Why don't beetles freeze in the winter?

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For 37 years, Queen's University Biochemistry professor Peter Davies has been unraveling the mystery of why some organisms including insects and fish don't freeze in the winter. His research into insect antifreeze protein (AFP) has shed new light in several areas, including a new paper on longhorn beetles native to Siberia.

"Many insects, plants and other organisms owe their survival to AFPs," says Dr. Davies. "This research found the most active AFP to date in the longhorn beetle, which we hypothesize means that, through evolution, AFPs have become more effective."

Working with Queen's PhD candidate Koli Basu and a team from Yale University, Dr. Davies has revealed how these insects and the antifreeze they produce may have evolved to handle temperatures that can drop below -40 degrees Celsius. The beetles produce AFPs to stop the growth of ice that might form in their internal fluids, which lowers the freezing temperature of the insect and prevents freezing related-tissue damage.

AFPs within these living organisms bind to seed ice crystals that form as the weather cools. By binding to the ice, AFPs prevent the ice from spreading and freezing the organism. Many organisms that live in cold weather have some level of AFPs including insects, fish, plants, bacteria, algae and fungi.

"My next project is looking at midges, the flies we find in swarms on the Kingston waterfront at this time of year," says Ms. Basu. "We have detected antifreeze activity in the midges and this could be the first time

an AFP has been characterized from flies."

As for practical applications, a manufacturer of ice cream has started adding AFP to its low fat brands to prevent large ice crystals from forming in the ice cream. Dr. Davies says there are many more practical applications including using AFPs during the transportation and storage of other frozen foods.

The paper was published in the *Journal of Biological Chemistry*.

Provided by Queen's University