



BORDER HEALTH NEWSLETTER - October 2016

WELCOME!

It has been another great time with HPOs at the PEST MANAGEMENT AND VECTOR SURVEILLANCE WORKSHOP in Auckland at the Holiday Inn. I've enjoyed our discussions a lot especially those about how to achieve the best results of aged water and about airports. Here is a good one (in terms of disease spread) about an airport in Africa: "It's chaotic and sweaty with illogical lines, likened to a mosh pit sauna. The boarding gates are notoriously hot, dirty and crowded, and toilets and seats are broken more often than not. Unfortunately the arrivals hall is a tent and a mosquito sanctuary, lacking toilets and air conditioning." Another sport anecdote from a mosquito perspective:

Bowler Ishant Sharma has returned to India's test side after missing the series with New Zealand through chikungunya. He was ruled out after failing to recover from the mosquito-borne viral disease but has proved his fitness by bowling extensively in domestic Ranji Trophy matches. DINUKA LIYANAWATTE/REUTERS



SAMPLES

During October 770 samples were collected by staff from the 12 DHBs with only 109 positives. That is a lot more than last month. Compared to October last year it is striking that we have approximately 800 more adults likely due to increased sampling efforts. The larvae found last month show a similar pattern to those found last month and during October last year.

Species	Adults		Larvae	
	Oct 16	Oct 15	Oct 16	Oct 15
New Zealand Mozzies				
<i>Aedes antipodeus</i> (winter mosquito)	50	0	0	0
<i>Ae. australis</i> (saltwater mosquito)	1	0	0	2
<i>Ae. notoscriptus</i> (striped mosquito)	224	0	1711	1659
<i>Coquilletidea iracunda</i>	3	0	0	0
<i>Culex astilae</i>	0	0	1	12
<i>Cx pervigilans</i> (vigilant mosquito)	461	4	825	1201
<i>Cx. quinquefasciatus</i> (southern house mosquito)	84	3	93	9
<i>Opifex fuscus</i> (rockpool mosquito)	0	0	40	18
Total	823	7	2670	2889



INCURSIONS/INTERCEPTIONS

During September 3 suspected interceptions were detected.

Please note that the interceptions of live unwanted mosquitoes are highlighted in red. Exotic species in general are highlighted in light blue.

11.10.2016 One live *Anisopodidae* was found at C-Force Transitional Facility AKL Mt Wellington in a container with new clothes from China. Information has been forwarded to MPI.

11 and 12.10.2016 At Primor Produce Transitional Facility AKL Mt Wellington approx. 500 dead mainly female Chironomids were found. On the following day after fumigation a badly damaged dead female and dead male *Culex pervigilans* were found as well as a dead *Drosophila sp.* and a headless *Anisopodidae*. Information has been forwarded to MPI.

MOSQUITO DISCUSSION

Florida voters to weigh in on GM mosquito releases: What are the issues?

By Kelly Servick Nov. 7, 2016, 10:45 AM

Voters on the tiny suburban peninsula of Key Haven, Florida, will find an unusual question on their ballot on Election Day:

“Are you in favor of the Florida Keys Mosquito Control District conducting an effectiveness trial in Key Haven using genetically modified mosquitoes to suppress an invasive mosquito that carries mosquito-borne diseases?”



The island suburb of Key Haven, Florida, is the proposed site of Oxitec's first U.S. release of genetically modified mosquitoes.

Behind that question is a ferocious debate about the first proposed release of genetically modified (GM) mosquitoes in the United States. The biotech company Oxitec designed the mosquitoes to carry a gene that causes their offspring to accumulate a toxic protein



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and die before adulthood, which could reduce populations of the *Aedes aegypti* mosquito that transmit the dengue, Zika, and chikungunya viruses.

The U.S. Food and Drug Administration (FDA) greenlighted the project in August, but local opposition has been so strong that the mosquito control board has held off on approving the release. The ballot referenda—one for Key Haven and another for the broader Monroe County—are nonbinding. But three of the five board members have said they will follow the voters' decision. Oxitec has been releasing mosquitoes in other countries since 2009; the Cayman Islands, Malaysia, Brazil, and Panama have all hosted field experiments, and the company has reported greater than 90% reductions in mosquito populations in small test areas. But we don't know everything about the mosquitoes or their potential impact. Here's what the evidence says so far about some concerns Florida residents and mosquito experts have raised.

Could a GM mosquito bite a Floridian?

It's possible. Oxitec aims to release only males, which don't bite, but its sorting system isn't perfect. The company says it ensures that a maximum of 0.2% of the mosquitoes released are female. Over the proposed 26-month trial, that works out to fewer than 62 females mosquitoes per person in Key Haven—2.4 mosquitoes per household per week. (Of course, it's hard to predict how many of them will actually alight on some human skin.)

Could a GM mosquito transfer genes to a human, or make them sick?

It's highly unlikely. As the agency's environmental impact document puts it, "mosquitoes have been feeding on humans and other animals for millennia but there is no evidence of DNA transfer between mosquitoes and humans." There's also "negligible" risk that the GM mosquito saliva would have any toxic or allergenic effects on humans. The two unique proteins it carries—the lethal one that affects gene transcription and a fluorescent protein to distinguish it from wild mosquitoes—were undetectable in the insects' saliva. If they're in there, the levels are likely too low to affect us, FDA concluded.

Could genes from the Oxitec strain spread to the wild mosquitoes?

Yes. In lab experiments, Oxitec's lethal gene isn't 100% lethal. The company has reported that about 4% of offspring survived to become flying adults. That survival rate might be lower in the wild, but if the offspring live long enough and are healthy enough to mate, they will introduce genes from the lab strain into the wild population.

"That's something that does have to be paid close attention to," says entomologist Zach Adelman of Texas A&M University in College Station. When Oxitec stops its releases, mosquito numbers will rebound, and it is not clear whether or how the genes from the release strain would influence the recovered population, including how mosquitos seek out hosts, mate, or lay eggs, for example. Of key concern, he says, is how good Oxitec's strain is at transmitting viruses compared with wild mosquitoes—its so-called vector competence. So far, studies of such changes in a postrelease population are missing, Adelman says.

Simon Warner, Oxitec's chief scientific officer in Abingdon, U.K., says there's no reason to think their lab strain—descendants of mosquitoes collected in Cuba, crossed with a Mexican strain—would be any more dangerous than another strain of *A. aegypti*. "Vector competence is not a question that we've been asked by the [FDA] regulators," he says. "We haven't studied it, because we don't think it's a concern."

Could mosquitoes become resistant to the Oxitec strategy?

Yes, if surviving larvae carried genetic variants that protected them from Oxitec's lethal gene. For example, if a mosquito happened to inherit genes that prevent the lethal protein from accumulating in its body, or that allow it to survive high levels of the protein, these



traits could get selected for over generations. That could mean that in the future, Oxitec's releases would make less of a dent in the population. That scenario is a "theoretical possibility," says insect geneticist Max Scott of North Carolina State University in Raleigh, but "it wouldn't stop me from going ahead and testing it in Florida, because I think this is a very useful technology."

NEW MOSQUITO TECHNOLOGY

Google and Microsoft Take Aim at Deadly Mosquitoes

Tech giants Google and Microsoft are throwing their weight behind controlling insect-borne diseases. Can they hold their own against biotech specialists?

Maxx Chatsko The Motley Fool Oct 30, 2016

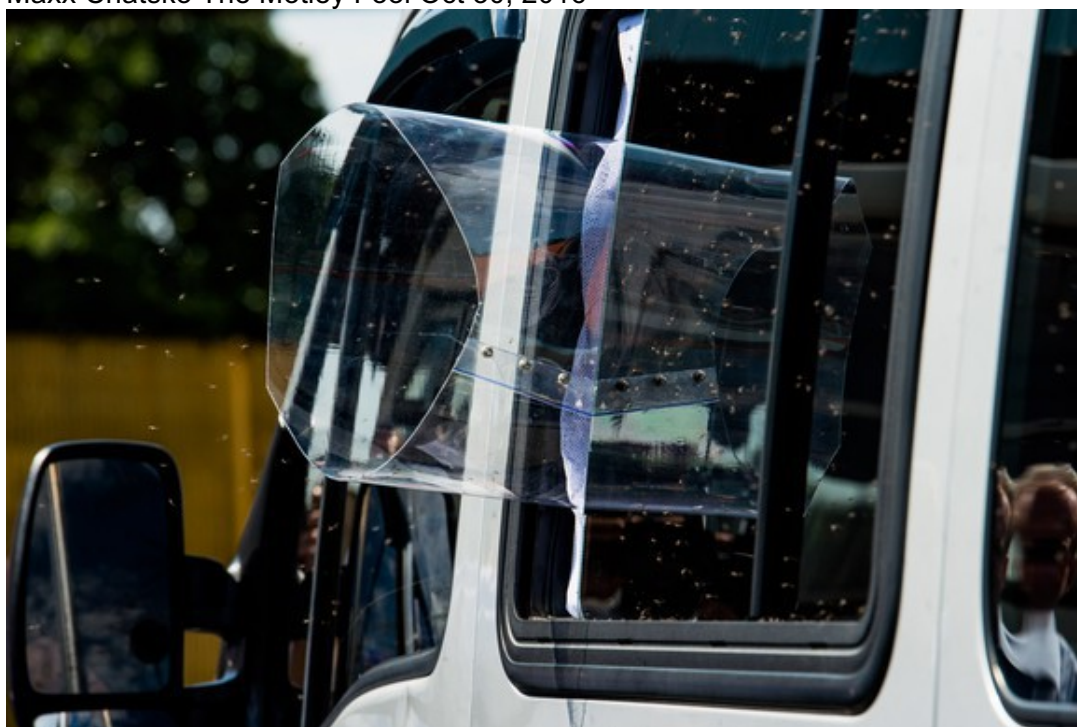


IMAGE SOURCE: OXITEC.

Investors have become accustomed to Alphabet's wacky acquisitions and moonshot projects. The reigning search engine champion has gotten involved in everything from self-driving cars to autonomous flying wind turbines to robot dogs. But its recent initiative is nonetheless raising eyebrows: mosquito control.

While combating the planet's deadliest animal has recently been more closely associated with next-generation biotech Intrexon information-technology companies including Alphabet and Microsoft are beginning to take aim at mosquitoes, too.

As it turns out, their forays into biotech aren't that illogical. In fact, Alphabet and Microsoft may have the perfect tool sets for excelling in next-generation biotech applications -- but only if they recognize some important limitations.

Intrexon has made waves with its self-limiting insect platform, brought under the conglomerate's technology umbrella when it acquired Oxitec in 2015. The idea is pretty simple: genetically engineer insects to contain a lethal gene and release them into the environment; they then mate with wild insects and produce offspring that don't survive to adulthood. That way, the modified gene and the insects are removed from the environment -- all without a single drop of insecticide.

While agricultural pests will find themselves in the crosshairs in the near future, the first



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targets are mosquito species that spread diseases like malaria, Zika virus, and yellow fever, among others. Intrexon is working on gaining regulatory approval in the United States sometime in 2017, but the self-limiting mosquito technology is already being deployed in the Brazilian city of Piracicaba. The company recently announced that a pilot program covering about 5,000 people was expanded to more neighbourhoods, which should give protection to roughly 60,000 individuals.

Why stop there? A mosquito production factory currently under construction will have enough capacity to cover the entire city's population of about 300,000 people. The public-health tool will cost Piracicaba about \$8 to \$10 per person, which, at full coverage, represents an annual revenue stream of about \$3 million for Intrexon. Expand the map to other Brazilian cities and those in the south-eastern United States, and the potential for a sizable business is clearly visible.

The opportunity to create and capture value in public health -- utilizing funds currently allocated for purchasing and spraying insecticides and treating infected citizens -- hasn't gone unnoticed by information-technology giants. Alphabet's in-house biotech venture, Verily, has been quietly developing technology very similar to Intrexon's self-limiting mosquito platform, albeit with a stricter focus on data collection and data-driven decisions. Like Intrexon, Verily plans to release millions or billions of modified mosquitoes by truck, but there are two major differences. Instead of genetically engineering them, Alphabet will infect its mosquitoes with Wolbachia bacteria. While this approach may mollify consumers sceptical about engineered biology, more recent polls (link opens PDF) have shown that 60% of Florida residents surveyed support the release of genetically engineered mosquitoes to combat insect-borne diseases. Only 19% of those polled "strongly opposed" the technology.

Additionally, Oxitec CEO Hadyn Parry has explained that the Wolbachia approach faces a more difficult path forward because the mosquitoes are harder to screen, and releasing even a small fraction of females limits the tool's effectiveness (both platforms aim to release only male mosquitoes). This is the major cause of the differences in field-trial results to date: Intrexon has routinely demonstrated wild-population declines greater than 90%, compared to just 70% for Wolbachia tools.

Another difference between the two approaches: Verily plans to track released mosquitoes using geospatial software. Although it has been quiet on the details, it's conceivable that Alphabet has the muscle to develop an algorithm for just this purpose.

Meanwhile, Microsoft has decided to focus on the data side of mosquito control. That means building a better mosquito trap. Standard traps today cannot single out a specific insect -- they collect flies, moths, and various mosquito species -- and require additional tests to be completed manually. The new mosquito trap being developed as part of Microsoft's Project Premonition, which includes insect-identification processes and behaviour analysis, changes that.

It's selective toward specific mosquito species, automates data collection and assays, and uploads data to the cloud in real time. Researchers are also applying the company's deep knowledge of machine learning and artificial intelligence to further improve the tests. Superior performance, combined with an easier path to market than that of engineered mosquitoes, could allow Microsoft to make a meaningful impact on public health in the very near term.



VECTOR-BORNE DISEASES - OUTBREAK NEWS

South Pacific



Pacific syndromic surveillance report – **Week 43, ending 30 October 2016**

Dengue: Solomon Islands: An outbreak of dengue was declared for Honiara and Guadalcanal on 8 October 2016 and expanded to include other provinces on 19 October. A total of 1,718 cases of suspected dengue have been reported in Honiara, Guadalcanal, Malaita, Isabel and Choiseul (506 additional cases since last report) from epidemiological week 33 to week 42 (15 August to 23 October 2016). Among the National Syndromic Surveillance System sites, 299 cases were reported in Week 42. An additional 207 cases have been reported by non-sentinel surveillance sites that have been activated for enhanced surveillance.

From Week 33 to Week 42, 706 rapid diagnostic tests have been conducted, and 220 were dengue NS1 positive (31%). In addition, 22 patients with negative NS1 tests were DENV IgM positive/IgG negative and are also considered as recent infections (total 242 positive; total 34% of those tested). A total of 54 cases were tested in Week 42; 12 were DENV NS1 positive and 4 positive, DENV IgG negative (16 overall in Week 42).

Dengue virus serotype 1 (DENV1) was confirmed in 3 out of 17 blood samples that were sent for confirmation in Pathology Queensland Laboratory.



Public Health Surveillance
Information for New Zealand Public Health Action



S/R

MONTHLY NOTIFIABLE DISEASE SURVEILLANCE REPORT - SEP 2016

Chikungunya fever: Five cases of chikungunya fever (4 confirmed and 1 under investigation) were notified in September 2016. Twenty-three cases have been notified in the year to date compared to 47 at the same time in the previous year. Cases were in the 20–29 years (3 cases), 40–49 years and 70 years and over (1 case each) age groups. All cases reported overseas travel during the incubation period for the disease, and countries visited were India (3 cases), Fiji and Tonga (1 case each).

ZIKA

HOW WIDESPREAD IS THE OUTBREAK?

Active Zika outbreaks have been reported in at least 59 countries or territories, most of them in the Americas, according to the CDC. Brazil has been the country most affected.

Africa:

Cape Verde

Americas:

Anguilla, Antigua and Barbuda, Argentina, Aruba, The Bahamas, Barbados, Belize, Bolivia, Bonaire, Brazil, British Virgin Islands, Cayman Islands, Colombia, Costa Rica, Cuba, Curaçao, Dominica, Dominican Republic, Ecuador, El Salvador, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Nicaragua, Panama, Paraguay, Peru, Saba, Puerto Rico, Saint Barthelmy, Saint Lucia, Saint Martin, Saint Vincent and the Grenadines, Saint Eustatius, St. Maarten, St. Kitts and Nevis, Suriname, Trinidad and Tobago, Turks and Caicos, United States, U.S. Virgin Islands, Venezuela.



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Asia:

Singapore, Thailand, Philippines, Malaysia, Vietnam, Indonesia, Brunei, Burma (Myanmar), Cambodia, Laos, Maldives, Timor-Leste (East Timor)

Oceania/Pacific Islands:

American Samoa, Fiji, Kosrae, Federated States of Micronesia, Marshall Islands, New Caledonia, Papua New Guinea, Samoa, Tonga.

Expect Zika virus to reach India and Africa, medical research charity warns

Sarah Boseley, 26 October 2016 The Guardian [excerpts]

Wellcome Trust chief says knowledge of Zika remains basic, while Gates Foundation cautions seasonal lull in epidemic should not prompt complacency:

The Zika virus is likely to spread to India and the continent of Africa, according to the director of the Wellcome Trust, a medical charity deeply involved in research to try to limit the damage.

"I think we can anticipate global spread," said Jeremy Farrar, speaking to the Guardian alongside Sue Desmond-Hellmann, the chief executive officer of the Bill and Melinda Gates Foundation. "Given the [*Aedes aegypti*] mosquito's availability across the world, I think the spread will next be across Asia and I think we really have to be prepared for it spreading in Africa. I don't see any reason why it wouldn't."

"You can anticipate reports from Vietnam, from Indonesia, from India. I don't think we're even at the start of the Zika knowledge base yet," said Farrar.

If Zika goes off the radar, it is because of the seasonal nature of the infections, when the mosquitoes are breeding, added Desmond-Hellmann, not because the epidemic is anywhere near its end. "The seasonality of this epidemic shouldn't make us complacent," she said. "I think that's really important. The other thing we shouldn't underestimate is a generation of families who are now going to see this impact with their children. It feels like a tip of an iceberg that we've seen in terms of the devastation on those children and their families."

DENGUE AND CHIKUNGUNYA

India

"Lazy mosquitoes" mean more women than men get chikungunya - scientists

Daily Mail REUTERS 8 November 2016 By Magdalena Mis

LONDON, Nov 7 (Thomson Reuters Foundation) -Chikungunya, which is commonly transmitted by the daytime-biting *Aedes aegypti* mosquito, can cause debilitating symptoms including fever, headache and severe joint pain lasting months.

A new study, published in the Proceedings of the National Academy of Sciences, analysed a 2012 outbreak of chikungunya in the Bangladeshi village of Palpara, around 100 km (60 miles) from the capital Dhaka.

The study said more than a quarter of cases were spread within the same household, while half of infections occurred in households less than 200 metres away, creating small clusters of the disease.

Because infected mosquitoes did not like to travel far, Bangladeshi women, who spend two thirds of the day at home, were 1.5 times more likely to develop chikungunya than men who spend less than half their time at home during the day.

"It appears that mosquitoes are very lazy," Henrik Salje, the research leader from Johns Hopkins University Bloomberg School of Public Health, said in a statement.

"They bite someone in a household and get infected with a virus and then hang around to bite someone else in the same home or very nearby. The extra time women spend in and around their home means they are at increased risk of getting sick."



The disease occurs in Africa and Asia, but cases have also been reported in Europe and the Americas.

The study said while there was no vaccine and little treatment available for diseases such as chikungunya, Zika, dengue and yellow fever, which are all transmitted by the *Aedes aegypti*, knowing where outbreaks were likely to be clustered could help in slowing them.

"We don't yet have a very good toolbox for fighting these diseases," Salje said.

"But once we do, this research tells us how we could trigger a response and tailor our interventions - particularly in rural communities - to those at the greatest risk, and those people are the ones who spend the most time in and around their homes."

The researchers said that coils designed to repel mosquitoes did not help stop chikungunya transmission in the Palpara region. (Reporting by Magdalena Mis, editing by Emma Batha. Please credit Thomson Reuters Foundation, the charitable arm of Thomson Reuters, that covers humanitarian news, women's rights, corruption and climate change. Visit news.trust.org)

Mumbai worst hit by dengue this year in Maharashtra

941 cases so far; most cases of chikungunya are from Pune

By: Express News Service | Mumbai November 8, 2016



According to an epidemiology officer in BMC, the cases of dengue are now on a steep decline. (Photo for representational purpose)

MAHARASHTRA HAS reported 2,280 cases of chikungunya and 5,653 cases of dengue — both diseases spread by the same vector, the *Aedes aegypti* mosquito — between January and October 31. Mumbai has recorded the highest number of dengue cases, while Pune city has recorded the most cases of chikungunya in Maharashtra.

VACCINATION NEWS

Malaria immunity: Researchers discover key to long-lasting protection and potential vaccine targets

November 7, 2016 Houston Methodist Science Daily

A set of immune proteins has been discovered that facilitate long-lasting immunity against malaria. In a new study, researchers report that elevated production of specific proteins regulating the immune system within 24 hours of infection was required for a resilient and sustained anti-malaria immunity in mice. Houston Methodist researchers have discovered a set of immune proteins that facilitate long-lasting immunity against malaria. In a study recently published in *Immunity* (online Oct. 25), researchers reported that elevated production of specific proteins regulating the immune system within 24 hours of infection



was required for a resilient and sustained anti-malaria immunity in mice.

"Nearly half a million people die from malaria every year," said Rongfu Wang, Ph.D., director of the Center for Inflammation & Epigenetics at Houston Methodist Research Institute. "This is in part due to the lack of an effective malaria vaccine and a limited understanding of the body's immune response during infection. We have identified the immune system pathways activated during infection and potential targets for a malaria vaccine."

Using mouse models, the research team led by Wang carefully dissected pathways in the immune system to identify sensors in the genes that recognize malaria DNA and RNA and activate interferon type I signaling following malaria infection. The increased production of interferon type I proteins within 24 hours of infection were essential for initial and long-term malaria immunity.

Current antimalarial drugs vary by country and are not 100 percent protective, according to the World Health Organization (WHO). The Centers for Disease Control reports that the malaria causing parasite, *Plasmodium falciparum*, has developed resistance to nearly all of the available antimalarial drugs, including chloroquine.

Wang hopes that his team's findings will help researchers understand how lethal malaria blocks type I interferon signaling and how regulating such signaling will aid in the development of effective anti-malaria vaccines for long-lasting malaria protection.

Zika breakthrough as researchers reveal antibody treatment that could protect infected pregnant mothers and their babies

- Research 'proof of principle that Zika virus during pregnancy is treatable'
- Tested on pregnant mice, the treatment reduced levels of the virus in the mothers, and also protected their pups from the ravages of the virus
- Researchers say it could be ready for human trials in a year

By MARK PRIGG FOR DAILYMAIL.COM 8 November 2016

A new study of the Zika virus in mice raises hope for a way to protect pregnant women and their babies from the possible repercussions of being infected, U.S. researchers said on Monday. The experimental treatment is derived from antibodies taken from the blood of people who have recovered from Zika infections.

Tested on pregnant mice, the treatment reduced levels of the virus in the mothers, and also protected their pups from the ravages of the virus.

Researchers hailed the study as 'proof of principle that Zika virus during pregnancy is treatable'. Tested on pregnant mice, it reduced levels of the virus in mothers, and protected pups.

Zika, spread primarily through mosquitoes, has been known to cause birth defects in infants whose mothers have been infected during pregnancy.

'This is proof of principle that Zika virus during pregnancy is treatable, and we already have a human antibody that treats it, at least in mice,' said Dr. Michael Diamond of Washington University School of Medicine in St. Louis, co-author of the study published on Monday in the journal *Nature*.

In the study, the researchers screened 29 Zika-specific antibodies taken from the white blood cells of patients who recovered from Zika infections caused by strains in Asia, Africa and the Americas.

They found one, called ZIKV-117, that neutralized all of the strains.

The team then tested the antibodies in pregnant mice one day before and a day after infection with Zika.



A researcher holds a tray of Zika virus growing in animal cells at Washington University School of Medicine in St. Louis. There is no treatment available to block Zika virus in a pregnant woman from infecting her fetus and potentially causing severe birth defects. But researchers have identified a human antibody that prevents, in pregnant mice, the fetus from becoming infected and the placenta from being damaged." A researcher holds a tray of Zika virus growing in animal cells at Washington University School of

Medicine in St. Louis. There is no treatment available to block Zika virus in a pregnant woman from infecting her fetus and potentially causing severe birth defects. But researchers have identified a human antibody that prevents, in pregnant mice, the fetus from becoming infected and the placenta from being damaged.

'The antibody reduces virus in the mother and also in the fetus, and it protects against placental and fetal damage,' said Dr. James Crowe of Vanderbilt University School of Medicine.

'These naturally occurring human antibodies isolated from humans represent the first medical intervention that prevents Zika infection and damage to fetuses,' said Crowe.

'We're excited because the data suggests we may have antibody treatments in hand that could be developed for use in pregnant women,' he said.

ZIKA infection could cause lasting infertility and lead to men's testicles shrinking, medical researchers warned in a recent study (stock image)

Crowe said he intends to keep pressing ahead, licensing the product to commercial partners.

He believes it can be ready for human trials in nine to 12 months, 'if we go flat out.'

Still, Dr. Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, which funded the research, cautioned that not everything that works in mice works in people.

However, he said: 'The very fact that you did get a positive result in the mouse model is a pretty good impetus to take it to the next step, which could be a non-human primate, and see if the same things works in a non-human primate.'

Vanderbilt is in the process of licensing the antibody to privately held Ridgeback Biotherapeutics, which has begun ramping up production of the antibodies in a facility designed to meet FDA manufacturing specifications.

'The antibody reduces virus in the mother and also in the fetus, and it protects against placental and fetal damage,' said Dr. James Crowe of Vanderbilt University School of Medicine.

'The antibody reduces virus in the mother and also in the fetus, and it protects against placental and fetal damage,' said Dr. James Crowe of Vanderbilt University School of Medicine (pictured).

As a treatment, antibodies for Zika could be given to pregnant women as infusions to offer temporary protection for the fetus.

The protection would last about three weeks, before another infusion is needed.

Getting support for a treatment for use in pregnant women may prove difficult, however.



'With many things outstanding in our knowledge gap with Zika, therapeutics that would be used in pregnant women to benefit an infected fetus is high risk and there is a lot of development work to be done to ensure those drugs could be used safely,' Rick Bright, who is leading Zika medical countermeasure development for Office of the Assistant Secretary for Preparedness and Response and BARDA, said in an emailed statement.

Bright said the agency might be interested in supporting the treatment in later-stage development, after it has been proven successful in early-stage studies.

'It's important to keep in mind that 80 percent of people do not even know that they have been infected with Zika, so we are focused first on vaccines to prevent infection, diagnostics to determine if someone has been infected, and screening to prevent the spread of the virus through the blood supply,' he said.

NEWS OF CONTROL MEASURES

Ecologists raise alarm over releases of mosquito-killing guppies

By Kelly Servick Oct. 25, 2016 , Science



For decades, health officials have used guppies (*Poecilia reticulata*) for mosquito control.

H. Krisp

The little guppy *Poecilia reticulata* has developed a big reputation. For decades, the fish has been championed as a mosquito fighter and dumped into ponds and ditches to eat up the insect's larvae. But among scientists, it has a different reputation—as an invasive species with a remarkable

ability to reproduce and spread. Now, as health officials in regions facing mosquito-borne viruses like Zika consider expanding use of these predatory fish, ecologists are urging them to think twice. In a paper published online today in *Biology Letters*, a group of ecologists argues that the guppies—and other nonnative fish used for mosquito control—haven't actually proven very effective mosquito fighters, but are known to pose ecological risks. "It all sounds like it's magical—you put the guppies in, they eat the mosquitoes, everything is fine," says Rana El-Sabaawi, an ecologist at the University of Victoria in Canada and lead author on the new paper. "Our concern is that you have a potentially invasive species that is being introduced haphazardly."

Larva-gobbling guppies may have been cutting-edge technology for U.K. colonialists aiming to rid the empire of mosquitoes at the turn of the century. But to El-Sabaawi, the strategy seems so old-fashioned that she was surprised to find out large-scale projects are underway. While "randomly Googling guppies," she came across news reports from Pakistan that health officials had released thousands of the fish into the ponds and sewers of Karachi in 2013 to fight the transmission of dengue fever. And in a widely circulated news video documenting Zika control efforts in Brazil, El-Sabaawi was troubled by footage of a municipal government worker apparently "wandering around with a bunch of guppies and basically just introducing them in ditches."

That's unnerving for El-Sabaawi and her co-authors because they know guppies are efficient invaders. They're hearty and fertile, surviving in relatively polluted water, reproducing often, and giving birth to fast-growing, live young. A combination of accidental



aquarium releases and mosquito control projects have spread the species from its native range in the Caribbean and the northern coast of South America to at least 69 countries, according to a 2011 survey.

And several studies suggest that introduced guppies threaten biodiversity. Researchers in Hawaii found that guppies released in the 1920s drove down native fish populations, perhaps by competing with them for food and living space, and had likely changed the cycle of nutrients in water: Guppy-rich areas showed increased levels of dissolved nitrogen—from ammonium in fish urine and gill excretions—which, in turn, stimulated algae growth. (Another fish commonly used in mosquito control—*Gambusia affinis*—has also been associated with declines in native fish species.)

The authors also question whether guppies are reliable mosquito slayers. Studies that back their effectiveness tend to have flaws, they say. Lab tests often starved the fish before exposing them to a diet of exclusively mosquito larvae. And studies in the wild have been small and poorly designed.

That critique may be correct, but dismissing guppies as a control strategy is counterproductive, says John Hustedt, senior technical officer of the non-profit Malaria Consortium in Phnom Penh, which has been releasing the fish into water storage jars in rural households to combat dengue fever and other mosquito-transmitted diseases. Hustedt hopes that a study his group has just completed will provide new evidence for the guppies' value. Preliminary results showed that reductions in the number of adult mosquitoes were two times greater in households with guppies than in those without.

"If someone comes out and says, 'Actually it doesn't work and it's going to cause you a problem,' that can decrease the chance that the government would be more open to trying [guppy release] on a large scale," he says.

As for ecological risks, guppies in isolated containers may be less likely to spread than those dumped into urban sewers and ditches. But Hustedt also questions the distinction between native and non-native for a species that is already so ubiquitous. The guppies used in his project were found in a farm in a province outside Phnom Penh; their original source is unknown. "It seems to me that they've been here for quite a long time, and they're already in the environment," he says.

Although the benefits and risks of guppy releases may be highly context-dependent, some researchers are simply taking a hard line. "The use of fish to control mosquito disease vectors should be abandoned by authorities," says Valter Azevedo-Santos, an ichthyologist at São Paulo State University in Botucatu, Brazil, who co-authored a letter objecting to the strategy published in *Science* earlier this year. He believes resources would be better spent on other control measures: insecticides, sanitary measures such as eliminating standing water in homes, and even the experimental release of genetically engineered mosquitoes to spread a lethal gene. As health workers cast around for ways to combat Zika, he hopes this paper will give them pause. "This mismanagement must be abandoned, or new fish invasions will occur in the near future," he says. "This is a special moment."

VECTOR NEWS

Australia

Australians waiting for the Tiger mosquito

October 31, 2016 by Andrew Trounson Phys.org

A swarm of mosquitoes is an accident waiting to happen. But perhaps the bigger issue facing Australia isn't so much whether the mosquitoes here are swarming, but rather whether a certain "tiger" mosquito lurking just to the north in the Torres Strait ever makes



it to the Australian mainland.

A female mosquito lays hundreds of eggs at a time, and within ten days newly minted adults are leaving their stagnant water homes to buzz around our ears and ankles. Victoria is braced for swarms of the things after late winter floods and warming spring temperatures created perfect breeding conditions, prompting public health warnings and forcing councils to start spraying breeding sites.

But as Victorians stalk their bedrooms and hallways armed with insecticide cans, they should count their blessings that for now at least the *Aedes albopictus* mosquito remains in the Torres Strait.

Nicknamed "Tiger" because of the bright white stripe on its back and the white bands on its legs, *albopictus* is a biting mosquito that can carry a variety of tropical diseases. And it doesn't mind a bit of chilly whether. Which means, if it crossed to the mainland it could cover much of the country, making once exotics tropical diseases into more common temperate ones.

"*Albopictus* is one of our main quarantine pests," says Professor Ary Hoffmann of the Bio21 Institute at the University of Melbourne. "Its ability to withstand colder weather has allowed it to invade Europe and North America." And as far as Professor Hoffmann is concerned, despite our quarantine efforts it is likely a matter of when, not if, the Tiger makes it to the mainland. It was first reported in the Torres Strait islands in 2005.

At the moment the rise in mosquito numbers in Victoria has prompted health warnings about comparatively rare mosquito-borne diseases such as the non-fatal Ross River Fever and Barmah Forest viruses, and the potentially fatal Murray Valley Encephalitis. But if *albopictus* arrives here Professor Hoffmann says we will have to add dengue fever, which is currently just limited to northern Queensland, as well as the zika and chikungunya viruses.

Many mosquito breeds tend to be more active at dawn and dusk when the air is more humid and the insects are at less risk of drying out. But Professor Hoffmann says *albopictus* doesn't mind a bit of daylight. It means that *albopictus* is active and biting in the middle of the day. "It is regarded as a massive irritant as well as being a vector for diseases, making it a real nuisance for outdoor activities."

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Professor Hoffmann and colleagues have modelled the possible reach of *albopictus* if it does arrive, and they predict it could become widespread as far south as northern Tasmania. "It will go a long way," he says

Aedes albopictus is an active biter during the middle of the day, making it an especial nuisance. Credit: Rick Miller/Flickr

While their modelling suggests it would be concentrated on the coastal fringes of the continent, its spread so far in North America and elsewhere suggests forms of this mosquito could also travel further inland in Australia.

Dengue fever is spreading rapidly elsewhere around the world as a direct result of *albopictus* migrating into more temperate climes and the ongoing spread of its sister species *Aedes aegypti*. Since 1970 the number of countries where dengue is endemic, that is it is present, has risen from just nine to now 100. And there are a rising number of outbreaks.

The World Health Organization says 2015 was a particularly bad year with outbreaks of over 100,000 cases in the Philippines and Malaysia, representing a 60 per cent and 16 per cent increase respectively on the previous year. The number of cases in Brazil trebled to over 1.5 million, and Delhi in India reported its worst outbreak since 2006 with 15,000 cases. In 2014, China's Guangdong province near Hong Kong reported its worst outbreak with 45,000 reported cases and six confirmed deaths.



WHO now warns that Europe is also at risk of possible outbreaks. Cases of local transmission were reported in France and Croatia in 2010.

The main vector of dengue has been *Aedes aegypti* mosquito, which is limited to tropical climates including northern Australia. But the ability of *albopictus* to withstand cold temperatures means the disease is now spread more widely. It is believed to have travelled into northern climes by breeding in water puddles caught inside imported tyres and bamboo. Its eggs can survive temperatures below freezing.

Dengue fever has similar symptoms to mosquito-borne malaria, but is less fatal. Dengue can cause severe flu-like symptoms, headaches and joint pain, as well as vomiting and rashes. Severe dengue fever, known as dengue haemorrhagic fever, is present in most Asian and Latin American countries, and with proper medical attention fatality rates from severe dengue can be kept below 1 per cent. It is estimated that every year about 500,000 people are infected with severe dengue fever requiring hospitalisation, of which about 2.5 per cent die. In contrast, in 2015 there were 438,000 deaths from malaria.

"Dengue isn't as deadly as malaria, but while the incidence of malaria is going down the incidence of dengue fever is going up, and the resulting economic impact can be massive because dengue can still really knock people around."

"We hope *albopictus* won't hit the mainland but I think it is inevitable that it will at some stage, it is just a matter of time. And when it does you will certainly notice it."

The odd temporary swarm of mosquitoes may be the least of our problems.

DID YOU KNOW?

Iceland only has one mosquito -- and it lives in a jar of alcohol

CHRIS WELLER NOV 4, 2016

Visit Denmark, Greenland, Scotland, or Norway, and you're bound to encounter at least one Draculaic pest. In nearby Iceland, not so.

The tiny country is among a handful of others that claim no mosquito population whatsoever. That is, unless you count the one that has lived in a jar of alcohol at the Icelandic Institute of Natural History ever since the 1980s, when a scientist captured it in an aeroplane. "I chased it around the cabin until I got it," Gisli Mar Gislason, a University of Iceland biologist, told the New York Times. "It's the only mosquito I've ever found in Iceland." There are a couple theories why the nation is mosquito-free.

In much of the Arctic, Greenland especially, there are numerous shallow ponds where mosquitoes lay eggs that hatch into larvae, which eventually become blood-hungry mosquitoes. In Greenland, the insects can get so big that they can take down baby caribou. Those shallow ponds are important because they are the first to heat up and thaw once the temperature begins to rise. "The mosquitoes go through their development faster which means there are fewer days to be eaten by a predator," Dartmouth ecologist Lauren Culler told Motherboard last year. "Lab studies, field studies, and population models show that a warming climate means more mosquitoes survive until adulthood."

Iceland has no such lakes in which the mosquitoes can breed. And as the Times reports, the country's ecology is such that it sees three main freezes and thaws throughout the year. Mosquitoes may simply not have enough time to mature in the warmer temperatures before it gets cold again. In case you needed another reason to be concerned about climate change, scientists suspect that Iceland might not be mosquito-free forever. A warming planet means the insects would have a better chance at reproducing without cold weather getting in the way. That would drop the list to just three places without mosquitoes: New Caledonia, French Polynesia, and The Seychelles.

For everyone who doesn't want to move: Invest in repellent.