

Multiple snake invasions in the Balearic Islands and tools to deal with them



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background

origin



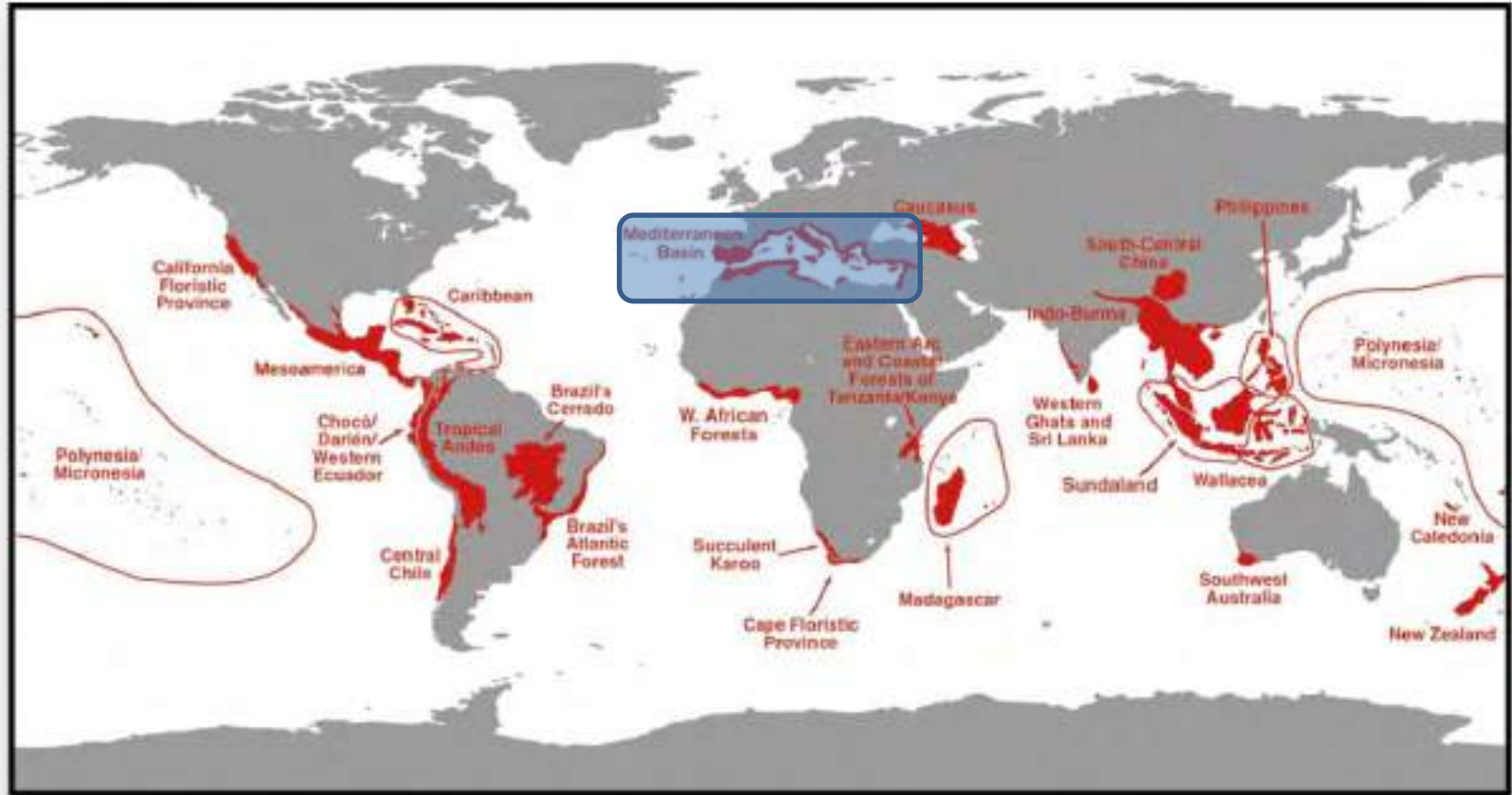
BALEARIC ISLANDS



impact

actions

Global biodiversity hotspots



Myers *et al.* (2000)

background

origin

impact

actions

The Mediterranean Basin

snakes in the Balearics



Messinian salinity crisis



Glacial refugia

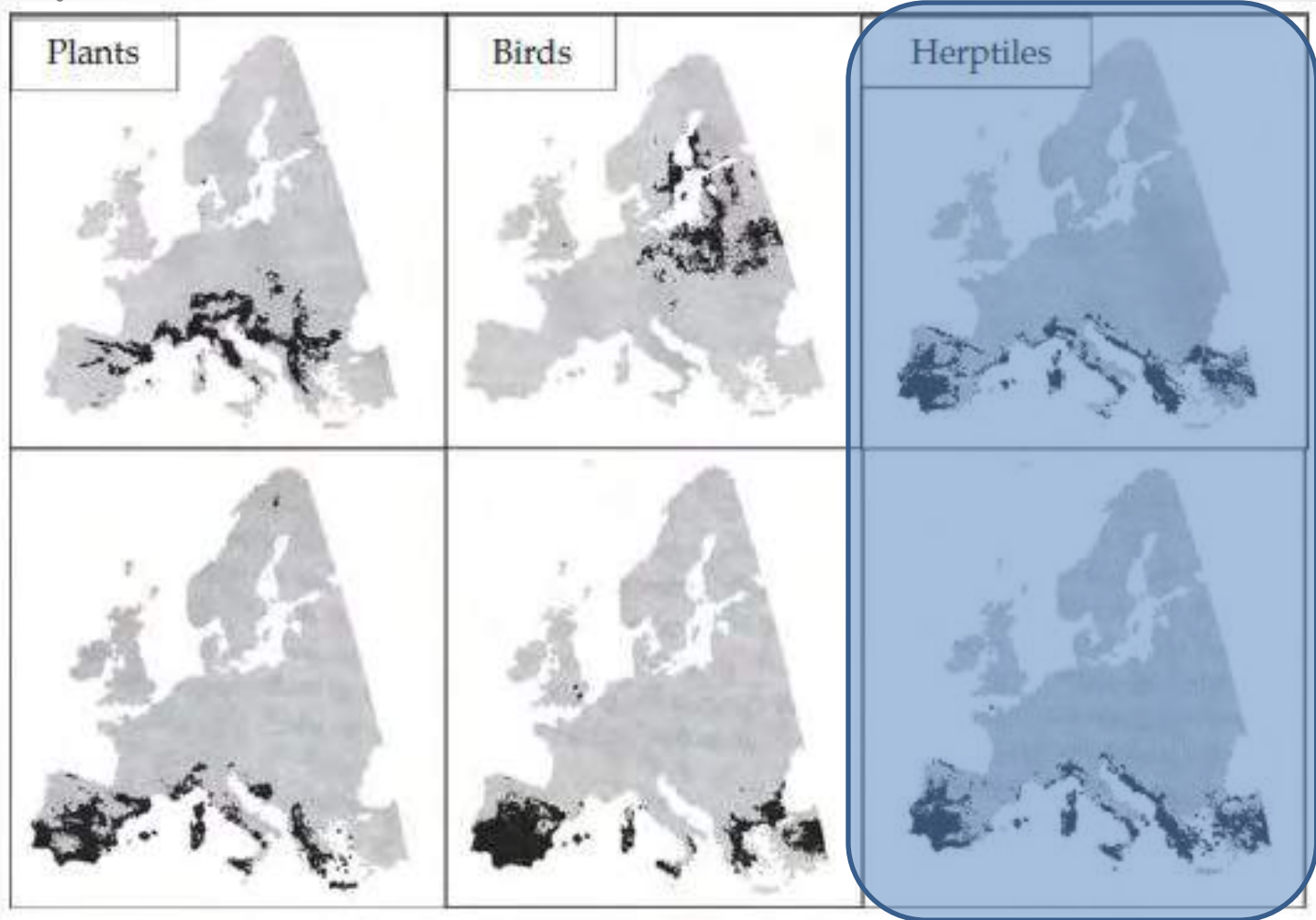
background

origin

impact

actions

Species and endemism richness



Araújo *et al.* (2000)

Since the Neolithic...

background

origin



Nuraghi



Phoenicians



Ancient Greeks



Romans



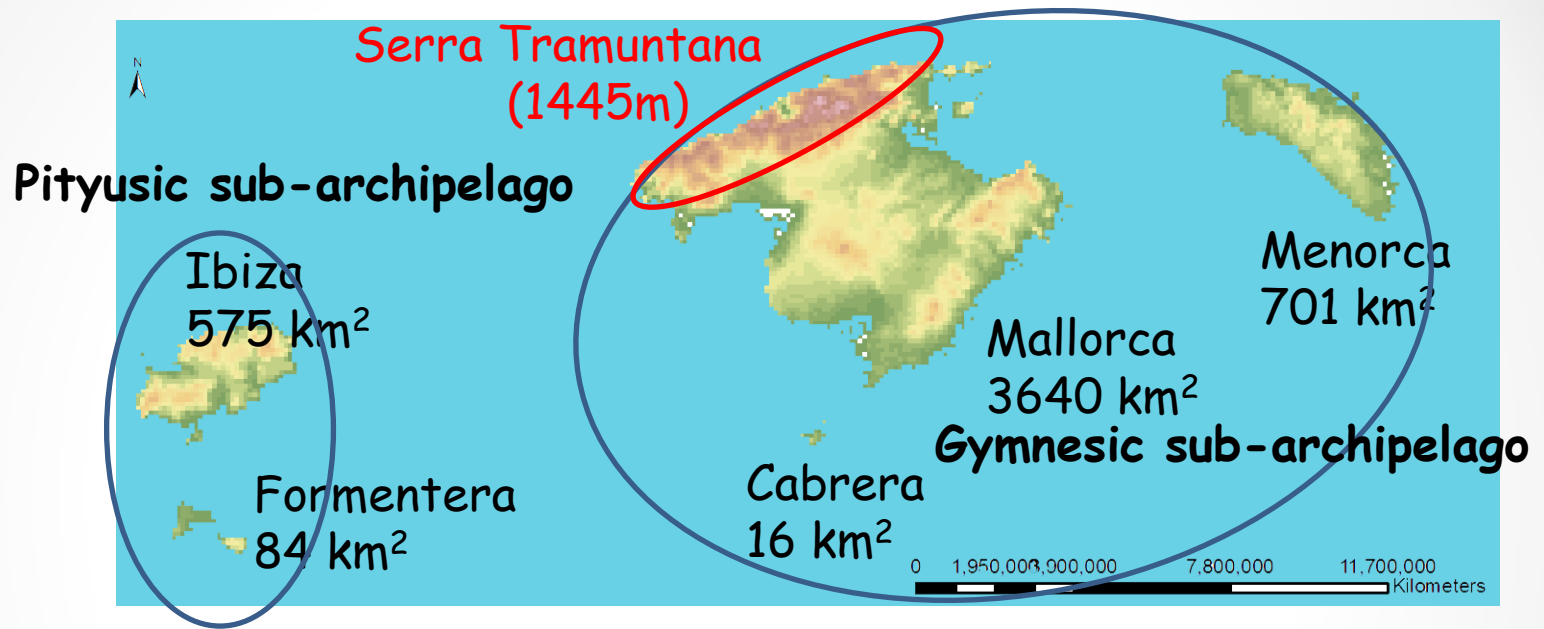
Arabs



impact

actions

The Balearic Islands



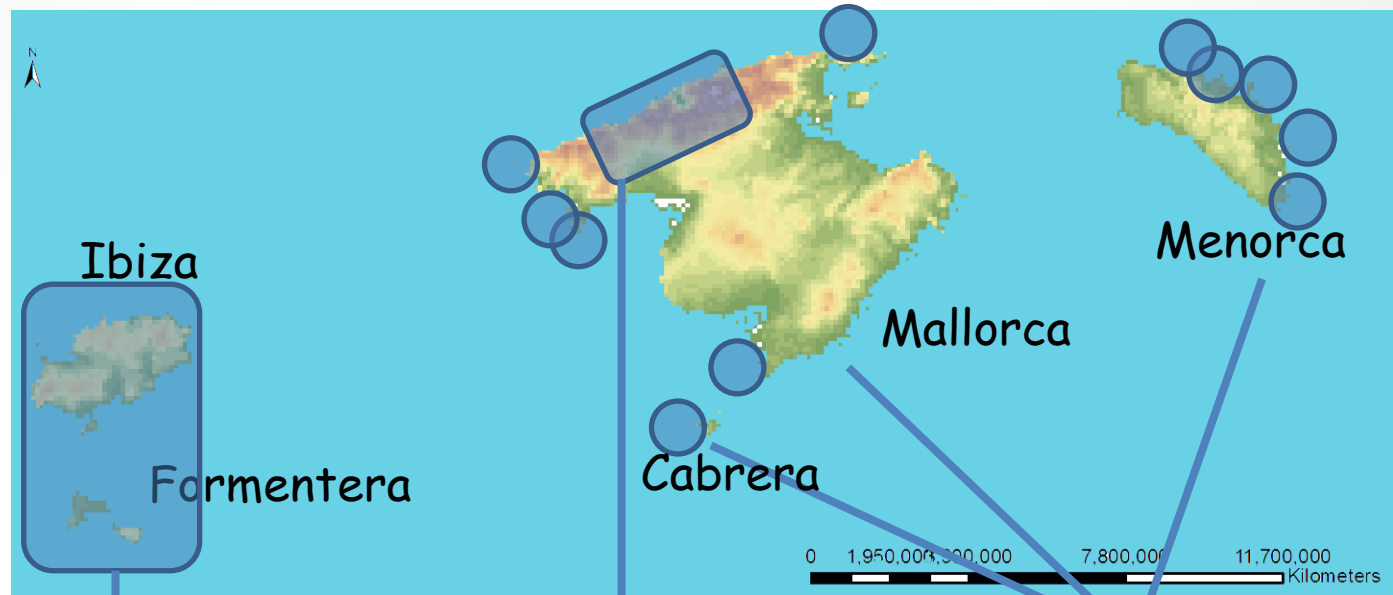
background

origin

impact

actions

Native herpetofauna



Podarcis pityusensis



Alytes muletensis



Podarcis lilfordi

background

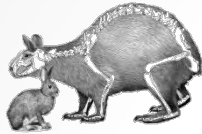
origin

impact

actions

Multiple historical and recent invasions

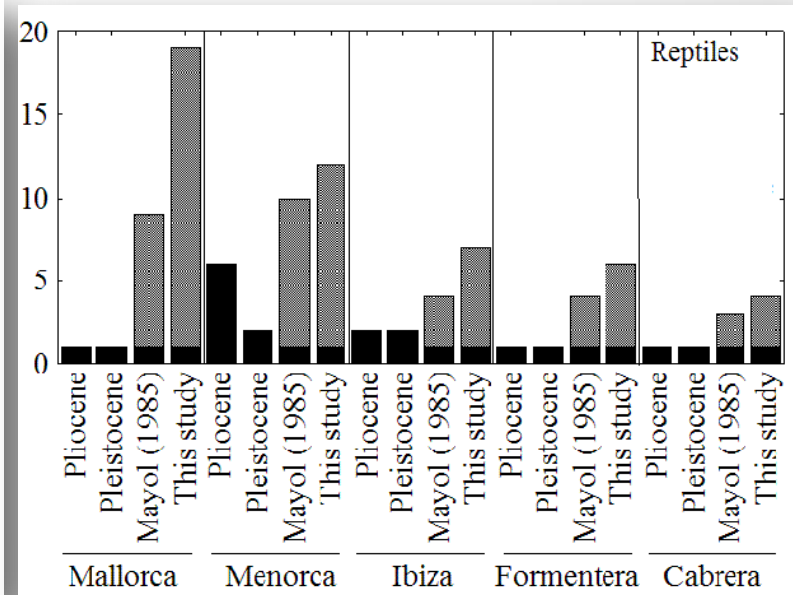
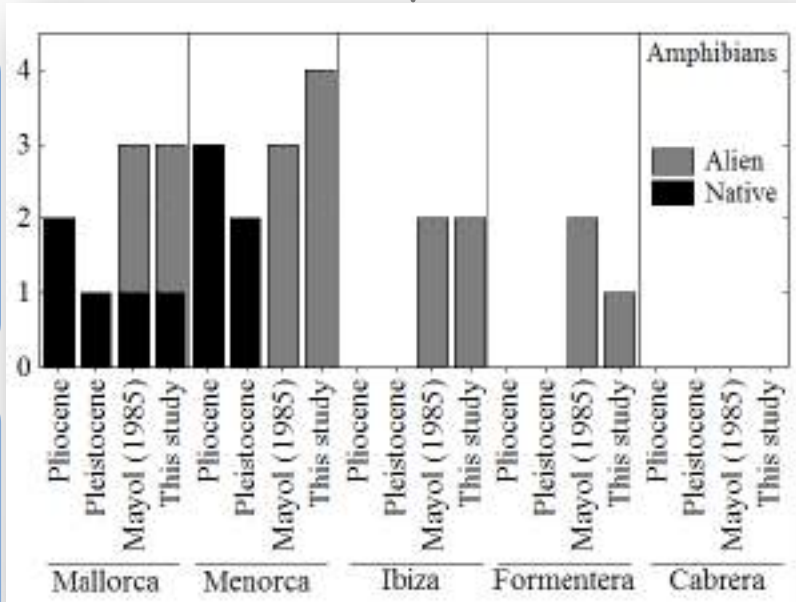
First human settlements: 3000 BCE



Nurolagus rex† *Myotragus balearicus*† *Hypnomys morpheus*† *Capra aegagrus* *Atelerix algirus* *Rattus* sp. *Mustela nivalis*

Bover *et al.* (2008)

Herpetofauna follows the same pattern



Pinya & Carretero (2011)

background

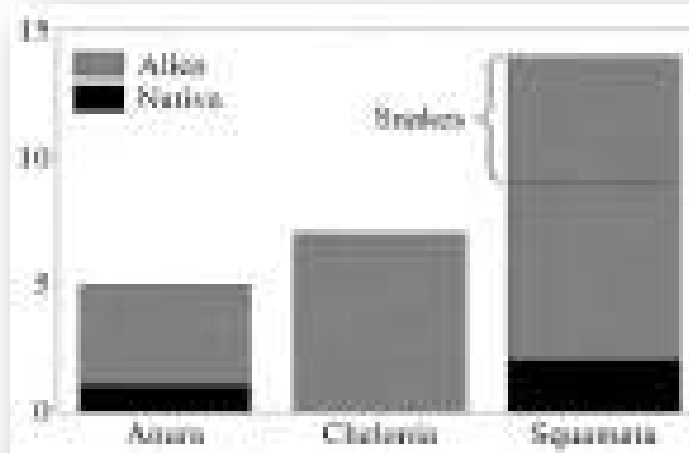
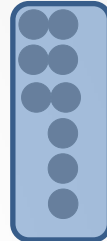
origin

impact

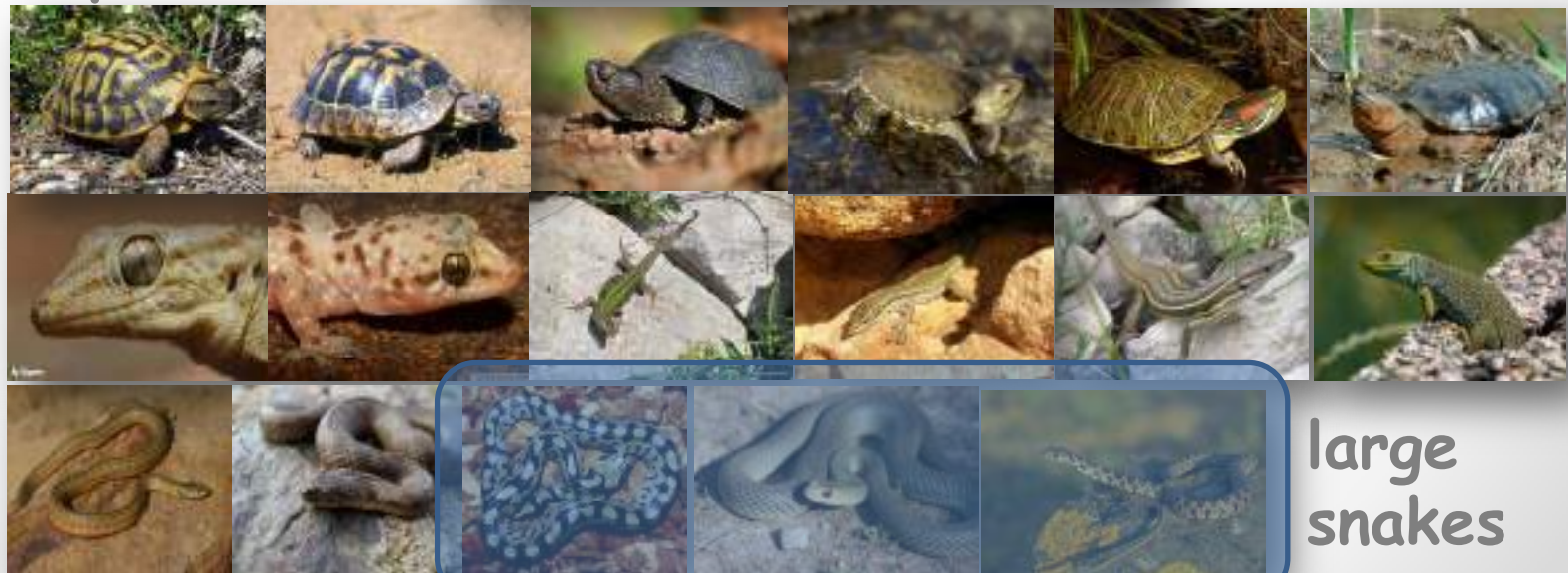
actions

Historical and recent aliens

500BCE 0 500CE 1000CE 1.500CE 2000CE



Reptiles



large
snakes

background

origin

impact

actions

background

origin

impact

actions

	Mallorca	Menorca	Ibiza	Formentera	Cabrera
CHELONIA					
<i>Testudo hermanni</i>	Na	Na	-	-	-
<i>Testudo graeca</i>	Na	-	Ex	Na	-
<i>Emys orbicularis</i>	Na	Na	-	-	-
<i>Trachemys scripta</i>	Na	Aa	Aa	-	-
<i>Chrysemys picta</i>	Na	-	-	-	-
<i>Mauremys leprosa</i>	Na	Aa	-	-	-
<i>Chelydra serpentina</i>	Aa	-	-	-	-
SQUAMATA					
<i>Chamaeleo chamaeleon</i>	Aa	-	-	-	-
<i>Tarentola mauritanica</i>	Na	Na	Na	Na	Na
<i>Hemidactylus turcicus</i>	Na	Na	Na	Na	Na
<i>Podarcis lilfordi</i>	Nv	Nv	-	-	Nv
<i>Podarcis pytiusensis</i>	Na	-	Nv	Nv	-
<i>Podarcis sicula</i>	-	Na	-	-	Na?
<i>Psammodromus algirus</i>	Na	-	-	-	-
<i>Scelarcis perspicillata</i>	-	Na	-	-	-
<i>Timon lepidus</i>	Aa	-	-	-	-
<i>Macroprotodon mauritanicus</i>	Na	Na	-	-	-
<i>Natrix maura</i>	Na	Na	-	-	-
<i>Malpolon monspessulanus</i>	Aa	-	Na	Aa	-
<i>Hemorrhois hippocrepis</i>	Na	-	Na	-	-
<i>Rhinechis scalaris</i>	Aa	Na	Na	Aa	-

background

Are they really aliens?

origin

Where they come from?

How did they arrive?

impact

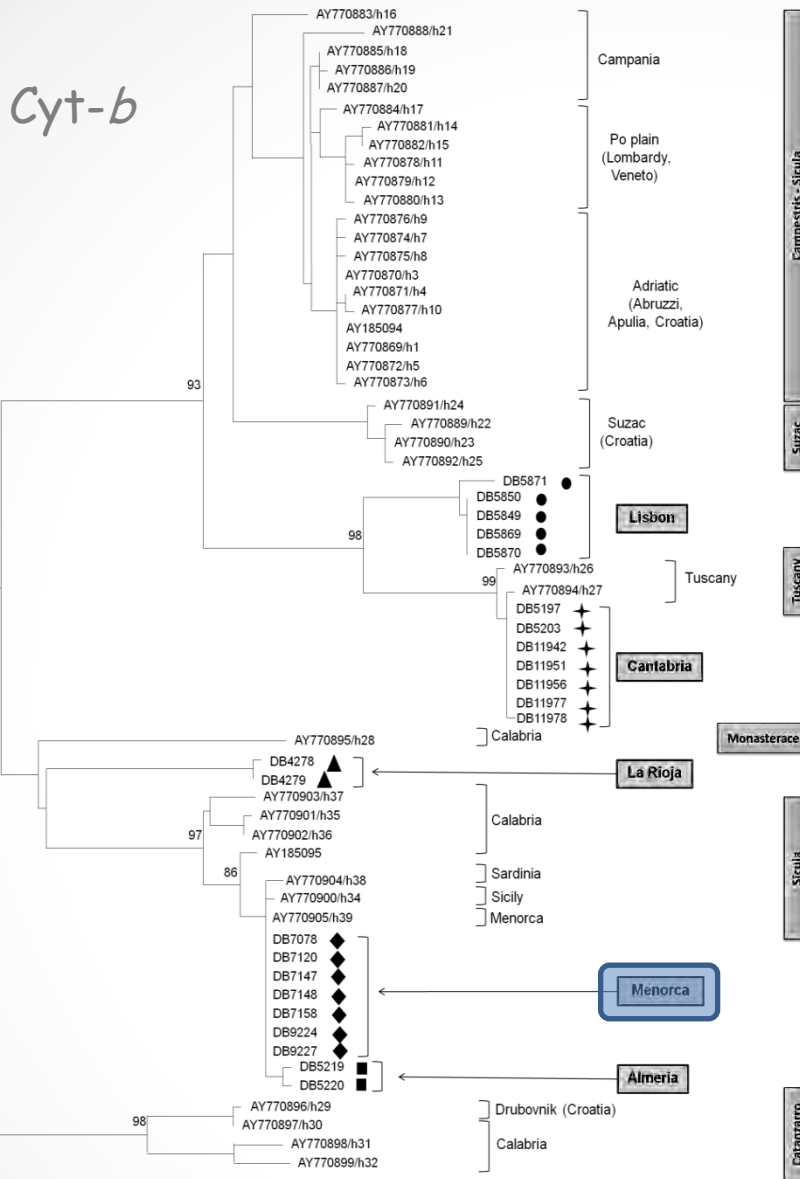
actions

background

origin

impact

actions



snakes in the Balearics

Podarcis sicula



Silva-Rocha *et al.* 2012

Type of introduction: Passive Transport (cargo?)
 Distribution: Menorca (Mallorca)
 Origin: Sicily-Sardinia.

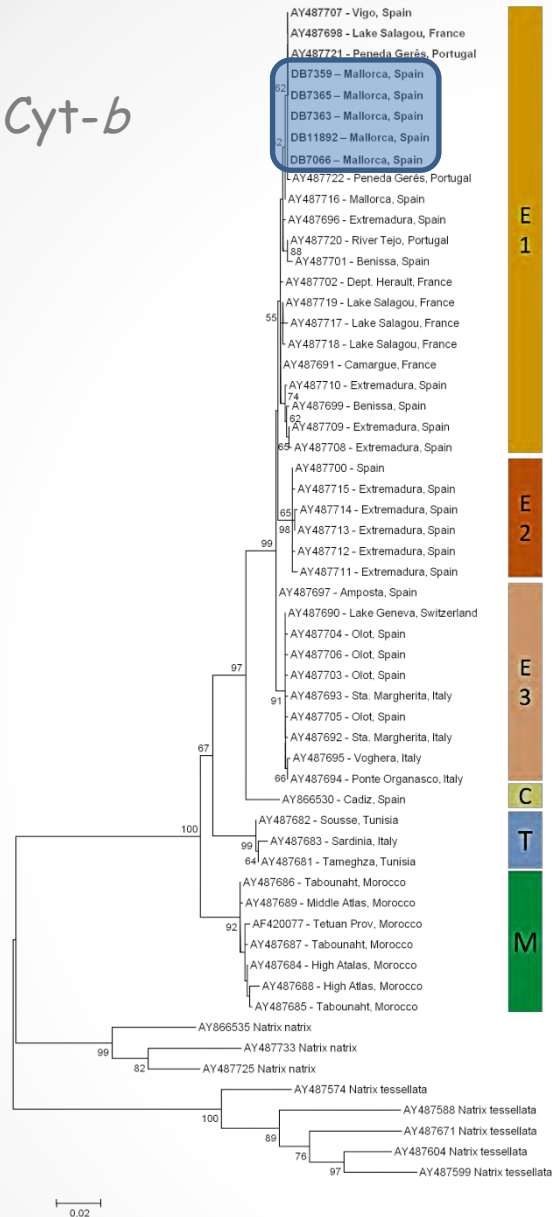
background

origin

impact

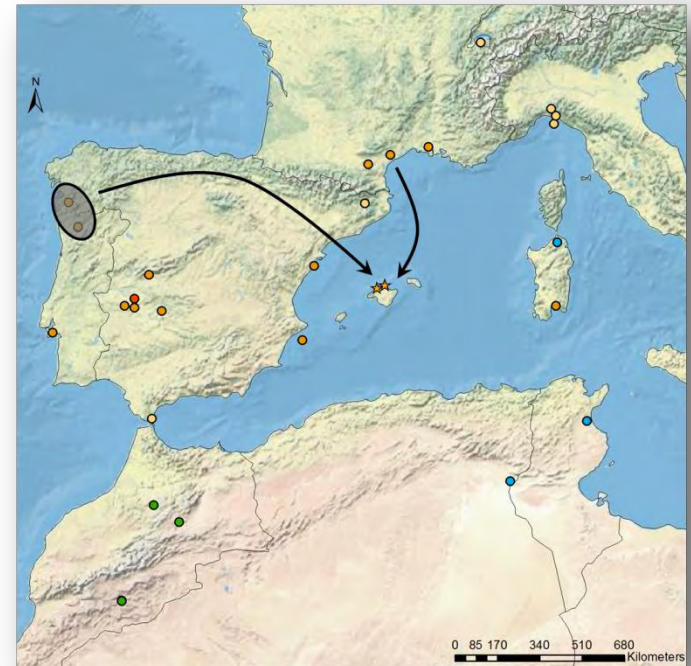
actions

Cyt-b



snakes in the Balearics

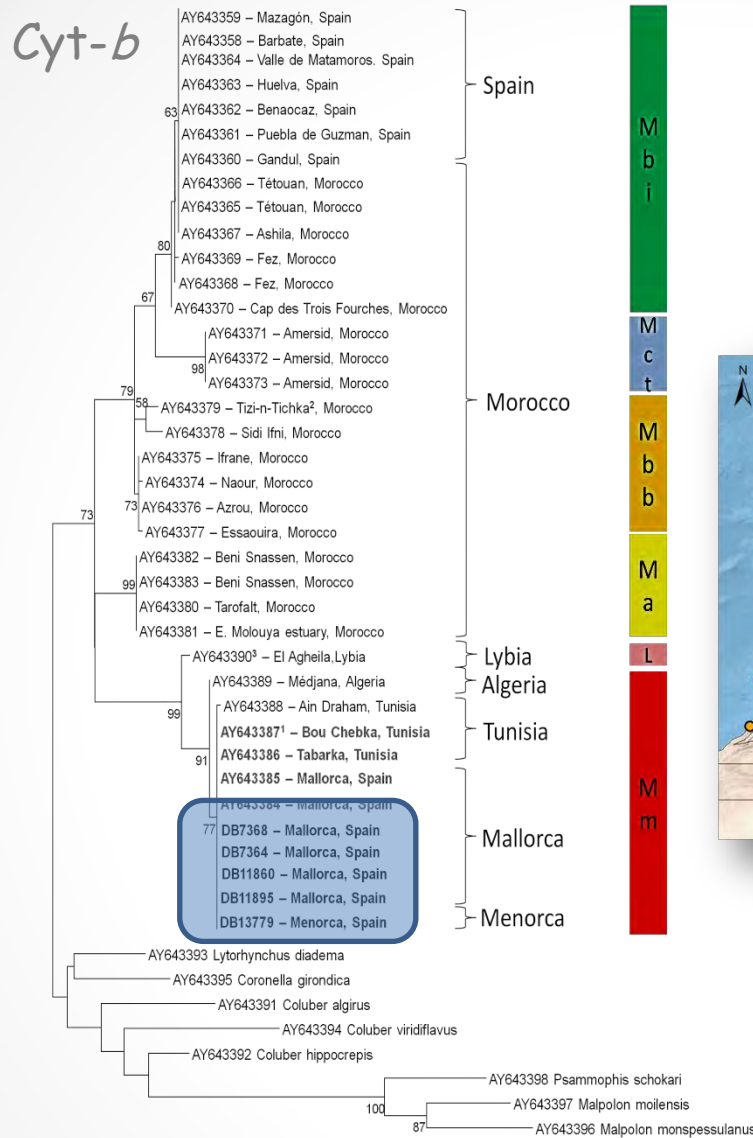
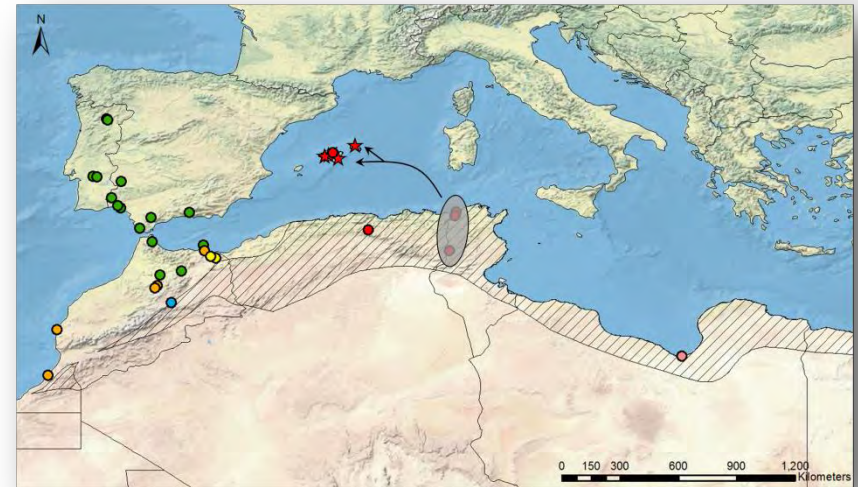
Natrix maura



Type of introduction: Active (religious) or passive (cargo?)
 Distribution: Mallorca and Menorca
 Origin: European

snakes in the Balearics

Macroprotodon sp.



Type of introduction: Active (religious) or passive (cargo?)
Distribution: Mallorca and Menorca
Origin: Tunisia/Algeria (*M. mauritanicus*)

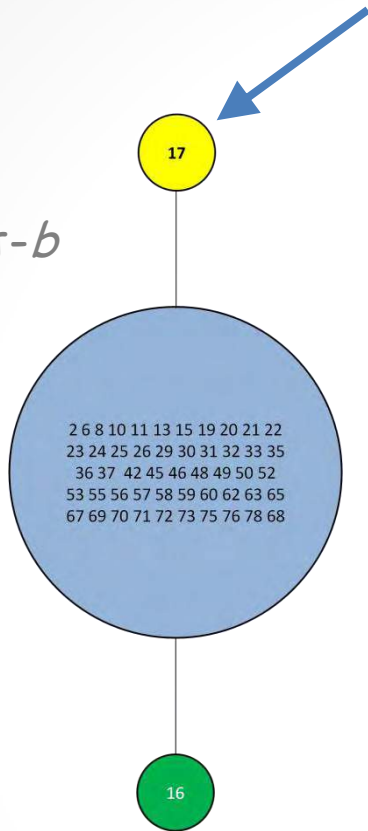
background

origin

impact

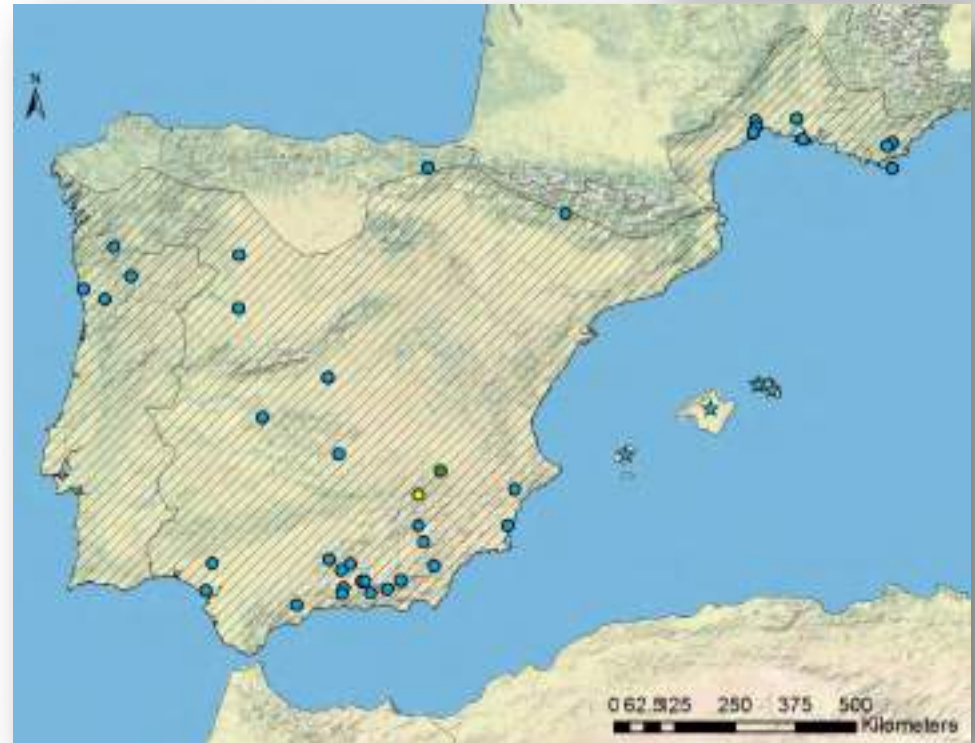
actions

Cyt-*b*



snakes in the Balearics

Rhinechis scalaris



Type of introduction: Tree trade (Menorca?)

Distribution: Menorca (Mallorca, Ibiza and Formentera)

Origin: Iberian Peninsula

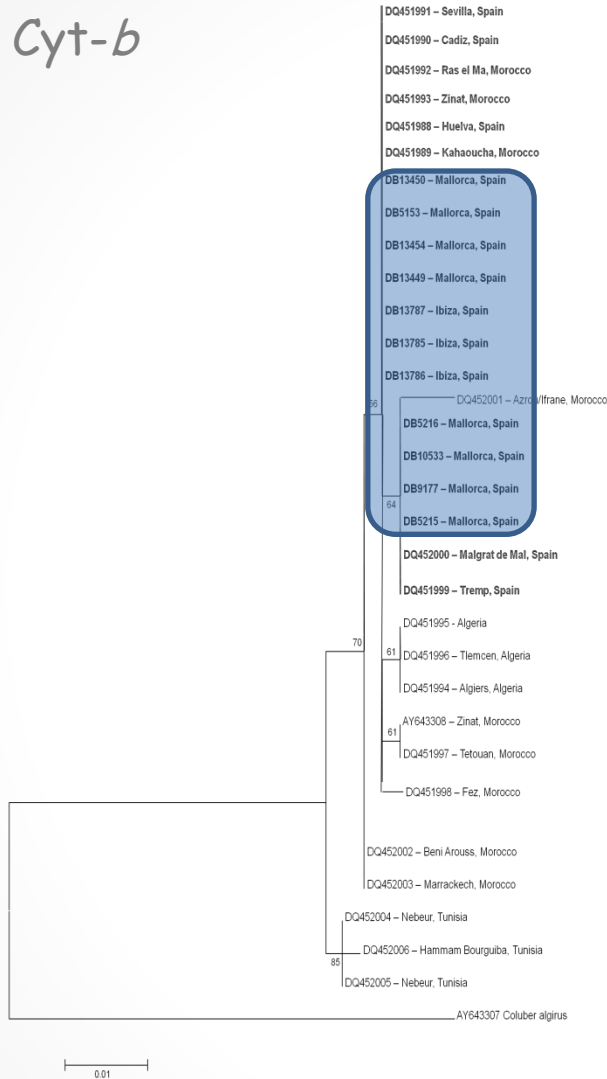
background

origin

impact

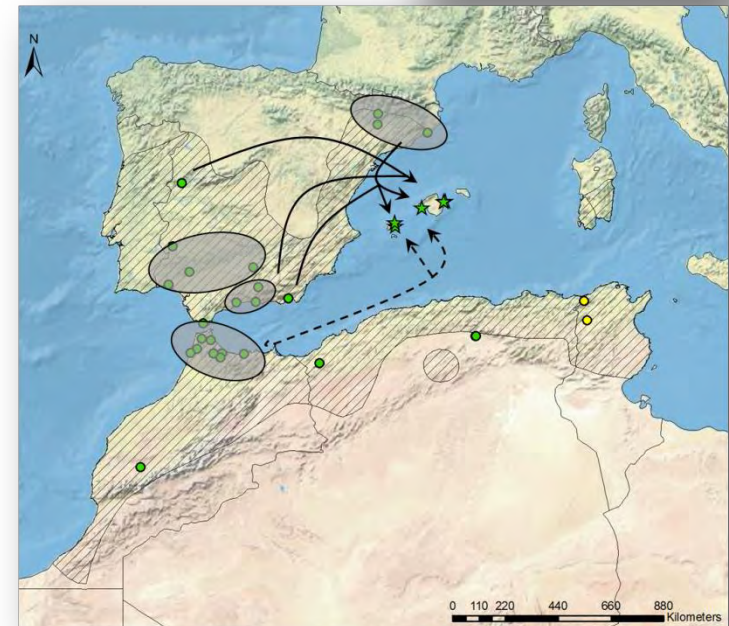
actions

Cyt-b



snakes in the Balearics

Hemorrhois hippocrepis



Type of introduction: Tree trade

Distribution: Mallorca, Ibiza and Formentera

Origin: Iberian Peninsula (N Africa)

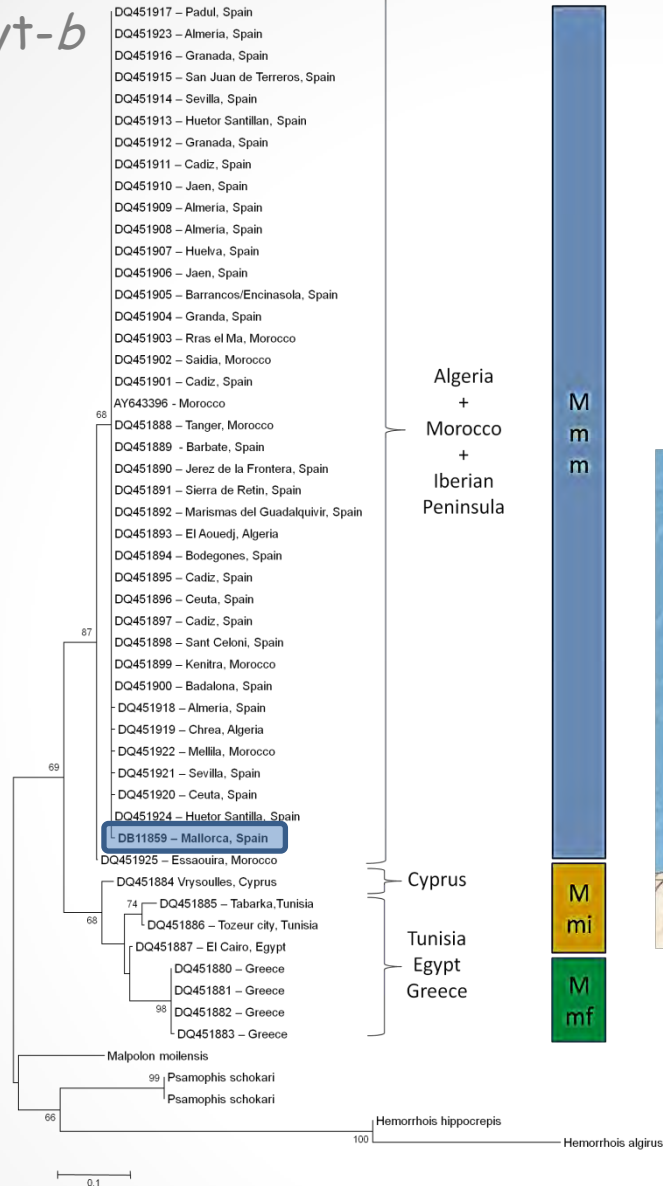
background

origin

impact

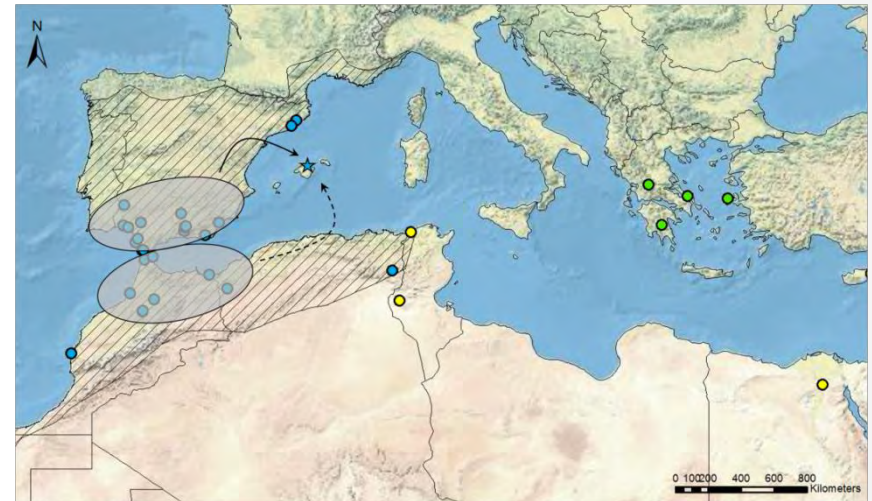
actions

Cyt-b



snakes in the Balearics

Malpolon monspessulanus



Type of introduction: Tree trade

Distribution: Mallorca, Ibiza and Formentera

Origin: Iberian Peninsula (N Africa)

background

origin

impact

actions

Are they really aliens?

Where they come from?

How did they arrive?

Why did not they arrive earlier?

background

Cargo trade



origin



impact



actions



background

More cargo trade...only?

origin



impact

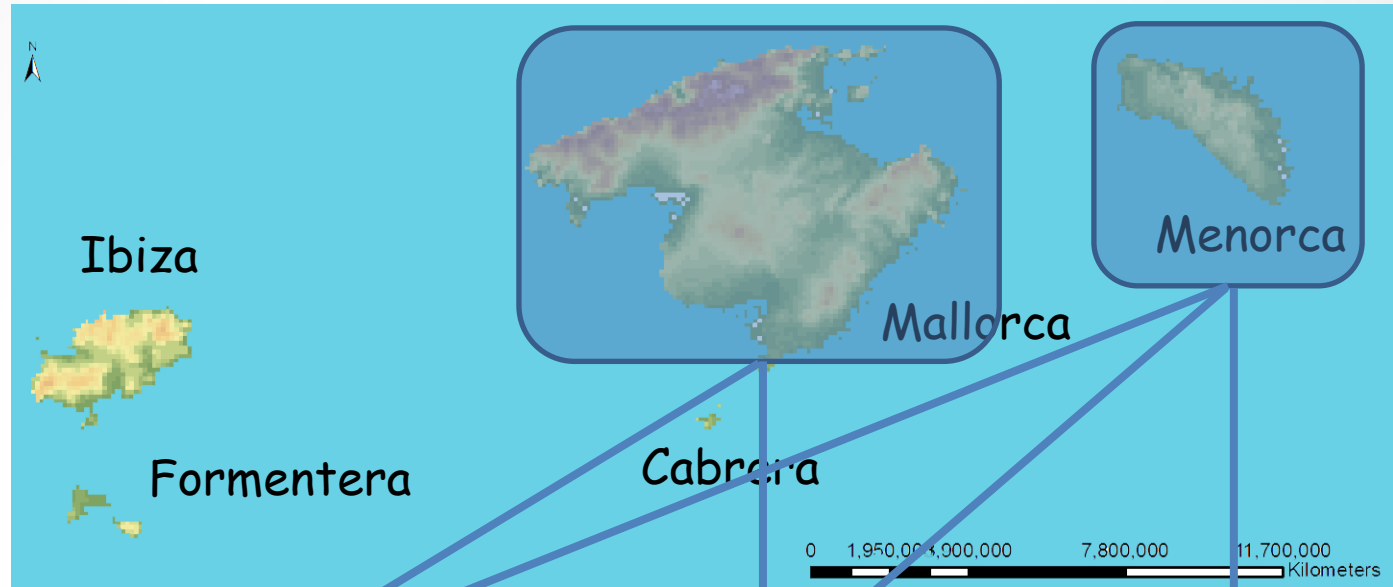


actions



Alien snakes (1985)

Mayol (1985)



Natrix maura



Macroprotodon mauritanicus



Rhinechis scalaris

background

origin

impact

actions

Pet trade...only?

background

origin

impact

actions



Trachemys scripta



Chelhydra serpentina



Back to the past

Ibiza, an island refractory to venom and toxic for snakes



Bes, the serpenticide god



Plinius The Old



Columbraria



"The land of Ebussus [Ibiza] repels the snakes, and that of Columbraria [Columbretes] begets them and is very harmful for everyone, unless you bring Ebussian soil with you"



background

origin

impact

actions

background

origin



impact

actions

So, what else?

Since the Ancient Greeks, olive culture has been important in the economy of the Balearic Islands.

I century: the historian *Diodorus Siculus* already mentions the existence of grafted olive trees in Ibiza.



However extensive olive tree only starts at the end of XX century.

background

So, what has changed?

During the last 25 years the use of old olive trees for gardening has greatly increased across the Mediterranean Basin.



origin

impact

actions

background

Common Agricultural Policy (EU)

Removal of low production olive trees
(north, <15% slope)

Reused for:

- Public gardens
- Roundabouts
- Touristic urbanisations

origin



impact



actions



background



origin

About 950,000 trees have been removed over the last decade. Same has been transplanted far from the original sites.

impact



In the Balearics, very old olive trees are protected and many are on steep slopes.

Many garden trees are imported from the Iberian Peninsula.

actions



Inside the old, hollow trees stowaways are travelling

Olive tree trade is not exclusive from the Balearics...

Girona, Zaragoza, Rioja



Aix en Provence, Cannes



but...



Capdepera (Mallorca)



Magaluf (Mallorca)



Sant Llorenç (Ibiza)

background

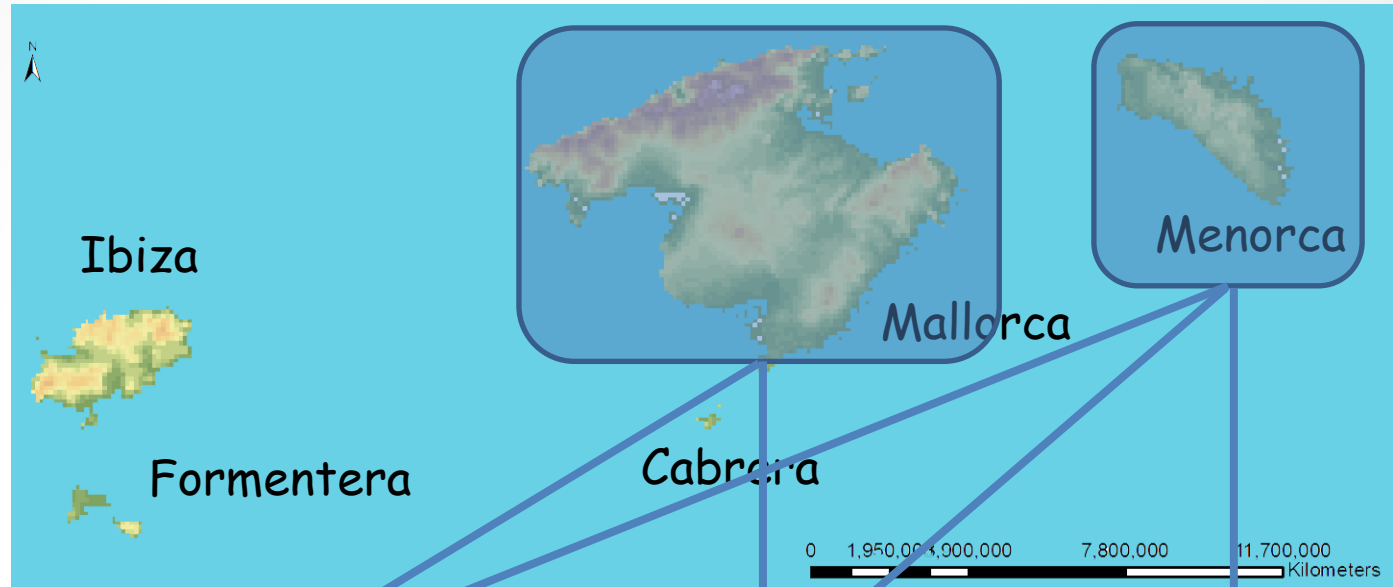
origin

impact

actions

Alien snakes (2014)

Pinya & Carretero (2011)



Natrix maura



Macroprotodon mauritanicus



Rhinechis scalaris

background

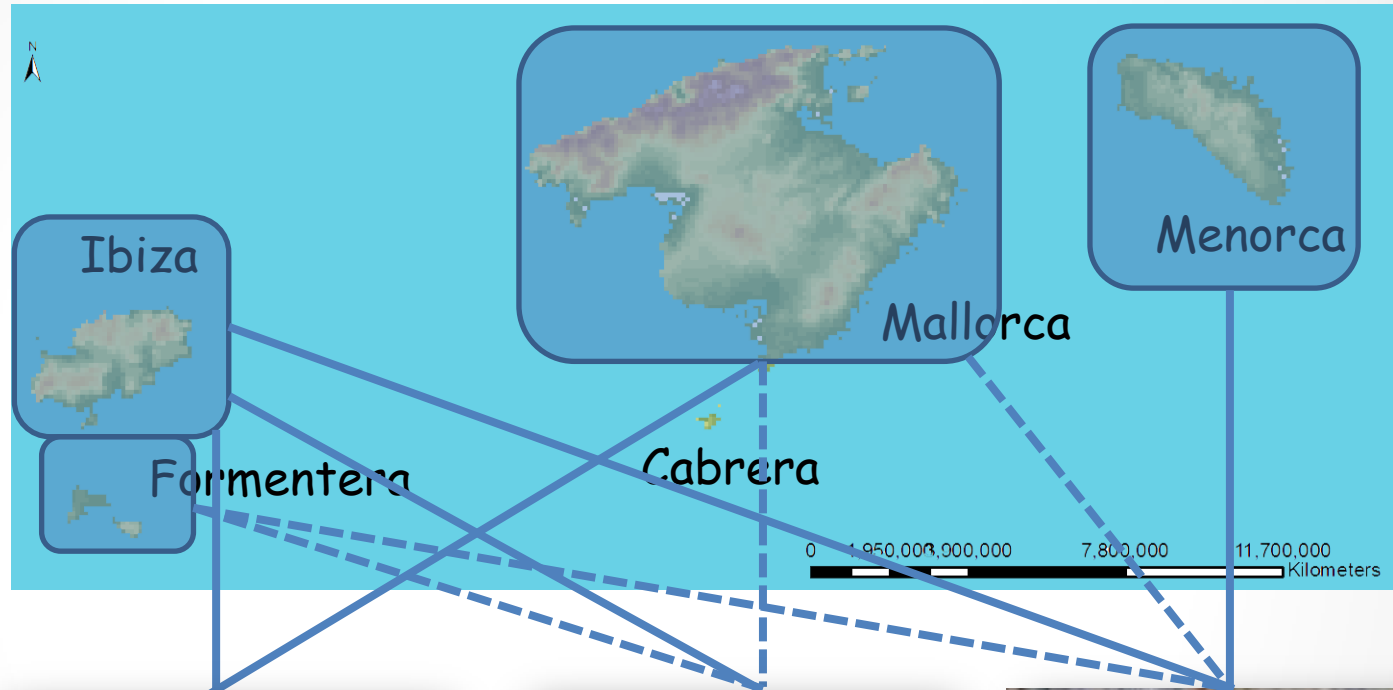
origin

impact

actions

Alien snakes (2014)

Pinya & Carretero (2011)



*Hemorrhois
hippocrepis*



*Malpolon
monspessulanus*



Rhinechis scalaris

background

origin

impact

actions

background

Which would be the effects?

- on ecosystems
- on species
- on people

origin

impact

actions

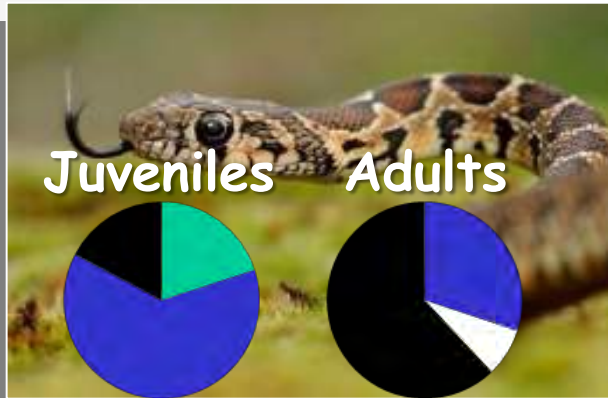
background

origin

impact

actions

Prey



Hemorrhois hippocrepis



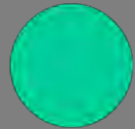
Rhinechis scalaris



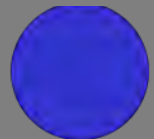
Malpolon monspessulanus



Insects



Reptiles



Birds



Mammals



Predators

background

origin

impact

actions



Hemorrhois hippocrepis
(active forager)



Rhinechis scalaris
(active forager)



Malpolon monspessulanus
(sit and wait)



Risk to humans?



None of the large three ophidians recently introduced in the Balearics is dangerous to humans.

Only *Malpolon monspessulanus* have opisthoglyph inoculating teeth making bite difficult; venom is little active to humans

background

origin

impact

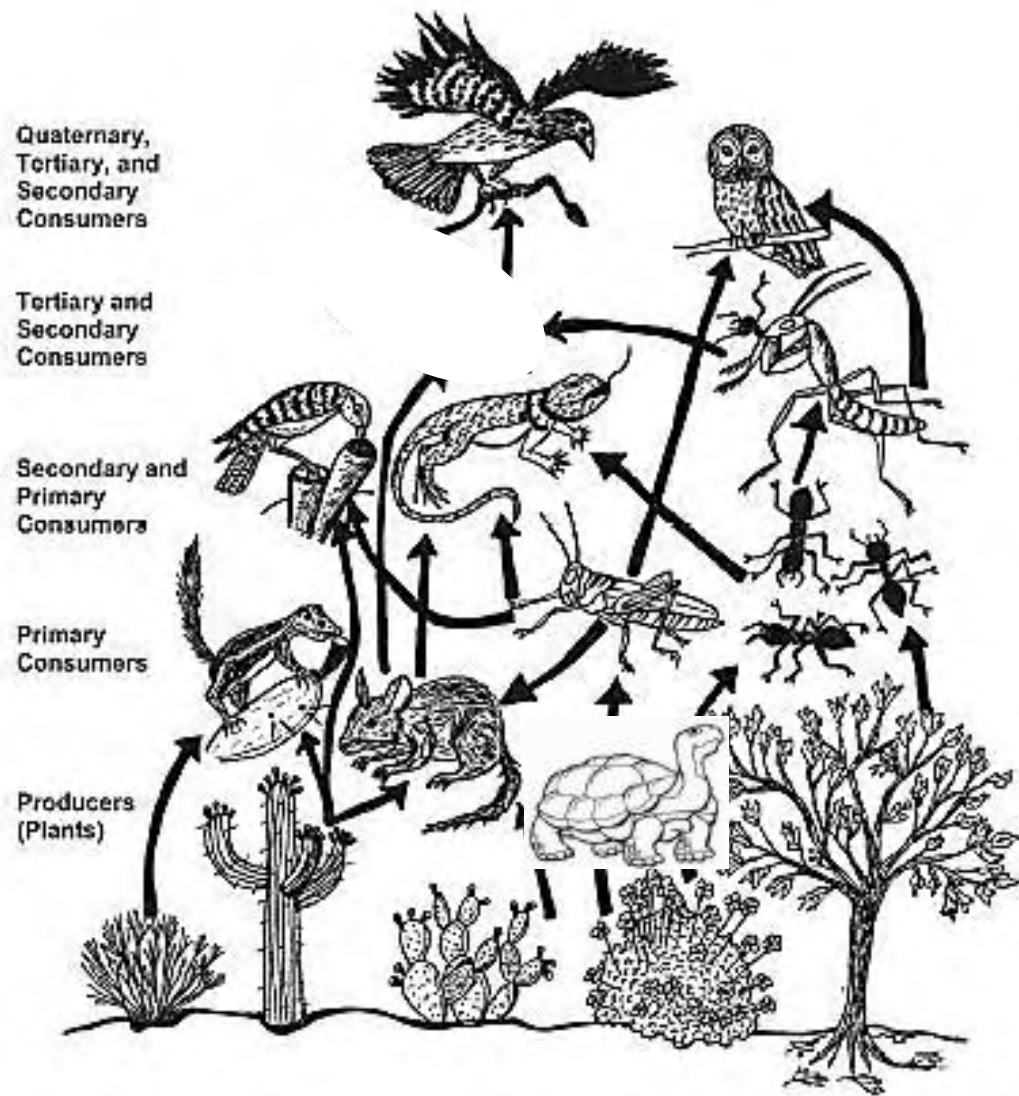
actions

background

origin

impact

actions



background



Impact on ground nesting birds

Stronger effects on native lizards

origin

Ibiza & Formentera



Podarcis pityusensis



impact

Mallorca & Menorca



Podarcis lilfordi



actions

background

What can be done?

- Monitoring
- Predicting
- Extirpating

origin

impact

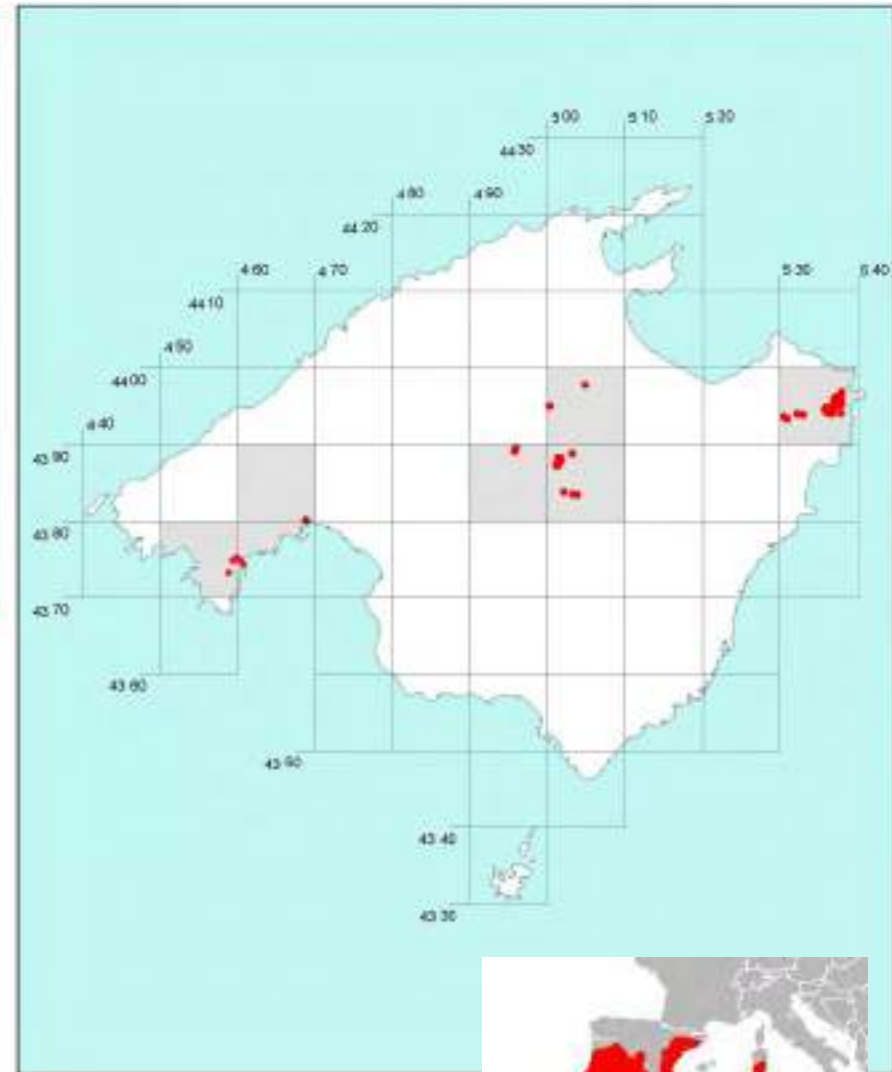
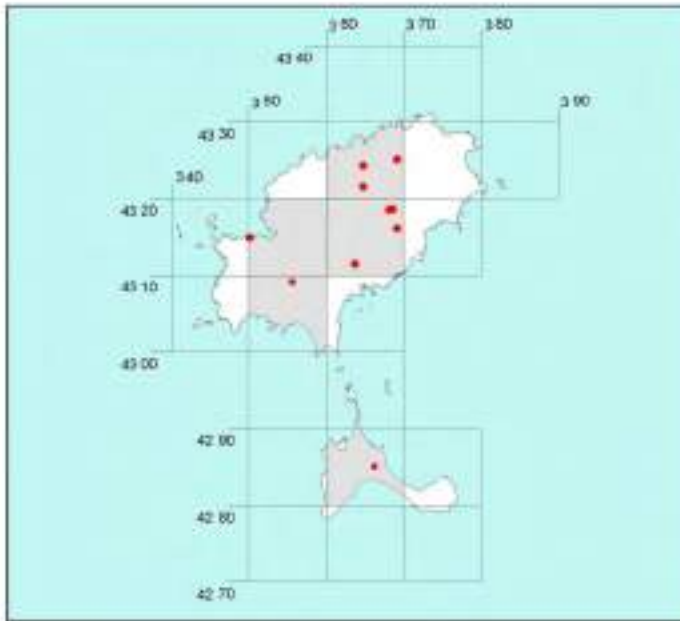
actions

background

origin

impact

actions



*Hemorrhois
hippocrepis*

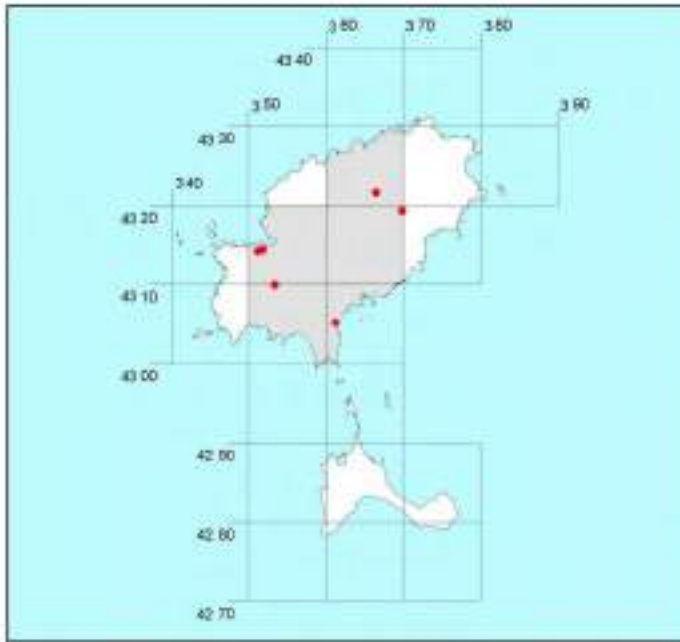


background

origin

impact

actions



*Malpolon
monspessulanus*

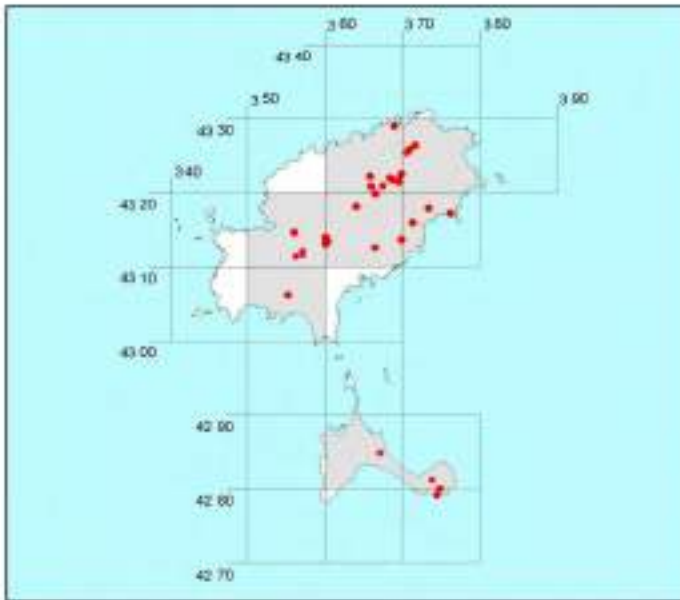


background

origin

impact

actions



*Rhinechis
scalaris*



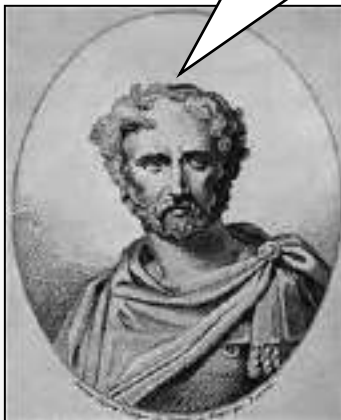
background

Monitoring

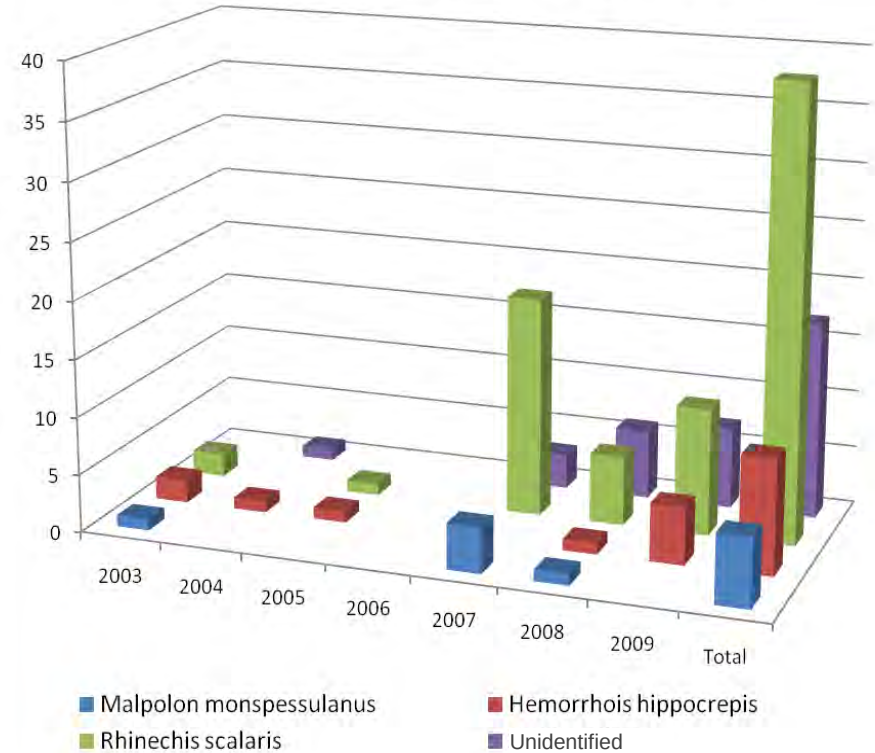
First record in Ibiza:
2003

Since then: hundreds
of observations and
captures.

Ego erravi
(I was wrong)



Records by species and year in Ibiza



impact

actions

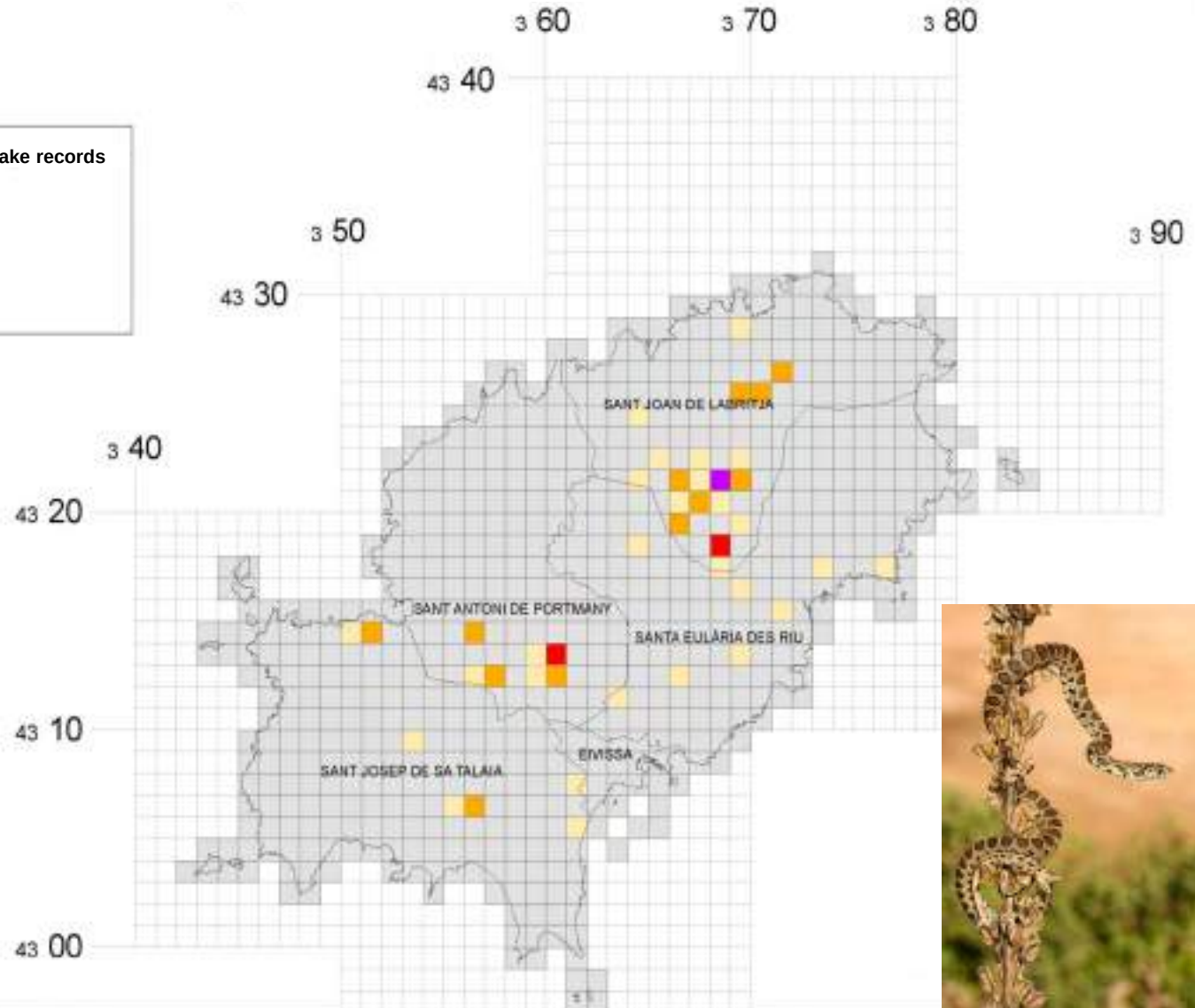
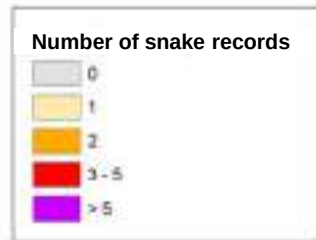
background

origin

impact

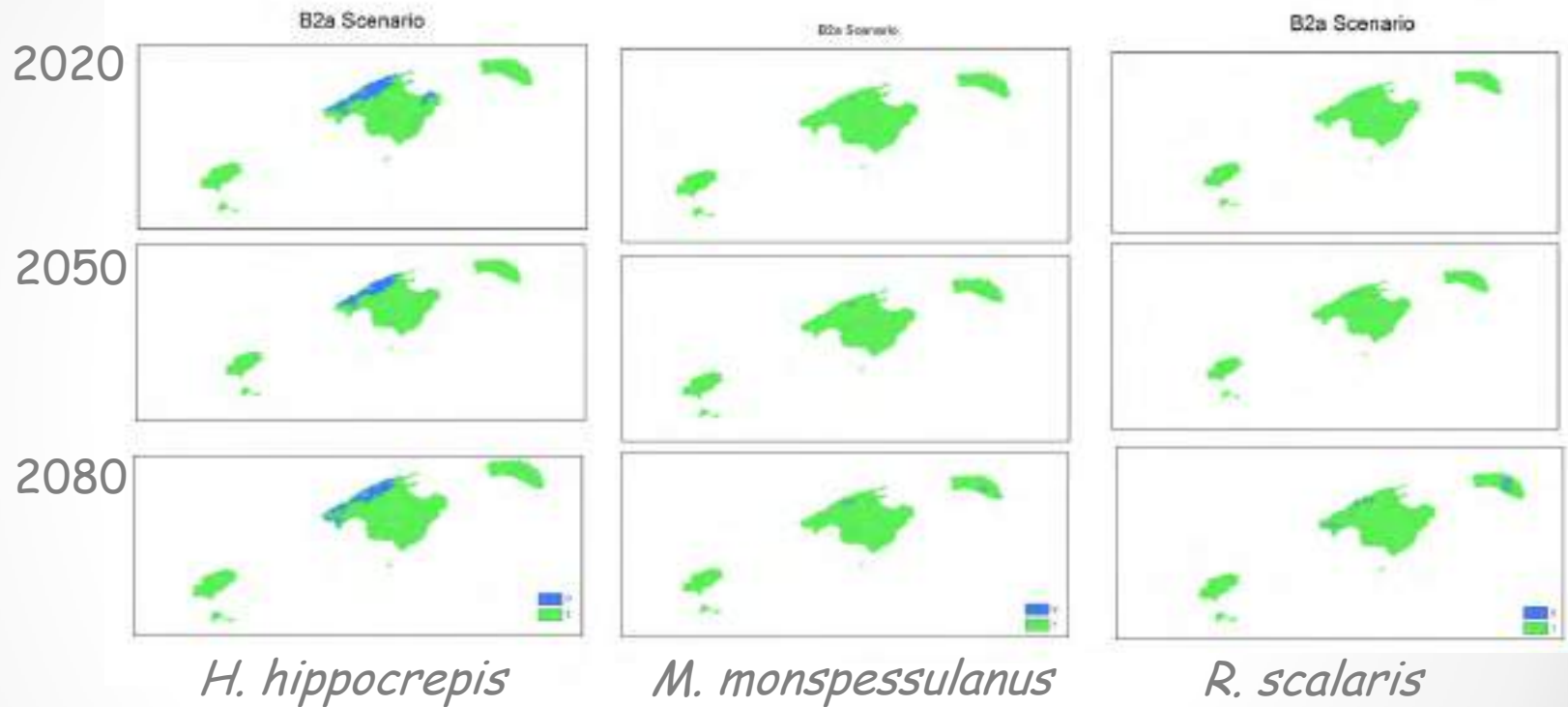
actions

Record quantification in Ibiza



Predicting expansion with ecological modelling

MaxEnt models from native range projected to the future



background



Testing snake trapping (2011)

origin



impact



actions



background

origin

impact

actions



Test in a high density area:
Sa Porrassa
- 10 funnel traps (4 weeks)
- 10 sticky traps (4 weeks)



+



=



background

Test in a low density area: surroundings of Capdepera (W Mallorca) close to a tree nursery



Effectiveness decreases as we move away from hotspots



impact

actions

background

origin

impact

actions



Hotspots:

- Dog detection
- Manual collection
- Trapping
- Fumigation
- Fences
- Decrease of refuges for snakes and their prey

Low density areas:

- Information networks
- Dog detection
- Manual collection
- Trapping (many or large traps)

Management guidelines for owners of tree nurseries and importers

Legislation (Balearics, Spain, EU)

background

origin

impact

actions



¡Gracias! Thank you!

Govern de les Illes Balears
Servei de Protecció d'Espècies
Agentes de Medio Ambiente
de Ibiza y Formentera
Departaments de Medi Ambient
de Consells Insulars y Ayuntamientos
Centros de Recuperación de Fauna de Sa Coma
COFIB
Universitat de Lleida
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