



GLOBAL WARNING

ALIEN Challenge

Delivering Alien Invasive Species Inventories for Europe

PRATIQUE

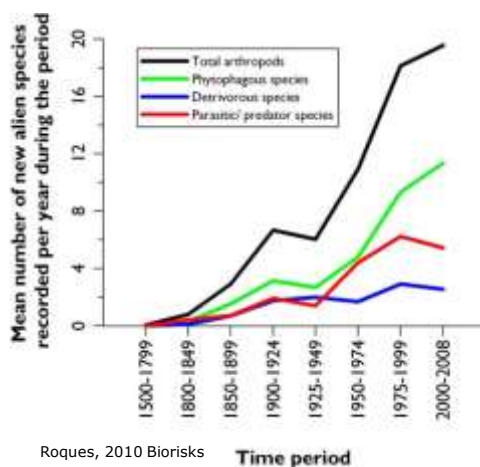
ISEFOR

Food and Agriculture Organization of the United Nations

Alain ROQUES, Dr., Research Scientist, INRA, France

Globalization= Exponential increase of invertebrate invasions

Primary cause: increase in phytophagous arrivals



Basic data for Europe
DAISIE 2005- 2008

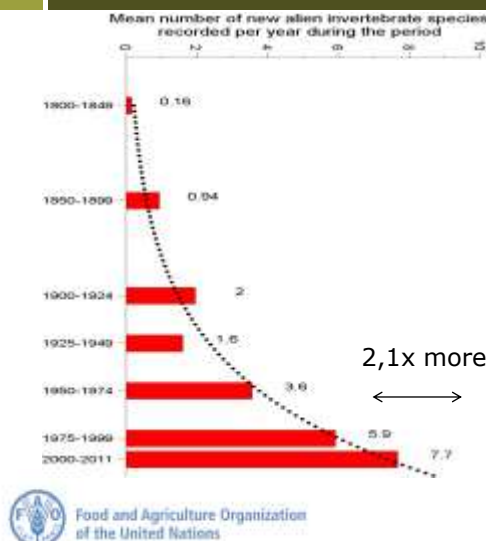
Update:
EASIN 2014

www.easin.org

ca. 11.5 new phytophagous
species per year in Europe
since the 2000s

Roques, 2010 Biorisks

Alien arthropod phytophages More associated to woody plants than herbaceous



461 exotic invertebrates related to woody plants established in Europe by 2014

- 385 insects
- 60 mites
- 16 nematodes

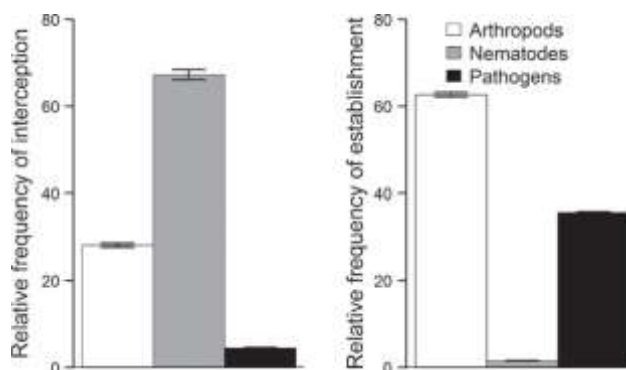
ca. 8 new species per year in Europe since the 2000s

Roques, 2010 NZJF updated

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Large discrepancies between interceptions and establishments !

Intercepted vs established 1995-2012:
only 7 species over 117 established !
(Eschen, Roques & Santini, 2014, Div & Dist.)



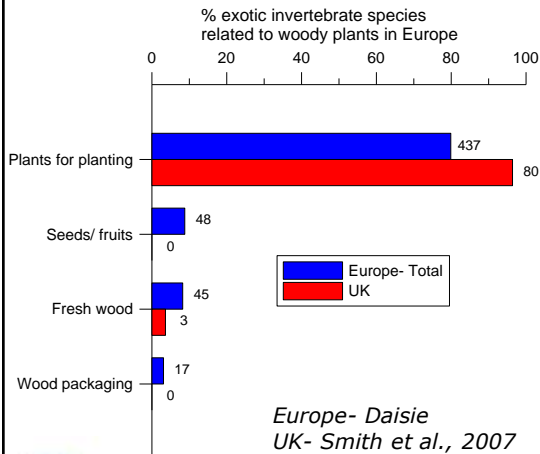
The major problem: only A1 and A2 pests targeted
Most new species: unknown as pests in countries of origin (cf EAB)

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Most likely pathway

Ornamental trade more important than forest products



But based on species' biology...

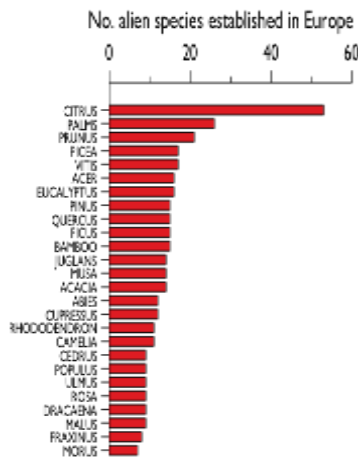
Actual pathway could be largely different
e.g. hitchhiking for a number of species !



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Another way to identify the invasive pathways ? Looking at the colonization by exotic insects of tree species growing in Europe



Exotic trees planted in Europe more colonized than native trees

The top 10 spp. includes Citrus, Palms, Eucalypts

A number of insects arrived along with the exotic host

Most did not switch (yet) onto natives (51%)

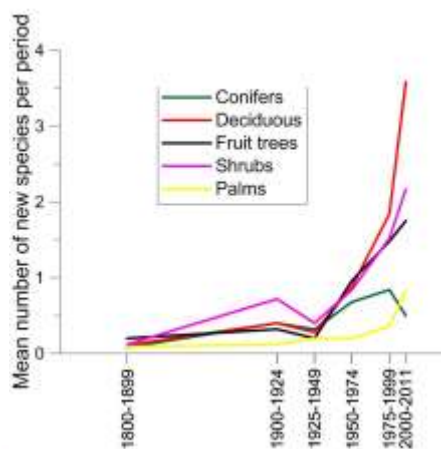
(Eschen, Roques & Santini, 2014, Div & Dist.)



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Temporal changes in colonization tends to reflect the invasive processes



Looking at large taxonomic groups during the last period

Faster increase in deciduous, shrubs, palms

vs.

decrease in conifers and slowing in fruit trees

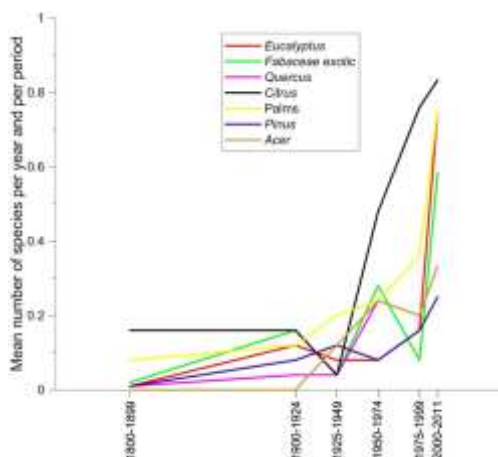
(Eschen, Roques & Santini, 2014, Div & Dist.)



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Faster increase in colonization of tropical/ subtropical alien trees vs. natives



Link with

- Climate change ?
- Change in trade because most exotics used as plants for planting and not for wood ?
- Both ?

(Eschen, Roques & Santini, 2014, Div & Dist.)



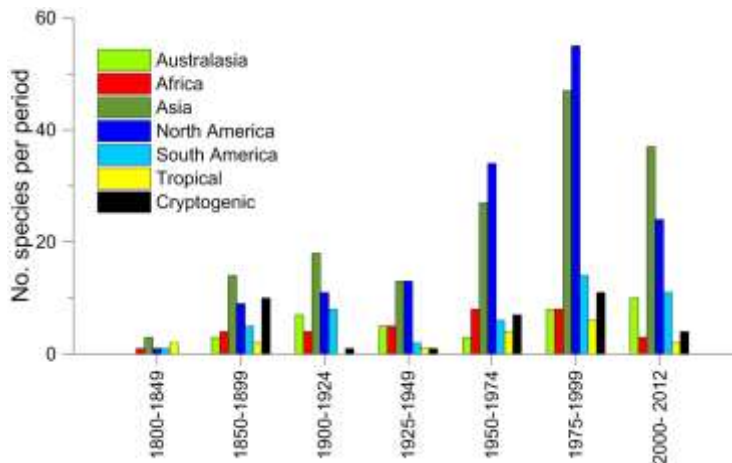
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Temporal changes in origin of the established species

New couples: Origin x Donor (imported) tree species

Asia turned dominant as area of primary origin



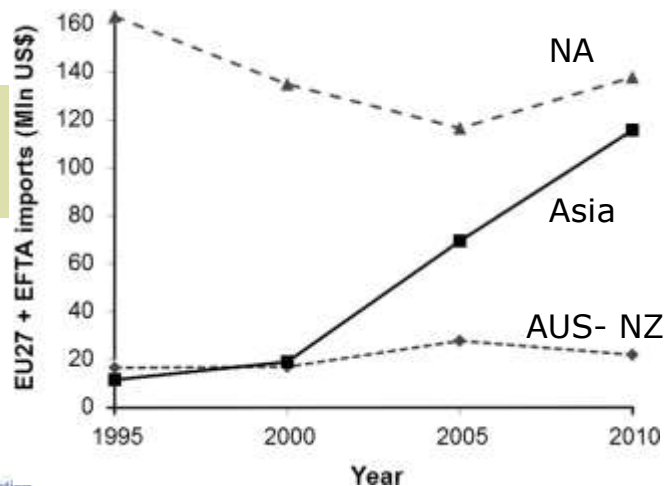
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Coherent with the temporal changes in the trade of plants for planting

Origin of the import of
live plants in the EU

Eschen et al., 2014 FEM



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Plants for planting but not precluding the trade of wood and derivatives as a pathway!

Wrong to consider only this pathway with regard to recent invasions:

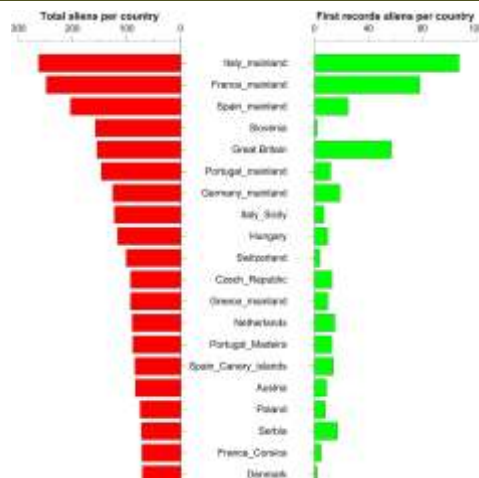
- Wood packaging still as issue:
 - *Aromia bungii*
 - New outbreaks of *A. glabripennis*
- Wood trade, too:
 - Exotic ambrosia beetles trapped in Italian ports (*Ambrosiodmus rubricollis*, *Cyrtogenius luteus*, *Xylosandrus crassiusculus*; Rassati et al., 2013)
- Hitchhikers in commodities:
 - *Leptoglossus* bugs



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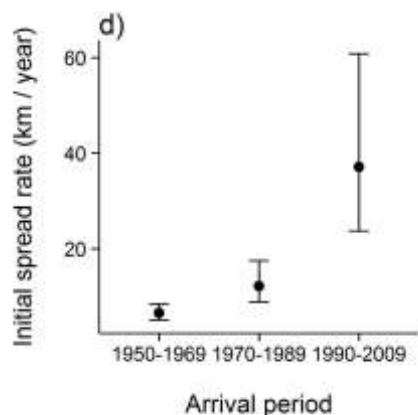
Arrivals mostly through continental Italy and France



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Since 1989, a much faster spread across Europe of invaders after establishment



Roques et al., 2016 Biol. Inv

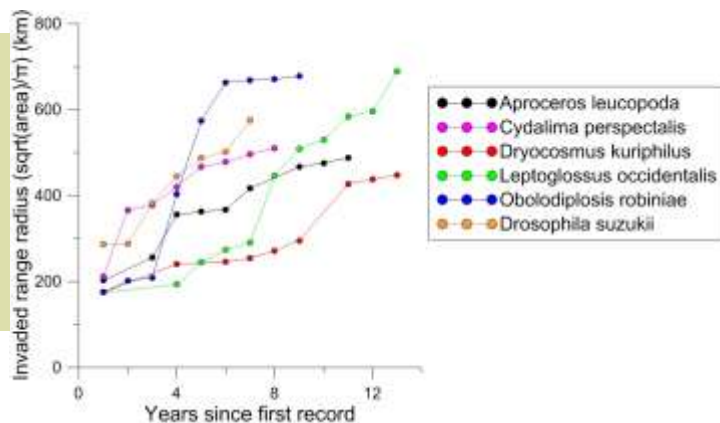


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Less than 15 years to invade all of Europe vs. dozens of years before

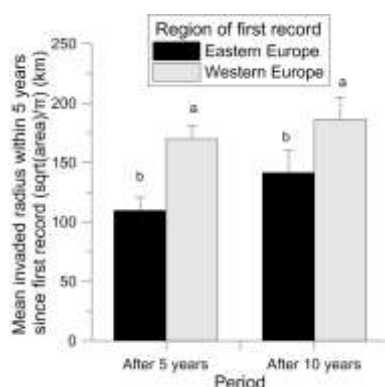
Explosion of
ornamental trade
combined with
collapse of Berlin
Wall and release of
EU internal border
controls
(Roques et al., 2016)



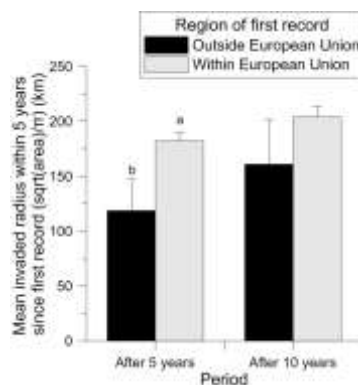
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Spread before and after the collapse of the Iron Wall and the EU enlargement



Arrival during 1950-1988



Arrival during 1989-2004



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Examples of very fast spread West to East I- the American Honeysuckle leaf gall-midge (first record 2003)



Honeysuckle leaf gall-midge
Obolodiplosis robiniae
(North America)

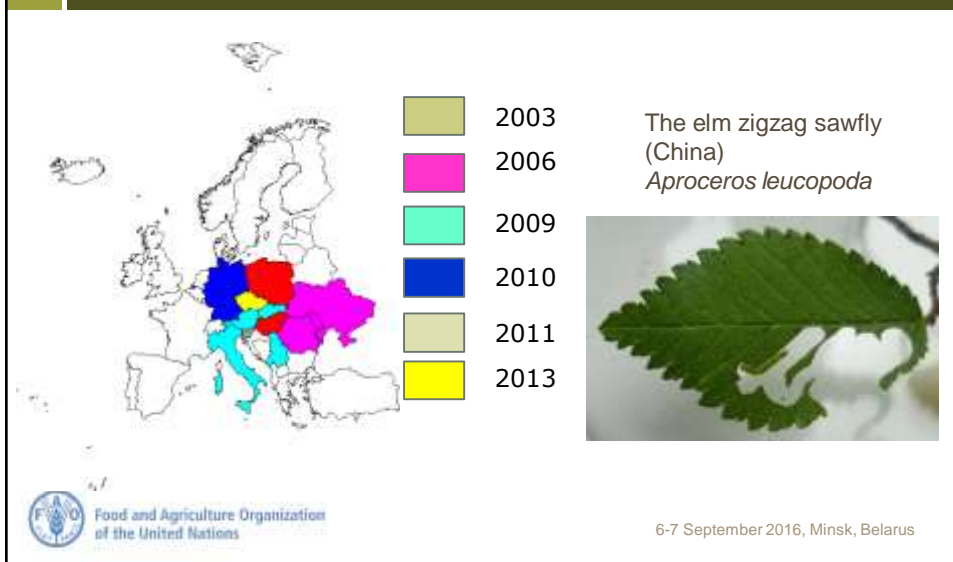


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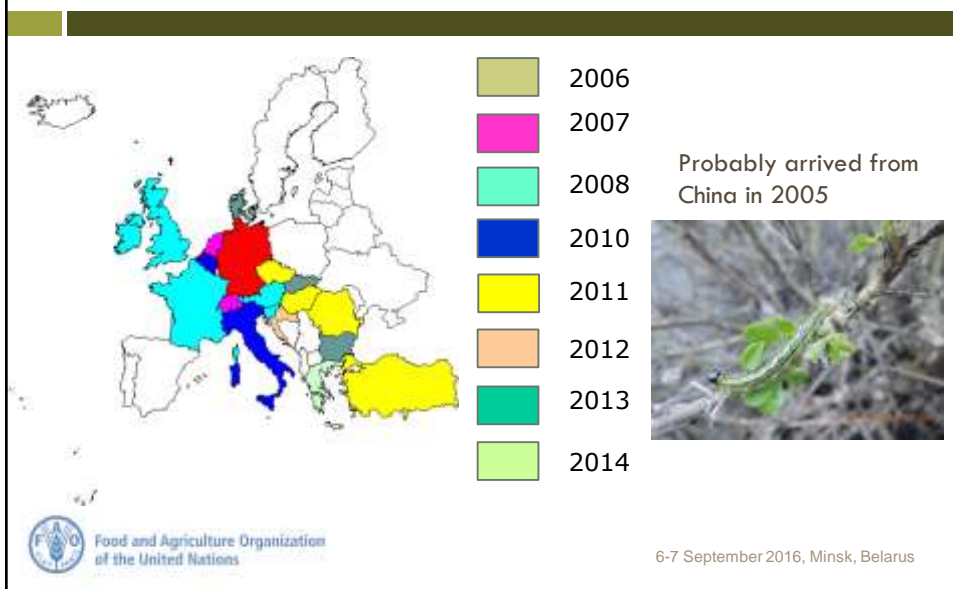
Examples of very fast spread West to East

II- The Asian elm zigzag sawfly (first record 2003)



Examples of very fast spread West to East

III- the Asian box tree moth, *Cydalima perspectalis*



Rapid spread towards Central Asia along the Black sea, resulting in heavy damage

A north route with
the Sochi games
and a south route
from Turkey

Krasnodar- 2012
Sochi- 2013
Chechen Rep- 2013
Abkhazia,
Georgia (Adjara,
Samegrelo- 2015 but
probably 2013)



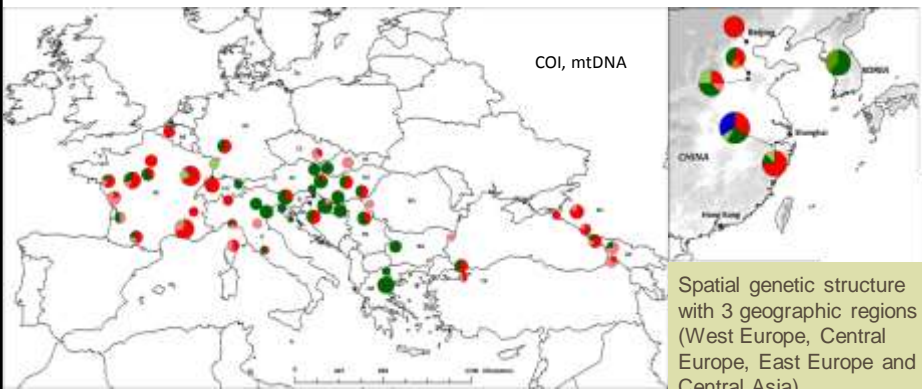
Heavy damage in Adjara in 2015 (M. Kenis courtesy)



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The probable routes: multiple introductions followed by human-mediated dispersal with ornamental trade



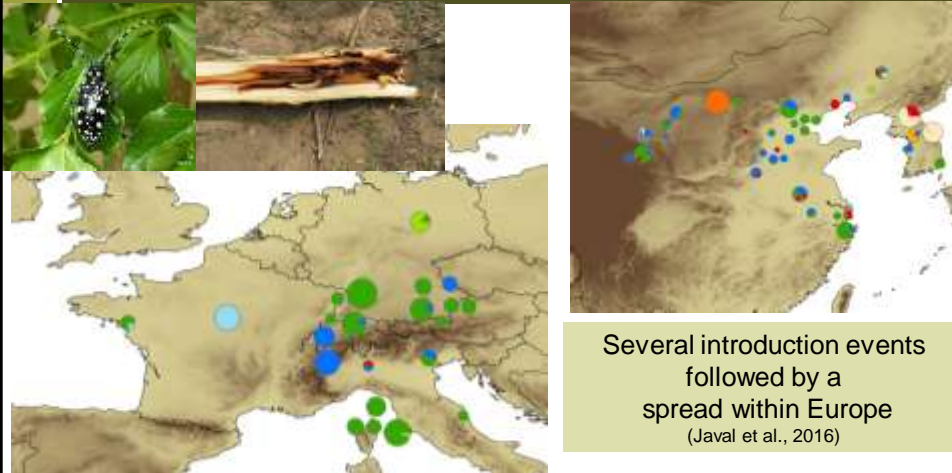
Bras et al, 2016



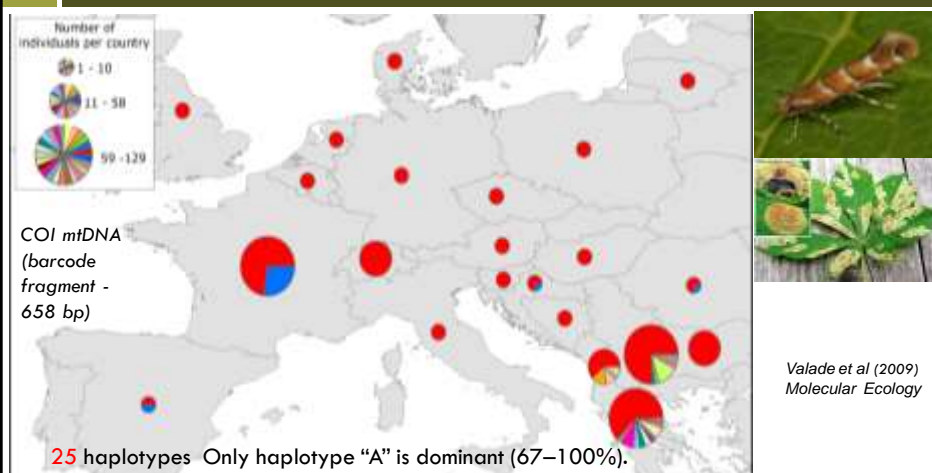
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The same scenario for the recent, multiple outbreaks
of the highly-threatening Asia long-horned beetle,
Anoplophora glabripennis



The same methods proved the Balkans as the region of
origin of the horse-chestnut leaf miner,
Cameraria ohridella



The invasion routes can be more complex: Bridgehead effects in an invasive seed bug threatening conifer regeneration and seed crops all over the Mediterranean basin

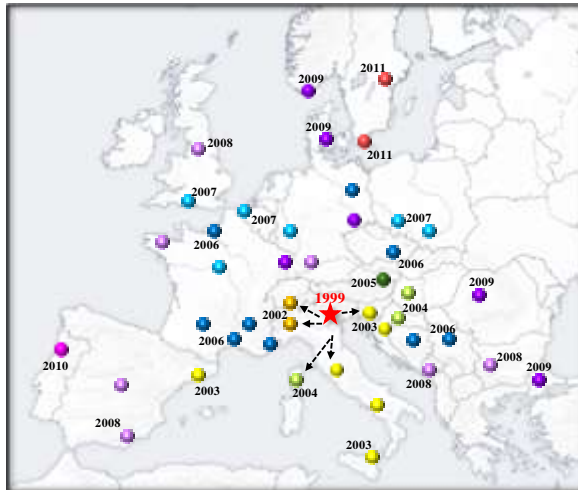
Western American conifer bug invasion in Europe
(*Leptoglossus occidentalis*)
from its arrival in Italy in 1999



Lesieur et al., submitted



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The most reliable scenarios for *Leptoglossus* European and Central Asian invasion



- ☐ Multiple independent introductions :
 - at least 2 in Italy and Spain
 - Probably much more : NW France, Spain, ...
- ☐ Source for all: not wNA but eNA= Bridgehead effect
- ☐ Movements within Europe: flight+ hitchhiking

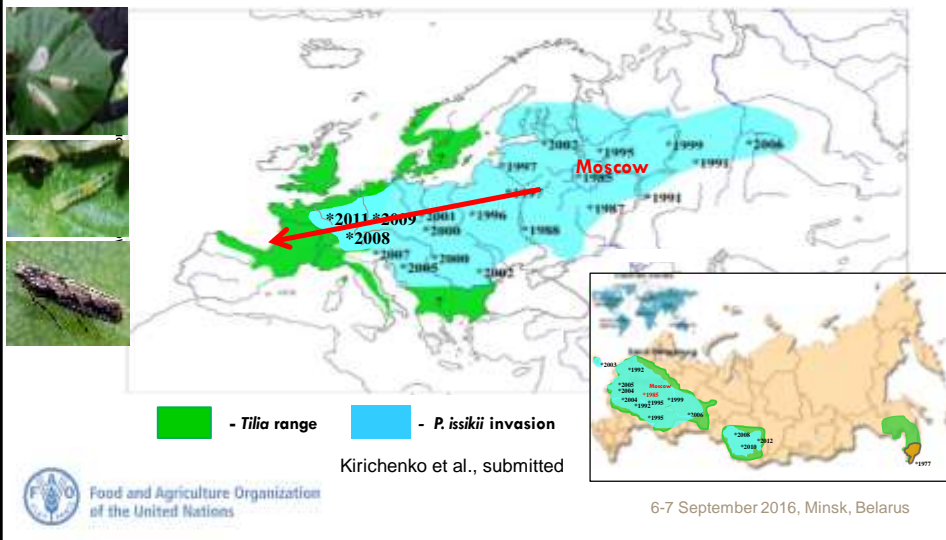
A particular invasive population serves as a source for subsequent invasions : genetic recombinations from different sources



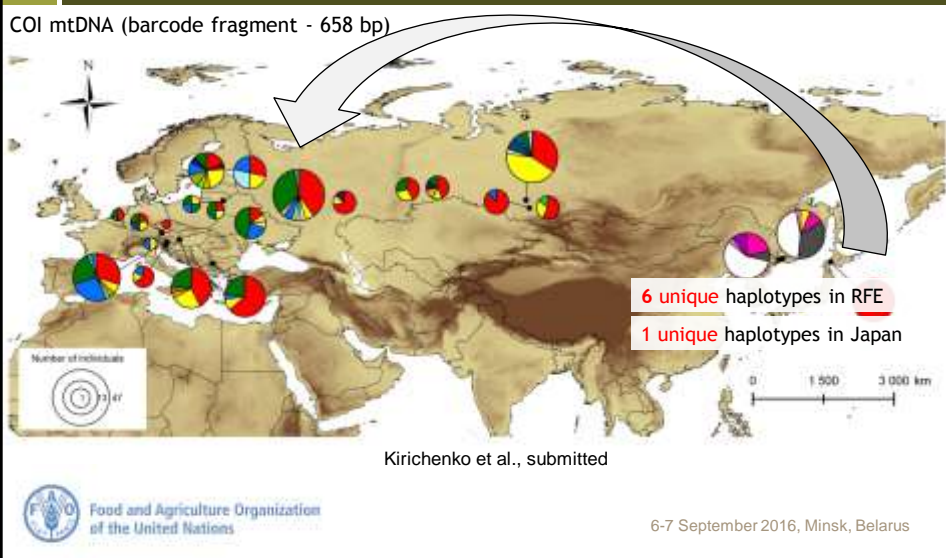
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Even more complex: Where does come from the Lime leaf miner, *Phyllonorycter issikii* East or West ?



Contradictory high genetic diversity in the putative invaded area vs the native one !



East to West:

Polygraphus proximus, a threat for European fir moving westwards with new fungal association



Introduced from the Russian Far East to Southern Siberia presumably late 1980s

Beetle's success related to lack of fir resistance to an associated blue stain fungus *Grosmannia aoshimae*

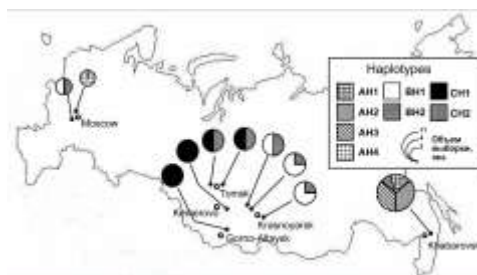
(Baranchikov, 2013)



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The invasive pathway: the transsiberian railway



(Baranchikov, 2013)



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Another East- West highly-threatening dispersal EAB progression westwards from European Russia



Human-aided transport from the native Far East
First record in Moscow in 2003



wind protection forest belt (near the town of Puschino, 2012)
(Photo: Y. Baranchikov)



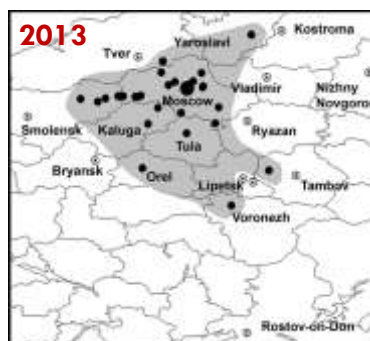
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Rapid expansion from Moscow towards West



(Baranchikov, Kurteev, 2012)



(Orlova- Bienkowskaja, 2013)

An accelerating effect of the Ukrainian conflict ?



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EAB invasion is favoring the expansion of a native species related to ash, *A. convexicollis*

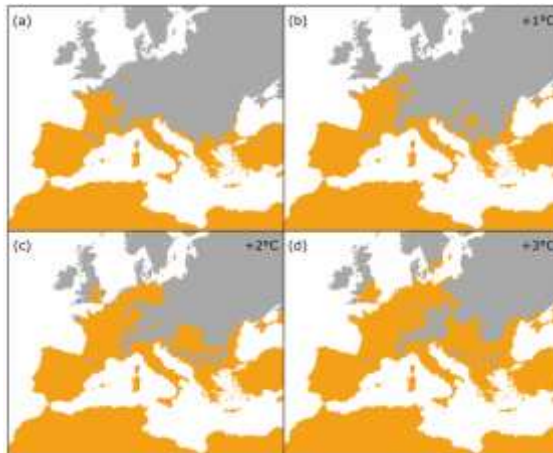


Relationships climate change- invasion: The expansion of a major pine (and urticating) pest the pine processionary moth, *Thaumetopea pityocampa*



European front edge (red) in winter 2012 (Roques et al., 2015)

All of Europe and Minor Asia likely to become susceptible in the near future



Any long-range transport with potted pines from the native range is likely to generate colony establishment

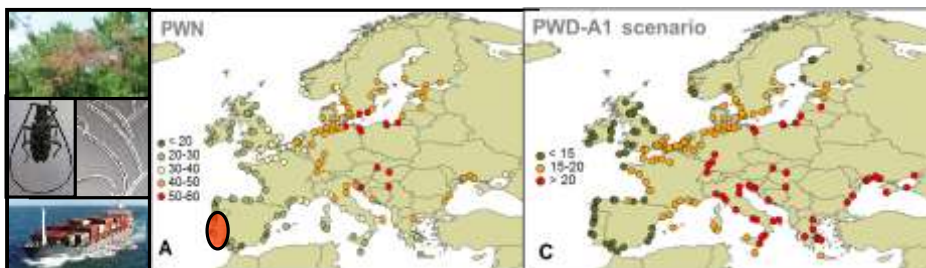
(Robinet et al., 2015)



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Eastern Europe and Black Sea ports to be targeted for survey of pine wood nematode potential invasion and pine wilt disease expression



Potential spread in case of a separate introduction at the 200 main ports in Europe. The symbol indicates the percentage of cells (10 km x 10 km) where the infested area is > 0 in 2030 if the nematode was introduced at the port located there. Spread of the pine wood nematode without climatic constraint (A), and spread of the pine wilt disease assuming the A1 scenario (C).



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Conclusions and take- home messages

- ❖ Tree pest invasions are accelerating with globalization
- ❖ They mostly arrive with plants for planting but wood and derivatives are still to be considered
- ❖ Hitchhiking is a serious problem difficult to be addressed
- ❖ Present EU inspections simply focusing on quarantine pests are not efficient
- ❖ New combinations origin * plant species have to be focused on
- ❖ Possible bridgehead effects have to be systematically considered and not only the native area of the species
- ❖ Possible new associations (insect* fungus*nematode) between invaders and natives to be systematically checked
- ❖ The release of barriers in EU facilitate the invasive spread as well as the trade of large trees



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Thank your for your attention !