

EDITORIAL

Introduction to the Special Issue on Comparative Biology of Sleep and Circadian Rhythms

Noah T. Ashley¹  | John A. Lesku² ¹Department of Biology, Western Kentucky University, Bowling Green, Kentucky, USA | ²Sleep Ecophysiology Group, La Trobe University, Melbourne, Australia**Correspondence:** Noah T. Ashley (noah.ashley@wku.edu)**Received:** 14 September 2024 | **Accepted:** 16 September 2024

This special issue highlights the growing diversity and importance of time-keeping mechanisms among nonmodel species, with emphasis upon sleep and circadian rhythms.

Sleep is a fundamental and often understudied component of animal life cycles. Regulated by both circadian and homeostatic processes, sleep is a reversible behavioral state of restfulness and environmental disengagement, associated with reduced responsiveness to sensory stimuli. There is mounting experimental evidence that sleep provides restorative functions for the brain (e.g., removal of toxic compounds, neuronal repair, synaptic plasticity) and for energy balance (e.g., reducing energy expenditure when food is low or during inclement weather). Sleep loss, either in the form of deprivation or restriction can lead to deleterious effects in most animals. Therefore, consolidated sleep is a common feature seen in animals, but there are exceptions to this rule.

Wakefulness permits animals to explore and interact with their environment. Perhaps unsurprisingly, behavioral ecologists typically study animal behavior, physiology, and ecology on those already awake. Yet, there is growing attention of sleep by those who study these subdisciplines of biology, and a call for more. This new-found appreciation may arise from sleep being a substantial part of animal life, and in some animals, it is the dominant state. Although most studies are conducted in laboratory settings, and often on a few established model species, recent research on sleep in wild animals suggests that not all animals sleep the same. Nesting chinstrap penguins (*Pygoscelis antarcticus*) buffeted by their colony mates and under the watchful glare of hungry nest predators, package their 11 h of sleep each day into 10,000 microsleeps, with each bout lasting on average just 4 s. For 3 weeks during the high-latitude breeding season, male pectoral sandpipers (*Calidris melanotos*)

nearly forgo sleep to maximize reproductive success during their limited window to breed. Some marine mammals and birds sleep unihemispherically and keep an eye open to mitigate risk.

The electroencephalographic properties of brain sleep have largely been measured in birds and mammals, to distinguish between their two types of sleep, rapid eye movement (REM) sleep and non-REM sleep. Interestingly, some reptiles, arthropods, and cephalopods also have two sleep states, that in some (but not all) ways resemble mammalian and avian sleep states. Although the neurophysiological correlates of sleep are largely unstudied in taxa outside of tetrapods, all animals studied exhibit some form of behavioral sleep. For instance, jellyfish (*Cassiopea* spp.) and *Hydra* sleep even though they lack a central nervous system, indicating that sleep serves a role not specific to the brain per se. This finding also suggests that sleep likely arose early in the metazoan lineage. No evidence of sleep is presently found in sponges, plants, or unicellular organisms.

To further explore sleep and circadian rhythms across the animal kingdom, the papers in this special issue take us to birds breeding in the high Arctic, fruit bats in Panama, root rats in Africa, carpet sharks in New Zealand, and also to house sparrows, cavefish, and flatworms. Clearly, sleep is not the domain solely of humans or even mammals, but shows inspiring diversity across a wide range of animals. Investigating the neurophysiological correlates of sleep in nonmodel species will provide additional insight into the evolution of sleep and how various sleep patterns compare among metazoans on a broader scale, and within and between individuals on a finer scale.

The contents of this special issue are:

- Galante et al. Experimentally elevated levels of testosterone advance daily onset of activity in short-day housed male house sparrows (*Passer domesticus*).
- Gallman et al. Postprandial sleep in short-sleeping Mexican cavefish.
- Heckley et al. The effect of group size on sleep in a Neotropical bat, *Artibeus jamaicensis*.
- Kruger et al. Sleep in the East African root rat, *Tachyoryctes splendens*.
- Lesku et al. An electrophysiological correlate of sleep in a shark.
- Omond et al. Oxygen consumption rate of flatworms under the influence of wake- and sleep-promoting neurotransmitters.
- Pullum et al. Effect of melatonin supplementation upon parental care and nestling growth in arctic-breeding songbirds.
- Roessler and Klein, More sleep for behavioral ecologists.

Data Availability Statement

The authors have nothing to report.