

UF-CTA

Potential Invasive Pests Workshop

October 10-14, 2010

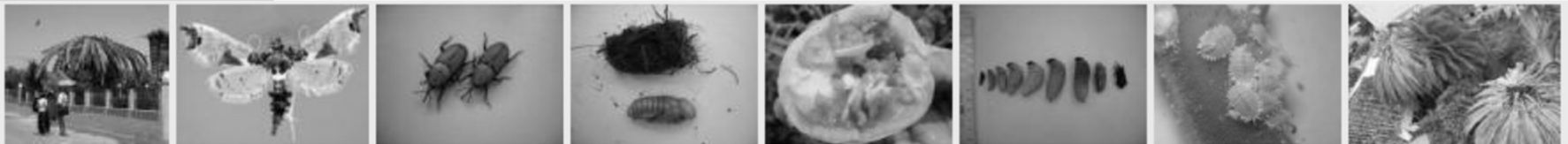
Mayfair Hotel • Miami (Coconut Grove), Florida USA

# Advances in the Management of the Red Palm Weevil in Spain

Josep A. Jacas

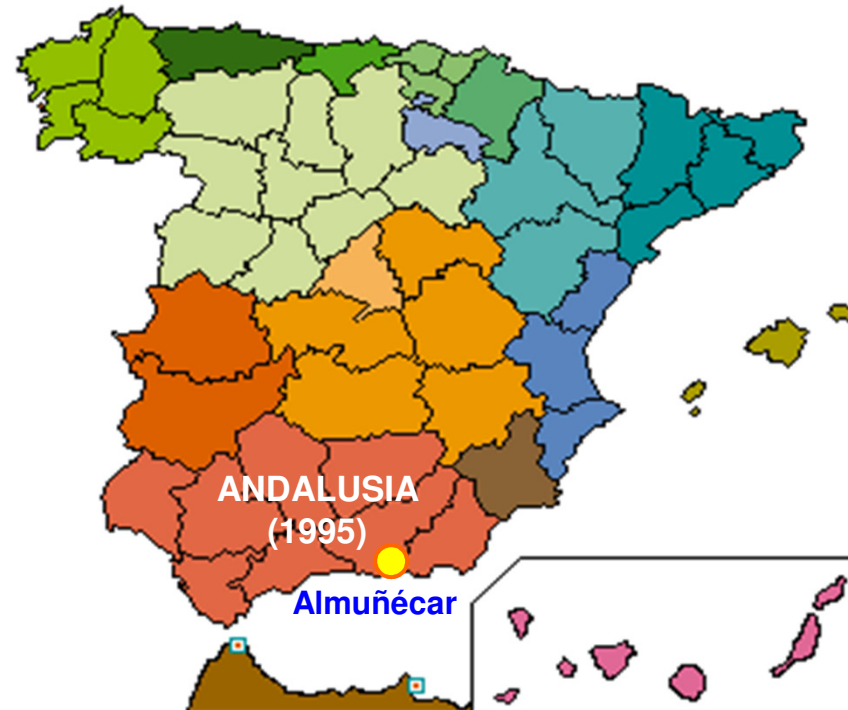
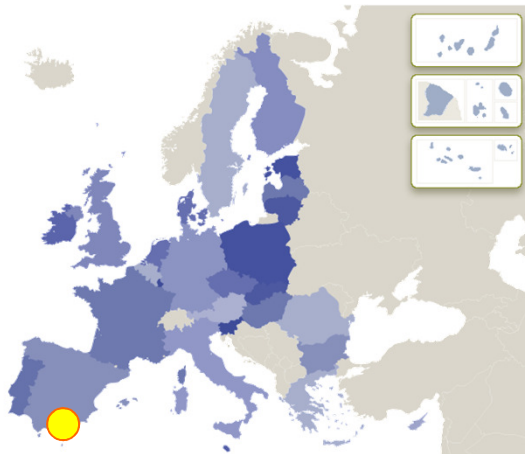


- **RPW introduction**
- **Current management strategy**
- **Research**



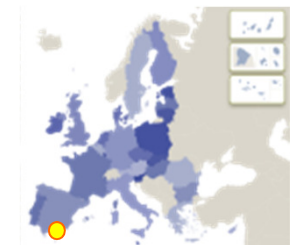
# Introduction

In 1995 *R. ferrugineus* is first detected in the EU: Almuñécar (Andalusia, Spain)



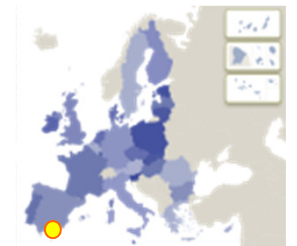
# 1995-2000: legal reaction

- 🪲 Andalusian Government:
  - 🪲 Palm movement within the area prohibited




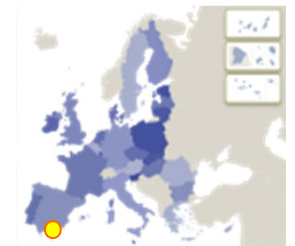
# 1995-2000: legal reaction

- 
- 🪲 Andalusian Government:
    - 🪲 Palm movement within the area prohibited
    - 🪲 Soil treatment (Aldicarb) in all nurseries




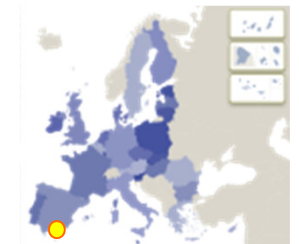
# 1995-2000: legal reaction

- 
- 🪲 Andalusian Government:
    - 🪲 Palm movement within the area prohibited
    - 🪲 Soil treatment (Aldicarb) in all nurseries
  - 🪲 Spanish Government:
    - 🪲 Palm importation from non-EU countries prohibited




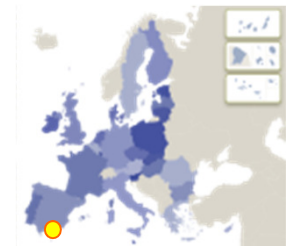
# 1995-2000: legal reaction

- 
- 🪲 Andalusian Government:
    - 🪲 Palm movement within the area prohibited
    - 🪲 Soil treatment (Aldicarb) in all nurseries
  - 🪲 Spanish Government:
    - 🪲 Palm importation from non-EU countries prohibited
    - 🪲 EU-Plant Passport for all palms moving within EU



# 1995-2000: legal reaction

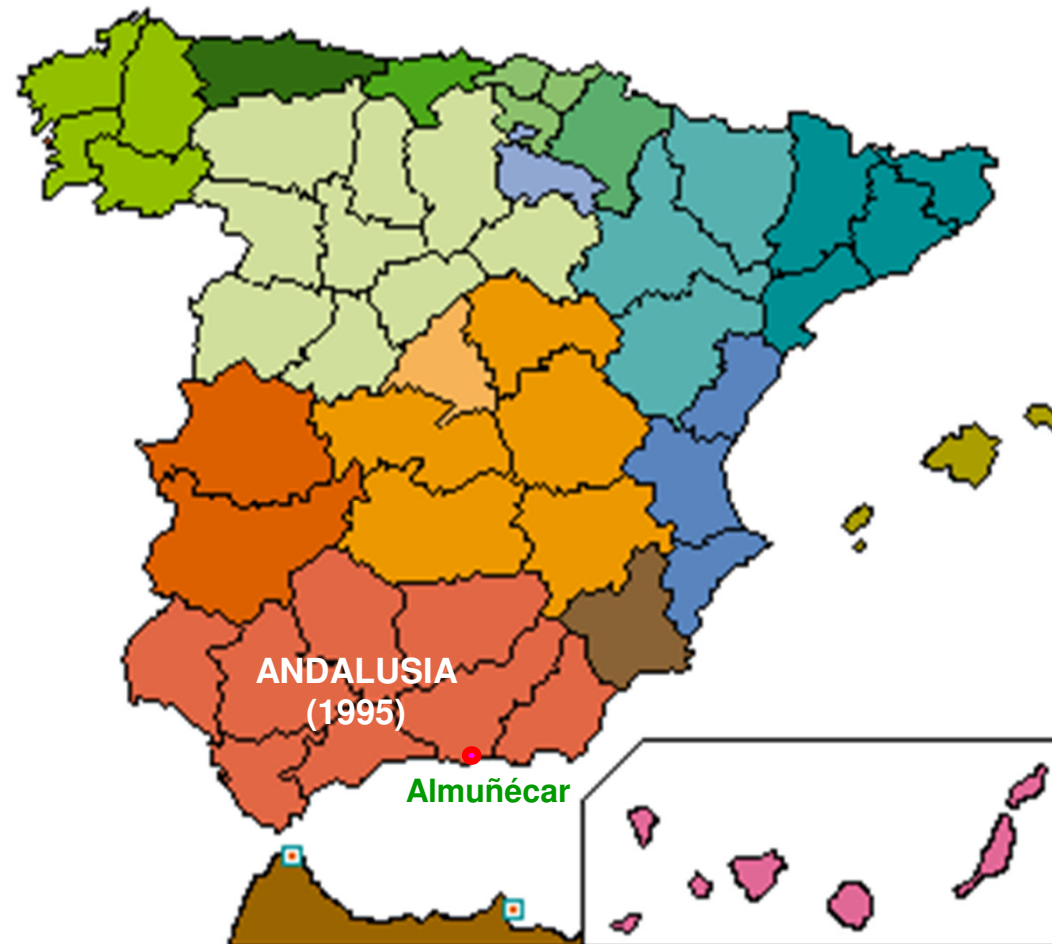
- 
- 🪲 Andalusian Government:
    - 🪲 Palm movement within the area prohibited
    - 🪲 Soil treatment (Aldicarb) in all nurseries
  - 🪲 Spanish Government:
    - 🪲 Palm importation from non-EU countries prohibited
    - 🪲 EU-Plant Passport for all palms moving within EU
    - 🪲 Eradication plan (chemical control, pheromone trapping and destruction of infested palms)





## 2000: legal reaction

- 🪲 *R. ferrugineus* localized around initial focus
- 🪲 Legal restrictions partially lifted



# The consequences

## Rapid spread starting in 2004



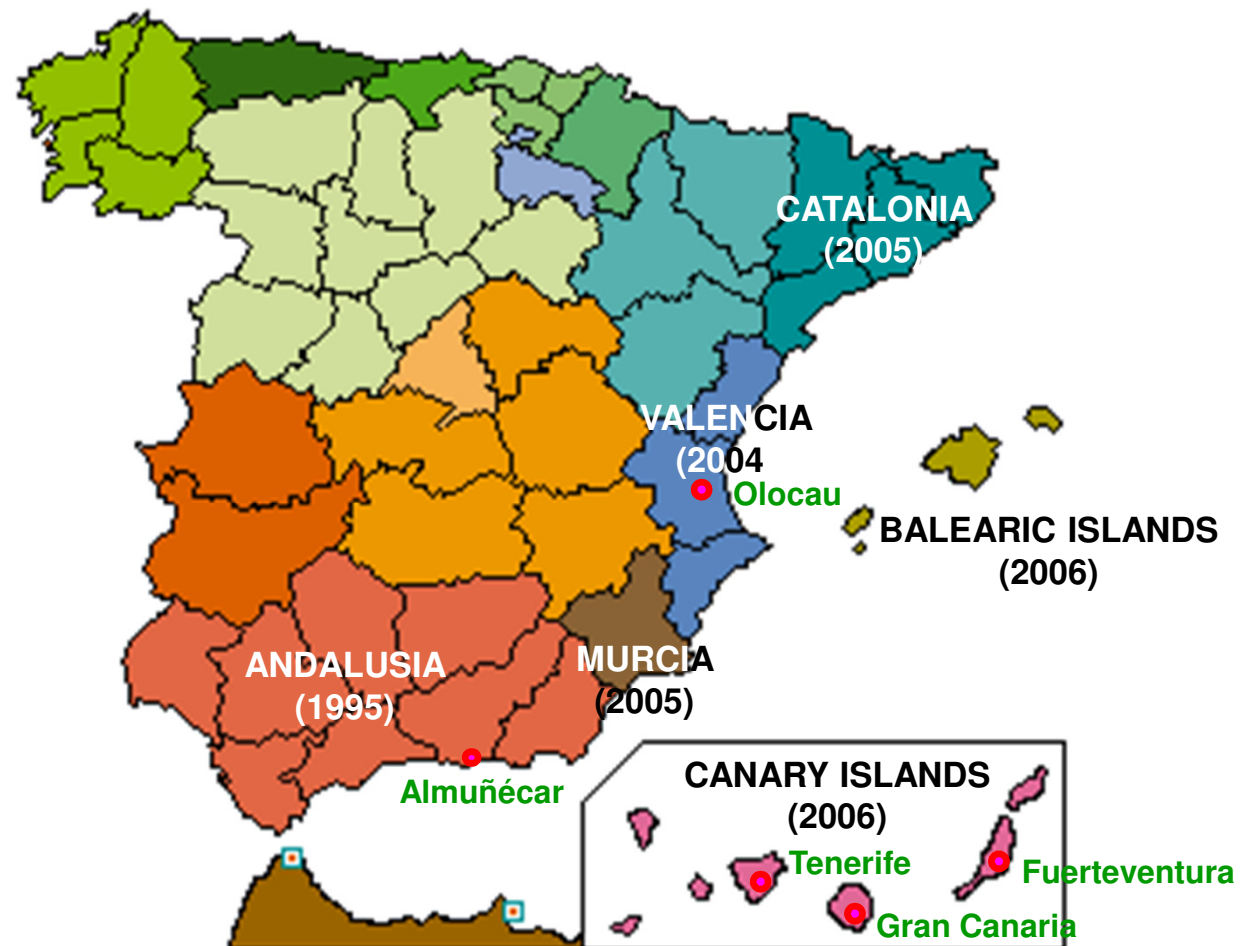
# The consequences

2005



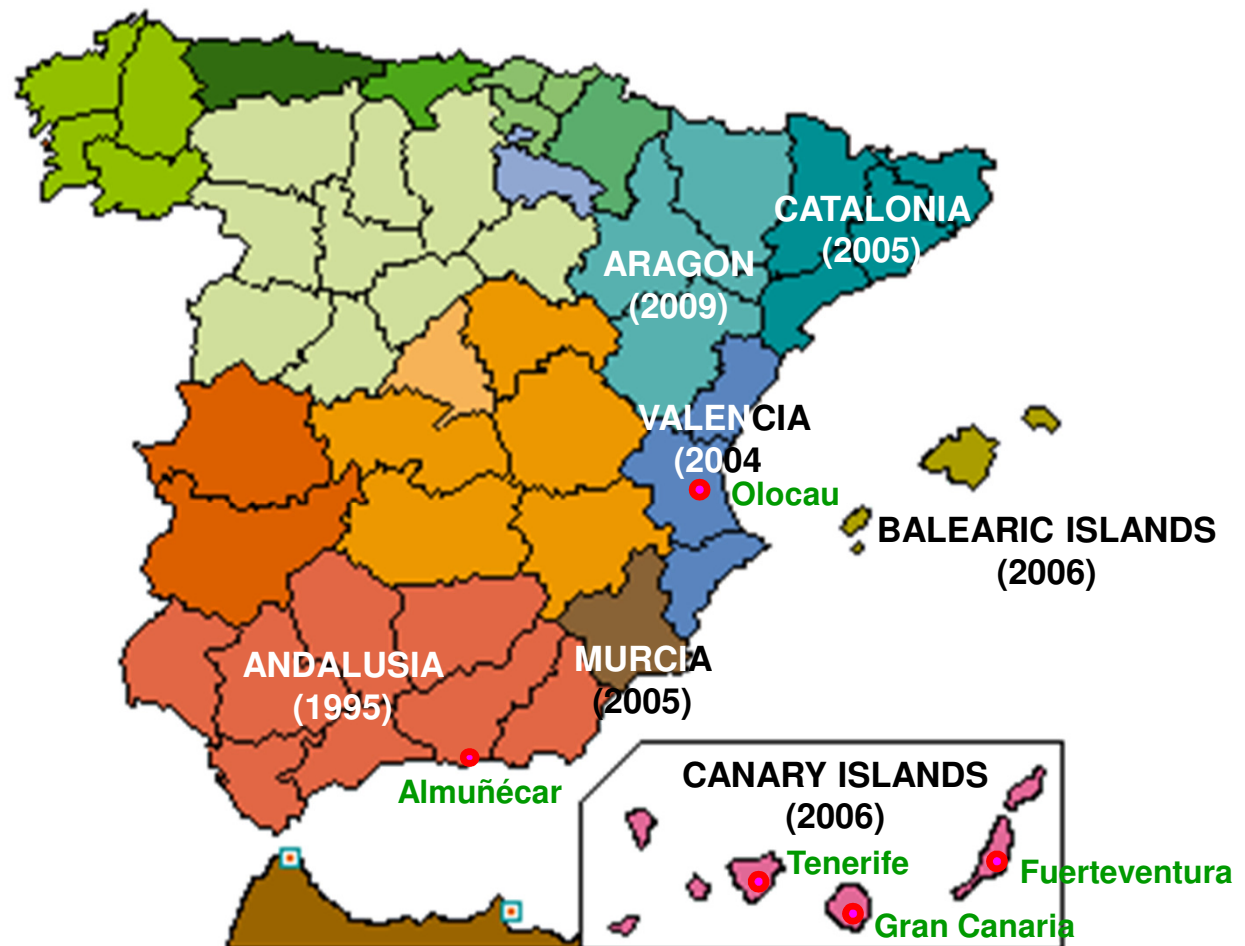
# The consequences

2006



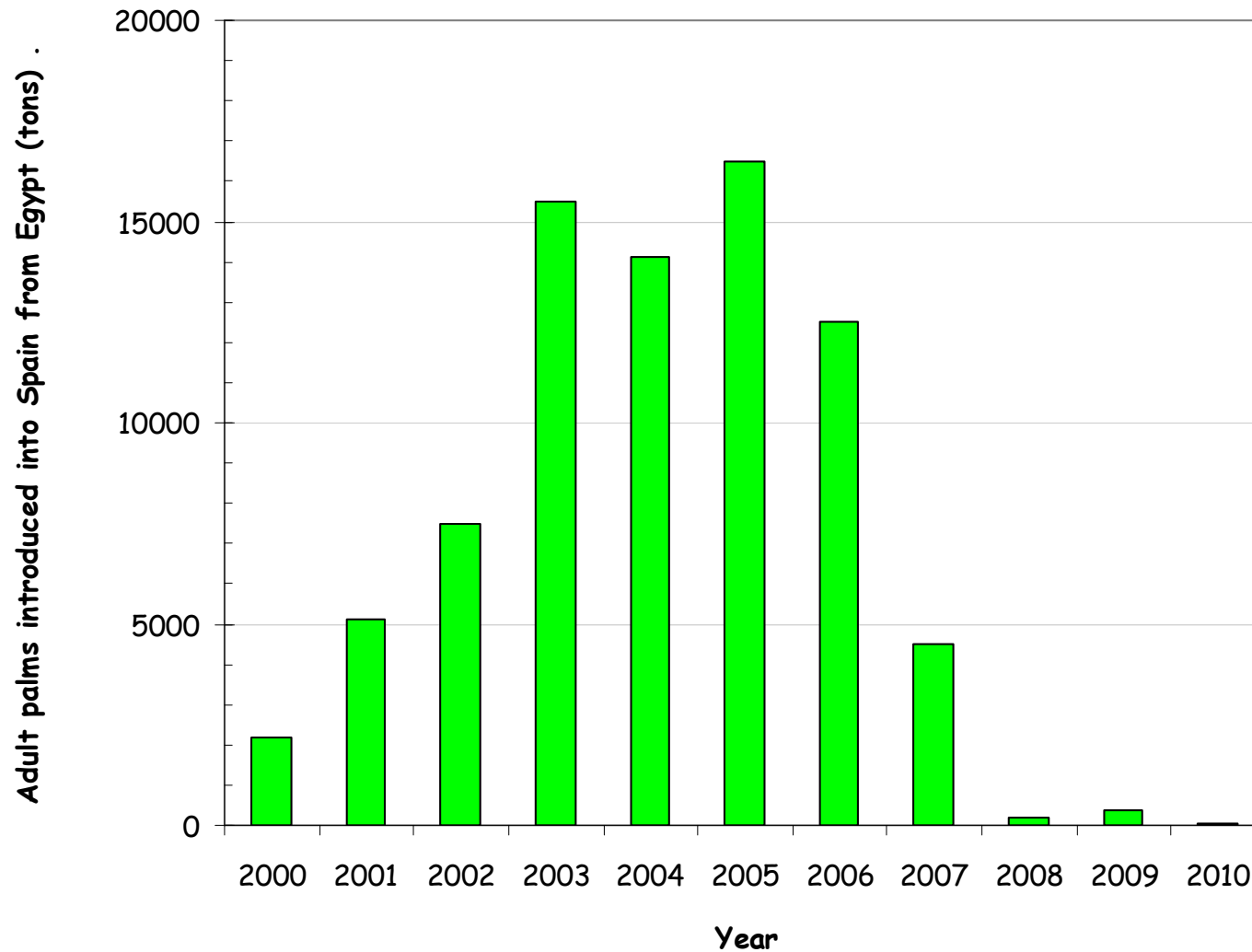
# The consequences

2009



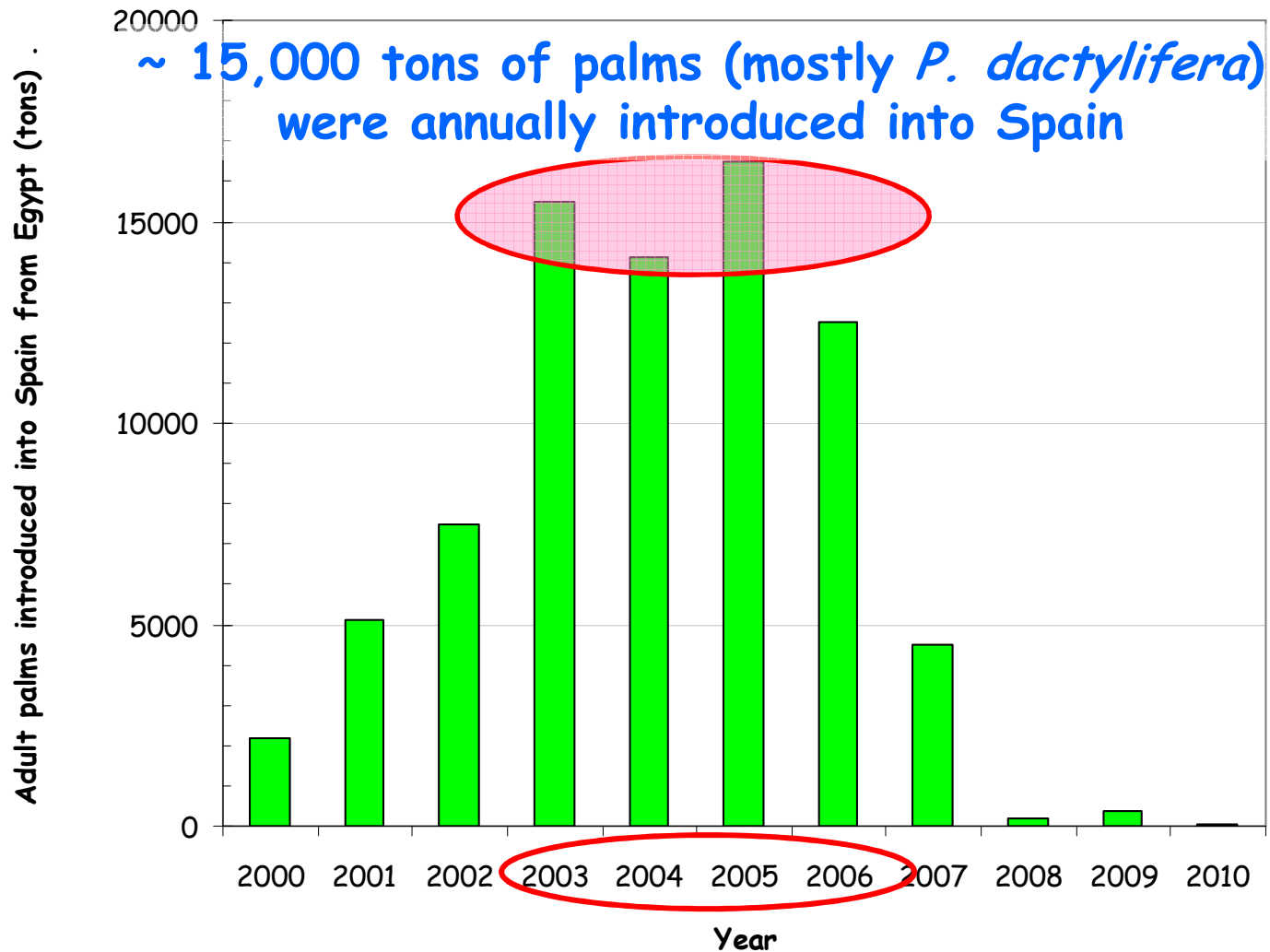
# The consequences

## How did it happen?



# The consequences

## How did it happen?



# *R. ferrugineus* in Spain

What was new?





# *R. ferrugineus* in Spain

## What was new?

- A basic difference:
- The main host is *Phoenix canariensis*



# *R. ferrugineus* in Spain

## What was new?

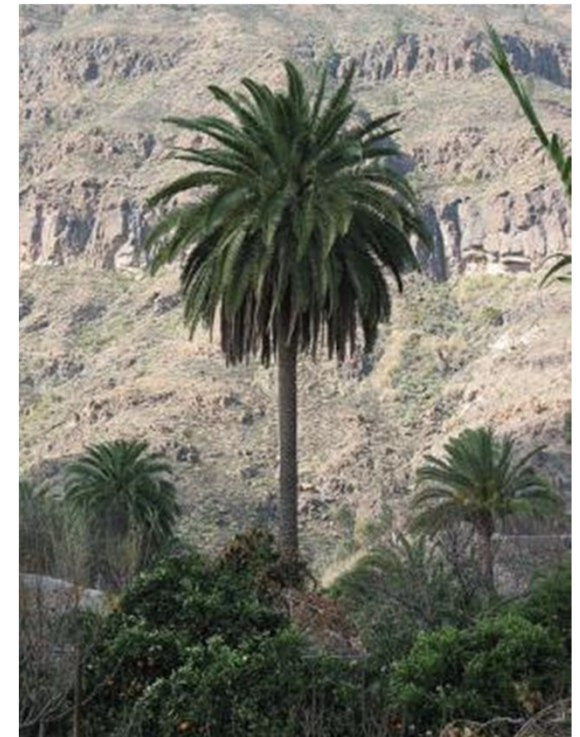
- A basic difference:
- The main host is *Phoenix canariensis*
- We knew almost nothing about this new host



# *R. ferrugineus* in Spain

## What was new?

- A basic difference:
- In the Mediterranean the main host was *Phoenix canariensis*
- We knew almost nothing about this new host
- *R. ferrugineus* became a pest of an ornamental plant and a direct threat for native palm species and historical palm groves



# *R. ferrugineus* in Europe

Rapid spread starting in 2004



# *R. ferrugineus* in Europe

Rapid spread starting in 2004



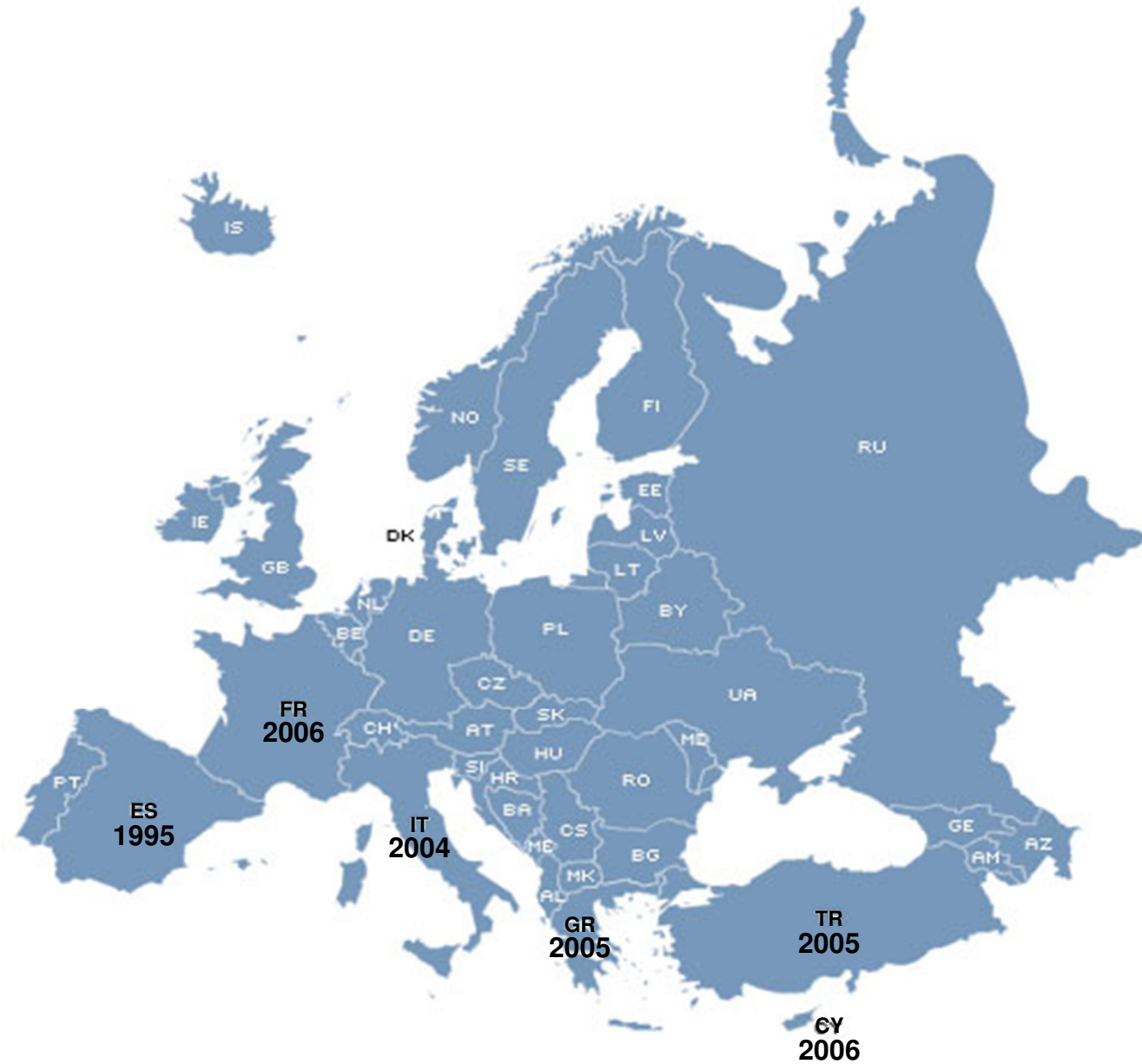
# *R. ferrugineus* in Europe

2005



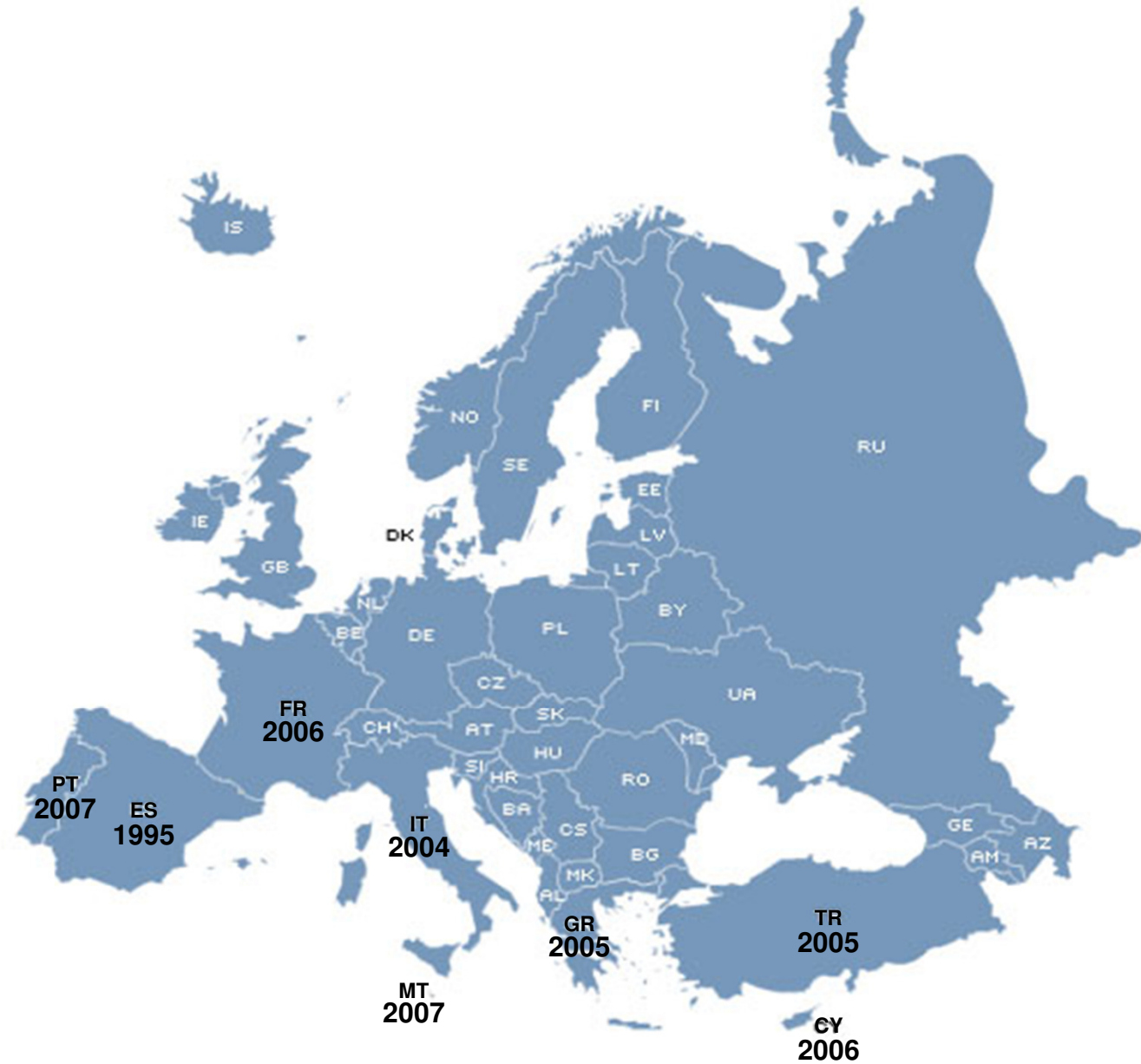
# *R. ferrugineus* in Europe

2006



# *R. ferrugineus* in Europe

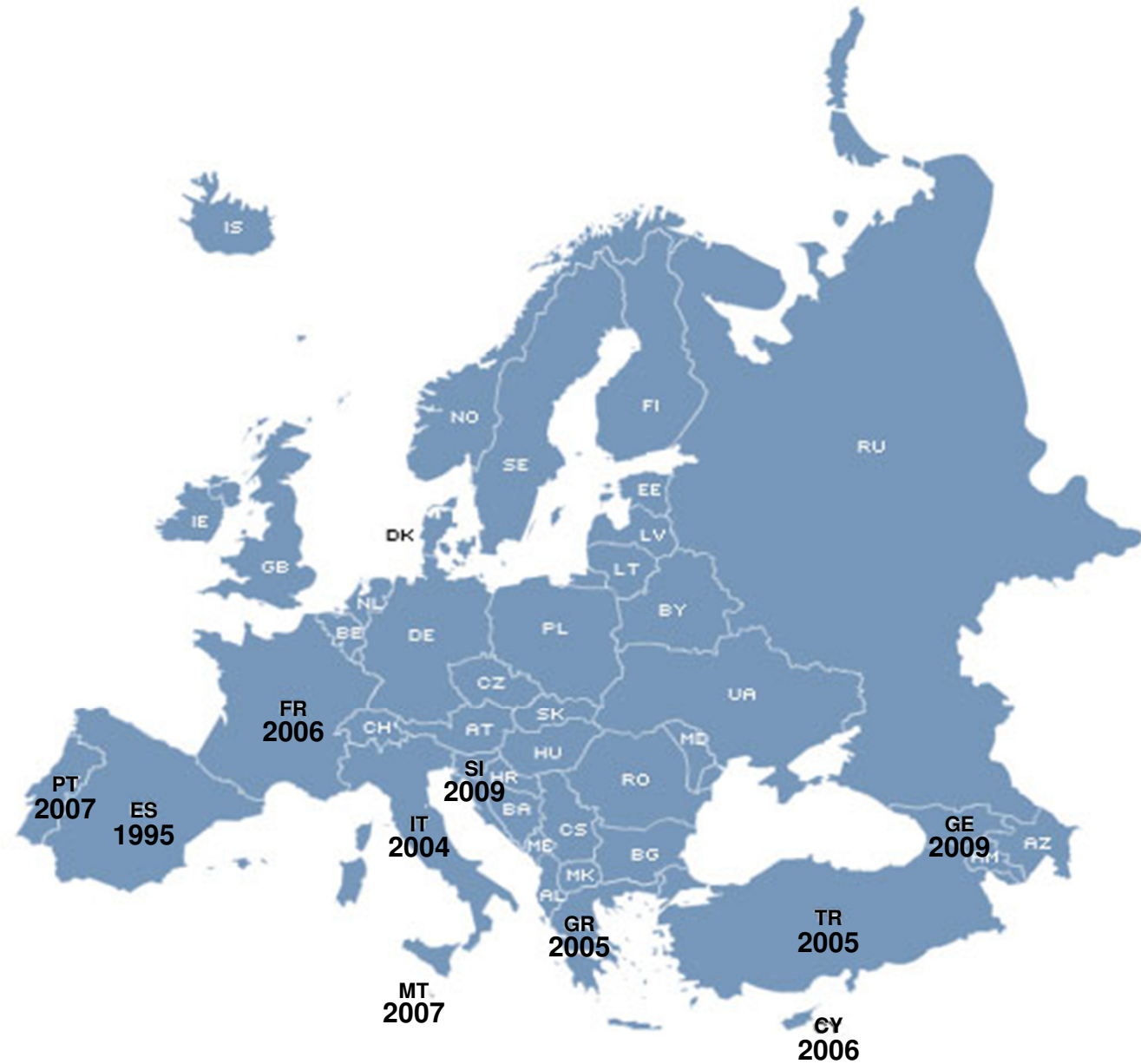
2007






# *R. ferrugineus* in Europe

2009



## *R. ferrugineus* in Europe


- 
- 🪲 EU Commission Decision on emergency measures (2007, reviewed in 2008 and 2010)
  - 🪲 Specific import requirements and conditions for movement => a 2-yr period of physical containment and official inspections prior to movement

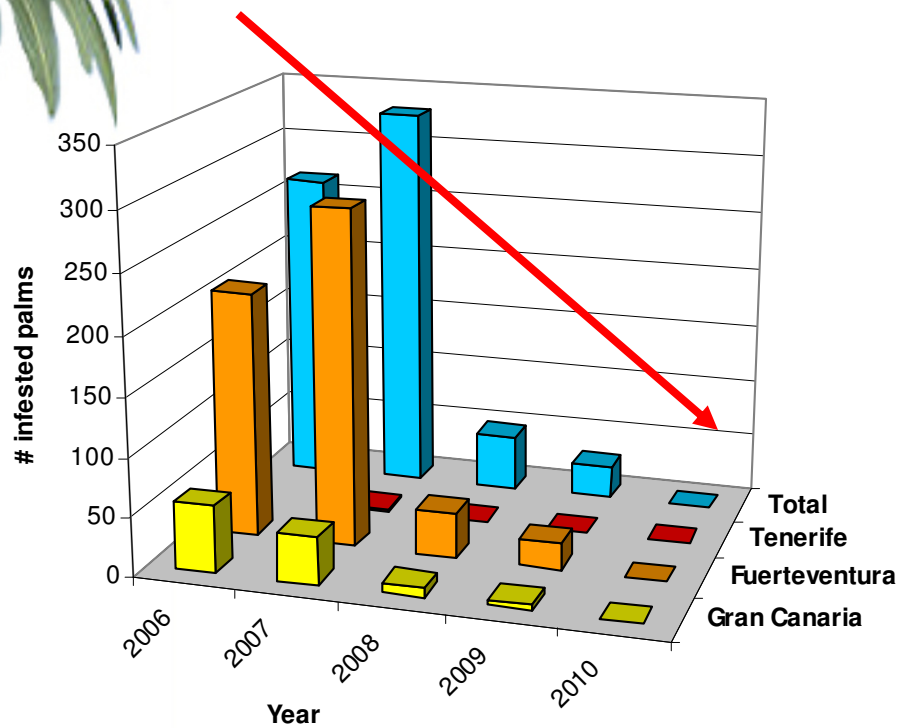
## *R. ferrugineus* in Europe

- 
- EU Commission Decision on emergency measures (2007, reviewed in 2008 and 2010)
    - Specific import requirements and conditions for movement => a 2-yr period of physical containment and official inspections prior to movement
    - Establishment of demarcated areas (10 km around infested areas)


**=> ERADICATION PROGRAM**

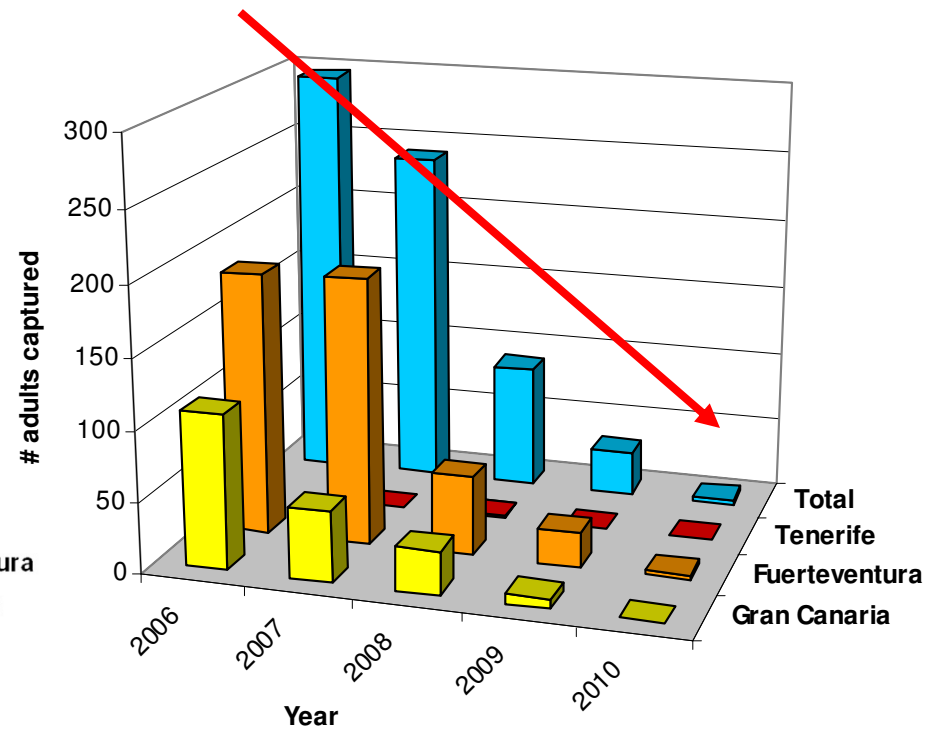
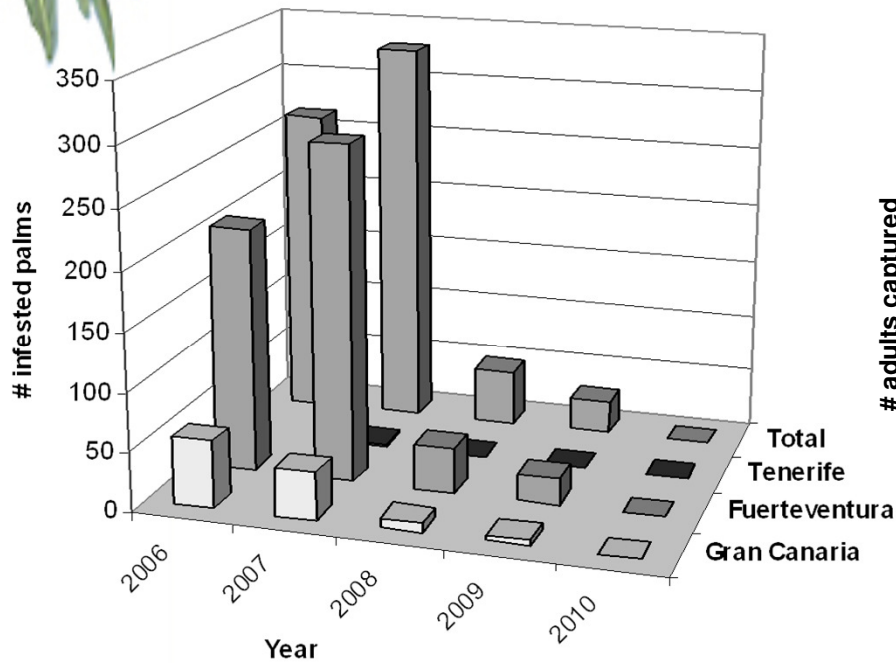
# The eradication program

 Eradication program successful in the Canary Islands,




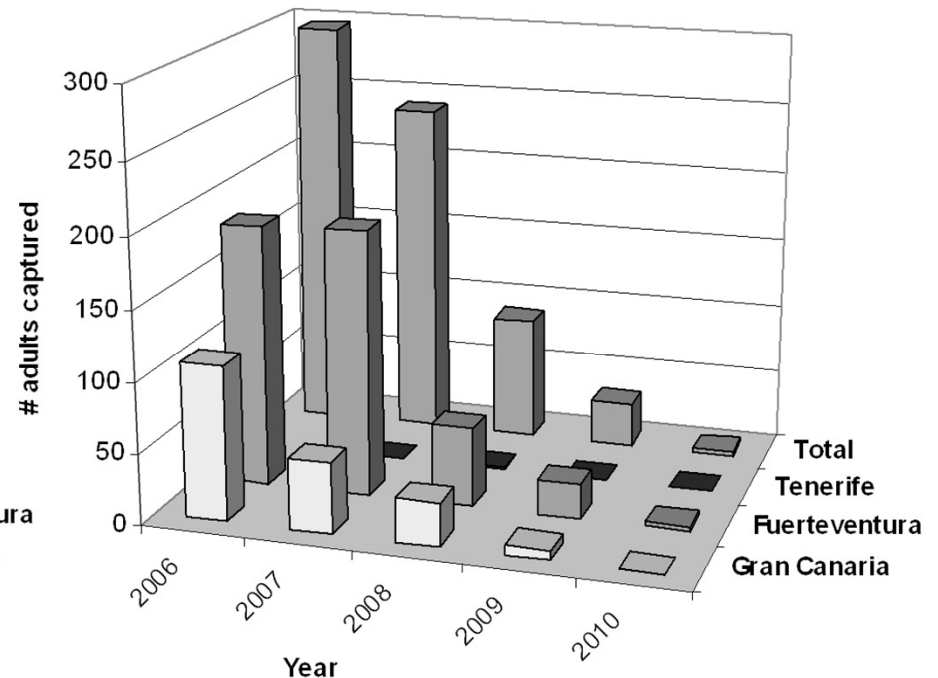
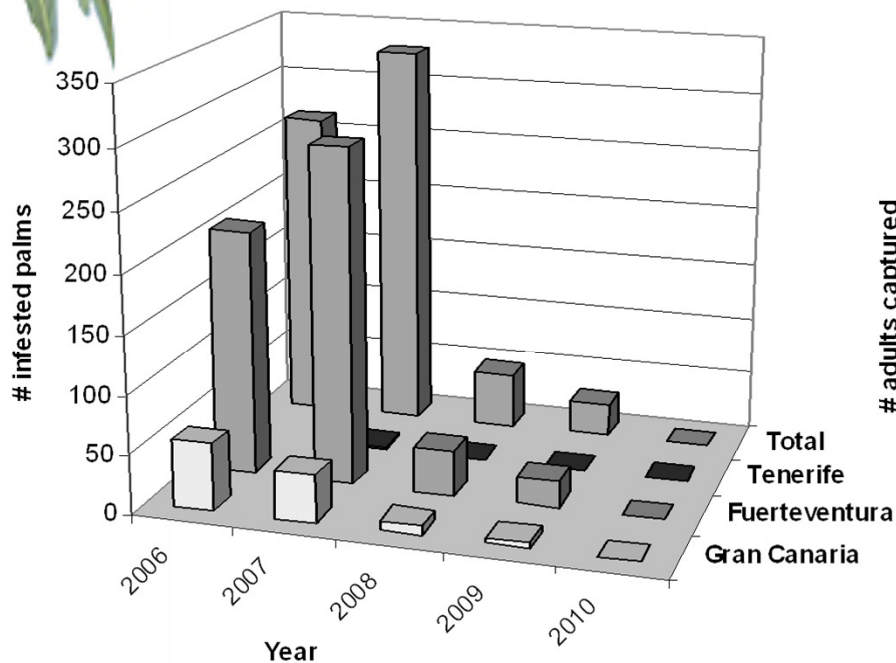
# The eradication program

 Eradication program successful in the Canary Islands,



# The eradication program

 Eradication program successful in the Canary Islands,



....but unsuccessful so far in the rest of EU

# The eradication program

- Reasons for failure:
- Difficult early detection,



# The eradication program

- Reasons for failure:
  - Difficult early detection,
  - No quarantine treatment available,





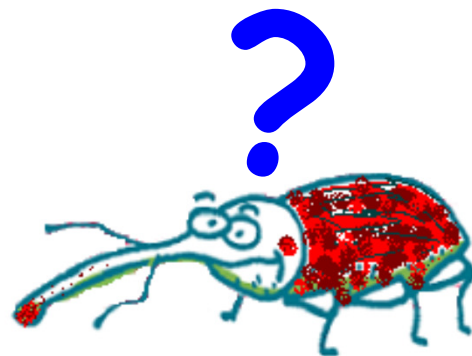
# The eradication program

- Reasons for failure:
  - Difficult early detection,
  - No quarantine treatment available,
  - Difficult involvement of homeowners,



# The eradication program

- Reasons for failure:
  - Difficult early detection,
  - No quarantine treatment available,
  - Difficult involvement of homeowners,
  - Risks of using semiochemicals in yet uninfested areas,



# The eradication program







## Reasons for failure:

- 🐛 Difficult early detection,
- 🐛 No quarantine treatment available,
- 🐛 Difficult involvement of homeowners,
- 🐛 Risks of mass trapping in yet uninfested areas,
- 🐛 Lack of control measures both effective and environmentally safe, &



# The eradication program

## Reasons for failure:

-  Difficult early detection,
-  No quarantine treatment available,
-  Difficult involvement of homeowners,
-  Risks of mass trapping in yet uninfested areas,
-  Lack of control measures both effective and environmentally safe, &
-  Incomplete knowledge of *R. ferrugineus* bio-ecology in *P. canariensis* under mediterranean climate



# 2010: Current management strategy



 The current management strategy in Spain includes **recommendations** on:

 New plantations

 Monitoring

 Pruning

 Preventive treatments

 Sanitation

 Removal and destruction of infested palms

 Trapping

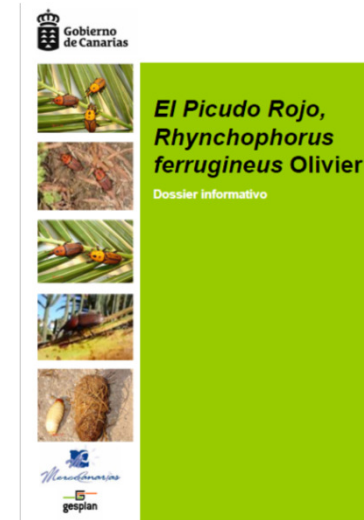
 Research

# 2010: Current management strategy


- 
- 🐛 Recommendation: **new plantations:**
    - 🐛 Use of **certified plants (EU-Plant Passport)**  
**compulsory**

# 2010: Current management strategy

- 🪲 Recommendation: **monitoring:**
  - 🪲 Training courses for gardeners and technicians by official agencies => **certified companies**
  - 🪲 Train the public: warning leaflets, TV advertisements, internet, ...



# 2010: Current management strategy

- 
- 🐛 Recommendation: **pruning:**
    - 🐛 Only **dry fronds** should be removed,
    - 🐛 Only during **winter**
    - 🐛 Apply **insecticide afterwards**



# 2010: Current management strategy

- 🪲 Recommendation: **preventive treatments:**
  - 🪲 **8 treatments per season (march to nov.):**
    - 🪲 Imidacloprid
    - 🪲 Phosmet
    - 🪲 *Steinernema carpocapsae*



Pipeline for treatments

# 2010: Current management strategy

## Recommendation: sanitation:

 Based on traditional production of palm honey in the Canary Islands



# 2010: Current management strategy




 **Recommendation: sanitation:**

 Based on traditional production of palm honey in the Canary Islands

# 2010: Current management strategy

 Recommendation: removal and destruction of infested palms :

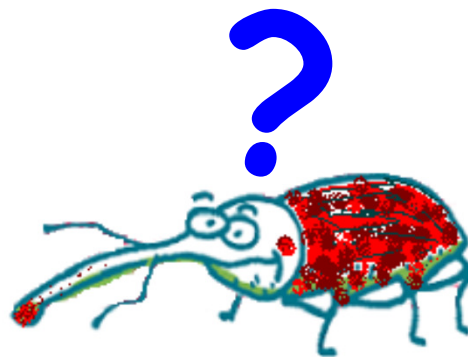
 Municipalities and homeowners responsible for cutting infested palms and their transportation to designated areas

 Destruction by shredding



# 2010: Current management strategy

- 🪲 Recommendation: **trapping** :
  - 🪲 **Mass trapping only under official supervision**




# 2010: Current management strategy


- 
- 🪲 Current management strategy in Spain:
    - 🪲 Preventive treatments
    - 🪲 Pruning
    - 🪲 Sanitation
    - 🪲 Monitoring
    - 🪲 New plantations
    - 🪲 Removal and destruction of infested palms
    - 🪲 Trapping
    - 🪲 **Research**

# 2010: Current management strategy

- 
- Research on *R. ferrugineus* in Spain:
    - Basic bio-ecology of *R. ferrugineus*
    - Detection:
      - Early detection
      - Trapping
    - Control:
      - Quarantine
      - Chemical control
      - Natural enemies
      - Induced plant defenses

# Research: basic bio-ecology



 Dembilio *et al.* (2009). Are the palms *Washingtonia filifera* and *Chamaerops humilis* suitable hosts for the red palm weevil. *J. Appl. Entomol.* 133, 565-567 (doi: 10.1111/j.1439-0418.2009.01385.x)



# Research: basic bio-ecology

 Dembilio *et al.* (2009). *J. Appl. Entomol.* 133, 565-567  
(doi: 10.1111/j.1439-0418.2009.01385.x)

## Antibiosis in *Washingtonia filifera*:


-  Natural infestation: failed
-  Forced infestation: failed


## Anxenosis in *Chamaerops humilis*:

-  Natural infestation: failed
-  Forced infestation: succeeded




# Research: basic bio-ecology



 Dembilio *et al.* (2010). Basic bio-ecological parameters of the invasive Red Palm Weevil in *Phoenix canariensis* under Mediterranean climate. **Bull. Entomol. Res.** in press (doi:10.1017/S0007485310000283)

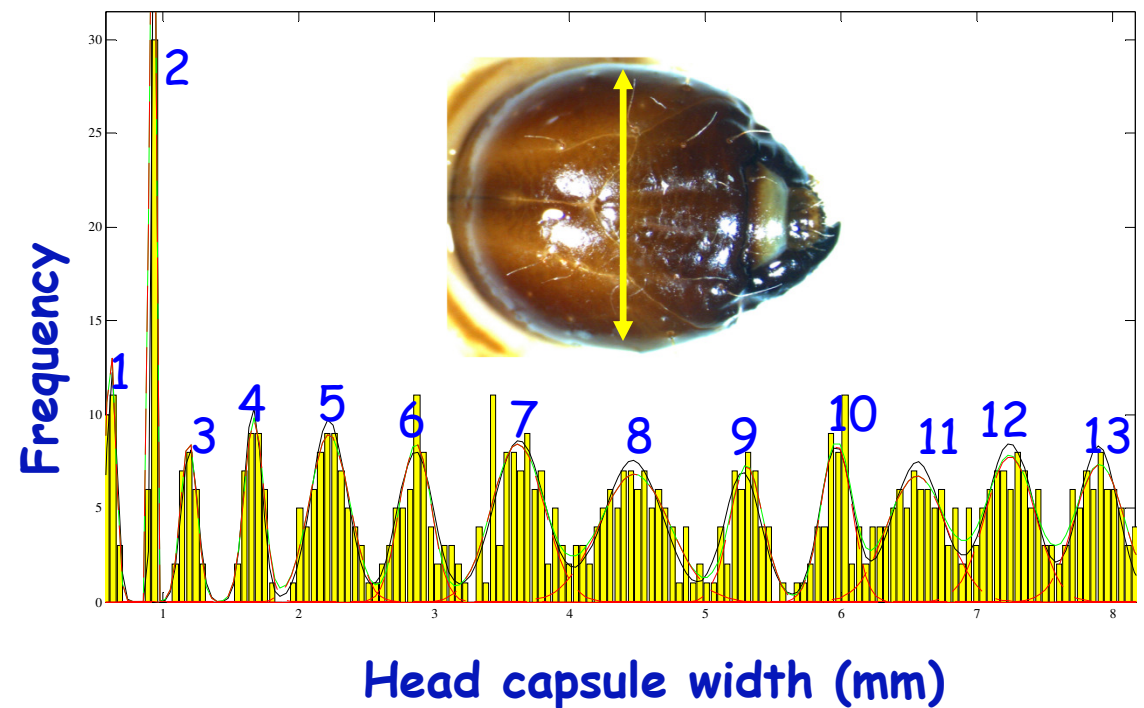
# Research: basic bio-ecology

 Dembilio *et al.* (2010). Bull. Entomol. Res. in press  
(doi:10.1017/S0007485310000283)


13 larval stages

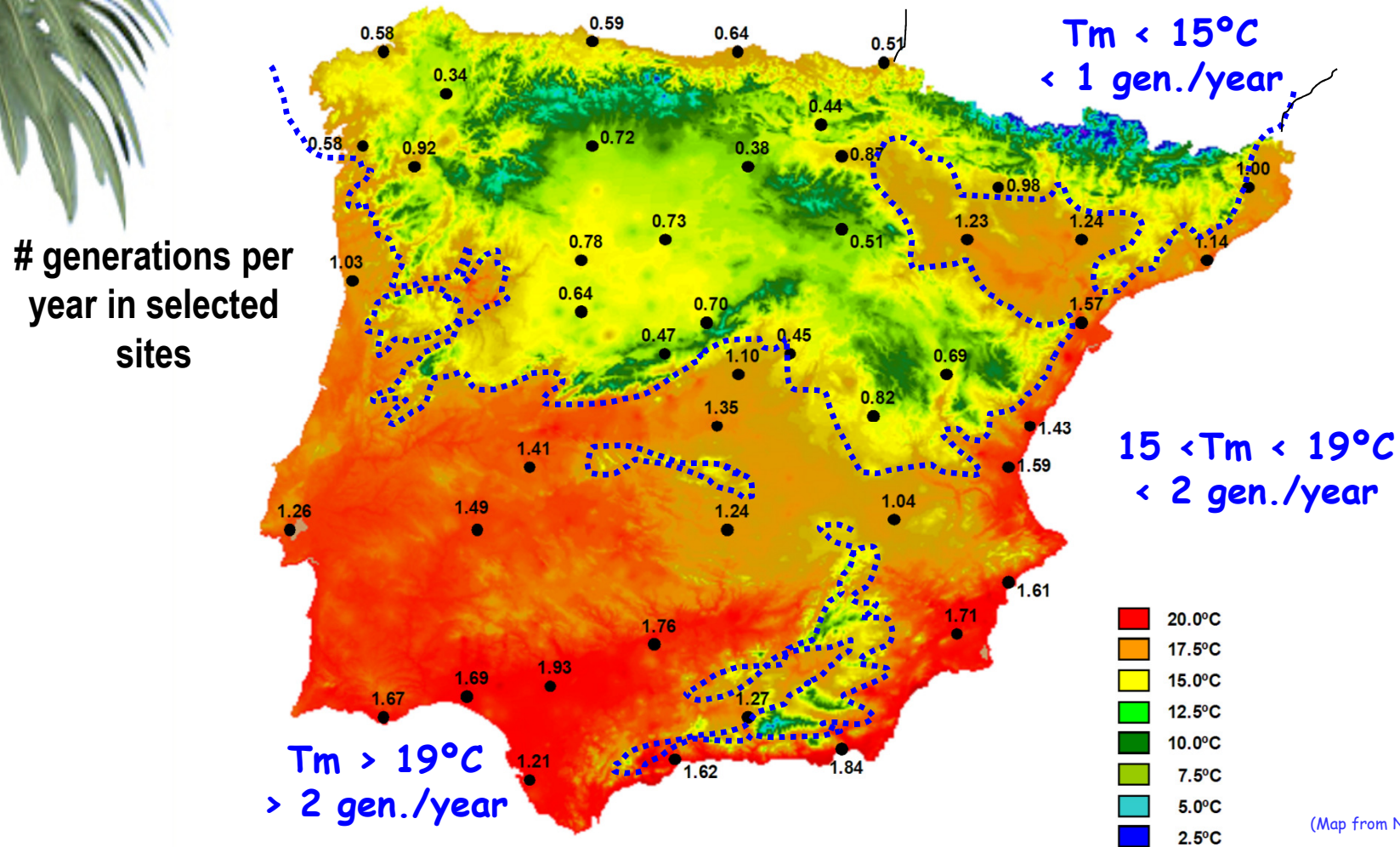
LDT egg = 13.1 °C  
LDT larvae = 15 °C  
LDT pupae = 13 °C

Thermal constant<sub>egg-adult</sub> = 989 DD



# Research: basic bio-ecology

 Dembilio *et al.* (2010). Bull. Entomol. Res. in press.  
(doi:10.1017/S0007485310000283).



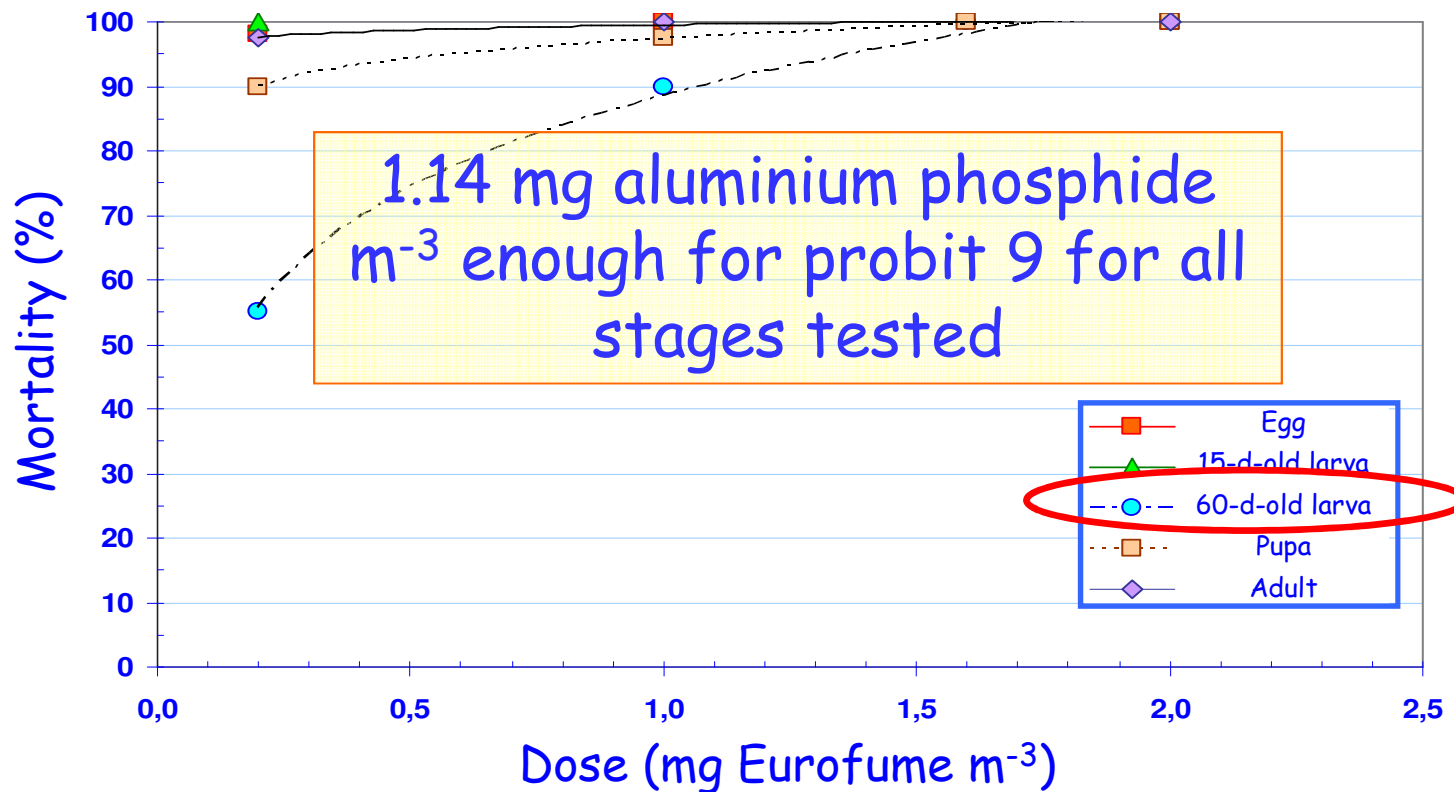
# Research: quarantine




 Llácer *et al.* (2010). Efficacy of phosphine as a fumigant against *R. ferrugineus* in palms. Spanish J. Agric. Res. 8, 775-9.


# Research: quarantine

 Llácer *et al.* (2010). Spanish J. Agric. Res. 8, 775-9.




# Research: chemical control

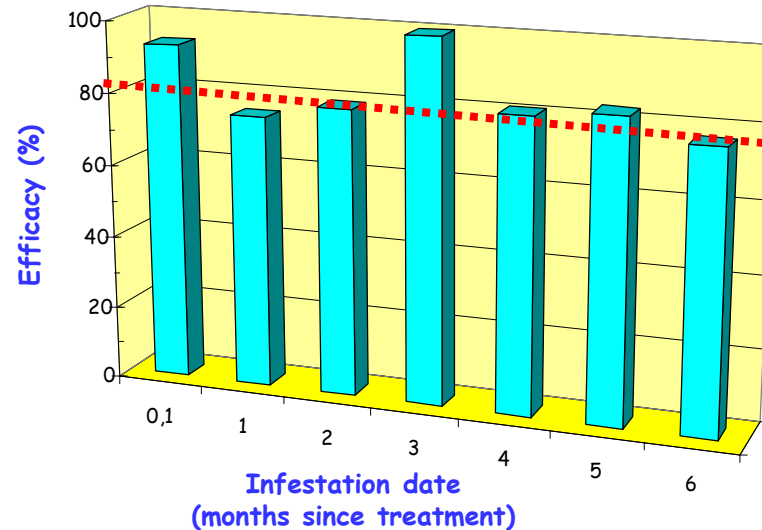


 Llácer *et al.* (2010). Evaluation of the efficacy of an insecticidal paint based on Chlorpyrifos and Pyriproxyfen in a microencapsulated formulation against *R. ferrugineus*. *J. Econ. Entomol.* 103(2): 402-408 (doi: 10.1603/EC09310)

# Research: chemical control

 Llácer *et al.* (2010). *J. Econ. Entomol.* 103(2): 402-408  
(doi: 10.1603/EC09310)

Semi-field assays:  
 Preventive




Mean efficacy:  
83.2 %  
up to 6 months




 Curative => No efficacy




# Research: natural enemies

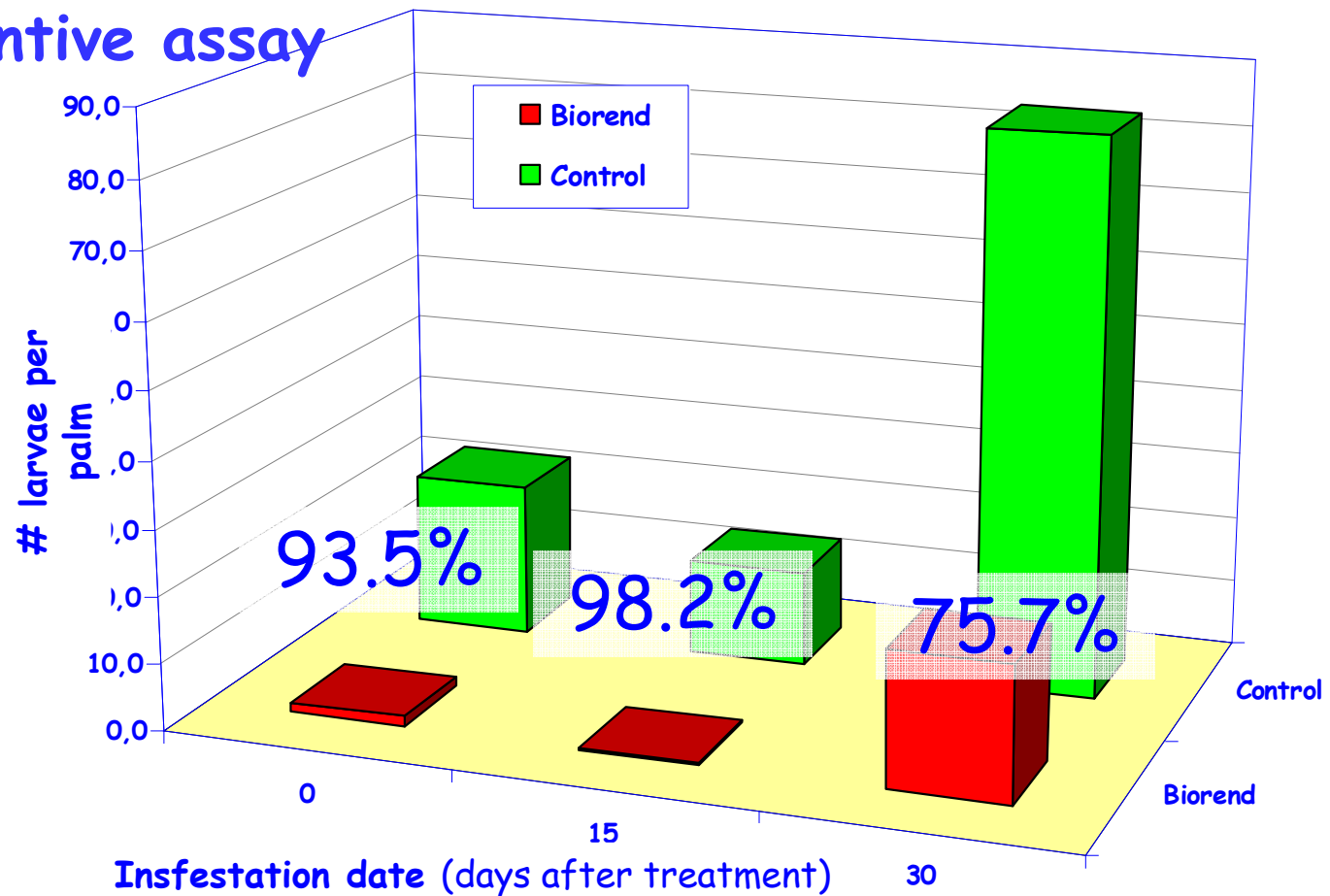


 Llácer *et al.* (2009). Evaluation of the efficacy of *Steinernema carpocapsae* in a chitosan formulation against the red palm weevil in *Phoenix canariensis*. *BioControl* 54, 559-565 (doi: 10.1007/s10526-008-9208-3)

# Research: natural enemies

 Llácer *et al.* (2009). *BioControl* 54, 559-565 (doi: 10.1007/s10526-008-9208-3)

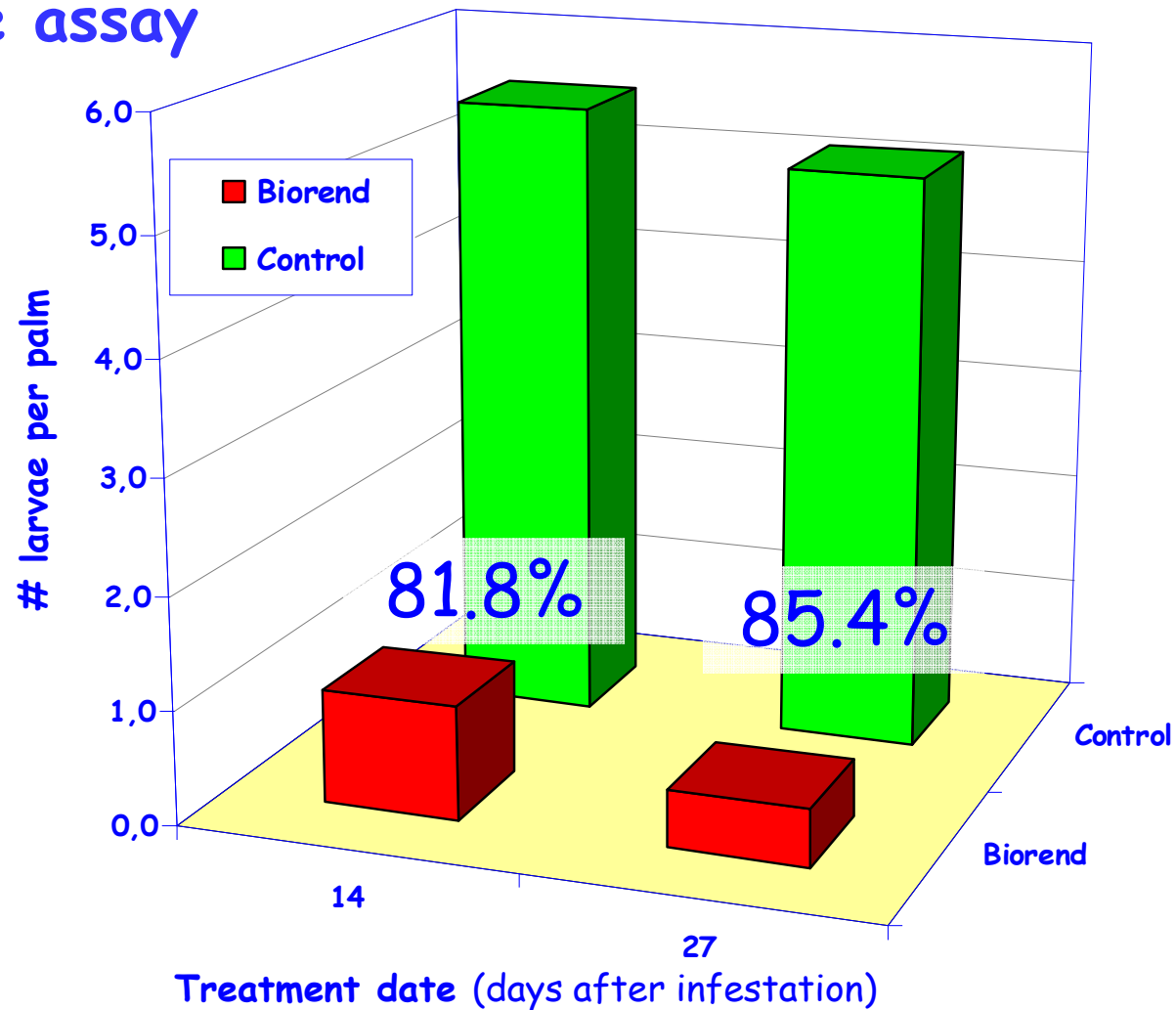
## Preventive assay




# Research: natural enemies


 Llácer *et al.* (2009) *BioControl* 54, 559-565 (doi: 10.1007/s10526-008-9208-3).

## Curative assay




# Research: natural enemies



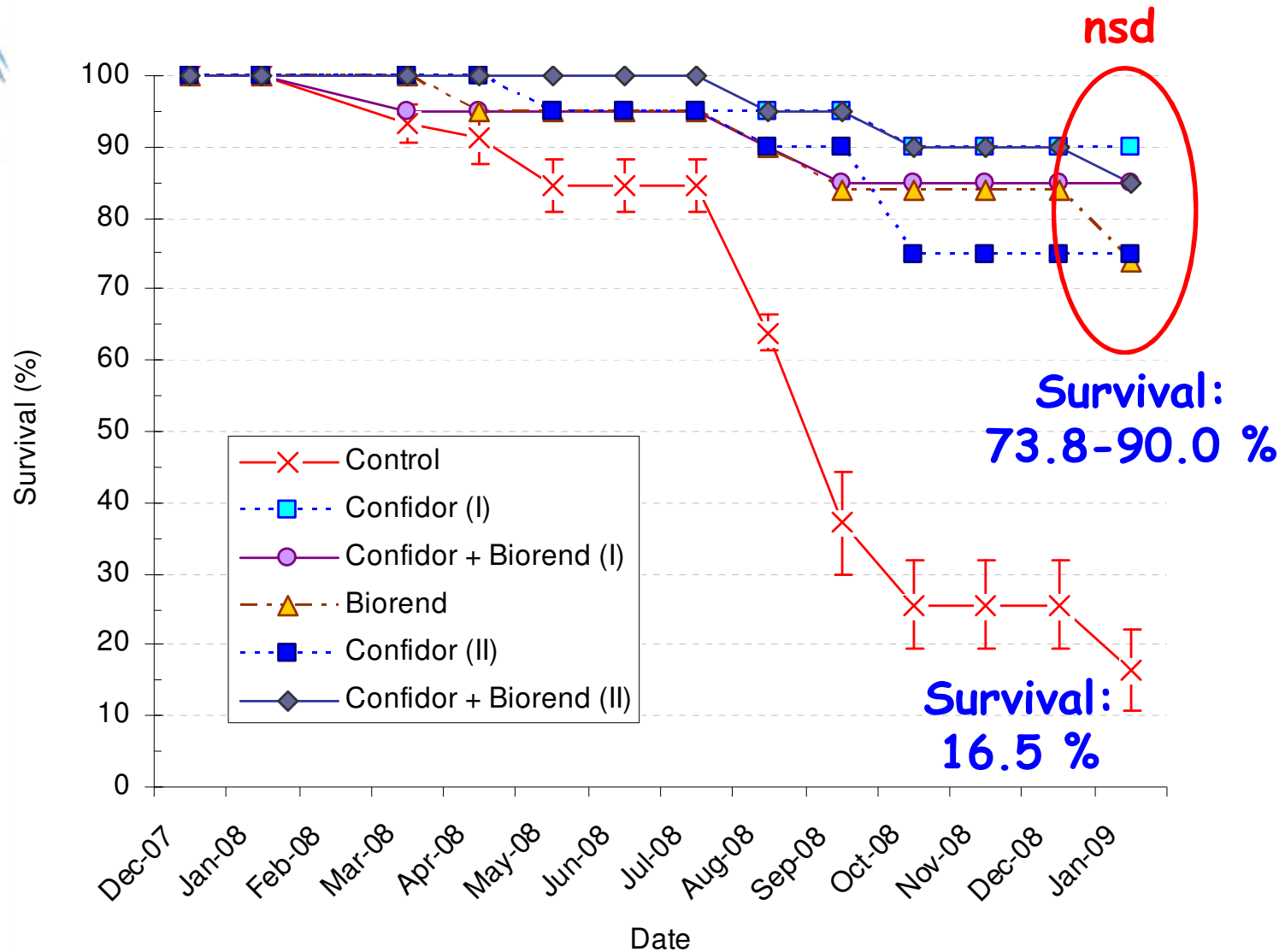
 Dembilio *et al.* (2010). Field efficacy of imidacloprid and *S. carpocapsae* in a chitosan formulation against the red palm weevil in *P. canariensis*. *Pest Manag. Sci.* 66, 365-370 (doi: 10.1002/ps1882)

# Research: natural enemies


- 
- 🐛 Dembilio *et al.* (2010). *Pest Manag. Sci.* 66, 365–370 (doi: 10.1002/ps1882)
  - 🐛 Field assay in a nursery (6–8 yr-old *P. canariensis*); 6 treatments:
    - 🐛 Control.
    - 🐛 Biorend monthly (*S. carpocapsae* + chitosan).
    - 🐛 Confidor (imidacloprid) drench in either:
      - 🐛 march and may
      - 🐛 may and july.
    - 🐛 Same as before + Biorend with first treatment (march or may) and september


# Research: natural enemies

 Dembilio *et al.* (2010) *Pest Manag. Sci.* 66, 365-370.




# Research: natural enemies



 Dembilio *et al.* (2010). Potential of an indigenous strain of the entomopathogenic fungus *Beauveria bassiana* as a biological control agent against the Red Palm Weevil. *J. Invert. Pathol.* 104, 214-221  
(doi:10.1016/j.jip.2010.04.006)

# Research: natural enemies

 Dembilio *et al.* (2010). *J. Invert. Pathol.* 104, 214-221  
(doi:10.1016/j.jip.2010.04.006)

## Laboratory:

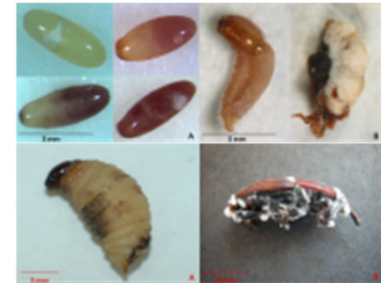
 Lower survival of treated insects.

 Disease transmission during mating: lower fecundity and egg hatching.

 Semi-field preventive assay: spray application :

 Efficacies from 70.4 to 88.7 %

 Persistence of minimum 45 d





# Acknowledgments

- ✓ To many colleagues for the data included in this talk and especially to my team members E. Llácer, Ó. Dembilio and M. Piquer.
- ✓ To the the institutions funding our reserach, especially the Valencian Department of Agriculture (CAPA) and the Spanish Ministry of Science and Innovation (MICINN).

Thank you!



UF-CTA

Potential Invasive Pests Workshop

October 10-14, 2010

Mayfair Hotel • Miami (Coconut Grove), Florida USA

# Advances in the Management of the Red Palm Weevil in Spain



Thank you for your attention!

