**Journalists vector GM fears as FDA considers Oxitec’s Keys mosquito plan**

*By* [*Christie Wilcox*](http://discovermagazine.com/authors?name=Christie+Wilcox) *| January 27, 2015 1:10 pm*

P1 In the past few days, a new “GMO scandal” has hit the headlines. The UK biotech firm Oxitec has proposed the release of special genetically modified mosquitoes in the Florida Keys to help with current mosquito control efforts. Or, according to the media:

**Millions of GMO mosquitoes to be released in Florida Keys if Oxitec gets its way**

**Florida, Meet Genetically Modified Mosquitoes, Which Are Coming Your Way By The Millions**

*The Washington Post* actually called them “genetically modified killer mosquitoes”*,* *in their headline*, warning that they “may attack Florida Keys”. George Dvorsky for io9 cautions that “Millions Of Mutated Mosquitoes Could Be Unleashed In Florida—On Purpose”. It’s safe to say news of the FDA’s **deliberations** on whether to allow these “Frankenstein mosquitoes” are causing quite the stir. There’s even a Change.org petition to fight the release, with nearly 140,000 signatures.

P2 While these mosquitoes are genetically modified, they aren’t “cross-bred with the herpes simplex virus and E. *coli* bacteria” [as claimed by one website] (that would require inter*kingdom* breeding!)—and no, they cannot be “used to bite people and essentially make them immune to dengue and chikungunya” (they aren’t carrying a vaccine!). The mosquitoes that Oxitec have designed are what scientists call “autocidal” or possess a “dominant lethal genetic system,” which is mostly fancy wording for “they die all by themselves”. The males carry inserted DNA which causes the mosquitoes to depend upon a dietary supplement that is easy to provide in the lab, but not available in nature. When the so-called mutants breed with normal females, all of the offspring require the missing dietary supplement because the suicide genes passed on from the males are genetically dominant*.* Thus, the offspring die before they can become adults. The idea is, if you release enough such males in an area, then the females won’t have a choice but to mate with them. That will mean there will be few to no successful offspring in the next generation, and the population is effectively controlled. Oxitec hopes to release millions of autocidal *Aedes aegypti* mosquitoes in the Keys because that species is a **vector** for deadly diseases, and Oxitec is hoping that reducing mosquito populations will protect residents. You would think that would be a good thing—but the headlines and rhetoric of the media suggest otherwise.

P3 The first concern seems to be that there’s no need for a new method of mosquito control. “If I knew that this was a real risk and lives could be saved, that would make sense,” the quote from the Associated Press article reads, “But there are no problems. Why are we trying to fix it? Why are we being used as the experiment, the guinea pigs, just to see what happens?” Actually, contrary to the esteemed opinion of “Key Haven resident Marilyn Smith” that is being included *in every article verbatim,* Floridians should be at least a little concerned about the two viruses that the Oxitec mosquitoes are largely aiming to fight: dengue and chikungunya. Both are nasty emerging diseases that, thanks to an ever-more-connected globe and climate change, are becoming more of an issue in the United States every year.

P4 “What worries public health scientists, entomologists, etc. is that our environment and ecology, particularly in the tropical Keys, make us *very* **vulnerable** to the threat of disease,” explains **vector** ecologist Tanjim Hossain from the University of Miami. “Dengue, for example, was well established in the U.S. for centuries.”

P5 Chikungunya is a relative newcomer in the infectious disease world. The first known outbreak occurred in Africa in 1952—it wasn’t until 2013 that it first appeared in the Americas. But while it lacks the long history and high death toll of dengue, it’s quickly becoming a major concern. Infections are accompanied by high fevers and debilitating joint pain that can last weeks. And guess what? According to the CDC, Florida is the only state in the US which has had locally-acquired cases. The CDC would rather stop chikungunya in its tracks before it settles in the US permanently, and thus, there’s a major focus in Florida right now to knock out the mosquitoes that transmit it. Conveniently enough, it’s the same species that transmits dengue: *Aedes aegypti*, which means control efforts can get twice the bang for the buck. And even better, this is a species that isn’t native to Florida; it doesn’t belong there, and there are no native species that rely on these invaders to survive. So there won’t be negative environmental impacts in Florida if Oxitec (or the government in general) is successful in removing all of the *A. aegypti*there. There simply won’t.

P6 Dengue, on the other hand, is much more of an immediate concern. The virus is responsible for one hundred *million* infections and tens of thousands of deaths each year. While it’s true that only a few of these are from the US, in recent years, the number of local cases has been increasing, and the Florida Keys is one of the areas most at risk of an outbreak. In 2009, the CDC found that more than 5% of the people tested in the Keys had recently been infected with dengue. Finally, after a dengue outbreak in 2009-2010, the Florida Keys Mosquito Control District (FKMCD) stepped up their anti-mosquito game, and began implementing more rigorous control methods, including house inspections and increased truck and aerial pesticide sprays. *That’s* why there hasn’t been a dengue outbreak since—not because there’s nothing to fear. After all, Marin County residents know the danger all too well, as they *just* had an outbreak in 2013. And while everyone seems to be worried about what kinds of terrible things the “mutant DNA” from these autocidal mosquitoes will do, few seem concerned with the fact that they’re constantly being coated in pesticides instead. The pesticides being used are the safest available, but even still, ecologists have raised concerns about the effects of non-target wildlife, including potential negative impacts on the beautiful aquatic habitats that draw tourists. If the Oxitec mosquitoes were used, they would reduce the mosquito populations without any dangerous chemicals: they’ve already shown that, unlike pesticides, the proteins produced to kill the larvae don’t have off-target effects, and don’t harm potential predators if they eat the larvae before they die.

P7 Oh, and it would be cheaper— according to Mother Jones, Key West would pay $200,000 to $400,000 a year for eggs. Right now, according to their website, the FKMCD spends approximately $1.1 million a year to combat *Aedes aegypti* in the Key West area. About $800,000 of that goes to purchasing the more than 7,500 pounds of pesticides that are used and would no longer be needed if Oxitec’s plan worked. It’s not that the Keys are doing nothing to fight the danger—the pesticides are used alongside what are called “source control” efforts (which eliminate mosquito breeding grounds), and they do kill mosquitoes. But combined, they only knock down about 50% of the mosquito population, and to prevent these disease outbreaks, that’s not enough. “The biggest problem is that there is only so much we can do,” says Hossain. “Without good **vector** control efforts on the part of the Florida Keys Mosquito Control District (and others around the state and country), we would have some serious problems.”

P8 “Oxitec’s strategy is a whole different ball game.”

P9 But, of course, the reason the mainstream media is going nuts over this story isn’t some debate about the importance of mosquito control— it’s because of the whole GM issue.  George Dvorsky explains for io9that “some people are worried that genetically modified DNA might get into humans after being bitten”, and goes on to imply that there needs to be careful study of the “health impacts of GMO mosquitoes” before he believes the FDA should sign off on the plan. I would say I’m surprised to see a science writer display such clear lack of understanding of biological science, but then again, this comes just a short time after the results of a recent study which found that over 80% of Americans want their food labeled if it contains *any DNA whatsoever (*only a few less than the number that support mandatory GMO labeling). Such is the state of biological education in our country that has led to this attitude that has so many up in arms about mosquitoes that could actually help save lives.

P10 Listen, I don’t care if even the most popular science page around *told* you “Oxitec can’t guarantee…that the DNA doesn’t pose a threat to humans.” The facts are simple: the mosquitoes’ new DNA is harmless.

P11 “This is not Jurassic Park,” says Hossain.

P12 First off, the mosquitoes that Oxitec hopes to release are male, which means they *don’t drink blood.*So, they won’t be “injecting” anything into your body. And even if a few females squeaked by and made it into the population, you’re talking about a few million mosquitoes over the entire Florida Keys—an area that can have the same number of mosquitoes in *every acre.*The odds of that you would be bitten by the accidental GM female that slipped through rather than a normal one are incredibly low. But that’s not the only way to be GM-bitten: many are quick to point out that the original study showed up to 4% of the offspring could survive, and thus the number of GM females might increase slightly in the second generation (though even in that case, being bitten by an engineered mosquito still wouldn’t begin to become a likely event). Because of this, some seem to be arguing that if, and it’s a big *if*, people were to start getting bitten by mutant mosquitoes, horrible things would happen because there are “unknown dangers” posed by this foreign DNA. “These females can and do bite, potentially inserting their modified DNA into people,” says The Atlantic. I can only assume they are talking about one of two possibilities: that the proteins the synthetic DNA creates are potential allergens, or that the DNA might somehow cause unforeseen genetic changes in people.

P13 The first is highly unlikely. Oxitec isn’t stupid: if they released a mosquito that was producing a new allergen in its saliva, the backlash would be intense and potentially bankrupting. So they’ve checked. They’ve included their investigation into the allergenicity potential of the larvae-killing protein—tTAV— in their releases. The officials which conducted the risk assessment for the release of GM mosquitoes in Brazil said that Oxitec has completed “a thorough study” and that they “rightly concluded that protein fails to exhibit allergenic potential.” They went on to say that “though there is a small probability of an individual being repeatedly bitten by female GM mosquitoes, the protein is not allergenic and the damage is null.”

P14 As for the second potential danger, let me be unequivocal: there’s simply no way that even if you were bitten by a GM mosquito, any DNA from the mosquito would alter your DNA in any way or otherwise cause you harm. That’s simply not how biology works.

P15 It’s not easy to make a genetically modified organism. Cells don’t just “pick up” DNA willy-nilly and insert it into their genomes for fun. If they did, all of us would be hodgepodges of the genes from everything around us. All things that are or were alive contain DNA, which means all of our foods, from corn to chicken, are chock-full of genes—and yet, we manage to eat them every day and our genomes remain intact. When you cut your finger chopping onions, you introduce onion DNA directly into your bloodstream—yet no one would be concerned about potential mutagenic effects. You don’t have to worry about how much DNA you breath in on pollen grains, or whether your yogurt will force yeast genes into your stomach cells, because DNA that enters your body is readily chopped up by enzymes. It does not infect your cells. End of story.

P16 To modify an organisms’ genome, scientists have had to come up with all sorts of ways to make cells permeable to the DNA they want them to take in. There are a myriad of methods, from heat-shock to nanoparticles. Oxitec literally injects the DNA they want expressed into mosquito eggs alongside other things that are designed to help with insertion into the genome, *then* they heat-shock them, and even after all that they readily admit that their transformation success rate is low (about 1%). And that’s how unlikely it is *when the DNA is directly injected into the cell.* Think for a second about how a mosquito bites—its proboscis is far too large to inject anything into that small a target. And even if a mosquito were to inject its DNA into one of your cells when it bit (and somehow not cause the cell to explode from the volume), the odds that the tiny piece of synthetic DNA, out of all the genes in mosquito’s genome, would be incorporated into that cell are unfathomably low, *and even then it wouldn’t matter*: blood cells are final products of our bodies. They don’t split to produce new cells. So *if* you impossibly got the modified mosquito DNA injected into a blood cell, *and* it incorporated into the genes of that cell, which is indescribably unlikely, the cell would do one of two things: either the DNA would land somewhere where it isn’t expressed and be completely ignored for the remainder of the cell’s lifespan (less than a month, for a white blood cell), or it would cause the cell to stop working correctly, and the cell would explode, trigger a self-destructive cascade, or be terminated on the spot by immune cells. Either way, the foreign DNA would be chopped up into nucleotides never to be seen again. There’s absolutely no chance that you’ll be transformed or mutated. *None*.

P17 The fact that it’s impossible for you to uptake the mosquito’s DNA and Oxitec’s research to ensure the proteins aren’t allergens are why Oxitec can confidently say that their mosquitoes are safe. “We are confident of the safety of our mosquito, as there’s no mechanism for any adverse effect on human health. The proteins are non-toxic and non-allergenic,” explained company spokeswoman Chris Creese. Furthermore, these mosquitoes aren’t ‘untested’. They’ve previously been released in places like Brazil and the Cayman Islands.  In those areas, they’ve reduced mosquito populations 80-96%. Oxitec claims that it has released more than 70 *million*mosquitoes worldwide, and “received no reports of human impacts caused by bites or from the synthetic DNA” whatsoever.

P18 Still, the Associated Press seems to be trying to make it sound like this is a completely **novel** technology. While they’re right that this *particular* kind of altered mosquito has not been used in the US before, a very similar technique for insect control has, explained Entomology Today.  The Sterile Insect Technique uses the release of insects which cannot produce offspring (thus are *sterile*in fertility terms) to suppress populations, particularly sterile males. The idea is that if you overwhelm the poor females with sterile mates, they’ll waste their efforts on those guys rather than the ones that can provide them with children, and thus the population plummets. Florida has been using SIT for years, spending $6 million a year on it, and other places like California spend almost three times that. The technique is so effective, the US was able to completely eradicate the screwworm (*Cochliomyia hominivorax*) in 1982. The only difference between Oxitec’s mosquitoes and the sterile ones used already is that the mosquitoes would effectively be sterilized using genetic tools rather than the usual radiation.

P20 So, to sum things up: the only things Oxitec’s GM mosquitoes will be killing are their offspring. The only real question that remains is whether they do that well enough to be worth it.

P21 So why does every media outlet seem to insist on using fear-mongering framing simply because genetic technology is involved? Rather than hyping up the fears of impossible Spiderman-like reactions in people, the media should be talking about the real benefits and drawbacks of Oxitec’s proposal, using this as an opportunity to educate about genetic engineering, rather than reveal their ignorance of the subject.

P22 They could, for example, discuss how, given all the potential genetic modifications to stop these deadly mosquito-**vector**ed diseases, Oxitec’s solution may not be the best option—at least in the long run. Yes, releasing millions of these mosquitoes will probably **suppress** populations in the short term without any human safety consequences, like it has over and over again. However, there are a few other things to consider. Autocidal mosquitoes require continual human input: these altered mosquitoes must be released multiple times, as basically all of the mosquitoes that get the suicidal DNA die, leaving only normal mosquitoes for the next breeding bout. This means that there’s no end in sight, which Oxitec has tried to say as a plus since it means its self-limiting, and if things don’t go well, Florida can stop introducing their mosquitoes any time and it will be as if they were never there. But I see this as a strong negative, as it means we’re not only reliant on one company’s mosquitoes, we’re intentionally choosing a plan that has no foreseeable conclusion. That’s like trying to fix a gushing wound with Band-Aid after Band-Aid after Band-Aid.

P23 The climate is changing, and with it, the mosquitoes that spread disease will only increase their range. We don’t need a stop-gap, we need a solution, one that will completely remove the invasive pests, or at least keep them in check over a larger time scale. And there are other projects looking to create such long-term solutions, where inserted DNA doesn’t bluntly kill the mosquitoes, but rather somehow makes them unable to carry the diseases in the first place or makes them easy targets for predators. There are also other options altogether—Bill Gates is particularly fond of the idea of infecting mosquitoes with special species of gut bacteria that makes them immune to dengue. Or, perhaps, the Keys should give up their efforts to control mosquitoes and hope that attempts to create vaccines are successful before the diseases become a real problem there.

P24 But all of these methods may ultimately be unwise, if we don’t take the time to look at the ecology of the mosquitoes. Hossain noted that a recent study suggested a different species, *Aedes albopictus*, may just move in after the control efforts get rid of *A. aegypti*. And, because of the self-limiting nature of Oxitec’s mosquitoes, *A. aegypti* could just come back anytime if the firm leaves town. “These problems will exist for any **vector** control effort,” explained Hossain. “Overall, GM mosquitoes are a ‘cool’ strategy that have the potential to significantly improve **vector** control practices and reduce disease transmission.”

P25 Point is: if you want to have a frank and honest conversation about whether the FDA should proceed with Oxitec’s mosquito plan, I’m all for it. Sadly, instead of that, media outlets seem to be content vilifying technology and inciting fear for no good reason. The reporting has been lazy, hyperbolic, and dangerously inaccurate. Shame on all who simply copied and pasted the AP’s story—that’s neither science nor journalism, guys, and you should be embarrassed.

**Questions:**

1. ***Explain*** why the term “*vector”* is used in the title.  Support your response ***using evidence from the text.***

1. Paragraph 2 describes the genetic modification made to the mosquitoes as “*dominant lethal genetic system.”* ***Describe*** the type of genotype the modified mosquitoes MUST have.  Use ***evidence from the text*** and your ***knowledge of genetics*** to support your answer.

1. ***Summarize*** the process and challenges involved in genetically modifying an organism.  Support your response ***using evidence from the text.***

1. ***Explain*** the importance of a scientifically literate population***; use evidence from the text*** in your response.

1. ***Describe*** how the different modes of persuasion (pathos, egos, logos) have been used by various parties involved in the GMO mosquito debate.  Support your response ***using evidence from the text***.

1. ***Compare and contrast*** the arguments made in the article on potential effects of genetically modified *A. aegypti*  mosquitoes on existing ecosystems.  ***Cite text*** in your response.