Spotted Wing Drosophila: where will this world citizen make its next travel destination?

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Project update for 'Improving the biosecurity preparedness of Australian horticulture for the exotic Spotted Wing Drosophila (Drosophila suzukii)' MT17005

The spotted wing drosophila (SWD) is a global pest of soft fruit industries and the subject of a current Hort Innovation funded biosecurity project led by Plant Health Australia, in collaboration with *cesar* and Plant and Food Research NZ. The SWD is not found in Australia, but recent incursions in the United States and Europe have raised concerns about the production impact if this fly were to breach Australian borders.

Late last year the project team ran information sessions in soft fruit growing regions around Australia. Since then we have been further developing our understanding of the SWD and the risks posed to Australian growers by this pest. Part of this research includes developing models that predict the rate of spread and likely regions for establishment in Australia. Using these models, we are able to identify probable entry points into Australia for the fly and the potential impacts for our soft-fruit industries if establishment were to occur. The information generated from the models can then be used by government and industry groups to direct surveillance activities aimed at early detection of the pest. So, while building accurate prediction models is a complex business, understanding how these models work and what they are saying is important if we are to be best placed to respond to exotic threats.

On the following page, we have broken down this model-building process and will show you how we develop accurate predictions for exotic pest incursions. As you can see from our recipe for cooking up a SWD establishment model, there are a few steps. Let's look at this process in some more detail.

Establish initial parameters for growth

In building a model of SWD establishment we first start with what we know about the pest biology and the response of SWD population growth in different climates.

By determining climatic growth parameters, we are able to map SWD establishment potential according to global climate data. Taking a look at the map in Figure 1 on PAGE 22, we see that based on a purely climatic perspective, temperate regions offer the most attractive conditions for population growth of SWD.

Note: while the climatic growth rate provides an indication of optimal conditions for population expansion (10°C – 25°C), this doesn't mean the SWD can't survive short-term fluctuations below or above these temperatures. Overseas studies have shown that the SWD can be found to survive in locations where temperatures go up to 43°C or below zero.

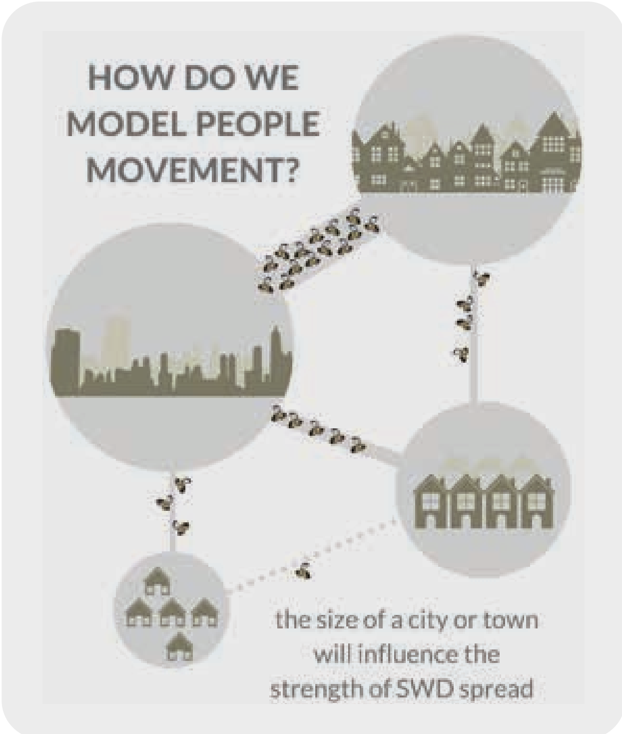
Add additional elements to the model

Okay, so we have climatic growth parameters, which is exciting, but don't get too giddy just yet. While this gives us a basic model for predicting habitable regions for SWD populations, to really understand how well this fly would likely spread across Australia's production zones we need to dig a little deeper. We know from the scientific literature on pest population movements, that there is more to geographic species expansions than just climate.

Developing a more nuanced and realistic model means incorporating landscape level variables such as seasonality, human population density (nearby cities, towns or roads that would enable the fly to hitch a lift), host density (delicious fruits to snack on), and dispersal methods.

Unfortunately for containment strategies, this little fly likes to hop rides in fruits carried by helpful humans and in cargo (particularly on trucks, planes and ships). As a result, cities and large regional centres can often act as entry and dispersal points in the spread of the SWD. This means that our model needs to account for short-range dispersal (all that wing flapping) and long-range dispersal (hitching a ride).

We also need to account for something called the 'Allee Effect'. This stipulates the minimum number of individual flies that need to be present in a specific location for establishment to occur. This might sound complicated, but it basically boils down to a numbers game – individual survival and reproduction depends on the presence of others of the same species.

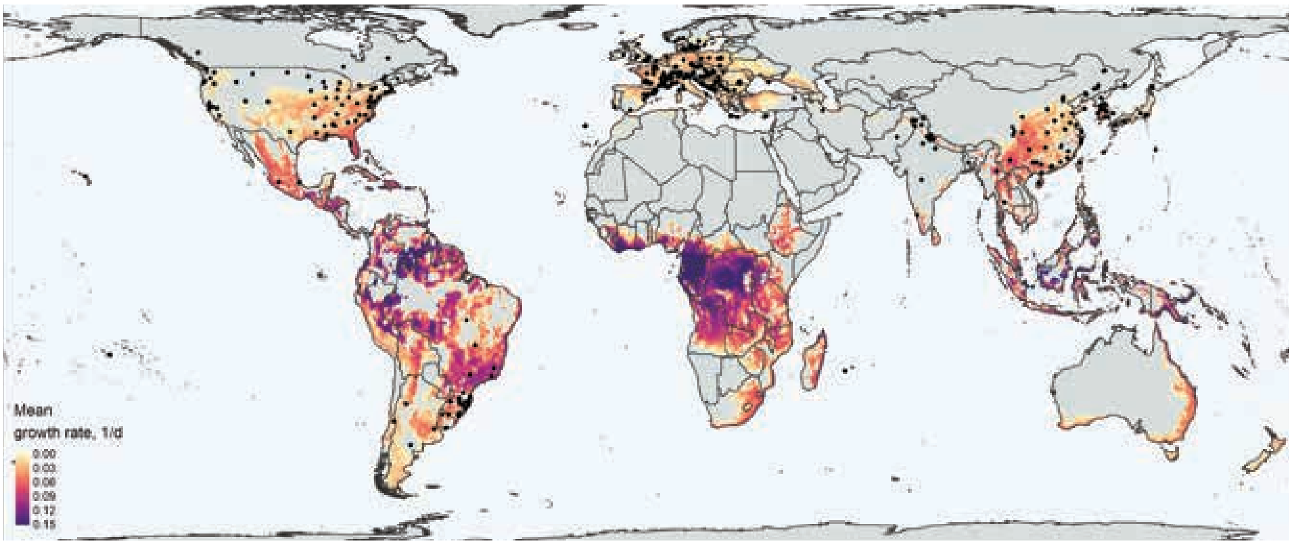


Test the model

So now we have our model with all the nitty gritty details included (phew!). But does it stack up? To test the strength of our predictions, we validate the model against data for known dispersal patterns across affected regions in Europe and the United States. By mapping our spread predictions against documented population movements over time, preliminary testing of our establishment model has indicated an accuracy rate of 75-85% - we think that's pretty darn good!

FIGURE 1

Mean growth rate potential for SWD based on climate *Source: James Maino, cesar*



Make predications

Having validated our model, the next step is to apply this to the Australian context. To make predictions about what production regions would be hardest hit by this species we simulate entry of the fly into Australia at different locations. The prediction map in Figure 2 assumes an incursion in Cairns and spread over ten years. Under this scenario we see that establishment would be most likely along the east and south-east coast of Australia where appropriate climatic conditions combine with large amounts of human movement and susceptible crops.

We have also used the model to test what would happen if other cities are the entry point (Brisbane, Adelaide, Darwin, Bundaberg and Melbourne). Despite slight variability, establishment was similar across the different entry points modelled, although Cairns was the only entry point that predicted a resultant establishment threat in Western Australia.

Note: While host densities were considered when building our models, our ability to account for their impact on likely establishment patterns was limited by data availability. For instance, the wild blackberry is a noxious weed throughout Australia and potential host for the SWD. However, due to lack of available data we were unable to include the impact of this host on establishment.

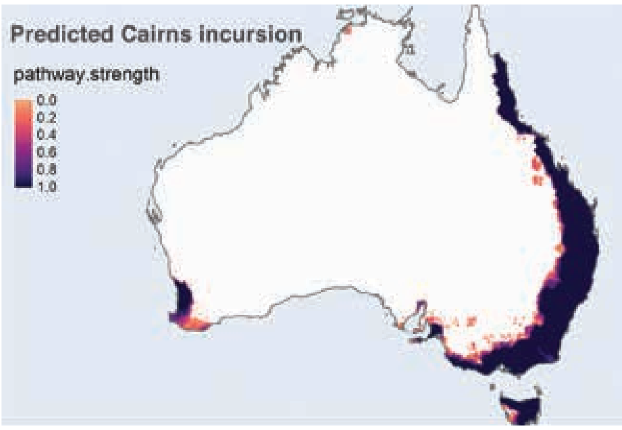


Figure 2.

Predicted establishment using expected dispersal pathways for a Cairns incursion scenario. *Source: James Maino, cesar*

The predicted impact on host crop groups

Now we can make predictions on the establishment potential of SWD in Australia, we also want to know what this means for Australian growers. Who's at risk? And, if SWD were to establish, how big an impact can we expect?

To understand what industries are most susceptible to SWD, we again look to international research. The empirical data indicates a level of variability in production losses depending on region, variety, and management practices.

While losses in the US and Europe as high as 80% have been reported among *Rubus*, strawberry and cherry crops, production losses of 20-40% on affected farms are more common. The average production loss for affected raspberry crops tended to be highest (35% loss), however this was also subject to significant variability. The research also shows that the most affected industries (based on the number of documented incidents) are blueberries, followed by raspberries, blackberries, strawberries, table grapes and sweet cherries.

Mapping the overseas production impacts against our establishment model and affected commodity distributions, the results indicate an economic risk to most major soft fruit growing regions if SWD establishment were to occur in Australia. The modelling also indicated that attempts at eradication after establishment at a suitable location would likely have low rates of success due to rapid population growth and movement.

*Infographic displays the number of SWD reports per crop identified during review of the literature. Data source: James Maino et al, 2019. [unpublished] Data sourced from European and United States primary reports.

So, is there any hope?

SWD is yet to reach Australian shores and our geographic isolation and border control efforts provide protection. However, given the fast spreading and invasive nature of this pest, developing targeted biosecurity measures and proactively developing a contingency plan is crucial. Industry awareness and on-farm monitoring in susceptible crops will support early detection. A detection made soon after the pest has arrived will give biosecurity authorities a better chance of eradicating the pest. As eradication will be difficult once establishment has occurred, early detection of the pest will be important for actioning effective management strategies.

What next?

Best methods of monitoring, a further look into SWD biology, and best management techniques will be the focus of our next project update and *cesar* is currently developing guidance material for growers with advice on identification and crop monitoring techniques. So keep an eye on this space as well as your crops!

If you are looking for more information on the morphology and life cycle of the spotted wing drosophila, have a read of our last project update on the *cesar* website: http://bit.ly/SWD-SUM-19.

Importantly, to best protect Australia from this pest it will require a whole industry approach.

So if you see anything unusual call the Exotic Plant Pest Hotline on

1800 084 881

Plant Health Australia, *cesar*, and Plant & Food Research NZ, with support from Hort NZ, are working together on a spotted wing drosophila (SWD) research and extension initiative. This is a collaborative project between Australia and New Zealand, and the aim is to increase how prepared horticultural industries are to detect, respond to, and manage this fly if it were found in either country.

This project has been funded by Hort Innovation, using the raspberry and blackberry research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

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