Evaluating costs and benefits of AWM using SIT for Qfly, *B. tryoni:* links to spatial population simulations

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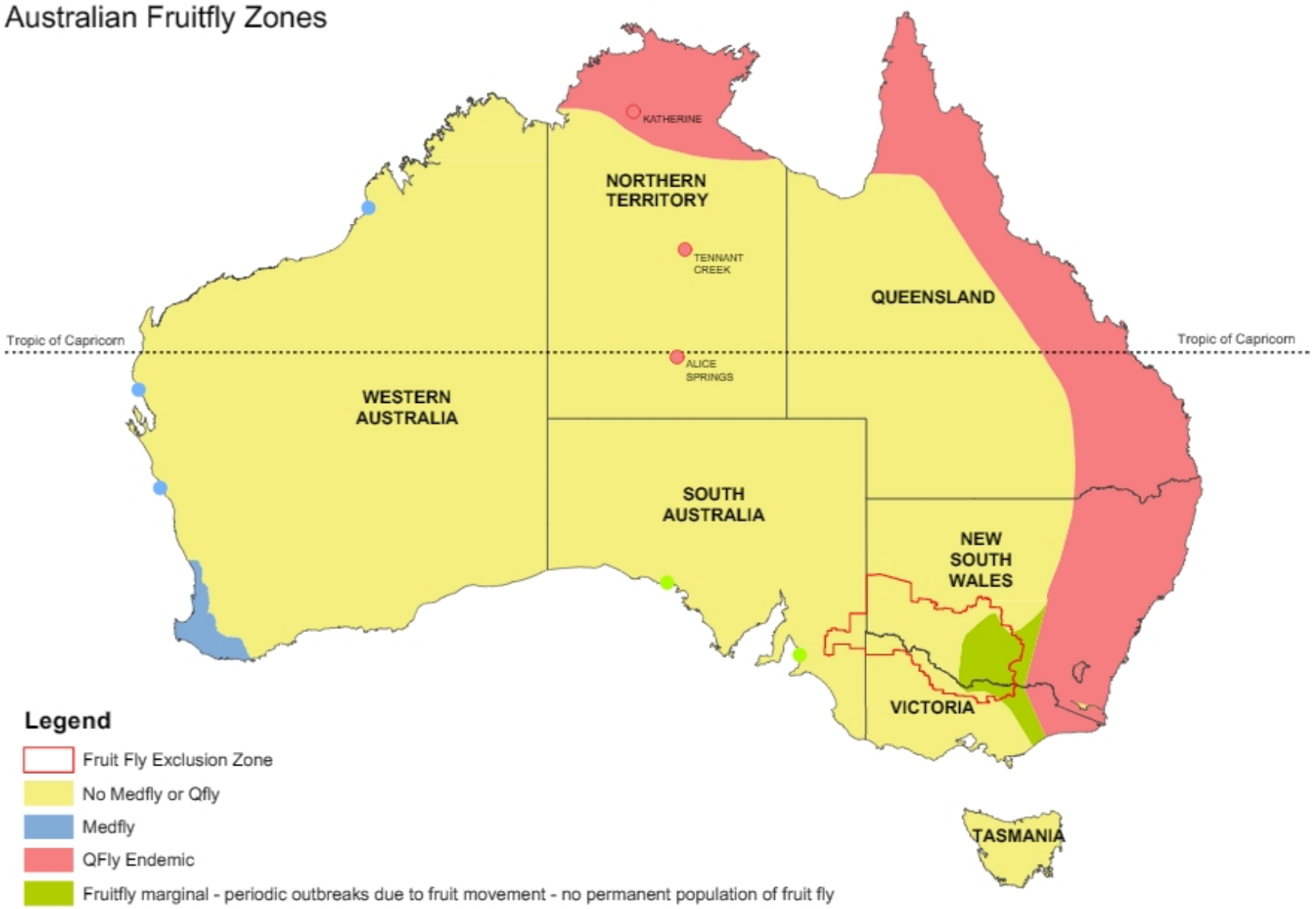
Bactrocera tryoni, Queensland Fruit Fly (Qfly)

#1 biosecurity barrier to trade of fruit & veg in Australia



Dominiak and Daniels 2012, *Aus J Ent*

History of Fruit Fly Exclusion Zone

1994: Tri-State Fruit Fly Exclusion Zone ('FFEZ') established

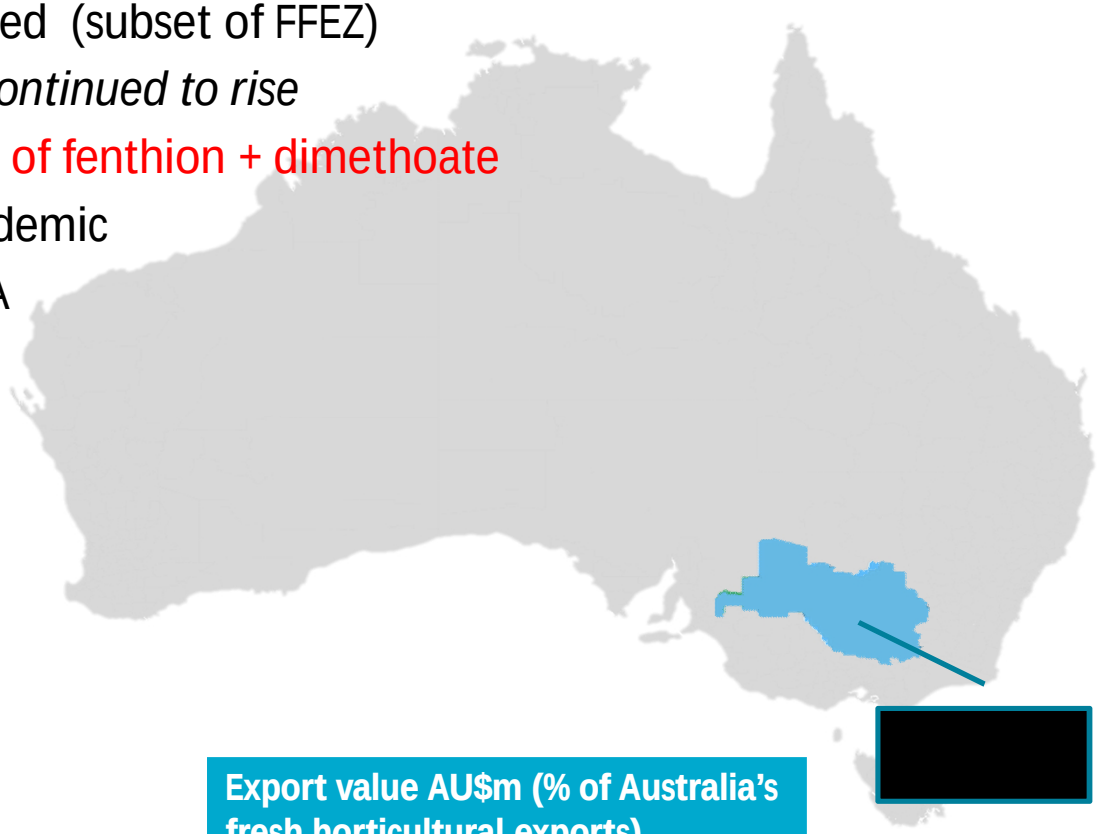
2007: Hard to maintain, area reduced (subset of FFEZ)

Frequency of outbreaks continued to rise

2011-12:Restrictions placed on use of fenthion + dimethoate

2012: Goulburn Valley declared endemic

2014: Suspended the Sunraysia PFA



Export value AU$m (% of Australia's fresh horticultural exports)	
South Australia	$204.9 (13%)
Victoria	$793.8 (51%)
New South Wales	$172.9 (11%)

Objective

Remove the market barriers to trade fruit & vegetables

$5b fruit-fly susceptible fruit; export $500m

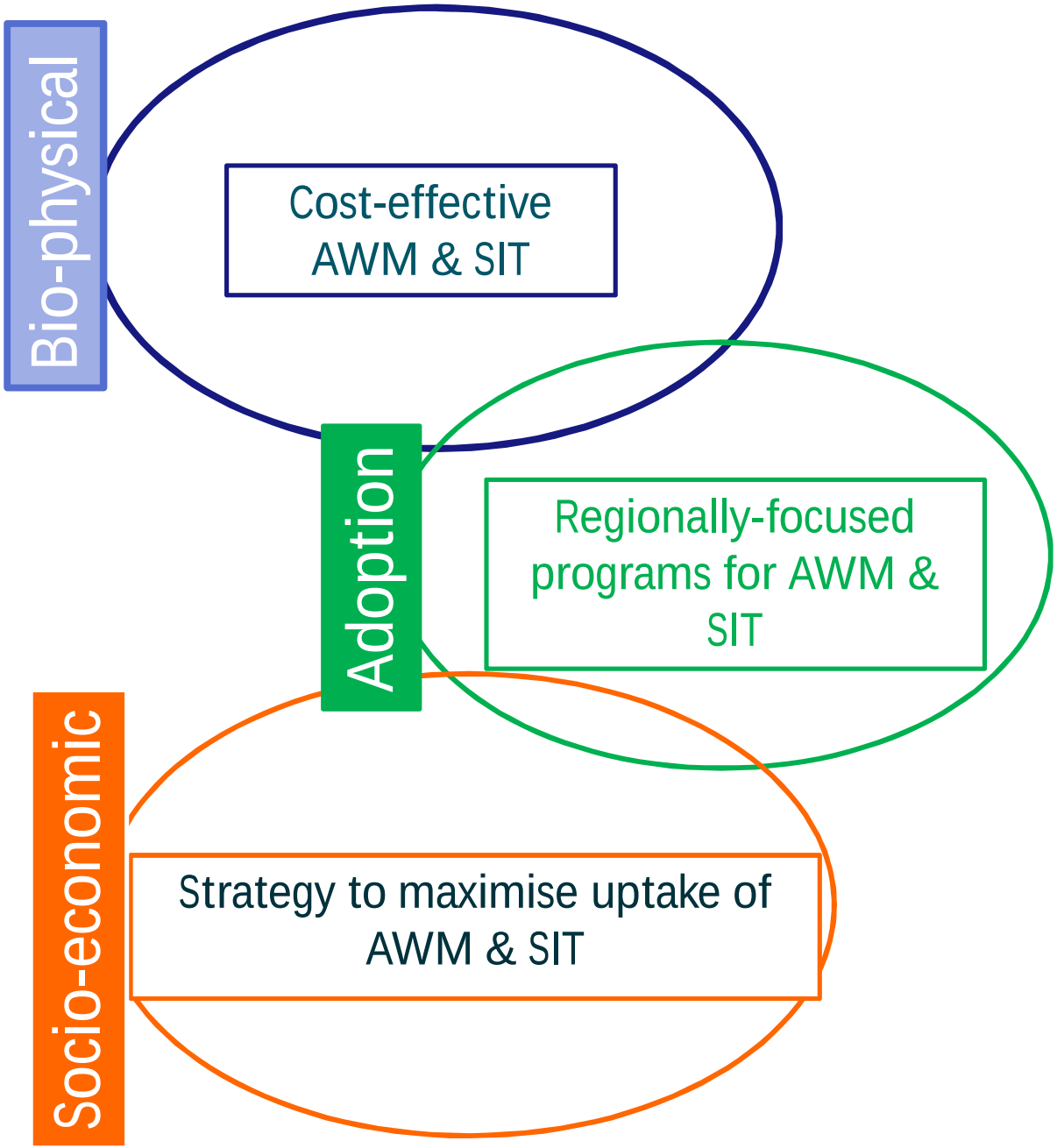
Area-wide Management &

SITplus

Port Augusta, South Australia

How?

Adaptive AWM of Qfly using SIT



IMPACT

Uptake of AWM for Qfly and the ability to incorporate SIT fly

Who? National Rural R&D for Profit project

Outline:

I. Background of the SE Australian fruit-producing regions

II. Economics of Qfly

Cost to growers, cost to regions

Costs and benefit of AWM & SIT

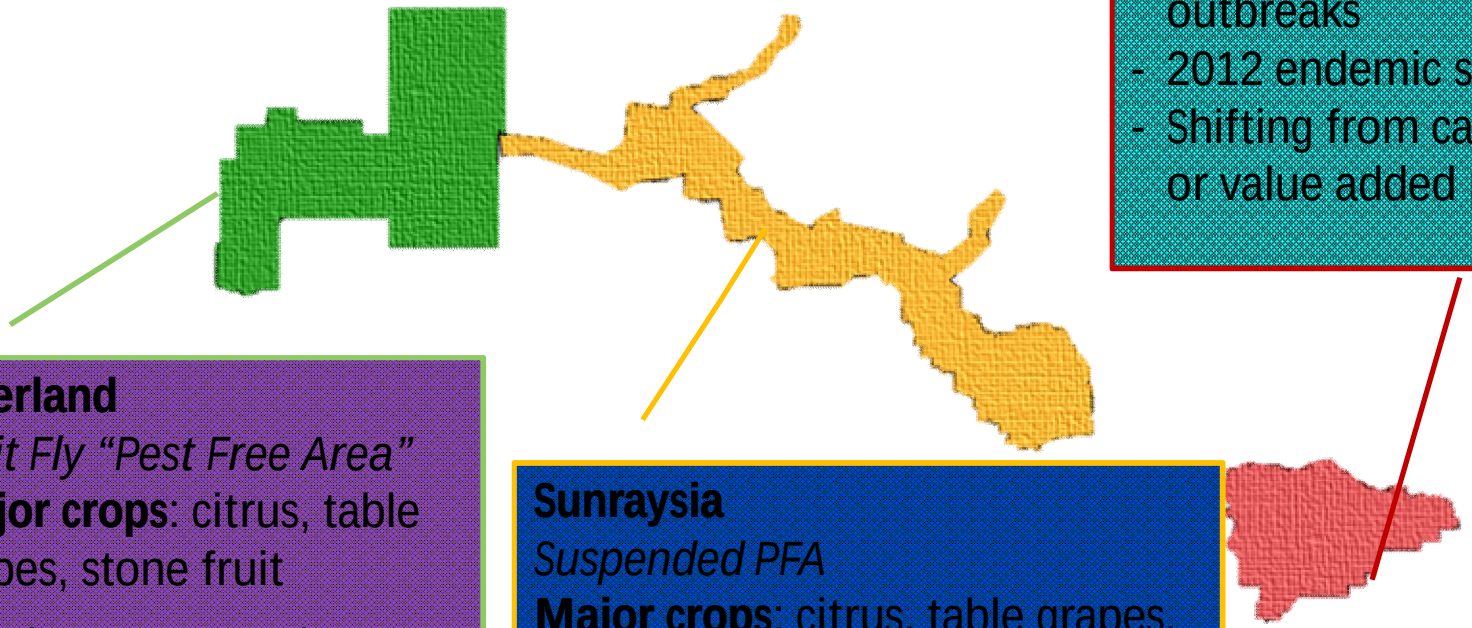
III. Regionally-specific AWM & SIT

- Where can AWM & SIT be efficient and effective?
- What are key factors necessary to identify whether AWM using SIT is economically viable?

Background

Setting the scene: Qfly status

Goulburn Valley
Endemic
Major crops: stone fruit, apples, cherries, pears
- 2011 persistent and increasing outbreaks
- 2012 endemic status declared
- Shifting from canning to fresh or value added produce



Riverland
Fruit Fly "Pest Free Area"
Major crops: citrus, table grapes, stone fruit
- State government conduct surveillance and response to fruit fly
- Gov release SIT (Qfly + Medfly)

Sunraysia
Suspended PFA
Major crops: citrus, table grapes, stone fruit
- 2007 GSPFA established to replace the FFEZ
- 2011-2014 persistent + increasing outbreaks
- 2014 voluntary suspension of PFA

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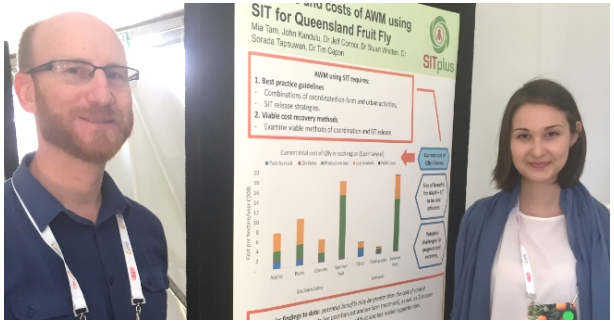
Key questions



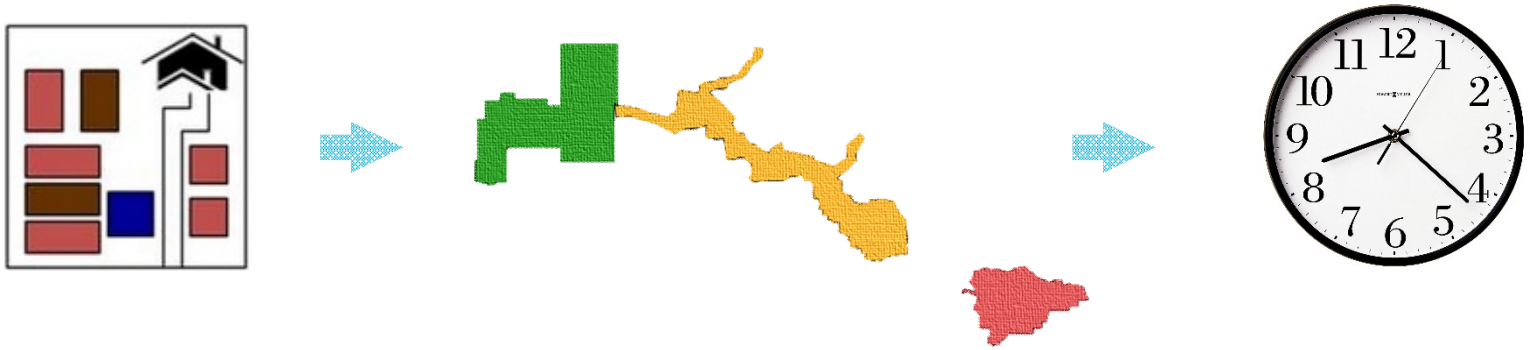
Tim Capon *Mia Tam*

Stuart Whitten

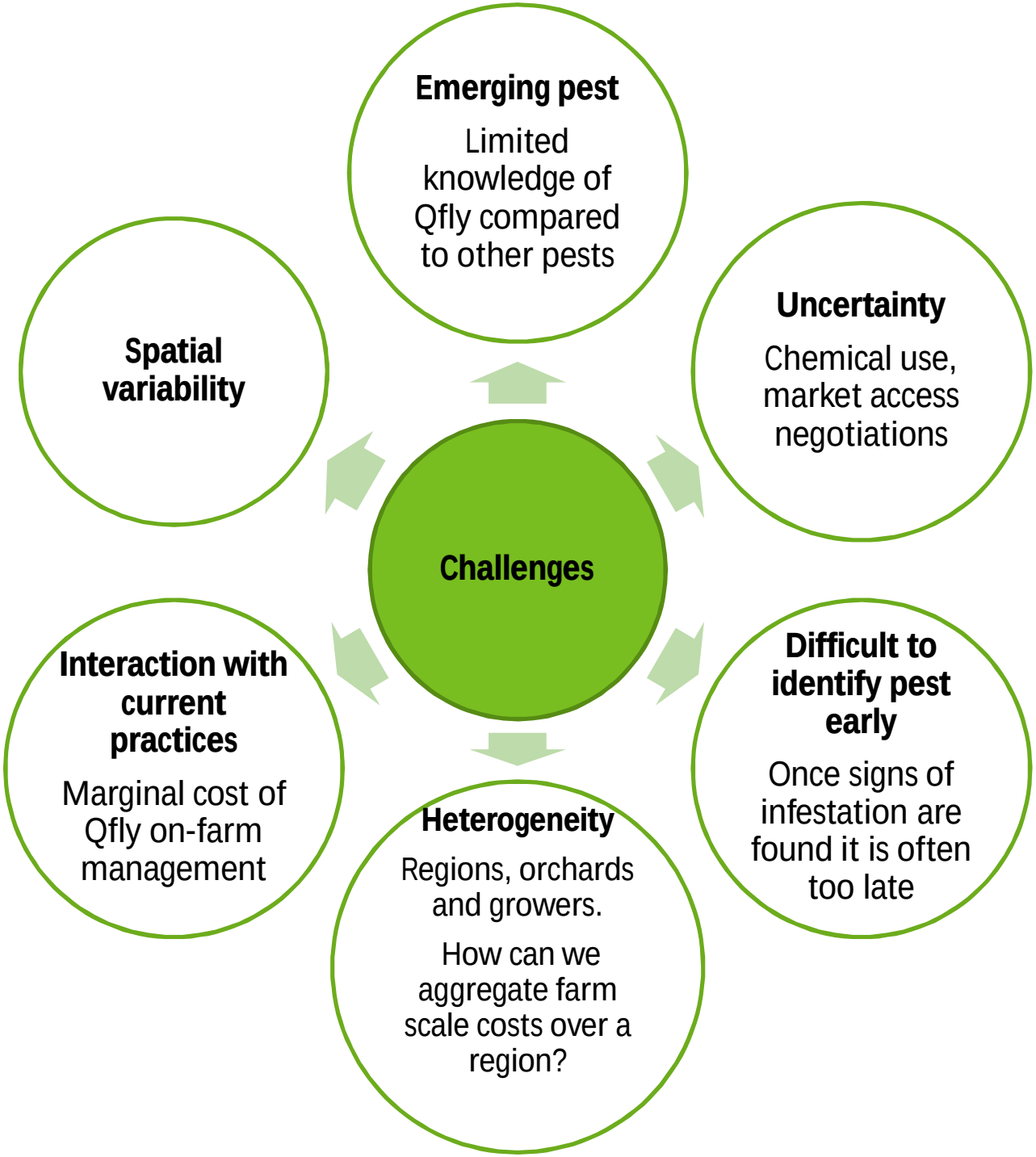
John Kandulu

- What is the cost of Qfly to growers?
- How do we scale farm-costs up to regional costs, given differences within and between regions?
- How does cost change over time?
  - **What is the cost when transitioning to AWM using SIT?**

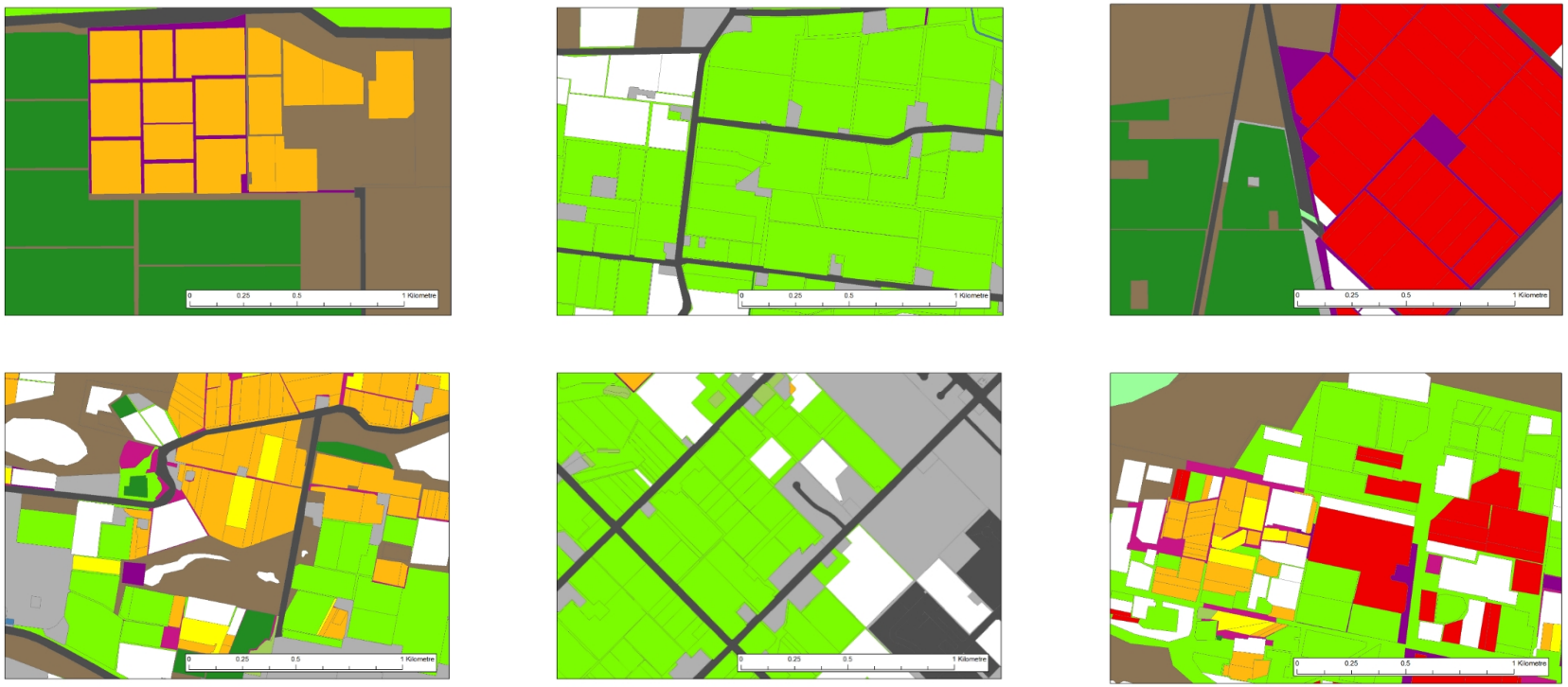
Economic analysis and modelling



Farm scale analysis	Regional aggregation	Temporal transition
• Expert elicitation to conduct: • on-farm pest mngt activities and costs • Early vs. mature experience with Qfly	• Aggregation for each region • Scenario analysis of potential costs for different pest pressures	• Costs and benefits of implementing AWM and SIT over time

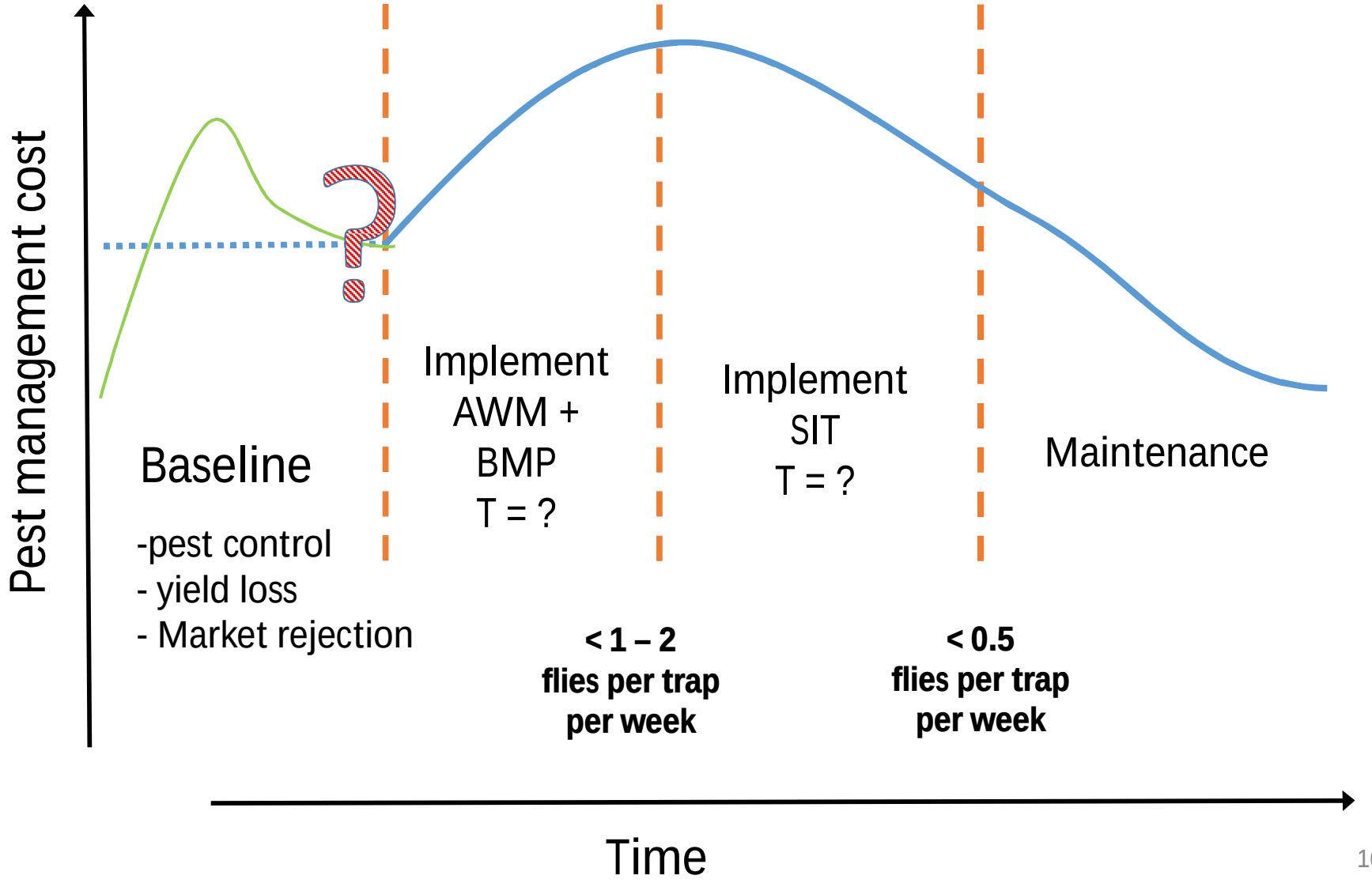

Challenges
Emerging pest
Limited knowledge of Qfly compared to other pests
Uncertainty
Chemical use, market access negotiations
Difficult to identify pest early
Once signs of infestation are found it is often too late
Heterogeneity
Regions, orchards and growers.
How can we aggregate farm scale costs over a region?
Interaction with current practices
Marginal cost of Qfly on-farm management
Spatial variability

Variability in Sunraysia



- different commodities (with different seasonality)
- crop-Mix vs. „monocultures“
- different proximities to urban areas

Costs of implementing AWM and SIT: overview



	Baseline		**Transition 1 AWM & BMP**		**Transition 2 AWM & SIT**	**Maintenance** (low pest lvls)
Cost: On-farm grower cost	Pest control Yield loss Market rejection	**Implement AWM + BMP adoption**	Increase BMP adoption increases on-farm costs	**Implement SIT**	Maintain full BMP	Decrease Reactive, so monitoring + lower activities due to lower pest pressure
Cost: SIT release	None		None		Flood *(higher cost)*	Maintenance *(lower cost)*
Benefit: Post-harvest trt	Treat		Treat		Treat	Potential to support negotiations for changes to PHT requirements
Benefit: market access	na		na		na	Potential for low pressure to support technical market access negotiations

Key finding #1 – the baseline cost of Qfly

The cost of Qfly varies over a **trajectory of pest management experience**.

Early costs are high:

- Due to lack of experience and adequate management growers face costs from:

  -Yield damage; and

  -Market rejection

Mature costs are low:

- Farmers adapt management through experience to reduce risk posed by Qfly
- Management activities for Qfly are incorporated into those for other pests

Key finding #2 – Baseline cost vs cost of AWM + SIT

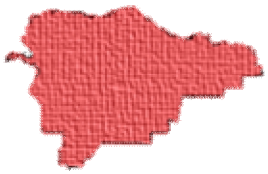
Pest-area status significantly impacts the conclusion for cost-effectiveness of Qfly control.

Results from our case study regions →

Sunraysia + Goulburn Valley

Sunraysia: Cumulative discounted* cost over 20 years	
Mature baseline	$70.6m
Potential best case	$97.6m
Potential worst case	$108.6m

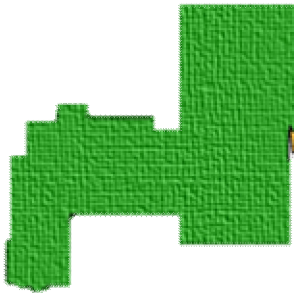
Goulburn Valley: Cumulative discounted* cost over 20 years	
Mature baseline	$48.4m
Potential best case	$71.2m
Potential worst case	$74.6m



1. AWM and SIT is not cost-effective for either region considering **only the impact to grower management costs**. Need to consider:
    - Impact of market access negotiations
    - Full IPM-context + non-market benefits
2. Results are highly sensitive to **the time taken in each transition state**, more so than to the cost.

*Best and worst case scenarios are framed around the potential time taken to achieve maintenance through states in the transition matrix. *discount rate = 7%; All values are in AUD.*

Riverland PFA – Pays to keep Qfly out!



Riverland: discounted cost of losing control	
Baseline (PFA)	$53.4m
Best case *higher Pr(outbreak)*	$67.3m
Worst case *endemic*	$110.1m

Benefit from maintaining control in the Riverland:

- Difficulty in reversing grower management costs once Qfly is established;
- Net benefit for keeping the pest out, but once established it is potentially not cost effective to suppress/eradicate it from a region;
- Is there a case for managing parts of Sunraysia bordering the Riverland to reduce pest pressure?

*discount rate = 7%, AUD

Caveat – uncertainty of SIT costs

Based on a release rate of **2,000 flies/ha** for the potential demand for SIT for the SITplus business case

Sunraysia	Flies released m/yr	Fly cost $	Release cost $	Total cost $/year
Eradication (initial)	504	756,000	1,555,344	2,311,344
Eradication (reduced)	49	73,500	151,214	224,714
Prophylaxis	144	216,000	44,384	660,384

There remains uncertainty in

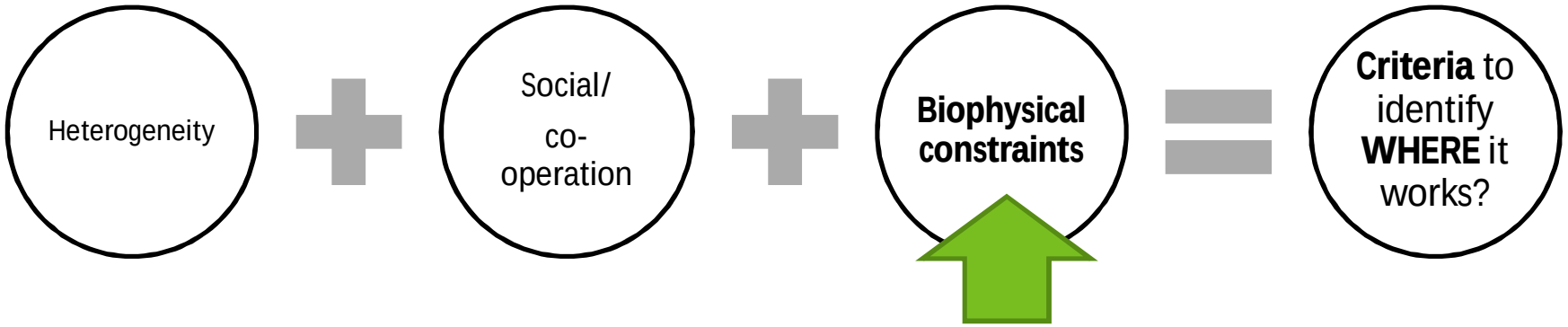
- Cost of flies
- Cost of release
- Area for release
- Flooding ratio likely to be higher in endemic regions

Goulburn Valley	Flies released m/year	Fly cost $	Release cost $	Total cost $/year
Eradication (initial)	488	731,946	1,505,856	2,237,802
Eradication (reduced)	49	73,195	150,568	223,780
Prophylaxis	274	410,333	844,192	1,254,525

Key finding # 3 – heterogeneity of commodities impacts cost-effectiveness

Finding: no net benefit from of AWM + SIT for large regions; may be net benefit at another spatial scale.

- How can we identify defined areas within regions where it might be viable?



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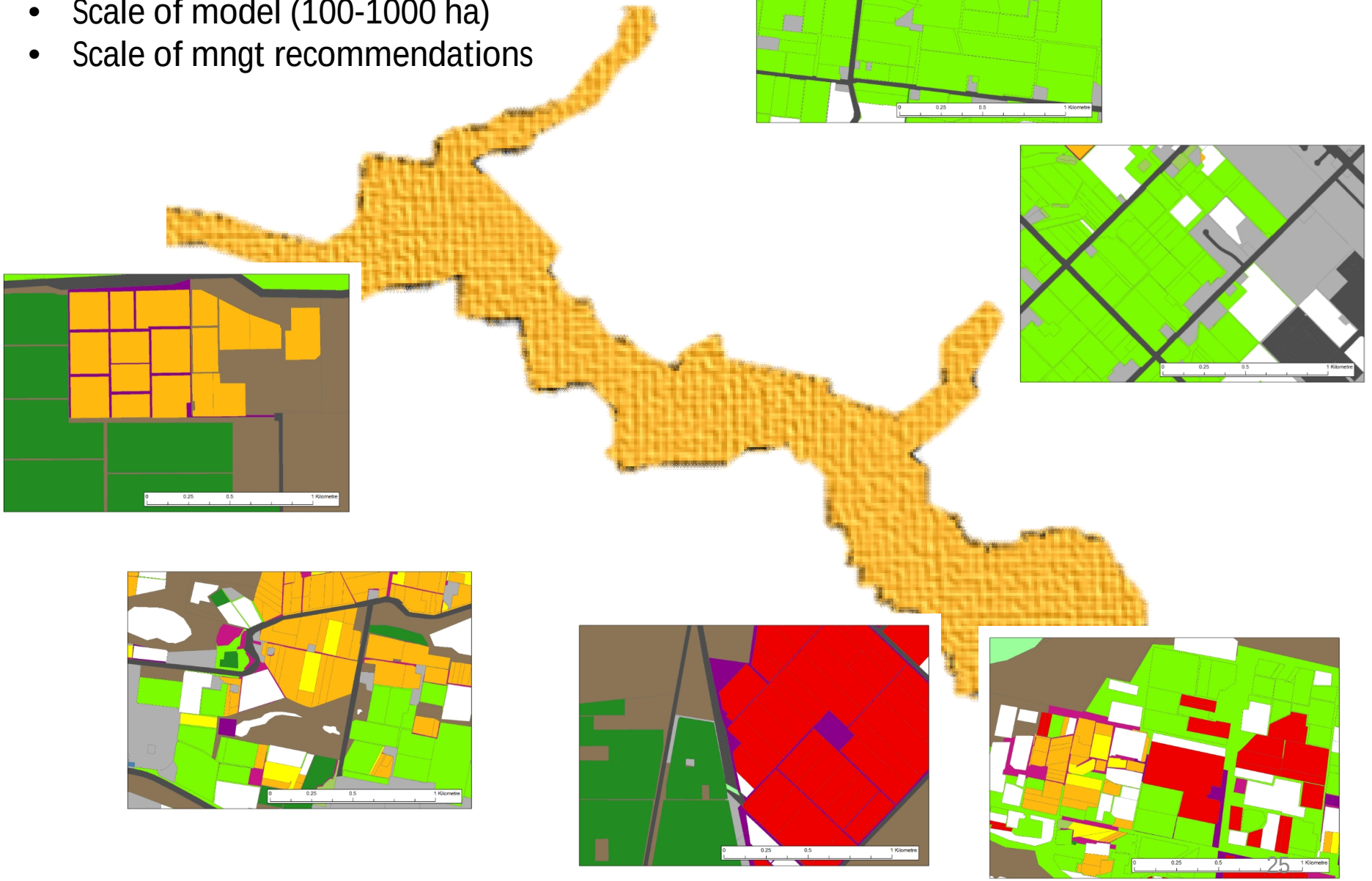
Variability in a region

- Scale of model (100-1000 ha)
- Scale of mngt recommendations



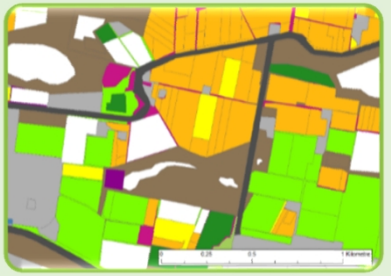
Spatially explicit population model

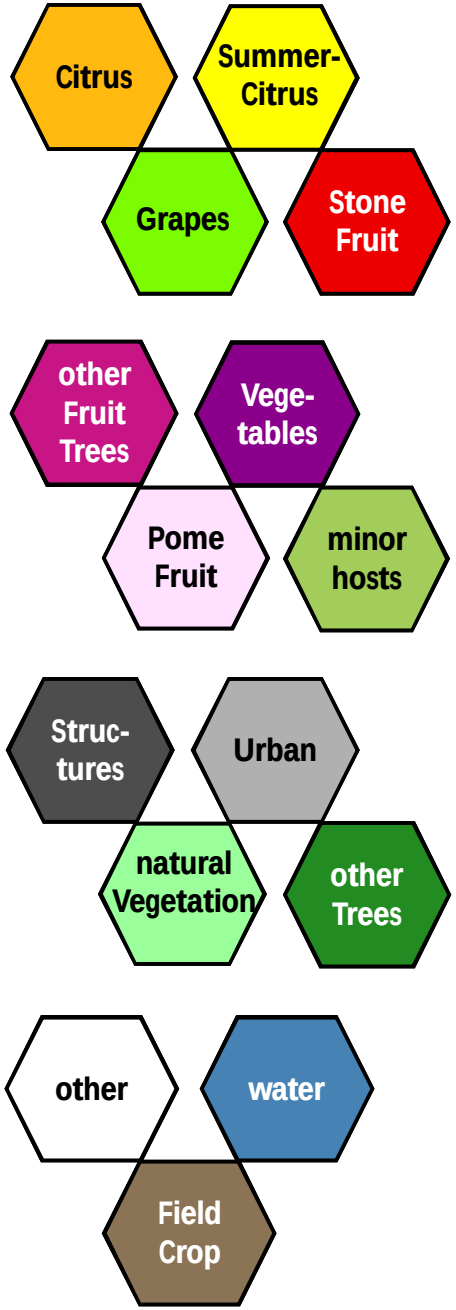
Florian Schwarzmueller

Hazel Parry

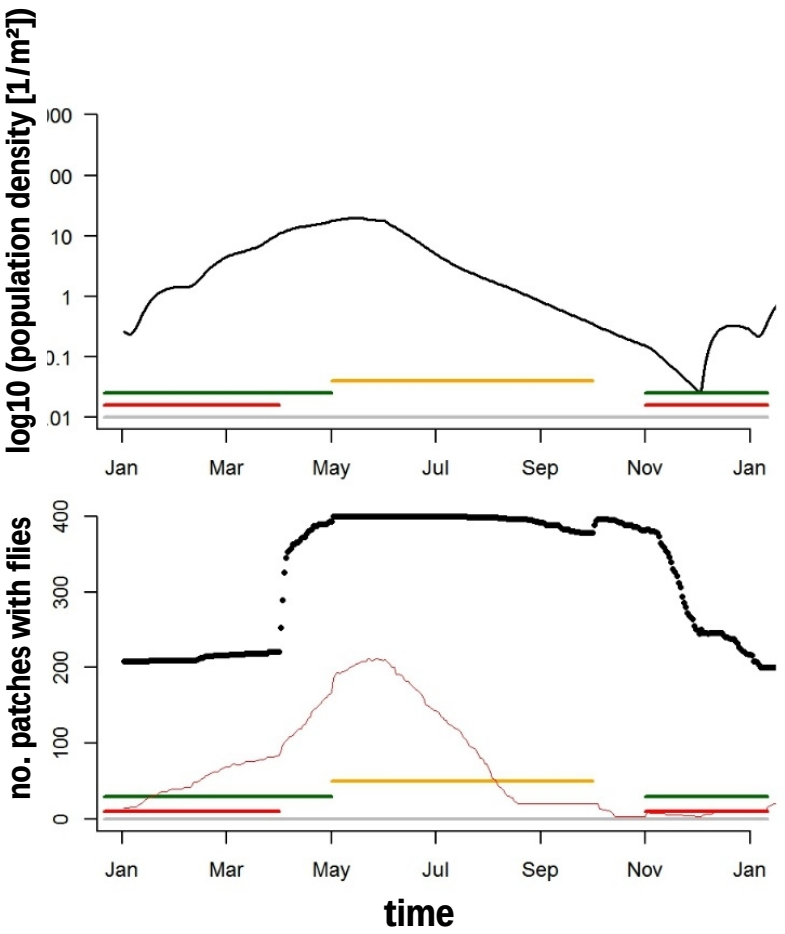
Ecology and behaviour of Qfly (reproduction, mortality, movement),

Host data (seasonality, quality, distribution)





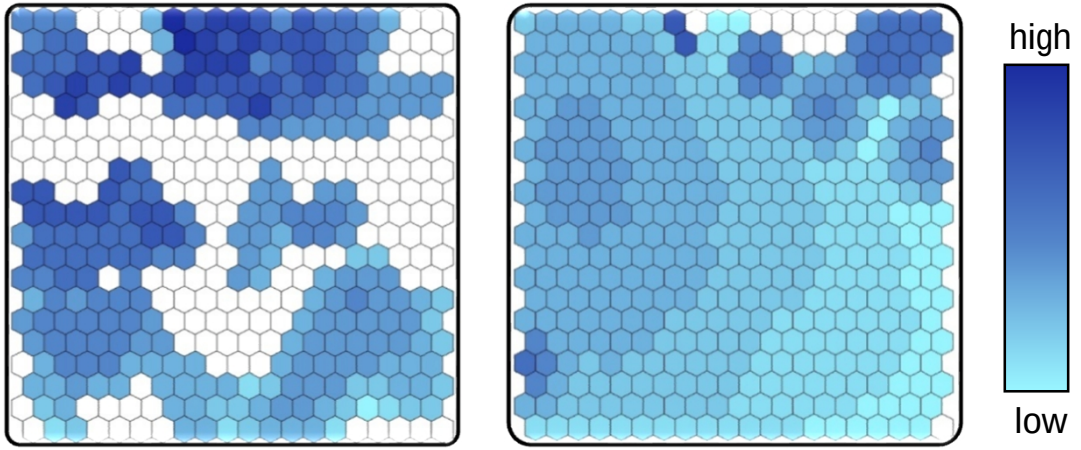
- Example -

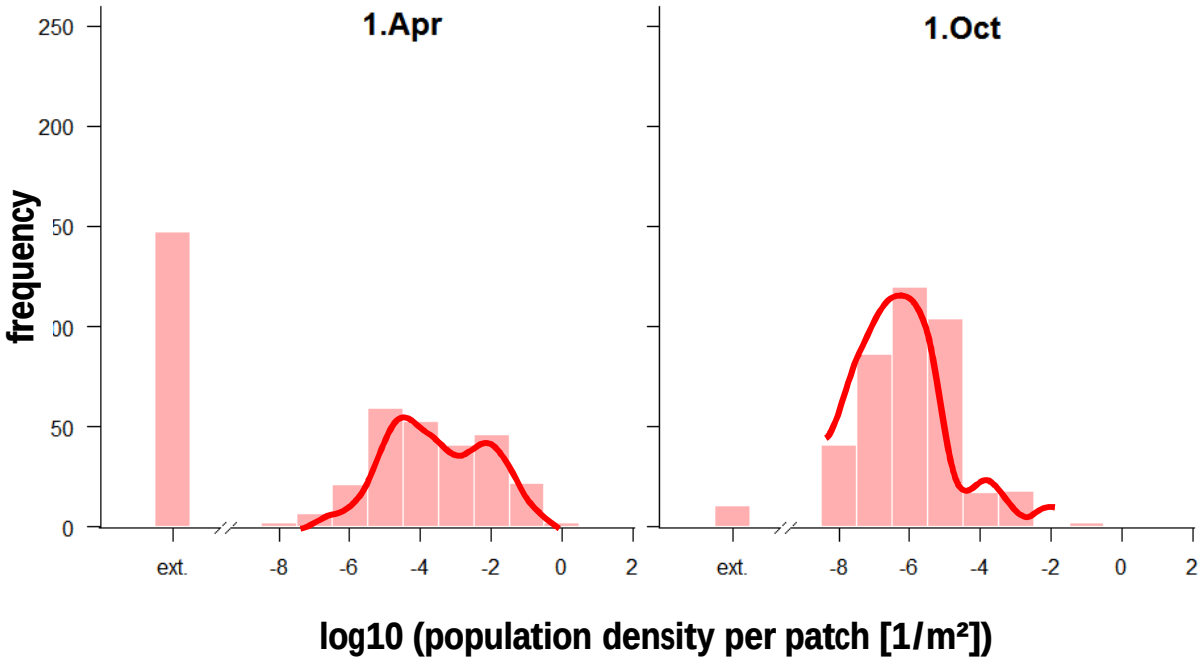


Population dynamics follow fruit availability
peaks at the end of Stonefruit/Grapes season (high quality crops)

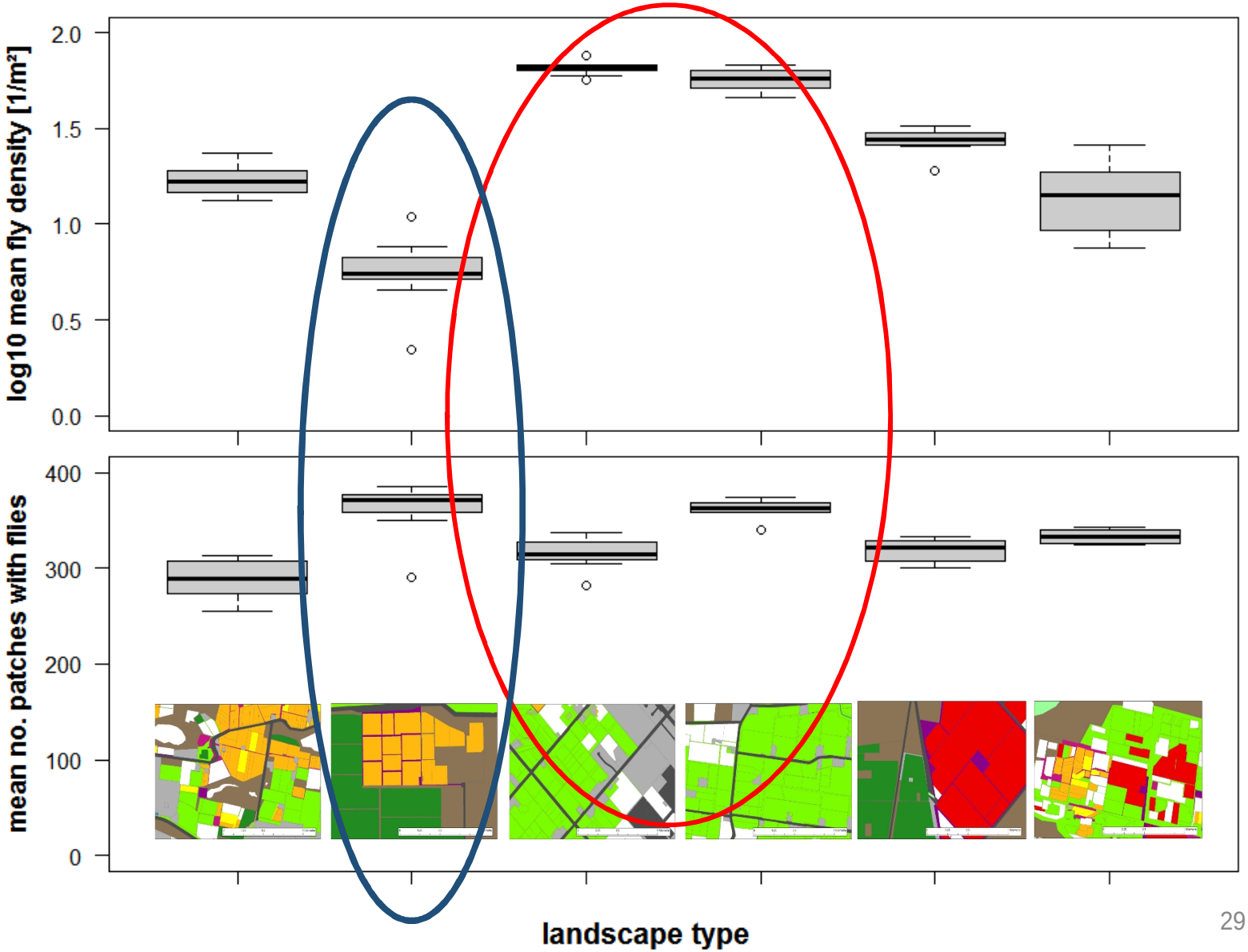
number of affected properties peaks later (flies searching for resources)

„spatially explicit“

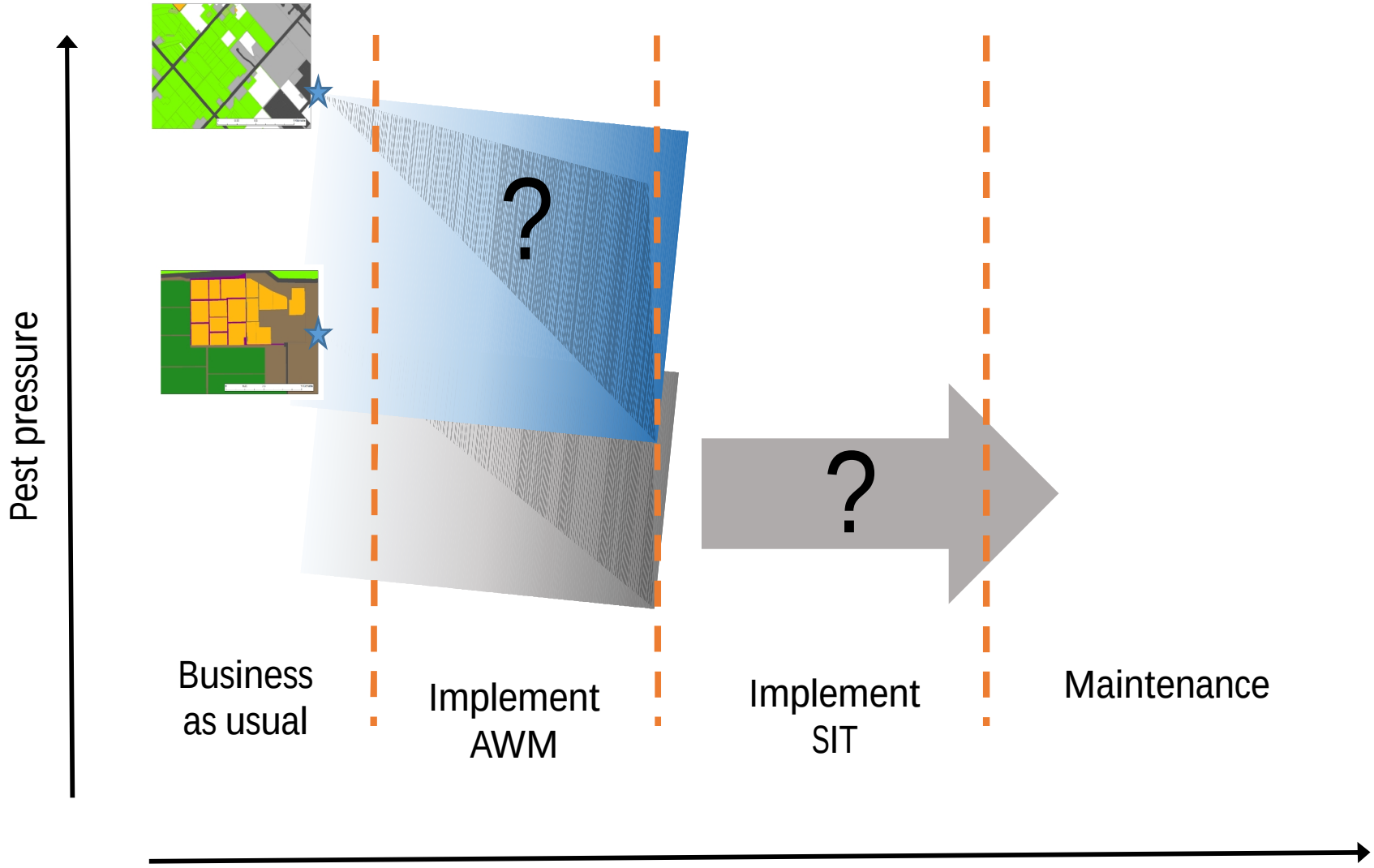




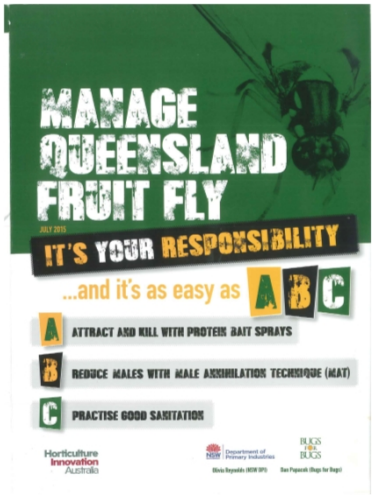
Variability



AWM and SIT – what's likely to work & what's not?



Best Management Practice (BMP)



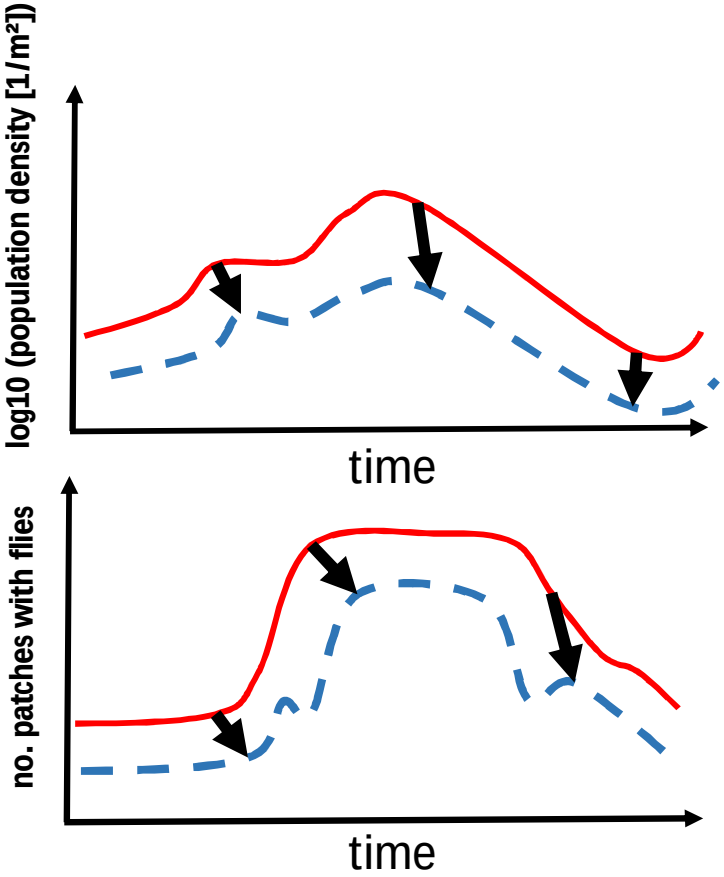
protein bait:
start early (4 weeks before ripening)
apply weekly
until 3 weeks after harvest

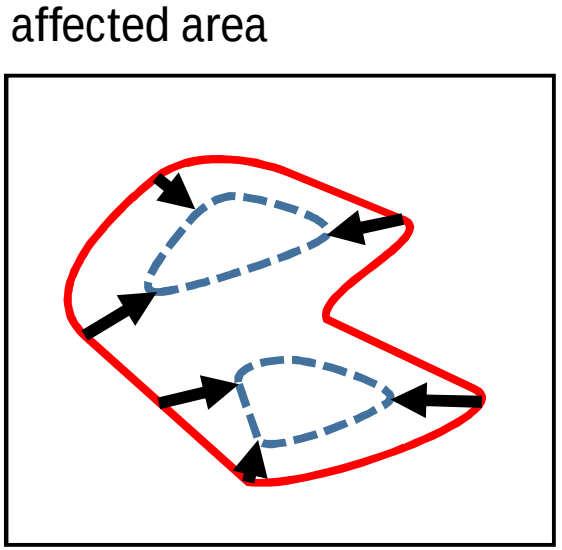
Male annihilation:
place MATs in orchards (10-20 per ha)
apply three times a year
leave out all year

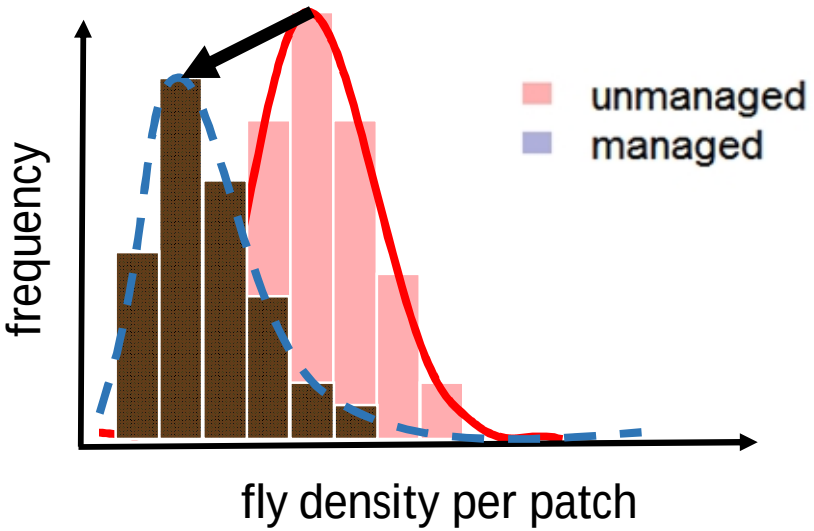
Sanitation:
remove all unpicked or fallen fruit
after harvest

- 60% adoption on farm -

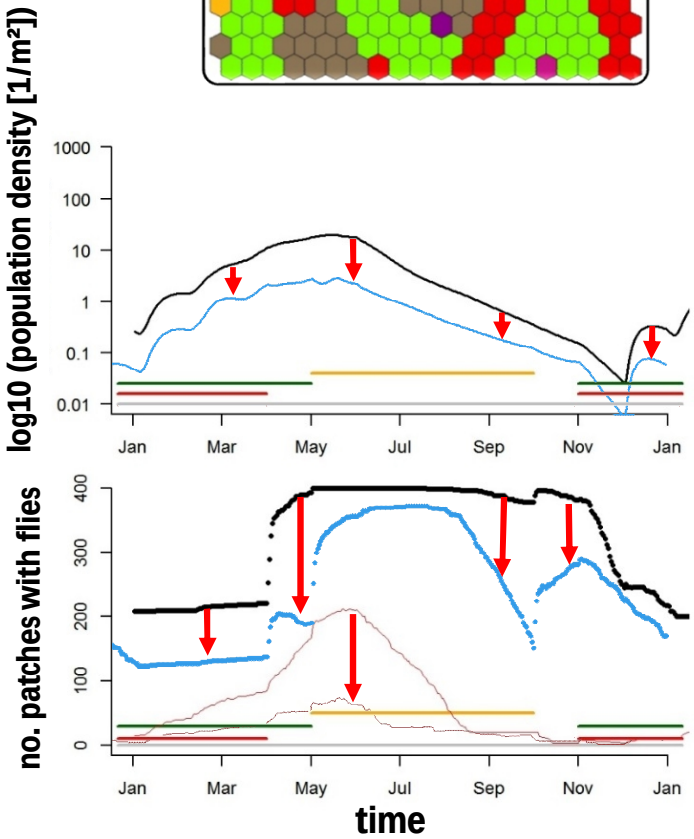
Effectiveness

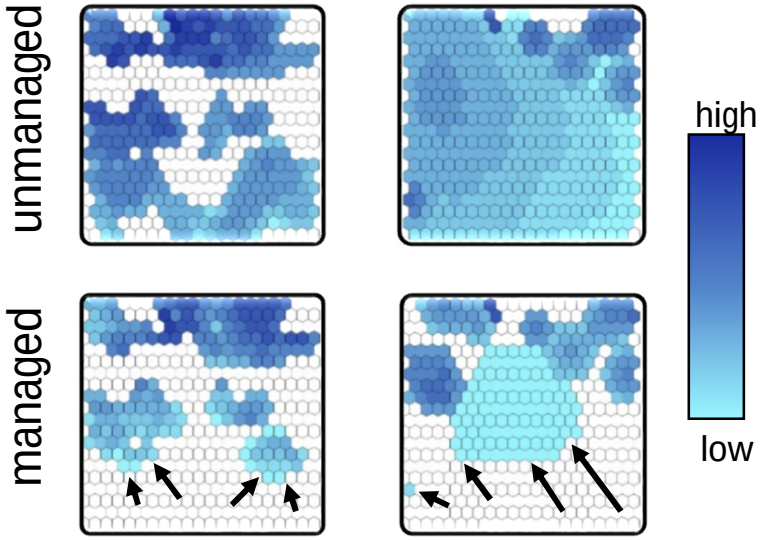


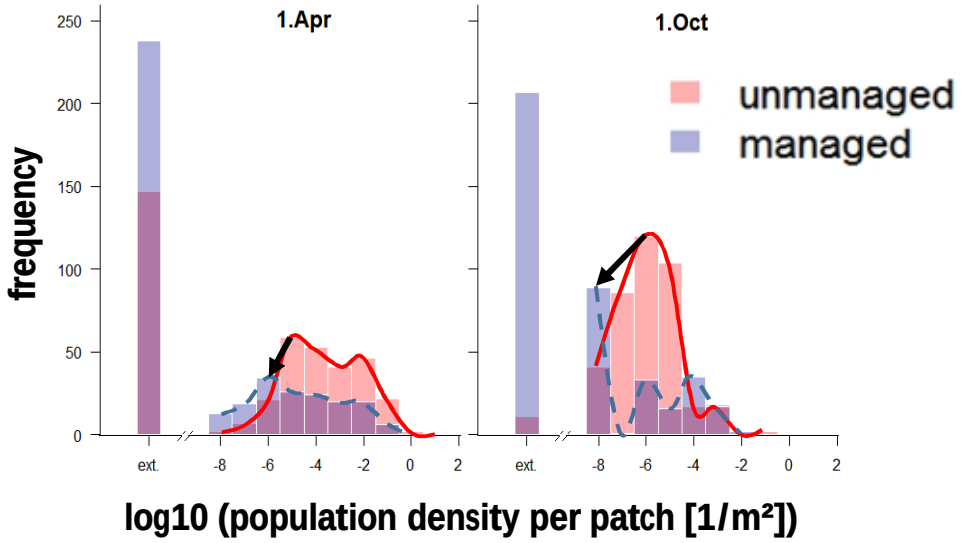




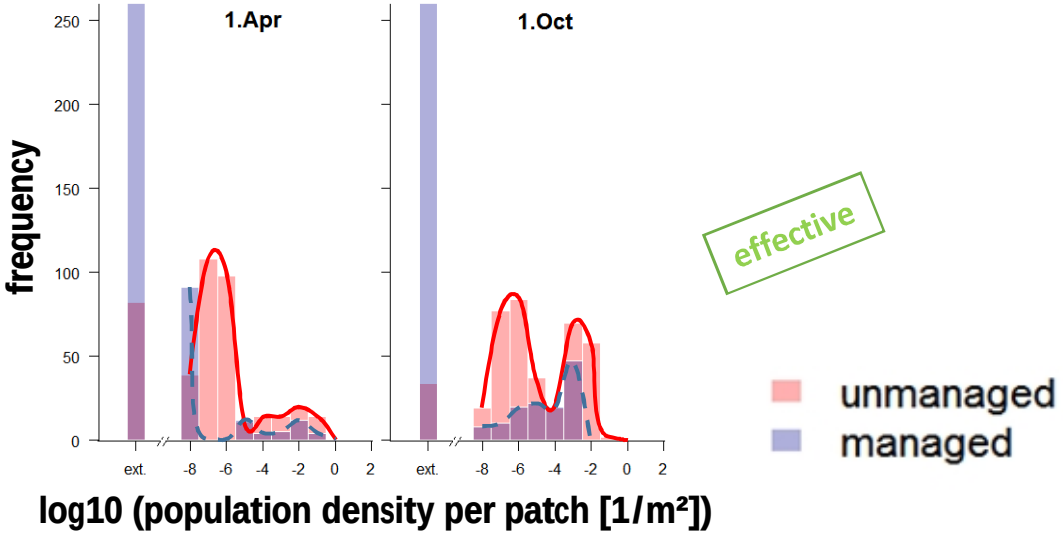
Example

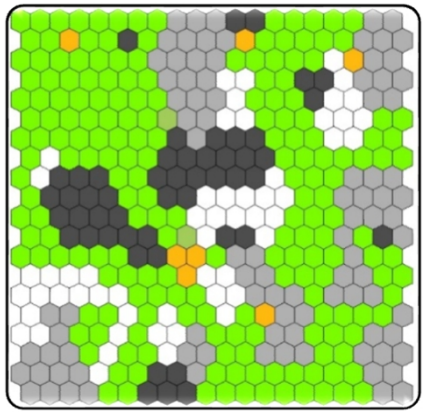

log10 (population density [1/m²])
1000
100
10
1
0.1
0.01
Jan
Mar
May
Jul
Sep
Nov
Jan
no. patches with flies
400
300
200
100
0
Jan
Mar
May
Jul
Sep
Nov
Jan
time

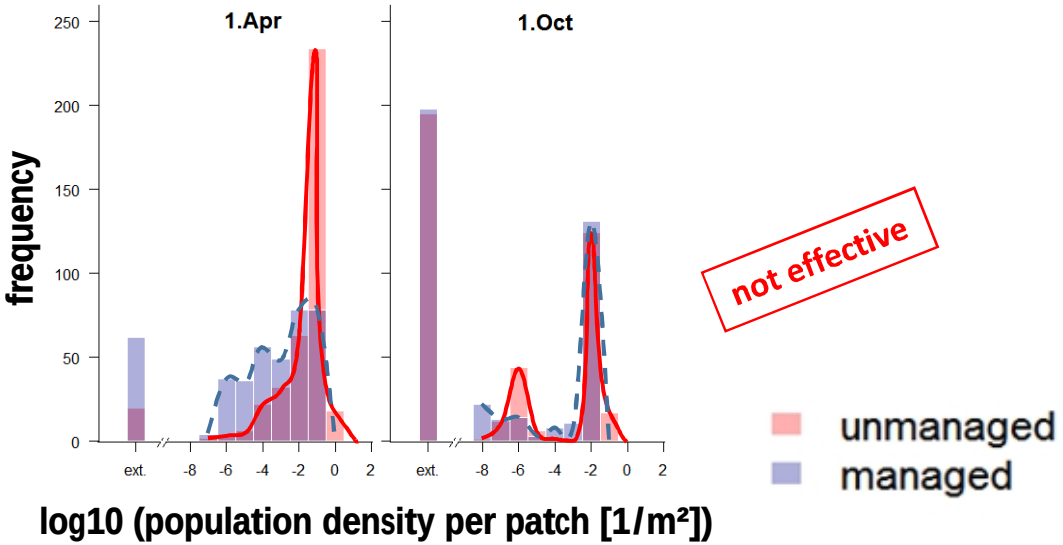

unmanaged
managed
high
low


1.Apr
1.Oct
unmanaged
managed
frequency
250
200
150
100
50
0
ext.
-8
-6
-4
-2
0
2
log10 (population density per patch [1/m²])

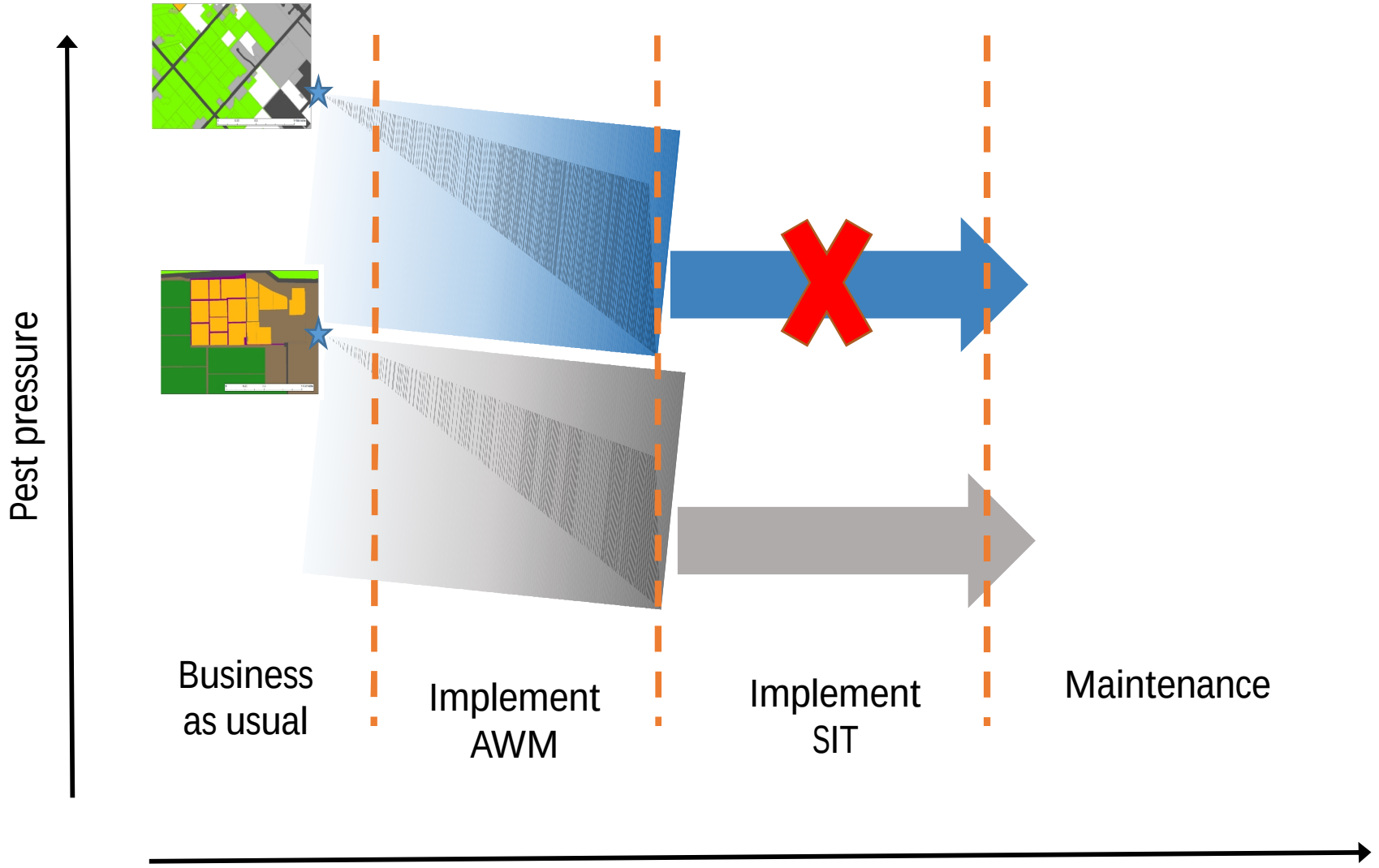
Feasability



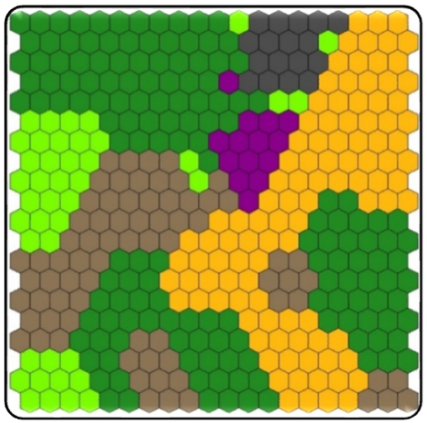




Effect of implementing AWM and SIT



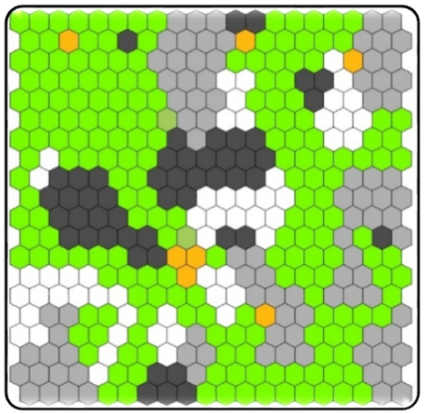
recommendations / trajectories



get growers engaged in BMP → social: how can you do this?

potential benefit of SIT → economics: costing of SIT delivery vs. getting 90% adoption

possibly ALPP → economics: benefits



get residents involved → social: facilitators + trust

options of urban treatment

probably no change in market access → economics: costs

Conclusions

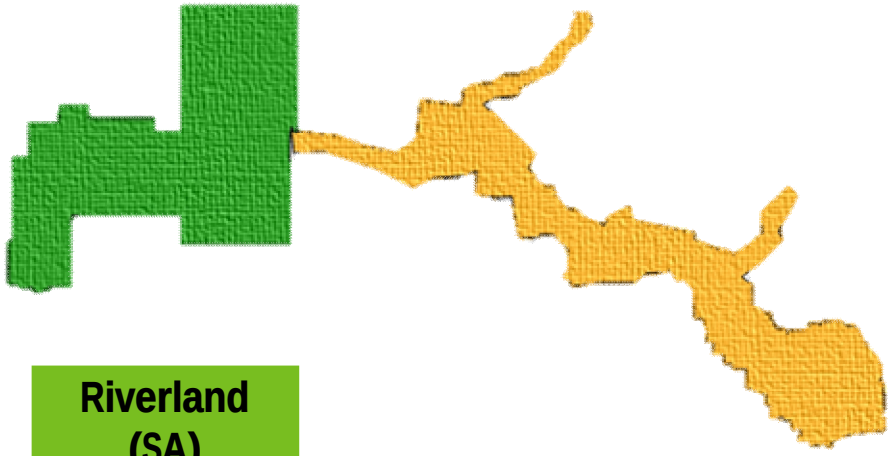
- Strong interdependence between economic, social and biophysical characteristics
- Identify criteria for determining where AWM + SIT could be efficient and effective
  - Heterogeneity within and b/t regions impacts on the costs and benefits of AWM and SIT
- Market access, FF mngt with an IPM context are key to consider benefits and costs.

Acknowledge the lead researchers, the wider team, growers, and community stakeholders!

THANK YOU!

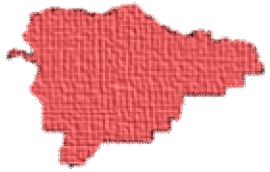
The 'Adaptive area wide management of Qfly using SIT' research project is supported by Horticulture Innovation Australia and CSIRO, through funding from the Australian Government Department of Agriculture and Water Resources, Rural R&D for Profit Programme..

Production (tonnes)



Riverland (SA)	
Citrus	157,236 t
Table Grapes	4,827 t
Stone fruit	11,280 t

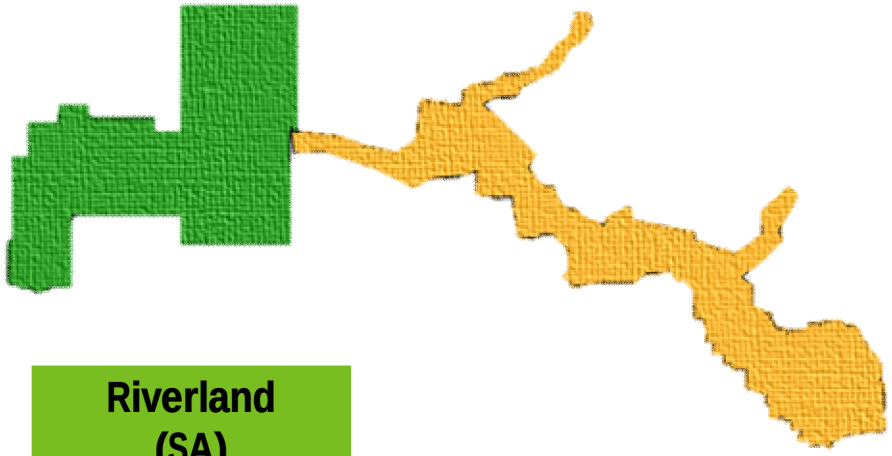
Sunraysia (Vic)**	
Citrus	102,757 t
Table Grapes	113,839 t
Stone fruit	102,240 t



Goulburn Valley (Vic)*	
Stone fruit	See Sunraysia
Cherries	4,599 t
Pome	231,304 t

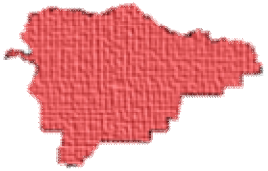
Source: Australian Horticulture Statistics Handbook 2014-15, by State (assigned to regions);
*including Goulburn Valley, Swan Hill (summerfruit), and Yarra Valley (cherries); **does not include production of citrus from NSW part of Sunraysia

International exports (AUD/tonnes)



Goulburn Valley (Vic)*	
Stone fruit	See Sunraysia
Cherries	$13.5m (1,015 t)
Pome	Pears $11.3m (7,153 t) Apples (474 t)

Riverland (SA)	
Citrus	$64m (54,066 t)
Table Grapes	$2.2m (683 t)
Stone fruit	< $1m (207 t)



Sunraysia (Vic)**	
Citrus	$75.9m (64,975 t)
Table Grapes	$223.6m (78,450 t)
Stone fruit	$28.1m (9,552 t)