



BIG MAMA IS WATCHING YOU—A BEDTIME STORY ABOUT HOW GIRAFFES SLEEP

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YOUNG REVIEWERS:



ANSHUL
AGE: 12



GIRL
SCOUT
TROOP 3738
AGE: 11



JULIANA
AGE: 11

Have you ever seen a sleeping giraffe in the wild? For years, researchers have been interested in how wild animals sleep and what factors influence their sleep behavior. However, very little is known about the sleeping behavior of wild giraffes. Since modern technology now allows scientists to more easily observe and analyze animal behavior, even at night, we were the first to describe the sleeping behavior of wild giraffes in Namibia. Besides the timing and rhythm of their sleep, the sleeping position of these attractive animals will probably surprise you the most. In this article, you will learn about the position that giraffes sleep in, how little they actually sleep at night, and how a sleeping giraffe is well protected by other giraffes, who always keep an eye on it!

TO SLEEP OR NOT TO SLEEP?

Giraffes live in the African savanna, which is a mixed woodland-grassland landscape characterized by bumpy ground, many low plants and bushes, as well as several types of trees. The giraffe's favorite

CLIQUEs

Groups of giraffes that can change over time and might have different members depending on the circumstances or the activity they are engaged in.

food, acacia trees, grow primarily in these areas. Giraffes roam the savanna in search of food, water, and other giraffes—sometimes up to several kilometers per day. Giraffes do not live and travel in unchanging groups. Rather, loose groups called **cliques** are formed from time to time [1]. These cliques spend some time together traveling, foraging, and sleeping before individual giraffes, or mothers (called cows) with young giraffes, split off from the clique again.

Young giraffes (called calves) stay with their mothers for many months. They only leave the group when they are big enough and no longer drinking their mothers' milk. Young males (called bulls) often roam together in what are called bachelor groups. They compete in playful fights until they are finally big and strong enough to go off on their own. Adult males often roam alone and only meet other females for breeding. Giraffes also spend the night together in cliques. Interestingly, it is very unusual for all the giraffes of a clique to sleep at the same time. While some giraffes are sleeping, other giraffes are always nearby, paying extra attention to protect their sleeping buddies. Let us take a closer look at the reasons for this interesting behavior.

GLOWING IN THE DARK

Analyzing the nightly behavior of wild animals takes a lot of resources, including equipment, people, money, and time. From what you already know about a giraffe's natural habitat, you can imagine that tracking and observing giraffes at night is not easy. Giraffes are animals that flee at the slightest danger, so observers must be very quiet and calm when approaching a group of giraffes in the wild. Therefore, we did our nightly observations by car, as cars do not signal danger for giraffes. To see the animals at night, we used **thermal imaging cameras** (Figure 1). In these images, the warm body of the giraffe stands out clearly against the cooler surroundings, and the animals can be easily recognized. The thermal images can tell us when giraffes are feeding, standing, walking, lying down, and, most important for this study, sleeping. With the help of the recorded videos, the behavior of giraffes can then be analyzed down to the second.

THERMAL IMAGING CAMERA

A device that produces an image using infrared radiation (heat) and functions similarly to a normal camera that produces an image using visible light.

COZY BUT STILL UNCOMFORTABLE

In mammals, which include giraffes, humans, and many other animals, sleep is divided into two stages. One stage is called **rapid eye movement (REM) sleep**. In humans, REM sleep is the stage in which we dream. The REM sleep stage is fascinating, as the body appears calm while the brain is working intensely. Often, the eyes are moving quickly behind closed eyelids—that is where the name of this stage comes from.

REM SLEEP

A sleep phase characterized, among other things, by rapid eye movements, often with closed eyelids. This phase is accompanied by muscle atonia.

Figure 1

“Glowing” giraffes recorded with a thermal imaging camera. **(A)** The thermal imaging camera is connected to a tablet and a video is recorded once night falls. **(B)** Thermal images allow us to see the positions and activities of giraffes at night. In this image, one animal is standing, two animals are lying down, and the animal on the right is in the typical sleep position. The awake animals, whether standing or lying, look all around to monitor the environment.

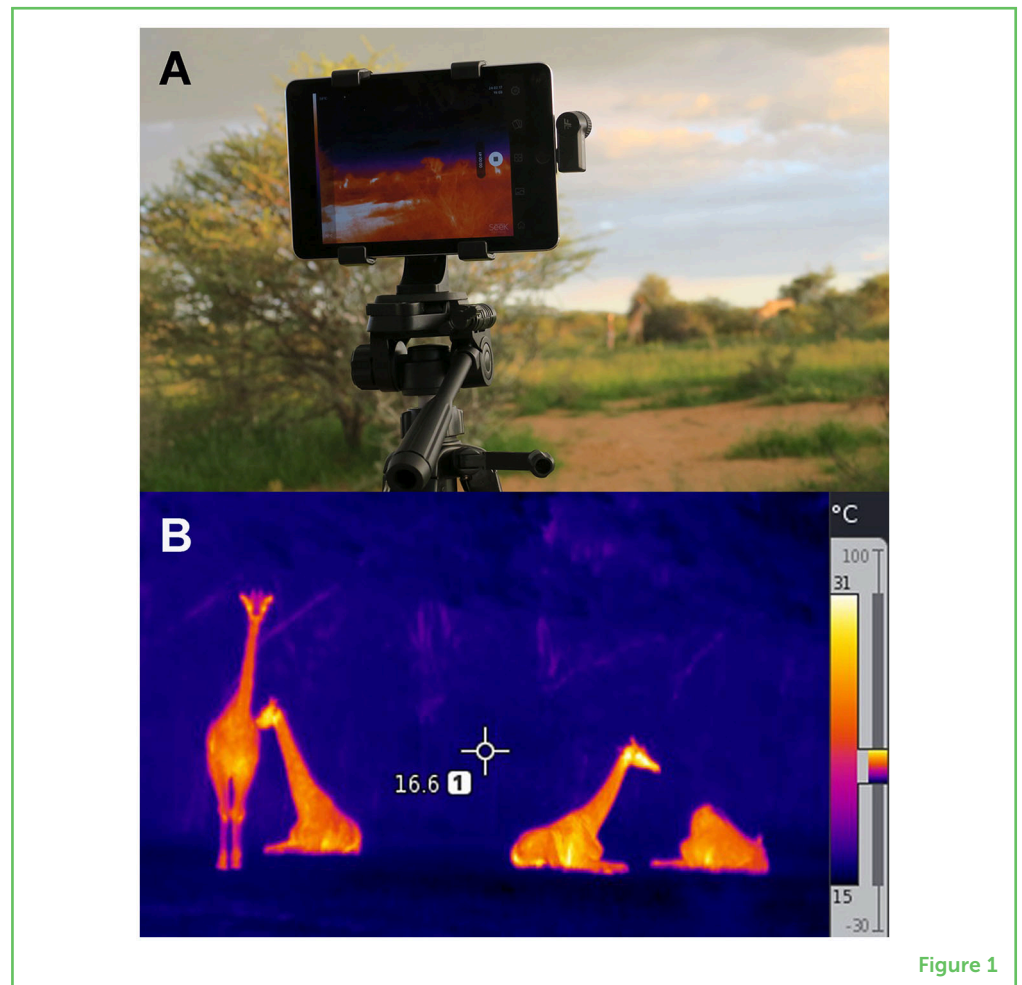


Figure 1

MUSCLE ATONIA

A phenomenon that occurs during REM sleep, in which the skeletal muscles are blocked from moving. This serves to protect the body—it prevents dreamed movements from actually happening.

SKELETAL MUSCLES

Muscles that are mainly responsible for active body movements, for example the movement of arms and legs.

For giraffes, an important characteristic of REM sleep is the position their bodies must be in. During REM sleep, the body experiences **muscle atonia**, in which the **skeletal muscles** become loose and relaxed and cannot respond to the brain’s signals [2]. So, an animal must rest all parts of its body during REM sleep. This means giraffes can only sleep in a very specific position (Figure 2) or their heads would fall toward the ground or they would fall over. Looking at the specific position a giraffe must be in during REM sleep, you can imagine how long it takes the animal to get up if it needs to. This means that a sleeping giraffe would be helpless against a lion attack! This could be why giraffes sleep so little! But giraffes are also protected by the behavior of the whole group. They often rest and sleep in a group of several animals, and most of the time only one giraffe is in the attackable REM sleep position. If one animal wakes up from this REM sleep position, another animal moves into this position. Basically, giraffes take turns sleeping, so the danger of being attacked becomes smaller. The non-sleeping animals carefully monitor the environment, providing additional security.

Figure 2

Typical REM sleeping position of a giraffe. The sleeping behavior of giraffes can be more easily studied in zoos [3]. The picture shows a young giraffe in a zoo, sleeping during the day—optimal conditions for taking a photo that shows the giraffe's head resting on its hind leg.



Figure 2

BIG ANIMALS, BUT LITTLE SLEEP

During the night, a giraffe spends an average of only 20–30 min in REM sleep, divided into several short sessions that last just 2–4 min. It is quite amazing that giraffes—the largest land mammals on Earth—sleep so little! The short sessions of REM sleep do not occur all at once, but are interrupted by an activity phase in which the animals feed and roam. After their midnight snack, another resting phase with REM sleep sessions follows. The rest and REM sleep phases occur more frequently after nightfall and then again in the early morning hours, shortly before sunrise. This cycle of rest and sleep phases during the night is part of the **circadian rhythm**, which is our body's natural clock that helps us know when to be active and when to rest (Figure 3).

As in humans and many other mammals, young giraffes sleep more than their mothers. The older a giraffe gets, the less it sleeps in REM position. Scientists have two common hypotheses as to why giraffes sleep for such a short time. One has to do with the giraffes' energy requirements and digestive system. Giraffes are **ruminants**, which are animals that have a special stomach with four parts to help them eat lots of leaves, and they chew their food again and again to get all the important nutrients from it. Giraffes have to eat a lot and often, to have enough energy—so they have to get up at night to eat, which means they cannot sleep through the night like humans and some other animals do. The other hypothesis relates to the risk of being killed by a predator during REM sleep, as we already mentioned [4]. The body position of the giraffe during REM sleep makes it easy for a lion to attack the giraffe. Therefore, scientists assume that the giraffe stays

CIRCADIAN RHYTHM

The internal rhythms, like sleeping and waking, that cycle over a period of ~24 h.

RUMINANTS

Herbivores that have a multi-part stomach. Pre-digested food is regurgitated and chewed again before being re-swallowed and going into actual digestion.

Figure 3

Circadian rhythm of giraffes. During the day, giraffes are mostly active, moving around between their feeding places and eating. In the darkness, phases of rest occur, in which short sessions of REM sleep can be observed. However, these nightly phases are interrupted by periods of activity.

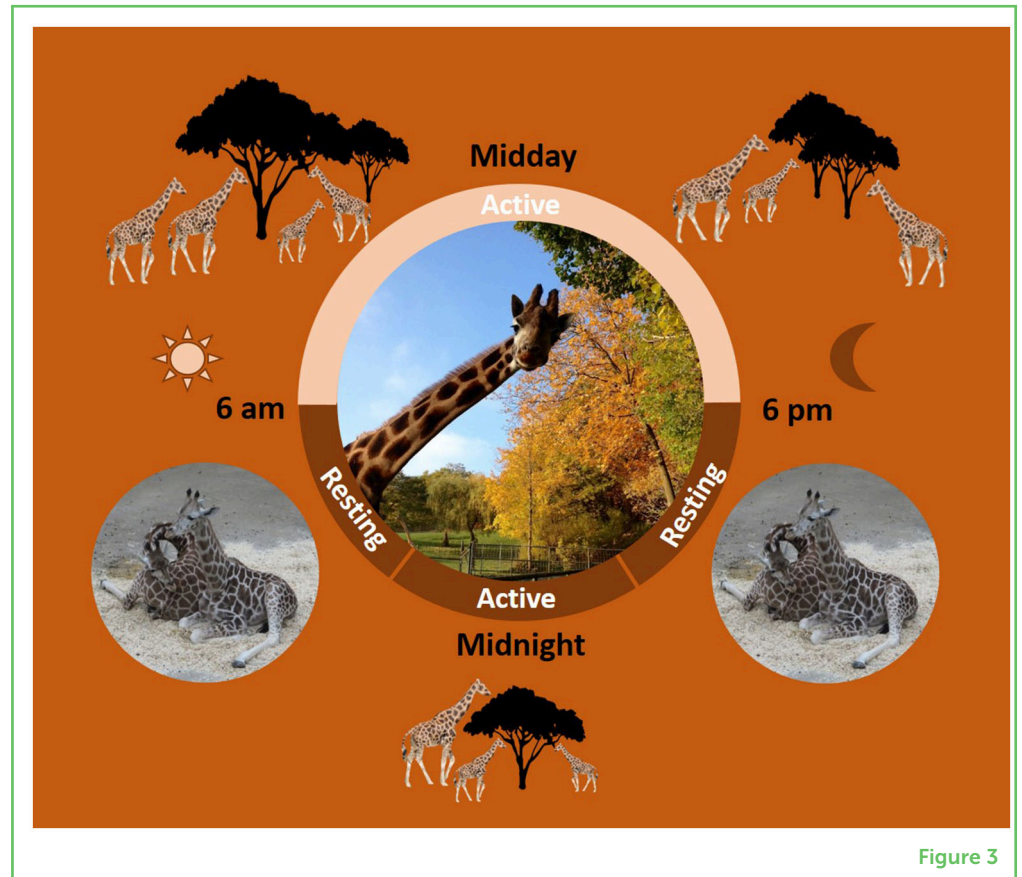


Figure 3

in this dangerous position during REM sleep for only a few minutes, to avoid being surprised by a lion during sleep. The behavior of the other giraffes within a group supports this hypothesis. If this position were not so dangerous, the other animals would not have to stay nearby to guard the sleeping animals.

CONCLUSION

Giraffes have lived on the African continent for thousands of years. But, due to habitat destruction and other human impacts, the population of wild giraffes has shrunk dramatically in recent decades. Something urgently needs to be done to protect these giants. One approach to conservation is to increase our basic knowledge of a species. The more we know about a species, such as how it behaves in its habitat and responds to changes in its environment, the better we can protect it. We want to expand this basic knowledge with our research and show what the nighttime behavior of giraffes looks like, how they sleep, and what their natural needs are. Our research shows that wild giraffes have only short sleep phases during the night. Their group behavior, in which awake and alert animals monitor the environment while others are in the vulnerable REM sleep position, is an important adaptation and safety strategy. If human impacts disturb these short sleep phases, that could have negative effects on these animals.

Hopefully, our research findings will help to ensure the survival of giraffes for many years to come.

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ORIGINAL SOURCE ARTICLE

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REFERENCES

1. Carter, K. C., Seddon, J. M., Frère, C. H., Carter, J. K., and Goldizen, A. W. 2013. Fission-fusion dynamics in wild giraffes may be driven by kinship, spatial overlap and individual social preferences. *Anim. Behav.* 85:385–94. doi: 10.1016/j.anbehav.2012.11.011
2. Siegel, J. 2011. REM sleep: a biological and psychological paradox. *Sleep Med. Rev.* 15:139–42. doi: 10.1016/j.smrv.2011.01.001
3. Burger, A. L., Hartig, J., Dierkes, P. W. 2021. Biological and environmental factors as sources of variation in nocturnal behavior of giraffes. *Zoo Biol.* 40:171–81. doi: 10.1002/zoo.21596
4. Lima, S., Rattenborg, N., Lesku, J., and Amlaner, C. 2005. Sleeping under the risk of predation. *Anim. Behav.* 70:723–36. doi: 10.1016/j.anbehav.2005.01.008

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YOUNG REVIEWERS



ANSHUL, AGE: 12

Hello! My name is Anshul and I am a seventh grader at Germantown Academy, which is close to Port Washington. I am very interested in Biology and Entomology. I am an active member of the Johns Hopkins CTY program, and my favorite hobbies are reading and observing the environment.



GIRL SCOUT TROOP 3738, AGE: 11

Our Cadette Troop of Girl Scouts likes learning about the world around us. We have done numerous STEM explorations and cultural activities. We like camping, crafts, and community service.



JULIANA, AGE: 11

Juliana is a 5th-grader with a passion for science and math. She has always had an innate curiosity about the world around her and has learned about the scientific method and hypothesis testing. She recently attended an experiment-based science camp focusing on genetics and molecular biology. Juliana also enjoys solving problems in algebra and geometry, particularly in the coordinate plane. She is delighted to work alongside the team and review manuscripts for Frontiers for Young Minds.

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