

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

The Honourable Jim Prentice, P.C., M.P.  
Indian Affairs and Northern Development  
House of Commons  
Ottawa, Ontario  
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Dear Ministers:

On behalf of the Environmental Studies Research Funds Management Board, it is my pleasure to submit the 2006 Annual Report for the Environmental Studies Research Funds in accordance with the *Canada Petroleum Resources Act*, paragraph 79(1)d.

Sincerely yours,

Robert Steedman, Ph.D.  
Environmental Studies Research Funds  
Management Board



**ENVIRONMENTAL STUDIES RESEARCH FUNDS**

**ANNUAL REPORT**

**2006**

**FEBRUARY 2007**



## **Environmental Studies Research Funds Profile**

The Environmental Studies Research Funds (ESRF) sponsor 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, 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 by industry through levies on exploration and production properties on frontier lands. The ESRF is directed by a joint government / industry / public Management Board and is administered by a secretariat which resides within the National Energy Board in Calgary, Alberta.

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## **Background on the Structure and Operation of the Funds**

The Environmental Studies Research Funds (ESRF) finance environmental and social studies pertaining to the manner in which, and to 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 “A work 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. Robert Steedman, Professional Leader Environment of the National Energy Board, is the current chair of the ESRF Management Board.

The ESRF Management Board directs 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 a calendar year basis. The Board generally meets three times a year; 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 its administration 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 that generally occurs in the first quarter of the calendar year.

## **Activities in 2006**

The total value of the 2006 ESRF program was \$1,340,500 for the 6 new and ongoing projects. The budget included \$305,500 for administration and oversight management of the ESRF research activities program.

A total of \$1,172,275.22 in funding was raised for the 2006 studies and administration program through Levy #18 (refer to Figure 1). This levy covered the new study program, the administration budget, and the continued funding of ongoing studies. The difference in the total amount levied and the program value was the result of a land sale after the calculation of the levy and prior to the issuance of invoices. Excess funds raised in these circumstances are credited against future years' levies. The collection of unpaid levies is being pursued by the Management Board.

Maps of the ESRF levy regions can be viewed on the ESRF website at:  
<http://www.esrfunds.org/legislation.html>.



**FIGURE 1**  
**ESRF LEVY #18**

REGION	LEVY #17 \$/ha 2006	TOTAL LEVIES INVOICED 2006	TOTAL LEVIES COLLECTED 2006	BACK LEVIES COLLECTED 2006	TOTAL REVENUES COLLECTED 2006
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	\$0.0816	226.28			
9 Newfoundland Slope	\$0.0275	66,690.61	37,246.85		37,246.85
10 Grand Banks North	\$0.1036	100,014.71	93,136.92	16,346.02	109,482.94
11 Grand Banks South	\$0.0734	181,977.68	181,977.68		181,977.68
12 Scotian Shelf East	\$0.0790	142,498.21	86,956.49		86,956.49
13 Scotian Shelf West	\$0.0863	14,375.77	14,375.77		14,375.77
14 Scotian Shelf	\$0.0507	74,693.01	74,693.01		74,693.01
15 Gulf of St. Lawrence	\$0.0373	33,914.39	19,136.80	66,134.15	85,270.95
16 Hudson Bay	\$0.0000				
17 Beaufort South	\$0.2626	163,859.99	163,859.99		163,859.99
18 Beaufort North	\$0.2878	8,657.02	8,657.02		8,657.02
19 Western Archipelago-Offshore	\$0.0466	348.06	348.06		348.06
20 Central Archipelago-Offshore	\$0.0000	11,175.30	11,175.30		11,175.30
21 Eastern Archipelago-Offshore	\$0.0000				
22 Baffin Bay	\$0.0000				
23 Yukon North	\$0.0000				
24 Yukon South	\$0.0000				
25 Mackenzie Delta	\$0.0707	30,201.91	28,747.40		28,747.40
26 Mackenzie North	\$0.0784	74,812.20	32,412.21		32,412.21
27 Mackenzie Central	\$0.0621	29,357.15	27,372.00		27,372.00
28 Mackenzie South	\$0.0712	11,392.05	10,828.07		10,828.07
29 Western Archipelago-Onshore	\$0.0796				
30 Central Archipelago-Onshore	\$0.0790	3,769.49	3,769.49		3,769.49
31 Eastern Archipelago-Onshore	\$0.0000				
<b>TOTAL</b>		<b>947,933.83</b>	<b>794,693.06</b>	<b>82,480.17</b>	<b>877,173.23</b>

## **2006 Study Program**

### **Recent Publications**

In 2006, ESRF published or prepared for publication the following reports<sup>1</sup> in the ESRF Technical Report Series.

#158 Christian, John R., Anne Mathieu, and Robert A. Buchanan, *Chronic Effects of Seismic Energy on Snowcrab*.

#159 Kemper, J. Todd, *Vegetation Changes on Seismic Lines from Recent (2000-2001) and Historic (1970-1986) Seismic Programs in the Mackenzie Delta Area*

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<sup>1</sup> Complete citations appear in the list of published reports at the end of this annual report.

## Ongoing Studies in 2006

The following studies continued through 2006.

- **Data Collection Optimization** – East Coast. AMEC, through its acquisition of Coastal Oceans & Associates Ltd., continued work on two studies pertaining to physical environment monitoring offshore. One of these compares platform-based radar measurements to wave rider buoy generated data, particularly during storm events, to evaluate the data quality of the former in comparison to traditional wave rider buoy data.. The second is a study to evaluate effectiveness of regional physical environment monitoring of waves and currents, as an alternative to installation-specific monitoring these parameters which is the method currently used by offshore operators.
- **Mapping of Spawning and Juvenile Habitat of Selected Fish Species in the Laurentian Channel** - East Coast. This project has extended the sensitivity mapping work undertaken for finfish and shellfish on the Grand Banks and Scotian Shelf to the Laurentian Channel. The product of the work is an atlas that displays the temporal and spatial variability in spawning/rearing habitat use for important fish species in the area. This atlas will be an important tool to assist in regulation of exploration activity to minimize effects on aquatic resources.
- **Effects of Oils and Sheens on Pelagic Seabirds** – East Coast. Dr Patrick O’Hara of the University of Victoria completed a literature review and laboratory methods development phase preparatory to conducting an experimental bioassay program to explore the mechanisms by which oil sheens impact seabird feathers and hence seabirds exposed to oil sheens. A report on the results of the project is anticipated in the second quarter of 2007.
- **CSA Structures** - ESRF continued to support the CSA Offshore Structures Program in 2006 to ensure that International (ISO) Offshore Structures Standards are adopted into Canada as they become available, with national annexes that include unique Canadian requirements.

- **Cumulative Effects Assessment – Development of Ecologically Based Thresholds for the Kendall Island Bird Sanctuary** – \$100,000. This project is proposed to build on a thresholds study recently completed for the Beaufort-Delta region. In the study, specific habitat models will be developed to aid in determination of habitat disturbance threshold limits. Valued Components that are measurable and of practical value in assessing and minimizing impacts will be developed and confirmed with stakeholders, existing data and data gaps will be evaluated, and estimates of thresholds, carrying capacity and/or limits of acceptable change will be developed for the Valued Components. These tools may then be applied to KIBS as a representative example of their effectiveness in environmental management and the information will aid regulatory decision-making on development in and adjacent to KIBS.

### **New Research for 2006**

In 2006, the ERSF Management Board will initiate work in the following priority and subject areas. Technical advisory groups, comprising a cross-section of stakeholder interests, will be formed to develop detailed terms of reference and review technical reports for work to be offered for contract.

- **Evaluation of Seismic Impacts on Invertebrates** - \$200,000. This project has been carried out by Fisheries and Oceans Canada Center for Offshore Oil and Gas Environmental Research (COOGER). Building on studies by of the effects of seismic exploration on Atlantic snow crab this project extended the work to American lobster exposing them to controlled seismic energy in the laboratory and field to evaluate the long-term effects on various the health condition indices and behavioral changes. Workshop sessions were held with stakeholders in the Maritimes to report on progress of the work and its results. The results of the work were also communicated to fishers in a seismic workshop convened by the Department of Fisheries and Oceans in Newfoundland.
- **Fate and Transport of Drilling Mud and Fluid Discharges** - \$50,000. The approach to this study was reviewed by the Technical Advisory Group during 2006. The study, in collaboration COOGER, will examine the biodegradation of representative synthetic oil based drill muds and the toxicity of the metabolic by products of that microbially mediated degradation under natural conditions. This approach will allow a preliminary evaluation of the chronic effect, if any, of the metabolic by products resulting from microbial degradation under natural conditions in the sediment.

- **Evaluation of Produced Water Toxicity and Environmental Significance** - \$500,000. Recognizing the importance of produced water as the largest waste stream from offshore oil and gas operations the ESRF is working with Fisheries and Oceans Canada's COOGER to carry out a phased approach to this project. Phase 1 will result in an international workshop on produced water held in St. John's Newfoundland and Labrador in mid-October 2007. This workshop will bring together experts in the field from around the world to discuss the current state of understanding of the environmental fate and effects of produced water discharges. The workshop proceedings and conclusions will be published in a peer reviewed volume in 2008. The conclusions of the workshop will be taken in to account in the final development of the second phase of the project which foresees a multi-year program of research to assess the potential for environmental risk from produced water discharges.

**CSA Structures** - \$195,000. ESRF Management Board will continue to support the CSA Offshore Structures Program in 2007 to ensure that International (ISO) Offshore Structures Standards are adopted into Canada as they become available, with national annexes that include unique Canadian requirements.

- **Offshore Seabird Monitoring Program** - \$470,000. The ESRF Management Board has entered into a multi-year Memorandum of Understanding with the Canadian Wildlife Service to carry out systematic and opportunistic collection of seabird monitoring data in Newfoundland marine areas, with an initial focus upon the northeast Grand Banks where three offshore oil production facilities are in operation. The interim report on progress for 2006 indicates field work that is carried out in cooperation with the offshore operators is proceeding well with CWS carrying out seabird surveys from offshore supply vessels on a regular basis.
- **Assessment of Influence of Seismic Testing on Fish Movements and Behaviour** - \$200,000. This project aims to determine the effects of seismic energy on the real-time behavior, movement and survival of fish as a result of exposure to seismic energy in the field and to evaluate short or longer term physiological effects

Fisheries and Oceans Canada researchers, through COOGER, have moved this project well into the experimental design stage and have initiated the development, testing and procurement of specialized acoustic equipment need to undertake the project. Technical experts from other jurisdictions and organizations have been contacted to advise on the design and execution of

the project to help ensure its success. Pilot studies to test the methodologies developed are planned for 2007. The full scale study is planned for 2008 -2009.

- **Post-Construction Evaluation of the Ikhil Pipeline near Inuvik, NWT-** \$30,000. The objective of the study is to see if there are lessons to be learned about the assessment and approval process that will facilitate the assessment of future projects in the Inuvialuit Settlement Region (ISR). The study will review all the public documents and include interviews with many of the individuals involved in the assessment process. A consultant has been selected and the study should be completed by May 2007.
- **Review of Traditional Knowledge Manual: Using Traditional Knowledge in Impact Assessment -** \$53,000. The objective of this study is to review the TK Manual (2005/06) with community representatives from the ISR. Note, the Manual was prepared for use by proponents, consultants and regulators who use or require TK in the impact assessment process in the ISR (ESRF-04-048). The manual provides approaches to developing collection and TK use protocols. It was based on past examples of TK use in EIAs and Inuvialuit expertise in collection and use of TK. A workshop will be held in June 2007 with a report due by 31 August 2007.
- **Biophysical Research Requirements (Data Gaps) for Beaufort Sea Hydrocarbon Development, 2007 -** \$60,000. This study is to summarize and prioritize biophysical research gaps related to Beaufort Sea offshore oil and gas exploration and development. Data gaps should relate to industry activities, key issues and cumulative effects. The scope includes identification of research gaps through literature review to determine status of current research. It shall also determine research priorities – baseline conditions, regulatory requirements, key issues (ie seismic), community concerns ( ie harvesting), and the length of time to collect the data. Stakeholders input will be solicited to confirm the priority areas based on the data gaps. An ESRF report shall be submitted in summer 2007.

## Financial Statement

<b>ESRF Regions</b>	<b>Revenue Forwarded Jan 1, '06</b>	<b>Administrative Expenditures 2006</b>	<b>Study Payments 2006</b>	<b>Levy Revenues &amp; Adjustments</b>	<b>Outstanding Study Commitments</b>	<b>Uncommitted Funds as of Dec 31, 06</b>
South (NRCan 1-16 North (IAND) 17- 31	\$2,538,518.20	\$118,383.96	\$568,160.74	\$590,003.69	\$2,418,453.47	\$23,523.72
North	\$892,623.00	\$78,922.64	\$182,517.07	\$287,169.53	\$898,094.28	\$20,258.54
Total	\$3,431,141.20	\$197,306.60	\$750,677.80	\$877,173.23	\$3,366,547.75	\$43,782.26

### Plans for 2007

In September 2006, the ESRF Management Board established the budget for the 2007 program, which will be supported by Levy #19. 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 \$1,070,500 which includes funding for continuing 2006 programs and for new programs within the established priority areas of seismic impacts, cumulative effects, waste management, traditional knowledge, and effects on waterfowl and marine mammals, specifically in the northern offshore.

A budget of \$290,500 was approved for 2007 to cover the administrative costs of the ESRF Secretariat and to support travel by some members of the Management Board.

In 2006, 2 appointments and 1 re-appointment to the Management Board were made. Please see Appendix 2 – 2007 ESRF Management Board Members.

## **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).

ESRF now utilizes a website for publishing Requests for Proposals, notification of new publications, and general information on ESRF. Please visit our website at [www.esrfunds.org](http://www.esrfunds.org)

Since its inception in 1983, the ESRF has published 159 reports which are distributed free of charge. The latest reports have been posted on the ESRF website. You may obtain copies of reports by visiting the website at [www.esrfunds.org](http://www.esrfunds.org) or contacting:

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**National Energy Board**  
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## Appendix 1 - ESRF Reports, 1993 - 2006

### **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 Nenninger, 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.
- 137 Hatch Associates Limited and Griffiths Muecke Associates. *Workshop on Cumulative Environmental Effects Assessment and Monitoring on the Grand Banks and Scotia Shelf. 2000*. 61 p.
- 138 Montevecchi, W.A., F.K. Wiese, G. Davoren, A.W. Diamond, F. Huettmann, J. Linke *Seabird Attraction to Offshore Platforms and Seabird Monitoring from Offshore Support Vessels and other Ships Literature Review and Monitoring Design*. 1999. 56 p.
- 139 Thomson, Denis H., Jack W. Lawson and Anne Muecke. *Proceedings of a Workshop to Develop Methodologies for Conducting Research on the Effects of Seismic Exploration on the Canadian East Coast Fishery, Halifax, Nova Scotia, 7-8 September 2000*. April 2001. 92 p.
- 142 ERIN Consulting Ltd. and OCL Services Ltd. *Sheens Associated with Produced Water Effluents – Review of Causes and Mitigation Options*. March 2003. Calgary. 46 p.
- 143 Mortensen, Pål B., Lene Buhl-Mortensen, Susan E. Gass, Donald C. Gordon Jr., Ellen L.R. Kenchington, Cynthia Bourbonnais and Kevin G. Macisaac. *Deep-Water Corals In Atlantic Canada: A Summary Of ESRF-Funded Research (2001-2003)*. December 2004. Calgary. 43 p.

- 144 Christian, John R., Anne Mathieu, Denis H. Thomson, David White and Robert A. Buchanan. *Effect of Seismic Energy on Snow Crab (Chionoecetes opilio)*. November 2003. Calgary. 106 p.
- 145 Racca, Roberto G., David E. Hannay, R. Bruce Murray, William B. Griffiths, and Michael Muller. *Testing Fish Deterrents for Use Under-Ice in the Mackenzie Delta Area*. March 2004. Calgary. 118 p.
- 146 Buchanan, Robert A., Joanne A. Cook and Anne Mathieu. *Environmental Effects Monitoring For Exploration Drilling*. December 2003. Calgary. 86 p
- 147 Dillon Consulting Limited with DMT Cordah. *Pollution Prevention Opportunities in the Offshore Oil and Gas Sector - Final Report*. October 2003. Calgary. 73 p
- 149 Trudel, K. 2004. *Workshop on Dispersant Use in Eastern Canada*. Environmental Studies Research Funds, Report No. 149, Calgary Alberta, 109 pp.
- 150 Martec Limited, CEF Consultants Ltd, DRDC Atlantic, St. Francis Xavier University. *Effects of Pipelines/Gathering Lines on Snow Crab and Lobster*. December 2004, Calgary, 61 p.
- 151 Lee, K., H. Bain, and G.V. Hurley, (eds). 2005. *Acoustic Monitoring and Marine Mammal Surveys in the Gully and Outer Scotian Shelf Before and During Active Seismic Programs*. December 2005. Calgary, 154 p + appendices.
- 152 Ellis & Associates. *Drilling Waste Management – Recommended Best Practices*. January 2005. Calgary. CD-Rom.
- 154 AMEC Earth & Environmental. *Inuvialuit Settlement Region Drilling Waste Disposal Sumps Study*. February 2005. Calgary. CD-Rom.
- 155 Dillon Consulting Limited and Salmo Consulting. *Beaufort-Delta Cumulative Effects Project*. February 2005. Calgary. CD-Rom.

- 156 Moulton, V.D., and B.D. Mactavish. *Recommended Seabird and Marine Mammal Observational Protocols for Atlantic Canada*. March 2004. Calgary. 80 p
- 157 Christian, John R., Anne Mathieu, and Robert A. Buchanan, *Chronic Effects of Seismic Energy on Snow Crab (Chionoecetes opilio)*. March 2004. 45 p.
- 159 Kemper, J. Todd. *Vegetation Changes on Seismic Lines from Recent (2000-2001) and Historic (1970-1986) Seismic Programs in the Mackenzie Delta Area*. May 2006. 29 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.
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