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Alaskan frogs survive after six months at minus 18 degrees celsius

Subodh Varma, TNN | Jul 23, 2014, 06.43 PM IST

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science of human organ transplantation.

"If science can figure out how to freeze human organs without damage it would allow more time to reach people in need of organs," said Larson.

Although wood frogs are well-studied freeze-tolerant amphibians, this new study is believed to be the first to examine the frogs under natural conditions. In subarctic Interior Alaska, wood frogs overwinter in the ground covered by duff and leaf litter, creating a hibernacula (a small cave like structure), where temperatures can remain below freezing for more than six months with minimum temperatures of minus four (minus 20 celsius).

Tracking wood frogs to their natural hibernacula, and using a fenced hibernacula in the Biological Reserve north of the UAF campus, Larson and co-author Brian Barnes, director of the UAF Institute of Arctic Biology and an expert in cold-climate physiology, wanted to know how cold and how long Alaska's wood frogs could survive in their natural habitat.

The curious thing Larson discovered is that when wood frogs are outside in their natural environment they accumulate much higher concentrations of glucose in their tissues than do frogs frozen in the lab.

NEW DELHI: Alaskan frogs can survive being frozen at minimum temperatures below minus 18 degrees celsius for up to 218 days with 100 percent survival afterwards. Extensive field research by scientists at the University of Alaska Fairbanks pushed back the endurance limits of these frogs. Earlier, frogs collected in the eastern US and Canada and kept in labs had been shown to survive being frozen for a only few weeks and to no lower than about minus 7.2 degrees celsius.

The feats of freezing frogs are more than just a curiosity and may one day have application in the

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Glucose concentrations in the outside frogs were 13-fold higher in muscle tissue, 10-fold higher in heart tissue and 3.3-fold higher in liver tissue compared to lab-frozen frogs, as described in their paper published in the Journal of Experimental Biology.


This extra protection enabled frogs to survive colder temperatures for a longer time than scientists previously thought, but Larson and Barnes wondered how they accumulated so much glucose?

"In the field, in early autumn, it's freezing during the night, thawing slightly during the day, and these repeated freezing episodes stimulate the frogs to release more and more glucose," Don Larson, UAF graduate student and lead author of the paper published on the study said. "It's not warm enough for long enough for the frog to reclaim much of that glucose and over time it accumulates giving the frog more protection against cell damage."

"Concentrating sugar inside the cell helps balance the concentration of salts outside the cell that occurs as ice forms," said Barnes. "Less water leaves the cell than if sugar was not present and sugar and other cryoprotectants are thought to ""hold"" water inside the cell."

Lab-frozen frogs are held at a constant temperature and without the freeze-thaw cycles Larson observed in the wild and so the frogs made glucose only when they initially froze and that was that.

"Whether the extremes in freezing tolerance in Alaska frogs as compared to more southern populations are due to patterns of temperature change during freezing or are due to genetic differences, and thereby represent evolutionary change, awaits further study," said Barnes.

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