



Environmental Studies Research Fund



ANNUAL REPORT 2018 - 2019

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The Environmental Studies Research Fund

ANNUAL REPORT 2018 - 2019

Message from the Chair

I am very pleased, on behalf of the ESRF Management Board, to submit the Environmental Studies Research Fund (ESRF) 2018 - 2019 Annual Report.

Over this past year, the Fund has provided significant funding for seven research projects related to the environment and social impacts of offshore oil and gas activities on Canada's frontier lands. Many of those projects have concluded their final field season. The Board has reviewed their findings at our March bi-annual meeting and we are seeing promising and informative results.



I am pleased to announce that as of this year, all ESRF reports published since 1985 are now publically available for download on the program's website: www.esrfunds.org.

Looking ahead to our upcoming year, the Management Board will be reviewing its current priority research areas and work toward developing a framework for future research calls. The Fund is also planning a new open call for research targeted on Atlantic salmon migratory behaviour while at sea that will increase our understanding of possible interaction between this species and with offshore oil and gas activities on Canada's east coast.

The Fund's ongoing support of research in Canada's frontier lands would not be possible without the dedication of the ESRF Management Board Members and Secretariat. This year, I would specifically like to thank Greg Janes (whose terms on the Board has expired) and David Burley (who has retired after many years representing the Canada-Newfoundland and Labrador Petroleum Offshore Board) for their service to the Board. Their insights over their years of service have contributed greatly to the program ongoing success. I would also like to welcome Marielle Thillet, Janine Murray and Elizabeth Young as new Members of the Management Board. They bring with them combined experience with the Canadian oil and gas industry, environmental management, and southern issues.

In closing, best of luck to all researchers this field season and we look forward to discussing progress made and research findings.

A handwritten signature in black ink that reads "J. Matthews".

Jennifer Matthews
Chairperson, ESRF Management Board
May 29, 2019

Mandate

The Environmental Studies Research Fund (ESRF) is a research program that sponsors studies on environmental and social implications related to oil and gas exploration and development in Canada’s frontier lands.

The information arising from these studies is designed to assist all involved stakeholders, including citizens, companies and government, in their decision-making related to oil and gas exploration and development.

Initiated in 1983 under the *Canada Oil and Gas Act (COGA)*, the ESRF now receives its legislated mandate through the superseding legislation, the *Canadian Petroleum Resources Act (CPRA)*, proclaimed in February 1987.

ESRF research is funded by levies on oil and gas companies that hold licenses for exploration and development in Canada’s frontier lands.

The Minister of Natural Resources, is responsible for the administration of the ESRF South Account for regions mainly south of 60° latitude, including the Hudson Bay, and the Minister of Intergovernmental and Northern Affairs and Internal Trade, is responsible for the administration of the North Account for regions north of 60° (See Annex 1 for specific details).

The ESRF is directed by a twelve-member joint government/industry/public Management Board and is administered by a Secretariat that resides within the Office of Energy Research and Development of Natural Resources Canada.

FRONTIER LANDS

The *Canada Petroleum Resources Act* “frontier lands” definition was amended on April 1, 2014, to include:

- (a) that part of the onshore that is under the administration of a federal minister,
- (b) Nunavut,
- (c) Sable Island,
- (d) the submarine areas in that part — of the internal waters of Canada or the territorial sea of Canada — that is not situated
 - (i) in a province other than the Northwest Territories, or
 - (ii) in that part of the onshore that is not under the administration of a federal minister, or
- (e) the continental shelf of Canada,

but does not include the adjoining area, as defined in section 2 of the *Yukon Act*.

ESRF Management Board Members

Private Sector

Jennifer Matthews, Chairperson
Canadian Association of Petroleum Producers

Marielle Thillet
Encana Corporation

Stephen Bettles
Husky Energy

Sherry Becker
Imperial

Public Sector

Vacant
Northern Regions

Philip Walsh
Southern Regions

Government of Canada

Mark Hopkins
Crown-Indigenous Relations and Northern Affairs
Canada

Janine Murray
Environment and Climate Change Canada

Patrice Simon
Fisheries and Oceans Canada

Robert Steedman, Vice-Chairperson
National Energy Board

Offshore Petroleum Boards

Elizabeth Young
Canada-Newfoundland and Labrador Offshore
Petroleum Board

Eric Theriault
Canada-Nova Scotia Offshore Petroleum Board

The ESRF Management Board members are selected for their expertise and specialized technical knowledge relative to the mandate of the Fund.

Members of the Management Board are appointed jointly by the Minister of Crown-Indigenous Relations and Northern Affairs and the Minister of Natural Resources.

The ESRF Management Board directs the business of the Fund, sets priorities for study topics, determines the program budget and facilitates the development of study proposals.

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ESRF Research Priority Areas 2015-2019

The five research priority areas for the 2015-2019 funding cycle were (see Annex 2 for the full description of each area):

North

1. Spill Preparedness and Response, Fate and Effects: to support marine safety by studying the fate and effects of accidental releases of petroleum and other hazardous substances in the Arctic marine environment and improve responses.
2. Regional Effects Assessment and Management: to support stakeholders in preparing and reviewing applications for oil and gas activities on themes including biophysical, socio-economic, traditional knowledge and cumulative effects.

Atlantic Offshore

3. Seismic: to improve the understanding of the effects of seismic sound on commercial fish and invertebrates, as well as marine mammals and/or species at risk.
4. Oil and Gas Liquids Spill Fate and Effects: to support marine safety by studying the fate and effects of accidental releases of petroleum in the Newfoundland-Labrador and Nova Scotia Offshore Areas.
5. Atlantic salmon migration at sea.

Studies in 2018 – 2019

SOUTHERN REGIONS

Assessment of the Potential Risks of Seismic Surveys to Affect Snow Crab Resources (2014-01S). The snow crab fishery is one of the highest landed value fisheries in the Newfoundland and Labrador region. Fishers have expressed concern over the potential for reduction in catch of snow crab in proximity to active seismic survey operations. This study aims to investigate potential effects of seismic exploration activity on commercial snow crab catch rates using scientific measures of changes in crab behaviour (i.e. movement), commercial catchability, and physiological effects in response to seismic air gun operations.

Acoustic Modeling and Monitoring on Canada's East Coast (2014-02S). This study will record the natural soundscape on Canada East Coast and study seismic sound propagation. It will create new knowledge on the natural soundscape in the region, generate accurate models of the effects of seismic surveys, and validate particle motion models for seismic airguns.

Assessing the Quality of Marine Mammal Detections using Three Complementary Methods (2014-03S). Monitoring for marine mammals is a required mitigation measure during the performance of marine seismic surveys in Canada. Sound energy emissions from seismic survey air gun arrays are halted when marine mammals and/or species at risk move within 500 meters of an array. Efficient and accurate observations of marine mammals are important in this context. This project will evaluate the comparative effectiveness and efficiency of three different methods of detecting marine mammals in the field.

The ESRF has sponsored and published over 200 studies on oil and gas exploration and development on frontier lands, including such topics as:

- *environmental effects on fish, bird and animal habits and habitats;*
- *iceberg detection and flow patterns;*
- *oil spill prevention and countermeasures;*
- *dispersant effectiveness in cold waters and ice;*
- *social and economic issues;*
- *improving accuracy of ocean and weather forecasting; and*
- *verification of codes and standards.*

*Reports can be accessed at:
www.esrfunds.org/174*

Investigation of Effects of East Coast Canada Water Accommodated Fraction and Chemically Enhanced Water Accommodated Fraction on Early Life Stages of Commercially Harvested Marine Species (2014-04S). The potential effects of exposure of commercial fish species to a crude oil spill and any dispersants used to mitigate the effects of such a spill are a concern. This study examines the toxicology of those fractions of a representative east coast crude oil that are entrained in water, both naturally and as a result of dispersant use, to the early life stages of Atlantic herring, Atlantic cod, American lobster and Northern shrimp.

Effect of Platform Discharges on Juvenile Fish in Field (2016-01S). The potential biological effects of operational discharges from the oil production platforms on the early life stages of commercial fish species. This study will collect samples of juvenile fish and measure these samples for petroleum hydrocarbons and associated indicators of contaminant exposure linked to operational discharges.

Assessment of Potential Risks of Seismic Surveys to Affect Groundfish Resources (2018-01S). Oil and gas exploration in Southern Atlantic frontier regions has been very active at a time when the fishing industry in this same area is becoming increasingly reliant on rebuilding the groundfish fishery. The effects of ocean noise on marine life is a growing concern globally, however the specific impacts including non-lethal effects and how they are manifested remains poorly defined for many species groups including fish. This project will examine potential risks of seismic air gun surveys to affect commercially important and culturally important groundfish species, including commercial catchability, and fish behaviour (movement).

NORTHERN REGIONS

Integrated Beaufort Observatory (2014-02N). This study will establish a regional ocean, sea ice and atmosphere observing system in the Canadian Beaufort Sea called the integrated Beaufort Observatory (iBO). The project will use a series of integrated state-of-the-art environmental technologies deployed on ocean moorings in the Beaufort Sea to enable systematic observation of the marine environment including ice and ocean conditions. Ultimately, this information will enhance the numerical models required for planning and review of offshore activities throughout the region.

Financial Statements

STATEMENT OF FINANCIAL POSITION

The ESRF Management Board is responsible for the presentation of the annual financial statements to the Ministers of Natural Resources and Crown-Indigenous Relations and Northern Affairs pursuant to the *Canada Petroleum Resources Act*.

Levies are collected from oil and gas companies that hold licenses for exploration and development in Canada's frontier lands. In accordance with the *Canada Petroleum Resources Act*, when a license is issued during the course of the year, levies are collected for the current year and the two years prior. The collection of unpaid levies is pursued on an ongoing basis by the ESRF Secretariat.

Table 1 below shows the fiscal information for the annual expenditures for ESRF in the 2018-19 fiscal year. All expenses are paid out of the fiscal year in which they are invoiced.

In 2018-19 the total study expenditures for the ESRF amounted to \$2,111,026. Administration costs for this period were \$283,989. Revenues collected through levies were \$3,053,082, with a total \$365,648 remaining in outstanding levies in the South as of March 31, 2019 (refer to Table 2 for details).

Table 1 – ESRF Expenditures April 1, 2018 to March 31, 2019 (in dollars)

REGION	OPENING CASH BALANCE APRIL 1, 2018 (\$)	TOTAL REVENUE, LEVIES & RETURNS (\$)	ADMINISTRATION COSTS (\$)	STUDY PROGRAM COSTS (\$)	CLOSING BALANCE MARCH 31, 2019 (\$)
SOUTH REGION	4,700,426	2,960,645	191,499	1,630,646	5,838,925
NORTH REGION	766,535	92,438	92,490	480,380	286,103
TOTAL	5,466,961	3,053,082	283,989	2,111,026	6,125,028

NOTE: The Public Accounts of Canada closing balances for the Southern and Northern Regions at the end of the 2018-19 fiscal year may differ. Given accounting processes at year-end, the distribution of Administration Costs between the regional accounts is not possible until the new fiscal year. The Administration Costs in this table account for the redistribution of funds between the accounts.

Table 2 – ESRF Regional sub accounts – Levy income 2018-19 (in dollars)

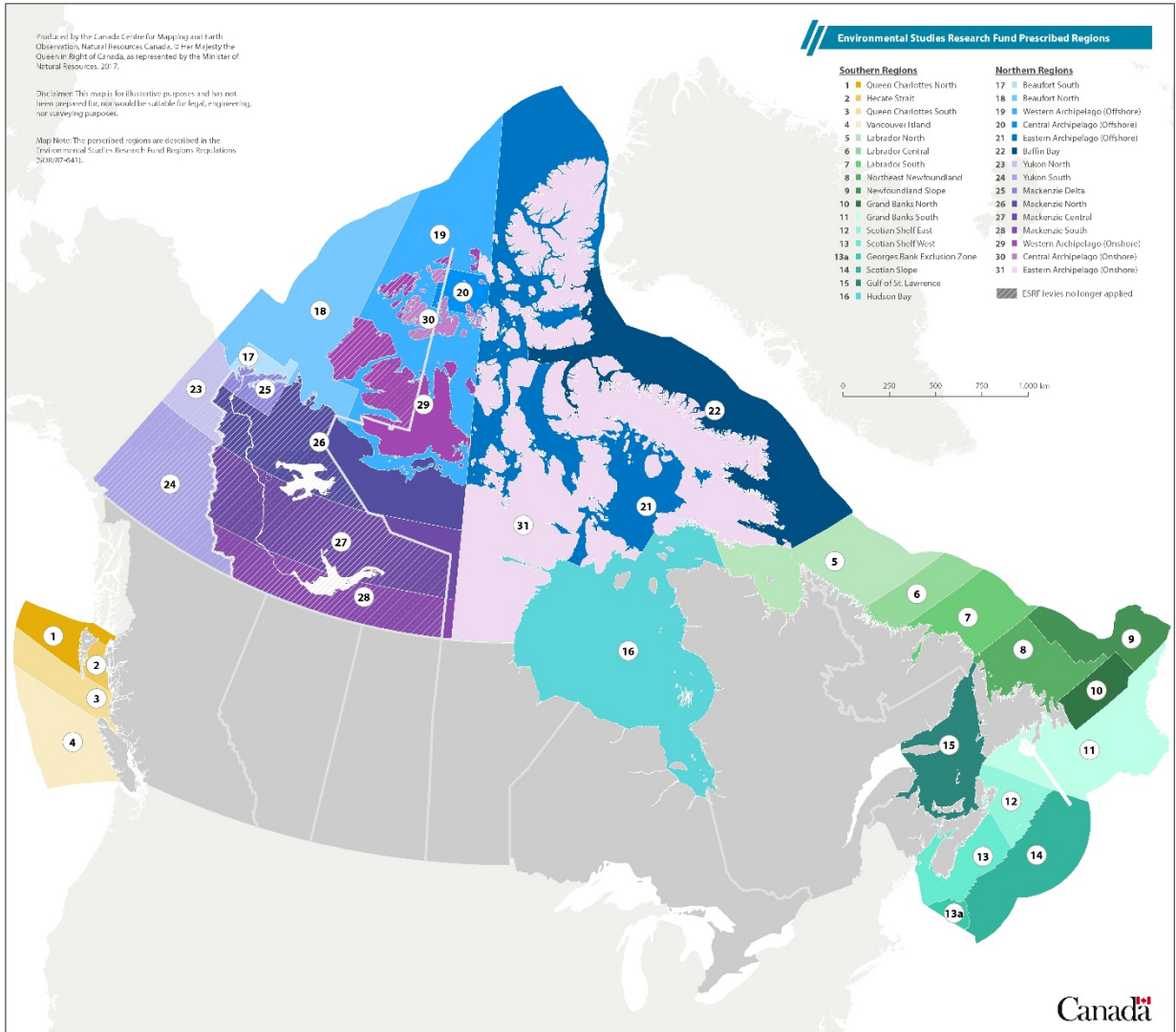
REGION		LEVY RATE Levy 30 2018-2019 (\$/Hectare)	REVENUES Levy 30 2018-2019 (\$)	REVENUES Back Levies (\$)	TOTAL LEVY INCOME (\$)
1	Queen Charlottes North	0	-	-	-
2	Hecate Strait	0	-	-	-
3	Queen Charlottes South	0	-	-	-
4	Vancouver Island	0	-	-	-
5	Labrador North	0.1194	867	-	867
6	Labrador Central	0	-	-	-
7	Labrador South	0.1803	1,017	-	1,017
8	Northeast Newfoundland	0.2991	77,424	-	77,424
9	Newfoundland Slope	0.2596	965,560	819,649	1,785,209
10	Grand Banks North	0.1067	82,033	551,939	633,972
11	Grand Banks South	0.1766	51,002	-	51,002
12	Scotian Shelf East	0.1519	30,418	-	30,418
13	Scotian Shelf West	0.1769	6,662	-	6,662
14	Scotian Slope	0.1377	252,232	-	252,232
15	Gulf of St. Lawrence	0.3696	121,840 ¹	-	121,840
16	Hudson Bay	0	-	-	-
	Total South		\$1,589,056	\$1,371,588	\$2,960,645
17	Beaufort South	0	23,442 ²	-	23,442
18	Beaufort North	0	68,996 ³	-	68,996
19	Western Archipelago-Offshore	0	-	-	-
20	Central Archipelago-Offshore	0	-	-	-
21	Eastern Archipelago-Offshore	0	-	-	-
22	Baffin Bay	0	-	-	-
23	Yukon North	0	-	-	-
24	Yukon South	0	-	-	-
25	Mackenzie Delta	0	-	-	-
26	Mackenzie North	0	-	-	-
27	Mackenzie Central	0	-	-	-
28	Mackenzie South	0	-	-	-
29	Western Archipelago-Onshore	0	-	-	-
30	Central Archipelago-Onshore	0	-	-	-
31	Eastern Archipelago-Onshore	0	-	-	-
	Total North		\$92,438	-	\$92,438
	TOTAL				\$3,053,082

1 A levy of \$365,648 remains outstanding in this region as of March 31, 2019.

2 An outstanding levy of \$23,442 was paid in this region in 2018-2019.

3 An outstanding levy of \$68,996 was paid in this region in 2018-2019.

Annex 1: ESRF Regional Map



Annex 2: Complete description of the ESRF Research Priority Areas for the 2015-2019 cycle

Northern Research Priority Areas

1. Research Priority Area #1: Spill Preparedness and Response, Fate and Effects

Summary: Studies will build on knowledge of the fate and effects of accidental releases of petroleum hydrocarbons and other hazardous substances in the Arctic marine environment and would be directed at the improvement of responses to such accidental releases.

Targeted Area: Eligible spill research areas include, but are not limited to, the biophysical, socio-economic, impact and assessment aspects of spills in the following categories:

- In-situ Burning;
- Dispersants;
- Mechanical Recovery;
- Shorelines;
- Spill Modelling; and,
- Detection and Monitoring.

Details regarding each of the eligible research areas can be found in the following report prepared by C-CORE for the ESRF Management Board. This report is on the ESRF website:

<http://www.esrfunds.org/pdf/194.pdf> - C-CORE (2013) Strategic Plan for Oil Spill Research in Canadian Arctic Waters, C-CORE Report R-13-108-1018, Revision 3.1.

Description: The risk of accidental releases of petroleum hydrocarbons and other hazardous substances into the Arctic marine environment has increased with the growing interest in the development of offshore petroleum operations in the Canadian Arctic. Hydrocarbon exploration is or might be taking place in both the near and offshore waters of the Beaufort Sea. In terms of oil spill response, the Arctic presents unique challenges, including the remote locations of potential spill sites, cold temperatures and limited availability of first-response personnel. Most of the research data on oil fate, effects and spill response in the Arctic have been derived from laboratory studies and field trials conducted in the 1970-1980's, with the exception of the recent Joint Industry Project effort by SINTEF in Norway (completed in 2009). The consensus of the international scientific community is that field trials are essential to advance the development of oil spill countermeasures for use in the Arctic. Unless methodologies can be validated in the field, they may not be fully accepted by regulators, Indigenous communities and the public as operational tools. Research in this priority area will focus on filling gaps in current spill countermeasures knowledge that will contribute to the production of effective environmental protection through the improvement of operational guidelines and best practices.

Studies should demonstrate benefit to stakeholders in areas where offshore petroleum operations are either ongoing or expected in the foreseeable future. In the North, offshore petroleum operations are anticipated in the foreseeable future only in the Beaufort Sea, encompassed by ESRF regions 17 and 18.

Exclusions: Research proposed exclusively for onshore areas.

2. Research Priority Area #2: Regional Effects Assessment and Management

Summary: Studies will focus on environmental and socio-economic studies that will build a knowledge base that extends to a regional scale, beyond single oil and gas lease blocks or operations. The information gathered by these studies is intended for use by all interested stakeholders in preparing and reviewing applications for oil and gas activities on Canada's northern frontier lands.

Targeted Area: Eligible research areas include:

- Biophysical studies;
- Socio-economic studies;
- Traditional knowledge studies; and,
- Studies contributing to the assessment and management of cumulative effects.

Description: Studies building on other regional research programs may be of particular interest including areas around offshore fish and bird populations and habitats, maintenance of long-term oceanographic observatories, and remote sensing, monitoring and modelling of sea ice.

Studies should demonstrate benefit to stakeholders in areas where petroleum operations are either ongoing or expected in the foreseeable future. In the North, offshore petroleum operations are anticipated in the foreseeable future only in the Beaufort Sea, encompassed by ESRF regions 17 and 18.

Exclusions: Research proposed exclusively for onshore areas.

Southern Research Priority Areas

3. Research Priority Area #3: Seismic

Summary: Studies will build on knowledge of the effects of the sound energy released to the marine environment during marine seismic surveys and be directed particularly at improving the understanding of the nature of seismic sound energy and its effects on commercial fish and invertebrate species as well as marine mammals and/or species at risk.

Targeted Area: Eligible research areas include but are not limited to:

understanding the "natural" underwater sound environment in the absence of sound energy arising from seismic survey operations; measuring the particle motion and sound pressure levels experienced by organisms at specified distances from seismic survey operations; modelling the propagation of sound energy from marine seismic surveys and the in-field verification of those model predictions documenting commercial fish and invertebrate behaviour in response to marine seismic survey sound energy in the field; documenting the effects of marine seismic survey sound energy on commercial fish and invertebrate physiology and gene expression associated with behavioural responses in the field; understanding of the quality (i.e., accuracy, data resolution) of the observations made by marine mammal observers and/or passive acoustic monitoring techniques; best practice for training and qualifying observers and passive acoustic monitoring operators.

Description: The effects of the sound energy released into the water column from the routine operation of airgun arrays used in marine seismic surveys on fish and invertebrate behaviour and, potentially, commercial harvesting of these species, are not fully understood.

There have been some attempts to study this issue in the field and the laboratory over the last twenty years but there is no consensus on the nature and/or significance of the effects observed. In recent years, workshops and conferences, some sponsored by the ESRF, have attempted to come to terms with this issue. These efforts were driven in no small measure by the concern for the socio-economic

effects of seismic surveys on fish harvesters. Without an understanding of the behavioural effects of the sound energy, including particle motion, resulting from marine seismic surveys' air gun arrays, the effects on marine species and their behaviour, and consequently on harvesting these species, is difficult to assess.

For the purposes of focussing this research priority area, the commercial fish species of greatest interest are northern shrimp, snow crab and Atlantic cod.

Exclusions: Laboratory scale studies, unless as part of a field study.

4. Research Priority Area #4: Oil and Gas Liquids Spill Fate and Effects

Summary: Studies will build on existing knowledge of the fate and effects of accidental releases of petroleum hydrocarbons in the Newfoundland- Labrador and Nova Scotia Offshore Areas.

Targeted Area: Eligible research areas include, but are not limited to: water column and benthic fate and effects of crude oil or natural gas liquids that may or may not have been treated with dispersants; surface and water column detection and monitoring of dispersed and non-dispersed crude oil or natural gas liquids; taint, toxicology and persistence of dispersed and non-dispersed crude oil or natural gas liquids in commercially harvested fish and invertebrate species; toxicology and persistence of dispersed and non-dispersed crude oil or natural gas liquids in seabirds; toxicology and persistence of dispersed and non-dispersed crude oil or natural gas liquids to benthic, zooplankton and/or phytoplankton species; modelling the fate and behaviour of dispersed and non-dispersed crude oil or natural gas liquids in deep water environments; socio-economic effects of a major spill event on the fisheries sector, particularly, the impact of markets refusing to purchase commercially harvested fish species and how those effects might be mitigated.

Description: This priority area is directed at improving the understanding of the effects of such releases on marine species, ecosystems and commercial fisheries.

Research proposed in response to this call should take into account recent research undertaken by the ESRF (e.g. ongoing studies that address: biodegradation rates for dispersed and non-dispersed crude oil and gas liquids and oceanography of the Flemish Pass) and findings and lessons learned arising from international research efforts, e.g., research on the Macondo Spill. Project proponents should also take in to account the trend to exploration in continental shelf break and deep-water areas of Canada's East Coast.

Exclusions:

- Laboratory scale, unless specifically linked to field studies or large scale experiments in wave tanks.
- Research designed and focussed exclusively on shorelines.
- Mechanical countermeasures and in-situ burning.

5. Research Priority Area #5: Atlantic Salmon Migration at Sea

Context

During recent key regulatory environmental assessment processes, questions were raised concerning: 1) the presence or absence of Atlantic salmon (*Salmo solar*) in areas of offshore oil and gas activity in eastern Canada; and 2) if they are present, what could be the possible impact of such activities on salmon survival while at sea.

Atlantic salmon is an important anadromous fish species in eastern Canada. These fish spend their early lives in freshwater and then migrate long distances to the sea to feed and grow before returning as mature adults to spawn in their natal river. Since the late 1980's, there has been a significant decline in the number of adult salmon returning to their native river to spawn, which has raised questions regarding the recovery and survival of many salmon stocks on the east coast of Canada (see DFO Stock assessment for the Maritimes Region and Newfoundland and Labrador Region).

Project Objective and Scope

The objective of this call is to develop a program of research aimed to determine the presence of Atlantic salmon (*Salmo salar*) in specific Canadian offshore regions to inform regulatory decision making in Canada's offshore areas. Studies should build on current knowledge of migratory behaviour of Atlantic salmon and be focussed on the duration Atlantic salmon are at sea. Projects that consider behaviour of Atlantic salmon in regions of offshore oil and gas activities may also be considered.

Key Outcomes

The studies funded by this research call are expected to support the decision-making process surrounding current and future offshore oil and gas activities by providing science-based information on Atlantic salmon migratory patterns at sea, especially in areas of offshore oil and gas activities in eastern Canada.

Key Criteria:

1. Project location: Projects must take place in the [ESRF Southern Regions 5 to 16](#). While studies could consider onshore or nearshore work, as appropriate and scientifically necessary, the focus of the work should reside in the offshore ESRF Southern Regions 8 to 15.
2. Atlantic salmon: Proposals must focus on Atlantic salmon (*Salmo salar*) as a key species of interest. Other species contributing to meet the objective of this Atlantic salmon research call could also be considered.

Annex 3: Study Selection Process

ESRF funding can be provided solely to legal entities validly incorporated or registered in Canada, including companies, industry associations, research associations, standards organizations, Indigenous and community groups, academic institutions as well as federal, provincial, territorial and municipal governments and their departments and agencies. These organisations are invited to participate in the ESRF study selection process.

The study selection process has three distinct phases:

- Letters of Interest
- Full project proposals
- Funding Agreements (or Memoranda of Understanding)

The selection process is launched with the ESRF Call for Letters of Interest (LOI). The received letters are reviewed by technical review committees and the ESRF Management Board members. The ESRF Management Board decides which proponents should be invited to submit full proposals.

Proponents who were successful in having their LOIs selected are invited to submit a full proposal, presenting a detailed version of their proposed research study. The received full proposals are reviewed, similarly to LOIs, by technical review committees and the ESRF Management Board members.

The ESRF Management Board decides which full proposal proponents should be invited to negotiate a Funding Agreement or, if the proponent is a federal, provincial or municipal government organization, a Memorandum of Understanding.

Selection Criteria

The LOIs and proposals that meet basic requirements regarding eligibility and completeness of information will be reviewed by a committee of technical experts mandated by the ESRF Management Board. These Technical Review Committees use the criteria provided in the LOI and full proposal Applicants' Guide to evaluate:

- the significance of the potential impact of the study being proposed; and,
- the probability that the study achieves its stated objective.

In addition to the above, the ESRF Management Board may consider other criteria, such as regional balance, in the final project selection. Any such criteria will be applied equitably to all Project Proposals reviewed.

Commitment to fairness and transparency

The ESRF Management Board, Natural Resources Canada and Indigenous and Northern Affairs Canada are committed to manage the selection process for the ESRF studies fairly and transparently. All assessments and decisions will be done in accordance with this commitment. No specific guidance or advice on preparing a LOI or full project proposal will be provided to any of the proponents. No meetings on the ESRF call for LOIs or call for full project proposals will be

held between any applicant and anyone involved with the project selection process. Further, to avoid the risk of real, perceived or potential conflict of interest, members of expert technical committees who have a vested interest as a potential participant in a particular project will be required to sign a declaration regarding their interest in the project and will not be allowed to participate in the assessment of that project.

Annex 4: Bibliography of Past ESRF Publications, 1985 - 2019

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. Since its inception in 1983, the ESRF has published over 200 reports and related studies.

All published reports and studies are available for download through the ESRF website:
<http://www.esrfunds.org/174>.

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- 026 Young, S.C. *Bibliography on the Fate and Effects of Arctic Marine Oil Pollution*. March 1986. 212 p.
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- 050 Finley, J.C. and C.R. Goodwin. *The Training and Employment of Northern Canadians: An Annotated Bibliography*. November 1986. 206 p.
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Environmental Effects and Monitoring

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- 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.

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- 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.
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- 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.
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