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Much of the Buzz About Genetically Engineered Mosquitoes Is Wrong

By Henry Miller — September 23, 2019

Genetic engineering has delivered monumental scientific, technological, and humanitarian achievements – from producing human insulin in bacteria and gene therapy to treat genetic diseases to increasing food security and reducing malnutrition in developing countries. But it continues to face brickbats, sometimes from unexpected directions.

The most recent were directed at an extraordinarily important product that helps reduce populations of the invasive mosquito species *Aedes aegypti.* This non-native, introduced pest transmits viral diseases, including Zika, dengue fever, chikungunya, West Nile, and yellow fever. For most of these, there are no vaccines and no effective medicines. It is no wonder that mosquitos kill more humans than any other animal on our planet.

Oxitec, a British subsidiary of an American company, has created a novel, scientifically elegant approach. Male mosquitoes are bred in the laboratory with a specific genetic mutation [1] that, in the absence of a certain chemical, causes most of their offspring to die before reaching maturity. Male mosquitoes do not bite, so their release presents no health risk, and, because most of their progeny die, the genetically engineered mosquitoes do not persist long in the environment. Releasing the males over a period of several months causes a marked reduction in the mosquito population.

In field tests conducted in Brazil, the Cayman Islands, Malaysia, and Panama, Oxitec showed that the release of these genetically engineered male mosquitoes has consistently reduced wild populations by more than 80 percent, and more recent field trials show up to a 95 percent reduction. In 2014, on the basis of these field trials, Brazil's regulatory authority approved the commercial release of these mosquitoes – in large part, because the traditional approaches to

mosquito control were failing to protect the country's inhabitants from *Ae. aegypti*–borne viral diseases.

Earlier this month [September 10], an international group of researchers published in *Scientific Reports* [2] the results of their analysis of wild local mosquitoes in Jacobina, Brazil, following the release of hundreds of thousands of mosquitoes per week by Oxitec from 2013 to 2015. They reported that a small fraction (3-5%) of the released mosquitoes survived, mated with wild individuals, and produced offspring that matured. (Oxitec had previously predicted survival in that range.) As a result, mosquitoes in the local population inherited and were found to contain fragments of the genomes of the Oxitec mosquitoes. But those pieces were *not* the transgenic portions that conferred the lethal mutation or the fluorescent-marker gene that was also introduced; they were just ordinary "background" genes from the parental mosquitoes. (And even if the even if the transgenic segments had been horizontally transferred, they are not hazardous, and the overall impact of the release of Oxitec's OX513A is still a vast reduction in the risk to humans from the diseases vectored by *Ae. aegypti*.)

Here is the clincher: Their findings were not new, and similar findings had been included in previous publications and in documents presented by Oxitec to local authorities. Nevertheless, the authors of the *Scientific Reports* paper went on to indulge in completely unsupported, alarmist speculation and misstatements that called into question the safety of the release of the Oxitec mosquitoes – observations that were picked up and widely circulated in some of the anti-biotechnology media and activists' echo chambers. "Failed GM mosquito control experiment may have strengthened wild bugs," was one headline [3].

The very title of the *Scientific Reports* article, "Transgenic Aedes aegypti Mosquitoes Transfer Genes into a Natural Population," suggests that the Oxitec mosquitoes self-limiting gene or the fluorescent-marker gene were transferred, although that is not the case (as some of the authors themselves demonstrated in a previous paper [4]).

The authors of the *Scientific Reports* article also speculated that the transfer of fragments of DNA from the Oxitec mosquitoes could confer resistance to insecticides or "hybrid vigor" -- improved general health, resistance to disease, etc. -- which would raise concerns. But there was no evidence of any of that. They might as well have speculated that the addition of tiny amounts of background DNA could cause the mosquitoes to start to devour Brazilian pirhanas.

Is there any reason for concern? Here are some salient facts that are found in or are consistent with the *Scientific Reports* paper:

-- The Oxitec OX513A mosquitoes drastically reduced the local population of disease-carrying mosquitoes, as intended.

-- The self-limiting (lethal) gene in the OX513A mosquitoes does not persist in the environment. (And if it did, it would kill the mosquitoes that harbored it, which would be a favorable outcome.)

-- The movement of background genes from the OX513A mosquitoes into small numbers of those in the local population confers no enhanced risk of disease transmission. (And the OX513A mosquitoes are not insecticide-resistant, so there is no possibility of their transferring insecticide resistance to other mosquitoes.) Finally, based on previous studies, these continue to die out from the population. No harm, no foul.

In short, this article has obvious, and apparently intentional, errors – errors that should have been detected by the journal's editors and peer-reviewers. It should be retracted. I will leave it to others to determine whether it constitutes professional misconduct by the investigators.

Links

[1] https://www.oxitec.com/our-technology
[2] https://www.sciencemag.org/news/2016/10/brazil-will-release-billions-lab-grown-mosquitoes-combat-infectious-disease-will-it
[3] https://newatlas.com/science/genetic-engineering-mosquito-experiment-goes-wrong/
[4] https://onlinelibrary.wiley.com/doi/full/10.1111/eea.12618