Informing Qfly management strategies using spatially-explicit simulation modelling

Schwarzmueller, F., Parry, H. & Schellhorn, N.A.

florian.schwarzmueller@csiro.au

SITplus

Introduction

Knowledge about the distribution and abundance of Queensland Fruit Fly (Qfly) in space and time has been generated over decades and is still accumulating. However, translation of this knowledge into possible management actions is still complicated because of various reasons:

1) Gaps of knowledge about the movement of Qfly in a complex landscape
2) Unknown effectiveness of management actions (including Sterile Insect Technique)
3) Context specificity of management actions (uptake rate amongst farmers, differences between agricultural and urban areas)

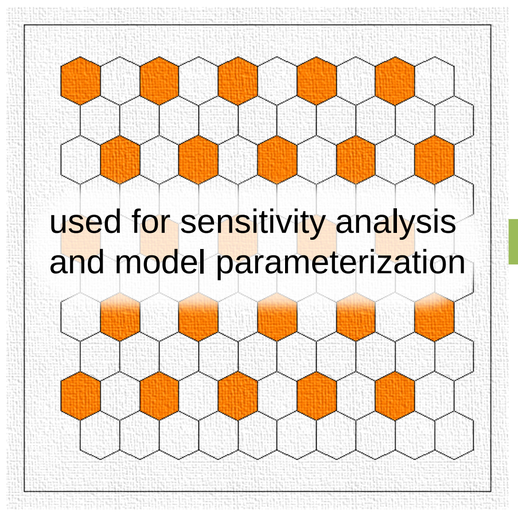
Spatially-explicit simulation modelling can help bridge the gap as it can (i) scale up existing knowledge to level of higher landscape complexity, (ii) identify the sensitivity of outcomes towards certain parameters and assumptions, and (iii) explore different ecological as well as management scenarios.

Methods

Fly parameters
number of eggs laid (per day)
development time
daily adult mortality
dispersal

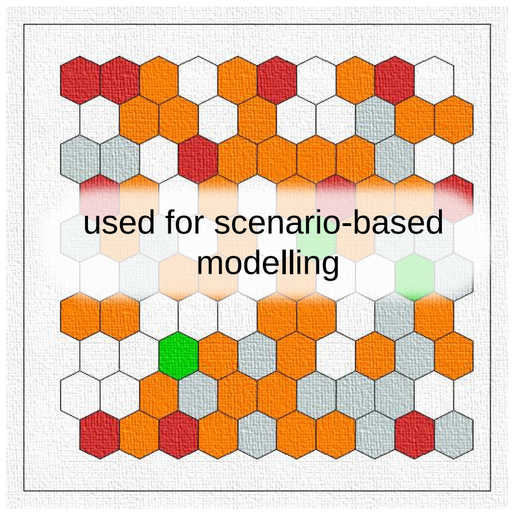
Commodity parameters
location
seasonality
fruit density
egg-carrying capacity of fruit
developmental success
oviposition likelihood
patch hostility

simple landscapes



Citrus, Pasture

complex landscapes

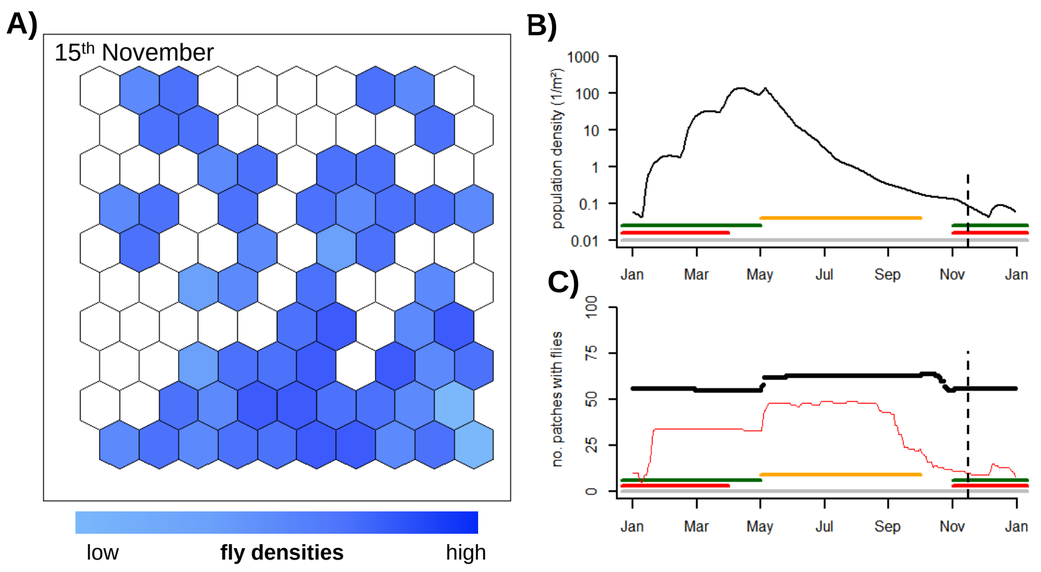


+ information about host distribution in case study areas

Citrus, Stonefruit, Grapes, Urban, Pasture

Results

The outcome of the model is a simulated fruit fly distribution in time and space.



A) Example of a simulated fly distribution in a complex landscape (see methods) for mid November.
B) Simulated population densities in flies per m² in the whole landscape over time.
C) Spatial extent of the population over time. The black dots are the number of patches that have any flies whereas the red line shows the number of patches where there are enough flies to actually be detected in traps. The colored lines at the bottom indicate the fruit availability in different land-use types (orange= Citrus, red= Stonefruit, green= grapes, gray= urban). Dashed lines indicate the timeslice presented in **A)**.

Scenario-based modelling can explore the effect of different management strategies on these distributions.

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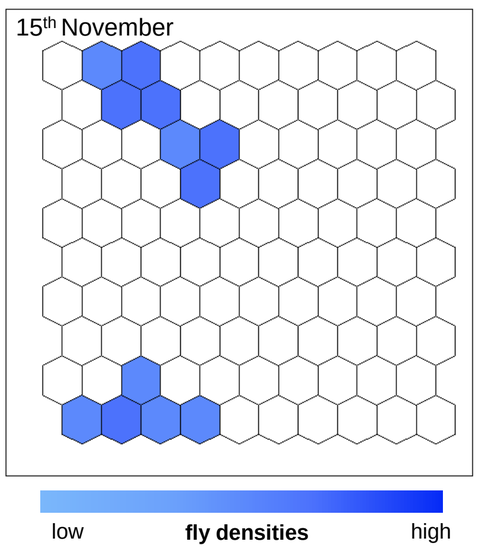
management
spatial extent
duration
effectiveness
mechanism

Outcomes of management scenarios will help to inform guidelines of Area-wide Management (AWM).



Example of a simulated fly distribution in the same landscape, at the same point in time, after management. This example shows the effect of „hot-spot sanitation“ which means taking out fallen fruit in highly infested areas to reduce adult emergence. This has the potential to bring populations down to levels where SIT might be cost-effective

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