Modelling the spread and control of *Xylella fastidiosa* in the early stages of invasion in Apulia

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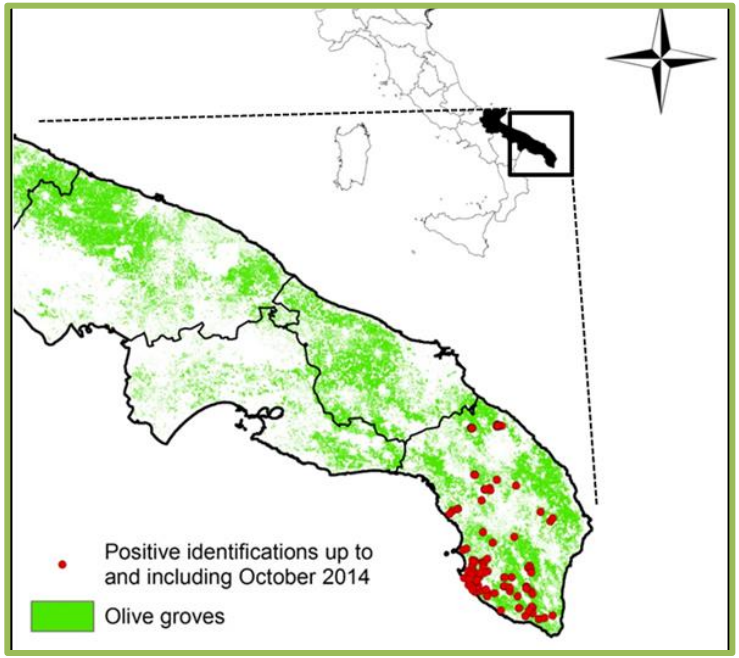
efsa European Food Safety Authority
Universitat de les Illes Balears
European Commission
POnTE Pest Organisms Threatening Europe
XF ACTORS
Euphresco

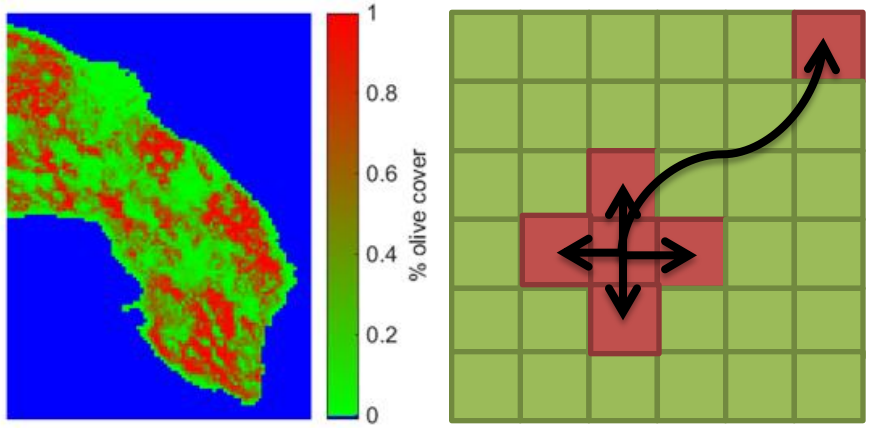
The Question

- Can we create models to predict how *Xf* is spreading?
- If we can do that, then
  - Can we inform control policies?
  - Can we guide surveillance?



Initial Model

- Initial approach was to use a simple model
- The model has 3 components
  1. Olive map (1km)
  2. Infection growth (yearly)
  3. Disease spread



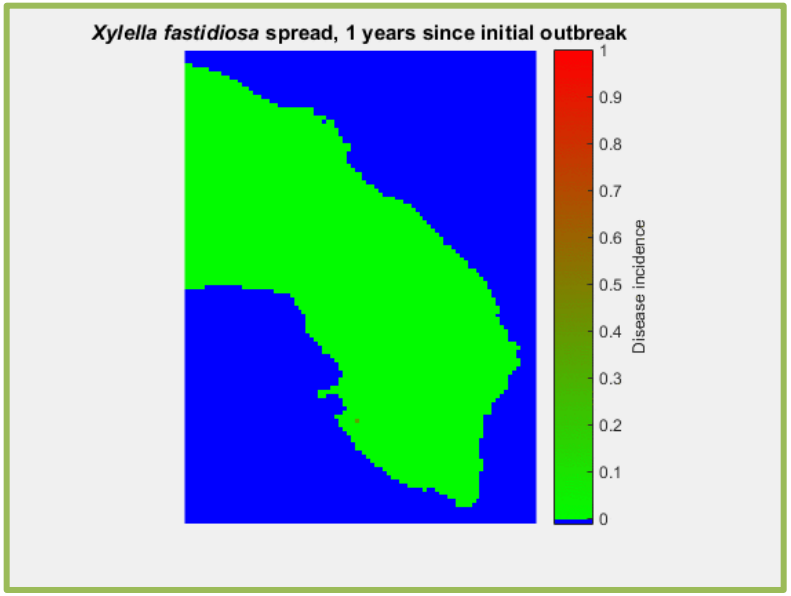
$$N_{t+1} = K\left(\frac{N_t}{K}\right)^{e^{-A}} =: f(N_t)$$

Carrying Capacity → $K = \Phi + a(1-\Phi)$

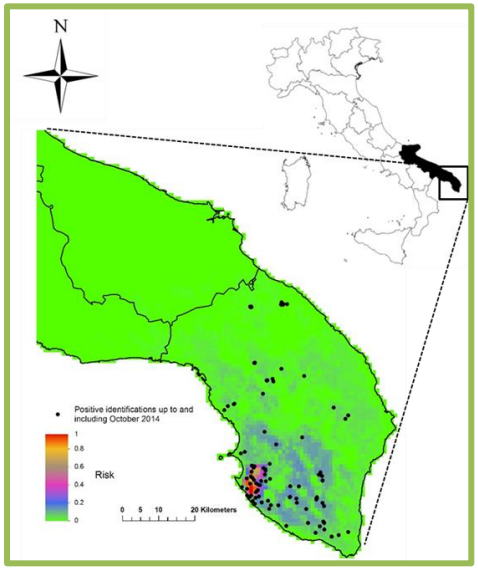
Φ: Olive Cover; a: Other Host Plants

$$N_{t+1}(x,y) = \sum_{i=1}^{n}\sum_{j=1}^{m} k(x-i, y-j)\, f\left(N_t(i,j)\right)$$

How Well Does the Model Work?



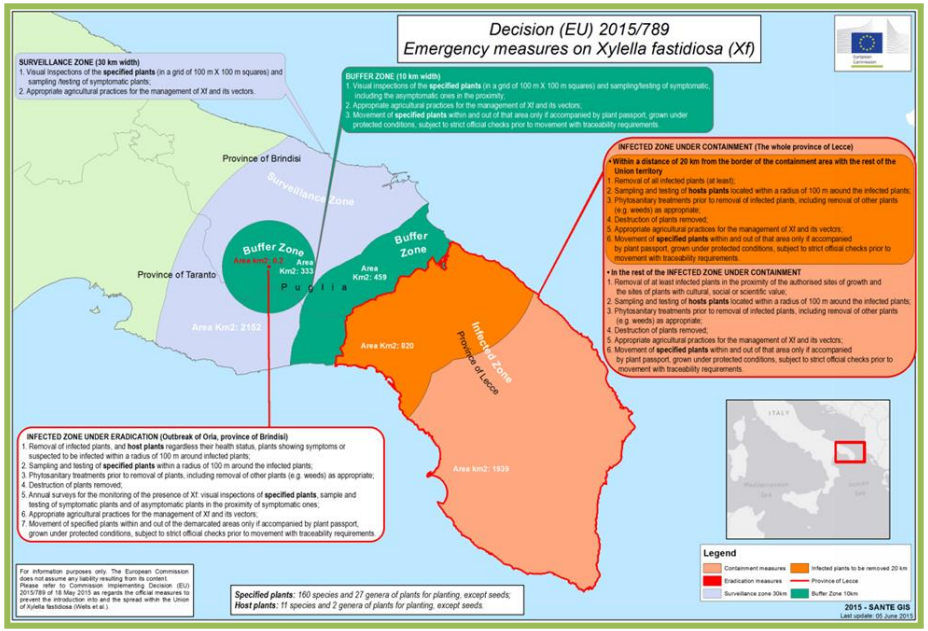
- Use the model to predict "risk" in the region
- Data and model are stochastic!
- Model predictions closely resemble data (Boyce index, B=0.951)



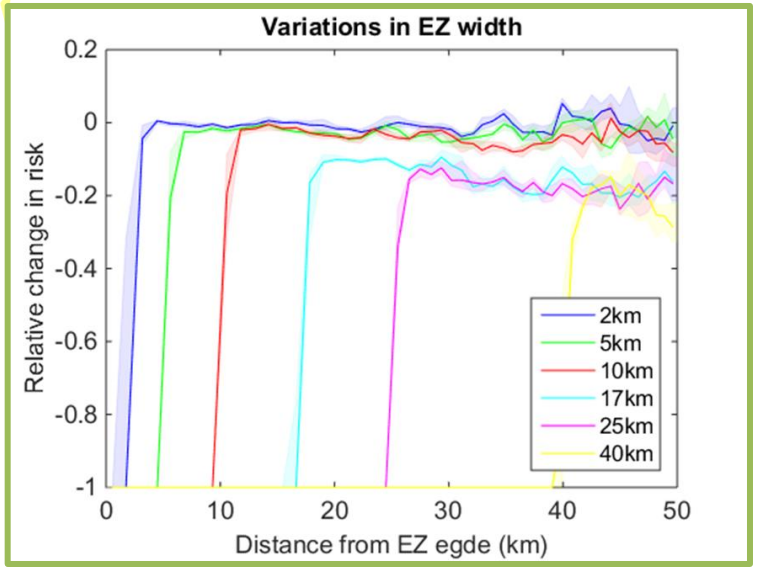
White et al. Biol Invasions (2017) 19: 1825. https://doi.org/10.1007/s10530-017-1393-5

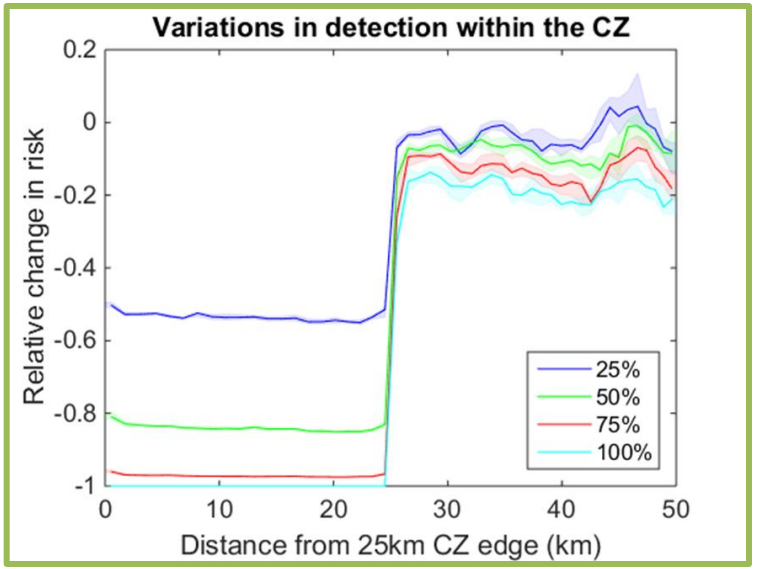
Buffer Zone

- Model the buffer zone by removing infected trees within the zone
- Will the buffer zone stop the spread of Xf?
- How wide should the buffer zone be?



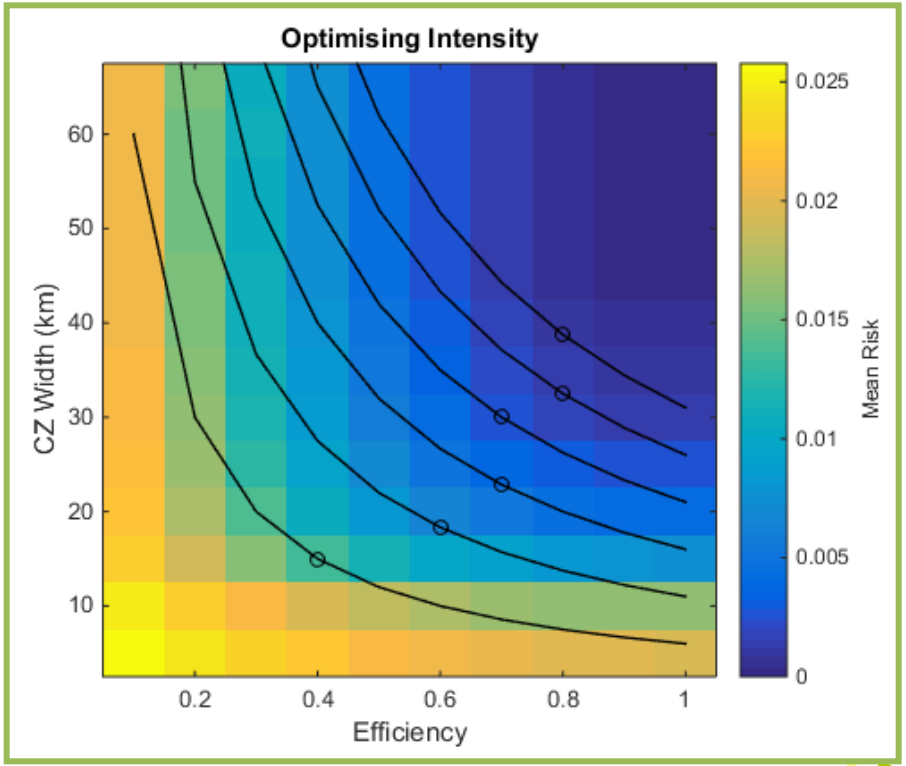
Buffer Zone Efficacy



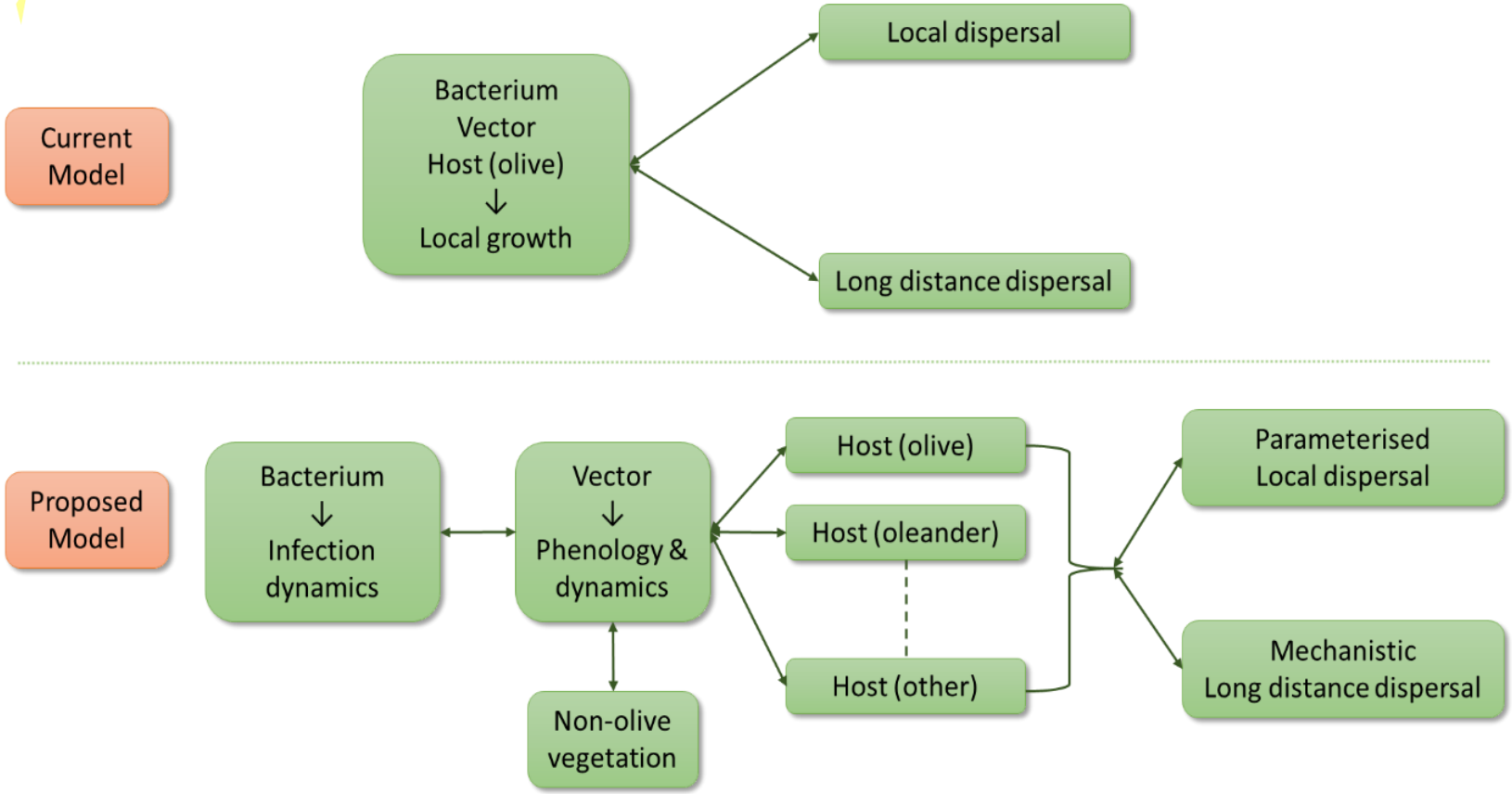


Optimisation

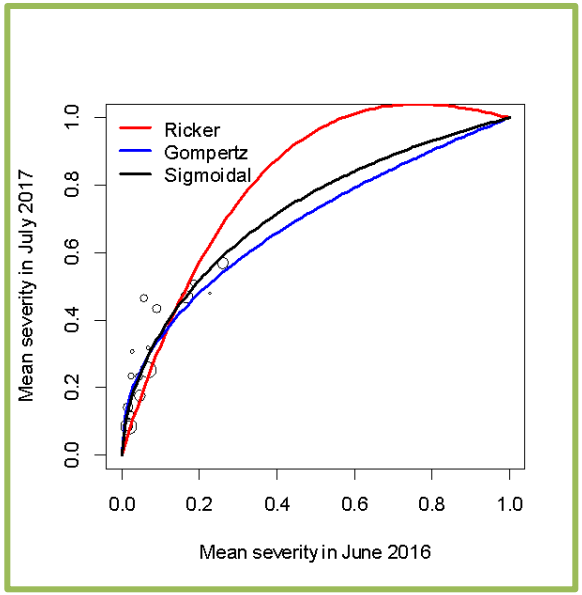
- What's better, increase buffer zone width or surveillance effort?
- Depends on your budget!
- Better to increase buffer zone width as the budget increases



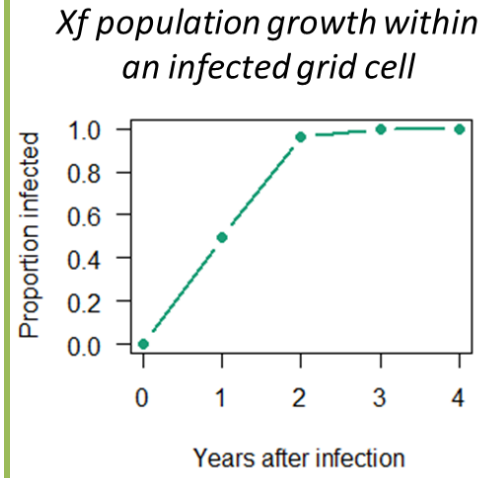
Developing The Model In XF-ACTORS



Improving Local Growth Model



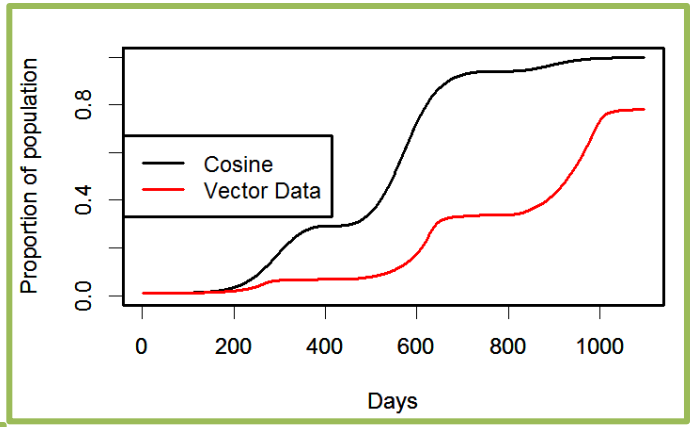
Data provided by Navas-Cortés

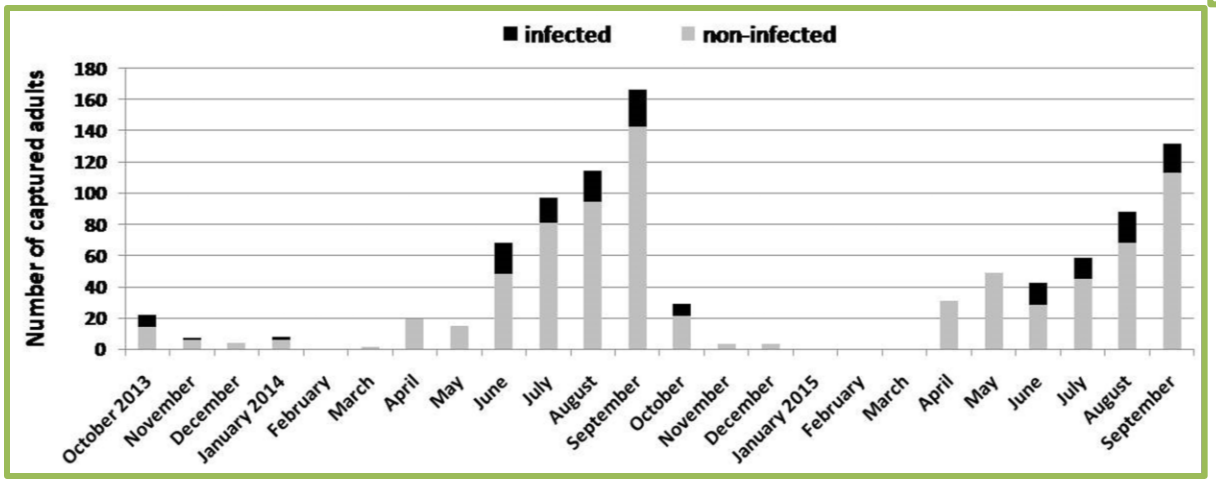


- Use severity data to parameterise growth
- Will be used in higher spatial resolution spread model
- Analysing the data to understand pruning

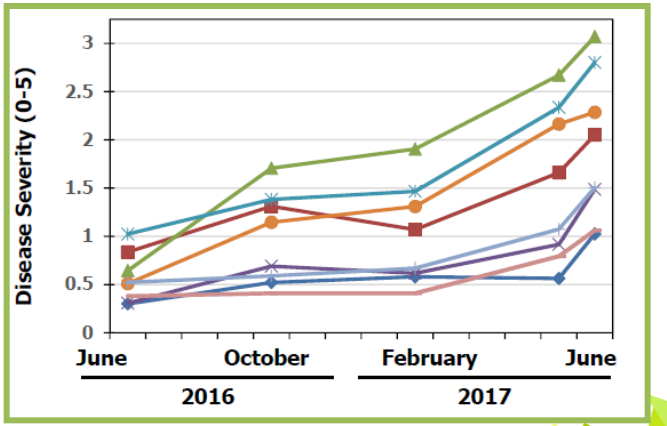
Vector Seasonality

- How does vector seasonality affect disease dynamics?
- Is disease severity seasonal?
- If so, what is the cause?





Ben Moussa et al 2016



Provided by Navas-Cortés

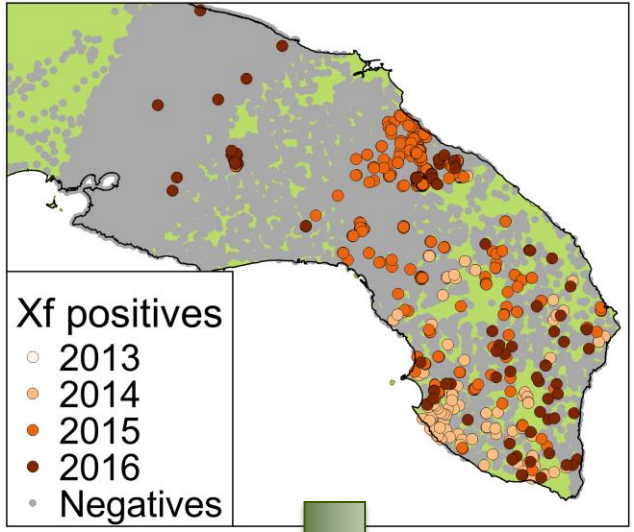
Dispersal

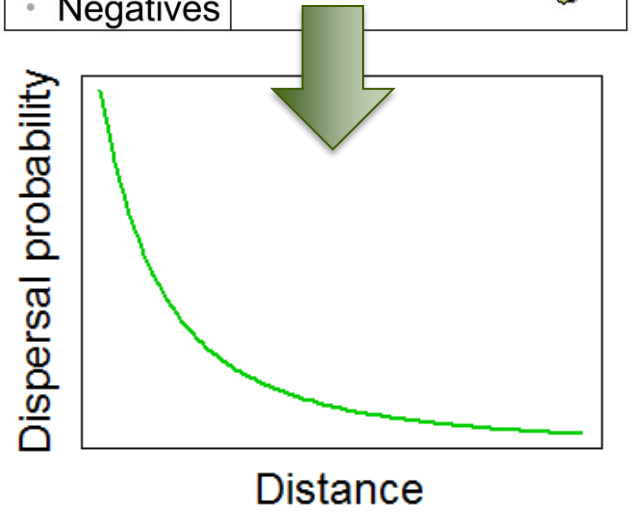
Spatio-temporal modelling of disease spread using the Xf sampling data:

- Dispersal kernels
- Influence of other factors (e.g. human activity)

Very preliminary analysis…
More positives:

- Near positives from earlier years
- Near positives from current year
- Near (but not too near) major roads
- Mixed land use rather than olive groves





Other

Data Needs

- Other hosts
- Within-host infection dynamics
- Transmission/ asymptomic lag
- Vector dispersal
- Human movement

Further Work

- Local spread model
- Surveillance
- Increased spatial and temporal resolution
- Calibration
- Control strategies
- Eradication?

Acknowledgements

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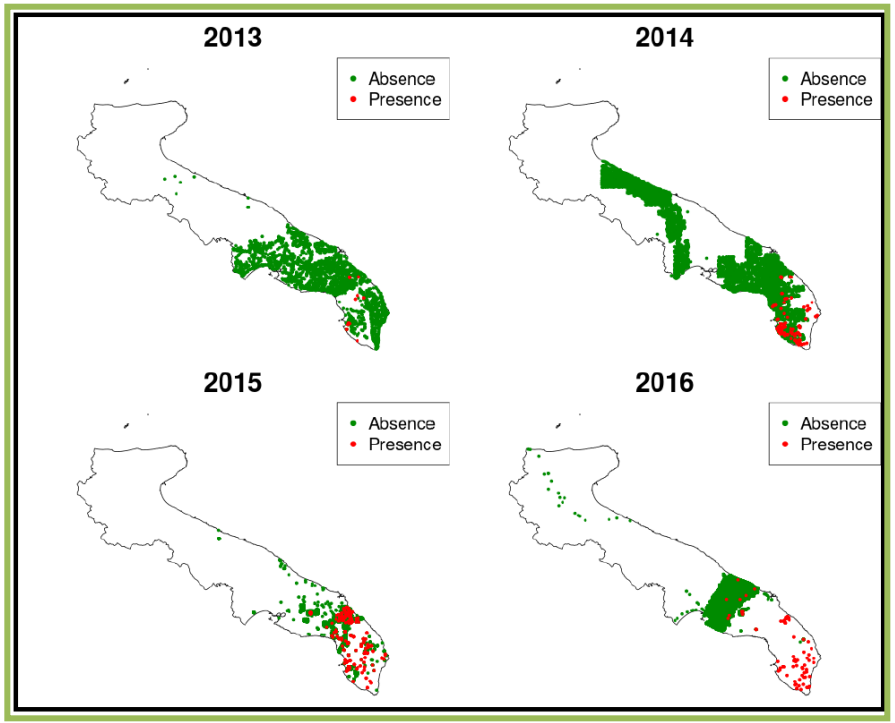

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