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INTERNAL WORKING PAPER
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ARCOD WORKING PAPER 84-3

THE DEPARTMENT OF FISHERIES AND OCEANS' WRITTEN INTERVENTIONS AND ATTENDANCE AT THE BEAUFORT SEA ENVIRONMENTAL ASSESSMENT PANEL'S GENERAL SESSIONS

ARCTIC OFFSHORE DEVELOPMENT COMMITTEE
DEPARTMENT OF FISHERIES AND OCEANS

August 1984

ARCOD gratefully acknowledges B. Nicholls for coordinating the Department's participation at the Resolute Bay General Session; A. Cornford and R. Josephson for coordinating the Department's participation at the Inuvik General Session; G. Ennis for coordinating the Department's participation at the Whitehorse General Session; J. Stein for coordinating the Department's participation at the Yellowknife General Session; R. Paterson and K. Yuen for coordinating the Department's participation at the Ottawa General Session; G. Vernon, G. Ewing, H. Lawler, N. Campbell and R. Josephson for appearing before the Panel at the Ottawa General session; and all departmental staff who were witnesses or attended the General Sessions.

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INTRODUCTION

In 1980, a group of companies led by Dome Petroleum Limited, ESSO Resources Canada Limited and Gulf Canada Resources Incorporated proposed to produce and transport oil and gas from the Beaufort Sea-Mackenzie Delta region. The Department of Indian Affairs and Northern Development referred the Proposal to the Federal Environmental Assessment and Review Office (FEARO) in July 1980 and the Minister of the Environment subsequently established an Environmental Assessment Panel The Panel developed guidelines for the preparation of an Environmental Impact Statement (EIS) (see ARCOD Working Papers 82-2 and 82-4). The Proponents prepared and released volumes of the EIS during the summer and fall of 1983. DFO completed its technical review of the EIS in February 1983 and then completed its technical review of the Supplementary Information, which the Panel requested from the Proponents, in August 1983 (see ARCOD Working Paper 84-1). After completing its technical reviews of the Proposal, DFO finalized its Position Statement on Beaufort Sea hydrocarbon development, and provided it to the Panel on 6 December 1983 (see ARCOD Working Paper 84-2).

The Panel held General Sessions to review the Proposal at Resolute Bay on 15-20 October 1983, at Inuvik on 9-25 November 1983, at Whitehorse on 1-3 December 1983, at Yellowknife on 5-9 December 1983, at Calgary on 12 December 1983, and at Ottawa on 14-16 December 1983. This Working Paper contains the written statements and interventions which were provided to the Panel at the General Sessions by DFO and three interventions which were prepared for the Inuvik General Session but were not presented formally to the Panel. It also contains the lists of DFO participants at the General Sessions. It does not contain the many oral interventions made and questions asked by DFO staff during the General Sessions; these can be found in the Panel's transcripts.

Resolute Bay General Session

Opening Statement

Department of Fisheries and Oceans

Beaufort Sea Environmental Assessment Panel - Resolute Public Session

OPENING STATEMENT

1. The Department is represented at the Resolute General Session by Dr. Tom Smith of the Arctic Biological Station, Dr.Tom Strong of the Freshwater Institute, and myself, Brian Nicholls of the Bedford Institute of Oceanography. Any topics or questions that we cannot adequately deal with (and I am sure there will be some because between us we do not cover all the areas of expertize in the Department) will be taken on notice, and answers provided in writing and/or by an expert at one of the subsequent sessions.

2. The Department of Fisheries and Oceans has evaluated the Beaufort Sea Hydrocarbon Production Proposal in the context of departmental objectives for:

- the management and protection of fish and marine mammal resources, their habitats and associated fisheries;
- the protection of marine and freshwater environmental quality; and
- the safety of facilities and operations from hazards of the marine environment.

Other factors considered in this evaluation were:

- departmental positions on other Arctic hydrocarbon developments and on environmental operating conditions for specific activities;
- the conceptual nature of the Proposal;

- the unproven nature of much of the proposed technology;
- the gaps in knowledge of arctic ecosystems;
- and the inadequacies of the assessments in the Environmental Impact Statement and the Supplementary Information.

3. In its Technical Review of the EIS the Department of Fisheries and Oceans identified eleven major topics of concern, several of which pertain to shipping through the Northwest Passage. These are outlined below together with the recommended actions proposed by the Department to address them.

(a) Safety of Shipping

Future year-round shipping in the Arctic will be affected by environmental conditions with which present experience is inadequate. The technology to enable such expansion of activity is, for the most part, unproven. Moreover, a satisfactory data base on environmental conditions is not available. The availability and reliability of technology for ice detection, ice movement prediction and weather and sea state prediction is still in question. The manoeuvrability and navigational capability of ice-breaking tankers in open water and in ice is unclear. The proponents have proposed many navigational aids but detailed navigational plans for the shipping corridors are not given.

RECOMMENDED ACTIONS

- The locations of shipping traffic corridors must be confirmed, thus permitting a hydrographic charting program that would be coordinated with the phasing of developments into presently uncharted regions.
- A reliable observational and forecasting network operating

year-round must be established before development proceeds in order to address oceanographic, weather and sea state data deficiencies. Automated meteorological stations on ice are warranted, and winter monitoring of currents should be undertaken. The proponents' present research to provide more reliable estimates of extreme waves is commendable and encouraged.

- A decision on the safety of year-round vessel traffic should be delayed until specific design information becomes available verifying the manoeuvrability of ice-breaking carriers in open water and in ice. Traffic projections in proposed corridors are required prior to increase in traffic so that coordinated, phased installation of navigational aids can proceed.
- A research program on ice behaviour and prediction of ice movement must be designed in cooperation with government agencies.

(b) Offshore Noise

Noise from mobile sources will increase as activities in the Beaufort Sea intensify. The effects of such noise on marine mammals are not yet known. In particular, the potential effects of cumulative noise from multiple sources are not known. Moreover, measures proposed to reduce noise levels may be ineffective.

RECOMMENDED ACTIONS

- The cumulative noise levels from multiple sources and the effectiveness of proposed mitigative measures must be assessed. Such studies should be carried out in conjunction with demonstration or pilot projects.

- The research program addressing noise-related effects on marine mammals must be planned in the context of the scope and timing of future development.

(c) Ice-Breaking

Landfast ice provides habitat for pupping ringed seals in many areas and supports the epontic community, consisting of plants and invertebrates which form a significant part of the marine food web. Offshore exploration and production proposals include plans to disrupt landfast ice in vessel traffic corridors. However, the total amount of ice-breaking to be associated with full production has not been predicted, and the effects and impacts of full-scale ice-breaking have not been assessed adequately. Consideration of the effect of ice-breaking on stability of landfast ice in the Northwest Passage and the Archipelago is based on a poor data base which is entirely descriptive.

RECOMMENDED ACTIONS

- The total amount of annual ice-breaking over the life of the development must be estimated to provide a better base for assessing the magnitude of possible effects. This may be possible to do only after some experience has been gained with ice-breaking practices associated with demonstration projects.
- Both theoretical and practical research are needed relating to ice thickness distributions, grounding frequency, driving forces on landfast ice, physical and numerical models of ice cover, and effects of ice-breaking on the pattern of break up of the ice edges. A research plan should be prepared and implementation begun prior to an increase of ice-breaking around newly placed

structures and in vessel traffic corridors.

- The proponents' proposal to continue to assess the effects of ice breakup on patterns and timing of white whale movements into the Mackenzie estuary is fully endorsed, as is the proposal to monitor and assess the response of ringed seals to increased ice-breaking activity. However, more detailed assessment is needed of the consequent effects on hunting practices and success. It may be necessary to undertake such studies in the context of marine vessel transit trials through seal habitat.
- A more rigorous proposal for protecting pupping seal populations must be devised. An estimate should be made of the residual impacts to be expected in instances where the mitigative measures fails to provide the protection needed.

(d) Oil Pollution

In spite of mitigative and safety measures, oil may be discharged from ships during normal operations or through accidental spills. The Department is concerned about the quantitative and qualitative changes in hydrocarbon concentrations that may be expected to occur in sediments, seawater and biota as a result of chronic discharges of oil. The proponents have underestimated the probability of accidental spills and the potential total volume of oil that could be released into the environment accidentally. The analysis of oil spill impact and behaviour under various environmental conditions leaves many questions unanswered. The Department also has concerns about the proposed clean-up measures.

RECOMMENDED ACTIONS

- Better estimates must be made of a) the concentrations of oil in

the environment to be expected from chronic discharge sources; b) the cumulative effect of numerous small spills; c) the formation of oil emulsions; and d) the effectiveness of burning oil as a clean-up measure.

- Improved methods for simulating oil movements on water in all seasons must be developed.
- A strategy for treatment and disposal of oil recovered after spillage must be prepared.
- A research program should address the prediction, tracking, countermeasures and technology development for oil spills. Regulatory and scientific agencies could assist in preparing an adequate research plan.

(e) Socio-Economic Aspects of Resource Harvesting

The development may threaten populations of fish and marine mammals that are domestic, recreational and commercial resources. In particular, development will increase the number of persons engaging in resource harvesting and also will provide increased access to resources. The overall lack of specific information about future development seriously constrains any assessment of the potential effects on renewable resources and on the use of these resources by the inhabitants of the region.

RECOMMENDED ACTIONS

- Quantitative data on fish and marine mammal catch levels and values must be obtained to assess the value of the resource to northern residents and to provide a basis for future comparisons.
- An approved plan for compensation for loss of property and livelihood as a result of development must be a condition for

approval of development.

- A plan must be proposed for conducting resource surveys, in consultation with fisheries officers of DFO and with the Department of Indian and Northern Affairs, preferably within the context of regional planning.
- The fish and marine mammal resources which are likely to be affected by development should be monitored to detect effects and changes.

In summary, the existing knowledge about bathymetry, ice conditions, Arctic navigation and ice-detection systems, winter oceanic circulation, and other marine environmental factors is inadequate for ensuring safe, year-round navigation. The vessels would operate through areas, such as Lancaster Sound, of great importance to Canada's marine mammals and other biological resources. Shipping will create underwater noise and will disrupt ice, with the potential for adverse effects on marine mammals and other resources. If an accident occurs to an oil tanker, the resultant spill would be difficult to contain and clean-up.

4. The Department has not yet finalized its overall position on the proposal, which will address such aspects as: production facilities on-land and offshore; port and other facilities along the Beaufort Sea coast; marine transportation; subsea pipelines; and the overland pipeline. It has, however, drafted a number of recommendations on the management of Beaufort Sea Hydrocarbon Development, as follows:

- the Panel should adopt the "Lancaster Sound planning principles" to guide Beaufort Sea development;
- a regional planning process should be implemented before further

development proceeds;

- a plan for Beaufort Sea coastal development should be implemented before further development proceeds;
- all specific projects resulting from the proposal must be subject to a complete environmental assessment and review;
- government agencies should review regulatory processes before development proceeds;
- a comprehensive program of research and monitoring is required to improve understanding of safety issues and risks to fish and marine mammal resources and the arctic marine environment, and thus to improve the basis for making decisions on hydrocarbon development proposals; specifically —

  i) any required research for approved activities can be conducted concurrently with the development; other research must precede further development;

  ii) whenever appropriate, results from research and monitoring must be incorporated into subsequent years' decisions and operating procedures (this may require changes in development plans or operations);

  iii) a mechanism is required to facilitate the design, coordination and implementation of research and monitoring programs which meet the needs of industry and the scientific and management responsibilities of government; and

  iv) carefully designed demonstration projects should be used when appropriate to improve understanding of the potential risks of full-scale activity.

5. The Departments overall position on the Beaufort Sea Hydrocarbon Production Proposal will be released at, or before, the general session in Ottawa on December 14, 15 and 16, 1983. It should be noted at this time, however, that the following factors will have a significant bearing on the position(s) with respect to marine transportation:

— action on the recommendations pertaining to technical issues, outlined above; and

— the undertaking of a demonstration project to show that the proposed commercial vessels can operate safely with a non-polluting cargo (LNG) in ice-covered waters, and to determine the inpacts on marine mammals.

In addition, the Department is committed to the decisions of the EARP Panel with respect to the proposal to drill in Lancaster Sound, and to the decisions resulting from the Lancaster Sound Green Paper exercise. It also supports the high priority afforded to the Lancaster Sound region for Land-Use Planning.

Closing Statement

Appendix 'C'

Closing Statement

1. The detailed comments of the Department of Fisheries and Oceans on the Parry Channel marine transportation component of the Beaufort Sea Hydrocarbon Production Proposal have been transmitted to the Panel in the Department's review of the EIS and Supplementary Information. These were summarized in the opening statement DFO presented at this session.
2. DFO will be participating in the Inuvik, Whitehorse, Yellowknife and Ottawa sessions. In particular, the Department will have serveral technical specialists at Inuvik who will elaborate on the major DFO concerns of the total project.
3. While several of the specific comments of DFO on the EIS have been addressed (and some resolved) here in the discussions at Resolute, the general concerns of DFO, as expressed in the opening statement, remain.
4. In its opening statement, DFO referred to the desirability of a "demonstration" marine transportation project. It is noted that, acording to the proponents, the first tanker will undergo extensive trials, without a cargo of oil, during approximately the first six months after entering service, i.e. until the second tanker is ready.
5. Many comments were made during this session on the effects of the project on renewable resources. As a contribution towards providing the information required in order to make decisions related to the environmental impacts of arctic hydrocarbon development, the Department has produced two major position papers. One of these pertains to the effects of vessel traffic in the Arctic on marine mammals, and has been

tabled at this meeting. The other, on the effects of oil on Arctic marine fish and marine mammals, will be tabled at Inuvik.

6. A word on DFO's Arctic programs, including its research programs. The Department has conducted major programs in the Canadian Arctic for many years. The main priorities are the gathering of biological information upon which to base resource management and habitat protection requirements, nautical charting, and oceanographic studies of the marine environment. Many of DFO's Arctic programs are designed specifically towards providing the necessary information required by government and industry in making decisions related to hydrocarbon development in the north. The Department has, in recent years, reallocated fiscal resources to support its Arctic programs. The level of effort is currently 85 person-years and $10 million annually for work north of 60°. In oceanography and hydrography 25% of all resources are devoted to Arctic work. Several of the concerns addressed here at Resolute are being addressed in these programs.
7. As joint chairman (with DOE), DFO is committed to the objectives of the Environmental Advisory Committee on Arctic Marine Transportation (EACAMT), and believes it to be an effective mechanism for marine environmental management in the north. This is illustrated by the work of the Committee pertaining to the APP route north of the 60°.
8. Thank you for this opportunity to participate in the hearings.

Topics and DFO Participation

RESOLUTE BAY (15-20 Oct.)

	DFO Participants
General Spokesman/Coordinator	B. Nicholls, BIO
Opening Statement (15 Oct. p.m.)	B. Nicholls, BIO
Tankers (15 Oct. eve.; 17 Oct. a.m., p.m.; 18 Oct. p.m.)	B. Nicholls, BIO
- Safety, field trials manoeuverability, feasibility.	T. Smith, ABS
- Navigation and routing, ice detection and surveillance, physical environmental conditions and restraints.	
- Oilspills - all aspects from risk to cleanup and effects.	
- Effects of icebreaking on ice patterns. All aspects from physical to man.	
- Noise	
- Support - navigation, communication, oil spill response.	
- Environmental assessment - definitions, methods, effects, risk, mitigation, impact management, monitoring, research,EIS supplementary information.	
Socio-Economic Effects (18 Oct. eve.; 19 Oct. a.m., p.m., eve.)	T. Strong, FWI
- Harvest pattern changes due to wildlife disturbance especially from oilspills, ice breaking.	
- Social/cultural changes resulting from above.	
- Compensation.	
Government Management (20 Oct. a.m.)	B. Nicholls, BIO
- Regional Planning - Lancaster Sound Green Paper.	
- Tanker routing - research into best route, shipping control authority. (EACAMT)	
- Environmental protection - park status, monitoring (noise/marine mammals), contingency plans, data bases, research and monitoring.	
Other Concerns (20 Oct. p.m.)	
Closing Statement (20 Oct. eve.)	B. Nicholls, BIO

Inuvik General Session

Opening Statement

DEPARTMENT OF FISHERIES AND OCEANS

OPENING STATEMENT

TO THE

BEAUFORT SEA

ENVIRONMENTAL ASSESSMENT PANEL

INUVIK

9 NOVEMBER 1983

Presented by

Dr. G. H. Lawler

Director-General

Western Region

Mr. Chairman,

I welcome this opportunity to present to the Panel some observations from the Department of Fisheries and Oceans on the Beaufort Sea Hydrocarbon Production Proposal. My name is Dr. Herb Lawler and I am the Director-General of the Department's Western Region, which has the fisheries management responsibility for the Northwest Territories and most Arctic marine waters.

The Department has provided you with several documents relevant to the Proposal, including a description of the Department's mandate and relevant programmes, its technical reviews of the Proponents' Environmental Impact Statement and Supplementary Information, and its scientific assessments of the effects of vessel traffic on Arctic marine mammals and of oil on Arctic marine fish and marine mammals.

The Department considers these hearings to be at the stage of the process when technical issues are debated. DFO has evaluated the technical aspects of the Beaufort Sea Hydrocarbon Production Proposal in the context of the departmental responsibility for:

- the management and protection of fish and marine mammal resources, their habitats, and associated subsistence, recreational and commercial fisheries;
- the protection of marine and freshwater environmental quality; and
- the provision of information for safety of facilities and operations from the hazards of the marine environment.

Given these responsibilities in the Arctic, the Department has to advocate an approach to Beaufort Sea hydrocarbon development which will ensure the long-term well-being of the fish and marine mammal resources. The

Department's technical reviews were approached from this perspective to make sure that all concerns related to possible impacts on fish and marine mammals and the aquatic environment are identified and considered at the early stages of any planning for the development of Beaufort Sea hydrocarbons.

I also would like to point out that the Department is committed to "cooperative resource planning" as a means of incorporating departmental concerns into air, water and land use plans in conjunction with industry and other government agencies. Damage to Canada's fisheries resources and to the marine and freshwater environment can often be avoided by:

- mitigating potential problems through design, construction and operational adjustments;
- encouraging the selection of alternative sites;
- restoring the quality of damaged habitats; and
- if necessary, prohibiting certain proposed activities that could severely damage fish, marine mammals or their habitat.

Therefore, if the decision is made to proceed with Beaufort Sea hydrocarbon development, the Department of Fisheries and Oceans expects to work cooperatively with industry, other government agencies and northern residents in protecting fish and marine mammal resources, their habitats, associated fisheries, and the marine and freshwater environments.

In its technical reviews of the EIS and Supplementary Information, DFO addressed eleven topics of major concern to the Department. Many aspects of these topics are relevant to the technical discussions to be held here, so I would like to outline for you some of the Department's main conclusions:

- at this time, an on-land focus for production and collection facilities and transportation may be preferable to an offshore focus because for on-land developments there are better scientific data and understanding, proven technology and experience, reduced and more localized risks to the environment and its biological resources, lower risks of spills, and better capability for detection, containment and clean-up of spills;
- it should be possible for impacts to aquatic resources from an overland oil or gas pipeline in the Mackenzie Valley to be kept to an acceptably low level with proper location, design, construction and operational conditions;
- in general, the safety of ports and other coastal facilities and operations has not been assessed adequately in relation to marine hazards;
- developments along the Beaufort Sea coast could displace or damage important fish and marine mammal resources and habitats with possible detrimental effects on harvesting activities;
- there are potential risks to the safety of offshore production facilities since extreme oceanic hazards cannot be known from existing observations;
- many activities, such as dredging, ice-breaking and waste disposal, associated with the construction and operation of offshore production facilities have the potential to adversely affect fish and marine mammals and their habitats, and their synergistic and cumulative effects are unknown.
- the potential effects of underwater noise on marine mammals remain a concern since the effects on most species are unknown; and

- the potential effects of accidental oil spills and chronic oil pollution and the ability to detect, contain and clean-up spills in the Arctic marine environment are a major concern.

Departmental staff are prepared to discuss these and related technical issues at these hearings. The Department also is preparing for the Panel a list of recommended actions to deal with the problems associated with these issues which also will be provided to the Panel at or before the Ottawa General Session.

I would like to take a few minutes to introduce to you the DFO staff who are here with me today and those who will be attending specific parts of these hearings to discuss topics relevant to the Department's interests:

- present with me today are Mr. Don Dowler who is District Manager of the N.W.T. Field Services in Yellowknife, and Mr. Brian Smiley who is Senior Environmental Affairs Office in the Ocean Information Division at the Institute of Ocean Sciences in Sidney, B.C.;
- for the discussion on Oil Spills, Mr. Smiley, Mr. Dowler, Mr. Michael Lawrence and Dr. Allyn Clarke will be present; Dr. Clarke also is prepared to discuss the physical oceanography of offshore Labrador;
- for the discussion on On-Shore Effects, Mr. Lawrence, Mr. Smiley, Mr. Larry de March and Mr. Brian Wong will be present;
- for the discussion on Offshore Effects, Mr. Smiley, Mr. de March, Mr. Lawrence, Mr. Wong, Dr. Lionel Johnson, Dr. Arthur Mansfield and Dr. Humfrey Melling will be present; Dr. Johnson and Dr. Mansfield will be here to discuss scientific assessments on the effects of oil and of vessel traffic respectively;

- for the discussion on Socio-Economic Effects, Mr. Rick Josephson, Mr. de March, Mr. Robert Moshenko and Mr. Tom Strong will be present.
- for the discussion on Government Management and on Other Concerns and for the Closing Statements, Mr. Josephson, Mr. de March, Mr. Strong, Dr. Allan Cornford, Mr. Roger Peet and Dr. Red Clarke will be present.

I hope that these arrangements will meet the Panel's needs. If any question arises that we cannot adequately deal with here, we shall take it on notice and provide you with an answer as soon as possible.

Finally, I wish to identify for you the topics on which the Department is proposing to develop positions to be presented to you at or before the Ottawa General Session after the technical discussions have occurred here and at Resolute Bay, Whitehorse and Yellowknife. The Department will address such aspects as:

- the location of production facilities on-land and offshore;
- the location of port and other facilities along the Beaufort Sea coast;
- marine transportation;
- subsea pipelines; and
- the overland pipeline.

The Department also will address the general management of Beaufort Sea hydrocarbon development such as:

- adoption of the "Lancaster Sound Planning Principles" to guide Beaufort Sea development;
- implementation of a regional planning process before further development proceeds;

- agreement upon a plan for development along the Beaufort Sea coast and the Mackenzie Valley before further development proceeds;
- requirement for complete environmental assessment and review of all specific projects resulting from the Proposal;
- review of regulatory processes; and
- development of a comprehensive programme of research and monitoring to improve understanding of safety issues and of risks to fish and marine mammal resources and the Arctic marine environment so that the basis for making decisions on Beaufort Sea hydrocarbon development proposals is improved.

Thank you very much for this opportunity, and I wish you success with the discussions here at Inuvik.

Intervention on Onshore Concerns (not presented formally)

DEPARTMENT OF FISHERIES AND OCEANS

INTERVENTION ON ONSHORE CONCERNS

TO THE

BEAUFORT SEA

ENVIRONMENTAL ASSESSMENT PANEL

INUVIK

14 November 1983

Prepared but not Presented Formally

Mr. Chairman,

My name is Michael Lawrence; I am a biologist with the Department of Fisheries and Oceans, Western Region.

Over the past decade I have been involved with field studies to inventory and describe the life history and habitat requirements of fish species occurring in the Mackenzie Delta and Tuktoyaktuk Peninsula area. And to some extent conducted studies related to some of the impacts of oil and gas exploration activities on fish and fish habitat of the region.

I have read those sections of the Environmental Impact Statement that address themselves to shorebased facilities and onshore pipelines, and in the light of my Department's responsibility for the protection of fish and fish habitat, I wish to make the following intervention.

Specifically, I would like to outline what we have found to be shortcomings of the Environmental Impact Statement in dealing with problems with regards to the planning, safety and environmental effects of shorebases and with regards to the planning, construction, testing and operation of an overland pipeline for the transport of oil. Subsequently and more importantly I wish to state the recommended actions which our Department has identified to deal with each of those problems.

Shorebases

Generally the short term requirements for shorebases have been adequately described, however the proponents have been unable to usefully describe the longer term - i.e. to the year 2,000 - requirements for shore facilities. While these shorebase requirements are likely to include at least one major port, an oil processing facility and other camps and facilities, an

appropriate appraisal of the risks to these facilities cannot be conduted on the basis of the available development plans. Coastal facilities and operations in support of offshore exploration and production may be subjected to severe marine hazards from sea ice, currents, high water level and waves. Some hazards such as shoreline erosion have not been addressed.

As new shorebases and temporary camps are constructed along the Beaufort Sea coast, fish, marine mammals and their habitats will likely be increasingly affected. There will be increased water use and recreational fishing pressure. Streams may be disturbed by construction activities and waste disposal, and shoreline process could be altered, resulting in altered sediment transport and subsequent maintenance dredging or shoreline stabilization problems.

For example, causeways planned for the Yukon coast may alter shoreline processes and, consequently, water characteristics. This may affect fish habitat or migrations of anadromous fish. Also, it has not been possible to estimate the potential impacts of the North Point Terminal and other possible facilities on the basis of presently available descriptions. Consequently, the adequacy, applicability and efficacy of proposed mitigative measures could not be assessed.

The Department recommends the following actions to address these shortcomings:

- Plans for shorebases, campsites and subsea pipeline approaches should be specified to the year 2000, under the auspices of a regional planning process.
- A research program to investigate the hazards associated with coastal processes must be planned and conducted prior to expansion of existing facilities or the construction of new facilities.

- Shorebase locations should be shared in order to reduce the proliferation of sites thereby reducing the overall risk to anadromous and marine fish.
- If the results of the assessment recommended above show that a port site is environmentally feasible, mitigative measures should also be planned to protect resources and habitat.
- Effective mitigation will require that modelling of Mackenzie plume dispersion and longshore currents is done in order to predict the possible effects of causeways on currents, temperatures and salinities. Subsequent predictions of effects on migrations of fish could then be accomplished.
- Shared shorebase locations must be identified within the context of a regional planning process prior to any further new construction or expansion of existing shorebase locations. The planning process should include a comprehensive assessment of effects which these sites, operations and inhabitants may have on adjacent resources and habitat.

On the topic of shared shorebases, we have had an opportunity to review the Discussion Paper No. 5 prepared by the proponents on that subject. This paper provided interesting information on the legal and economic advantages and disadavantages of sharing shorebase facilities. Unfortunately neither the discussion on the advantages and disadvantages of sharing locations (as opposed to facilities) nor the environmental pros and cons of sharing were adequately described. In our opinion the assessment should have focussed on the sharing of locations rather than on the sharing of shorebase infrastructure. Tuktoyaktuk Harbour for example, with Dome, Esso, Gulf, ATL, NTCL and MOT as principal users, would have and still does, offer an opportunity

to look at some of the advantages and disadvantages of a number of users of a single location (for purposes of impact prediction).

Aquatic Impacts from Overland Pipelines

Overland pipelines have a potential for many impacts on aquatic resources, including blocking fish passage, habitat destruction, toxic contamination and, indirectly, through increased harvesting of fish. Although the proponents have described a general pipeline design, certain aspects of the proposal are still required to permit an adequate assessment of the likely impacts to aquatic resources. In particular, location of stream crossings, site specific data on fish and their habitat, specific facility locations, sources of granular construction materials and sources of freshwater for a variety of uses, are still needed. Synergistic or additive effects such as from increased sediment action combined with methanol are not addressed. In addition, the potential impact of methanol or oil relesed into fresh waters raises concern. The detection of oil leaks from pipelines, mitigative measures and clean-up procedures and countermeasures, especially during spring breakup, are not adequately described. Insufficient analysis has been given to the effects of quarrying granular material along pipeline routes.

The proponents have proposed to use standard and accepted remedies of countermeasures for northern construction which should ensure protection of fish and their habitat provided these measures are properly implemented. However, pertinent environmental protection recommendations and guidelines from previous Mackenzie Valley pipeline reviews have not been incorporated into the proponents plans. Nor has environmental awareness training for construction personnel. Since the Department concluded during the Mackenzie Valley pipeline hearings that a pipeline could be safely built provided

adequate attention was given to protection of aquatic resources, the following actions are recommended:

- A pipeline design plan must be prepared with sufficient detail to permit an adequate assessment of risks and of site specific problems. For example - stream crossings, facility locations, locations of preferred granular sources and their proximity to water.
- Before the pipeline is approved an assessment should be prepared of possible synergistic or additive impacts, the impact of methanol spills or discharges, the risk of pipeline rupture and potential effects, and effects of quarrying granular construction materials, and of water withdrawal.
- The guidelines and recommendations from the Berger Inquiry sould be applied where appropriate to the pipeline construction and opration.
- A comprehensive spill detection, clean-up and countermeasures plan for pipeline cnstruction and operations must be prepared and should include long distance transport into the Mackenzie Delta and estuary.
- A long-term monitoring program to determine the effects of pipeline construction and operation on fish and fish habitat is needed.

As Dr. Lawler mentioned in his opening statement, our Department is preparing a list of recommended actions and mitigative measures proposed either by the proponents or our Department to deal with problems associated with Beaufort Sea development issues. This list is to be provided to the Panel at or before the Ottawa general session.

Should the panel wish, I can provide some information regarding that list.

Intervention on Offshore Concerns (not presented formally)

DEPARTMENT OF FISHERIES AND OCEANS

INTERVENTION ON OFFSHORE CONCERNS

TO THE

BEAUFORT SEA

ENVIRONMENTAL ASSESSMENT PANEL

INUVIK

17 November 1983

Prepared but not Presented Formally

Because of the nature of the proposed Beaufort Sea Oil Development and the presence of many fish and marine mammal resources, most of the concerns of the Department of Fisheries and Oceans relate to the Offshore areas of the Beaufort Sea and Northwest Passage

Our Department has concerns in seven general categories. These are:

Safety of shipping and offshore structures,

Discharge of wastes into offshore waters,

Noise in offshore waters,

Chronic and accidental oil pollution,

Ice breaking,

The presence of artificial islands, and

Dredging

I will briefly outline both the Department's concerns within each category and also recommended actions for dealing with these concerns. Detailed information on these and other concerns can be found in the DFO Technical Reviews of the EIS and Supplementary Information. More refined versions of the recommended actions will be presented at a later date in the Department of Fisheries and Oceans Position Statement on The Beaufort Sea Hydrocarbon Production Proposal.

Offshore Safety

The Department is involved in offshore safety through the Canadian Hydrographic Service which provides charts for safe shipping and Ocean Sciences which provide industry with information on such things as tides, currents and ice.

We found that the Environmental Impact Statement provided inadequate information on a number of topics. These were: tanker routes within described

corridors, the navigational aids required for safe shipping and descriptions of project details, engineering designs and operational procedures. Without these details it is not possible to assess whether or not safety problems exist.

There are data gaps for the movement of ice and water in the Northwest Passage, for extreme ice features and for waves in the Beaufort Sea. Without such environmental data, risks to ships and offshore structures cannot be assessed adequately nor can engineering parameters for offshore structures be set with full confidence.

Hydrographic charts have not been completed for the Beaufort Sea and Northwest Passage, nor have seabed anomolies such as Pingo Like Features been adequately surveyed. The time required to produce adequate charts must be taken into account in planning for any shipping.

The technology for ice detection is currently inadequate and developing technologies are yet unproven. Also, technologies for detecting and predicting ice movement are still in question.

The descriptions of research programs to address these problems was inadequately described and it cannot be determined whether or not it will achieve the desired results.

DFO recommends the following actions:

Industry must confirm the locations of offshore structures and shipping corridors in order to permit a coordinated hydrographic program.

A reliable observational and forecasting network must be developed to assess oceanographic, weather and sea state deficiencies.

Research should be conducted on ice movement and behaviour and also on ice-structure interactions to verify models prior to increased offshore construction. Government agencies should be consulted when developing research programs.

A decision on year-round shipping should not be made until design information is available to verify the manoevrability of tankers in open water and in ice, till shipping routes are identified and traffic projections made.

Discharge of Wastes in Offshore Waters

Wastes such as heavy metals and toxic chemicals are a threat to whales, seals, fish and the plants and animals on which they feed. Hydrocarbon developments in the Beaufort Sea will involve the production of large quantities of wastes.

The EIS did not adequately describe the probable locations of offshore waste disposal sites though it did identify the probable types and amounts of wastes to be produced. The cumulative effects of multiple wastes and multiple sources of wastes were inadequately assessed as was the possibility of adverse impacts from resuspension of contaminated sediments.

Adequate waste management strategies have not been developed and research and monitoring programs have not been described adequately. In addition, not enough information is available to compare natural inputs of certain chemicals to introduced amounts in order to help predict impacts.

Recommended Actions

We recommend three actions to help rectify these problems.

Industry must produce a detailed plan of waste disposal sites in order that possible effects can be assessed. The possibility of on-land disposal of wastes should be considered.

Using this plan, industry should evaluate the likely effects of multiple wastes and cumulative effects of multiple waste sources.

Last, industry and government should jointly develop a comprehensive waste management plan and a complementary research and monitoring program.

Offshore Noise

Hydrocarbon development in the Beaufort Sea will introduce many sources of noise in the water. If tankers are used there will be increased noise in the Northwest Passage.

The EIS described all of these noise sources and the probable levels of noise from each but it did not attempt to predict the total noise from multiple sources at single locations. The EIS and Supplementary Information inadequately predicted the effects of noise on marine mammals.

There is currently insufficient information available on sound propogation and propogation losses in the Beaufort Sea, on the hearing abilities and use of sound by marine mammals, the reactions of marine mammals to sound and the long-term effects of noise on marine mammals.

DFO is also concerned that measures to reduce noise levels may not be effective. The EIS did not provide enough information on countermeasures and remedies to noise and on research and monitoring programs.

Recommended Actions

Industry should estimate cumulative noise levels from multiple sources and assess the possible effects on marine mammals. The effectiveness and applicability of proposed mitigative measures also should be assessed. The best approach to this problem might be to carry out experiments and measurements in conjunction with demonstration or pilot projects.

Research on noise and marine mammals should be planned in the context of the scope and timing of future development activities.

Dr. Arthur Mansfield of the Department of Fisheries and Oceans recently prepared a report titled "The Effects of Vessel Traffic in the Arctic on Marine Mammals and Recommendations for Future Research". He is here and can answer questions on this topic.

Oil Pollution

There are two types of oil pollution, chronic pollution or that which will occur such as oil in formation water, rig wash water, other wastes and from small frequent accidents and that which might occur from large spills due to accidents such as blowouts or tanker spills. These have to be dealt with separately. The amount of chronic pollution can be estimated, the effects on the environment assessed and mitigative measures employed. It is possible to judge the acceptability of such pollution and to reduce it if predicted levels are found to be unacceptable.

Catastrophic pollution can only be guessed at with probabilities based on past experience assigned to future operations. Effects can be estimated but a decision has to be made on whether the risks are too great to take.

The EIS did not adequately predict the quantitative and qualitative changes in hydrocarbon concentrations in sea water, sediments, plants and animals because of chronic hydrocarbon releases which could easily equal or exceed natural imputs from the Mackenzie River.

The EIS also does not adequately discuss a strategy for discharge of contaminated formation waters. Too, there are data gaps pertaining to the effects of hydrocarbons on the plants and animals of the Beaufort Sea and Northwest Passage.

Our department has many concerns about how catastrophic spills were treated in the EIS and Supplementary Information. Because time is limited I will mention only some of these. The others may be found in our Technical reviews.

We believe that the spill scenarios are not representative of what might actually occur. The summer Beaufort Sea Scenarios do not adequately reflect the area of contamination and numbers of animals which may be affected. The

winter Beaufort Sea Scenarios are inadequate for a transition zone location. The Lancaster Sound Scenario does not reflect the potential seriousness of such a spill.

The discussion of the scenarios does not reflect differences in effects due to changes in time of year or of locations.

There is inadequate discussion of the formation and movement of oil-in-water emulsions, inadequate appraisal of the effectiveness of measures to reduce spill impacts and inadequate description of leak detection and reaction times to leaks.

We beleive that risks of spills have been underestimated as have the possible volumes of oil resulting from spills.

In addition to these concerns, technology for detecting oil in ice and water is not well developed, the models for predicting oil movement are inadequate and the operational ability for predicting oil movement is poor.

Recommended Actions

We recommend the following actions:

Better estimates should be made: for the potential spills from subsea pipelines; for the duration of uncontrolled flows from blowouts; for the concentration of hydrocarbons expected in the environment from chronic hydrocarbon pollution; for cumulative effects of small spills (less than 1,000 barrels each); for the formation of oil-in-water emulsions and the effectiveness of burning as a cleanup measure.

Improved methods must be devleoped for simulating the movement of oil on water and under ice.

A strategy must be developed for treatment and disposal of oil contaminated production water, cuttings, other wastes and recovered spilled oil.

Research must be carried out on the prediction of movement, tracking of and countermeasures technology for oilspills in conjunction with government agencies.

Dr. Lionel Johnson of our department recently prepared a paper on the effects of oil on fish and marine mammals. He is here today and can answer questions on this topic.

Ice Breaking

Whether or not tankers are used for transportation of oil, there will be an increase in ice breaking in the Beaufort Sea. Landfast ice is an important habitat for a number of species including pupping ringed seals and the under ice or epontic community which is an important part of the Arctic marine web.

There is currently poor knowledge of landfast ice dynamics and poor knowledge of the sea ice community, therefore the assessment of impacts is hindered.

The Environmental Impact Statement did not adequately describe research and monitoring for these problem areas nor did it assess the effects on hunters if seal populations decrease in areas where they are normally hunted.

Recommended Actions

The Proponents should estimate the total annual ice breaking requirements for the life of the project. This will provide a base for assessing effects. This action may require the experience gained during a demonstration project.

Theoretical and practical research has to be carried out on ice thickness distributions, grounding frequency and driving forces on landfast ice and the effects of ice breaking on ice edge breakup patterns. Physical and

numerical models of ice cover should be developed. These activities should be implemented prior to increases in ice breaking in vessel corridors and around offshore facilities.

A more detailed assessment of the subsequent effects of ice breaking on hunting practices and hunter success is required. Trial vessel transits through seal habitat may be necessary to aid in this assessment.

A rigorous proposal is required for the protection of seal pups. The residual impacts after mitigative measures should be estimated and effects if mitigative measures fail should also be estimated.

Artificial Island Presence

By the end of the century there could be eighty islands built in the Beaufort Sea. There is concern that these islands could affect landfast ice stability and the time of breakup in the Beaufort.

Currently there is poor knowledge of fast-ice dynamics and this hinders the assessment of effects of islands on its stability. There is also poor knowledge of the habitat requirements of white whales. This hinders the prediction of effects of delayed breakup on the whales.

The Department believes that plans to use satellite imagery, wind and water current measurements will not address the problems of landfast ice stability and breakup satisfactorily. We also have reservations about the white whale monitoring program.

Recommended Actions

The proponents should provide specific plans for an ice breaking capability associated with offshore islands.

A research program should be instituted to provide a qualitative description of factors affecting fast ice stability. Subsequently a dynamic model of ice cover should be developed to simulate the stabilizing effects of islands. Monitoring techniques should be developed for routine use.

Dredging

Large amounts of dredging will be required for building islands, deepening harbours and channels and maintaining these facilities. Bottom dwelling plants and animals and the animals which feed on them are threatened by dredging.

The EIS did not adequately describe the extent of total substrate disturbance to be expected from dredging, dumping and offshore construction, the scale and duration of operations and their zones of influence. It also did not adequately recognize erosional losses and the need for maintenance dredging.

These and some other inadequately described factors combined with a poor knowledge of recovery times of benthic organisms and the secondary effects on animals feeding on them resulted in an inadequate assessment of the effects of dredging.

Research and monitoring were inadequately described as were plans for disposal of overburden and unwanted dredge spoil. The lack of detail on dredge and dump sites hinders assessment of effects as does the inadequate treatment of the topics of abandonment and dredging of contaminated sediments.

Recommended Actions

Before further offshore and coastal construction the Proponents should refine dredging plans to include the following information: the need for

ancillary dredging at temporary facilities and for maintenance; the estimates of amounts of overburden and of erosional losses; a strategy or plan for the regional extent and volume of dredging and possible sites; total areas of dredging and construction and their zones of influence over the life of the project; estimates of volumes of unwanted spoil and a disposal strategy and comparative data on natural sediment disturbance by ice.

A research plan should be developed to examine possible impacts on benthos. This should include the ecological significance of benthos and possible impacts as well as potential impacts from redistribution of contaminated sediments.

The poponents should develop an operational plan for reducing entrainment of fish and a monitoring program for this and other effects as operations progress or expand.

We will be pleased to answer any questions on these concerns. I would remind you that Dr. Mansfield can respond to questions on the effects of vessel traffic on marine mammals and Dr. Johnson to questions on the effects of oil on fish and marine mammals. Questions on ice and currents can be directd to Dr. Melling and on fish to Mr. Lawrence.

The Biology of Arctic Cod

THE BIOLOGY

OF

THE ARCTIC COD,

Boreogadus saida

BY

LIONEL JOHNSON

Prepared for the Beaufort Sea
EARP hearings
INUVIK,
November 1983

ARCTIC COD, Boreogadus saida

Introduction

Although comparatively little is known about the detailed aspects of Arctic marine food webs and specific rates of energy transfer between the trophic levels, there appears to be little doubt that a considerable fraction of the total incoming energy passes through the population of Arctic cod, Boreogadus saida. It is probably the most numerous fish in the Arctic ocean and undoubtedly it is a very important species in the maintenance of the upper trophic levels, represented by the marine mammals and Arctic charr.

Arctic cod is circumpolar in its geographic distribution, having been recorded from the coast of Labrador and the Gulf of St. Lawrence (Leim and Scott 1966) to the vicinity of the North Pole in latitudes 80 - 85.5° N (Andriyashev et al. 1980). The most abundant catches have been recorded in 100 - 150 m depth off northern Labrador (Lear 1979). In the highest latitudes Arctic cod as well as its relative Polar cod, Arctogadus glacialis, were found in some concentration by Russian scientists of the floating ice-island expeditions. The cod accumulated in cracks and in depressions in leads throughout the year, mostly being found in water at temperatures between -1.2 to -2.0°C. Based on these and other observations it has been concluded that Arctic cod occupies a key position in the 'epontic' or 'cryopelagic' biota of the under-ice surface (Andriyashev 1954; Ponomarenko 1967; MacAllister 1975). The basic food chain is believed to be green algae, amphipods and copepods to Arctic cod or Polar cod (Cross 1982). Although this feeding sequence does exist, Bain and Sekerak (1978) questioned whether it was as simple as other workers have indicated, as they could find very little activity along these lines by direct underwater observation. However, as they point out, the vastness of the under-ice surface (13 million km^2) ensures considerable total

production even if only very sparsely inhabited. Bain and Sekerak (1978) believe that the most probable hypothesis with respect to Arctic cod distribution is that "low densities are the normal distribution pattern of this species under the ice and continues for an unknown period after spawning and prior to any major feeding and/or spawning migrations."

There is, however, no doubt that Arctic cod is also associated with the benthic biota, often in near-shore environments (Nikolski and Radakov 1968; Bain and Sekerak 1978) and frequently in great abundance (Craig and Haldorson 1980; Craig et al. 1982). Equally important for this species is the ice-edge that forms along the edges of the melting fast-ice in spring.

Spawning and Juvenile Stages

Bain and Sekerak (1978) found aggregations of Arctic cod in Allen Bay, Cornwallis Island, in the late summer and fall that they believed might be analogous with the "pre-spawning migration into warm, shallow waters" reported by Hognestad (1968). According to Ponomarenko (1967) gonad development begins at this time of the year in preparation for spawning which begins in November and continues through until March. Bain and Sekerak (1978) found large schools in September in the ice-free waters of Wellington Channel but they showed no sign of maturation. They could collect no Arctic cod over one year of age in pelagic waters.

Eggs and larvae appear to be planktonic in waters of 0 - 5°C. The only observations on spawning Arctic cod have been made by Russian scientists; spawning congregations have been seen in the vicinity of Wrangel Island (80°04' - 81°21'N) that subsequently move towards Bering Strait (Ponomarenko 1967; Andriyashev et al. 1980) (Fig. 1). Spawning has been observed to take place from December to March in this area. Other spawning sites have been

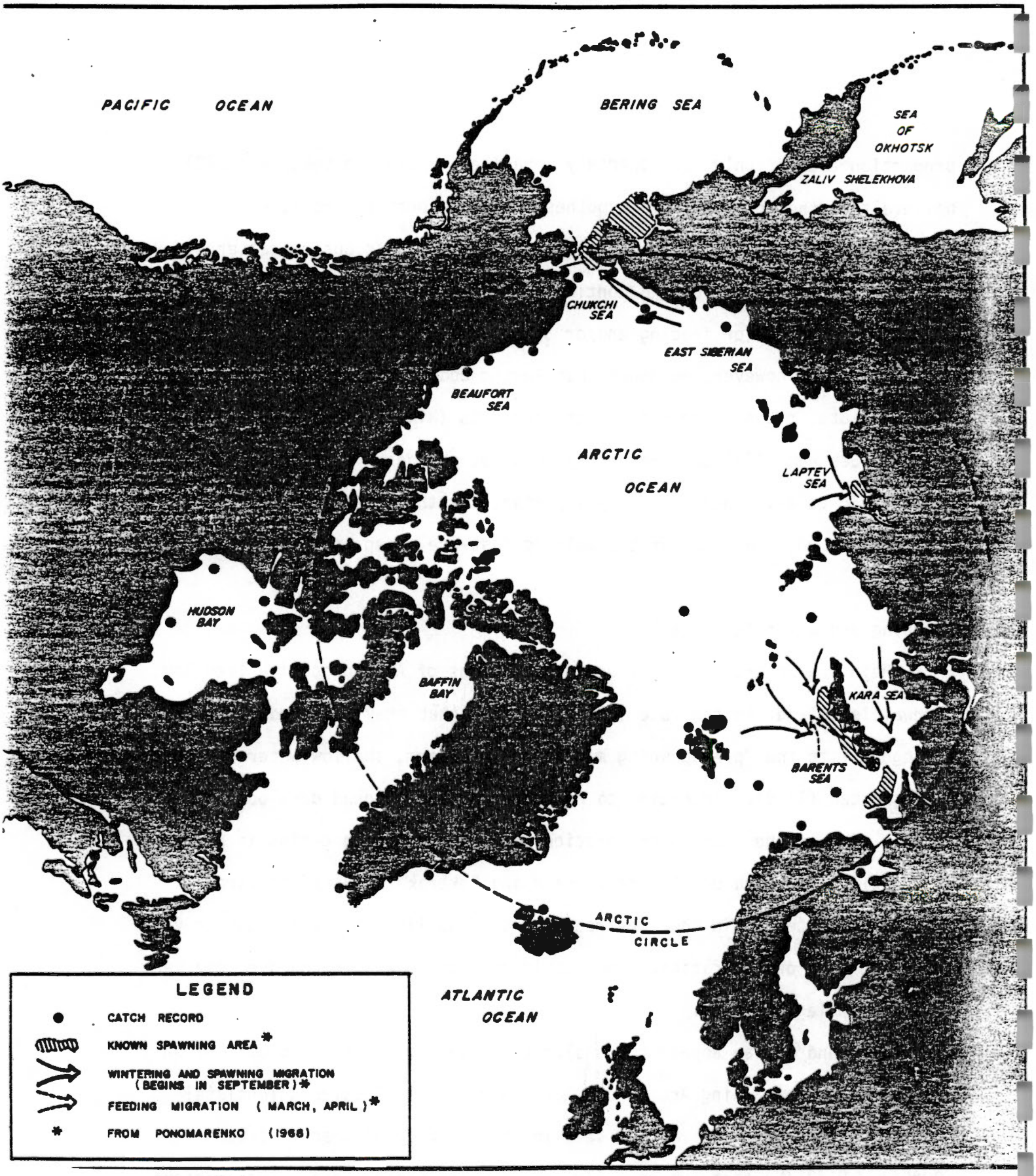


FIGURE 1. Map of the Arctic Region illustrating catch records, known spawning grounds, general migratory routes and circumpolar distribution of Arctic cod. (From Bain and Sekerak 1978).

located in the Laptev Sea and along the coast of Novya Zemlya, where spawing may start as early as November.

Spawning in the Canadian Arctic probably occurs at about the same time as that observed in USSR waters and is certainly widespread since larvae have been collected in spring over a wide geographical area. One possible site has been designated by Bain and Sekerak (1978) at the north end of Wellington Channel in the vicinity of the Sverdrup Channel, Queens Channel or Penny Strait, as larvae have been observed in early spring in the southern part of Wellington Channel in the southerly drift between Cornwallis and Devon Islands.

In Lancaster Sound and western Baffin Bay 86 percent of the ichthyoplankton consisted of young-of-the-year Arctic cod (Sekerak 1982). In the Chukchi Sea, Quast (1974) found increased concentration of young-of-the-year down to a depth of 40 - 50 m. Similarly Hunter (1979) found that juvenile Arctic cod was the most abundant planktonic species in the Amundsen Gulf region. Between June and mid-August young-of-the-year cod were most abundant between 10 and 20 m, density decreasing with increasing depth; they were rare or absent in the surface waters and after mid-August densities declined at all depths sampled; no specimens were taken at any time at depths below 250 m in the Beaufort Sea; Hunter (1979) also showed that juveniles decline in abundance from 10 m down to a depth of 125 m. Fry have also been taken from Creswell Bay, Somerset Island, Assistance Bay, Cornwallis Island and young-of-the-year have been captured in Simpson Lagoon (Frost et al. 1978).

Adult distribution

Cod older than one year appear to be common along the ice-edge and in the bays in summer and fall (Bain and Sekerak 1978); prior to July 17, 1976, only young-of-the-year (planktonic) and one-y-olds (in the benthos) could be found. After July 17 there was a strong influx of older fish, but these left the bays before the end of September. In Allen Bay schools of 3 - 600 were found in pools and tide cracks.

In Simpson Lagoon, Alaska, massive schools of Arctic cod occur on a somewhat erratic basis from year to year (Craig et al. 1982). In mid-August 1978, Bain and Haldorson (1979) reported catching 124,000 specimens in fyke nets set along the shore, but daily catches were erratic and no directional component to their movement could be determined. A run in the same year was detected further along the Alaskan Coast. Bendock (1977) noted that Arctic cod were common in Prudhoe Bay in 1975 and 1976. As in the eastern Arctic, few cod were caught in the early part of the open water season in Simpson Lagoon, but were abundant in August and September. This appears to be a regular characteristic of the species.

Lear (1979), documenting the catches of exploration cruises of the m.v. A.T. Cameron and Gadus Atlantica, showed that great concentrations of Arctic cod occur at different localities in different years. The greatest abundance was found in depths between 100 and 150 m. These depths have never been explored in the High Arctic owing to the difficulties of operating trawlers in this region.

During early summer, adults appear to be strongly associated with the edge of the fast ice, particularly in the region of Barrow Strait and Lancaster Sound. At this time they are heavily preyed upon by sea birds and marine mammals. Later in the year they appear in large numbers inshore,

particularly in leads and tide cracks beneath the fast ice of the bays. In Creswell Bay no Arctic cod were found in the stomachs of Arctic charr between the middle of June and the middle of August (Johnson 1980; Sekerak et al. 1976). All the charr taken in gillnets were from depths of less than 25 m. In the later part of the season, during the upstream migration, Arctic charr had been feeding heavily on Arctic cod between 150 - 200 mm in length (deMarch et al. 1978). It is therefore presumed that the older fish remain in deeper waters until the later part of the open water season.

Concentrations of Arctic cod were found in the Beaufort and Chuckchi seas late in the summer by Frost et al. (1978) and they also noted that the cod in the Simpson Lagoon were larger for their age than those in the offshore waters. Arctic cod was also collected from the bottom of Resolute Bay in very early July (Bain et al. 1977), Brentford Bay, Boothia Peninsula, in late May, and from Allen Bay in mid-July (Bain et al. 1977), Brentford Bay, Boothia Peninsula, in late May, and from Allen Bay in mid-July (Bain and Sekerak 1978).

Adult cod have an estimated life-span of 6 y, but the majority appear to be 3-y-olds. The size at first maturity is about 160 mm. Off Labrador, Lear (1979) found a considerable variation in size from locality to locality and from year to year, with the size at peak abundance varying between 70 and 280 mm and a maximum size of 350 mm.

Feeding relationships

Information on the feeding of Arctic cod confirms its central role in the energy flow of the Arctic marine ecosystem; it is probably the major consumer at the tertiary trophic level (Quast 1974). Ponomarenko (1967) found that the larvae and fry feed successively on copepod eggs, nauplii, and

copepodites. Older fish in the Barents Sea, according to Hognestad (1968) feed mainly on Calanus finmarchinus; Andriyashev et al. (1980) list the calanoid copepods Calanus hyperboreus, C. galcialis, Pareuchaeta glacialis, Chiridius galacialis, Pseudocalanus major and particularly Metridia longa, as being the major food items from one group of 30 Arctic cod examined. In addition he found the Hyperiid amphipod Parathemisto libellula and the pelagic amphipods Langunocalanus wilkitzskii, Apherusa galacialis, Pseudalibrotus nanseni and juvenile stages of Euphausiacea, Chaetognatha and Oikopleura.

THE PREDATORS OF ARCTIC COD

Lilly (1978) examined the diet of Arctic cod from the Labrador Sea (Table 1), concluding that it was very similar to that of capelin, Mallotus villosus; however competition for food, he considered, is not likely to be severe as Arctic cod tend to live in colder water. Lilly points out that Arctic cod do not appear to be feeding directly off the bottom as polychaetes seldom occur in stomach contents and benthic molluscs and echinoderms are completely absent.

In the upper levels of the food web Arctic cod are extremely important, forming the basic diet of many species of bird, fish and sea mammal. In spring, as the ice begins to melt, cod appear to congregate at the edge of the shore-fast ice in large numbers; this has been observed in some detail in Lancaster Sound and Barrow Strait where over one million sea birds spend the summer (Bradstreet 1977; Nettleship and Gaston 1977; Bradstreet and Finley 1977; Gaston and Nettleship 1981). These birds are mainly of five species: northern fulmar, Fulmarus glacialis, glaucus gull, Larus hyperboreus, black-legged kittiwake, Rissa tridactyla, thick-billed murre, Uria lomvia, and black guillemot, Cepphus grylle.

TABLE 1. The food of Arctic cod, Boreogadus saida, at various locations in the Arctic and northern Atlantic The size or age of the fish is given whenever reported. (From Lilley 1980).

LOCATION	SIZE OR AGE	FOOD	AUTHORITY
Northeast Greenland	5-15 cm	mainly mysids; also copepods (Calanus) and an amphipod	Johansen (1912).
Barents Sea		Euphausiidae and Calanidae (C. finmarchicus); also amphipods, Crangonidae, small fish.	Thielemann (1922), quoted by Svetovidov (1948).
Barents Sea	adult	mainly Calanus finmarchicus; also Larvacea (Appendicularia) and Hyperiidae.	Hognestad (1968)
Barents Sea, Kara Sea	larvae and fry	mainly eggs, nauplii and copepodites of Copepoda; also larval or young Pteropoda, Bivalvia, Larvacea, Euphausiacea, Decapoda (Crustacea), Amphipoda	Ponomarenko (1967)
Laptev Sea		Copepoda, various species of fish	Nikolsky & Radakov (1968)
Amundsen Gulf	larvae and 0-group	Calanoida, Larvacea, Cyclopoida, invertebrate eggs, Chaetognatha, Hyperiidae, Euphausiidae, Cirripedia	J.G. Hunter (pers. comm.).
Dease Strait		Amphipoda, Calanoida, Mysidacea, larval fish	Tyler (1979)
Cornwallis Island nearshore ice cracks	1-5 year-olds	Harpacticoida, epibenthic Amphipoda; also Calanoida, Hyperiidae, Mysidacea	Bain and Sekerak (1978)
open water and under ice		Hyperiidae, Calanoida; also epibenthic Amphipoda, Pteropoda, Pisces, Mysidacea. (In both areas, cod < 10 cm ate mainly copepods; those greater than 10 cm ate mainly amphipods and the other largely organisms).	
Northern Baffin Island		Copepoda, pelagic Amphipoda (Lysianassidae) Decapoda (Crustacea) (Copepods more prevalent in fish less than 10 cm).	Bohn & McElroy (1976)
Hudson Strait	28-31 cm	Amphipoda, Mysidacea, Euphausiacea	Vladykov (1933)
Labrador	4-26 cm	Copepoda, Hyperiidea; also Euphausiacea Chaetognatha, 0-group B. saida. (Copepods more prevalent in small fish; hyperiids more prevalent in larger fish).	present study
Unspecified		phytoplankton, zooplankton, bottom crustaceans eggs of fish and shrimp, fish fry.	Andriyashev (1954)

Intensive studies on the feeding of the thick-billed murre of Prince Leopold Island in Lancaster Sound (Gaston and Nettleship 1981; Bradstreet 1976, 1977) has provided considerable information on the importance of Arctic cod in these waters. Birds start feeding on cod in May and June, at this time they are of rather a small size (80 - 100 mm in length), but as the season progresses and the rearing of chicks starts, the mean size increases to about 150 mm. These fish are 2-3 year-olds and are taken mostly at the ice-edge; as the season progresses further into August the size of the cod captured again appears to decrease in size to a mean of 100 - 130 mm. From these data it is presumed that the Arctic cod are inhabiting the upper layers as they are readily accessible to the feeding birds, although later in the open water season Bain and Sekerak (1978), trawling in this area, could catch only young-of-the-year.

Many marine mammals also depend heavily on Arctic cod; they have been reported from seals, walrus, beluga, or white whale, and narwhal (Andriyashev 1954; Mansfield et al. 1975; Finely and Gibb 1982).

Arctic cod are exploited by Arctic charr when their ranges overlap, but this only appears to occur comparatively infrequently. In other respects charr and cod have very similar diets, representing to a large extent, whatever resources may be available in the sub-littoral regions: mysids, amphipods and other small invertebrates.

In general Arctic cod is closely associated with ice and cold water, usually occurring in water temperatures below 0°C; Arctic cod larvae and fry are found in warmer waters (4 - 7°C) but larger fish are always encountered in water below 3°C (Olsen 1962, cited by Lear 1979).

Arctic cod is probably the prime fisheries resource in the Arctic Ocean although never harvested directly by man. The general pattern of energy flow is given in Figure 2.

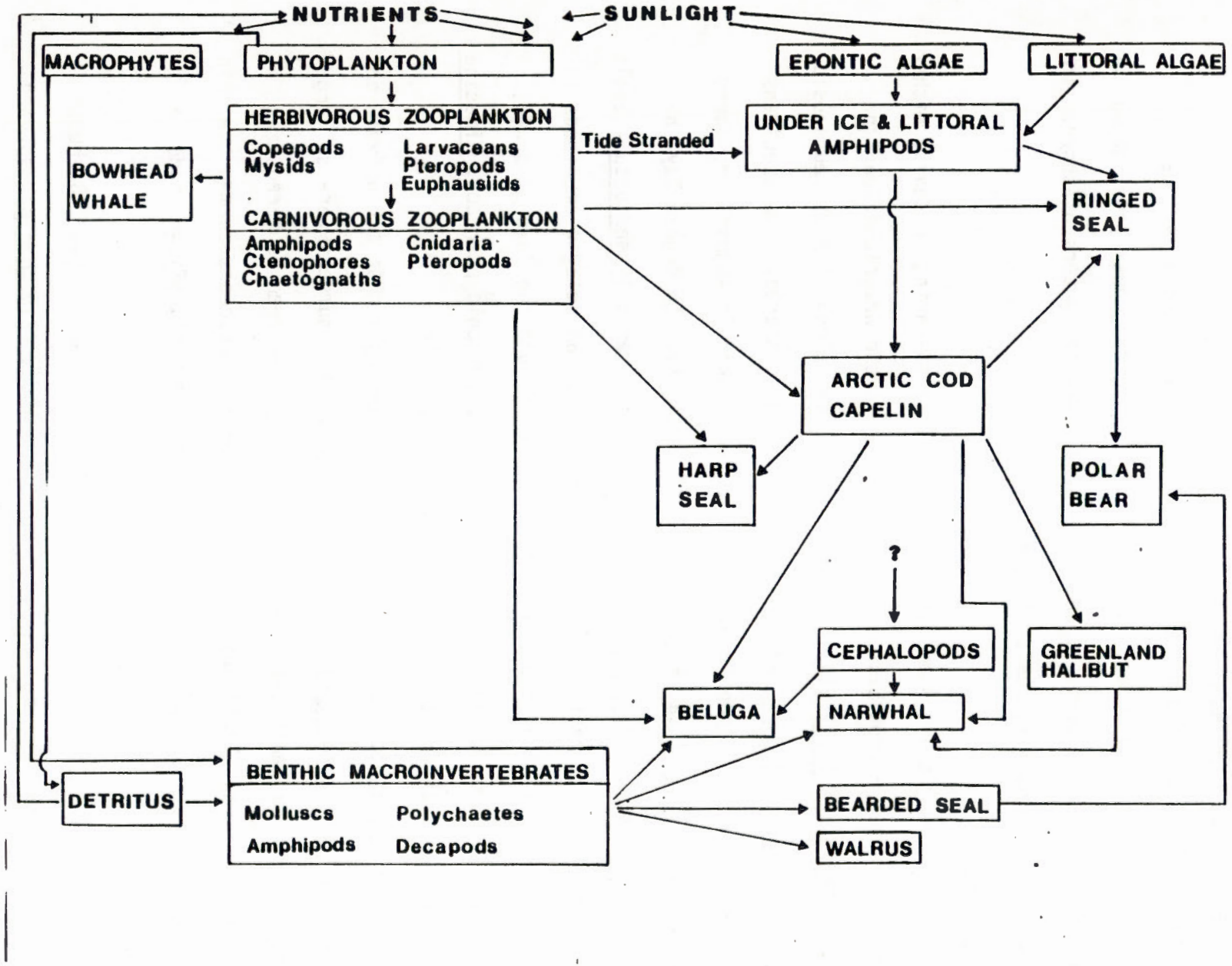


FIGURE 2. Summary of major energy flows in Arctic marine waters. (From Davis (et al. 1980).

Marine mammals and Arctic cod

The general relationship between marine mammals and the various organisms on which they depend is given in Figure 3; the upper panel shows the situation in inshore waters and the lower panel that the waters offshore. In both cases Arctic cod figures prominently.

i) Ringed seals

Dunbar (1949) could find little evidence of fish-eating in seals, either in the literature or from his own observations: in the Greenland Sea, the amphipods Thermisto libellula, and Gammarus locusta, along with the euphausid Meganycitiphanes norvegica were most frequently encountered. Two specimens from Lake Harbour and Clyde Inlet, Baffin Island, taken in August were found to be eating Mysis oculata (Fig. 4) almost exclusively. In Ungava Bay the main diet appeared to be Mysis and Euphausids of the genus Thysanoessa. Seals in the east Greenland region, shot in the drift ice, had pelagic amphipods in their stomachs as well as the otoliths of Arctic cod and the jaws of squid, mysids and other crustaceans. Occasionally, the planktonic pteropod, Limacina is consumed, in addition to small sculpins and seasnails.

In Foxe Basin, McLaren (1958) found seals feeding almost exclusively on the amphipod Apherusa glacialis. McLaren suggests that numbers were so large and the amphipod so small that they could scarcely have been captured individually. Smith (1973) stated that planktonic crustaceans formed the main summer diet of seals but small Arctic cod was the most significant food in winter.

Finley (1978) recorded that ringed seals in Freeman's cover, Bathurst Island, during June, consumed mainly mysids, amphipods (Parathemisto sp. and Onisimus sp.) and Arctic cod, and in offshore areas of Barrow Strait, in mid-winter, they were feeding heavily on Parathemisto libellula. In Alaska

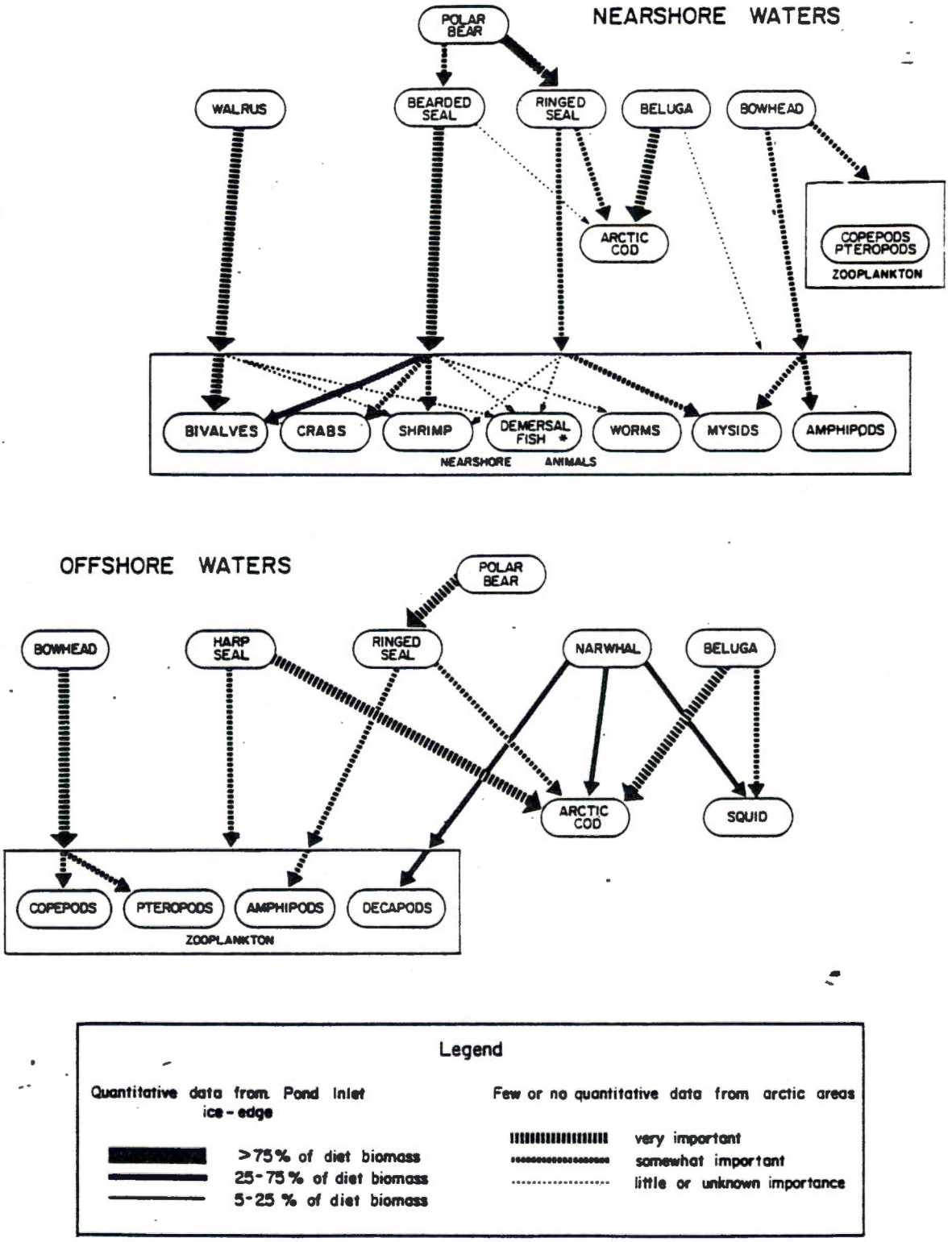
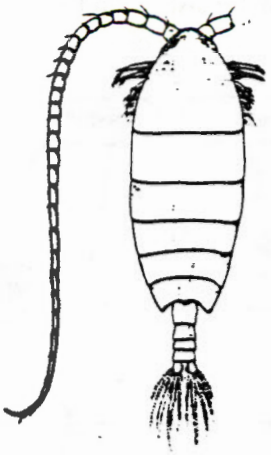
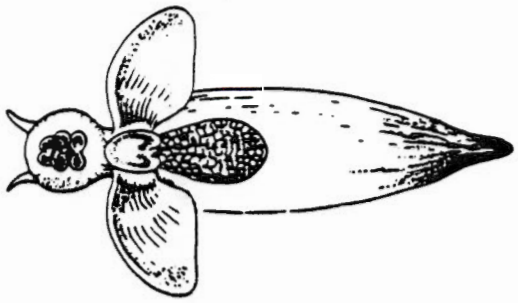


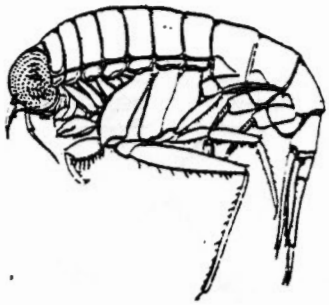
FIGURE 3. Suspected major trophic relationships of Marine Mammals in the Canadian Arctic. (From Davis et al. 1980).



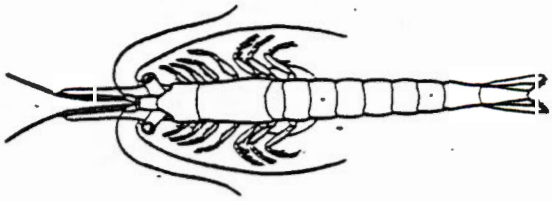
Calanus hyperboreus
(Copepod)
3-8 mm



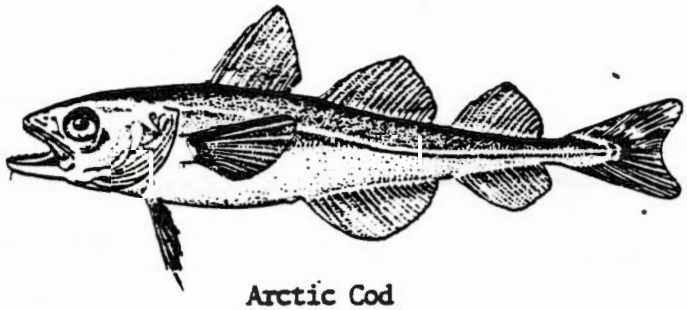
Clione limacina
(Pteropod)
5-10 mm



Parathemisto libellula
(Amphipod)
15-35 mm



Mysis oculata
(Mysid)
12-30 mm



Arctic Cod
50-175 mm

FIGURE 4. Some of the animals important in Arctic marine food chains. (From Davis *et al.* 1980).

the winter diet was found to be mostly Arctic cod with some sculpins, but in spring invertebrates, mainly shrimps, crabs and amphipods, were the dominant items (Davis et al. 1980).

In a detailed review of the energetics of the Alaskan ringed seal Lowery et al. (1970) found foods to be of three main types: 1) Fishes of the cod family (saffron cod, Eleginus gracilis, and Arctic cod), 2) Mysis, the shrimps Pandalus spp., Eualus spp. Lebbeus spp. and Crangon sp., and gammariid amphipods, and 3) Parathemisto libellula and Thysanoessa spp. From the USSR to Greenland, Arctic cod is considered to be the most important food between November and April; mostly small cod (7 - 12 cm) are consumed, irrespective of the age of the seal or the area of collection.

In studies at the ice-edge in Pond Inlet, northern Baffin Island, Bradstreet and Cross (1982) recorded that Arctic cod otoliths were found in the faeces of 92 percent of the samples examined from adult ringed seals; Arctic cod comprised 92 percent of the total food items but formed 99.9 percent on dry weight basis. The diet of juvenile seals shot at the ice-edge was dominated by amphipods (96 percent by number and 38 by dry weight); cod comprised 2.6 percent by number but 62 percent by dry weight, both Boreogadus saida and Arctogadus borealis were included; most of the amphipods were of the species Parathemisto. Differences in the diet of seals were also found between inshore and offshore locations but no general relationships could be established with respect to the feeding of juveniles and adults, inshore or offshore.

Most feeding in ringed seals appears to be in water depths of less than 100 m.

Daily intake of 1600 Kcal is considered by Lowry et al. (1980a) to be the normal food requirement of an adult ringed seal; this nutritional

requirement can only be met by no less than 5 "stomachfulls" each day when feeding on Arctic cod; when feeding on crustaceans up to 10 stomachfulls daily is required.

ii) Bearded seal

Bearded seals are primarily benthic feeders so that their distribution is largely confined to waters less than 100 m deep (Vibe 1950; Burns 1967; Burns and Frost 1979); in the Beaufort Sea, Stirling et al. (1977) believed that only waters less than 75 m deep were occupied. During surveys in the North Water, a number of bearded seals observed by Finley and Renaud (1980) were hauled out on the ice in an area where the water is over 500 m deep. Vibe (1950) reported that bearded seals, normally omniverous benthic feeders, turn almost exclusively to Arctic cod when the water depth exceeds 100 m; the implication being that water over 100 m deep exceeds their diving capability.

The major invertebrate foods of bearded seal are mollusks, particularly the gastropod Buccinum, followed by bivalves and cephalopods (squids and octopus); crabs and shrimps are also found as well as amphipods, isopods, holothurians (sea-cucumbers), echiurids, sponges, priapulids and polychaetes (Davis et al. 1980). Chapskii (1938) believed that Arctic cod are paricularly important in this species and Burns (1967) concluded that Arctic cod assumed greater importance the further north the animal was living. Lowry et al. (1980b) assumed that adult and adolescent bearded seals segregate during feeding as the adolescents had stomach contents made up of more pelagic organisms than was the case with the adults. Other items listed by Davis et al. (1980) are several benthic fishes: sculpins, halibut, eelpouts, lumpsuckers and seasnails. In Hudson Bay, Smith (1981) documented stomach contents: decapoda (49%), pelecypoda (34%), gasteropoda (7%) and polychaeta (5%). The most frequent fish species was Arctic cod but a number of other

fish species were found, mostly characteristic of inshore waters. In winter bearded seals were found more off-shore and this it was suggested by Stirling and Archibald (1977) may indicate a change to fish feeding.

iii) Walrus

The distribution of the Atlantic walrus has contracted greaty within recent historical times; in the 17th century large herds were frequent in the Gulf of St. Lawrence, around Sable Island and along the coast of Maine (Dunbar 1949, 1956, 1973; Reeves 1978). A similar contraction has been recorded for the Pacific sub-species, but neither of these contractions can be ascribed to climatic change (Fay 1957; Dunbar 1956). The implication is that the range contraction is a result of human perturbation either through hunting or environmental disturbance.

At the present time only the Atlantic walrus is found in Canada; it is confined to the eastern Arctic, ranging from Smith Sound to the southern end of James Bay. There is apparently little or no interchange between the Atlantic and Pacific sub-species, as the Pacific walrus rarely penetrates to the Beaufort Sea and the Atlantic stocks are seldom seen in the central Arctic.

The feeding of the Atlantic walrus has been dealt with in considerable detail by Vibe (1950) and Mansfield (1958) and the Pacific sub-species by Fay et al. (1977). By examination of the wear on tusk surfaces Mansfield concluded that the walrus 'forages in sand and mud by standing on its head on the bottom and rotating its tusks from side to side in the substrate,' presumably nipping off the feet or siphons of the molluscs as they are encountered. Vibe found that in waters less than 40 m deep off northwest Greenland, walruses feed primarily on the feet of cockles, *Cardium* spp., and in deeper water on the siphons of the bivalves *Mya* and *Saxicava*. Other

bivalves, particularly Macoma and Astarte, were recorded as well as cephalopods, priapulids and holothurians. In a detailed study of Canadian walrus diets Mansfield concluded that the young start feeding in the adult manner at the age of about 3 y; up to this age milk has been found in the stomach and it is about this time that signs of wear first appear on the distal surfaces of the tusks. Vibe has shown that, in Greenland Mya truncata, Cardium spp., Saxicava arctica, and Astarte borealis were the species most frequently found, but again stomachs contained only the feet or siphons of the animals consumed; the two species of Cardium most frequently eaten also occur in water depths between 15 - 35 mm, whilst Mya and Saxicava are also both abundant in relatively shallow water. Vibe concluded that walrus select the larger Cardium, when available, in order to maximize their foraging strategy.

Somewhat similar results were derived from a study of the feeding habits of the Pacific walrus in the Bering Sea (Fay et al. 1977). Over 60 genera of benthic organism were ecountered but bivalve molluscs were most important particularly: Mya, Spisula, Serripes, Clinocardium and Hitella.

Fish, apparently, only form a very small fraction of the walrus diet. Mansfield found otoliths in one out of 19 stomachs examined. Records from the USSR (Mansfield 1958; Krylov 1971) indicate that walrus may occasionally feed extensively on Arctic cod. It also appears that walrus may attack and consume seals and in one case it is recorded that a walrus killed and devoured a 4 m narwhal (Dunbar 1949).

iv) Beluga

Beluga are restricted to the eastern and western Arctic, being rare or non-existent in the central region even in summer. In the eastern Arctic, the summer distribution of beluga is quite widespread with concentrations in Lancaster Sound, Jones Sound and even into Kane Basin and Prince Regent Inlet down to Bellot strait.

In the western Arctic movement has been more precisely documented as the pattern is much simpler (Fraker 1979). White whales migrate into the Beaufort Sea from their wintering grounds in the pack ice of the Bering Sea, passing along the Alaskan Coast, sometime between the last weeks in April and the first weeks in June. They then move north-east following leads in the ice developed under the influence of the Beaufort Gyre, then south along the coast of Banks Island, until they reach the large polynya off Cape Bathurst in the Amundsen Gulf in May-June, approximately 1 - 2 months ahead of the general break-up. The beluga remain in the Amundsen Gulf for a considerable time after there is access along the coast to Mackenzie Bay, then passing along the shore line to the Mackenzie Delta they remain there for some time before returning along the Alaskan coast to their winter habitat.

Beluga feed on a wide variety of fish and invertebrates both benthic and pelagic (Kleinenberg et al. 1964) but most authors are agreed that Arctic cod is the food of prime importance (Vibe 1950; Kleinenberg et al. 1964; Medevdev 1971; Finley 1976). Greenland halibut, Reinhardtius hippoglosoides, is also listed as being important in Greenland waters (Vibe 1950); Doan and Douglas (1953) and Sergeant (1973) found capelin, Mallotus villosus, to be important for the whales of the west coast of Hudson Bay; other items recorded were decapod crustaceans and squid.

Captive beluga were estimated to consume about 5 percent of their body weight in food, each day (Sergeant 1969).

v) Narwhal

Narwhal, a relative of the beluga, readily distinguished by the great development of a spirally twisted incisor tooth in males, is again, in Canada, confined to the eastern Arctic; to some extent, its summer distribution

overlaps, that of the white whale; both species occur in Kane Basin, Lancaster Sound, Smith and Jones sounds, Prince Regent Inlet and Peel Sound. In general, however, narwhal prefer the deep cold waters of the fiords of northern Baffin Island, Lancaster and Jones sounds (Mansfield 1975). Herds of narwhal have been observed to pass down Prince Regent Inlet to Bellot Strait, passing through this waterway into the seas around Prince of Wales Island (Finley and Johnson 1977; Sergeant and Hay 1978).

Recent studies (McLaren and Davis 1981) have indicated the very close association of narwhal with heavy ice cover in their winter range. In Davis Strait, narwhal were found exclusively in waters with over 50% ice-cover with densities greatest where the ice-cover was 91 - 99 percent; over 85 percent of the animals recorded on transect, were in this high ice-cover category.

The diet of narwhal is incompletely known, but most authors list Arctic cod as being the most significant item. Mansfield et al. (1975), working in northern Baffin Island found that most of the stomachs that they examined were empty: out of 62, only 10 contained food, consisting mainly of Arctic cod and squid. Vibe (1950) considered Arctic cod so important in the diet that he attempted to relate narwhal movement to Arctic cod distribution. Davis et al. (1980) reporting on extensive studies by K. Hay (Arctic Biological Station), H. Silverman (McGill University) and K. Finley (LGL Ltd.) confirmed the importance of this species; in addition they found small quantities of decapod crustaeans, squid and Greenland halibut. At Pond Inlet, Finely and Gibb (1982) found mostly Arctic cod and Greenland halibut in narwhal stomachs; the Greenland halibut were assumed to have been captured in water depths of 500 m or more. In Russian waters, Davis et al. (1980) quoting Tomilin (1957), state that squid are the most significant dietary item, with fish and crustaceans of secondary importance.

There is no information of the food habits of narwhal in winter but large accumulations of squid beaks in narwhal stomachs in spring are very suggestive (Finley and Gibb 1982).

Intervention on Government Management

Government of Canada | Gouvernement du Canada
Fisheries and Oceans | Pêches et Océans

Your file Votre référence

Our file Notre référence

29 November 1983

Mr. D. W. I. Marshall
Executive Secretary
Beaufort Sea Environmental Assessment Panel
Federal Environmental Assessment & Review Office
700 - 789 West Pender Street
VANCOUVER, B.C.
V6C 1H2

Dear Mr. Marshall:

As promised during the Inuvik session of the Beaufort Sea hearings, I have enclosed a copy of the Department of Fisheries and Oceans intervention on Government Management. I trust it will be of use to the Panel despite not having been formally presented.

Sincerely,

F. J. O. Josephson
Director
Arctic Operations
Western Region

/sa

cc: [redacted]
J. N. Stein

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DEPARTMENT OF FISHERIES AND OCEANS

INTERVENTION
ON GOVERNMENT MANAGEMENT
TO THE
BEAUFORT SEA
ENVIRONMENTAL ASSESSMENT PANEL

INUVIK, N.W.T.

Presented by

F.J.O. Josephson

Director, Arctic Operations

Western Region

Mr. Chairman,

I would like to summarize for you the Department of Fisheries and Oceans' responsibilities and programs which are relevant to the Beaufort Sea Hydrocarbon Production Proposal.

The Department's mandate covers matters related to:

- sea coast and inland fisheries (including marine mammals),
- fishing and recreational harbours,
- hydrography and marine sciences, and
- the coordination of the policies and programs of the Government of Canada respecting oceans.

The specific legislative basis for the management and protection of fish and marine mammals is the Fisheries Act which contains provisions to control the harvesting of various species and to protect them and their habitats from the effects of human disturbances. In fulfilling this mandate DFO undertakes studies on the distribution and abundance of fisheries resources, the identification of various habitats, and the understanding of biological and ecological processes. The results of such investigations are used to formulate requirements for the protection and sustained usage of fisheries resources. In addition the effects of industrial developments are monitored, and the Fisheries Act and its regulations are enforced.

For ocean sciences, the Department acts primarily as a service and advisory agency applying oceanographic knowledge, data and information to the solution of a variety of marine problems including those arising from the exploitation, regulation and management of Arctic hydrocarbon resources and shipping. In this context DFO undertakes long-term and often large-scale process-oriented research. A major function is the provision of ocean

information and advisory services to the regulatory agencies. As well, the Department has an important support function with respect to environmental emergencies.

The Department has the national responsibility for the provision of hydrographic charts and related nautical productions. The Charts and Publications Regulations of the Canada Shipping Act require that ships navigating in Canadian waters have the latest edition of appropriate hydrographic charts. Adequate chart coverage is a prerequisite to the provision of navigational aid systems by Transport Canada. It has the responsibility for the publication of Tide and Current Tables and of Sailing Directions.

In addition to using directly the powers of the Fisheries Act and its other statutes to manage and protect fisheries resources and their habitats, the Department achieves its objectives through a variety of other mechanisms. In relation to the Beaufort Sea Hydrocarbon Production Proposal, DFO participates with other departments and industry on committees, boards and panels which deal with subjects such as policy for northern development, stipulations for specific projects, land use planning, marine transportation and environmental reviews.

DFO has conducted major programs in the Canadian Arctic for many years. The principal priorities are the gathering of biological information upon which to base resource management requirements and stipulations for the protection of habitat especially in the Arctic marine environment; oceanographic research in relation to industrial proposals; and the provision of nautical charts in support of Arctic shipping.

Many of DFO's Arctic programs are designed specifically to provide the information required by government and industry for making decisions related to hydrocarbon development and transportation.

The present capability of DFO to respond to hydrocarbon issues is a reflection of departmental decisions to support Arctic programs by reallocating internal resources. It is estimated that about 85 person-years and $10 million are currently spent annually on programs which have a direct application to the Beaufort Sea Hydrocarbon Production Proposal.

This does not include person-years and costs devoted to policy development, information analysis and participation on the numerous committees and task forces relevant to Arctic hydrocarbon development. Nor does it include substantial support costs (person-years and dollars) associated with operating in the north, such as the cost of the operation of vessels for hydrographic surveys and oceanograpic research. Also it does not include the costs of certain other Arctic oriented research, such as the Arctic Basin and Labrador Sea studies. When the cost of these related programs is included, the DFO Arctic budget is in excess of $20 million.

I would like to present a brief synopsis of the on-going programs most relevant to Beaufort Sea hydrocarbon development and transportation.

The Department manages and protects fish, shellfish and marine mammal stocks in the Arctic. Most of these stocks do not have high profile economic payoffs when compared to those which can be developed in southern coastal areas. However, they do support subsistence, commercial and recreational fisheries which are of extreme importance when considered at the local community level, not just in economic terms but in cultural and nutritional terms as well. Consequently the Department conducts several programs designed to protect and manage these resources and their habitats from the effects of man-made disturbances. This includes identifying critical habitats and the

spatial and temporal distribution of fish and marine mammals, and subsequently predicting, monitoring and, if possible, mitigating the effects of various human activities. In this context the major emphasis is on projects in the Beaufort Sea area, and the coastal and freshwater fish and marine mammal resources in that area. Specific projects include i) assessment of fish habitat along the Beaufort Sea coast from Richards Island to Liverpool Bay, along the Yukon coast, and in Tuktoyaktuk Harbour and its freshwater drainages, ii) locating spawning areas of anadromous whitefishes in the Mackenzie Delta and Mackenzie River, iii) mapping marine resources in the Beaufort Sea that may be affected by Beaufort Sea development and the sensitivity and vulnerability of habitats, iv) assessment of the commercial fishery potential of whitefish and pacific herring in the Mackenzie Delta and certain inshore areas, v) monitoring the beluga harvest in the Mackenzie Delta, and vi) assessment of habitat and fish resources at King Point.

Research is conducted to develop and provide scientific expertise and knowledge of biological processes in the Arctic in support of the Department's responsibility to manage fisheries resources and their habitats. Research is being undertaken on ecology and energy flow in selected freshwater and marine ecosystems where important fisheries resources (such as Arctic charr and beluga) occur, on metal levels in marine mammals and ecosystems, on the dynamics and effects of Beaufort Sea crude oil components, and on population ecology, behaviour and stock identification of marine mammals throughout the Arctic, and on monitoring seal pupping in relation to ice cover.

Arctic oceanography conducted by DFO in the Arctic Archipelago relies to a great extent upon over-the-ice tracked vehicles, helicopter and aircraft support. In eastern Arctic waters, two large ice-strengthened vessels are

used for ship-based research. Throughout the Arctic, limited investigations also are undertaken on an opportunity basis utilizing vessels that have other primary tasks, such as hydrographic surveys and icebreaking. In recent years, increasing collaboration with industry has occurred.

Understanding Arctic marine processes, which influence ocean circulation, heat exchange, and the dynamics of ice formation and movement,is essential for resource management and for DFO input into various offshore development and shipping proposals. The general oceanographic regime plays an essential role in determining the distribution of fish, marine mammals and other wildlife; annual productivity and year-to-year variability. Ocean and ice dynamics information contributes to oil spill trajectory modelling and contingency planning. It is also important in the selection of optimum shipping routes and the identification of environmentally sensitive areas. Physical oceanographic information is essential for determining design criteria for ships and offshore production structures, and in predicting ice conditions in support of shipping.

The emphasis of Arctic chemical oceanographic research has been to establish baseline levels of contaminants prior to major industrial development and to identify various water masses. After preliminary research during the Beaufort Sea Project, a long-term program was initiated in the late 1970s to provide chemical information for Davis Strait, Baffin Bay, Lancaster Sound, Jones Sound and Smith Sound. Research has continued on the natural oil seep north-east of Baffin Island and on various chemical processes in Baffin Bay.

Knowledge and understanding of marine ecosytem processes is fundamental to environmental impact assessment, whether by government or by industry. The greatest proportion of the effort has been directed at attacking the most

neglected areas of knowledge, such as the physiology and ecology of Arctic organisms in general, rather than concentrating on site-specific studies in places judged to be likely candidates for industrial development. The logistical constraints of ship-based operations have limited most Arctic marine ecology studies to the waters of the eastern Arctic and to the ice-free season. However, some biological work is conducted during the spring, in association with the physical oceanographic program in the Northwest Passage.

Hydrographic surveys are concentrated along the main tanker route eastward from the Beaufort Sea through the Northwest Passage. The corridor survey through the dangerous pingo area of the Beaufort Sea is considered the highest priority and will continue to completion.

The Department is active in the development of techniques and equipment for use in the Arctic. Such activities are a necessary adjunct to the Department's fundamental research and survey responsibilities, partly because the required equipment is not available in the market and also because it represents a concerted effort to support federal research and development policy and the National Energy Program.

DFO is responsible nationally for the management of oceanographic data. The Marine Environmental Data Service (MEDS) and other regional data centres archive ocean data and provide data products and services to clients in government, industry and the public sector. As well, ocean data are collected routinely from all offshore rigs under guidelines issued by the Canada Oil and Gas Lands Administration. MEDS is responsible for the management of such data, and DFO also is involved in the approval of proposed oceanographic programs by oil and gas operators.

In view of the imminent production of Arctic hydrocarbons and the associated year-round shipping through the Northwest Passage, data compilation

and appraisal activities have been accelerated for all available data in the relevant Arctic marine regions. These appraisals are being undertaken in anticipation of future requirements from regulatory agencies, the review of environmental impact assessments, and expected regional planning initatives. The first phase has included data for the Beaufort Sea (physical, chemical, benthos, plankton, fish and whales), the Northwest Passage (physical, chemical), the Queen Elizabeth Islands and Baffin Bay (physical). Secondary phases include the origin, distribution and fate of natural and industrial substances in the Beaufort Sea, oil spill trajectory analyses utilizing Beaufort Sea data, and an overview scenario of Beaufort Sea industrial activities.

The Department has obtained funds from the National Energy Program Research and Development Fund to develop i) marine mammal remote sensing techniques, ii) marine mammal underwater detection and census techniques, iii) methods to detect physiological response of marine mammals to oil, and iv) methods to detect heavy metals in Arctic marine mammals. [OSS Projects?]

The Department has also identified the following new or enhanced programs for funding by the Northern Oil and Gas Action Program: i) effects of vessel traffic and noise on Arctic Marine mammals, and ii) identification and characterization of critical Arctic marine and estuarine habitats and Western Arctic freshwater habitats. [OSS Projects?]

A more complete description of the Department's role in the Arctic was provided to the Panel in The Implications of the Beaufort Sea Hydrocarbon Production Proposal to the Department of Fisheries and Oceans.

I would be pleased to answer any queries.

Thank you.

Draft Tables on Management of Technical Issues

DEPARTMENT OF FISHERIES AND OCEANS

DRAFT TABLES ON MANAGEMENT OF TECHNICAL ISSUES

The following draft tables summarize activities associated with production and transportation of Beaufort Sea hydrocarbons, some sources of impact from these activities, safety considerations, the population or factor at risk and the ecological and social significance of that population or factor. For each activity, a number of methods are suggested for eliminating or minimizing (mitigating) impacts. Specific examples of these methods, their judged urgency, estimated completion time, and responsibility for each method are presented.

The list of mitigative measures is not intended to be comprehensive. Rather, it provides examples of the types of measures that can be taken to reduce or eliminate impacts. There are probably other methods which can and should be implemented. This is particularly true for cumulative and synergistic impacts which have not been addressed in the draft tables. Also, the Department recognizes that it is more appropriate for some items in the draft tables to be addressed by other government agencies.

The draft tables are preliminary and not exhaustive; they form a basis for discussion during joint consultations between government, industry and the public before specific developments are initiated. The Department of Fisheries and Oceans will reconsider these recommendations in the light of new information presented at these hearings. The draft tables will appear in final form in the Department's Position Statement.

LIST OF TABLES

1. Hazards to Offshore Exploration and Production Facilities (Mackenzie Shelf)
2. Hazards to Shipping (Mackenzie Shelf and Tanker Corridors)
3. Hazards to Coastal Support, Exploration and Production Facilities (Beaufort Sea)
4. Noise on the Mackenzie Shelf
5. Noise in the Northwest Passage
6. Icebreaking on the Mackenzie Shelf
7. Icebreaking in the Northwest Passage
8. Offshore Platforms and Terminals
9. Dredging on the Mackenzie Shelf
10. Oilspills on the Mackenzie Shelf
11. Oilspills in the the Northwest Passage
12. Fluid and Solid Wastes on the Mackenzie Shelf
13. Blasting - Mackenzie Valley / Delta
14. Granular Borrow - Mackenzie Valley / Delta
15. Stream and Channel Crossings - Mackenzie Valley / Delta
16. Accidental Oil Spills - Mackenzie Valley / Delta
17. Testing and Fluid Disposal - Mackenzie Valley / Delta
18. Permanent and Temporary Roads - Mackenzie Valley / Delta
19. Ancillary Facilities - Mackenzie Valley / Delta

Definitions and Assumptions:

Asmnt (Assessment): Scientific and technical review of issues concerning safety, environmental protection and renewable resource utilization associated with future hydrocarbon development.

Bas (Baseline Research): Improved scientific knowledge and understanding of biophysical processes and interactions relevant to regulatory and planning needs (e.g. evaluation of existing information, collection of new data).

BD (Before Development): Indicates action must be taken before a particular development activity is approved.

DD (During Development): Indicates action should be taken both during and before a particular approved development activity.

Dem (Demonstration Project): An early production research and development scheme or pilot project of limited scale, careful design and cautious implementation to determine the best or preferred technology or procedures for mitigating adverse impacts, while minimizing unacceptable (irreversible, serious accident) risks to life or threats to the environment (e.g. prototype artificial islands for drilling, experimental icebreaking at ice-edge).

Ecological Significance: Of known or suspected prominence within a region's ecosystem(s) or biotic community(ies).

Eng (Engineering): Research, design and construction of new techniques and components for exploration, production and transportation which increase environmental protection and human safety (e.g. modified propeller shroud) and the application of engineering principles of proven effectiveness.

Leg (Legislation): Both new and improved acts and codes to ensure environmental protection and safety.

Mon (Monitoring): Design and conduct of systematic and repetitive studies to detect changes in the environment and to judge the adequacy of the mitigative measures specified in regulations and approvals (e.g. routine chemical analysis of marine sediments in industrial harbours and shorebases).

Ops (Operations): New or improved strategies for carrying out hydrocarbon development activities (e.g. contingency plans for emergencies, restricted access of company personnel).

Pln (Regional Planning): Design and implementation of regional plans for resource and land uses.

Population: Group of animals of one species found within a region.

Reg (Regulation): Compliance, surveillance and enforcement of existing regulations (e.g. Fisheries Act, Arctic Waters Pollution Prevention Act) concerning environmental protection and safety.

Region: An arbitrary area of the Canadian Arctic used for general purposes of discussion and assessment in this FEARO review.

Social Significance: Present or future importance of a population or species to a region's human community and renewable resource economy.

Suggested Ways and Means of Reducing or Avoiding Threats: Mitigative measures which are proposed by the proponents or suggested by our Department and which should be implemented as terms and conditions of future hydrocarbon development in order to eliminate, offset or minimize adverse impacts on the environmental or renewable resource economy.

TABLE 1

Activity and region HAZARDS TO OFFSHORE EXPLORATION & PRODUCTION FACILITIES (MACKENZIE SHELF)

Some sources of impact i) sea ice iii) ocean currents v) _____

ii) waves iv) water level fluctuations vi) _____

Population/ factors at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Pln	Ass	Mon	Res	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
Personnel/Operations	Offshore safety! - the proposed offshore facilities for drilling, oil and gas processing and storage, subsea pipelines, production platforms, loading terminals, etc. will be exposed to extreme oceanic hazards from sea ice (collision, pile-up, ride-up and scour), storm surges (erosion and flooding) and ocean currents (erosion). Short-term environmental observations are inadequate for predicting marine conditions (especially the infrequent extreme events).	X	X									Engineering design criteria and operational procedures based on existing knowledge of environmental forces and available technology. (EIS Vol. 2)	BD	-		X		
					X							Legislation must be reviewed, and revised if necessary, to ensure that appropriate statutory controls exist to manage the development. (DFO P.S.)	BD	1-2	X			
							X					A reliable observational and forecasting network operating in the arctic over the entire year must be established before development proceeds in order to address oceanographic, weather and sea state data deficiencies. (DFO P.S.)	BD	1-2	X			
									X			Joint planning by government and industry of comprehensive research programs to ensure effective, well coordinated and efficient research (i.e. ice behaviour and prediction). (DFO P.S.)	BD	<1	X	X		
									X			Short-term future research using analytical models, model tests and field observations particularly on the interaction of sea ice and offshore structures using prototypes, ice forecasting surveillance and construction techniques in order to refine and optimize design criteria. (EIS Vol. 7; DFO T.R.; DFO P.S.)	BD, DD	1-5		X		
								X				Long-term data to determine infrequent extreme oceanic/weather hazards for risk analysis (verifying model, forecasting, etc.). (DFO P.S.; EIS Vol. 7)	BD, DD	Several	X	X		

Activity and region HAZARDS TO SHIPPING (MACKENZIE SHELF & TANKER CORRIDORS)

Some sources of impact i) shoals, shallows, bars iii) collisions v) poor visibility and restricted daylight

ii) ice ice (icebergs, ice arch, etc) iv) pingos & pingo-like features vi)

TABLE 2

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Fin	Aes	Mon	Res	Dem	Ot		BD(Before) DD(During)		Gov	Ind	Pub	Int
Personnel	Safety: The existing level of knowledge about ice conditions, bathymetry, arctic navigation and ice-detection systems; water circulation and other oceanic/atmospheric factors important to shipping is inadequate for ensuring safe year-round navigation.										X	Locations of structures and platforms and shipping traffic corridors must be confirmed in order to establish a well coordinated hydrographic charting program. (DFO PS and DFO T.B.)	BD	<1		X		
		X	X									Specific engineering design information and operational procedures for manoeuvrability of ice-breaking carriers in open water and in ice is needed for a decision on their safety. (DFO PS and DFO T.B.)	BD	1		X		
											X	Details of traffic projections are required in order that a coordinated and phased installation of navigational aids can proceed. (DFO PS)	BD, DD	2-5	X	X		
				X	X							Legislation and the regulatory process must be reviewed, and revised if necessary, to ensure that appropriate controls (i.e. surveillance and enforcement capability) exist or are established. (DFO PS)	BD	1-2	X			
									X			Research to develop ice detection, surveillance, forecasting and pressure sensing methods is needed for safe year-round navigation. (DFO PS)	BD	2-3	X	X		
							X					RACANT reviews of proposed shipping corridors. (DFO P.S.)	BD	ongoing	X	X		
							X					TERMPOL reviews of proposed harbour developments. (DFO P.S.)	BD, DD	ongoing	X			
										X		Use of prototypes to determine the effects of hazards such as entrapment in ice fields, superstructure icing, severe sea states, icebergs, etc. for risk analyses (DFO PS and TB)	DD	3-5		X		
									X			Charting of vessel corridors including inshore areas and seabed anomalies (DFO PS and DFO T.B.)	BD, DD	5-10	X			
								X				More data is needed on the nature of sea-ice cover in Prince of Wales Strait and Viscount Melville Sound and also for the rest of the shipping routes for risk analyses. (DFO PS)	BD, DD	2-5	X	X		
								X				Long-term weather data and data on ocean currents, upwellings and circulation patterns (especially in winter) are needed for risk analyses. (DFO PS)	BD, DD	5-10	X			

TABLE 3

Activity and region: HAZARDS TO COASTAL SUPPORT, EXPLORATION & PRODUCTION FACILITIES (BEAUFORT SEA)

Some sources of impact: i) Sea ice pile ups & scour; ii) erosion and flooding; iii) groundings; iv) storm surges; v) ; vi)

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Pln	Aes	Hon	Res	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
Personnel/Operations	Safety: The safety of coastal facilities and operations in support of offshore exploration and production is not adequately considered vis-a-vis major marine hazards of sea ice, ocean currents, water levels and waves and bottom hazards to navigation (shoals, bars, etc.). Facilities include harbours, wharfs, navigational aids, waste disposal sites, pipeline approaches and possibly oil and gas processing and storage.	X	X									Engineering design criteria and operational procedures based on existing knowledge of environmental factors and available technology.	BD	-		X		
						X						Plans for shorebases, campsites and subsea pipeline approaches need to be specified to the year 2000 under the auspices of a regional planning process. (DFO FS)	BD	1		X		
				X								Guidelines for coastal development should be established such as the requirement for erosion and flood-prone limits where appropriate.	BD	1	X			
							X					TERMPOL review of proposed harbour or marine base facilities. (DFO FS)	BD, DD	ongoing	X	X		
								X	X			Site-specific research and monitoring is necessary on erosion processes including currents, storm surges, ice rideup and scour, sediment transport and waves to ensure the safety of shore bases and subsea pipelines and to mitigate possible environmental impacts (i.e. obstructing migratory fish pathways). (DFO FS and EIS Vol. 7/3.9)	BD, DD	5-10		X		

Coastal

TABLE 4

Activity and region: NOISE ON THE MACKENZIE SHELF

Some sources of impact: i) DRILLSHIPS, ARTIFIC- iii) PROCESS BARGES; ii) ISLANDS, DRYDOCKED DREDGES; v) ICEBREAKERS, TANKERS, SUPPORT VESSELS; vi) AIRCRAFT

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Lng	Opw	Reg	Loc	Flu	Ana	Mon	bas	Den	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
marine mammals:							X					IMPROVED PROJECTIONS OF TYPES, LEVELS AND ZONES OF INFLUENCE FROM STATIONARY AND MOBILE NOISE SOURCES, BOTH AIRBORNE AND MARINE, WITH SPECIAL EMPHASIS ON PROBABLE AREAS OF CUMMULATIVE/ADDITIVE NOISES SUCH AS PRODUCTION FIELDS, RESUPPY CORRIDORS, AIRPORT APPROACHS, ETC.	BD	1-2		X		
RINGED AND BEARDED SEALS	IMPORTANT FOOD & COMMODITY FOR INUIT OF TUK AND OTHER BEAUFORT COMMUNITIES; NECESSARY PREY OF POLAR BEAR																	
BOWHEAD WHALES	RARE/ENDANGERED SPECIES; IMPORTANT FOOD OF INUIT OF ALASKA					X						INTEGRETED SHIP ROUTING AND AIRCRAFT ROUTEFLIGHT CORRIDORS ANALYSIS, WITH EMPHASIS ON RINGED SEAL AND WHALE REQUIREMENTS FOR MIGRATION, BREEDING AND FEEDING, IN SELECTION OF BEST ROUTES AND SCHEDULES	BD	1-2	X	X	X	
WHITE WHALES	IMPORTANT FOOD AND HUNTED SPECIES FOR INUIT OF TUK AND OTHER COMMUNITIES	X										IMPROVED SHIP DESIGNS TO REDUCE ASSOC NOISE LEVELS ASSOCIATED WITH ENGINES, PROPELLORS AND HULLS, ESPECIALLY UNDER ICE CONDITIONS	BD,DD	3-5		X		
	NATIONAL INTEREST IN SURVIVAL OF WHALE SPECIES																	
	GROWING RECREATIONAL PURSUIT OF PHOTOGRAPHERS & NATURALISTS		X									BETTER OPERATIONAL PROCEDURES WHICH ALLOW CONVOYING AND SPEED REDUCTION, ESPECIALLY IN CRITICAL SEASONS AND LOCATIONS FOR SEALS AND WHALES	DD	NA		X		

TABLE 4 (cont'd)

Activity and region: NOISE ON THE MACKENZIE SHELF (CONT'D)

Some sources of impact: i) _____ iii) _____ v) _____

ii) _____ iv) _____ vi) _____

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Leg	Ope	Reg	Leg	Pla	Aes	Mon	Res	Den	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
				X								STRICT COMPLIANCE AND IMPROVED SURVEILLANCE OF NEW DESIGNATED SHIPPING CORRIDORS AND AIRCRAFT ALTITUDE RESTRICTIONS	DD	NA	X	X		
										X		IMPROVED MEASUREMENTS OF MARINE NOISE SOURCES, ESPECIALLY RELATED TO MARINE TRAFFIC UNDER CONDITIONS OF SHALLOW, ICE-COVERED WATERS	BD,DD AND PROPOGATION	3-5		X		
									X			IMPROVED KNOWLEDGE AND ADDITIONAL STUDIES OF SEAL AND WHALE VOCALIZATIONS, THEIR NATURE AND USE FOR COMMUNICATION, LOCATION AND FEEDING	BD,DD	5-10	X			
								X		X		IMPROVED OBSERVATIONS OF BEHAVIOR RESPONSES OF SEALS AND WHALES TO MARINE/AIRBORNE NOISE SOURCES. WITH EMPHASIS ON RINGED SEAL (MOTHER/POP BOND) AND WHITE WHALE (CONCENTRATION AREAS IN ESTUARY)	BD	3-5	X	X		
									X			BETTER KNOWLEDGE OF POPULATION DYNAMICS OF SEALS AND WHALES, WITH EMPHASIS ON DISTRIBUTION AND ABUNDANCE RELATED TO FEEDING, BREEDING AND MIGRATION/TRAVEL	BD,DD	5-10	X			

TABLE 5

Activity and region: NOISE IN THE NORTHWEST PASSAGE

Some sources of impact: i) TANKERS; ii) SURVEILLANCE; iii) ; v) ; vi) ;

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats: Eng	Ope	Reg	Leg	Pln	Ass	Mon	Res	Hon	Oth	Recommended examples	Judged Urgency (BD: Before; DD: During)	Completion Time (yrs)	Responsibility: Gov	Ind	Pub	Int
NARWHALS WHITE WHALES	AND COMMODITY IMPORTANT FOOD FOR INUIT OF POND INLET ARCTIC BAY AND OTHER COMMUNITIES	X										IMPROVED SHIP DESIGN TO REDUCE NOISE LEVELS ASSOCIATED WITH ENGINES, PROPELLORS AND HULLS	BD,DD	3-5		X		
			X									BETTER OPERATIONAL PROCEDURES WHICH ALLOW CONVOYING AND SPEED REDUCTION, ESPECIALLY IN CRITICAL SEASONS AND LOCATIONS FOR RINGED SEALS AND WHALES	DD	NA		X		
BOWHEAD WHALES	RARE/ENDANGERED SPECIES NATIONAL AND INTERNATIONAL INTEREST IN WHALE SURVIVAL					X	X					IMPROVED INTEGRETED SHIP ROUTE ANALYSIS WHICH CONSIDERS RINGED SEAL PUPPING CONCERNS IN PRINCE OF WALES STRAIT AND VISCOUNT MELVILLE SOUND, AND WHALE COMMUNICATION PROBLEMS IN LANCASTER SOUND, BAFFIN BAY	BD	1-2	X	X	X	
RINGED SEALS	IMPORTANT FOOD AND COMMODITY FOR INUIT OF REGIONAL COMMUNITIES			X								STRICT COMPLIANCE AND IMPROVED SURVEILLANCE OF NEW DESIGNED SHIPPING CORRIDORS AND AIRCRAFT ALTITUDE RESTRICTIONS	DD	NA	X	X		
								X		X		IMPROVED OBSERVATIONS OF BEHAVIORAL RESPONSES OF SEALS AND WHALES TO VESSEL TRAFFIC, WITH EMPHASIS ON RINGED SEALS IN BARROW STRAIT AND BOWHEAD WHALES IN LANCASTER SOUND AND BAFFIN BAY	BD,DD	3-5	X	X		

Activity and region: NOISE IN THE NORTHWEST PASSAGE (cont'd)

Some sources of impact: i) _____ ii) _____ iii) _____ iv) _____ v) _____ vi) _____

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Plo	Ana	Mon	Res	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
									X			BETTER KNOWLEDGE OF POPULATION DYNAMICS OF SEALS AND WHALES, WITH EMPHASIS ON DISTRIBUTION AND ABUNDANCE RELATED TO FEEDING, BREEDING AND MIGRATION/TRAVEL	BD, DD	5-10	X			
									X			IMPROVED KNOWLEDGE AND ADDITIONAL STUDIES OF SEAL AND WHALE VOCALIZATIONS, THEIR CHARACTERISTICS and USE IN COMMUNICATION, LOCATION AND FEEDING.	BD, DD	5-10	X			
								X		X		IMPROVED MEASUREMENTS OF TANKER NOISE LEVELS AND PROPOGATION NARROW, ICE COVERED CHANNELS SUCH AS BARROW STRAIT, AND DEEP OFFSHORE WATERS IN BAFFIN BAY.	BD, DD	3-5	X	X		

TABLE 6

Activity and region: ICEBREAKING on the Mackenzie Shelf

Some sources of impact: i) ice management at harbours; ii) local transport of supplies; iii) dredging support; iv) tanker transport; v) ; vi)

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats: Inc	Ops	Ter	Ler	Pin	Ass	Pon	Bas	Wen	Oth	Recommended examples	Judged Urgency: DD(Before) DD(During)	Completion Time (yrs)	Responsibility: Gov	Ind	Pub	Int
ringed and bearded seals	-main prey of polar bears and arctic foxes -important food and commodity for Inuit -most common and abundant arctic marine mammal -public interest in survival of pups					X						....Improved projections of icebreaking requirements and overall zone of influence (corridor locations and widths, frequency and timing of use), with emphasis on the landfast ice of the Mackenzie Shelf	SD	1-2		X		
						X						... New integrated analysis of preferred icebreaking routes/corridors based on factors of safety, environmental protections and economics	SD	2-3				X
white whales	-important food for Inuit -public interest in survival of whale species -recreational pursuits of southerners -most common arctic cetacean								X			... Additional research and improved understanding of sea ice dynamics (patterns of breakup and freezeup, ice thickness and type, driving forces, grounding frequency, etc), with emphasis on landfast ice in production fields and transportation corridors	SD,DD	5-10	X			
landfast ice	-stable platform for breeding ringed seals -important feeding and travel habitat for winter resident wildlife -access to and locale for hunting by Inuit -control factor in local weather								X			... Additional research and improved understanding of seal and whale population dynamics (abundance, distribution, reproduction, mortality, food habits, etc) especially during the spring and summer in the vicinity of production fields and transportation routes	SD,DD	5-10	X			
				X								... Strict compliance and surveillance of new designated icebreaking corridors and schedules	DD	N/A	X	X		
			X									... Possible convoying and speed reduction of vessels at critical places and times	DD	N/A		X		
										X		... Improved observations and further assessment of landfast ice disruptions on the Mackenzie Shelf due to restricted routine icebreaking on the Mackenzie Shelf	DD	4-5		X		
										X		... Improved observations and further assessment of seal and whale mortality, disruptions and other adverse responses due to restricted, routine icebreaking, especially during the spring breeding and summer migration periods.	DD	4-5		X		
							X					... Better assessment of the adverse effects of icebreaking activities on Inuit hunting	SD	1-2		X		

TABLE 7

Activity and region ICEBREAKING in the Northwest Passage

Some sources of impact i) oil tanker transport iii) support icebreakers v) _____
ii) LNG carrier transport iv) resupply vessels vi) _____

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Veg	Leg	Pub	Ass	Mon	Res	Dem	Oth		SD(Before) DD(During)		Gov	Ind	Pub	Int
ringed and bearded seals	-main prey of polar bears and arctic foxes						X					...Improved projections of icebreaking requirements and overall zone of influence (corridor widths, alternative routes, exceptional events), with emphasis on areas of landfast ice	SD	1-2		X		
	-important food and commodity for Inuit																	
	-public interest in survival of seal pups					X						.. Better integrated analysis of preferred icebreaking routes/corridors based on factors of safety, environmental protections and economics	SD	2-3				X
narwhal and white whales	-important food and commodity for Inuit								X			.. Additional research and improved understanding of sea ice dynamics in the Northwest Passage, especially in relation to patterns of breakup and stability of ice-edges	SD,DD	5-10	X			
	-public interest in survival of whale species																	
	-recreational pursuit of southern naturalists, photographer, etc								X			.. Additional research and improved understanding of seal population dynamics, especially during the spring molt and pupping season in Barrow Strait and Amundsen Gulf						
	-most common arctic cetaceans																	
landfast ice	-seasonal platform for feeding, breeding and/or migrating marine mammals			X								.. Strict compliance and surveillance of new designated icebreaking corridors and schedules	DD	N/A	X	X		
	-factor in local weather		X									.. Possible convoying and/or speed reduction of vessels at critical times and places	DD	N/A		X		
	-access to and/or site of hunting, trapping and fishing by Inuit									X		.. Improved observations and better evidence of ice-edge destabilization in the Northwest Passage and Amundsen Gulf due to routine, year-round icebreaking traffic	DD	4-5	X	X		
										X		.. Improved observations and better evidence of seal mortality, behavior and other responses of breeding and molting seals, and migrating whales to icebreaking traffic	DD	4-5	X	X		

OFFSHORE PLATFORMS AND TERMINALS

TABLE 8

Some sources of impact i) exploration & production platforms ___ ii) offshore tankers terminals ___ v) _____ vi) _____

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Efficacy BD(Before) DD(During)	Completion Time (yrs)	Responsibility			
		Enc	Dev	Coe	Leg	Pln	Ass	Mon	Ess	Dem	Oth				Gov	Ind	Pub	Oth
white whales	- important food for Inuit of Tuk, Inuvik and Aklavik						X					- improved projections of hypothetical locations and spacings of exploration and production islands	BD	1-2		X		
	- national public interest in survival of whale species		X									- seasonal deployment of icebreakers such as Kigorlak to promote landfast ice breakup if unduly delayed by physical presence of islands	DD	N/A		X		
	- increasing recreational value to photographers, naturalists, etc.								X			- additional data and improved understanding of dynamics of landfast ice on the Mackenzie Shelf, with emphasis on behavior of ice edge near production zone	BD,DD	5-10	X			
landfast ice	- natural barrier to whale migration into the Mac-Kenzie estuary						X	X				- improved observations and further assessment of the effects of additional island construction on landfast ice patterns of freezeup and breakup	DD	4-5		X		
	- travel locale and hunting areas for Inuit of Tuk and other communities								X			- additional research and improved knowledge of white whale migration into and other uses of the Mackenzie estuary with emphasis on timing and routes during the ice breakup period	BD,DD	5-10	X			
	- control factor in local weather						X	X				- improved observations and further assessment of the effects of modified ice conditions caused by artificial islands on white whale movements and uses of the Mackenzie estuary	DD	4-5		X		
BOWHEAD WHALE	- ENDANGERED SPECIES																	

TABLE 9

Activity and region: DREDGING on the Mackenzie Shelf

Some sources of impact: i) construction/maintenance of islands, harbours and ~~approaches~~; ii) ice scour protection of submarine pipelines and ~~other production equipm.~~; iii) abandonment of production islands; ;

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Ena	Ops	Enc	Enf	Fin	Ass	Mon	Res	Dem	Oth		ED(Before) DD(During)		Gov	Ind	Pub	Int
Marine and anadromous fishes	-main prey of whales, seals and marine-associated birds -important food for Inuit -desireable recreational pursuit of national status						X					... Better projection of regional dredging requirements (volumes, aerial extent, locations, timing) including (i)ancillary dredging for temporary facilities and harbours, (ii)overburden removal and dispersion losses (iii)major sand and gravel reserves (iv)abandonment of islands	SD	1-2		X		
	-public interest in survival of arctic ener						X					... Improved impact prediction of regional and site-specific dredging (zone of influence, nature and rates of recovery) on marine fishes and benthos, especially during the winter months	SD	1-2	X	X		
Marine zoobenthos	-main prey for fishes, whales, seals and marine-associated birds		X									... Adherence to new and improved dredging guidelines and codes of conduct to reduce the likelihood of fish entrainment especially during periods of migration and spawning	OD	N/A		X		
						X						... New integrated analysis of preferred borrow and dump sites based on factors of environmental protection, economics and other marine uses	SD	2-3				X
				X								... Compliance and surveillance of new designated dredging zones and sites	OD	N/A	X	X		
					X							... New acts and legislation to control marine dredging as mining activities on Canada Lands	SD	2-3	X			
								X				... Improved observations and further assessment of benthic recolonization at routinely-disturbed and/or contaminated localies	OD	3-5		X		
									X			... Additional research and improved understanding of marine benthic and fish population dynamics, with emphasis on breeding and feeding locations within the potential dredging region	SD,DD	5-10	X			
								X				... Additional research and improved understanding of marine sediment dynamics, and its influence on dredging activities	SD,DD	4-5	X			

TABLE 10

OIL SPILLS ON THE MACKENZIE SHELF

Sources of Impact: i) Formation Water; ii) Drilling Wastes; iii) Blowouts; iv) Pipeline Ruptures; v) Vessel Accidents; vi) Harbours, Dry Docks, etc.

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Ins	Ops	Enc	Leg	Fin	Ass	Mon	Ean	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	In
Marine and Anadromous fishes	- main prey of other marine life such as seals, whales	X	X									- improved design and efficiency of oil-water separators, especially for emulsified oil	BD,DD	2-5		X		
	- desirable recreational pursuit by Canadians and others	X	X									- maximum reinjection of production water into reservoirs	DD	N/A		X		
		X	X									- new/improved techniques for leak detection in sub sea pipelines	BD,DD	2-5		X		
	- important food for Inuit of Tuk and other communities						X					- improved projections of types, amounts, rates, concentrations, duration, timing, probabilities and zones of influence of chronic spills (including major accidents) and discharges involving oil	BD	1-2		X		
Marine Zoobenthos	- main prey of fishes, whales, seals and birds						X					- improved predictions of the environmental consequences to marine mammals and fishes, especially in restricted waters (e.g. coastal bays, shallow estuarine areas, offshore leads) where spills/wastes are chronic or accumulate	BD	1-2	X	X		
Bowhead and White Whales, ringed and bearded seals	- important food for Inuit of Tuk and neighbouring communities, including Alaskan coastal hamlets											- improved technology and better contingency plans for detection, control and cleanup of oil spills, especially during the ice-cover seasons	BD	2-5		X		
	- public interest in survival of whales and seal pups	X	X									- improved trials and demonstration of capability to contain oil spills at sources especially where spill risk is high such as tanker loading, product, drilling, fuel storage	BD	2-5		X		
	- recreational pursuit of Canadians and others									X		- better assessment of the effectiveness and practicality of major cleanup mesasures in particular burning in ice-covered periods	BD	1-2		X		
							X					- better assessment of the limitations to oilspill countermeasures (relief well, cleanup) due to unignited gas or burning fallout during a blowout not on fire/on fire, respectively	BD	1-2		X		
							X					- improved predictive/real time methods for simulating oil movements at sea, under extreme and typical conditions of ice, wind, currents	BD	2-5	X	X		
								X				- additional research of oceanographic and meteorological processes (ocean currents, ice movements, water characteristics e.g. sediments, winds) affecting predicted fate of oilspills, especially in potential production fields and during the winter/ice infested seasons.	BD,CD	5-10	X			
								X				- new regional and site-specific monitoring program for the early detection of accumulating hydrocarbons, especially in areas of high industrial activity such as harbours, production fields	BD	2-3	X	X		

TABLE 11

Activity and region: OILSPILLS IN NORTHWEST PASSAGE

Some sources of impact: i) TANKERS; ii) ; iii) ; iv) ; v) ; vi)

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Pln	Aau	Mon	Res	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
NARWHAL	IMPORTANT FOOD AND RAW MATERIAL FOR INUIT OF POND INLET AND ARCTIC BAY						X					IMPROVED PROJECTIONS OF OILSPILL HAZARD FOR TANKER ACCIDENT, WITH EMPHASIS ON FATE OF OIL UNDER ICE-COVER CONDITIONS	BD	1-2		X		
WHITE WHALES	IMPORTANT FOOD FOR INUIT OF MOST REGIONAL COMMUNITIES						X					BETTER PREDICTIONS OF ENVIRONMENTAL CONSEQUENCES OF LARGE ACCIDENTAL SPILLS ON MARINE MAMMALS, ESPECIALLY IN RESTRICTED AREAS SUCH AS LEADS AND EMBAYMENTS OR DURING CRITICAL PERIOD SUCH AS PUPPING	BD	1-2	X	X		
BOWHEAD WHALES	RARE/ENDANGERED SPECIES						X					BETTER ASSESSMENT OF EFFECTIVENESS AND PRACTICALITY OF MAJOR CLEANUP MEASURES ESPECIALLY DURING OPEN WATER SEASON AND IN CONDITIONS OF MOVING ICE	BD	1-2		X		
	NATIONAL/INTERNATIONAL INTEREST IN WHALE SURVIVAL AND COMMODITY																	
RINGED SEALS ESPECIALLY PUPS	IMPORTANT FOOD FOR INUIT OF ALL REGIONAL COMMUNITIES			X								NEW CONTINGENCY PLAN FOR OILSPILL RESPONSE IN EVENT OF ACCIDENTAL SPILL	BD	1-2		X		
	NATIONAL/INTERNATIONAL INTEREST IN PUP SURVIVAL	X										IMPROVED TANKER DESIGN FOR CONTAINMENT AT SOURCE IN EVENT OF GROUNDING, FIRE, ETC	BD	2-3		X		
MARINE ZOOBENTHOS	MAIN PREY OF FISHES, WHALES, SEALS and BIRDS																	

FLUID AND SOLID WASTES ON THE MACKENZIE SHELF

TABLE 12

Some sources of waste: i) ballast water from vessels; ii) formation (production) waters; iii) domestic sewage; iv) steel and scrap metal; v) drilling wastes (muds, cuttings, fluids); vi) heated water

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threat: Reg	Ops	Tec	Lec	Pla	Ars	Pon	Bal	Gen	Oth	Recommended examples	Judged Urgency (B)Before/(D)During	Completion Time (yrs)	Responsibility: Gov	Ind	Pub
marine and anadromous fishes	- important prey for sea-birds, seals and whales						X					- improved projections of waste types, and chemical components, especially the ingredients of trade name products used in drilling	BD	1		X	
	- major domestic food for Inuit of Tuk, Aklavik and Inuvik						X					- improved projections of cumulative/additive waste discharge requirements/locations, and zone of influence, especially for potential development of nearshore reserves in shallow water (e.g. Adgo and West Atkinson).	BD	1-2		X	
	- a valuable recreational pursuit (e.g. arctic char) by sportsmen																
benthos	- important prey for sea-birds, seals, whales and fishes						X					- improved comparison of projected industrial chemical inputs and natural background concentrations in sediments and waters, with emphasis on hydrocarbons and trace metals	BD	1-2		X	
						X	X					- new integrated and regional waste management strategies for the disposal/discharge of offshore and coastal contaminants from exploration, production and support facilities and operations, with emphasis on site selection of discharge waters and landfill sites to avoid confined, environmentally-sensitive locales (e.g. shallow coastal waters under winter ice cover).	BD	2-3			
					X							- continued and improved surveillance and compliance to regulations and guidelines for waste discharge to Beaufort Sea, coastal water courses and on land (e.g. primary/secondary treatment of domestic sewage, oily water discharge limit at 30 ppm)	DD	N/A	X	X	
								X				- new and improved techniques to reduce survival of exotic organisms in ballast water of tankers (e.g. screens on intakes, biocides).	BD	2-3		X	
									X			- additional research and improved knowledge about natural chemical concentrations, sources, sinks, residence times and transport mechanisms, especially for trace metals and hydrocarbons in the sediments and waters within the projected zone of influence of offshore and coastal production facilities	BD,DD	5-10	X		
								X				- New well-designed comprehensive monitoring research program to detect fates and concentrations of major waste contaminants discharged into receiving waters, especially in locales or restricted circulation such as harbours, nearshore estuary, etc.	DD	N/A		X	
								X				- New research and further assessment on the potential effects of contaminated waste disposal on benthic communities and fishes, including acute toxicity, bio-accumulation of and sub-lethal physiological and benavior responses to certain elements or compounds in formation water, drilling wastes and other common discharges.	BD,DD	5-10	X	X	

TABLE 13

Activity and region: Blasting - Mackenzie Valley/Delta

Some sources of impact: i) Seismic Delineation; ii) Construction (trenching etc.); iii); iv); v); vi)

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Pln	Ass	Mon	Bas	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
Freshwater and Anadromous Fish	- important food source for local people.		x									- Timing blasting activities to avoid periods of concentrated fish resources (spawning, migration).	DD	N/A		x		
	- support recreational fishing and tourism.			x								- Compliance with terms and conditions of water authorizations and explosives permits.	DD	N/A	x			
	- potential for commercial fishing activities.								x			- Completion of surveys designed to identify areas of critical fish habitat within areas where blasting operations may occur.	BD	1 - 2		x		
								x				- Additional research to determine site-specific effects of blasting operations on aquatic resources, particularly under ice.	DD	3 - 4	x	x		
				x								- Formulation of guidelines concerning the use of explosives in the freshwater environment.	BD	1 - 2	x			

TABLE 14

Activity and region: Granular Borrow - Mackenzie Valley/Delta

Some sources of impact: i) Increased Sedimentation; ii) Stream Gravel Removal; iii) Water Diversions; iv) Road Access; v) ; vi)

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Pln	Ass	Mon	Bas	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
Freshwater and Anadromous Fish	- important food source for local people.						x					- Better projections of borrow needs including those for future projects and local communities as well as the identification of sources, quantity and quality of materials available.	BD	2 - 3	x	x	x	
	- support recreational fisheries and tourism.																	
	- potential for commercial fishing operations.		x									- Avoidance of material sites located within the active flood plains or high water marks of waterbodies.	BD	N/A		x		
Zoobenthos	- primary food organisms for many fish species and early life stages of others.		x									- adherence to new and improved guidelines for pit and quarry development so as to reduce the likelihood of impacts to fish or fish habitat.	BD - DD	N/A		x		
			x									- Timing of activities so as to avoid migration and spawning periods.	DD	N/A		x		
				x								- Compliance with terms and conditions associated with development permits or authorizations.	DD	N/A	x			
									x			- Identification of critical fish habitat which may be affected by borrow and removal activiites.	BD - DD	1 - 2		x		

TABLE 15

Activity and region: Stream & Channel Crossings - Mackenzie Valley/Delta

Some sources of impact: i) Pipeline Trenching; ii) Bank/Slope Clearing; iii) Increased Sedimentation; iv) Flow Diversion; v) ; vi)

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Pln	Ass	Mon	Bas	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
Freshwater and Anadromous Fish	- important food source for local people.								x			- Completion of stream surveys designed to identify areas of critical fish habitat (spawning areas, overwintering areas, etc.).	BD	1 - 2		x		
	- support recreational fisheries and tourism.	x	x									- Selection of crossing sites which avoid areas of critical fish habitat, bank instability, etc.	BD	N/A		x		
	- potential for commercial fishing operations.		x									- Timing of construction to avoid concentrated fish populations (spawning, migration, etc.)	DD	N/A		x		
	- public interest in protection of wilderness areas.			x								- Compliance with construction terms and conditions included in water authorizations/ licences.	DD	N/A	x			
Zoobenthos	- primary food organisms for many fish species and early life stages of others.									x		- Determination of best or preferred methods for slope stabilization particularly in ice rich soils.	BD	2 - 3	x	x		
								x				- Observations as to the effectiveness of mitigating measures/techniques applied.	DD	5 - 6	x	x		
						x						- Integrated analysis of pipeline right-of-way based on factors of environmental protection, economics and land use patterns.	BD	2 - 3	x	x	x	
			x									- Development of suitable contingency plans for the control and cleanup of accidental spills.	BD	1 - 2		x		

TABLE 16

Activity and region: Accidental Oil Spills - Mackenzie Valley/Delta

Some sources of impact: i) Spilled Oil; ii) Clean Up Activities; iii); iv); v); vi)

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Plu	Ass	Mon	Bas	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
Freshwater and Anadromous Fish	- important food source for local people. - support recreational fisheries and tourism. - potential for commercial fishing operations.		x				x					- Improved impact predictions of regional and site-specific oil spills (zone of influence, nature and rates of recovery, resources effected) for all seasons.	BD	1 - 2	x	x		
												- Development of suitable contingency plans for the detection, control and cleanup of accidental spills, especially during the winter months.	BD	1 - 2		x		
Zoobenthos	- Primary food organisms for many fish species and early life stages of others.	x							x			- New or improved techniques for leak detection (particularly for marine crossings) and spill tracking for all seasons and flow conditions.	BD	2 - 3		x		
												- Research on toxicity of water soluble fractions of oil on larval, juvenile and adult stages of a variety of indigenous species of fish.	BD	2 - 3	x	x		

TABLE 17

Activity and regio. Testing and Fluid Disposal - Mackenzie Valley/Delta

Some sources of impact i) Water Withdrawal iii) Fluid Disposal

ii) Freeze Depressants iv) _____

v) _____

vi) _____

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Pln	Ass	Mon	Ban	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
Freshwater and Anadromous Fish	- important food source for local people.								x			- Additional research to identify waterbodies where water can be extracted for testing purposes with little or no effect on aquatic resources.	BD	1 - 2		x		
	- support recreational fisheries and tourism.								x			- Additional research to examine the toxicity of freeze depressants to arctic aquatic organisms under arctic conditions.	BD	3 - 4	x	x		
	- potential for commercial fishing operations.			x								- Compliance with terms and conditions included in water authorizations/licences.	DD	N/A	x			
Zoobenthos	- primary food organisms for many fish species and early life stages of others.		x									- Development of suitable contingency plans for the control and cleanup of accidental spills.	BD	1 - 2		x		
							x		x			- Improved impact prediction for site-specific fluid disposal (zone of influence, temperature effects, fluid toxicity) on aquatic resources, especially during the winter months.	BD	2 - 3	x	x		
		x	x									- Development of suitable techniques for handling of wastes other than overboard disposal - i.e. transport to suitable disposal sites.	BD	1 - 2		x		

TABLE 18

Activity and region: Permanent & Temporary Roads - Mackenzie Valley/Delta

Some sources of impact: i) Increased Sedimentation; ii) Flow Diversions; iii) Migration Blockages; iv) Water Withdrawal; v) Winter Roads; vi)

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Plu	Ass	Mon	Bas	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
Freshwater and Anadromous Fish	- important food source for local people.								x			- Completion of stream surveys designed to identify areas of critical fish habitat (spawning areas, overwintering areas, migration routes).	BD	1 - 2		x		
	- support recreational fisheries and tourism.	x										- Selection of road alignments and crossing sites so as to avoid waterbodies or areas of critical fish habitat, bank instability, etc.	BD	N/A		x		
	- potential for commercial fishing operations.																	
Zoobenthos	- primary food organisms for many fish species and early life stages of others.		x									- Timing of instream construction so as to avoid concentrated fish populations (spawning, migration, etc.).	DD	N/A		x		
			x									- Adherence to existing or improved guidelines for the protection of aquatic resources during road construction activities.	DD	N/A		x		
		x	x									- Designing and constructing culvert crossings so as to permit easy passage by resident fish species.	BD - DD	N/A	x	x		
				x								- Compliance with construction terms and conditions included in water authorization/ licences.	DD	N/A	x			
								x				- Observations as to the effectiveness of mitigative measures/techniques applied, especially for fish passage and slope stabilization.	BD - DD	5 - 6	x	x		
									x			- Selection of water withdrawal sites (for ice roads) which avoid areas of critical fish habitat.	BD	1 - 2		x		

TABLE 19

Activity and regic: Ancillary Facilities - Mackenzie Valley/Delta

Some sources of impact: i) Waste Spills/Disposal; ii) Water Withdrawal; iii) Increased Fishing Pressure; iv) Location of Facilities; v) Increased Vessel/Aircraft Traffic; vi)

Population/ species at risk	Ecological and/or social significance	Suggested ways and means of reducing/avoiding threats										Recommended examples	Judged Urgency	Completion Time (yrs)	Responsibility			
		Eng	Ops	Reg	Leg	Pln	Aus	Mon	Ban	Dem	Oth		BD(Before) DD(During)		Gov	Ind	Pub	Int
Beluga Whale	- hunted by local natives.		x	x								- Adherence to guidelines governing the routing and timing of aircraft and vessel support activities in the Delta during periods of whale occupation.	BD - DD	N/A	x	x		
	- of cultural significance to Inuit.																	
	- public interest in survival of whales.								x			- Additional research to identify waterbodies of little or no importance to aquatic resources where water can be extracted for camp use, field flooding, processing, etc.	BD	1 - 2		x		
Freshwater and Anadromous Fish	- important food source for local people.	x	x									- Locating processing and pumping facilities, stockpile sites, wharfs, airstrips, etc. so as to avoid waterbodies of importance to aquatic resources.	BD	N/A		x		
	- support recreational fisheries and tourism.			x								- Compliance with regulations governing the treatment and disposal of sewage effluents, wastes and process waters.	DD	N/A	x			
	- potential for commercial fishing operations.		x									- Development of suitable contingency plans for the control and cleanup of accidental spills.	BD	1 - 2		x		
Zoobenthos	- primary food organisms for many fish species and early life stages of others.					x						- Integrated analysis of facility locations based on factors of environmental protection, economics and land use patterns.	BD	2 - 3	x	x	x	
				x								- Development of regulations or controls to limit fishing pressure on specific fish populations.	BD	1 - 2	x	x		
								x				- Additional research to determine the effects of water withdrawal on specific aquatic resources and habitats.	DD	1 - 2	x	x		

Closing Statement

DEPARTMENT OF FISHERIES AND OCEANS

CLOSING STATEMENT

TO THE

BEAUFORT SEA

ENVIRONMENTAL ASSESSMENT PANEL

INUVIK

24 NOVEMBER 1983

Presented by

A. B. Cornford

Chief, Ocean Information Division

Pacific Region, OSS

Mr. Chairman,

The Department of Fisheries and Oceans has benefitted from its participation at these hearings since it has had the opportunity to discuss its concerns about the Beaufort Sea Hydrocarbon Production Proposal with the Panel and its technical advisors, with the Proponents and with the other intervenors.

The detailed comments of the Department on the Beaufort Sea Hydrocarbon Production Proposal were provided to the Panel in our technical reviews of the EIS and Supplementary Information. During this session, there has been considerable debate on the technical issues which the Department found beneficial. In the opinion of our technical experts there has, however, been no substantive additional information that would alter the Department's current preference for an on-land focus to development at this time.

In addition, during this session we have addressed in general terms the Departments' present programs, and future needs. Summary tables containing suggestions and observations for managing and mitigating environmental concerns have been submitted to you for consideration. We trust these will be taken into account during subsequent hearings and in your final recommendations.

The Department looks forward to participating and discussing further technical issues at the Whitehorse and Yellowknife general sessions, and then presenting our positions on the Beaufort Sea Hydrocarbon Production Proposal to you at the Ottawa general session.

Thank you.

Topics and DFO Participation

INUVIK (9-25 Nov.)

	DFO Participants
General Spokesmen/Coordinators*	A. Cornford, IOS R. Josephson, FWI
General Resource Peqple*	B. Smiley, IOS L. de March, FWI
Opening Statement (9 Nov. p.m., eve.)	H. Lawler, FWI
Oilspills (10 Nov. a.m., p.m., eve.; 12 Nov. a.m., p.m.; 14 Nov. a.m.)	B. Smiley, IOS A. Clarke, BIO D. Dowler, YK
- Topics other than environmental and socio-economic effects including risk.	
Environmental Effects - Onshore (14 Nov. eve.; 15 Nov. a.m., p.m., eve.; 16 Nov. a.m., p.m.)	M. Lawrence, FWI B. Wong, YK
- Production systems, physical environmental impacts, oil spill effects.	
- Pipelines - impacts, ecological consequences, permafrost, oilspill effects, Discussion Paper #6.	
- Shorebases #, location, scale.	
- Roads and their use.	
- Quarries.	
- Construction support camps.	
- On and offshore supply operations.	
- Summary of effects on wildlife - sources - species	
- Environmental assessment - definitions, methods, risk, cumulative and synergistic effects, mitigation, impact management, monitoring, research, EIS Supplementary Information.	

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* Attendance was divided between the two Coordinators and the two Resource People.

Environmental Effects - Offshore (16 Nov. p.m.; 17 Nov. a.m., p.m., eve.; 18 Nov. a.m., p.m.)	B. Smiley, IOS
- Effects of oilspills.	A. Mansfield, ABS
- Common wastes, hazardous/toxic materials.	M. Lawrence, FWI
- Dredging.	L. Johnson, FWI
- Ice regime impacts - extension of landfast - icebreaking.	H. Melling, IOS
- Noise.	
- Summary of effects on wildlife.	
- Environmental assessment - ringed seal. Topics - see Resolute Bay.	
Socio-Economic Effects (19 Nov. a.m., p.m., eve.; 21 Nov. a.m., p.m., eve.; 22 Nov. a.m., p.m.; 23 Nov. a.m., p.m., eve.)	R. Moshenko, FWI T. Strong, FWI
- Socio-economic consequences of changes to native harvesting due to oilspills, other effects on wildlife, baseline wildlife data.	
- Compensation.	
- Examination of development in Alaska, James Bay, Fort McMurray, North Sea.	
Government Management (24 Nov. a.m., p.m.)	A. Cornford, IOS
- Ability of governments to control and manage activities and environmental and social effects.	R. Josephson, FWI R. Peet, FWI
- Responsibilities, role of departments, coordination, community roles, regulation and enforcement.	
Other Concerns (24 Nov eve.)	
Closing Statement (25 Nov. a.m., p.m.)	A. Cornford, IOS

Whitehorse General Session

Opening Statement

11M/250 20:57 GMT PACIFIC REGION PFF VANCOUVER

Government of Canada / Gouvernement du Canada

Fisheries and Oceans / Pêches et Océans

Fisheries - Pacific Region
1090 West Pender Street
Vancouver, B.C.
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Pêches - Région du Pacifique
1090 rue Pender Ouest
Vancouver (C.-B.)
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Your file / Votre référence

Our file / Notre référence

November 25, 1983

Dr. John Tener
Beaufort Sea Environmental
Assessment Panel
700-798 West Pender Street
Vancouver, B.C.
V6C 1H2

Dear Dr. Tener:

Re: Whitehorse General Session, Beaufort Sea Panel

The Department of Fisheries and Oceans will be participating in the Beaufort Sea Panel's Whitehorse General Session. In this regard it is my pleasure to forward 14 copies of our Department's opening statement which I will be presenting at the session. In addition to contributing to your discussions through questions, etc., it is our intention to table a separate discussion on the subject of Yukon shorebases. We will supply you with copies of this document in Whitehorse prior to commencement of the session.

We look forward to your Whitehorse session.

Yours truly,

ORIGINAL SIGNED BY
R. BELL-IRVING
Habitat Management Division

for F.C. Boyd
Head
Habitat Management Division

GLE/cs
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Enclosure

cc: C.W. Shinners

Canada

DEPARTMENT OF FISHERIES AND OCEANS

OPENING STATEMENT

TO THE

BEAUFORT SEA

ENVIRONMENTAL ASSESSMENT PANEL

WHITEHORSE

1 DECEMBER 1983

Presented by

Forbes C. Boyd
Head, Habitat Management Division
Pacific and Yukon Region

Mr. Chairman,

I welcome this opportunity to present to the Panel some observations from the Department of Fisheries and Oceans on the Beaufort Sea Hydrocarbon Production Proposal. My name is Forbes Boyd and I am the head of the Department's Pacific and Yukon Region's Habitat Management Division. Also with me today to take part in the discussion on Yukon Shorebases is Mr. Gordon Ennis, Senior Biologist with the Habitat Management Division, Mr. Al Von Finster, Habitat Specialist in our Whitehorse office, Mr. Sandy Johnston, Management Biologist, Whitehorse, and Mr. Gordon Zealand, District Supervisor of our Whitehorse office.

I hope that these arrangements will meet the Panel's needs. If any question arises that we cannot adequately deal with here, we shall take it on notice and provide the Panel with an answer as soon as possible.

During the past 14 months the Department has provided the Panel with several documents relevant to the Proposal, including a description of the Department's mandate and relevant programmes, its technical reviews of the Proponent's Environmental Impact Statement and Supplementary Information, and its scientific assessments of the effects of vessel traffic on Arctic marine mammals and of oil on Arctic marine fish and marine mammals.

The Department of Fisheries and Oceans has evaluated the technical aspects of the Beaufort Sea Hydrocarbon Production Proposal in the context of the Departmental responsibility for:

- the management and protection of fish and marine mammal resources, their supporting habitats and the associated subsistence, recreational and commercial fisheries;

- the protection of marine and freshwater environmental quality; and

- the provision of information for safety of facilities and operations from the hazards of the marine environment.

Given these responsibilities in the Arctic, the Department has adopted an approach to Beaufort Sea hydrocarbon development designed to ensure the long-term well-being of the fish and marine mammal resources while at the same time attempting to reconcile the needs of the hydrocarbon industry. The Department's technical reviews were approached from this perspective to make sure that concerns related to possible impacts on fish and marine mammals and the aquatic environment are identified and considered at the early stages of any planning for the development of Beaufort Sea hydrocarbons.

The Department is committed to cooperative resource management and if the decision is made to proceed with Beaufort Sea hydrocarbon development, the Department of Fisheries and Oceans expects to work cooperatively with industry, other government agencies and northern residents in protecting fish and marine mammal resources, their habitats, associated fisheries, and the marine and freshwater environments.

In its technical review of the Environmental Impact Statement and Supplementary Information, the Department of Fisheries and Oceans addressed eleven topics of major concern to the Department, several of which are relevant to the technical discussions to be held here. I would now like to outline for the Panel and those people participating at this session, the Department's main conclusions with respect to our eleven major topics of concern.

1) If new shorebases are constructed along the Beaufort Sea coast, fish, marine mammals and their habitats will likely be affected. There would be increased water use, waste disposal, stream disturbances and shoreline processes could be altered. For example, causeways planned for the Yukon coast may alter shoreline processes and water characteristics which may in turn affect fish habitat or migrations of anadromous fish. The nearshore waters of the Yukon coast are important as migration corridors to marine

and anadromous fish. These waters also provide fish with important nursery and feeding habitat, particularly at locations west of Kay Point.

2) Shorebases, exploration and production facilities may be subjected to severe marine hazards from sea ice, ocean waves, storm surges and erosional effects on frozen shorelines. Some hazards such as sediment transport and shoreline erosion have not been addressed. Marine hazards should be included in the site selection criteria for future facilities.

3) Suction dredging associated with offshore production facilities and for shorebase facilities may destroy bottom-dwelling marine plants and animals and impact on fish.

4) Ice-breaking for vessel traffic corridors, at artificial islands, drilling vessels and at shorebases will disrupt the sea ice (epontic) community consisting of plants and animals which form a significant part of the marine food web and in addition will directly affect ringed seals for which ice provides pupping habitat.

5) Oil may be released from accidental spills and from chronic discharges in spite of mitigative and safety measures

resulting in quantitative and qualitative changes in hydrocarbon concentrations that may be expected to occur in sediments, seawater and biota. The technology to detect, contain and clean-up spills under adverse Arctic marine conditions is limited.

6) Possible impacts on ice breakup from the presence of artificial islands are inadequately identified. Delayed breakup could prevent white whales from entering nearshore waters and the Mackenzie estuary. This concen cannot be adequately addressed without white whale monitoring and research on ice stability.

7) Safety of shipping and offshore exploration and production facilities will be affected by hazards from sea ice, ocean currents and waves the full scope of which has not yet been experienced. The technology to enable expansion of industrial activity and of shipping is, for the most part, unproven.

8) Underwater noise remains a concern since there is insufficient information on the effects of long-term cumulative noise from multiple sources on most species of marine mammals.

9) Discharge of industrial wastes from offshore exploration and production operations and from coastal facilities would release large quantities of pollutants which may have a detrimental effect on marine benthos, fish and mammals, and potentially on people using these resources.

10) Overland pipelines have the potential for many impacts on aquatic resources. However, we believe it should be possible for impacts to aquatic resources from an overland oil or gas pipeline in the Mackenzie Valley to be kept to an acceptably low level with proper location, design, construction and operational conditions.

11) Beaufort Sea development may threaten populations of fish and marine mammals that are domestic, recreational and commercial resources by increasing the number of persons engaging in resource harvesting and by increasing access to resources. The overall lack of specific information about future development seriously constrains any assessment of the potential effects on renewable resources and on the use of these resources by the inhabitants of the region.

In summary, this technical review suggests that there are currently serious shortfalls in both baseline data and cause and

effect relationships. Accordingly, an on-land focus to development is considered preferable. This position is based on our assessment that on-land there are better scientific data and understanding, proven technology and experience, reduced and more localized risks to the environment and its biological resources, lower risks of spills, and better capability for detection, containment and clean-up of spills.

As the Panel is aware, the Department of Fisheries and Oceans has also participated at the Resolute and Inuvik technical sessions and will be participating at the Yellowknife sessions. On completion of these technical dicussions the Department is committed to develop more detailed positions to be presented to the Panel at or before the Ottawa general session. These positions will outline when and how components of the project should proceed and will address such aspects as:

- the location of land and offshore production facilities;
- the locations of port and other coastal facilities;
- marine transportation;
- subsea pipelines; and

- the overland pipeline.

In conclusion I wish to ensure the Panel that the Department of Fisheries and Oceans will cooperate fully with other government agencies and industry to reach effective decisions and avoid undue delays to development. In this regard, the Department will also address, at the Ottawa session, the general management of Beaufort Sea hydrocarbon development by preparing positions related to:

- adoption of the "Lancaster Sound Planning Principles" to guide Beaufort Sea development;

- implementation of a regional planning process before further development proceeds;

- development of a Mackenzie Valley and Beaufort Sea coast action plan before approvals for development are given;

- requirement for complete environmental assessment and review of all specific projects resulting from the Proposal;

- review of regulatory processes; and

- development of a comprehensive programme of research and monitoring to increase the understanding of marine ecosystems, in order to improve the quality and increase the certainty of decision making involving both natural resources and safety.

Thank you very much for this opportunity, and I wish you success with the discussions here at Whitehorse.

wuu2/f

Intervention on Yukon Shorebases

Department of Fisheries and Oceans

Brief
On the Fisheries Implications
of Yukon Shorebases

Presented to the

Beaufort Sea

Environmental Assessment Panel

Whitehorse

1-3 December 1983

Preface

This paper briefly presents information on Arctic marine fish and mammals and their supporting habitats. Information for this review was primarily obtained from Kendel et al. (1975), Johnson (1983), Mansfield (1983), LGL and ESL (1982) and from the Beaufort Sea Environmental Impact Statement (Dome et al., 1982). Possible impacts to the fisheries resources of the Beaufort Sea are discussed in relation to potential Yukon shorebases. Finally, some site selection criteria and mitigative measures for shorebases are discussed.

Marine and Anadromous Fish

The abundance and distribution of fish in the Beaufort Sea is ultimately controlled by the production of plant material which forms the basis of the food chain. Primary production in the Beaufort Sea water column is extremely low owing to light filtering by the ice. Sea ice also limits mixing during storm events which in turn limits nutrient cycling and further restricts photosynthesis. Most of the production, both primary and secondary, occurs either in the benthic regions or on the under-surface of the ice (epontic biota). This low production in the water column limits the development of truly pelagic stocks of fish. Common marine species recorded during studies conducted in the region include Arctic cod (Boreogadus saida), Pacific herring (Clupea harengus pallasii), fourhorn sculpin (Myoxocephalus quadricornus), Arctic flounder (Liopsetta glacialis) and starry flounder (Platichthys stellatus). Saffron cod (Eleginus navaga), snailfish (Liparis spp.) and ellpouts (Gymnelis spp. and Lycodes spp.) have also been consistently reported in the region. Marine species are not important in the domestic fisheries of the Beaufort Sea, although some species such as Arctic cod are particularly important to arctic marine food webs as food sources for marine mammals and birds.

The fishes of significance in the economy of the Arctic are primarily anadromous. Anadromous species are found in the more productive nearshore areas of the Beaufort Sea during the open water season. Dominant species include: Arctic cisco (Coregonus autumnalis), least cisco (C. sardinella), Arctic char (Salvelinus alpinus), boreal smelt (Osmerus eperlanus), humpback whitefish (Coregonus clupeaformis), broad whitefish (C. nasus) and inconnu (Stenodus leucichthys). A complete list of marine and anadromous fish species occuring in the Yukon sector of the Beaufort Sea is appended, as is a list of the freshwater species.

Shortly after breakup, when meltwater begins to enter coastal areas, anadromous species descend into nearshore habitats and migrate along the shore of the Beaufort coast. The distances which anadromous fish travel along the coast varies with species and age. For example, most mature anadromous fish do not spawn each year and the spawning segment of the population may either remain in freshwater, or undertake short coastal migrations in the early summer. Immature fish and mature non-spawners tend to be more prevalent in coastal waters and migrate greater distances. Arctic char have been known to travel 500 or 600 km. Arctic cisco also undertake long migrations. Arctic cisco tagged at Herschel Island have been recaptured at Shingle Point while others tagged at Stokes Point and at King Point have been recaptured several hundred kilometers away in the Peel River (a

tributary of the Mackenzie River). These anadromous fish migrations likely result in substantial mixing of fish stocks along the Yukon coast.

Although various studies completed in the Beaufort Sea have documented different depths or distances from shore to which these species are confined, in almost all surveys they have been restricted to the productive nearshore waters which are less than 5 m deep. The major factor affecting the distribution of anadromous fish appears to be the nearshore presence of relatively warm brackish water which may be necessary for these species to achieve optimal summer growth.

The anadromous species appear to be well adapted to harvest the brief bloom of production occurring in the coastal waters of the Arctic in the open water period. During the three or four months the fish are in the narrow coastal corridor they accumulate much of the energy reserves required for spawning and overwintering. The most important feeding areas for fish in Yukon coastal waters occur west of Kay Point in bays, lagoons and in coastal waters of the mainland and Herschel Island. Phillips Bay bounded by Stokes Point to the west and by Kay Point to the east is probably the most critical area along the Yukon coast. It contains large numbers of fish and is used as a feeding and rearing area. Phillips Bay is also thought to be a pre-migrational staging area

for Arctic char which spawn and overwinter in the Babbage, Malcolm and Firth Rivers. Main fish food items include: amphipods, isopods, mysids, chironomids, copepods and fish. During late summer the fish return to freshwater habitats to spawn and/or overwinter.

Marine Mammals

The other predators of great importance in the Arctic marine ecosystem are the marine mammals. Species most abundant in the Yukon include the bowhead whale, Balaena mysticetus, and the white whale (or beluga) Delphinapterus leucas which migrate along the Yukon coast. The ringed seal, Phoca hispida, maintains breathing holes in first year ice along the Yukon coast. Since the holes can only be maintained in first-year ice the distribution of adult seals is largely restricted to bays and indentations of the coast line where land-fast ice forms.

Fisheries Value

Commercial harvesting of fish or marine mammal stocks does not currently take place in Yukon waters and there appears to be little commercial potential.

At present subsistance fishing takes place for white whale in Yukon waters while the bowhead whale is hunted in Alaska waters. The ringed seal is the marine mammal taken in greatest numbers by Inuit in the Canadian Arctic.

Arctic char is the most important species of fish harvested in the region. Other fish species harvested include: Arctic cisco, humback whitefish, broad whitefish and inconnu. Herring, smelt, flounder and sculpins are also occasionally harvested.

In monetary terms the value of the marine fisheries in the Arctic, including both true fishes and marine mammals, is not high when compared with the marine fisheries of the east and west coasts of Canada. However, in cultural terms and with respect to meeting the subsistence needs of the Indian and Inuit poulation their importance is clearly very great.

Yukon Shorebase Proposals

King Point and Stokes Point along the Yukon Coast are described in the Beaufort Sea Environmental Impact Statement (E.I.S.) as potential sites for a future shorebase. We understand from the Beaufort Sea E.I.S. that shorebase development would include provision of accomodation for personnel, land storage for certain

materials, an airstrip, development of a potable water supply, a sewage discharge site, repair and maintenance facilities for the marine fleet, facilities for transferring fuel and drilling consumables to the ships and provision of artificial illumination for all the operations. The port itself would require a deep water harbour which would require shoreline alteration through dredging, filling and construction of a 2 km long solid fill causeway out to the minus 10 m contour. Ice breaking would be required in the vicinity of the port.

Potential Shorebase Impacts on the Fisheries Resources

Construction and operation of the proposed Yukon shorebases have the potential to impact marine, anadromous, and freshwater fish and their supporting habitat by:

1) Changing shoreline sediment and water circulation processes by dredging, filling, and causeway construction which may in turn affect fish habitat or migrations of anadromous fish.

2) Operation of dredges may impact fish and operation of ice breakers and other vessels may physically impinge marine mammals and interfere with their sound production and hearing.

3) Waste water and sewage disposal and accidental spillage of oil and other commodities which may degrade water quality and affect fish and their habitat.

4) Increasing water use which may create minimum flow problems and overwintering problems for freshwater and anadromous species.

5) Creating migration barriers during the construction and operation of stream crossings such as bridges and culverts.

6) Increasing aquatic sediment concentrations during the construction and operation of the road, and other facilities thereby affecting freshwater, anadromous and marine fish and their habitat.

7) Use of aircraft which may disturb marine mammals, artificial lighting which may increase the vulnerability of fish to predation and possibly other impacts.

8) Increasing the number of persons engaging in resource harvesting and increasing access to the resources.

It is noted that many of the impacts described above are a concern irregardless of whether the shorebase is used as a

production orientated port or used as an exploration or support service port.

Shorebase Sharing and Siting

In view of the potential shorebase impacts and considering the value of the fisheries resource it is our belief that every effort should be made to avoid or reduce damage to the fisheries resources. If shorebase facilities are indeed required on the Yukon coast it is our belief that locations should be shared in order to reduce the proliferation of sites thereby reducing the overall risk to anadromous and marine fish and marine mammals. However, any shared shorebase should be carefully sited so that it avoids important fish habitat.

In this regard and in view of the Yukon Coast fisheries information presented above it is apparent that the proposed shorebase development at Stokes Point should be strongly discouraged. That location is used as a feeding and rearing area for large numbers of fish. The Stokes Point area is also thought to be a pre-migrational staging area for Arctic char which spawn in the Babbage, Malcolm and Firth Rivers. In addition the confluence of longshore currents in the region creates a sediment sink (Forbes, 1976; Kendel et al., 1975). In such a location the

effects of oil invasion could be substantial and prolonged. Deposition of oil in the vicinity would deleteriously affect the benthic plants and animals upon which the marine and anadromous fish feed in the vicinity of Stokes Point.

It is our belief that the location for a shared shorebase facility should be selected on the basis of a comprehensive siting exercise which includes consideration of fisheries information. In this regard our Department is prepared to supply available data, expertise and to work cooperatively with industry and other government agencies to select a suitable site. We believe, an effective site selection process for the shared shorebase could lead to an acceptable, restricted and local concentration of impacts. For instance, water use and waste disposal could utilize non-sensitive habitats, and adverse impacts on coastal fish migrations and shoreline processes may be minimized by limiting the number of shoreline alterations resulting from the construction of docks, causeways, breakwaters, mooring basins and so on. Even from monitoring and regulatory points of view, it will be easier to measure environmental perturbations and socio-economic effects at fewer larger bases (locations).

Fisheries criteria which could be used in a shorebase siting exercise to choose the best location for a port include:

A) Proximity to or presence of important habitats:

- "proximity" should be weighed and reflect up or downstream nearness to the habitat (based upon residual current direction).

Important habitats are defined as areas important to biota for purposes of:

1. Migration (whales and fish) - migration corridors/ routes provide access to and from locations which provide specific life history requirement.

2. Spawning (marine and anadromous fish).

3. Larval and post larval development (fishes), neonatal development (white whates).

4. Calving and pupping areas (whales and seals respectively).

5. Overwintering areas for fish.

6. Feeding (concentrated feeding areas for whales and

fish) - including freshwater coastal systems. These will include areas of known high productivity which will have special ecological importance.

B) Known presence of rare and/or endangered species:

- Bowhead whales (this factor should be weighted depending upon the relative concentration of whales in the area).

C) Unique habitat:

- Proximity to or presence of unique habitat.

- Unique habitat is a special case of important habitat designation.

- Its importance lies in its singular possession of specific environmental attributes, which support a unique assemblage of marine or freshwater fauna.

- The disruption of unique habitat might result in major to minor ecological consequences.

D) Resource use:

Proximity to areas of known resource use such as:

1. Sports fishing.

2. Commercial fisheries.

3. White whale hunting areas.

4. Domestic fisheries.

Mitigation

If the results of the site selection process referred to above show that a port site is environmentally feasible a thorough review of the proposal should be implemented. Site specific resource information should be collected and evaluated in terms of the sensitivities and life history stages of the fisheries resources occurring at the site. These data should form the basis for design, construction and operational adjustments which can be developed and applied to further reduce or avoid problems to the fisheries resources. In the present Environmental Impact Statement resource information is not site specific and

mitigative measures are only briefly described making it difficult to judge their adequacy, applicability and efficiency.

These mitigative measures need to be further developed for all details of the proposal. We believe particular attention needs to be given to causeway design modifications owing to the potentially high level impacts (which were not identified in the E.I.S.) associated with solid fill causeways.

The solid fill causeways are proposed to extend about 2 km out from shore, past the minus 5 m contour. As indicated in a previous section several species of anadromous fish utilize a narrow feeding and migration corridor, primarily within the 5 m contour. Many of these anadromous species probably depend on the less saline and warmer waters occurring nearshore. The causeways may cause current, sediment transport, temperature and salinity changes and could block fish migrations or force them out into cooler, more saline water. The 2.8 km causeway at Prudhoe Bay in the Alaska sector of the Beaufort Sea has altered the marine environment (Craig and Griffiths, 1981). Adult tagging studies indicated that the causeway did not impede the westward movements of large anadromous ciscos. The effects of the Prudhoe Bay causeway on eastward migrating fish and on smaller, immature and possibly more sensitive anadromous fish has not been reported upon. Recent evidence does indicate that during certain

oceanographic conditions (with onshore currents) the abundance of fish in the vicinity of the causeway is reduced (W. McNeill, personal communication). Additional causeways may alter near-shore temperature/salinity regimes further and the cumulative effect of these changes may be of significant consequence to anadromous fish which rely on brackish coastal waters (Craig and Griffiths, 1981). Design changes to eliminate the need for solid fill causeways or the introduction of fish passage facilities through the causeways are considered essential. If significant design changes are proven to be infeasible and if the facility cannot be sited off the coastal migration route then further cause-effect studies should be undertaken to determine if fisheries concerns can be otherwise dealt with.

The Department of Fisheries and Oceans is prepared to cooperate fully with government and industry in this phase of a review to ensure that the fisheries resource is protected while at the same time resolving the needs of the hydrocarbon industry.

Summary

The neashore coastal environment of the Beaufort Sea supports important stocks of marine and anadromous fish and marine mammals. Shorebases, as proposed for Yukon coastal waters would

alter the shorezone occupied by dense concentrations of anadromous fish and could potentially impact those fish. Water use and use of backup lands could impact freshwater fish stocks. Vessel traffic movements including ice breakers could potentially impact marine mammal stocks. In view of these potential impacts we believe shorebase sites should be shared in order to reduce the overall risks to the fisheries resources. The location for the shorebase should be carefully chosen to minimize potential impacts. On the basis of fisheries information examined to date it is apparent that shorebase development west of Kay Point should be strongly discouraged. Our Department is prepared to contribute to a siting exercise designed to select a suitable site for a shorebase and we have listed various fisheries criteria which should be considered in such an exercise. Once an environmentally acceptable location is selected a thorough review of the proposal should be implemented and appropriate mitigative measures developed to further reduce or avoid problems to the fisheries resources.

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ANADROMOUS AND MARINE FISH SPECIES DOCUMENTED
IN THE BEAUFORT SEA

Species	Common Name
ANADROMOUS	
Lampreys:	
Lampetra japonica	Arctic lamprey
Salmonids:	
Coregonus autumnalis	Arctic cisco
Coregonus clupeaformis	humpback whitefish
Coregonus nasus	broad whitefish
Coregonus sardinella	least cisco
Coregonus laurettae	Bering cisco
Oncorhynchus gorbuscha	pink salmon
Oncorhynchus keta	chum salmon
Oncorhynchus tshawytscha	chinook salmon
Oncorhynchus nerka	sockeye salmon
Prosopium cylindricaem	round whitefish
Salvelinus alpinus	Arctic char
Stenodus leucichthys	inconnu
Smelts:	
Osmerus eperlanus	boreal smelt (Arctic rainbow smelt)
MARINE	
Herring:	
Clupea harengus pallasii	Pacific herring
Smelts:	
Mallotus villosus	capelin

ANADROMOUS AND MARINE FISH SPECIES DOCUMENTED
IN THE BEAUFORT SEA
(Cont'd)

Species	Common Name
MARINE (Cont'd)	
Sticklebacks:	
Pungitius pungitius	ninespine stickleback
Cods:	
Arctogadus glacialis	polar cod
Boreogadus saida	Arctic cod
Eleginus navaga	saffron cod
Sculpins:	
Artediellus scaber	rough hookear sculpin
Gymnocanthus tricuspis	Arctic staghorn sculpin
Icelus bicornis	twohorn sculpin
Icelus spatula	spatulate sculpin
Myoxocephalus quadricornis	fourhorn sculpin
Myoxocephalus scorpioides	Arctic sculpin
Triglops pingeli	ribbed sculpin
Poachers and Alligator fishes:	
Aspidophoroides olriki	Arctic alligatorfish
Lumpfishes and Seasnails:	
Eumicrotremus derjugini	leatherfin lumpsucker
Liparis herschelinus	bartail seasnail
Liparis koefoedi	gelatinous seasnail
Sandlances:	
Ammodytes hexapterus	Pacific sand lance

ANADROMOUS AND MARINE FISH SPECIES DOCUMENTED
IN THE BEAUFORT SEA
(Cont'd)

Species	Common Name
MARINE (Cont'd)	
Pricklebacks:	
Eumesogrammus praeciscus	fourline snakeblenny
Lumpenus fabricii	slender eelblenny
Lumpenus macultus	shanny
Lumpenus medius	stout eelbenny
Eelpouts:	
Gymnelis viridis	fish doctor
Lycodes mucosus	saddled eelpout
Lycodes polaris	polar eelpout
Lycodes ~~reposi~~ rossi	Ross's eelpout
Anglerfishes:	
Ceratias holbölli	deepsea angler
Flatfishes:	
Liopsetta glacialis	Arctic flounder
Platichthys stellatus	starry flounder

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FRESHWATER FISH SPECIES
IN BEAUFORT SEA DRAINAGES

Species	Common Name
Thymallus arcticus	Arctic grayling
Salvelinus alpinus	Arctic char
Salvelinus namaycush	Lake trout
Stenoclus leucichtys (Stenodus leucichthys)	Inconnu
Coregonus clupeaformis	Humpback whitefish
Coregonus cylindraceum	Round whitefish
Coregonus nasus	Broad whitefish
Coregonus sarda	Least cisco
Esox lucius	Northern pike
Lota lota	Burbot
Myoxocephalus quadricornis	Fourhorn sculpin
Mypomensus olidus	Pond smelt

~ d35glebrief

Topics and DFO Participation

WHITEHORSE (1-3 December)

General Spokesman/Coordinator	G. Ennis, Vanc
General Resource People	A. Von Finster, Whitehorse G. Zealand, Whitehorse
Opening Statement (1 Dec. a.m.)	F. Boyd, Vanc

Environmental Effects of Yukon Developments (1 Dec. p.m., eve.)

- Shorebases - number, location, scale — G. Ennis, Vanc
  - construction effects
  - operation effects
  - Discussion Paper #5
- Roads - locations, construction materials, sources, use.
- Quarries.
- Wildlife disturbance - sources, species (fish, whales).
- Environmental Assessment (e.g. caribou?) see Resolute Bay.

Socio-Economic Effects (2 Dec. a.m., p.m.)

- Changes to harvesting due to impacts.

Government Management (3 Dec. a.m.) — F. Boyd, Vanc

- Role of Yukon Government.
- Regional planning, Parks proposal.

Other Concerns (3 Dec. p.m.)

Closing Statement (3 Dec. p.m.)

Yellowknife General Session

Opening Statement

Government of Canada / Gouvernement du Canada
Fisheries and Oceans / Pêches et Océans

Your file / Votre référence

Our file / Notre référence

25 November 1983

Mr. D. Marshall
Executive Secretary
Beaufort Sea Environmental Assessment Panel
700 - 789 West Pender Street
VANCOUVER, B.C.
V6C 1H2

Dear Mr. Marshall:

Please find enclosed the Department of Fisheries and Oceans opening statement which will be presented at the Panel's Yellowknife session. Also included are resumes for Mr. J. Stein and Mr. A. Barber who will be participating in the Yellowknife hearings.

Sincerely,

G. H. Lawler
Director General
Western Region

/sa

cc: F. J. O. Josephson
[redacted]
J. N. Stein
A. Barber

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DEPARTMENT OF FISHERIES AND OCEANS

OPENING STATEMENT

TO THE

BEAUFORT SEA

ENVIRONMENTAL ASSESSMENT PANEL

YELLOWKNIFE

5 DECEMBER 1983

Presented by

F.J.O. JOSEPHSON

DIRECTOR, ARCTIC OPERATIONS

WESTERN REGION

Mr. Chairman,

I welcome this opportunity to present to the Panel further observations from the Department of Fisheries and Oceans on the Beaufort Sea Hydrocarbon Production Proposal. My name is Rick Josephson and I am the Director of the Arctic Operations Group of the Department's Western Region, which has the fish and marine mammal management responsibility for the Northwest Territories and most Arctic marine waters.

The Department has provided you with several documents relevant to the Proposal, including a description of the Department's mandate and relevant programmes, its technical reviews of the Proponents' Environmental Impact Statement and Supplementary Information, and its scientific assessments of the effects of vessel traffic on Arctic marine mammals and of oil on Arctic marine fish and marine mammals.

DFO has evaluated the technical aspects of the Beaufort Sea Hydrocarbon Production Proposal in the context of the departmental responsibility for:

- the management and protection of fish and marine mammal resources, their habitats, and associated subsistence, recreational and commercial use of those resources;
- the protection of marine and freshwater environmental quality; and
- the provision of hydrographic and oceanographic information and advice related to the safety of facilities and personnel from the hazards of the marine environment.

Given these responsibilities in the Arctic, the Department advocates an approach to Beaufort Sea hydrocarbon development which will ensure the long-term well-being of the fish and marine mammal resources. The Department's

technical reviews were approached from this perspective to make sure that all concerns related to possible impacts on fish and marine mammals and the aquatic environment are identified and considered at the early stages of any planning for the development of Beaufort Sea hydrocarbons.

Damage to Canada's fisheries resources and to the marine and freshwater environment can often be avoided by:

- mitigating potential problems through design, construction and operational adjustments;
- encouraging the selection of alternative sites;
- restoring the quality of damaged habitats; and
- if necessary, prohibiting certain proposed activities that could severely damage fish, marine mammals or their habitat.

I also would like to point out that the Department is committed to "cooperative resource planning" with industry and other government agencies as a means of incorporating departmental concerns into air, water and land use plans.

Therefore, if the decision is made to proceed with Beaufort Sea hydrocarbon development, it is within this context and mandate that the Department of Fisheries and Oceans expects to work cooperatively with industry, other government agencies and northern residents.

In its technical reviews of the EIS and Supplementary Information, DFO addressed eleven topics of major concern to the Department. These were discussed at previous sessions of this Panel.

When assessing the overland pipeline option for Beaufort Sea Production, our reviewers concluded that while the existing information may be sufficient for a concept, the specifics necessary to assess accurately the likely impacts

to aquatic resources are NOT ADEQUATE. Of particular concern are the following:

- The corridor shows only approximate stream crossing lcoations. Site specific data on fish and their habitat have not been provided.
- Specific facilitiy locations such as pumping stations, construction camps, stockpile sites, wharfs, etc. are not provided. Potential impacts on fish, their habitats or on fishing activities only can be generalized.
- While a number of potential sources of granular materials have been identified, preferred sources and their proximity to water bodies have not been indicated.
- Other than the Mackenzie River, sources for water withdrawal are not identified. The effects that withdrawal may have on fish and their habitats have not been assessed.

Although we lack necessary specifics for the project, our reviewers further noted that the potential impact to aquatic resources resulting from construction and operation of such a project could be minimized since:

- The existing environmental data base for the Mackenzie Valley is extensive.
- A number of standard and accepted remedies or countermeasures for northern construction are being called for.
- Such a project would generally involve proven technology and will further benefit from experience gained through construction of the Alyeska and Norman Wells Pipelines.

The Department of Fisheries and Oceans has therefore concluded that the construction and operation of a pipeline in the Mackenzie Valley would be acceptable with the completion of studies necessary to support a final project design, and if the sensitivity and importance of fish and fish habitat are reflected in the location, design and operation of the pipeline.

Finally Mr. Chairman I would like to introduce Mr. Jeff Stein and Mr. Mike Lawrence of my staff who are prepared to discuss any technical issues related to fisheries which may arise at these hearings. Mr. Al Barber of our Regional Economics and Marketing Services Group will also be in attendance during the discussions on socio-economic effects. If any question arises that we cannot adequately deal with here, we shall take it on notice and provide you with an answer as soon as possible.

I would further like to indicate that the Department is developing positions on a number of topics associated with the Beaufort Sea Production Proposal. These will be presented to you at or before the Ottawa General Session.

I trust these arrangements will meet the Panel's needs. Thank you very much for this opportunity to address you today.

Intervention on Pipeline Construction

Government of Canada | Gouvernement du Canada
Fisheries and Oceans | Pêches et Océans

Your file Votre référence

Our file Notre référence

29 November 1983

Mr. D. W. I. Marshall
Executive Secretary
Beaufort Sea Environmental Assessment Panel
Federal Environmental Assessment & Review Office
700 - 789 West Pender Street
VANCOUVER, B.C.
V6C 1H2

Dear Mr. Marshall:

Please find enclosed a copy of the Department of Fisheries and Oceans intervention on the effects of pipeline construction on aquatic resources. This will be presented by Mr. J. N. Stein of our office during the Yellowknife session of the Beaufort Sea hearings.

Yours truly,

G. H. LAWLER
Director General
Western Region

/sa

cc: F.J.O. Josephson
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DEPARTMENT OF FISHERIES AND OCEANS

INTERVENTION ON CONSTRUCTION EFFECTS TO THE BEAUFORT SEA ENVIROMENTAL ASSESSMENT PANEL

YELLOWKNIFE

6 December 1983

Presented by

Mr. J. N. Stein

Head, Resource Impact Division

Western Region

Mr. Chairman:

While this intervention is intended to address the effects of pipeline construction, I wish to point out to the Panel that it also touches on other topics to be discussed at these hearings including operations effects, environmental assessment, research and monitoring. I also understand that the Panel has already received Department of Fisheries and Oceans recommendations as to research and monitoring needs, including those related to the pipeline option.

The construction of an overland pipeline poses many potential impacts to aquatic resources. While the Department of Fisheries and Oceans recognizes that many threats cannot be completely eliminated, it is felt that losses of fish or fish habitat can be held to acceptable levels if appropriate protective measures are included in the design of such a project as well as during its construction.

There are seven major aspects of the pipeline proposal which are of concern to DFO. These include the locations and effects of ancillary facilities, construction and maintainance of permanent and temporary roads, pipe testing and fluid disposal, accidental oil spills, stream and channel crossings, granular borrow sites and blasting.

Ancillary facilities is intended to include such things as pumping stations, airstrips, stockpile sites, and wharfs. These facilities are often located adjacent to waterbodies creating problems associated with accidental spills, waste disposal, water withdrawal and increased sport fishing pressure. Many of these problems can be eliminated at the design stage by locating facilities away from waterbodies and by complying with existing regulations governing the treatment and disposal of wastes, sewage effluents

or process waters. Similarly, wharfs can be located away from fishing areas so as to avoid interference with subsistence or commercial fishing operations. Field studies can usually identify waterbodies of little or no importance to aquatic resources where water can be extracted for camp use, field flooding, processing or other uses.

Permanent and temporary roads can result in impacts associated with increased sedimentation or flow diversions at stream crossings, blockages to fish migrations, or with the withdrawal of water for the construction of ice roads. Again, many of these impacts can be avoided or minimized at the design stage by selecting road alignments and crossing sites so as to avoid waterbodies or areas of critical fish habitat, bank instability, etc. Slope stabilization techniques must adequately protect streams from increased sedimentation. Similarly, culvert crossings can be designed and constructed so as to provide easy passage for resident fish species. Instream construction can usually be timed so as to avoid concentrated fish populations such as during spawning or migration periods. Water withdrawal sites can be selected so as to avoid areas of critical fish habitat.

Pipeline testing and the disposal of testing fluids also pose threats to aquatic resources in that large volumes of water are required as is a freeze depressant, such as methanol, which can be toxic to aquatic organisms. To eliminate or minimize impacts, studies should be conducted to identify waterbodies where water can be extracted for testing purposes with little or no effect on aquatic resources. When possible, non-toxic or low toxicity freeze depressants should be used for testing purposes and suitable techniques for the handling of wastes should be sought, such as transport to a suitable disposal area. It will also be necessary to develop appropriate contingency plans for the control and cleanup of accidental spills.

Accidental oil spills and their effects on aquatic resources are of particular concern to DFO since it is difficult to accurately predict these effects as well as the effectiveness of mitigative measures. Research is required to improve our predictive capabilities regarding total areas likely to be affected, the nature and rates of recovery, and the resources affected, for all seasons and for winter in particular. Suitable contingency plans will be required for the early detection, control and cleanup of accidental spills, especially during the winter months. Efforts are required to develop new or improved techniques for leak detection, particularly for marine crossings, and spill tracking for all seasons and flow conditions.

Activities associated with the construction of stream or channel crossings can effect aquatic resources through the physical disruption of habitat during trenching operations, through increased levels of suspended sediment resulting from instream activities as well as bank clearing or slope failure or by diverting stream flows away from important habitat areas. For the most part these problems can be minimized by selecting crossing sites which avoid areas of critical fish habitat or bank instability or by timing instream construction activities so as to avoid concentrated fish populations. The application of appropriate erosion control and bank stabilization techniques, where necessary, can considerably reduce the amounts of sediment entering streams at crossing locations.

A project of this nature and magnitude will also require large quantities of granular materials for the construction and maintenance of roads, pumping stations, work pads, stockpile sites and airstrips. Because of the general importance of river or lake deposits of granular materials as fish habitat, DFO recommends that granular material sites not be located within the active flood plains or high level marks of waterbodies. Material sites should

also be developed in such a way that an appropriate buffer strip is left between the site and any waterbody of importance to aquatic resources.

Finally, DFO has concerns associated with blasting operations for seismic delineation, or pipeline trenching. Such operations in or near waterbodies can result in physical alteration of fish habitat or direct fish mortalities. Once again, the impacts can be minimized during the route selection process by locating crossing sites away from areas of critical fish habitat. In addition, it is often possible to time blasting activities such that they avoid periods of concentrated fish resources.

Mr. Chairman, it was apparent from the Beaufort Sea EIS that the proponents are aware of the potential impacts to aquatic resources which could result from the construction of an overland pipeline. The proponents also indicated that special effort will be required to mitigate these impacts, including many of the methods outlined above. However, DFO reviewers encountered difficulties with the EIS in that it presented a concept rather than a specific development proposal. As such it lacked the specifics necessary to assess accurately the likely impacts to aquatic resources or the effectiveness of the proposed mitigative measures.

Nevertheless, there were a number of factors which led us to conclude that potential impacts to aquatic resources could be successfully minimized. For instance:

- The existing environmental data base for the Mackenzie Valley is extensive.
- A number of standard and accepted remedies or coutermeasures for northern construction are being called for.
- Such a project would generally involve proven technology and could benefit from experience gained through construction of the Alyeska and Norman Wells pipelines.

In conclusion Mr. Chairman, it is the opinion of the Department of Fisheries and Oceans that with the completion of studies necessary to support a final project design and with the adoption of appropriate construction techniques, construction schedules, pipeline alignment and mitigative measures, it should be possible for impacts to aquatic resources from an overland pipeline in the Mackenzie Valley to be kept to an acceptably low level. Should the decision be made to proceed with the pipeline option for Beaufort Sea production, the Department is prepared to work closely with the proponents to ensure that area fish resources and their habitats are adequately protected.

I would be pleased to answer any questions.

Thank you Mr. Chairman.

Intervention on Government Management

DEPARTMENT OF FISHERIES AND OCEANS

SUBMISSION ON GOVERNMENT MANAGEMENT TO THE BEAUFORT SEA ENVIRONMENTAL ASSESSMENT PANEL

YELLOWKNIFE

DECEMBER 8, 1983

PRESENTED BY:

Mr. J.N. Stein

Head, Resource Impact Division

Western Region

Mr. Chairman:

If I may I would like to read in a brief statement on Government Management as we see it relating to the Department of Fisheries and Oceans. My comments will touch on three (3) topics, specifically, Government Regulation, Field Inspection and Monitoring.

Concerning Government Regulation, there has been considerable discussion on existing methods as well as alternatives such as the one "Agency" approach.

The Department has stated in previous hearings that it supports the one window approach for regulating and permitting industrial development in the Northwest Territories.

Since licences or permits are issued under the legislation of other departments, it is the responsibility of the Inspection Officers of those departments to ensure that terms and conditions of the licence are adhered to. However, should those conditions not meet the regulatory requirements of the Department of Fisheries and Oceans, or where industries' activities result in violation under the Fisheries Act, the Department of Fisheries and Oceans

retains the right to act independently to enforce the provisions of the Fisheries Act. It is worthwhile noting that this course of action has not yet had to be followed by the Department of Fisheries and Oceans in the Northwest Territories.

D.I.A.N.D.'s regulatory review may or should improve and clarify the one window approach for all parties involved.

The issue of Field Inspection is one which greatly concerns the Department of Fisheries and Oceans. At the present time, our Department has sixteen (16) Fishery Officers stationed across the Northwest Territories. In addition to their regular duties, it is recognized that adjustments will have to be made to provide the Department with a field inspection capability in association with major construction projects.

In the case of the Norman Wells project, the Department of Fisheries and Oceans is opening an office in Fort Simpson in January 1984. The primary responsibility of the Officer-In-Charge will be to conduct surveillance of construction activities, to identify and deal with

fish and fish habitat problems. He will be assisted by officers, on a part-time basis, from the Hay River and Inuvik offices, as well as other officers on an opportunistic basis. In addition, the staff associated with our pipeline monitoring project will provide surveillance assistance when possible should the Beaufort Sea pipeline proceed, similar staff commitments will have to be made.

I do not wish to leave the Panel with the impression that the Department of Fisheries and Oceans considers its' inspection capability to be adequate to meet expected demands. However, with existing staff, any further commitment will result in regular duties being neglected. The Department of Fisheries and Oceans has repeatedly identified to Government its' need for increased enforcement staff, its' last attempt being through the NOGAP program. Our attempts to date have not been successful and in fact, our NOGAP proposal related to incremental enforcement needs has been rejected.

We will continue however, to identify this as a deficiency in our ability to manage Beaufort Sea hydrocarbon developments.

I would now like to provide the Panel with a brief outline of the Department of Fisheries and Ocean's past monitoring activities in the Valley as well as our current Norman Wells Pipeline Monitoring Project. As we indicated earlier, the Department of Fisheries and Oceans has been conducting impact related studies in the Beaufort Sea/Mackenzie Valley Region for the last thirteen (13) years, with varying success I might add.

For instance, our Mackenzie Highway Monitoring Study had collected two (2) years of pre-construction data before Government halted construction, without having crossed the streams under study. On the other hand, several years of monitoring and surveillance efforts were associated with construction of the Liard Highway. We are quite satisfied with the results of our efforts to minimize habitat impacts and to ensure adequate fish passage designs for culvert crossings.

Currently we are conducting an effects monitoring program on the Norman Wells Pipeline. The objective of these efforts will be to determine the effects on fish and fish habitat of winter stream crossing construction and year-round operation of the pipeline. It is designed as a five (5) year study involving two (2)

permanent employees, plus casual staff at an estimated annual A-based cost of $70,000.00. I am prepared to discuss the details of this study if the Panel wishes.

We will try and answer any questions you may have of us.

Closing Statement

DEPARTMENT OF FISHERIES AND OCEANS

CLOSING STATEMENT

TO THE

BEAUFORT SEA

ENVIRONMENTAL ASSESSMENT PANEL

YELLOWKNIFE

9 DECEMBER 1983

Presented by

Mr. J. N. Stein

Head, Resource Impact Division

Western Region

Mr. Chairman,

The Department of Fisheries and Oceans would like to express its appreciation for the opportunity to participate in the Panel's Yellowknife session. DFO had stated during the hearings that with the completion of studies necessary to support a final project design and with the adoption of appropriate construction techniques, construction schedules, pipeline alignment and mitigative measures, it should be possible for impacts to aquatic resources from an overland pipeline in the Mackenzie Valley to be kept to an acceptably low level. While DFO has not heard reasons to justify altering this conclusion, there were issues raised during the hearings which are deserving of final comment.

With regard to oil toxicity, we believe that the Panel has benefitted from additional information presented by the proponents regarding the effects of a summer oil spill into the Atigun River. We do not quarrel with the predicted fate of a 700 barrel oil spill into the Great Bear River. However, we remain unchanged in our concern regarding a prolonged, undetected wintertime leak of crude oil or the accidental discharge of the more toxic refined products such as fuel oils and lubricants.

We would also like to reiterate to the Panel that as a Department we are committed to providing both the regional baseline physical and biological information and the enforcement capability that has been legislated as our mandate to provide. However, we do have reservations regarding our capability at current resource levels to meet, within the required time frame, public expectations of us.

In addition Mr. Chairman, DFO has filed with the Panel a list of studies which we feel are required should a Beaufort Sea/Mackenzie Valley pipeline

become a reality. The list includes time frames, and proposed responsible parties. Should the Panel feel further details are required on these proposals DFO is prepared to respond.

I understand that during the Inuvik general session the Panel had questioned DFO's preparedness to respond to an oil spill in the Beaufort Sea. We had anticipted that this topic would be discussed further during these hearings. While it has not, I would like to table a DFO document entitled "Scientific Studies to be Conducted in Response to an Oil Spill in the Beaufort Sea" as well as a report by Donald Mackay entitled "Scientific Response to Spills of Opportunity". We would be happy to discuss these further at the request of the Panel.

In conclusion Mr. Chairman, I wish to point out for the benefit of the proponents and other intervenors that the Department of Fisheries and Oceans Position Statement is finally in the hands of the Panel. I regret the delay in making it available but trust you will find it of assistance in your deliberations. We look forward to further discussions in Ottawa. Thank you.

Topics and DFO Participation

YELLOWKNIFE (5-9 December)

General Spokesman/Coordinator	J. Stein, FWI
General Resource People	M. Lawrence, FWI D. Dowler, YK D. Moshenko, YK B. Wong, YK
Opening Statement (5 Dec. a.m.)	R. Josephson, FWI
Overland Pipeline (5 Dec. p.m., eve.; 6 Dec. p.m., eve.) - Alternatives - size, routing timing flowrates, hot or cold, buried or elevated. - Construction effects including associated activities. - Operation effects including maintenance and oilspills. - Environmental assessment (e.g. caribou?) see Resolute Bay.	J. Stein, FWI R. Josephson, FWI M. Lawrence, FWI
Socio-Economics Effects (7 Dec, a.m., p.m., eve.; 8 Dec. p.m.) - See other sections. - Compensation.	A. Barber, FWI
Government Management (8 Dec. eve.) - Role of NWT Government. - Research and monitoring. - Wildlife management. - Regional planning.	J. Stein, FWI
Other Concerns (9 Dec. a.m.)	
Closing Statement (9 Dec. p.m.)	J. Stein, FWI

Calgary General Session

Topics and DFO Participation

CALGARY (12 Dec.)

DFO
Participants

Observer

L. de March,
FWI

Opening Statement (12 Dec. a.m.)

General Concerns (12 Dec. a.m., p.m.)

Closing Statement (12 Dec. p.m./eve.)

Ottawa General Session

Opening Statement

DEPARTMENT OF FISHERIES AND OCEANS

OPENING STATEMENT

TO THE

BEAUFORT SEA

ENVIRONMENTAL ASSESSMENT PANEL

OTTAWA

14 DECEMBER 1983

Presented by

Dr. G. H. Lawler

Director-General

Western Region

Mr. Chairman,

Throughout the hearings, DFO has stressed its mandate, the framework within which we have reviewed the EIS and the role that we have played in the review process. I will not repeat these details, but it is important to stress that the Department is committed to "cooperative resource planning" as a means of incorporating departmental concerns into air, water and land use plans in conjunction with industry and other government agencies. Therefore, if the decision is made to proceed with Beaufort Sea hydrocarbon development, the Department of Fisheries and Oceans expects to work cooperatively with industry, other government agencies and northern residents in protecting fish and marine mammal resources, their habitats, associated fisheries, and the marine and freshwater environments. The Department also plans to continue and accelerate oceanographic research, hydrographic surveys and the development of ocean and ice information services related to the safety of offshore development and arctic shipping.

I would like to take this opportunity to summarize for you the Department's positions on the overall concept of the Beaufort Sea Hydrocarbon Production Proposal, on specific aspects of the Proposal and on management of Beaufort Sea hydrocarbon development.

The Department of Fisheries and Oceans has evaluated the Beaufort Sea Hydrocarbon Production Proposal in the context of departmental responsibilities for the management and protection of fish and marine mammal resources, their habitats and associated fisheries, for the protection of marine environmental quality and for the provision of environmental design criteria related to the safety of facilities and personnel from the hazards of the marine environment. Five other factors considered were 1) departmental policies on other arctic hydrocarbon developments and on environmental operating conditions for specific activities, 2) the conceptual nature of the Proposal, 3) uncertainty of impacts from technology which has not been fully tested under winter arctic conditions, 4) the gaps in knowledge of arctic aquatic ecosystems, and 5) the inadequacies of the assessments in the Environmental Impact Statement and the Supplementary Information.

Overall, the Department has concluded that:

- Development is unacceptable in areas used by year-round or high seasonal concentrations of fish and marine mammals and which are considered habitats critical to the continued productivity and well-being of such populations.

- Development should occur at a rate commensurate with the demonstration of safety, reliability and environmental acceptability.

- On land production facilities and a Mackenzie Valley pipeline is conditionally acceptable.

- Only demonstration projects for subsea pipelines, offshore production facilities and year-round marine transportation of hydrocarbons may proceed at this time.

- Expansion of offshore production and transportation should be considered only after the demonstration projects have been shown to be safe, reliable and environmentally acceptable.

- Specific projects must be subject to the requirements of regional land use plans, environmental assessment, the regulatory process, and research and monitoring.

The Department's positions on specific aspects of the Proposal are:

- The development of production facilities on land is conditionally acceptable;

- The acceptability of offshore production facilities is undetermined, but the Department would find demonstration projects to be conditionally acceptable;

- The development of new shorebases or ports is unacceptable in critical habitat areas;

- New harbour development west of Kay Point is strongly discouraged;

- The construction of a new port elsewhere along the Beaufort Sea coast would be conditionally acceptable;

- Marine transportation of arctic liquified natural gas (LNG) or oil through the Northwest Passage during the ice-free season would be conditionally acceptable;

- A demonstration project to test winter marine transportation of LNG in arctic waters would be conditionally acceptable;

- DFO is unable to determine the acceptability of full-scale shipping of oil through the Parry Channel and Lancaster Sound during the ice-covered season, because considerable uncertainty exists respecting the potential effects of noise and physical presence of ships on marine mammals, and the potential impact on fish and marine mammals should an oil spill occur. Recognizing the uncertainty of these issues, the Department would be prepared to accept shipment of oil in winter on a demonstration basis under conditions specified in our position statement.

- The acceptability of subsea pipelines is undetermined but a demonstration project would be conditionally acceptable;

- The construction of an overland pipeline in the Mackenzie Valley would be conditionally acceptable.

The management of Beaufort Sea hydrocarbon development must address not only the effective and economic production and transportation of oil and gas to markets, but also allow for adequate safeguards to ensure that federal departments and agencies with responsibilities for the environment or social welfare in the North can fulfill their obligations. The Department of Fisheries and Oceans recommends the following criteria to guide the Panel:

- The "Lancaster Sound planning principles" should be adopted to guide Beaufort Sea development;

- A regional planning process for the Beaufort Sea Region, Mackenzie Valley and Northwest Passage should be initiated as soon as possible, and specific plans should be approved for the affected areas;

- Aboriginal hunting and fishing rights must be respected and the resources to which they apply, safeguarded;

- All specific projects must be subject to environmental assessment and review;

- Outstanding deficiencies in the understanding of safety issues and risks to fish and marine mammal resources should be addressed in an accelerated program of research and monitoring by both government and industry;

- Specific mechanisms to coordinate research and monitoring between government and industry should be established;

- Research requirements should be stipulated as part of conditions imposed on demonstration or development projects and should complement research programs and results under the Environmental Studies Revolving Fund, Environmental Advisory Committee on Arctic Marine Transportation, land use plans and other programs;

- Results from research and monitoring must be incorporated into the planning, construction, operating, and decision-making processes;

- In addition, the Department has provided you with a list of suggested mitigative measures for specific activities which should be used as guidance for any Beaufort Sea hydrocarbon development.

- Also in response to the Panel's request at Resolute Bay, the Department has provided you with an outline of current DFO research and perceived research priorities related to Beaufort Sea hydrocarbon development.

The Department is looking forward to the opportunity to discuss these positions and any related matters with the Panel tomorrow afternoon. Then, the Department will be represented by Mr. Gary Vernon who is Assistant Deputy Minister for Pacific and Freshwater Fisheries, Dr. Neil Campbell who is Director General of the Marine Sciences and Information Directorate, and myself.

Thank you.

Closing Statement

DEPARTMENT OF FISHERIES AND OCEANS

CLOSING STATEMENT

TO THE

BEAUFORT SEA

ENVIRONMENTAL ASSESSMENT PANEL

OTTAWA

16 DECEMBER 1983

Presented by

Dr. G. H. Lawler

Director-General

Western Region

MR. CHAIRMAN,

DURING THESE HEARINGS, THE DEPARTMENT OF FISHERIES AND OCEANS HAS HAD THE OPPORTUNITY TO DISCUSS ITS CONCERNS ABOUT THE BEAUFORT SEA HYDROCARBON PRODUCTION PROPOSAL WITH THE PANEL, ITS TECHNICAL ADVISORS, THE PROPONENTS AND THE OTHER INTERVENORS.

THE DEPARTMENT'S DETAILED TECHNICAL COMMENTS ON THE PROPOSAL WERE PROVIDED TO THE PANEL IN OUR REVIEWS OF THE EIS AND THE SUPPLEMENTARY INFORMATION. THE DEPARTMENT ALSO HAS RESPONDED TO SPECIFIC REQUESTS FOR INFORMATION FROM THE PANEL. FINALLY, THE DEPARTMENT HAS PROVIDED THE PANEL WITH OUR POSITION STATEMENT ON THE PROPOSAL. THESE POSITIONS ARE BASED ON CURRENT INFORMATION AND ANALYSIS, AND AS NEW INFORMATION BECOMES AVAILABLE THESE POSITIONS WILL BE AMENDED ACCORDINGLY.

IN THIS CONTEXT, THE DEPARTMENT WISHES TO STRESS THAT IT IS AVAILABLE FOR ANY FURTHER DISCUSSIONS AND CLARIFICATION OF ISSUES WITH THE PANEL AND PROPONENTS.

THE DEPARTMENT HAS BENEFITTED FROM ITS INVOLVEMENT IN THIS PANEL PROJECT, AND THANKS THE PANEL FOR PROVIDING US WITH THE OPPORTUNITY TO MAKE OUR VIEWS AND CONCERNS KNOWN.

WE WISH THE PANEL WELL IN ITS DELIBERATIONS, AND LOOK FORWARD TO SEEING YOUR REPORT.

THANK YOU.

Topics and DFO Participation

OTTAWA (14-16 Dec.)	DFO Participants
Coordinators	R. Paterson, FM HQ K. Yuen, OSS HQ
General Resource People	See Attached List
Opening Statement (14 Dec. a.m.)	H. Lawler, FWI
Interventions (14 Dec. a.m., eve.; 15 Dec. a.m., eve.)	See Attached List
Government Departments	See Attached List
Department of Transport (14 Dec. p.m.)	
Department of Energy, Mines and Resources (14 Dec. p.m.)	
Department of Environment (15 Dec. p.m.)	
Department of Fisheries and Oceans (15 Dec. p.m.)	G. Vernon, FM HQ G. Ewing, OSS HQ H. Lawler, FWI N. Campbell, OSS HQ R. Josephson, FWI
Department of Indian Affairs and Northern Development (16 Dec. a.m., p.m.)	
Canada Oil and Gas Lands Administration (16 Dec. p.m.)	
Closing Statement (16 Dec. p.m.)	H. Lawler, FWI

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DFO ATTENDANCE AT OTTAWA GENERAL SESSION

	December 14			December 15			December 16	
	AM	PM	EVE	AM	PM	EVE	AM	PM
G. C. Vernon					X			
G. N. Ewing					X			
G. H. Lawler	X	X			X		X	X
N. J. Campbell	X				X			
G. L. Robins					X	X		
K. B. Yuen		X			X		X	X
M. P. Adam	X	X		X	X		X	X
J. O'Shea					X			
R. J. Paterson		X			X		X	X
K. Brown	X	X			X	X	X	X
F. J. O. Josephson					X		X	X
J. N. Stein	X	X		X	X			
L. de March	X	X	X	X	X		X	X
R. McV. Clarke	X	X	X	X	X	X	X	X