

The Honourable Ralph Goodale, P.C., M.P.  
Natural Resources Canada  
House of Commons  
Ottawa, Ontario  
K1A 0A6

The Honourable Robert Nault, P.C., M.P.  
Indian Affairs & Northern Development  
House of Commons  
Ottawa, Ontario  
K1A 0A6

Dear Ministers:

On behalf of the Environmental Studies Research Funds Management Board, it is my pleasure to submit the 1999 Annual Report for the Environmental Studies Research Funds in accordance with the *Canada Petroleum Resources Act*, paragraph 79(1)d.

Sincerely yours,

Bonnie J. Gray  
Chair  
Environmental Studies Research Funds  
Management Board

**ENVIRONMENTAL STUDIES RESEARCH FUNDS**

**ANNUAL REPORT**

**1999**

**FEBRUARY 2000**

## **Environmental Studies Research Funds Profile**

The Environmental Studies Research Funds (ESRF) is a research program which sponsors environmental and social studies designed to assist government decision making related to oil and gas exploration and development on Canada's frontier lands. The ESRF program, which was initiated in 1983 under the *Canada Oil and Gas Act (COGA)*, now receives its legislated mandate through the superseding legislation, the *Canada Petroleum Resources Act (CPRA)* proclaimed in February 1987. Funding for the ESRF is provided through levies on frontier lands paid by interest holders such as the oil and gas companies. The ESRF is directed by a joint government/industry/public Management Board and is administered by a small secretariat which resides within the Operations Business Unit of the National Energy Board office in Calgary, Alberta.

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1. Background on the Structure and Operation of the Funds

The purpose of the Environmental Studies Research Funds (ESRF) is to finance environmental and social studies pertaining to the manner in which, and the terms and conditions under which, petroleum exploration, development and production activities on frontier lands should be conducted. Section 101(1) of the *Canada Petroleum Resources Act (CPRA)* defines an environmental study as Awork pertaining to the measurement or statistical evaluation of the physical, chemical, and biological elements of the lands, oceans, or coastal zones, including winds, waves, tides, currents, precipitation, ice cover and movement, icebergs, pollution effects, flora and fauna, both onshore and offshore, human activity and habitation, and any related matter@.

The Environmental Studies Research Funds (ESRF) are directed by a twelve-member Management Board which has representation from the federal government, the regional petroleum boards, the oil and gas industry, and the general public. Bonnie J. Gray, Professional Leader, Environment of the National Energy Board, is the current chairperson of the ESRF Management Board.

The ESRF Management Board directs the conduct of the business of the ESRF, sets priorities for study topics, determines the program budget, and facilitates the development of study proposals on behalf of the Minister of Natural Resources Canada and the Minister of Indian Affairs and Northern Development.

The program operates on calendar year basis. The Board generally meets on a semi-annual basis; however, the frequency of meetings is adjusted as circumstances dictate. The Board assesses the information requirements of government and industry to determine priorities for the study program for the coming year. The budget to support the study program and the administrative costs forms the basis for the calculation of the levy rate schedule. The budget and levy rates are submitted to the Ministers for approval by November 1 of each year. The projects under the study program are initiated following the collection of the levies which generally occurs in the first quarter of the calendar year.

2. Activities in 1999

The ESRF undertook an ambitious program of activity for 1999. The ESRF Management Board met four times during the year. Three new studies were approved for 1999 with a total value of \$440,000. The 1999 ESRF operations budget of \$42,400 supported the management of the ongoing study program and provided administrative support for the ESRF Management Board.

Funding for the 1999 studies and administration program, was raised by means of Levy #11 (Refer to Table 1). The total study and administration budget for 1999 was set at \$482,400. Levy #11 was expected to provide \$292,500 towards this budget.

Upon issue of levy invoices, the interest holders have 30 days to either pay the levy or release the land holding license to which the levy is assigned.

**TABLE 1**  
**ESRF LEVY #11**

REGION	LEVY #11 \$/hect 1999	TOTAL LEVIES INVOICED 1999	TOTAL LEVIES COLLECTED 1999	BACK LEVIES COLLECTED 1999	TOTAL REVENUES COLLECTED 1999
1 Queen Charlottes North	0.0000				
2 Hecate Strait	0.0000				
3 Queen Charlottes South	0.0000				
4 Vancouver Island	0.0000				
5 Labrador North	0.0000				
6 Labrador Central	0.0000				
7 Labrador South	0.0000				
8 Northeast Newfoundland	0.0236	\$1,633.12	\$1,633.12		\$1,633.12
9 Newfoundland Slope	0.0199	\$3,452.61	\$3,452.61		\$3,452.61
10 Grand Banks North	0.0183	\$16,253.55	\$16,253.55		\$16,253.55
11 Grand Banks South	0.0533	\$10,464.39	\$10,464.39		\$10,464.39
12 Scotian Shelf East	0.0662	\$134,150.01	\$134,150.01		\$134,150.01
13 Scotian Shelf West	0.0662	\$34,629.09	\$34,629.09		\$34,629.09
14 Scotian Shelf	0.0662	\$190,300.91	\$190,300.91		\$190,300.91
15 Gulf of St. Lawrence	0.0341	\$55,214.07	\$54,672.80		\$54,672.80
16 Hudson Bay	0.0000				
17 Beaufort South	0.0000				
18 Beaufort North	0.0000				
19 Western Archipelago-Offshore	0.0000				
20 Central Archipelago-Offshore	0.0000				
21 Eastern Archipelago-Offshore	0.0000				
22 Baffin Bay	0.0000				
23 Yukon North	0.0000				
24 Yukon South	0.0000				
25 Mackenzie Delta	0.0000				
26 Mackenzie North	0.0000				
27 Mackenzie Central	0.0000				
28 Mackenzie South	0.0000				
29 Western Archipelago-Onshore	0.0000				
30 Central Archipelago-Onshore	0.0000				
31 Eastern Archipelago-Onshore	0.0000				
<b>TOTAL</b>		<b>\$446,097.75</b>	<b>\$445,556.48</b>		<b>\$445,556.48</b>

### 3. 1999 Study Program

The 1999 study program comprised three studies. The following are brief descriptions of the projects= objectives:

#### Effects of Seismic Exploration on the East Coast Fishery

This project was designed to monitor and assess the effects of an operating seismic program on the Atlantic herring and groundfish fisheries. The study will examine: 1) disturbance effects on herring and groundfish and associated effects on both fisheries, and 2) physical effects on herring. A Request for Proposal was issued for this project and three responses were evaluated by the Technical Committee. No contract award was made, and the project was held over to 2000 for additional background work and additional funding from the 2000 levy.

#### Practical Considerations for Cumulative Effects Monitoring and Assessment in Eastern Canadian Offshore Areas

The project was designed to evaluate the applicability of cumulative environmental effects assessment (CEA) and monitoring theory and practice to offshore petroleum development on the east coast of Canada. Using the particular example of the northeast Grand Banks, it will recommend practical, scientifically defensible approaches to the identification and evaluation of the significance of cumulative effects based on consideration of realistic environmental conditions and development scenarios. To better coordinate with related initiatives, this project was deferred to 2000.

#### Coastal Resource Inventory - Great Northern Peninsula (North Head, Bay of Islands to Cap Bauld)

This project complements other resource inventory projects undertaken by ESRF in the past. However, in addition to identification of shoreline types and features, it will provide detailed segment-specific options, strategies and recommendations for protection, treatment and clean-up. The database contains 143 attributes for each of the roughly 8,000 shoreline segments in the Atlantic Region. The existing environmental sensitivities included at this stage for the west coast of Newfoundland are only those identified in previous atlases and the information is sparse and dated. The products would include both digital and hard copy atlases.

4. Financial Statement

ESRF Regions (NORCAN) 1-16th ND) 17-31	Revenue For Jan 1, '99	Administrative Expenditures 1999	Study Payments 1999	Levy Revenues & Adjustments	Outstanding Study Commitments	Uncommitted Funds as of Dec 31, '99
South	\$176,783.12	(\$13,592.25)	(\$40,000.00)	\$445,556.48	(\$400,000.00)	\$168,747.35
North	\$147,312.34	(\$9,944.11)	\$0.00	\$0.00	\$0.00	\$137,368.23
Total	\$324,095.46	(\$23,536.36)	(\$40,000.00)	\$445,556.48	(\$400,000.00)	\$306,115.58

5. Plans for 2000

The August 1999 ESRF Management Board meeting established the content and budget for the 2000 program. This program was recommended by the Management Board and has been approved by the Minister of Natural Resources Canada and the Minister of Indian Affairs and Northern Development. The program has an estimated value of \$380,000 which includes funding for two new studies and the expansion of the Seismic Study Program. The following projects are to be initiated in 2000 pending the successful outcome of the collection of Levy #12: Identification of Sensitive Areas and Environmental Constraints to Oil and Gas Exploration in the Southern Gulf of St. Lawrence, and a small contingency set aside for continuation of an industry-initiated study on seabird monitoring.

A budget of \$42,400 was approved for 2000 to cover the administrative costs of the ESRF Secretariat. In 2000, one new appointment from the Department of Fisheries and Oceans will be made to fill the current vacancy on the Management Board.

6. Publication of Reports

All ESRF studies are subject to a scientific/technical peer review. Reports that are deemed to be scientifically or technically significant are published in the ESRF Technical Report Series. Reports are distributed to oil and gas companies, universities, federal, provincial and territorial government libraries, and research institutes. The series is documented on several international databases including the Canadian Institute for Scientific and Technical Information (CISTI).



In addition to the technical report series, the ESRF publishes a newsletter, UPDATE, that contains information on the status of the program. This includes notification of requests for proposals for studies, and brief descriptions of study results. UPDATE is circulated to a broad audience of about 1400 across Canada and selected international institutes. Should you wish to have your name or organization added to the general distribution list, please contact the ESRF Secretariat (below).

7. List of ESRF Reports

Since its inception in 1983, the ESRF has published 135 reports which are distributed free of charge. You may obtain copies of reports by contacting:

**ESRF Secretariat**  
**National Energy Board**  
**444 - 7th Avenue S.W.**  
**Calgary, Alberta**  
**T2P 0X8**  
**Telephone: (403) 292-4800**  
**Facsimile : (403) 292-5503**

**SEDIMENT TRANSPORT**

- 017 Keith Philpott Consulting Ltd. with Acres Consulting Services Ltd. **Scour Around Seafloor Structures.** April 1986. 225 p.
- 027 Hodgins, D.O., D.A. Huntley, W.D. Liam Finn, B. Long, G. Drapeau and A.J. Bowen. **Sediment Transport - Present Knowledge and Industry Needs.** April 1986. 394 p.
- 029 Plasse, D. **Surficial Geology Surveys on the Scotian Shelf: Compilation of Maps from Government, Industry, University & Foreign Sources.** April 1986. 47 p.
- 041 Hodgins, D.O., G. Drapeau and L.H. King. **Field Measurements of Sediment Transport on the Scotian Shelf - Volume I. The Radio-isotope Experiment.** June 1986. 160 p.  
Hodgins, D.O. and O.J. Sayao - **Volume II. Boundary Layer Measurement and Sand Transport Prediction.** August 1986. 222 p.
- 054 Hodgins, D.O., O.J. Sayao, E.D. Kinsella and P.W. Morgan. **Nearshore Sediment Dynamics - Beaufort Sea.** December 1986. 195 p.
- 061 Judge, J.T., R.K. Watanabe and J.L. Warner. **Seafloor Stability Study, Inner Scotian Shelf.** May 1987. 88 p.

096 Gillie, R.D. **Beaufort Sea Artificial Island Erosion Data.** May 1988. 119 p.

#### ENVIRONMENTAL EFFECTS AND MONITORING

001 McLaren, P.L. and R.A. Davis. **Distribution of Bowhead Whales in the Beaufort Sea.** Summer 1983. February 1985. 62 p.

005 Thomas, D.J., W.S. Duval, C.S. Johnston, G.S. Lewbel, A. Birdsall, M.S. Hutcheson, G.D. Greene, R.A. Buchanan and J.W. MacDonald. **Effects Monitoring Strategies and Program for Canada's East Coast.** May 1985. 88 p.

009 Harwood, L.A. and A. Borstad. **Bowhead Whale Monitoring Study in the Southeast Beaufort Sea.** July-September 1984. August 1985. 99 p.

021 Tidmarsh, W.G., R. Ernst, R. Ackman and T. Farquharson. **Tainting of Fishery Resources.** January 1986. 174 p.

025 Kingsley, M.C.S. **Distribution and Abundance of Seals in the Beaufort Sea, Amundsen Gulf & Prince Albert Sound.** 1984. February 1986. 16 p.

028 Thomson, D.H., D.B. Fissel, J.R. Marko, R.A. Davis and G.A. Borstad. **Distribution of Bowhead Whales in Relation to Hydrometeorological Events in the Beaufort Sea.** March 1986. 119 p.

036 Norton, P. and L.A. Harwood. **Distribution, Abundance and Behavior of White Whales in the Mackenzie Estuary.** June 1986. 73 p.

057 Duval, W.S. (ed.) **Distribution, Abundance and Age Segregation of Bowhead Whales Relative to Industry Activities and Oceanographic Features in the Beaufort Sea, August-September 1985.** March 1987. 117 p.

060 Yunker, M.B. and R.W. Drinnan. **Dispersion and Fate of Oil from Oil-based Drilling Muds near Sable Island, N.S.** January 1987. 169 p.

063 Drinnan, R.W., M. Yunker, A. Gillam, N. Charchuk and S.R.H. Davis. **Options for Treatment and Disposal of Oil-based Mud Cuttings in the Canadian Arctic.** February 1987. 167 p.

066 Nenner, R.D. **Monitoring a Sump Containing Drilling Mud with High Salt Content.** March 1987. 47 p.

- 075 Cross, W.E. and B. Humphrey. **Monitoring the Long-Term Fate and Effects of Spilled Oil in an Arctic Marine Subtidal Environment.** August 1987. 120 p.
- 080 Ernst, R.J., W.M.N. Ratnayake, T.E. Farquharson, R.G. Ackman and W.G. Tidmarsh. **Tainting of Finfish by Petroleum Hydrocarbons.** September 1987. 150 p.
- 089 Ford, J.K.B., J.C. Cabbage and P. Norton. **Distribution, Abundance, and Age Segregation of Bowhead Whales in the Southeast Beaufort Sea, August-September, 1986.** November 1987. 53 p.
- 090 Wainwright, P.F. and B. Humphrey. **Analysis of Sediment Data from the Beaufort Shorebase Monitoring Program, 1982-1984.** March 1988. 78 p.
- 093 Hardy BBT Limited and Stanley Associates Engineering Ltd. **Handling and Disposal of Waste Drilling Fluids from On-Land Sumps in the Northwest Territories and Yukon.** February 1988. 58 p.
- 101 Erickson, P., B. Fowler, and D. Thomas. **Oil-based Drilling Muds: Off Structure Monitoring-Beaufort Sea.** June 1988. 188 p.
- 102 Nakashima, D.J. and D.J. Murray. **The Common Eider of Eastern Hudson Bay: A Survey of Nest Colonies and Inuit Ecological Knowledge.** November 1988. 174 p.
- 109 Lawrence, M.J. (ed.) and S.L. Davies (ed.) **Wildlife and Wildlife Habitat Restoration and Compensation in the Event of an Oil Spill in the Beaufort Sea.** March 1993. 88 p.
- 110 Hurlbut, S.E., D.P. French and B.J. Taylor. **Evaluation of the Potential Effects of Major Oil Spills on Grand Banks Commercial Fish Species as a Result of Impacts on Eggs and Larvae.** January 1991. 53 p.
- 117 Sekerak, A.D., N. Stallard and W.B. Griffiths. **Distribution of Fish and Fish Harvests in the Nearshore Beaufort Sea and Mackenzie Delta During Ice Covered Periods, October-June.** November 1992. 157 p.
- 118 Thomas, D.J. **Considerations in the Design of Effects Monitoring Strategies: Beaufort Sea Case Study.** January 1992. 54 p.
- 121 S.L. Ross Environmental Research Limited and Ledrew, Fudge and Associates. **The Risk of Tainting Flatfish Stocks During Offshore Oil Spills.** January 1993. 67 p.

- 122 Mackinnon, D.S. and P.A. Lane. **Saltmarsh Revisited - The Long-Term Effects of Oil and Dispersant on Saltmarsh Vegetation.** September 1993. 24 p.
- 123 Duval, W.S. **Proceedings of a Workshop on Beaufort Sea Beluga February 3-6, 1992, Vancouver, B.C.** March 1993. 26 p.
- 134 Richard, P.R., A.R. Martin and J.R. Orr. **Study of Summer and Fall Movements and Dive Behaviour of Beaufort Sea Belugas, Using Satellite Telemetry.** 1992-1995. 34 p.

#### **OIL SPILL RESEARCH AND COUNTERMEASURES**

- 006 Belore, R.C. **Effectiveness of the Repeat Application of Chemical Dispersants on Oil.** June 1985. 66 p.
- 012 Harper, J.R. and E.H. Owens. **Shoreline Monitoring Programs for Oil Spills-of-Opportunity.** September 1985. 50 p.
- 013 Abdelnour, R., T. Johnstone, D. Howard and V. Nisbett. **Laboratory Testing of an Oil-Skimming Bow in Broken Ice.** January 1986. 60 p.
- 018 S.L. Ross Environmental Research Ltd. **Testing of an Oil Recovery Concept for Use in Brash and Mulched Ice.** January 1986. 43 p.
- 019 Witherspoon, P., J. Swiss, R. Kowalchuk and J. Armstrong. **Oil in Ice Computer Model.** December 1985. 129 p.
- 031 Harper, J.R. and B. Humphrey. **Stranded Oil in Coastal Sediments: Permeation in Tidal Flats.** April 1986. 23 p.
- 033 Harper, J.R. **Practical Insights into Decision-making for Shoreline Cleanup of Oilspills.** May 1986. 44 p.
- 034 Belore, R.C. **Development of a High Pressure Water Mixing Concept for Use with Ship-based Dispersant Application.** May 1986. 51 p.
- 051 S.L. Ross Environmental Research Ltd. and Energetex Engineering. **Decision-making Aids for Igniting or Extinguishing Well Blowouts to Minimize Environmental Impacts.** November 1986. 119 p.
- 053 MacNeill, M.R. and R.H. Goodman. **Oil Motion During Lead Closure.** January 1987. 13 p.

- 058 S.L. Ross Environmental Research Ltd. and Hatfield Consultants Ltd. **Countermeasures for Dealing with Spills of Viscous, Waxy Crude Oils.** October 1986. 59 p.
- 062 S.L. Ross Environmental Research Ltd. and D.F. Dickins Associates Limited. **Field Research Spills to Investigate the Physical and Chemical State of Oil in Pack Ice.** February 1987. 116 p.
- 064 Brown, H.M. and R.H. Goodman. **In Situ Burning of Oil in Ice Infested Waters.** February 1987. 27 p.
- 068 Belore, R.C. **Mid-Scale Testing of Dispersant Effectiveness.** April 1987. 82 p.
- 069 Hatfield Consultants Ltd. **Spills-of-Opportunity Research.** February 1987. 124 p.
- 070 Lane, P., M.J. Crowell, D.G. Patriquin and I. Buist. **The Use of Chemical Dispersants in Salt Marshes.** May 1987. 100 p.
- 072 Nawwar, A., A. Godon, H.W. Jones, E. Yeatman, J. Ohuja, M.B. Frish and I. Arvin. **Acoustical Methods for Measuring Thickness of Oil on Water.** April 1987. 57 p.
- 074 Bennett, J., I.R. McAllister, L. Pertile and D. McQuillan. **Removal of Stranded Oil from Remote Beaches by In-Situ Combustion.** March 1987. 122 p.
- 077 Comfort, G. **Analytical Modelling of Oil and Gas Spreading Under Ice.** August 1987. 57 p.
- 078 Reimer, E.M. and J.R. Rossiter. **Measurement of Oil Thickness on Water from Aircraft: A. Active Microwave Spectroscopy. B. Electromagnetic Thermoelastic Emission.** August 1987. 82 p.
- 079 S.L. Ross Environmental Research Ltd. and L.C. Oddy Training Design Ltd. **The Development of a Canadian Oil-Spill Countermeasures Training Program.** May 1987. 194 p.
- 082 Belore, R.C. and D. MacKay. **Drop Size and Dispersant Effectiveness: Small-Scale Laboratory Testing.** July 1987. 31 p.
- 083 Thorpe, J.W. and K.E. Hellenbrand. **Microbial Degradation of Hydrocarbon Mixtures in a Marine Sediment Under Different Temperature Regimes.** September 1987. 48 p.

- 084 S.L. Ross Environmental Research Limited and D. MacKay. Environmental Research Ltd. **Laboratory Studies of the Behaviour and Fate of Waxy Crude Oil Spills.** December 1988. 250 p.
- 086 Pelletier, E. and C. Brochu. **Prototype, Mesoscale Simulator for the Study of Oil Weathering Under Severe Conditions.** November 1987. 55 p.
- 092 Trudel, B.K., B.J. Jessiman, S.L. Ross and J.J. Swiss. **Guide to Dispersant - Use Decision Making for Oil Spills in the Canadian Southern Beaufort Sea.** February 1988. 227 p.
- 095 D.F. Dickins Associates Ltd., S.L. Ross Environmental Research Ltd. and Seakem Oceanography, Ltd. **Evaluation of Hovercraft for Dispersant Application.** February 1988. 57 p.
- 098 Goodman, R.H. **Simple Remote Sensing System for the Detection of Oil and Water.** December 1988. 32 p.
- 100 Swiss, J.J. and N. Vanderkooy. **Beaufort Sea Dispersant Trial.** July 1988. 44 p.
- 106 S.L. Ross Environmental Research Ltd. **Proceedings of a Workshop to Establish Canadian Marine Oil Spill Research and Development Priorities.** April 1990. 56 p.
- 108 Harper, J.R. **Development of a National Directory of Canadian Oil Spill Specialists.** October 1991. 62 p.
- 119 Guenette, C. **Modification and Testing of a Portable Reciprocating kiln for Cleaning Oiled and Sand and Gravel.** March 1992. 46 p.
- 120 Guenette, C. **Development and Testing of a Prototype Rock Washer for Cleaning Oiled Beach Cobble.** January 1991. 45 p.
- 124 Englehardt, R. **Oil Base Drilling Mud Toxicity.** December 1989. 47p. (Unpublished)
- 126 Koski, W.R., S.D. Kevan and W.J. Richardson. **Bird Dispersal and Deterrent Techniques for Oil Spills in the Beaufort Sea.** December 1993. 122p.
- 127 Demsey, J., et al. **West Coast Newfoundland Oil Spill Sensitivity Atlas.** March 1995. 62 p.

**ICE/ICEBERGS/ICE DETECTION**

- 008 Ryan, J.P., M. Harvey and A. Kent. **The Assessment of Marine Radars for the Detection of Ice and Icebergs.** August 1985. 127 p.
- 011 Gammon, P.H. and J.C. Lewis. **Methods for the Fracturing of Icebergs.** July 1985. 91 p.
- 014 Buckley, T., B. Dawe, A. Zielinski, S. Parashar, D. MacDonald, H. Gaskill, D. Finlayson and W. Crocker. **Underwater Iceberg Geometry.** September 1985. 216 p.
- 016 Rossiter, J.R., L.D. Arsenault, E.V. Guy, D.J. Lapp, E. Wedler, B. Mercer, E. McLaren, and J. Dempsey. **Assessment of Airborne Imaging Radars for the Detection of Icebergs.** September 1985. 320 p.
- 022 Ryan, J.P. **Enhancement of the Radar Detectability of Icebergs.** January 1986. 83 p.
- 035 Harvey, M.J. and J.P. Ryan. **Further Studies on the Assessment of Marine Radars for the Detection of Icebergs.** June 1986. 82 p.
- 038 Marko, J.R., D.B. Fissel and J.R. Birch. **Physical Approaches to Iceberg Severity Prediction.** July 1986. 104 p.
- 042 Anderson, D.G., D. McDonald, P. Mitten, S. Nicholls and D. Tait. **Management of Small Ice Masses.** August 1986. 195 p.
- 044 Hay & Company Consultants Inc. **Motion and Impact of Icebergs.** September 1986. 146 p.
- 045 Canpolar Consultants Ltd. **Iceberg Detection by Airborne Radar: Technical Review and Proposed Field Program.** September 1986. 235 p.
- 048 Davidson, L.W., W.I. Wittman, L.H. Hester, W.S. Dehn, J.E. Walsh and E.M. Reimer. **Long Range Prediction of Grand Banks Iceberg Season Severity: A Statistical Approach.** October 1986. 163 p.
- 052 de Margerie, S., J. Middleton, C. Garret, S. Marquis, F. Majaess and K. Lank. **Improvement of Iceberg Drift Forecast - Grand Banks.** November 1986. 86 p.
- 081 Warbanski, G. and E. Banke. **Evaluation of a Modified Water Cannon System to Control Small Iceberg Masses.** August 1987. 142 p.
- 091 Klein, K., J.P. Ryan and M. House. **Ryan Evaluation of Two Search Radar Systems for Detection of Ice Masses.** January 1988. 240 p.
- 104 Terry, B.F., D.J. Lapp, C.L. Balko, K.E. Hancock and P.A. Lapp. **Ice Data Management System.** July 1989. 151 p. plus appendices.
- 113 Finlayson, D.J., J. Bobbitt, P. Rudkin and I.J. Jordan. **Iceberg Trajectory Model: Real-Time Verification.** March 1992. 47 p.

- 115 Pilkington, G.R., M.C. Hill, M. Metge and D. McGonigal. **Beaufort Sea Ice Design Criteria - Acquisition of Data on EIFs.** October 1992. 154 p.
- 125 Davidson, L.W. **Long-Range Ice Forecasting System (LRIFS) Applied for the Beaufort Sea.** May 1993. 58 p.
- 132 Rossiter, J.R., et al. **Remote Sensing Ice Detection Capabilities - East Coast.** April 1995. 172 p.
- 133 Davidson, S.H. and A. Simms. 1997. **Characterisation of Iceberg Pits on the Grand Banks of Newfoundland.** February 1997. 162p

### SEA BOTTOM ICE SCOUR

- 007 El-Tahan, M., H. El-Tahan, D. Courage and P. Mitten. **Documentation of Iceberg Groundings.** May 1985. 162 p.
- 032 Shearer, J., B. Laroche and G. Fortin. **Canadian Beaufort Sea 1984 Repetitive Mapping of Ice Scour.** May 1986. 93 p.
- 037 Comfort, G. and B. Graham. **Evaluation of Sea Bottom Ice Scour Models.** June 1986. 115 p.
- 039 Woodworth-Lynas, C.M.T., D.W. Bass and J. Bobbitt. **Inventory of Upslope and Downslope Iceberg Scouring.** July 1986. 103 p.
- 043 Geonautics Ltd. **Design of an Iceberg Scour Repetitive Mapping Network for the Canadian East Coast.** March 1987. 45 p.
- 049 Lewis, C.F.M., D.R. Parrott, P.G. Simpkin and J. T. Buckley (eds.). **Ice Scour and Seabed Engineering. Report on Calgary Workshop, February 1985.** November 1986. 322 p.
- 055 Gilbert, G. and K. Pedersen. **Ice Scour Data Base for the Beaufort.** December 1986. 93 p. plus appendices.
- 094 Hodgson, G.J., J.H. Lever, C.M.T. Woodworth-Lynas and C.F.M. Lewis (eds.). **Dynamics of Iceberg Grounding and Scouring. Volume I The Field Experiment. Volume II Maps and Charts.** June 1988. 316 p.
- 097 Gilbert, G.R., S.J. Delory and K.A. Pedersen. **Beaufort Sea Ice Scour Data Base (Scourbase).** Update to 1986. March 1989. 99 p.
- 105 Geonautics Limited. **Regional Ice Scour Data Base Update Studies.** October 1989. 177 p. plus appendices.
- 107 Davidson, S.H., W.T. Collins and P.G. Simpkin. **An Experiment to Monitor Four Iceberg Scours on the Grand Banks of Newfoundland.** December 1991. 110 p.
- 128 Geonautics Limited. **East Coast Repetitive Seafloor Mapping 1979/1990.** March 1991. 49 p.



plus appendices.

- 129 Myers, R., S. Blasco, G. Gilbert, and J. Shearer. **1990 Beaufort Sea Ice Scour Repetitive Mapping Program.** March 1996. 147p + Appendices.

## WAVES

- 020 Brown, R.D., P. Roebber and K. Walsh. **Climatology of Severe Storms Affecting Coastal Areas of Eastern Canada.** February 1986. 233 p.
- 023 Murray, M.A. and M. Maes. **Beaufort Sea Extreme Wave Studies Assessment.** January 1986. 97 p.
- 056 Lemon, D.D. **Wind Speeds from Underwater Acoustic Measurements During the Canadian Atlantic Storm Program.** December 1986. 116 p.
- 059 Dobrocky Seatech Ltd. **Wave Climate Study - Northern Coast of British Columbia.** May 1987. 93 p.
- 065 LeDrew Environmental Management Ltd. (ed.). **Proceedings of the International Workshop On Wave Hindcasting and Forecasting.** Halifax Workshop, September 1986. February 1987. 370 p.
- 073 Hodgins, S.L.M. and D.O. Hodgins. **Evaluation of Wave Forecasting Models and Forecast Wind Fields in the Canadian Context.** June 1988. 356 p.
- 076 Eid, B.M. and V.J. Cardone. **Operational Test of Wave-Forecasting Models During the Canadian Atlantic Storms Program (CASP).** August 1987. 256 p.
- 088 Penicka, F.X. **Wave Hindcast Sensitivity.** April 1987. 114 p.
- 099 Juszko, B.A. **Comparison of Directional Wave Spectra.** July 1988. 227 p.
- 103 Hodgins, D.O., C.T. Niwinski and D.T. Resio. **Comparison and Validation of Two Shallow Water Spectral Wave Models.** June 1989. 143 p. plus appendices.
- 114 Eid, B.M. and V.J. Cardone. **Beaufort Sea Extreme Waves Study.** March 1992. 143 p.

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- 002 Gardner, M. **Interaction Between the Fisheries & the Oil and Gas Industry off the East Coast of Canada.** March 1985. 70 p.
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