Learning from modelling pest introduction: what data is needed and is it available?

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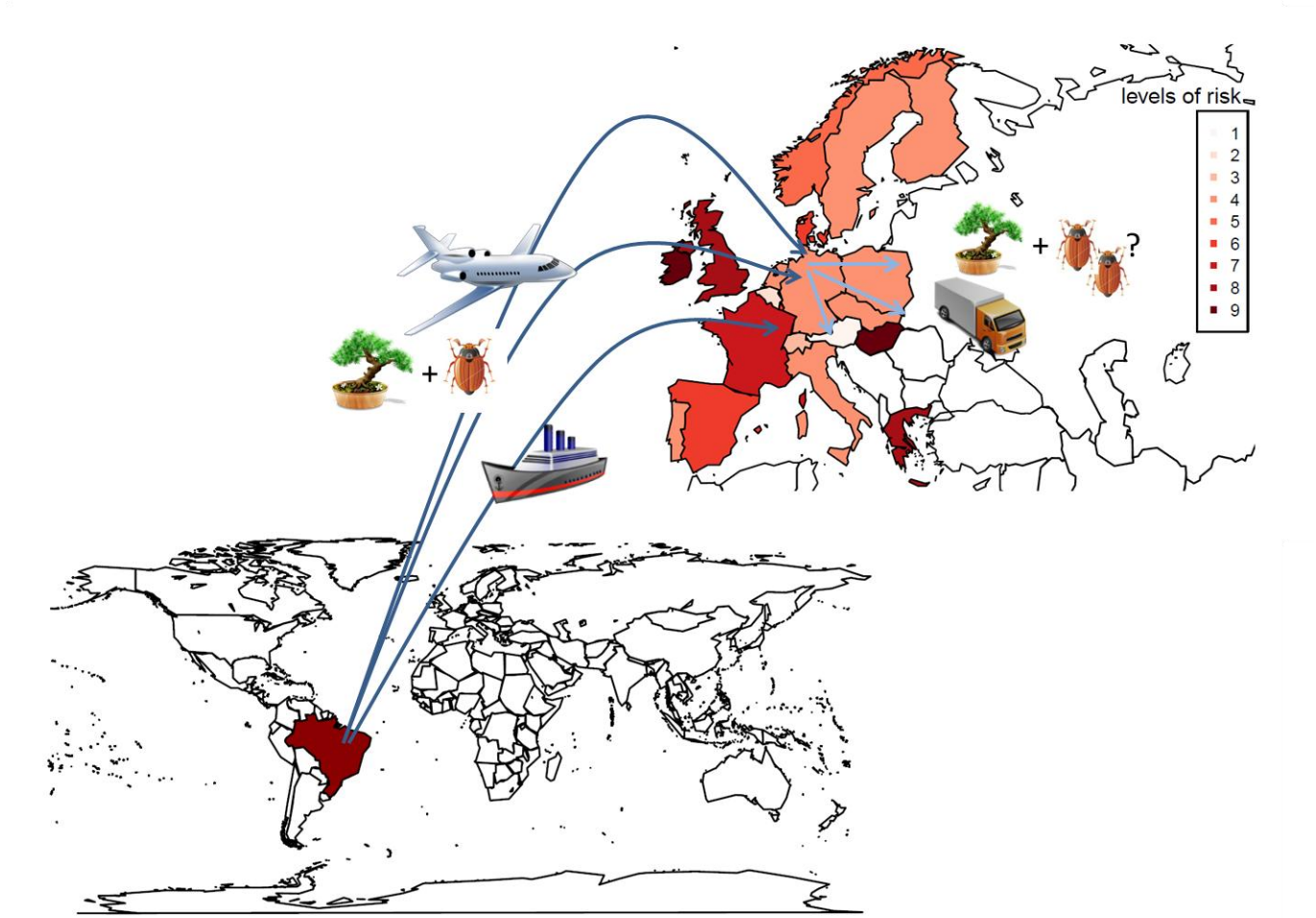
How to model pest introduction?

- Pests are introduced via pathways
- *"The combination of processes and opportunities resulting in the movement of propagules from one area to another, including aspects of the vectors involved, features of the original and recipient environments, and the nature and timing of what exactly is moved"* (Richardson *et al.*, 2010 in *Fifty Years of Invasion ecology)*
- Pathway model: mathematical description of pathway
- Description: pest, carrier + movement, area of origin and destination (hosts)

How do PPMs work? Graphical summary

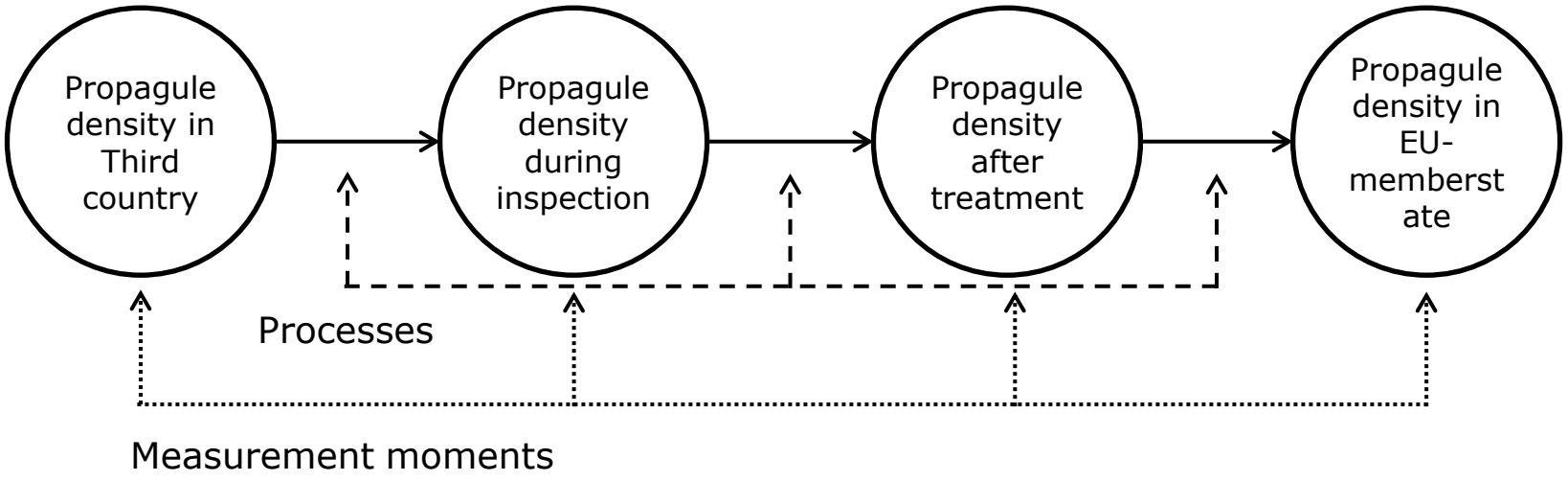


A modellers perspective on data needs for risk assessment

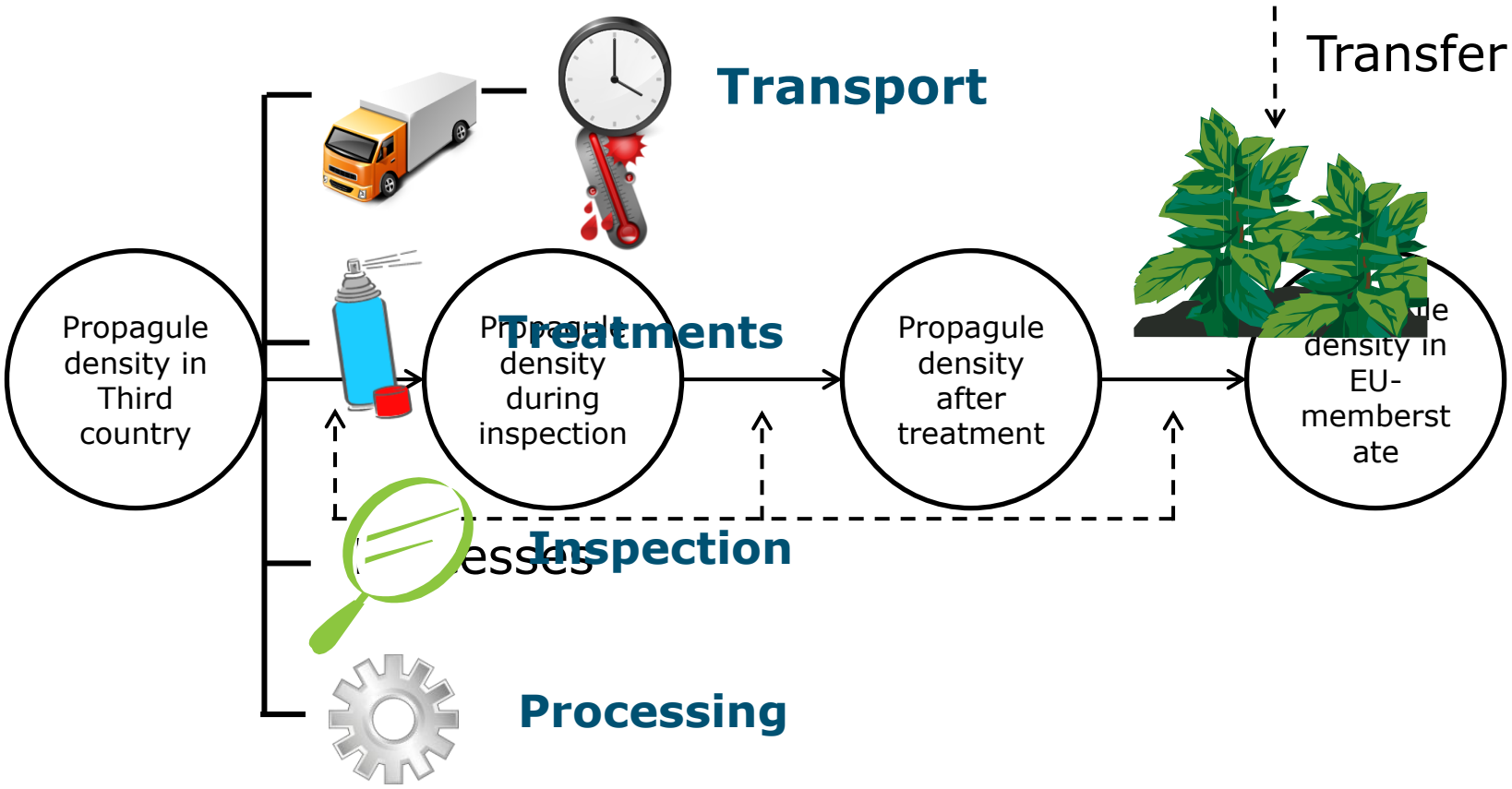
Conceptualisation of the model

- Divide the import process of a pest in nodes; from the source (agro-)ecosystem in the country of origin to introduction into the target (agro-)ecosystem in the EU territory
- Consignment as modeling unit

A sequence of nodes, connected by edges (links):

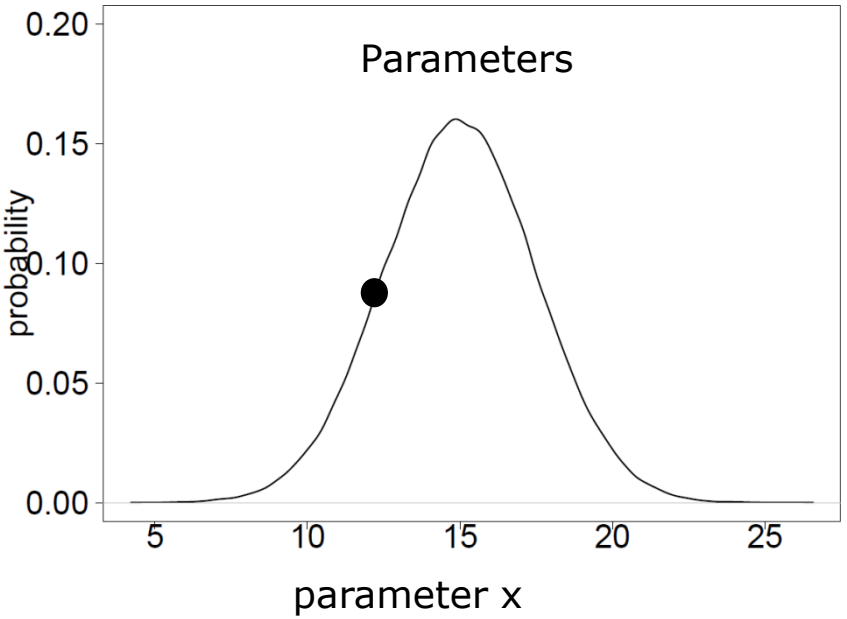


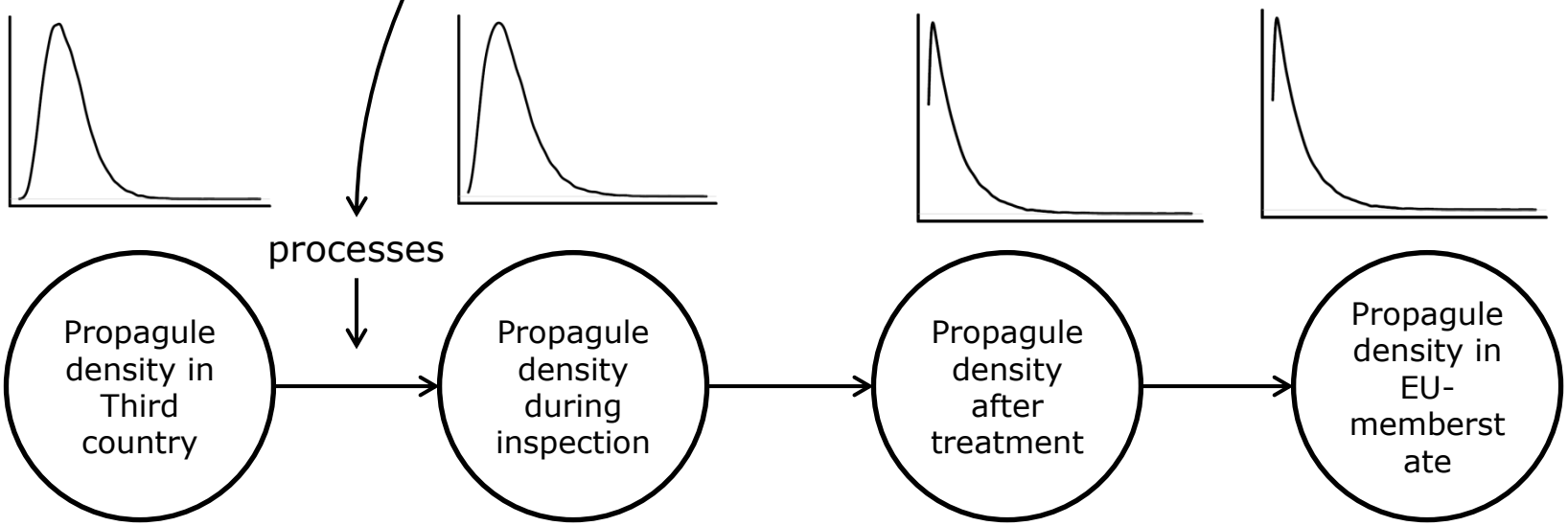
Conceptualisation of the model



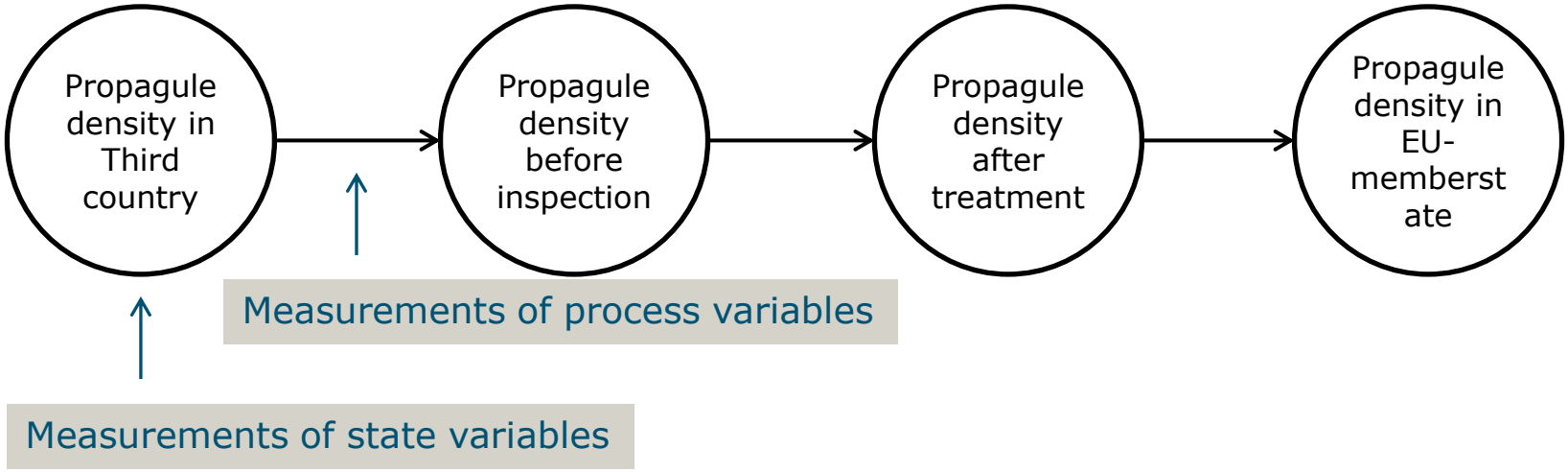
Conceptualisation of th

Draw from parameter space (Monte Carlo)





Data requirement of PPMs



- Measurements of state variables
  - Size of consignments
  - Consignment infested/not infested
  - Number of infested plants per consignment

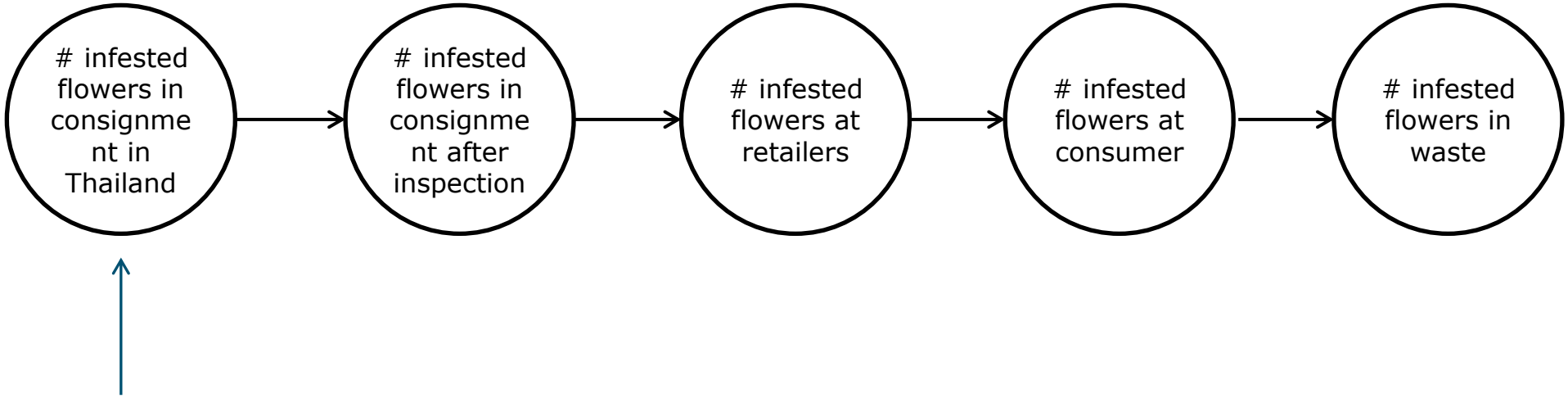
1) Piel et al 2008

Lesson 1: What can we learn from models without having the data?

- A PPM integrates consistently all pathway elements (pest, carrier, host)
- Helpful structure for risk assessors to think about the invasion process
- Identification of what is available of what data is needed

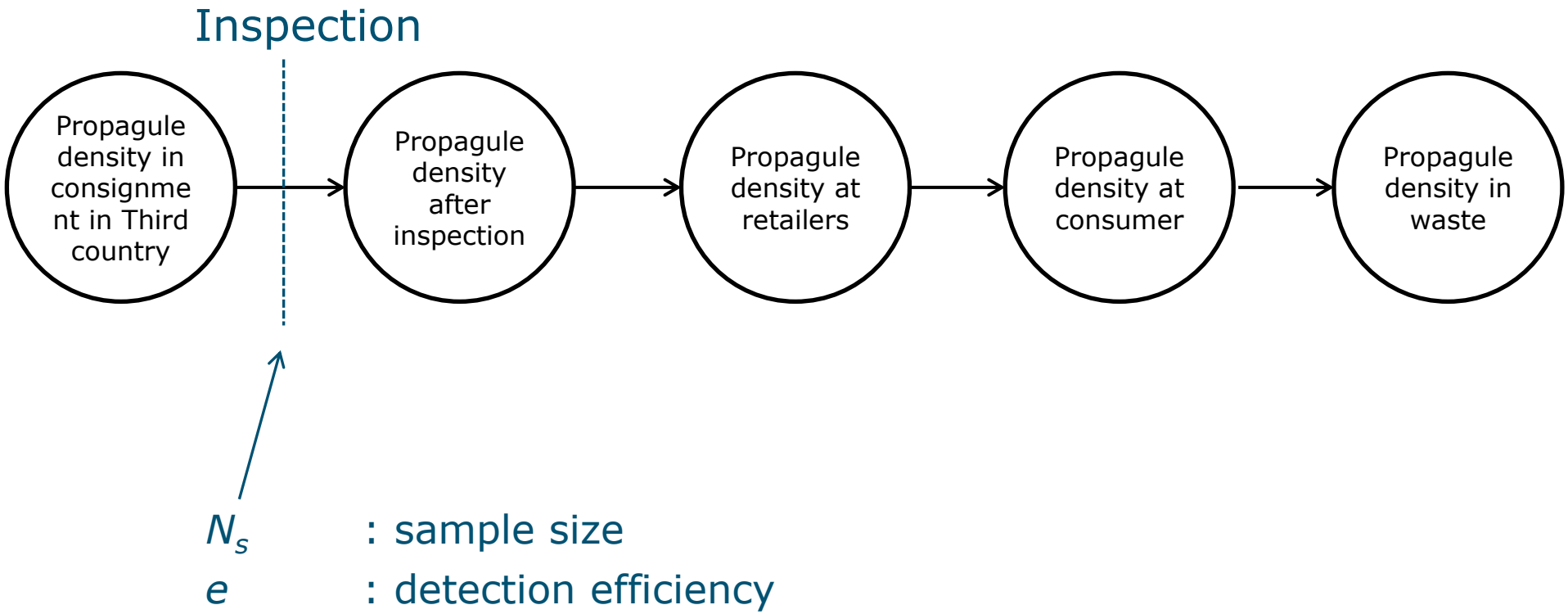
Expert quote: “This model shows what we don’t know”

Cut-orchids and *Thrips palmi* from Thailand



- N : consignment size
- Ny : yearly export
- p_{inf} : probability that a flower is infested

Cut-orchids and *Thrips palmi* from Thailand



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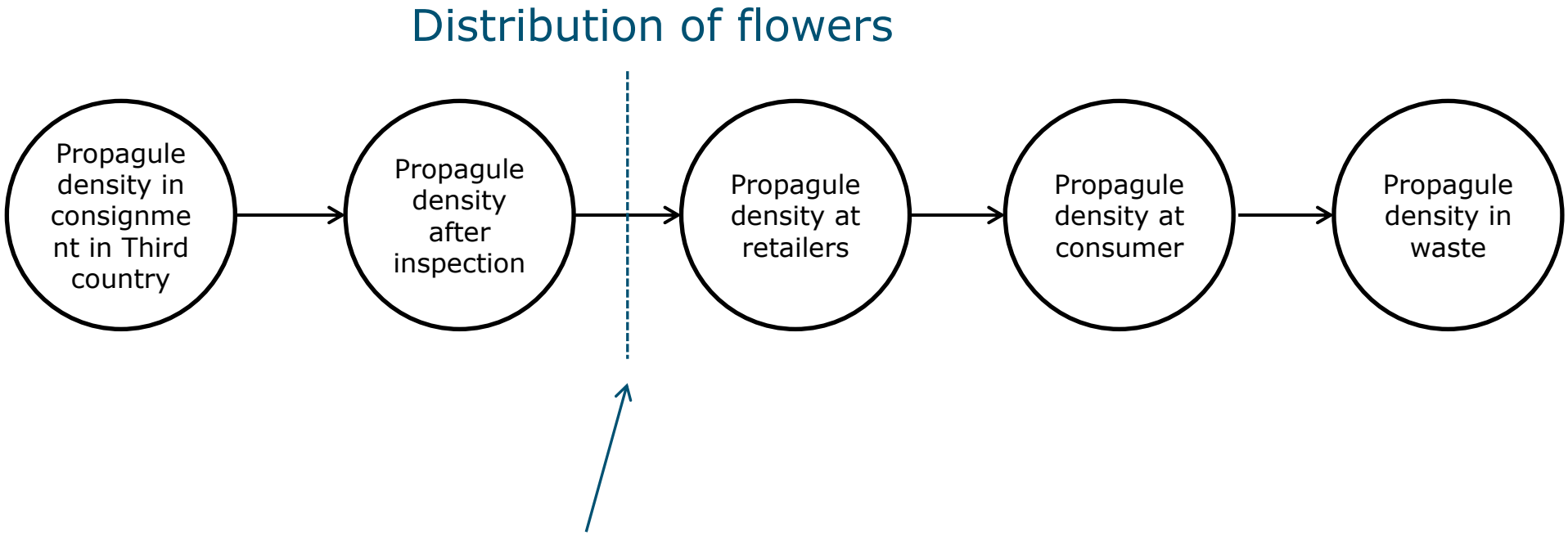
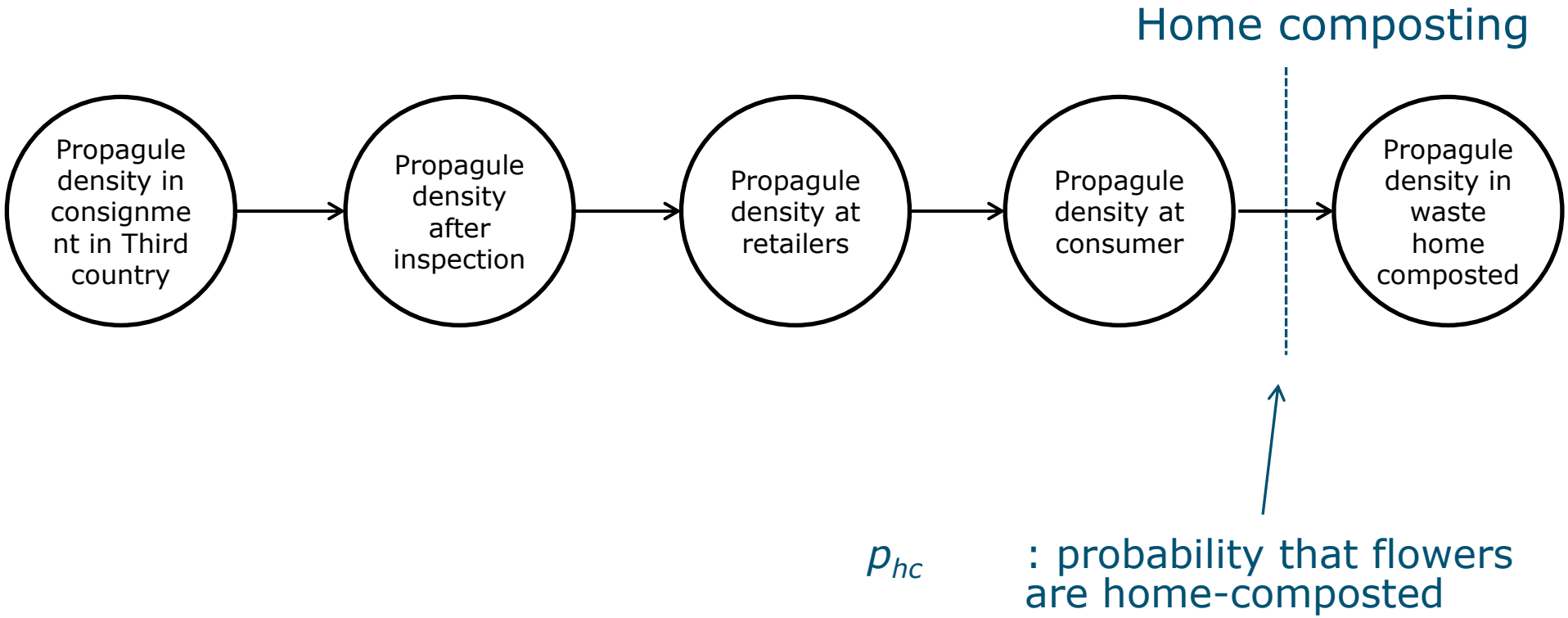


$P_{v,j}$: probability to be re-exported to country j

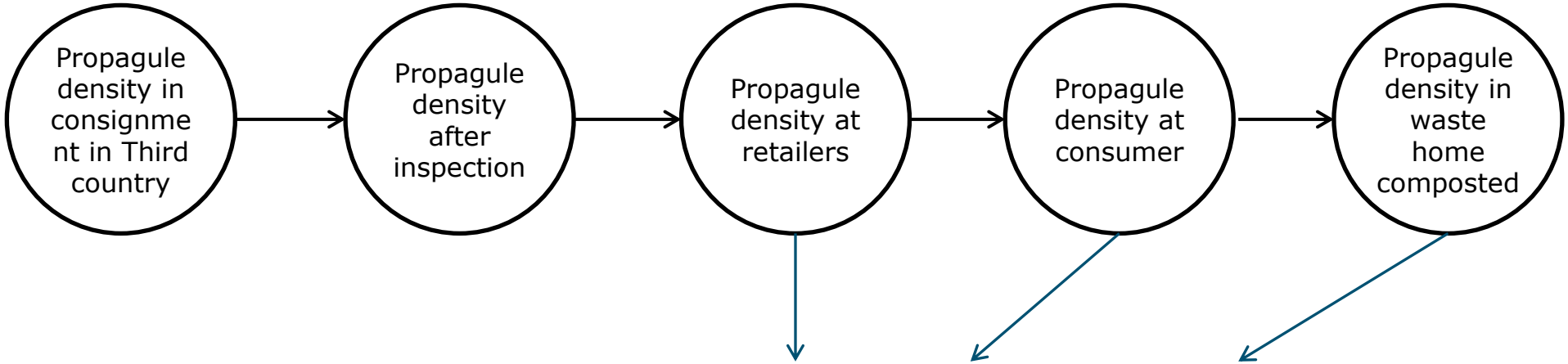
$P_{r,i}$: probability to be send to retailer type i

Cut-orchids and *Thrips palmi* from Thailand



Cut-orchids and *Thrips palmi* from Thailand

Home composting



P_{esc} : probability that pest escapes from flower

p_{enc} : probability that flowers encounter a suitable host

p_{disp} : probability that pest disperses to host

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Findings from other case-studies

	Commodity	Citrus fruits	Orchids Thailand	Conif. wood China	Oak from USA	Tomato seeds
	Pest	Citrus Black Spot	Thrips palmi	Pine wood nematode	Oak Wilt	PSTVd
Country of origin	proportion infested					
Inspection	Sampling protocol					
	Inspection data					
Trade data	Import from CO					
	intra-EU trade					
	End users					
Transfer	Escape					
	Dispersal					
Host data						

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	Commodity	Citrus fruits	Orchids Thailand	Conif. wood China	Oak from USA	Tomato seeds
	Pest	Citrus Black Spot	Thrips palmi	Pine wood nematode	Oak Wilt	PSTVd
Country of origin	proportion infested	indirect	indirect	indirect	indirect	No data
Inspection	Sampling protocol	1 country	2 countries	1 country	1 country	1 country
	Inspection data	1 country	1 country	1 country	1 country	1 country
Trade data	Import from CO	Country level - monthly basis	Flowers good P4P sparse	Country level - monthly basis	Country level - monthly basis	no data
	intra-EU trade	Country level - monthly basis	Flowers good P4P sparse	Country level - monthly basis	Country level - monthly basis	no data
	End users	Well specified	Well specified	Sparse	Sparse	Well specified
Transfer	Escape	study funded by EFSA	no data	no data	no data	data available
	Dispersal	study funded by EFSA	sparse	research	Sparse	NA
Host data		well specified	some data available	well specified	well specified	well specified

Lesson 2: Where to focus data collection on:

Data categories	Parameter
Country of origin	Proportion of infested product (and its variability)
Inspection	Inspection protocol Inspection efficiency (validation!) + registration
Trade data	Waste flows Plants for planting
Transfer	Likelihood of escape from commodity Dispersal characteristics
Host data	

Feedback, comments, ideas, questions?

All welcome!

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Photo credit: Cathal Mcnaughton/PA

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