Keeping warm: Coordinated movements in a penguin huddle

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Emperor penguins with chicks. Photo: Cal Young

To survive temperatures below -50 C and gale-force winds above 180 km/h during the Antarctic winter, Emperor penguins form tightly packed huddles and, as has recently been discovered – the penguins actually coordinate their movements to give all members of the huddle a chance to warm up.

Physicist Daniel P. Zitterbart from the University of Erlangen-Nuremberg, Germany, recently spent a winter at Dronning Maud Land in the Antarctic, making high-resolution video recordings of an Emperor penguin colony.

Together with biophysicist Ben Fabry from Erlangen University,

physiologist James P. Butler from Harvard University, and marine biologist Barbara Wienecke from the Australian Antarctic Division, they found that penguins in a huddle move in periodic waves to continuously change the huddle structure.

This movement allows animals from the outside to enter the tightly packed huddle and to warm up.

The results have now been published in the journal *PLoS ONE*.

The survival techniques of Emperor penguins have long intrigued scientists. One unresolved question was how penguins move to the inside of a huddle when the animals stand packed so tightly that no movement seems possible.

Daniel P. Zitterbart and his team discovered that penguins solve this problem by moving together in coordinated periodic waves.

This was observed by tracking the positions of hundreds of penguins in a colony for several hours.

The periodic waves are invisible to the naked eye as they occur only every 30-60 seconds and travel with a speed of 12 cm/s through the huddle. Although small, over time they lead to large movements that are reminiscent of dough during kneading.

The authors compare the formation of a huddle to "colloidal jamming" and the periodic waves to a "temporary fluidization".

"Our data show that the dynamics of penguin huddling is governed by intermittency and approach to kinetic arrest in striking analogy with inert non-equilibrium systems, including soft glasses and colloids."

Daniel P. Zitterbart is currently developing a remote-controlled observatory to study penguins all year round. He hopes to witness the reversal of the dramatic decline in penguin colony sizes that is occurring in all areas of the Antarctic.

More information: Zitterbart DP, Wienecke B, Butler JP, Fabry B (2011) Coordinated Movements Prevent Jamming in an Emperor Penguin Huddle. *PLoS ONE* 6(6): e20260. doi:10.1371/journal.pone.0020260