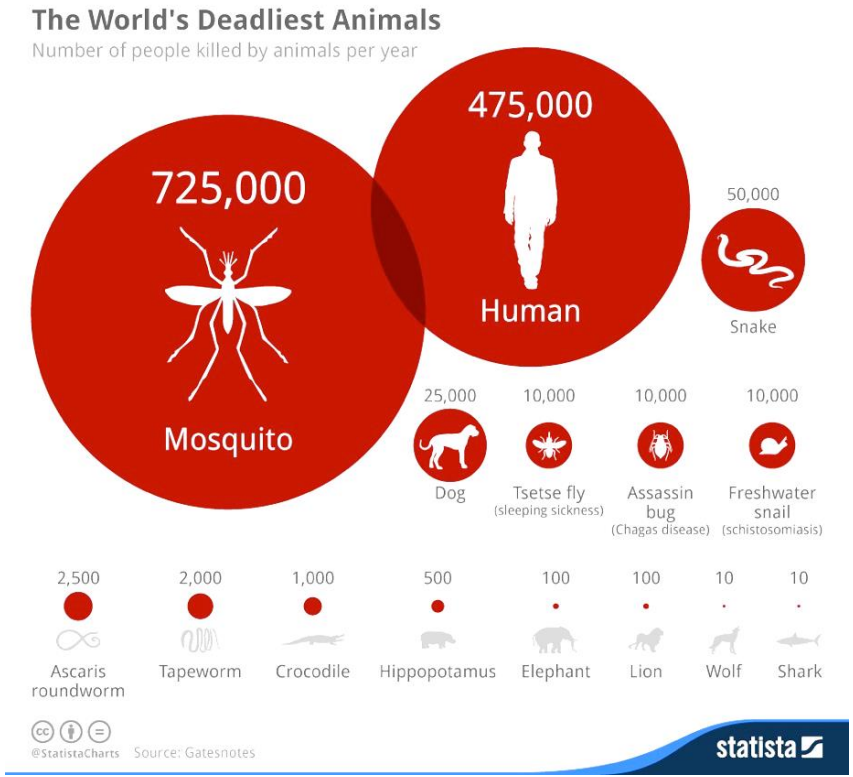
Oxitec Mosquito Vector Control Technology

A New Paradigm to combat Dengue, chikungunya and the emerging threat of Zika

Mosquitoes – The World’s Deadliest Animal

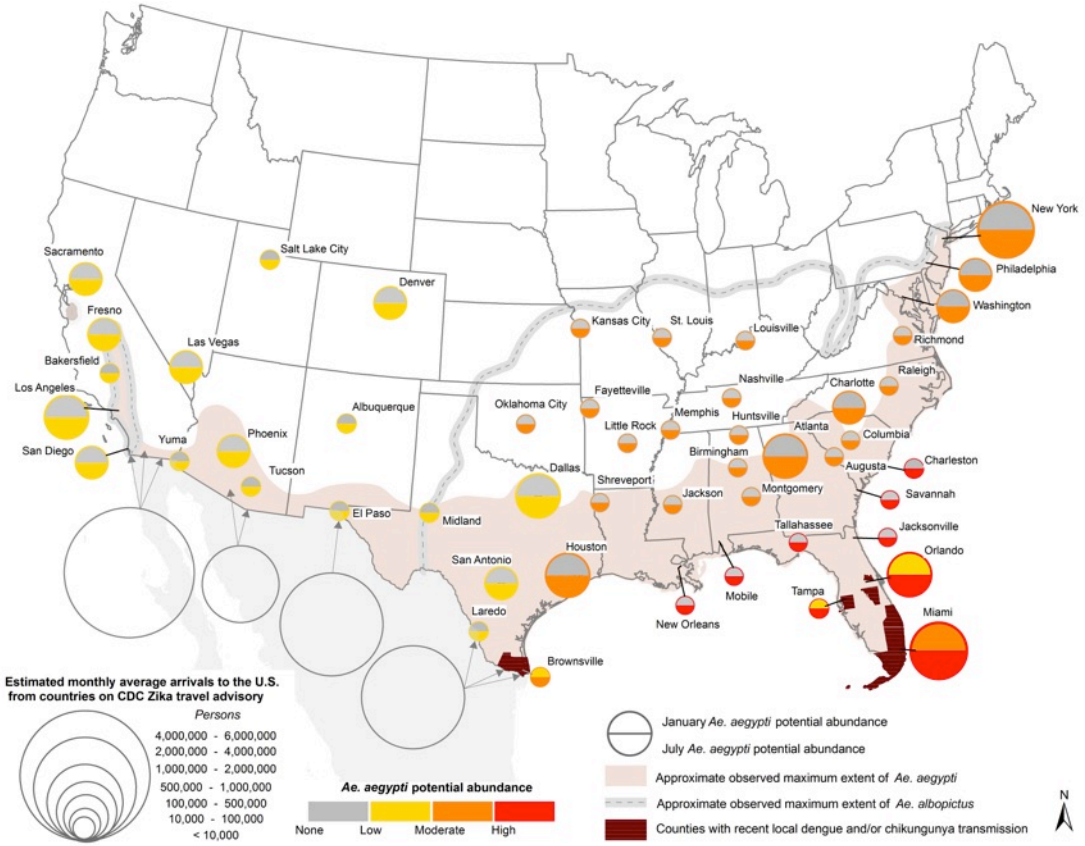


The Impact of Zika on the Health System the Environment, National Economy, and International Travel Is Growing

Pics 1-4: Lianne Milton/Panos Pictures for The Washington Post

Ernesto Benavides/Agence France-Presse — Getty Images

March 2016 research article regarding Zika virus pandemic



http://currents.plos.org/outbreaks/article/on-the-seasonal-occurrence-and-abundance-of-the-zika-virus-vector-mosquito-aedes-aegypti-in-the-contiguous-united-states/

USA

	Travel related	Local transmission	Pregnant	Guillain-Barré
US mainland	388		33	1
Of which Florida:	84		5	
Territories	3	500	48	4

CDC 20th April 2016

Governor Scott directed the State Surgeon General to issue a Declaration of Public Health Emergency for the counties of residents with travel-associated cases of Zika.

The Declaration currently includes the 15 affected counties:

Alachua	**Brevard**	**Broward**	**Clay**	**Collier**
Hillsborough	**Lee**	**Miami-Dade**	**Orange**	**Osceola**
Palm Beach	**Polk**	**Santa Rosa**	**Seminole**	**St. Johns**

Example of Mosquito Eradication in a School Room

The Current Insecticide Model for Mosquito Vector Control

Challenges

- Inadequate control
- Insecticide resistance
- Public concerns about health effects and impacts on the environment and other species

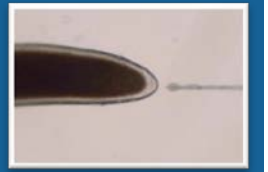
Oxitec Development History

Pink bollworm

OX513A

Brazil factory

2002/4	2005/7	2008/9	2010/12	2013	2014	2015
Company formed as spin out from Oxford University Technology platform developed and exemplified in both agricultural and mosquito species	Global first release of a GE insect Pink Bollworm (marker only) in USA Mosquito development spurred by Gates funding	First outdoor release of OX513A mosquito in the Caymans Environmental Impact Statement in the USA – environmentally preferred solution	First outdoor release of OX513A in Brazil First agricultural collaborations Oxitec Brazil established	Outdoor trials of OX513A in Panama and Brazil First larger scale urban project starts in Jacobina, Brazil First agricultural strains into development Medfly, DBM & Olive fly	Oxitec Brazil National Biosafety approval in Brazil Panama outdoor trial USDA approval for agriculture trial in USA Brazil approval for agricultural trial	First direct projects OX513A Brazil WHO VCAG recommendation for large scale Oxitec acquired by Intrexon to accelerate development



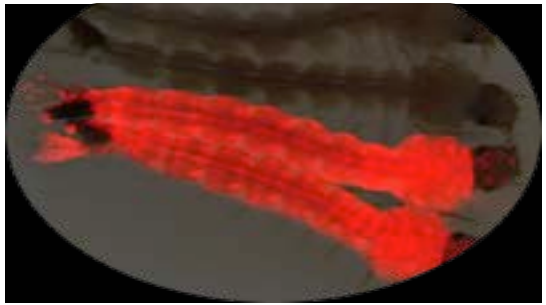
WORLD ECONOMIC FORUM
Technology Pioneer 2008

How Oxitec's Technology Works

Inject genes into insect egg

Self Limiting Gene

- Inherited and offspring do not survive to adulthood
- Repressed with an antidote during male insect production, allowing low cost multiplication
- After releases stop, genes do not persist in the environment



Fluorescent Marker Gene

- Fluorescent protein detected by special light
- Monitoring of pest population suppression
- Releases adjusted in nearly real time
- 'Track and trace' capability

Oxitec male mosquitoes are produced for release and mate with pest females

Offspring die before they can reproduce and transmit disease

Key Benefits

Efficiency

- Targeted delivery: males are attracted to wild females whose offspring die at the larvae and pupal stage (consuming resources along the way)
- Insects and offspring contain a marker gene that is easy to monitor - “track and trace”
- Local deployment by local people

Safety

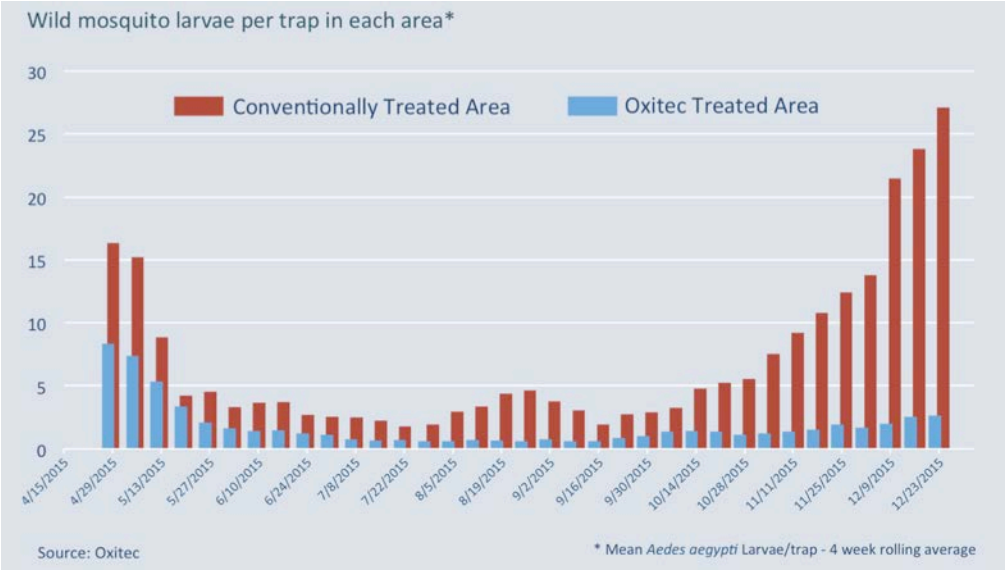
- Male-only releases (only female mosquitoes bite)
- Genetic change is not toxic or allergenic

Environment

- Species-specific pest control, no off-target effects
- Reduction of *Aedes* does not impact insects or other animals that may feed on *Aedes*
- Neither insects nor progeny persist over time in the environment

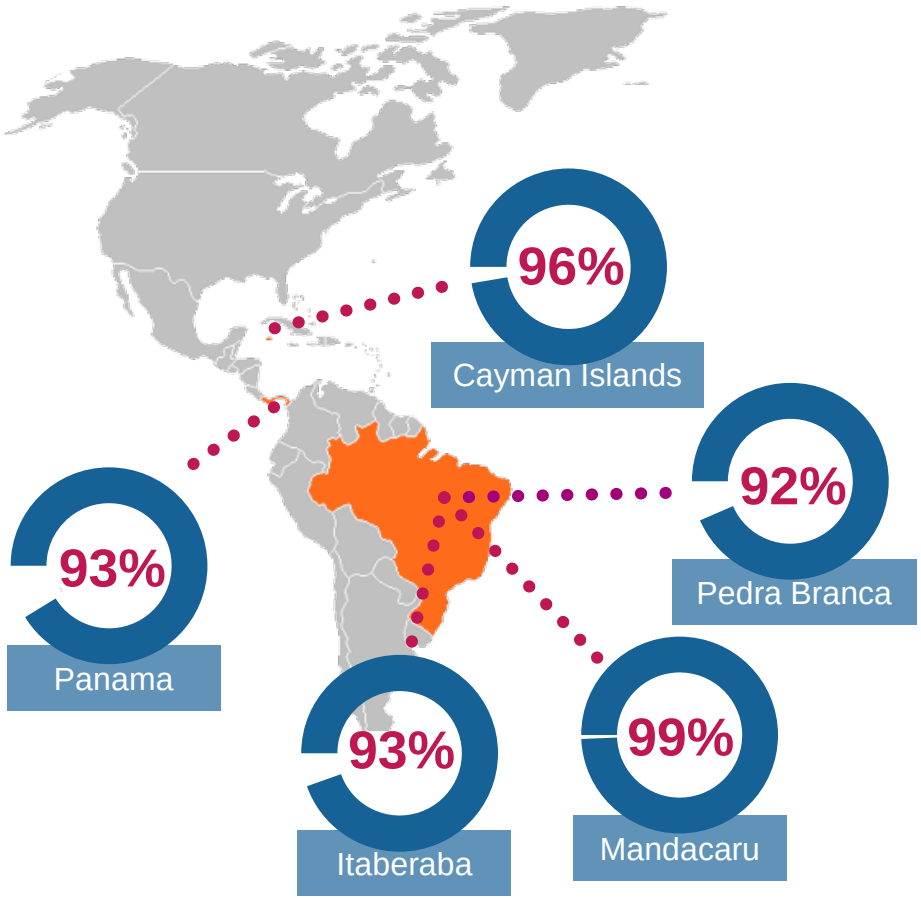
Promising Suppression Results Ongoing in Piracicaba, Brazil

Reduction in wild mosquito larvae by 82%



- Oxitec and Piracicaba City Hall are expanding the ‘Friendly *Aedes aegypti* Project’ in Piracicaba, Brazil
- Oxitec is planning a new mosquito production facility in Piracicaba

Oxitec Mosquito Trial Results Summary



Up to 90+% suppression of *Aedes aegypti* in selected field trials and projects

Cayman: Mosquito Research Control Unit
Brazil: University of São Paulo and Moscamed
Panama: The Gorgas Institute

Attacking Global Epidemics at the Source: Brazil Case Study

Early 1970s

- No Aedes aegypti
- No dengue

Recent years

- 1.5 million cases of dengue in 2015, up 176% y-o-y with 811 dengue-related deaths
- First local transmission of chikungunya in 2014 and Zika virus entered in 2015
- Over $1 billion spent on the dengue vector control program annually

Oxitec in Brazil – 2011 to Present

- Trials 2011–13
- National Biosafety Approval granted 2014
- Oxitec do Brasil established
- In April 2015, Piracicaba became world's first municipality to release Oxitec mosquitoes operationally – project now being expanded

96% of local Piracicaba residents **support** the Oxitec program

Brazil press describe Oxitec solution as *Aedes aegypti* do bem: **'the good mosquito'**

Oxitec in Florida

2009

A New York woman caught dengue while vacationing in Key West. The first case of dengue in the area since 1933. Dengue was transmitted to an additional eighty-seven people in the area between ’09 and ’10.

2010

The Key West Mosquito Control District contacts Oxitec to explore new solutions to control the Aedes Aegypti mosquito.

2011

Oxitec applies to the Food & Drug Administration for permits to hold a field study in Key West, Fla.

2012

2013

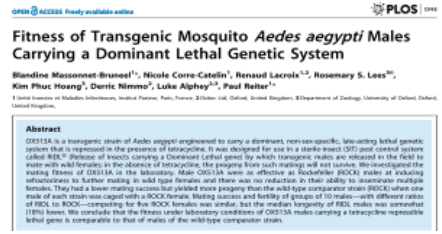
Key West proposes using Oxitec genetically modified mosquito to stop the *Aedes Aegypti* mosquito

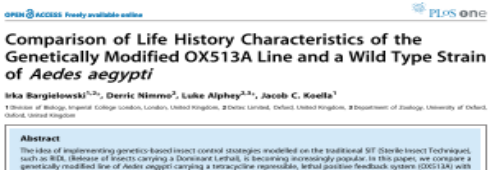
2014

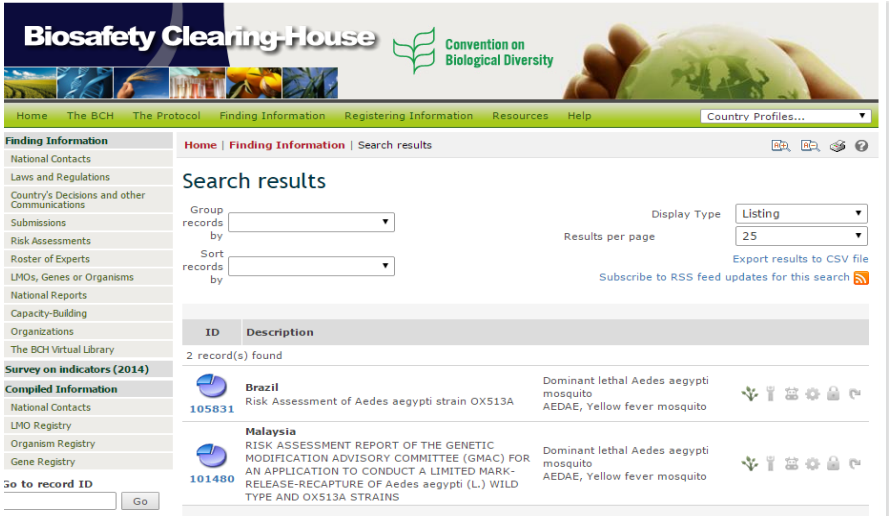
2015

The Food & Drug Administration issues a finding of “No Significant Environmental Impact” from a proposed field study.

2016





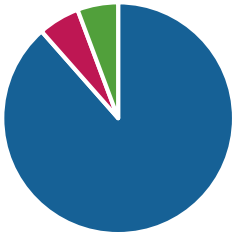


Rigorous evaluation by independent experts

- Detailed regulatory dossiers submitted and approved in multiple countries
- National Biosafety Commission in Brazil approved Brazil-wide use in April 2014
- FDA-CVM publication of preliminary EA with FONSI March 2016
- WHO recommendation for OX513A March 2016

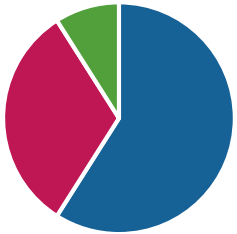
Strong Consumer Support

Piracicaba, Brazil



■ Support ■ Neutral ■ Oppose

Florida, USA



■ Support ■ Neutral ■ Oppose

+ Pre-zika outbreak surveys above show strong support
+ Post-zika Purdue study 78% support in USA*

* https://www.purdue.edu/newsroom/releases/2016/Q1/survey-public-supports-use-of-gmo-mosquitoes-to-fight-zika-

Production and Release

More than 130 million Oxitec mosquitoes released worldwide

Global Supply Vision

Global facilities produce eggs- highly durable and can ship globally

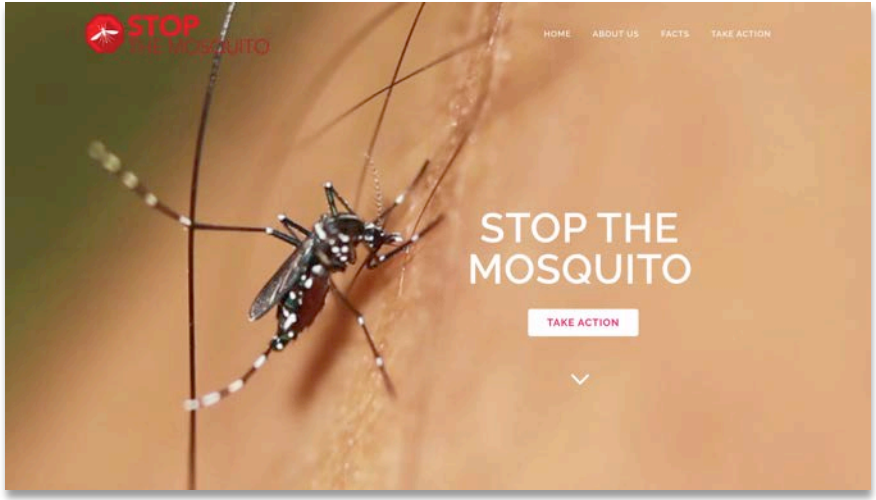
Regional and local facilities prepare pupae and distribute.

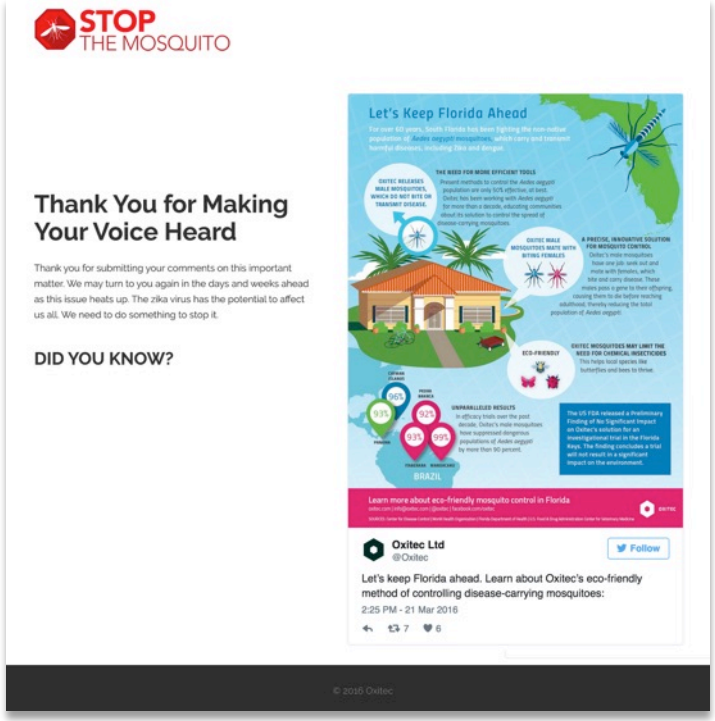
Summary

- Oxitec now wholly-owned by Intrexon, a U.S. company with the expertise, scale, and determination to execute on significant global issues
- Oxitec has had field success supressing the pest populations of *Aedes aegypti* of up to 90+%
- Current results have proven entomological end points
- CTNBio in Brazil have approved the Oxitec mosquito (OX513A) from an efficacy and environmental safety perspective for commercial application
- FDA-CVM have issued a preliminary Finding of No Significant Impact
- WHO have made a recommendation for pilot deployment
- Oxitec has solutions that apply to *Aedes albopictus* as well
- The technology is compatible with current interventions and would be synergistic with future vaccine and therapeutic drug interventions

StopTheMosquito.com

STOP THE MOSQUITO





QUESTIONS?