

Blood meal analysis answers some questions about West Nile virus.

By analyzing the DNA found in the blood extracted from engorged female mosquitoes, scientists at Orange County Vector Control District (OCVCD) have learned some very interesting information about the feeding habits of local mosquitoes. OCVCD submitted 179 blood fed mosquitoes to the Connecticut Agricultural Experiment Station (CAES) to see what they had been feeding on. The mosquitoes were trapped all over the County, and represented several different species. Researchers at CAES were able to do an analysis of the DNA in the blood and determine what the mosquitoes had fed on. Blood meals came from 22 different host species; 15 were birds and 7 were mammals. The most commonly fed on bird as it turns out is the Mourning Dove; 43 percent of the mosquitoes tested had fed on Mourning Doves. This is consistent with the findings in other studies, showing that high numbers of the Mourning Doves tested were found to be positive for West Nile virus (WNV). Mourning Doves are known as “dead end hosts,” meaning that even when they are infected they often fail to amplify the virus sufficiently to pass enough on to feeding mosquitoes, the host itself is frequently not affected by the virus either. Other popular sources for blood meals were House Finches, which comprised 34 percent of the sample and surprising enough, the American Robin which represented 8 percent of the blood meals. The American Robin is not a locally abundant bird, certainly not 8 percent of the bird population. All seven mammal species combined comprised less than 6 percent of the total sample. Of the 179 mosquitoes tested, only six had fed on two different hosts, including one that had fed on a human and a House Finch. This data is consistent with studies done on the east coast and the Midwest indicating that mosquito feeding is not random – mosquitoes do have preferences.

The American Crow, often implicated in the WNV transmission cycle provided only about 2 percent of the sample. Crows were one of 55 bird species in Orange County to be found with WNV, but they made up over 80 percent of the total number of positive dead birds reported by the public and tested by OCVCD. The fact that American Crows made up only 2 percent of the blood meals was unexpected. As it turns out, the social structure of American Crow populations seems to have created conditions allowing Crow to Crow transmission. Crow behaviors, such as feeding together and roosting in dense groups, puts these birds in close contact with one another and may allow transmission through other means besides the bite of a mosquito, possibly via saliva or fecal material. One study reported that a caged group of ten Crows, one of which was infected ultimately resulted in all ten becoming infected, even though the cage was mosquito proof. There is no evidence of crow to human transmission. Crows develop very high levels of virus. They are also very susceptible to WNV and it appears most perish within days of becoming infected. This high fatality rate and short survival period probably keeps the American Crow from infecting many mosquitoes. Instead of being an important player in the transmission cycle, it looks like American Crows may be the ultimate victim of WNV. Because of their size and distinctive appearance crows are noticed. This coupled with their susceptibility makes them excellent indicators of the comparative level of WNV activity. Their mobility, often traveling over ten miles a day, makes them poor indicators of specifically where WNV is active

In order to understand the significance of the data, there needs to be some understanding of mosquito biology and the mechanics of disease transmission. Mosquitoes feed on plant nectar except when the females need the protein in blood to nourish their developing eggs. Mosquitoes are also typically short lived so the number of times they need this blood meal is usually only once; occasionally the mosquito feeds twice, and rarely a third time. If a mosquito feeds on a WNV infected source, and lives long enough to feed again, the next source has a chance of receiving the causative agent of WNV. In other words, only the occasional mosquito feeds more than once and can pass on a pathogen. If a dead end host like a Mourning Dove is bitten first, there is no virus picked up by the mosquito. If the Dove is the second or third blood meal, the virus, if present, is essentially taken out of circulation. In order for there to be a disease transmitted, a mosquito needs to feed on a host with an infection level high enough to

allow the mosquito to take up some virus. The next blood meal, if there is one, could result in the transfer of virus, but if that blood source is a dead end host, the cycle is effectively ended.

It is important to mention that only 1.5 percent of the tested mosquitoes had fed on a human. By knowing the food preferences of different mosquitoes from different breeding sources, we can determine the greatest threats to public health. OCVCD could, if necessary, use this information to prioritize control and source reduction efforts.

This is an ongoing study, and is an example of a cooperative arrangement between OCVCD and the CAES. OCVCD provided material from Orange County to be tested and in exchange the Connecticut Agricultural Experiment Station provided the results of those tests. Orange County Vector Control District is increasing its abilities to perform tests on site, but the equipment and expertise required will keep OCVCD from ever being able to test for every aspect of every vector-borne disease at its headquarters in Garden Grove. OCVCD has been very successful in crafting partnerships with Universities and other institutions around the country to help in the many different surveillance programs being conducted by OCVCD.