

1. Insect abundance and distribution

Learning objectives:

- a. species-area relationships
- b. major guilds and their traits
- c. host specialization guilds
- d. Invasive species

Learning objective a. species-area relationships

The species-area relationship based on the island biogeography theory (MacArthur & Wilson 1967). Assuming that the area of a host tree corresponds to an 'island':

number of species = (area of host)^z where 0.3 < z < 0.4

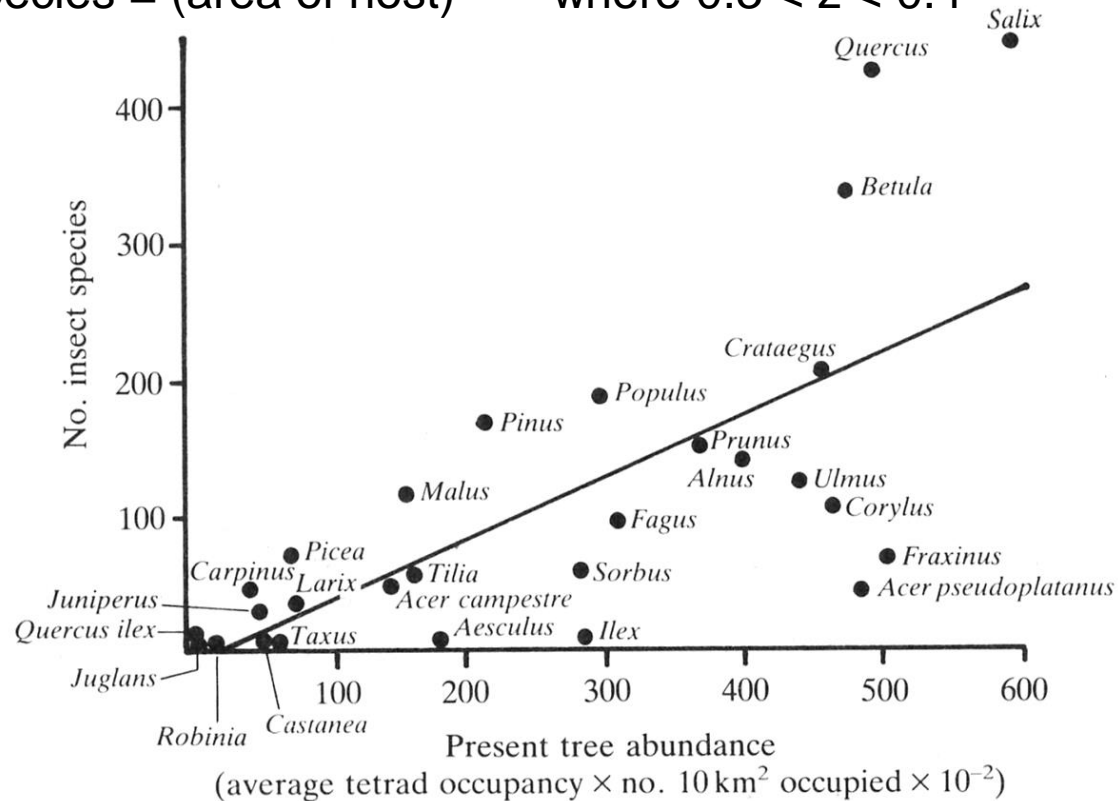


FIG. 2.3. The number of insect species associated with trees in Britain in relation to their estimated present abundance (from Kennedy and Southwood 1984).

Table 2.1. *The number of insect species on broad-leaved and coniferous trees that occur in both Britain and Russia, showing differing relative abundance in the two countries*

Tree	Numbers of insect species	
	Britain	Russia
Broad-leaves		
Oak (<i>Quercus</i>)	284	150
Willow (<i>Salix</i>)	266	147
Birch (<i>Betula</i>)	229	101
Hawthorn (<i>Crataegus</i>)	149	59
Poplars (<i>Populus</i>)	97	122
Apple (<i>Malus</i>)	93	77
Alder (<i>Alnus</i>)	90	63
Elm (<i>Ulmus</i>)	82	81
Hazel (<i>Corylus</i>)	73	26
Beech (<i>Fagus</i>)	64	79
Ash (<i>Fraxinus</i>)	41	41
Lime (<i>Tilia</i>)	31	37
Hornbeam (<i>Carpinus</i>)	28	53
Holly (<i>Ilex</i>)	7	8
Conifers		
Pine (<i>Pinus</i>)	91	190
Spruce (<i>Picea</i>)	37	117
Larch (<i>Larix</i>)	17	44
Fir (<i>Abies</i>)	16	42

From Southwood 1961.

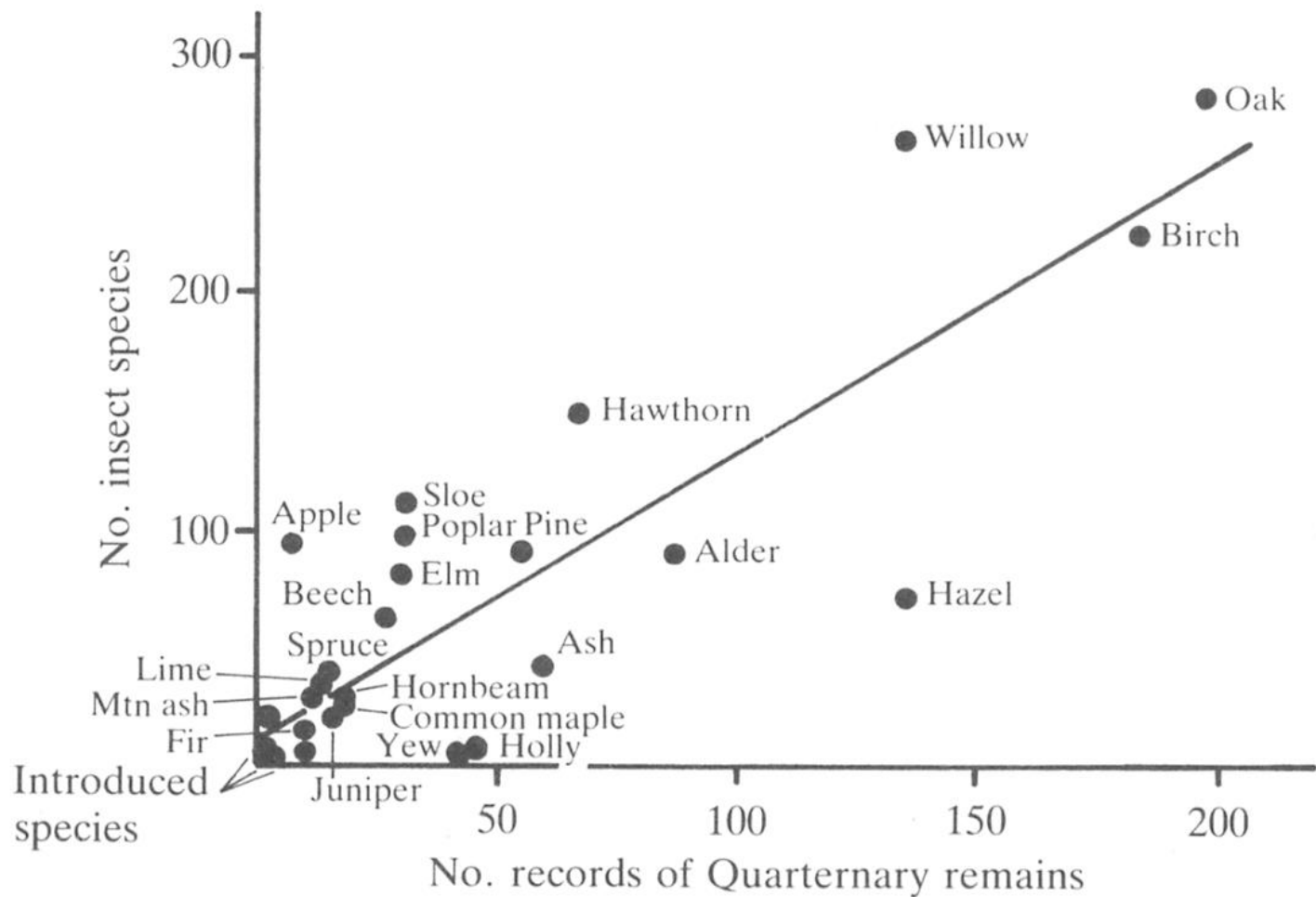


FIG. 2.4. The number of insect species associated with trees in Britain in relation to the number of records of Quarternary remains (from Southwood 1961).

Learning objectives:

- a. species-area relationships
- b. major guilds and their traits**
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- d. invasive species

Feeding guilds and abundance of:

- . Species
- . Individuals
- . Biomass

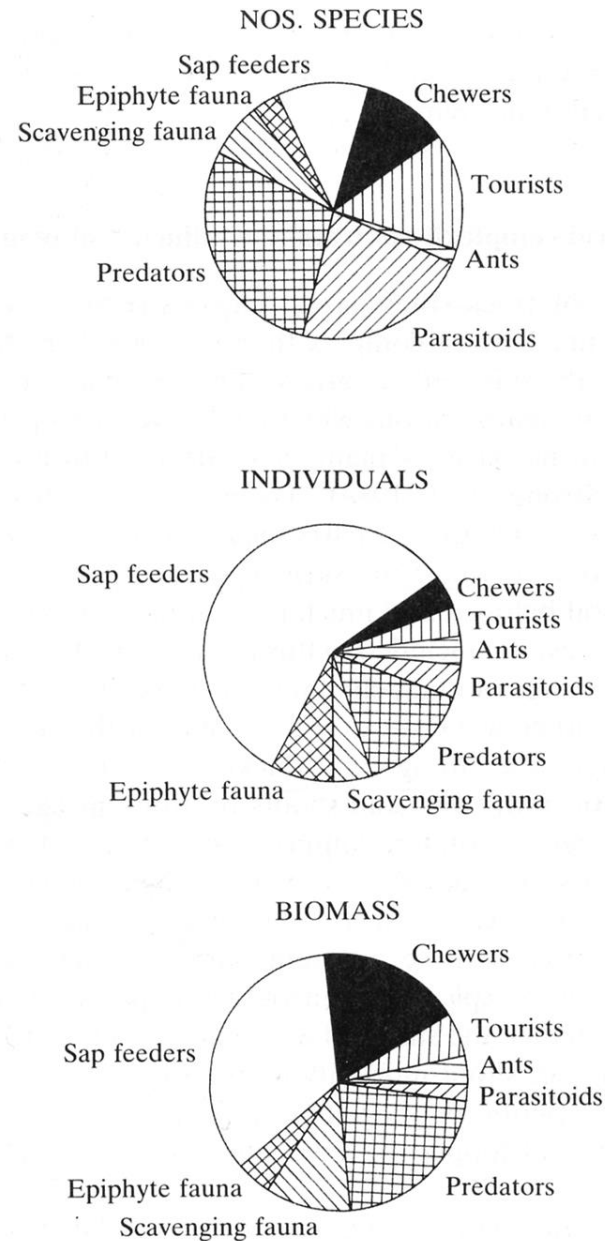


FIG. 2.1. The proportions of the major guilds of arthropods on trees sampled in Britain and South Africa. Ten species of tree were sampled, three of which were common to both countries, namely birch, oak and *Robinia* (from Strong *et al.* 1984; after Moran and Southwood 1982).

Feeding guilds	Orthoptera	Heteroptera	Homoptera	Lepidoptera	Diptera	Coleoptera	Hymenoptera
Sap suckers		X	X				
Gall makers			X		X		X
Leaf feeders	X			X	X	X	X
Shoot feeders				X		X	
Wood borers				X		X	X
Cone and seed		X	X	X	X	X	X
Parasitoids					X		X
Predators	X	X			X		X

Learning objectives:

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- Host plant

Monophagous: one genus of trees → specialist

Oligophagous: one family of trees → generalist

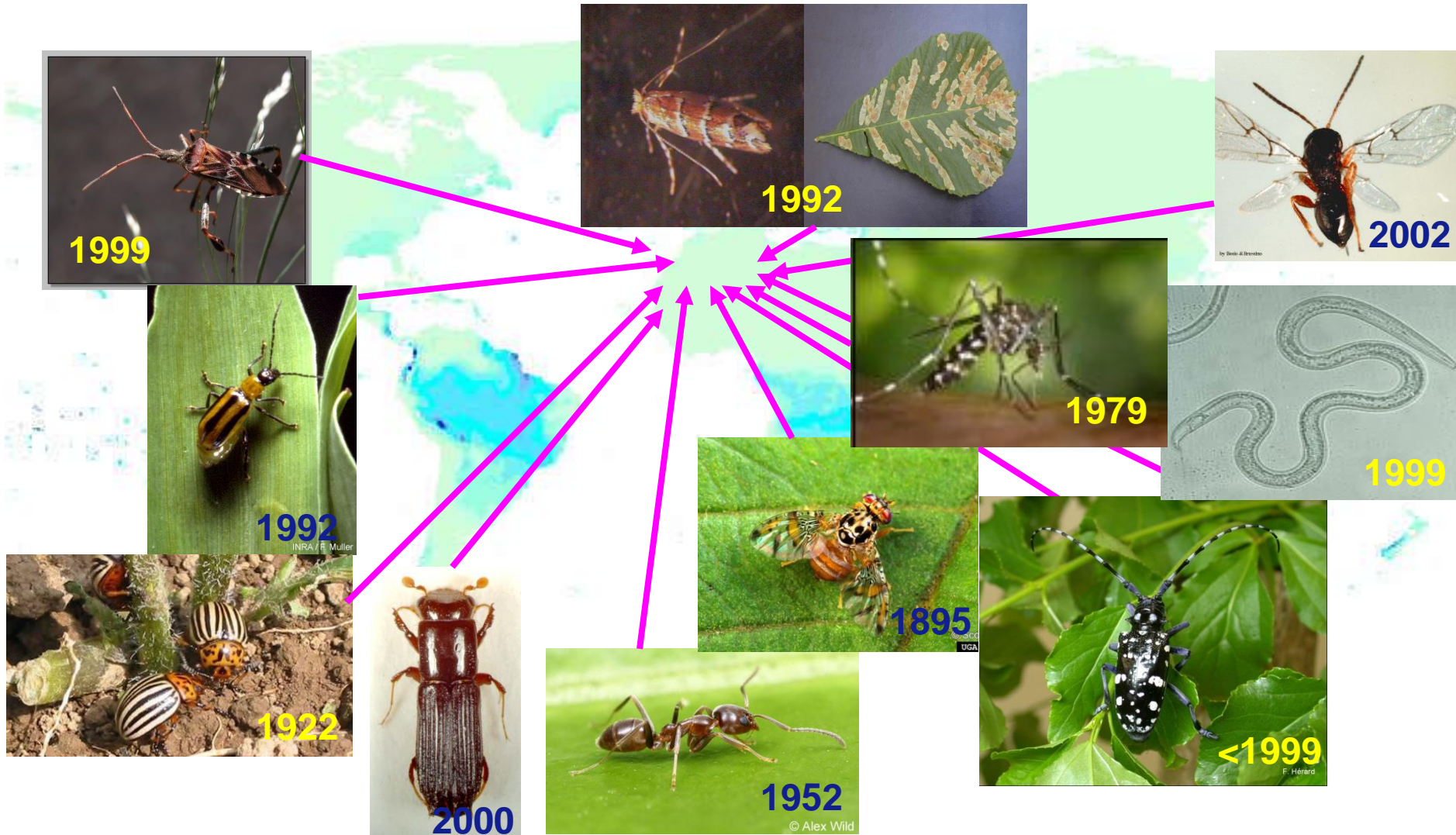
Polyphagous: more families of trees → generalist

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Invasive alien species

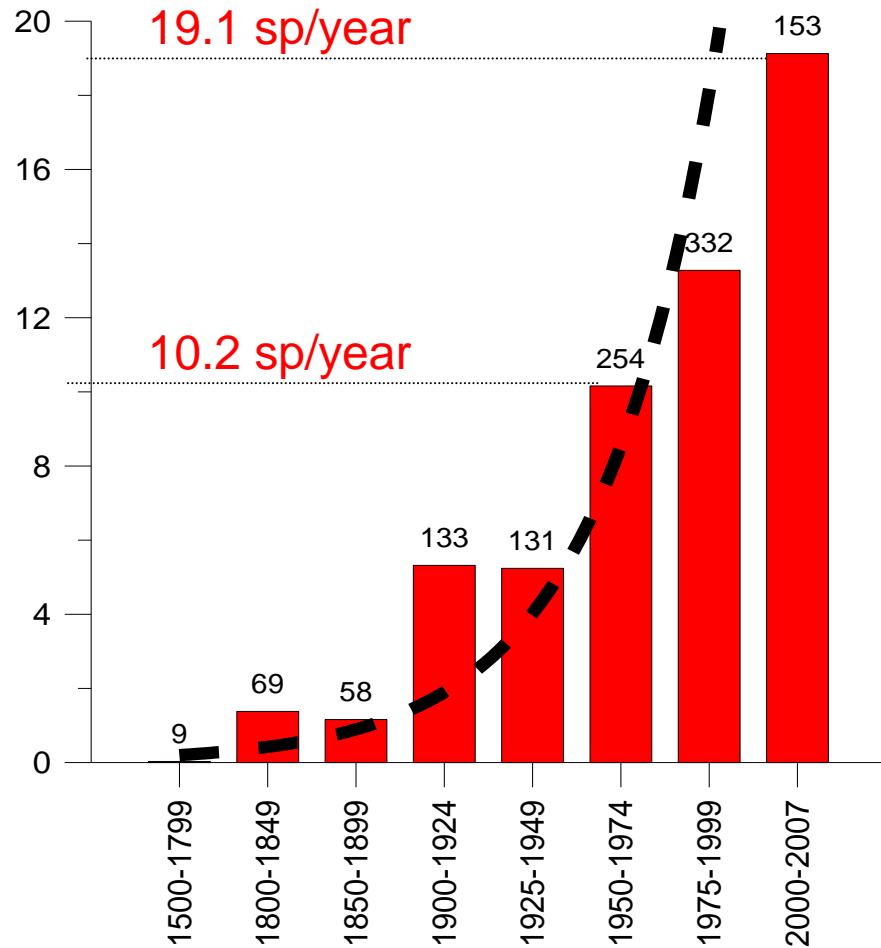
Species whose arrival is mediated directly or indirectly by man



Exponential increase with globalization

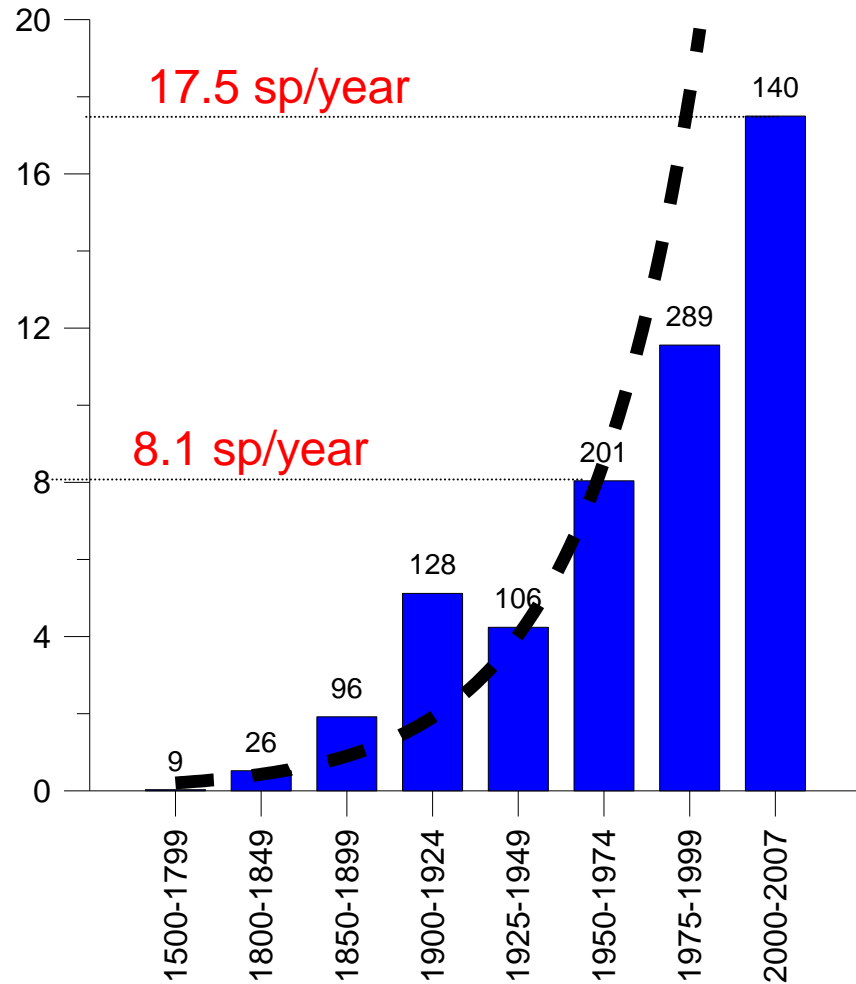
All invertebrates

Average number of exotic invertebrates newly recorded per year in Europe

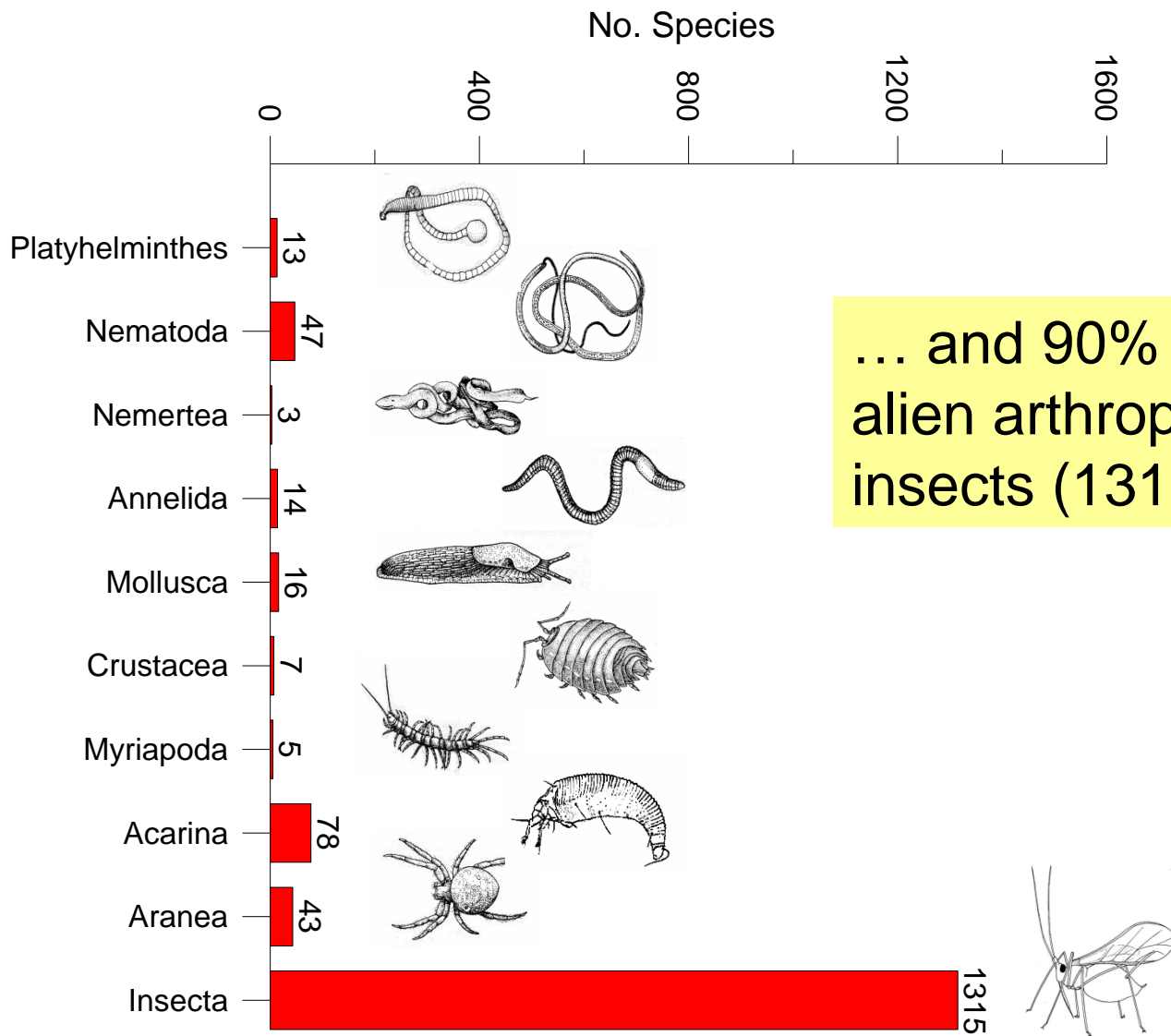


Insects

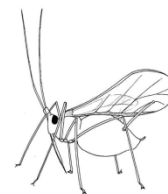
Average number of exotic insects newly recorded per year in Europe



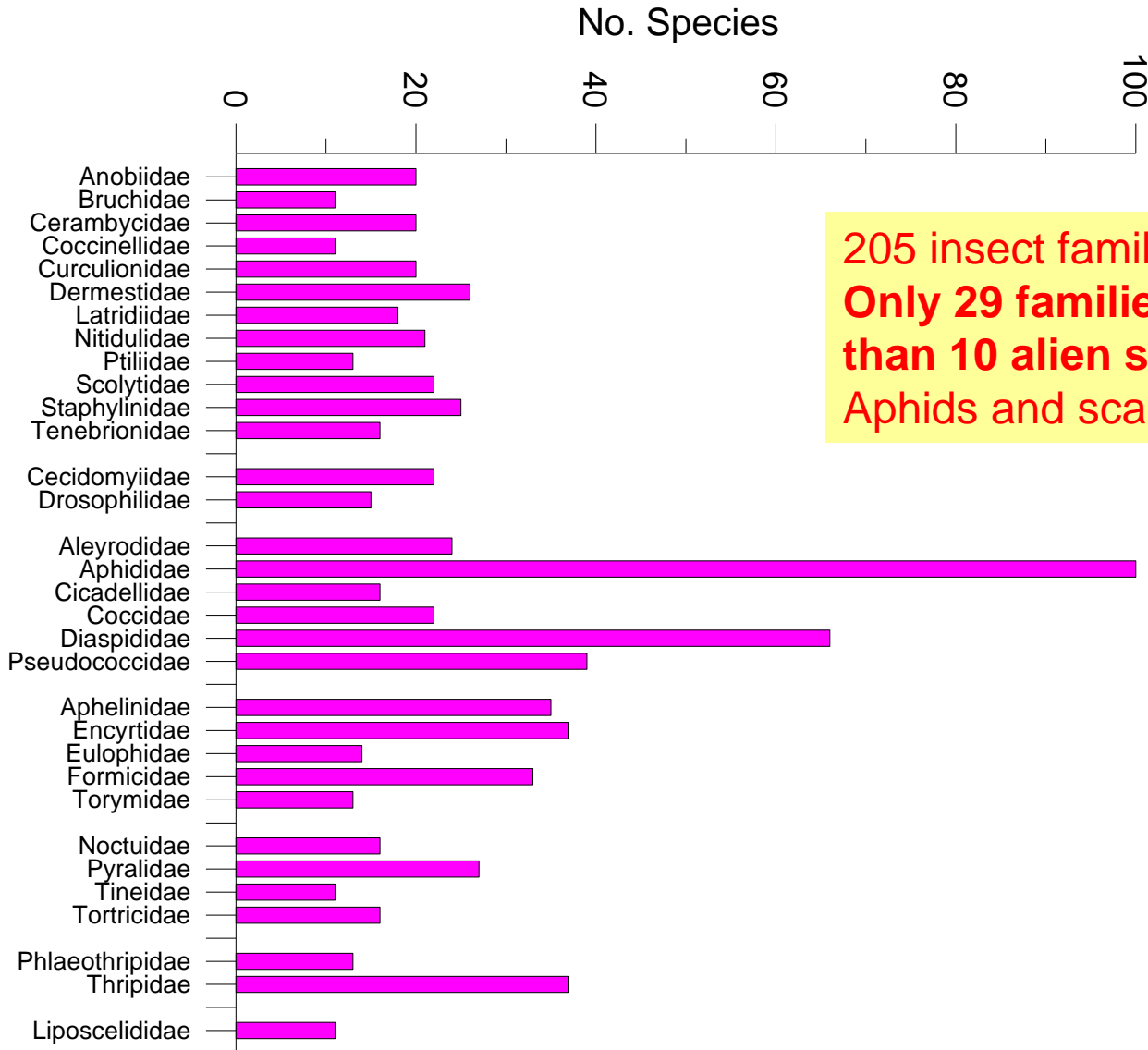
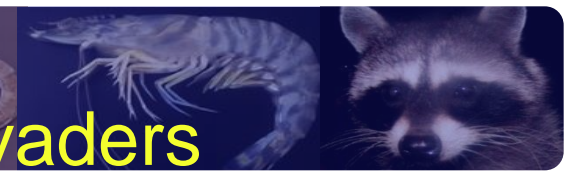
1541 species of alien invertebrates already present in Europe ! 94% are arthropods



... and 90% of the alien arthropods are insects (1315)



Large diversity in alien insect families but aphids and scales are the major invaders

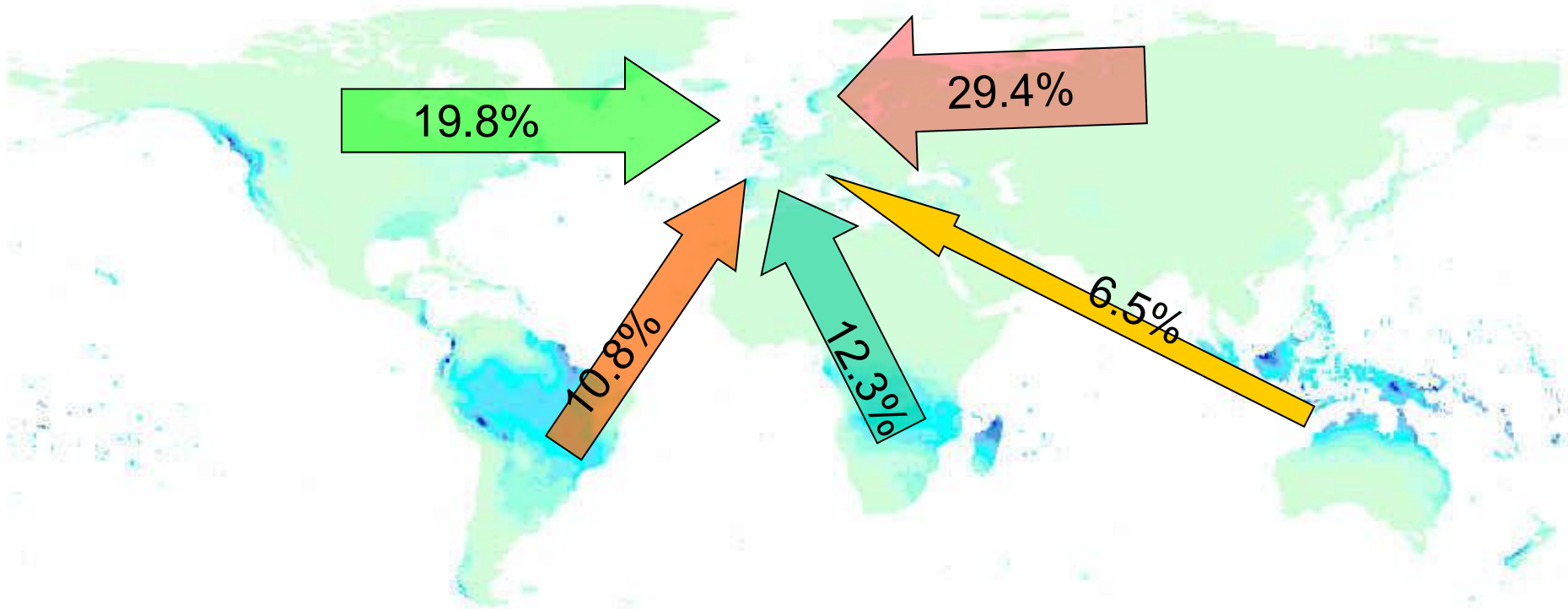


205 insect families involved
Only 29 families contribute for more than 10 alien species
Aphids and scales predominant



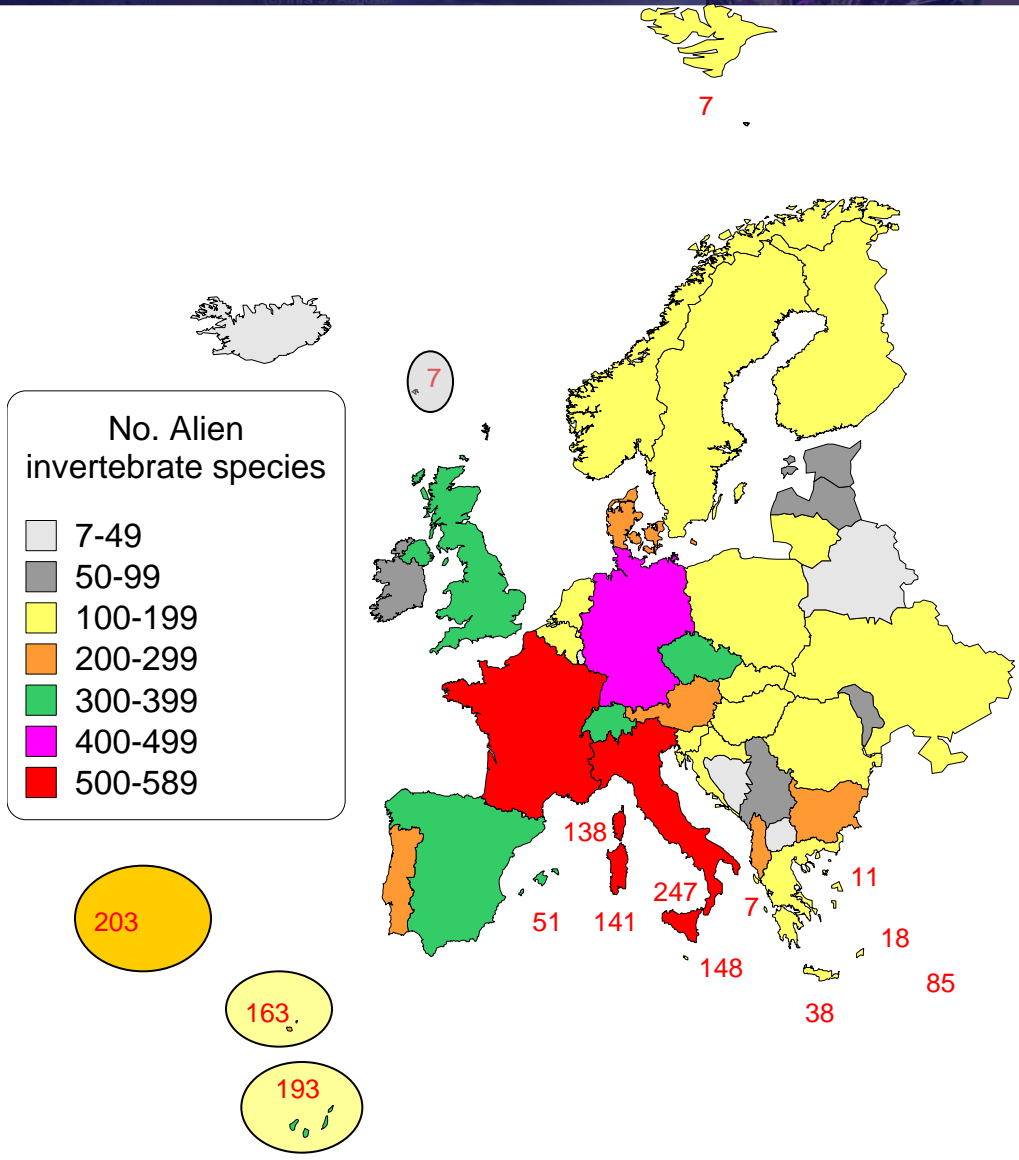
Asia became the major supplier of alien invertebrates

6.7% tropical/ subtropical
14.5% cryptogenic



Contribution of tropical and subtropical areas up to 37% !

European countries largely differ in the number of alien invertebrates “rich” Western countries the most colonized



Sampling efforts ?
Taxonomic expertise ?

Invasive species: main issues

1. Pathways of introduction

Many and very different according to organisms. For forest insects, we focus on

- Wood packing material: Asian longhorn beetles
- Plants for planting: chestnut gall wasp

2. Economic impacts

How much they cost to human society

3. Ecological impacts

How deep they modify the ecosystems

4. Management measures

How to deal with them before, during, and after the arrival

Invasive species: Asian longhorn beetle

Anoplophora glabripennis (Coleoptera Cerambycidae)

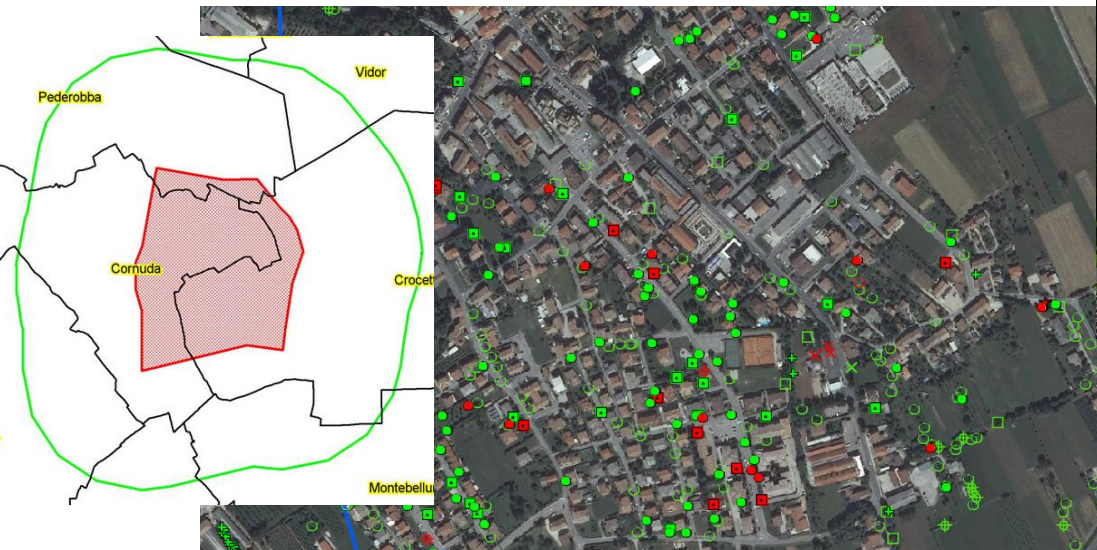
1. Pathway of introduction



Invasive species: Asian longhorn beetle

2. Economic impacts

How much they cost to human society

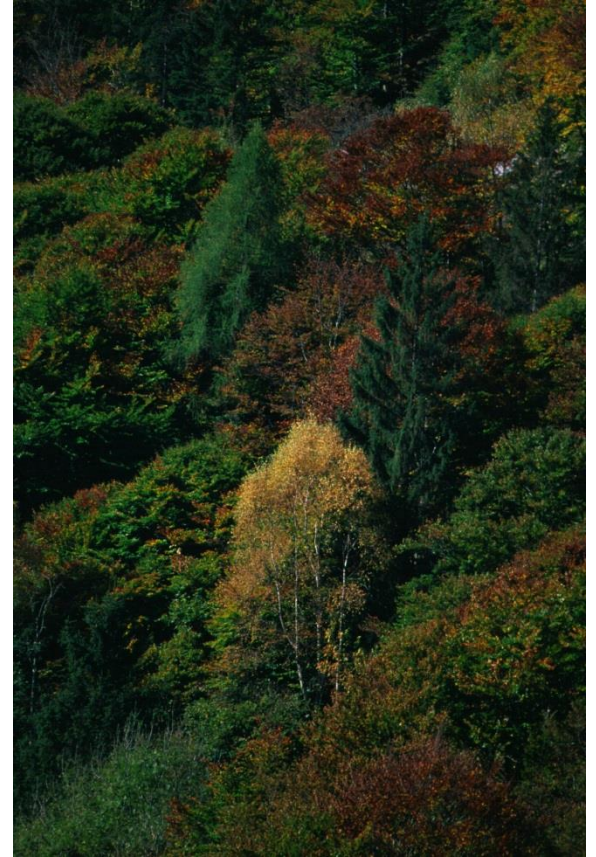


Invasive species: Asian longhorn beetle

3. Ecological impacts

How deep they modify the ecosystems

Alter tree composition of forest stands



Affect indirectly the community of insects associated with trees:
to be demonstrated

Invasive species: Asian longhorn beetle

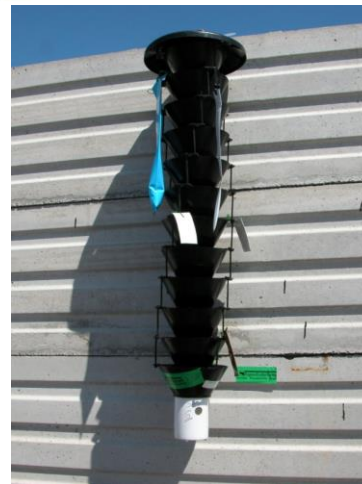
4. Management measures

How to deal with them before, during, and after the arrival

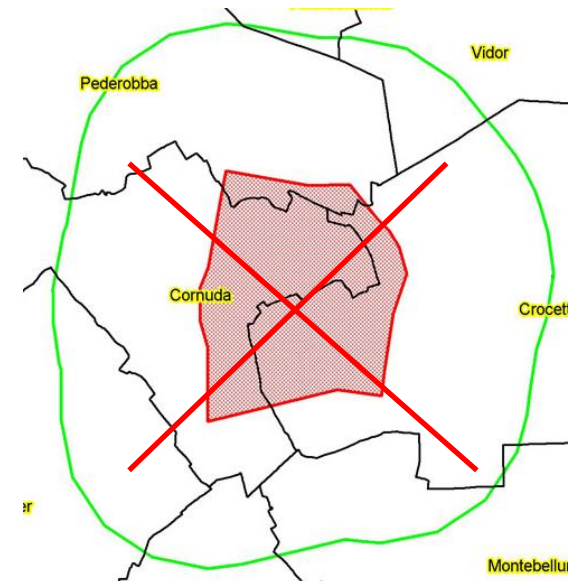
FAO ISPM 15



Surveillance: inspection
trapping



Eradication: removal of infested trees



Invasive species: chestnut gall wasp

Dryocosmus kuriphilus (Hymenoptera Cynipidae)

1. Pathways of introduction

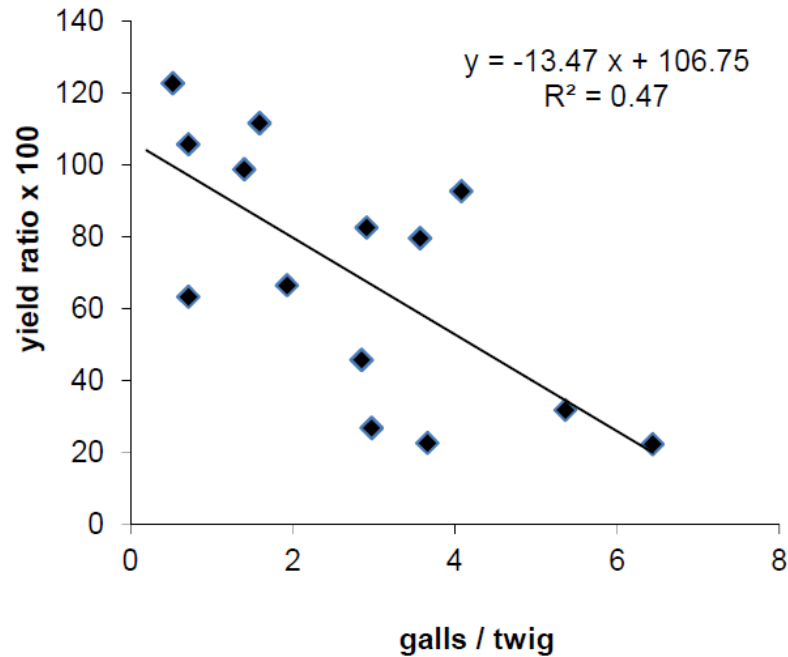
- Plants for planting



Invasive species: chestnut gall wasp

2. Economic impacts

How much they cost to human society: nut yield reduction in relation to gall density



Invasive species: chestnut gall wasp

3. Ecological impacts

How deep they modify the ecosystems

Suspected impact on the community of parasitoids associated with gall wasps on oak (*Quercus* spp.)



Invasive species: chestnut gall wasp

4. Management measures

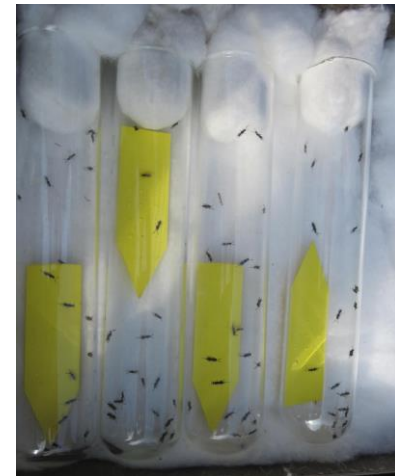
How to deal with them before, during, and after the arrival

FAO ISPM 10 pest free production area

Surveillance: molecular test

Eradication not possible → Biological control

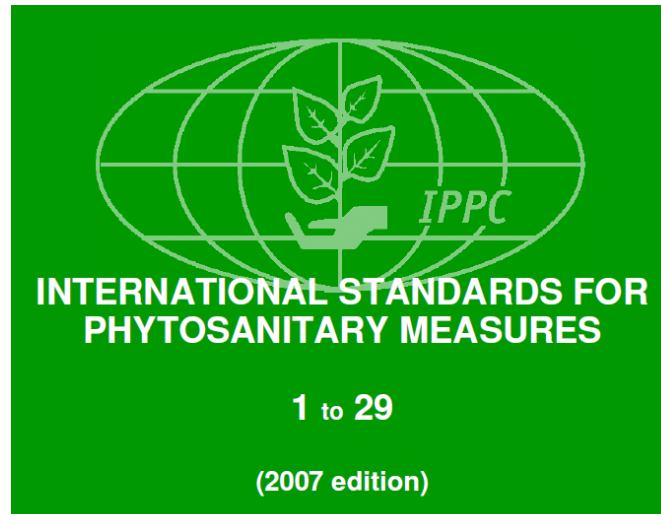
Torymus sinensis



Invasive species: Pest Risk Assessment

Process addressed to identify the risk before the arrival of the pest (quarantine lists) and to review measures to limit the risk

FAO ISPM 11



EPPO scheme

EFSA scheme

PRATIQUÉ



CAPRA - Computer Assisted Pest Risk Analysis

CAPRA is a software developed by the European and Mediterranean Plant Protection Organization in the Framework of the European Union 7th Framework Programme project PRATIQUÉ (Grant Agreement No. 212459).

It is intended to assist pest risk analysts in running the EPPO decision-support scheme for Pest Risk Analysis (PRA), and the decision support scheme for generating contingency plans and prioritizing action during outbreaks.

Invasive species: Surveillance network for early detection

