

How studying poop may help boost white rhino populations

June 5 2023, by Matt Shipman



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Researchers at North Carolina State University have identified significant differences in the gut microbiome of female southern white

rhinos who are reproducing successfully in captivity, as compared to females who have not reproduced successfully in captivity. The work raises questions about the role that a particular genus of gut microbes may be playing in limiting captive breeding of this rhinoceros species.

"Our work focuses on the southern white rhinoceros (*Ceratotherium simum simum*), because while it is not yet endangered, [species](#) numbers are declining in the wild due to poaching," says Christina Burnham, first author of a paper on the work and a former graduate student at NC State. The paper, "Effects of Age, Seasonality, and Reproductive Status on the Gut Microbiome of Southern White Rhinoceros (*Ceratotherium simum simum*) at the North Carolina Zoo," is published in the open access journal *Animal Microbiome*.

"There is a significant population of southern white rhinos under human care in the United States, but there have been challenges in getting many of these animals to reproduce successfully. It is critical we understand why, as the managed rhinos serve as important assurance populations in case wild rhino numbers continue to fall. We wanted to know how the [gut microbiome](#) may influence the reproductive ability of these rhinos."

To that end, the researchers collected multiple fecal samples from eight female southern white rhinoceroses over a six-month period. The study population consisted of two juveniles; two "subadults" who are no longer nursing but are not yet of reproductive age; two adults who have reproduced successfully; and two adults who have not reproduced successfully.

"We wanted to have a robust sample size that would allow us to assess the gut [microbiome](#) of females in this species while accounting for age, the time of year and reproductive status," Burnham says.

The researchers extracted and sequenced DNA from the [fecal samples](#),

which allowed them to identify the diversity and abundance of bacteria in the gut of the study animals.

"We found differences between rhinos in each age group," says Erin McKenney, co-author of the study and an assistant professor of applied ecology at NC State. "In other words, microbial communities in the gut microbiome change predictably as animals age from juveniles to subadults to adults. This likely reflects, among other things, changes in the diet and behavior of the animals. This sort of microbiome 'succession' is fairly common in many animal species. And it's important here because it casts the differences we found between reproductively successful adults and reproductively unsuccessful females in stark relief."

The researchers found that reproductively successful females had less diversity in the types of microbial species present in their gut microbiome, when compared to the microbiome of reproductively unsuccessful females. The researchers also found that each group of adults was playing host to microbial species that have previously been associated with reproductive health.

"One of the microbial families we found at significant levels in reproductively successful adults was Rikenellaceae," Burnham says. "This is of interest because Rikenellaceae has previously been theorized to play a role in helping southern white rhinos break down dietary plant compounds—including phytoestrogens that are associated with limiting reproductive success.

"On the other hand, we only saw significant enrichment of *Mobiluncus* microbes in reproductively unsuccessful adults," Burnham says. "Previous work has found that *Mobiluncus* is associated with a range of reproductive health problems in a variety of non-rhinoceros species.

"However, in those previous studies, *Mobiluncus* was detected in cervical and vaginal microbiomes. We looked only at the gut microbiome. We hypothesize that the gut may serve as a reservoir for *Mobiluncus*, but we need to collect cervical or vaginal swabs from the adult females we studied to determine whether *Mobiluncus* may be present in those microbiomes."

"Because this was a [longitudinal study](#), we collected multiple samples from each animal over the course of half a year," McKenney says. "And the differences we saw in the gut microbiomes of adult females were consistent over time, which suggests that these differences in [microbial communities](#) may be playing an important role in the reproductive health of these animals. That said, we will need to do additional research to determine what that role may be, if any."

More information: Christina M. Burnham et al, Effects of age, seasonality, and reproductive status on the gut microbiome of Southern White Rhinoceros (*Ceratotherium simum simum*) at the North Carolina zoo, *Animal Microbiome* (2023). [DOI: 10.1186/s42523-023-00249-5](https://doi.org/10.1186/s42523-023-00249-5)

Provided by North Carolina State University

Citation: How studying poop may help boost white rhino populations (2023, June 5) retrieved 6 May 2024 from <https://phys.org/news/2023-06-poop-boost-white-rhino-populations.html>

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