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Assessing the probability of freedom from pine wood nematode based on 19 years of surveys

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Pest surveys & Confidence in pest freedom

- Several quarantine pests are surveyed annually in all EU countries
- However, the confidence in pest freedom achieved with the surveys is not commonly assessed

- EFSA has proposed that the methods employed in RiBESS+ could be used for this purpose

- We test run the methods by assessing the confidence in pest freedom achieved with 19 years of annual surveys of the pine wood nematode

RiBESS+ = Risk Based Estimate of System Sensitivity Update tool

Pine wood nematode (PWN)

- Serious pest of pine trees
- Spread
  - over long distances in wood and wood packaging material
  - from tree to tree by longhorn beetles of the genus *Monochamus*
- Native in North America, introduced in Asia and Europe (PT and ES)
- Quarantine pest in the EU & all EU countries must conduct annual surveys

PWN survey in Finland

- Annual surveys since 2000
  - Sampling of **wood** 2000–2018 (8097 samples)
  - Trapping of **vector beetles** 2012–2018 (47 samples)

- In the Finnish climate PWN is not expected to cause symptoms

→ The surveys must be based on laboratory analyses of samples

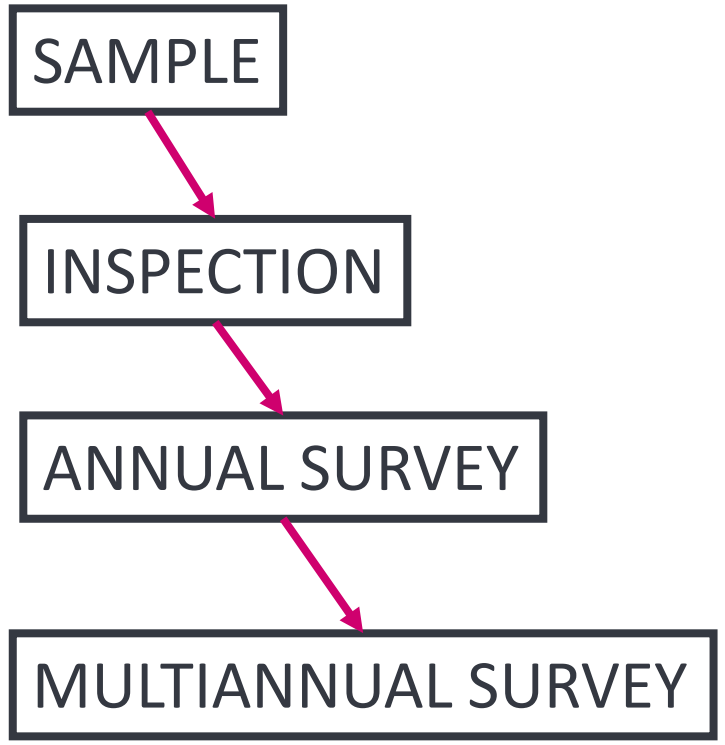
- PWN not found in any of the samples

PWN survey in Finland

- Each **annual survey** consists of a number of **inspections**

- Each **inspection** covers an area with a fixed size from which a **sample** of
  - wood or
  - *Monochamus* beetles

  is collected



Aims of the survey & Design prevalence

- *Design prevalence ≈ the minimum pest prevalence that the survey is expected to detect*

1) We considered two alternative aims
   a) Proving pest freedom to justify import requirements and to facilitate export
      = **IMPORT-EXPORT SURVEY**
   b) Early detection of invasions to facilitate eradication
      = **EARLY DETECTION SURVEY**

2) and defined design prevalences according to these aims

Inspection level design prevalence

- Defined as the **proportion of infested wood objects & *Monochamus* adults**
- Based on the prevalence of an ecologically similar species, *B. mucronatus*

a) Import-export survey

= prevalence of *B. mucronatus* ~ population that has reached maximum density

- Wood: 0.12; *Monochamus*: 0.09

b) Early detection survey

= 0.5 × prevalence of *B. mucronatus* ~ population that is established, but growing

- Wood: 0.06; *Monochamus:* 0.045

Region & country level design prevalence

- Defined as the **proportion of infested area** (where the inspection level prevalence ≥ inspection level design prevalence)

a) Import-export survey

= 0.01 (≈ 2250 km^2 with PWN host plants)

b) Early detection survey

- Based on the **maximum area from which eradication could be attempted**
  - based on the **harvesting capacity** that could be made available for eradication measures

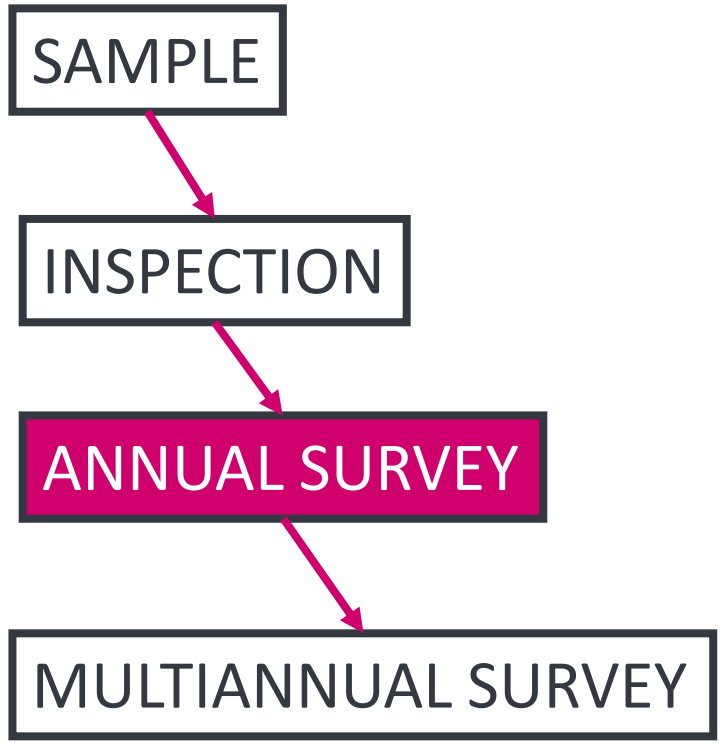
= 0.0027 (≈ 598 km^2 with PWN host plants)

The sensitivity of annual surveys

= *The probability that the pest will be detected in the survey if it is present in the area at a prevalence ≥ the design prevalence*

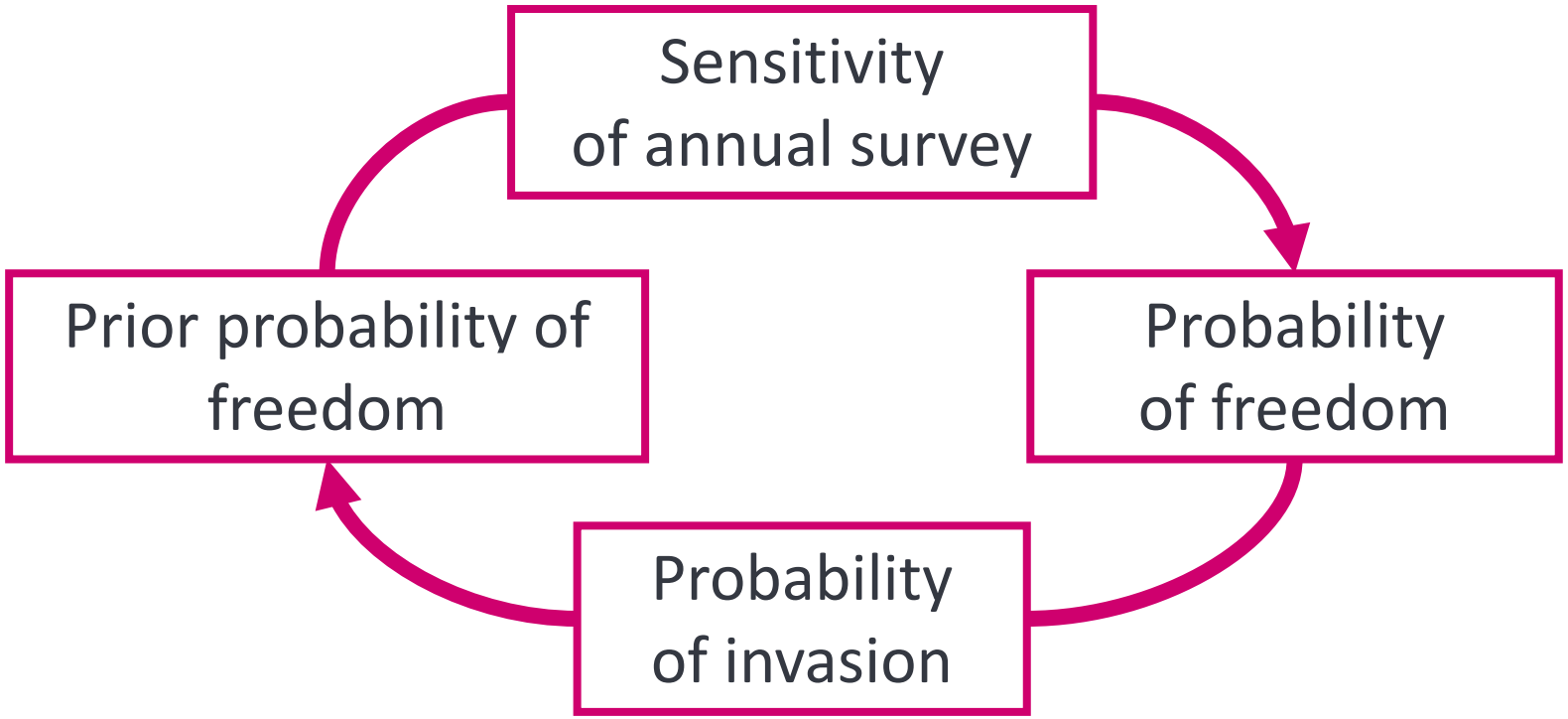
1) Sensitivity of inspections
   - Finite population, hypergeometric distribution
   - Separately for wood and beetle samples

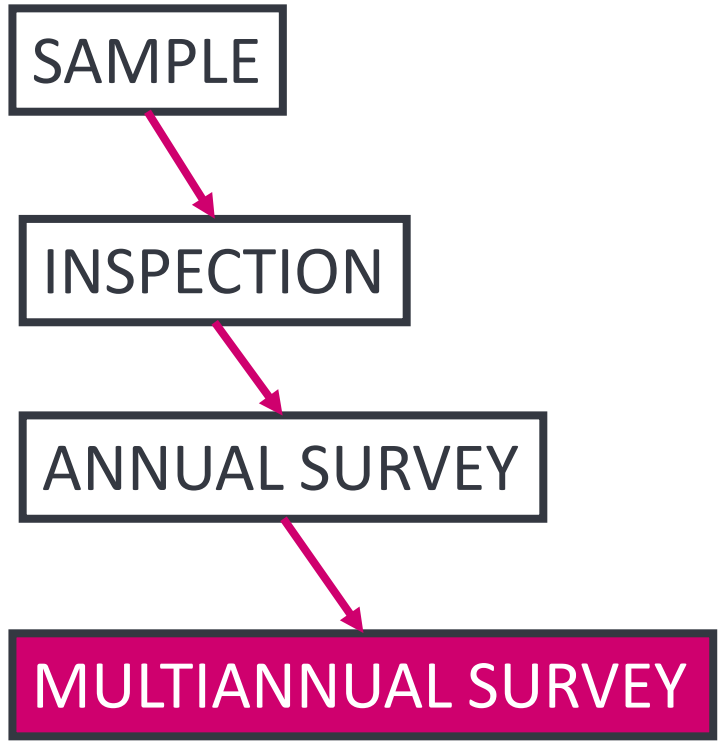
2) Sensitivity of annual surveys
   - Infinite population, binomial distribution
   - First combined for each region, then the whole country



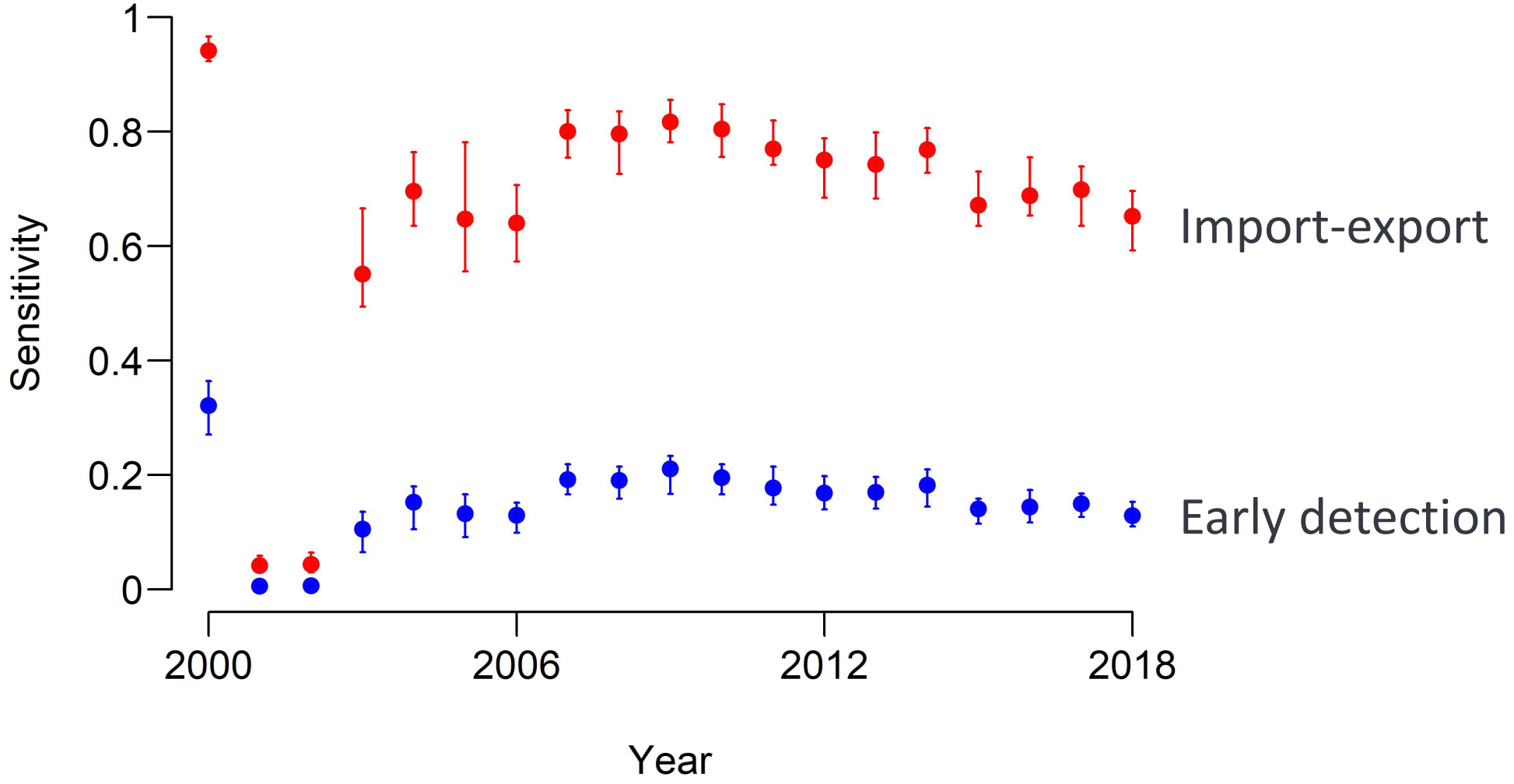
The probability of freedom based on multiannual surveys

= *The probability that the prevalence of the pest is < the design prevalence if the pest is not detected in the surveys*

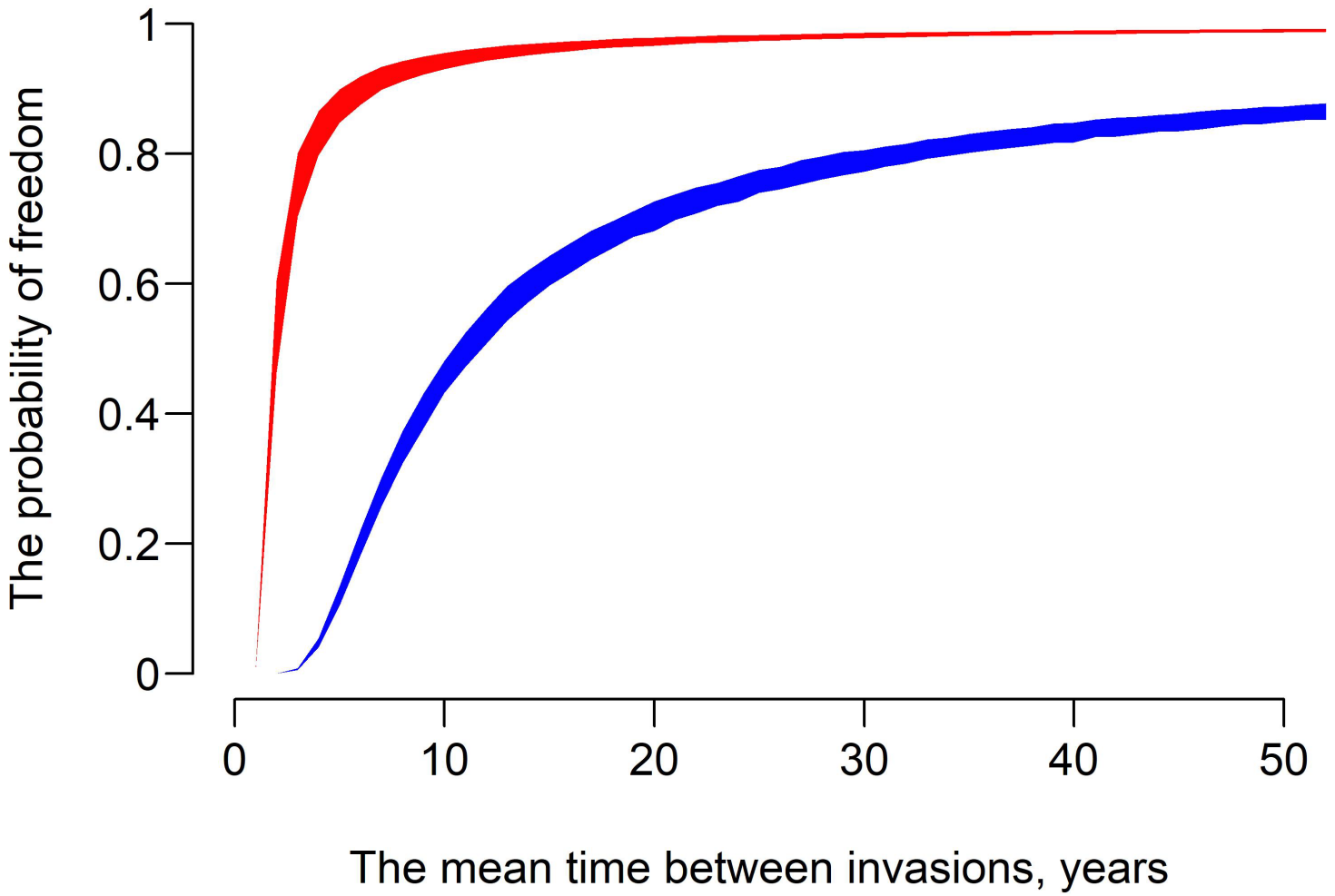




The sensitivity of annual surveys



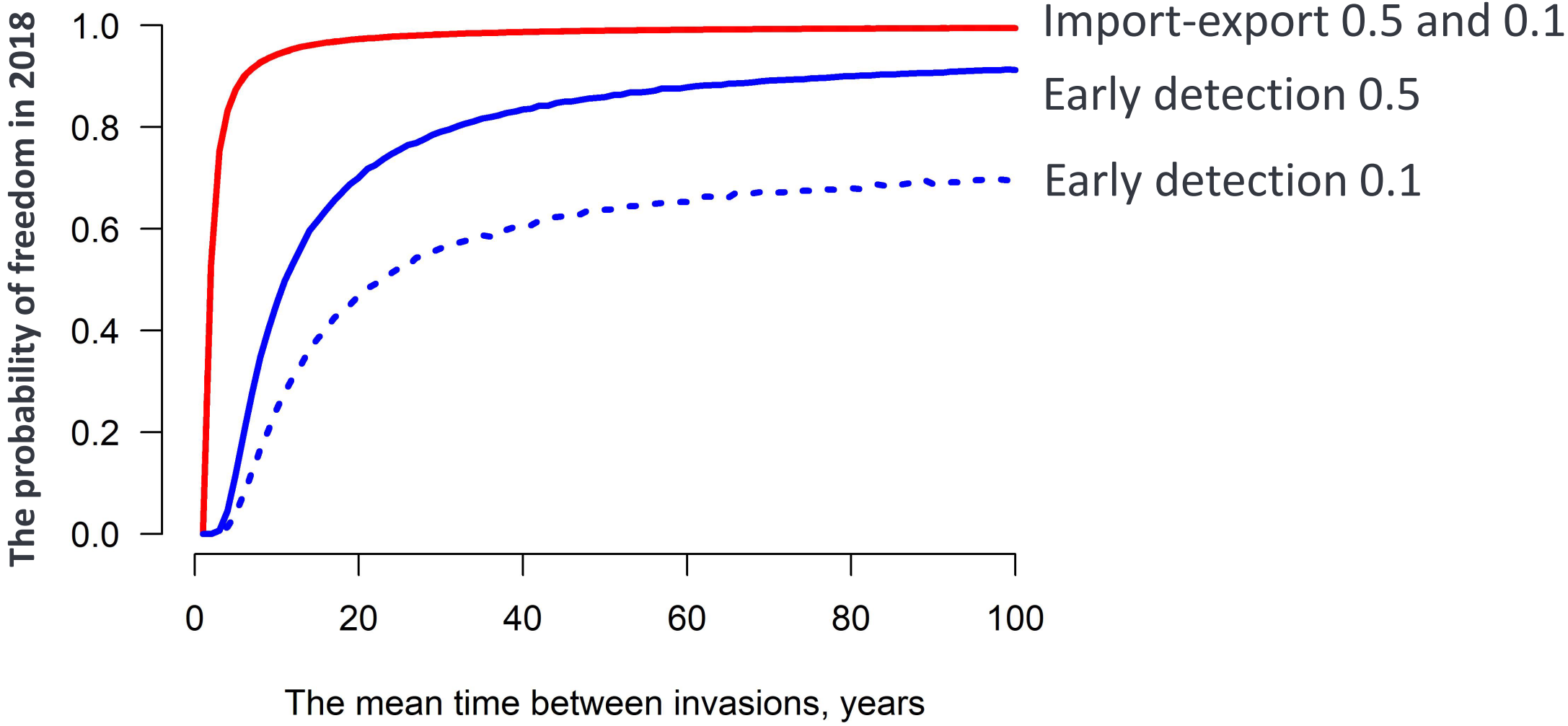
The probability of freedom achieved by 2018



Import-export

Early detection

The initial prior probability of freedom => the probability of freedom in 2018



Conclusion

- We can be rather sure that PWN is not (widely) present in Finland

- The surveys were unlikely to be extensive enough to ensure early enough detection to facilitate eradication of outbreaks

Conclusions

- The confidence in pest freedom may be overestimated because

1) Hypergeometric and binomial distributions are used to assess sensitivity
   - Pest population is assumed to be not aggregated,
     although aggregated distribution is typical for invasive pests

2) The probability of freedom is adjusted only with probability of invasion
   - Pest prevalence is assumed to increase between surveys only due to pest invasions,
     although it could increase also due to pest spread within the considered area

Conclusions

- The results of multiannual surveys should be **interpreted with caution** if the **initial prior probability of freedom** is not based on a proper assessment

- **Quantitative estimates of the probability of invasion** are needed to be able to accumulate confidence from multiannual surveys
  - But a rather rough estimate may be sufficient

- Ideas on **how to determine meaningful design prevalence** are needed to properly assess the risk management capacity of surveys

- **Examples of the confidence** that can be achieved with survey are needed to gain an understanding about the risk management capacity of surveys

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Thank you!

For more information, please contact

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