Identification and potential uses of spatial patterns for predicting pest species outbreaks

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Asynchrony of populations in time

Sherratt & Smith, 2014; Lambin et al, 1998
Spatio-temporal asynchrony

Looking at larger areas relative to pattern yields greater complexity

Johnson et al, 2014; Berthier et al, 2014; Sherratt & Smith, 2014
Invasion of Spain!!
(By common voles)
85.555 transects from 94.000 km²

Outbreak crash

Full outbreak

“Drought” outbreak

\[ R_t = X_{t+1} - X_t \]

\[ X_t = \log(\text{Mean Index}) \]

\[ X_{t+1} = \log(\text{Mean Index}) \]

JANUARY  FEBRUARY  MARCH  APRIL  MAY  JUNE

JCyl hazte cargo de lo que estás sembrando
How to characterise [a]synchrony

An example with a completely random population
How to characterise [a]synchrony

An example with an asynchronous population

Distance between two points (km)

Departure from regional correlation

λ
Synchrony of growth at low density!
Complex patterns at high density:
Anisotropy, wave-like patterns and gradients
Is there any consistency in the patterns?
Rich pattern leads to complexity
• No large scale synchrony despite large scale data

• Complex, time-varying spatial patterns in growth rate;
  • Directional and wave like at times
  • Related to \( N \) following period of high \( R \)?
  • Large scale stochastic events disrupt patterns?

• What about mechanisms?
  • Mobile predators can possibly drive patterns
    • Steep gradients within range of predators

• Implications for predictions?
  • Work towards outbreak detected in Location A
    allowing prediction of time till outbreak in Location B

Why is this important?
Acknowledgements

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