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Genetically modified mosquitoes could wipe out the world's most deadly viruses. If we let them.

By Kristen V. Brown (<http://fusion.net/author/kristen-v-brown/>)

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By Kristen V. Brown (<http://fusion.net/author/kristen-v-brown/>)

The *Aedes aegypti* mosquito is a beautiful, brilliant killer.

Dark with white spots and a wingspan of only a few millimeters, it is smaller and stealthier than the mosquitoes that might keep you up at night, buzzing in your ear. There are thousands of species of mosquitoes, but only a few hundred are interested in humans. The *Aedes aegypti* is among the deadliest (<http://www.theatlantic.com/science/archive/2016/04/aedes-aegypti/479619/>) of them all.

The *Aedes* lives and breeds in places where people are, laying its eggs in a few droplets of stagnant water at the bottom of a forgotten beer can and then spending its short life hiding under beds and in closets. Its hardy eggs can survive months without water, waiting until conditions are just right to hatch. It bites legs and ankles, feeding quickly before it gets swatted away. It prefers small meals from many people, spreading disease with incredible efficiency as it goes.

Native to Africa, globalization has aided the *Aedes'* travels to nearly every continent, and with it, the proliferation of disease. It is the primary carrier of yellow fever, dengue fever, Zika virus and chikangunya. With the exception of yellow fever, these diseases do not have vaccines or cures. The *Aedes* assists in the killing of tens of thousands of people each year and infects many, many more. As its footprint has widened, our methods of fighting it have weakened. Insecticides are still our best form of defense, but *Aedes aegypti* have begun to develop resistance.

At long last, though, mankind may be on the verge of a mosquito-busting panacea. In August, faced with the Zika crisis, the Food and Drug Administration gave the green light (<http://fusion.net/story/333793/oxitec-zika-fighting-mosquitoes/>) to Oxitec, a British biotech company that aspires to release millions of genetically modified mosquitoes into the wilds of the Florida Keys. Oxitec has engineered male mosquitoes to turn the species against itself, giving them a lethal gene that kills off any offspring they might have with a wild female. The idea is to flood the local mosquito population with genetic mutants, until the wild population eventually dies out. In Key West, Oxitec hopes to assess how well the Frankenskeeters fare in the realm of Mother Nature.

Such innovations offer a dream of a world free from many of the ailments that plague it.

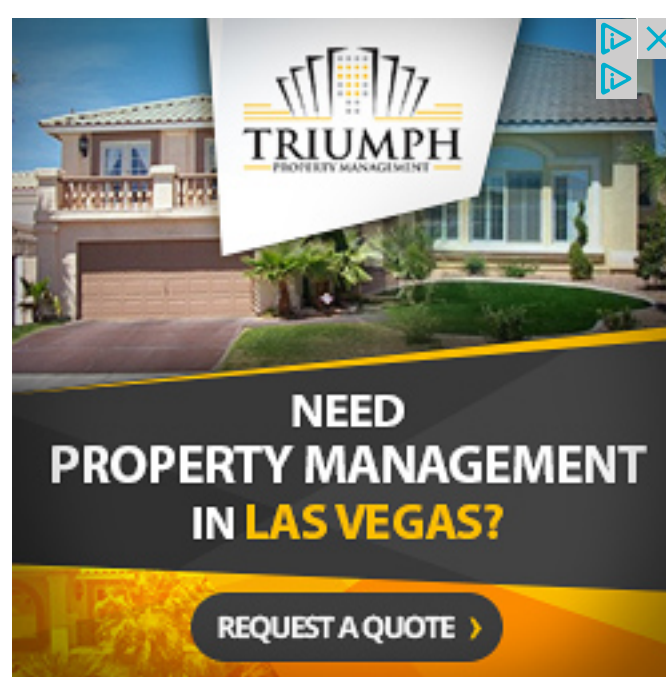
But the Keys is not Oxitec's first test site. It has similar projects underway in Brazil, Panama, India and the Cayman Islands. And others are also testing their own visions for disease-smiting killer mosquitoes. The Bill and Melinda Gates Foundation has invested \$75 million (<https://www.technologyreview.com/s/602304/bill-gates-doubles-his-bet-on-wiping-out-mosquitoes-with-gene-editing/>) in a plan to use a technology called gene drive (<http://fusion.net/story/317396/kevin-esvelt-gene-drive-responsive-science/>) to quash troublesome mosquito populations. Another company, MosquitoMate, has developed a mosquito that relies on a type of bacteria called Wolbachia to render them sterile. MosquitoMate has already begun trials in California (<https://www.wired.com/2016/08/california-city-fending-off-zika-releasing-40000-mosquitoes-every-week/>). It recently received regulatory approval to expand them to Key West.

Such innovations offer a dream of a world free from many of the ailments that plague it. It could mean the end of malaria and dengue fever. It could mean crops free from pests and pesticides. It could offer a way to combat ecological damage wrought by insects showing up in places they do not belong (<http://www.newyorker.com/news/daily-comment/could-genetically-modified-mosquitoes-save-hawaiis-endangered-birds>).

What crushes that dream may be us. While at one point in history, genetic modification was a beacon for the future's glittering possibility, today you can scarcely utter the words "genetic" and "modified" without causing a fuss.

Oxitec has faced opposition in all corners of the globe. In the Cayman Islands, the rollout of its mosquitoes was briefly delayed after anti-GMO activists took their fight to court (<https://www.yahoo.com/news/court-suspends-release-gmo-mosquitoes-cayman-islands-214312425.html>). But nowhere has the resistance been stronger or more hostile than in the Florida Keys where local activism threatens to upend the whole thing (<http://fusion.net/story/334570/zika-oxitec-key-haven-rumors/>).

As the pioneering synthetic biologist Jack Newman (<https://www.fastcompany.com/3000040/rise-and-fall-company-was-going-have-us-all-using-biofuels>) put it to me, "What stands between us and addressing one of the biggest public health issues in the world is not science. It's how we talk about science."



Absent a vaccine (<http://www.newyorker.com/magazine/2016/08/22/the-race-for-a-zika-vaccine>), Oxitec's technology could be our most effective tool in fighting Zika. Genetically engineered mosquitoes could go a long way towards fighting some of the world's deadliest viruses. The bigger question is whether we will let them.



Lightning flashed over a dark sea as a hurricane made its way north towards the Keys' western coast. The air was heavy and damp. It smelled of salt water. And bug spray.

“People here really love this place and they will protect the things they love,” Barry Wray, an aging Keys entrepreneur, told me over dinner. “We love the ecosystem here.”

I had come to the Keys to better understand the opposition that threatens Oxitec’s proposal. Wray, a short, stubbled man who favors the local uniform of pastel colors and shorts, is the executive director of the Florida Keys Environmental Coalition (<http://www.fkec.org/>) and one of the residents leading the charge against Oxitec’s mosquitoes. The Keys, he explained, are a fiercely autonomous community that has always been hostile to outsiders trying to make changes.

“You’ve just walked into a very independent subset of America called the Conch Republic,” Wray told me.

Key West once even talked (<https://warisboring.com/key-west-declared-a-faux-war-on-the-united-states-in-1982-f2c40b429e75#.fyld1e16g>) of seceding from the U.S.

Kristen V. Brown/FUSION

Florida Keys resident Barry Wray is leading the charge against genetically engineered mosquitoes.

Key West was chosen as the trial site for Oxitec because of the isle’s geographic isolation and historical propensity for attracting disease-carrying bugs. But that isolation has become a hurdle, politically. Key West is separated by a few hundred miles and a whole lot of water from the Florida mainland’s Zika problems. It has yet to have its own locally transmitted case.

Mainland Florida, though, is in the midst of a full-on Zika panic. It is the only state in the US to have local transmission of the disease, with now more than 70 cases on the mainland (<http://www.nbcnews.com/storyline/zika-virus-outbreak/florida-zika-count-hits-70-local-cases-n647851>). Tests for the disease are backlogged (http://www.nytimes.com/2016/09/15/us/florida-gets-help-to-deal-with-backlog-of-zika-tests.html?_r=0), as hundreds of pregnant women have rushed to take them. We don’t know the full impact that mosquito-borne Zika can have on people, but we do know that when the virus is present in a pregnant woman, it can lead to miscarriage (<http://health.nytimes.com/health/guides/disease/miscarriage/overview.html?inline=nyt-classifier>), severe birth defects (http://topics.nytimes.com/top/news/health/diseasesconditionsandhealthtopics/birth_defects/index.html?inline=nyt-classifier) and other threats to a baby’s health.

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A Florida congressman brought live mosquitoes to the House floor to protest inaction on Zika

(<http://fusion.net/story/344757/mosquitoes-congress-zika-funding/>)

The situation in Florida is grim and as Zika spreads it seems clear fighting it with chemicals alone is not enough. This month, a bipartisan coalition of Florida politicians petitioned the federal government (<http://www.reuters.com/article/us-health-zika-usa-idUSKCN11D2J0>) to grant an emergency use of Oxitec’s technology areas affected by Zika. Delaying its use, they wrote, poses “an unnecessary health risk” to the people of Florida.

But without an emergency intervention, whether Florida uses genetically engineered mosquitoes to beat back Zika is up to the people of the Florida Keys.

The Keys trial has FDA approval. Now it requires the go-ahead from the local mosquito control district, which is waiting to decide until after the public casts a vote on the proposal in November. The result of the public vote isn’t binding, but three of the five commissioners (<http://www.flkeysnews.com/news/article79625142.html>) on the mosquito control board have promised to decide in line with voters’ wishes. Come November, a community of 80,000 people living just off Florida’s southern tip will have a hand in deciding the fate of a technology that could prevent major public health crises.

“People here really love this place and they will protect the things they love.”

Wray's opposition movement is small, but effective. A letter signed by local physicians (<https://www.facebook.com/NoToGMMosquitoes/posts/621880684638604>) raising questions about the mosquitoes' potential for creating antibiotic resistant “superbugs” went viral locally, racking up more than 200 Facebook likes. A Change.org petition (<https://www.change.org/p/say-no-to-genetically-modified-mosquitoes-release-in-the-florida-keys>) started four years ago has garnered nearly 170,000 signatures. Members of Wray's group have traveled to Washington D.C. (<https://www.change.org/p/say-no-to-genetically-modified-mosquitoes-release-in-the-florida-keys/u/16710584>) to petition Congress. And they have tapped into wider online communities of anti-GMO activists and conspiracy theorists for support, circulating rumors of Zika cover-up scandals, (<http://m.greenmedinfo.com/blog/what-zika-virus-epidemic-covering>) underhanded corporate controversy (<https://www.facebook.com/NoToGMMosquitoes/posts/616053555221317>), and general government mistrust (<https://www.facebook.com/NoToGMMosquitoes/posts/614038642089475>). One particularly sticky rumor, which seems to have begun on Reddit (https://www.reddit.com/r/conspiracy/comments/42mhii/genetically_modified_mosquitoes_released_in/), suggested that Oxitec's mosquitoes were actually Zika's source (<http://www.factcheck.org/2016/02/gmos-didnt-cause-zika-outbreak/>). Another said the bite of its mosquitoes could make children sterile. Their outrage has made the pages of *The Guardian* (https://www.theguardian.com/us-news/2016/aug/14/florida-keys-zika-virus-genetically-modified-mosquitoes?CMP=twt_gu) and *The New York Times* (http://www.nytimes.com/2016/08/25/us/zika-florida-keys-mosquitoes.html?_r=1).

Back in 2013, 59% of residents in Key Haven, the neighborhood where the trial is planned, supported Oxitec's project, with only 9% opposed (<http://keysmosquito.org/wp-content/uploads/2013/10/Key-Haven-GM-Release-Survey-March-May-2013-2.pdf>). Now, 58% are in opposition (<http://currents.plos.org/outbreaks/article/genetically-modified-mosquito-use-to-reduce-mosquito-transmitted-disease-in-the-us-opinion-survey/>).

Kristen V. Brown/FUSION

Campaign signs for the Florida Keys Mosquito control board abound on every intersection of Key West.

Oxitec has actually been pressing for this trial since long before Zika arrived on Florida's shores. The company first came to Key West when it was fending off an epidemic of dengue. In 2009 and 2010, Key West had more than 100 confirmed cases, spread locally by infected mosquitoes.

This was despite the fact that the Keys have one of the most advanced mosquito control efforts in the nation, if not the world. Its annual operating budget for mosquito control is more than \$15 million, with four helicopters, two airplanes and more than 30 inspectors, their efforts spent mainly on spraying insecticide and hunting for standing water where mosquitoes might breed. By contrast, prior to Zika, the budget for fighting mosquitoes in Miami-Dade County, which is 20 times larger and has 30 times as many people, was just \$1.5 million (<http://www.miamiherald.com/news/local/community/miami-dade/article95166097.html#storylink=cpy>).

In 2010 (<http://keysnews.com/node/36843>), desperate for an alternative to seemingly ineffective chemicals, the mosquito control district reached out to Oxitec's founder and CEO. In 2012, they attended a town meeting to explain the science of eradicating disease-carrying mosquitoes from the Keys with genetic engineering. But by then, the town had managed to quell its dengue outbreak, so interest had waned.

However, within hours of the meeting agenda going public, the opposition mobilized, plastering flyers all around the city. Since then, it has only grown.

“We solved our last dengue outbreak with boots on the ground,” said Kathryn Watkins, a social media consultant running for the mosquito control board on an anti-GMO platform. “Why do we need a different solution now?”

Friends have taken to calling her “Spill-the-Water Watkins” because she pesters them to make sure their homes have no empty flower pots or coffee mugs with standing water where clever *Aedes* might breed. Education about such tactics, Watkins believes, is the best solution. When I visited her, she had just come back from patrolling her neighbor’s house. But Key West is the tropics. On average, it rains 100 days a year. The giant empty lot across from Watkins’ house is filled with stagnant puddles .

“If Zika comes here, we’ll all be asking for this. We don’t have a problem, so the risk is not worth it.”

Those opposed to genetically modified mosquitoes have many concerns. While the *Aedes aegypti* is not native to the Keys, and makes up a small percentage of the area’s 46 mosquito species, opponents still wonder how removing it might impact the environment. And they worry about the effect of adding a mosquito that contains DNA cobbled together from E.coli, coral, a vinegar fly and a cabbage looper moth. While Oxitec aims to only release male mosquitoes, an estimated one in 500 will be female, and female mosquitoes are the ones that bite. What happens if someone gets bit by a genetic mutant? The mayor of Key West told me that even if those fears are remote possibilities, they could still be bad for Key West by discouraging tourists from visiting.

Kristen V. Brown

Kathryn Watkins is running for the Keys' mosquito control board on an anti-GMO platform.

Drive through Key Haven and every third lawn bears a placard reading “No Consent to Release of Genetically Modified Mosquitoes” in aggressive red-and-white. I went door to door asking for citizens’ thoughts on the project. Some were in favor and a few hadn’t heard of it, but most were not fans of the idea at all. “We’ve never had a mosquito problem here. Why would I want genetically altered mosquitoes?” explained 80-year-old Mary Murray, who moved to the Keys 20 years ago.

When I visited the mosquito control board, an hour’s drive north of Key West in Marathon, a dozen or so protesters campaigned outside with signs such as “We are not your experiment.” One of the protesters followed me inside. She sat down next to me as the mosquito board chairman talked on camera with the local news. For every fact he offered the camera, she hissed in my ear that it was “hearsay” or “lies.”

Inside, Oxitec scientist Derric Nimmo, who runs the Keys project, told me that he spends his time more often on public relations now than science. Oxitec rents two small labs from the mosquito control district, with which it would partner in releasing the mosquitoes if the trial is approved in November. Oxitec would ship engineered eggs from the U.K. and rear them in Florida. For now the stainless steel shelves that one day may hold thousands of mosquitoes lay empty and bare.

Kristen V. Brown

Derric Nimmo, the head of Oxitec's Florida Keys project.

“As a scientist you deal with data and facts and you have to say a lot to prove something quite small. But with the public you have to be able to boil that down. When you do that you lose certain information,” Nimmo told me. “You can say we release males and people say, ‘You’re lying,’ because a very small number of our mosquitoes wind up being female. We’ve learned by trial and error.”

Oxitec maintains that it has always been forthright with the community about its intentions, but some even within the scientific community say it could be more transparent. There was the perception, in both the Keys and Grand Cayman, for example, that public meetings were not advertised quite vigorously enough.

Kristen V. Brown/FUSION

Protestors outside of the Florida Keys Mosquito Control District.

Wray and his comrades parse with unforgiving exactness every “fact” Oxitec puts forward. Why, for instance, does Oxitec claim to reduce the local mosquito population, when their technique includes releasing many more?

“We called the insects sterile in the beginning and people said, ‘You’re lying,’ because they do produce eggs,” Nimmo told me. “So we’ve gone more towards ‘self-limiting’ now in terms of description.”

It certainly didn’t help stem corporate conspiracy claims that Oxitec—a small upstart born of an Oxford zoology department—was acquired by a major international conglomerate in 2015. Or that when Oxitec first came to the Keys, the technology was so novel the federal government had no idea how to regulate it.

Nimmo fights fears and fiction by going door-to-door in Key West to explain Oxitec’s science. Recently, the company placed an ad for canvassers to help with the spread. But some dissenters, like Wray, Nimmo said, will never be swayed by science or fact.

“If people don’t want to listen,” he told me, “There’s nothing I can do.”

Oxitec’s supporters fear the danger of waiting. If Zika comes to the Keys, it will threaten both locals and the tourism industry on which the economy relies. With all the chemicals in the world, the Florida Keys have only been able to suppress about half the *Aedes* population.

“This is a tool we have to fight disease that we could be using today if we weren’t trying to get the public on board,” Phil Goodman, the chairman of the mosquito control board, told me. “We are in the business of public health, not public opinion.”



Though this feels like the future, the truth is that there’s little about Oxitec’s technology that is truly “new.” As one scientist put it to me, “this technology is rooted in what we’ve been doing since the 50s. It’s just a slightly more clever way to do it.”

Oxitec’s technology is riff on what’s known as the sterile insect technique, an approach to insect management first proposed in the 1930s by a U.S. Department of Agriculture scientist named Edward Knipling (https://en.wikipedia.org/wiki/Edward_F._Knipling). Knipling suggested using radiation to “sterilize” male screwworms, pests that were terrorizing the American cattle industry by laying flesh-eating larvae in the open wounds of cows. By blasting the flies with gamma rays in the lab, scientists could mutate the flies, rendering them unlikely to produce viable offspring. The wild females that mated with them would then go on to produce eggs with little chance of survival. Eventually, the population would die out, no nasty chemicals necessary.

By the end of the 1950s, after field trials on Florida islands and in the Caribbean, the screwworm was all but eradicated from the American Southeast. By 1982, it was gone from the US.

In “Silent Spring,” the 1962 best-seller that sounded the alarm on DDT and spawned modern environmentalism, citizen-scientist Rachel Carson suggested the sterile insect technique as the antidote to pesticides. Solving crises by creating altered insects was the environmentally friendly approach—hard as that might be to believe today when anti-GMO rhetoric has become part of most environmentalist platforms.

Kristen V. Brown/FUSION

A house in Key Haven with an anti-GMO mosquito sign.

The problem with the radiation technique was that it didn’t work on every insect, including the mosquito. Radiation made it too weak to compete with its non-irradiated brethren for a female mate.

In 1994, Oxitec founder Luke Alphey was working on editing the genome of a fruit fly when a friend told him about the sterile insect technique. The work he was doing, he realized, might be used to improve it, but the mosquito genome hadn’t yet been edited.

“To do this kind of thing in [fruit flies] was not that big a deal,” said Alphey, who left Oxitec in 2014 to return to academia. “But the ability to put any kind of foreign DNA into any pest was a big deal.”

When a scientist later successfully edited the mosquito genome, Alphey decided to give his idea a shot. He inserted two new genes into mosquito eggs—one that made the mosquito over-produce a protein that interferes with gene regulation, stymying development, and another that gave the mosquitoes a red glow under the microscope, so that scientists could track the spread of their lab-created population. Because mosquito female pupae are significantly larger than males, scientists could use size to sort the mosquitoes with near-perfect accuracy and release only males.

Oxitec’s original target market was agriculture, but it turned to mosquito-borne disease after it realized agriculture was already too crowded with other takes on the sterile insect approach. The company hopes to court consumers one day, in addition to governments. Oxitec CEO Haydn Parry told me that the company imagines selling its genetically modified mosquitoes at the garden store, competing with citronella candles as a way to prevent bites in your yard.

“I can send you eggs and you can protect your own biosphere,” he told me.

Part of the reason the scientific community has embraced Oxitec’s proposal so vigorously is that it hinges on a method scientists have long thought of as an ideal way to kill pests. One scientist told me Oxitec’s approach actually feels safer than older sterile insect techniques, since genetic engineering allows scientists to render a mosquito sterile with just one known mutation, rather than rely on radiation to create many unknown ones randomly. Oxitec has already released millions of genetically engineered pink bollworms, a cotton pest, in the US.

“I can send you eggs and you can protect your own biosphere.”

The biggest concern the scientific community has about Oxitec’s technology is whether it will work on a scale large enough to solve the world’s urgent *Aedes Aegypti* problem.

“At this point, I know that this is safe,” Matthew DeGennaro, a mosquito geneticist at Florida International University, told me. “What we don’t know is how effective it will be at scale, or how effectively reducing the mosquito population will also reduce disease.”

Kristen V. Brown/FUSION

Signs protesting Oxitec's proposal in front of the Florida Keys Mosquito Control District headquarters.

So far, test results have been encouraging. Oxitec’s biggest effort is in Brazil, where in 2015 it began releasing mosquitoes in two small neighborhoods with a combined 5,000 residents in the city of Piracicaba. By the end of the year preliminary results showed wild mosquito larvae were reduced by 82%. Three prior trials had shown even higher suppression rates. According to the city, dengue cases dropped from 112 cases per year to 13 in the neighborhoods where the mosquitoes were released.

The city’s mayor was so pleased that he lobbied for state financing to expand the program. Oxitec is now building a new mosquito production facility in Piracicaba, which will have the capacity to produce 60 million mosquitoes a week to help protect over 300,000 people and is slated to open by the end of this year.

“I don’t see it as a silver bullet.”

In July, (<https://caymannewsservice.com/2016/09/gm-mosquito-offspring-begin-to-appear-in-field-test/>) Oxitec began a similar program in the Cayman Islands, where it's in the midst of releasing millions of mosquitoes in a 300-acre area over nine months.

"We have already begun to see evidence of males mating with wild females," Bill Petrie, the head of Grand Cayman's mosquito program, told me. "It's too early to see reduction in the population, but it is encouraging."

Petrie said that it will likely take five years to do the whole island. He's optimistic that the technology will help get Grand Cayman's mosquito population under control. But he cautioned against viewing it as an emergency solution to an epidemic or a cure-all. "I don't see it as a silver bullet," he told me.

Oxitec's technology has a good shot at working well in a relatively confined area, such as a small island or a specific neighborhood, said Anthony Fauci, the director of the National Institute of Allergy and Infectious Diseases at the NIH. He's more skeptical, though, that it will work as well in larger areas such as mainland Florida or all of Brazil.

"Mosquitoes do not fly more than 500 feet and so you would have to release multiple iterations of modified mosquitoes over a vast geographic area to get 'scale,'" Fauci said.

The need to release mosquitoes frequently over long periods of time could wind up making it financially taxing. Malaysia, where Oxitec conducted trials, decided to not go ahead with the project after trials, citing cost. Negotiations are under way in Panama to release more mosquitoes, but cost is a factor there as well. In Brazil, the pilot project cost about \$50,000, which the city of Piracicaba split with Oxitec. Piracicaba anticipates paying about \$2.7 million a year when it scales up the number of mosquitoes released.

In the Keys, Oxitec has said it will pay for the trial. But it is still unclear how much it will cost once the trial is over if indeed the FDA grants Oxitec's mosquitoes a commercial license.



For some, the phrase "genetically engineered" alone inspires an immediate resistance to Oxitec's mosquitoes.

A recent Pew survey found 60% of Americans fear genetic engineering (<http://fusion.net/story/342379/pew-study-genetic-engineering/>). According to another Pew survey last year, 88% of scientists believe it's safe to eat genetically modified foods, but only 37% of the public does. That gulf is even wider than the one between the public and scientists on the subject of climate change.

"The public perception of danger is unwarranted and largely based on poor understanding and perceptions of risk," Paul Eggleston, a molecular entomologist at Keele University, told me.

Mosquito Mate's sterile mosquitoes, which rely on the addition of bacteria instead of altered DNA, were released earlier this year in California with hardly any public comment and skated through the regulatory process.

In testimony before Congress (<https://science.house.gov/legislation/hearings/full-committee-hearing-science-zika-dna-epidemic>) in May, Oxitec CEO Parry pleaded for legislators to consider the implications of the technology itself, rather than getting hung up on the fact that it's "genetically modified."

"We want to make this technology available in the coming months rather than the coming years," he said. "We need to be able to distinguish products by what their risk profile is, rather than assign a label."

Encouragingly, though, the Pew survey found that people were more willing to embrace a technology if they had more knowledge of it. As the threat of Zika virus raises awareness of both the disease and the technologies that could stop it, society might warm up to the potential benefits of genetic engineering. A recent national survey by Purdue University (<https://www.purdue.edu/newsroom/releases/2016/Q1/survey-public-supports-use-of-gmo-mosquitoes-to-fight-zika-virus.html>) found both high levels of awareness of Zika virus and "overwhelming" support (78%) of using genetically altered mosquitoes to stop it. The fear isn't of science; it's of the unknown.

Bill Irwin, a one-time protestor of Oxitec that has become a supporter.

Before I left Key West, I met Bill Irwin, a Florida Keys Community College biology professor who helped found the local environmental group that birthed the mosquito resistance movement. Irwin has since defected to become one of Oxitec's most vocal supporters. I wanted to know what changed his mind.

He told me that when Oxitec's proposal first came up, he was dubious. Genetically altered mosquitoes inherently just sound like an awful idea.

"When I teach environmental biology, generally I am teaching the evils of genetically modified things," he told me. "There are some good GMOs, like insulin of course, but generally I am not a fan."

Then, Irwin said, he spent hours digging into the science. For every query the opposition brought up, he would immerse himself in the literature to understand exactly how Oxitec's mosquitoes work and what kind of impact they might have on the environment.

"And as I analyzed it," he told me, "I said, 'Wow, this is exactly what we need.'"

Like Rachel Carson before him, Irwin felt that using altered insects was more environmentally friendly than pesticides. He feared what increased spraying to guard against Zika would do to the treasured habitat he wanted to protect. His fear was prescient: The next week, after heavy insecticide spraying in South Carolina, millions of bees wound up dead (<https://www.washingtonpost.com/news/morning-mix/wp/2016/09/01/like-its-been-nuked-millions-of-bees-dead-after-south-carolina-sprays-for-zika-mosquitoes/>).

Not every Key West resident has a Ph.D. in biology. It's the complicated job of scientists to explain science in an era where more and more of it interfaces with the public's world. In this time of great fear, maybe we will finally listen.

Fusion reporter Manuel Rueda contributed reporting from Brazil.

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WHAT'S THAT BUZZING SOUND 9 (<http://fusion.net/2016/09/>)/7 (<http://fusion.net/2016/09/07/>)/16 (<http://fusion.net/2016/>) 12:24 PM

A Florida congressman brought live mosquitoes to the House floor to protest inaction on Zika

By Patrick Hogan (<http://fusion.net/author/srolhogan/>)

Screenshot

By Patrick Hogan (<http://fusion.net/author/srolhogan/>)

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By Patrick Hogan (<http://fusion.net/author/srolhogan/>)

Congress is dragging its feet on funding the fight against the Zika virus (<http://fusion.net/video/343976/congress-zika-funding-legislature-florida/>) and one Florida congressman is taking a theatrical step in protest.

"I rise today to talk about Zika," Rep. David Jolly, R-FL, said as he began to address the House of Representatives on Wednesday. "And I rise with about 100 mosquitoes straight from Florida."

No, he wasn't being metaphorical. Video posted by CSPAN shows the congressman was actually holding a jar of live mosquitoes in his hand.



CSPAN ✓
@cspan

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"I rise with about 100 mosquitoes from Florida."

[@USRepDavidJolly](#) brings jar of mosquitoes onto House floor.

[#Zika](#)

7:42 AM - 7 Sep 2016

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Jolly was trying to communicate the distress and anxiety Floridians are feeling over growing reports of the insect-borne disease in the Miami area. And he did it with live mosquitoes.

Jolly was quick to point out the bugs from the University of South Florida were not carriers of the virus. But he still thought it would have an effect if he released them into the room (he did not).

"Can you imagine, colleagues, the fear and anxiety in this chamber if the 100 mosquitoes were outside this jar and not inside this jar?" Jolly said. "That is the fear and anxiety of Floridians."

Jolly did criticize President Obama's original plan to fight Zika as going too far, but he had harsher words for Congress for failing to pass a compromise.

"The time for politics of Zika is over. The politics of Zika are garbage right now," Jolly said.



David Jolly ✓
@USRepDavidJolly

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I brought mosquitoes to DC to convey the fear & anxiety of millions of people. We must pass a #Zika funding pkg.
[youtube.com/watch?v=ppNM1r...](https://www.youtube.com/watch?v=ppNM1r...)

7:54 AM - 7 Sep 2016

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Maybe it would help if Jolly could convince his own party to stop tying funding to help Zika to defunding Planned Parenthood. Because he's right, those politics are garbage (<http://www.nbcnews.com/storyline/zika-virus-outbreak/zika-funding-fails-again-congress-n643626>).

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FEAR AND LOAFING 8 (<http://fusion.net/2016/08/>)/16 (<http://fusion.net/2016/08/16/>)/16 (<http://fusion.net/2016/>) 7:59 AM

Pregnant in the time of Zika: How Congress failed women like me

By Alicia Menendez (<http://fusion.net/author/alicia-menendez/>)

Shutterstock, FUSION

By Alicia Menendez (<http://fusion.net/author/alicia-menendez/>)

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By Alicia Menendez (<http://fusion.net/author/alicia-menendez/>)

M

y husband and I married over a year ago, and in that time we found plenty of reasons not to get pregnant: international trips, professional commitments, a general love of sleep. Thus, when we finally decided that our desire for a child superseded those other priorities, it seemed ironic that nature presented us with yet another compelling reason to wait—the threat of the mosquito-borne Zika virus arriving in Miami, where we live.

As Latin American governments, concerned about the link between the virus and birth defects, advised citizens of childbearing age to postpone pregnancy for up to two years, we decided to take our chances. We knew it was a calculated risk: I was almost 33 years-old, and for us, waiting felt like as much of a gamble as attempting to get pregnant with the threat of Zika looming on the horizon. We hoped that with enough advance notice the federal government would prevent the spread of the virus throughout the continental United States.

Almost six months later, at 22 weeks pregnant, I have never worried that we made the wrong decision in trying to become pregnant. Instead, as Florida confirms more than 20 (<http://www.reuters.com/article/us-health-zika-florida-idUSKCN10N2EY>) locally-transmitted cases of Zika, I now fear that I placed too much faith in my government to address this crisis.

Like any first-time mom, I expected sleepless nights worrying about everything that could go wrong with a pregnancy—and even more nights spent cataloguing my many inadequacies and anxieties, the myriad ways in which I might not be cut out for the challenges of motherhood. Will I remember to feed the baby? What if the baby inherits my bad eyesight? Should I be concerned about the one sonogram in which my sweet fetus looks disturbingly like Darth Vader? I did not expect to stay awake wondering if I should flee the city and state that I live in to protect myself and my baby from the ravaging effects of Zika.

Right now, the odds of contracting the virus are still relatively slim, but the consequences if you do can be devastating. The Centers for Disease Control and Prevention warn (<http://www.cdc.gov/zika/geo/pregnancy-outcomes.html>) that Zika-transmission during pregnancy can result in severe fetal brain defects, including microcephaly. The virus has also been linked to issues with eyesight, hearing, and overall growth. Last week a baby born in Texas died of Zika-related brain defects. And to add to the terror, there is so much we still don't know, including the connection between the trimester of transmission and subsequent effects, or the risk the virus might pose for future pregnancies.

When I asked U.S. Surgeon General Dr. Vivek Murthy recently if there is a point during pregnancy at which the known birth defects associated with Zika could decline, his response—"We don't fully know the answer to that"—only highlighted the dearth of information about the virus.

And what happens if the virus continues to spread? I asked Dr. Murthy if there will be a tipping point when pregnant women will be encouraged to leave the Miami area. The Surgeon General demurred on the possibility of a future in which escaping is necessary and stuck instead to the here and now, telling me, "We're not encouraging women to leave the Miami area."

Meanwhile, with Zika funding repeatedly ensnared in partisan debates (<http://www.usatoday.com/story/opinion/2016/08/03/zika-congress-funding-blame-editorials-debates/88040600/>), Congress has failed to pass the emergency legislation necessary to properly address this crisis. Public health officials warn that without those additional resources, efforts to combat Zika will be jeopardized. As Murthy explained, funding is crucial for developing a vaccine, ensuring that anyone can get tested for the virus, and expanding public education. "Without additional resources," he told me, "Our ability to plan and execute the second phase of studies that is required to develop a vaccine will be impaired. And that's not a risk or a chance that any of us should take."

Last Thursday, the Obama administration said it was moving \$81 million away from other programs to pay for the development of a Zika vaccine, but that is still woefully short of the \$1.9 billion in emergency funding that the White House urged Congress to approve back in February. The seven months it has taken to get even this commitment may not mean much to a bureaucrat, but it means everything to a woman who is five-and-a-half months pregnant.

As an expectant mother, I make daily choices for the well-being of my pregnancy—everything from how much caffeine I consume to the position I sleep in. Now those choices include wearing long sleeves and pants in Miami's 90-degree August heat, dabbing bug spray on my wrists and neck, limiting my exposure to the outdoors, and a larger looming decision about whether to stay or go. But ultimately, my personal control is limited. I am placing much of my health and my pregnancy in the hands of a government that purports to prioritize the wellbeing of women and children but has failed to live up to that commitment.

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A Zika panic in South Carolina accidentally killed millions of honeybees

By Rafi Schwartz (<http://fusion.net/author/rafi-schwartz/>)

Getty Images

By Rafi Schwartz (<http://fusion.net/author/rafi-schwartz/>)

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By Rafi Schwartz (<http://fusion.net/author/rafi-schwartz/>)

Authorities in Dorchester County, South Carolina had only the best intentions in mind.

An outbreak of the Zika virus had been reported in the area, and in an effort to combat the disease, local officials took to the sky for an aerial insecticide assault on the mosquitoes that carry the deadly virus. But it appears they did not think about what the broader impact of their war on bugs would be, because they wound up killing millions of honeybees—and that’s bad both for the bees (RIP) and for the wider world.

According (<http://counton2.com/2016/09/01/millions-of-bees-killed-in-summerville/>) to NBC affiliate WCBD News 2, the decision to conduct the August 28 aerial spray of a mosquito-killing insecticide came after a handful of travel-related Zika infections were reported in and around the town of Summerville. County officials had previously sprayed insecticides from moving trucks. Local beekeepers reportedly claimed that they were not informed of this aerial spray and instead were ambushed with the discovery to discover millions of their bees were deceased.

Flowertown Bee Farm and Supplies (<https://www.facebook.com/Flowertown-Bee-Farm-and-Supplies-169371146803372/>), a local apiary, lost 46 hives, and over two million bees as a result of the county’s spray effort. Speaking with local CBS affiliate WCSC Live 5 News, Flowertown co-owner Juanita Stanley described (<http://www.live5news.com/story/32935181/beekeepers-devastated-on-loss-of-bees-after-mosquito-aerial-spray>) the extent of the damage, saying, “all of my equipment is contaminated, my honey is contaminated, my cone is contaminated, I’m totally shut down here.”

Video posted by Flowertown offered glimpse at one of the Farm’s ruined hives:

Andrew Macke, another local beekeeper, also lost several hives. “I was angry that day, I just couldn’t wrap my head around the fact that we spray poison from the sky,” Macke told News 2. Nevertheless, Macke was optimistic, telling the station that this could be turned into a “teachable moment, how important bees are to the environment and how unhealthy it is to aerial spray a pesticide.”

Naled, the chemical used in Dorchester, kills mosquitoes on contact, and has been in rotation for over 50 years. On its website (<https://www.epa.gov/mosquitocontrol/naled-mosquito-control##1>), the Environmental Protection Agency explains that while not harmful to humans when applied correctly, Naled can be dangerous for honeybees. But, the

agency said, “applications made between dusk and dawn, while bees are not typically foraging, can reduce exposure to honey bees.” To that end, the EPA also recommends keepers cover their hives, or remove them to a different location altogether, to further limit contact with the insecticide.

According to the *Miami New Times*, Naled was used (<http://www.miaminewtimes.com/news/pesticide-sprayed-over-wynwood-is-banned-in-europe-may-also-harm-fetuses-8671169>) to combat Florida’s Zika outbreak earlier this summer, as well as in Puerto Rico. Despite the EPA’s assurances in the United States, its use is banned (<http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32012D0257&from=EN>) in the European Union out of fears that unchecked exposure could be harmful to children.

This past June, environmental advocates delivered over two million dead bees (<http://fusion.net/story/317809/keep-hives-alive-bees-epa/>), and a petition with five million signatures, to the Washington DC headquarters of the EPA in an effort to highlight the adverse effects pesticides have had on bee populations, and the Earth’s ecosystem as a whole.

In a press release (http://www.summerville.sc.gov/index.asp?SEC=8D74E391-3140-4CD2-AE82-5E36515F39E4&DE=D1C77D18-EE9A-4B88-BBD2-5D315DAC11AC&Type=B_PR), County Administrator Jason Ward stated that notices of Dorchester’s aerial spray were, in fact, shared with local news outlets and posted across social media in the days prior to the event. What’s more, while no additional aerial sprays are scheduled for the county currently, authorities will provide at least three to five days of advance notice. According to News 2, soil and honey samples have been collected by officials at Clemson University to learn more about the bees’ deaths.

Keepers who lost hives in this aerial spray have been encouraged to reach out to a designated county official.

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Welcome to the Brazilian town that’s experimenting with mutant mosquitoes

By Manuel Rueda (<http://fusion.net/author/manuel-rueda/>)

By Manuel Rueda (<http://fusion.net/author/manuel-rueda/>)

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By Manuel Rueda (<http://fusion.net/author/manuel-rueda/>)

PIRACICABA, Brazil— Cecilia Kossman grabs a pint-sized plastic container from the back of her van, shakes it, then quickly dumps its contents out of the window, releasing about 1,000 genetically engineered mosquitoes into the city's streets.

The tiny winged critters are mutated versions of *Aedes aegypti*, the notorious mosquito (<http://fusion.net/story/347298/oxitec-genetically-modified-mosquitoes/>) that has infected millions of people around the world with dengue, Yellow fever, Chikungunya and more recently Zika.

But Kossman's mosquitoes don't bite. They're male and they carry a gene that makes it impossible for their offspring to reach adulthood. The mutant mosquitos are trojan horses, deployed on a mission to exterminate their own species.

Cecilia Kossman dumps a batch of friendly aedes mosquitoes out of her van

"Their job now is to mate with regular females," says Kossman, a biologist for Oxitec, a British bioengineering company. She says *Aedes* females can mate only once in their life, so if they choose the wrong partner and mate with a GM mosquito, they'll effectively be neutralized and the overall mosquito population will decrease by one family.

"It's a new idea," Kossman says as she gets ready to release another batch of modified mosquitoes. "We are eliminating mosquitoes by releasing other mosquitoes into the city."

(**Related:** Genetically modified mosquitoes could wipe out the world's most deadly viruses. (<http://fusion.net/story/347298/oxitec-genetically-modified-mosquitoes/>))

Piracicaba is a quiet town in the state of Sao Paulo that's known for its world class ping pong center. But now it's gaining new fame as the world's largest testing ground for the so-called "friendly aedes," the bioengineered mosquito designed to kill off its own species.

The friendly aedes van makes its way around downtown Piracicaba spewing out mosquitos

The mosquitos were invented by Oxitec, a British firm that thinks GM mosquitoes can be powerful tools to eradicate dangerous viruses such as dengue and zika, as well as a series of agricultural plagues.

The company recently got FDA approval to develop its mosquito project in the U.S., and hopes its experiences in Brazil will help them to successfully deploy the "friendly aedes" in South Florida, if residents in the Keys allow it (<http://fusion.net/story/347298/oxitec-genetically-modified-mosquitoes/>).

But not everyone is comfortable with the thought of fighting mosquitoes with mutant mosquitoes. In Brazil, Oxitec's "Friendly Aedes" scheme has been met with some resistance from environmentalists and skeptical scientists who say the town was never consulted on the project and more research is needed to better understand the potential drawbacks and unintended consequences of releasing a new type of insect.

"We need to see more data," said Jose Maria Ferraz, an ecology professor at Brazil's University of Campinas and a former member of CTNBio, the government regulatory commission for biological products.

Ferraz thinks Brazil rushed into experimenting with the GM mosquitoes without fully understanding what it was getting itself into.

"This mosquito was approved by a commission that relied on data compiled by the same company who profits from promoting its use," he says.

On a regular morning up to 200,000 aedes mosquitoes can be distributed in each neighborhood

Oxitec insists its technology is safe. The company says it's been designing GM mosquitoes since the early 2000s, and testing them in different parts of the world with positive results.

Oxitec set up shop in Piracicaba in the spring of 2015, at the invitation of the city's own mayor at a time when the town was reeling from a dengue epidemic.

The genetically manufactured mosquito was first tested in a neighborhood on the outskirts of the city known as CE-CAP, home to 5,000 people. It was an area that was one of the hardest hit by the 2015 dengue outbreak.

The health center in CECAP is not as full as it used to be

“We used to have up to eight people per day here, vomiting and with fever,” said Maria Tonossi, a health worker at the local public clinic. “But now we don’t really have any people coming with those symptoms. I think the mosquito has really helped us to do our work.”

The number of dengue cases in CECAP dropped from 133 cases in the 2014-2015 season to just 12 this past season. Oxitec believes that this is related to the thousands of GM mosquitoes they released in the neighborhood each week, which led to a drastic drop in the local population of *Aedes Aegypti*.

According to Oxitec CECAP had 82% less aedes mosquitoes than another non-treated area of the city, after the first nine months of the program.

“Those numbers tell us that the project is working,” says Kossman, the biologist

But others think there is not enough data to tell just how helpful the gm mosquito was in reducing Dengue, or the *Aedes Aegypti* population.

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Genetically modified mosquitoes could wipe out the world's most deadly viruses. If we let them.

(<http://fusion.net/story/347298/oxitec-genetically-modified-mosquitoes/>)

Professor Ferraz notes that the city government has also been fumigating in the CECAP area, and increasing programs that urge people to eliminate mosquito breeding sites.

“There could be many factors involved,” Ferraz said. “To get a better sense of what happened you would need to compare this neighborhood with a place that has similar characteristics.”

Health worker Maria Tonossi hands out dengue materials to a neighbor in CICAP

Ferraz also worries about the unintended effects of eliminating *Aedes aegypti*, which could just be replaced by another type of mosquito known as *Aedes albopictus*. That could lead to a situation where one vector for diseases is simply replaced by another, he said.

Oxitec employees say their program in Piracicaba has not led to an increase in the population of *albopictus* mosquitoes. And in any event, the company says the *albopictus* feeds primarily off animal blood, so it doesn’t pose as much of a threat to humans.

But a memo written by a member of Brazil’s biological regulatory commission in 2014 proposes another theory.

“Scientific studies show that until the 18th and 19th centuries, *albopictus* was the species that bit people most frequently in the daytime in Asian cities,” the report reads. “It has the aggressiveness and potential to once again occupy that niche.”

A supervisor inspects mosquito larvae at Oxitecs lab in Campinas

Critics of the project are also concerned that the offspring of GM mosquitoes might actually survive if the eggs are laid in water that is contaminated with tetracycline, an antibiotic that is used as medicine for farm animals, and is also used in the Oxitec lab to help its GM mosquitoes survive.

The company says that its mosquitoes are raised in water with very high concentrations of tetracycline, a condition that cannot occur outside the lab environment.

Despite the controversy, Piracicaba plans to push ahead with the GM mosquito. The city plans to expand the “friendly Aedes” project to an additional 13 neighborhoods by the end of this year, covering an area that’s home to about 60,000 residents. It will be the largest deployment area ever for a genetically modified animal.

Oxitec plans to expand its labs to breed more mosquitoes

Oxitec meanwhile is planning to set up a new production facility in Piracicaba, so it can breed up to 60 million mosquitoes per week. The company is also setting its sites on the lucrative U.S. market.

In November the Florida Keys town of Key Haven will vote on a referendum on whether or not to incorporate Oxitec’s GM mosquitoes into its arsenal of zika fighting tools. The same courtesy wasn’t extended to the people of Piracicaba. But Oxitec says it has tried to provide information about its project to the local population.

“The whole region is taking a look at this to see if it works,” said Veruska Segura, a resident of the nearby town of Limeira who dropped by a public info booth that the company runs in Piracicaba’s lone shopping mall. “We had 20,000 cases of dengue in my town...and that’s very expensive for the local health system.”

A local resident checks out the transgenic mosquitoes at Oxitec’s shopping mall booth

Oxitec’s employees stress that their genetically engineered mosquito is not a magic bullet for dengue or zika, rather another means of combating those illnesses.

Kossman, the biologist who supervises the mosquito’s release in Piracicaba, says that globalization has helped *Aedes aegypti* to move easily from one place to another, in cars, ships, and planes, which makes it a very difficult species to eliminate in the 21st century. So she thinks cities should use everything at their disposal to fight the mosquito.

“We know that one technology on its own is not going to save us,” Kossman said. “But the more tools you have at your disposal the better. The important thing is to fight the mosquito and the diseases it carries.”

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How a small Florida town is standing in the way of stopping Zika in the US

By Kristen V. Brown (<http://fusion.net/author/kristen-v-brown/>)

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By Kristen V. Brown (<http://fusion.net/author/kristen-v-brown/>)

When scientists proposed releasing thousands of genetically modified Zika-killing mosquitoes in the Florida Keys, the biggest hurdle was not government regulation. On Friday, the Food and Drug Administration gave the project the green light (<http://fusion.net/story/333793/oxitec-zika-fighting-mosquitoes/>), finding that its potential Zika-busting benefits outweighed any slim potential for environmental impact.

Instead, scientists at the biotech firm Oxitec face a formidable opponent in local residents armed with a powerful tool: the internet.

In the small town of Key Haven, Oxitec has proposed releasing male *Aedes aegypti* mosquitoes engineered to kill off the local mosquito population by passing on a gene (<http://fusion.net/story/333629/genetically-modified-mosquitoes-zika-oxitec/>) lethal to any offspring they might have with wild females. By doing so, Oxitec also hopes it will kill any chance of a local Zika outbreak.

Local residents are not enthusiastic about the plan. Organizing via hashtags like #buzzoffOxitec and a Facebook group (<https://www.facebook.com/NoToGMMosquitoes/?fref=nf>) titled “No to GM Mosquitoes in Key Haven” with just over 700 likes, a small group of Keys residents have become a very loud opposition to Oxitec’s field test in Florida.

“We should not be forced to be part of human experiment,” the group explains on its page, “and do not consent.”

Oxitec first set its sights on the Keys back in 2011, after a local outbreak (<http://www.nytimes.com/2010/07/24/health/24dengue.html>) of the mosquito-borne virus dengue fever. But its plan has become all the more urgent as an outbreak of Zika virus has moved rapidly across the globe, spread by international travel and the *Aedes aegypti*. To date, at least 42 countries (http://www.paho.org/hq/index.php?option=com_content&id=11599&Itemid=41691) have confirmed local transmission of Zika. In the US, there have been more than 7,000 cases (<https://www.washingtonpost.com/graphics/national/us-zika-cases/>). And in Florida, where the first US transmission of Zika spread by mosquitoes occurred in late July, an outbreak has now spread to at least 21 people (<http://abcnews.go.com/Health/zika-virus-cases-reported-florida-outbreak/story?id=41243403>). On Tuesday, the first Zika case was confirmed (<http://www.flkeysnews.com/latest-news/article94646242.html>) in the Keys, though it was a travel-related case, indicating that Keys mosquitoes are not infected with Zika—at least not yet.

This would not be the first time that Oxitec has performed this experiment. It has conducted trials in Brazil, Panama and the Cayman Islands, where it claims (<http://www.oxitec.com/oxitec-vector-control-solution-in-brazil-attacking-source-of-zika-virus/>) the mutant mosquitoes successfully reduced the local mosquito population by 90%.

The opposition has many specific concerns about Oxitec’s proposal, with varying degrees of plausibility. Oxitec, for example, releases male mosquitoes because only the females bite humans. But what happens, the naysayers wonder, if an engineered female mosquito somehow gets released and bites a pregnant person? Can the antibiotics given to the mosquitoes in the lab inadvertently create super bugs? Is it possible that the engineered mosquitoes could thrive in the wild, establishing colonies of man-made mutants? Are Keys residents really just guinea pigs to a sinister money-hungry company?

“As we peeled this onion, the answers become less and less clear,” Barry Wray, one of the Keys residents organizing against Oxitec, told me. “There are people in our ranks that are just against anything GM, but I’m not like that. I just don’t feel that this technology was vetted with rigor.”

These are the kinds of anxieties that drive Derric Nimmo, the head of Oxitec’s Florida Keys project, absolutely crazy.

“There is a very vocal minority that have these wild ideas,” he said. “Some of the rumors about our project are just totally fake.”

The anti-Oxitec rumor mill is swift and efficient. In June, for example, a local physician spoke out at a community meeting, raising concerns that the antibiotics given to the engineered mosquitoes could breed superbugs harmful to both animals and people. It wasn’t long before those concerns began circulating in the community, both by word of mouth and online (<https://www.facebook.com/NoToGMMosquitoes/photos/a.556450014515005.1073741828.553209811505692/613324092160930/?type=3&theater>). A talking point parroted by many anti-GMO groups (<http://www.nyrnaturalnews.com/health/2015/02/superbugs-warning-for-genetically-modified-insect-factories/>), a Facebook post of the meeting was shared 59 times and racked up 1,500 views—a lot for a community of just a few thousand people.

Oxitec's mosquitoes are engineered to include two copies of a gene that kills them before they reach adulthood, overriding natural selection that makes it almost certain offspring will receive their dad's killer abilities. Mosquitoes in the lab receive small doses of tetracycline to counteract this gene's effect until they can pass it along to their ill-fated offspring.

But the levels of tetracycline used, Nimmo said, are much lower than the dosages frequently given to people as treatment for things like urinary tract infections and acne. This means the levels of the antibiotic in any wastewater from Oxitec's facility—where critics think a superbug might breed—are also low. Studies have also shown that even if Oxitec were pumping out gallons of tetracycline-infused waste, the drug almost entirely degrades in just one day.

"It is highly unlikely that the use of tetracycline in the production of OX513A mosquitoes would have any adverse effects on the environment," the FDA's report (<http://fusion.net/story/333793/oxitec-zika-fighting-mosquitoes/>) concluded.

Still, in a small community, rumors to travel far and fast.

For this reason, Nimmo has spent much of his time in the Keys trying to win over residents with "the facts." After the FDA's approval, Oxitec still needs approval from the board of the local Mosquito Control District. In the fall, the board plans to survey the community on their feelings about the proposal, and make a decision with those results in mind.

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The FDA just greenlit releasing mutant Zika-killing mosquitoes in Florida

(<http://fusion.net/story/333793/oxitec-zika-fighting-mosquitoes/>)

Past surveys have been favorable. A survey in 2013 (<http://keysmosquito.org/wp-content/uploads/2013/02/All-Keys-Survey-Results-2013.pdf>), found that more than 60% of local residents supported using genetic engineering technology in Key West to control mosquitoes that spread dengue. Only 18% said they were opposed; another 21% were neutral.

But as a trial of such technology has come closer to becoming a reality, opposition has grown, at least in volume if not number. A small, more recent survey (<http://currents.plos.org/outbreaks/article/genetically-modified-mosquito-use-to-reduce-mosquito-transmitted-disease-in-the-us-opinion-survey/>) of 88 of the community's 456 households by Johns Hopkins found that 58% of residents now either "oppose" or "strongly oppose" genetically modified mosquito use. All over Key Haven (<http://www.tampabay.com/features/humaninterest/terror-in-paradise-mutant-mosquitoes-could-fight-zika-in-florida-but/2287850>), protestors abhor the release of genetically modified mosquitoes, swarming community meetings wielding "No Consent" signs. (More than 160,000 people also signed a petition (<https://www.change.org/p/say-no-to-genetically-modified-mosquitoes-release-in-the-florida-keys>) opposing Oxitec's trial in the Florida Keys, though most did so before the Zika crisis.)

There are few places where the opinions of the public are so divorced from that of science as genetic engineering. According to a Pew Research Center survey (<http://www.pewinternet.org/interactives/public-scientists-opinion-gap/>) last year, while 88% of scientists believe that it is safe to eat genetically modified foods, only 37% of the public does. That gulf is even wider than the one between the public and scientists on the subject of climate change.

"People care at least as much about the process and motives of the project backers as they do about what is done," Kevin Esvelt (<http://fusion.net/story/317396/kevin-esvelt-gene-drive-responsive-science/>), a scientist who runs MIT's Sculpting Evolution lab, told me. "That's especially true for a new technology, when most people start out neutral, and is of course less true for GMOs."

Esvelt, who has been working on his own project (<http://capeandislands.org/post/genetically-engineered-mice-may-combat-lyme-disease-marthas-vineyard>) to combat Lyme disease in the Northeast using genetically engineered mice, says that any solution which relies on genetic engineering is bound to face more intense criticism. An approach to combatting Zika that Oxitec's dissenters endorse, for example, relies on infecting males with a virus-killing bacteria called Wolbachia (<http://www.wired.com/2016/08/california-city-fending-off-zika-releasing-40000-mosquitoes-every-week/>) instead, an approach that at least on the surface seems more 'natural.' (The Wolbachia approach is also promising, but tests have so far only been successful with a different species of mosquito, the *Aedes albopictus*. Tests using *Aedes aegypti* have only just begun (<http://www.wired.com/2016/08/california-city-fending-off-zika-releasing-40000-mosquitoes-every-week/>).

"People are apprehensive about the release of these mosquitoes simply because they are genetically modified," molecular geneticist Nina Fedoroff (<http://www.ofwlaw.com/attorneys/dr-nina-v-fedoroff/>) and former secretary of agriculture John Block (<http://www.ofwlaw.com/attorneys/john-r-block/>) wrote recently (http://www.nytimes.com/2016/04/06/opinion/mosquito-vs-mosquito-in-the-battle-over-the-zika-virus.html?_r=3) in a *New York Times* op-ed. "This is unfortunate, because biological insect control can eradicate pests over large areas."

In the Keys, residents are suspicious at least in part because the project is being undertaken by a private corporation, in a way that at least to them feels opaque. Additionally, a 2010 outbreak of dengue fever, was conquered in the Keys without having to rely on genetic engineering. To residents of Key Haven, Oxitec's mosquito project seems like a lot of risk to solve a problem they don't actually have.

"When I've gone around to people and explained it to them most people are fine with it," Nimmo told me. "Other people say, 'You're from a company, how can I believe you?' In some ways, I can understand that."

At community meetings in the Keys, Nimmo has fielded questions from apprehensive residents on whether bites from Oxitec's mosquitoes could sterilize children.

Nimmo said that for most people, the hardest thing to swallow is that with such an experiment, there is no 100% guarantee of how anything will turn out. There are still lots of unanswered questions about what might happen if we release genetically engineered mosquitoes into the wilds of the Florida Keys. Nimmo can't promise for certain that it will prevent Zika, or that releasing thousands of mutant mosquitoes won't wind up having unforeseen consequences. In its assessment, the FDA determined that adverse effects are "highly unlikely," but there are no guarantees.

"I'm a scientist. We deal with the facts as much as we can," he told me. "We can never say anything is 100% certain. And some people are dead set to say that if it's not 100%, then it's not worth the risk. That's a general starting point I find quite challenging."

But Nimmo insists that the risk is minimal—and worth it. Discovering a way to stop mosquitoes from spreading multiple diseases would save tens of thousands of lives every year. Perhaps most importantly, while many other Zika interventions are in the works, Oxitec's is tested, FDA-approved and ready to go.

"Everywhere else where we've done this there's been 90% or better control of the population," he told me. "If we can show that it's the same in the Key Haven, it has a really good chance of being able to prevent Zika in Miami or wherever in the U.S."

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