News in focus

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Biotech firm Oxitec is working closely with the Florida Keys Mosquito Control District to monitor a trial of its designer mosquitoes.

FIRST GENETICALLY MODIFIED MOSQUITOES RELEASED IN THE UNITED STATES

Biotech firm Oxitec launches controversial field test of its insects in Florida after years of opposition from residents and regulatory complications.

By Emily Waltz

After a decade of fighting for regulatory approval and public acceptance, a biotechnology firm has released genetically engineered mosquitoes into the open air in the United States for the first time. The experiment, launched this week in the Florida Keys — over the objections of some local critics — tests a method for suppressing populations of wild *Aedes aegypti* mosquitoes, which can carry diseases such as Zika, dengue, chikungunya and yellow fever.

Oxitec in Abingdon, UK, which developed the mosquitoes, has previously field-tested the insects in Brazil, Panama, the Cayman Islands and Malaysia.

But until now, owing to a circuitous series of regulatory decisions and resistance from Florida residents, no genetically engineered mosquito had been trialled in the United States — even though the country previously allowed tests of a genetically engineered diamondback moth (*Plutella xylostella*) in New York state and an engineered pink bollworm (*Pectinophora gossypiella*) in Arizona, both developed by Oxitec. "When something new and revolutionary comes along, the immediate reaction of a lot of people is to say: 'Wait,'" says Anthony James, a molecular biologist focused on bioengineered mosquitoes at the University of California, Irvine. "So the fact that [Oxitec] was able to get the trial on the ground in the United States is a big deal."

Aedes aegypti makes up about 4% of the mosquito population in the Keys, a chain of tropical islands off the southern tip of Florida. But it is responsible for almost all mosquito-borne disease transmitted to humans in the region,

according to the Florida Keys Mosquito Control District (FKMCD), which is working closely with Oxitec on the project. Researchers and technicians will release bioengineered male *A. aegypti* mosquitoes, which don't bite, to mate with the wild female population, responsible for biting prey and transmitting disease. The genetically engineered males carry a gene that passes to their offspring and kills female progeny in early larval stages. Male offspring won't die, but instead will become carriers of the gene and pass it to future generations. As more females die, the *A. aegypti* population should dwindle.

The FKMCD approached Oxitec in 2010 about testing its approach in the Keys, because Florida was — and still is — experiencing an increase in mosquito-borne disease. In 2009, the state began seeing cases of locally transmitted dengue, and, a few years later, locally transmitted Zika.

Experiment launched

In late April of this year, project researchers placed boxes containing Oxitec's mosquito eggs at six locations in three areas of the Keys. The first males are expected to emerge in the first two weeks of May. About 12,000 males will exit the boxes each week over the next 12 weeks. In a second phase later this year, intended to collect even more data, nearly 20 million mosquitoes will emerge over a period of about 16 weeks, according to Oxitec.

Genetically engineered mosquitoes are an alternative to insecticides, which are used heavily in the United States to control insect populations. This has resulted in the evolution of mosquitoes that are resistant to insecticides.

"Unfortunately, we're seeing our toolbox shrinking due to resistance," said Andrea Leal, executive director of the FKMCD, at a press conference last week. "That's one of the reasons why we're really looking at these new innovative tools and new ways to control this mosquito."

To monitor the trial's progress, researchers will use capture devices to trap mosquitoes for study. They will measure how far the male mosquitoes travel from the boxes, how long they live, how effectively they squelch the wild female mosquito population and whether all of the females with the gene are indeed dying. Oxitec mosquitoes carry a fluorescent marker gene that makes them glow when exposed to a specific colour of light, which makes identification easier.

The biotech firm plans to present the results to the US Environmental Protection Agency (EPA), which gave the green light for the trial. The data will help the EPA to determine whether Oxitec can release the mosquitoes more broadly in the United States. The company is still testing them in Brazil and other countries.

Opposition to the Florida field trial has been fierce from some residents in the Keys. Worried about being bitten by the mosquitoes or that the insects will disrupt the Florida ecosystem — and generally unhappy about being chosen as a test site — some have threatened to derail the experiments by spraying insecticides near the release points.

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"As you can imagine, emotions run high, and there are people who feel really strongly either for or against it," says molecular biologist Natalie Kofler, who lectures at Harvard Medical School in Cambridge, Massachusetts, and is the founder of Editing Nature, an organization that advocates for responsible development and oversight of gene-editing technologies. "And I can see how, if you didn't agree to this, it could be really concerning to have mosquitoes released in your neighbourhood."

Many of the concerns stem from the uncertainty of a new technology, says Kofler, who has been following this project for years. Oxitec has been engaging with the Florida Keys community to provide answers to queries. It explained, for instance, the very low likelihood that female mosquitoes with the lethal gene could reproduce. But many people don't have confidence in what they're hearing, because it's coming from a company, says Kofler.

Kofler is hoping that enough data are gathered to assess the mosquitoes' impact, including on other species in the Keys and local ecosystems, and that it's done "in a way that's transparent, and in a way that can make some community members feel better about the whole situation".

Oxitec employees have taken precautions against vandalism by placing their mosquito boxes on private, fenced-in properties, and not disclosing the boxes' precise locations to the public.

THE FLIP SIDE OF UNRESTRICTED VIRAL GENOME SHARING

Global-south scientists say open-access movement led by wealthy nations could exploit their COVID work.

By Amy Maxmen

"I was up all last night," says Nnaemeka Ndodo, a molecular bioengineer at the Nigeria Centre for Disease Control (CDC) in Abuja. He sequences coronavirus genomes during the day, and then analyses and uploads the results to an online database at night, working tirelessly alongside his colleagues. "We don't know Saturday, we don't know Sunday," he says.

Researchers around the world are racing to spot variants of the coronavirus SARS-CoV-2 so that they can determine whether the mutated viruses will evade vaccines or make COVID-19 deadlier. Like many scientists, Ndodo shares SARS-CoV-2 genome sequences in a popular data repository, GISAID, that requires users to sign in and to credit those whose data they analyse.

But a growing faction of scientists, mostly from wealthy nations, argues that sequences should be shared on databases with no gatekeeping at all. They say this would allow huge analyses combining hundreds of thousands of genomes from different databases to flow seamlessly, and therefore deliver results more rapidly.

The debate has caught the attention of the US National Institutes of Health (NIH) — which runs its own genome repository, called GenBank — and the Bill & Melinda Gates Foundation, which has considered encouraging grantees to share on sites without such strong protections, *Nature* has learnt.

But many researchers — particularly those in resource-limited countries — are pushing back. They tell *Nature* that they see potential for exploitation in this no-strings-attached approach — and that GISAID's gatekeeping is one of its biggest attractions because it ensures that users who analyse sequences from GISAID acknowledge those who deposited them. The database also requests that users seek to collaborate with the depositors.

Fears of inequitable data use are amplified by the fact that only 0.3% of COVID-19 vaccines have gone to low-income countries. "Imagine Africans working so hard to contribute to a database that's used to make or