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ECONOMIC ANALYSIS OF THE 1992 AND 1993 SUMMER WALRUS HUNTS IN NORTHERN FOXE BASIN, NORTHWEST TERRITORIES

by

L.E. Anderson and J. Garlich-Miller

Central and Arctic Region

Department of Fisheries and Oceans

Winnipeg, Manitoba R3T 2N6

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ABSTRACT

Anderson, L.E., and J. Garlich-Miller. 1994. Economic analysis of the 1992 and 1993 summer walrus hunts in northern Foxe Basin, Northwest Territories. Can. Tech. Rep. Fish. Aquat. Sci. 2011: iv + 20 p.

Economic data collected during two summer walrus hunting seasons are analyzed to determine the costs and net economic contribution of walrus products to the northern Foxe Basin communities of Igloolik and Hall Beach. Hunting costs are estimated to be $390 and $139 per walrus in Igloolik and Hall Beach respectively. Walrus meat is not distributed through formal markets so there is no observed price to indicate its economic value. Instead, three alternate methods are used to estimate economic value. Depending on the method, the net economic value of the summer walrus hunt to both communities is estimated to be $160 000, $386 000, or $659 000. Differences of this magnitude were expected because each method is based on a different view of the traditional economy, or is appropriately used in different circumstances. Regardless of the valuation technique, the analysis clearly indicates that walrus hunting generates a high economic return for Igloolik and Hall Beach.

Key words: walrus; *Odobenus rosmarus*; Inuit traditional economy; domestic fisheries; economic analysis; economic valuation.

RÉSUMÉ

Anderson, L.E., et J. Garlich-Miller. 1994. Economic analysis of the 1992 and 1993 summer walrus hunts in northern Foxe Basin, Northwest Territories. Can. Tech. Rep. Fish. Aquat. Sci. 2011: iv + 20 p.

Pendant deux saisons de chasse estivale au morse, on a recueilli des données afin de déterminer le coût et l'apport économique des produits de cette chasse dans deux collectivités de la partie nord du bassin Foxe, Igloolik et Hall Beach. Le coût a pu être estimé à 390 $ par morse pour Igloolik, et à 139 $ pour Hall Beach. En outre, comme la viande de morse ne fait pas l'objet d'un commerce comme tel, elle n'a pas de prix qui puisse indiquer sa valeur économique. Au lieu du prix, on a donc dû utiliser trois méthodes pour estimer la valeur économique nette de la chasse estivale au morse dans les deux collectivités concernées. Les résultats ainsi obtenus ont été de 160 000 $, 386 000 $ et 659 000 $. Les écarts s'expliquent par le fait que chaque méthode s'inspire d'une conception particulière de l'économie traditionnelle et peut ou non s'appliquer, selon les circonstances. Mais, quelle que soit la méthode employée, l'analyse des données indique clairement que la chasse au morse produit des bénéfices économiques importants pour Igloolik et Hall Beach.

Mots clés: morse; *Odobenus rosmarus*; économie traditionnelle inuit; pêche de subsistance; analyse économique; estimation de la valeur économique.

INTRODUCTION

A Department of Fisheries and Oceans (DFO) survey of walrus (*Odobenus rosmarus*) hunts in the northern Foxe Basin communities of Igloolik and Hall Beach, conducted from 1982-1984, provides information on hunting techniques and effort, biological samples and measurements from landed animals, and information on walrus distribution and abundance (Orr et al. 1986). The status of the Foxe Basin walrus stock remains unknown, but because of the large annual harvest, DFO commenced a three-year monitoring program in 1991.

The program incorporated an economic component designed to document the economic dimensions of the hunt and estimate the economic value of its products. Such economic monitoring and analysis provides a base of information and understanding for resource users and managers in support of: (a) allocation decisions on alternative uses of the resource; (b) assessments of economic development options; and (c) decisions on the level of management activity in relation to the value of the resource.

This report presents an analysis of the information and understanding garnered from field observations of walrus hunts. Alternative valuation techniques are discussed, and estimates of the economic value of the northern Foxe Basin walrus hunt resulting from each technique are made and compared.

BACKGROUND

Igloolik Island, where the modern community of Igloolik is sited, has always been an important settlement area for the Inuit and their ancestors living in the Foxe Basin region (Brody 1976). First contact with Europeans came with the 19th century explorations of Parry, Rae and C.F. Hall. In the 20th century, Igloolik people traded at posts on north Baffin Island and at Repulse Bay until the 1939 opening of a Hudson Bay Company (H.B.C.) trading post on Igloolik Island. When Defensive Early Warning (DEW) Line stations were built in the Foxe Basin region in 1955, building materials were made available to other settlement sites for house and tent frame construction. One such site was on Igloolik Island near the H.B.C. post. In 1959, the Anglican Church built a mission which has been occupied ever since, and a school opened at the same time. The population of Igloolik in 1991 was 936 (GNWT Bureau of Statistics 1992).

Hall Beach is a relatively new settlement on the northwest coast of Melville Peninsula, named after the American explorer, C.F. Hall, who lived in the vicinity in the 1860's. The settlement came into being during 1955-1956, when Fox Main, one of the principal DEW-Line stations, was built near the present location of the settlement. Although there are some Thule house ruins in the area, there is no indication of more recent inhabitation by the Inuit (Anders 1966). The population of Hall Beach in 1991 was 526 (GNWT Bureau of Statistics 1992).

Walruses have traditionally been of great importance to the people of the northern Foxe Basin as a major food source, both for themselves and their dogs. Aged walrus meat, organs and blubber (igoonuq) is considered a delicacy by residents of the area (Orr et al. 1986). The Igloolik region has long been noted for its dogs, which could be supported by walrus kills, even when dogs elsewhere were dying of starvation (Brody 1976). Walrus hunting remains an integral part of a wide-ranging seasonal cycle of land based activity, with caribou (*Rangifer tarandus*) and ringed seals (*Phoca hispida*) also being central to the annual pattern of hunting. Other species of traditional importance include beluga whales (*Delphinap-terus leucas*), narwhal (*Monodon monoceros*), foxes (*Alopex lagopus*), wolves (*Canis lupus*), polar bears (*Ursus maritimus*), Arctic charr (*Salvelinus alpinus*), and lake trout (*Salvelinus namaycush*) (Brody 1976).

Prior to 1930, most walrus hunting took place in the fall, through newly-formed ice with

lance and harpoon. Brody (1976) reports that the first major change in hunting technique occurred when whale boats were introduced to the region in the 1920's, greatly extending the hunting range and enabling open-water hunting. A second major change was the shift in distribution of walruses upon colonization of Igloolik and Hall Beach. The disappearance of large herds along the east coast of Melville Peninsula has been attributed to increased boat traffic and hunting around the communities (Brody 1976). Most present-day walrus hunting occurs some distance from the communities, often southwest of Rowley Island (Fig. 1). Hunting is most commonly done from boats and with high powered rifles. There is a continuing shift towards more powerful outboard motors, larger boats, and higher calibre rifles.

Participation in land-based activities takes different forms, depending on the time of year and ability of the individual. While an experienced hunter will hunt during any season, providing the conditions are good, family groups generally spend time on the land in the spring and summer. In July and August, there are usually more than 50 families camped at the southeast side of Igloolik Island, from which walrus hunts are staged. Orr et al. (1986) report that in the early 1980's there were at least four men highly respected for their knowledge of walrus hunting, who made final decisions on whether a hunt should take place. Hunts were usually directed by the most experienced walrus hunter present, accompanied by one or more younger hunters or boys. While younger members of the hunting party did not actively participate in the kill, they assisted hunters by fetching equipment, preparing food and beverages, and actively participated in the butchering of walrus.

RELEVANCE

Estimates of the value of country foods have a number of important applications. They are helpful in assessing compensation for loss of harvests due to environmental damage, and with respect to resource management, can help to ensure that the level of management effort is in accord with the value of the resource. Yaremchuk and Wong (1989a) note that when an analysis of the value of subsistence harvests is lacking, there may be insufficient funding, planning and execution of programs for the management, development and habitat protection of stocks used primarily for subsistence.

Value estimates are also important in ensuring allocation decisions promote the best use of the resource (Yaremchuk and Wong 1989b). For example, efforts to increase the cash incomes of subsistence hunters often involve developing export or inter-settlement markets for country foods. However, as Usher and Weihs (1989: 25) note,

> country food exports may require reduced local access or consumption. Given the high replacement costs of country food locally, this may not be a net economic benefit. Allocation of country food resources for sport harvest may have the same effect. There are of course successful examples of both: what is needed in each new case is sound economic and social evaluation. It cannot be simply assumed that new exports are benefits without costs.

Economic development options can be better assessed if values of country foods are available. Most assessments of the Arctic regional economy are expressed in market terms but because subsistence production operates outside cash markets, its importance tends to be under-estimated. As a result of these distortions, it is not possible to correctly evaluate the impact of economic development programs on the traditional sector (Palmer 1974) and "...effective social and economic development as a whole is handicapped because an important element is not properly taken into account" (Roots 1981: 1).

Walrus hunting is part of an economic system of subsistence. In the Canadian Arctic, this system is often referred to as the traditional

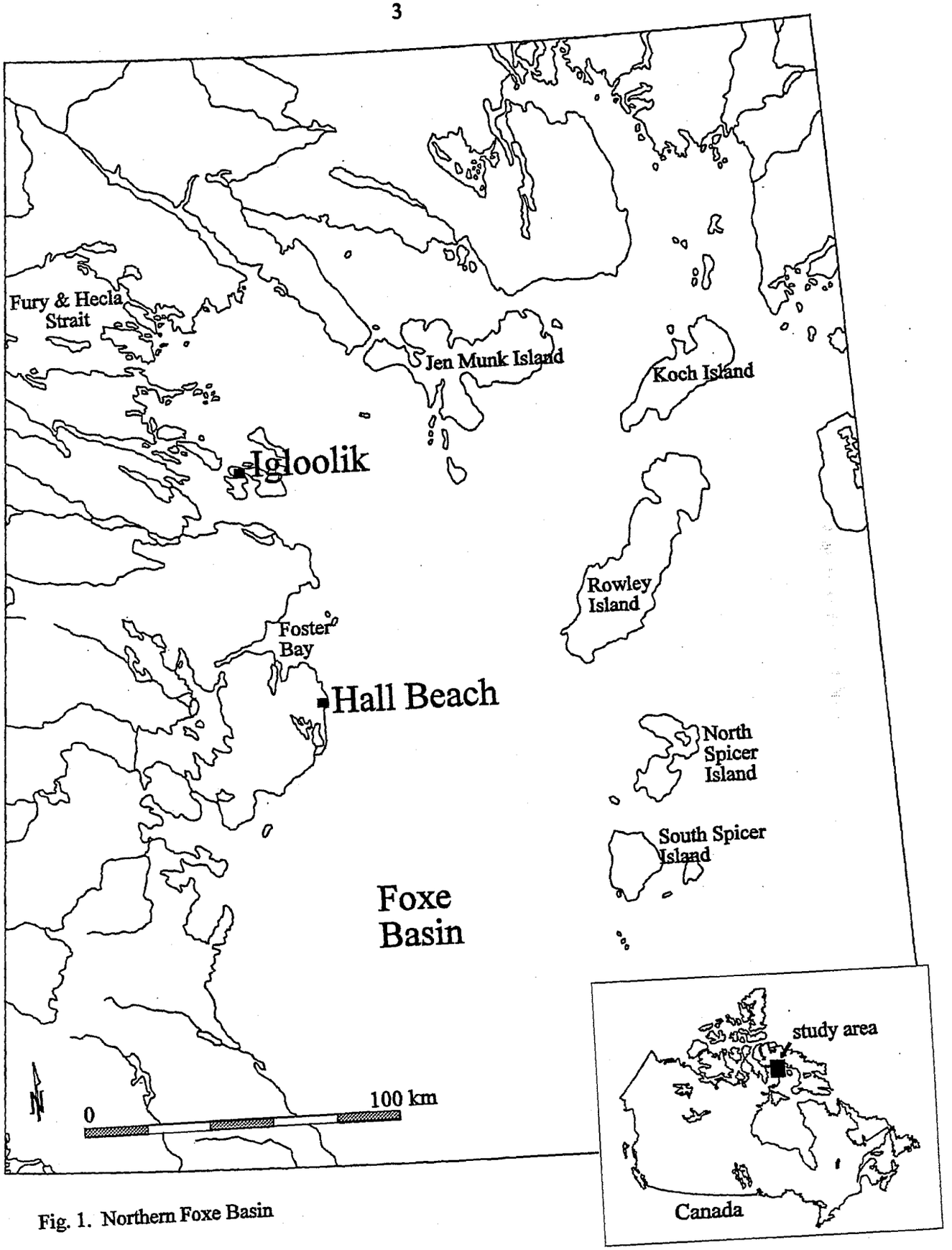

Fig. 1. Northern Foxe Basin

economy. It involves not only the production and distribution of tangible goods, but also the generation of multiple social, nutritional, and cultural products (Lonner 1986). Kinship ties and community cohesion are constantly reinforced by participation in group hunts and the sharing of the proceeds, helping to maintain a way of life that is highly valued by the Inuit (Wenzel 1991). Further, a strong sense of community is believed to aid the development and maintenance of self-esteem, which in turn helps to diminish social problems within a community. Duerden (1992) views this social product as the most important value of the traditional economy.

The high nutritional value of country foods contributes to the value of the traditional economy. Malouf (1986) cites a number of studies that have shown that Inuit diets typically deteriorate when country foods are substituted with foods imported from the south. Currently, there is a high level of dependence on country foods in the eastern Arctic. A recent survey found that 91% of Inuit households in Nunavut consumed some meat or fish obtained through subsistence harvesting, and 59% depend on the traditional economy for all or most of their meat consumption (GNWT 1991).

While mindful of the related impacts, the scope of the analysis presented in this report is limited to an examination and estimation of only the economic value of the tangible products of walrus hunting in the northern Foxe Basin. Its purpose is to provide quantitative estimates of the contribution that walrus hunting makes to the economies of Igloolik and Hall Beach.

METHODS

DATA COLLECTION

The biological monitoring provided hunting effort and harvest data required for cost of production analysis. This was supplemented with economic information collected in 1992 and 1993.

In 1991, a personal interview survey administered by an Inuit contractor sought to collect information on walrus hunting in terms of (1) the amount of hunting effort, and the value of tusks, igoonuq, fresh walrus meat and walrus dog foods, and; (2) other foods and how they compared to walrus, how they are usually obtained, and what they would cost if purchased. The response to this survey was poor, and the limited information could not be used for analysis.

In 1992, DFO economics staff met with the Hunters and Trappers Associations (HTAs) to explain the rationale for economic monitoring, and to consult on options for economic analysis. That year, an alternative tact was taken, in which the DFO biological staff person was contracted to prepare a profile of some of the most basic economic and social aspects of the hunt. This provided a base of information on the quantity and costs of hunting inputs, as well as the quantity, utilization and prices of the outputs of hunting.

In 1993, the DFO biological staff person was contracted to provide another year of data on the economic and social aspects of the walrus hunt. In addition, an economics staff person observed portions of the hunt and collected anecdotal information on seasonal hunting patterns and substitute country foods.

VALUATION OF WALRUS PRODUCTS

Most walrus meat harvested during the summer hunt is cached in gravel beach ridges close to the communities. Cached walrus meat, dug up throughout the winter and spring, is available to anyone who desires it. In this regard, the major output of the hunt is a source of communal value. The other products of walrus hunting are the baculum and tusks, which can be sold and are the property of the hunter who shot the walrus.

Much of the theoretical basis for the economic valuation of subsistence production comes from studies of peasant agriculture production for subsistence in developing countries. Three general approaches can be identified: (1) not attempting to value crops consumed at home, (2) assigning retail buying prices, and (3) assigning market selling prices (Chibnik 1978).

The first approach arises from the view that economic theory only explains behaviour in capitalist societies where goods are allocated via market systems. Since subsistence production and distribution operate outside of market systems, it is concluded that economic values are meaningless. A similar argument is often made against applying economic measures to the traditional economy of the Arctic. Inuit production, it is argued, is not motivated by individual self-sufficiency, profits, or capital accumulation, but instead operates to provide a continuous flow of goods and services to a community (Wenzel 1991) and to maximize security (Lonner 1986).

In contrast, economic analysis may be done through the use of "shadow" or "accounting" prices - the price an economist attributes to a good or factor in the argument that it is more appropriate for the purpose of economic calculation than its existing price, if any (Mishan 1976). Without an estimated monetary value the importance of the traditional economy tends to be undervalued or ignored. As a result, assessments of economic development options, and decisions on resource allocations and the level of resource management activity assigned to a resource are made without complete information.

An alternative view, that market prices can be used to estimate the value of subsistence production, is supported by the observation that Arctic communities contain elements of both traditional and modern (capitalist) economic systems. Inuit need cash to buy the capital equipment and inputs now required for hunting, and increasingly they have the option to sell at least some of their harvests either locally or through inter-settlement trade. As a result, it has been argued that subsistence production and utilization decisions are influenced by economic considerations. Wolfe (1986), for example, demonstrated that food production in a sample of Eskimo communities in Alaska was determined by a household production strategy of maximizing food output per unit of monetary input.

If the notion that market prices can be used to approximate the value of subsistence production is accepted, the question becomes whether the selling or buying prices facing the subsistence producer should be used. In the Canadian Arctic, this question is further complicated by the lack of markets for most country foods. Even where such markets exist, they typically deviate so significantly from the theoretical ideal of the 'perfect' market that the prices they generate are almost meaningless. Consequently, a third method of valuing country food products, based on the cost of imported substitutes, is often used in economic studies of Inuit country food production.

Usher (1976) examines the alternatives to approximate prices for country food, calling them: *local exchange values*, *alternative market prices*, and *substitution costs*. Local exchange value is the price at which the product trades in the community. It parallels the retail price facing the peasant farmer in a developing country. Chibnik (1978) argues that this is the most plausible price for valuing peasant farm production used at home because any loss of production intended for home use would have to be replaced at retail prices. This approach has appeal on theoretical grounds "...since it applies the 'willingness to pay' concept that is a cornerstone of consumer demand analysis." (Topolniski 1991: 13). Unfortunately, this option is seldom available in Arctic communities. Local cash trade in country foods is very limited and prices observed are not indicative of economic value. Local exchange values may be further distorted by the social obligations of kinship or friendship between buyer and seller (Usher 1976).

Alternative market values are the selling prices available to subsistence producers. This method is based on the economic concept of opportunity cost, in that it represents the value of the product in its next best alternative use. Market selling prices are well established as the appropriate value to use in national income accounting (Topolniski 1991, Usher 1976) and are used by Statistics Canada in valuing farm production consumed at home (Lu 1972).

Valuation at substitution costs is favoured by Usher (1976). He argues that any loss in home production would have to be replaced by local purchases, and since in most cases there is only a limited market for country foods, the next best alternative would be to buy imported substitute goods at retail prices. Usher proposes that this method be used when analyzing a situation in which the traditional sector is eliminated in favour of the development of an industrial economy. In his view, a traditional and an industrial economy can not co-exist, so industrial development in the Arctic "...will lead to an absolute reduction in the amount of country food available ... [and native people] will be forced to live on food imported into the areas where they live" (Usher 1976: 113).

In resource management, the valuation questions that typically arise are not as sweeping as those considered by Usher. Instead, resource managers are often concerned with the marginal or incremental value of an animal, or a stock of a specific species of animal. For the northern Foxe Basin walrus stock, the relevant questions relate to allocation issues (e.g. Is a walrus used for subsistence of more or less value to the community of Igloolik than a walrus allocated to another use, such as a recreational hunt?), or ensuring that the level of management effort is matched to the stock's importance, or that compensation can be assessed for loss of harvests in the event of environmental damage caused by other economic activities.

When estimating the marginal value of walrus, a more precise application of the substitution cost method would be to use the costs of alternative country foods. Given that country foods are generally considered to be cheaper and preferred over imported foods, a reasonable assumption is that reduced supplies of one type of country food will be substituted with another. This is especially true when procuring food for dogs which are never fed imported dog food.

The best country food substitute for a walrus will depend on the availability of other game at the time that the walrus would have been hunted, the costs of hunting for alternative country foods, whether the walrus would have been used for human or dog food and, if it was to be used for human food, individual tastes and preferences.

In this study, the economic value of the northern Foxe Basin Walrus hunt is estimated using alternative market prices and the costs of both imported and country food substitutes. The local exchange values was not used, because there is no local market for walrus.

Alternative market value estimates are based on anecdotal information on the selling prices for igoonuq. The costs of imported substitutes are calculated from the average price of meats available in retail grocery stores in Igloolik and Hall Beach. Seasonal hunting patterns were determined through informal interviews with hunters and the Renewable Resource Officer, and these provided the basis for determining which country foods are the most likely substitutes for walrus. The prices of alternative country foods are estimated by the harvesting costs per edible kilogram of meat. These were made on the basis of published data, limited monitoring of hunts, and anecdotal information on 'typical' hunts for substitute species.

Prices paid to hunters for the tusks and the baculum were collected from the Co-op in Igloolik.

WALRUS HUNTING COSTS

All three valuation techniques provide estimates of the gross value of walrus. Hunting costs must be deducted to arrive at net values. The costs of a walrus hunt are categorized as either fixed or variable. Fixed costs are expenses that are independent of output, which for a hunter are the costs of his equipment. Variable costs include the hunter's out-of-pocket cash outlays for items such as gas, ammunition and food, that vary with the number and length of hunts. An important component of the variable costs of production is the labour input of the hunter. Although hunters are not paid a cash wage for their participation in a hunt, there is a cost associated with their time. Time spent hunting means less time available for other activities and, to the extent that time spent in other activities generates value, there is an opportunity cost associated with hunters' time.

Estimating the fixed costs of hunting requires (a) determining the appropriate measure of costs, and (b) developing an allocation method for multi-use assets. The economic cost of capital equipment is measured by its replacement value and the annual capital cost for each piece of equipment is calculated based on its expected life and interest costs. Because the capital equipment used for walrus hunting is also used for a number of other activities, only a portion of the total annual capital costs is allocated to walrus hunting. In economic studies, an approach based on "separable costs-remaining benefits" is most widely accepted (Herfindahl and Kneese 1974). The data limitations of this study make this type of allocation impossible, so an alternative method based on proportion of capacity is used instead. It was assumed there are a potential 60 days of use per year for a boat and motor, and 120 days of use for rifles and other hunting equipment. This is in accord with Beaubier (1970), who observed the number of days during which the weather was suitable for hunting at various times of the year.

SENSITIVITY ANALYSIS

The success and therefore the cost of hunting can vary considerably depending on the skill of the hunter, the time of year, weather and ice conditions, and variations in the annual migration patterns of the target species. Because of this variability, accurate statistical measures on which to base cost estimates would require field observations of a large number of hunts over several years. Such data are not available, so as an alternative, this analysis models a representative 'typical' hunters on a 'typical' hunt. The model is based on field observations, but because of the small sample size, there is no way to measure the statistical precision of estimates generated. Instead, a sensitivity analysis, in which the estimated net economic value is recalculated after changing key attributes of the model, gives an indication of the extent of this uncertainty. The attributes chosen for the sensitivity analysis are those that are most variable and have the greatest impact on the estimated net values when changed.

RESULTS

THE 1992 AND 1993 HUNTS

1992

A cool spring and late breakup of the land fast ice delayed the 1992 summer walrus hunt by about two weeks in Igloolik. Because effort shifted to caribou in early August, as is customary in the area, the walrus hunt was restricted to the last two weeks of July. Hall Beach hunters were able to launch their boats about a week earlier than hunters in Igloolik, but in early August they too shifted their efforts to caribou. Ten hunts were monitored in 1992, seven from Hall Beach and three staged from camps at Igloolik Point.

Hunts were carried out only on relatively calm and clear days, usually after consultation with an older experienced hunter. Hunting parties in Igloolik were made up of at least two boats for safety reasons. In Hall Beach hunting parties tended to be smaller and less formally organized.

Aside from the difference in party size, the hunting techniques observed in Igloolik and Hall Beach in 1992 were virtually identical. Upon arrival at the hunting site, hunters often spent several hours searching for a suitable group of walruses hauled out on the pack ice. Hunters prefer hunting hauled-out walruses because they can usually be approached to within a few meters before becoming alarmed, offer a clear stationary target, are less likely to be lost, and do not have to be hauled out of the water. If there are many animals, hunters tend to favour either adult males with large tusks or, when there is a need for fresh meat, mother-calf pairs as fresh meat from calves is considered a delicacy.

Hunters prefer to butcher walruses on an ice floe as it is cleaner than the beach and more efficient than butchering in the water. Animals killed in the water were hauled on to an ice pan by four or five people using a block and tackle anchored to the ice. Butchering generally took at least two hours, depending on the size of the walrus and the skill of the hunter. After butchering was complete, hunting and carving equipment was cleaned and put away and the meat was loaded into the boat. The weight of the carcasses slowed travelling speed on the way home and, because of the increased danger of swamping, required calm conditions. Most of the meat from summer hunts was cached in gravel beach ridges to make igoonuq. Caching the meat requires two to three person hours per pit, adding about one hour to the labour input to process a walrus.

1993

The 1993 summer walrus hunt was affected by extremely unusual ice conditions in the northern Foxe Basin. Although there was an early spring melt of the landfast ice around Igloolik Island, the pack ice was frequently driven ashore by southerly winds. This severely restricted boat travel throughout the summer and hunters were unable to get to their traditional walrus hunting grounds. By mid-July most hunters had shifted their hunting effort to seals or had travelled to Baffin Island to hunt caribou and fish for charr. Narwhal were sighted in Richard's Bay on July 25, about two weeks earlier than normal, and most available hunters rushed to fill the annual quota of 25 whales.

Hunters in Hall Beach estimated that the 1993 boating season was delayed by two to three weeks due to heavy ice conditions. They were not able to launch their boats until the last week of July, and even then dense pack ice restricted travel to a narrow corridor along the coastline south of town. Poor conditions resulted in limited hunting success and most hunters turned their efforts to charr fishing and caribou hunting to the south along the Melville Peninsula.

Four hunts in Igloolik and five in Hall Beach were monitored in 1993. Hunting parties were smaller and less organized than those observed in 1992, likely a result of the peculiar ice conditions. Very few hunters were interested in participating in hunts when travel was restricted to areas where finding walruses was unlikely. The ice conditions also affected hunting techniques. Hunters were inclined to shoot any animals that they came across instead of waiting to find groups hauled out on ice floes and selecting specific animals. Hunters in both communities reported that the walrus hunting in the summer of 1993 was the worst they could remember. During July, Igloolik hunters landed only 14 walruses, and Hall Beach hunters took eight. In a normal year, roughly 75 to 150 walruses are taken during the summer hunts.

In both communities in both years, hunters said they would try walrus hunting again in the fall, when they believed walrus migrate further north. While this would not allow for the preparation of igoonuq, which has to be in the

ground by late July to properly ferment, a fall hunt would replenish meat supplies. This could be especially important to hunters with dogs.

Of the 19 hunts monitored over the two seasons, two were excluded before calculating the median values of catch and effort data for each community and year (Table 1). Only partial information was available for one hunt of the three Igloolik hunts in 1992. Data from another was excluded because the hunters did not have a harpoon, resulting in a very low retrieval rate of walruses shot.

Data collected in 1993 did not represent a typical hunt because the unusual ice conditions of that year prohibited access to the customary hunting grounds, distorting both the level of hunting effort and the catch rates. The model of a typical hunt was therefore based only on hunts observed in 1992 (Table 1).

Table 1. Median values of catch and effort of monitored hunts in Igloolik and Hall Beach.

	Igloolik		Hall Beach	
	1992	1993	1992	1993
Hunters	4	3	2	3.5
Boats	2	2	1	1.5
Hunting effort (h)	13	9.5	8	6
Gas used (L)	182	114	68	182
Shots fired	7	0	3	8
Walrus landed	2	0	2	1
Number of hunts Monitored	1	4	7	5

HUNTING COSTS

Variable costs were $0.66/l for gas, $6.49/l for outboard motor oil, $1.50 per shell, and an estimated $15 per hunter per day for miscellaneous camp supplies. These miscellaneous expenses included naphtha for the coleman stove, and tea, sugar, jam, and bannock or pilot biscuits. Labour costs were estimated at $7.50/h, an amount chosen to approximate the value forgone in some activity other than walrus hunting.

The total variable costs of an Igloolik walrus hunt based on these prices is $639, while a Hall Beach hunt has estimated variable costs totalling $207 (Table 2). Based on the replacement cost and expected life of the equipment of a 'typical' hunter, estimated annual capital costs are $4 375. Daily fixed costs for summer hunting are estimated to be $70 (Appendix A). When variable and fixed costs are added, the total estimated cost of a walrus hunt is $780 and $277 for Igloolik and Hall Beach respectively (Table 2).

Table 2. Total variable and fixed costs of walrus hunting in Igloolik and Hall Beach.

	Igloolik	Hall Beach
Variable Costs		
Labour	$390	$120
Fuel	$141	$53
Shells	$10	$4
Misc.	$98	$30
Total Variable Costs	$639	$207
Total Fixed Costs	$140	$70
Total Costs		
- Per Hunt	$780	$277
- Per Walrus	$390	$139

The higher costs in Igloolik result from: Igloolik hunters travelling much further to hunting grounds, increasing the costs of fuel; and Igloolik hunting parties tending to be larger, involving twice as many boats and hunters as those from Hall Beach, increasing both the

labour and the fixed costs. Hunts in both communities typically resulted in a harvest of two walrus in 1992. The hunting costs per walrus are therefore estimated at $390 for Igloolik and $139 for Hall Beach.

ECONOMIC VALUES

A landed, butchered walrus provides a hunter with cash income upon the sale of ivory and the baculum in the case of males, and with income in kind from walrus country foods.

Tusks weigh between 1.4-2.7 kg and could be sold for $55/kg in 1993, while the baculum of the male walrus sold for $10. The meat and edible viscera that an average walrus yields when harvested in the summer is estimated to be 460 kg (Appendix B).

While some of the meat from summer hunts is brought into town to be consumed fresh, most is cached to make igoonuq. Hunters in both Igloolik and Hall Beach suggested that the practice of sharing game among community members is common and that igoonuq is available to anyone who desires it. Although the HTA in Igloolik is now buying and selling caribou, arctic charr, muktuk and whale meat, there is no local market for walrus. Hunters in both communities have indicated a desire to sell igoonuq to other communities. The GNWT Department of Health and Welfare cautions against this practice because of potential health concerns associated with improper packaging and storage of igoonuq during transport (pers. comm., Dr. R. Allen, Baffin Regional Health Board).

Hunters had varying views on what proportion of their walrus meat would be consumed by humans and how much would be fed to dogs. Responses varied from 100% human consumption to 80% dog food, probably reflecting the fact that not every hunter maintains a dog team. Those with dogs suggested that their annual quota of four walruses could feed a team throughout most of the winter. For those who do not own dogs, igoonuq is probably consumed primarily by their family and friends. However, not enough hunters were interviewed to provide an accurate estimate of how walrus meat is used. This analysis first sets the utilization at 50% for human food and 50% for dog food, and then tests the effect of different utilization proportions in the sensitivity analysis.

Import substitution value

A walrus harvested entirely for human consumption provides the equivalent of $4 600 in imported foods valued at $10/kg, while a walrus harvested for dog food provides the equivalent of $1 840 in imported dog foods valued at $4/kg. Using the proportions of 50% for human consumption and 50% for dog food, the meat from one walrus is estimated to generate a gross benefit of $3 220. The total gross value of a walrus, including the sale of the tusks and baculum, is $3 350. When the hunting costs are subtracted, the net import substitution value of a walrus is estimated to be $2 960 for Igloolik and $3 211 for Hall Beach.

Alternative market value

Anecdotal reports from Igloolik residents indicate that there is some inter-settlement trade in igoonuq, at a price of roughly $1.00/lb or $100 for each bundle. Based on a yield of 9 bundles per walrus, selling igoonuq could generate $900 cash in addition to the $130 from the sale of the tusks and the baculum. The total gross value of a walrus using this technique is $1 030, while the net values are estimated at $640 for Igloolik and $891 for Hall Beach.

Substitute country food value

The most likely country food substitutes for walruses are caribou for human consumption and seals for dog food. This is consistent with reported seasonal hunting patterns (Beaubier 1970, B. Parker, Renewable Resources,

Igloolik, pers. comm.) and the observed behaviour of hunters in response to poor walrus hunting in 1993. Further, caribou is a favoured food that has been estimated to make up about 40% of the total country food available in both communities (Weihs and Okalik 1989: 53-54).

Hunters interviewed in 1993 who owned dog teams suggested that if walruses were unavailable as a source of dog food, they would have to hunt more seals and catch more fish. Seals were chosen as the substitute because they are abundant when the summer walrus hunt normally takes place.

The substitute country food value was estimated by the cost of hunting caribou and seals in the summer, converted to a per edible kilogram yield per hunt (Appendix C). The substitute country food cost is estimated to be $3.62/kg for seal meat and $4.86/kg for caribou. At these values the meat from one walrus is estimated to generate a benefit valued at $2 082, including the sale of the tusks and baculum. When hunting costs are deducted, the net substitute country food value for a walrus is estimated to be $1 692 for Igloolik and $1 943 for Hall Beach.

Estimated total values

DFO records show that walrus harvests over the past 5 years have ranged from 63 to 225 in Igloolik, with an average of 124, and from 61 to 74 in Hall Beach, with an average of 71. When asked in 1992, hunters in Igloolik estimated that the total community annual harvest is between 100 and 150, while hunters in Hall Beach estimated that between 80 to 100 walrus are harvested in their community each year. DFO records of walrus harvests are believed to be incomplete as they depend on a Renewable Resource Officer or a Fishery Officer being present when hunting occurs (DFO 1991). For the purposes of this study, hunters' estimates of total harvest are used. While also approximate, hunters' estimates are based on their more complete observation of the hunts.

The total annual walrus harvest in the northern Foxe Basin is assumed to be 215, 125 in Igloolik and 90 in Hall Beach. Multiplying these harvests by the net values estimated by the 3 methods described above results in an estimated annual net benefit of between $160 000 and $958 000 for the total Foxe Basin harvest (Table 3).

Table 3. Estimated net economic values of a walrus in Igloolik and Hall Beach, and of the total northern Foxe Basin annual harvest.

Valuation Technique	Igloolik	Hall Beach	Total Annual Benefit
	(per walrus)		
Import Substitution	$2 960	$3 211	$659 000
Alternate Market	$640	$891	$160 000
Country Food Substitute	$1 692	$1 943	$386 000

SENSITIVITY ANALYSIS

The estimated net value of walrus was recalculated when the success of the walrus hunt, the opportunity cost of labour, and the proportion of walrus consumed by humans were changed (Fig. 2).

Hunting success

The base model of walrus hunting for both communities assumes that each hunt results in a harvest of two walruses. The sensitivity analysis examines the effect on the estimated value of increasing the harvest to one walrus per hunter. This changes only the model for an Igloolik hunt, but results in a hunting cost reduction sufficient to raise the total estimated net value by 4-15%, depending on the estimation technique.

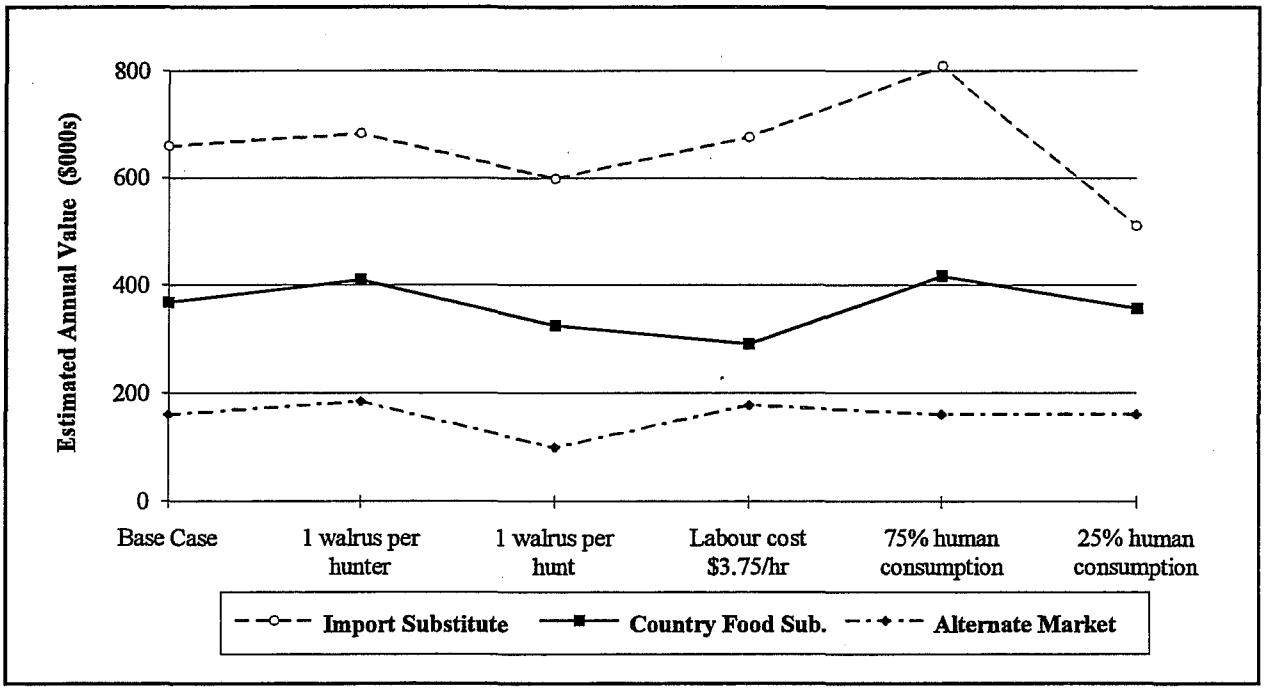

Fig.2. Sensitivity analysis of the estimated annual value.

Conversely, a lower success rate of one walrus per hunt results in higher hunting costs, and the estimated net value of the northern Foxe Basin walrus hunt is lowered by 10-40%.

Cost of labour

The opportunity cost of labour was estimated to be $7.50/h, but that may be too high for communities like Hall Beach and Igloolik where hunters are not likely to be giving up wage incomes to participate in a walrus hunt. It is sometimes suggested that the opportunity cost of labour should be $0 in areas with high unemployment, but that presumes that people would not utilize their time in any alternative productive activity and place no value on their leisure time. In Arctic communities, the opportunity cost of labour should reflect the likelihood that walrus hunting probably occurs at the cost of lost production in some other aspect of the traditional economy. Further, even if no other productive activity were undertaken, "...people place a positive value on leisure, [so] it is clearly inappropriate to assume that there is zero opportunity cost in employing labour which would otherwise be unemployed." (Government of Canada, Treasury Board 1976: 20-21).

Topolniski (1993) uses $7.50/h to estimate the opportunity costs for wage employment alternatives and 50% of the wage employment option as a conservative estimate of the opportunity cost of labour engaged in alternative activities in the traditional economy. The sensitivity analysis therefore re-estimates the value of the walrus hunt with the labour costs set at $3.75/h. This reduces the hunting costs and results in an increase of the net economic value of the walrus hunt by about $17 000, or 3% of the import substitution value estimate and 11% of the alternate market value estimate.

The results are very different when the costs of substitute country foods are used to estimate income in kind for walrus meat because in this method labour costs are a component of value. Lowering the labour costs to $3.75/h results in the net value estimates that are reduced by $96 000 (25%).

Utilization

The amount of walrus meat fed to dogs and the amount used for human consumption is another critical factor for which there is little data. While changes in utilization have no effect on the alternate market value estimate, they have significant effects on the estimated values based on imported or country food substitute values, as substitutes for human food are more expensive.

Reducing human consumption of walrus meat to 25% lowers the net import substitution value of the total hunt by $149 000. Increasing human consumption to 75% has the opposite effect, increasing the net value of walrus by $149 000 (23% over the base case value). Similarly, reducing or increasing the proportion of walrus consumed by humans reduces or increases the net country food substitute value by $31 000 (8%).

Hunting success for substitute species

The models used to estimate the cost of country food substitutes are based on data from other studies and anecdotal information (Appendix C). The accuracy of these models is even less certain than those used to estimate the variable costs of walrus hunting. Sensitivity analysis reveals that the main factor affecting the cost of substitute country foods is the success of a hunt. Increasing the seal harvest of a typical hunt from four to five reduces the cost of the substitute for walrus meat that would have been fed to dogs from $3.62/kg to $2.90/kg. Conversely, a less successful seal hunt, with a harvest of only three seals, increases the cost of seal meat to $4.83/kg. Similar calculations for caribou hunting indicate that if the harvest is typically seven animals, the cost is $4.86/kg. Increasing the harvest by two caribou lowers the cost to $3.78/kg, while decreasing the harvest by two caribou increases the cost to $6.81/kg.

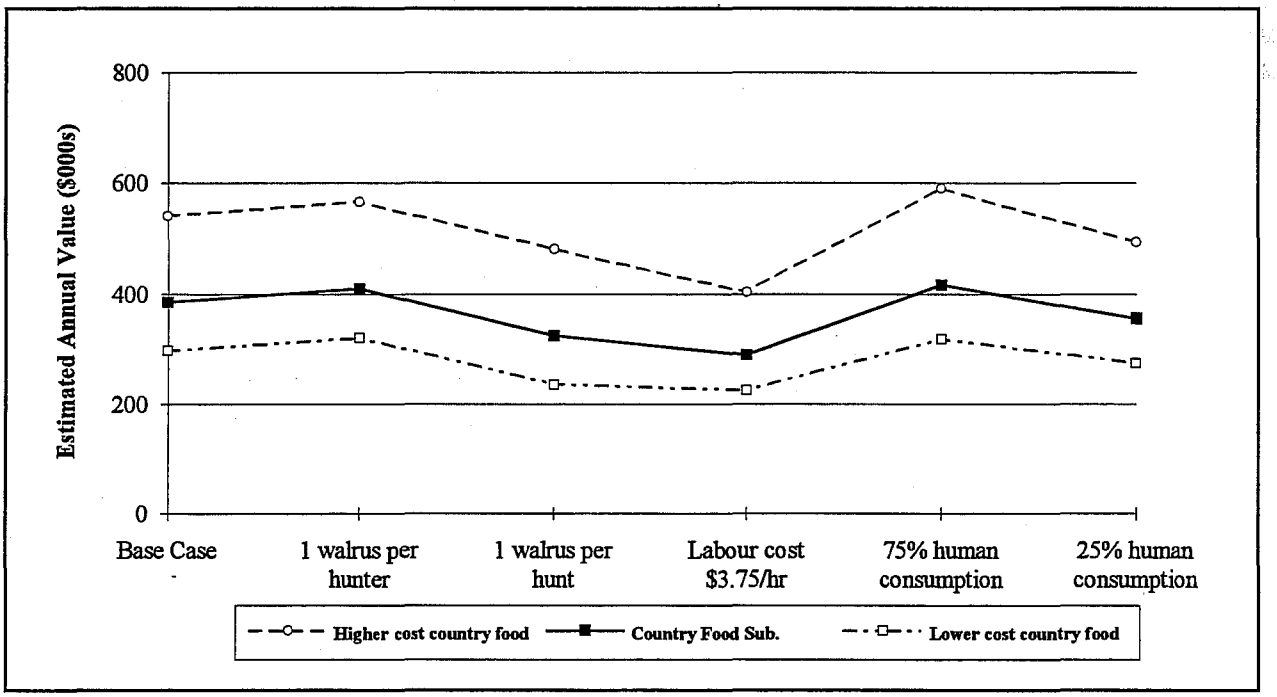

Fig. 3. Sensitivity analysis of the substitute country food value estimate.

The effect of these price changes on the net estimated value of the northern Foxe Basin walrus hunt varies, depending on how the typical walrus hunt is defined. For the base case model of a walrus hunt, a less successful hunt for substitute species increases the estimated net value of the annual walrus harvest by $156 000 (40%), while more successful hunts lower the estimated net value by $89 000 (23%). When the hunting success, the cost of labour, and the utilization of walrus in the base case model of a walrus hunt are altered, and catch rates for seals and caribou are low, the net value of walrus estimated by the cost of country food substitutes ranges from $404 000 to $591 000. Alternatively, if seal and caribou catch rates are high, the estimated net values range from $225 000 to $319 000 (Fig. 3).

DISCUSSION

There is no observable price for walrus country food, so it has been necessary to impute its value. Three alternative methods were used, resulting in three very different estimates of the net economic value of the northern Foxe Basin walrus harvest. Using the price of imported substitutes generated the highest estimates because of the high cost of shipping goods to the Arctic. Valuing walrus products at the cost of acquiring substitute country food resulted in a net value estimate about 60% as high, while the alternate market value estimate is only 25% of the import substitution value estimate.

Differences of this magnitude were expected because each method is based on a different view of the traditional economy or is appropriately used in different circumstances. The lowest estimate is based on alternative market values, which is appropriately used when estimating the value of the traditional activities to be included in the N.W.T.'s system of economic accounts. This method is problematic because of the limited market for walrus country foods. Anecdotal information indicates that inter-settlement trade in igoonuq is limited to exchanges between friends and family members, likely at selling prices that are significantly lower than those that might be observed in a perfectly competitive market. Only if trade in igoonuq reaches a volume large enough to provide anonymity to buyers and sellers can prices set in this market provide an accurate measure of the value of walrus.

Valuing goods produced in the traditional economy at the prices of imported substitutes is appropriate if estimating the cost of industrial development that will supplant the traditional economy. If instead the analysis is focused on the marginal value of a walrus, imported food purchases are probably poor indicators of preferences and alternative actions. In a situation where one type of country food is not available, but the traditional economy is still operating, hunters are more likely to redirect their efforts to an alternative country food. The field observations of this study, especially in 1993, support this view. Faced with poor walrus hunting opportunities and low supplies of walrus meat, hunters directed their hunting efforts to seal and caribou hunting and charr fishing.

The alternative country food measure of value also addresses to some extent the problem of the nutritional inferiority of imported substitutes, and the tastes and preferences of people in Igloolik and Hall Beach. This is not to say that all country foods are perfectly substitutable, but rather that they are closer substitutes than are game meat and imported meat. It is also noteworthy that the losses of social and cultural values associated with hunting are minimal when one type of hunt is replaced with another.

A problem with valuing walrus at the costs of substitute country foods is that marginal costs are not likely to be constant. If the loss of only one walrus out of the total annual harvest from the northern Foxe Basin stock is being replaced by an increased harvest of an other species, it is not likely to have a significant impact on the availability of that other species. This is probably true for two, three and even 10 walruses. However, there will likely be some level of

increased harvest of substitute species that will cause availability to decrease to the point that hunting costs for that other species will start to rise.

Another problem is that calculating the cost of substitute country foods is currently constrained by data limitations. Limited data on hunting success introduce a great deal of uncertainty to the value estimates, as is clear from the sensitivity analysis (Fig. 3). Changing the hunting success of substitute species resulted in estimated values that varied by an order of magnitude almost half as great as the difference between the values estimated using the three different methods (Fig. 2). Unfortunately, as the experience of this study has shown, collecting enough data on hunts of other animals to accurately estimate the average costs and catch rates is expensive and may not be operationally feasible. However, the currently available data on hunts of substitute species can be expanded through the collection of additional anecdotal reports and this may significantly reduce the current uncertainty associated with this estimation technique.

Regardless of the valuation technique employed and despite the data limitations, this analysis clearly indicates that walrus hunting generates a high positive return to the communities of Igloolik and Hall Beach. By utilizing local resources and the specialized skills of the local population, walrus hunting provides a low-cost source of highly nutritious food in an area where the cost of living is very high and incomes are low.

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APPENDIX 1. ESTIMATING THE CAPITAL COSTS OF A TYPICAL HUNTER

In 1992 and 1993, 22' or 24' wooden freighter canoes and fibreglass Lake Winnipeg fishing boats were the most common type of boats observed in both Igloolik and Hall Beach. Motors ranged from 50 to 90 hp, but the most common were the 70 and 90 hp. Some hunters, especially those with the larger Lake Winnipeg fishing boats, also had auxiliary engines. Hunters were observed using high powered hunting rifles (.30-30 and .308) and old military rifles (6.5 x 55) with 100-150 grain ammunition. Small calibre rifles were used to hunt seals and walrus calves.

The 1993 replacement cost of capital equipment is estimated to be $22 500 for a typical hunter. This includes $11 000 for a Lake Winnipeg boat, $9 000 for a 90 hp motor, $1 500 for rifles and a scope, and $1 000 for miscellaneous equipment (including a coleman stove and cooking utensils, a harpoon with line and float, a seal hook, binoculars or a telescope, butchering knives and a sharpening stone or iron, a tent and caribou skins for bedding, and parts and tools for the boat).

While hunters suggested a boat and motor could be used for more than 10 years, a more conservative estimate based on the observed age of hunters' equipment would be 7 years for a boat and 5 years for a motor. Rifles and other equipment are expected to last 10 years.

The annual and daily capital costs of a hunter are estimated in Table A.1. The annual costs are calculated by multiplying the replacement value of each piece of equipment by the capital recovery factor for the equipment's expected life and an interest rate of 5.5%. The resulting annual capital cost thereby includes both the cost of the equipment and the interest expense associated with investing in equipment. The daily capital cost is then calculated by simply dividing the annual cost by the estimated days of potential use.

Table A1.1. Calculating daily capital costs of summer hunting.

	Replacement Price	Expected Life	Capital Recovery Factor (5.5%)	Annual Capital Cost	Days of Potential Use	Capital Cost per Day
Boat	$11,000	7	0.17596	$1,935.56	60	$32.26
Motor	$9,000	5	0.23418	$2,107.62	60	$35.13
Rifles	$1,500	10	0.13267	$199.01	120	$1.66
Misc.	$1,000	10	0.13267	$132.67	120	$1.11
TOTAL	$22,500			$4,374.86		$70.19

APPENDIX 2. AVERAGE TOTAL AND EDIBLE WEIGHT OF WALRUS

The biological sampling carried out during 1991-1993 included collecting data on the weights of harvested walrus when possible. The average male walrus weighed 872 kg, the average female weighed 585 kg, and calves of both sexes weighed an average of 75 kg. The average weight of an adult walrus harvested, assuming males and females were harvested in equal numbers was 729 kg. This is higher than the average weight found in other studies (Table B.1).

In 1992, 2 female walrus were weighed before and after butchering. The weight of all walrus parts removed from the ice was 64% of the total carcass weight for one and 75% of the total carcass weight for the other. This is consistent with the utilization rates estimated by other authors (Table B.1).

Based on data collected in this and past studies, the average edible weight from a walrus is estimated to be 460 kg.

Table A2.1. Reported average total weights and edible yields of walrus.

Source	Total Weight (kg)	Percent Usable	Edible Weight (kg)	Location
Anders 1966	658	81%	533	N. Foxe Basin
Friesen 1975	680	67%	456	Nunavut
Loughrey 1959	615	74%	454	Southampton Is.
Freeman 1969/70	512	70%	358	Southampton Is.
Orr et al 1986	660	70%	462	N. Foxe Basin
This study	729	70%	510	N. Foxe Basin
Average of all Sources	642	72%	462	

APPENDIX 3. ESTIMATING THE COST OF SUBSTITUTE COUNTRY FOODS

Table 3A.1. Models of a typical seal hunt and a typical caribou hunt.

	Seal Hunt[a]	Caribou Hunt[b]
Hunters	2	2
Boats	1	1
Hours of hunting	12	35
Gas used (L)	30	227
Shots fired	10	28
Animals landed	4	7

Table 3A.2. Total variable and fixed costs of a seal hunt and a caribou hunt

	Seal Hunt	Caribou Hunt
Variable Costs		
Labour	$180	$525
Fuel	$23	$177
Shells	$15	$42
Misc. supplies	$45	$131
Total Variable Costs	$263	$875
Total Fixed Costs	$70	$351
Total Costs		
- Per Hunt	$333	$1 226
- Per kg of edible weight[c]	$3.62	$4.86

Notes: [a] based on travelling distances, shots fired, and number landed reported by Beaubier (1970).
[b] based on description provided by B. Parker, Ren. Res. Officer, Igloolik.
[c] based on estimated edible weights of 23 kg per seal and 36 kg per caribou (Anders 1966).