Transitioning Cereal Systems to Adapt to Climate Change

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From impact assessment to climate change adaptation: What do we need to know for invertebrate management in grains

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From impact assessment to climate change adaptation: What do we need to know for invertebrate pest management in grains

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NATIONAL INVERTEBRATE PEST INITIATIVE

GRDC Grains Research & Development Corporation

Your GRDC working with you

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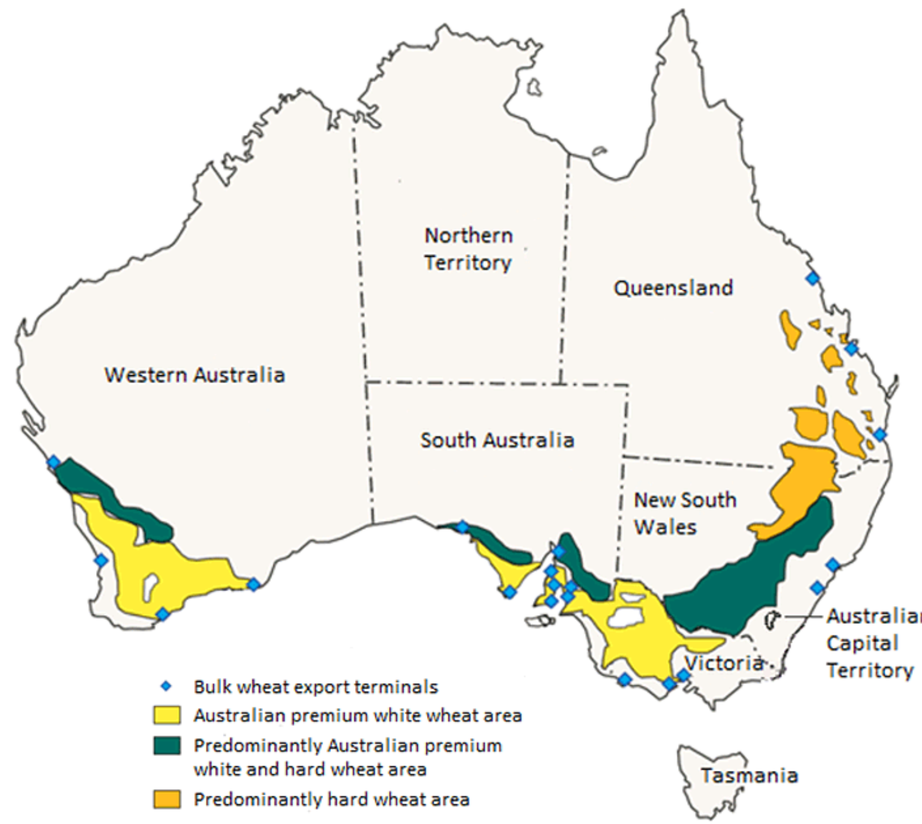
Climate change impact on grain production in Australia

- Less rainfall in autumn/winter – sowing time
- Shift to earlier sowing (assuming adequate rainfall)
- Accelerated crop development lead to reduced yields
- Heat waves may impact grain protein content



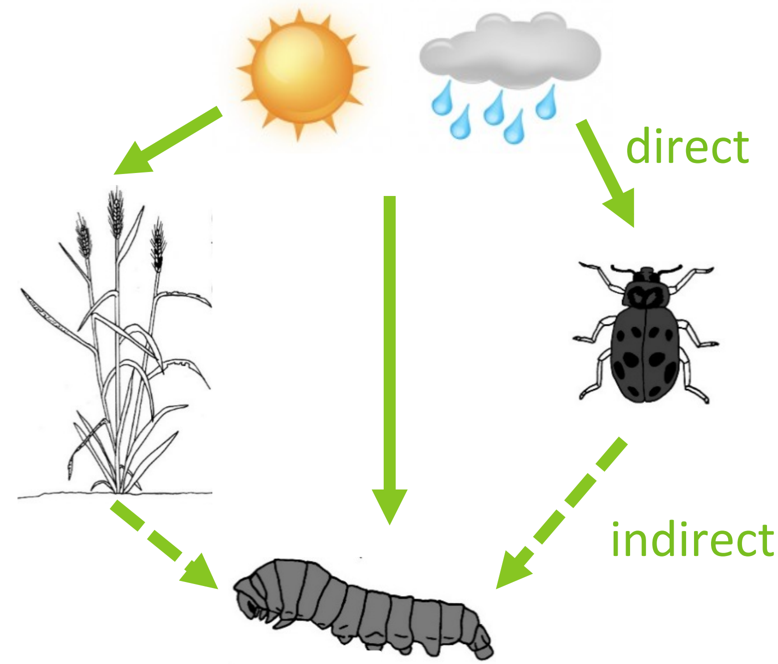
Source: ABARES

Will there be more problems from invertebrate pest outbreaks?

Response to climate change

Potential responses of pest herbivores:

1. Shifting distribution
2. Altering phenology
3. Adjusting to persist *in situ* (phenotypic plasticity or evolutionary adaptation)



- Growers manage for multiple pest species

Adapted from: Klapwijk, Ayres, Battisti, Larsson (2012) Assessing the impact of climate change on outbreak potential. In: Insect Outbreaks Revisited, eds. Barbosa, Letourneau, Agrawal. Chapter 20.

Pest herbivore species

Halotydeus destructor

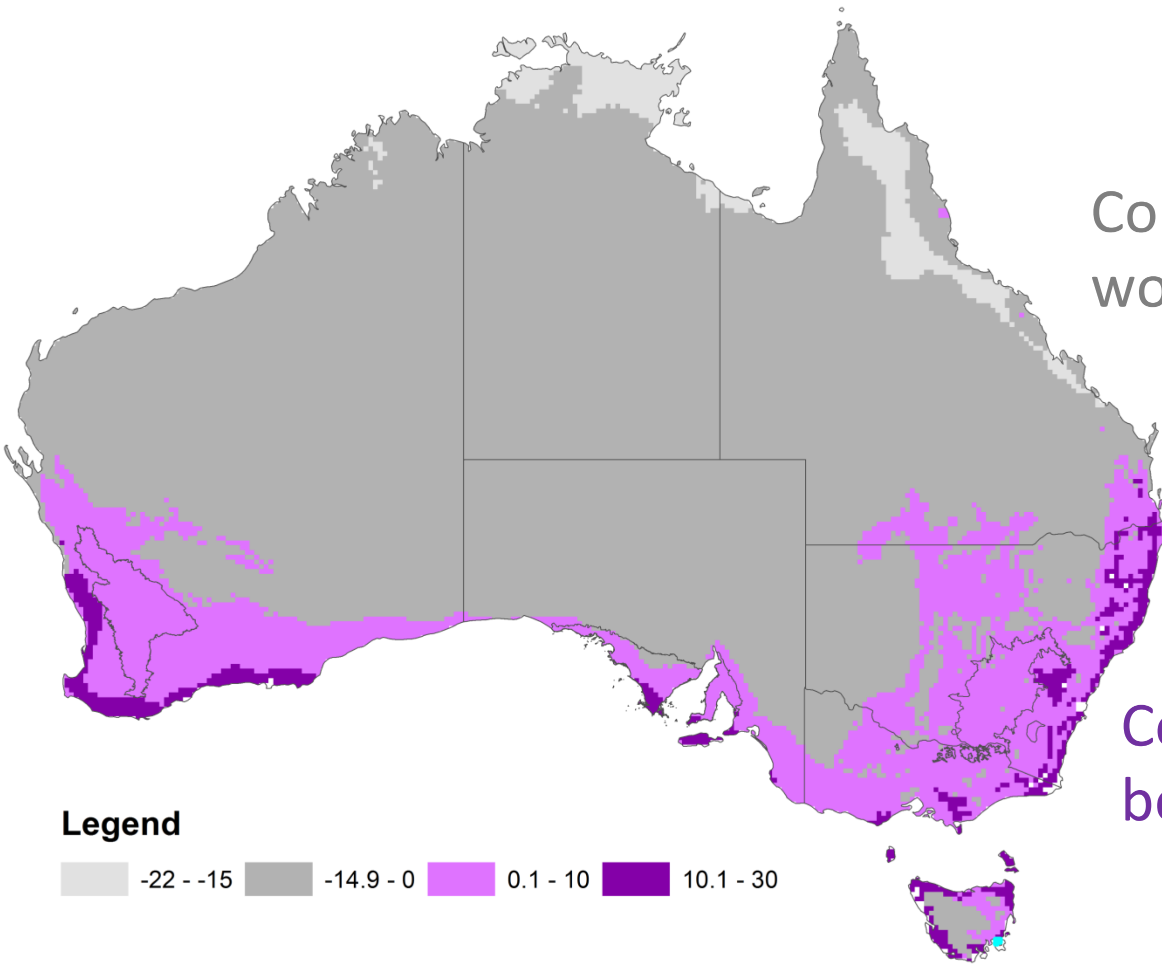
Plutella xylostella

Rhopalosiphum padi

Sminthurus viridis

Helicoverpa armigera

1. Shift in distribution - Northern species moving south – *Helicoverpa armigera*

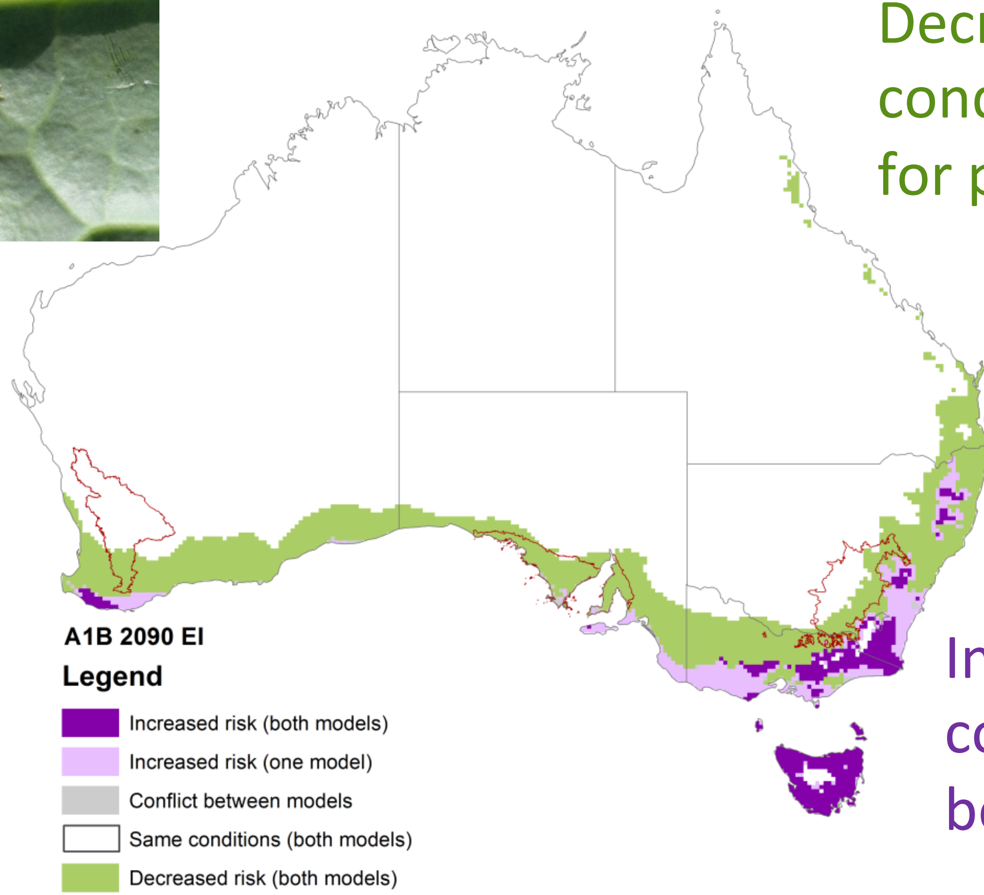


Conditions are getting worse for pest

Conditions are getting better for pest

Change in the suitable conditions (change in EI) for growth of *H. armigera*
A2, MR climate change scenario, historical and 2090

1. Reduction in risk in certain areas – *Plutella xylostella*

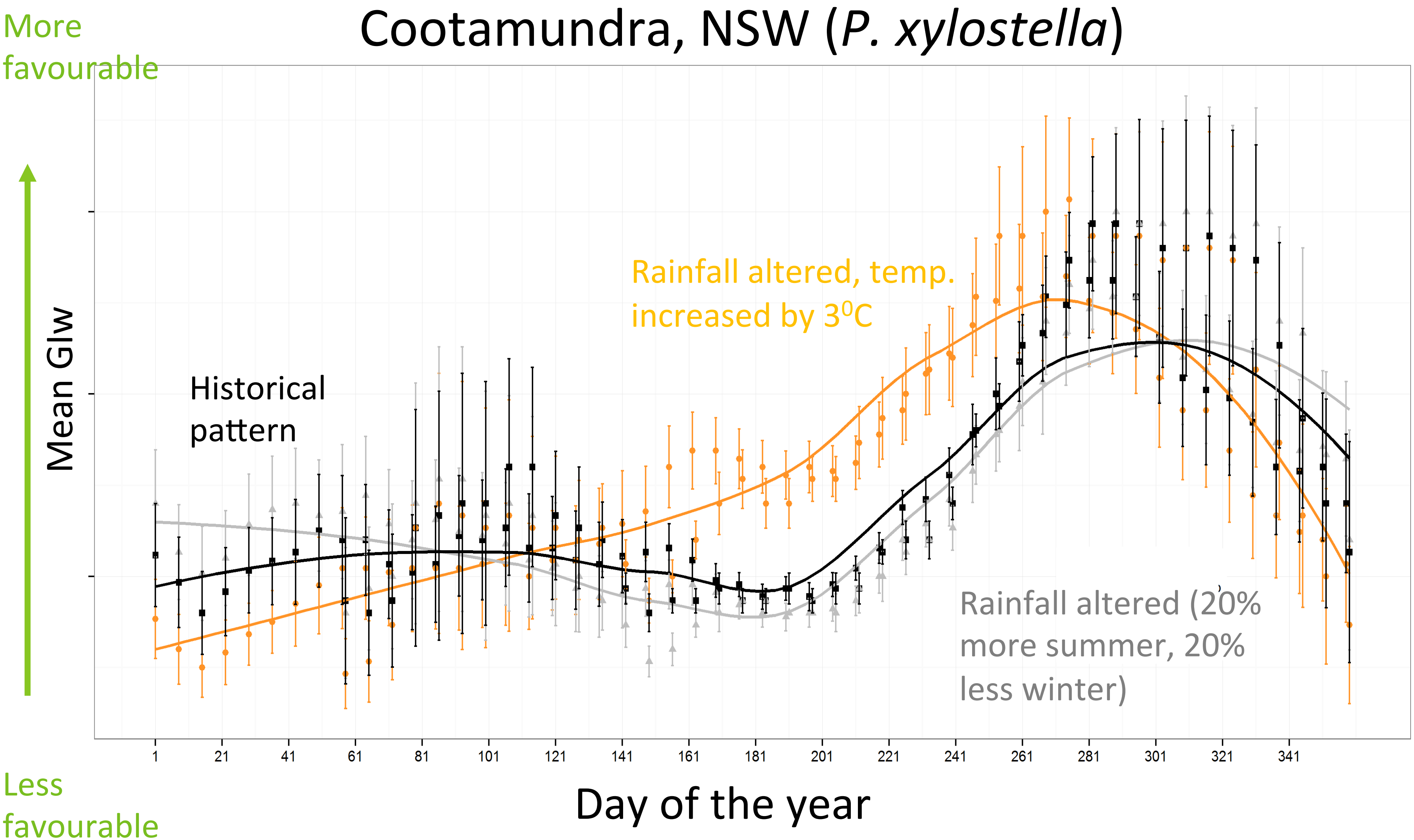


Decreased risk - conditions getting worse for pest

Increased risk - conditions getting better for pest

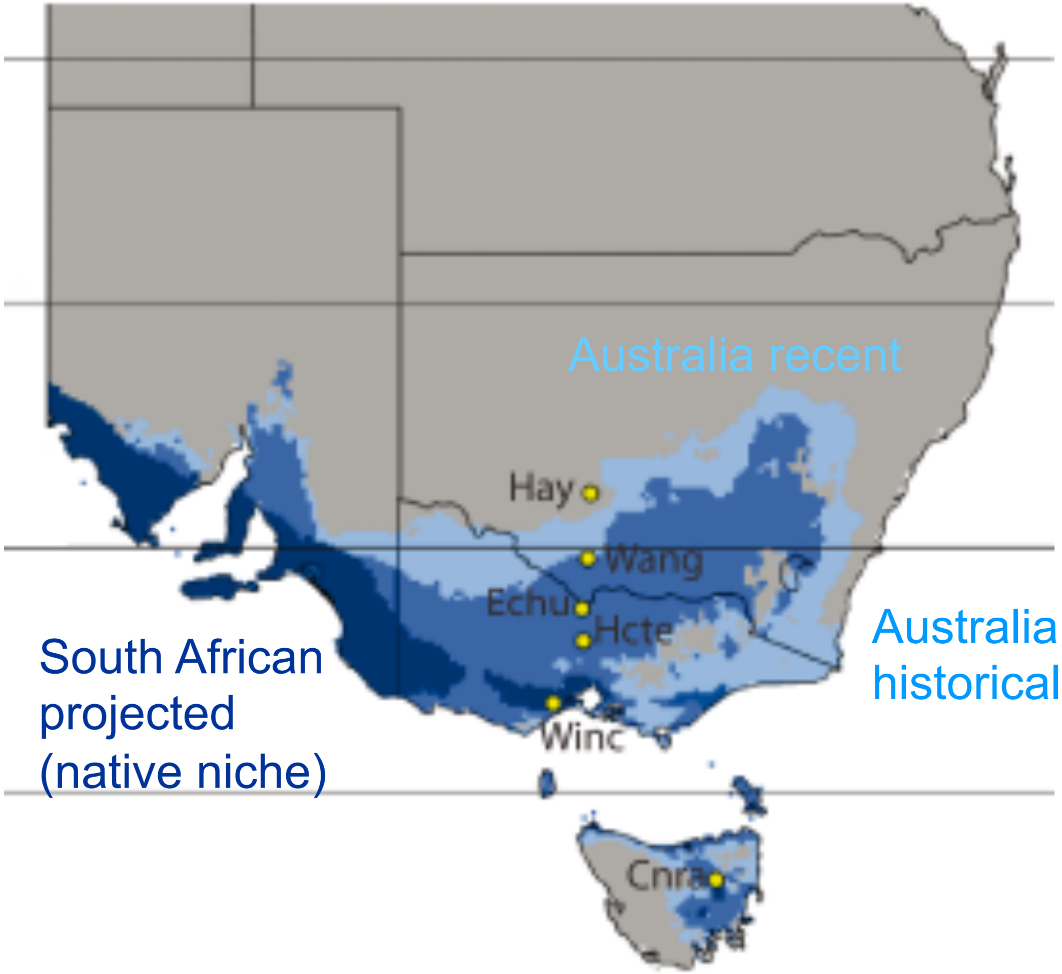
Change in the suitable conditions for year-round growth of *P. xylostella*
A1B and consensus areas between two GCMs (CS and MR), historical versus 2090

2. Altered phenology – interaction of rainfall and temperature



3. Adaptive capacity of pests

Halotydeus destructor



Australian populations:
Increased upper thermal threshold for movement
Recover from cold stress more quickly

Hill et al. (2013) A predicted niche shift corresponds with increased thermal resistance in an invasive mite, *Halotydeus destructor. Global Ecology and Biogeography, 22: 942-951.* Hill, et al. (2012) Understanding niche shifts: using current and historical data to model the invasive redlegged earth mite, *Halotydeus destructor*. Diversity and Distributions 18, 191-203.

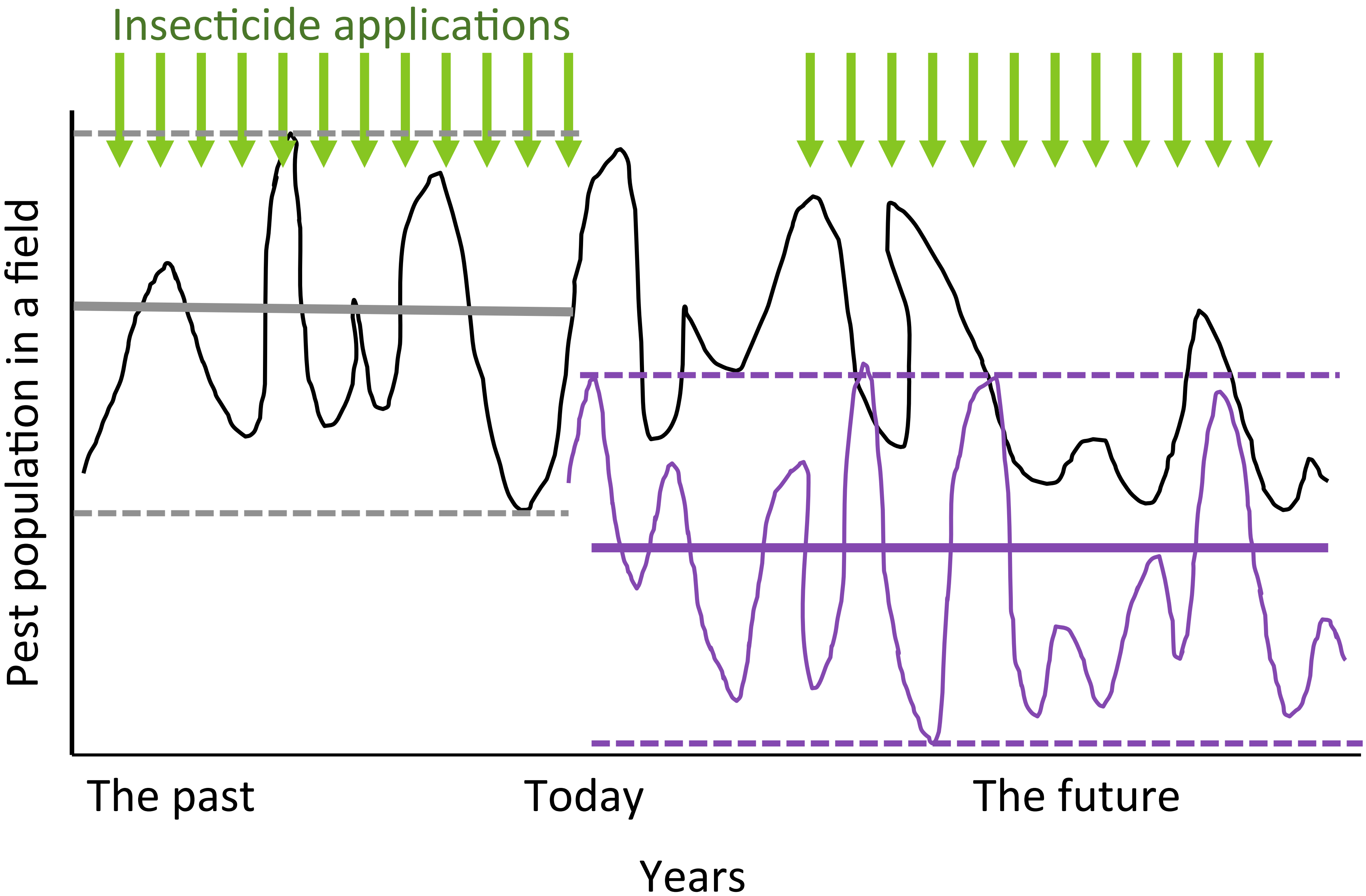
Discussion areas

- Adaptive capacity of pests and natural enemies – do we understand enough?

- The current way we manage pest outbreaks is maladaptive under more variable environmental conditions.

- A reduction in pest risk across time is just as difficult to manage effectively as an increase in pest risk.

Insecticide-use in the face of uncertainty



Acknowledgements
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Thank you

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REACCH
Regional Approaches to Climate Change –
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Thank you!

University of Idaho

Washington State University

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

Oregon State University OSU

CHS

Pacific Northwest Farmers Cooperative

Monsanto