

# Area-wide management of fruit flies in a tropical mango growing area using the Sterile Insect Technique: From a research project to an operational program

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# Fruit Flies Situation in México (2011)

- » Free of *Ceratitis* y *Bactrocera*
- » Presence of *Anastrepha*
- » AW-SIT MOSCAMED Program
- » National program MOSCAFRUT
  - > AW-SIT from North to South
- » Metapa mass-rearing facilities
  - > Sterile medflies
  - > Sterile *Anastrepha ludens* and *A. obliqua* flies
  - > Parasitoid *Diachasmimorpha longicaudata*









# Medfly current status

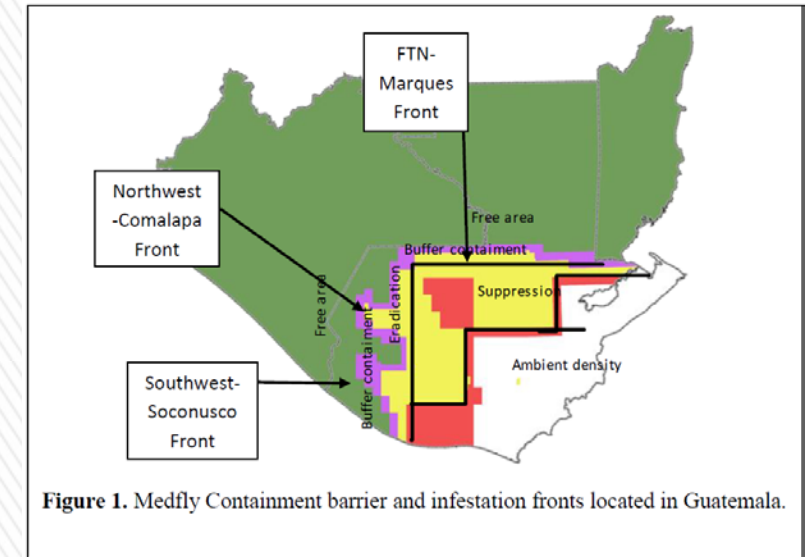
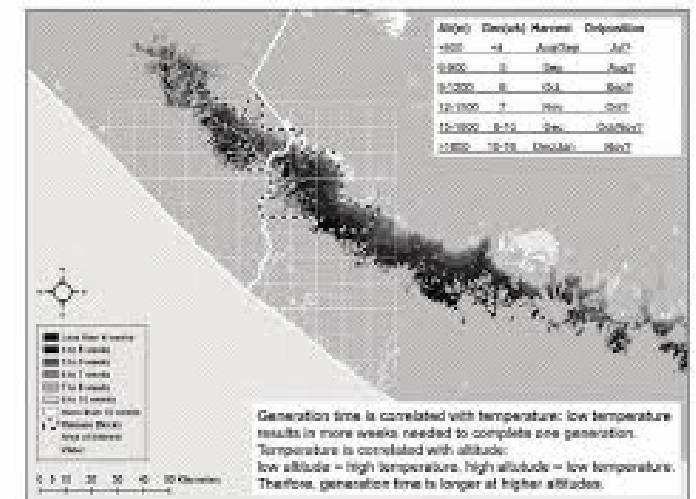


Figure 1. Medfly Containment barrier and infestation fronts located in Guatemala.



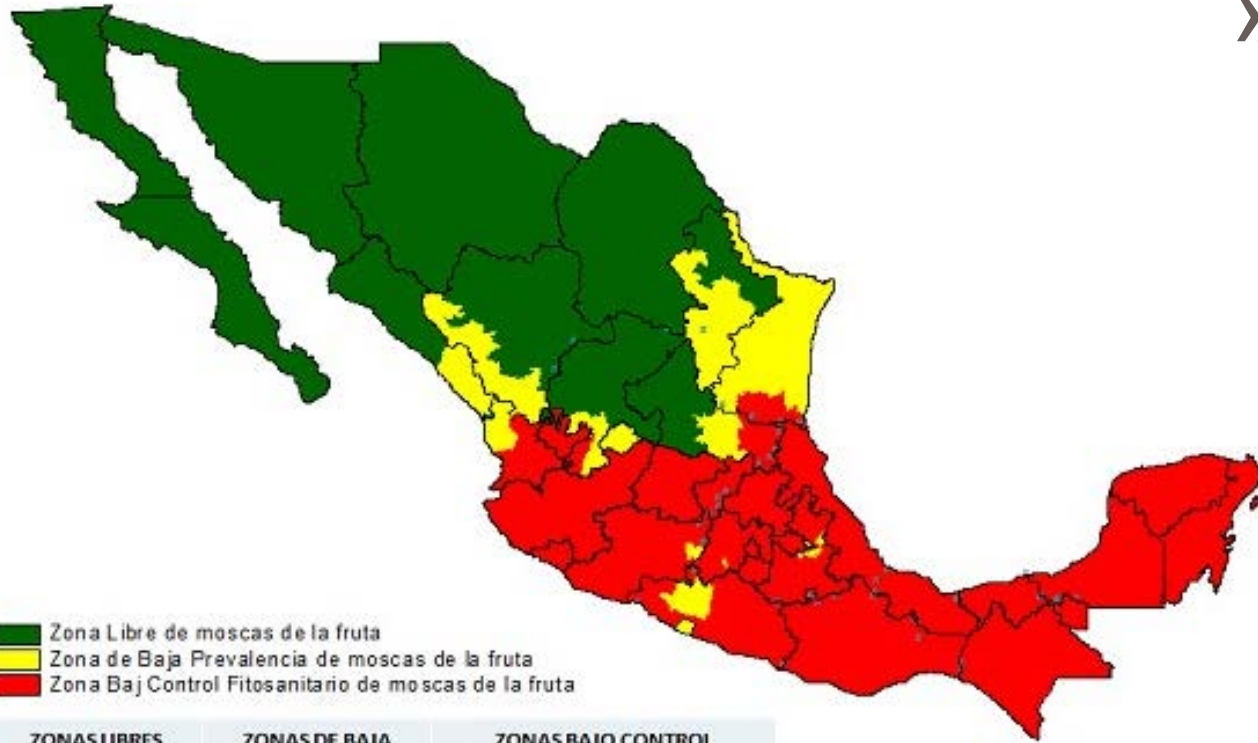
# Native fruit flies *Anastrepha spp*

- National Program since 1992 following MOSCAMED strategy from North to South.
- MOSCAFRUT: IPM + SIT+ ABC: MOSCAFRUT facility produces *A. ludens*, *A. obliqua* and *D. longicaudata*





# Achievements and challenges



ZONAS LIBRES	ZONAS DE BAJA PREVALENCIA	ZONAS BAJO CONTROL FITOSANITARIO
50.25 %	10.44 %	39.31 %
984,479 km <sup>2</sup>	204,497 km <sup>2</sup>	770,272 km <sup>2</sup>

» In 2011, after 20 years:

- > 50% free, 10% low prevalence, 40% under phytosanitary control
- > Is feasible to continue with the same approach?
- > What can be done in the mango growing areas?

# Research Project Aim

Validate SIT and ABC as elements of AW-IPM in a mango growing area

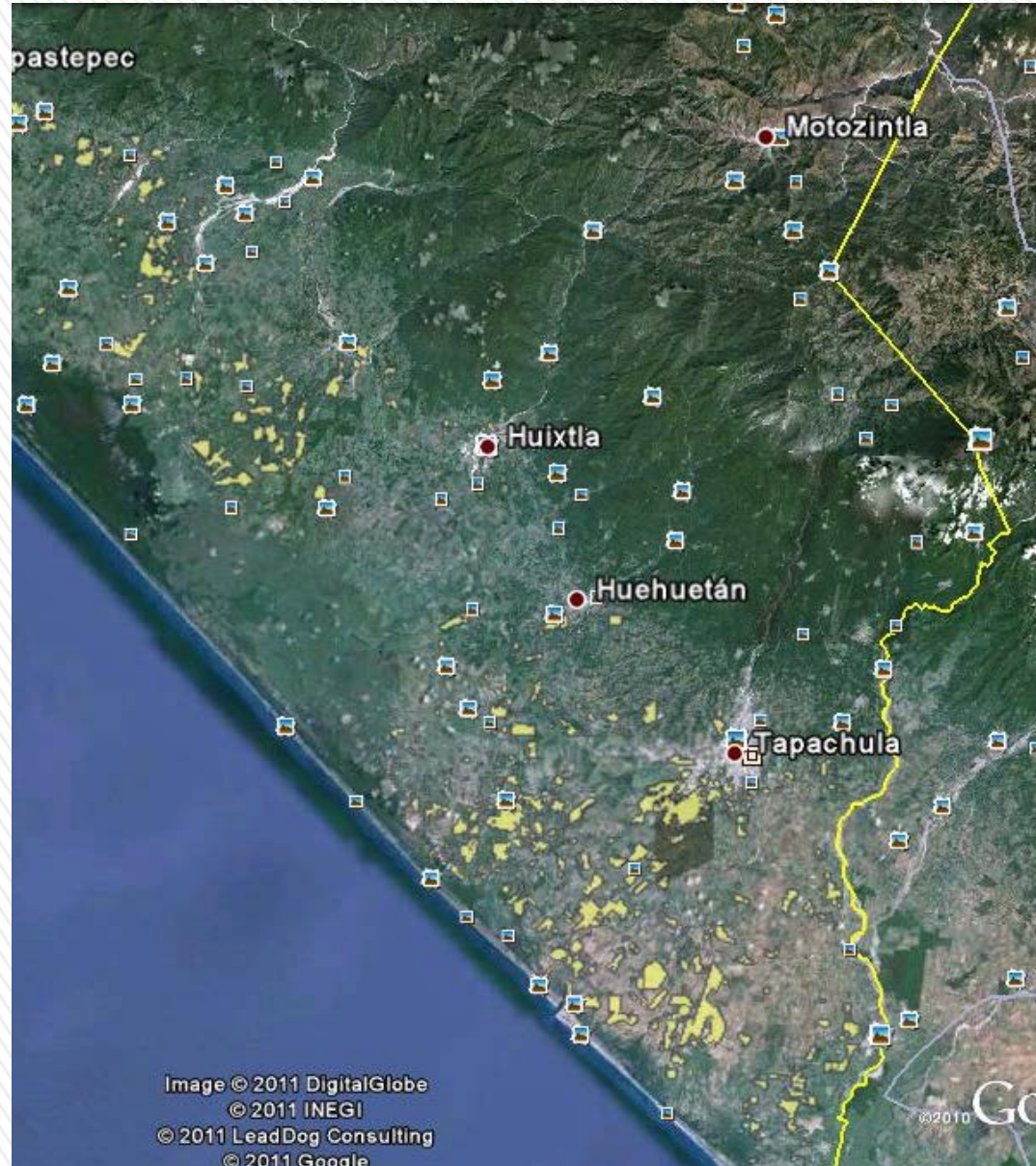
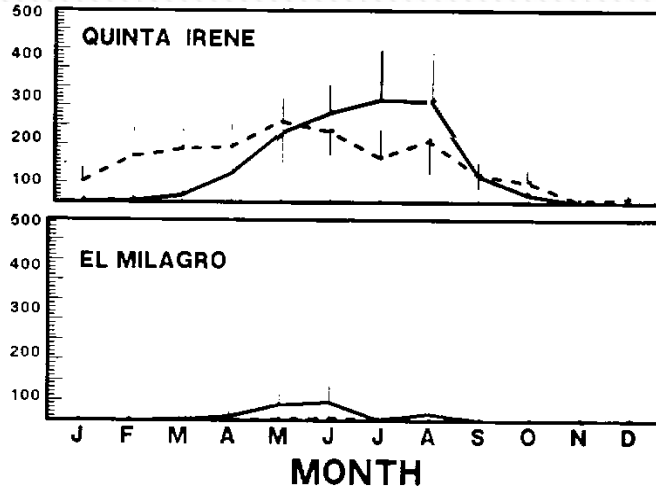
» Soconusco region

- > Environmental and host conditions favor high populations levels
- > Assumption: refugee areas



# Knowledge of Populations

1980's



2007-2011

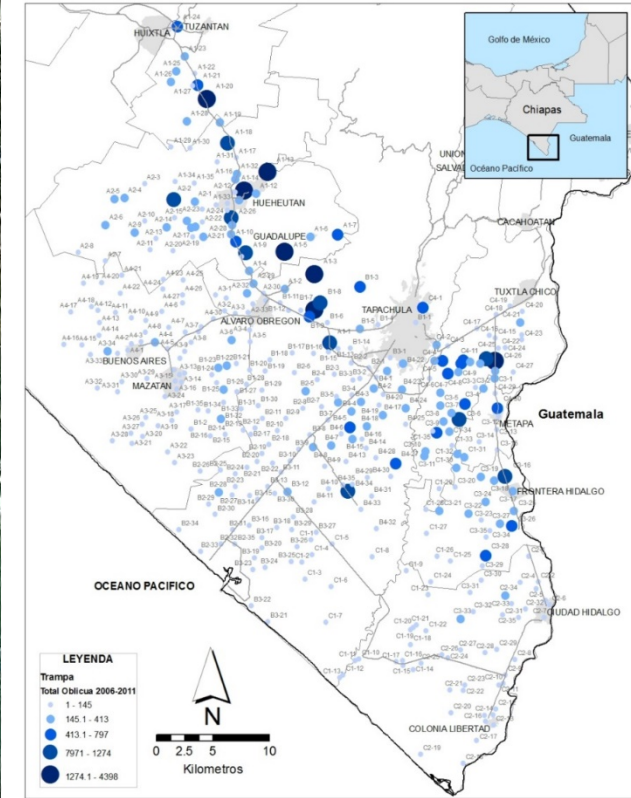
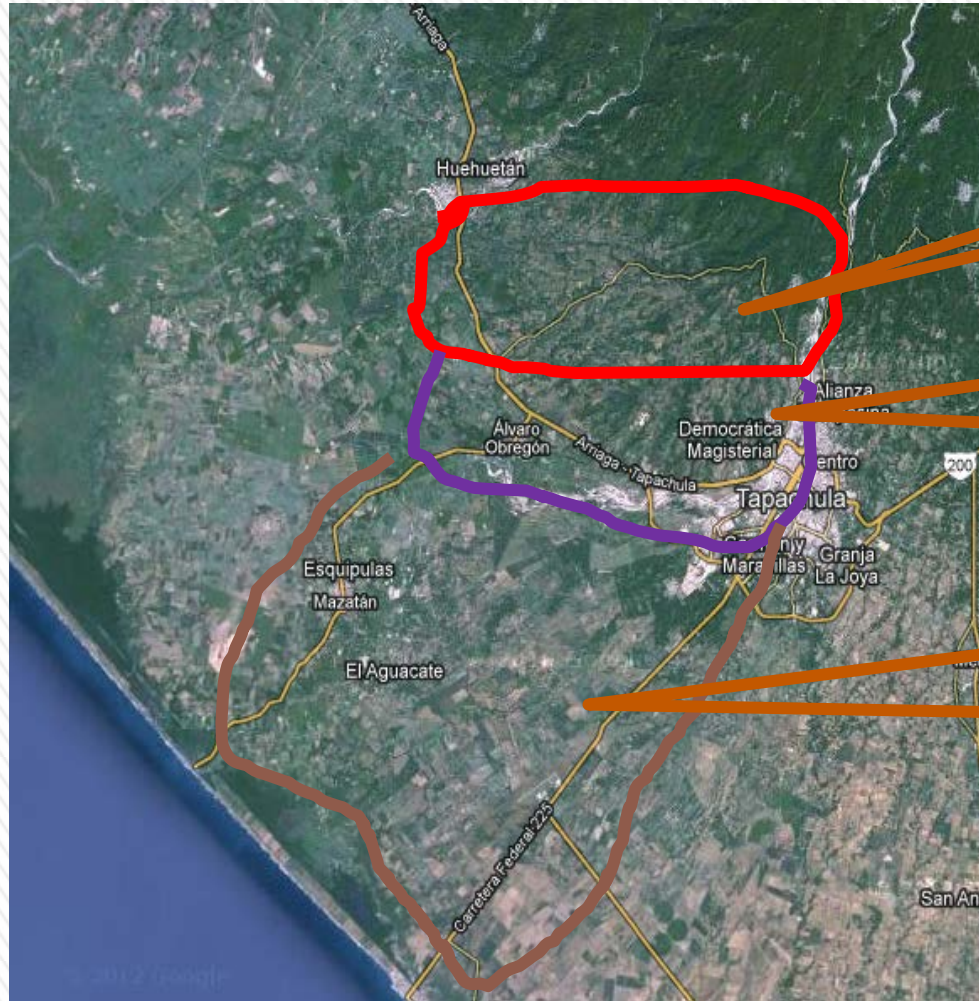


Image © 2011 DigitalGlobe  
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 © 2011 LeadDog Consulting  
 © 2011 Google



# AW-IPM General Strategy



## Refugee zone

- Population monitoring

## Buffer zone

- Population monitoring
- ABC + SIT

## Mango orchards zone

- Population monitoring
- IPM: Bait stations or mass trapping
- GF-120 sprays

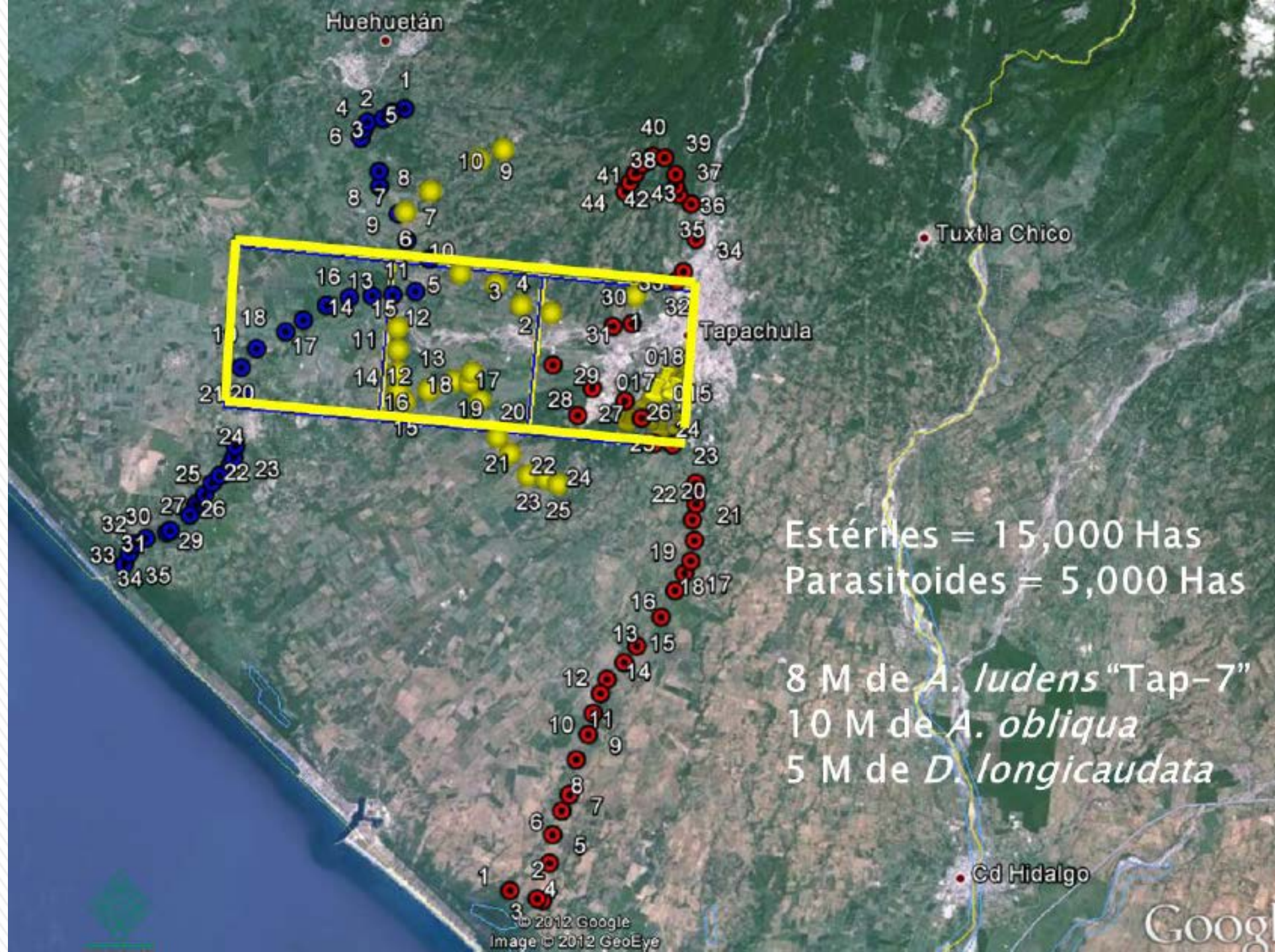
1<sup>st</sup> year= Current management

2<sup>nd</sup> year= AW-IPM

3<sup>rd</sup> year= AW-IPM - adjustments

4<sup>th</sup> year= Analysis and technology transfer

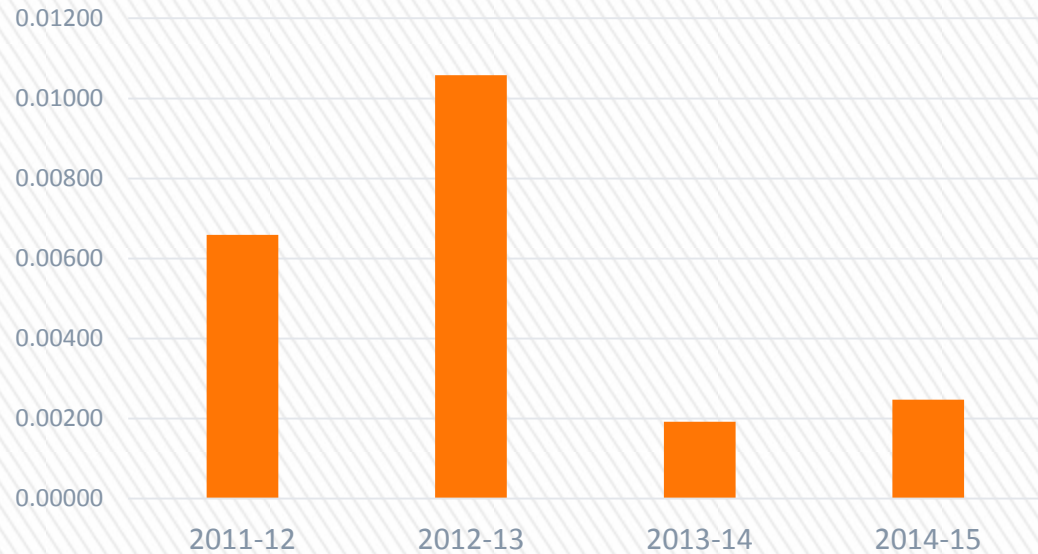






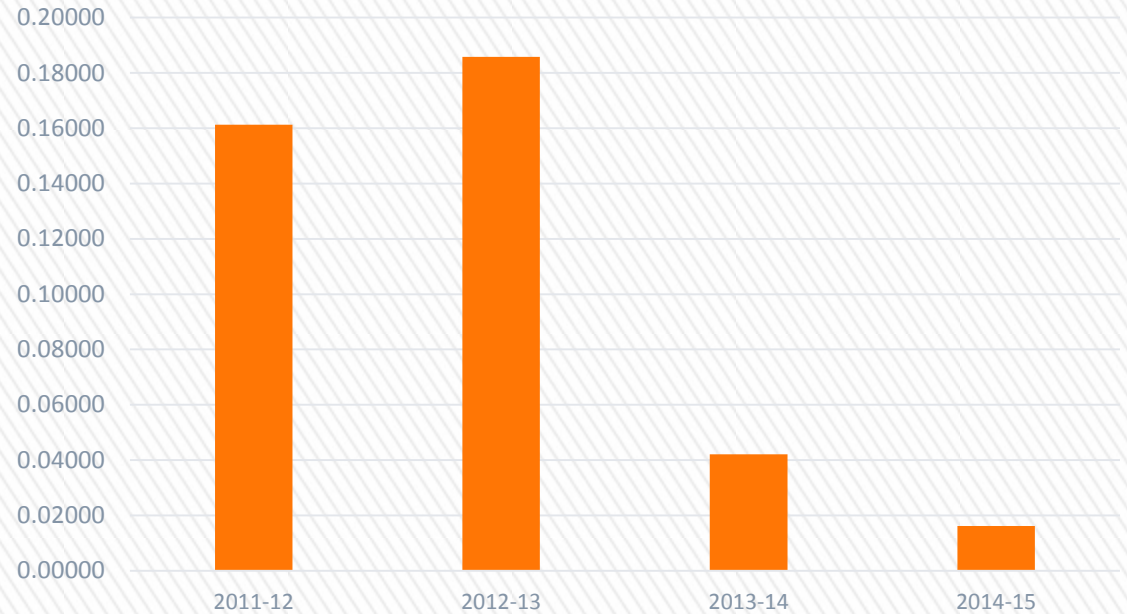
# Captures of wild flies

FTD *A. ludens* wild females  
Release block



Suppression = 76 - 81%

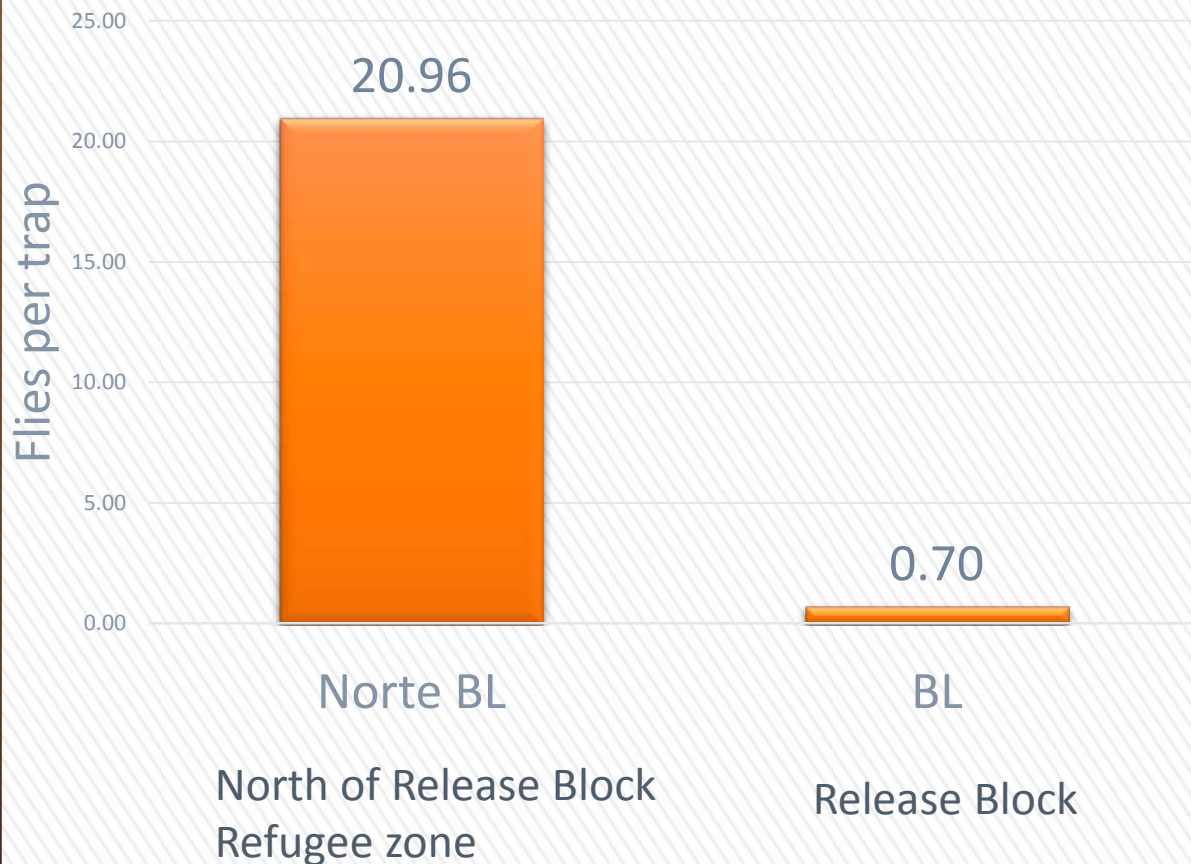
FTD *A. obliqua* wild females  
Release block



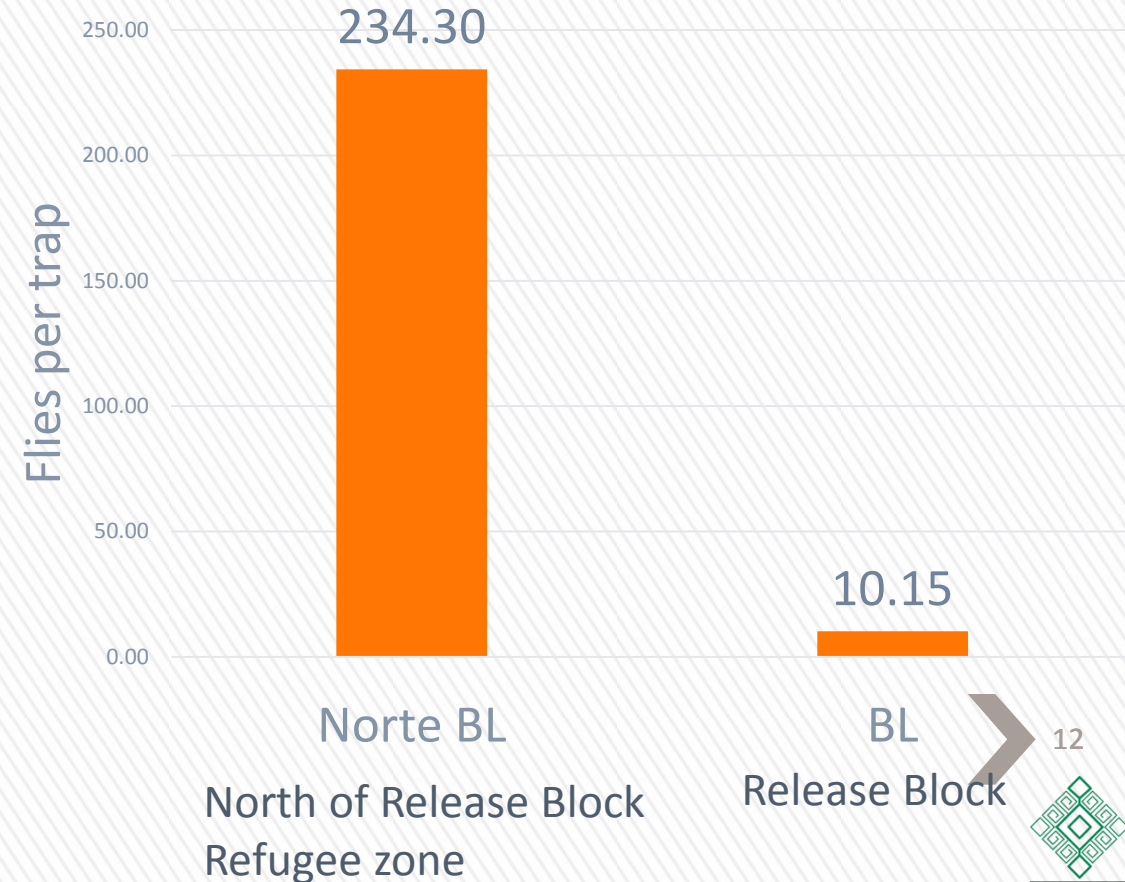
Suppression 89 – 91%

# Comparison between captures in the release block and at the North on the third year (2014).

*Anastrepha ludens* wild females



*Anastrepha obliqua* wild females



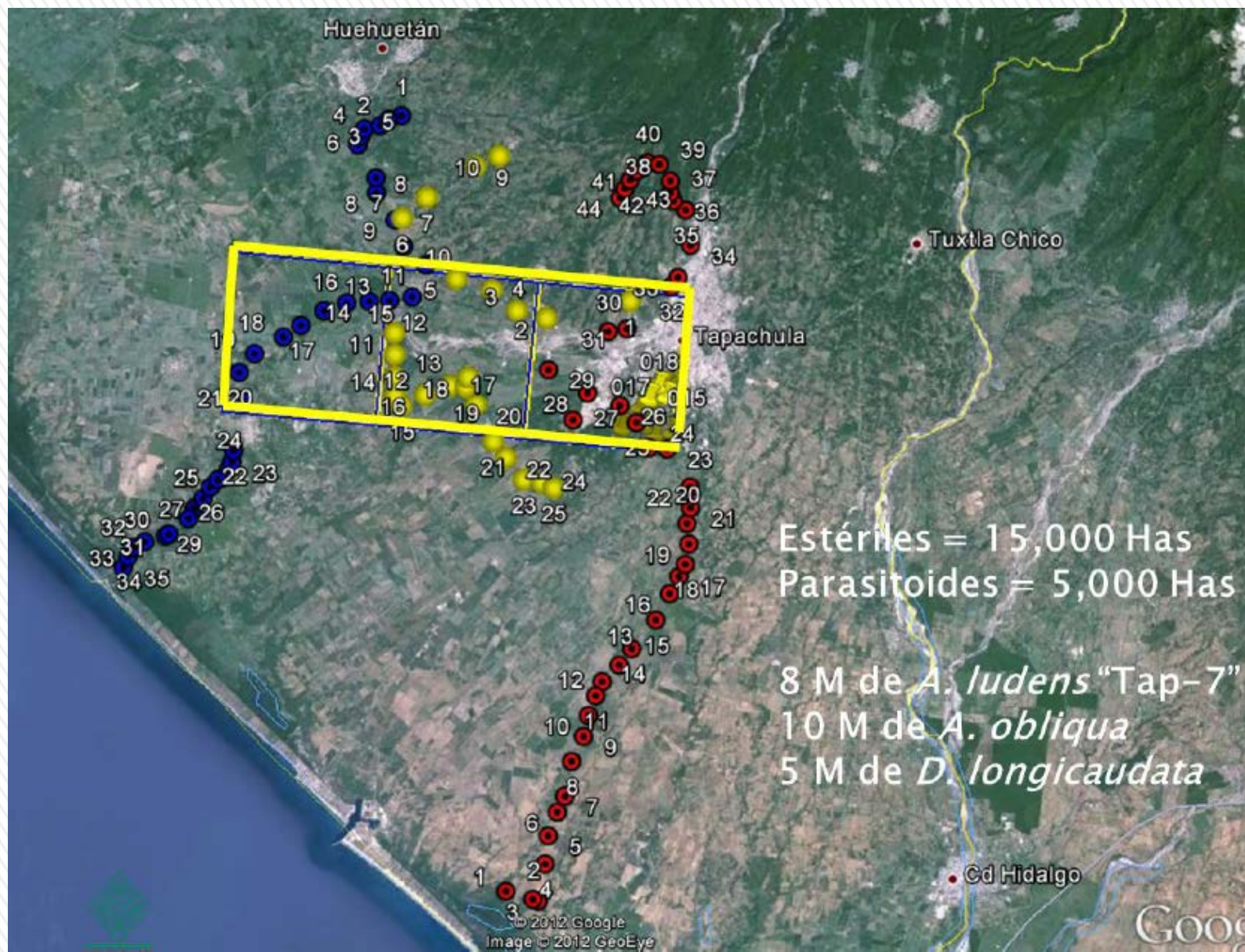


# Sterile : Wild Ratio (males)

SEASON	<i>A. ludens</i>			<i>A. obliqua</i>		
	Sterile	Wild	S/W	Sterile	Wild	S/W
2012-13	7,936	31	256	6,956	618	11
2013-14	15,058	29	519	5,929	145	41
2014-15*	2,131	10	213	575	25	25

\* First 5 weeks

# Aumentative Biological Control





# ABC

- Percent parasitism significantly increased
- Fruit size was a key factor y determining percent parasitism

	Flies	Parasitoids	Parasitism (%)	Samples with pstods (%)
Zone without releases	468	5	1.05	3.8
Zone with releases	5271	947	16.5*	27.7

\* 15.2% *D. longicaudata*

# Infested batches

2010	164
2011	177
2012	154
2013	151
2014	143
2015	143

	<i>A. obliqua</i>	<i>A. ludens</i>	% <i>A. ludens</i>
2012	21	390	94.9
2013	9	401	97.8
2014	6	236	97.5
2015	3	241	98.8

PLANT RESISTANCE

## Susceptibility of 15 Mango (*Sapindales: Anacardiaceae*) Cultivars to the Attack by *Anastrepha ludens* and *Anastrepha obliqua* (Diptera: Tephritidae) and the Role of Underdeveloped Fruit as Pest Reservoirs: Management Implications

M. ALUJA,<sup>1,2</sup> J. ARREDONDO,<sup>3</sup> F. DÍAZ-FLEISCHER,<sup>3,4</sup> A. BIRKE,<sup>1</sup> J. RULL,<sup>1</sup> J. NIOGRET,<sup>5</sup> AND N. EPSKY<sup>5</sup>

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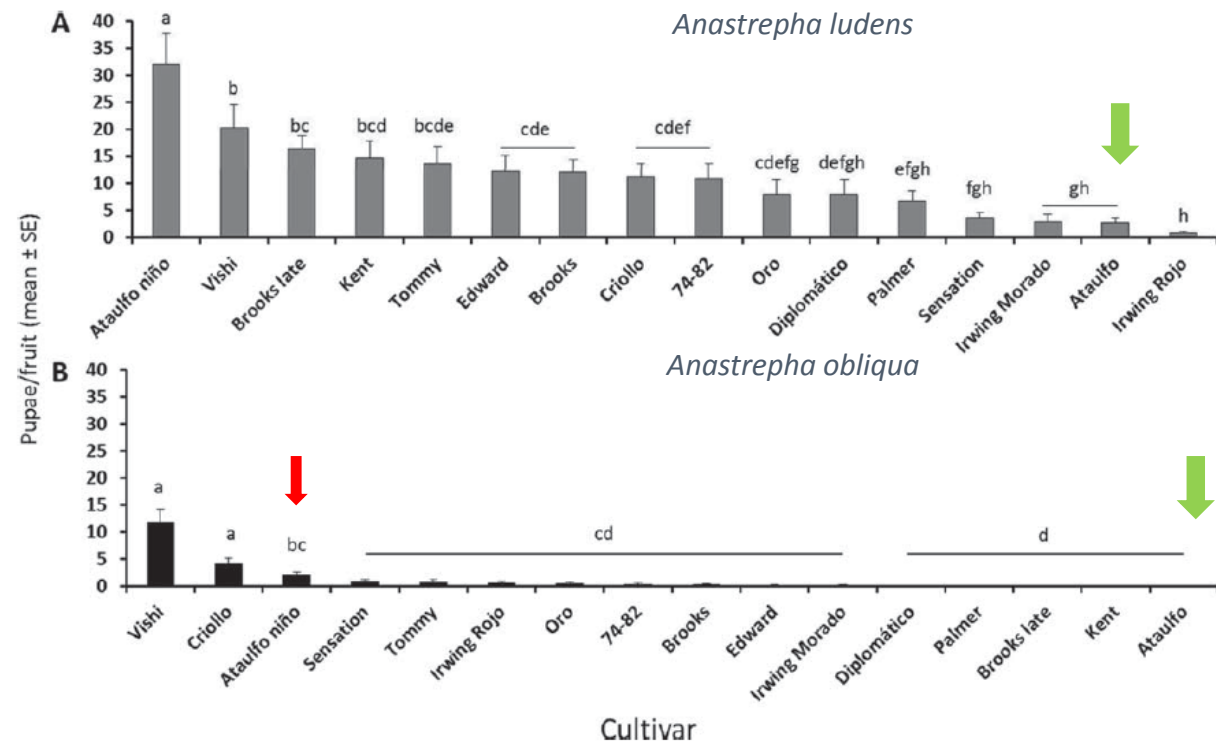


Fig. 1. Infestation rate under no-choice seminatural forced conditions by (A) *A. ludens* and (B) *A. obliqua* on 15 mango cultivars and Ataulfo "niño." Means with the same letter(s) over the bar are not significantly different at the 0.05 level.

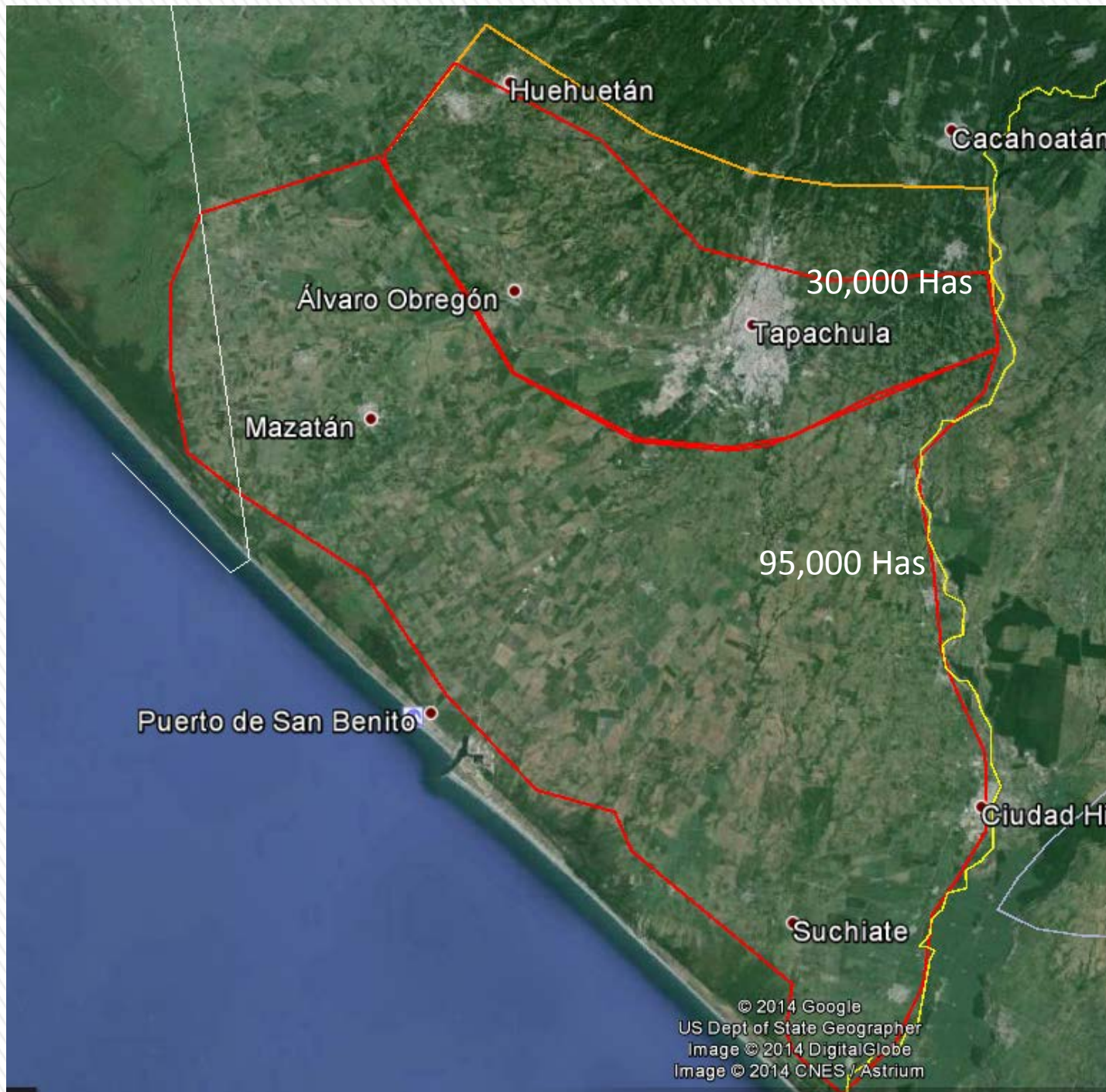


# Conclusions

- » Focus on *A. ludnes*
- » Density >1000 males per hectare
- » Sterile : wild ratio > 200
- » SIT +ABC successfully work under conditions of high population densities under an area-wide approach.

# From a research project to an action program





## Biological Material:

*A. ludens* Tap-7 = 20M


*A. ludens* Bis. = 20M


*D. longicaudata* = 5M




Release block: 15,000 Has.  
Weekly release:

- 15 million *A. ludens* Tap-7
- > 5 million *D. longicaudata*

 Polígono Liberación *A. ludens* Estériles

 Estéril

 Fértil

 Estéril - Fértil


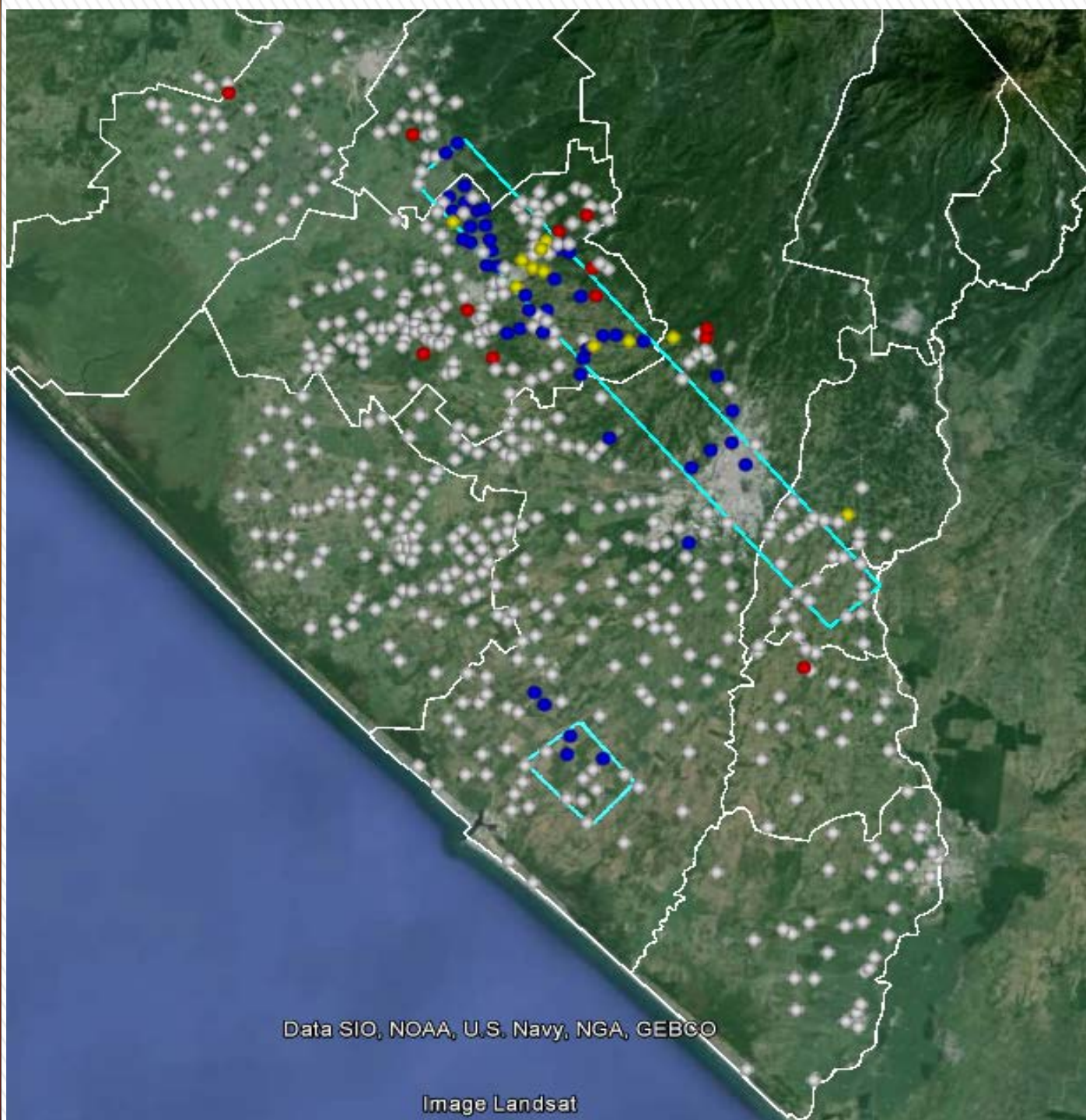

 Red de Trampeo Marginal. Sin Capturas

Image © 2016 DigitalGlobe  
Image © 2016 CNES / Astrium  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO







## Spatial distribution of wild and sterile *Anastrepha ludens* trap captures. Week 23 de 2016

 Polígono Liberación *A. ludens* Estériles

 Estéril

 Fértil

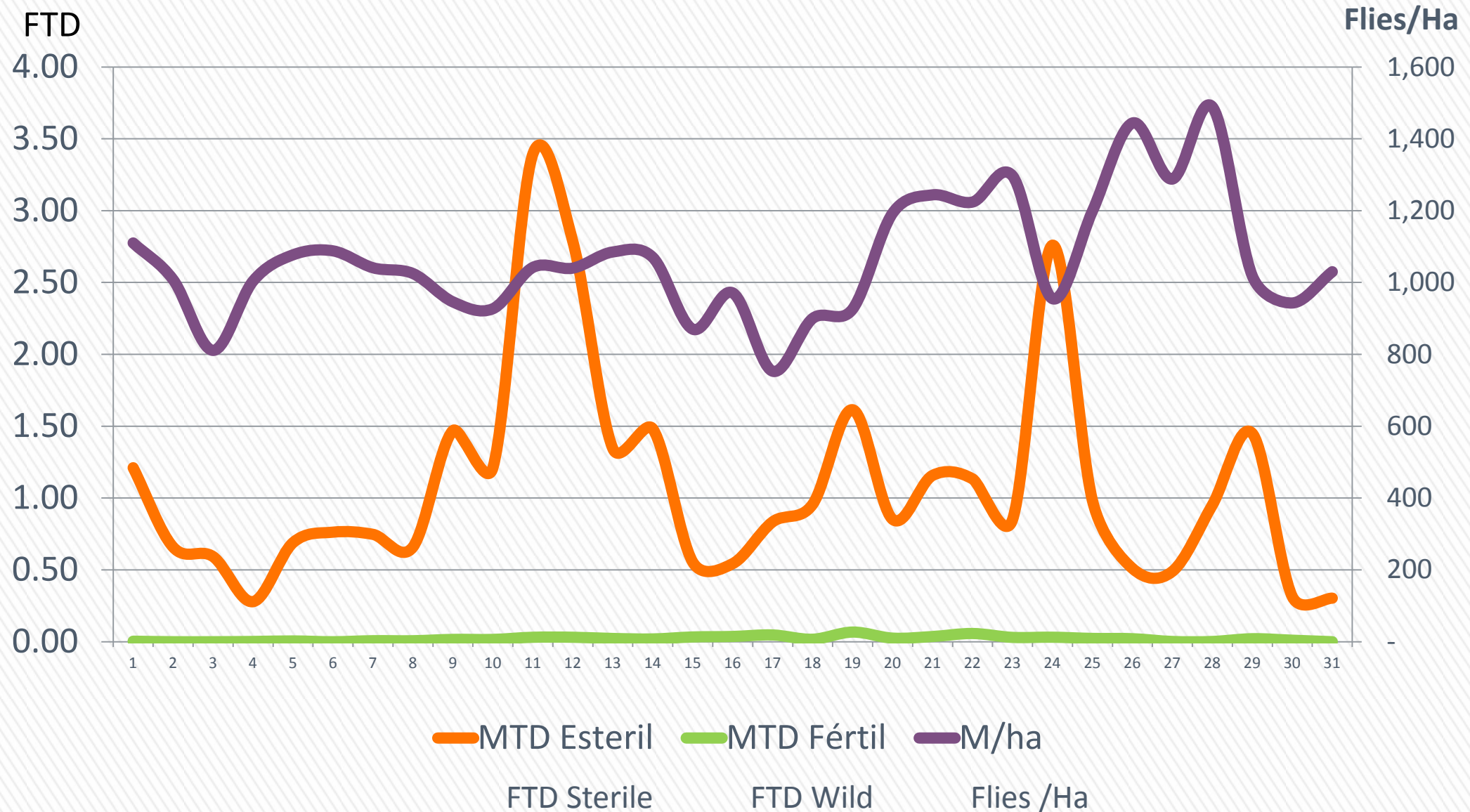
 Estéril - Fértil

 Red de Trampeo Marginal. Sin Capturas

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

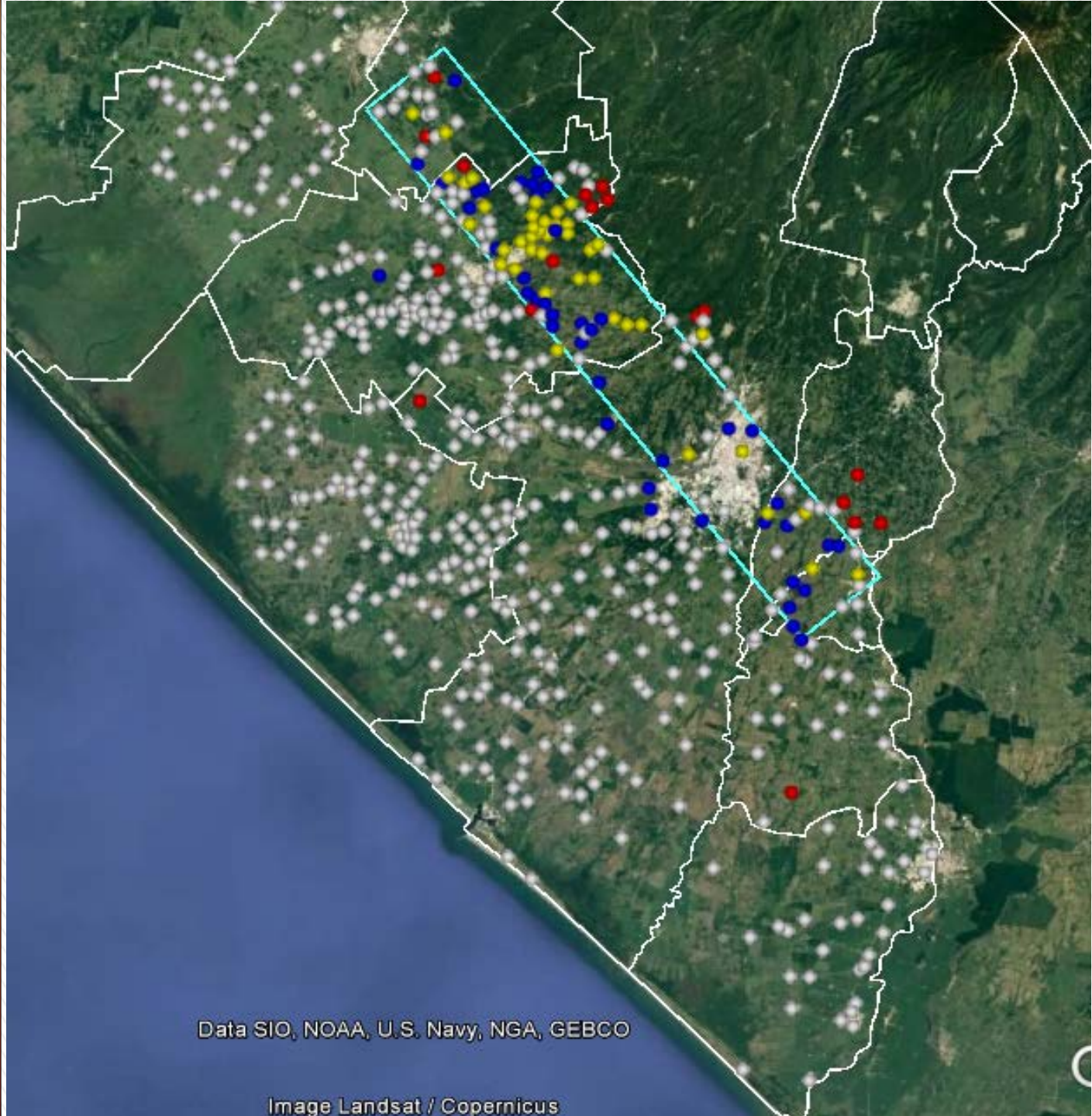
Image Landsat

# FTD sterile and wild *A. ludens* males in the release block, 2016





# Spatial Distribution of wild and sterile *Anastrepha ludens* Week 18, 2017



Polígono Liberación *A. ludens* Estériles

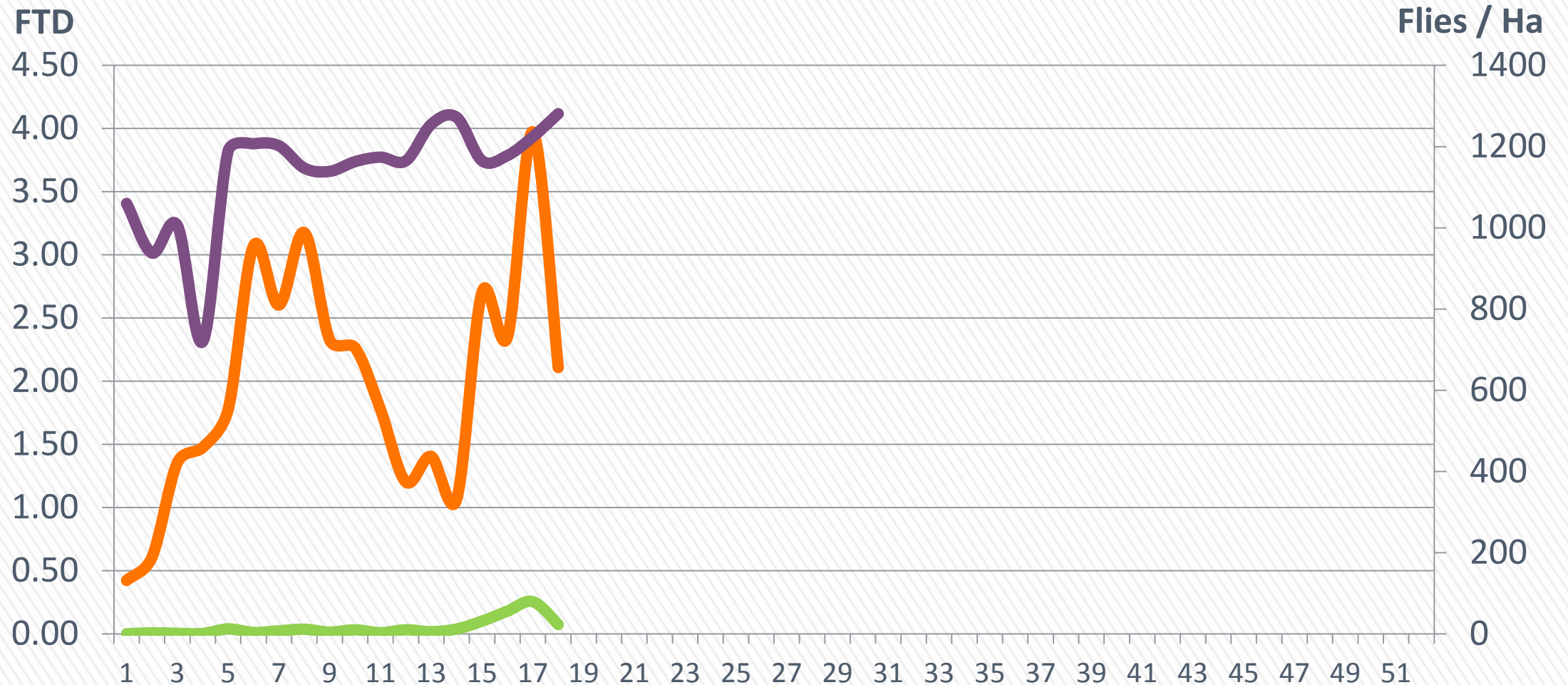
Estéril

Fértil

Estéril - Fértil

Red de Trampeo Marginal. Sin Capturas

# FTD sterile and wild *A. ludens* males in the release block, 2017



— MTD Esteril — MTD Fértile — M/ha

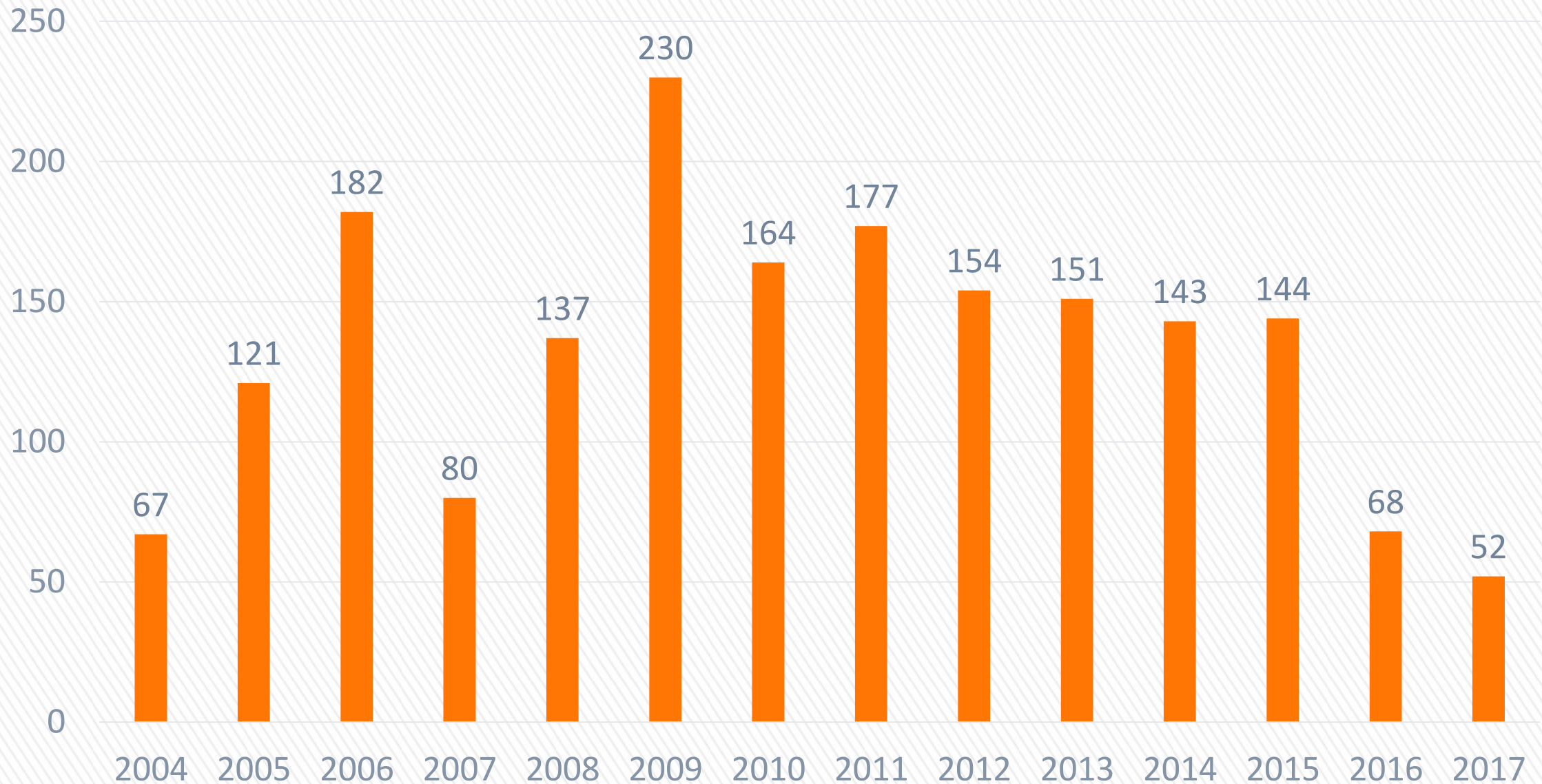
FTD Sterile

FTD Wild

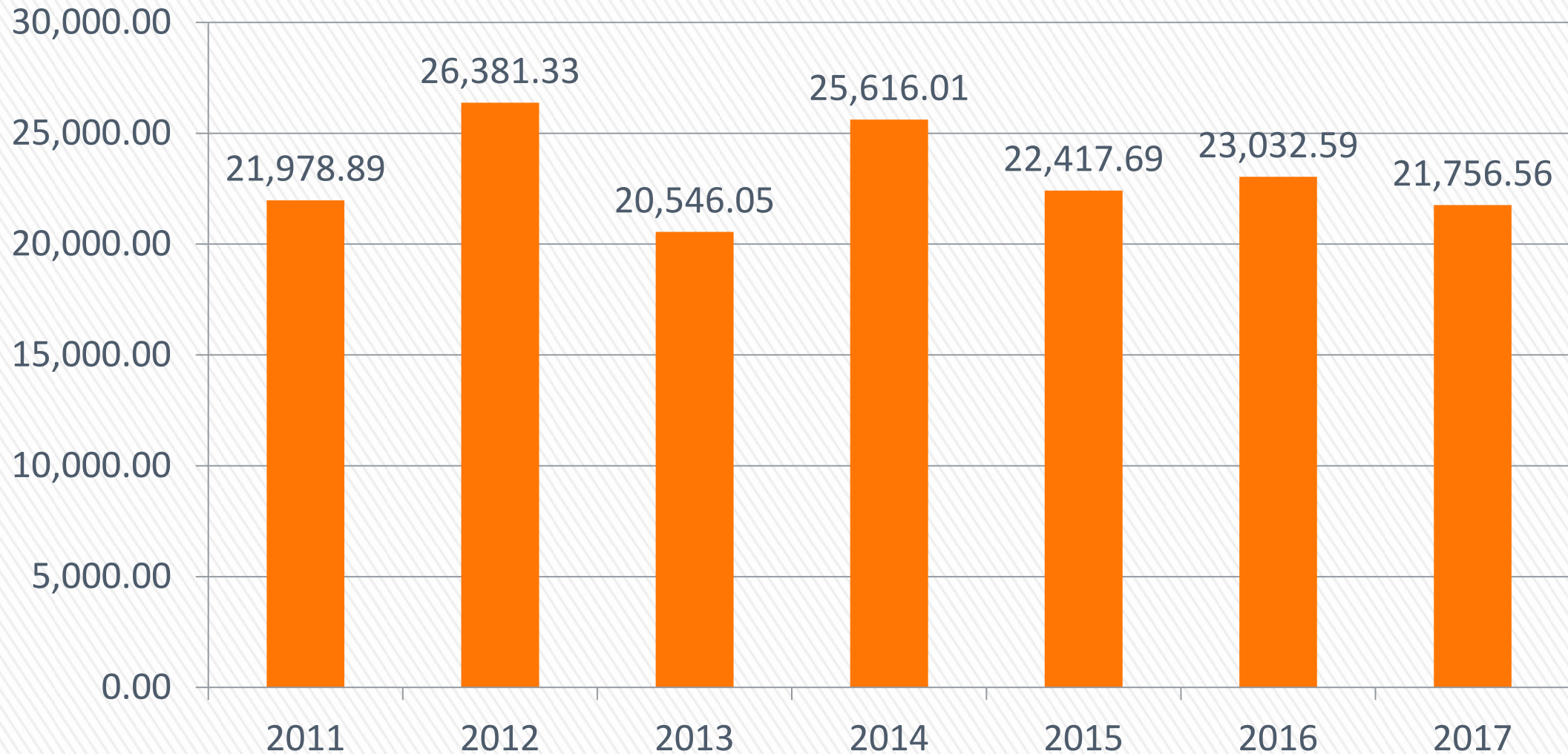
Flies /Ha



# Infested batches per year

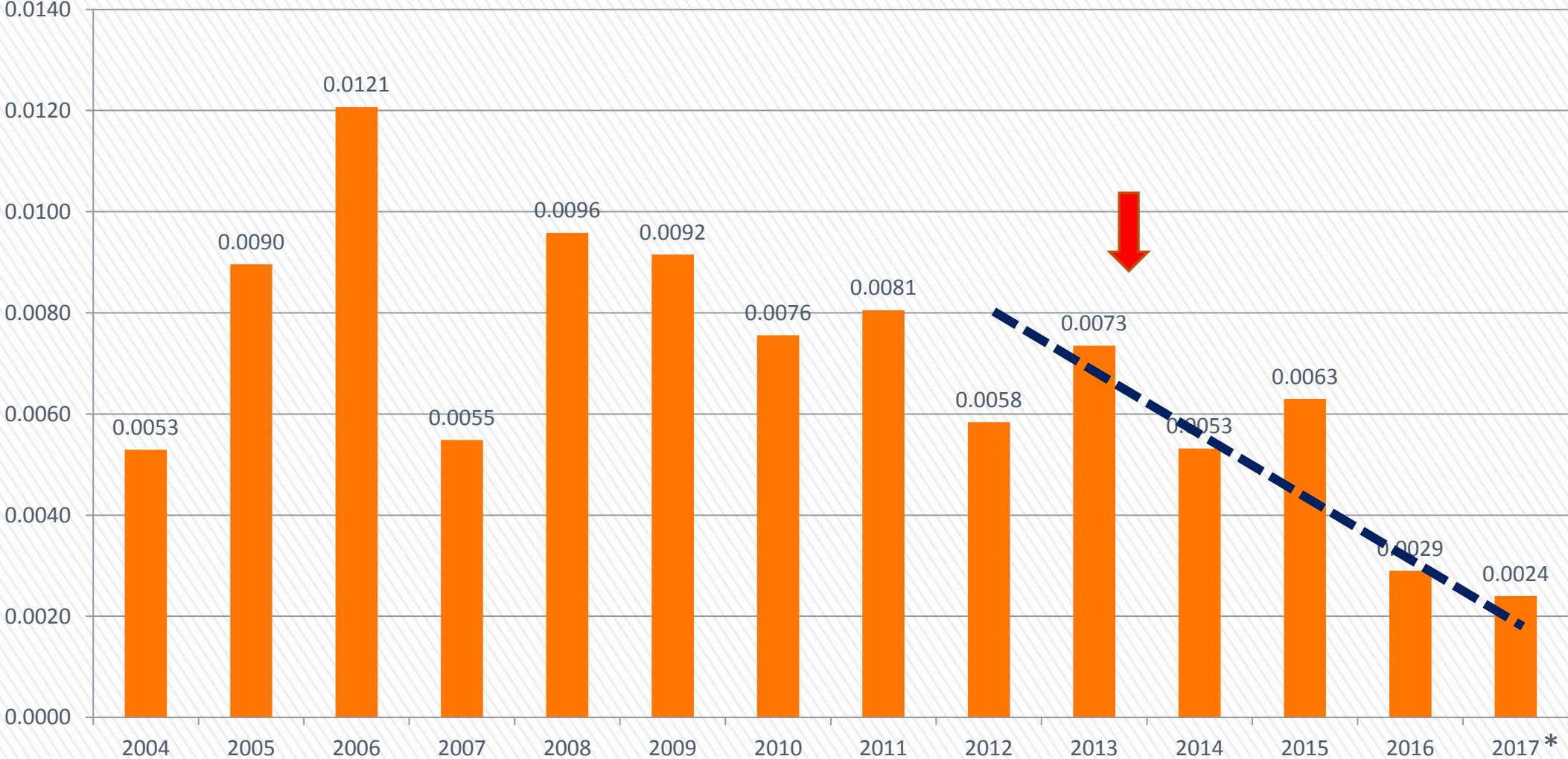


# Tons exported to the USA





# Infested batches per ton of exported fruit (2004 – 2015)



\*Up to week 18 (may 6)

# Benefits of AW-IPM with SIT and ABC

- » Significant risk reduction in infested batches
- » Benefits all growers in the region
- » Reduction in the use of pesticides





## **PROYECTO DE INVESTIGACIÓN**

Programa MOSCAFRUT, SENASICA, SAGARPA, IICA  
Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP)  
Universidad Veracruzana, Instituto de Biotecnología y Ecología Aplicada (INBIOTECA)  
Universidad Michoacana de San Nicolás de Hidalgo, Instituto de Investigaciones Agropecuarias y Forestales (IIAF)  
El Colegio de la Frontera Sur (ECOSUR)  
FONDO SECTORIAL SAGARPA-CONACYT

## **PROGRAMA DE MANEJO**

Comité Estatal de Sanidad Vegetal de Chiapas  
Junta Local de Sanidad Vegetal de Fruticultores de Chiapas  
Asociación Agrícola Local de Fruticultores del Soconusco  
Programa Nacional de Moscas de la Fruta, SENASICA,  
SAGARPA, IICA  
El Colegio de la Frontera Sur

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**Thank you**