STUDY PROPOSAL

A RESEARCH PROGRAM TO INTEGRATE INUIT KNOWLEDGE WITH A NEST SURVEY OF THE COMMON EIDER (*Somateria mollissima sedentaria*) IN PREPARATION FOR DRILLING ACTIVITIES IN HUDSON BAY

Submitted to:

Environmental Studies Revolving Fund

Submitted by:

The Kuujjuaq Research Centre of Makivik Corporation
in cooperation with
The hamlet of Sanikiluaq
The community of Kuujjuarapik
The community of Inukjuak

1985

TABLE OF CONTENTS

LIST OF FIGURES

Project Overview

PROJECT OVERVIEW

The Inuit Perspective

External social, economic and political pressures have brought about many changes in Inuit society over the last 35 years. Inuit have responded by organizing socially and politically to counteract these forces and to defend the integrity of their culture. Two important elements for the maintenance of Inuit culture are the subsistence economy and the land-man-animal relationship that underlies this economy. Any force that might disrupt harvesting activity or alter the nature of the hunter's relationship to the land would profoundly affect the society.

Inuit have a deep concern about the northern environment and its wildlife, and they deplore the pursuit of actions which might damage or disrupt the northern ecosystem. In spite of this concern, Inuit recognize the need for and inevitability of, certain types of development in the north. Inuit have responded to the pressure associated with the development by insisting that appropriate precautions and preparations be made to foresee and avoid or minimize impacts on the environment. In addition Inuit are now calling for an active role in the environmental and wildlife research necessary to prepare for development.

In recognition of this new role, Makivik Corporation formed, in 1980, a research department that was mandated to accomplish two critical objectives. The first is to assure that Inuit have direct participation in the design, execution and application of research projects that affect their culture, livelihood, land and resources. The second objective is to transfer skills and expertise in scientific research from the south to the north. The long term goal is to improve the capacity of Inuit to actively participate in scientific research and to incorporate their traditional knowledge, skills, and points of view into this process.

In northern Quebec, active involvement in wildlife research and management has been achieved through the development of the Kuujjuaq Research Centre and through the creation of the Anguvigaq wildlife management group. The Research Center has undertaken a series of cooperative research programs with government and other scientific groups and it has initiated independent studies for wildlife and management problems that are of concern to Inuit communities or organizations. The Inuit staff of the Research Centre is undergoing an intensive training program and they actively participate in all phases of northern research.

Anguvigaq Wildlife Management Group was created in 1982 by the hunters of northern Québec. Its principal objectives are to protect the renewable resources and habitats on which the Inuit susbistence economy depends, and to protect the interest of Inuit harvesters with respect to the development, management and conservation of biological resources and their environment. Anguvigaq will provide a clear direction to Inuit as well as to all northern institutions, government agencies and developers on how best to deal with wildlife concerns and issues in northern Québec. Thus, this regional body will play an increasingly important role in identifying wildlife management problems and incoordinating with the responsible government body, the actions required to solve these problems.

Project scope and objectives

In view of impending exploratory drilling for oil and gas in Hudson Bay and considering the shortcomings of our scientific knowledge about wildlife in the region, this proposal requests funds for a program of research which will provide critical baseline information about the Common Eider, Somateria mollissima sedentaria, in southeast Hudson Bay. Until recently the size and importance of this population was not recognized by biologists. Basic biogeographic and ecological information, little of which is available from the scientific literature, will be collected from Inuit hunters, and nest surveys of Common Eider colonies in the southeast region, will provide a much-needed population estimate. Both types of information are fundamental to the effective monitoring and management of this eider population.

This information is urgently needed for the following reasons. First, Common Eiders share the rather dubious honour, along with other seaducks and alcids, of being the species most vulnerable to severe damage from oil spills. Second, eiders are an important subsistence resource and a potentially important commercial resource through the collection, processing and sale of eiderdown. A sudden or prolonged decline of the eider population, as a result of an oil spill, would negatively affect the northern subsistence lifestyle and hinder or prevent the development of an eiderdown industry. Third, an oil spill's deleterious affects on eiders could be minimized or avoided, given an adequate foreknowledge of the locations of critical eider habitats, the time of their use and the reasons for their importance. This valuable ecological information is not available in the scientific literature, but can be collected from Inuit hunters. Finally, as no accurate estimate of the size of the sedentaria population exists. The nest survey will provide a clear statement on the importance of this sub-species in relationship to other Common Eider populations in the Canadian north, and it will also provide a valuable means to monitor the health of the eider population, whether it be threatened by an oil well blowout, or any other environmental hazard.

The Inuit of the communities of Kuujjuarapik, Sanikiluaq and Inukjuak, who will participate in this study, are not reassured by statements from industry and government, which maintain that an oil well blowout is extremely unlikely. They are concerned because the possibility of an oil well blowout occurring, although small, is very real and because a single occurrence of such an event could have devastating and long-term impacts on their lives. They are not convinced that the contingency plans provided by the government and industry are an adequate safeguard against severe environmental damage. Finally they are distressed by the lack of environmental/ecological information presently available to those individuals in government and industry who, in the event of a spill, will have to make decisions with serious consequences for Inuit and their land.

This research program has implications which go beyond its importance as a much-needed baseline study of the Common Eider. It is a land mark study which has arisen from the concerns of the Inuit of the Northwest Territories and the Inuit of Quebec. These concerns have united them in a cooperative research venture. The study will be coordinated and managed by the Kuujjuaq Research Centre, an Inuit organization with core-funding from Makivik Corporation. The research program will document and utilize Inuit ecological knowledge, demonstrating its usefulness as a source of biological baseline data and as a tool for wildlife management planning. Inuit will play a major role in all phases of the project, including the data collection, data processing and analysis, and the report production.

In short, this research project is a statement by Inuit which emphasizes not only their concern about the threat that oil exploration poses to Common Eiders and the marine ecosystem, but also their desire to have their unique and extensive knowledge of the northern ecosystem recognized. It also highlights their demand for active participation in northern research and wildlife management.

Oil and Gas Exploration in Hudson Bay

1. OIL AND GAS EXPLORATION IN HUDSON BAY

1.1 Proposed Activities and History of Past Events

The Canadian Oil and Gas Lands Administration (COGLA) has negotiated Exploration Agreements for Hudson Bay with Canadian Occidental Petroleum Ltd. (CanOxy: main partner in the Trillium Operation Group, a consortium that also includes Ontario Energy Corp. and Soquip) and Inter City Gas (ICG). These agreements require that the companies drill one or two wells in their lease acreage before the end of 1986 and 1987 respectively. Accordingly, CanOxy and ICG have requested Canterra Energy Ltd. to drill two exploratory wells in Hudson Bay this summer, 1985. Canterra is still awaiting final approval of the drilling program from COGLA.

In brief, the activities planned for this summer are as follows. Canterra will utilize a single drillship and three supply vessels. The holes will be drilled consecutively. The drillsites will be located in central Hudson Bay, between 88° and 89° W, and 59° and 59°40' N (EAG 1984). This is about 300 km ENE of Churchill and approximately 250 km from the nearest land (See Fig. 1). The two sites will most likely be less than 50 km apart. Personnel and supplies will be moved between Churchill and the drillship by helicopter and/or support vessels.

As the drillship and supply vessels will be coming from Newfoundland, through Hudson Strait, ice conditions will determine the date when drilling will commence. A likely scenario would have the first well begun in late July or early August, and the second well started in late August or early September. As each well is expected to take 30 days to complete, it is unlikely that the operation will be completed before the end of September.

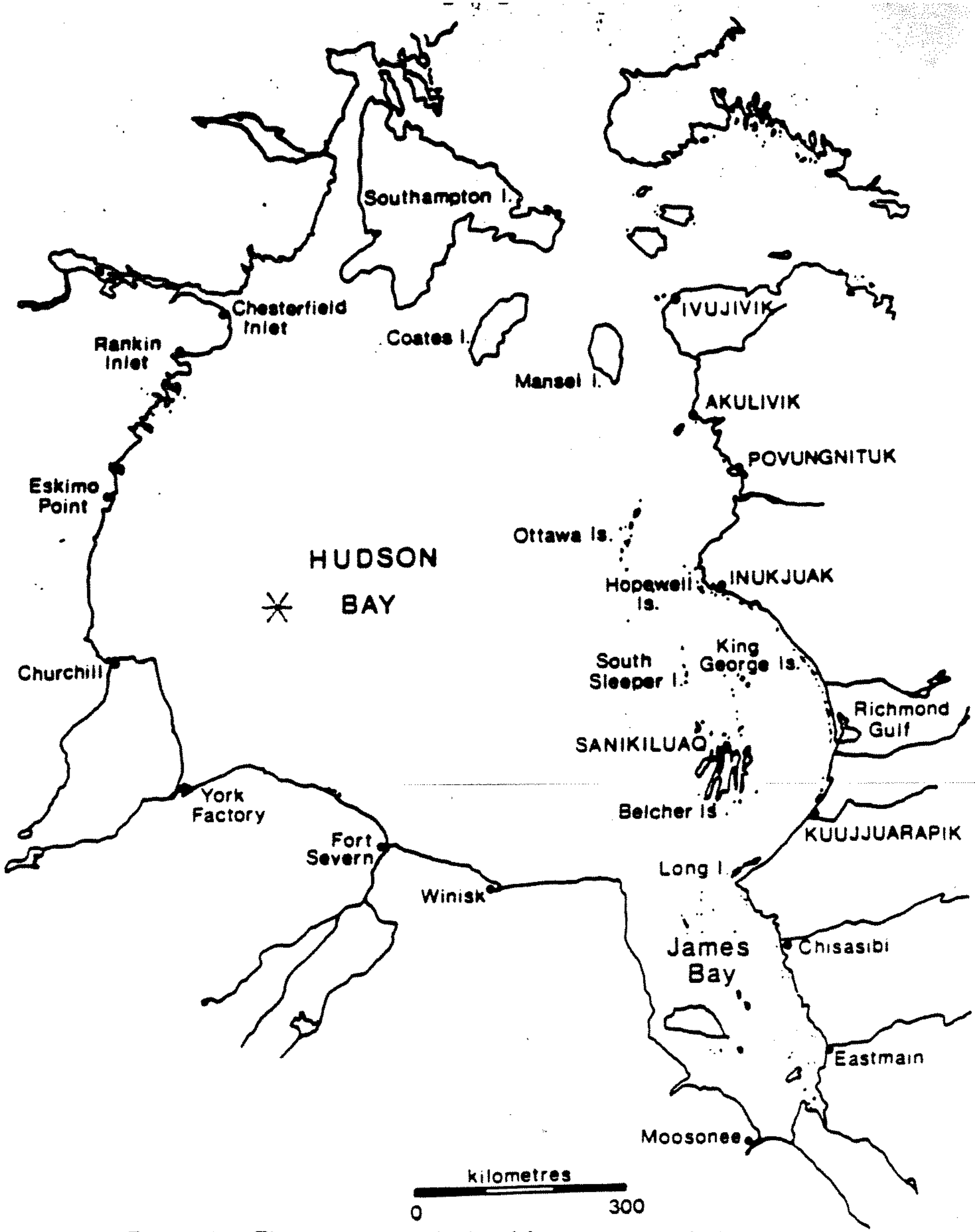


Fig. 1 The proposed drilling site (*) and locations of the communities of Hudson Bay.

Canterra Energy Ltd., the operator for the 1985 drilling, was formerly know as Aquitaine Co. of Canada (Worbets pers. com.). Aquitaine formerly held 4.3 million acres under permit in Hudson Bay (Pimlott et al. 1976). The three previous offshore wells in Hudson Bay were drilled by this company. Aquitaine drilled "Walrus" in 1969, and "Polar Bear" and "Narwhal" in 1974 (CanOxy 1982). These holes proved to be dry, although Walrus produced some oil-stained sands. The 1985 wells will probe other possible entrapment sites for oil along the same reef structure investigated by Walrus and Polar Bear. The operators are optimistic about finding oil (Worbets pers. com.), but as yet reserves remain unproved.

Aquitaine encountered serious problems while drilling Walrus in 1969. An unforecast storm struck the drillship on October 16 causing the vessel to lose connection with the hole. Severe damage was sustained and the operators were unable to plug the well, which at that point had been drilled to 3 926 feet (Pimlott et al. 1976). The hole remained unplugged for over five years. In 1974 Aquitaine returned to drill two more wells and plug Walrus. No oil seepage is thought to have occurred from the unplugged well. It is generally acknowledged that the inadequacy of weather forecasting for the area, the inappropriate response to the forecasts that were available (DFO and DOE 1980) and the unsuitability of the drillship (Alt pers. com.) were the prime reasons for the unfortunate events of 1969.

1.2 Oil Blowout: Likelihood, Causes and Concerns

Of the estimated 5 to 7 million tonnes of oil released into the marine environment each year (Birchard 1982), offshore drilling and production accounts for only 1 5 to 3% (Dexter 1981). Offshore wellhead blowouts and associated oil spills are more common during the development/ production phase than during the exploration phase (Pimlott et al. 1976).

If exploitable reserves of oil were found in Hudson Bay and brought into production, northern people would be concerned about oil pollution : problems associated with production well drilling, platform mishaps and tanker transportation and the ever-present danger of a wellhead blowout or tanker accident. As the oil reserves of Hudson Bay are largely unproved, we will restrict the discussion to impacts of the exploration phase.

Most environmental impacts associated with exploratory drilling are chronic but controllable. The effects may be considerable, but they are usually localized. The exception to this generalisation is oil leakage occurring either at the platform or at the seafloor. The most potentially damaging form of uncontrolled oil release is a wellhead blowout. Environmental damage and the resultant socio-economic impact of such an event can be regionally extensive and severe.

Many precautions are taken to prevent such an event from occurring. Canadian controls on equipment design and condition, operations procedures, and training and experience of drill crews are amongst the most stringent in the world (Dexter 1981). While drilling, a number of factors are continually monitored by drillsite engineers in order to detect and counteract increases in geopressures which can lead to a blowout. Blowout preventers, designed to seal the well, are set on top of the well casing as a final defence, ready to be activated in the event of an emergency (Ross et al. 1977).

Blowouts and oil spills, still occur. Figures for the outer continental shelf of the U.S. for the period 1971 to 1978 reveal that for 7 553 new wells drilled, blowouts with oil spillage greater than one barrel occurred on 46 occasions. In the North Sea, less than 2 blowout spills of greater then 1 000 barrels have occurred per 1 000 wells drilled (Dexter 1981). World-wide, one out of every 250 wells drilled suffers a blowout of greater than 100 barrels (DAFSAC 1981).

Accurate calculation of the "risk factor" for offshore drilling is almost impossible. Sufficient data are not available to attempt to determine a blowout risk factor for arctic and subarctic Canada (Leighton et al. in press). In northern Canada, some 150 to 200 offshore wells have been drilled (Alt pers. com.). In 1970 Panarctic experienced two blowouts in the high Arctic islands. The first flowed water for over 12 months, and the second flowed high quantities of gas (Pimlott et al. 1976). In 1976, Dome suffered a water blowout and an underground gas blowout while drilling in the Beaufort Sea (Berger 1977). These events, in conjunction with Acquitaine "losing hole" in Hudson Bay in 1969, serve as a reminder that problems do occur.

The primary cause of oil blowouts in human error (Pimlott et al. 1976; Ross et al 1977; Dexter 1981). Pimlott et al (1976) point out that although the Council on Environmental Quality considers exploration drilling to be more hazardous than development drilling (a result of foreknowledge of the geological characteristics of the area), a survey of 32 well blowouts revealed that 65% were development wells. The human factor (extra caution by exploration drill operators) was believed to have caused the unexpected result (fewer blowouts on exploration wells).

Although much effort has gone into evaluating the probability of an oil blowout, and gathering statistics on past rates of occurrence, the conclusion is that although the probability of occurence of a blowout is small, it can happen. The potential for extensive, and long-term damage to wildlife resources exists. Northern people are concerned about these resources and insist on an active role in protecting wildlife from the danger of an oil spill.

1.3 The Fate of an Oil Slick in Hudson Bay

In the event of a blowout, the control plan proposed by Canterra Energy Ltd. is to drill a relief well to plug the blowout with mud and/or cement (Worbets *pers. com.*). This would require bringing in another drillship, the nearest of which would be no closer than Newfoundland. Five or ten days, given good weather conditions, would pass before the second drillship reached the site. Further time would be required to drill the relief hole and plug the blowout. "It would take at least as long to drill a successful relief well as it did to sink the original hole" (Ross *et al.* 1977, p.13). Canterra expects to take about 30 days to complete 1 well (Worbets *pers. com.*). As oil is more likely to occur deep in the hole, it is conservative to assume that after five days travel, the drillship will take at least 15 days to plug the well. Twenty days of uncontrolled flow can release a great deal of oil into the environment.

September, October and November are extremely windy months. In September, Churchill, the nearest weather station, experiences the highest mean wind speed of any Canadian station (Pimlott *et al.* 1976). Mean wind speeds for October and November are higher (AES in EAG 1984). Recalling that, after human error, storms are the second most important cause of blowouts (Pimlott *et al.* 1976), the probability of a blowout should increase as the fall season progresses. Other factors could interact to worsen the situation. Weather systems with prolonged high winds could lead first to a blowout, then delay the arrival of a relief ship and the drilling of a relief well, hinder or prevent clean-up activities and speed the oil slick's progress towards ecologically sensitive areas.

This discussion is speculative but not unrealistic. Canterra, as Aquitaine Co. of Canada, has already suffered at the hands of severe Hudson Bay storms. Available weather forecasting for the offshore area of Hudson Bay was severely criticized by DFO and DOE (1980) as "not adequate for the proposed operation". In spite of a strong recommendation to close these information gaps, a recent assessment of CanOxy's Environmental Overview reveals that little or no progress has been made towards this end (COGLA 1984).

Oil spill clean-up procedures that are effective in adverse weather conditions have yet to be devised (Logan et al. 1975). Oil retention booms and clean-up equipment are rendered useless by seas higher than 3 on the Beaufort scale of sea state (a scale of 1 to 9). Continuous winds of 7 to 10 km per hour will result in a sea of 3 on the Beaufort scale. Fall winds are frequently stronger than this. A 1983 International Tanker Owners Pollution Federation newsletter(in Leighton et al. in press) reports that the capabilities of clean-up equipment have not improved since that time.

In their environmental overview, CanOxy speculates about the probable pathway of an oil spill from the proposed drillsite (EAG 1984). Their analysis of available wind and current data (eg. Princeberg 1982) suggests that the slick would move southeast, towards the Belcher Islands and James Bay. Assuming a maximum of 50 km per day as the travel speed of the spill, CanOxy calculated that it would be at least 5 days before the slick travelled the 250 km to the nearest land (Cape Churchill).

At this speed, moving east or southeast, the slick would take at least 11 or 12 days to reach the vicinity of Inukjuak or the Belcher Islands. Both COGLA (1984) and CanOxy (EAG, 1984) consider it extremely unlikely that an oil spill would reach these areas, unless the spill were "major and prolonged" (EAG 1984).

No attempt is made to clarify what constitutes a "major and prolonged" spill. Any attempt to predict how much oil would spill from a blown well in Hudson Bay is speculative. However flow rates from blowouts elsewhere in the world are available, and estimates of potential flow rates from the Beaufort Sea and Hibernia have been made. Recent blowout flow rates and information from Hibernia tests predict a flow of 600 to 2 500 tonnes per day (Wiseman et al. 1981). Beaufort Sea estimates are approximately 300 tonnes per day for the first month, and dropping to 180 tonnes per day thereafter (Ross et al. 1977).

If we use the minimum figure of 20 days for the well to be plugged and a flow rate of 300 tonnes per day, a blowout in Hudson Bay could produce a slick of at least 6 000 tonnes of oil. Information from sea-birds kills in Denmark allow us to put this figure into some perspective. Joensen (1972) provides a minimum estimate of 50 000 sea birds (more then half were Common Eiders) killed by 5 oil spills in the Kattegat between 1969 and 1971. In all cases the spills were minor, never amounting to more than a few tonnes of oil. Along the south coast of Newfoundland a slick of 27 tonnes was responsible for the death of greater than 5 500 seabirds (Brown 1982). By comparison, a slick of 6 000 tonnes has great potential for serious environmental damage.

The limited wind and current data for Hudson Bay make slick trajectory modeling difficult and probably ineffectual. Vandermeulen (1981) points out some of the pitfalls of trajectory calculations and emphasizes the "unexpected mobility" of a surface slick. He comments that "it must be realized that a strong, consistent two or three day wind can drive a surface slick several hundred kilometers in an unexpected direction" (Vandermeulen 1981, p.34).

It is worth pointing out that the direction of tidal current flow in Hudson Bay (counter-clockwise) would complement the prevailing north-west winds and speed the progress of the slick towards the southeast sector of the bay. Engelhardt (1984), in his comments on the CanOxy over-view, points out that modeling by Freeman indicates potential tidal currents of up to 100 cm/sec at the drilling site. To put this into perspective, note that a 120 km/hr wind would be required to create a surface current of this magnitude (calculating surface current speed as 3% of wind speed (Mackay 1982)). Surges of tidal current of this magnitude coupled with strong persistent winds could move a slick quickly into sensitive areas.

CanOxy (EAG 1984) also points out that a clean-up operation could be staged before the slick reaches land, and that weathering would occur to reduce the size and danger of the slick. However, the high wind conditions that might precipitate a blowout and move the slick into a sensitive area, would also severely hamper or prevent a clean-up operation.

Much attention has been given to the weathering of oil slicks. Briefly, the processes that change the nature of the slick include evaporation, dispersion, dissolution, biodegradation and photolysis (Mackay 1982). To state that, in the short term (less than 50 days), weathering renders the slick less harmful is, at best, deceptive. The nature and outcome of the weathering process varies considerably depending upon the composition of the oil, and environmental factors such as temperature, wind, turbulence and rain. In a "typical" sequence of events, after 10 days only 30% of the oil will remain on the surface, most of the remainder having been evaporated or dissolved. Consider however that 30% of the estimated 6 000 tonnes of oil released is still 100 fold more oil than that which killed tens of thousands of seabirds in Denmark (Joensen 1972).

Polycyclic, aromatic hydrocarbons (eg. napthalenes) have been identified as the components primarily responsible for the toxic effect of oil on birds and other organisms (Leighton _et al_. in press). Weathering concentrates these components as they are not readily soluble nor volatile (Leighton _et al_. in press; Mackay 1982). Biodegradation of these compounds may also be neglegible (Mackay 1982). Some oils contain high levels of toxic heavy metals which would concentrate through weathering (Leighton _et al_. in press). Oxidation of hydrocarbons produces some products more toxic than the original compound (eg. phenols) (Mackay 1982). Toxicity of the oil slick may therefore increase as a result of weathering.

No consideration has been made of the impact of a blowout that would continue through the winter. Such an event is not inconceivable. Severe weather conditions could prevent the relief ship's arrival or prevent the successful drilling of a relief well. Geological complications may resist all attempts at plugging the well. Ice formation may require the abandonment of the site until the following season. COGLA (1984), in its initial environmental screening for drilling in Hudson Bay, recommends that the time reserved for relief well capability should be "at least two months, leaving two months for countermeasures"(COGLA 1984, p.14). As Canterra expects to finish its second well by the end of September, it is depending upon October and November conditions to be suitable for relief well capability. Archibald (in EAG 1984), however, modeling the energy of moving ice in Hudson Bay, concluded that in November "there is potentially sufficient energy in ice pans to be of concern to a drilling rig" (EAG 1984, p.51). Maps of the extent of sea ice from Fisheries and Oceans Canada, indicate that by December 1, or average, all of Hudson and James bays are completely covered with ice (EAG 1984).

No attempt will be made here to speculate about the possible consequences of oil leakage through the winter. Research has been done about the behaviour of oil under ice and in ice-infested water (Ross et al. 1977). It is sufficient to comment that ice circulation patterns in Hudson Bay would carry oil into the region of the Belcher Islands and the Nastapoka arc (Beales 1968), that weathering and dissolution of oil under ice is negligible (Ross et al. 1977) and that oil in the few open leads northwest of the Belcher Island, where the majority of Hudson Bay eiders winter, would have serious consequences for the population.

In short, the limited information on blowout response, probable slick trajectory, clean-up capability and oil weathering processes provided by CanOxy (EAG 1984), offer little reassurance to the Inuit of Inukjuak, Sanikiluaq and Kuujjuarapik. The research program on Common

Eiders is an expression of this concern. It reflects their awareness of the unpredictable nature of weather extremes in Hudson Bay, the singular vulnerability of eiders to oil and the considerable social and material significance of the species to their subsistance lifestyle. It is but one indication of Inuit concern for the welfare of the entire northern ecosystem.

The Common Eider:
An Important Northern Resource

2. THE COMMON EIDER: AN IMPORTANT NORTHERN RESOURCE

2.1 Social Significance and Subsistence Use of the Common Eider

For Inuit throughout the Arctic and sub-Arctic regions hunting, fishing and trapping does not constitute a recreational activity. It is a lifestyle; an integral part of their daily existence and cultural identity. Subsistence has allowed Inuit to weather the onslaught of external pressures and internal change and to retain their integrity as a distinct people (Freeman 1982; Brody 1977).

Marine resources have always played a key role in the Inuit subsistence economy. Land-use (Makivik Research unpublished data; Brice-Bennett 1977; Freeman 1976) and harvesting studies (JBNQHRC 1982, 1982, 1979; Donaldson 1983a, 1983b) repeatedly emphasize the importance of this relationship with the marine ecosystem. Alone, these data provide an incomplete picture of the significance of subsistence activities for the Inuit community. Nevertheless the insights provided by these spatial and quantitative assessements, are valuable.

By examining the harvest data for the communities of eastern Hudson Bay (See Figs. 2a, 2b, 3a, 3b) we can begin to appreciate the important contribution of Common Eiders to the subsistence economy. The numbers and the edible weights of harvested Common Eiders and their eggs are presented in Table 1. The estimated annual harvest of eiders for Sankiluaq for 1981 to 1983, is 5 035 ducks (BRIA unpublished data; Donaldson 1983a, 1983b). Kuujjuarapik, Inukjuak and Akulivik recorded mean estimated annual harvests of 1 401, 4 469 and 943 eiders respectively for the years 1979 and 1980 (JBNQHRC 1982). The total regional annual harvest (no data is available for Povungnituk) is 11 848 eiders.

Egg harvest data is available for the three Québec communities (see Table 1). The annual estimated harvest totals are 1 604, 3 439 and 2 082 eggs for the communities of Kuujjuarapik, Inukjuak and Akulivik respectively (Makivik Research 1984).

TABLE I

Common Eider harvest statistics for the communities of east Hudson Bay

COMMUNITY	ESTIMATD ANNUAL EIDER HARVEST		ESTIMATED ANNUAL EGG HARVEST	
	#	edible wt (kg)	#	edible wt (kg)
Sanikiluaq, NWT.	5 035	5 950	N/A	N/A
Kuujjuarapik, Qc.	1 401	1 681	1 604	160
Inukjuak, Qc.	4 469	5 363	3 439	344
Akulivik, QC.	943	1 132	2 082	208
E. Hudson Bay TOTAL*	11 848	14 126	7 125	712

* excludes Povungnituk, as data not available.

Note: For Sanikuluaq, eider harvest data is for the years 1981 to 1983 (BRIA unpublished data; Donaldson 1983a, 1983b) egg harvest data not available

For Québec, eider harvest data is for the years 1979 and 1980 (JBNQHRC, 1982) egg harvests data is for the years 1976 to 1980 (JBNQHRC, 1982).

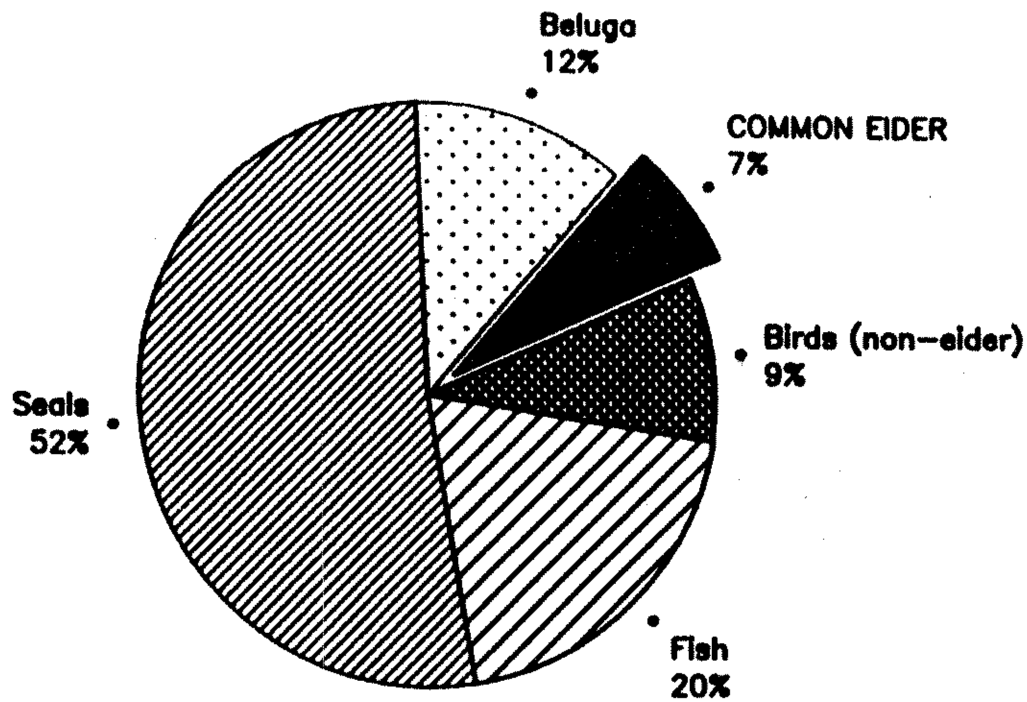
These numbers can be translated into kilograms of edible product using an edible weight value of 1.2 kg per duck and 0.1 kg per egg (Cooch in press). Considering both meat and eggs, the total edible weight of the harvest of these four communities is 14.8 tonnes. This is an underestimate as data is not available for the egg harvest of Sanikiluaq.

Although this is a great deal of food, eiders and eider eggs only contribute between 1.5 and 2.2% of the total edible weight harvested by the three Quebec communities. The eider harvest of Sanikiluaq constitutes a somewhat large proportion by edible weight, at 7.2%. These numbers represent a significant contribution to the overall harvest but are not in themselves particularly impressive. However when the harvest is examined on a monthly basis, we begin to appreciate the considerable seasonal importance of eiders.

For the four communities the peak months of eider harvesting are June/July and October to December. The November harvest of eiders by edible weight, for the communities of Sanikiluaq and Kuujjuarapik, surpasses that of any other single species including ringed seal and beluga whale. In this month, Common Eiders constitute 36 and 20% respectively of the total edible weight harvest of these two communities (See Figs. 2b and 3b). The October and December eider harvests in Sanikiluaq are 12.0 and 21.5% of total edible harvest respectively. The October and December harvests in Kuujjuarapik are 11.2 and 4.8%, respectively (BRIA unpublished data; JBNQHRC unpublished data).

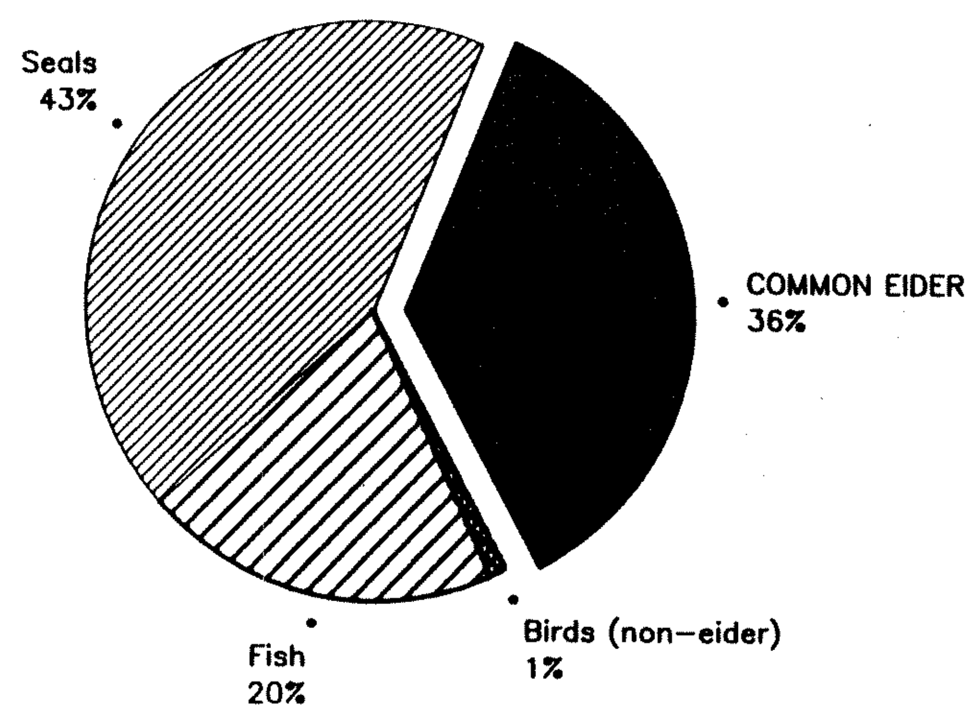
Although Inukjuak and Akulivik exhibit less pronounced peaks in their eider harvests, early summer and fall are still the important months. In June and October, eiders constitute 5.7 and 5% respectively of the total edible weight harvest for Inukjuak (JBNQHRC, unpublished data).

Figure 2a: Contribution of Common Eider to total harvest by edible weight.



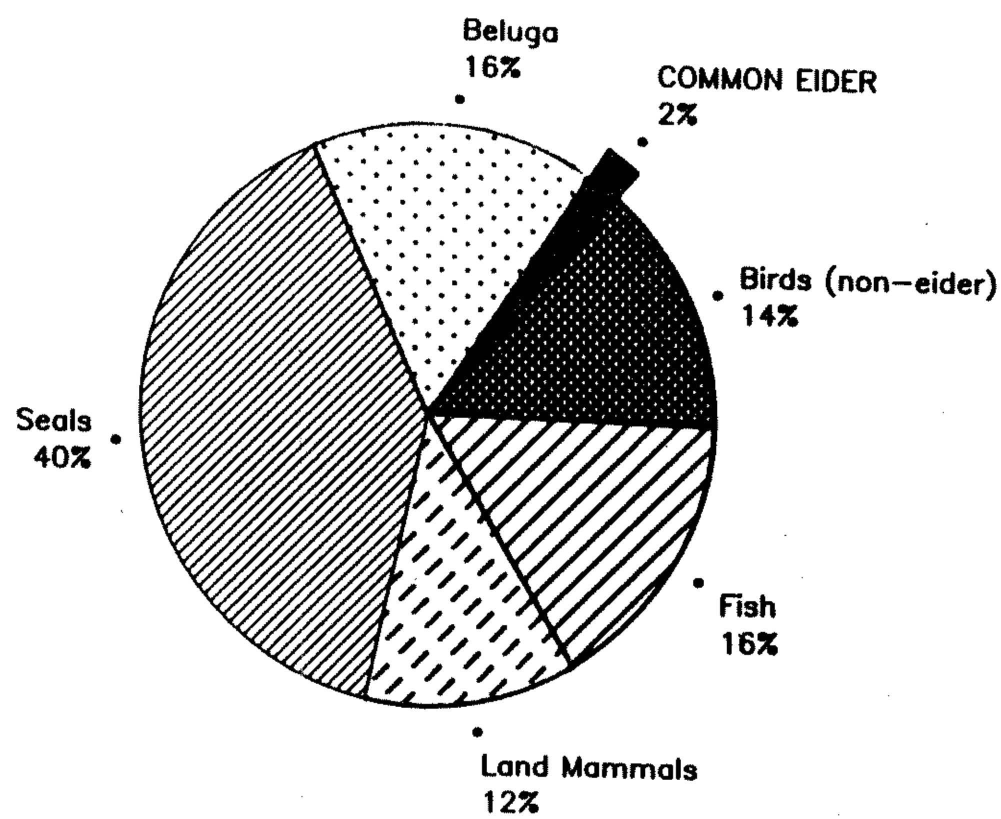
Sanikiluaq
Complete Year

Figure 2b: Contribution of Common Eider to total harvest by edible weight.



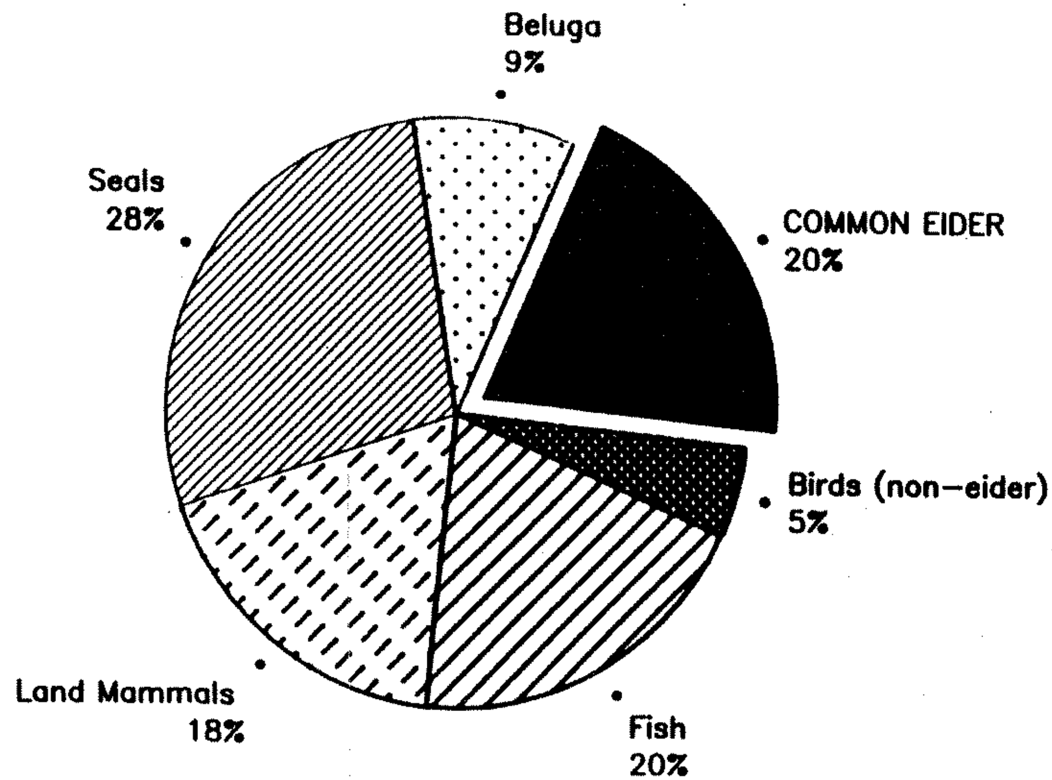
Sanikiluaq
November

Figure 3a: Contribution of Common Eider to total harvest by edible weight.



Kuujjuarapik
Complete Year

Figure 3b: Contribution of Common Eider to total harvest by edible weight.



Kuujjuarapik
November

In addition to meat and eggs, eiderdown is harvested from the nests. The down is hand-cleaned and used to insulate parkas, wind pants and mittens. There is no record of the amount of down harvested.

While harvest data provides a quantification of the economic importance of Common Eiders to Inuit hunters, it does not promote an understanding of the social significance of the eider hunt and the collection of eggs and down. Freeman (1982) very aptly describes hunting as a socialization process which binds the society. Hunting and the activities associated with this pursuit (aquisition, sharing and consumption) are the mechanisms by which fundamental values and beliefs are transmitted from elders to youth (Freeman 1982).

Eider hunting and egg/down gathering are a part of this ecological/ sociological network. In the Belcher Islands eiders are an important resource because of their local occurrence in large numbers at all times of the year (Freeman 1982). The presence of a "dependable" resource, acts as a type of insurance which sustains hunters on the land when less predictable resources (eg. whale, seal) are difficult to find. A shortage of eiders may compromise, or even preclude the harvest of seals or whales, by forcing unsuccessful hunters to return to the settlement earlier than planned. Families that were trapped in camp by freeze-up have survived only as a result of the dependability of the Common Eider harvest (Freeman pers. com.).

Eggs and down are unique resources, with no comparable substitute. In order of importance, the following bird eggs are collected by the communities of east Hudson Bay : Common Eider, Canada Goose (Branta-canadensis), Herring Gull (Larus argentatus), Black Guillemot (Cepphus grylle) and other duck species (eg. Oldsquaw, Pintail, Red-breasted Menganser). Common Eiders and Canada Goose probably account for greater than 95% of the total egg harvest. The ratio of eider eggs to goose eggs is 4 : 1 (Makivik Research 1984).

Eider and goose down are both collected to insulate clothing. However, Inuit and the international down markets agree that eiderdown is clearly the superior of the two . No data is available on down harvesting but it is reasonable to assume that eiderdown constitutes greater than 80% of the total down harvest.

The early summer visits to eider nest colonies to collect eggs and down are important social events that involve all family members. There are few other harvesting activities (eg. berry-picking, clam and mussel gathering) in which old and young participate on such on equal basis. The evolution of specialized methods for this harvest are an indication of its social and economic significance. Eggs are candled or tested in water to assess state of development. Unwanted eggs are handled carefully and replaced in the nest (S. Annahatak pers. com.). Other conservation practices include the covering of nests to conceal eggs from foraging gulls. Inuit have a protective attitude towards eider colonies. Fox, and on rare occasion, polar bear, have been shot in eider colonies in order to prevent further destruction of nests.

In the past, when caribou were scarce, Common Eider skins were sewn together to make parkas of exceptional warmth and beauty. Sanikiluaq is renowned for the production of these exceptional items of clothing. Today eiderskin parkas have been replaced by parkas made of eiderdown or duffel. One small, but significant, indication of the continuing importance of eiders to the people of Sanikiluaq is that the local coop store is named Mitiq (Common Eider in inuktitut) and the hotel is named Amaudlik (eider drake or male).

2.2 Eiderdown: A Future Cottage Industry for the North?

In recent years, Québec and NWT Inuit have shown increasing interest in the development of local eiderdown industries. An economic venture of this nature has many appealing features. First, it would rely upon experience and skills already largely present in the north. Down collection, cleaning and parka-making are day-to-day activities carried out to fulfill personal needs. Second, the industry can be organized so that commercial down collection can be integrated with normal activities of the season, such as summer camp and seal hunting. Third, hand down-cleaning and down product fabrication, are labour intensive and can be done in the home according to one's own schedule. Fourth, eiderdown commands a very high price on the world market (Can $ 350 to 400 per kg. of clean down (Poole 1984)). A high price per unit weight is an important asset for a northern product, because transportation costs are high. The production of hand-sewn, and embroidered eiderdown parkas, quilts or vests would further increase the return to the community. A final consideration is that eiderdown is harvested from the nest and does not require the trapping or killing of any animal. The industry may thus provide an important substitute for seal pelt and fur-trapping enterprises, which have suffered considerably at the hands of animal welfare groups.

The concept of an eiderdown industry is not a new one. The Hudson's Bay Co. obtained 1 720 kg of clean down from the south Baffin coast between 1939 and 1942 (Reed in press). In the 1950's the Dept. of Northern Affairs established protected eider colonies near Kangirsuk, Québec and Cape Dorset, NWT in order to increase the local population and exploit the eiderdown (Reed in press; Cooch 1965). The Québec Federation of Cooperatives has purchased and sold considerable quantities of uncleaned down in the past, and still continues to purchase and sell eiderdown on a small scale. As recently as the spring of 1984, the Federation sold 45 kg. of clean eiderdown to a Toronto buyer for $18 500 (J.-G. Bousquet pers. com.)

The community of Kangirsuk, Québec has shown the most active interest in an eiderdown industry. They have encouraged and supported local eider management studies by the Kuujjuaq Research Centre from 1982 to 1984. In 1984 an economic feasibility study was commissioned and it reported favorably on the possibilities for development (Poole 1984). The community is presently evaluating the best way to undertake a commercial operation.

Oil and Eiders

3. OIL AND EIDERS

3.1 The Vulnerability of Eiders to Oil Spills

It is generally accepted that seabirds, and in particular alcids and seaducks, are the most vulnerable of all arctic and sub-arctic fauna (Leighton *et al*. in press; EAG 1984; Percy and Wells 1984; Brown 1982; Blood 1977). King and Sanger (*in* Leighton *et al*. in press) have developed an Oil Vulnerability Index which serves as a tool to rank birds according to the degree to which they would be threatened by oil pollution. In an evaluation of birds of the northwest Atlantic, Common Eiders, Northern Gannets (*Morus bassanus*) and all alcids (except Black Guillemot) were ranked as extremely vulnerable to oil pollution. The Beaufort Sea Project, in an evaluation of the vulnerability of birds, seals, polar bears and whales, judged sea ducks as the species likely to be most adversely affected by an oil spill (Blood 1977).

A variety of physiological, behavioural and ecological traits render birds, and in particular eiders, vulnerable to lethal or sub-lethal affects from oil. The most conspicuous impact is direct mortality from external oiling. Massive wrecks of seabirds are associated with all major oil spills. Oiled birds generally die from exposure. Unlike sea mammals which rely upon a thick layer of subcutaneous fat for insulation, birds depend upon the delicate physical arrangement of water-proofed feathers and down. These provide insulation by excluding cold water and air. Even a small amount of oil will disrupt this insulation layer and allow cold water and air to contact the body surface. A heavily-oiled Scaup (*Aythya* sp. - a seaduck) loses heat at twice the normal rate and the compensatory rise in basal metabolic rate is greater than 30% (McEwan and Koelink *in* Brown 1982). Eiders and other diving seaducks are susceptible to heavy oiling because they may surface in the midst of a slick. Alarmed by the presence of oil, they may dive and resurface in the oil repeatedly (Leighton *et al*. in press).

In the Arctic or subArctic, an oiled bird has little chance of survival. As eiders must dive in icy waters to forage for food, even a small amount of oil may be deadly. Energy balance is even more precarious in the winter. It is therefore noteworthy that the <u>sedentaria</u> subspecies of the Common Eider winters in Hudson Bay (Freeman 1970). An oil slick in the ice leads northwest of the Belcher Islands, where the majority of the population winters, would be of major concern.

In addition to the loss of insulation, external oiling causes feathers to adsorb water, increasing body weight and decreasing bouyancy. Energy consumption would increase as a result of the increased difficulty of flight, swimming and/or diving (Brown 1982). Food search and gathering would become more difficult. This disruption of energy balance due to impaired thermoregulation, mobility and feeding is generally fatal (Leighton <u>et al</u>. in press; Brown 1982).

Birds respond to oil-fouled feathers by preening. Experiments by Hartung (<u>in</u> Leighton <u>et al</u>. in press) reveal that as much as half of the external oil may be ingested by preening within 8 days. Ingested oil may have a variety of toxic effects. Oil ingestion coupled with other usually non-fatal forms of stress significantly increase mortality (Holmes <u>et al</u>. <u>in</u> Leighton in press). Adrenal exhaustion is generally the cause of death.

Osmotic imbalance and dehydration have been shown to occur in response to even a small dose of oil. In this respect, weathered oil was found to be more disruptive than unweathered oil (Percy and Wells 1984; Brown 1982). Oil has also been found to depress growth rate in young birds (Leighton <u>et al</u>. in press). Inuit hunters report high mortality of young eiders during severe winters. Winter survival is probably a function of body size and energy reserves. Depression of growth by oil could severely decrease overwinter survival and the rate of recruitment to the breeding segment of the population may drop.

Oil ingestion has also been found to affect reproduction. Cessation of egg laying, reduced fertility and disruption of the normal oestrous cycle are all symptomatic of birds that have ingested oil. The toxic effect of very small quantities of oil on eggs has been demonstrated for many species (Leighton et al. in press). Only 69% of Common Eider eggs hatched when treated with 20 microlitres of No.2 fuel oil, versus a 96% hatching rate for controls (Szaro and Albers 1977). Oiled incubating adults would easily transfer these amounts to their eggs.

In summary, external oiling, oil ingestion and the transfer of oil to eggs, are significant sources of mortality for many species of birds. Seaducks, such as eiders, are considered to be particularly vulnerable. First, choice of habitats increases their chance of encounting an oil slick. Common Eiders are an entirely marine species. All stages of their life cycle are closely tied to the marine ecosystem. The only occasion on which eiders leave the sea is to nest, and nesting occurs on offshore islands. Only the Common Eider and Black Guillemot remain in Hudson Bay in significant numbers through the winter. Therefore at no point in time or space does the Common Eider escape from the possibility of encountering oil spilled in Hudson Bay.

Second, their tendency to gather in large groups means that a significant proportion of the population may be at risk at one time. Eiders are a social species, frequently gathering in large numbers for such purposes as nesting, moulting and feeding. This trait increases their vulnerability, as the population could be severely impacted by a single, relatively small slick that was at the wrong place at the wrong time.

Finally, eiders are K-selected. Average life expectancies of 26 years (Baillie 1982) and annual adult survival rates of 90% (Coulson 1984) have been recorded in some colonies. Annual adult survival rates greater than 80% has been recorded for Hudson Strait (Cooch in press) and the St-Lawrence Estuary (Reed 1975). Small clutch sizes (less than 4 eggs) (Chapdelaine et al. in press), low fledging rates (Milne 1974) and delayed sexual maturity result in a low population growth potential. Therefore eiders depend on long-term adult survival to maintain population stability. Major losses of adults are a much greater threat to the population than are seasons of reproductive failure (Leighton et al. in press). If an oil spill were to kill a significant number of adult eiders, the population would take many years to recover.

3.2 Environmental Impact Assessment and Drilling in Hudson Bay

In 1973 the commencement of drilling from drillships in the Beaufort Sea was stayed by the Federal Cabinet until the summer of 1976. The reason for this delay was to allow time for the Beaufort Sea Project to collect critical physical and biological baseline data, to assess the potential impacts of oil exploration, and to evaluate and prepare oil spill countermeasures. The total cost of the project was estimated at $12 million. The primary concern was a subsea oil blowout (Blood 1977).

In 1976 the Minister of Indian Affairs and Northern Development responded similarly to demands for the right to probe offshore areas of the eastern Arctic for oil. The Eastern Arctic Marine Environmental Studies (EAMES) program was established to assess the physical and biological environment in order to better understand the impact of offshore drilling in this region. The total cost of the EAMES program was $12.9 million, the great proportion of the funds being supplied by private industry. Drilling was delayed until an Environmental Impact Statement could be prepared and accepted by the Federal Environmental Assessment Review Office. Once again the need to prepare for a wellhead blowout was a key consideration of EAMES (DIAND 1981; DIAND 1977).

The Beaufort Sea Project and the EAMES program examined such diverse topics as the nature of the ice environment, the pattern of current and wind movements, the distribution and abundance of species of marine mammals, bird migration pathways and chronology, the effects of oil on arctic fauna, the socio-economic impacts of oil exploration and the capabilities of oil clean-up procedures. The Beaufort Project produced more than 45 reports, and EAMES more than 80. (DIAND 1981; Ross et al. 1977).

An examination of the projects' literature published on birds, reveals that the greater part of this research effort comprised extensive field surveys. These surveys documented for many different species, the major migration pathways, the chronology of movement and habitat use and the location of principal feeding, nesting, moulting and brood-rearing areas. These data are fundamental to an appreciation of the potential impact of an oil spill, and critical guidelines to determine the most appropriate response to avoid a disaster.

Is this baseline information available for Hudson Bay? To date the following impact assessment studies have been conducted by CanOxy: an Environmental Overview (EAG 1984), which is a literature review for the region, and 1982 and 1983 wildlife observer programs (Milani 1984), which only superficially address the issue of local environmental impact. Canterra Energy may submit their own environmental overview, but its assessment of impacts on the biological environment is not expected to differ to any significant degree.

Although the following comments apply to other species groups, such as marine mammals, we will restrict our discussion to birds, in particular Common Eiders. The scientific literature on the avian fauna of Hudson Bay is limited. Consequently CanOxy's Environmental Overview with respect to birds, is similarly deficient. Although Common Eiders are identified as amongst the species most sensitive to oil contact (EAG 1984), insufficient information is presented to allow effective protection or monitoring of this resource.

3.3 Present State of Scientific Knowledge of the Hudson Bay Eider

The scientific literature provides limited information on S. m. sedentaria, the Hudson Bay eider. The most comprehensive information is available from Freeman (1970) who spent the summers of 1959 and 1960 and the winter of 1961 on the Belcher Islands. He reviews the brief literature on the sedentaria subspecies and identifies the important wintering areas for the population to the north and west of the Belcher Islands. The coastal area southwest of Robertson Bay is heavily used for nesting while areas to the east are relatively sparsely occupied (Freeman 1970). Nettleship and Smith (1975) estimate the Belcher Island breeding population at 35,000 eiders, but no information is provided to explain how this estimate is derived. Chapdelaine et al. (in press), using a broad extrapolation from an aerial survey in 1978, provide a breeding population estimate of 41 556 individuals on the nearshore islands along the Québec coast of Hudson Bay. A population estimate of 45 165 individuals for the entire sedentaria population is provided by Abraham and Finney (in Reed and Erskine in press). This estimate, although derived from the most recent and complete set of information available falls short of providing the accuracy required for the purposes of managing the sedentaria (Reed pers. com.). The author insist that this must be considered a very conservative estimate of the population.

At the present time, no survey data available for Hudson Bay, whether alone or in combination with other information, are suitable to provide a comprehensive and reliable population estimate. Reed and Erskine (in press) state that nest surveys of sedentaria are "badly-needed", and call for detailed surveys of the Québec coast and the Belcher Islands.

Manning (1976) provides some observations on eiders in the Belcher Islands. His observations of large flocks of eiders seen at different locations during the non-breeding season are interesting. Murie (in Todd 1963) provides incidental observations on eiders made along the Québec

He provides some documentation of nesting locations, but he concedes that "The native Eskimo... know the nesting-places". Twomey, (in Todd 1963) reports on eiders in the Belcher Islands and mentions the eider skin parka. Palmer (1976) provides an effective summary of the literature available on S. m. sedentaria.

From this brief review of the literature it is quite clear that scientific information on the Hudson Bay eider is restricted. Reed and Erskine (in press), in the context of developing winter surveys, urge the investigation of sedentaria's winter distribution. In fact the distribution of eiders in all seasons of the year is poorly understood. Population estimates are correspondingly weak and in great need of new and comprehensive data. CanOxy's Environmental Overview has no new information to offer and was conducted without reference to recent assessments of the status of the Hudson Bay eider by CWS (Reed in press).

Although many of the results of the Beaufort Sea and EAMES programs have application elsewhere in the Arctic and sub-Arctic, the primary focus of the biological studies was to identify the distribution, habitat use and ecological relationships between organisms within each of the two regions. These studies are essential to the decision-making process for they provide an evaluation of the environmental risk associated with particular decisions. By definition, much of this information (eg. location of nesting or moulting areas, estimates of abundance) has strictly local application.

This basic information is largely not available for Hudson Bay. Distribution, abundance and migration routes of marine mammals and birds are understood at only a gross level, if at all. For the Common Eider, the scientific literature offers little understanding of the species' use of the region. Important feeding, moulting and brood-rearing sites are undocumented. Migration routes are largely unknown. Ecological relationships are poorly understood. Distribution and abundance information is lacking for all areas and all seasons. Our decision-making capacity is severely limited.

If a prolonged blowout should occur, and if the slick should approach areas frequented by eiders, we will have to make decisions about countermeasures (eg. disperse the slick and risk contamination of the water column or leave the slick and attempt to disperse the birds). To make decisions we need information. We also require a mechanism whereby we can monitor the effects of an oil spill on the eider population. Although a substantial kill of eiders has an impressive visual impact, only systematic population monitoring can assess the long-term effects on the population.

Hudson Bay is only sparsely populated by people. Although Inuit hunters traverse much of this region in summer and winter, the high winds and rough waters often restrict their movements in the fall. As these fall north-westerlies may also guide a slick to land, it is not unimaginable that a major bird wreck in an area remote from any community, might pass unnoticed. The negative effect on the population would be the same but the only quantitative mechanism of detection and assessment would be standardized population monitoring.

Finally, oil may impinge upon eider habitat in another form ie. weathered and scattered. Eider mortality at any one location, or at any one time, may not be dramatic. However the oil may cause a high number of deaths from direct contact, but at scattered locations. Diminished food supply (from toxic effects on benthic fauna), decreased reproductive success and sublethal toxic effects may take their toll in a relatively inconspicious fashion over an extended time period. Again, systematic population monitoring would be the only quantitative means of detecting and assessing such effects. Early detection of such trends is essential in order to take appropriate countermeasures to prevent severe population decline.

Study Design

4. STUDY DESIGN

4.1 Approach

The Common Eider Ecology and Survey Project is a joint venture of the communities of Sanikiluaq, NWT, Inukjuak and Kuujjuarapik, Québec and the Kuujjuaq Research Centre. It is a northern research venture, coordinated by the staff of the Research Centre, and drawing upon the knowledge, experience and resources of the three communities. The objectives of the project address the concerns of Inuit about the future of eiders in this region. The results of this work will have immediate application as a decision-making tool to assess and/or minimize negative impacts from oil and gas activities in Hudson Bay. They will also have broad application as an essential monitoring tool for the purposes of wildlife management.

The study objectives and design complement the efforts of the Research Centre in Kuujjuaq, Québec. Primary goals of the Centre include 1) the carrying out of all phases of research in the north rather than the south; 2) the direct integration of Inuit into all facets of the research program and; 3) the active pursuit of the documenting and utilization of Inuit Hunter knowledge.

This joining of Inuit from Québec and NWT, to address a common concern and a common need, is rooted in the recognition that effective wildlife research and management is a cooperative and regional affair. The vision shared by Inuit throughout the north, and implicit in this research project, is a central and active role for Inuit in northern environmental and wildlife management.

This research program is subdivided into two compotents. Component A, gathers Inuit biogeographic/ecological information on Common Eiders. Component B is a nest census of Common Eider colonies. Both of these components will contribute to the impact assessment process. Information from Inuit hunters, component A of the project, will contribute towards the documentation of the qualitative norm or baseline. Component B, the nest survey will provide a quantitative baseline. By combining Inuit knowledge with systematic surveys, to develop sensitive qualitative and objective quantitative baselines, this research program provides an excellent illustration of how Native and scientific knowledge systems can complement each other.

4.2 Project Components: Objectives and methodology

4.2.1 The Ecology of the Common Eider in Southeastern Hudson Bay: A documentation of Inuit Knowledge: Component A

4.2.1.1 Specific Objectives

A review of the scientific literature on Common Eiders in Hudson Bay reveals substantial information gaps. Key biogeographical information, necessary for the planning of oil spill countermeasures, and the assessment of potential environmental impacts, are not available. Missing or poorly understood elements include the locations of migratory pathways and moulting, brood-rearing, feeding and wintering areas.

The main objective of this component is to document Inuit knowledge about the ecology of the Common Eider in southeast Hudson Bay. Interviews conducted with hunters in Ungava Bay confirm that much of the relevant biogeographical information is readily obtainable (Nakashima in press). However, hunter information has considerably more ecological scope, and should provide valuable insights into other phenomena such as eider life history, feeding ecology, phenology and population dynamics.

4.2.1.2 Interview Methodology

Data will be collected from hunters in each of the three communities of southeast Hudson Bay: Inukjuak, Sanikiluaq and Kuujjuarapik. Each community will select those individuals that are considered to be particularly knowledgeable about Common Eiders and are interested in participating. Hunters may choose between various data collection techniques. They may be interviewed individually or in small groups of up to three individuals. Alternatively, they may record information themselves by writing, speaking into a tape recorder and/or marking on maps overlays.

Interviews will be conducted using techniques developed and refined by the Ungava Bay Eider ecology interviews (Nakashima, in press) and the Northern Québec Inuit Land Use and Ecology Mapping Project (Makivik Research,unpublished data). All interviews will be taped and biogeographic information will be recorded on transparent acetate overlaid on a 1:250 000 base map. Two sessions will be conducted with each hunter. After the first session, self-recorded and interview tapes will be transcribed and translated. Verbal and map data will be compared for inconsistencies, and preliminary maps will be prepared for digitization. All map information will be digitized and extended into a computer. An line plotter will provide full-size, multi-coloured map output to be used for the second data collection session.

P. Wilson of the Makivik Research Department, has prepared and refined the computer program for map reproduction for the northern Québec Inuit Land Use and Ecology Project. The computer system will be at the Kangiqsujuaq Cartography Laboratory in northern Québec. One individual from each participating community will go to Kangiqsujuaq to be trained in map digitization by the Cartography Laboratory staff. This individual will then be hired to help enter the hunter data from their community onto the computer and to produce the preliminary maps for the second session.

The second session will be a recheck of the data and allow the hunter to add to or refine the information he has provided.

All interviews will be conducted in a flexible manner, allowing the informant to provide his own structure. Experience has demonstrated that this is the most productive and unbiased interview style.

4.2.1.3 Hunter Information to be Collected

The information collected from hunter interviews will include, but not be restricted to the following:

1- Taxonomy - Types of eiders, names and classification relative to other species.

2- Common Eider Ecology

(i) Biogeography

- localization of important areas for eiders (eg. nest colonies, brood-rearing sites, wintering grounds)
- functional explanations for eider site-selection (eg. food abundance, lack of disturbance, shelter from the elements)
- identification of migration routes

(ii) Phenology

- timing of different seasonal activities
- year-to-year variation in phenology

(iii) Life History

- differential survival of life stages (eg. egg vs. duckling vs adult) or cohorts (generations)
- age at first breeding, frequency of non-breeding and frequency of renesting

(iv) Feeding Ecology

- identification of major food types
- seasonal and age-related changes in food use
- observations of feeding behaviour

(v) Population Dynamics

- observed changes in eider population size

(vi) Interspecific Relationships

- predators and parasites of eiders
- nature and significance of associations with other species (eg. nesting association with gulls/terns; health and parasite load)

(vii) Anatomy and Physiology

- identification and naming of body parts
- seasonal changes in plumage, fat content, meat flavour/quality

3. Environmental Information

(i) Seasonal changes in weather and their effect on eiders and their distribution

(ii) Description of water currents and the ice environment as it relates to eider ecology and distribution

4. Common Eiders and Man

(i) Potential impacts of development on eiders

- oil and gas development
- hydroelectric development
- establishment of the new community of Umiujaq (Richmond Gulf)

(ii) Inuit use of Common Eiders

- important harvesting areas
- association of eider hunt with other harvesting activities
- documentation of past and present uses of eiders
- hunting techniques, past and present
- impacts of hunting pressure, community growth, new technology.

Due to the flexible nature of the interviews, hunters will largely determine topics to be addressed. Consequently individual interviews are expected to vary considerably in content and emphasis. One disadvantage of this variability is the difficulty of obtaining enough views on any one issue to enable the identification of trends. Our experience with interviewing however strongly suggests that these and other disadvantages are more than compensated for by the greater information flow, and the special insights of hunter-identified priorities, that stem from unstructured interviewing.

4.2.2 Nest Survey of Common Eider Colonies in Southeast Hudson Bay: Component B

4.2.2.1 Specific Objectives

The main objective of the eider nest survey, Component B, is to obtain anestimate of the number of eiders nesting in southeast Hudson Bay. This estimate will serve as a reference point against which subsequent survey results can be compared. In this manner we will be able to monitor changes in the size of the eider population. Repeated censusing will provide some measure of the effect of an oil spill on eiders, whether that effect be a dramatic large-scale kill, or a more subtle long-term undermining of the population.

Available information suggests that the majority of the sedentaria population of the Common Eider nests along the east coast of Hudson Bay, and that a significant proportion of these nest within the study area (Reed pers. com.). The census results are therefore expected to be a significant contribution towards estimating the size of the entire sedentaria population.

The survey will also provide information on local population size and breeding distribution. This information will allow the communities to plan the local management of nesting colonies. Egg and down collection and hunting on nest islands have local effects which can be monitored and responded to at a community level. Colony management has long-term local effects because the site faithfulness of female eiders (Reed 1975) dictates that the events of one year have local repercussions in later years. The mobilility of eiders in the non-breeding season, demands regional monitoring and regional resource use planning, although local management is effective and important. Thus management must be pursued at both regional and local levels.

4.2.2.2 The Study Area

The outer boundary of the study area is shown in Fig. 4. It can be roughly described as that area including all of the offshore islands along the east side of Hudson Bay that occur between Long Island in the south, and Kogaluk Bay in the north. It is an area of considerable size, with numerous islands. For the purposes of the survey, this area will be further subdivided into island groups or chains, which will be treated as the units to be sampled. Twelve such island groups have been defined on Fig. 5. Note that the Belcher Islands, Island Group 6, will be further subdivided according to recommendations made by the community of Sanikiluaq. The communities will be consulted to define the study areas which their survey teams will count, and to identify a priority list to determine the survey sequence.

4.2.2.3 Selection of a Survey Methodology

Common Eiders are a highly social species, and at specific stages of their annual cycle of activities, they gather in large numbers. The concentration of all or a part of the population facilitates population census. Thus, various authors have assessed population size during the nesting period (Chapdelaine et al. in press; Nakashima and Dumas 1984;

Lock 1982; Ahlen and Andersson 1970), in pre-moulting flocks (Almkvist et al. 1975), in moulting flocks (Campbell and Milne), during migration (Alerstam 1974) and on the wintering grounds (Gillespie and Learning 1974).

Of these different approaches to population estimation, only nest surveys provide the precision required for effective local population monitoring. Local monitoring is considered essential for the communities to plan the subsistence and commercial use of local nest colonies.

Furthermore, as little or nothing is presently known about the pattern of movement and the seasonal distribution of eiders within Hudson Bay, counts made during migration, moulting or wintering are compromised by the fact that we do not know the origins of these birds, nor the proportion of the total population that they represent. Information to be collected from the Inuit hunters, as described in Component A of this project, will prove useful in resolving these problems and may eventually facilitate the census of eiders away from their nest colonies.

Surveys of nesting areas are conducted either by air or by foot. The former is an indirect method which relies on counting the male eiders near the nest islands. Aerial counts are time-efficient and minimize manpower. However, flight timing is critical and if the brief and somewhat unpredictable pre-nesting and early incubation phase of the nest cycle is missed, aerial counts may grossly underestimate the population.

The accuracy of aerial surveys is also dependent upon visibility, complexity of coastline, and the ability of the observers to quickly count and identify birds. Highly complex archipelagos, such as those found in east Hudson Bay would be particularly difficult to systematically count by air. In northern Quebec communities, people are sceptical about the accuracy of aerial counts of eiders, and ground census techniques are greatly favoured.

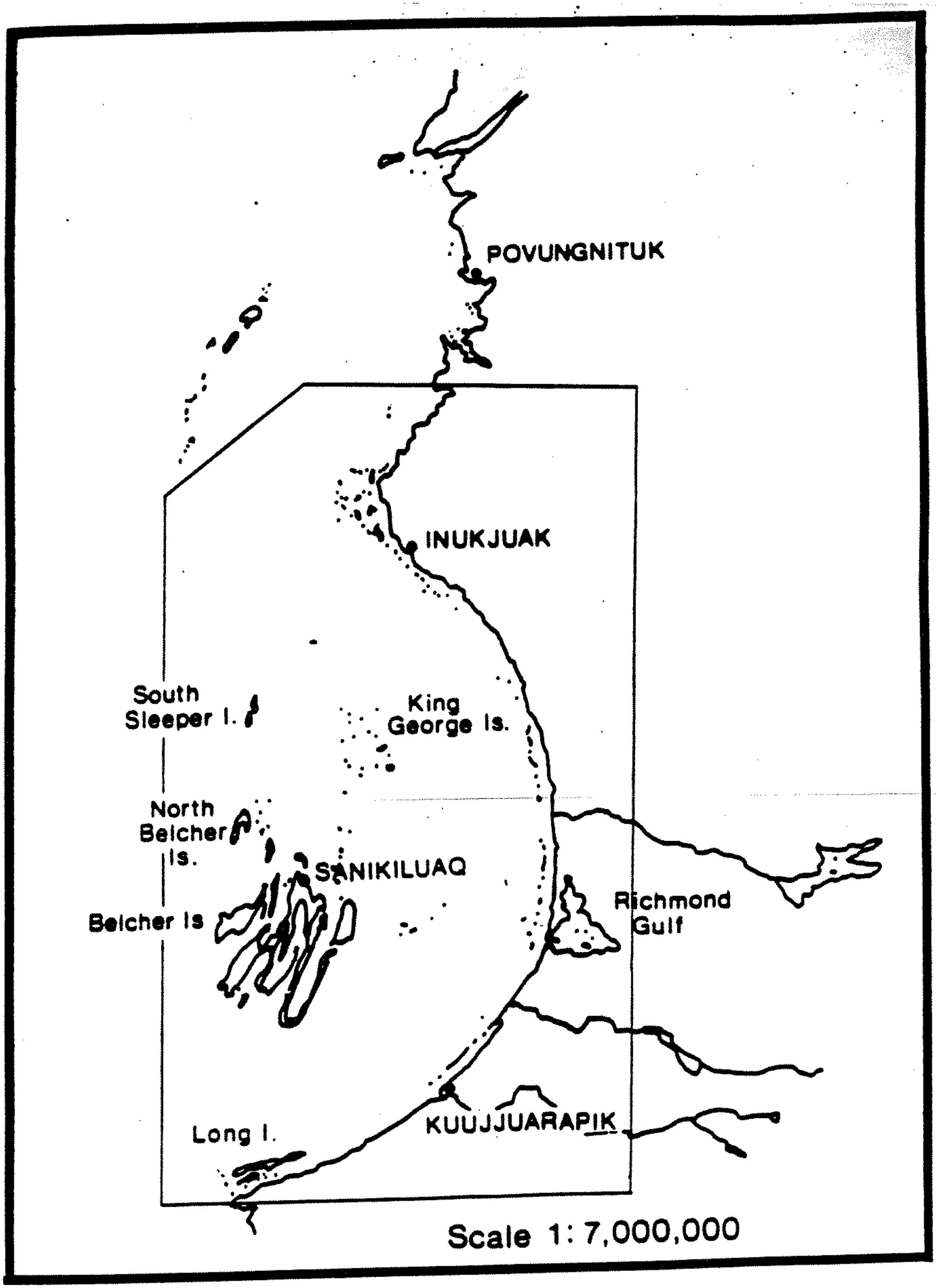


Fig. 4 Outer limit of survey area.

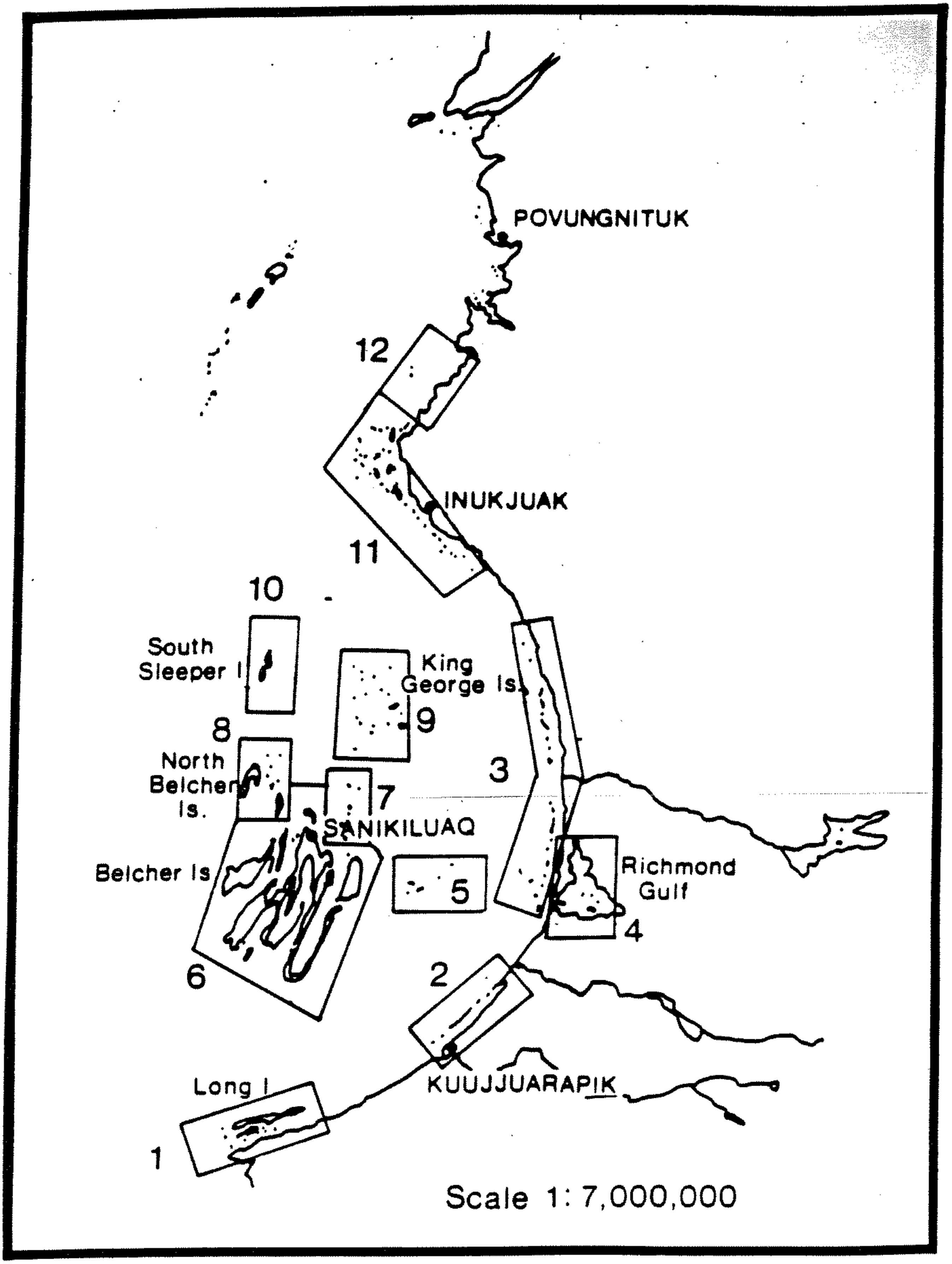


Fig.5 Survey area showing major island groups identified as possible survey targets.

Although ground censuses are time consuming and require much manpower, they provide the most accurate means of assessing the size of individual breeding colonies. While a total regional count is ideal, this is seldom possible in large areas with many islands. A population estimate with reasonable confidence limits can be attained, though, if a large enough proportion of islands is censused.

Ground surveys allow the collection of useful biological information such as clutch size, nest dispersion, nesting chronology and observations on predation. Although ground censuses cause disturbance, careful planning and instruction will minimize these affects.

An important final consideration is that ground survey work maximizes socio-economic benefits to the communities by creating local employment and allowing direct participation of local people in a project pertinent to their own future. Direct participation is invaluable as a means to promote an awareness of personal responsibility for resource use and management.

For the above reasons the Common Eider survey will be organized as a ground survey of eider nest colonies.

4.2.2.4 Survey Methodology

Before the field season, a meeting will be held with Canadian Wildlife Service personnel of the Quebec regional office. A. Reed, G. Chapdelaine and C. Drolet are the key individuals to consult because of their considerable knowledge and experience with Common Eider research. The field methods discussed below will be evaluated and refined with their advice. The survey will make use of new census techniques and sampling methods which were devised and tailored for northern application during the 1980 joint CWS-Makivik Research Survey of Ungava Bay eider colonies (Chapdelaine et al. in press).

Nest surveys will be conducted by three teams, one from each of the participating communities. Each team will consist of a coordinator from the Kuujjuaq Research Centre and 5 local Inuit, at least two of which are experienced hunters, familiar with the census area.

Temporary base camps will be set on offshore islands while census work is being conducted in the area. Transportation will be entirely by boat. Canoes, speedboats and possibly Peterheads will be used. Consultation with the communities indicates that at the time the census work will be undertaken, ice will no longer interfere with access to offshore islands.

The surveys will be timed to commence when the majority of breeding females are in early incubation, and terminate before the peak of the hatch. The timing is critical in order to obtain accurate information and yet minimize disturbance to the colonies. It is estimated that about 20 survey days will be available in each region.

Mid-June is viewed as a probable starting date for the surveys. However year-to-year fluctuations in nesting date can be considerable (Schmutz 1981). Therefore close contact will be kept with the communities to check upon the advancement of the season.

Counts of nests will be carried out on foot. Standard data sheets will be devised for systematic data recording. The survey team will be organized to ensure that island coverage is complete, and that nests are neither missed nor counted twice. Total counts will be obtained for small islands. For large islands, local hunters will help to decide how to proceed. Where eiders are known to nest in a highly clumped fashion and where hunters are confident that these represent a high percentage of the total island population, only the eider colonies will be censused. The number will be considered a total count for the island. Where the above assumptions are not possible, the island population will be estimated from a random sample of the island area.

The following information will be collected. The number of Common Eider nests, the number of eggs per nest and the condition of the nest (incubating, hatching, hatched or destroyed). Similar data will be collected for the nests of others species that are encountered. Two species are of particular interest. As gulls (Larus spp.) are significant predators on eiders, their numbers and nest distribution will be thoroughly documented. It will also be valuable to collect information on the location of Black Guillemot colonies, since alcids and sea ducks have been judged the species most vulnerable to oil spills. The guillemot is the only alcid nesting in the study area.

4.2.2.5 Island Categorization and Sampling Procedure

There are far too many islands in the region to obtain a total nest count. Consequently a sampling procedure must be defined in order to obtain a reasonable estimate of total eider numbers. Island groups within the study area will be defined (see section 4.2.3.2). All islands within the group will be assigned individual identification numbers. In order to facilitate the sampling of an island group an attempt will be made to have hunters categorize islands. The precise nature of categorization needs to be discussed with hunters. One possible system would be to identify islands known to have no nests, and islands with very large nest numbers. The former could be removed from the sample. All exceptionally good islands could be censused to obtain an absolute nest number. The remaining islands could then be selected at random for surveying. Statistical checks in the field will allow us to determine when a large enough proportion of the islands have been surveyed, to provide reasonable confidence limits. The estimate of nest number from the sampled islands could then be added to the total counts from the exceptional islands, to provide a total estimate for the island group.

4.2.2.6 Data Processing

The field census data will be collected on precoded computer sheets. The data will be key-punched into the computer at the Kuujjuaq Research Centre. Double entry of the data will allow a back-to-back data check for key punching errors. A computer program has already been written to handle census data from our Ungava Bay work. This program provides nest number per island and per unit area, clutch size, and determines the number of nests being incubated, hatching, hatched or destroyed.

In order to obtain a population estimate we need to know total island number and individual island size. It will also be interesting to look at nest densities per unit area. Large scale maps of a large proportion of the offshore islands are not available. However enlargements of aerial photographs of these areas can be obtained from the Department of Energy, Mines and Resources. A computer digitizer, available at the Makivik office, will allow us to make accurate measurements of island area. These island area data can then be merged with the census data to allow the computation of nest densities per unit area for the region.

4.2.2.7 Eiderdown Sampling Cleaning and Weighing

Samples of eiderdown will be collected from eider nests in order to be able to determine mean clean down production per nest for the south-east region of Hudson Bay. This data will help future planning of commercial eiderdown exploitation. The techniques of down collection processing and weighing have been refined by three years of eiderdown sampling by Kuujjuaq Research Centre Staff. These data were collected as part of eider management studies conducted at Virgin Lake near Kangirsuk, Québec.

Eiderdown samples will be individually weighed before and after cleaning. This information will provide us with an estimate of clean down production per nest, and a conversion factor for uncleaned to cleaned down. We will attempt to arrange cleaning of a series of down samples by the Kangisuk down-cleaning machines, and another series by means of the traditional hand-cleaning process. This will allow us to compare the down quality and the down loss associated with each of these cleaning processes.

4.2.2.8 Population Estimation

The survey work will provide estimates of the number of eider nests in selected island groups (see Fig. 5). These estimates will be useful for the purposes of local eider management. An estimate of the total breeding population for the study area can be obtained by extrapolation using the mean number of nests per island and the total number of potential nest islands (Chapdelaine et al. in press). Potential nest island is defined on the basis of size and proximity to the mainland. The maximum acceptable size will be that of the largest surveyed islands upon which eider nests occured. Islands which connect to the mainland at low tide will not be considered to be potential nest islands. According to Inuit, eiders are unlikely to nest on islands to which fox can easily gain access (Nakashima in press). Consultation with A. Reed and G. Chapdelaine of the Canadian Wildlife Service will insure that our statistical treatment is appropriate.

Report and Data Presentation

5. REPORT AND DATA PRESENTATION

The Kuujjuaq Research Centre has been focussing its energies on developing a report style in which research results can be presented in a rigorous but more easily understandable manner. It is of little value to promote northern research if the results remain largely unintelligible to the people in the communities. At the same time, it is important to provide those key elements of information which allow a thorough understanding of the methodology, statistical analysis and derivation of results. The objective is to provide the essential information in a style which is easily digested.

The report will be subdivided into two sections corresponding to the main study components. The first section will report on the ecological information obtained from hunters. Regional maps summarizing ecological, environmental and land-use information will be of particular importance. The format and organization of these maps will be determined once the nature and content of the information is determined.

The second section will present the results of the Common Eider nest census. The population estimates and relevant biological information will be the primary components of this section of the report. A final visit to the communities will be organized to present the results of the research project. Visual displays and slides will be used to animate the results of the work, and to explain its significance as a tool for impact assessment and resource use planning.

Work Plan

Environmental
Studies
Revolving
Funds

FOR ESRF USE ONLY
Study Proposal:
Work Authorization:
Date Received: day month year

Work Plan

Use Supplement III to the Guidelines for Study Proposals as an aid to completing this form

STUDY TITLE: A Research Program to Integrate Inuit Knowledge with a Nest Survey of Common Eider (*Somateria mollissima sedentaria*) in Preparation for Drilling Activities in Hudson Bay

APPLICANT: Makivik Corporation - Kuujjuaq Research Centre
company, association or individual

LAST REVISION DATE: day month year

UPDATE NO.:

[signature]
authorized officer's signature

DATE 2 7 | 0 3 | 8 5
day month year

UNITS OF TIME: (Week, Month or Quarter) Specify in the boxes below

WORK BREAKDOWN		1 MAY	2 JUNE	3 JULY	4 AUG	5 SEPT	6 OCT	7 NOV	8 DEC	9 JAN	10 FEB	11 MARCH	12 APRIL	% completed	Estimated Expenditure	FOR ESRF USE ONLY
COMMON EIDER NEST SURVEY: Research Component B	P															
	A/E															
Survey Planning: CWS/Community Meetings	P													%		
	A/E															
Field Preparation: Purchasing/Shipping	P													%		
	A/E															
Field Survey: Training and Census	P			▲1										%		
	A/E															
Data Processing: Computer Input Digitization/Down Cleaning	P													%		
	A/E							▲2								
Data Analysis: CWS Meeting Population Estimate/Statistics	P													%		
	A/E															
Report Production:	P													%		
	A/E												▲3			
INUIT ECOLOGY INTERVIEWS: Research Component A	P													%		
	A/E															
Preliminary Interviews:	P													%		
	A/E															
Intensive Interviews: First Round	P													%		
	A/E						▲4									
Data Processing: Tape Translation Map Digitization	P													%		
	A/E								▲5							
Intensive Interviews: Second Round Verification	P													%		
	A/E										▲6					
Data Processing-Final: Tape Translation/Map Digitizatn	P													%		
	A/E															
Data Analysis: Report Production:	P													%		
	A/E												▲7			
	P													%		
	A/E															

Canada

Government of Canada Gouvernement du Canada

FOR ESRF USE ONLY

program officer

scientific advisor

$

52-320 (4-81)

Budget

7. PROPOSED BUDGET

7.1 SALARIES

7.1.1 Project Coordinator

Hunter interviews 3 persons x 20 days @ $100	6 000
Nest survey supervision 3 persons x 40 days @ $100	12 000
Data processing and analysis supervision 3 persons x 25 days @ $100	7 500
Report writing and production supervision 3 persons x 25 days @ $100	7 500
Total Project Coordinators	**33 000**

7.1.2 Community Workers - Data Collection

Hunter consultations in 3 communities 60 hours @ $20/hr	3 600
Interpreters in 3 communities 60 hours @ $20/hr	3 600
Survey Crew in 3 communities 5 workers x 30 days @ $100	45 000
Total Community Workers Data Collection	**52 200**

7.1.3 Community Workers - Data Processing and Analysis

Interview tape transcription 300 hours @ $10/hr	3 000
Interview Transcript Translation 100 hours @ $12/hr	1 200
Preliminary map - computer input 200 hours @ $10	2 000
Nest survey - data entry and double check 350 hours @ $10	3 500
Down samples - cleaning and weighing 100 hours @ $10	1 000
Total Community Workers Data Processing and Analysis	**10 700**

7.1.4	**Benefits 12%**	**11 500**
7.1.5	Professional Support - Kangiqsujuaq Cartography Lab	
	Island area: tracing and computer digitizing 300 hours @ $10	3 000
	Final hunter information maps 200 hours @ $10	2 000
	Final report: figures and tables 200 hours @ $10	2 000
	Community presentation displays 100 hours @ $10	1 000
		(8 000)
7.1.6	Professional Support : Makivik	
	Computer programming 100 hours @ $12	1 200
	Word processing 100 hours @ $15	1 500
	Final report translation 100 hours @ $15	1 500
		(4 200)
7.1.7	Professional support : CWS	
	Survey techniques 2 persons x 5 hours @ $20	200
	Statistical analysis 2 persons x 5 hours @ $20	200
		(400)
	Total - Professional Support	**12 600**
7.2	TRAVEL/ACCOMODATION EXPENSES	
7.2.1	Airfare in North	
	Survey preparation	1 600
	Nest survey field work and preliminary interviews	2 800
	Hunter interview and recheck	3 800
	Kangiqsujuaq lab consultation	4 200

7.2.2 Airfare to South

Technical consultation CWS and Makivik	2 750

7.2.3 Group and Transportation

Montréal - Québec city 2 persons x 2 trips @ $20	80
Taxis in Montréal and Québec city 8 trips @ $20	160
Taxis in northern communities 12 trips @ $20	240
Total Transport	**15 630**

7.2.4 Accommodation

Survey preparation 2 persons x 12 days @ $40	960
Survey field work 3 persons x 25 days @ $40	3 000
Hunter interview and recheck 3 persons x 25 days x 2 trips @ $40	6 000
Kangiqsujuak lab consultation 3 x 14 days @ $40 2 x 8 days @ $40	 1 680 640
Community presentation 3 persons x 12 days @ $40	1 440
Consultation - Montréal/Québec 4 days @ $100	400
Total - Accommodation	**14 120**

7.3 MATERIALS AND EQUIPMENT RENTAL

7.3.1 Hunter Interview Materials

Cassette tapes 200 hours @ $1.50	300
Drafting Materials Acetate, pens, labels, letraset	300
Maps and air photos	200
Computer Supplies	500

7.3.2 Hunter Interview Equipment Rental

Cassette Tape Recorders 3 x 8 weeks @ $10	2 500

7.3.3 Nest Census Materials

Fuel (gas and oil) 3 crews x 30 days x 125 l @ 0.90	10 200
Naphtha 3 crews x 80 l @ $3.00	720
Food and supplies 3 crews x 30 days @ $180 (18 people)	16 200
Field books, data sheets	300
Spare parts for equipment	500
Air photo blow ups 100 @ $25	2 500
	(34 220)

7.3.4 Nest Census Equipment Rental

Boat and outboard 9 canoes x 25 days @ $50	11 250
Tents 4 x 3 crews x 30 days @ $10	3 600
Cooking equipment 3 crews x 30 days @ $10	900
Radio - SBX 11A - single side band 3 crews x 30 days @ $10	900
	(16 650)

Total Material and Equipment Rental 50 870

7.4	Other Expenses	
	Purchaser - Montréal 10 days @ $75	750
	Airfreight	1 500
	Equipment and supply storage and handling in north	500
	Telephone - communications	1 000
	Administration costs	2 000
7.5	Contingengy - Emergency helicopter evacuation	2 000
	Total Other Expenses	7 750
	GRAND TOTAL	208 370

Community and Regional Support

8. COMMUNITY AND REGIONAL SUPPORT

Consistent with its approach to northern research, the Kuujjuaq Research Centre and the Research Department of Makivik consulted with all the Inuit communities and regional organizations implicated in the project prior to developing this proposal.

A consultation trip to Kuujjuarapik, Sanikiluaq and Inukjuaq was taken from February 26 to March 4, 1985 by Mr. Douglas Nakashima and Mr. Edward Tukkiapik with the funds from Makivik allocated for these purposes. Meetings were held in Kuujjuarapik and Inukjuaq with the municipal councils and the local Anguvigaq Wildlife Management groups. In Sanikilujuaq, meetings were arranged with the community council and the local Hunters and Trappers Association. Support was received for the research program from Kuujjuarapiq and Inukjuaq during the consultation meetings. Figures 6 and 7 are the resolutions passed by each community reflecting this decision.

At Sanikiluaq, the process was more complex. Political and jurisdictional questions arose with regards to northern Québec and the Northwest Territories. Several meetings were arranged during and after the consultation trip to try and resolve some of the misunderstandings that developed concerning the role of this research program in this larger political question. Efforts were made to clarify the value of this type of baseline research and its uses within the context of oil and gas activities in Hudson Bay. It was explained that Sanikiluaq would have full and, if desired, independent access to the results, and that the study and results would not prejudice land claims negociations. On March 23, 1985 the community gave its official support to the program and agreed to actively participate (See Fig. 8).

On March 6, 1985 Mr. Nakashima, Mr. Tukkiapik and Ms. Lorraine Brooke met with the Hudson Bay Oil and Gas Committee in Ottawa. The research program was presented for discussion and review by the Committee. The Committee supported this project in the context of development activities in Hudson Bay and encouraged submission to the Environmental Studies Revolving Fund. (see Figure 9 for resolution of support).

The Baffin Regional Inuit Association, the Department of Renewable Resources GNWT, the Canadian Wildlife Service, the Anguvigaq Wildlife Management Group, and of course, Makivik Corporation have all been informed of our plans.

Figure 6

Corporation of the Northern Village of Kuudjuarapik

RESOLUTION NO. 55-7

Concerning the exploratory oil drillings on the Hudson Bay and it's effect on the wildlife in the Hudson Bay area.

WHEREAS: the Common Eider Ducks are a part of the wildlife subsistance of the Kuudjuarapik Inuit.

WHEREAS: the possibilities of commercial use of Common Eider Ducks are predictable with the proper planning.

WHEREAS: the Inuit of Kuudjuarapik feel that exploratory oil drillings on the Hudson Bay may have a negative effect on the Common Eider Ducks, as well as, other forms of wildlife in the area.

THEREFORE IT IS RESOLVED THAT:

1. the Municipal Council of Kuudjuarapik request that the Wildlife Department of the Makivik Corp. commence the study this summer, that is to say, the summer of 1985.

2. the Wildlife Department of the Makivik Corporation supply the Municipal Council with a copy of the study, once the study has been completed.

3. this resolution comes into effect immediately.

Moved by: Paulosie Napartuk

Seconded by: Willie Tooktoo

In favour: 7

Opposed: 0

Abstentions: 0

Absentees: 0

Date of Adoption: March 6, 1985

Mayor's signature: [signature]

Sectetary-treasurer's signature: [signature]

Figure 7

The Municipal Corporation,
ᓄᓇᓕᐅᑉ ᑯᐊᐳᕆᓴᓐᖓ
Inukjuak, Québec.
ᐃᓄᒃᔪᐊᒃ ᑯᐸᐃᒃ
J0M 1M0

Resolution No. 85-06

Concerning approval of proposed Commo~~n~~ eider Research Project

Whereas; the Municipal Council of Inukjuak had a meeting with Douglas Nakasima and Etua Taqiapik of the Kuujjuaq Research Centre on March 1, 1985 concerning the proposed research project on common eider in Hudson Bay,

Whereas; Commomn eiders are an important subsistance resource for the people of Inukjuak,

Whereas; the people of Inukjuak are concerned about the exploratory drilling for oil and gas which will take place this summer in Hudson Bay,

Whereas; the people of Inukjuak feel it is necessary to gather more information on how to protect the common eiders in the event of an oil spill,

Therefore, On the Municipal Council meeting on March 20, 1985, It is resolved that:

The municipality of Inukjuak supports the Kuujjuaq Research Centre proposed research project on the common eider which is to take place this summer.

MOVED BY : Jobie Kutchaka

SECONDED BY : Unakoosie Patsang

IN FAVOUR : 4

OPPOSED : 0

ABSENT : 3

DATE OF ADOPTION : March 20, 1985

SECRETARY-TREASURER : [signature]

WHEREAS common eiders are an important source of food and clothing for the people of Sanikiluaq.
WHEREAS the community of Sanikiluaq wants to ensure that eiders will always be available for the use of future generations.
WHEREAS the importance of gathering together more information on common eiders is recognized.
WHEREAS the proposed drilling for oil and gas in Hudson Bay is a matter of great concern.
WHEREAS the community of Sanikiluaq wishes it to be understood that their co-operation with the Quebec communities of Inoucdjouac and Great Whale,with respect to the Makavik eider study, in no way prejudices future or current harvesting rights or sovereignty of the offshore islands.
THEREFORE it is resolved that the Council of the Hamlet of Sanikiluaq, which represents the community of Sanikiluaq, supports the research program on the common eider proposed by the Kuujjuaq Research Centre of Makavik Corporation.

April 1- 85
Date

Mayor

April 1- 85
Date

Secretary Manager

Figure 9

RESOLUTION No. 2

March 6, 1985
(Ottawa)

HUDSON BAY OIL AND GAS COMMITTEE

WHEREAS the Hudson Bay Oil and Gas Committee has a mandate to review oil and gas activities in Hudson Bay in order to make recommendations to ensure theprotection of the environment. wildlife and the interests of Inuit in the region;

WHEREAS the Committee supports, in principle, research projects designed to provide information to respond to possible negative consequences of oil and gas activity;

WHEREAS the Committee has had an opportunity to review a proposed project by the Research Department of Makivik to survey the eider duck populations of southeastern Hudson Bay in order to prepare baseline documentation on this important species;

THEREFORE BE IT RESOLVED:

THAT the Committee supports the Research Department of Makivik's proposal to the Environmental Studies Revolving Fund to conduct studies on eider ducks in southeastern Hudson Bay.

Moved by: E.Parr

Seconded by: J.Koneak

Carried

Project Management

9. PROJECT MANAGEMENT

9.1 The Kuujjuaq Research Centre and the Research Department of Makivik

The staff of the Kuujjuaq Research Centre will be responsible for the coordination of the research program. Field operations, data collection, processing and analysis, report production and the presentation of results to the communities will be organized and directed from the Research Centre.

The Kuujjuaq Research Centre was established in the fall of 1982 in order to answer the research needs of the northern Québec communities. It began with a full time staff of 3 individuals (E. Tukkiapik, M. Koneak and R. Dumas) and has since rapidly expanded to its present size of 8 full time personnel (5 Inuit researchers, 2 biologists and 1 secretary/administrator). In addition, students work at the Centre on a part time basis.

Since its inception, the Kuujjuaq Research Centre has focussed its energies in two main directions. At the request of the community of Kangirsuk, northern Québec, the Centre has been investigating management techniques, monitoring population size and hatching success and assessing eider down production in Common Eider colonies on a freshwater lake near Kangirsuq. The Centre is also conducting studies of commercial and subsistence fisheries on the Koksoak, Whale and George Rivers in southern Ungava Bay. These studies, which involve extensive scale and otolith interpretation, examine sex and age structure of the fish population, life history strategies and harvest statistics. The Research Centre, with the aid of le ministère des Loisirs, de la Chasse et le la Pêche has recently become involved in research on the George River caribou herd. It is likely that in the near future this will become a third field of intensive study.

Fundamental working principles of the Kuujjuaq Research Centre include the following:

1. carry out all phases of research, including planning, data collection, data analysis, and report production, in the north;

2. involve Inuit, as much as possible the community, in all research stages; and

3. make full use of Inuit and scientific knowledge systems in order to maximize information input to research programs.

As part of the Makivik Research Department, the Kuujjuaq Research Centre will have access to experienced professional and support staff which will greatly assist the carrying out of the research program (see 9.3 for details). All computer assistance and cartographic expertise is available within the Department.

Financial management will be handled by the Project Administrator and the Finance Department of Makivik in accordance with terms specified in the contract. The Research Department has had 7 years of experience with the administration of major research contracts from industry and government. During its 1983/84 operating year, the Department was responsible for 1.2 million dollars of contracts (see Annex IV for details).

9.2 Relevant Experience

The Kuujjuaq Research Centre and the Makivik Research Department have considerable experience with both the collection of Inuit information and the surveying the Common Eider nest colonies. Early documentation of Inuit land-use information was carried out by the Wildlife Department of the Northern Quebec Inuit Association before its transformation into the Research Department of Makivik Corporation in 1979. Since then much time and energy has been invested into the development of the data collection and recording process. The scope of the project has been greatly expanded by the addition of ecological mapping.

Specialized interviews focussing on the Common Eider were carried out by D. Nakashima and E. Tukkiapik in 1980. Detailed information on eiders was collected from Inuit in the communities along Hudson Strait and Ungava Bay. The results are reported in a paper to be published as part of a CWS report series called Eiders Ducks in Canada (Reed in press - see Appendix I).

In 1980, the Makivik Research Department and the Canadian Wildlife Service (CWS) cooperatively surveyed Common Eider colonies on offshore islands in Ungava Bay. These surveys provide the basis for an estimate of the eider population along the Québec coast of Hudson Strait and Ungava Bay. Experience with innovative survey and sampling techniques developed in 1980 will greatly aid the planning and direction of surveys in Hudson Bay.

Since 1982 the Makivik Research Department through the Kuujjuaq Research Centre has been conducting Common Eider studies at Virgin Lake near Kangirsuk. Exhaustive nest surveys of the Virgin Lake area have provided total population counts for each of the three years of study. Basic breeding parameters, such as clutch size and hatching success have been determined (see Appendix II). Major predators have been identified and experiments have been conducted with wooden and stone nest shelters designed to protect eiders and their eggs from inclement weather and predators in order to increase hatching success and down production.

The Kuujjuaq Research Centre has recently produced an information booklet on Common Eiders for the northern communities. "MITIQ; the ecology, use and management of the Common Eider in norhern Québec" integrates information from Inuit, southern scientists and Research Centre study results (see Appendix III).

9.3 Project Personnel

Douglas Nakashima - Project Director and Project Coordinator No. 1

Mr. Nakashima will be responsible for overseeing all aspects of the project. In the field, he will act as a coordinator for one of the study areas. He will also ensure the consistency and quality of the interviews with Inuit hunters. His experience with eider surveys and studies since 1980 in Ungava Bay and his work with Inuit hunters have equipped him to successfully carry out this project (C.V. attached).

Edward Tukkiapik - Project Coordinator No. 2

Mr. Tukkiapik will act as coordinator at the second study area and will contribute these findings at the analysis and report production stages. Mr. Tukkiapik has been a key member of the Kuujjuaq Research Centre and has several years of direct experience with eider research (C.V. attached).

To be selected - Project Coordinator No. 3

William Kemp - Project Advisor

As senior science advisor in the Research Department of Makivik, Mr. Kemp will act as advisor to the project. Mr. Kemp has had 25 years of extensive experience in the north in the areas of human geography, energetics and cultural adaptation. At Makivik he has directed major research projects, of particular interest to this proposal is the Inuit Land Use and Ecological Mapping Project (C.V. attached).

Peter Wilson - Computer Analyst

Mr. Wilson will be responsible for all computer analysis of census data. In addition, he will develop computer mapping applications for the project data for analysis and presentation (C.V. attached).

Lorraine Brooke - Project Administrator

As head of the Research Department, Ms. Brooke will administer this project within Makivik. Her experience with all aspects of research projects, will be drawn on as required by the Project Director.

All other project personnel will be recruited from the communities of Kuujjuarapiq, Inukjuaq and Sanikiluaq. External project advisors will also be brought in to the project as required. At the present time, Mr. Austin Reed and Mr. Charles Drolet of the Canadian Wildlife Service, Environment Canada, have agreed to act in this capacity.

Curricula Vitae

10. Curricula Vitae

Douglas J. Nakashima

Biologist, Kuujjuaq Research Centre, Kuujjuaq, Qué.

Personal Information:

Date of Birth	:	May 24, 1955
Place of Birth	:	Montréal, Québec
Citizenship	:	Canadian
Language	:	English (mother tongue); french; spanish.

Education:

B. Sc. 1978 McGill University, Montréal, Québec
Biology Major with Great Distinction

Graduate studies (incomplete) University of California, Santa Barbara, CA.

Academic Awards:

1975 to 1977	McGill University Scolarship
1976	Logan Prize, McGill University
1978	National Research Council Postgraduate Scholarship
1981	Regent's Fellowship, University of California, Santa Barbara

1980 Biologist for Common Eider Nest Survey in Ungava Bay, northern Québec. Joint CWS - Makivik Research Department project to estimate the size of the southern Hudson Strait breeding population of eiders. Responsibilities: field survey work and data collection; coordination of data processing; result analysis; report production.

1980 Biologist for Beluga Whale Population Study. Joint LGL. Ltd - Makivik Research Department project to assess the size and seasonal distribution of beluga whales in northern Québec. Responsibilities: behavioaral observations in estuarine habitat; biological sampling of hunter-killed whales; fall migration census.

1979-80 Director of Inuit Ecology of the Common Eider Study. Makivik Research Department study to document Inuit knowledge of eider ecology. Responsibilities: planning of research; interviews and mapping with hunters; data analysis; direction of final summary map production; report production.

1978-79 Biologist for Makivik Research Department projects including research to establish Levels of Native Harvesting in northern Québec and Koksoak River Fishery Study.

1977-78 Field Assistant at Charles Darwin Research Station, Galapagos Islands, Ecuador. Assisted with data collection on the following projects : Feeding ecology of two species of Darwin's finches on Isla Pinta; Competition studies of Darwin's finches on Isla Daphae; Behavioaral studies of Galapagos sea lion and fur seal; Census and population structure of sea lion and fur seal colonies throughout the archipeligo.

Relevant Experience:

1984 Director of Common Eider Management Study at Virgin Lake, northern Québec. Kuujjuaq Research Centre project to assess the effectiveness of nest shelters and other management techniques at increasing hatching success and eiderdown production. Responsibilities: design of field research; coordination of data collection; training of field assistants from Kangirsuk community; processing and analysis of data; report production.

1983 Consultant for Common Eider Management Study at Virgin Lake, northern Québec. Kuujjuaq Research Centre project (see above desciption). Responsibilities: design of field study; advice on data collection process; processing and analysis of data; report production.

1982 Director of Common Eider Breeding Biology Study at Virgin Lake, northern Québec. Makivik Research Department Study to collect beseline information on population size, distribution, hatching success and eiderdown production. Responsibilities: research design and implementation; data processing and analysis; report production.

1981 Field Research for Brown-headed Cowbird Song Dialect Study, Mammoth Lakes, CA. Ph.D candidate of Dr. S.I. Rothstein. Responsibilities: behavioaral observations; vocalization recording; trapping, banding and colour-marking of cowbirds.

Publications and Reports:

In press Inuit Knowledge of the Ecology of the Common Eider (Somateria mollissima borealis) in northern Québec. In Reed, Austin (ed.). Eider Ducks in Canada. CWS Report Series no.47.

In press Population d'eider à duvet près des côtes du Québec septentrional. In Reed, Austin (ed.). Eider Ducks in Canada. CWS Report Series no.47.

In prep. Report on the Results of Common Eider Research at Virgin Lake, northern Québec Kuujjuaq Research Centre report to community of Kangirsuk: 1983 and 1984.

1984 Mitiq - The Ecology, Use and Management of Common Eider in northern Québec. Kuujjuaq Research Centre publication. (english and inuktituk) 60pp.

1984 Breeding Biology and Economic Potential of an Inland-nesting Population of the Common Eider in northern Québec. Makivik Research Department, internal report. 49pp.

1983 Common Eider Research in northern Québec : Research Update. Taqralik (May 1983): 26-33.

1983 Makivik Research Centre : northern science moving ahead. Taqralik (Sept. 1983): 28-30.

1982 The Population and the Ecology of the Common Eider (Somateria mollissima borealis) in northern Québec. Makivik Research Department internal report.

1978 Relationships between Body Size and Some Life History Parameters Oecologia (Berl) 37 : 257-272.

Symposium (invited participant)

1984 Kativik Regional Government and University of Montréal, Environment Conference, invited participant in workshop on Wildlife Management, Kuujjuaq, Québec.

Edward Tukkiapik

Researcher, Kuujjuaq Research Centre, Kuujjuaq, Québec

Personal Information

Date of Birth : July 31, 1958
Place of Birth : Kangirsuk, Québec
Citizenship : Canadian
Language : Inuktituk (mother tongue); english

Education

9th year Federal High School, Kuujjuaq, Québec

Relevant Experience:

1983-84 Head Researcher for Common Eider Management Study at Virgin Lake, northern Québec. Kuujjuaq Research Centre study to assess the effectiveness of nest shelters and other management techniques at increasing hatching success and eiderdown production. Responsibilities : planning of field research; data collection (population census, nest colony checks; colony observation, down sample collection); data processing and analysis; report production; community information and coordination.

1982 Research for Koksoak River Fishery Study. Kuujjuaq Research Centre study to analyze the biological characteristics of the population and document harvest levels. Responsibilities : biological sampling of catches; data processing and analysis.

1982 (Aug.) Researcher for Beluga Whale study. Makivik Research Department project to assess the beluga population size and distribution. Responsibilities: field observation of estuarine behaviour of whales at Mucalic River.

1979 Researcher for Inuit Ecology of the Common Eider Study. Makivik Research Department Study to document Inuit knowledge of eiders. Responsibilities: mapping and interviews with hunters; community information and coordination.

1977-79 Researcher for Research to Establish Levels of Harvesting by Native peoples in northern Québec. Makivik Research Department Study. Responsibilities : interviewing hunters; community animation and coordination; data processing and confirmation.

<u>Publications and Reports</u> (Co-author or contributing researcher)

In press Inuit Knowledge of the Ecology of the Common Eider in northen Québec. In Reed, Austin (ed.) Eider Ducks in Canada. CWS Report Series no.47.

In prep. Report on the results of Common Eider Research at Virgin Lake, northern Québec : 1983 and 1984. Kuujjuaq Research Centre report to community of Kangirsuk.

1984 Mitiq - The Ecology, Use and Management of the Common Eider in northern Québec. Kuujjuaq Research Centre publication (english and inuktituk) 60pp.

1983 Common Eider Research in northern Québec : Research update Taqralik (May 1983); 26-33.

1983 Makivik Research Centre : northern science moving ahead. Taqralik (Sept 1983): 28-30.

<u>Symposium</u> (invited participant)

1984 Kativik Regional Government and University of Montréal, Environment Conference, invited speaker in workshop on Wildlife Management, Kuujjuaq, Québec.

WILLIAM B. KEMP

1. EDUCATION

1959	B.A.	Miami University, Oxford. Ohio.
1963	M.A.	Michigan State University, East Lansing. Michigan.
(in prep).	Ph.D.	Michigan State University

2. TEACHING EXPERIENCE

1977-present	McGill University. Geography (Auxiliary Professor. part time).
1970-1977	McGill University. Geography (Associate Professor, full time).
1966-1970	State University of New York. Geography.

3. PRESENT POSITIONS

Makivik Corporation, Senior Researcher

Responsibilities: to give direction to the development of scientific research in northern Québec that is relevant to the needs of Inuit communities and organizations: to encourage cooperative research ventures between Inuit and other scientific bodies· to participate in the transfer of research skills and information from southern scientists to Inuit, and for the transfer of Inuit skills and knowledge to non-natives: to develop appropriate educational and training programs to facilitate this transfer: to actively participate in the design. conduct and presentation of major research projects: and to review research projects carried out in northern Québec by outsiders.

McGill University, Auxiliary Professor, Geography

Responsibilities: undergraduate teaching: graduate supervision and advice: availability for advice on northern research for undergraduate and graduate students. Since September 1970. I have been responsible for honors and graduate supervision at the M.A. and Ph.D. levels. To date. eleven honors theses. six M.A. theses, and three Ph.D. theses have been completed under my direction.

4. MAJOR FIELD RESEARCH AND SUPPORT

1977 - present	- Environmental and Social Impact Assessment for Northern Airstrips Infrastructure Improvement Program Ivujivik and Salluit (1983-84): Povungnituk. Kangirsuk, Tasiujaq. Inoucdjouac. (1984-1985) (Transport Québec). - Inuit Land Use and Ecological Mapping Project in Northern Québec: 1981 to present (Makivik. IUCN). - Studies of the Distribution. Population Size. Stock Identity and Inuit Use of the White Whales of Northern Québec, 1980 (Department of Supply and Service). - Program of Research on the Location. Ecology and Nesting Population of Eider Ducks in the Inuit Territory of Northern Québec. 1980-1981: (C.W.S. Department of Supply and Service). - Koksoak River Fishery Study (1977) (Société d'Énergie de la Baie James).
1976	Director and senior researcher. Social Economic Baseline Study, Resolute and Kuvanaluk. N.W.T. (Polar gas).
1975-1977	Director and senior researcher. Research to establish present levels of native harvesting in northern Québec (Joint funding).
1974	Inuit Land Use and Occupancy Project. central and south Baffin Island (D.I.A.N.D. and I.T.C.).
1973	Principal Investigator. archaeological inventory and survey. to establish prehistoric land use and settlement, Davis Strait from Padloping Island to Home Bay, N.W.T. (Parks Canada).
1972	Field research. cultural evolution and changing economic adaptation, southern Baffin Island Inuit, Middle Savage Islands to Markham Bay (National Museum of Man).
1971	Field Research on resource harvesting and calorie potential of native foods, southern Baffin Island (McGill University Social Science).

1970	Field Research on economic change and energy adaptation, southern Baffin Island Inuit, Lake Harbour. Cape Tanfield, N.W.T. (National Museum of Man).
1966-1968	Two years residence in all Inuit hunting community, southern Baffin Island, to collect quantitative data on economic behaviour and community energetics for Inuit hunters (National Museum of Man).
1966	Field Research on process of economic development and cultural change, Kuujjuaq, Québec (D.I.A.N.D.).
1965	Field Research on process of economic development and cultural change, Fort Chimo, Québec (D.I.A.N.D.).
1964	Field Research on village adaptation and economic development, Payne Bay and Koartak, Québec (D.I.A.N.D.).
1963	Same as 1964.
1963	Field Director, southern Baffin Island, archaeological project on Pre-Dorset Eskimo (National Science Foundation).
1962	Assistant Director, Michigan State University and National Museum of Canada archaeological investigation of cultural adaptation (stability and change) on southern Baffin Island (National Science Foundation).
1961	Field reconnaissance by canoe from Lake Athabaska to Coppermine River and Coronation Gulf.

5. PUBLICATIONS AND MAJOR REPORTS

1985 "The Baffin Land Eskimo". Handbook of American Indians, Smithsonian Institute, Washington, D.C.

1984 "Social and Environmental Impact Assessment for the Northern Airports Infrastructure Improvement Program: Ivujivik". Submitted to Le Service de l'Environnement, Ministère des Transports, Gouvernement du Québec.

1983 "Inuit Knowledge and Perceptions of the Proposed Great Whale River Hydro-Electric Project on the Environment, Ecology and Subsistence Economy of Kuujjuarapik". Prepared for and submitted to the Kativik Environmental Quality Commission.

1982 "Inuit Land Use and Ecological Knowledge": A report on the first phase of a research project carried out among the Inuit of Northern Québec. Submitted to the International Union for the Conservation of Nature.

1980 Research and Information Priorities for Implementation of Section 24 of the James Bay and Northern Québec Agreement. (Montréal) 30 pp. Submitted to the Bureau de la Baie James et du Nord Québecois.

1977 "The Communities of Resolute and Kuvanaluk", socio-economic baseline study. (Toronto) 210 pp. Submitted to Polar Gas.

1976 "Inuit Land Use in South and East Baffin Island", in Freeman, "Land Use and Occupancy Project: volume I, Land Use and Occupancy", pp. 124-152, Ottawa 1976.

1976 "Research to Establish Present Levels of Harvesting by Native Peoples of Northern Québec: A Report on the Harvests by the Inuit of Northern Québec", The Native Harvesting Research Commitee (Montréal).

1975 "Energy, Behaviour and Thule Adaptation", the Mercury Series, National Museum of Canada (Ottawa) (in press).

1975 "The Harvesting Level and Food Potential for All-Native Inuit Camps", final report, Northern Science Research Group, D.I.A.N.D. (Ottawa).

1974 "Energy Flow in Inuit Communities: Theory Models and Measurement", in Energy Flow in Human Communities: Proceedings of a Workshop, P.L. Jamison and S.M. Friedman (eds), University Park, pp. 35-41.

1973 "The Archaeology and Early History of Davis Strait from Padloping Island to Nedlusiak Fiord", Vols. I, II, III. Report to Parcs Canada, 220 pp.

1971 "Energy Flow in a Hunting Society". Scientific American, vol. 224, No. 3, pp. 104-115. See also Scientific American books: Energy, Horgensen, J.G. (ed.), Biology and Culture in Modern Perspective and North American Archaeology.

1967-1972 "The Evolution of Inuit Adaptation, Southern Baffin Island". Report to the National Museum of Canada of Baffin Island Research, 105 pp.

6. REPORTS

1983 The Koksoak River Fishery 1977-81: A Summary Report. Submitted to S.E.B.J.

1983 "A Wildlife Management Policy and Program for Northern Québec": A Discussion Paper. Submitted to Makivik Corporation and Anquvigaq Wildlife Management Inc.

1982 The Population and Ecology of the Common Eider in Northern Québec: A Field Survey and Review of Inuit Knowledge. Submitted to the Canadian Wildlife Service.

1981 Historical Development of Current Patterns of Inuit Culture and Implications with respect to Future Development - the Eastern Canadian Arctic. (Montréal). Submitted to Petro Canada.

1978 "The Koksoak River Fishery 1977": A report on the level of harvest and harvesting effort by the Inuit of Fort Chimo. (Montréal) 38 pp. Submitted to S.E.B.J.

7. SYMPOSIUM (Invited Participant with Paper)

1977 Canadian Archaeological Association, invited participant, paper entitled "Modern Inuit and the Reconstruction of Thule Adaptation", Ottawa.

1976 Organizer, Northern Demography Workshop, Nos. I and II, sponsored by D.I.A.N.D.

1975 The Institute of Ecology, Energy Flow Workshop II, invited speaker, Energy Flow and Cultural Change, University of Florida.

1974 American Association for the Advancement of Science, invited speaker, Energy Flow and Cultural Change, San Francisco.

1974	Social Science Research Council. N.Y.C.. invited participant in workshop on Energy Flow in Non-Industrial Human Communities.
1973	International Biological Program. invited participant in conference on Man in the Ecosystem. Annapolis. Maryland.
1972	School of American Research advanced seminar. invited participant in seminar on Prehistory of the Canadian Eskimo. Santa Fe. New Mexico.
1970-1972	International Biological Program, working seminars. Winnipeg and Toronto.

PETER WILLIAM WILSON

ADDRESS:

7241 Fielding Avenue,
Apartment #305
Montreal, P.Q.
Canada H4V 1R4
(514) 486-3286

EDUCATION:

Master of Science, Department of Geography, McGill University, Montreal, November, 1984. Thesis topic: The relationship between land use change and land capability in Western Barbados.

Bachelor of Science (Great Distinction), Department of Geography, McGill University, Montreal, June, 1978.

Grade 13, Ashbury College, Ottawa, June, 1975.

ACADEMIC DISTINCTIONS:

McConnell Fellowship, McGill University, 1978, 1979, 1980, 1981.

Canadian Association of Geographers Undergraduate Award, 1978.

University Scholarship, McGill University, 1977.

Head of Connaught House, Ashbury College, 1975.

EMPLOYMENT EXPERIENCE:

Environmental Information System Co-ordinator, Research Department, Makivik Corporation. Duties include the management of, and computer programming for, an automated environmental information system with digital mapping capability. Other responsibilities include the planning and flying of aerial photography missions in Arctic Quebec, as well as the writing of computer programs for biological, environmental, cartographic and photogrammetric applications. 1982 to present.

Consultant (part-time) to Planned Parenthood Federation of Canada. Duties include computer programming for donor list management and mailout purposes, as well as instruction in word processing and data base management.

Previous employment experience includes:

President, Sky Impressions Inc., Ottawa, 1980, 1981.

Research Assistant, Defence Research Establishment Vehicle Mobility Study, Montreal, 1980.

Teaching Assistant, Department of Geography, McGill University, September, 1978 to May, 1980.

Teaching Assistant, Faculty of Engineering, McGill University, 1979.

Project Co-ordinator, Young Canada Works Feasibility Study on Single Parent Housing, Ottawa, 1978.

OTHER EXPERIENCE:

June, 1980 to April, 1981: Proposed the production of, and assisted in the research, filming, editing and publicity for the film "Just Another Missing Kid". This documentary was produced for the CBC current affairs show 'the fifth estate'. It recounts my family's efforts to locate and bring to justice the murderers of my younger brother, Eric. "Just Another Missing Kid" won an Academy Award for the best documentary of 1983, as well as an ACTRA Award for the best Canadian television show of 1981. It has also won numerous other Canadian and international awards.

1980 - 1982 (part-time): Fund Raiser, Pickering Institute for Living, Ottawa.

PROFESSIONAL QUALIFICATIONS AND MEMBERSHIPS:

Canadian and American Commercial Pilot Licences with seaplane and multi-engine ratings.

Canadian Owners and Pilots Association.

American Society of Photogrammetry.

Canadian Association of Geographers.

Pickering Institute for Living.

Citizens United for Safety and Justice.

PERSONAL BACKGROUND AND INTERESTS:

Born May 29, 1957 in Montreal.
Social Insurance Number: 455 164 699.
Married. Health excellent.

Extracurricular activities (McGill University) included: Vice-President of University Residence Council, Member of Residence Staff Selection Committee, Member of Graduate Student Selection Committee, Member of Graduate Affairs Committee, Member of Undergraduate Affairs Committee, Member of university residence football, soccer and hockey teams.

Extracurricular activities (Ashbury College) included: Member of editorial and photographic staffs of school newspaper, Member of school hockey and soccer teams.

I enjoy flying, photography, travel, cinema, cycling and skiing.

Reference List

11. REFERENCE LIST

Ahlen, Ingemar; Andersson, Ake. 1970. Breeding biology of an eider population on Spitsbergen. Ornis Scand. 1 : 83-106.

Almkvist, B; Andersson, A; Jogi, A; Pirkola, M.K.; Soikkeli, M.; Virtanen, J. 1974. The number of adult eiders in the Baltic Sea. Wildfowl 25 : 89-94.

Alerstam, T.; Bauer, C-A.; Roos, G. 1974. Spring migration of the eiders, Somateria mollissima, in southern Scandinavia. Ibis 116 : 194-210.

Baillie, Stephen R.; Milne, Henry. 1982. The influence of female age on breeding in the eider, Somateria mollissima. Bird Study 29 : 55-66.

Beales, C.S. 1968. Science, History and Hudson Bay. Department of Energy, Mines and Resources, Ottawa.

Berger, T.R. 1977. Northern Frontier, Northern Homeland. Lorimer and Co. Toronto.

Birchard, Evan C. 1982. Introduction. In: Sprague, J.B.; Vandermeulen, J.H.; Wells, P.G. (eds.). Oil and Dispersants in Canadian Waters - Research appraisal and recommendations. Environment Canada, Economic and Technical Review Report. EPS 3-EC-82-2.

Blood, Donald A. 1977. Birds and Marine Mammals: The Beaufort Sea and the Search for Oil. Beaufort Sea Project. Department of Fisheries and Environment. Ottawa.

Brice-Bennett, Carol (ed.) 1977. Our Footprints are Everywhere. Labrador Inuit Association. Dollco Printing Ltd.

Brody, Hugh. 1977. Permanence and Change Among the Inuit and Settlers of Labrador. In: Brice-Bennett, Carol (ed.). Our Footprints are Everywhere. Labrador Inuit Association. Dollco Printing Ltd.

Brown, R.G.B. 1982. Birds Oil and the Canadian Environment. pp.105-112. In : Sprague, J.B., Vandermeulen, J.H. and Wells, P.G. (eds.). Oil and Dispersants in Canadian Seas - Research appraisal and recommendations. Environment Canada. Economic and Technical Review Reports EPS 3-EC-82-2.

CAFSAC (Canadian Atlantic Fisheries Scientific Advisory Committee). 1981. Consultation on the consequences of offshore oil production on offshore fish stocks and fishing operations. Research Document 81/8.

Campbell, L.H.; Milne, H. 1983. Moulting eiders in eastern Scotland. Wildfowl 34: 105-107.

CanOxy (Canadian Occidental Petroleum Ltd.) 1982. Hudson Bay Exploration Program 1982. Internal Report.

Chapdelaine, Gilles; Bourget, André; Kemp, William B.; Nakashima, Douglas J.; Murray, David J. In press. Population d'eider à duvet près des côtes du Québec septentrional. In: Reed, Austin (ed.). Eiders Ducks in Canada. CWS Report Series no.47.

Chapdelaine, G., Tremblay, G. 1979. Indices de la distribution et de l'abondance de l'eider à duvet (Somateria mollissima sedentaria et S. m. borealis) le long de la côte est de la baie d'Hudson, du détroit d'Hudson et de la baie d'Ungava. Unpublished document, CWS. Québec, 21 pp.

COGLA (Canada Oil and Gas Lands Administration). 1984. Initial Environmental Screening for Renewed Exploratory Drilling in Central Hudson Bay. Environmental Protection Branch, COGLA.

Cooch, F.G. in press. Changes in numbers of nesting Northern Eiders on the West Foxe Islands, N.W.T. 1956-1976. In: Reed, Austin (ed.). Eider Ducks in Canada. CWS Report Series no.47.

1965. The breeding biology and management of the Northern Eider (Somateria mollissima borealis in the Cape Dorset Area, Northwest Territories. C.W.S. Wildlife Management Bull. Series 2, No.10.

Coulson, J.C. 1984. The population dynamics of the eider duck, Somateria mollissima and evidence of extensive non-breeding by adult ducks. Ibis 126 : 525-543.

Dexter, Tom. 1981. Probable statistics of accidental release of hydrocarbons. pp. 17-25. In : Canadian Atlantic Fisheries Scientific Advisory Committee. Consultation on the consequences of offshore oil production on offshore fish stocks and fishing operations. Research document 81/8.

DFO and DOE, 1980. A summary of environmental concerns associated with the disposition of lease acerage in Hudson Bay. Appendix 1. In : COGLA, 1984. Initial Environmental Screening for Renewed Exploratory Drilling in Central Hudson Bay. Environmental Protection Branch, COGLA.

DIAND (Department of Indian Affairs and Northern Development). 1981. EAMES : The achievement of an environmental program. DIAND, Ottawa. 36 pp.

1977. Eastern Arctic Marine Environmental Studies (EAMES). Outline of a Program. Minister of Supply and Services Canada, Ottawa. 76 pp.

Donaldson, Judy. 1983[a]. 1982 Wildlife Harvest Statistics for the Baffin Region, NWT. BRIA technical Report No.2.

Donaldson, Judy. 1983b. Wildlife Harvest Statistics for the Baffin Region, NWT. BRIA Technical Report No.1.

EAG (Environmental Applications Group Ltd.). 1984. Environmental literature review: Hudson Bay offshore petroleum exploration. Draft Final Report prepared for Canadian Occidental Petroleum Ltd. Toronto.

Englehardt, F.R. 1984. COGLA comments on CanOxy environmental overview of Hudson Bay. Appendix 2. In: COGLA. Initial summary evaluation of environmental concerns for renewed exploration drilling in central Hudson Bay. Environmental Protection Branch.

Freeman, MMR. 1982. An ecological perspective on man-environment research in the Hudson and James Bay region. Naturaliste Can. (Rev. Ecol. Syst.) 109 - 955-963.

(ed.) 1976. Inuit Land Use and Occupancy Project. Vol. I to III. Thorn Press Ltd. Ottawa.

1970. Observations on the seasonal behaviour of the Hudson Bay Eider (Somateria mollissima sedentaria). The Canadian Field-Natwalist 89: 145-153.

Gillespie, D.I.; Learning, W.J. 1974. Eider numbers and distribution off Newfoundland. In : Boyd, H. (ed.). Waterfowl Studies. C.W.S. Report Series No.29: 73-78.

JBNQHRC (James Bay and Northern Quebec Harvesting Research Committee). 1982. Research to establish present levels of native harvesting. Harvests by the Inuit of northern Quebec. Phase II (1979 and 1980). Montréal.

1982. (Research to establish present levels of native harvesting. Harvests by the Inuit of northern Quebec. Phase II (1977 and 1978). Montréal.

1979. Research to establish present levels of native harvesting. Harvests by the Inuit of northern Quebec. Phase II (1977 and 1978). Montréal.

Joensen, Anders Holm. 1972. Studies on oil pollution and seabirds in Denmark, 1968-1971. Danish Rev. of Game Biology. 6:1-32.

Leighton, F.A.; Butler, R.A.; Peakall, D.B. In press. Oil and arctic marine birds : an assessment of risk. In Englehardt, F.R. (ed.) Petroleum effects on the arctic environment. Elsevier Applied Science Publ., London.

Lock, A.R. 1982. An assessment of the breeding population of the Labrador breeding population of the Common Eider. Canadian Wildlife Service Report. Bedford Institute, Dartmouth.

Logan, W.J.; Thronton, D.E., Ross, S.L. 1975. Oil spill countermeasures for the southern Beaufort Sea. Environment Canada. Report EPS 3-EC-77-6. Ottawa.

Mackay, Donald. 1982. Fate and behaviour of oil spills. pp.7-28. In : Sprague, J.B.; Vandermeulen, J.H.; Wells, P.G. Oil and Dispersants in Canadian Seas - Research Appraisal and recommendations, Environment Canada. Economic and Technical Review Report. EPS 3-EC-82-2.

Makivik Research Department. 1984. Memorandum to Mayor, president of Landholding Corporations and the Local Wildlife Group members. re: Negotiations for guaranteed levels of harvesting. Makivik Corp. Montréal.

Milani, David W. 1984. Wildlife observations from a marine seismic vessel operating in Hudson Bay during September and October of 1983. Keewatin Environmental Consulting Services Ltd. Rankin Inlet, N.W.T.

Nakashima, Douglas J. In press. Inuit knowledge of the ecology of the Common Eider (Somateria mollissima boreales) in northern Québec. In: Reed, Austin (ed.). Eider Ducks in Canada. CWS Report Series No.47.

Nakashima, Douglas J.; Dumas, Réjean. 1984. Breeding biology and economic potential of an inland-nesting population of the Common Eider, Somateria mollissima borealis in northern Québec. Internal Report. Makivik Research Department, Montréal.

Nettleship, David N.; Smith, Pauline A. (eds). 1975. Ecological sites in northern Canada. Canadian Committee for the International Biological Program. Ottawa.

Palmer, R.A. 1976. Handbook of North American Birds. Vol.III, Yale University Press. London.

Percy, J.A.; Wells, P.G. 1984. Effects of Petroleum in Polar Marine Environments. Marine Technology Society Journal 18 : 51-61.

Pimlott, Douglas H.; Brown, Dougald; Sam, Kenneth P. 1976. Oil Under the Ice. Canadian Arctic Resources Committee. Ottawa. 67 pp.

Poole, Peter. 1984. Eiderdown industry development in Kangirsuk, northern Québec : A Market Study and a Development Plan. Report produced for the Kativik Regional Government and the Community of Kangirsuk.

Prinsenberg, S.J. 1982. Time variability of physical oceanographic parameters in Hudson Bay. Naturaliste Can. (Rev. Ecol. Syst.) 109: 685-700.

Reed, Austin (ed.) In press. Eiders Ducks in Canada. CWS Report Series No.47.

Reed, Austin. In press. Harvesting eiderdown and other uses of Common Eider in spring and summer. In: Reed, Austin (ed.). Eider Ducks in Canada. CWS Report Series No.47.

Reed, Austin; Erskine, Anthony J. In press. Population units of the Common Eider in eastern North America : their size and status. In Reed Austin (ed.) Eider ducks in Canada. CWS Report Series No.47.

Ross, S.L.; Logan, W.J.; Rowland, Wade. 1977. Oil Spill Counter measures. Dept of Fisheries and the Environment. Ottawa. 67pp.

Schmutz, Josef K. 1981. Coloniality of the Hudson Bay Eider Duck. Doctoral thesis. Queen's University. Kingston.

Szaro, Robert C.; Albers, Peter H. 1977. Effects of external applications of No.2 fuel oil on Common Eider eggs. In : Wolfe, Douglas A. (ed.), Fate and Effects of Petroleum Hydrocarbons on Marine Ecosystems and organisms. Pergamon Press, Toronto.

Tod, W.E. 1963. Birds of the Labrador Peninsula and Adjacent Areas. University of Toronto Press, Toronto. 819 pp.

Vandermeulen, John. 1981. Oil behaviour offshore and concentrations of biota. In: CAFSAC. Consultation on the consequences of offshore oil production on offshore fish stocks and fishing operators. Research Document 81/8.

Wiseman, R.J.; Payne, J.; Akenhead, S. 1981. Probable statistics of accidental release of hydrocarbons. In: CAFSAC. consultation on the consequences of offshore oil production on offshore fish stocks and fishing operations. Research Document 81/8.

Appendices

APPENDIX I

Inuit Knowledge of the Ecology of the Common Eider in Northern Québec

APPENDIX II

Breeding Biology and Economic Potential of an Inland-Nesting Population of the Common Eider in Northern Québec

APPENDIX III

MITIQ-Booklet

APPENDIX IV

Some Major Research Programs
Conducted by the Research Department of Makivik
and the Kuujjuaq Research Centre in Recent Years