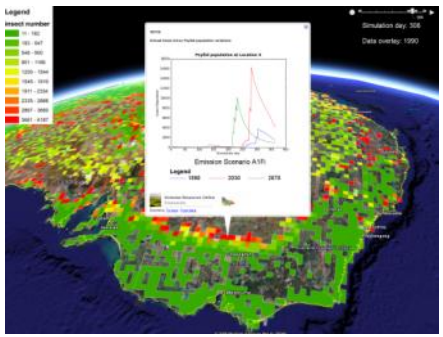
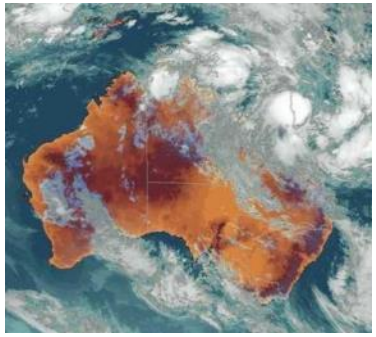
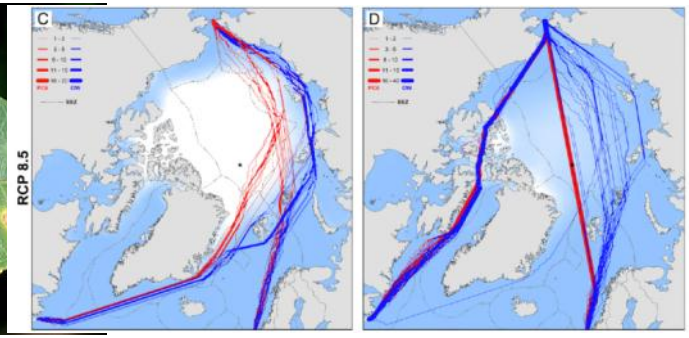
An overview of the effects of climate change on plant biosecurity

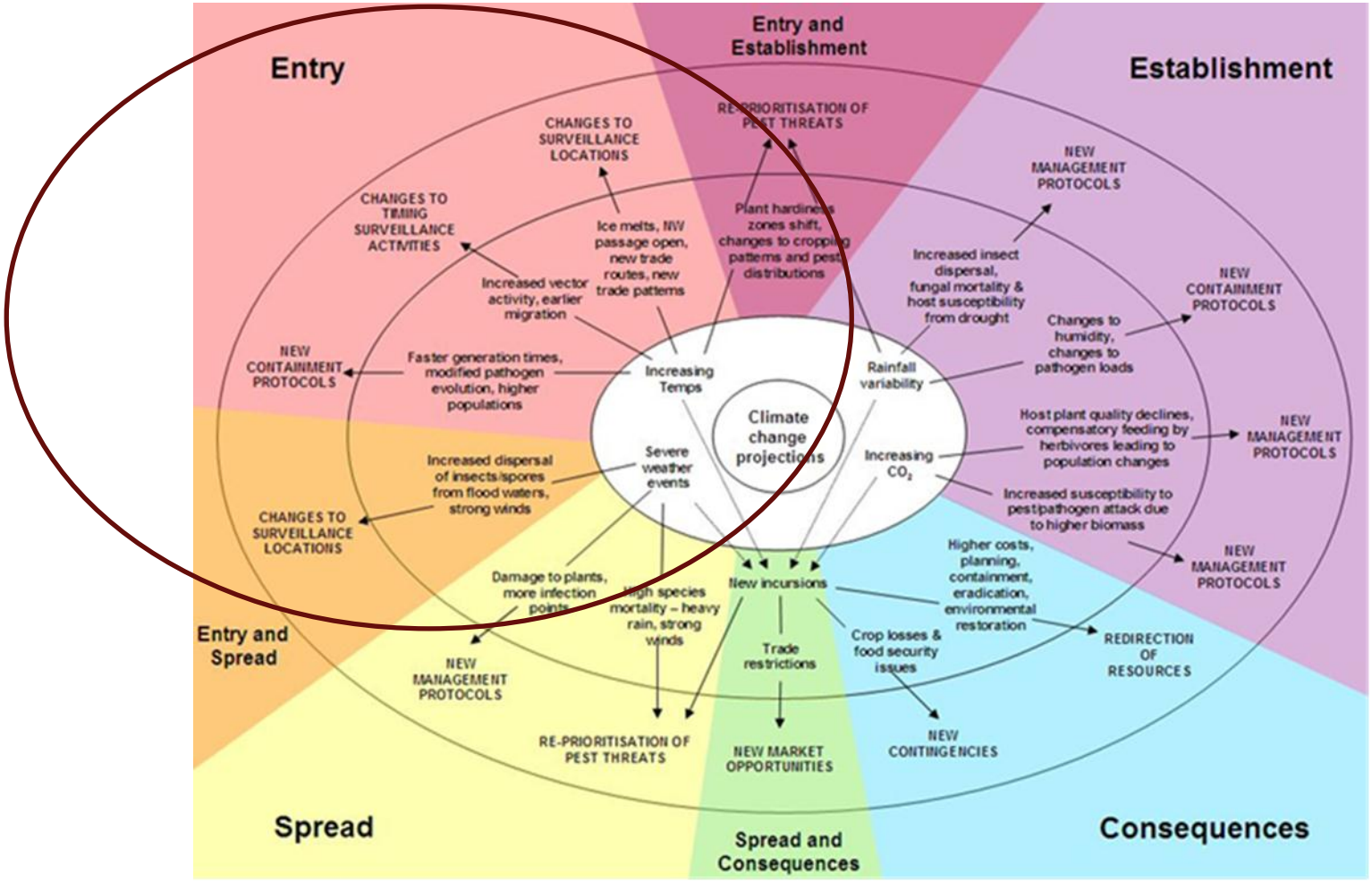


Jo Luck, Ian Campbell, Roger Magarey, Scott Isard,
Jean-Philippe Aurambout & Kyla Finlay
Quadrilateral Climate Change and Biosecurity Working Group (2011-2012)

Climate Change and Pest and Disease Research

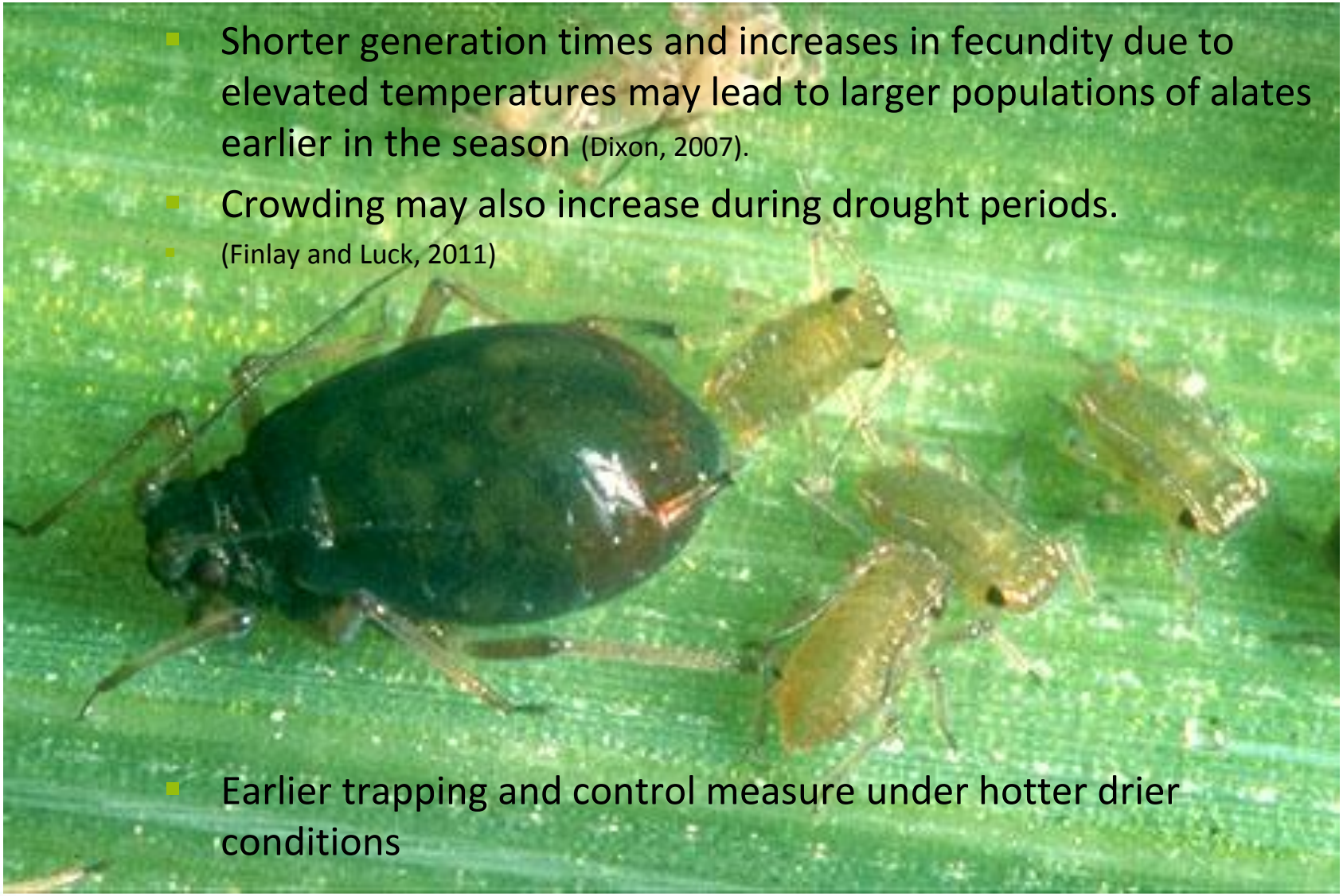
- No generic responses of taxa
- Spatial heterogeneity with regional climate projections
- Pest Risk Analysis – International guidelines developed by the FAO.
- Biosecurity guidelines - quarantine zones, surveillance and containment strategies are all based on species biology and life cycle.
- As more data becomes available on the effects of climate change on pests and diseases Pest Risk Analyses will need to be modified.

Pest Risk Analysis and Climate Change



J. Luck, I.D. Campbell, R. Magarey, S. Isard, J-P. Aurambout and K. Finlay, 2014

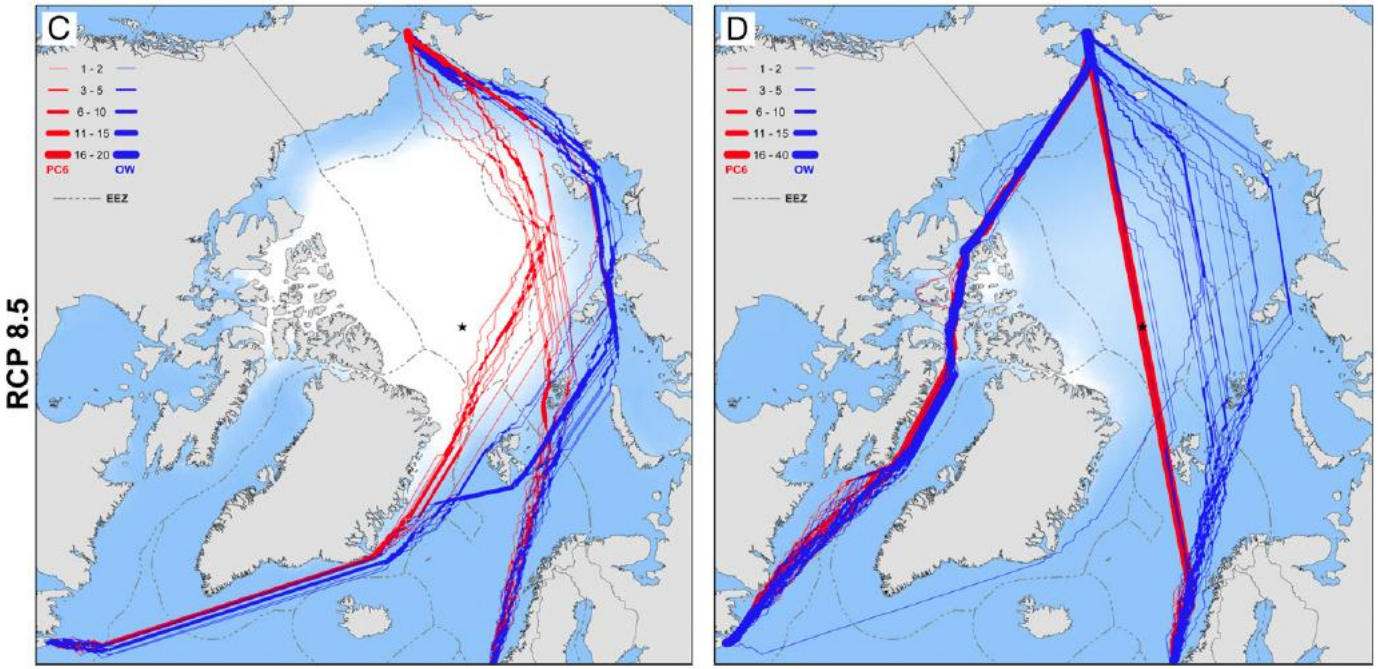
Entry - Increasing Temperature and Aphid Migration



- Shorter generation times and increases in fecundity due to elevated temperatures may lead to larger populations of alates earlier in the season (Dixon, 2007).
- Crowding may also increase during drought periods.
- (Finlay and Luck, 2011)
- Earlier trapping and control measure under hotter drier conditions

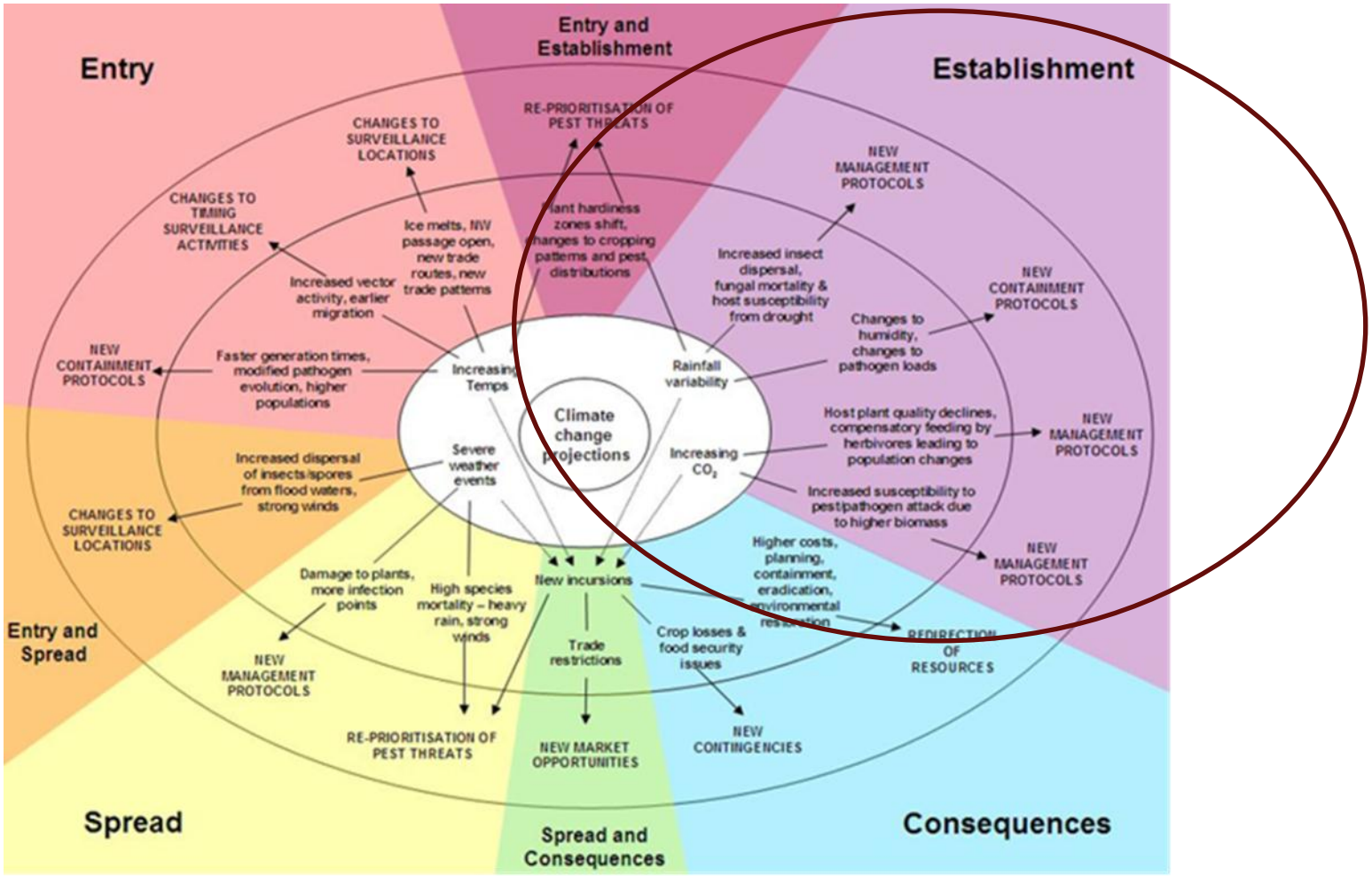
Entry Potential - Increasing Temperature and Trade

- An analysis of the melting of Arctic sea ice revealed the potential for ships to traverse the ice-free Northwest Passage by 2050 (Smith and Stephenson, 2012).
- Potentially much shorter transit times and greatly reduced cost of shipping.
- New trade routes will require an analysis of the risk along this pathway for the introduction of pests and pathogens associated with commodities.



(Smith and Stephenson, 2012)

Pest Risk Analysis - Establishment



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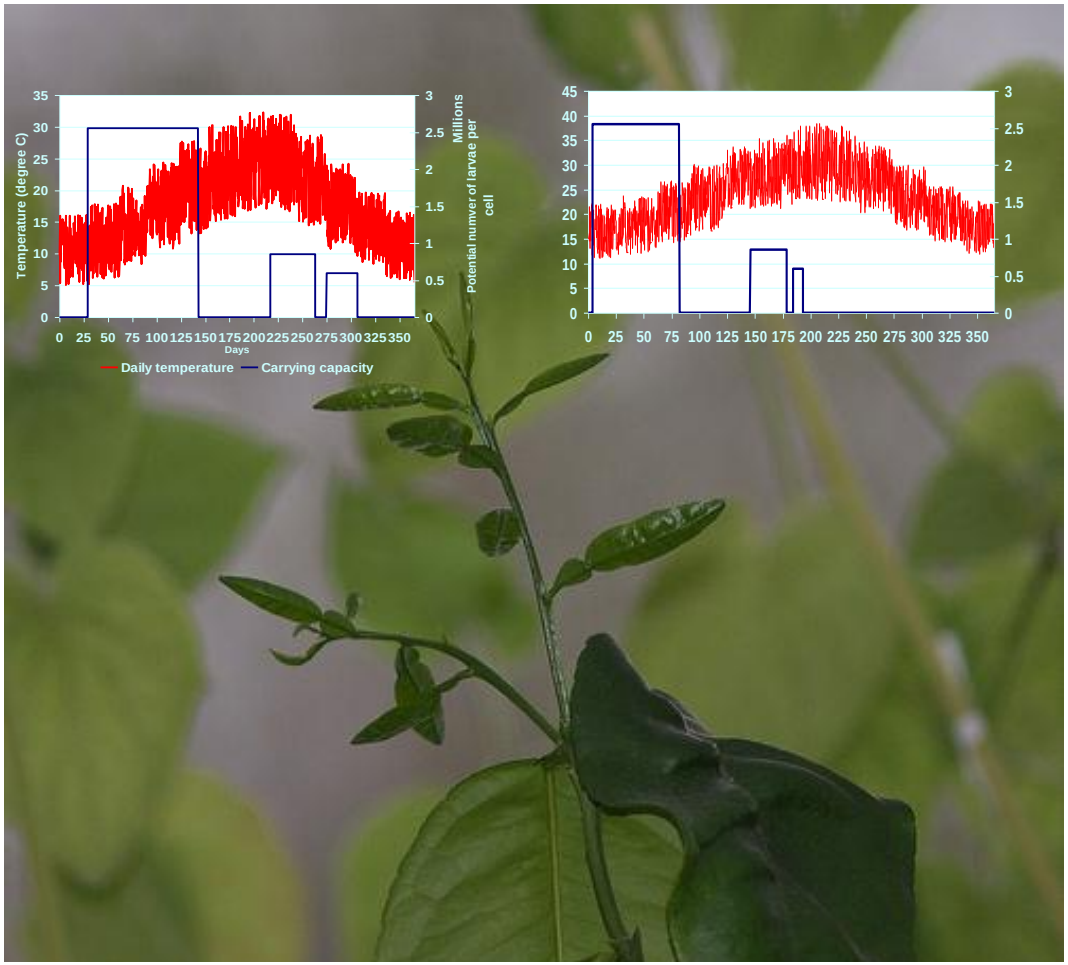
Citrus Greening - Huanglongbing

Establishment- Citrus Greening



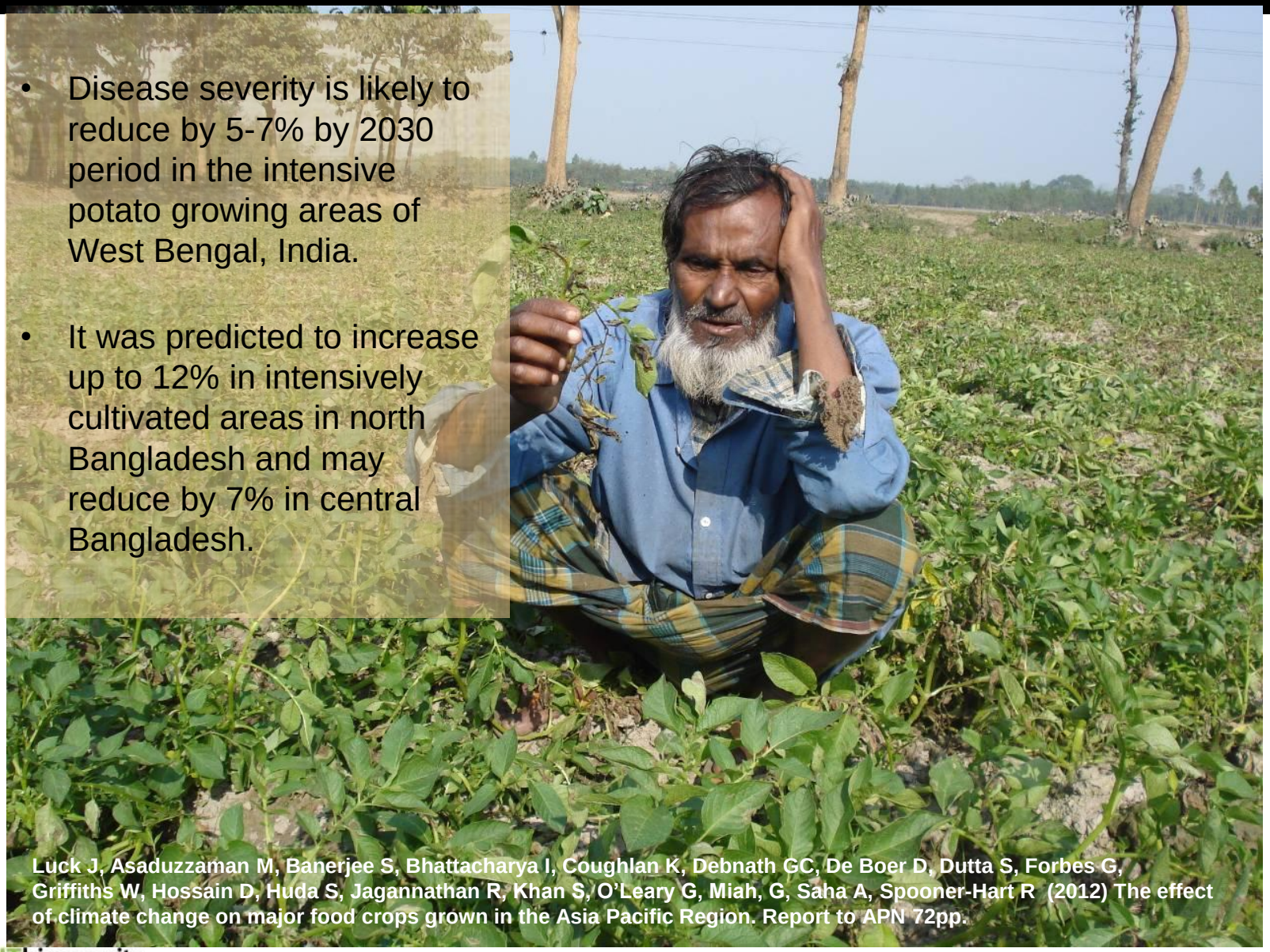
Aurambout, Finlay, Luck and Beattie (2009) *Ecological Modelling* 220 (19): 2512-2524.

1. **2008 compared to 2070 (+6ºC)**
2. **Start and duration of growth flush**
3. **Psyllid carrying capacity**

- New growth flushes are expected to start earlier and be available to the insect for a shorter time eg.1st flush starts 25 days earlier and is shortened by 35 days
- Carrying capacity reduced
- Shortened life cycle therefore more generations
- Earlier surveillance as growth flush advances

Establishment - Potato Late Blight

- Disease severity is likely to reduce by 5-7% by 2030 period in the intensive potato growing areas of West Bengal, India.
- It was predicted to increase up to 12% in intensively cultivated areas in north Bangladesh and may reduce by 7% in central Bangladesh.

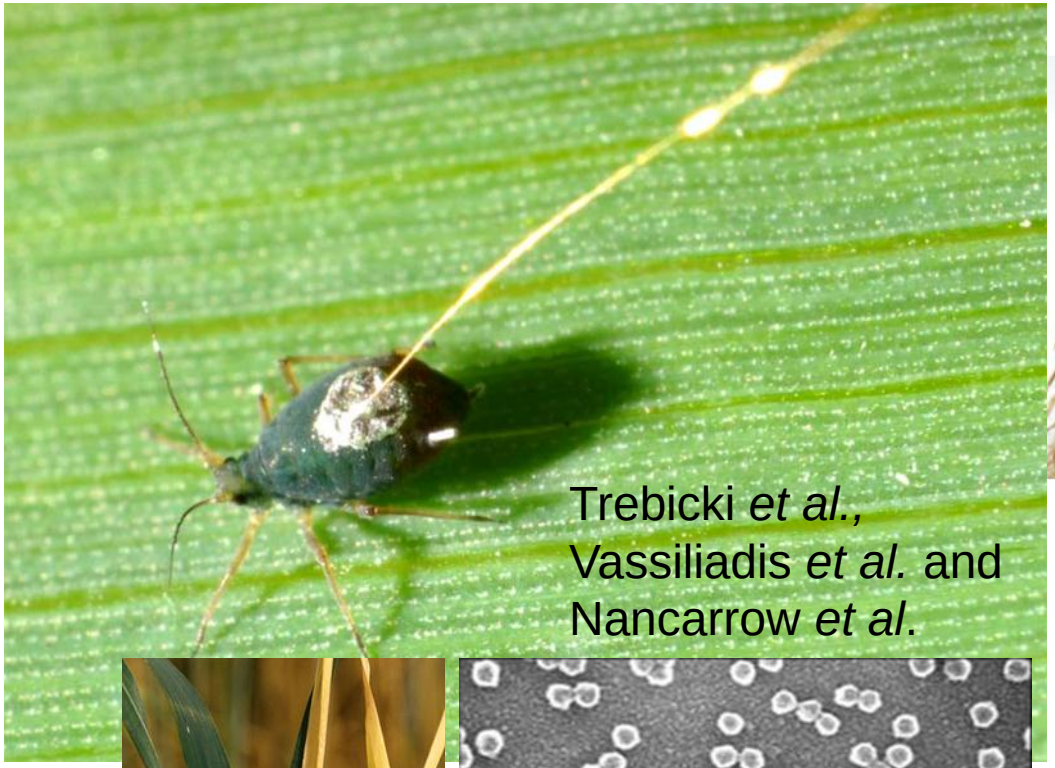


Luck J, Asaduzzaman M, Banerjee S, Bhattacharya I, Coughlan K, Debnath GC, De Boer D, Dutta S, Forbes G, Griffiths W, Hossain D, Huda S, Jagannathan R, Khan S, O'Leary G, Miah, G, Saha A, Spooner-Hart R (2012) The effect of climate change on major food crops grown in the Asia Pacific Region. Report to APN 72pp.

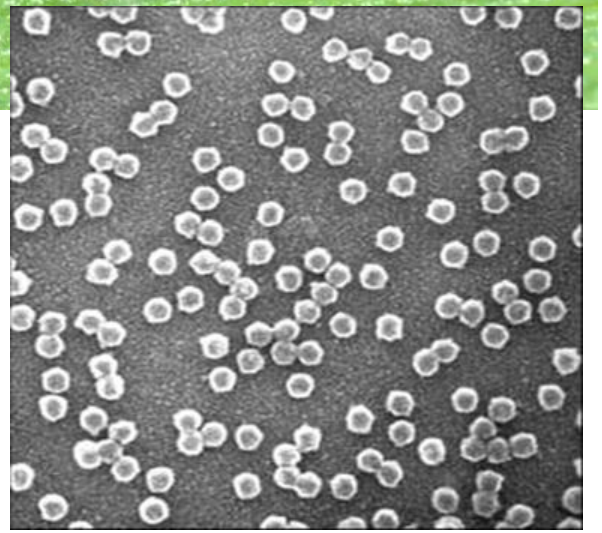
Establishment - Potato Late Blight

- Two potato growing regions – Kairi and Thorpdale
- The likely warmer but drier conditions expected in the tropical and temperate regions of Australia is expected to result in reduced incidence and severity of PLB at both locations despite a general increase in productivity.
- At Kairi, Qld, a delay in the onset of infection was predicted by 12 days by 2030
- In contrast, at Thorpdale, the onset of PLB is predicted to be 15 days earlier by 2030. A delay in sowing may minimise PLB infection in Victoria.

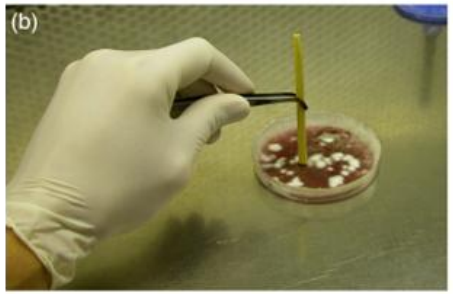
Establishment- Increased atmospheric CO_2

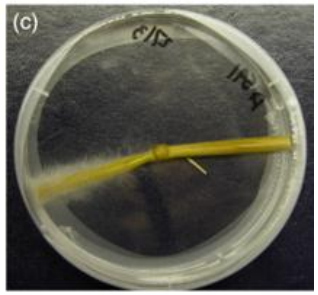


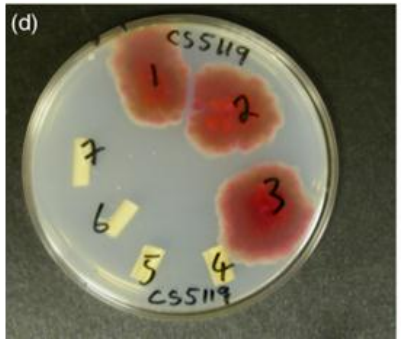
Trebicki *et al.*,
Vassiliadis *et al.* and
Nancarrow *et al*.

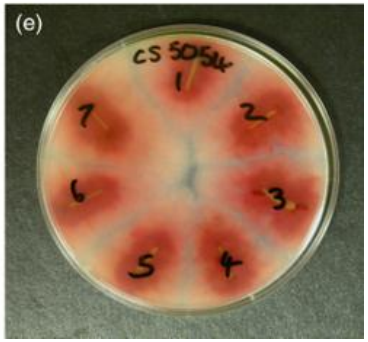


Chakraborty *et al.*
Melloy *et al.*









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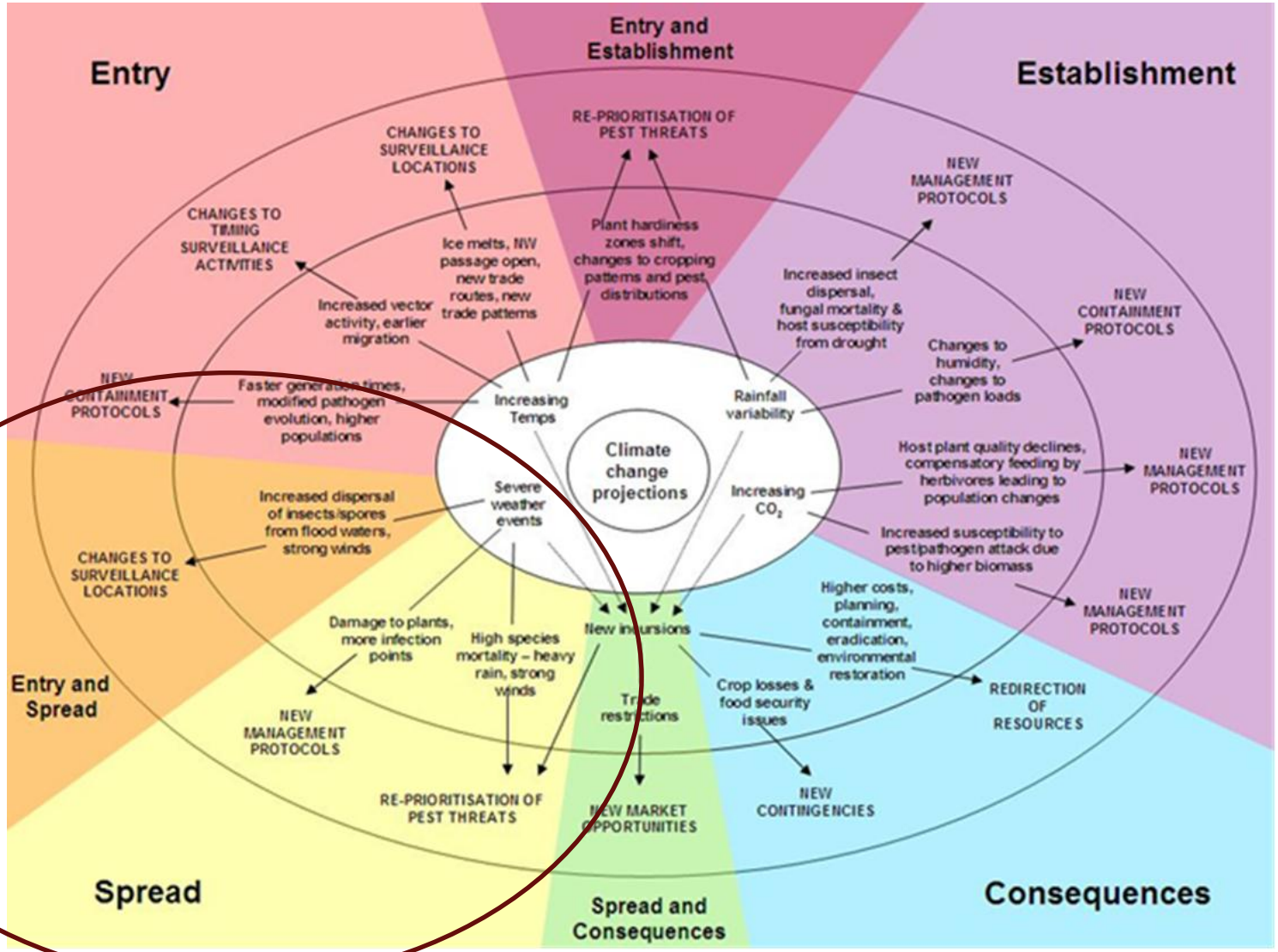
Pest Risk Analysis - Spread

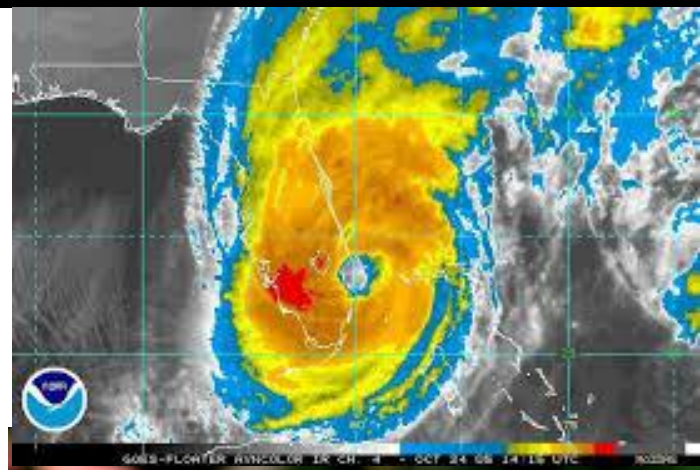


Spread – Natural Dispersal

- In 2005, winds and rain associated with Hurricane Wilma rapidly spread *Xanthomonas citri* subsp.*citri* destroying 170,000 acres of commercial citrus groves.

- Apart from fruit drop and physical damage, the movement of the bacterium breached the pre-existing 579 metre (1900 feet) quarantine zone for Citrus Canker management (Gottwald *et al.* 2001). After Wilma, eradication was not feasible.

- Severe weather events had not previously been accounted for in containment strategies (Irey *et al.* 2006; Gottwald & Irey 2007).



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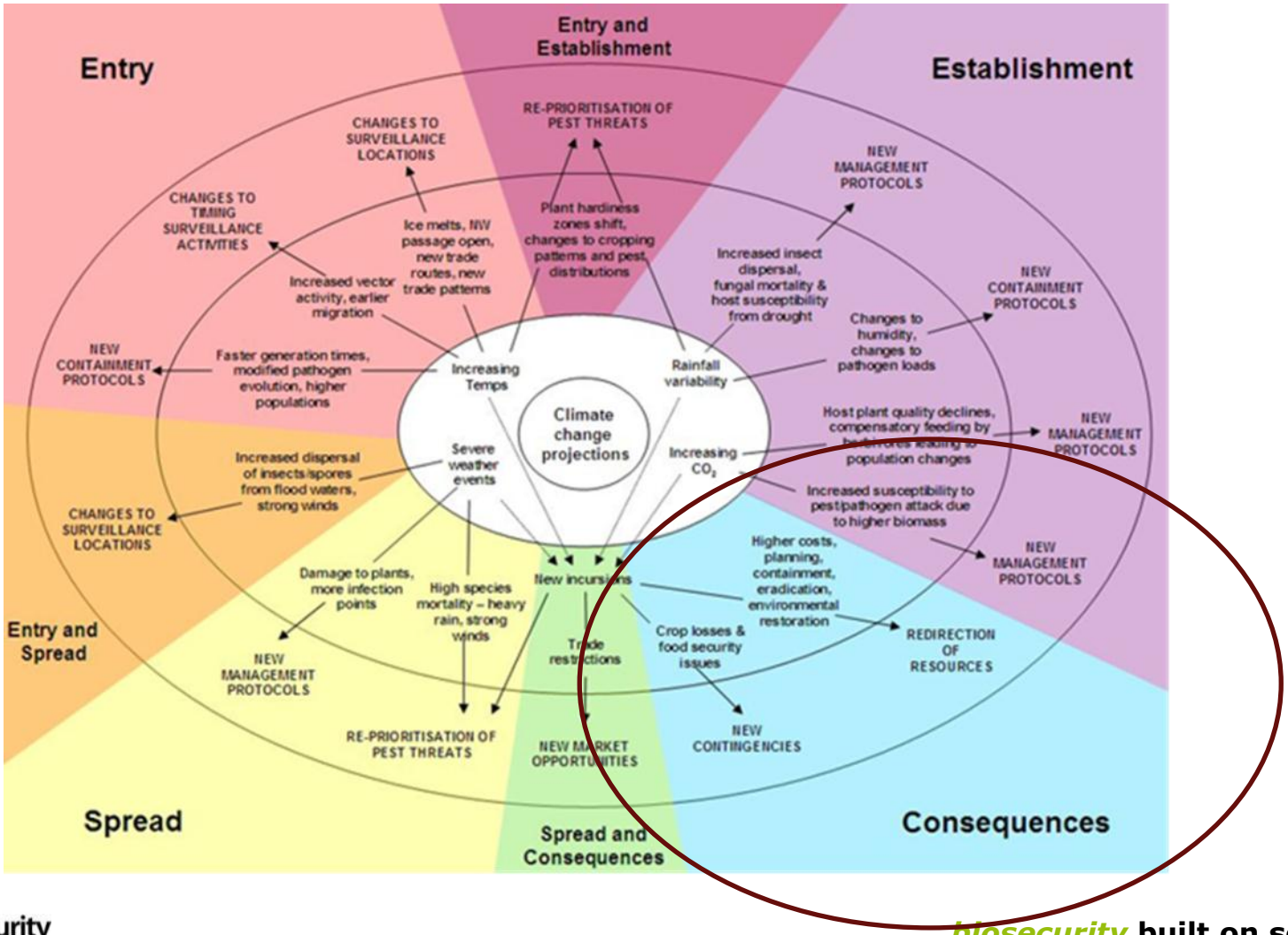
Pest Risk Analysis - Consequences



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Consequences- Citrus Greening

- The consequences of *D.citri* establishing in Australia would be a severe downgrading or substantial loss of production, unmarketable fruit and costs incurred due to implementing control measures (depending on the location of an outbreak).
- At a local scale the grower will be subject to immediate quarantine restrictions and may bear the cost of orchard destruction.
- Interstate trade and export revenue loss will be incurred with 25% of Australian citrus exported - half the total value of production (PHA, 2009).
- Australia is one of the rich biodiversity centres for native citrus. The effect of Citrus Greening on these species is not known (Finlay, Yen and Luck *et al*, 2009).
- Other host plants such as orange jasmine (*Murraya* spp.) and curry leaf (*Bergera koenigii*) also pose a risk of introducing Huanglongbing-infected Asiatic Citrus Psyllids.

Future Work

- Testing new surveillance strategies based on results from a pilot study for wind dispersal and potential for entry (including cyclonic events)
- Identification and prioritisation of new and emerging pest and disease threats.
- Identify altered trade or cropping patterns as a result of changing climate with potential for introduction of new pests and diseases.
- Develop guidelines to incorporate climate change into PRAs and quarantine policy guidelines.

Thank you

- Kyla Finlay, Jean-Philippe Aurambout, Piotr Trebicki & Sukumar Chakraborty
- APN-GC, Crawford Fund, CSIRO, BSF, BARI, BCKV, Kalyani and Tamil Nadu Agricultural University.

State Government Victoria Department of Environment and Primary Industries

An Australian Government Initiative

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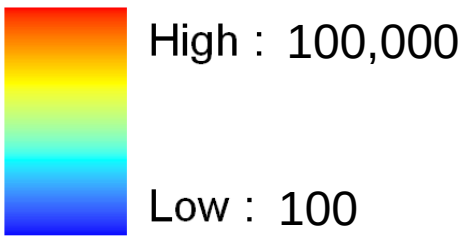
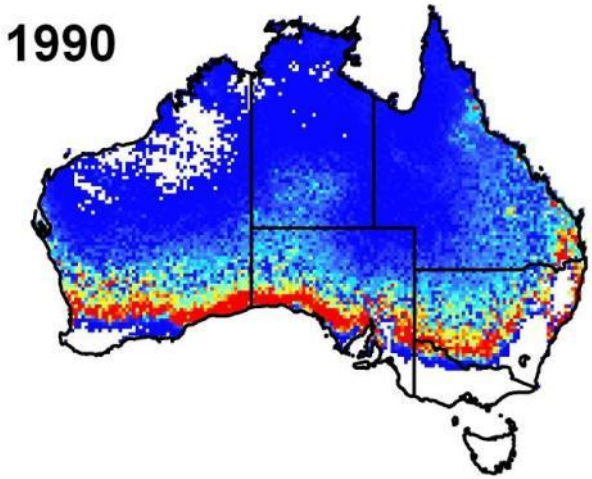
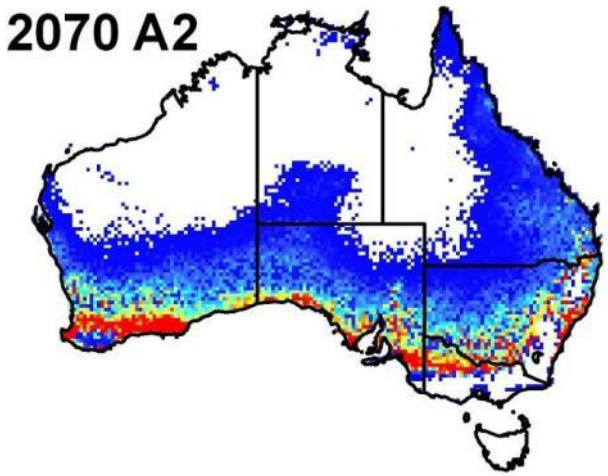
Adult psyllid population –Increasing temperature

- Population reduction north and inland
- Psyllid population shift southward
- Southern citrus growing areas may become more favourable

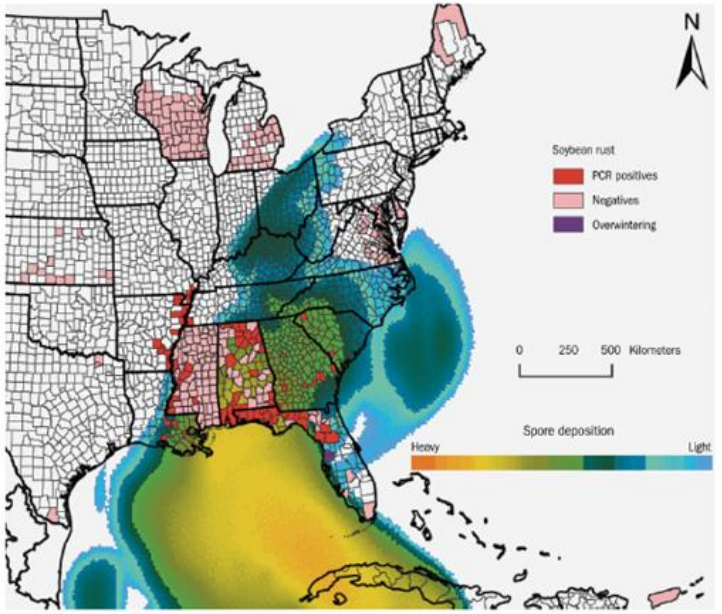






Entry and Spread – Increased severe weather events

- Atmospheric pathways are critical factors for determining the introduction and spread of pests (Isard *et al*. 2005 and Aurambout *et al.* 2006).
- Tropical cyclones are projected to increase in intensity with larger peak wind speeds and greater frequency of heavy precipitation (IPCC, 2007).
- Prior to 2004, Asian Soybean Rust was considered the most serious foliar disease of soybean that could potentially impact the US.
- ASR spores were blown from north-western South America to the south-eastern USA in September 2004 on winds associated with Hurricane Ivan.



(Isard *et al.* 2005).