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Economic Potential of the MacKenzie Delta Broad Whitefish Exploratory Fishery

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ECONOMIC POTENTIAL OF THE MACKENZIE DELTA BROAD WHITEFISH EXPLORATORY FISHERY

by

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ABSTRACT

Anderson, L.E. 1994. Economic potential of the Mackenzie Delta broad whitefish exploratory fishery. Can. Manuscr. Rep. Fish. Aquat. Sci. 2319: iv + 17 p.

A financial model of the Mackenzie Delta broad whitefish fishery is constructed. It shows that plant and collector vessel costs together account for 75% of the fishery's total costs. Without government support, the fishery would incur major losses and provide no revenue for fishermen. Break-even analysis is used to assess the changes in market prices or sales volumes required for financial viability. Fish from the Mackenzie Delta are not likely to command the price premium required to break even. Viability could be achieved through large increases in sales volumes, but this could threaten the sustainability of the fishery. The constraints to viable fishery development are: a small local market that is already met by local fishermen, high transportation and operating costs, and competition from lower-priced fish in southern markets. These constraints were first identified 20 years ago and have not been over come despite three previous attempts to develop larger scale commercial fisheries in the Mackenzie Delta.

Keywords: broad whitefish; *Coregonus nasus*; Mackenzie Delta; exploratory fishing; fishery development; financial analysis.

RÉSUMÉ

Anderson, L.E. 1994. Economic potential of the Mackenzie Delta broad whitefish exploratory fishery. Can. Manuscr. Rep. Fish. Aquat. Sci. 2319: iv + 17 p.

L'auteur élabore un modèle financier de la pêche au corégone tschir du delta Mackenzie. Ce modèle montre que les coûts de transformation en usine et d'exploitation des navires de collecte représentent 75 p. 100 des coûts totaux de la pêche. Sans l'aide gouvernementale, le secteur essuierait d'importantes pertes et ne pourrait pas faire vivre les pêcheurs. L'auteur a recours à une analyse du seuil de rentabilité pour déterminer les changements qu'il faudrait apporter aux prix du marché ou aux volumes de vente pour permettre la viabilité économique. Il y a peu de chances que le poisson du delta Mackenzie se vende au prix nécessaire pour atteindre le seuil de rentabilité. La viabilité pourrait être obtenue au moyen d'une importante augmentation des volumes de vente, mais, en procédant ainsi, on menacerait la durabilité de l'industrie de la pêche. Les obstacles à l'expansion et à la viabilité de la pêche sont les suivants: besoins du petit marché local déjà comblés par les pêcheurs de la région; coûts de transport et d'exploitation très élevés, concurrence de poissons meilleur marché sur les marchés du sud. Ces obstacles avaient déjà été cernés il y a 20 ans. Cependant, on n'a pas encore réussi à les surmonter, malgré trois tentatives d'accroître l'envergure de la pêche commerciale dans le delta Mackenzie.

Mots clés: corégone tschir; *Coregonus nasus*; delta Mackenzie; pêche d'exploration; expansion de l'industrie de la pêche; analyse financière.

INTRODUCTION

The Mackenzie Delta fishery comprises several small community-based subsistence fisheries. There is also a modest commercial component in that fishermen sometimes sell surplus harvests in local markets to supplement their subsistence activities. Broad whitefish (*Coregonus nasus*) is the most sought-after species of both the subsistence and commercial fisheries of the Mackenzie Delta because it is cyst-free, and is available at predictable times and locations (Stewart et al. 1993). Other commonly harvested species include lake whitefish (*Coregonus clupeaformis*), inconnu (*Stenodus leucichthys*) and northern pike (*Esox lucius*).

There have been a number of attempts to develop larger-scale and export commercial fisheries in the region, but none have achieved economic viability. The small local market, poor product quality and high production and transportation costs are believed to be the reasons for these failures (Stewart et al. 1993). This report examines the most recent attempt, a pilot project carried out under the Department of Fisheries and Oceans' (DFO) exploratory fishery program. The operation of the fishery is described, its operating expenses and revenues for the years 1989 to 1992 are analyzed, and a financial model of the fishery is constructed. The fishery's potential is determined by finding the market prices or sales volumes required for viability.

BACKGROUND

Inuvik is located on the East Channel of the Mackenzie Delta and has a population of 3306 (GNWT 1991) with an ethnic distribution of 10% Gwich'in, 10% Metis, 33% Inuit, and 47% non-native (Outcrop Ltd. 1990). The Inuvialuit and the Gwich'in traditionally fished and hunted in the area around Inuvik, but the community was not established until the 1950s. Prior to this, Aklavik was the main trading, transportation and government administrative centre of the Mackenzie Delta. Due to serious flooding and erosion problems in Aklavik, suitable building sites were limited, making further growth impossible. In 1954 the federal government decided to move the community to the present site of Inuvik. By 1961, all major government facilities had been transferred and Inuvik was quickly established as the new administrative and transportation centre for the area (Outcrop Ltd. 1990). Many people resisted movement from Aklavik, and today the community has a population of 805 (GNWT 1991).

Attempts to develop commercial fisheries in the Inuvik area began shortly after the community was established. Bissett (1967) documented the earliest efforts, starting with a whitefish fishery at Holmes Creek on the East Channel (90 miles north of Inuvik) conducted by the Department of Northern Affairs in 1962. A total of 19 255 kg of whitefish were harvested and sold in Inuvik at $0.77/kg for fillets and $0.48/kg for whole fish. The fishery was constrained by the small local market, and the lack of a regional marketing system to provide access to southern Canadian markets.

In 1965 and 1966, a privately operated commercial whitefish and Arctic charr fishery was undertaken. The central area of the Delta between Aklavik and Inuvik was fished for whitefish, and Pauline Cove on Herschel Island and Ptarmigan Bay on the Yukon coast were fished for Arctic charr. Fish were collected by packer vessel on a weekly basis, and the production was iced and packed in plastic bags for air shipment to Edmonton. In the first year, 7 295 kg of Arctic charr and 9 040 kg of whitefish were

harvested and sold for a total of $14 166. These revenues were more than offset by the loss of the collection boat in drift ice off Herschel Island and the high air transportation costs. The second year saw continued technical and mechanical problems, high operating costs, and low harvest levels. Many fishermen left the fishery because casual employment paying up to $526/month was available in Inuvik that summer (Bissett 1967).

There were no further attempts to establish an organized commercial fishery until 1972. By then the Territorial Government was emphasizing commercial fishing for the local market only and providing support for subsistence fisheries (Davies et al. 1986). The Holmes Creek fishery was re-opened and over the next three years a total of 26 000 kg was harvested. Most was sold in Inuvik, but in 1974, 10 500 kg was sold to the Freshwater Fish Marketing Corporation (FFMC) in Winnipeg. Although the quota was taken each year, the fishery proved uneconomical and was closed (Davis et al. 1986).

Through the late 1970s and the 1980s, commercial fisheries operated on a small, local scale, with fish mostly being sold by subsistence fishermen holding commercial licences and seeking to earn cash incomes to help offset their cash costs of fishing for food. Some fish were reportedly sold to a country food store that periodically operated in Inuvik during that time. In 1988, a private entrepreneur arranged to purchase and ship fish to Whitehorse, Yukon, but the undertaking was constrained by its high costs, equipment problems, and an apparent lack of fishermen interest (Stewart et al. 1993).

The most recent effort to develop the fishery was initiated in 1988, when DFO was approached by the Renewable Resources Economic Development Project, established by the Inuvialuit after the settlement of their claim, with a proposal to harvest Mackenzie Delta fish for marketing in Ontario and Quebec. The impetus for this proposal came from the interest in fresh northern fish expressed by a distributor/broker in Ontario who had attended a GNWT promotional foods banquet in Toronto. In the broker's opinion, although northern species are not distinguishable from their southern counterparts on the basis of taste or texture, the fact they originated in the Arctic would create a demand for the product.

The initial proposal was quite modest, suggesting a small scale fishery for broad whitefish, whitefish and northern pike. It was felt that a pilot project approach was appropriate because of a number of constraints to the development of a fishery in the Delta area: (1) there were no organized commercial fisheries in the area at the time, (2) the proponent had no prior experience in handling fresh fish and were uncertain as to the costs and benefits, and (3) the plant at Inuvik could not be made operational where it was located because of zoning restrictions. It was recognized that the cost of relocation of the plant or new investment could only be justified if a sizable market were established.

DFO (1989) identified areas of concern that needed to be addressed if a sustainable commercial fishery were to be established:

- existing information suggested that several distinct stocks may occur in the proposed harvest area and further research was required to delineate stocks so that scheduled harvests

could be designated in accordance with each stock and area;

- existing commercial quotas could not be substantiated with the biological data extant at that time;

- there was inadequate information on subsistence harvest levels by species and community;

- regulation and boundary changes would be required for commercial zones within the Delta to meet the terms and conditions of the Inuvialuit Final Agreement. Such changes would influence the quotas available for the proposed commercial fisheries.

In view of the above concerns and those raised in the initial proposal, DFO and the Fisheries Joint Management Committee (FJMC) recommended a three to five year test fishery/pilot project be conducted. DFO subsequently granted permission to the Inuvik Hunters and Trappers' Committee (HTC) to conduct an exploratory fishery in the Horseshoe Bend area of the Middle Channel (Fig. 1) where a number of traditional fishing camps are located and a fall subsistence fishery is customary.

METHODS

A financial model of the Mackenzie Delta fishery was developed based on data provided by the proponents to meet the reporting requirements of the funding agencies supporting the project. Additional information was obtained by the author's observation of the 1992 fishery. The model uses a "market-back" approach in which the costs of the processing plant and the collector vessel are subtracted from the wholesale market value of the fishery's production to determine the amount available to fishermen. The amount available to fishermen, less their fishing costs, provides an estimate of the return to fishermen's labour.

The model is designed to predict the performance of the fishery once it has progressed past the exploratory/pilot study phase and is a fully operational market-driven commercial fishery utilizing the entire quota available in the Horseshoe Bend area of the Middle Channel. Those expenses that would not normally be incurred in a commercial fishery (e.g. biological sampling required under the exploratory licence, coordinator and trainer salaries, etc.) and government grants and contributions are therefore excluded. Data were unavailable on the fixed costs of the plant and collector vessel and on fishing costs, so these were estimated. The simplifying assumptions made to construct the model and the methods used to estimate costs are presented in Appendix 1.

Break-even analysis is used to assess the potential of the Mackenzie Delta fishery to become a viable fishery in the absence of government support, capable of providing fishermen with cash incomes sufficient to cover their labour input and the entire annual capital cost of their fishing equipment. This approach addresses the stated goal of this and many other northern commercial fishery development initiatives of providing fishermen with sufficient cash incomes to cover the costs of subsistence fishing. By varying the sales volumes and market prices used in the financial model of the fishery, break-even analysis determines the changes in

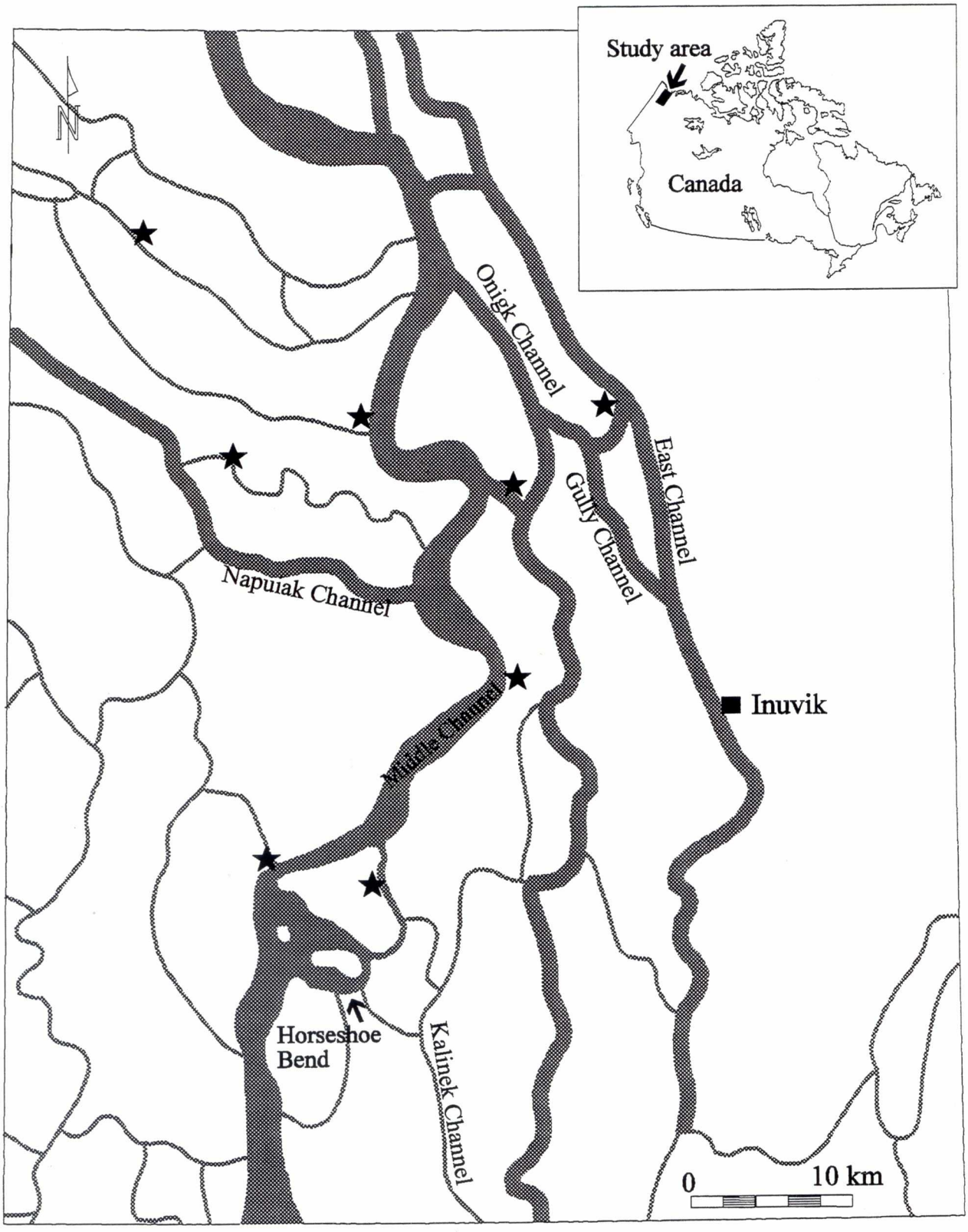

Fig. 1. Mackenzie Delta exploratory fishery broad whitefish fishing camps.

market conditions required for the fishery development to meet this goal.

A reasonable return for fishermen, after covering their variable and fixed fishing costs, was arbitrarily set at $60/day (based on $7.50/hour and an eight hour day) for the purpose of this analysis. When calculating break-even prices, all other variables in the base case model were held constant. When calculating break-even sales volumes, ideally all variable costs in the model would be adjusted according to changes in sales volumes. However, available data permitted only plant labour costs and freight costs to be varied as sales volumes were increased (Appendix 1). The effect is to underestimate by an unknown amount the sales volumes required to break even.

The break-even analysis was done under three possible scenarios: fresh dressed fish sold in an export market; frozen dressed fish sold in the local market; and frozen vacuum-packed fillets sold in the local market. For each scenario, the increase over 1991 prices or the 1992 quotas that would be required to provide a reasonable return to fishermen was determined. Also examined was the level of public subsidy that would be required if prices and sales volumes remain constaint.

RESULTS

DESCRIPTION OF THE FISHERY

Fishing began on August 30, 1989, but had to be stopped two days later for collector vessel repairs. Fishing resumed on September 6 for another three days. Total harvests that year were 14 367 round equivalent kilograms (rd kg) of broad whitefish, lake whitefish, inconnu and northern pike (Table 1). This represented about 42 percent of the total quota of 16 000 rd kg for broad whitefish and 6 000 rd kg each for lake whitefish, northern pike and inconnu. The six fishermen and their helpers operated from five fishing camps, and were paid a total of $12 932 for this harvest. Sales to the FFMC totalled $16 320, including agency fees.

Funding under the Canada-Northwest Territories Economic Development Agreement (EDA) was obtained to support the pilot project. Additional funding and support were provided by the GNWT's Departments of Economic Development and Tourism (ED&T) and Renewable Resources (DRR) as well as by DFO.

The project continued in 1990, with the Uummarmiut Development Corporation (UDC) as the proponent instead of the Inuvik HTC. UDC is the business arm of the Inuvik Community Corporation that undertakes renewable resource business projects on behalf of the Inuvialuit residents of Inuvik. Funding and support were again provided by the EDA, ED&T, DRR and DFO. Additional funding was furnished by the Inuvik HTC, and the GNWT Department of Public Works agreed to provide technical expertise if the collector vessel used in the project experienced mechanical difficulties. Also in 1990, DFO undertook an intensive biological monitoring project with the objective of being able to provide biological advice on commercial quota changes at the end of the exploratory fishing period. DFO provided the technical expertise for the biological aspects, while the operating costs were shared between the EDA, ED&T, DRR and the FJMC.

Table 1. Mackenzie Delta exploratory fishery harvests, 1989-1992.

	1989	1990	1991	1992
		(rd kg)		
Broad whitefish	5 781	13 101	19 234	17 797
Lake whitefish	6 451	0	0	0
Northern pike	1 661	7 184	8 757	9 086
Inconnu	474	1 042	2 187	2 160
Total	14 367	21 327	30 178	29 043

Source: DFO

There were nine commercial fishermen with helpers operating from six fishing camps involved in the project. Fishing took place between September 14 and October 2, 1990. Mechanical problems with the collector vessel continued to plague the project, but these were rectified by the purchase and installation of a new motor. A total of 21 327 rd kg of broad whitefish, northern pike, and inconnu were harvested, earning the fishing camps a total of $21 284. These fish were sold to the FFMC for $26 930, including agency fees. The UDC decided that they would exclude lake whitefish from the pilot project because of their high cyst *(Triaenophorus crassus)* count which lowers their market acceptance and value.

In 1991 the pilot project continued with the UDC as the proponent. Quotas were increased to 20 450 rd kg and 10 200 rd kg for broad whitefish and northern pike respectively, while the quota for inconnu was lowered to 3 400 rd kg. The fishing season extended from September 6 to 28, and the total harvest increased slightly over the previous year to 30 178 rd kg. The eight fishermen and their helpers, who operated from seven fishing camps, earned a total of $29 338. Most of the fish was sold to the FFMC, earning the project $42 164, including agency fees. In addition, 1 213 kg of frozen dressed whitefish and 79 kg of frozen dressed inconnu were made available to the local market in 1991. Stanton's Distributing Co. Ltd., a subsidiary of the Inuvialuit Development Corporation, agreed to sell this fish on consignment. Sales proved to be disappointing, and 90% of the fish was either donated to the elders' home or used as dog food.

Commercial fishing began again on September 4, 1992 and ended on September 21 when it was discontinued due to severe weather conditions. Six fishermen and their helpers operating out of five fishing camps harvested 17 797 rd kg of broad whitefish, 9 086 rd kg of northern pike, and 2 160 rd kg of inconnu for which they were paid a total of $29 141. Most of the fish was shipped to the FFMC, but approximately 2 300 kg of whitefish and inconnu were processed into vacuum-packed fillets and steaks for the local market. Local wholesale prices were set at $2.50/lb ($5.51/kg) for whitefish and $4.00/lb ($8.82/kg) for inconnu. As of March 31, 1993, local sales had totalled $5 858 with approximately $4 000 worth of fillets still in inventory.

The operation of the fishery evolved over the course of the pilot project as various fishing techniques and operating procedures were tried and abandoned. Fishermen operated from their own fishing camps and used their own boats, motors and other equipment, but were provided with nets owned by the UDC. Nets were normally set and checked twice each day. Harvests of

broad whitefish, northern pike and inconnu were dressed by the fishermen and their helpers and iced in FFMC fish boxes. The boxes were stored in larger plywood boxes to protect the fish from gulls and other animals while awaiting pick up by the collector vessel. By 1992, harvests of lake whitefish were not transported to Inuvik, but were kept by the fishermen for dog food. Most camps were making either stick fish, where fish are skewered on sticks and hung to dry and freeze, or pit fish, where fish are stored in a hole dug into the permafrost. Both stick fish and pit fish are used for dog food.

The collector vessel was a 32 foot aluminum-hulled "bowpicker" owned by DRR called the Northwind. Once a day, seven days a week, the Northwind made a circuit from Inuvik to each of the fishing camps and back to Inuvik. The fish was transported from the dock in Inuvik by leased truck to the fish plant where it was either re-iced and stored in waxed cardboard boxes in the plant's cold room until enough was accumulated for a truck load, or it was processed for the local market. The processing included freezing whole (for later steaking) or filleting and then freezing.

The UDC oversaw the operation of the fish plant and the collector vessel. The building in which the fish plant was housed is owned by the GNWT, but is under a long term lease to Umayot Corporation, another Inuvialuit development subsidiary. Umayot owns most of the equipment in the fish plant and has previously used the facility for storage and for processing caribou, whale and muskox. The plant and equipment were provided to UDC free of charge.

It took anywhere from two to five days for enough fish to be caught to make up a truck load. Once sufficient quantity had accumulated, the fish was trucked to Winnipeg. Total travelling time from Inuvik to Winnipeg ranged from four to seven days. The assessment of the FFMC was that most of the fish was not suitable for fresh sale by the time it reached Winnipeg. However, on those occasions when the transportation time was minimized, the fish was considered to be of excellent quality, despite having travelled close to 5 000 kilometers and being out of the water five to seven days.

OPERATING COSTS AND REVENUES

Available data on the variable operating costs of the collector vessel and the fish plant, as well as the revenues for fish sales and agency fees are listed in Table 2. Data on fishing costs were not collected as part of this project. Also excluded are the values of the technical expertise and the capital equipment which were donated to the project. In addition, some capital equipment was purchased for the project (Table 3), but depreciation expenses for these were not reported by the projects proponents, nor are they reported in Table 2. Despite these omissions, the data clearly indicate that even in the short run the fishery could not continue to operate without government support.

PUBLIC FUNDING

The 1985-1990 EDA contributed $139 000 for the first 2 years of the pilot project with the stated objective of assessing the technical, economic and logistical parameters of a commercial fishery for broad whitefish. The current EDA (1991-1996) budgeted a further $500 000 to the project, of which $255 000 had been spent by the end of the 1992 fishery. The objective of the second EDA

Table 2. Mackenzie Delta exploratory fishery and pilot project reported costs and revenues.[a]

	1989	1990	1991	1992
VESSEL OPERATING EXPENSES				
Vessel lease	-	-	$5 000	-
Labour	$10 902	$10 705	$15 049	$7 120
Fuel, oil, food, etc.	$7 323	$10 185	$11 857	$8 285
PLANT OPERATING EXPENSES				
Fish Purchases	$12 932	$21 284	$29 338	$29 141
Truck Rental	$2 409	$4 233	$4 396	$4 686
Labour	$5 171	$9 926	$11 653	$15 749
Plant Supplies	$1 760	$730	$3 542	$1 903
Utilities	$2 265	$3 160	$3 898	$2 772
Freight	$7 097	$10 519	$12 521	$10 119
ADMINISTRATIVE AND MISC.				
Salaries				
- Project Administrator	-	-	$5 000	$7 701
- Coordinator Trainer	$25 000	$17 626	$18 864	$12 000
- Coordinator Trainee	-	-	$6 537	-
- Admin. & Office Staff	-	$2 700	$1 800	-
Employer's Share	-	-	$5 247	$4 547
Office Supplies	-	$192	$97	$47
Communications	-	$431	$1 028	$693
Insurance	-	-	$1 250	$1 350
Bank Charges	-	$133	$216	$12
Miscellaneous	$2 076	$200	$570	$119
TOTAL VARIABLE COSTS	$76 935	$92 022	$137 864	$106 243
REVENUES				
FFMC Fish Sales	$12 105	$26 930 [b]	$33 731	$28 273
Local Fish Sales	-	-	$282	$5 858
FFMC Agency Fees	$4 216	-	$8 430	$4 989
TOTAL REVENUES	$16 321	$26 930	$42 443	$39 120
REVENUES NET OF REPORTED COSTS	- $60 614	- $65 092	- $95 421	- $67 123

[a] reported costs do not include capital expenditures (Table 3) or fishing costs

[b] Includes FFMC agency fees

Source: UDC Mackenzie Delta Test Fishery Reports

Table 3. Record of capital expenditures.

	1989	1990	1991	1992
New engine for vessel	-	-	$9 697	-
Vessel repairs	$5 028	-	-	$1 225
Equipment	-	$24 020	$12 437	$12 726
Nets	$4 582	-	-	-
Ice making machine	$17 031	-	$25 766	-
Plant renovations	$19 455	$12 053	$4 274	$4 855
Total	$46 096	$36 073	$52 174	$18 806

project was to establish the foundation for a viable commercial fishery in the Delta. Anticipated benefits included new income and employment opportunities, promoting fishing to provide a potentially stable source of income, and creating additional exports to southern Canada.

ED&T financial support for the project in 1989 to 1992 totalled $137 000 (Table 4). This was justified on the basis of import-substitution and encouragement of traditional subsistence harvesting. It was estimated that approximately 20% of the total production would be devoted to the local market, although it was recognized that market predictions were unproven at that time. It was also estimated that the fishery would provide a cash pool of about $40 000 for 30 people (fishermen and their families) pursuing a traditional subsistence fishery.

The project also received support in the form of donated labour and equipment. The value of some of this support was estimated (Table 4), but much of it could not be quantified. This included an unknown amount of labour from GNWT Departments of Public Works, ED&T, and Renewable Resources; administrative services from UDC and the Inuvik HTC; and the value of the project's free use of the fish plant, vacuum packer, band saw, freezer, cold storage room, and other equipment owned by the Umayot Corporation.

During the 4 years of 1989 to 1992 the fishery was supported by public funds totalling $535 398 plus donated equipment and labour with an estimated value of $115 500 (Table 4). Including cash contributions in 1993 and the non-valued donated equipment and labour throughout the 5 year project, a total of over $800 000 has probably been spent in an effort to develop the Mackenzie Delta broad whitefish fishery.

FINANCIAL ANALYSIS

A financial model of the base case Mackenzie Delta fishery is presented in Table 5. It provides a useful picture of the cost structure of the Mackenzie Delta fishery. A significant feature of this structure is that the plant and collector vessels costs together account for 75% of the fishery's total costs. It is also apparent that in the absence of government support, the fishery would incur major losses and provide no

revenue for fishermen. Even if fishermen received the total wholesale revenues from fish sales (ie. if the plant and collector vessel costs were zero), their return after covering the fixed and variable costs of fishing would be $14/day, or the equivalent of $1.75/hour.

Table 4. Summary of funding and support to the Mackenzie Delta exploratory fishery, by agency, 1989-1992 total.

Agency	Type of Support	Amount
EDA	Financial	$393 692
ED&T	Financial	136 706
Inuvik HTC	Financial	5 000
DRR	Equipment	40 000[a]
DFO	Labour	30 000[a]
FJMC	Contract	42 000
FFMC	Equipment	3 500
Total		$650 898

[a] estimated

Source: UDC Mackenzie Delta test fishery reports

Break-even analysis

The base case model clearly indicates that if harvest levels, operating costs and market prices remain at their 1991 levels, the fishery will never be a viable fishery capable of providing fishermen with cash incomes sufficient to cover all the costs of subsistence fishing. The results of the break-even analysis (Table 6) suggest that significant increases in market prices or sales are required for viability.

Export market: In 1991 the FFMC prices, including final payments, were $1.26, $1.59 and $2.77 per kilogram (f.o.b. Winnipeg) for broad whitefish, northern pike and inconnu respectively. Break-even analysis reveals that if the total available quota (34 050 rd kg) were delivered to the FFMC, prices would have to increase by over four times to generate revenues sufficient to cover all the costs of the fishery and provide an adequate return to labour for fishermen. Based on past trends of FFMC prices, an increase of this size is not likely. Whitefish, northern pike and inconnu prices have all fluctuated over the past several years, but only inconnu prices were higher in 1991 than in 1987, and only by 7%. Prices for all species dropped in 1992 and again in 1993.

Table 5. Financial model of the base case Mackenzie Delta fishery.

Item of Revenue or Expense	
Plant & Collector Vessel Operations	
Gross wholesale revenues	$51 403
Plant variable costs	$54 852
Plant fixed costs	29 889
Vessel variable costs	26 906
Vessel fixed costs	15 000
Total plant & vessel costs	$126 647
Fishing Operations	
Net available for fishermen	-$75 244
Fishing variable costs	16 160
Fishing fixed costs	25 436
Total fishing costs	$41 596
Total net return from fishing	-$116 840
Return per camp	-14 605
Return per fisherman	-4 868
Return per fisherman per day	-270

Table 6. Break-even analysis to determine price or sales volumes increases required to meet target returns to fishermen in the Mackenzie Delta fishery.

		Break-even Wholesale Prices[a] ($/kg product weight)	Break-even Sales Volume[b] (rd kg)
Export market	Broad whitefish	$5.43	121 678
	Northern pike	$6.85	60 690
	Inconnu	$11.94	20 230
	Increase over base case	330%	495%
Local market	Broad whitefish	$8.84	69 326
	Inconnu	$17.68	11 526
	Increase over base case	160%	239%
Value added	Broad whitefish	$16.26	536 813
	Inconnu	$32.52	89 250
	Increase over base case	171%	2525%

[a] assuming prices for all species increase by the same percentage
[b] assuming sales volumes for all species increase by the same percentage

The alternative to higher market prices is increased production. Break-even analysis indicates that sales volumes would have to increase by 495% over those in the base case. Since the mandate of the FFMC specifies that it must purchase all fish delivered to it (although UDC opted out of selling to the FFMC in 1993), market size is not likely to be the limiting factor. Instead, sustainability of the fishery becomes the issue. Sales of the volume required to break even would required a combined quota for broad whitefish, northern pike and inconnu of 202 598 rd kg, about six times the current available quota.

Local market: In 1991 whole frozen broad whitefish and inconnu were available to Inuvik residents at retail prices of $3.40/kg and $6.80/kg respectively. The local market is limited to these two species because northern pike and lake whitefish are normally only fed to dogs. If the fishery's entire production of broad whitefish and inconnu was to be sold locally, because of the market's limited size, most would have to be frozen so that sales could be spread over a period of several months. This would increase the plant's labour costs. The net effect of the freight cost savings and the extra labour costs is an increase of $7 355 in the plant's variable costs.

At the maximum sales volumes possible with the current quota (19 875 dressed kg), the wholesale prices required to cover the total costs of the fishery would be $8.84/kg for broad whitefish and $17.68/kg for inconnu. Alternatively, if the fish plant received the retail prices set in 1991, sales volumes would have to increase about 3½ times to break even, again raising the question of sustainability.

Value added production: Processing the total harvest of broad whitefish and inconnu into vacuum packed fillets increases the plant variable costs from $53 529 in the base case to $70 825. Value added production is examined in the context of the local market because this eliminates the freight costs associated with sales to an export market. With this increase in costs, and assuming that the total production could be sold in the local market, wholesale prices of $16.26/kg for broad whitefish fillets and $32.52/kg for inconnu fillets would be required to break even.

Alternatively, if local prices were set to $6/kg for whitefish fillets and $12/kg for inconnu fillets (which are the fillet weight equivalents to the dressed weight local prices in 1991), the fishery could break even only if local sales increased to about $2 million annually. Sales revenues of that magnitude would require harvests of 626 063 rd kg, or about 26 times the current quota. Both the sustainability of a fishery of this size and the ability of the local market to absorb this quantity are highly questionable.

Public funding requirement: Until break-even prices or sales volumes are achieved, continuation of the fishery requires on-going government support. Financial analysis reveals that, if prices are held at 1991 levels and sales volumes are limited by the current available quota, an export fishery would require additional revenues of $146 000 to cover all the fishery's costs and provide a reasonable return to fishermen. Alternatively, annual transfer payments totalling $117 000 would be required to assure the long term operation of a fishery serving the local market with whole frozen dressed fish, assuming the local market could absorb the total quota at prices set in 1991. If the harvest were instead processed into vacuum-packed fillets for the local market, because of the increased production costs, the annual level of government support required for viability increases to $161 000.

In return for these on-going transfers, approximately 24 fishermen would receive a total of $9 000 in returns to labour and $25 000 to cover the total capital costs of their fishing equipment (ie. average fishermen's earnings after covering their variable fishing costs would be about $1 040). In addition, an estimated 28 person-weeks of employment is provided to plant workers and vessel crew hands.

DISCUSSION

In order for a fishery to be economically viable it must be possible to harvest, process, and distribute the fish products such that the participants earn a reasonable return and, at the same time, consumers obtain an acceptable product at a price that is comparable to similar goods (Anderson 1986). Suggested options to improve the viability of the Mackenzie Delta broad whitefish fishery are increasing sales or prices in export markets, increasing sales or prices in the local market, or increased production of

value-added products. Each option was explored using break-even analysis and the results suggest that the fishery's viability will depend on continued government support.

Prices paid by the FFMC are too low to generate revenues high enough to cover the high costs of operating the fishery. The alternative of developing a new export market, where northern fish would command a premium price, was suggested to increase the returns from the Mackenzie Delta fishery, but over the 5-year pilot project, no such market was found. A study of the production and marketing of country foods carried out on contract for ED&T (Deloitte Haskins & Sells 1988) offers an explanation. The contractor interviewed restaurant chefs, airlines and food suppliers in Edmonton, Vancouver and Montreal to determine southern impressions of country foods from the north and the most important factors influencing their purchasing decisions. The results indicated that, with the exception of Arctic charr, demand is not created for northern fish products by virtue of their being from the Arctic, nor do these products command a premium price. Freshwater fish from the N.W.T. has to compete with that from the south on the basis of price, quality and consistency of supply. This is consistent with the FFMC's findings that the samples of broad whitefish they received in 1989 were not superior to the lake whitefish they normally receive from southern lakes (B. Popko, FFMC, Winnipeg, pers. comm.).

It is not realistic therefore, to expect that Mackenzie Delta fish could command a market price premium of the magnitude required to break-even. A more realistic assumption is that the fishery's production must be priced competitively with other whitefish and substitute fish products from more accessible, southern locales. Unfortunately, the constraints to producing a competitively priced product from the Delta fishery appear intractable: input costs generally are much higher in the north; there are no economies of scale by virtue of the small size of the fish stocks available for commercial development; harvesting is organized for subsistence production rather than economic efficiency; transportation costs are large in relation to the value of the final product; and a permanent fishery infrastructure is lacking.

On the surface, a commercial fishery developed for local consumption would appear to be a more realistic approach, potentially contributing to local self-sufficiency and import substitution, while freed of competitive pressures and high transportation costs in the export market. In practice however, the local market is extremely limited because of the availability of fish through the subsistence and non-native domestic fisheries, and Inuvik's small population. In 1990, for example, an estimated 16 420 broad whitefish, inconnu, and northern pike were harvested by subsistence fishermen in Inuvik (Fabijan 1991), providing approximately 46 tonnes of fish to the community.

The country foods store in Inuvik was initially seen as an local retail outlet for some of the project's production. This store operates only periodically and is currently defunct, evidence of the logistical and economic difficulties of servicing this market. Sales through Stanton's Distributing in 1991 were disappointing, but were not considered indicative of the local market potential because Stanton's is a wholesaler not typically visited by consumers, and advertising was limited to the posting of signs around

town for a short time period. The expectation was that sales would increase if the fish were processed into steaks and fillets and sold through a retail outlet, but sales at the Northern Store in 1992 indicated that the forecasted local market potential was exaggerated.

Value added production is commonly suggested in development proposals because of the local employment it generates. However, increasing employment also increases plant operating costs, and higher revenues are required for the fishery to break even. Local sales of fillets, like local sales of dressed fish, are limited by the Inuvik's small population and the general availability of fish from the subsistence and domestic fisheries. The export market, while not as limiting in terms of volume, would require that fillet prices be competitive with other fish, and would involve the additional and significant cost of transportation. Value added production shows little potential for the Mackenzie Delta fishery given its current cost structures.

CONCLUSIONS

Over 20 years ago, Bissett (1967) assessed the potential for a viable commercial fishery in the Mackenzie Delta. In his view there were a number of constraints to such a development: the local market was small and was at least partially met by local fishermen; large transportation costs were involved in reaching outside markets where there was competition from lower-priced fish; and heavy investment would be required in collection boats, blast freezers and storage facilities. Bissett also noted that the Department of Fisheries had expressed considerable reservations about the feasibility of a commercial fishery in the lower Mackenzie Region because the volumes of exportable fish for a viable enterprise were significant (at least 227 000 kg), and the domestic requirements for human consumption and dog food were high.

Available information on the financial aspects of the 1989-1993 Mackenzie Delta exploratory fishery, augmented with estimated cost data in this report, indicate that the constraints to commercial development have not changed. In order for the Delta fishery to continue there will be a need for one or more of (a) ongoing external funding to supplement market revenues, (b) external funding support for plant infrastructure investment and operation, and (c) a willingness of fishermen to participate for nominal cash returns for their labour and capital investments. The financial analysis conducted here suggests funding of over $100 000 will be required each year for the fishery to operate at current market prices and available quota. Further, there is a disparity between government transfers and the local benefits generated as a result of the fishery's cost structure. While some employment is generated in the community, much of the government support for the fishery is diverted to the high costs of acquiring and maintaining capital equipment.

This raises the question of the efficiency of commercial fishery development as a means to provide cash support to the subsistence fishery. The subsistence fishery and its commercial component in which surplus harvests are sold locally may offer the best fishery development option for the Mackenzie Delta. This is especially true since the volume of harvests required for an export fishery to be viable would encroach

on the quantity available for the subsistence fishery, which under the terms of the Inuvialuit Final Agreement, must be given first priority in allocation of the amount available for harvest.

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APPENDIX 1. BASE CASE FINANCIAL MODEL AND BREAK-EVEN ANALYSIS.

Constructing the base case financial model (Table 5) and the manipulation of this model to determine break-even prices and harvest levels (Table 6) required the estimation of several of the fishery's costs and revenues. The assumptions and processes behind these estimates are described below.

PLANT AND COLLECTOR VESSEL OPERATIONS

Gross wholesale revenues

The base case model assumes that the entire available quota is harvested and sold to the FFMC. Prices and agency fees are set to their 1991 levels.

Plant variable costs

All variable costs except labour and freight are assumed to be equal to those reported for 1991 (Table 2), despite the increased volumes assumed for the model. This implies that all other variable costs are independent of volume, a simplifying assumption made necessary by the data limitations. The effect on the analysis is to under-estimate by an unknown amount the total variable costs.

In a fully operational commercial fishery it is assumed that administrative staff would be reduced to a fishery coordinator/plant manager and a bookkeeper/office manager. Salaries for the two positions are assumed to be $1 500 and $1 000 per week respectively, and the term of employment is set to six weeks.

Average labour costs for producing fresh dressed fish for sale to the FFMC are set to the average labour costs in 1989 ($0.41/dressed kg), when no value added processing was done. For the break-even analysis, the labour costs of producing frozen dressed fillets for sale in the local market are based on the labour costs attributed to glazing, freezing and packaging fish for the local market in 1991 ($1 653 to process 1 282 kg of dressed whitefish and inconnu = $1.29/dressed kg). The labour cost of preparing vacuum packed fillets for the local market is estimated to be $2.97 per rd eq kg based on FFMC labour cost data. Total labour costs are calculated by multiplying the average per kg labour costs by the volume of fish processed.

Freight costs for the base case and the examination of export markets in the break-even analysis are based on the average rate in 1991 ($0.51/dressed kg).

Plant fixed costs

The project has been allowed to use the fish plant and much of the equipment it contains free of charge and UDC reports provide no estimate of the value of this contribution. Long run equivalent annual costs are estimated by assuming a $300 000 investment for both plant and equipment, amortized over 15 years at 5.5% interest.

Vessel variable costs

The variable costs of operating the vessel were set equal to the costs reported by UDC for 1991, the year with the highest harvest levels.

Vessel fixed costs

The Northwind is owned by Renewable Resources and is provided to the project free of charge. The UDC reports value this contribution at $10 000. In 1991 the harvest level exceeded the capacity of the Northwind and an additional vessel was leased at a cost of $5 000. The cost of leasing both vessels is used as a proxy for the equivalent annual cost of the vessels.

FISHING OPERATIONS

Fishing variable costs

Fishing cost data have not been collected from fishermen participating in the pilot project. Total variable costs for each fishing camp were therefore estimated based on DFO staff knowledge of their operations, the costs of DFO field work in the Delta, and data collected in studies of the small scale fisheries in the NWT. The resulting estimates, shown below, were multiplied by the number of camps to arrive at the total variable fishing costs for the entire fishery.

Fuel & oil	$600
Supplies	900
Parts & repairs	500
Licence fees	60
Total	$2 060

Fishing fixed costs

Estimated fixed costs were also based on DFO staff knowledge. A typical fishing camp is assumed to utilize a $7 000 yawl with a 10 year lifespan, and a 55 hp motor, costing about $5 500, with a three year lifespan. The equivalent annual cost for each fishing camp is $2 967, and for the entire fishery is $23 738. Added to this is the equivalent annual cost of the fishing nets, purchased by UDC, used in the pilot project. These costs $4 582 and have an expected lifespan of three years, giving them an equivalent annual cost of $1 698.

The base case model shown in Table 5 includes 100% of the capital costs of the camps boats and motors. If the fishery is to provide sufficient cash income to offset the costs of domestic fishing it must be able to cover the entire capital costs associated with fishing. This assumes that the boats and motors are not utilized in any other income generating activities.