Forest Health Cooperative Annual Meeting - FY2021

Pine Needle Study Update

Presented By

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Committee Members

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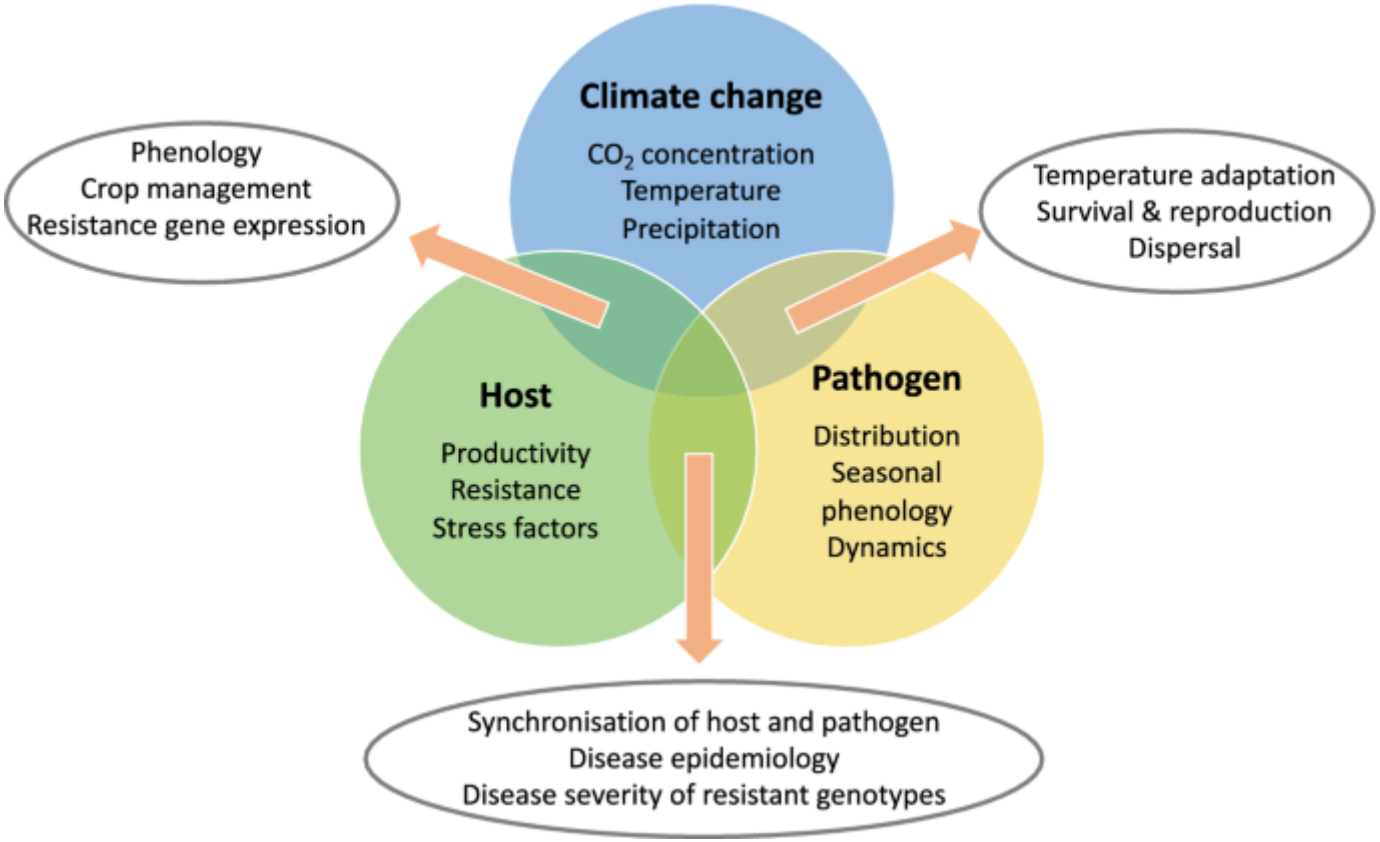
Prediction of Loblolly Pine Defoliation Severity associated with Changes in Pathogen Pressure in response to Climate Change in the Southeastern USA



Introduction

Needle disease and host susceptibility

- Climatic factors (temperature and moisture)
- Distribution and potential migrations of pathogens
- Spore survival and reproduction

Challenges

- Predictions of pathogen behavior
- High degree of uncertainty
- Long-lived nature of trees vs short life-span of pathogens

Loblolly pine defoliation and tree mortality

- Increased pathogen pressure
- Host susceptibility

Objectives

To determine climatic patterns that might drive the emergence and spread of loblolly pine defoliation

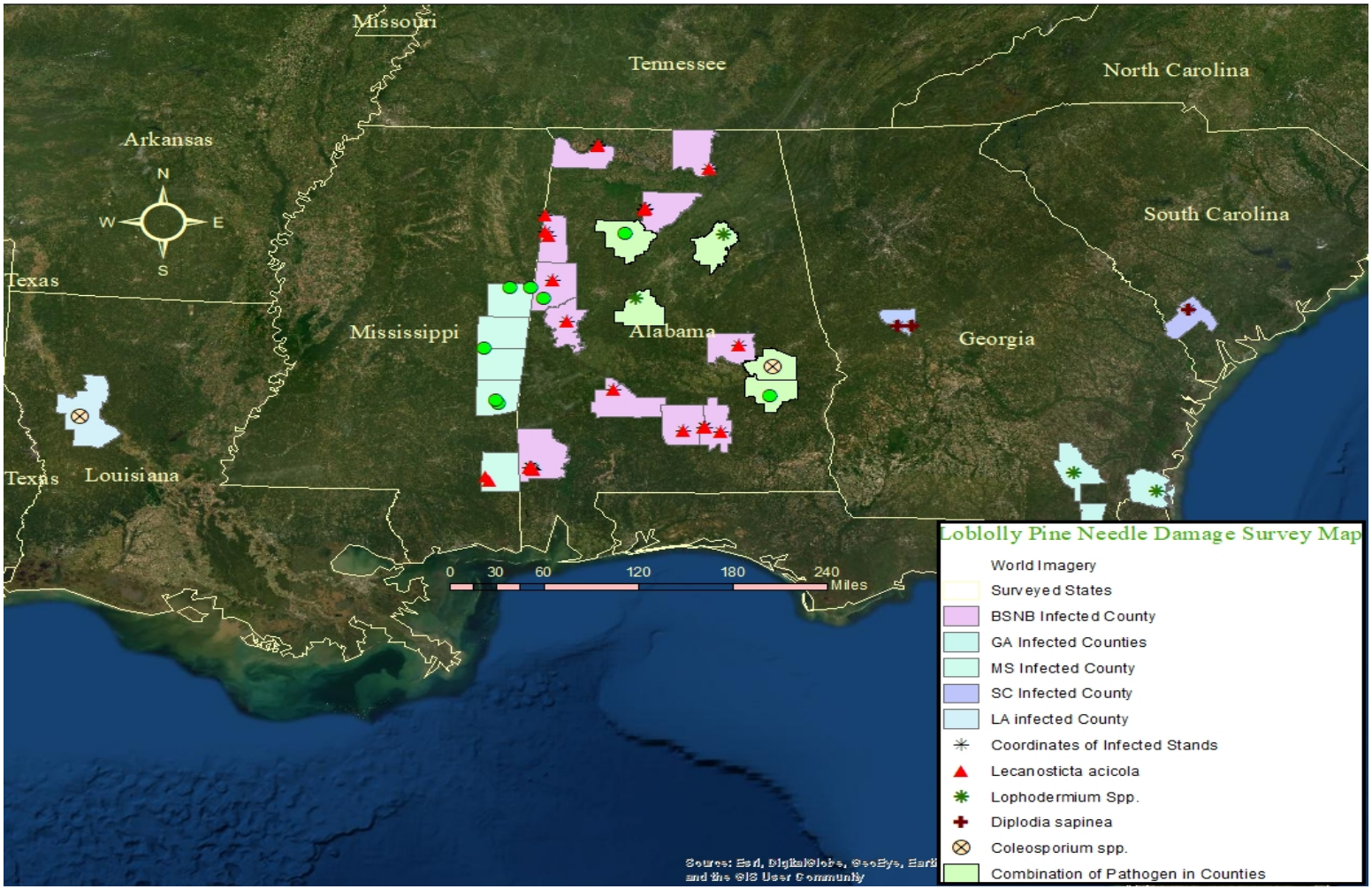
To develop climatic regression models to predict defoliation severity in following years to aid private landowners, forest managers to adjust their management strategies accordingly

Materials & Methods

Visual rating and map of pathogen distribution:

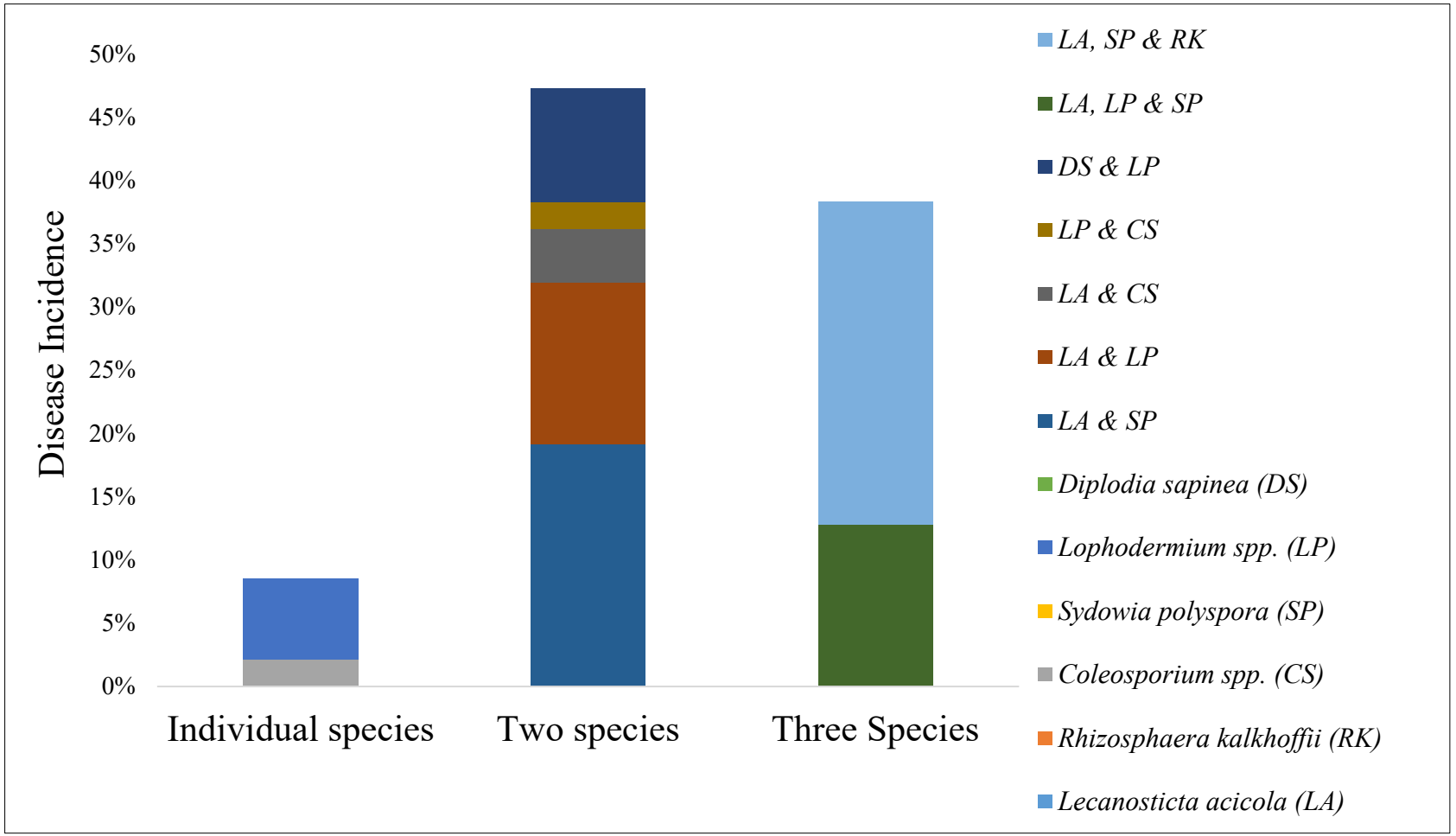
- Data used from presentation I
- Ten miles radius and data availability
- Preceding year climate variables
- NOAA online data
    - Maximum and minimum temperature
    - Sum of precipitation
    - Relative humidity
- Forty-nine variables
- Stepwise regression
- SAS 9.4 version software

Needle Pathogen Distribution



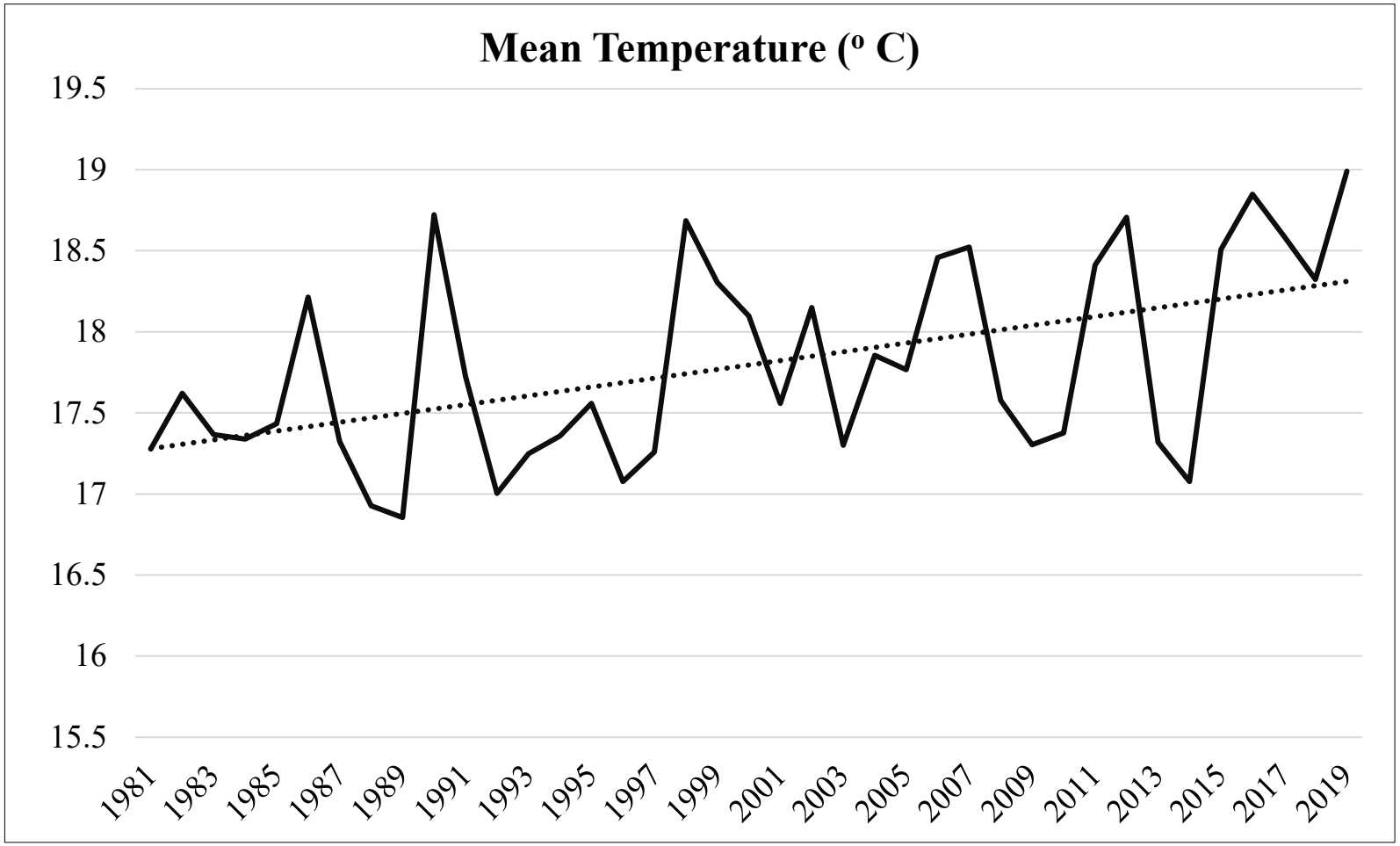
Pathogen distribution map of *Lecanosticta acicola* (LA), *Coleosporium* spp. (CS), *Lophodermium* spp. (LP), *Sydowia polyspora* (SP), *Rhizosphaera kalkhoffii* (RK) and *Diplodia sapinea* (DS)

Needle Pathogen Distribution



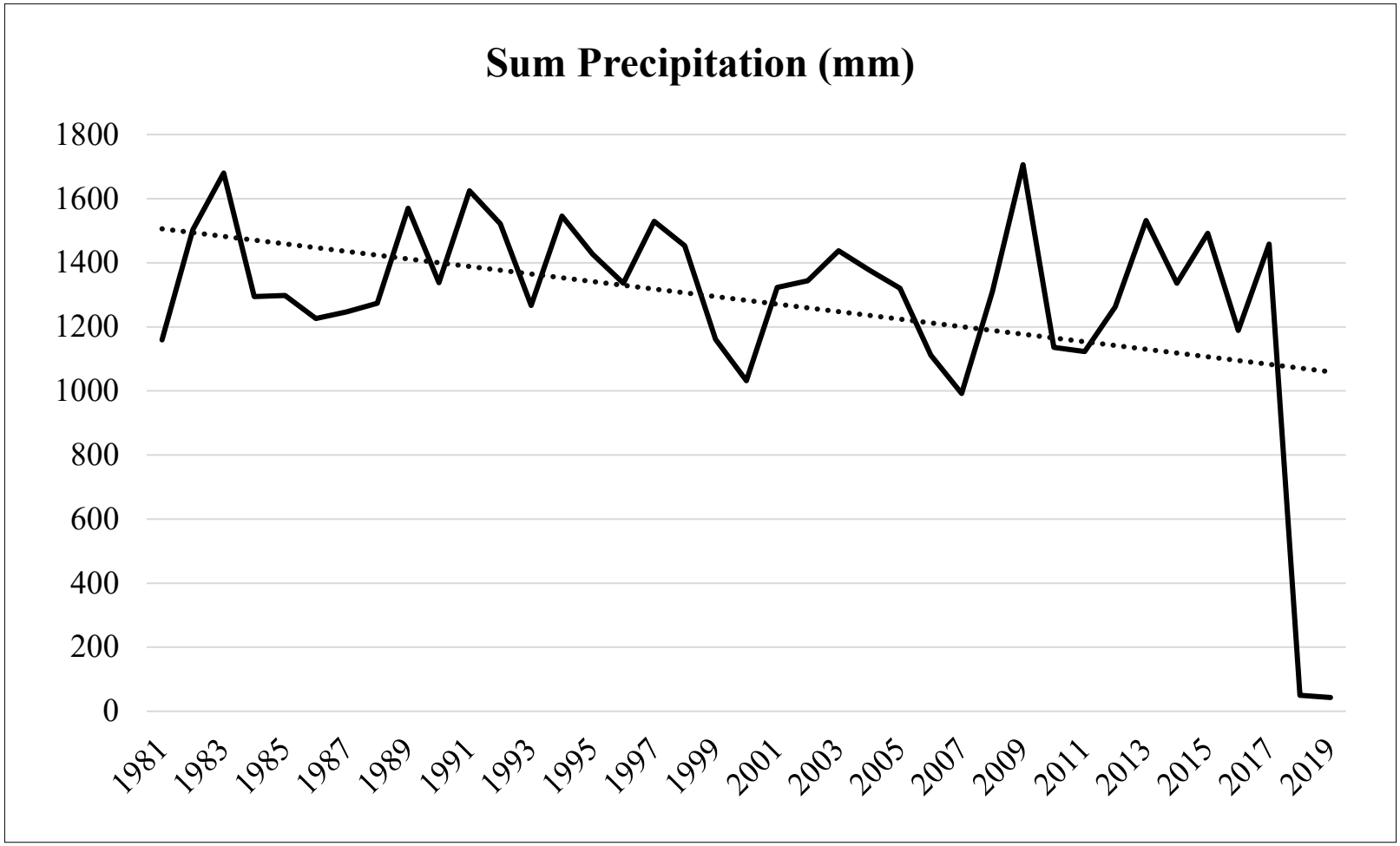
Frequency of *Lecanosticta acicola* (LA), *Coleosporium* spp. (CS), *Lophodermium* spp. (LP), *Sydowia polyspora* (SP), *Rhizosphaera kalkhoffii* (RK) and *Diplodia sapinea* (DS)

Long-term Regional Weather Data



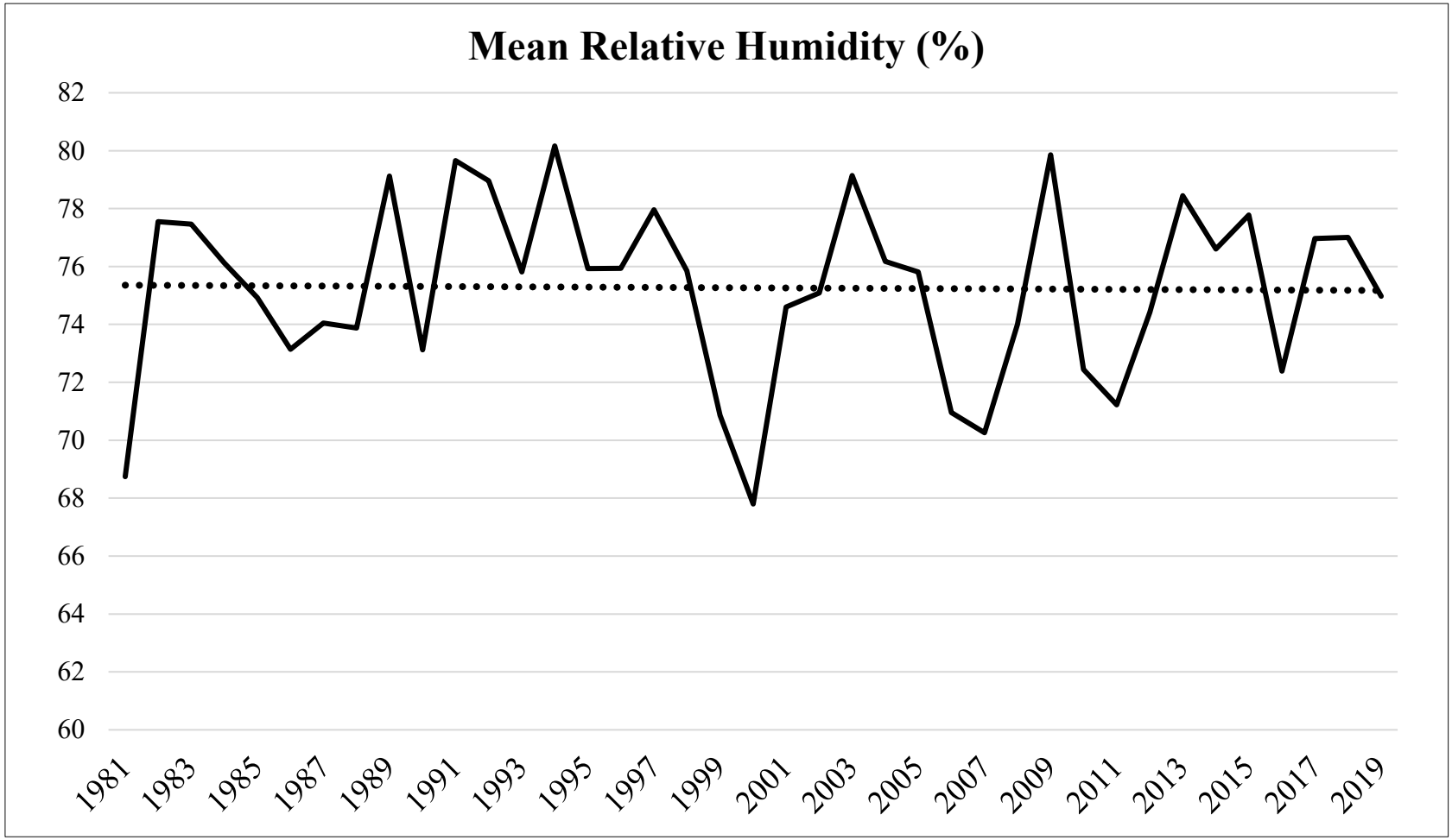
Mean temperature during loblolly pine growing season at 19 infected sites in the southeastern United States

Long-term Regional Weather Data



Sum of precipitation during loblolly pine growing season at 19 infected sites in the southeastern United States

Long-term Regional Weather Data



Mean relative humidity during loblolly pine growing season at 19 infected sites in the southeastern United States

Climatic Regression Model

Model	Variables	Model Prob. > F	Adjusted R^2
1-factor	Min. May T	0.0413	0.2277
2-factor	Modified Spring P, Fall P	0.0010	0.6298
3-factor	Min. April T, Modified Spring P, Fall P	0.0002	0.7725
4-factor	Min. April T, Max. July T, Modified Spring P, Fall P	<.0001	0.8809
5-factor	Min. April T, Max. July T, April P, Modified Spring P, Fall P	<.0001	0.9121

Results

Based on climatic regression models

- Eleven climatic variables identified
- Five variables significantly correlated
- Best model identified
- April, May and July temperature
- April, May, June, July and August precipitation

Discussion

Temperature

- Increase fungal fitness and transpiration
- April, May and July temperature

Precipitation

- Increase fungal growth and spread
- April, Modified spring and fall precipitation

Loblolly pine defoliation

- High density of loblolly pine
- Climatic parameters
  - Summer precipitation
  - Frequency of warm-wet days
  - Overnight minimum and winter temperatures

Conclusions

Loblolly pine defoliation severity

- Changing climatic conditions
- Spring and summer temperature and precipitation
- High-density occurrence of loblolly pines
- Proximity of water body
- Poor drainage
- Wide geographic distribution
- Increasing temperature and precipitation

Future Directions of the Study

Management perspectives

- Development of inoculation protocol
- Resistant loblolly pine families
- Biomarker development
- Long-term monitoring plots

Research perspectives

- Population genetic study
- Whole genome sequence

Finally, LPD must be monitored, forecasted, included in management strategies

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