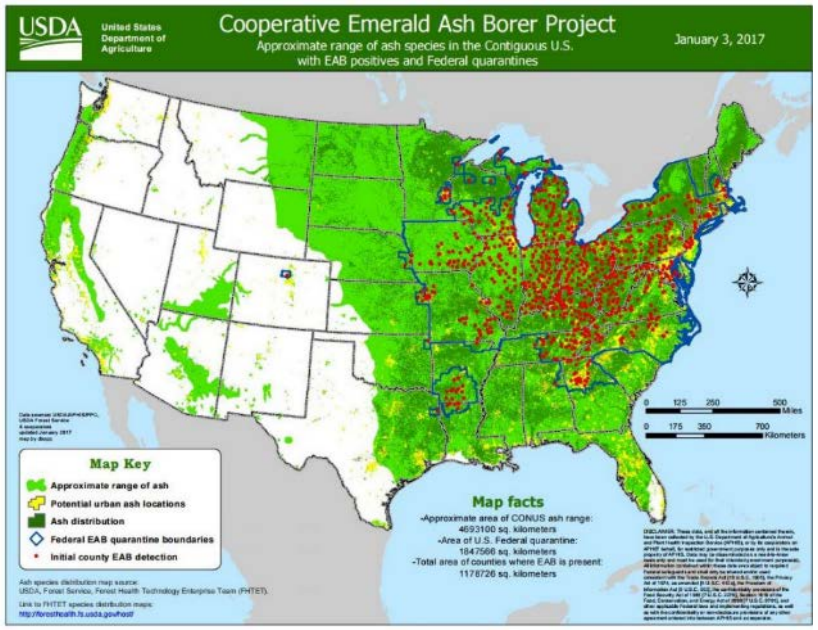
Impact of global change on risks associated with invasive pests in European forests

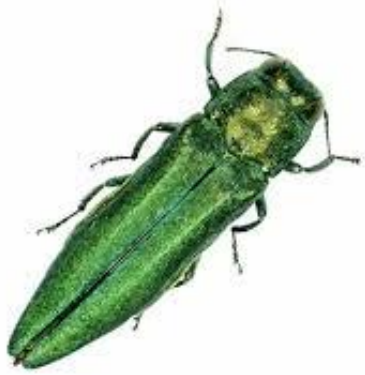
Hervé Jactel

INRA
SCIENCE & IMPACT

Emerald ash borer : projected costs by 2020 = 25 billion $



Belvedere Dr., Toledo, OH. Left: Before EAB June 2006 | Right: Peak EAB June 2009

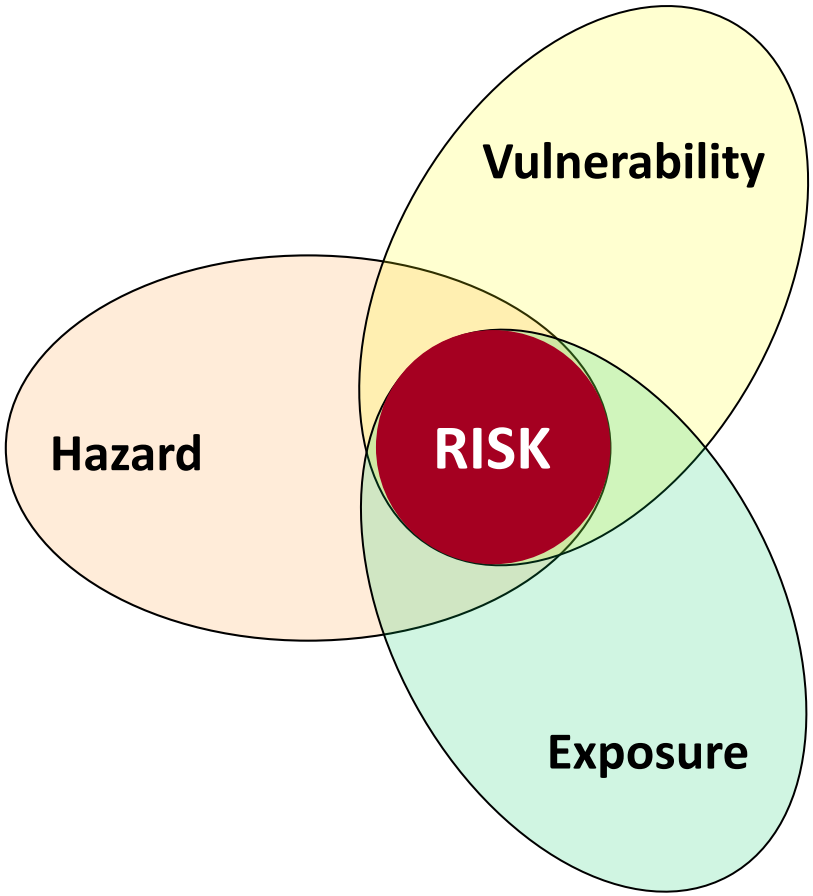


First detected 2002

3 components of risk

Vulnerability = tree / stand **susceptibility** to hazards resulting in damage

Hazard = **cause** of damage, abiotic (wind, fire) & biotic (pests, diseases)

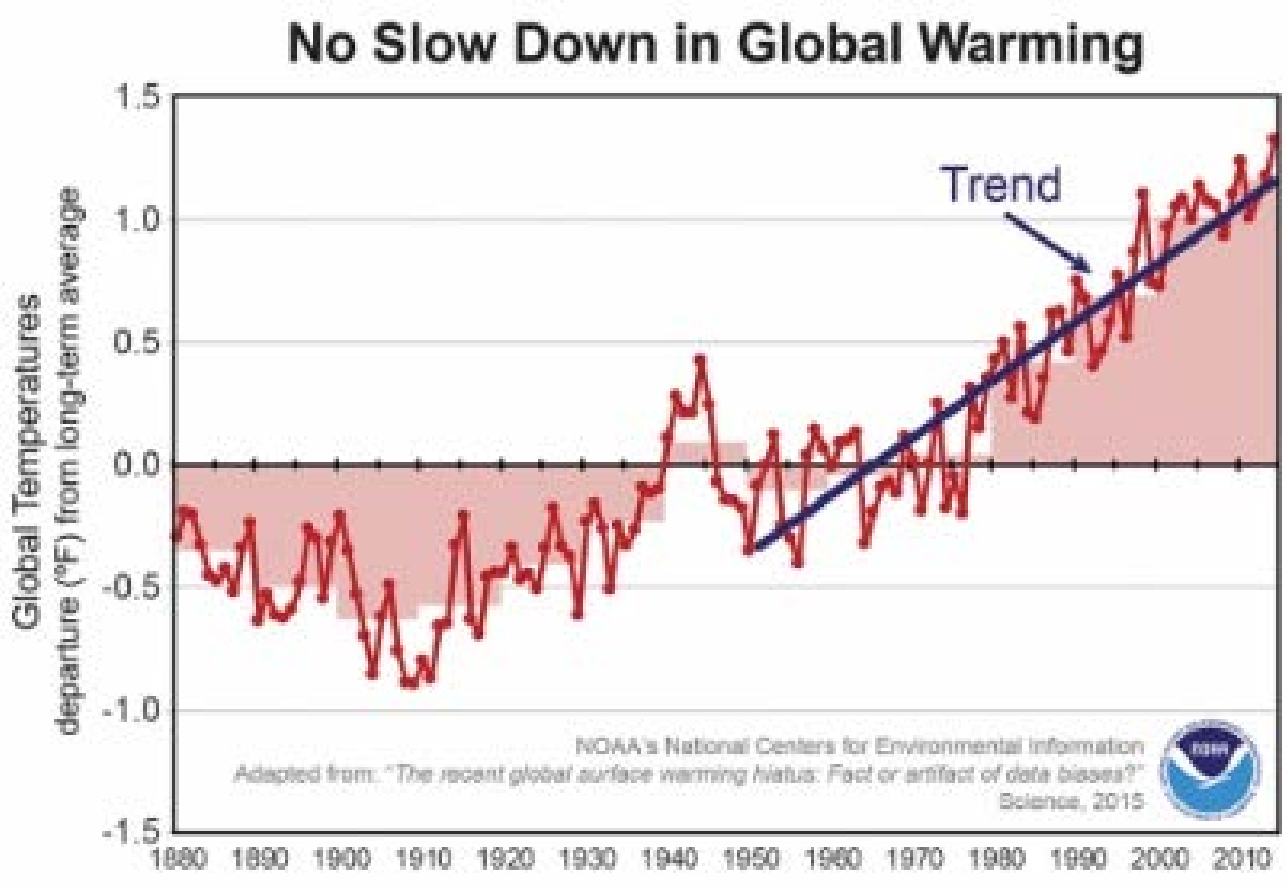


Exposure = socio-economic **consequences** of damage, related to values at stake

Risk = Hazard (likelihood) **x Vulnerability** (level) **x Exposure** (amount)

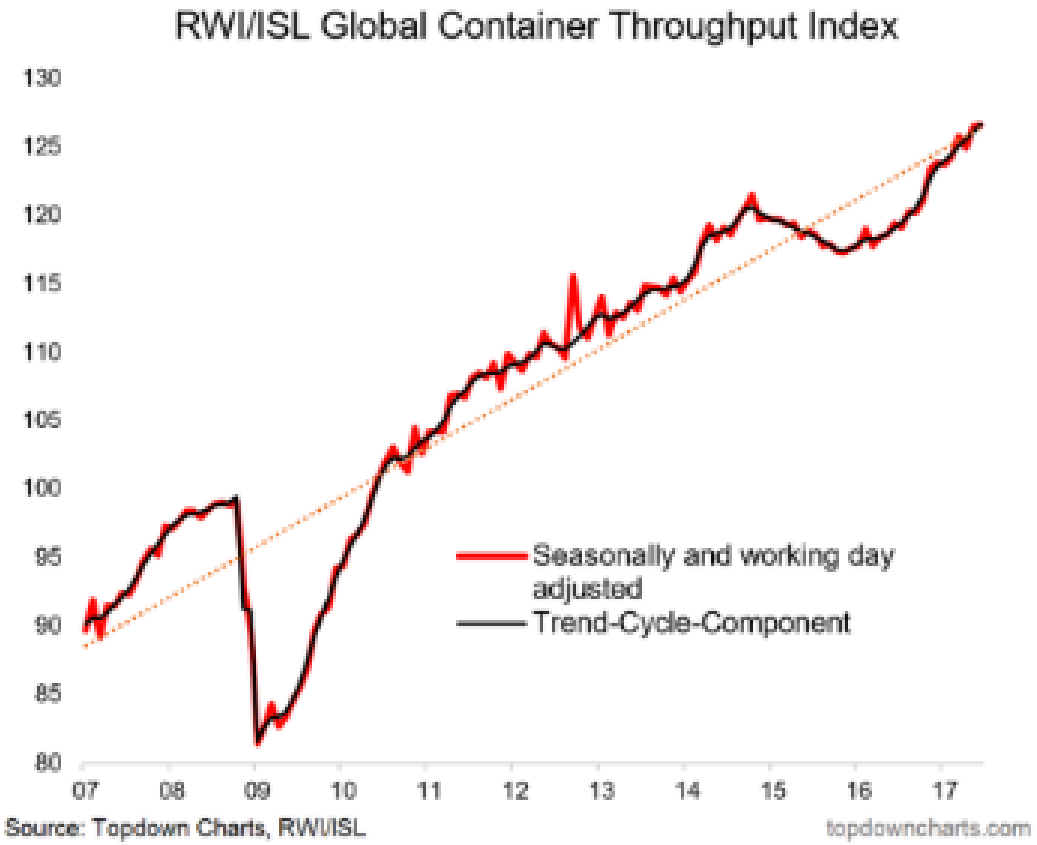
3 dimensions of global change

1. Climate change



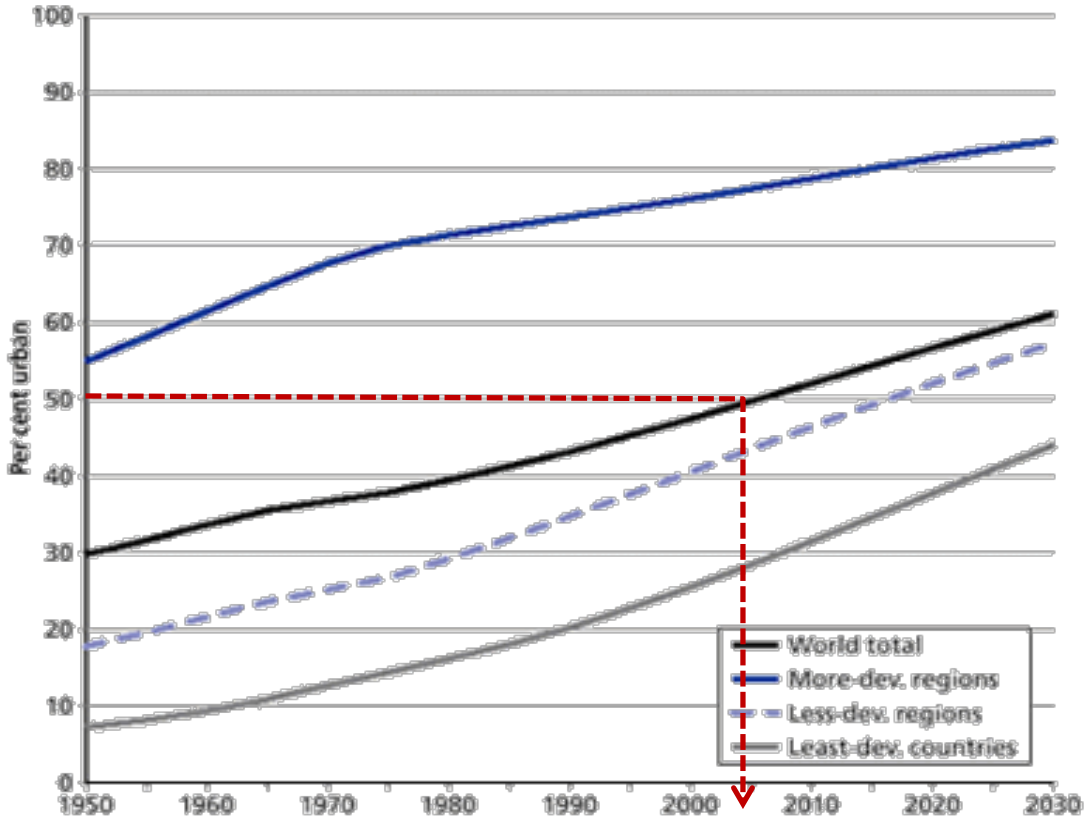
3 dimensions of global change

2. Global trade



3 dimensions of global change

3. Urbanization



Source: United Nations, *World Urbanization Prospects (The 1996 Revision)*.

	Climate	Trade	Urbanization
Hazard			
Vulnerability			
Exposure			

1. Hazard = likelihood of entry and establishment of exotic pests in forests

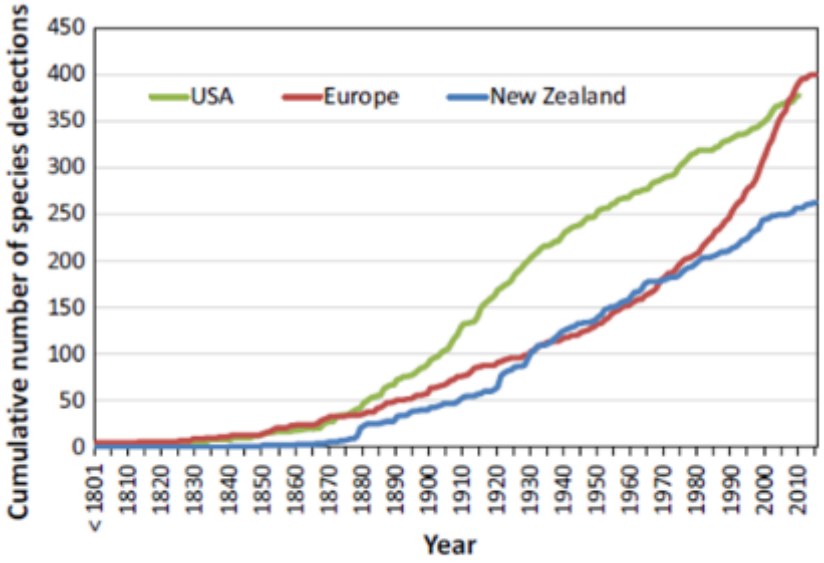
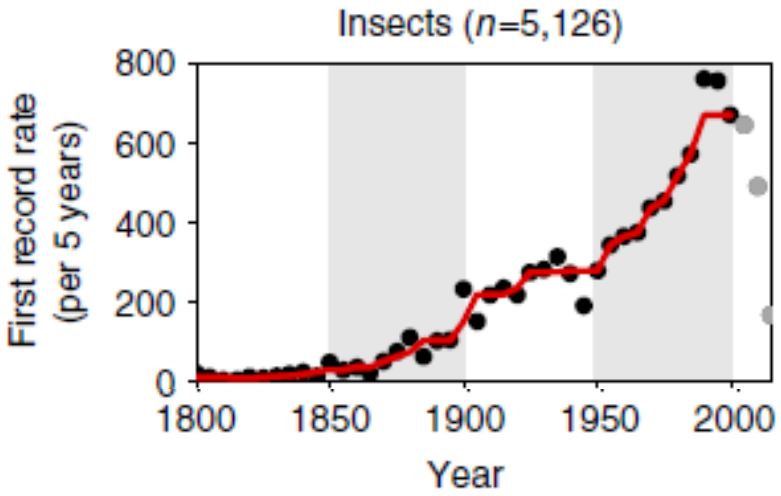
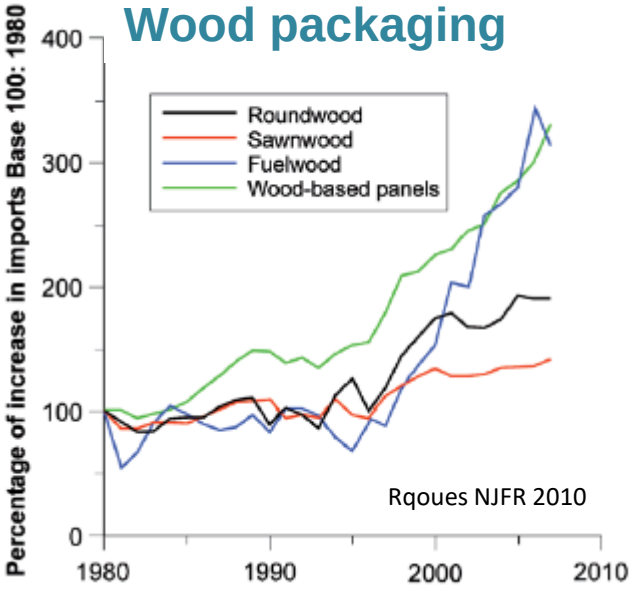


Fig. 1 Cumulative number of detections (i.e., new establishments) of non-native forest insect species over time in the USA, Europe, and New Zealand. Data shown are for non-native insects 'feeding on forest trees' in the USA and New Zealand) or 'feeding on woody plants' (Europe). Data for the USA (showing detections until 2010) are based on Aukema et al. (2010) and Yamanaka et al. (2015); data for Europe are according to Roques et al. (2016) and Alain Roques (pers. comm.); for New Zealand data see Suppl. Mat. 1



1.1. Hazard = exotic pests vs. global trade

Wood packaging



Plant for planting

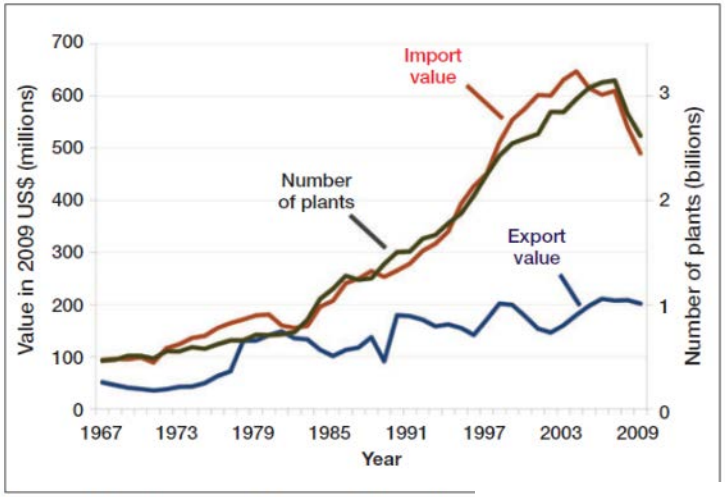
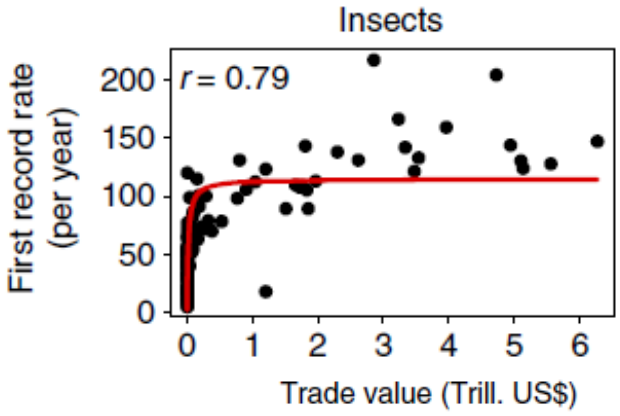


Figure 2. US imports and exports of live plants Liebhold et al. FEE 2012



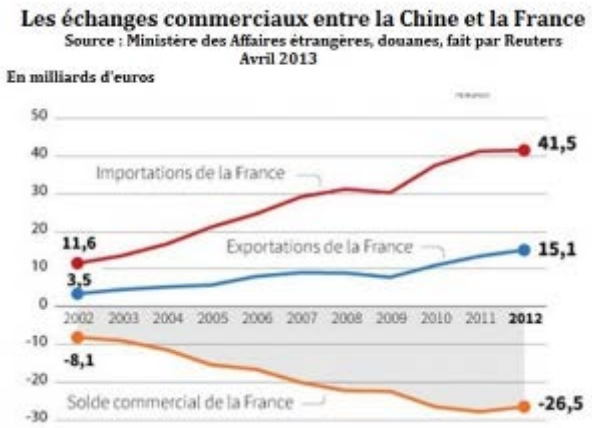
Seebens et al. 2016

1.1. Hazard = exotic pests vs. global trade

14 days

OBOR
一带一路

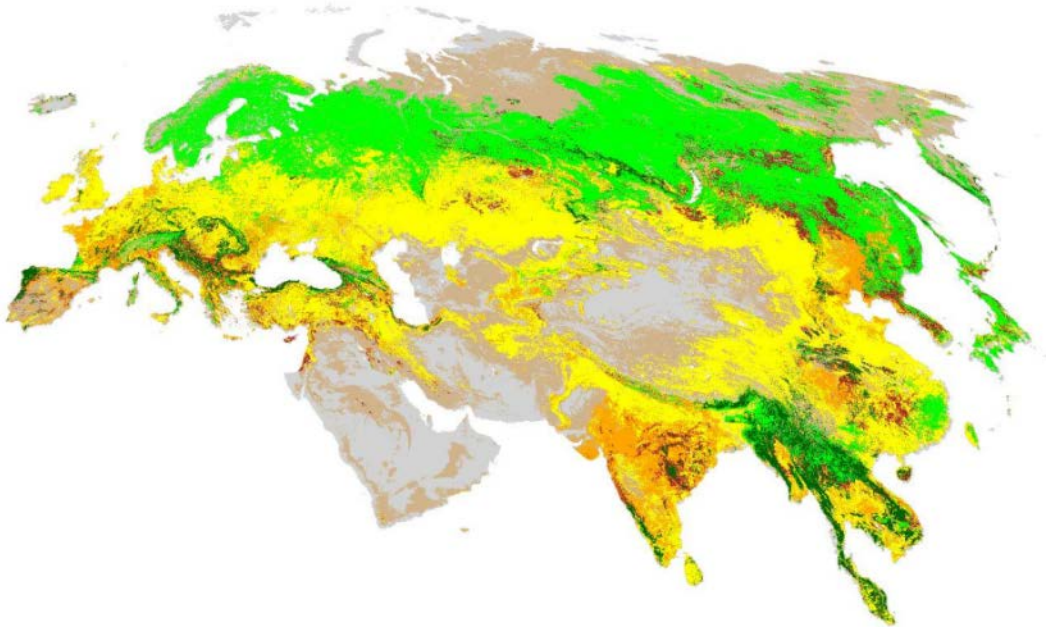
1000 billions $



1.1. Hazard = exotic pests vs. global trade

Tree genera present in China

Abies
Acer
Alnus
Betula
Buxus
Castanea
Corylus
Cupressus
Fagus
Fraxinus
Juniperus
Larix
Malus
Pinus
Populus
Salix
Sorbus
Taxus
…



ScienceDaily®

Your source for the latest research news

OBOR 一带一路

China's program 'riskiest environmental project in history,' researcher warns

Date: May 15, 2018

China's Global Infrastructure Initiative Could Bring Environmental Catastrophe

An interview with conservation biologist William F. Laurance

comment

Environmental challenges for the Belt and Road Initiative

The Belt and Road Initiative will greatly influence the future of global trade. However, it may also promote permanent environmental degradation. We call for rigorous strategic environmental and social assessments, raising the bar for environmental protection worldwide.

Fernando Ascensão, Lenore Fahrig, Anthony P. Clevenger, Richard T. Corlett, Jochen A. G. Jaeger, William F. Laurance and Henrique M. Pereira

China's new Eurasian ambitions: the environmental risks of the Silk Road Economic Belt

Elena F. Tracy, Evgeny Shvarts, Eugene Simonov & Mikhail Babenko

To cite this article: Elena F. Tracy, Evgeny Shvarts, Eugene Simonov & Mikhail Babenko (2017) China's new Eurasian ambitions: the environmental risks of the Silk Road Economic Belt, Eurasian Geography and Economics, 58:1, 56-88, DOI: 10.1080/15387216.2017.1295876

1.2. Hazard = exotic pests vs. climate change

Box tree moth (*Cydalima perspectalis*)

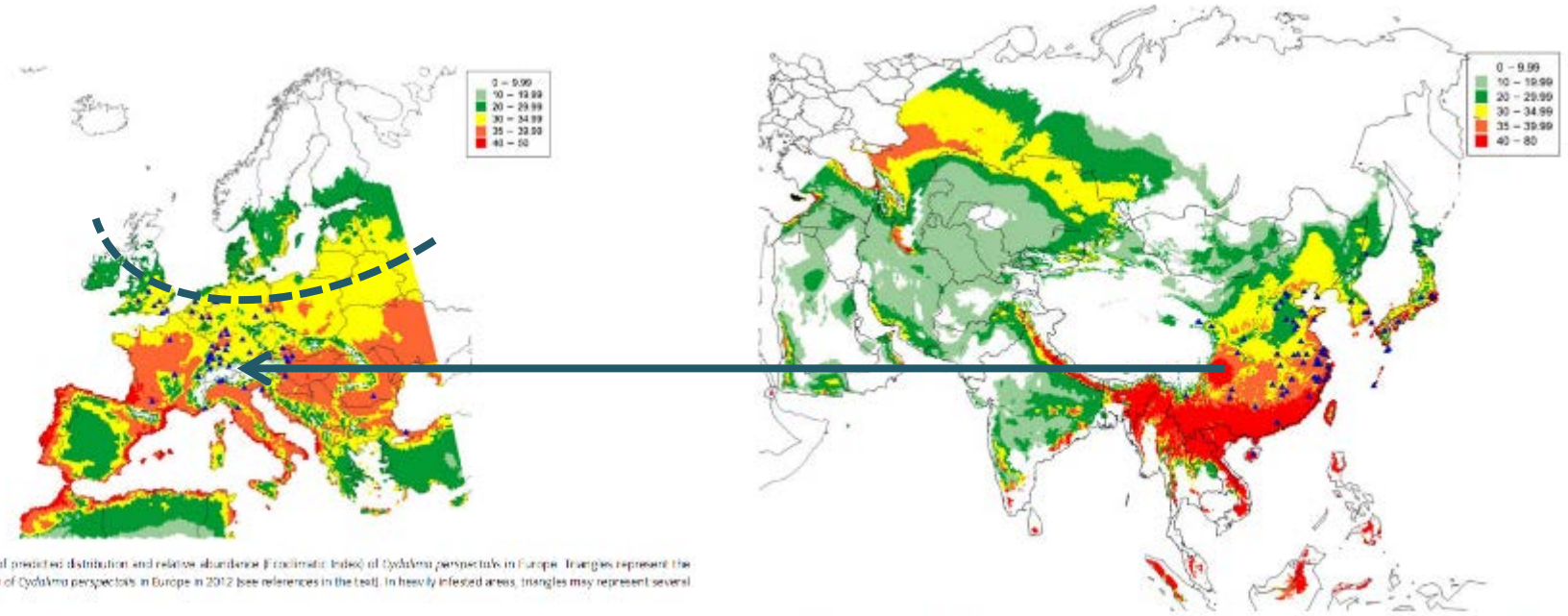


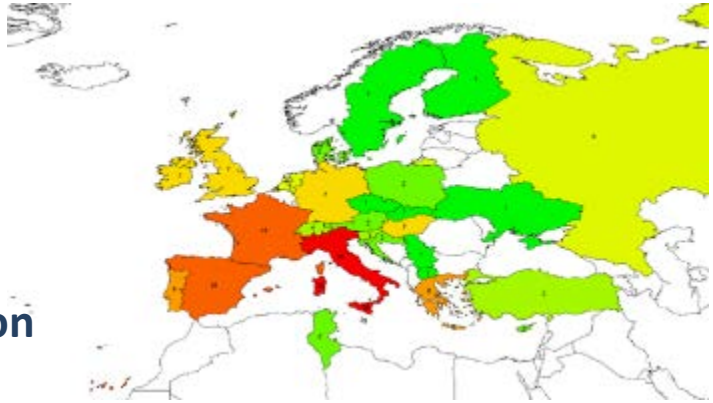
Fig. 6 CLIMEX map of predicted distribution and relative abundance (Ecoclimatic Index) of *Cydalima perspectalis* in Europe. Triangles represent the published distribution of *Cydalima perspectalis* in Europe in 2012 (see references in the text). In heavily infested areas, triangles may represent several notifications.

Fig. 5 CLIMEX map of predicted distribution of *Cydalima perspectalis* and relative abundance (Ecoclimatic Index) in Asia. Triangles represent the known distribution of *Cydalima perspectalis* in Asia from the literature (see references in the text) and unpublished observations by H. Wan and M. Kenis.

Nacambo et al. 2014

1.3. Hazard = exotic pests vs. urbanization

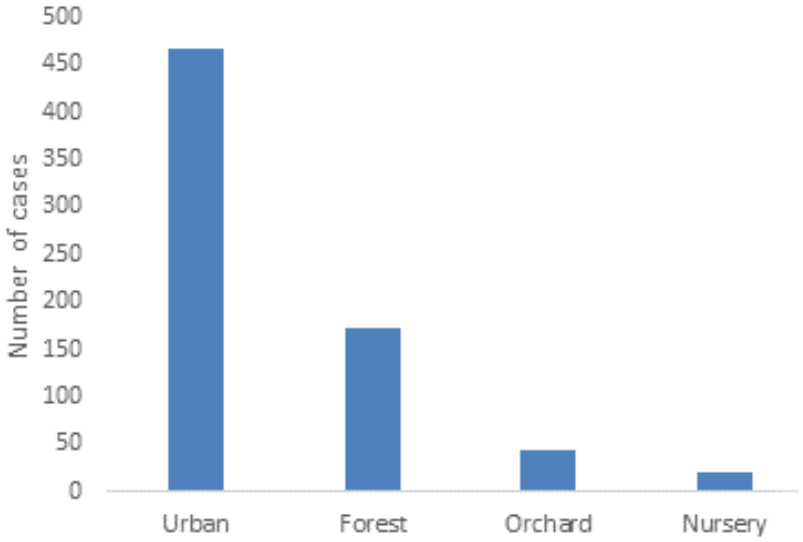
- High population density
- Proximity to ports of entry
- Tree diversity hotspots



Transnational plans for the management of forest risks
PLURIFOR

Branco, M., Roques, A., Jactel, H.

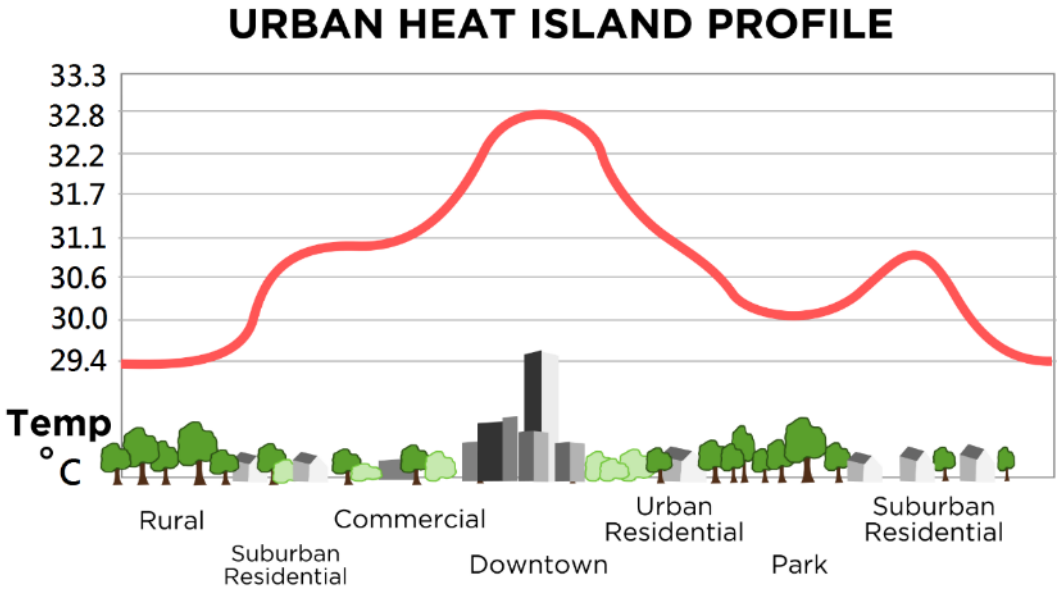
750 records of 1st interception
In 46 EPPO countries
150 exotic forest insect species



Type of habitat

Distance to the nearest seaport (10km)

1.3. Hazard = exotic pests vs. climate change × urbanization



2. Vulnerability = susceptibility of native forests to exotic forest pests, leading to damage

Evolution of Improved Competitive Ability hypothesis : investment in growth > defence in absence of coevolution with herbivore

Enemy release hypothesis : lack of predators from the area of origin

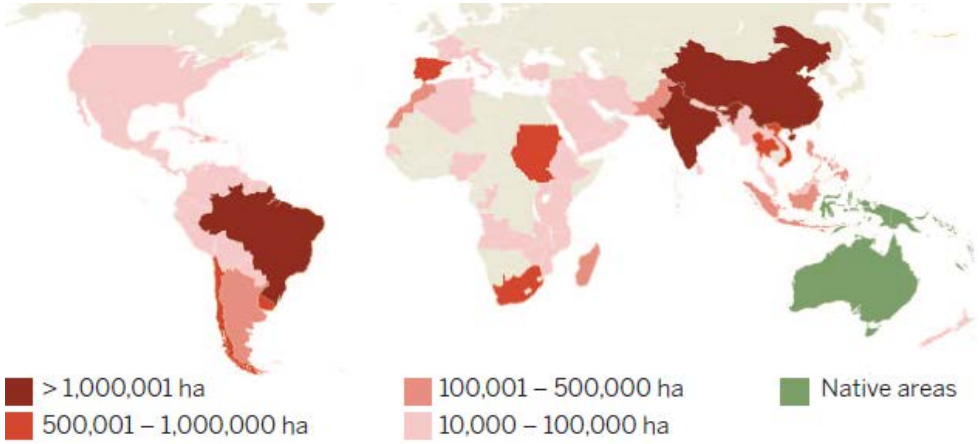
Table 3 Natural enemies of *Cydalima perspectalis* in Asia and Europe

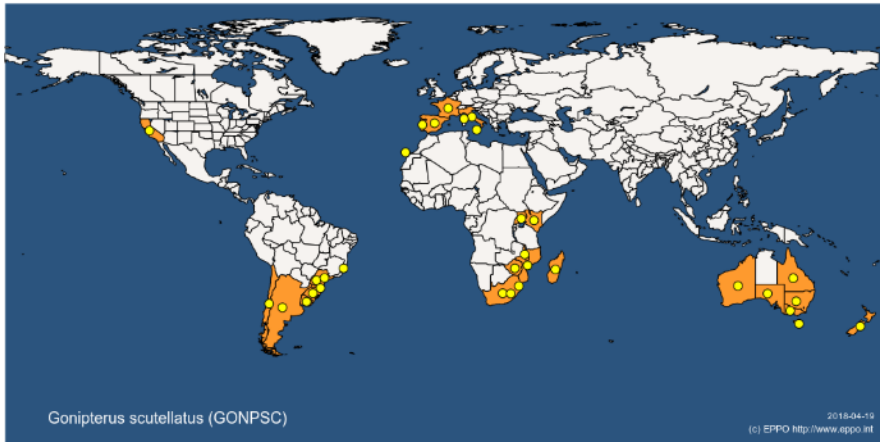
Order	Family	Species	First stage attacked	Country	References
Parasitoids					
Diptera	Tachinidae	*Compsilura concinnata* (Meigen)	Larva	Japan	Shima (1973)
	Tachinidae	*Exorista* sp.	Larva	China	Shi and Hu (2007)
	Tachinidae	*Pseudoperichaeta nigrolineata* (Walker)	Larva	Japan, Switzerland	Shima 1973; Nacambo 2012
Hymenoptera	Braconidae	*Chelonus inanitus* (Tosquet)	Egg	China	Shi and Feng (2006)
	Braconidae	*Chelonus* sp.[1]	Egg	China	Chen et al. (2005)
	Braconidae	*Bathythoracoides stantoni* (Ashmead)	Larva	China	Shi and Feng (2006)
	Chalcidae	*Brachymeria lasus* (Walker)	Pupa	China	Chen et al. (2005)
	Encyrtidae	*Tetrastichus* sp.	Egg	China	Zhao et al. (2004);
	Ichneumonidae	*Apechthis compunctator* (L.)	Pupa	Switzerland	Nacambo (unpublished data)
	Ichneumonidae	*Casinaria* sp.	Larva	China	Zhao et al. (2004)
Predators					
Thysanoptera	Aeolothripidae	*Aeolothrips* sp.	Egg	China	Chen et al. (2005)
		Undescribed spiders	Larva	China	Chen et al. (2005)

Wan et al. 2014

2.1. Vulnerability = exotic pests vs. global trade

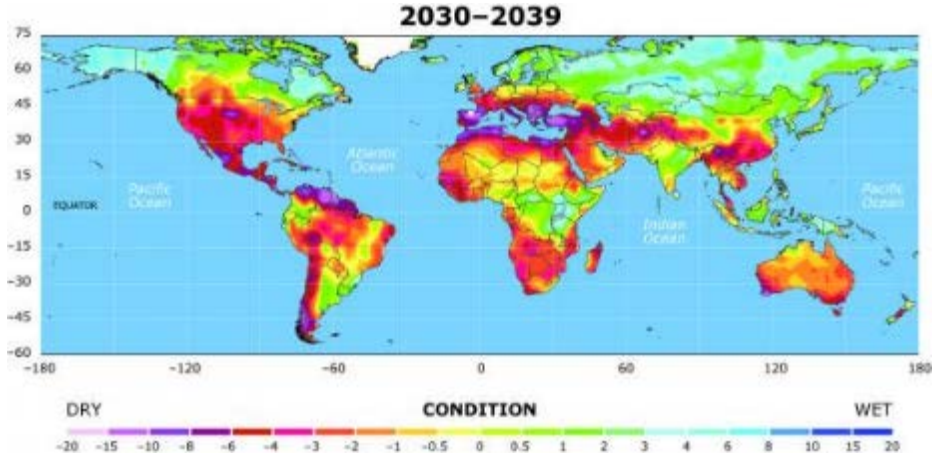
- Globalization of forest resources (biotic homogenization)
- Same main productive tree species widely spread, problematic if vulnerable





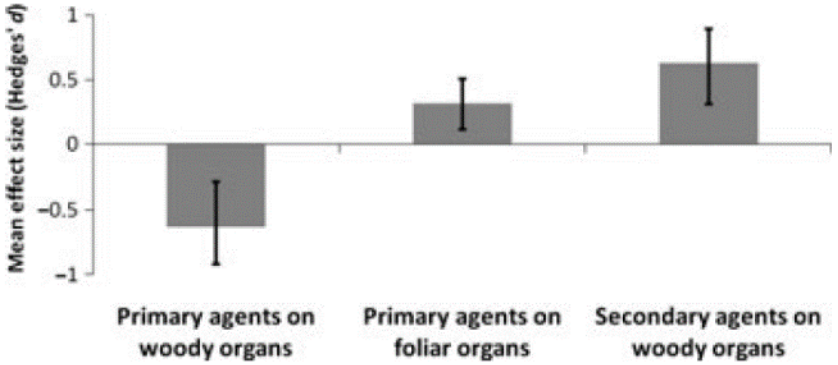
2.2. Vulnerability = exotic pests vs. climate change

- **Prediction of dryer conditions**



Credit: University Corporation for Atmospheric Research

Xylosandrus germanus
Ambrosia beetle



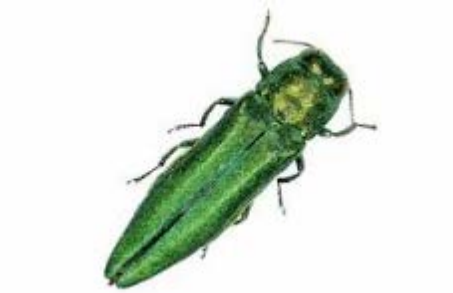
Global Change Biology (2012) 18, 267–276, doi: 10.1111/j.1365-2486.2011.02512.x

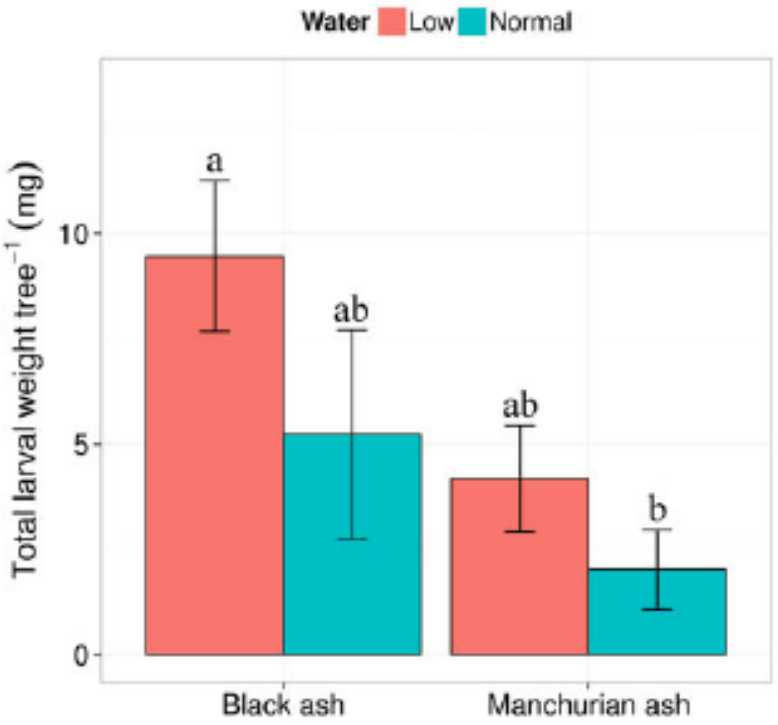
Drought effects on damage by forest insects and pathogens: a meta-analysis

HERVÉ JACTEL*, JÉRÔME PETIT†, MARIE-LAURE DESPREZ-LOUSTAU*, SYLVAIN DELZON*, DOMINIQUE PIOU‡, ANDREA BATTISTI§ and JULIA KORICHEVA¶

2.3. Vulnerability = exotic pests vs. urbanization

- Stressful conditions of urban trees: air pollution, soil compaction, drought
- Stressed trees in urban conditions are more susceptible to exotic pests





Plant, Cell and Environment (2014) 37, 1009–1021 doi: 10.1111/

Original Article

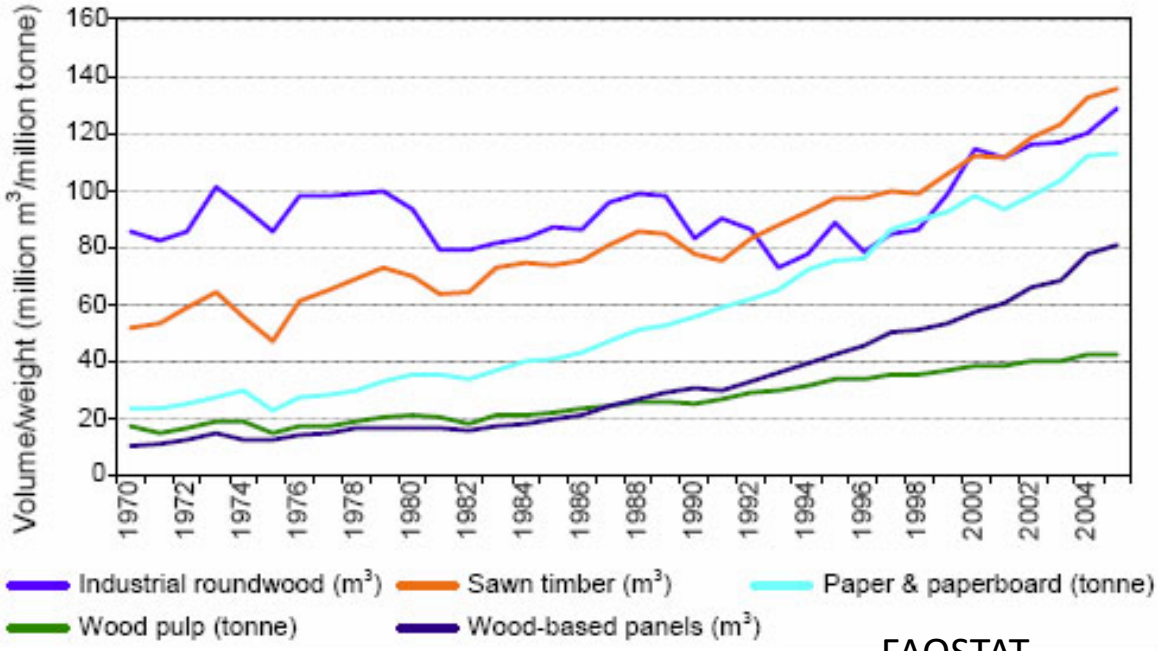
Effects of water availability on emerald ash borer larval performance and phloem phenolics of Manchurian and black ash

Sourav Chakraborty[1]*, Justin G. A. Whitehill[1†], Amy L. Hill[1], Stephen O. Opiyo[2], Don Cipollini[3], Daniel A. Herms[4] & Pierluigi Bonello[1]

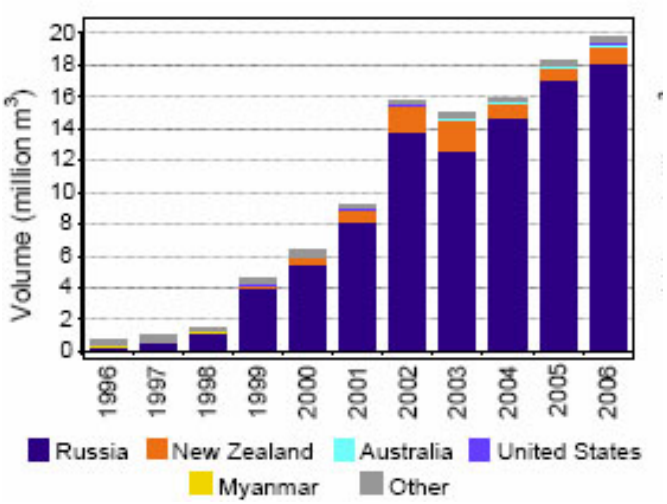
3. Exposure = forest values exposed to damage by exotic forest pests

3.1 Exposure = forest values vs. global trade

- **Worldwide increasing demand for wood products: tension around forest resources (shortage of fibre in the future)**



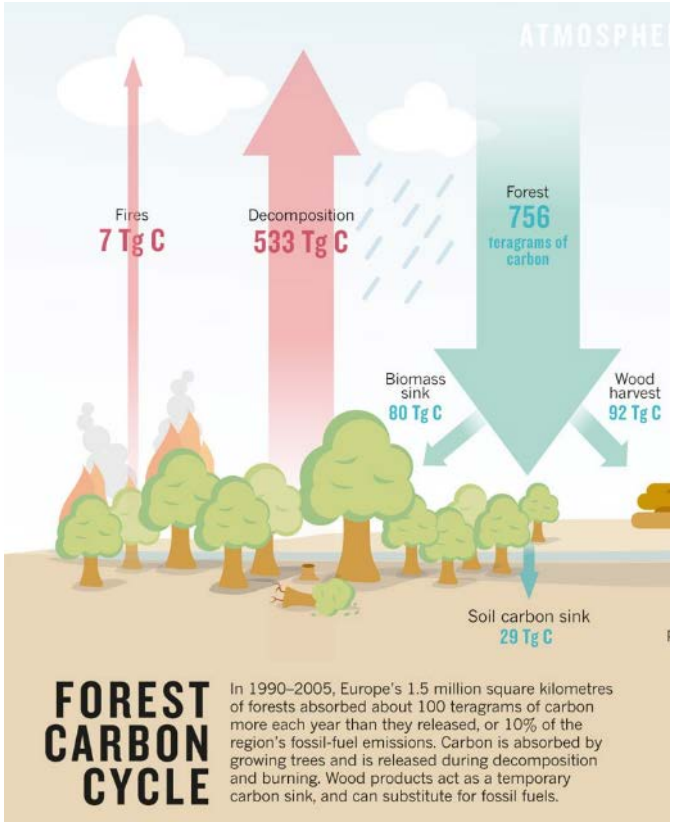
FAOSTAT



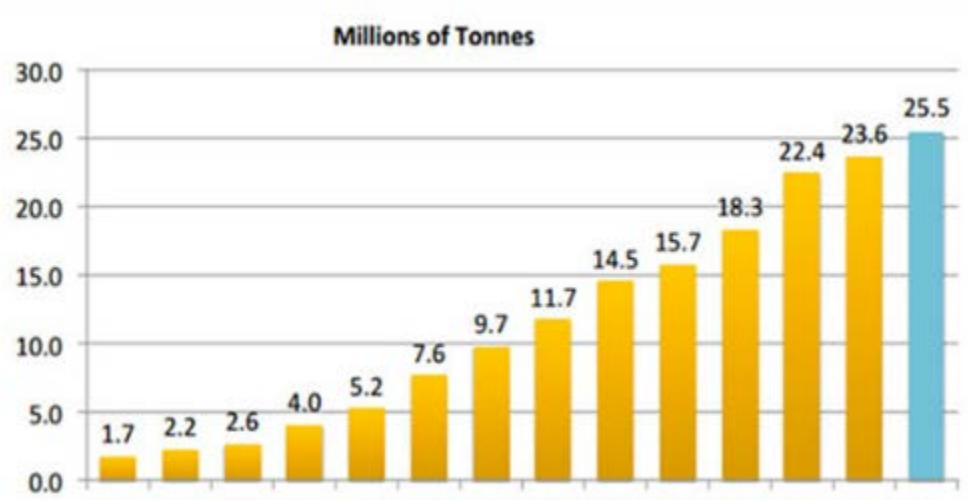
Chinese imports

3.2 Exposure = forest values vs. climate change

- Climate change mitigation: carbon sequestration in forests
- Climate change mitigation: fossil fuels replaced by energy wood



European forests absorbed 10% fossil-fuel emissions



Wood pellets global production

Bellassen & Luyssaert 2014

3.3 Exposure = forest values vs. urbanization

- More wood-based buildings
- Increasing recognition of services provided by urban trees

12-storey wood building in Quebec

Reduce air and sound pollution, runoff
Increase air quality, biodiversity, aesthetic

	Climate	Trade	Urbanization
Hazard			
Vulnerability			
Exposure			

Conclusions

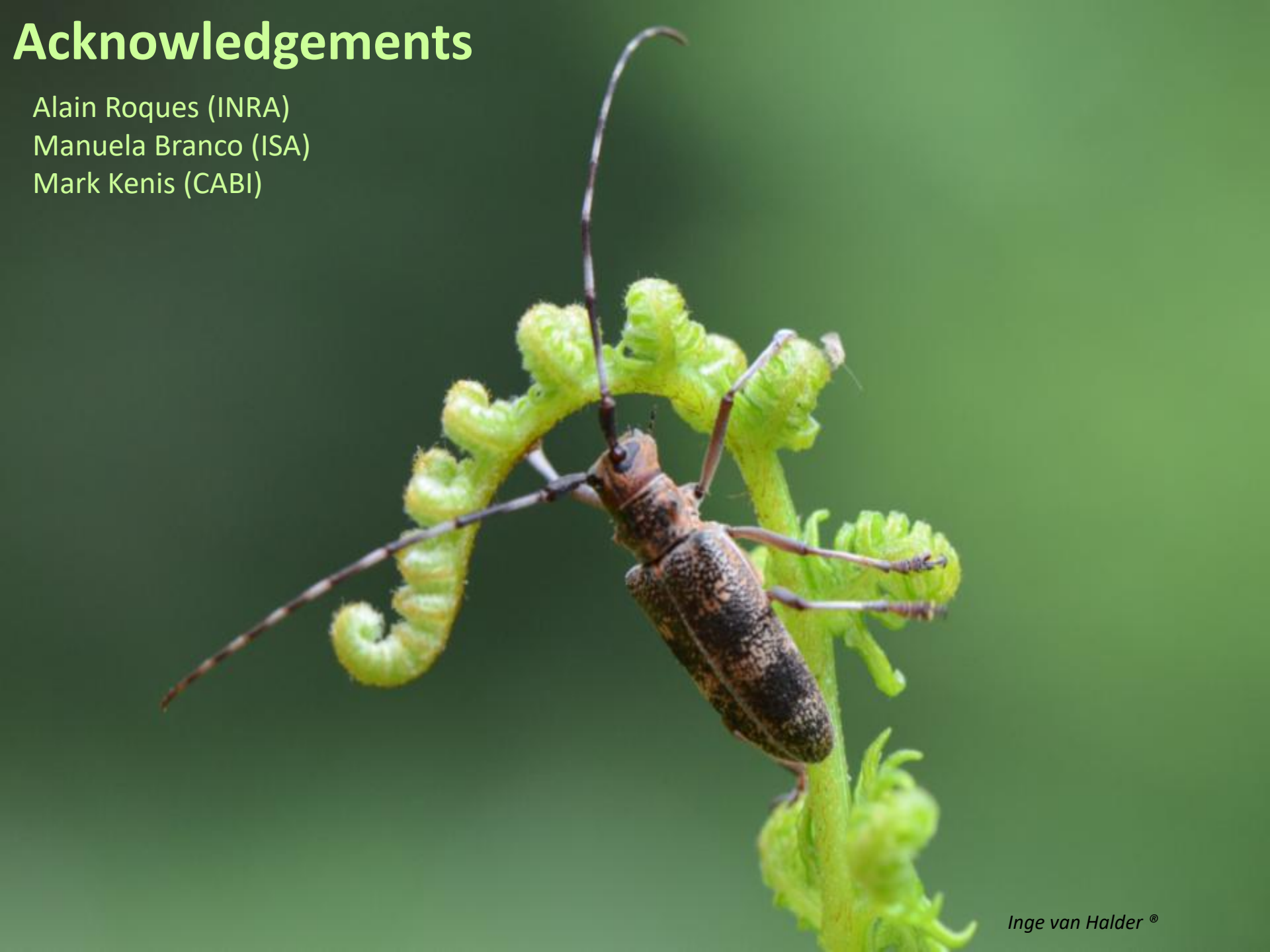
- Global change increases risks posed by exotic forest pests
- Once established, very difficult to eradicate or contain

- Prevention is better than cure:
  1. Avoid hazard = improve detection at entry
  2. Reduce vulnerability = improve forest diversity
  3. Reduce exposure = increase forest resources, plant more trees!

- Raise risk awareness

Acknowledgements

Alain Roques (INRA)
Manuela Branco (ISA)
Mark Kenis (CABI)



Inge van Halder ®