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To Arctic animals, time of day really doesn't matter

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Summary: In the far northern reaches of the Arctic, day versus night often doesn't mean a whole lot. During parts of the year, the sun does not set; at other times, it's just the opposite. A new study shows that Arctic reindeer have come up with a solution to living under those extreme conditions: They've abandoned use of the internal clock that drives the daily biological rhythms in other organisms.

FULL STORY

Wild arctic reindeer in the wilderness of Svalbard islands, Norway.

Credit: iStockphoto/Laila Røberg

In the far northern reaches of the Arctic, day versus night often doesn't mean a whole lot. During parts of the year, the sun does not set; at other times, it's just the opposite. A new study reported online on March 11th in *Current Biology,* a Cell Press publication, shows that Arctic reindeer have come up with a solution to living under those extreme conditions: They've abandoned use of the internal clock that drives the daily biological rhythms in other organisms.

"Our findings imply that evolution has come up with a means of switching off the cellular clockwork," said Andrew Loudon of the University of Manchester. "Such daily clocks may be positively a hindrance in environments where there is no reliable light-dark cycle for much of the year."

Light-dark cycles drive hormone rhythms via a circuit that involves the eye and nervous system projections to structures involved in regulating hormone rhythms, in particular melatonin, Loudon explained. In most mammals, this wiring circuit also involves an internal clock that drives hormone levels in a rhythmic 24-hour fashion, even when there is no light-dark cycle.

"In reindeer, it is this clock element that seems to be missing," Loudon said. The reindeer show no natural internal rhythm of melatonin secretion at all. Instead, hormone levels rise and fall in direct response to light and dark. The researchers show that melatonin levels remain at or below detectable levels during daylight hours. Those hormone concentrations spike almost as soon as the light goes out, only to dive again when it switches back on.

Further studies by Loudon and his colleague Karl-Arne Stokkan of the University of Tromsø in Norway using reindeer skin cells showed that two well-known clock genes don't oscillate the way they do in other organisms as a way of keeping time. "We suspect that they have the full range of normal clock genes, but these are regulated in a different way in reindeer," Loudon said.

The researchers say that the findings initially came as a surprise, but they now suspect that similar patterns will be uncovered in other Arctic animals.

"Synchronization of seasonal cycles in mammals is a prominent feature of physiological adaptation in northern temperate and Arctic species," Loudon and Stokkan write. "Studies of seasonal sheep reveal that melatonin signals need only be present for a few weeks of the year to entrain an annual reproductive cycle. It is attractive to speculate that in reindeer, informative melatonin signals associated with equinoxes directly entrain a 'circannual clock' that, at least in reindeer, may not involve circadian mechanisms."

The researchers include Weiqun Lu, University of Manchester, Manchester, UK, Qing-Jun Meng, University of Manchester, Manchester, UK; Nicholas J.C. Tyler, University of Tromsø, Tromsø, Norway; Karl-Arne Stokkan, University of Tromsø, Tromsø, Norway; and Andrew S.I. Loudon, University of Manchester, Manchester, UK.

Story Source:

Materials provided by **Cell Press**. *Note: Content may be edited for style and length.*

Journal Reference:

1. Weiqun Lu, Qing-Jun Meng, Nicholas J.C. Tyler, Karl-Arne Stokkan, and Andrew S.I. Loudon. **A Circadian Clock Is Not Required in an Arctic Mammal**. *Current Biology*, 2010; DOI: 10.1016/j.cub.2010.01.042

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