Australian Government
Department of Agriculture

Prioritising and Designing Surveillance to Support Risk Management

IPPC International Symposium for Pest Free Areas and Surveillance

Venue: Hotel Associa Shizuoka, Shizuoka, Japan

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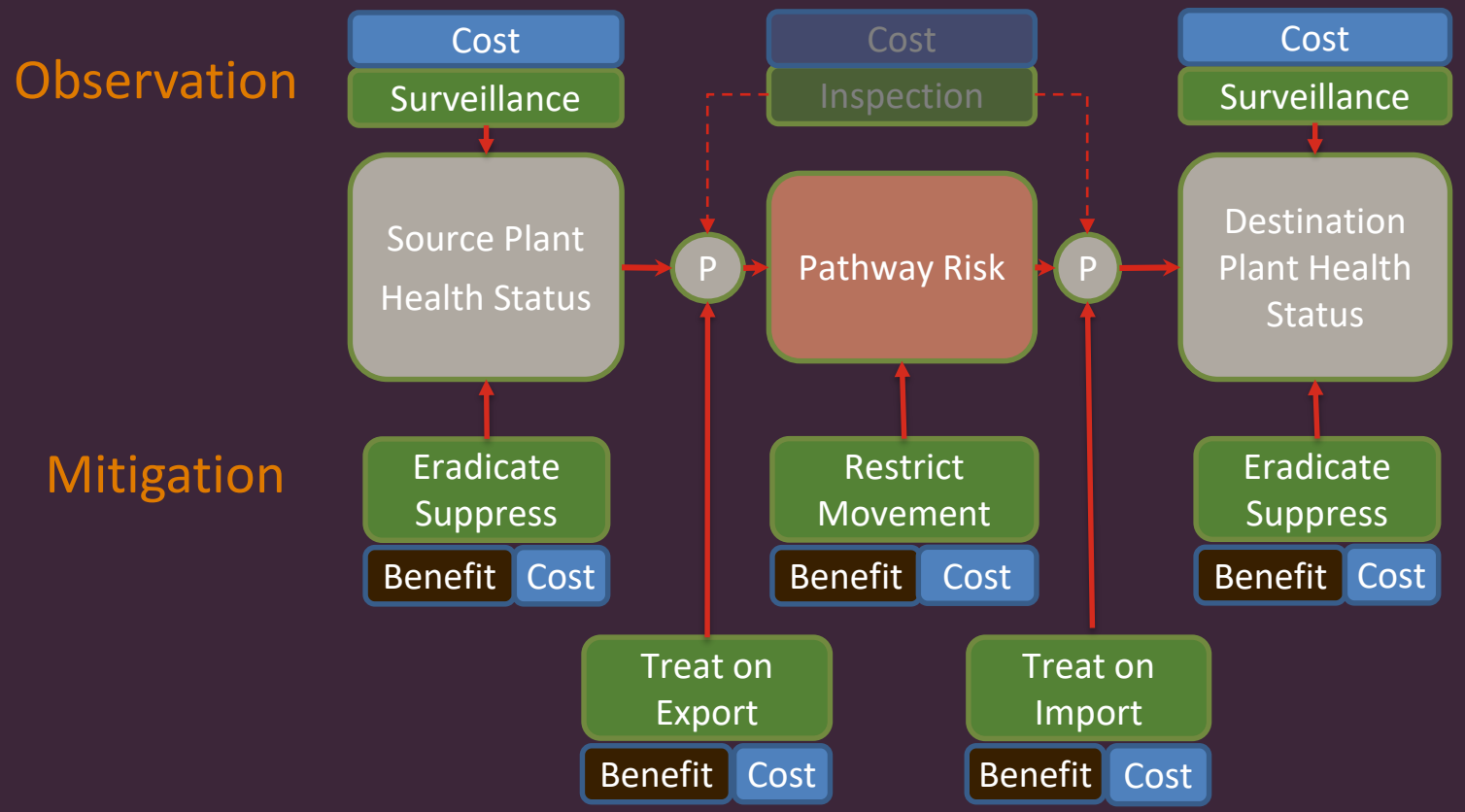
We will strengthen our biosecurity surveillance activities to prevent exotic pests and diseases from entering, establishing and causing damage

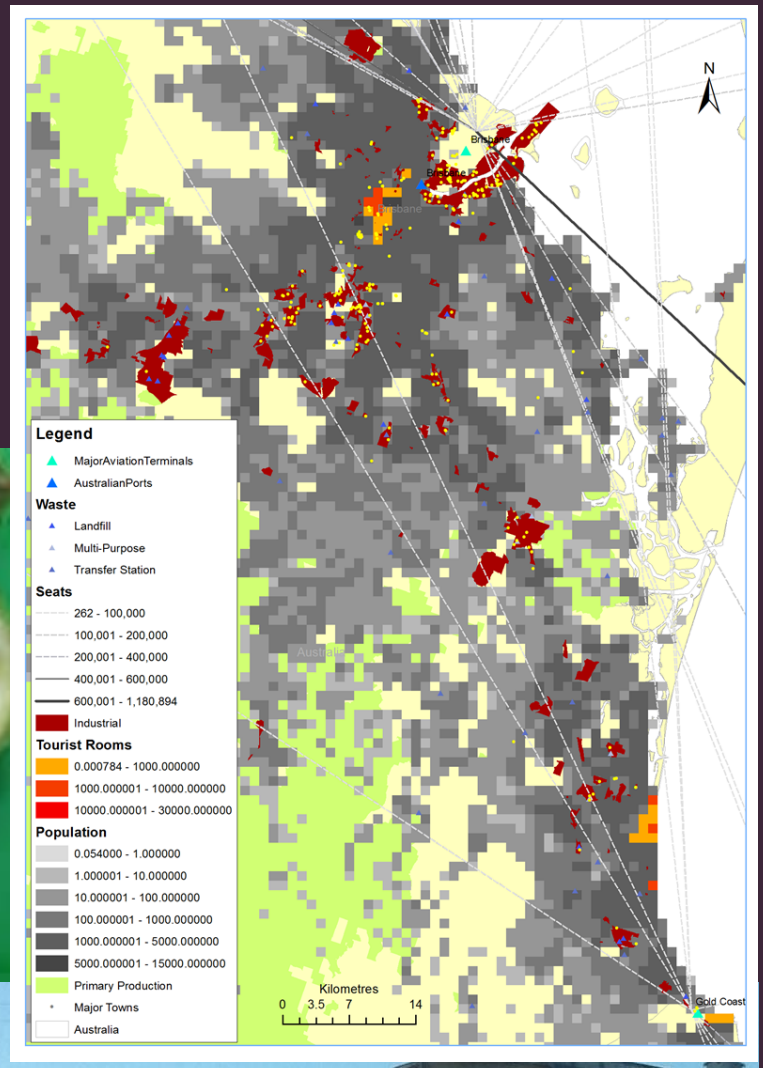
learn about pest distributions and pathways so that we can implement management practices that

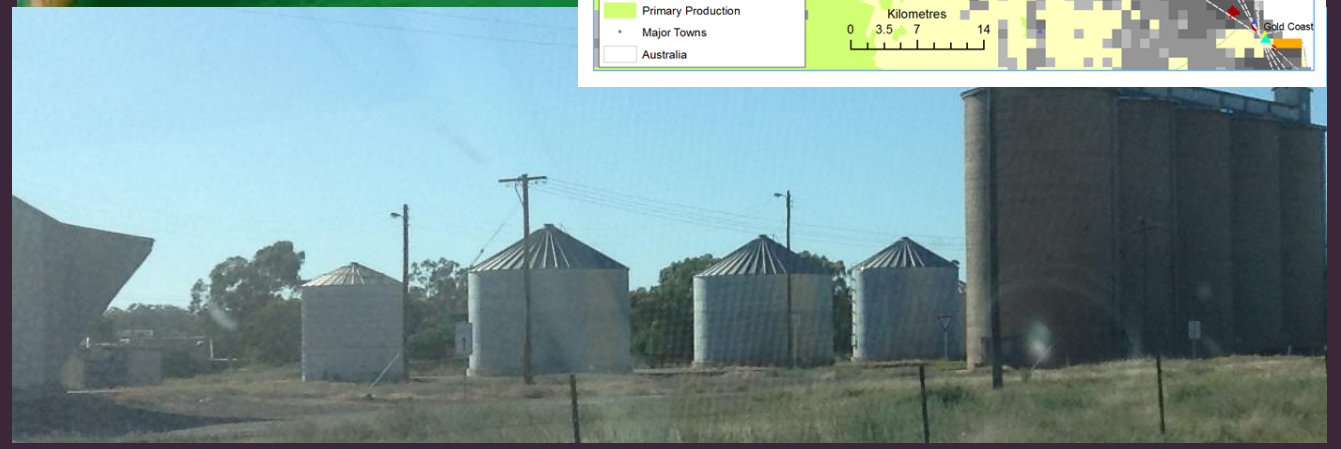
To prioritise we must build benefits and costs of surveillance into the risk management system



Assessing Benefits

- **Threat** assessment
  - Probability of where & when
- **Efficacy** of surveillance
  - Probability of finding if present
- **Value** statement
  - Consequences and options

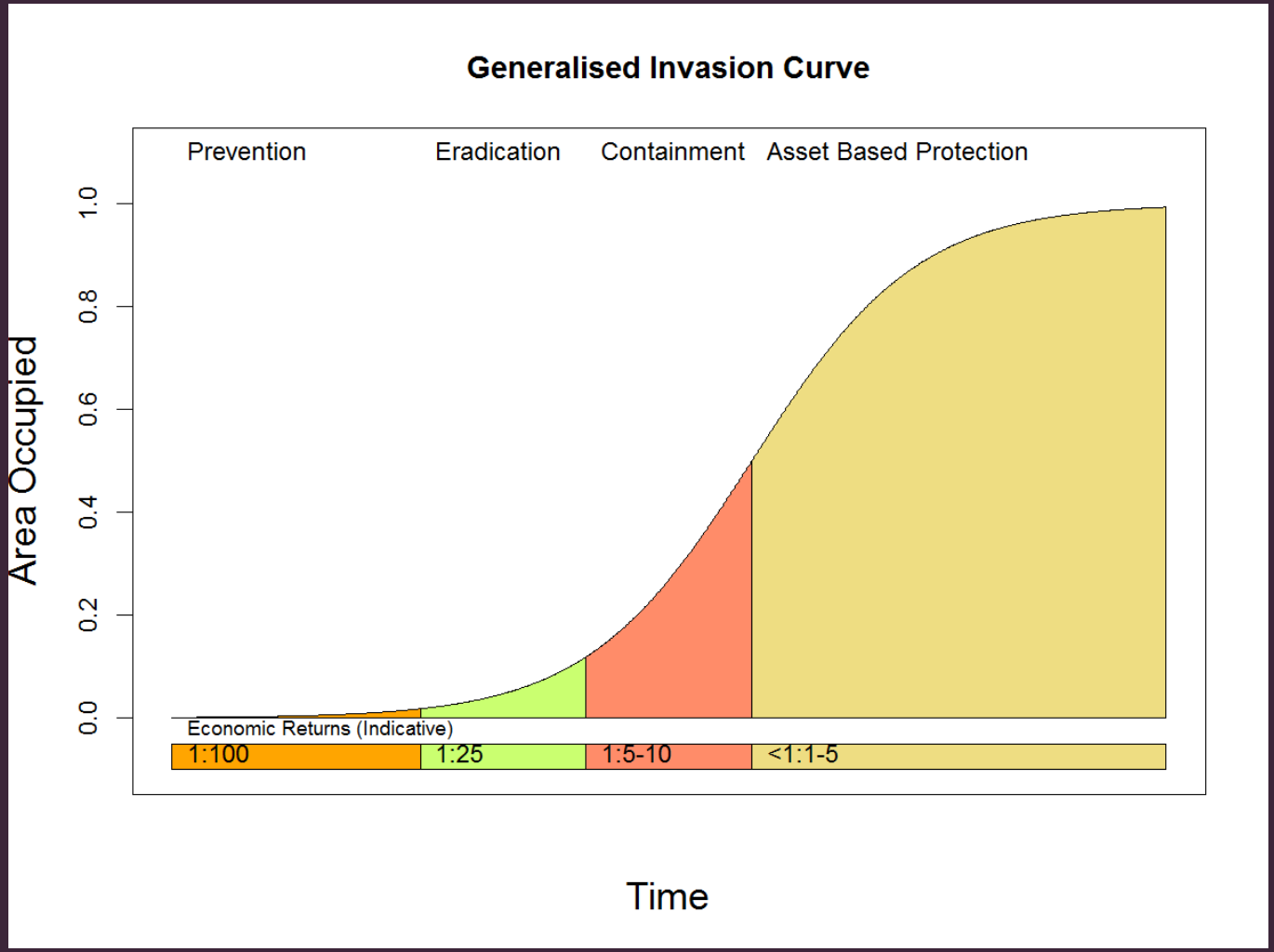




NPPO Objectives and Value

- Early warning surveillance
  - Manage border threats
- Early detection surveillance
  - Reduce eradication and containment costs
- Delimiting surveillance
  - guide eradication and containment

- Pest status surveillance
  - demonstrate requirements for markets
  - pest free area or low pest prevalence



Challenge: Pest free areas, how much surveillance is enough to get the market?

NPPO Prioritisation on Pests

Pests			Impacts			Management Options				Benefits/Efficac				Targets				Pathway Material							Establishment Location										Operations				
National rank (framework)	Scientific name	Common Name	Asset	Market Access International	Market Access Domestic	ED Eradication Technical Optior	ED Contain and Manage Option	PSD Options to Maintain or Opt	Surveillance Target Notes	ED Eradication/Containment be	PSD Market Access benefits	Specific Surveillance efficacy	General Surveillance efficacy	National Surveillance Target (NST)	NEDST specific	NPSDST specific	NGST general	Hitchhiker	Nursery	Fruit and Veg	Grain	Cut flowers	Timber	Natural	Ports vicinity	AA vicinity	Northern connection	Transport hub	Wholesale_retail_storage	Urban	Peri-Urban	Tourist	Environment	Production Area	Border	NAQS	States & Territories	Industry	General Surveillance
1	Xylella fastidiosa	Pierce's disease of grapev	H	H	H	L	M	L	Difficult pest to detect therefore limited ir	M	M	L	M	Y	N	N	Y		X							X				X	X							X
1	Homalodisca vitripennis	Glassy winged sharp shoc	H	M	H	M	M	L	Can be distinctive and has control options	M	M	M	M	Y	Y	Y	Y	X	X	X		X			X	X		X		X	X	X			X		X	X
1	Acrogonia terminalis	sharpshooter	H	M	H	M	M	L	Trappable but success only likely close to	M	M	M	M	Y	Y	Y	Y	X	X	X		X			X	X		X		X	X	X			X		X	X
1	Dilobopterus costalimai	sharpshooter	H	M	H	M	M	L	Trappable but success only likely close to	M	M	M	M	Y	Y	Y	Y	X	X	X		X			X	X		X		X	X	X			X		X	X
1	Draeculacephala minerva	grass sharpshooter	H	M	H	M	M	L	Trappable but success only likely close to	M	M	M	M	Y	Y	Y	Y	X	X	X		X			X	X		X		X	X	X			X		X	X
1	Graphocephala atropunctata	blue-green sharpshooter	H	M	H	M	M	L	Trappable but success only likely close to	M	M	M	M	Y	Y	Y	Y	X	X	X		X			X	X		X		X	X	X			X		X	X
1	Oncometopia fascialis	sharpshooter	H	M	H	M	M	L	Trappable but success only likely close to	M	M	M	M	Y	Y	Y	Y	X	X	X		X			X	X		X		X	X	X			X		X	X
1	Xyphon fulgidum	red-headed sharpshooter	H	M	H	M	M	L	Trappable but success only likely close to	M	M	M	M	Y	Y	Y	Y	X	X	X		X			X	X		X		X	X	X			X		X	X
1	Philaenus spumarius	meadow froghopper	M	M	H	M	M	L	Trappable but success only likely close to	M	M	M	M	Y	Y	Y	Y	X	X	X		X			X	X		X		X	X	X			X		X	X
2	Trogoderma granarium	Khapra beetle	M	H	H	M	H	H	Markets need to be identified but even sr	M	H	M	L	Y	Y	Y	Y	X			X				X	X		X	X	X					X		X	X
3	Bactrocera carambolae	Carambola fruit fly	M	H	H	H	M	H	Effective lure and benefits	H	H	H	L	Y	Y	Y	Y			X										X		X					X	X
3	Bactrocera caryae	Fruit fly	M	H	H	H	H	H	Effective lure and benefits	H	H	H	L	Y	Y	Y	Y			X										X		X					X	X
3	Bactrocera correcta	Guava fruit fly	M	H	H	H	H	H	Effective lure and benefits	H	H	H	L	Y	Y	Y	Y			X										X		X					X	X
3	Bactrocera curvipennis	Bannana fruit fly	M	M	M	H	H	H	Effective lure and benefits	H	H	H	L	Y	Y	Y	Y			X										X		X					X	X
3	Bactrocera dorsalis	Oriental fruit fly	H	H	H	H	H	H	Eradication is cost effective and required f	H	H	H	L	Y	Y	Y	Y			X				X			X			X		X				X	X	X

- First pass to assess if surveillance can help manage a threat
  - Qualitative impact, management, benefits and sensitivity
- Identify operational surveillance groups for consultation
- Select potential surveillance targets for detailed assessment

Pest Surveillance Requirements

- Detailed assessment of value of surveillance
- Only possible for a small number of pest specific programs

Establishment Nodes	Early Warning	Early Detection	Pest Status Determination	Delivery Program
Residential Node 1 Residential areas Tourist areas	**NA**	**Medium Priority** Specific surveillance in high risk residential areas to detect later stage incursions	**Low Priority** Supporting information for retail nurseries status and containment	States & Territories Incidental Border and Northern
Semi-Commercial Node 3 Peri-urban Semi-commercial nursery suppliers	**Low Priority** General surveillance	**High Priority** Higher risk peri-urban areas with focus on propagation to improve eradication prospects and educate	**Medium Priority** Specific surveillance in propagating nurseries to build a base level of confidence.	States & Territories General Surveillance
Production planting Node 2 (and Onshore Destination Node) Agricultural Production Area	**Low Priority** Industry awareness from incidental observations of strains offshore	**Medium Priority** Augmented general surveillance program may assist eradication and containment in commercial growing districts	**Medium Priority** Commercial production premises and towns for pest free areas in conjunction with early detection	Citrus Industry
Traditional trade Node 4 Torres Strait Islands	**Medium Priority** Offshore to identify changes in PNG treaty village status	**High Priority** Torres Strait islands for eradication	**NA**	Northern
Nursery planting Onshore Destination Node 1 Retail Nursery Production Nursery	**NA**	**Medium Priority** Specific industry surveillance program with government collaboration to detect early	**High Priority** Specific industry surveillance program with government collaboration to monitor status	Nursery and Garden Industry
National Pest Status	**NA**	**NA**	**Low Priority** Assemble other surveillance sources for Australia's pest freedom	All
Export Pathway 1 Fresh Produce Export	**NA**	**NA**	**Low Priority** No immediate need for export	**NA**

NPPO Prioritisation on Pathway

- Pest establishments associated with a few major pathways
- Surveillance around these pathways contributes to integrity of the surveillance system

Pathway Themes and Endpoint Categories	Examples of pests	Risk Mitigation Characteristics	Partners
Residential Private produce and soil directly	Fruit flies, leaf miners, fire blight, vectors	Difficult to target spatially. Major benefits are in containment unless traps are effective.	States & territories, industry, general
Propagation Propagating material into residential and rural areas	Xylella, citrus canker, bee mites	Illegal imports with potential for untraceable spread. Need to manage distribution.	States & territories, industry
Hitchhiker Hitchhiker pests to commercial areas	Gypsy moths, exotic ants, stink bugs, timber pests, snails	Opportunities for eradicating early border escapes and border/early post-border system monitoring.	Border, states and territories
Northern Natural spread into northern Australia	Fruit flies, citrus psyllid, stem borers	Opportunities for eradication in Torres Strait but more difficult elsewhere.	NAQS, states & territories, industry

Design of a National Surveillance System

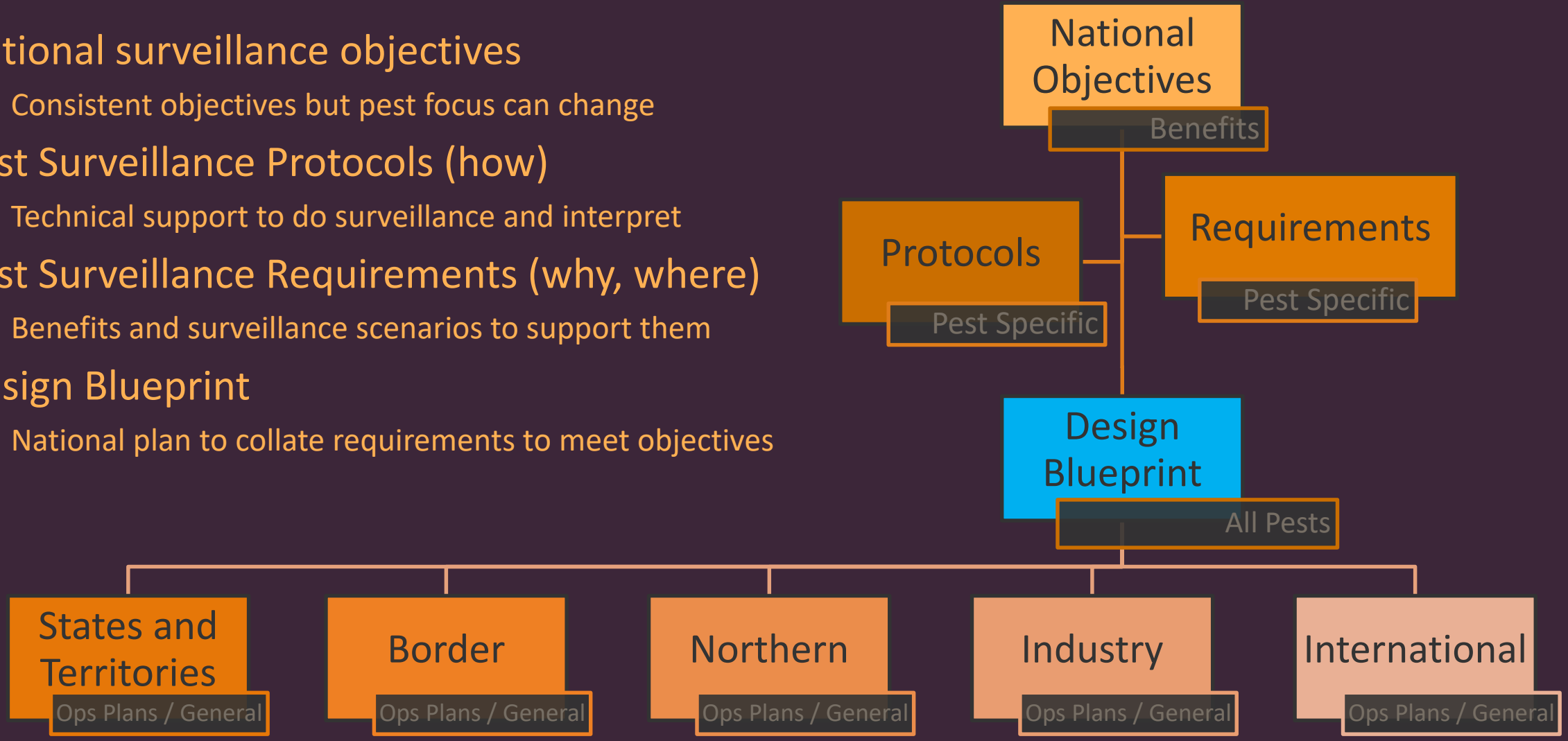
ISPM 6 Designing Surveillance Programmes

The methodology of surveillance should be described in **surveillance protocols**. The protocols developed by NPPOs should aim to achieve the **purpose** of the surveillance programme.

Surveillance protocols should provide clear instructions for carrying out a surveillance activity in a **consistent manner** that can be used by various operational personnel at **different locations**. Methods used in the surveillance protocol may be distinguished by, for example, the means by which data are collected, where the surveillance is carried out, the aim of the surveillance or whether the methods are focused on the pest, host or pathway.

National System: Priorities to Surveillance Design

- National surveillance objectives
  - Consistent objectives but pest focus can change
- Pest Surveillance Protocols (how)
  - Technical support to do surveillance and interpret
- Pest Surveillance Requirements (why, where)
  - Benefits and surveillance scenarios to support them
- Design Blueprint
  - National plan to collate requirements to meet objectives



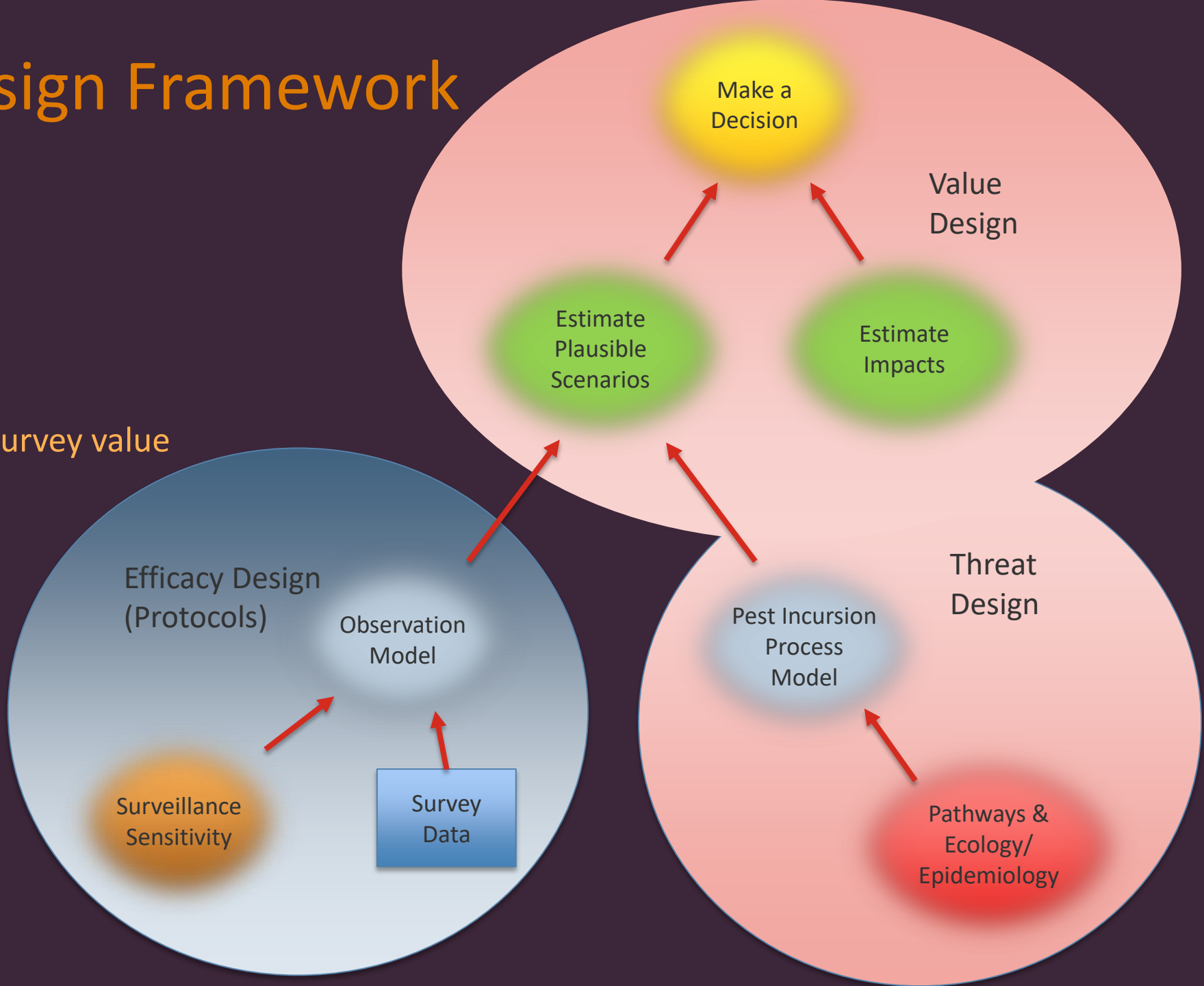
Challenge: How to bring surveillance design together for a common objective

Quantitative Design Framework

Three design components

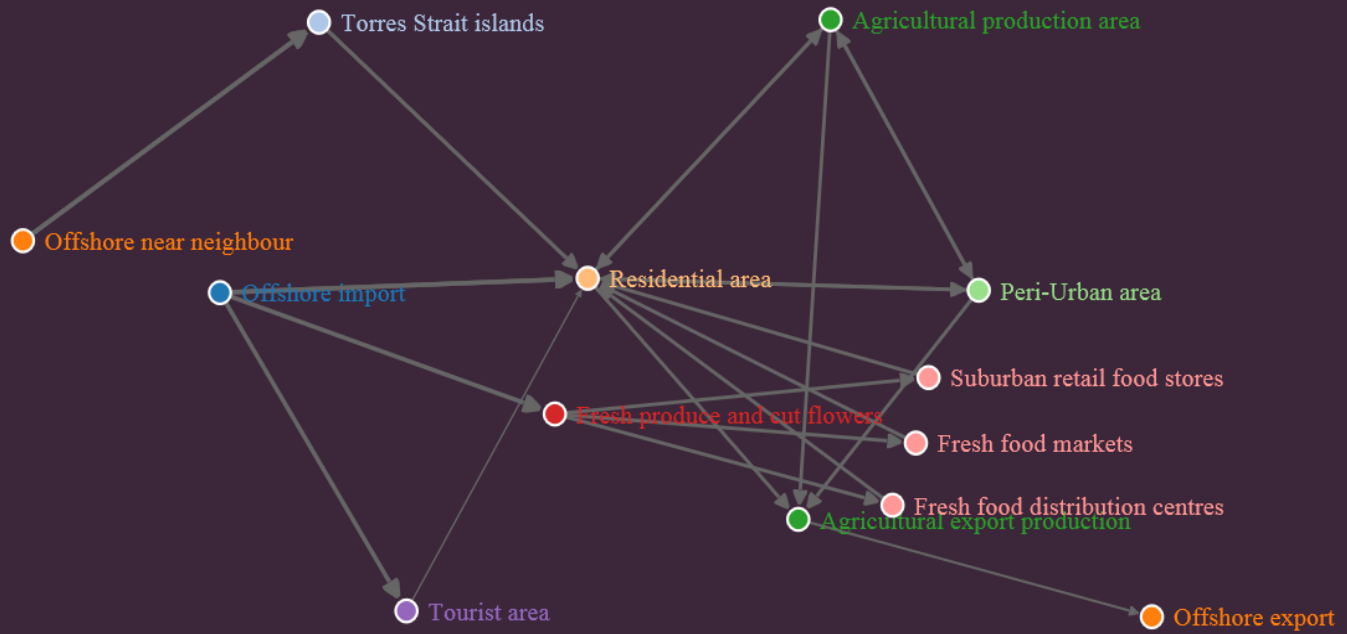
- Threat design
  - scenarios for incursions
- Efficacy design
  - Protocols describe local survey value
- Value design
  - Identify the risks

  that are to be managed

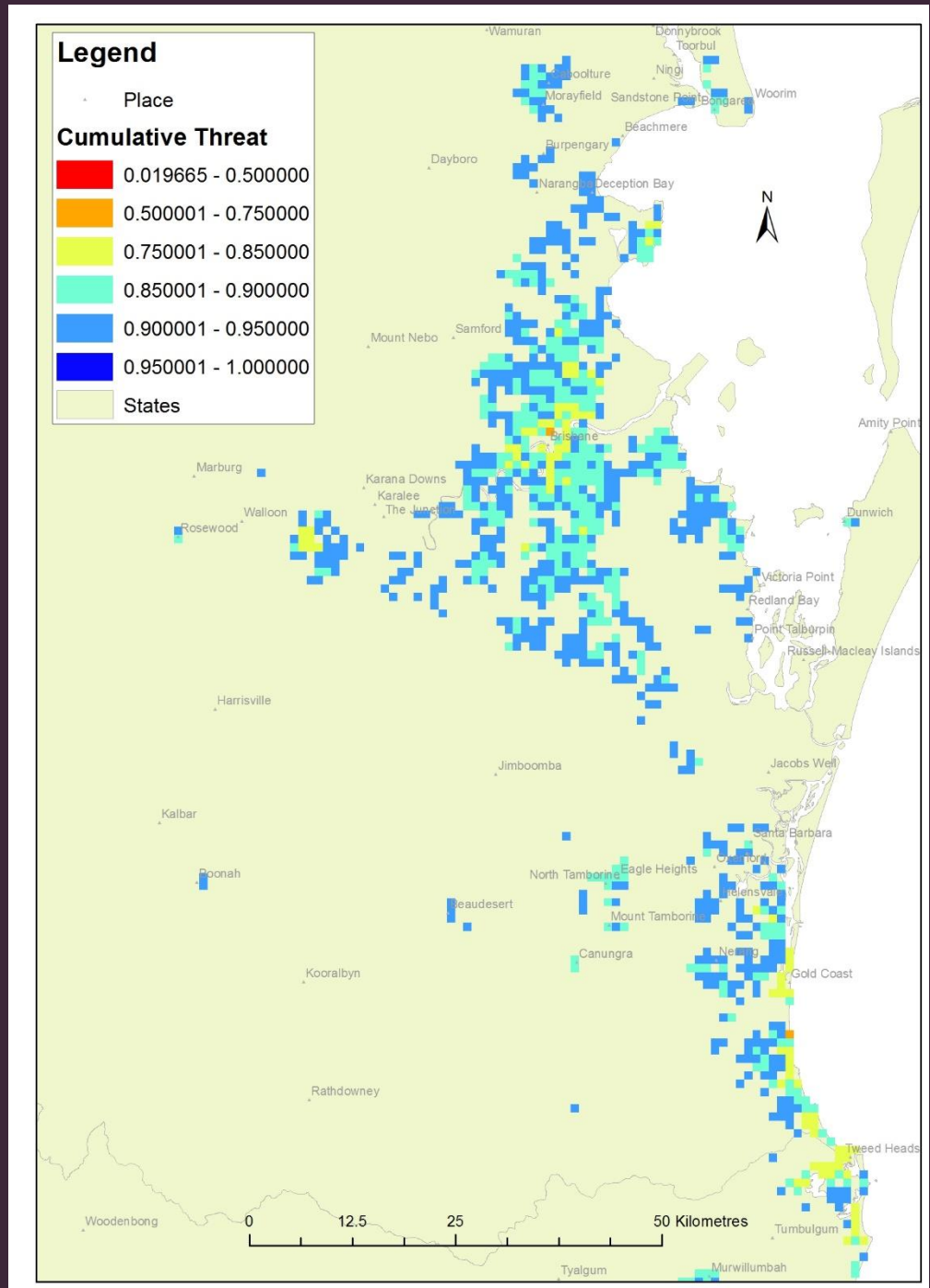


Threat Design

- Probability of entry and establishment
- Onshore spread scenarios
- Impacts



Challenge: Surveillance in a source provides pest status information on destination



Value Design

Value identified through worked scenarios

Example Citrus Canker

Eradication

- Eradication in a major residential area difficult, response based on the scenario.
- Eradication on commercial properties and towns in isolated districts.
- Eradication on northern pathways relatively easy.

Containment and Domestic Market Access

- Controlled by restricting the movement of propagating materials on nursery pathways
- Citrus fruit movement restrictions, uncertain how domestic markets would react

International Market Access

- Evidence to support citrus canker free status for import conditions
- Evidence to support citrus canker free status for export conditions

Challenge: How to design pest free area surveys around threat and level of protection

ISPM Advice on Surveillance Statistics

- ISPM 31 Scope

This standard does not give guidance on field sampling (for example, as required for surveys).

- ISPM 6 Statistical Design

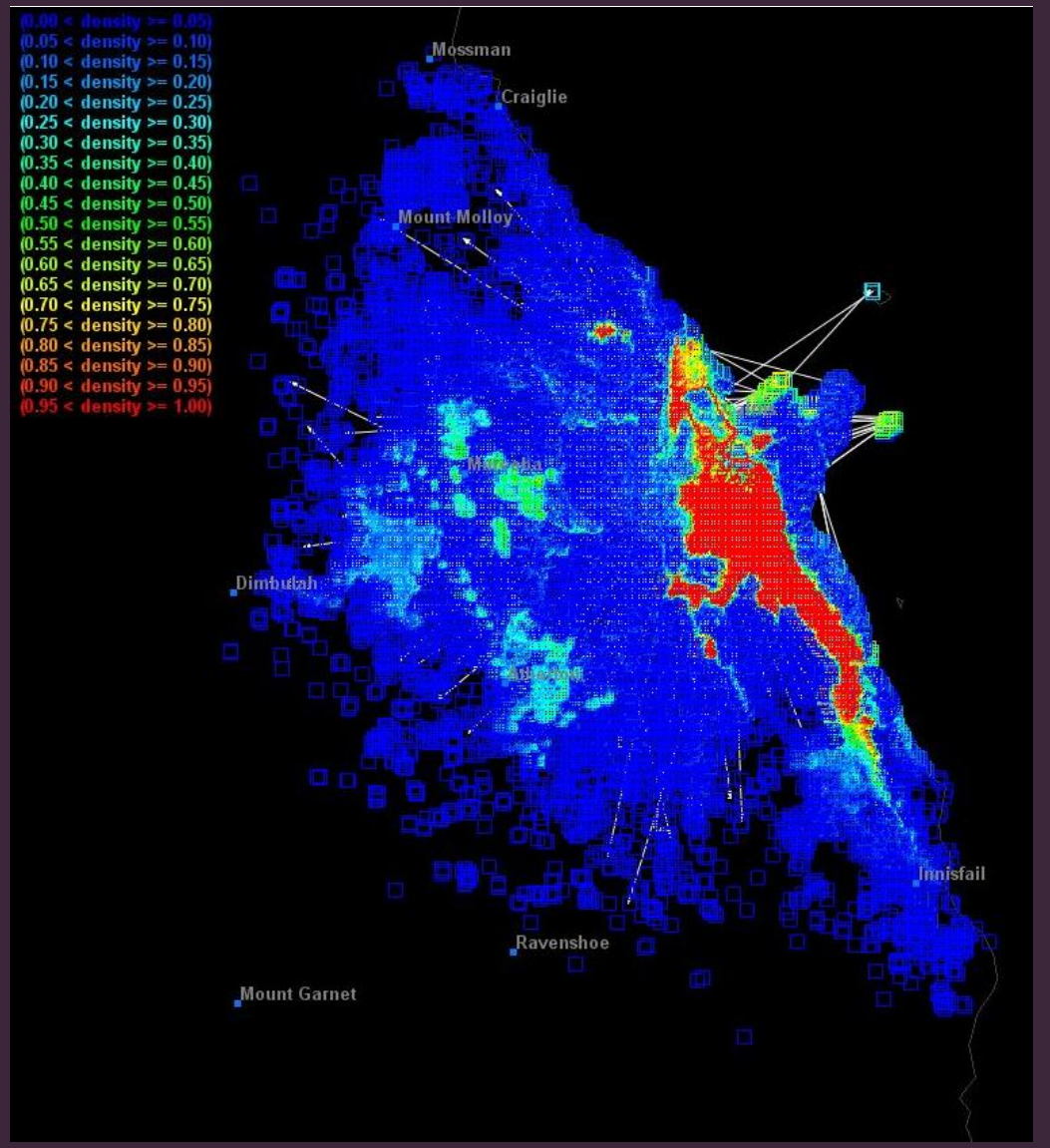
Statistical sampling methods described in ISPM 31 (Methodologies for sampling of consignments) or other appropriate methods should be used as appropriate. They are often used when the data captured are of a binary nature (presence/absence). The statistical analysis of the data should be based on an appropriate method and may require expert advice.

Some “Rules” of Quantitative Surveillance Design

1. There is no right number, no right answer
2. There is a diminishing return of information on surveillance effort
3. A good statistical model will be simple and relate surveillance to the mitigation decision
4. If you want quantitative answers to risk-based surveillance you need to model that risk
5. You will probably underestimate uncertainty, so be prepared for your models to be wrong

Be prepared for your model to be wrong

- Incursions are complex and the processes are difficult to observe
- Document and share models, including assumptions and sensitivities
- Relate the model and its assumption to the decisions you are trying to make
- Know how you will identify when your model is going wrong



A good model will be simple and relate to the problem

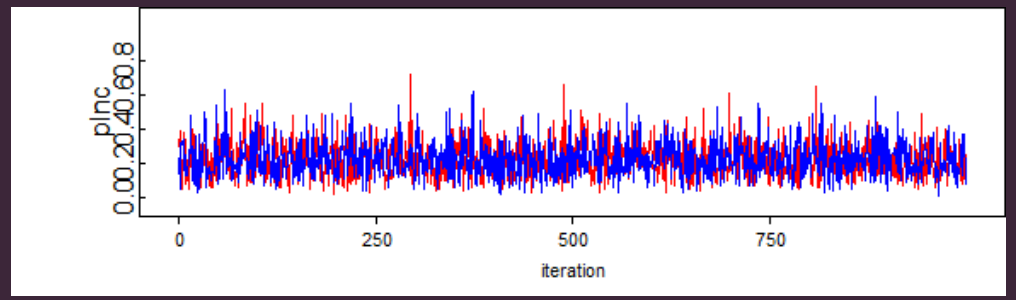
1. Design pest prevalence binomial model

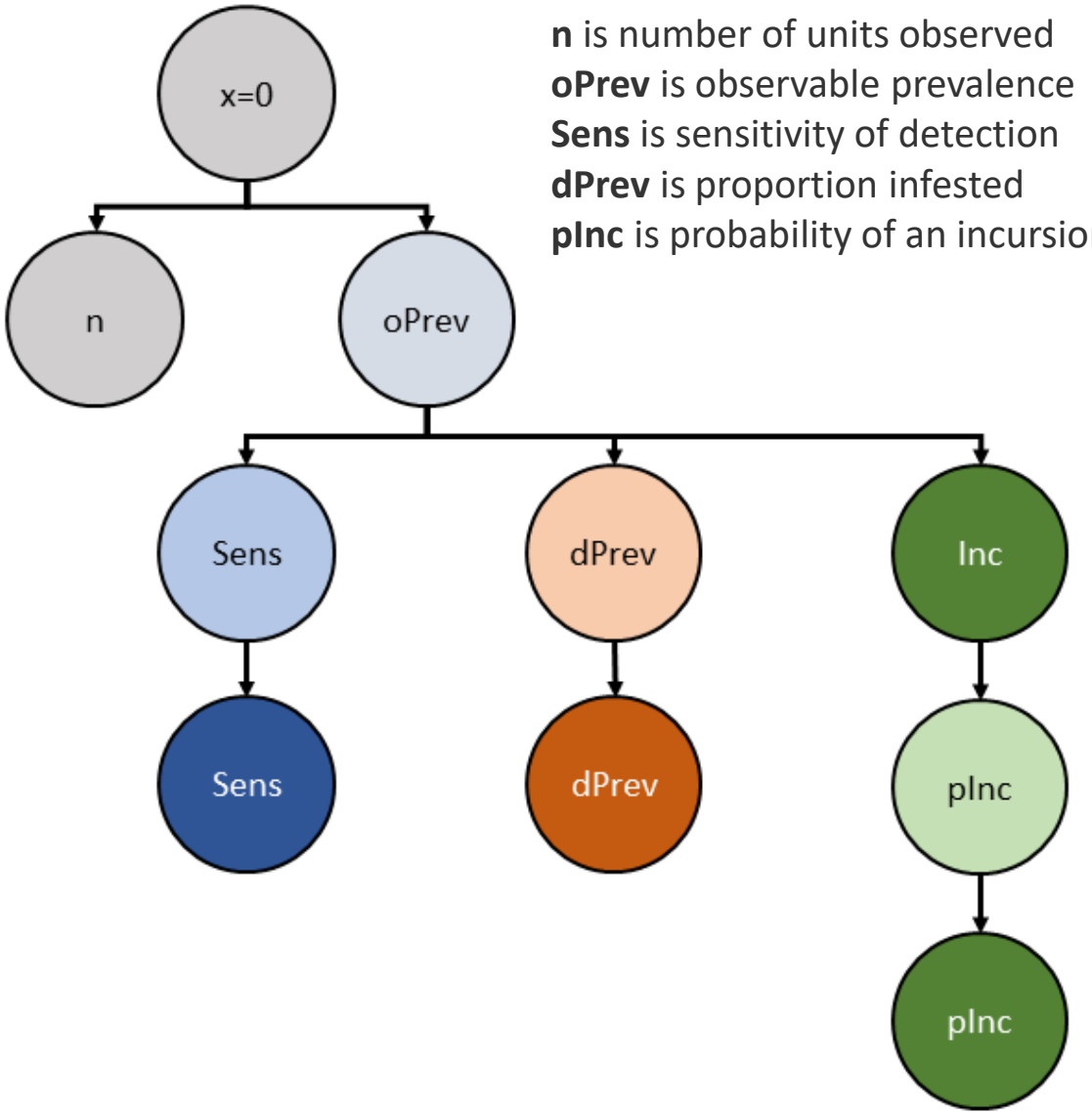
$$P(x = 0) = (1 - dPrev \times Sens)^n$$

2. Zero –inflated binomial model

$$P = \frac{\left(pInc \times \left(1 - (dPrev \times Sens)\right)^n\right)}{1 - pInc \times \left(1 - \left(1 - (dPrev \times Sens)\right)^n\right)}$$

3. Zero –inflated with uncertainty





x is number found
n is number of units observed
oPrev is observable prevalence
Sens is sensitivity of detection
dPrev is proportion infested
pInc is probability of an incursion

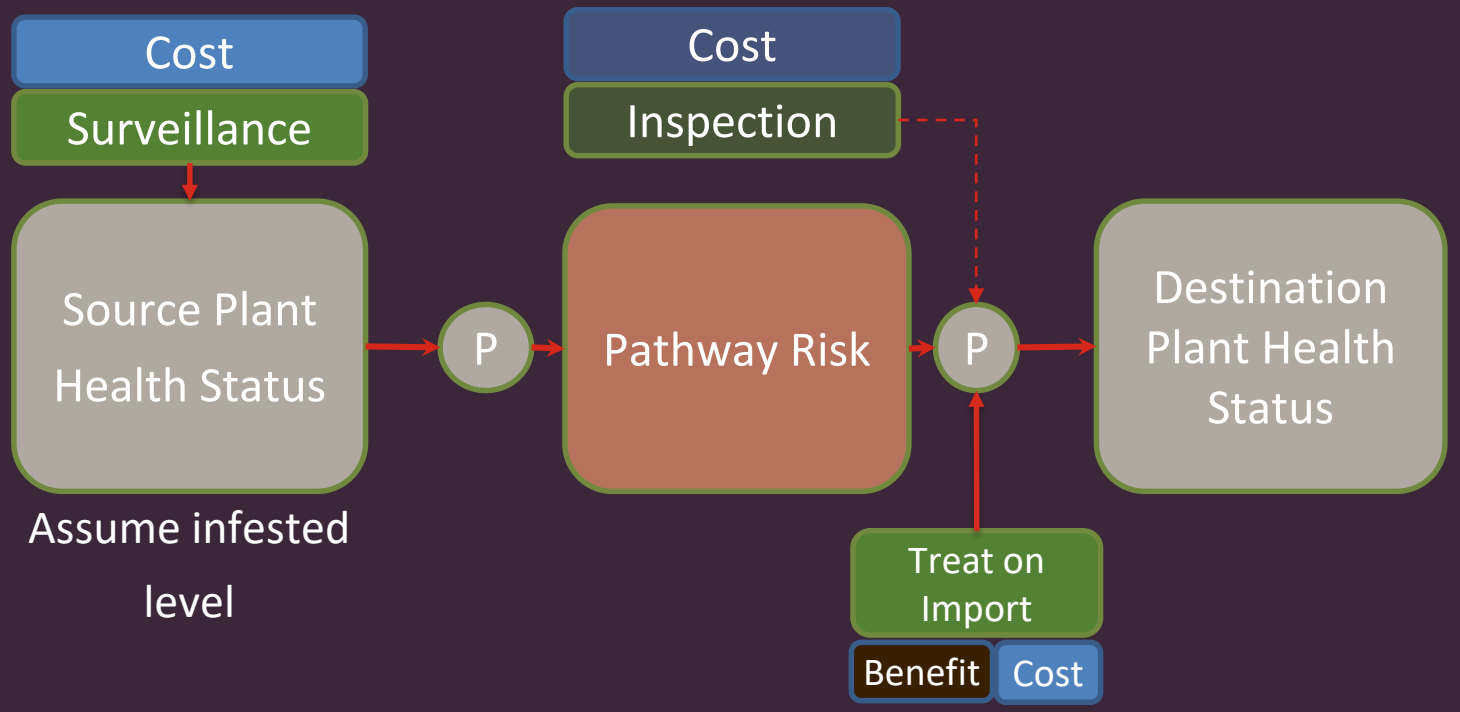
A good model will be simple and relate to the problem

Frequentist statistical approaches

Area of Low Pest Prevalence

where

ALOP is determined by quality control criteria on an assumed prevalence threshold at the source and the risk posed



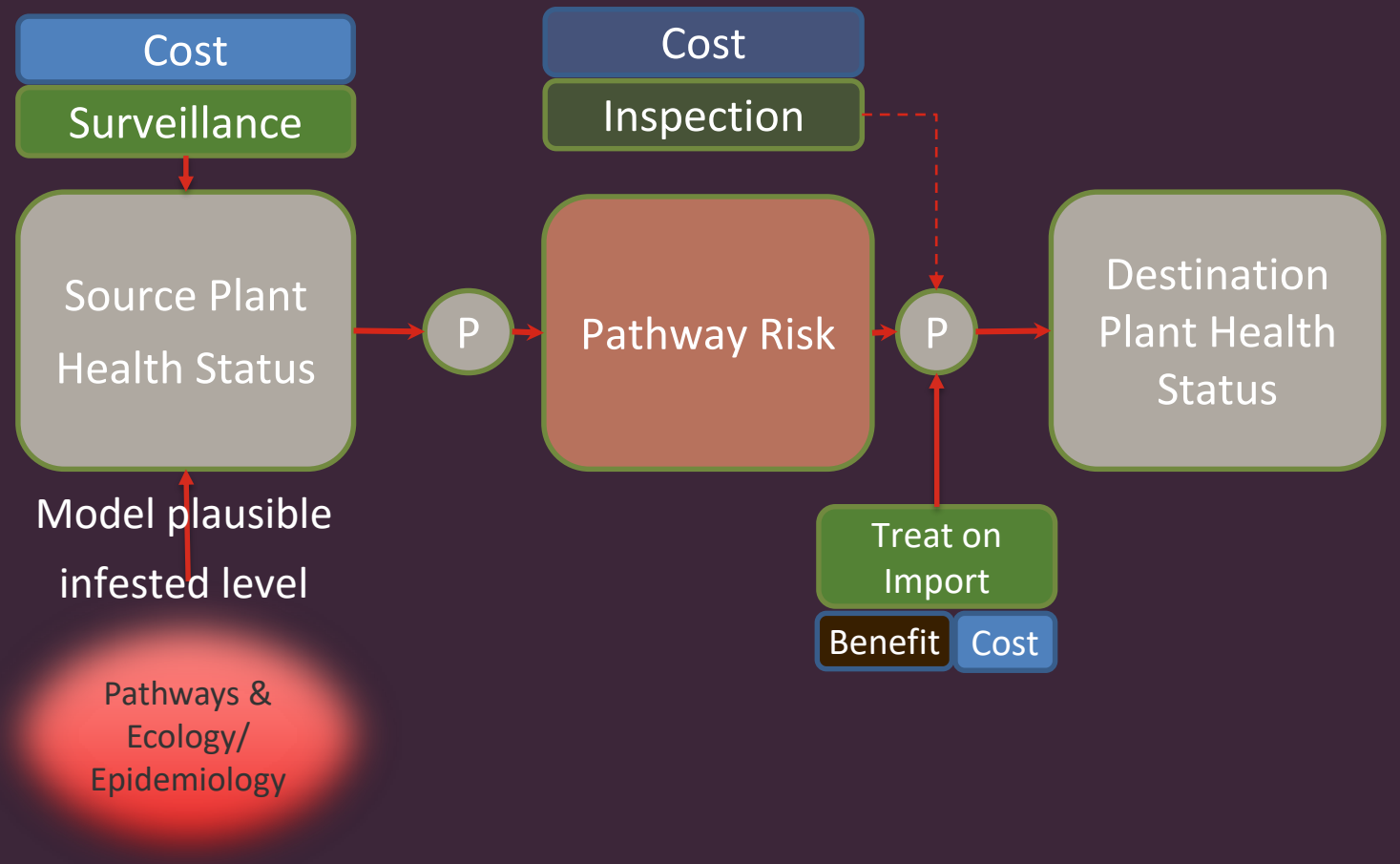
A good model will be simple and relate to the problem

Bayesian Statistical Approaches

Pest Free Area

where

Probability that an area is free of a pest requires a model with prior knowledge



Conclusions on Quantitative Design of Plant Health Surveillance

- Use a range of qualitative and quantitative approaches that focus on policy outcomes

- Statistical tools for pest free areas need to acknowledge
  - threats (and uncertainty in ecology)
  - efficacy (and uncertainty in observation)
  - value (and uncertainty in impacts and mitigation)

- Statistical models to estimate pest status of an area
  - can be difficult to communicate to policy-makers
  - require transparent communication of assumptions, weaknesses and their robustness for decisions

Challenge: How to guide decision-makers around uncertainty