

INVASIVE SPECIES IN CATALONIA: TIGER MOSQUITO

OBJECTIVES

- Invasive species: what are they, causes of introduction and consequences.
- Actual situation in Catalonia: origin, repercussions and measures for tiger mosquito
- Alternative methods for its control.

INTRODUCTION WHAT ARE THEY?

“Animals, plants or other organisms introduced by human in places out of their distribution area, where they establish and disperse creating a negative impact in ecosystem and local species”.
Causes: trade, tourism or freight transport

IN CATALONIA

Impact in animal communities and biodiversity:
largemouth bass, american mink, water velvet
I. in health: tiger mosquitoes & giant hogweed
I. in agriculture: red palm weevil & apple snail
I. in landscape: cactus pear...

THE TIGER MOSQUITO IN CATALONIA

Origin: southeast Asia
Nowadays: all continents
(no Antartida)

DISTRIBUTION

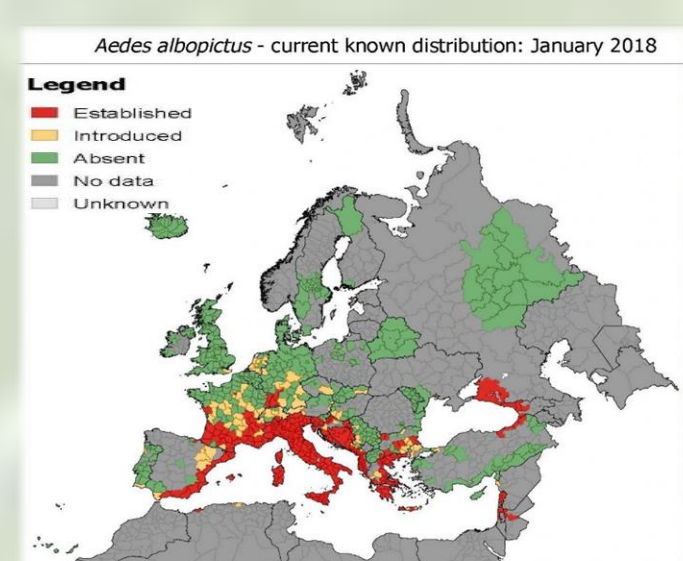


Fig. 1. Distribution in Europe of *A. Albopictus* 2018.
Source: <https://ecdc.europa.eu/en/publications-data/aedes-albopictus-current-known-distribution-january-2018>

HABITAT & ACTIVITY

- Where:
- Small dimensions
 - Water
 - >10d
- Activity:
- May-Nov
 - T>10 °C

PERJUDICIAL EFFECTS

- Quality of life
Sanitary risk:
- Dengue
 - Yellow Fever
 - Occidental Nil Fever
 - Chikungunya Arthritis

GENOME

- Repetitive DNA
 - Insecticide & detoxification resistance
 - Diapause
 - Similar sequences to flavivirus
- Results in: success as invasive species

ACTUATION IN CATALONIA

1. Environmental surveillance: oviposition and adult traps
 - Distribution study: presence areas, expansion and colonization
 - Quantification of density in each zone
2. Control of the mosquito:
 - Preventive measures: avoid egg laying and development of aquatic larvae
 - Pesticide treatments: larvicides (adults)
3. Sanitary surveillance: surveillance of mosquito as a vector of diseases, measures to prevent mosquito bites and measures to take after bites.
4. Sensitization
5. Professional formation
6. Research

CONCLUSIONS

- The tiger mosquito is extended around the world. The most important problems that it causes are bites and health hazards.
- Measures in Catalonia: surveillance and control (pesticides)
- Pesticides: concerning of people, able to affect other populations and resistances of mosquitoes.
- Public opinion about GMO: variety of opinions. Concerns about uncontrolled expansion, hybridization, unknown disease transmission and resistances to insecticides, behaviour in wildlife and impact in the ecology of the insects.
- Proposed alternative methods could be a good tool for the control of invasive species as the tiger mosquito in the future.

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ALTERNATIVE METHODS FOR THE CONTROL OF MOSQUITOES

1. Sterile Insect Technique

Application of ionizing irradiation to ♂
Dominant lethal mutations in sperm cells
Release males in nature → Irradiated ♂ x wild ♀
Death of zygotes during embryogenesis

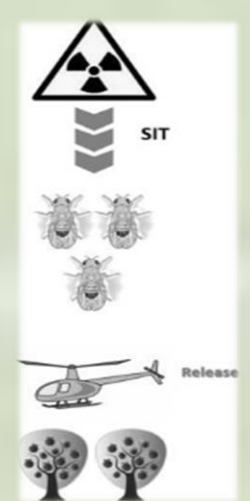


Fig. 2. SIT. Source: <https://link.springer.com/article/10.1007/s10340-017-0944-y#citeas>

2. Flightless female

Transcription factor tTAV just expressed in ♀
Recognises promotor tetO
Promoter tetO initiates transcr. of interest. genes
Toxic proteins → no functional wings



Fig. 3 & 4. Flightless Female. Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2826341/>

3. Wolbachia infection

Manipulates reproduction host →
Genetic engineering:

- Incompatible Insect Technique
- Replacing of the population:
 - Paratransgenesis, Popcorn effect, Disease blocking

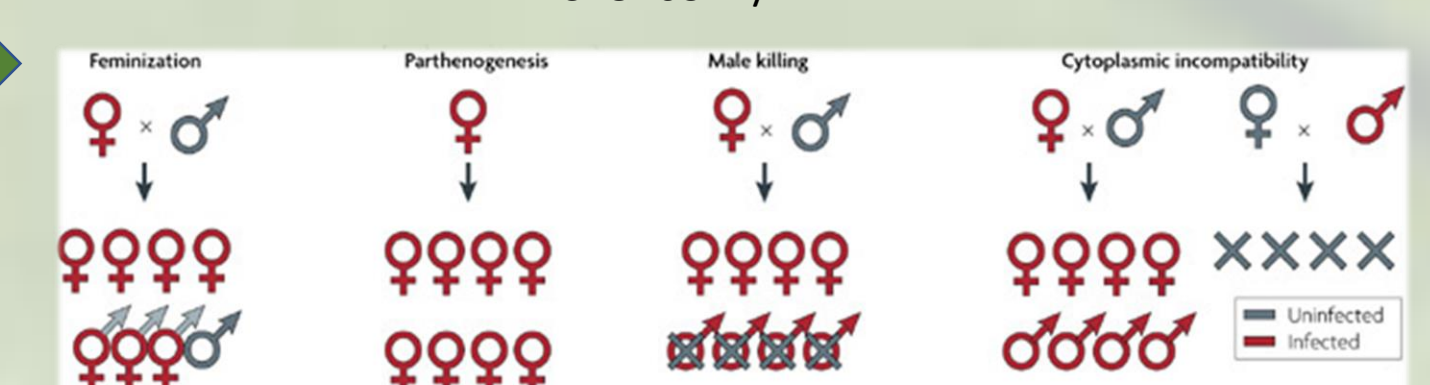


Fig. 5. Phenotypes in Wolbachia infection. Source: <http://www.nature.com/articles/nrmicro1969>

4. Gene drive

Genetic engineering technology that can propagate a particular suite of genes throughout a population. These genes can be disseminated even though they are harmful for the host because they are inherited in a higher proportion than mendelian genes.

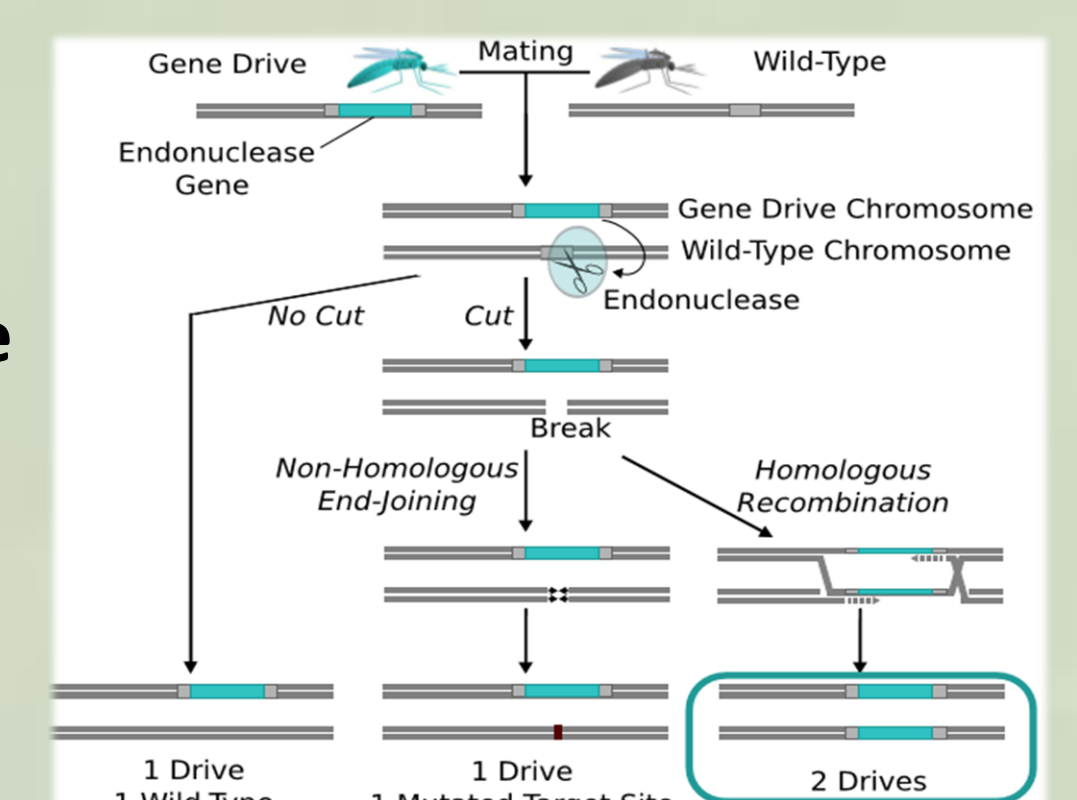


Fig. 6. Gene drive. Source: Esvelt et al. 2014

• Homing Endonuclease Genes (HEG)

HEG codes for an endonuclease
Endonuclease recognises & cuts DNA sequence
Reparation machinery uses HEG+ CHR as a copy
Introduces HEG into the other CHR → 2 HEG+ alleles

• CRISPR Cas9

Similar to HEG mechanism but instead of protein (endonuclease)-DNA union it uses crRNA (CRISPR)-DNA union and endonuclease (Cas9) cuts DNA seq.

Function of HEG and CRISPR Cas 9: to interrupt, substitute or add a gene.

Sex-ratio distortion:

♂ express Cas9 in spermatogenesis (under control of promotor β2 tubulin)
CRISPR Cas9 recognises and cuts specific sequence of the X CHR
Sperm cells will have Y CHR → Descendants will be ♂