Birds roosting in large groups less likely to contract West Nile virus

PUBLISHED OCTOBER 23, 2014

URBANA, Ill. – Although it would seem logical that large numbers of roosting birds would attract more mosquitoes that carry West Nile virus and contract the disease when bitten, recent research at the University of Illinois found the opposite to be true. That is, when large groups of birds roost together the chances that an individual bird will get bitten by mosquitoes carrying West Nile virus and subsequently contract the disease actually go down.

Bethany Krebs (on ladder) assembling one of the flight cages used to house a sentinel sparrow for University of Illinois research on the relationship between roosting and West Nile virus transmission.

"Our study is the first field-based evidence to support what's called the 'encounter-dilution effect' acting in a vector-borne disease system with an experiment," said U of I researcher Bethany Krebs. "There have been other laboratory and modeling studies that suggest that mosquitoes feed less per individual in a group than they do on a solitary bird but it's hard to get the information in natural settings."

The experiment was conducted over a period of three years. "We trapped mosquitoes inside and outside of roosts from 2010 to 2012 to determine whether roosts attracted more mosquitoes than non-roost sites," Krebs said. "Then we sent the mosquitoes to a lab in Texas that ran analyses on them to determine if they carried the virus. Uninfected house sparrows were used as sentinel birds to assess host risk of West Nile exposure in 2012—the timing coincided with the historical period of peak West Nile virus transmission in the Chicago study areas known to be 'hot spots' for the disease."

The house sparrows were placed in flight cages—23 birds in cages near communal roosts and 25 in non-roost cages. Krebs explained that sentinel birds are used by public health departments as sort of a "canary-in-the-coal mine" early warning system to detect the presence of a vector-borne disease.

"Only three sparrows near roosts contracted West Nile virus whereas 11 birds in non-roost cages were infected," Krebs said. "So the risk of West Nile virus exposure for those sentinel birds caged within roosts was significantly lower than for birds caged in non-roost locations."

Jeff Brawn, U of I ecologist and department head of the Natural Resources and Environmental Sciences, described how this study sheds light on the spread of vector-borne diseases, such as West Nile virus, compared to those transmitted via direct contact. "If you're in a group, the probability of infection goes way up with direct contact diseases such as colds and flu," Brawn explained. "This study confirmed that the risk is spread out among the individuals in the herd; in the case of West Nile virus, which is a vector-borne disease, individual risk is minimized."

Brawn said that they don't understand why some birds roost and others of the same species do not. But this study shows that those who do choose to roost together benefit by the lower risk of exposure to West Nile virus infection.

The maintenance and transmission of West Nile virus goes something like this: The common mosquito *Culex pipiens* is the carrier (vector) of the disease. The mosquitoes bite birds, usually at night while they are roosting and infect them with the virus. Crows and jays typically die after they contract West Nile virus, but robins are called "super-amplifiers of the disease." They are able to serve as hosts for the virus. Later, other mosquitoes bite the infected birds, get the virus, and transmit it to another host—which could be another bird or a human.

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This brings to a close almost 10 years of research on West Nile virus in the Chicago area supported by funding from the National Science Foundation. "This was the last year that we were planning to do significant field work in that area of Chicago," Krebs said.

Brawn said that a study like this that has many components also requires experts from many disciplines. "It can only happen when you have field biologists, mosquito specialists, disease experts, epidemiologists–that team of researchers that worked on this project is multi-faceted. That's what it takes to do this kind of work. We collected blood samples from the birds and sent those to be analyzed. We sent the mosquitoes to someone else who knew how to do all of the genetic analysis. It's a team working together."

Brawn added that, although the study was on birds, it could provide an interesting implication with respect to human behavior and health risk. "If you are in the woods alone, you may have a greater probability of getting bitten than if you are in a large group of people," he said.

"Host group formation decreases exposure to vector-borne disease: a field experiment in a 'hotspot' of West Nile virus transmission" was written by Bethany L. Krebs, Marilyn O. Ruiz, and Jeffrey D. Brawn from the University of Illinois; Tavis K. Anderson from Georgia Southern University; Tony L. Goldberg and Christina M. Newman from the University of Wisconsin; Gabriel L. Hamer from Texas A&M; Uriel D. Kitron from Emory University; and Edward D. Walker from Michigan State University. The research was published in the *Proceedings of the Royal Society B: Biological Sciences* and was supported by the National Science Foundation Ecology of Infectious Disease program.

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