FINANCIAL TIMES

October 24, 2014 4:43 pm

Biochemistry: the cold facts

Clive Cookson and Tyler Shendruk

Antarctic icefish survive in sub-zero waters thanks to 'anti-melt' proteins

Icefish survive in sub-zero waters thanks to "anti-melt" proteins

Polar seawater is so cold that Antarctic icefish depend on antifreeze proteins that have evolved to prevent blood and other body fluids freezing solid. These proteins do not just lower the blood's freezing point, new research published in the journal PNAS shows; they also raise slightly the melting temperature of any ice crystals that do form in the blood – which causes many fish to have ice particles flowing through their veins all year round.

Because it is salty, seawater remains liquid at subzero temperatures. Car antifreezes similarly contain dissolved molecules that lower the freezing/melting temperature. But the proteins that allow Antarctic icefish to survive in frigid waters are different. They don't stop tiny ice crystals from forming but instead prevent their growth, by binding to the crystal faces that encase the tiny particles.

The researchers at the universities of Oregon and Illinois studied icefish in gelid aquariums and the wild. "The fish are the same temperature as the seawater but they are about half as salty, which means that they would freeze at about -1C," says Paul Cziko, project leader. With the antifreeze protein, however, blood is supercooled, remaining fluid to temperatures nearly two degrees lower.

More surprisingly, the ice crystals can be superheated, remaining solid above the temperature at which they would normally melt. "Because the antifreeze proteins bind so tightly to the ice crystal surface, they not only stop the crystals from growing but can also affect the melting," explains Cziko. "So although we call these antifreeze proteins, they are also 'anti-melt' proteins." Christina Cheng, his co-author, adds: "Our discovery may be the first example of ice superheating in nature."

Although antifreeze proteins allow the fishes to live in glacial temperatures, it comes at a cost. The tiny crystals can become entrenched in tissue, potentially causing inflammation or clogging circulation through blood vessels.

Cziko and colleagues collected icefish and 11 years' worth of data from McMurdo Sound in Antarctica. The

Palaeontology: Roos on the run

Giant kangaroos, three times

seawater varied by less than 2C annually and even at its warmest never rose above zero. Even during summer months, the fish retained internal ice crystals, despite the water temperature rising above their normal melting point. The study shows that the same proteins that stop the fish from freezing solid also cause the tiny invasive ice crystals to persist for months or even years until the sea becomes unusually warm and a rare melting opportunity occurs.

Photograph: Paul Cziko

bigger than today's largest roos, lived in Australia until 30,000 years ago and walked on two feet rather than hopping