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(Metz, France): A call for mixed surveillance strategies  
for containing the invasion of the Japanese Beetle in  
Europe**

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# A call for mixed surveillance strategies for containing the invasion of the Japanese Beetle in Europe

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## The conquest of the world by the Japanese beetle

Biological invasions are successful introduction and establishment of species outside of their native range.

Biological invasions can impact ecosystems, food security and economic balances.

Biological invasions have been greatly facilitated by globalization.

The Japanese beetle successfully reached and established outside its native range through human-mediated transports.



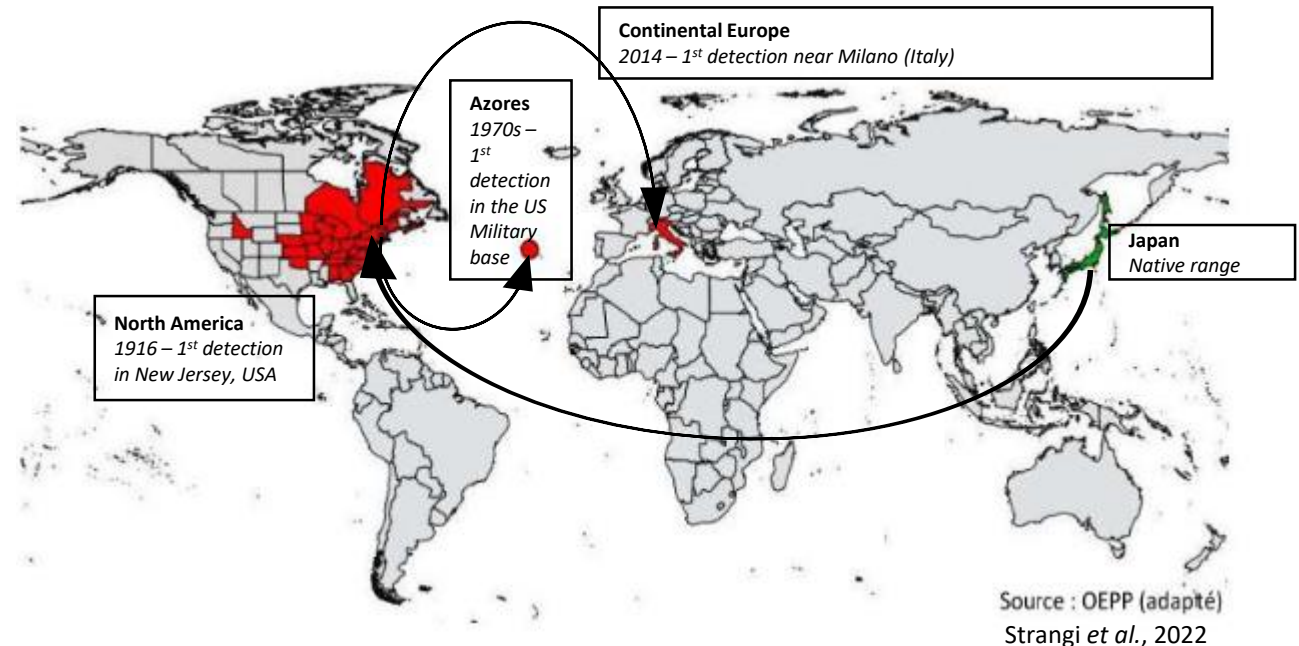
Japanese beetle

*Popillia japonica*

Native to Japan

Current distribution:

- Japan,
- North America,
- the Azores archipelago,
- Continental Europe










## Biology and behavior of the Japanese beetle





Piedmont region, Italy - July 2021  
© INRAE, Leyli Borner

 adult stage    larval stages

### Life cycle

-   Life cycle: 1-year (sometimes 2-years)
-  Emergence: between May and July
-  Life span: ~ 4-6 weeks
-   Egg-laying in grasslands (late summer): 40-60 eggs/female
-  Three larval stages, buried >15cm deep: December

### Damages in larval and adult stages

-  Grass roots (grass, lawns, pastures)
-  Fruits, flowers and foliage of host plants (> 400 plant species)

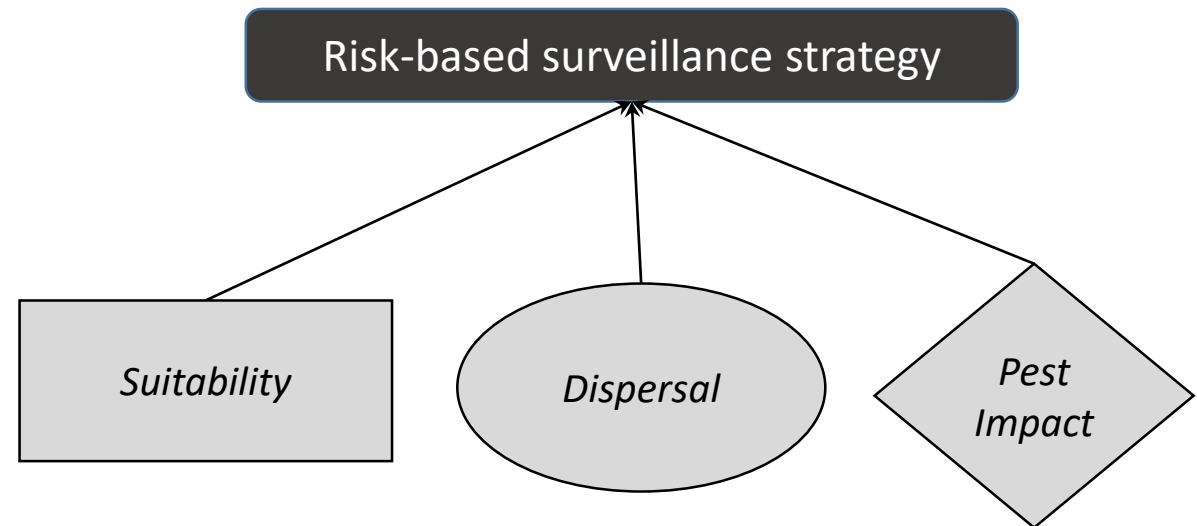
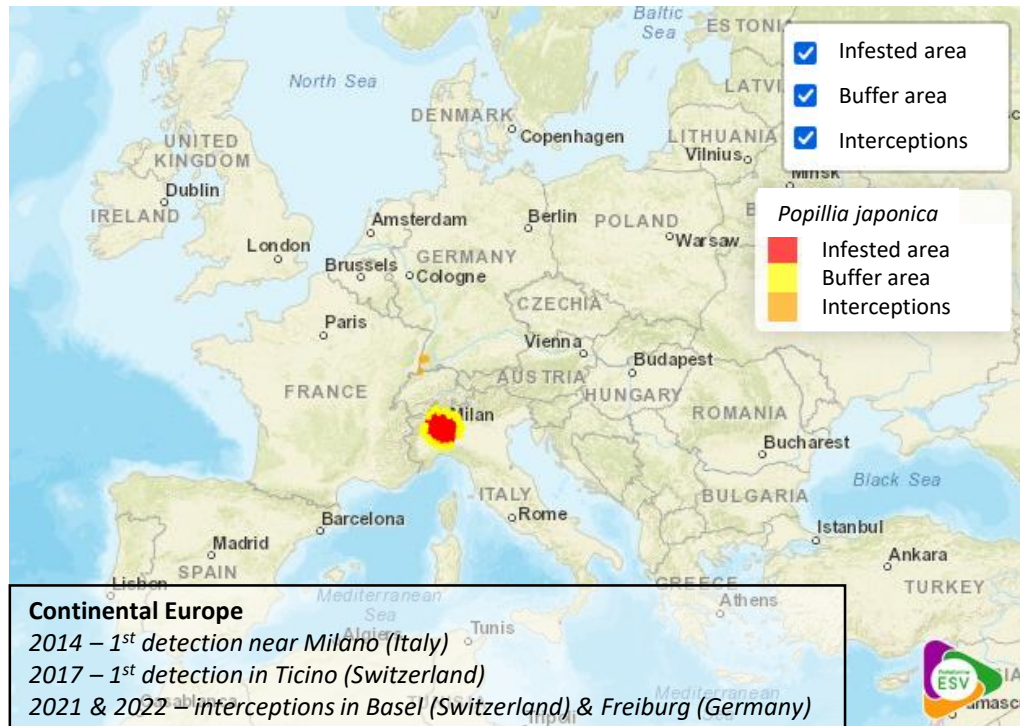


## Surveillance to restrict the spread of the Japanese beetle

Assessment based on environmental, social and economic impacts

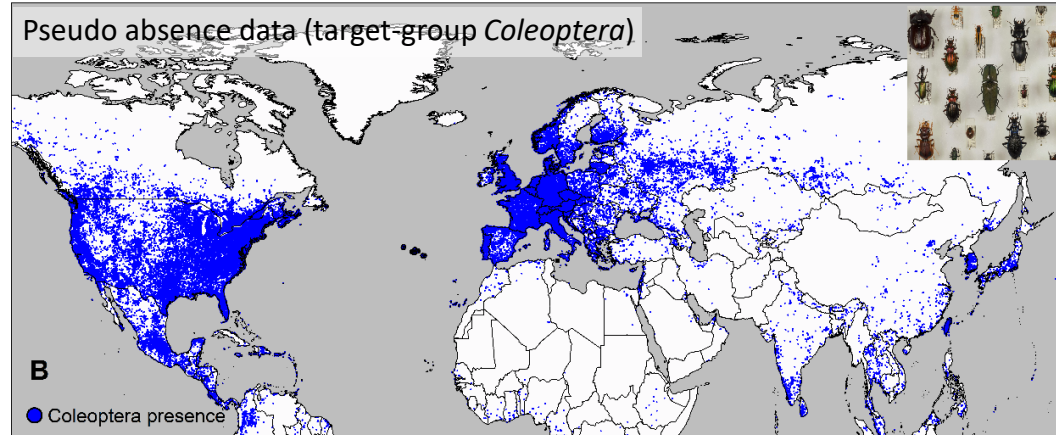
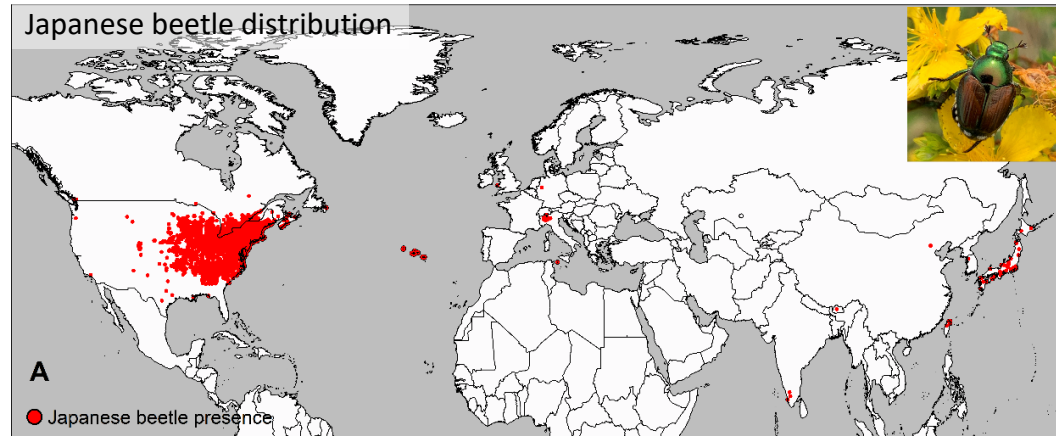
- European plant health agencies classified the Japanese beetle as a high priority quarantine pest (EFSA, 2019)

Goal: **Design surveillance to restrict the spread of the Japanese beetle**

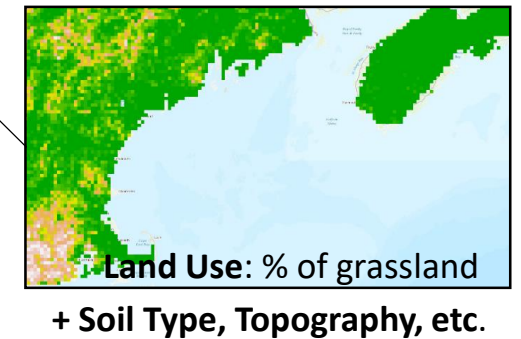
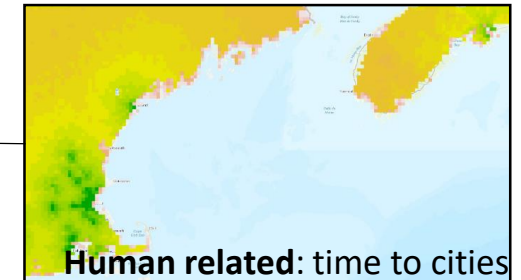
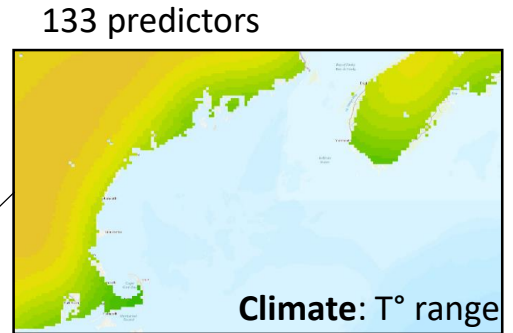


## Learning from long-infested areas to predict environmental suitability in Europe

Species Distribution Model, at 4km spatial resolution,  
 Model trained on native and long-infested areas & projected on Europe  
 Citizen-science distribution data & large set of predictor variables

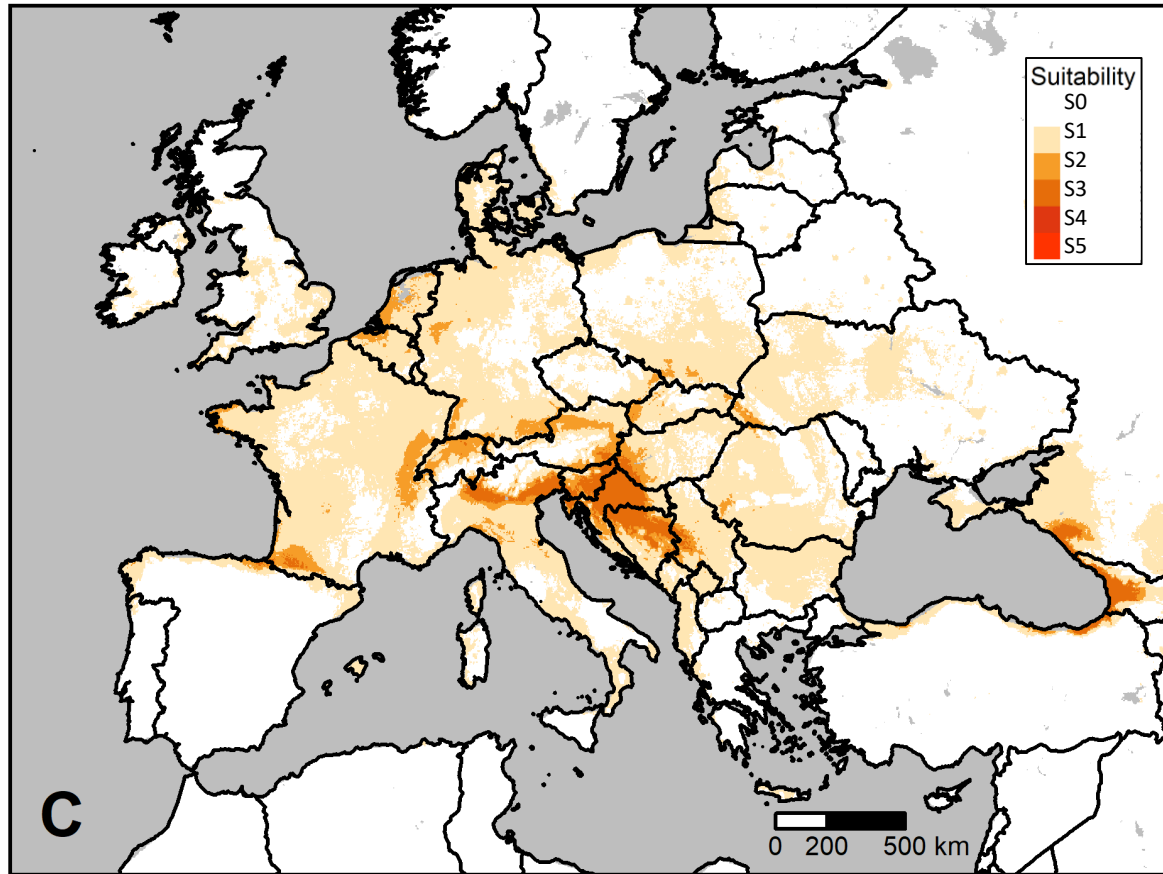


Random Forest Model



- Outputs
- Suitability map
  - Ranking of variable importance
  - Effects of variables on suitability

## Distribution of suitability calls for a mixed surveillance strategy



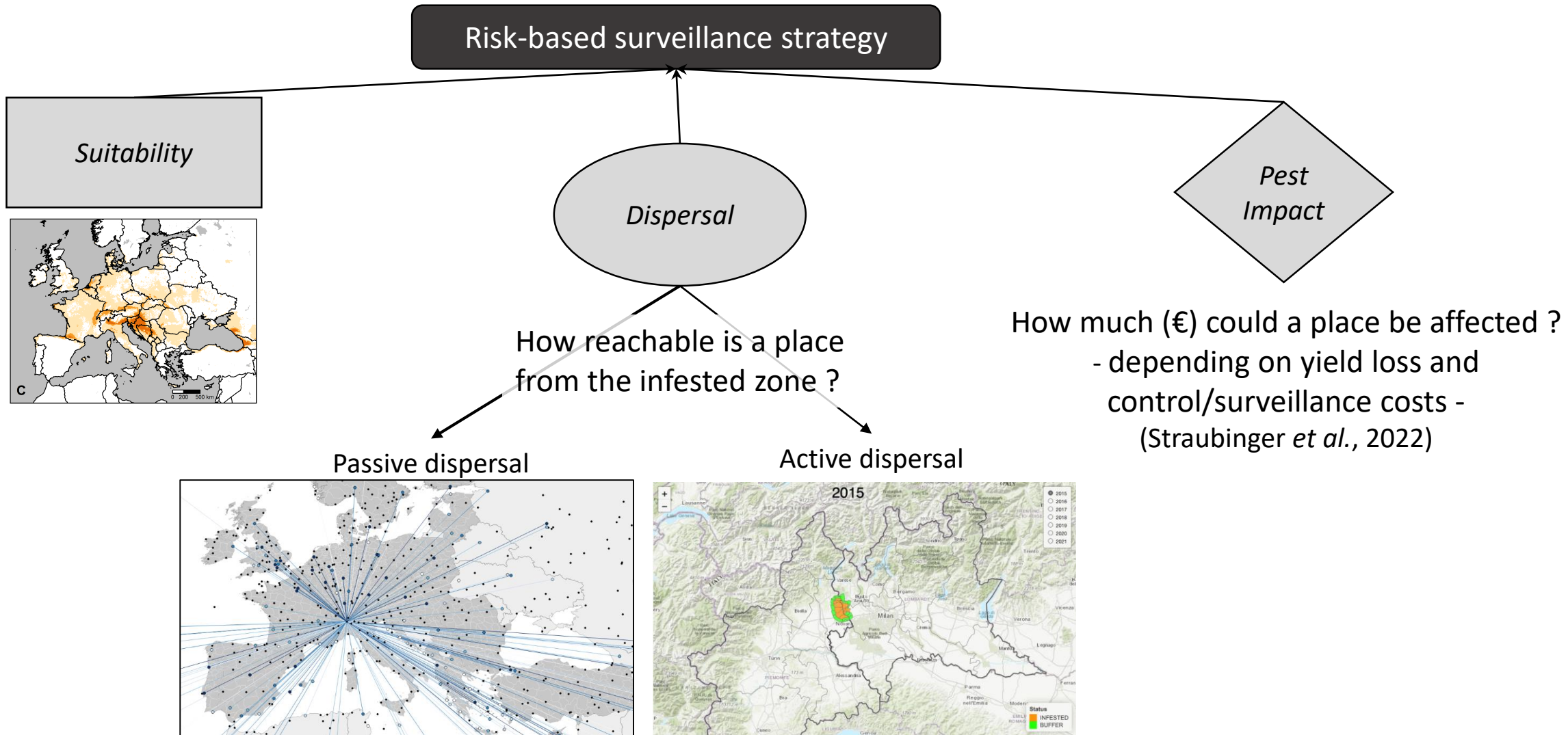
Continuum of suitable land across the continent and embedded clusters of **moderate** and **high** suitability. **Foothills of the Alps (North and South) and Northern Balkans & Eastern shores of the Black Sea.** **Southwestern France, close to the Pyrenees, in Brittany, Germany, & the Low Lands (coastal Belgium and Netherlands).**

- Highly suitable area would reflect high infestation levels
- 1% of highly suitable areas are currently occupied
- All clusters of high suitability are connected through moderate and low suitability areas

⇒ Mixed surveillance: tracking the front of invasion & early detection in neighbouring non-infested areas

⇒ Need to include human-mediated dispersal in risk-based surveillance strategy (connectivity by planes, trains, and trucks)

Combining suitability, dispersal, and pest impact to build a surveillance strategy








# Thank you all for your attention

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Ecology & Evolution: New perspectives  
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H2020 IPM Popillia project

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**IPM Popillia**

Integrated Pest Management of Japanese Beetle



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## Suitability publication

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<https://doi.org/10.1101/2022.11.14.515960>.

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