

The main area of this proposal are widely understood Earth science. In particular, during the implementation of the project there will be raised such important issues as protection of nature - radioecology, radioactive pollution of the biosphere, atmosphere, hydrosphere and their links.

The presence of radioactive elements is related to both the natural processes and human activity. The result of human activity is raising the level of natural radioactivity and the introduction of new, artificially produced radioisotopes. This implies an increase ionizing radiation dose received by living organisms, as well as the exposure of these organisms on highly toxic substances. The proposed project concerns of both groups of pollutants - natural and artificial isotopes emitting radiation: alpha, beta and gamma due to their decay. However, the production of pollution wouldn't have been such a serious problem for humanity, if these radioactive contamination hadn't spread through the atmosphere and ocean currents globally and locally. Despite the fact that quite a long time has passed since the introduction of pollutants into the environment, their presence can be still detected.

This proposal focuses on the vast land area of the Arctic: West Greenland, islands and peninsulas along the sea route connecting the Atlantic Ocean with the Pacific Ocean, known as the Northwest Passage, coastal zone of Labrador and Newfoundland, Canada. Arctic environment is generally seen as an extremely sensitive to contamination. This vulnerability is primarily due to the following specific factors: the relatively short food chains that exist in the Arctic, efficient transfer of contaminants between different organisms forming these chains and close relationship with the terrestrial and marine ecosystems. Moreover, there is observed warming temperature, changes in precipitation type and amount, which probably contribute to the increase mobility of radionuclides in the Arctic terrestrial environment. Previously thought, that the mobility of contaminants is there relatively low.

On the radioecological point of view quite important is the uptake of pollutants by plants. This is a potential threat for local ecosystems that are exposed to penetration of toxic radioactive elements through the food chain. Intermediaries in the transfer of radionuclides between humans and plants are herbivores (reindeer, caribou). One of the dominant representatives of arctic flora are lichens and mosses. These organisms are widely used as biological indicators of environmental pollution. The lack of wax cuticle and root systems cause that lichens and mosses have to uptake of nutrients from the atmosphere and surface water together with inherent contaminants. Furthermore a relatively slow growth rates and long lifespan of these organisms results in the incorporation of greater amounts of impurities in the intracellular structure with time.

The main objectives of the research include:

- estimation of the level of activity concentration of radioisotopes ( $^{134}\text{Cs}$ ,  $^{137}\text{Cs}$ ,  $^{90}\text{Sr}$ ,  $^{238,239+240}\text{Pu}$ ,  $^{241}\text{Am}$ ,  $^{40}\text{K}$ ,  $^{210}\text{Pb}$ ,  $^{230,232}\text{Th}$ ,  $^{234,238}\text{U}$ ) in lichens and mosses from the western regions of the Arctic, by calculation the level of activity concentration of radioactive elements,
- identification sources of artificial radionuclides pollution through calculation of isotopic ratios:  $^{238}\text{Pu}/^{239+240}\text{Pu}$ ,  $^{239+240}\text{Pu}/^{137}\text{Cs}$ ,  $^{241}\text{Am}/^{239+240}\text{Pu}$ ,  $^{239+240}\text{Pu}/^{90}\text{Sr}$ ,  $^{240}\text{Pu}/^{239}\text{Pu}$ ,  $^{137}\text{Cs}/^{90}\text{Sr}$ ,  $^{134}\text{Cs}/^{137}\text{Cs}$ ,
- examination properties of lichens and mosses in the case of radioactive contamination by comparing concentrations of activity between different species of lichens and mosses from different locations and selecting organisms with the best ability to accumulation of radioactive pollution.

In consider Arctic area, pollution of anthropogenic radionuclides should come from the global fallout, which could be slightly modified by expected influence of the explosion carried out in Arctic nuclear training ground at Novaya Zemlya. Apart from the global fallout there will be considered the impact of other anthropogenic sources of radioactive substances such as Chernobyl fallout (1986), fallout from Fukushima (2011) and regional sources, for instance: crash of a Boeing B-52 with nuclear bombs on board near the Thule Base, Greenland (1968) and Kosmos 954 satellite crash over the Great Slave Lake in Northern Canada (1978). Due to the fact, that the samples come mainly from the coastal zone, may also be significant radioactive contamination transported by ocean currents from discharges from nuclear fuel reprocessing plants at Sellafield and Cap de Hague into the Irish Sea and the English Channel, respectively, or those released as a result storage of radioactive waste by the USSR in the Arctic seas. Thanks to characteristic values ?? of isotopic ratios it will be possible distinguished pollution coming from these sources from the global fallout.

It is presumed that in lichens and mosses from several locations in the Canadian Arctic, level of activity concentrations of natural radioactive isotopes, especially uranium - 234 and 238, will be increased because of the existence and extraction of uranium ore deposits in Canada. It is believed that the ability to accumulate radionuclides by mosses is better than lichens. The research described in this project will allow to check these all hypothesis.

Because of the proposal concern the vast area of ?? the western Arctic (14 positions), many different species of lichens and mosses collected in a relatively short period of time (August - September 2012, July - August 2013) and measurements of activity of a large number of different radioactive isotopes will be possible to:

- supplement and update the state of knowledge about levels of radioactive contamination and the sources of these pollutants in the western Arctic; absolute novelty there will be search for traces of contamination with Cs-134, which is result of the power plant disaster in Fukushima (2011), moreover there will be made designation of isotopes Pu and Am-241, which is extremely rarely studied in the Canadian Arctic terrestrial environment,
- enrich the database of information about radioactive contamination in lichens and mosses, which are extremely important element of nature of the Arctic,
- extend knowledge about the ability to accumulate of radioisotopes by various species of lichens and mosses in different climatic conditions of different parts of the western Arctic.