following pattern in terms of the actual number of days fishing when vessels are deployed on specific fishing grounds:

2+3KL	Days on Ground	Days Fished	Days Fished as % of Days on Ground
Period			
Jan-March	77	67	87%
Apr-June	186	166	89%
July-Sept	375	331	88%
Oct-Dec	272	236	86%

3LNO	Days on Grounds	Days Fished	Days Fished as % of Days on Ground
Period			
Jan-March	55	36	65%
Apr-June	40	38	95%
July-Sept	545	500	91%
Oct-Dec	20	20	100%

The above data was compiled from approximately 1,570 vessel days on ground (excluding FRG vessels). While there appears to be very little seasonal variation in the ratio of days fished to days on ground in NAFO Divisions 2+3KL, particularly in the January - March period, this may reflect the low level of effort in that period. Over the 1983-1984 period FRG vessels fished a total of 141 days out of 157 days on ground or 89% of the time on the ground. From this basis, it is assumed that the effective ratio of days fished to days on ground for factory trawlers and freezer trawlers is as follows:

	2+3KL	3LNO
Jan-March	89%	91%
Apr-June	91%	93%
July-Sept	91%	93%
Oct-Dec	89%	91%

The seasonal variation in the effective fishing effort of wetfish trawlers has not been projected. It is assumed that the wetfish trawlers will have the following days fished/days on ground ratios:

	Days on Ground	Days Fished	Days Fished as % of Days on Ground
Lunenburg	260	150	58%
St. John's	234	191	82%

The difference in the number of days on ground between St. John's and Lunenburg based vessels is based on observed behaviour of vessels in each port and may reflect differences in union contracts and slower turnaround times between trips. The difference in days fished reflects the more favourable location of St. John's-based trawlers to the fishing grounds and the longer steaming distances involved with a Lunenburg-based vessel.

C. Port Turn-around Time

It is assumed that a total of 5 days will be required at the end of each factory trawler trip to unload the product, to replenish the ship's stores and provide for crew transfer and shore time.

A total of 5 days will be required for freezer trawlers and 2 days for wetfish trawlers.

It is also assumed that all vessels will tie-up over the Christmas period in accordance with most existing union contracts. Thus the ship is assumed to return to port by December 22 and return to sea on January 3. This will provide for an effective operating year of 355 days.

D. Species Priority

In determining which species and grounds that vessels will fish, the following species priority is assumed (in order of descending priority):

1. Cod
2. Redfish
3. Turbot

This ordering is somewhat arbitrary and reflects resource availability/catch ability and market returns.

E. Catch Rate Analysis: General

Many factors will cause catch rates to vary among the three technologies. First, size of vessel is an important determinant in explaining differences in catch rates among vessels. The reasons for this include: a larger fishing deck which can handle gear more efficiently, permitting the net to be retrieved quickly, repaired, emptied and shot away; a larger fishing deck and higher freeboard (deckline above water) makes it safer and more efficient for crewmen to work in adverse weather conditions; a larger vessel is more stable in adverse weather conditions and therefore, its net stays on the bottom more of the time resulting in higher catch rates; larger vessel are more capable of sustaining fishing operations in heavier ice conditions.

The engine size of vessels also affects catch rates. A wetfish trawler has a 2,000 to 2,400 horsepower single engine; a freezer trawler a 3,000 to 3,500 horsepower single engine; and a factory freezer trawler twin 4,800 horsepower engines.

Catch rates are also affected by the ability of each technology to process its catch. In order to maintain a high average catch rate, vessels must be able to take advantage of peak periods of fish availability. Wetfish trawlers are limited by the ability of the crew to handle fishing gear, to gut, wash and store fish. A freezer trawler is limited by its ability to freeze its catch in a headed and gutted (H & G) form. The limiting factor for a factory freezer trawler is its ability to freeze the catch (i.e. either H&G or fillet form).

Catch rates may also be affected by the degree of self-reliance of the vessel. For instance, in times of equipment failures, wetfish and freezer trawlers must interrupt fishing or even return to port for repairs. Factory freezer trawlers, because of twin engines, could fish on one engine while repairing the other.

F. Catch Rate Analysis: Factory Freezer Trawlers

There is little current catch/effort data for the operation of large factory trawlers (i.e. FRG vessels). The only current data available is limited to the months of January and February i.e. the peak fishing months for the 2J3KL cod fishery. Catches per day fished by FRG class 7 vessels greater than 3,000 gross tons were, for the 1982-84 period, as follows:

Catch Per Day Fished (tonnes): 2J3KL Cod

Period	Cod	Redfish	Other	Total
Jan. - Feb.	72.72	1.23	0.23	74.18

This total number, 74.18 has been used for purposes of this analysis however, it should be noted that in reality the catch rates for cod in December and particularly March and April could be considerably lower than this.

The West German (FRG) fleet does not fish other species to any significant extent. To estimate the catch rates in other fisheries, the catch/effort data with respect to other factory trawlers was reviewed. These data are summarized for 2 + 3KL Greendland halibut and 2 + 3K redfish, 3LN redfish and 3O redfish in Table 3. These catch rates tend to reflect averages and may in fact be higher for factory freezer trawlers. However, it must be noted that projected future catch rates for 2 + 3K redfish could be less than current levels. The 2 + 3K redfish stock has historically been only lightly fished. The recent increase in fishing pressure (i.e. catches) in conjunction with a further increase in catch levels resulting from the operation of a factory trawler is likely to reduce the stock's biomass and hence the effective catch rate. Unfortunately, the degree to which catch rates will change cannot be predicted at this time.

TABLE 3

SEASONAL CATCH RATES OF GREENLAND HALIBUT AND REDFISH DIVISION 2 + 3KL GREENLAND HALIBUT (CATCH PER DAY FISHED)

2 + 3KL Greenland Halibut

Period	Greenland Halibut	Cod	Plaice	Redfish	Other	Total
Jan.-Mar.	7.90	0.77	1.42	1.41	1.83	13.33
Apr.-June	10.28	1.49	0.28	2.07	2.39	16.51
Jul.-Sept.	9.80	1.77	0.51	0.37	1.73	14.18
Oct.-Dec.	14.10	2.14	0.20	1.16	1.54	19.14

2 + 3K Redfish

	Redfish	Cod	Plaice	Greenland Halibut	Other	Total
Jan.-Mar.	-	-	-	-	-	-
Apr.-June	8.65	1.39	0.04	3.05	1.33	14.46
Jul.-Sept.	31.89	0.13	0.01	0.07	0.61	32.71
Oct.-Dec.	13.52	1.20	0.04	0.42	1.30	16.58

3 LN Redfish

Jan.-Mar.	5.85	1.45	0.25	-	0.85	8.40
Apr.-June	-	-	-	-	-	-
Jul.-Sept.	12.09	0.03	0.02	-	0.08	12.22
Oct.-Dec.	-	-	-	-	-	-

3O Redfish

Jan.-Mar.	-	-	-	-	-	-
Apr.-June	14.64	0.01	0.02	-	1.04	15.71
Jul.-Sept.	20.62	-	0.02	-	-	20.64
Oct.-Dec.	16.99	0.07	0.11	-	1.74	18.91

The maximum catch per trip is limited by the hold capacity of 900 product tonnes or by an assumed constraint on trip duration of 56 sea days whichever is reached first. A hold capacity of 900 product tonnes represents a catch of 3,100 tonnes of cod (with a 29% yield) or a catch of 1,650 tonnes of redfish or turbot (with a 55% yield).

Based on the catch rates and operating assumptions noted previously, a hypothetical fishing plan has been developed for a factory trawler. It must be emphasized that this plan is, at best, a crude approximation of the actual behaviour of a factory trawler. Clearly vessel deployment will change from year to year depending upon market conditions, resource availability and environmental conditions.

The projected fishing plan is described in Table 4. In essence it projects that the vessel will be at sea 328 days per year, will be on the fishing grounds 292 days per year and will fish 268 days. This is a critical assumption to the viability analysis. It should be pointed out that there has been no year-round Canadian experience with a factory freezer trawler to provide a factual basis for this assumption. Also, actual performance would of course, vary considerably from one year to the next. The total catch is projected to be 11,335 tonnes comprised of:

Species	Catch	% of Total
Cod	7,645	67%
Redfish	3,040	27%
Greenland Halibut	450	4%
Other	200	2%
Other	11,335	100%

TABLE 4

PROJECTED FISHING PLAN

Period	Days			Species:Area	Days Fshd	Catch Rate(s)	Catch by Species				Total Catch
	At Sea	On Grnd	Fshd				Cod	Redfish	Turbot	Other	
Jan 3/ Feb 25	53	47	42	Cod: 2J3KL	42	74.2	3,054	52	-	10	3,116
Mar 3/ Apr 24	53	47	42	Cod: 2J3KL	42	74.2	3,054	52	-	10	3,116
Apr 30/ June 24	56	50	46	Redfish: 30	30	15.7	-	439	-	32	471
				Cod: 2J3KL	10	74.2	727	12	-	3	742
				Turbot: 2+3K	6	16.5	9	12	62	16	99
June 30/ Aug 24	56	50	47	Redfish:2+3K	32	32.7	4	1,020	2	20	1,046
				Redfish: 30	10	20.6	-	206	-	-	206
				Turbot: 2+3K	5	14.2	9	2	49	11	71
Aug 30/ Oct 24	56	50	47	Redfish: 30	20	20.6	-	413	-	-	413
				Redfish:2+3K	12	32.7	2	382	-	8	392
				Turbot:2+3K[1]	15	19.1	32	17	212	26	287
Oct 30/ Dec 22	54	48	44	Redfish: 30	20	18.9	1	340	-	37	378
				Cod: 2J3KL[2]	10	74.2	727	12	-	3	742
				Turbot:2+3KL	9	19.1	19	10	127	16	172
				Redfish:2+3K	5	16.6	7	68	-	8	83
	328	292	268		268	42.3	7,645	3,037	452	200	11,334

1 fishing to take place in October
2 based on Jan-March catch rate

The overall catch rate of the vessel is projected at 42.3 tonnes per day fished or 34.6 tonnes per sea day. This catch rate level is supported almost exclusively by the high rates in the northern cod fishery.

G. Catch Rate: Freezer Trawler

The catch rate performance of a standard freezer trawler (Class 6: 1,000-1,999 GRT) was extropolated from that of the factory trawler and is based on the following assumptions:

1) catch rates in the 2J3KL cod fishery would be 75% of the average catch rate of a factory trawler. Depending on size of vessel, engine horsepower, weather conditions etc. catch rates for a freezer trawler could attain catch rates as high as 90%.[3]

2) catch rates in the Greenland halibut and redfish fisheries would be equal to those of factory trawlers.

The projected fishing plan for a freezer trawler is therefore:

Directed Species	Days on Ground	Days Fished	Catch Rate For Days Fished[1]	Total Catch[2]
Cod	134	100	55.635t[3]	5,535
Redfish	125	94	23.170t	2,185
Greenland halibut	27	19	17.971t	350
Total	286	219	34.487t	8,070

1) Includes by-catch of non-directed species,
2) Includes catch of specified species caught as a by-catch in the other directed fisheries.
3) At 90% this would be 66.78 t per day fished, yielding a total cod catch of 6,678 t and total annual catch of 9,213 t.

H. Fishing Plan: Wetfish Trawlers

The fishing plan of a wetfish trawler is based largely on the operation of a Fame class wetfish trawler operating out of Lunenburg. Shifting the port of operations to St. John's results in an increase in catch due to a reduction in steaming times to the northern fishing grounds. The assumed catches by species for a wetfish trawler based in St. John's and Lunenburg are as follows:

	Lunenburg	St. John's
Cod	3,442	4,113
Redfish	1,370	1,638
Greenland halibut	206	249
Total	5,017	6,000

The catch rate per sea day for a wetfish trawler was projected at 19.3 for vessels based in Lunenburg and 35.6 for vessels based in St. John's.

6. COST PARAMETERS AND ASSUMPTIONS

A. Processing Costs

A.1. Fixed Onshore Costs include production related costs such as salaries of head office support staff and costs such as depreciation and interest associated with fish processing on-shore or the use of onshore facilities.

Production related costs are calculated as a percentage of net sales. Depreciation and interest are calculated for wetfish trawlers on the basis that 100% of catch is processed on-shore; for freezer trawlers, that 69% of catch is processed onshore; and, for factory trawlers a figure of $50,000 is used to cover onshore support production facilities which may be used.

A.2. Variable Onshore Costs include raw materials costs, labour, packaging, other processing costs such as additives and manufacturing overhead.

Variable onshore processing costs are calculated for each product form for each species as a function of predetermined cost allotments for such factors as yield, trawler purchase price, trawler assessment, labour, packaging, additives, plant manufacturing overhead and fixed overhead costs.

B. Harvesting Costs

B.1. Fixed Costs include the (1) fleet costs associated with insurance, electronic rentals and onshore divisional and Head office fleet administration costs, and (2) interest and depreciation charges associated with operation of the vessel.

Fleet costs are calculated as a fixed percentage of net sales revenue.

Depreciation costs for new vessels were calculated on a straight line basis over 20 years. Interest charges were based upon an interest rate of 13% amortized over 20 years for new vessels.

B.2. Variable Costs associated with the catching and onboard processing of fish are labour, fuel, gear, ice, repair and maintenance and other miscellaneous expenses.

Variable costs are calculated on per metric tonne basis (round weight) by species and are based on actual average operating costs in 1984 for wetfish trawlers; for freezer trawlers variable costs are based upon an assumed operating performance. Factory freezer operating costs are based upon the 1984 experience of West German vessels operating in Canadian waters and adjusted to costs in Canadian dollars. Two cost components have been altered. Crew (harvesting) shares are based on the per tonne average of wetfish trawler in Lunenburg for all vessels on the assumption that lay arrangements would not be affected by the technology used. This assumption requires further consideration inasmuch as factory trawler crews may require additional incentives in order to compensate them for the additional time spent at sea per trip. Fuel costs are based upon estimated requirements for a vessel with 4000 bhp, operating at 80% capacity.

Variable costs are averaged over the total catch and do not reflect differences in catch rates. As a consequence, harvesting costs may be overstated for cod and understated for redfish and turbot. Conversely, processing costs may be overstated for redfish and turbot but understated for cod. This area needs further refinement.

B.3. Fixed Corporate Costs include costs associated with storage of finished product; marketing costs related to the cost of salaries and other office costs of the marketing organization; corporate administration costs such as head office accounting, purchasing and financial management; and working capital interest charges.

Variable Fleet Cost Per Metric Tonne

1. Cod

	Wetfish St. John's	Wetfish Lunenburg	Freezer	Factory Freezer
Fuel	$94.40	$118.00	$129.57	$132.200
Gear	33.00	33.00	27.99	13.889
Ice	18.00	18.00	--	--
R&M	74.00	74.00	77.62	43.008
Mis.	13.00	13.00	9.56	17.024
Labour - Crew	201.20	201.20	201.20	201.200
- Processing	--	--	80.18	193.563*
Total	$433.60	$457.20	526.12	600.884

2. Redfish

	Wetfish St. John's	Wetfish Lunenburg	Freezer	Factory Freezer
Fuel	$94.40	$118.00	$129.57	$132.200
Gear	33.00	33.00	27.99	13.889
Ice	18.00	18.00	--	--
R&M	74.00	74.00	77.62	43.008
Mis.	13.00	13.00	9.56	17.024
Labour - Crew	125.70	125.70	125.70	125.700
- Processing	--	--	103.38	193.563*
Total	$358.10	$381.70	$473.82	$525.384

3. Turbot

	Wetfish St. John's	Wetfish Lunenburg	Freezer	Factory Freezer
Fuel	$94.40	$118.00	$129.57	$132.200
Gear	33.00	33.00	27.99	13.889
Ice	18.00	18.00	--	--
R&M	74.00	74.00	77.62	43.008
Mis.	13.00	13.00	9.56	17.024
Labour - Crew	116.40	116.40	116.40	116.400
- Processing	--	--	91.71	193.563*
Total	$348.80	$457.20	$458.85	$451.084

* Average labour processing cost for all species and product types.

Fixed Corporate costs are calculated as a fixed percentage of net sales revenue and the total (including fixed costs associated with harvesting and onshore processing) amount to 16%. Current industry averages are estimated to be in the range of 10-12%. In view of the uncertainties with respect to such costs, the more conservative (higher) estimate of 16% is desirable.

7. PRODUCT MIX AND REVENUES

The product mix for each vessel technology is described in Table 5. An optimal mix was selected in each case taking into consideration the operating capabilities and constraints, the marketing opportunities and profit margins associated with each type of vessel.

Table 6 describes the product yields associated with each product type and technology. The yields associated with the factory trawler are conservatively estimated and, as a result, are somewhat lower than for the other technologies. There is some reason to believe that yields from machine filleting could, in fact, be higher and may exceed those associated with onshore processing. All products are assumed to be sold at the current market prices. (Weighted average product prices by species are described in Table 7.) No price differentials for frozen-at-sea products have been assumed.

TABLE 5

DISTRIBUTION OF 13,720 t COD, 5,460 t REDFISH AND 820 t TURBOT BY PRODUCT PACKS BY TYPE OF VESSEL

		Wetfish Trawler	Freezer Trawler	Factory Freezer Trawler
Cod	- Fresh	1,509	-	-
	- Shatter Pack 1	3,842	3,430	10,976*
	- BND 5	823	1,084	-
	- One's	1,166	1,536	-
	- Shatter Pack 2	1,372	2,511	1,372*
	- BND I/W	343	494	-
	- Block	3,293	3,293	-
	- NP Block	1,372	1,372	1,372*
		13,720	13,720	13,720*
Redfish	- H&G	310	5,460*	5,460*
	- Fresh	2,185	-	-
	- Bnd 5	1,326	-	-
	- One's	1,092	-	-
	- Shatter Pack 2	468	-	-
	- Bnd I/W	78	-	-
		5,460	5,460*	5,460*
Turbot	- H&G	-	820*	390*
	- Fresh	55	-	-
	- One's	131	-	-
	- Shatter Pack 2	525	-	390*
	- NP Block	109	-	40*
		820*	820*	820*
	TOTAL	20,000	20,000	20,000*

* Processed at sea

Note: See Annex 1 for product pack description and Annex 2 for a summaryu of product packs and market comparisons among the different technologies.

TABLE 6

PRODUCT YIELDS[1] BY TYPE OF VESSEL

		Wetfish Trawler	Freezer Trawler	Factory Freezer Trawler
Cod	- Fresh	37.5	-	-
	- Shatter Pack 1	32.17	28.96	26.75
	- BND 5	32.92	29.71	
	- One's	37.58	34.38	-
	- Shatter Pack 2	32.17	28.96	26.75
	- BND I/W	35.42	32.21	-
	- Block	33.17	29.96	-
	- NP Block	30.42	27.21	25.00
Redfish	- H&G	53.5	55.00	55.00
	- Fresh	28.9	-	-
	- Bnd 5	29.8	-	-
	- One's	30.0	-	-
	- Shatter Pack 2	30.0	-	-
	- Bnd I/W	29.9	-	-
Turbot	- H&G	-	74.76	74.76
	- Fresh	35.34	-	-
	- One's	37.28	-	-
	- Shatter Pack 2	37.38	-	-
	- NP Block	36.02	-	-

1. This is the yield used to convert the allocation from round weight to finished product weight in the various product packs. Yields for cod on freezer trawlers were decreased so as to account for drip loss during defrosting; for the factory freezer vessels, yields were decreased to reflect actual conversion factors utilized by Departmental surveillance officers.

TABLE 7

AVERAGE PRODUCT PRICES BY SPECIES BY TYPE OF VESSEL
($ PER POUND OF FINAL PRODUCT EXCLUDING BY-PRODUCTS)

	Wetfish Trawler	Freezer Trawler	Factory Freezer Trawler
Cod	1.50	1.48	1.59
Redfish	1.51	.89	.89
Turbot	1.57	.80	1.08
WEIGHTED AVERAGE	1.51	1.20	1.26

8. COMPARATIVE VIABILITY ANALYSIS

Table 8 summarizes the annual financial performance of each technology assuming the purchase of new vessels. Depreciation and interest costs associated with harvesting and processing have been included in costs.

TABLE 8

FINANCIAL PERFORMANCE BASED ON A PRODUCT MIX COMPRISING 13,720 t COD, 5,460 t REDFISH AND 820 t TURBOT
($ 000, PURCHASE OF NEW VESSELS)

		Wetfish Trawler		Freezer	Factory Freezer
		St. John's	Lunenburg	Trawler	Trawler
1.	Number of Vessels	3.33	3.99	2.48	1.76
2.	Total Capital Cost New Vessels	26,640	31,920	32,240	35,200
3.	Net Sales Revenue	22,864	22,864	21,366	20,807
4.	Less: Total Variable Costs	14,354	15,579	14,349	12,110
5.	Equals: Operating Margin	8,510	7,285	7,017	8,697
6.	Less: Fixed Costs	8,337	9,089	8,617	8,390
7.	Equals: Net Income before Tax	173	(1,804)	(1,600)	307

Table 9 summarizes the annual return on total vessel investment for each technology as well as the number of years required to recover initial investment costs:

TABLE 9

CASH FLOW AND RETURN ON INVESTMENT FOR NEW VESSELS

	Wetfish Trawler		Freezer	Factory Freezer
	St. John's	Lunenburg	Trawler	Trawler
1. Net Cash Flow Excluding Debt Repayment and Interest Charges for New Vessel Acquisition ($000)	3,965	2,740	2,989	5,318
2. Annual Return on Vessel Investment (%)	15	9	11	15
3. Pay Back Period (years)	6.7	11.6	10.8	6.6

In Table 8, interest and depreciation costs related to the acquisition of new vessels have been included in harvesting costs. Vessel depreciation costs were calculated on a straight line basis over 20 years and interest charges were based on an interest rate of 13 percent amortized over 20 years.

Net sales revenue has been calculated using 1985 market prices for each product pack. Volume rebates, cash discounts, commissions and cooperative advertising have been incorporated to arrive at net sales revenue.

Processing costs for wetfish trawlers relate to onshore plants as all of the catch is processed onshore. The freezer trawler catch is processed to the frozen headed and gutted (H&G) stage and only cod is processed onshore.

For used vessels, the analysis shows that factory freezer trawlers are more profitable than either wetfish or freezer trawlers. Net incomes before tax are higher than for new vessels. There are a few factory freezer trawlers for sale at this time.

Analysis of Results

Based on the assumptions in this analysis factory freezer trawlers are the most profitable of the three technologies.

Freezer trawlers are more profitable than comparable wetfish trawlers based in Lunenburg because they produce H&G redfish and turbot which require considerably less processing than fillets. This advantage more than compensates for the reduced operating margin on cod products caused by onshore thawing of frozen H&G cod landings. Assuming that H&G cod will be further processed ashore, new freezer trawlers will operate with a loss of $1.6 million per 20,000 t whereas a new wetfish trawler operation will result in a loss of $0.6 million with the same throughout.

Based on the assumptions in this analysis factory freezer trawlers are more profitable than freezer trawlers because they combine an increased operating margin on cod with the advantages of quality H&G redfish and turbot production. The higher operating margin on cod is possible because of reduced fixed costs associated with processing at sea. The profitability and return on investment to both vessels depend heavily on being able to market the H&G redfish and turbot production.

The profitability of all technologies is greater if used vessels rather than new vessels are purchased, but the difference is particularly evident for factory freezer trawlers which can currently be acquired at relatively low prices.

The comparative viability of wetfish, freezer and factory freezer trawlers is sensitive to the mix of species harvested. The net contribution to fixed costs is higher for redfish and turbot than for cod. As a consequence, a species mix concentrated on redfish and turbot would emphasize the natural competitive advantages of freezer and factory freezer trawlers. A product mix concentrated on cod reduces significantly the relative viability of freezer trawlers and decreases the advantage of factory freezer trawlers over wetfish trawlers.

In summary, based on various assumptions about stocks fished, catch rates, and product mix, the analysis substantiates the conclusion that factory freezer trawlers are more viable than wetfish or freezer trawlers with the differential increasing, the further the home base is located from the fishing grounds.

ANNEX 1

PRODUCT PACK DESCRIPTION

Fresh	- whole fillets; top quality; packaged in 10 or 20 lb. plastic trays.
Shatter Pack 1	- whole frozen fillets; top quality; boned and skin-off (depending on market); fillets separated by plastic wrap and frozen in 10 lb. cartons; easily separated into individual frozen whole fillets.
BND 5 (Boned cello 5)	- whole frozen fillets; top or medium quality depending on fillet texture; boned; one or two fillets per plastic wrap, 5 lb. total weight.
One's	- frozen pieces of fillets; quality depends on texture; pin bone-in; 1 lb. blocks; always retail.
Shatter Pack 2	- same as shatterpack 1 except medium quality.
BND I W	- frozen fillet portion; medium quality; V bone removed, boned; individually rapped; 350g/12 oz. retail pack.
Block	- frozen fillets or pieces of fillets; lower quality; 16½ lb. weight, rectangular block, sodium tripolyphosphate added as preservative; intended for further secondary processing.
Block NP	- same as block above but no sodium tripolyphosphate added.
H&G	- Headed and gutted fish, frozen; redfish and turbot packaged in 20 kg. boxes ready for market, cod frozen into 44 kg. blocks and unpackaged for further processing.

ANNEX 2
PRODUCT PACKS AND MARKET COMPARISONS AMONG DIFFERENT TECHNOLOGIES

PRODUCT PACKS	MARKETS		
	WETFISH TRAWLER	FREEZER TRAWLER	FACTORY FREEZER TRAWLER
Groundfish (Traditional)			
Fresh, round fillets	U.S.A., secondary processing; North America, retail and high-end food service.	———	———
Round, frozen	U.S.A., secondary processing; North America, retail and high-end food service.	UK, secondary processing; North American, secondary processing.	———
H&G	Japan, retail (redfish only, quality limits market).	Japan, retail (redfish only, quality not limiting factor); Germany, secondary processing (turbot).	Japan, retail (redfish, quality not limiting factor); Japan, retail & German, secondary processing - turbot; Portugal, retail (small redfish).
Frozen, fillets whole	North America, food processors, food service - upgraded; North America, retail-regular.	———	North America, restaurant chains - upgraded (cod & pollock); North America, retail (complement to fresh).
Frozen, fillets portions	North America, food processors - upgraded; North America, retail-regular.	———	North America, retail-regular.
Blocks, frozen	North America, bread/battered processing-primarily lower grade.	———	North America, bread/battered processing - premium grade.
Cured	Iberia and Caribbean, retail.	———	———
Groundfish (Non-Traditional)			
Other species, by-catch (Hake, Grenadier, Argentine)	International, majority to meal (regular quality).	Eastern Europe, retail (Hake); by-catch others, discarded.	Europe, retail (whole fillets - hake, grenadier, argentine); East Europe, retail (Hake - H&G); North America retail (Hake); Japan, retail (Argentine).
Non-Groundfish			
Shrimp, frozen & cooked	———	North America, Europe, Japan, food service and retail.	North America, Europe, Japan, food service and retail.
Squid, frozen whole	———	Japan secondary processing - regular.	Japan and North America, retail, secondary processing and food service premium.
Capelin, frozen whole with roe (Vessel likely tied at dock to purchase).	———	———	Japan, retail
Herring, frozen butterfly;	———	———	Europe, retail and food processing (depending on market prices); Japan (retail)
Herring, frozen whole with roe.	———	———	Japan (retail)

APPENDIX B

QUALITY & MARKETING CONSIDERATIONS FOR WETFISH, FREEZER AND FACTORY FREEZER TECHNOLOGIES

INDEX

PAGE

1. Purpose:

To examine the ability of the three different technologies to meet the requirements of the marketplace and provide opportunities for domestic producers requires a close examination of the market and the quality standards required.

2. Marketing Opportunities

(a) Background

The Atlantic fisheries sector is highly export oriented and this reliance is likely to increase with our expanding resource base. Currently many countries, such as the United States, are aiming at self sufficiency through attempts to revive and expand their domestic fisheries. Tariff and non-tariff trade barriers are also increasing which impede our access to export markets. At the same time, the Canadian fishing industry continues to face a cost/price squeeze coupled with unfavourable exchange rates that is eroding the gross margins of many fishing companies.

Canada's major competitors, on the other hand, in the groundfish business are introducing new technologies and differentiating products in order to capture specific market segments. One example of this is frozen premium cod fillets (one to two fillets per wrap) from Iceland and Norway.

Faced with an expanding resource base, unfavourable exchange rates in non-U.S. markets and increasing costs it is essential that the Canadian industry profitability expand the North American market in order to survive. Recent favourable publicity in the U.S.

regarding the health benefits from fish consumption offers a growing export opportunity for good quality, cost competitive fish products from Canada.

In the context of the above, our industry requires a number of improvements in the catching, processing and marketing of fish products in order to improve viability and cost competitiveness in the marketplace. The production of frozen-at-sea fish products is one opportunity available to our industry to compete effectively and also to maintain and expand market shares, particularly in the North American groundfish market and in Western Europe and Japan. Other markets such as the U.S.S.R. and the G.D.R. also show potential.

(b) <u>The United States Market</u>:

The U.S. market can, essentially, be divided into three segments: public food service, institutional and retail. The public food service (restaurants, fast-food outlets, etc.) represents approximately 50% of groundfish consumption in the U.S. The chain restaurant component which requires consistent good quality products has shown the largest growth potential in recent years. One key product in this area is premium quality cod fillets. This segment consumes an estimated 100 million pounds of product, 25% of which is currently frozen at sea cod fillets. While Iceland and Norway could probably supply more frozen-at-sea products to this market, U.S. factory freezer trawlers are expected to increase their share. A reduced demand is expected for wetfish produced fish in this premium market segment.

The premium fillet market in the U.S. could be supplied by land frozen fish caught by wetfish trawlers, providing consistent top quality products can be maintained throughout the system. Historically the Atlantic fishing industry has not acheived this standard although many improvements have taken place in recent years.

In the past the Scandinavians have had an edge over Canadian exporters in the U.S. premium market segment. Icelanders for example are increasingly resorting to frozen-at-sea fish and are taking advantage of the growing trend in the U.S. for frozen-at-sea products. In the near future, one is likely to see a further shift in the premium fillet market towards frozen-at-sea. Canadian market share could be directly affected.

The perception among U.S. buyers is that frozen-at-sea cod fillets provide consistent high quality fish products for the premium market segments. Other market segments can be supplied by existing Canadian producers. The institutional segment of the U.S. market (schools, hospitals, military, etc.) represents about 20% of the U.S. groundfish consumption. This segment, which may decline, can be supplied with acceptable quality products from Canadian suppliers using fresh wetfish. Frozen-at-sea products would not normally be targeted for this market.

The retail segment (fresh and frozen) accounts for 30% of the U.S. market. The fastest growing component in the retail area is fresh fish. This market can also be supplied with existing inshore vessels and wetfish trawlers. Freezer or factory freezer trawlers are not required for this market segment. Although the

Icelanders may be targetting frozen skin on fillets to compete in this market segment.

Preliminary estimates for the U.S. frozen groundfish fillet market are as follows:

<u>U.S. Frozen Fillet Market (Million - lbs)</u>

	1981	1984	1987
Premium/ High Quality	70-80	90-100	180-230
Standard/ Lower Quality	250-260	245-265	180-200
TOTAL	320-340	335-365	360-430

(c) <u>Japanese Market</u>

A significant market potential for redfish exists in Japan which was once a 120,000 tonne market that declined to 20-30,000 tonnes due to a drastic decline in domestic landings. It is estimated that Japan could import 25-30,000 tonnes of H&G Atlantic redfish annually. The key market factor is consistent quality including color retention during the entire shelf-life of the product. Canada's redfish exports to Japan remain insignificant. Japan's imports from Cuba, Portugal, Iceland and Norway are currenly 6-8,000 tonnes.

Iceland and Norway are gearing up to expand this profitable business while both the Faroes and Greenland are currently involved in joint ventures with the Japanese that could supply up to 5,000 tonnes by 1986-87.

Although the total Scandanavian (Iceland, Norway, Faroes and Greenland) supply of redfish for Japan is expected to expand, significant potential still exists for Canadian products. In the near future, Canada could supply 5,000-10,000 tonnes annually to Japan providing the Canadian industry could:

a) utilize freezer or factory freezer trawler technology to product a high quality H&G product,
b) form some cooperative of joint venture arrangement with the Japanese; and,
c) maintain fisheries goodwill relations with Japan.

Exports of frozen Atlantic cod to Japan could also be feasible if processed by factory freezer trawlers and if costs and quality can be competitive.

d) West European Markets

European markets show potential for frozen at sea products such as turbot and H&G cod if frozen at sea. Turbot in interleaved fillets, H&G and block forms are popular in Europe. France and West Germany are the main importers (1 000 t per year) while Iceland and Scandinavian countries are the major suppliers. Some products are frozen at sea.

Canada's inability to effectively penetrate this market has been mainly due to the strength of the Canadian dollar relative to European currencies, the restrictive EEC tariff structure (i.e., 15% duty on turbot) and the high production costs of Canadian products.

The comparative cost advantage of a factory freezer trawler over a wetfish trawler could result in Canadian products, such as turbot fillets, becoming price-competitive in European markets. As present, Canada exports about 250 tonnes of turbot fillets to Europe (FRG, France, Sweden, Switzerland, Beneluc and the U.K.). Canadian frozen-at-sea products, could result in an increase of up to 3 000 tonnes or more per year.

It is also worth noting that Canada's exports of about 4 500 tonnes of frozen at sea H&G cod to the U.K. is one of the profitable Canadian seafood markets in Europe. The present volume is limited only by Canada's ability to produce. The market potential is estimated at 10 000 tonnes per year in the U.K. Canada's current production of this product comes from freezer trawlers.

(e) Other Markets:

In markets such as U.S.S.R. and G.D.R. Canada could also sell a great deal more H&G cod with frozen at sea fish. This option could alleviate pressure on the U.S. market thereby helping to keep prices firm. Egypt and other African countries also show potential for bulk frozen-at-sea products such as redfish. These products can be produced either by freezer trawlers (currently allowd under Canadian policy) or FFTs.

(f) Conclusion:

In conclusion, the major groundfish marketing opportunities facing Canada can be summarized as follows:

i) greater penetration into the premium quality fillet market in the U.S.;

ii) increased markets for H&G redfish, turbot and cod, harvested either with freezer or factory freezer trawler technology; and,

iii) increased sales of H&G cod to U.S.S.R. and G.D.R. (greater market options) again using either freezer or factory freezer trawlers.

From a marketing perspective, Canadian companies must increase frozen at sea production to increase or maintain profitable market segments that are not, presently, adequately serviced by Canadian producers using traditional wetfish technology. If Canada is unable to meet the competition, competitors will continue to expand their share of the premium quality seafood markets throughout the world.

3. Quality Considerations

While the perception remains among U.S. buyers that only frozen at sea fish can meet consistent high quality standards, there is, still, the question of whether the existing wetfish trawler/on-shore processing operations are capable of meeting consistent high quality standards.

To answer this question an attempt is made to define quality standards and compare the ability of the three technologies to produce to such standards.

Quality is generally defined as a degree of excellence or fitness for purpose; and for food products, is determined by its safety, nutritional value and acceptability. The latter includes attributes which either satisfy or do not satisfy the buyer of raw material or consumer products. Acceptability criteria include smell, taste, texture, appearance and defects in workmanship.

The smell, taste and texture attributes of fish are often described in terms of freshness or the lack thereof, that is the degree of spoilage which has occurred after death. For example, the odour characteristic of fresh fish becomes neutral, then stale and finally decomposed. The texture, while originally firm and resilient, becomes slightly soft, soft, generally soft and flabby and then mushy. Quality deterioration in this sense can be retarded by chilling, as is the practice on inshore vessels and wetfish trawlers and during holding prior to processing. Depending upon how soon after harvesting the fish are chilled, the fish will be of acceptable quality for up to two weeks under ideal conditions, with the peak freshness preserved for about three days. Decomposition can be stopped by the application of correct freezing techniques although, with time, flavour, odour and texture will deteriorate, depending on the storage temperature. Cold storage deterioration differs from spoilage in that cold store odours and flavours and texture toughening develop. The latter, as well as fillet shrinkage and drip loss may also result from processing pre-rigor, in-rigor and post-rigor fish, depending on a number of process controls.

For fish in particular, appearance and defects in workmanship are closely related. These are defined by colour of the flesh and the presence of jellied or chalky conditions and parasites; and, for fillets, surface texture, shape, gloss and translucency and by the presence of bones, fins, scales, bruises, blood spots, foreign material, etc. These defects in appearance or workmanship can be removed and/or controlled through correct raw material handling and processing practices, and by trimming/candling and inspection during processing.

All of these acceptability attributes and defects are used, either singly or in combination, to differentiate levels of acceptable quality and to identify reject material. The importance attached to each factor depends on product form, ultimate end use and the market for which the product is intended. Increased attention is now paid to appearance defects in the edible portion of fish as opposed to the appearance of the whole or dressed form.

The quality attributes and their absence or severity are influenced by a number of interdependent and related factors, all of which must be recognized and controlled if prime quality products are to be produced. These include intrinsic conditions at the time of harvesting (geographic location, season, age, size, sex, feed, nutritional status, level of energy reserved, etc.); harvesting methods (type of gear, time gear fishing, depth, volume of catch - particularly for other trawls - and whether the fish are alive or dead); post-harvesting and pre-processing considerations (rough onboard handling, effective bleeding and gutting, chilling and storage conditions, time between catching and processing, etc.); processing and freezing practices (type of product - fish, fillets or minces, processing steps - filleting, skinning, deboning, trimming, candling and packaging and time delays between steps, use of additives, type and rate of freezing, i.e. horizontal or vertical plates, blast, IQF, and post-mortem state of the fish, i.e. pre-rigor, in-rigor, or post-rigor); storage conditions (temperature, glazing); the workforce (training, pay, discipline and working environment); maintenance of equipment and a sanitary processing environment; and quality control and management practices and philosophy.

In addition to their impact on fish quality, all of these factors, and the complexity of their interactions, significantly influence processing yields, productivity and labour costs and product mix. High yields and productivity and products of high and consistent quality are significant factors in improving the economic viability of any processing enterprise.

Does freezing-at-sea produce superior quality products? As with any quality process it is the control of raw material quality, handling, processing, workmanship, freezing and storage which detemines the quality level of products. Consistent, superior quality products can be produced from fish which are alive when caught, gently and correctly handled onboard, properly bled, gutted and, if processing is not commenced promptly chilled. It must be processed and frozen according to good manufacturing practices. If these principles are followed, the highest possible quality may be produced by any type of vessel from the small inshore open boat to the factory freezer trawler. This has been demonstrated throughout Atlantic Canada during the past four years in quality improvement projects.

Specific concerns which will determine the quality of the product and influence the viability of the operation are addressed below.

Harvesting

The major harvesting factors which affect fish quality are the amount of fish caught during a single tow and the length of time between harvesting and bleeding/gutting. Recent experience with Northern cod has shown qualities approximating 75% Grade A, 15% Grade B, 10% Grade C fish when fish are first brought onboard, the downgrading being due almost entirely to the bruising in the fillet portion of the fish. The delay between harvesting and bleeding/gutting has a substantial effect on raw material quality. While a delay of one hour has little effect, a two-hour delay reduces the percentage of Grade A to 50%, and a delay of four hours reduces this further to 30%. Delays beyond four hours have no increased effect. The amount of fish caught in any one tow has a significant, although varying, effect. In general, tows of less that 45 t are of higher quality than larger tows because of the quality deterioration due to the delay betwen harvesting and bleeding/gutting.

The study cited above also noted that the quality of Northern cod when first brought onboard was similar to that of cod caught by inshore draggers in the Northeastern Gulf of St. Lawrence. It was also similar to fish caught by gillnets set on Cape Ballard Bank for 1-2 days, then bled, gutted and iced at-sea prior to being graded at dockside on the day of catching. However, it was slightly inferior to cod caught by baited hook on Cape Ballard Bank or by traps set on the Northeastern coast of Newfoundland and treated at-sea prior to being graded at dockside.

The quality of raw material determines the quality of the final product. A catch rate of up to 74 t per day may seriously affect the quality of final product if individual tows are large or long or the delay between taking on deck and bleeding/gutting exceeds one hour. Strict control of fishing operations will be required to minimize the degree of bruising and to facilitate the orderly bleeding and processing operations.

Bleeding

In order to obtain the desired premium quality, correct and prompt bleeding is essential. This has been shown for all freezer and factory freezer trawler operations in recent Icelandic experience with the latter type of vessel and is particularly true if fish or fillets are to be frozen pre-rigor. The fish require bleeding in cold seawater at or as close to 0°C as possible for between 30 minutes and one hour to obtain the desired flesh colour and to delay the onset of rigor. A somewhat longer time, eg. up to three hours has been noted on Icelandic vessels.

The method of bleeding may not be important in this instance; however, bleeding is facilitated if the heart remains active. Current Icelandic practice is to throat-cut and slit the belly, leaving the gut intact. If fish are to be held in ice to permit passage of rigor, the gut is removed.

Rigor Mortis/Buffer Storage/Freezing Whole Fish vs. Fillets

Changes caused by rigor mortis before fish are frozen may affect quality by causing; (1) toughness and high drip loss in frozen whole fish or fillets; (2) gaping (separation of individual muscle flakes) in fillets taken from frozen whole fish; and, (3) shrinkage of frozen fillets. These effects can be reduced or prevented by cooling the fish, especially before it enters rigor, handling carefully when in rigor and freezing pre-rigor fillets as soon as they are cut.

There appears to be no clear-cut answer to the questions of whether or not it is best to freeze fish or fillets pre-, in-, or post-rigor. The advantages and disadvantages of freezing fish or fillets under various rigor conditions are given in the Table.

Recent Icelandic experience indicates it is possible to freeze fillets pre-rigor without observing the deleterious effects of rigor if the fish is correctly bled and chilled and the fillets frozen without delay and processed and stored under ideal conditions.

If fish are to be processed post-rigor, buffer storage is required to hold the bled and gutted fish on ice for up to three days, necessitating a larger vessel. This is equivalent to current processing practices for onshore plants. Provided proper harvesting, handling and holding practices are followed premium quality products could be produced on land as well as at-sea.

Processing

Products most suitable for processing in factory freezer trawlers are: (1) skin-on and bone-in; (2) skin-off and boned (both packed as layer shatter packs or in 20-lb. blocks); (3) IQF large fillets; and, (4) H&G. The production of prime cuts and other value added products are difficult due to vessel operation circumstances as well as the weight tolerance required for such products can not be met with existing weigh scales for use on vessels. Trimming and candling operations are also impeded because of the unstable platform, and the wrapping and packaging of 1 or 5-lb. consumer packages is virtually impossible. The need to freeze product quickly also precludes the expenditure of much time on trimming and removal of bruises, blood spots and parasites and other workmanship defects such as bones or pieces of fin, scales, etc. Also fillets can not be returned for reworking because the process flow is dictated by catch rates, machine cutting and the necessity to freeze promptly.

Although restricted in product mix, factory freezer trawlers can produce high quality fillet packs provided the raw material is of the correct quality.

With the implementation of final product grading standards in 1986, procedures not currently used will have to be implemented to ensure the monitoring, inspection and labelling of products according to the grade standards.

The production of high quality, dressed cod, turbot, pollock and redfish should present no problems if the raw material is correctly harvested, handled and processed. In this instance, the vessel would be acting as a factory trawler.

Work Force

The quality of the final product will not be as high as expected unless there is good discipline amongst the workers and proper attention paid to all aspects of harvesting, handling and processing. This discipline and proper attention can only be maintained if the production capacity is not overloaded by high catches. Freezing must be completed correctly even if this means suspension of fishing operations.

Summary

The production of superior quality fish products requires that superior quality raw material be handled carefully, processed quickly and correctly, and packaged and graded consistently. It is not directly dependent upon vessel or processing facilities and can be achieved with or without facotry freezer trawler technology, utilizing freezer trawlers, wetfish trawlers or inshore vessels.

ANNEX 1 - RIGOR AND EFFECTS ON QUALITY

FROZEN WHOLE FISH

	Advantages	Disadvantages
Frozen pre-rigor	- buffer store not required - no gaping, except possibly from thaw rigor	- thaw rigor gaping possible - high drip loss may occur - large processing capacity required to cope with high catching rates
Frozen in-rigor	- uniformly good quality obtainable generally	- buffer store required - texture variation possible - gaping or broken fillets when fish are forcibly straightened or rigor temperature is high - pack less well in freezer
Frozen post-rigor	- uniformly good quality obtainable generally - danger of contraction damage avoidable	- buffer store required - gaping may occur when held too long or at too high a temperature before freezing

ANNEX I - RIGOR AND EFFECTS ON QUALITY (continued)

FROZEN FILLETS

	Advantages	Disadvantages
Frozen pre-rigor	- buffer store not required - fillets can be cut by hand or machine	- large processing capacity required to deal with high catching rates - fillets shrink when awaiting freezing or after thawing - rough cut surface - particularly unsuitable for smoking - may be high drip loss
Frozen in-rigor	- excellent quality possible - no shrinkage	- buffer store required - difficult to fillet by machine or by hand - less yield from hand filleting - usually suitable for smoking - bent fish yield gaping fillets
Frozen post-rigor	- uniformly high quality - no shrinkage - machine or hand filleting	- large buffer store required for up to 3 days - usually suitable for smoking

From Stroud, G.D. 1969. Rigor in Fish. The Effect on Quality. Torry Advisory Note No. 36, Torry Research Station, Aberdeen, Scotland.