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osquitoes carry diseases such as malaria, Zika virus, West Nile virus and dengue fever. Some consider the female mosquito to be the deadliest creature on the planet,

Female mosquitoes also carry heartworm disease to dogs. Female mosquitoes need to feed on flesh to get the nutrients they need for their eggs, while male mosquitoes mostly feed on plant nectar and are important pollinators.

As many as 20 species of mosquitoes can transmit heartworm to dogs. The female mosquito bites an infected dog and ingests the microfilariae. They develop further for 10 to 30 days, inside her, and then move out of the gut, as larvae, and enter her mouthparts. At this point they are described as infective 3rd stage larvae. After an infected mosquito bites a dog, 4th stage larvae begin to mature in the dog's body and eventually grow into heartworms. It takes from **50 to 70** days for the 3rd and 4th stage larvae to mature into adult heartworms. Heartworm "preventive" drugs kill only the 3rd and 4th stage larvae.

Heartworm preventives do not prevent these larvae from entering your dog's bloodstream; rather they kill any larvae present, working backwards in time. The drugs work by paralyzing the heartworms ... which means they contain neurotoxins that can also be harmful to your dog. However, I'm not getting into a discussion about these drugs here.

What I do want to talk about are the changes in the mosquito population due to genetically modified mosquitoes. This is what has me worried.

GENETICALLY MODIFIED (GM) MOSQUITOES

The mosquito population has changed because laboratories have modified the mosquito, resulting in frankenmosquitoes. A British company, Oxitec, came up with the idea of genetically modifying male mosquitoes to help prevent the spread of disease.

The World Health Organization (WHO) has asserted that interfering with the mosquito life cycle was the most effective strategy for stopping the transmission of mosquito-borne diseases. In 2014 the WHO defined genetically modified organisms to include plants, animals and microorganisms whose DNA has been altered in a way that does not occur naturally.

THEY WEREN'T MEANT TO REPRODUCE

The OX513A genetically modified male strain of mosquitoes, created by Oxitec and funded by the Melinda and Bill Gates Foundation (among other sponsors) were created with gene editing. A manufactured gene is inserted, controlled by tetracycline, and the offspring of this genetically modified mosquito will die before they can mate. You see, the modified males are raised being exposed to tetracycline, as they can only survive with this exposure to this antibiotic. Supposedly, their offspring, as they are not exposed to tetracycline and need it to survive, will die.

But wait! How about all the chicken and pig feed on farms – that have tetracycline in them? How about all of the standing water on these farms, which contain tetracycline as it comes out in their waste? That's what I thought as I read about this several years ago.

And yes, it appears that Oxitec was wrong about their GMO mosquitoes. As revealed in a study in the esteemed journal *Nature*, Oxitec's transgenic mosquitoes are not only able to reproduce, but their presence within the native population has created super-mosquitoes that are more resilient than the ones that previously existed in nature. In fact, these mosquitoes have been found to have enhanced insecticide resistance. [Evans, B.R., Kotsakiozi, P., Costa-da-Silva, A.L. et al. Transgenic Aedes aegypti Mosquitoes Transfer Genes into a Natural Population.*Sci Rep* **9**, 13047 (2019). doi. org/10.1038/s41598-019-49660-6]

"WE KNOW THAT GENETICALLY MODIFIED TRANSGENIC MOSQUITOES HAVE BEEN RELEASED IN QUITE A NUMBER OF PLACES. ALL THE COMPANY'S OPEN FIELD EXPERIMENTS TO DATE INVOLVE ITS OX513 STRAIN OF THE AEDES AEGYPTI MOSQUITO - AND THE AEDES SPECIES IS TOP OF THE LIST IN SPREADING HEARTWORM DISEASE IN DOGS."

Note: Nature later published an Editorial Expression of Concern about this paper, which you can read at nature.com/articles/ s41598-020-62398-w.

Oxitec's GMO mosquitoes came to be dubbed *super mosquitoes*, as they are much like the *superbugs* and *superweeds* that become more resilient than the varieties they were supposed to eradicate.

WHERE ARE THE SUPER-MOSQUITOES?

In 2009 Oxitec conducted the first known global release of genetically modified mosquitoes in the Cayman Islands, without public knowledge. In 2011 Oxitec instigated another release without public knowledge in Malaysia. In 2014 Oxitec released genetically modified mosquitoes in Panama. Bill Gates wanted to release genetically modified mosquitoes in Key West, Florida in 2016. But it was voted down by the community members. Or was it?

In January 2018, lab bred Aedes aegypti mosquitoes carrying Wolbachia bacteria were released in South Miami, Florida. Then, 666 million more mosquitoes were to be released. These mosquitoes had already been tested in Florida, Kentucky, California and New York. I couldn't really feel certain that the GMO mosquitoes hadn't been released in Florida in 2016 or shortly thereafter. While there was a large outcry from local inhabitants, these mosquitoes were released in many places around the globe without informing the populace beforehand. Additionally, the FDA approved the release of these mosquitoes in Florida in 2016.

There is some conjecture that these transmosquito strains are combining with each other. I haven't mentioned yet that these GM mosquitoes were also released in Brazil from 2013 to 2015. The bugs in that area are now made up of three strains mixed together: the original Brazilian locals, plus strains from Cuba and Mexico all mixed into the two strains crossed to make the GM insects. (Remember the Brazilian Zika virus epidemic of 2015? You'll find plenty of internet stories about how this GM mosquito plan "backfired.")

DRUG RESISTANT HEARTWORMS IN THE US

In October of 2018 swarms of supersized mosquitoes were reported to be besieging North Carolina. These mosquitoes were monstrous in size, hyper-aggressive and hatching by the millions in the wake of Hurricane Florence. Sometimes, like the old detective from the show *Columbo*, I bravely attempt to think deeply. (OK, fine – call me a conspiracy theorist.)

So, here's what I thought: these monstrous mosquitoes were attributed to the hurricane, but NC gets hurricanes every single year ... so why is this year different? Another fact that I tied into this unusual picture was that suddenly heartworm preventive medicine was not working as reliably in the Carolinas and the drug companies had to honor their guarantees, paying for heartworm treatment for dogs whose owners could show that they had dutifully given the preventive. What had changed?

Coincidence? We know that genetically modified transgenic mosquitoes have been released in quite a number of places. All the company's open field experiments to date involve its OX513 strain of the *Aedes aegypti* mosquito – and the *Aedes* species is top of the list in spreading heartworm disease in dogs.

THERE'S MORE TO COME

These experiments will continue. On May 1, 2020. Oxitec announced that the US Environmental Protection Agency (EPA) granted them an Experimental Use Permit (EUP) for piloting its Friendly[™] Aedes aegypti mosquito technology. The Centers for Disease Control (CDC) as well as the US Department of Agriculture (USDA) supported Oxitec's application. You can read the announcement as well as the EPA's press release at oxitec.com. Oxitec does still have to get state and local authority approvals.

The EPA release states:

"The EUP is designed to test the effectiveness of genetically engineered Aedes aegypti mosquitoes as a way to reduce mosquito populations in a controlled environment with appropriate safeguards as a first step to potentially wider use in the United States. The company must receive state and local approval before proceeding with field testing.

Oxitec's carefully developed field tests will be conducted, if approved by state and local authorities, over a two-year period in Monroe County, Florida, beginning in summer 2020, and in Harris County, Texas, beginning in 2021."

So, if you live in these places, you might want to contact your state health department to find out more about the plans.

Some human activities, with the sole purpose of improving the environment, or the human condition, wind up having devastating consequences. Let's hope the multiple releases of genetically modified mosquitoes haven't changed things for the worse. Our dogs don't need more and more added poisons to their systems because of flawed experiments.

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