400-year-old frozen moss brought back to life in scientist's lab

BY SHEILA PRATT, EDMONTON JOURNAL MAY 28, 2013

University of Alberta Professor Catherine La Farge has grown moss from a 400-year-old specimen discovered frozen under an Arctic glacier.

Photograph by: Shaughn Butts, Edmonton Journal

EDMONTON - In Arctic summers, Catherine La Farge camps out at the toe of the Teardrop glacier on Ellesmere Island in Canada's North.

The University of Alberta biologist has watched the ice retreat, up to four metres a year now, giving her an unprecedented view of what was entombed under the ice for 400 years — old rocks, mud, and her specialty, ancient moss.

One day, walking along the edge of the ice, La Farge noticed some of the moss had a greenish tinge. That gave her a hunch — could there be life in that old moss after all?

In an amazing experiment, La Farge found the frozen moss was able to revive itself though it had been buried since the Little Ice Age (1550-1850). Her study, published this week in the Proceedings of the

National Academy of Science, is shaking up some basic assumptions about land plants.

In the past, when scientists occasionally came across plant material previously frozen under an Arctic glacier, they assumed the plant material was dead. Discoloured and lifeless, it certainly looked like it was.

In 2009, La Farge brought samples back to the lab. On closer examination, she noticed a tiny green stem. There were two possible explanations.

"Either it kept its colour under the glacier or it grew after the moss emerged 400 years later."

There was only one way to find out.

La Farge ground up the old plant material, put it in petri dishes full of potting soil and set it in the grow chamber next to her office. Then she and graduate student Krista Williams and master's student David Wilkie watched for signs of life.

It didn't take long. In about four to six weeks, tiny green filaments or strands called protonema began to grow.

Months later, a dish was almost full of green moss from cells frozen for 400 years. Of 24 samples potted, seven produced new growth.

"It was just incredible," said La Farge, whose work has given scientists another window into the basic life systems of plants.

"Now we have Little Ice Age moss material that produced juvenile plants."

In glaciers, there are all kinds of fungi and bacteria, but no one has ever considered that land plants could survive being entombed underneath, she said.

"Now we have to think there may be populations of land plants that survived that freezing. It makes you wonder what's under the big ice caps in the Arctic and Antarctic and alpine glaciers.

"And we have a 400-year-old lineage of genetic material," she added.

Mosses are especially hardy and ancient — 400 million years old, she said. Mosses played a key role in moving life from water to land in evolution. They evolved from green algae and paved the way for other land plants.

Unlike most other plants, mosses reproduce by cloning their cells so "all you need is even one cell to survive."

Also, moss cells are very powerful — totipotent is the scientific term — because they can reprogram

themselves to start growth all over again.

La Farge's work shows that ability to regenerate — the totipotency of a cell — doesn't diminish with age, at least not over 400 frozen years.

"If we could find some moss that went back 1,000 years or 5,000 years we may find some material that could be revived. But it all depends on the specific way the material is buried and the conditions" — cold and dry is best.

A group of researchers in Germany is already using bryophyte cells — basically moss stem cells — in medical research. La Farge's work shows the resilience of the cells which could be a factor in their use.

There might be uses. Before sending colonies of humans to Mars, it might be worth seeing how well moss survives the cold dry climate, she said.

La Forge's discovery shakes up a few assumptions of glacial science, a major one being that as glaciers carved their way forward they crushed everything beneath them. The landscape from retreating ice can no longer be considered barren of land plants ready to grow again. Mosses could be a key agent for regenerating the land.

There's one other significant aspect to this discovery. While biological diversity is shrinking in the world, the frozen world under glaciers could provide an "unrecognized genetic reservoir."

These are reservoirs that could be tapped in the future," La Farge said.

"We really have not examined all the biological systems that exist in the world; we don't know it all.

"We need curiosity-driven research to make these discoveries."

La Farge's co-authors on the study include Williams and Arctic researcher John England, also at the University of Alberta.

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