

Reindeer sleep while chewing their cud, a strategy that may help them in the summer

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Screenshot of reindeer surveillance. Credit: Current Biology/Furrer et al.

Researchers report December 22 in the journal [Current Biology](#) that the more time reindeer spend ruminating, the less time they spend in non-rapid eye movement (non-REM) sleep. EEG recordings revealed that reindeer's brainwaves during rumination resemble the brain waves present during non-REM sleep, and these brainwave patterns suggest that the reindeer are more "rested" after ruminating.

The researchers speculate that this multitasking might help reindeer get enough [sleep](#) during the [summer months](#) when food is abundant, and reindeer feed almost 24/7 in preparation for the long and food-sparse arctic winter.

"The more reindeer ruminate, the less additional non-REM sleep they need," says first author and neuroscientist Melanie Furrer of the University of Zurich. "We think it's very important that they are able to save time and cover their sleep and digestive needs simultaneously, especially during the summer months."

Light-dark cycles are absent in the Arctic during winter and summer, and previous studies showed that Arctic-dwelling reindeer don't display circadian behavioral rhythms during these seasons, though they tend to be more active during the daytime during the spring and autumn equinox when light-dark cycles are present. However, whether these seasonal differences also impacted how much—and how well—reindeer sleep was unknown.

To investigate the influence of seasonal light-dark cycles on reindeer sleep patterns, the researchers performed non-invasive electroencephalography (EEG) on Eurasian tundra reindeer (*Rangifer tarandus tarandus*) in Tromsø, Norway (69°N), during the autumn equinox, summer solstice, and winter solstice.

The reindeer, who were all [adult females](#), were part of a captive herd at UiT, The Arctic University of Norway in Tromsø, and the experiments were conducted in indoor stables with controlled lighting, unlimited food, and constant temperature.

They found that reindeer slept approximately the same amount during winter, summer, and autumn despite the fact that they were much more active during the summer. This is in contrast to other species that change

the amount they sleep in response to environmental conditions. On average, the reindeer spent 5.4 hours in non-REM sleep, 0.9 hours in REM sleep, and 2.9 hours ruminating during a given 24-hour period, regardless of season.

"The fact that reindeer sleep the same amount during winter and summer implies that they must have other strategies to cope with limited sleep time during the arctic summer," says Furrer.

One possible strategy is the opportunity for rest during rumination—the re-chewing of partially digested food, which is an important component of digestion for reindeer and other ruminants. Domestic sheep, goats, cattle, and Lesser mouse-deer have all been previously observed to produce sleep-like brain waves during rumination, but it was unclear whether rumination could serve a similar restorative function to sleep.

The researchers found that the reindeer's EEG readings during rumination resembled brainwave patterns that are indicative of non-REM sleep, including increased slow-wave activity and sleep spindles.

Sleeping and ruminating reindeer also displayed similar behavior, tending to quietly sit or stand during both activities, and were less reactive to disturbances such as a neighboring reindeer sitting down or getting up—reindeer directly responded to these disturbances (by looking toward the neighboring reindeer) 45% of the time if they were awake, but only 25% of the time if they were ruminating, and 5% of the time if they were in non-REM sleep.

Next, the researchers tested whether rumination could reduce the reindeer's drive to sleep by depriving the reindeer of sleep for 2 hours and measuring their brain waves during sleep before and after this deprivation.

Following sleep deprivation, the reindeer's EEG readings showed increased slow-wave activity, which is indicative of a build-up of "sleep pressure"—the unconscious biological drive for more and deeper sleep—suggesting that reindeer experience deeper sleep following sleep deprivation.

However, when the reindeer ruminated, this slow-wave activity was decreased during subsequent sleep, and the more they ruminated, the more the slow-wave activity decreased. "This suggests that rumination reduces sleep pressure, which could benefit the reindeer because it means they don't have to compromise on sleep recovery when they spend more time ruminating," says Furrer.

This is especially important during the summer because the more they eat, the more time the reindeer need to spend ruminating. "Rumination increases nutrient absorption, so it's crucial for reindeer to spend enough time ruminating during the [summer](#) in order to gain weight in anticipation of winter," says Furrer.

Since reindeer appear to sleep while ruminating only some of the time, follow-up studies should compare the impact of rumination while sleeping with rumination while awake and would also ideally measure reindeer behavior and sleep in more natural outdoor conditions, the researchers say. However, such measurements would require surgically implanted EEG sensors rather than the non-invasive surface electrodes used in this study.

"Another thing we could add is to look at young reindeer," says Furrer. "We know sleep need is much higher in [young children](#) and babies compared to adults, so it would be interesting to look at sleep in younger [reindeer](#)."

More information: Reindeer in the Arctic reduce sleep need during

rumination, *Current Biology* (2023). DOI: [10.1016/j.cub.2023.12.012](https://doi.org/10.1016/j.cub.2023.12.012).
[www.cell.com/current-biology/f ... 0960-9822\(23\)01667-6](https://www.cell.com/current-biology/fulltext/S0960-9822(23)01667-6)

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