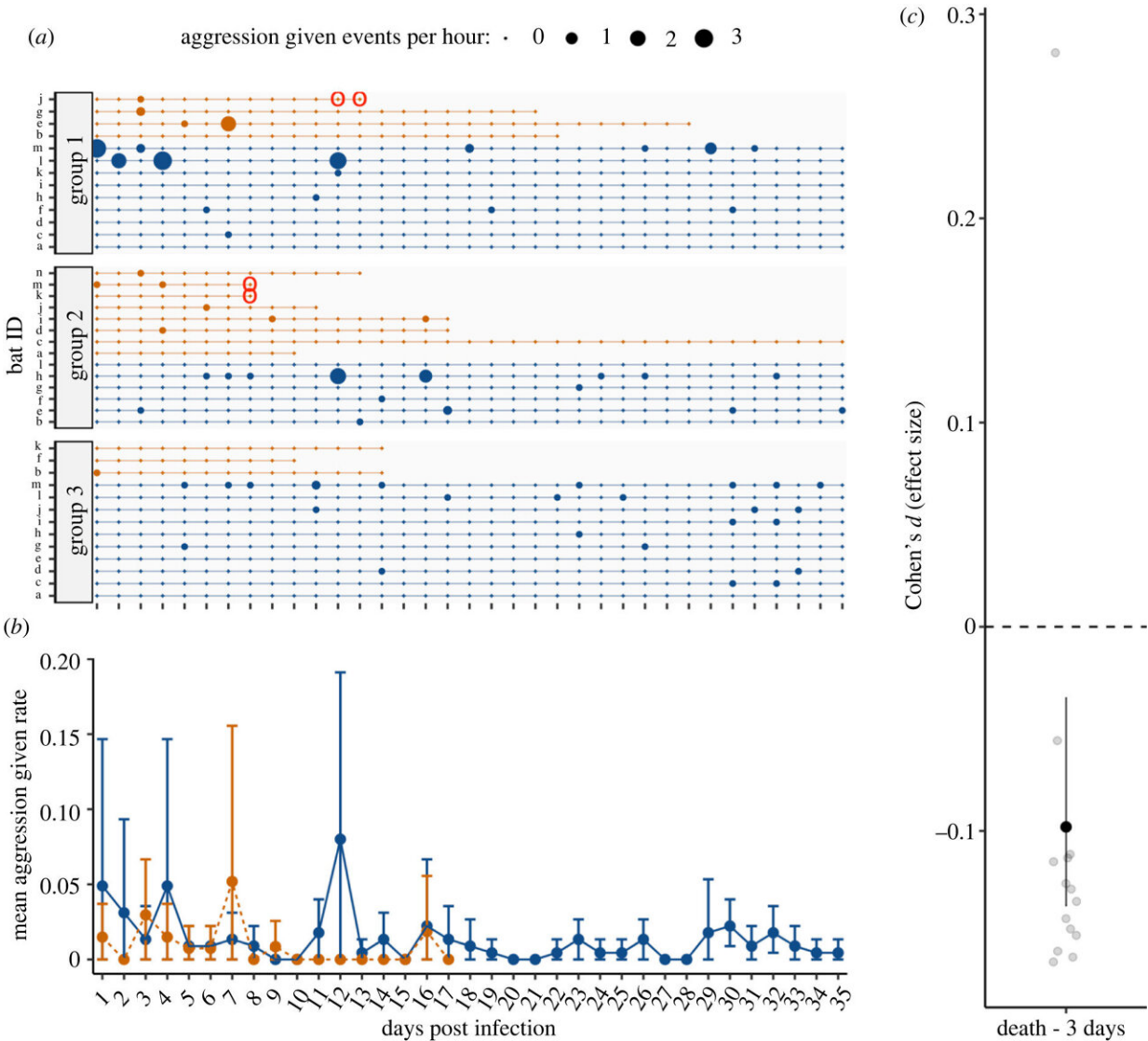


# The first look at how rabies affects vampire bat social behavior

September 20 2022, by Emily Caldwell



No evidence of increased aggression in rabid male vampire bats prior to death. Panel (a) shows timeline of aggression event counts for each rabid (orange

points) and non-rabid (blue points) vampire bat across three groups. Point size reflects the rate of observed events per hour. Red circles show RABV positive saliva sample. Panel (b) shows mean rate of aggression events per hour with 95% CIs for rabid and non-rabid bats starting one day after inoculation with RABV. Panel (c) shows the standardized mean difference with 95% CIs between rabid bats and healthy cagemates in the three-day time interval before death. Outlier is one rabid bat (group 2-i) that showed high aggression 16 days post-challenge (2 days prior to death). Credit: *Biology Letters* (2022). DOI: 10.1098/rsbl.2022.0298

Vampire bats infected with the rabies virus aren't likely to act stereotypically "rabid," according to a new study—instead, infected male bats tended to withdraw socially, scaling back on the common habit of grooming each other before they died of the disease.

The study was the first to observe how rabies affects vampire bat [social behavior](#), and one of only a few research efforts to understand how rabies infection impacts behavior in one of the species most responsible for causing rabies outbreaks in humans and livestock in Latin America. The virus is typically transmitted to other species by direct contact between [vampire bats'](#) infected saliva and the broken skin of the livestock or other animals (and, rarely, humans) they bite to feed on blood.

In the roost, vampire bats might infect each other through the licking and chewing that constitute the grooming behavior they engage in for up to 5% of their active time, said Gerald Carter, senior author of the study and assistant professor of evolution, ecology and organismal biology at The Ohio State University.

"Despite that possibility, no previous studies had tried to quantify changes in grooming habits in vampire bats infected with rabies," Carter said. "It could be that vampire bats' tendency to withdraw from [social](#)

[activity](#) when they're sick that we've seen in our earlier work lowers the likelihood for rabies transmission to groupmates despite living in close quarters inside the roost."

The study was led by co-first authors Sebastian Stockmaier, an Ohio State University President's Postdoctoral Scholar in Carter's lab, and Elsa Cárdenas-Canales, then a Ph.D. student and now a postdoctoral scholar in pathobiological sciences at the University of Wisconsin-Madison.

The research was published recently in the journal *Biology Letters*.

Previous research in a variety of animal species and humans has shown that there are two observed responses to rabies infection: "furious" symptoms of increased aggression, or "paralytic" symptoms that lead to lethargy and paralysis. The furious response is expected to increase transmission to other hosts.

In this work, the researchers equipped a lab with infrared surveillance cameras to observe 40 male common vampire bats that were part of a larger sample of bats used to test a rabies vaccine candidate. Groups of bats subjected to three treatments—oral vaccination, topical vaccination or placebo—were placed together in cages for four months before being challenged with a coyote variant of the [rabies virus](#).

One day after the challenge, the team began quantifying behaviors from three one-hour sample periods each night, recording the absence or presence of either grooming or aggression. The team analyzed the resulting 18,808 behavioral samples to estimate behavior rates.

"We were generally interested in how social behaviors that might be relevant to rabies transmission—allogrooming and aggression—changed when vampire bats were infected," Stockmaier said.

All bats showed low rates of aggression and, compared to their healthy cagemates, rabid vampire bats showed a reduction over time in giving and receiving grooming. The effect was first seen about 12 days after inoculation with the virus and got stronger closer to when the bats died.

The researchers can't be sure what caused the decrease in grooming—whether it resulted from a general immune response that made the bats sick and lethargic, and therefore less social, or from dysfunction of the central nervous system from the rabies infection.

Cárdenas-Canales noted that signs of either the aggressive or paralytic forms of rabies are the last to show before the animal dies—suggesting that disease transmission can occur without any obvious changes in behavior.

"In some cases, asymptomatic bats fly, forage and interact normally while having infectious saliva—making every bite, by feeding or fighting, potentially infectious," she said. "We could learn even more by measuring how often bats in the late stages of disease shed virus in their saliva and get fed by others, and what this might implicate for rabies transmission."

The results, in male vampire bats, which can be aggressive toward each other, actually raise a question about a common idea regarding rabies infection—that the virus manipulates its host into becoming aggressive to improve the chances for viral transmission.

"Rabies might not have to manipulate the behavior of its host if the host is frequently aggressive anyway or if it is likely to bite other animals to feed," Stockmaier said. "This remains to be tested."

Another possible explanation for not observing increased aggression is that the behavioral effects of rabies are highly variable and might differ

by the viral strain. The researchers noted that bats infected with variants from other populations or other species did not show clear "furious" rabies in six other cases, but three [observational studies](#) did record signs of increased aggression, and these were all in vampire bats that were naturally exposed to rabies in the wild.

**More information:** Elsa M. Cárdenas-Canales et al, Social effects of rabies infection in male vampire bats ( *Desmodus rotundus* ), *Biology Letters* (2022). [DOI: 10.1098/rsbl.2022.0298](https://doi.org/10.1098/rsbl.2022.0298)

Provided by The Ohio State University

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