Project Dashboard

Predicting environmental health risk from radioactivity in the Canadian Arctic (148304)

Proposal Status: Conformity Determination Issued

Project Overview

Type of application: **New**

Proponent name: Dr. Lars Brinkmann

Company: Canadian Nuclear Laboratories

Schedule:

Start Date: 2016-07-01

End Date: 2017-12-31

Operation Type: Seasonal

Project Description:

Project background: Radioisotopes are toxic substances that are released into the environment by industrial activities, nuclear waste upgrading and disposal, nuclear weapons tests and nuclear accidents, and are transported to the Arctic on ocean currents and the atmosphere. Radioisotopes can be very similar to substances that are important to living organisms, including water and certain nutrients. Therefore radioisotopes can accumulate to high levels in fish and plants that are consumed by humans and large animals. The recent Fukushima accident, which released radioactive contaminants into the Pacific Ocean, has demonstrated that our understanding of radiological risk assessment in complex marine systems is generally very limited. This, and prospects of increasing industrial expansion and human habitation along with dramatic effects of climate change on Arctic landscapes and Ocean environments, has renewed interest in radiological risk assessments in the Arctic. In order to fill knowledge gaps of radiological risk to humans and wildlife in the Arctic, this project focuses on the environmental fate and transfer of radioisotopes commonly released to the environment from historic weapons tests, submarine accidents, waste disposal, nuclear accidents and nuclear power reactors: cesium, strontium and hydrogen. Radioactive cesium and strontium are persistent contaminants released to the environment as a consequence of nuclear accidents and weapon tests. Cesium and strontium are known to accumulate in fish, particularly in freshwater environments. However, very little is known about the ecological fate of these radioisotopes in fishes such as migratory Arctic char, which spend time in both near-shore Ocean and freshwater habitats in the Arctic, and are an important food source for people and animals. Radioactive hydrogen, known as tritium, was historically released during the weapon tests and is also released in small quantities, albeit highly regulated and monitored, by nuclear reactors of Canadian design. It becomes part of water molecules and disperses with atmospheric water vapour. Precipitation in the form of snow and rain deposit radioactive water on the land, from where it is taken up by plants and accumulated in foliage and fruits. Models describing this process to predict radiological risks to people have been shown to underestimate the accumulation of tritium in plants considerably, and also focus primarily on agricultural products grown in temperate regions. Very little is known about tritium accumulation in wild plants of northern regions, whose fruits are an important food source for people and animals. The project will consist of two component studies at two sites in Nunavut,

Kugluktuk and CFS Alert, representing the southern and high northern Arctic, respectively, and will address two central research questions: 1) What will be the risk of fish contamination from a nuclear accident in near-shore ocean food webs? 2) What will be the risk of contamination of plant life due to atmospheric releases of radioactive water from nuclear reactors? These component studies are planned as follows. Study 1: Developing a risk assessment model for Arctic charr in near-shore Arctic Ocean food webs. The Arctic Ocean study components will focus on Arctic char, as this species is an important food source for people. Char also migrate between ocean and freshwater and are therefore at higher risk to be exposed to accidental releases in both ocean and inland situations. Specific objectives of this study are: 1) To provide an analysis of the feeding ecology of arctic char to determine exposure pathways of radioactive elements cesium and strontium to char through diet and water. 2) To measure concentrations of cesium and strontium in char and their diet. 3) To develop a dynamic model by which risk from a radiological release anywhere in the Arctic Ocean can be predicted for char. To meet these objectives we are planning a sampling campaign for 2016-2017. We will seek assistance from communities with the collection of char. The samples of char we require can be derived from wastes from subsistence catches: We require and accurate measurement of live fish length and weight, and only need 1) stomach contents and internal organs, 2) skin samples, 3) the head and backbone with attached scraps of muscle tissue for our further analyses. The edible filets are not needed for our analyses and can stay with the community. For further sampling we seek to employ a local guide with boat to help with collecting marine organisms, such as crabs, shrimp and molluscs. Study 2: Revision of Canadian regulatory models for organic tritium in plants. The study investigating tritium accumulation by land plants will focus on perennial fruit-bearing plants, such as blueberry and cranberry, grasses and deciduous trees. These plants were chose as they represent important food sources for people and grazing and browsing animals. Specific objectives of this study are: 1) To determine the concentrations of tritium in organic tissues of the foliage and fruits of plants. 2) To examine the relationship between tritium concentrations between atmospheric water, soil water and free plant water. 3) To examine the transfer of tritium from senescent plant material to soil matter. 4) To develop an empirical model describing these processes for risk assessment purposes. Sampling for this study is planned for 2016-2017 and will encompass collection of air moisture, precipitation, surface water, soil water, soil material, fresh plant leaves, fruits and roots. Air moisture will be collected using specialized apparatus, which pumps air through a drying medium to trap water. Plant samples will include fruit-bearing woody plants and grasses. For woody plants only fruits and fresh foliage will be collected. Grasses will be collected whole, including above-ground and below-ground parts. Soil samples will be collected using a coring technique, which produces a 10cm-deep plug. Soil moisture will be initially measured with a probe and subsequently isolated quantitatively from soil core samples. The tritium concentrations will be measured in the laboratory for all materials isolated. Outlook and Deliverables: This two year project will result in a number of mathematical models and parameters for use in risk assessments for radioactive releases in the Canadian Arctic. Analyses performed to meet the project objectives will produce supporting data that is useful for future studies in wide-ranging contexts, including arctic food-web ecology, atmospheric processes and climate change. Results of this research project will be published as a series of articles in peer-reviewed scientific journals. Copies of published articles will be made available to the Nunavut government and individual communities and a presentation could be made to an appropriate group.

Personnel:

Persons: 3
Days: 28

Project Map

List of all project geometries:

ID	Geometry	Location Name
948	polygon	Study area around Kugluktuk
949	polygon	Study area around Alert

Planning Regions:
Qikiqtani
Kitikmeot
Affected Areas and Land Types
Inuit Owned Surface Lands
Municipal
Crown Lands
Settlement Area

Project Land Use and Authorizations

Project Land Use
Scientific Research
Licensing Agencies
DFO
GN-NRI
Other Licensing Requirements
No data found.

Material Use

Equipment

Type	Quantity	Size	Use
Scientific apparatus	1	100kg	To collect water samples from air, soil core sampling, plankton net and hand-held nets to collect marine invertebrates, beach seine.

Fuel Use

Type	Container(s)	Capacity	UOM	Use
Gasoline	3	20	Liters	Transportation

Hazardous Material and Chemical Use

Type	Container(s)	Capacity	UOM	Use
None	0	0	Liters	None

Water Consumption

Daily Amount (m^3)	Retrieval Method	Retrieval Location

0

Waste and Impacts

Environmental Impacts

This project does not use hazardous chemicals. No environmental impacts expected from this project.

Waste Management

Waste Type	Quantity Generated	Treatement Method	Disposal Method
Combustible wastes	5kg	None	Regular municipal disposal
Greywater	1000kg	none	Regular municipal infrastructure
Sewage (human waste)	100kg	none	regular municipal infrastructure