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# **Influence of climate on tree health evaluated by defoliation in level I network (Romania)**

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# 1. General aspects

- Scientific results on tree forest decline emphasized the following :
  - Accelerated climate change process
  - expansion of the area of pollutants with phytotoxic effects on trees and stands
  - action of pathogen invasive species, altering the physiological growth and development of plants
  - altering the forest structure and its capabilities to produce non-wood products and maintain social and protective functions

# 1. General aspects

- It is well known that climate change, air pollution and other stress factors with cumulated and multiple effects have a considerable influence on forest health status at local, regional and global scales.
- Major consequences of these influences are:
  - rapid shifting of vegetation boundaries at altitudinal levels
  - higher intensity of tree damaging process and of tree mortality and declining of other forest ecosystem parameters
  - threatening of ecosystems biodiversity and forest habitats

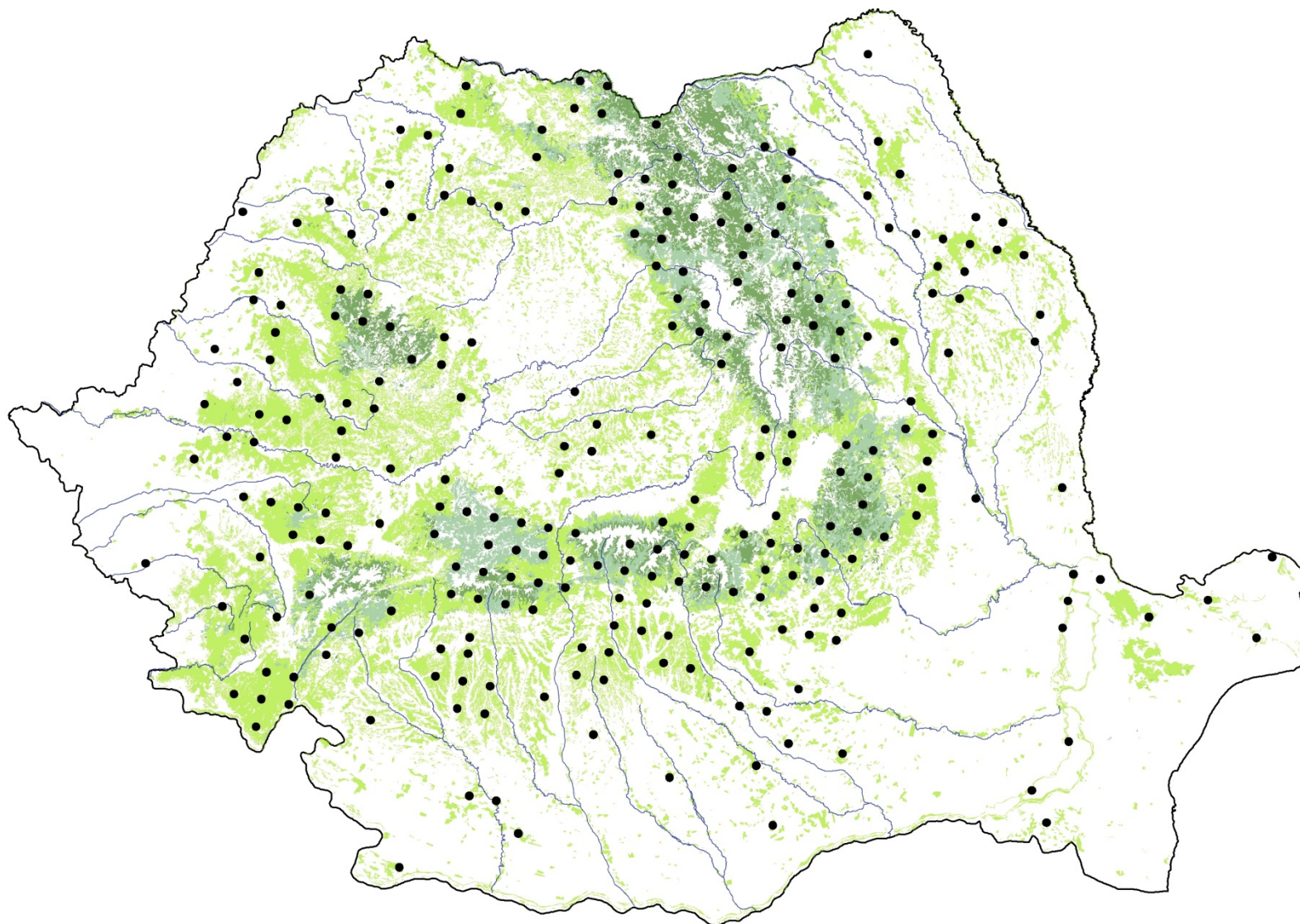
## 2. Study objectives

- Analysing of long- term level I results on defoliation dynamics at national and regional scale by all species, conifers, broadleaves and main species
- Statistical analysis of climate influence (temperature and precipitation) on defoliation in Level I forest monitoring network in Romania
- Regional and species detailed variability on statistical relationship between climate and defoliation

# 3. Methodology

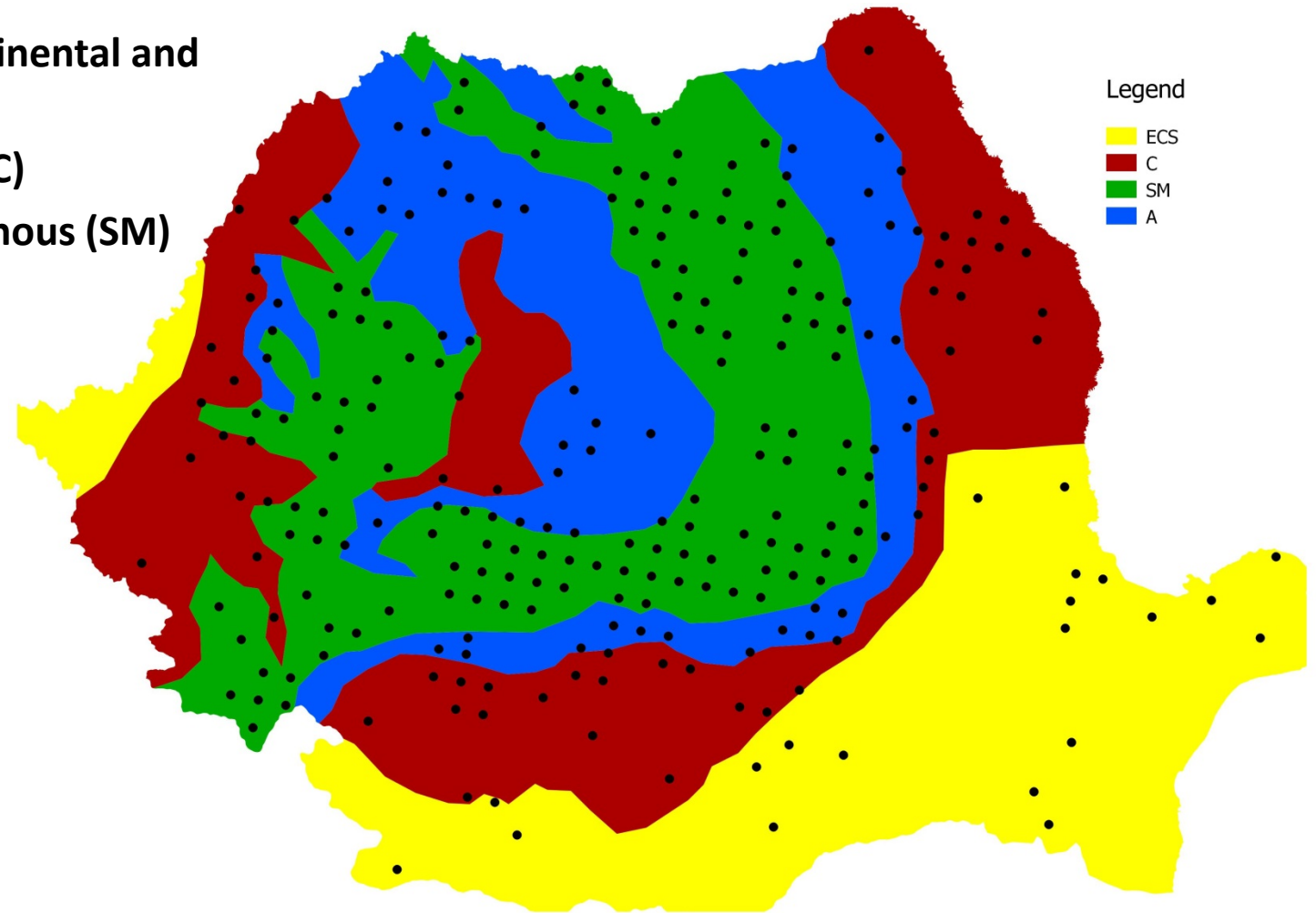
- Available data:
  - Defoliation data for the period 1992-2013
  - Climate data from E-OBS grid database (1950-2013)
- Parameters:
  - Def\_m = average defoliation percentage
  - fDef\_d = share of damaged trees (defoliation classes 2-4)
  - Seasonal mean of temperature (T°C) and precipitation (Pmm):
    - Previous growing season - pA\_pA (april-august)
    - Previous autumn - pS\_pN (september-november)
    - Winter - pD\_M (december-march)
    - Current growing season - A\_A (april-august)
    - year seasons pS\_A (september-august)

## ICP Level I network – 261 plots



# Biogeographic regions of Romania (adapted from EEA)

- Extreme continental and steppic (ECS)
- Continental (C)
- Sub-mountainous (SM)
- Alpine (A)



ICP Level I network – 261 plots

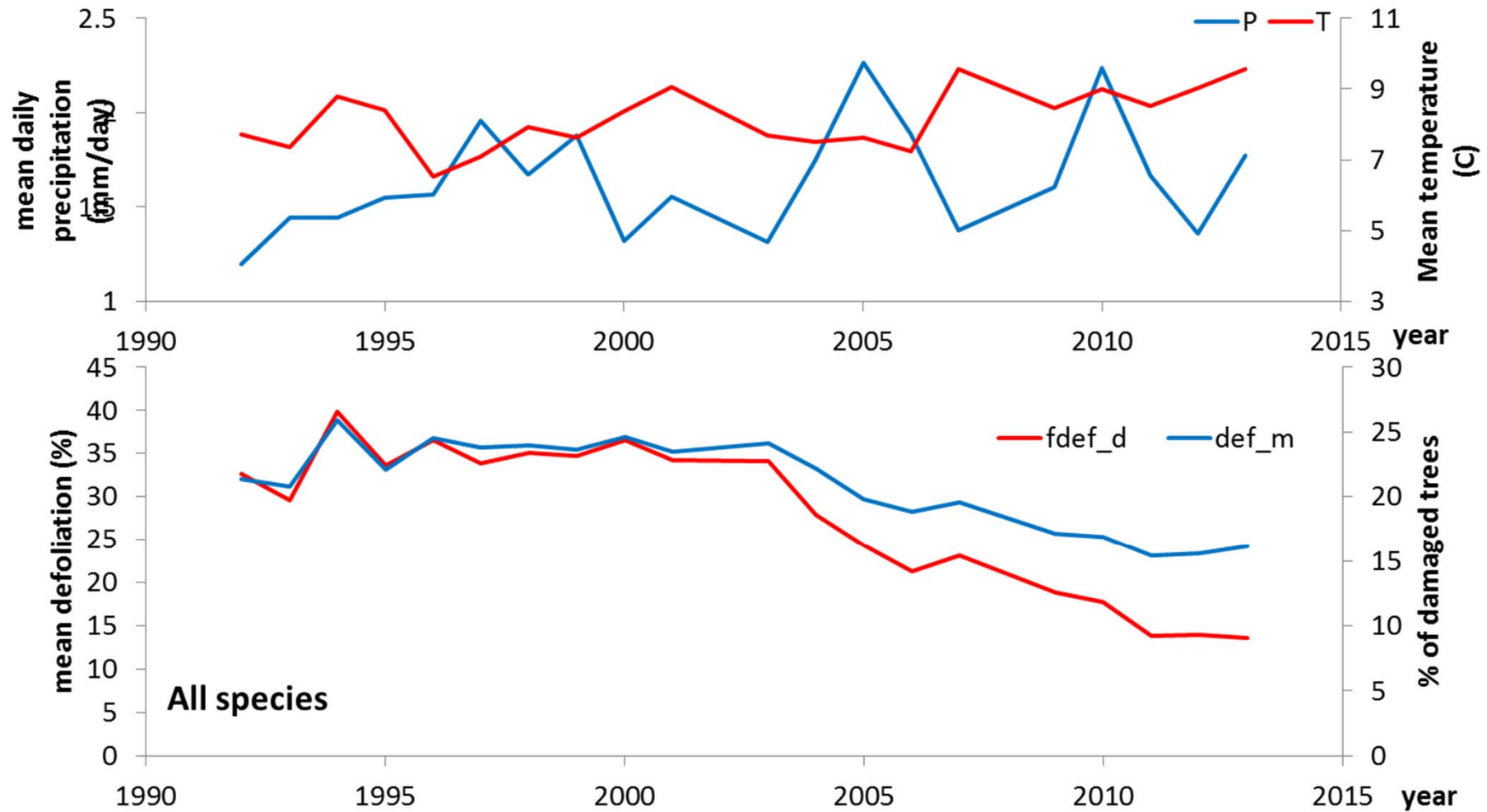
# Methodology

- Data constraints:
  - Minimum 8 of the total 24 trees per plot for the main species (group of species)
- Statistical indicators:
  - Kendall's tau ( $\tau$ ) correlation, GLM – generalized linear model



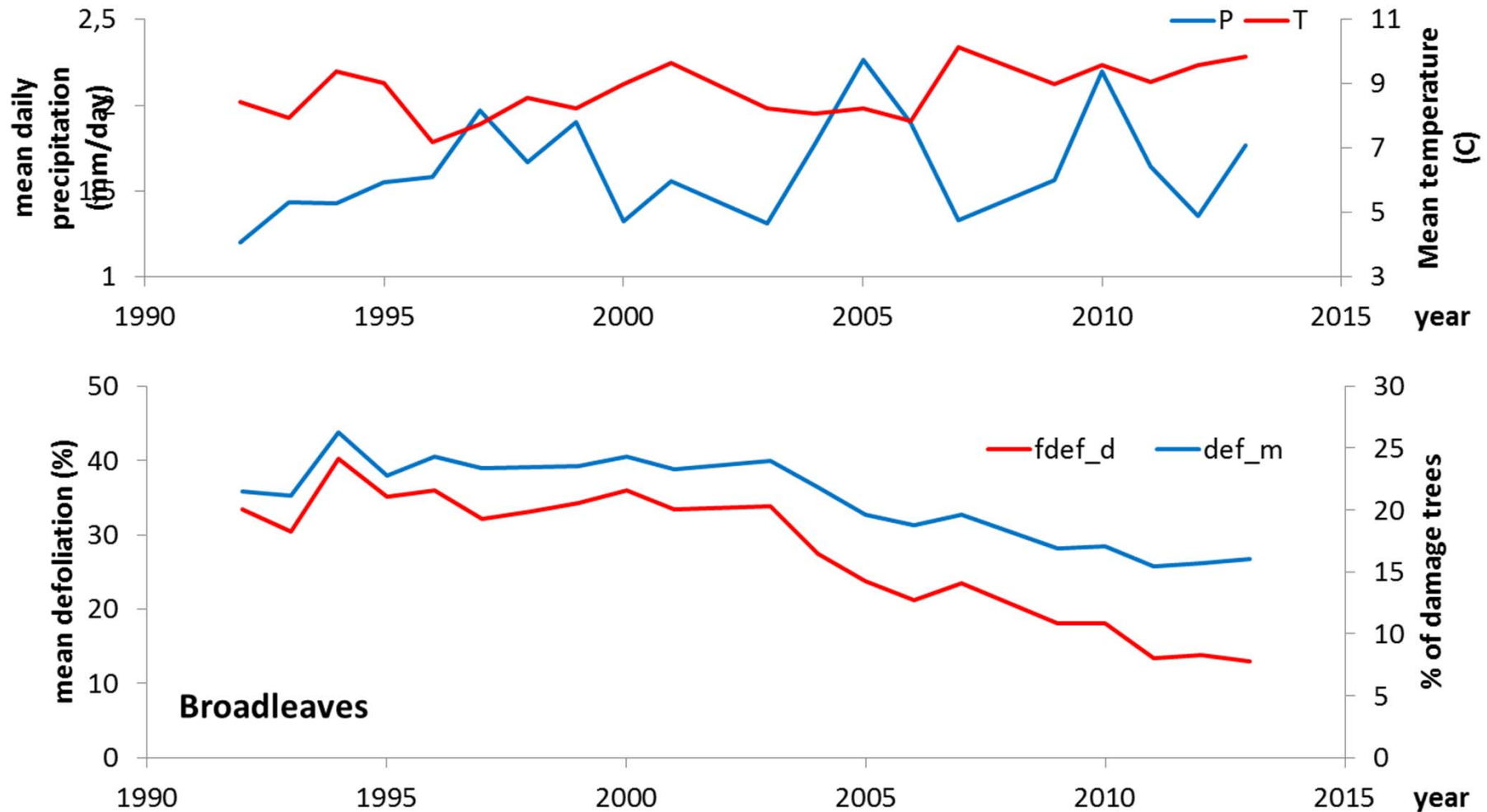
## 4. Results

- Dynamics of the mean temperature ( $t^{\circ}\text{C}$ ) and daily mean precipitations (mm/day) vs. the share of damaged trees  $fdef\_d$  (%) and mean defoliation  $def\_m$  (%),



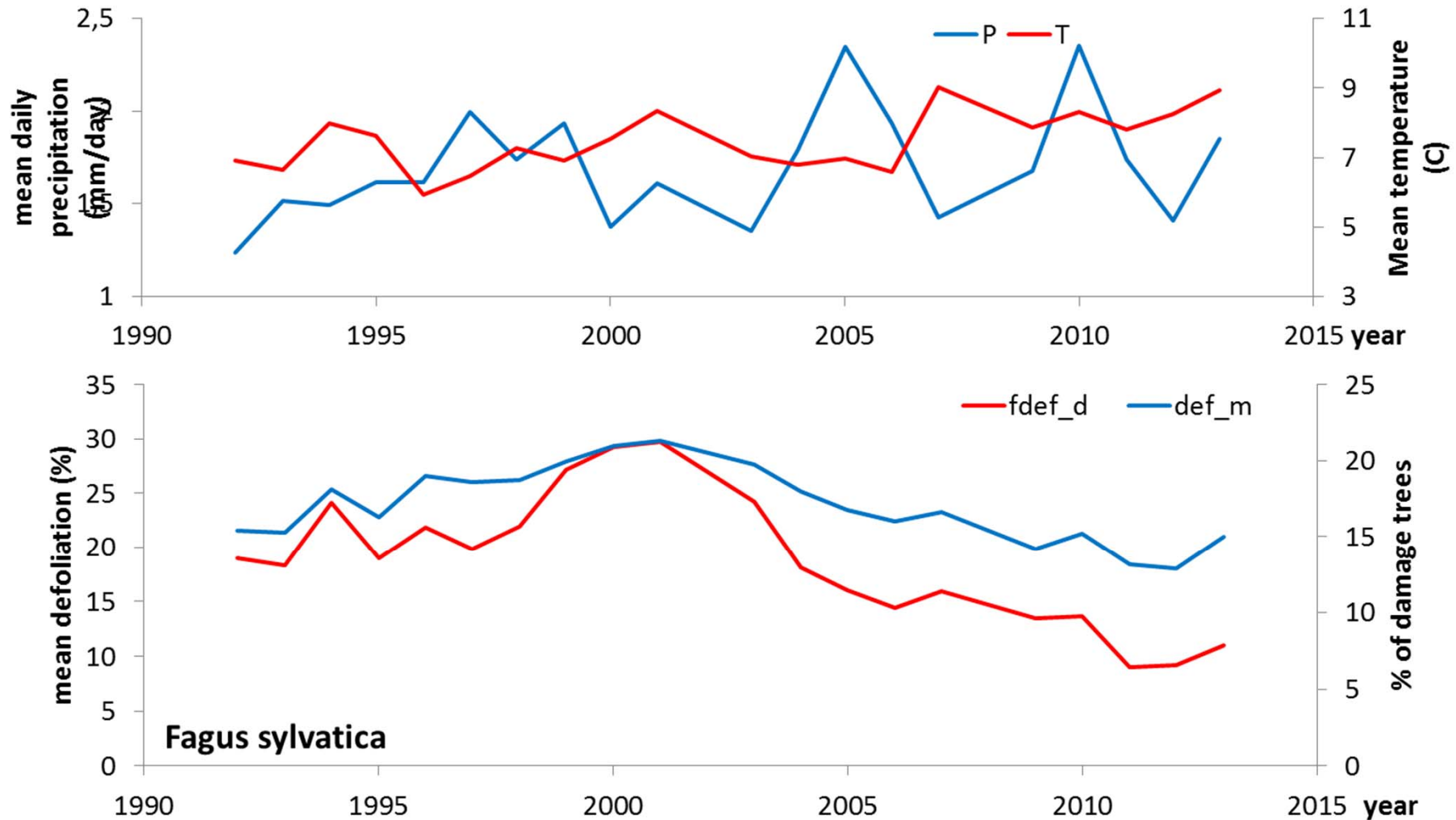
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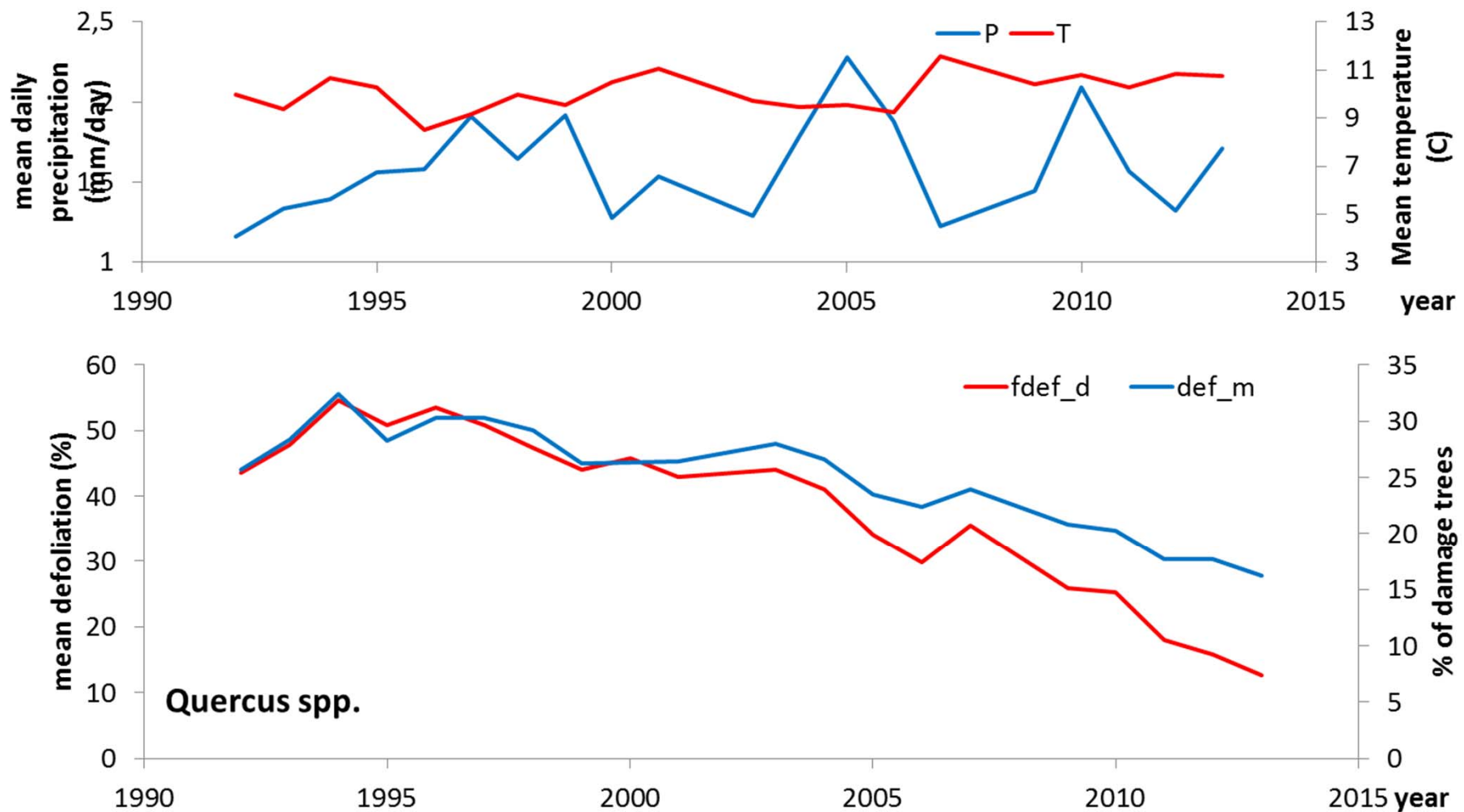
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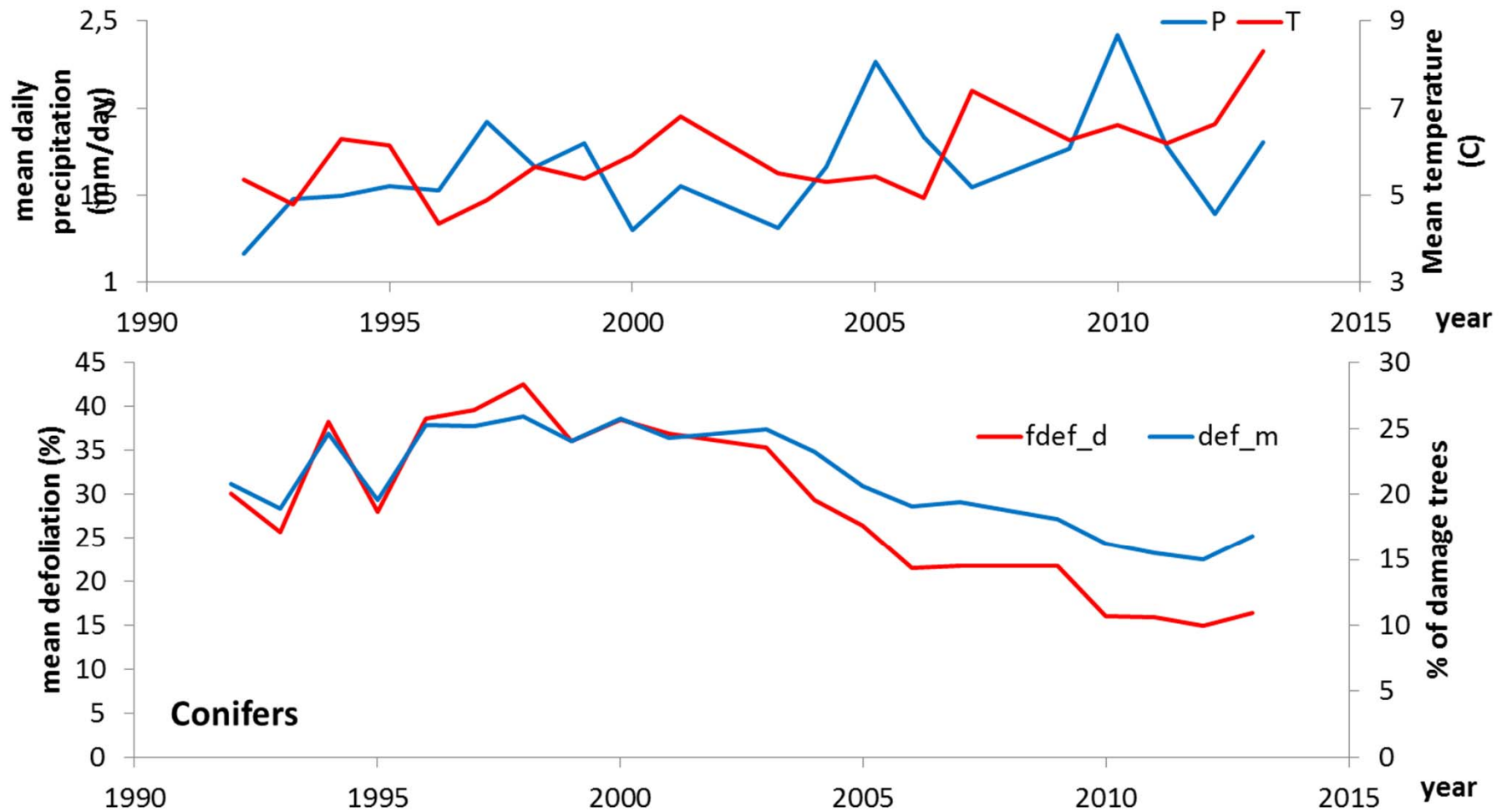
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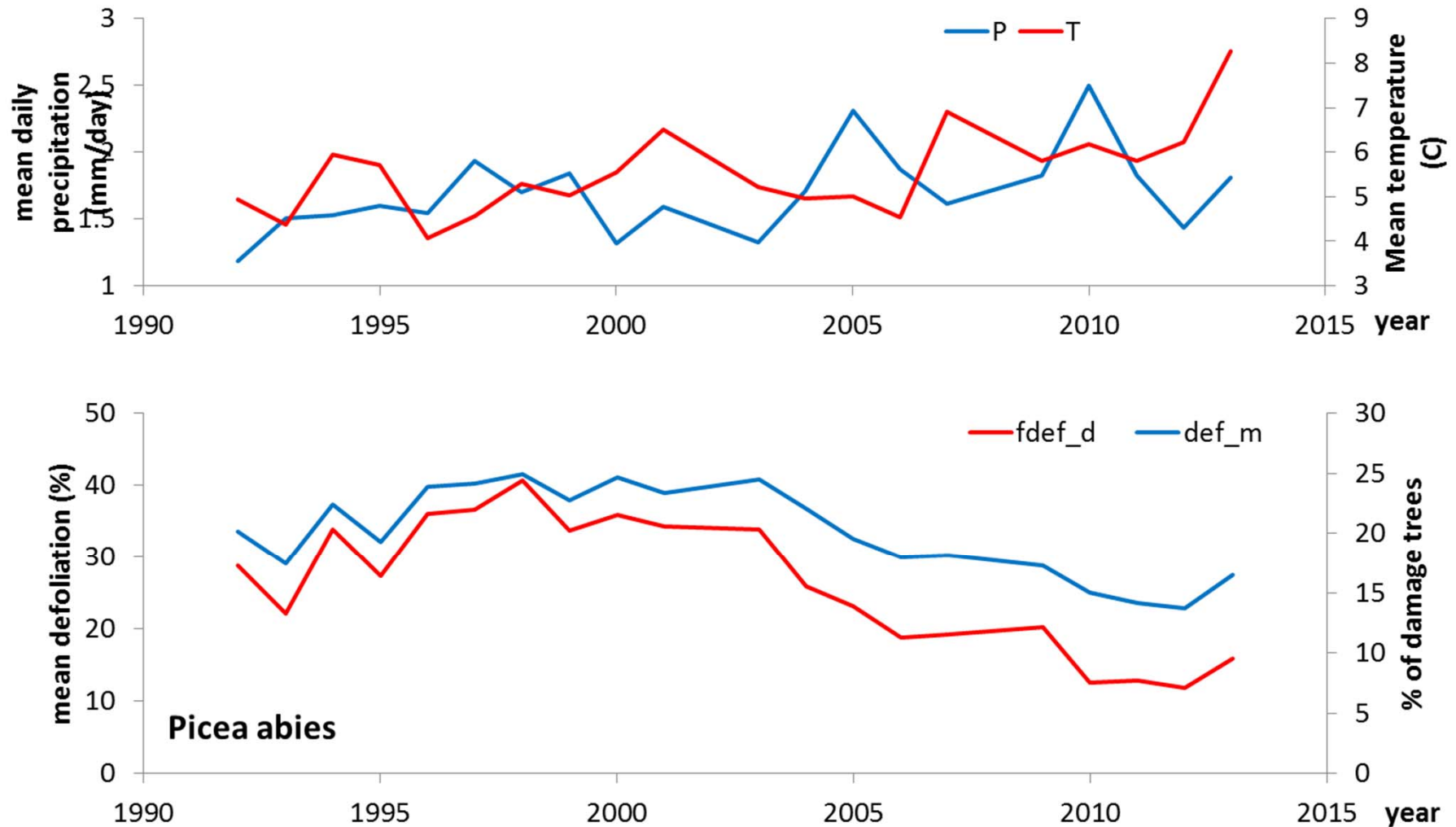
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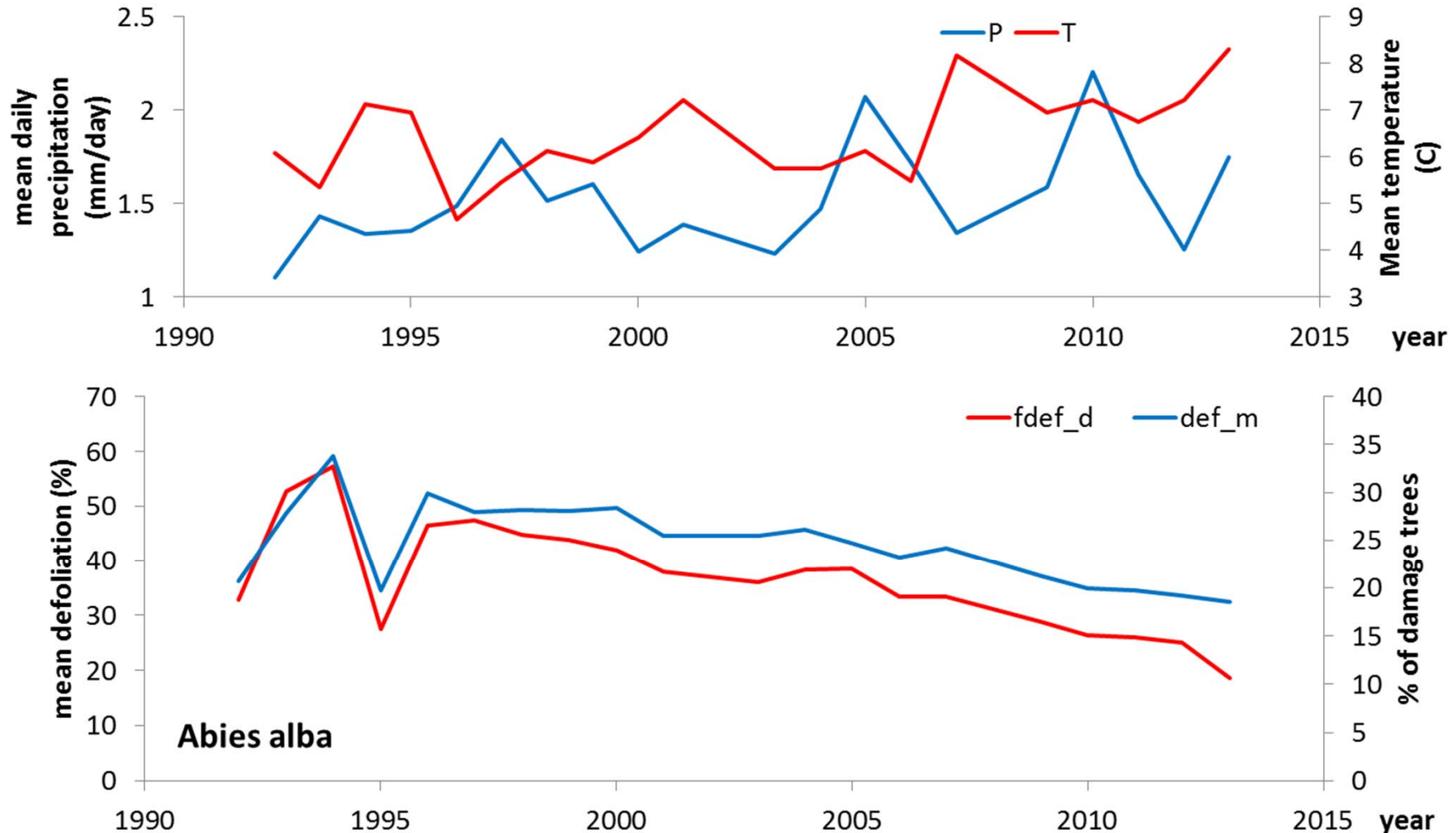
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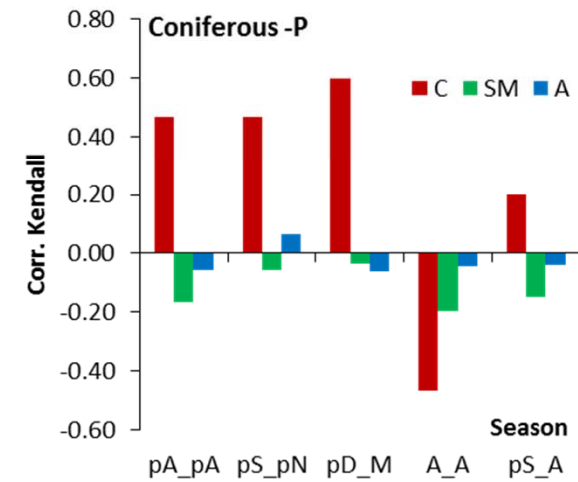
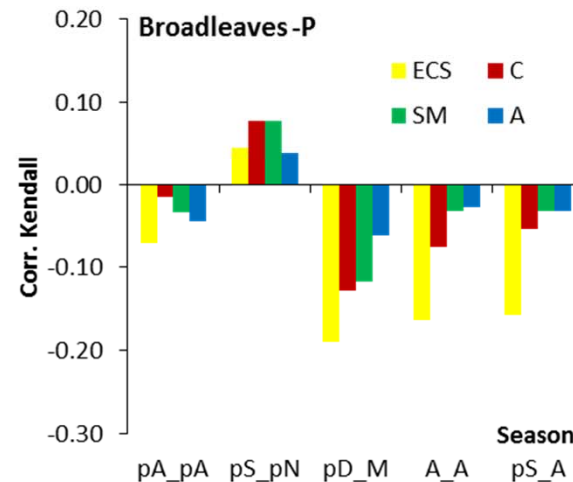
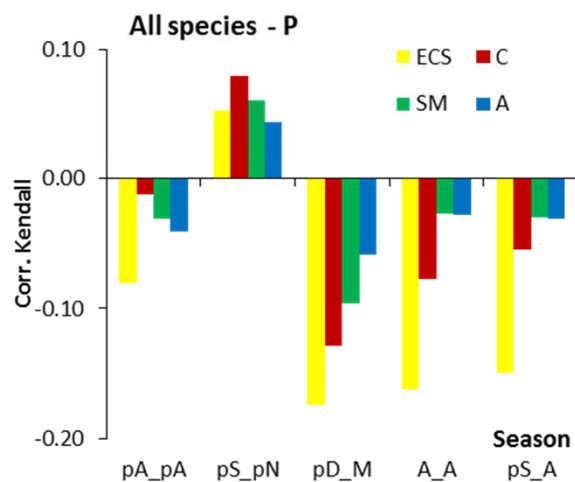
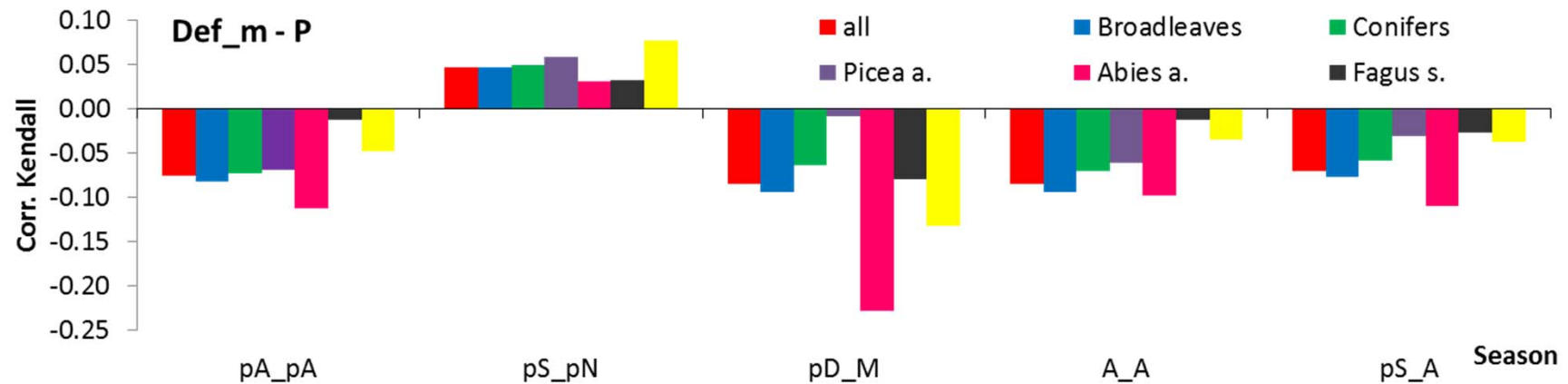
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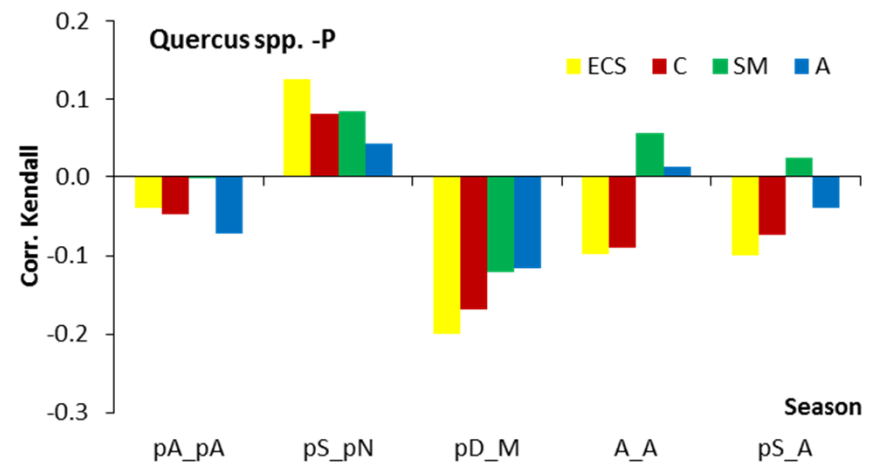
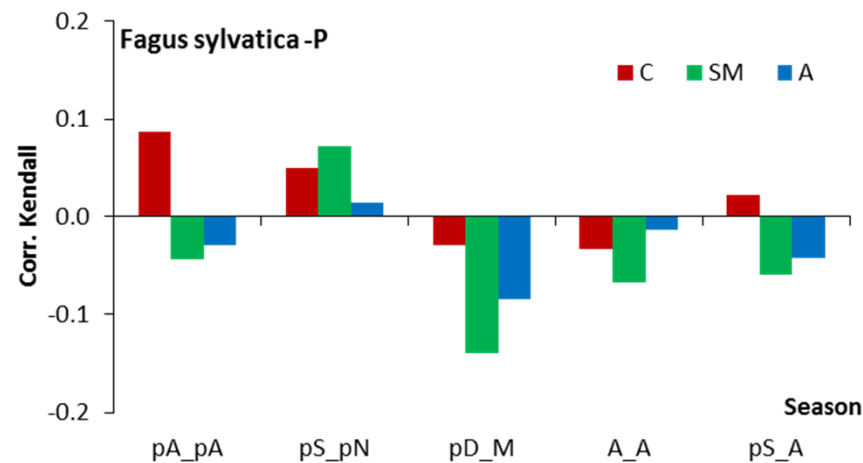
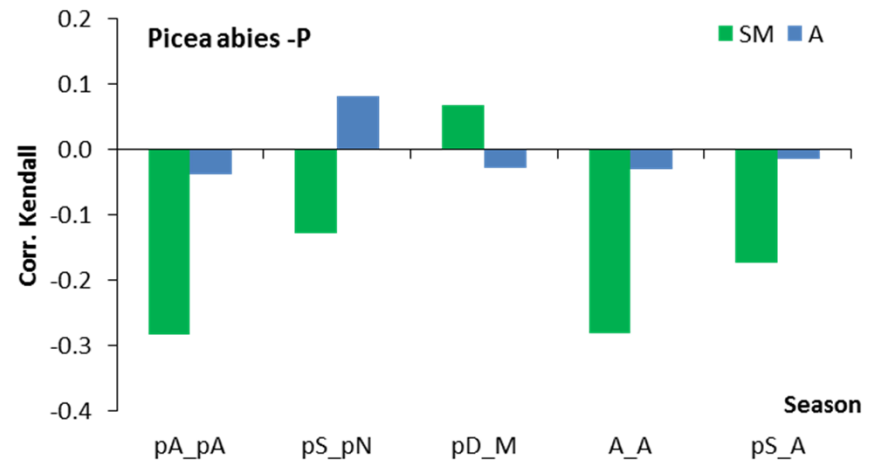
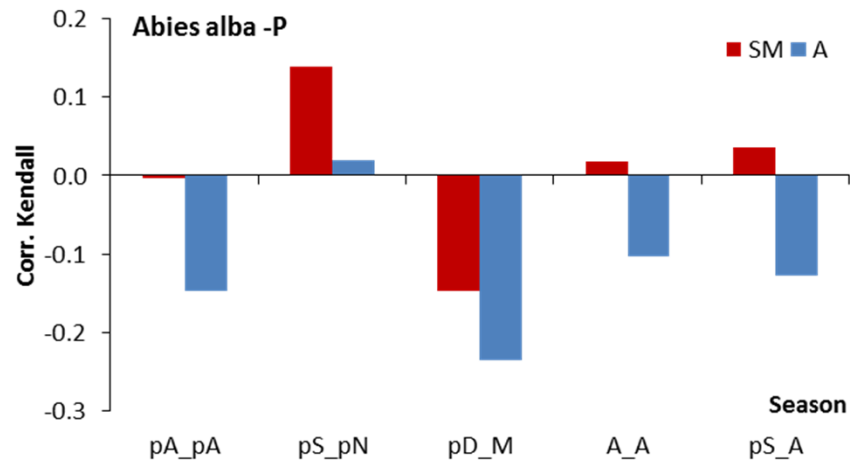
- Kendall's tau correlation between average defoliation (Def\_m) and precipitation (P) at national and regional levels





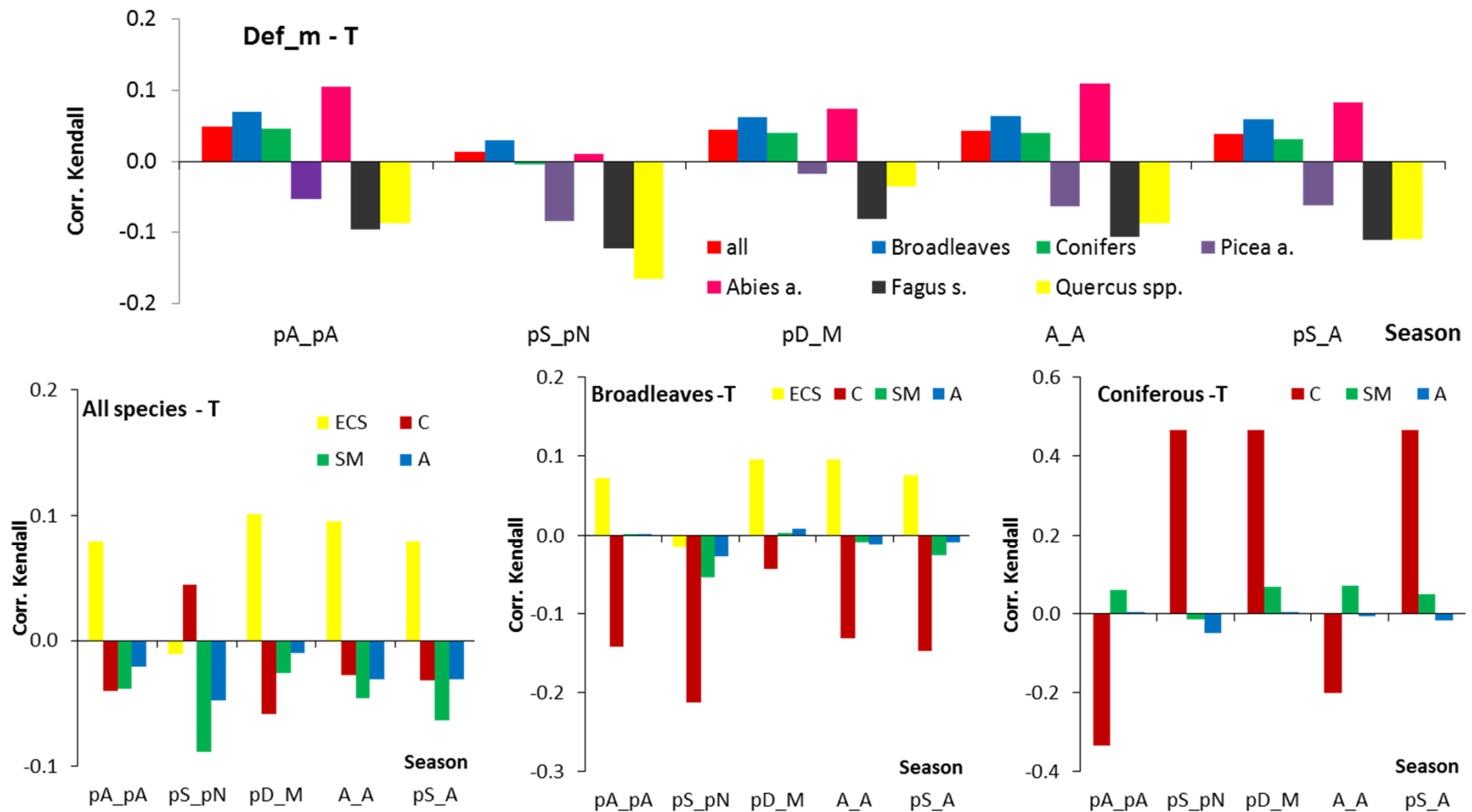
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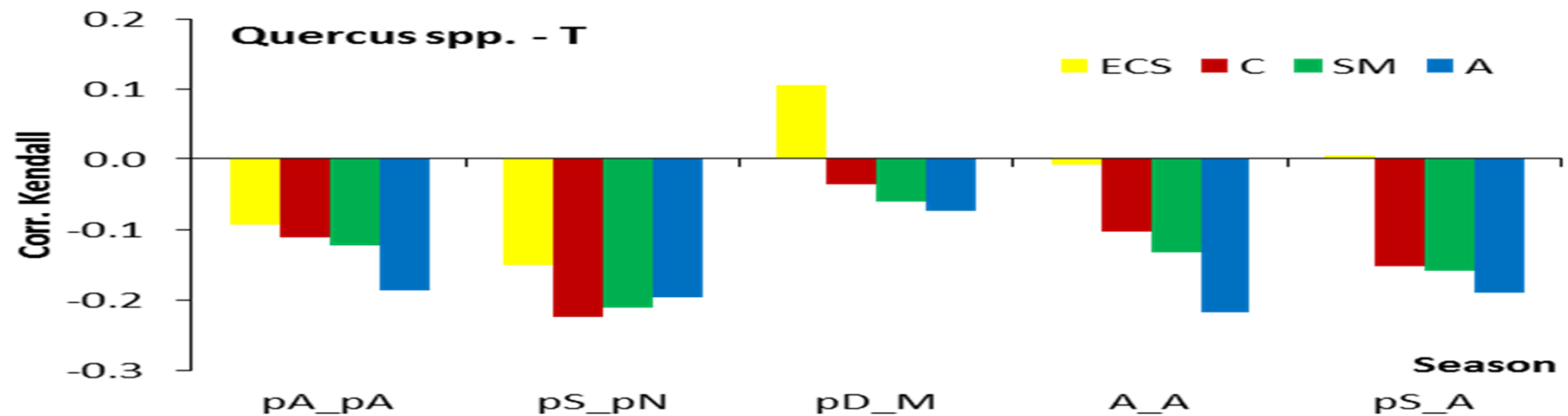
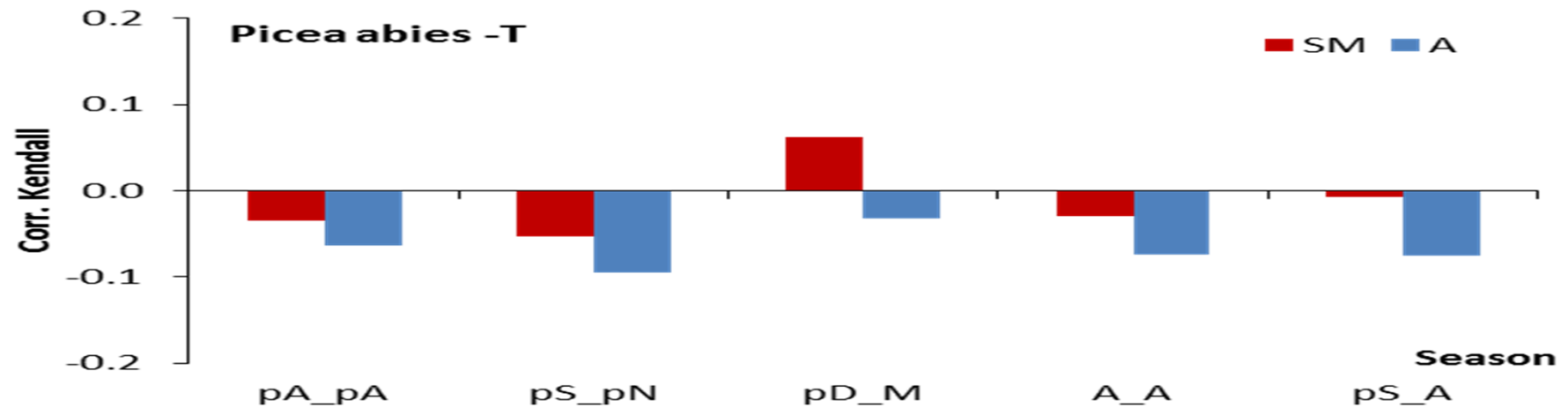
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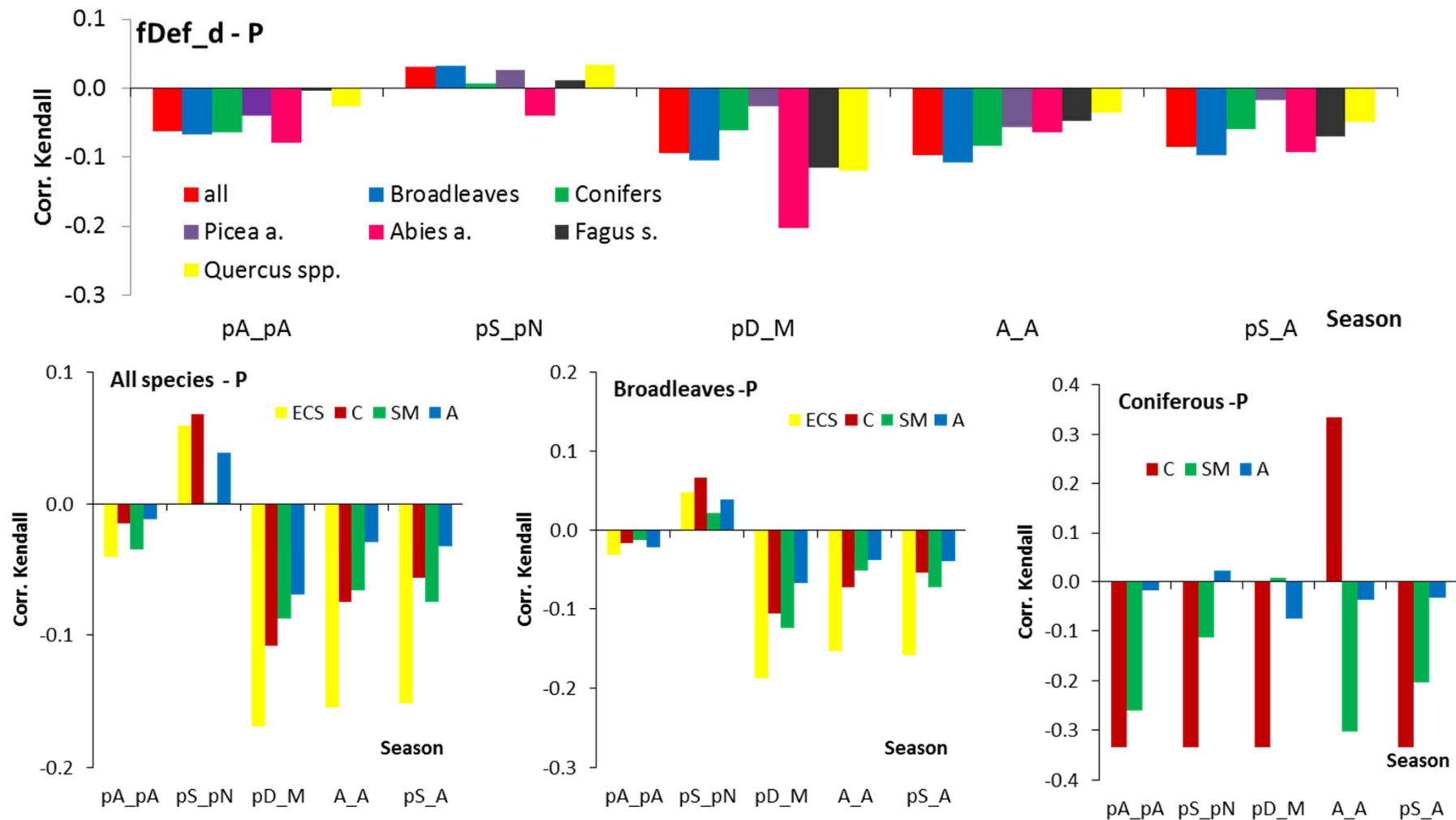
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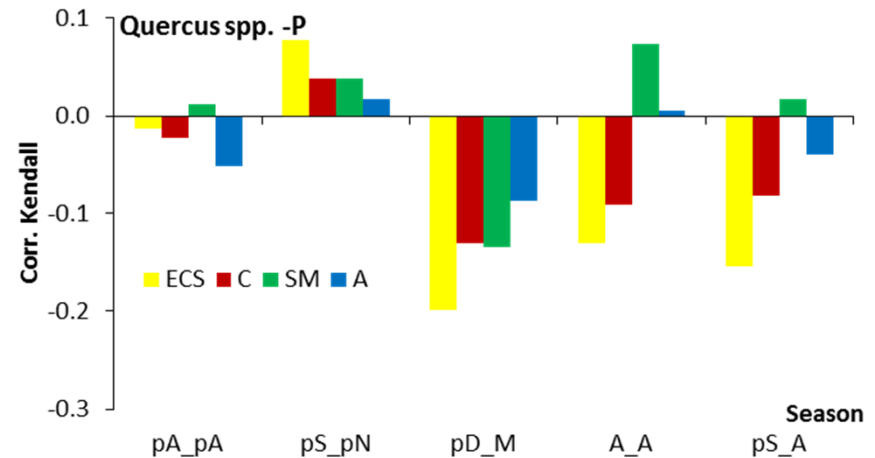
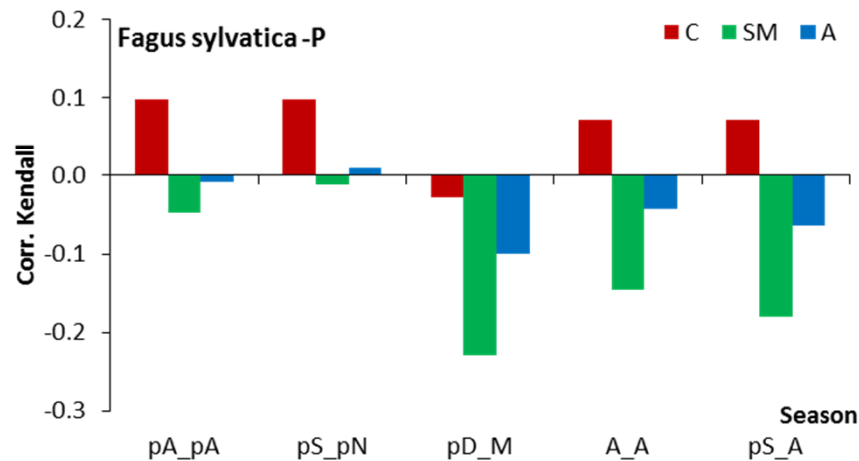
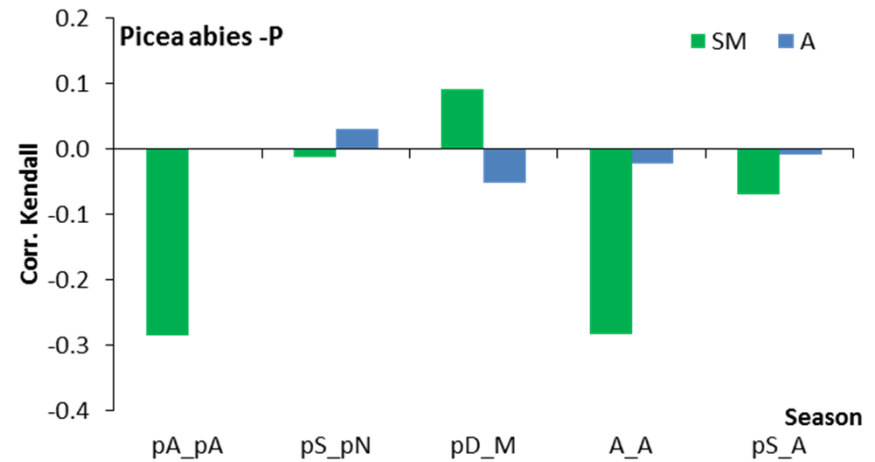
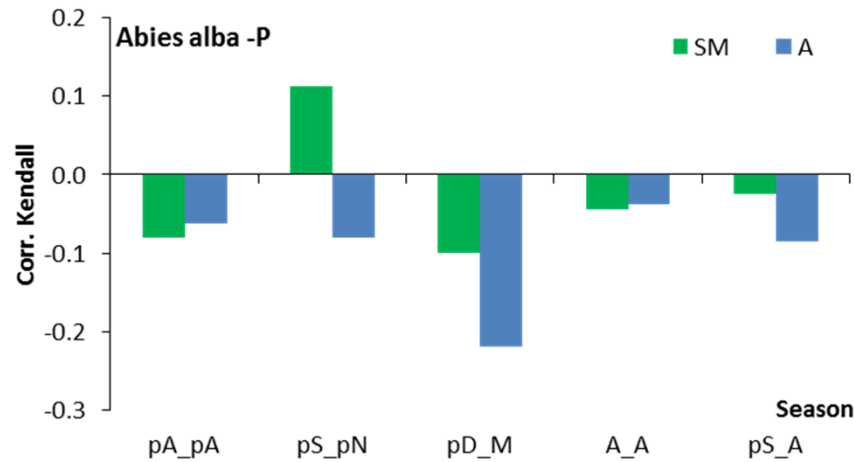
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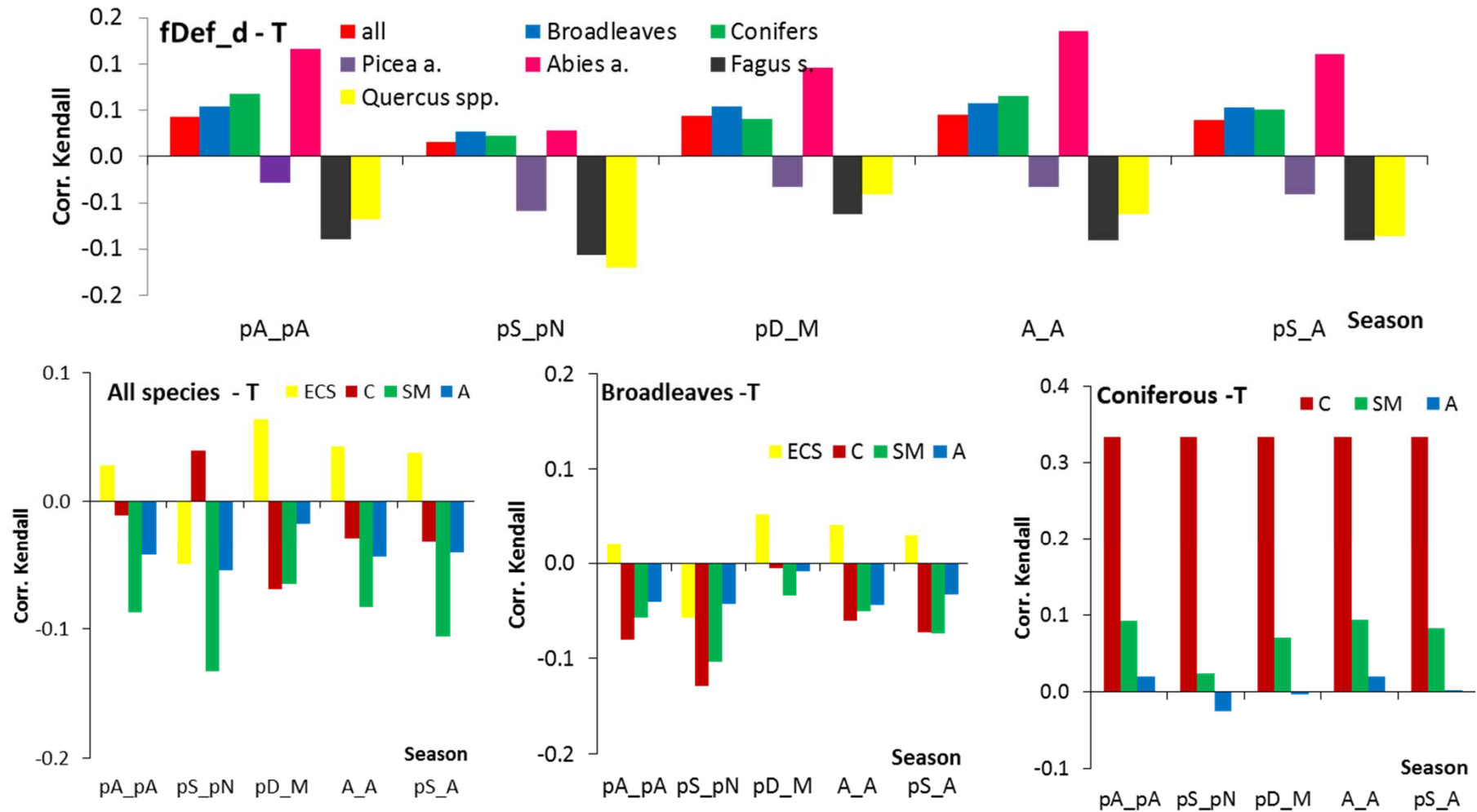
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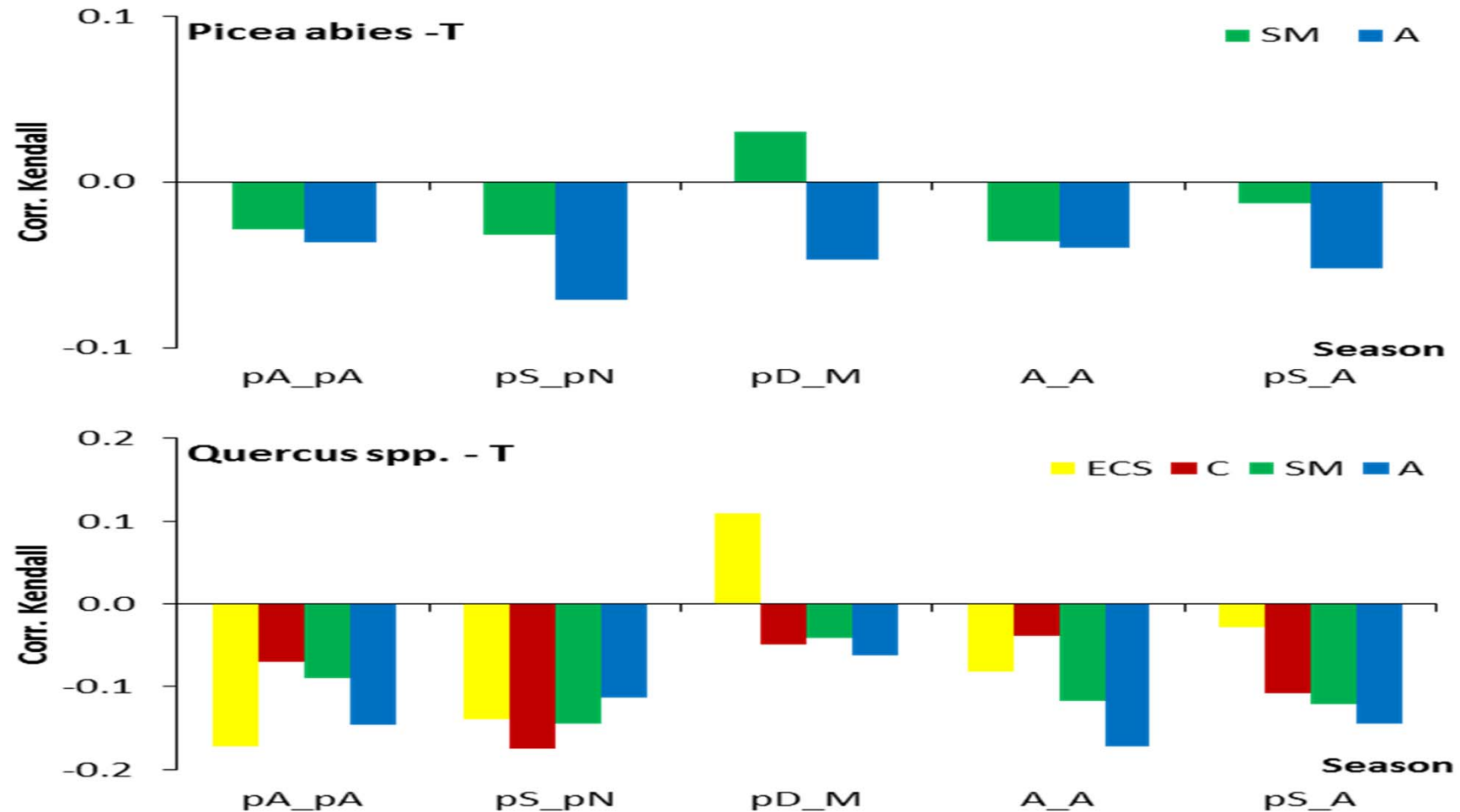
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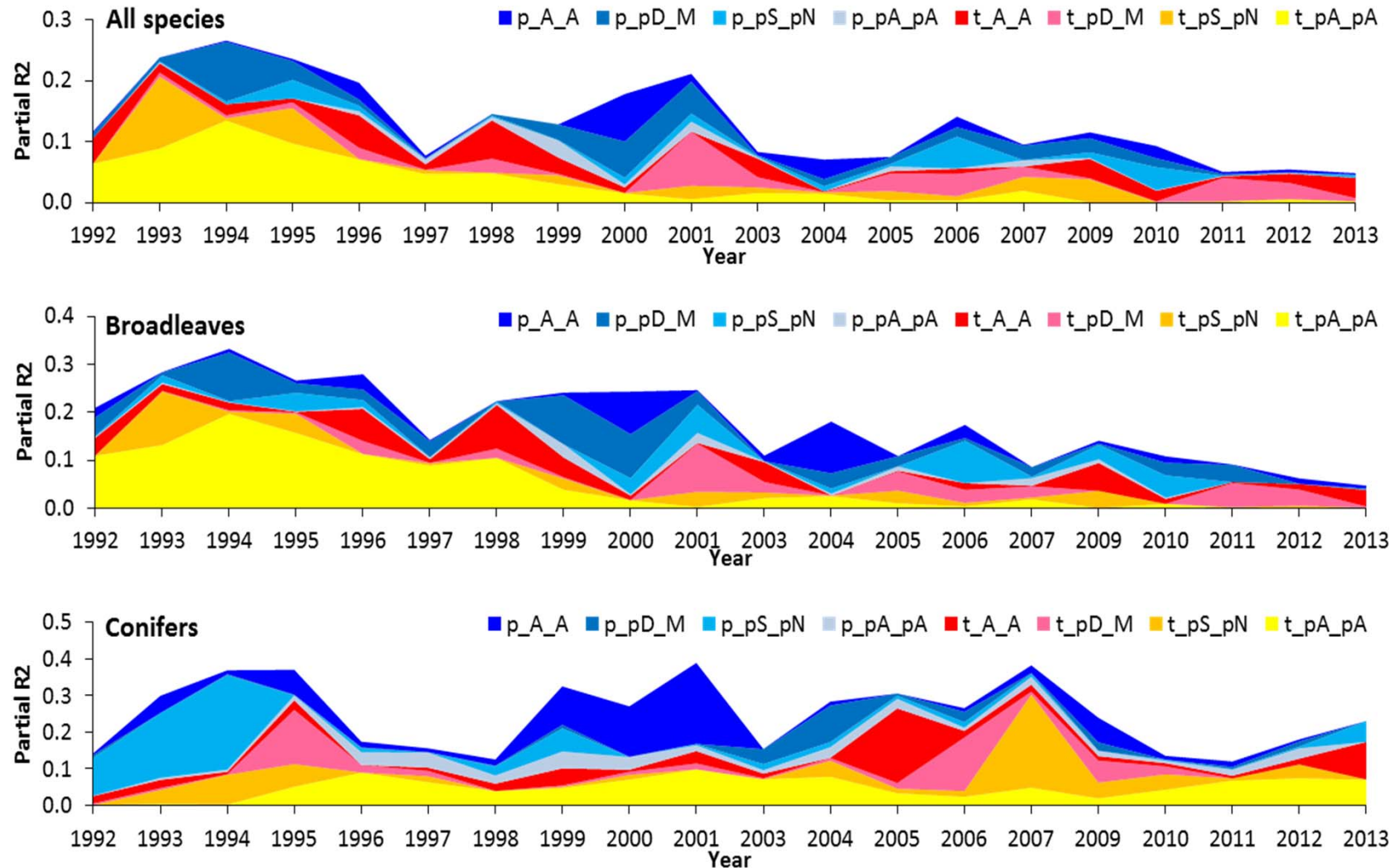
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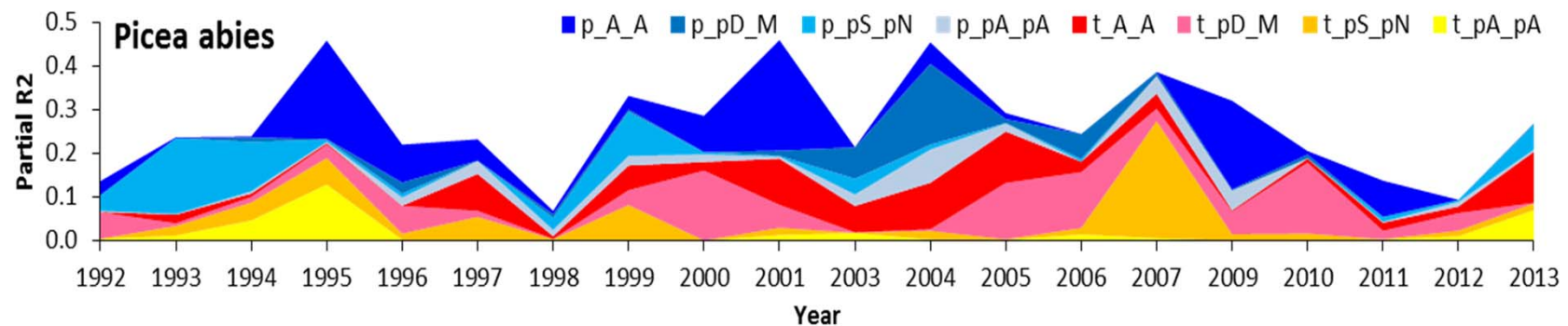
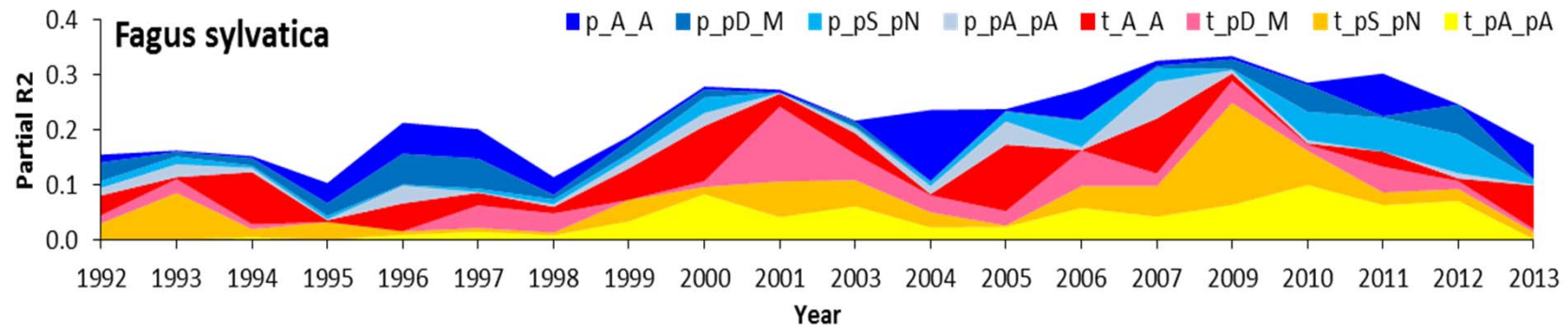
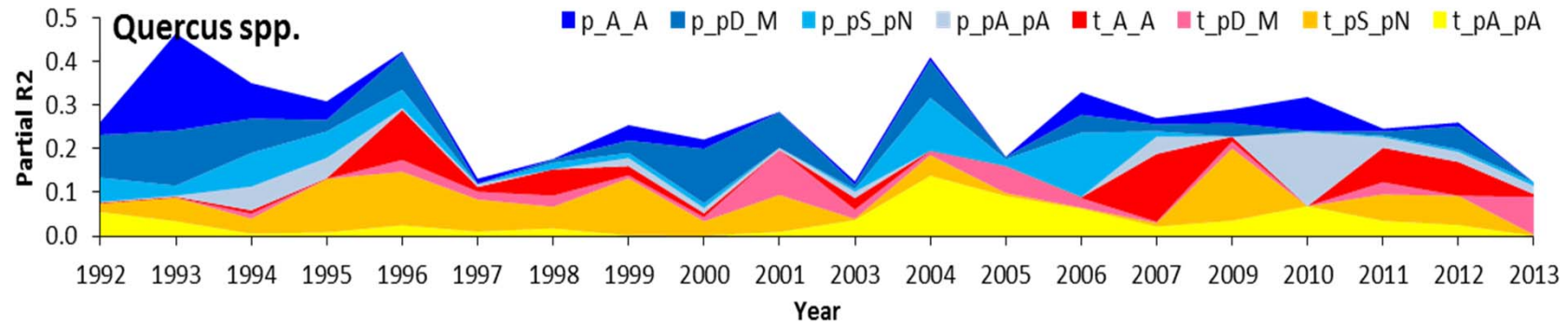
- Multiple linear regression analysis for all available plots with at least 8 trees of the main species/group of species (average defoliation)





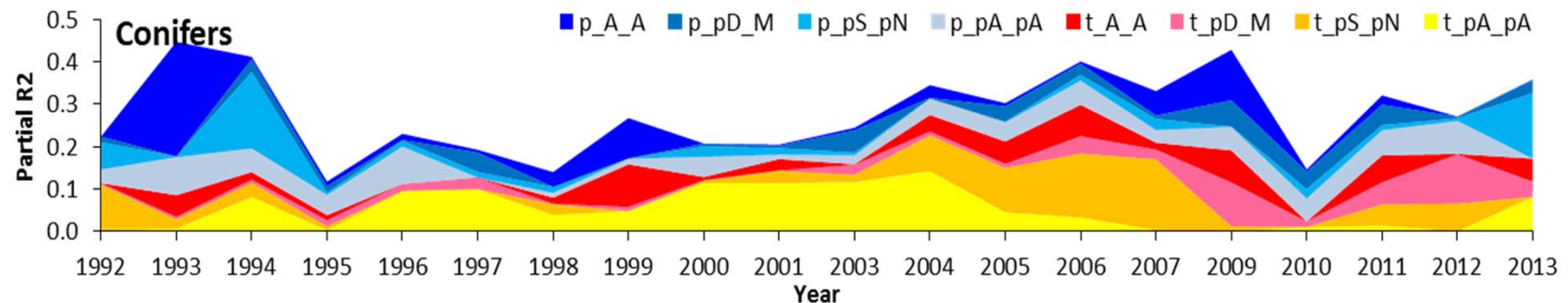
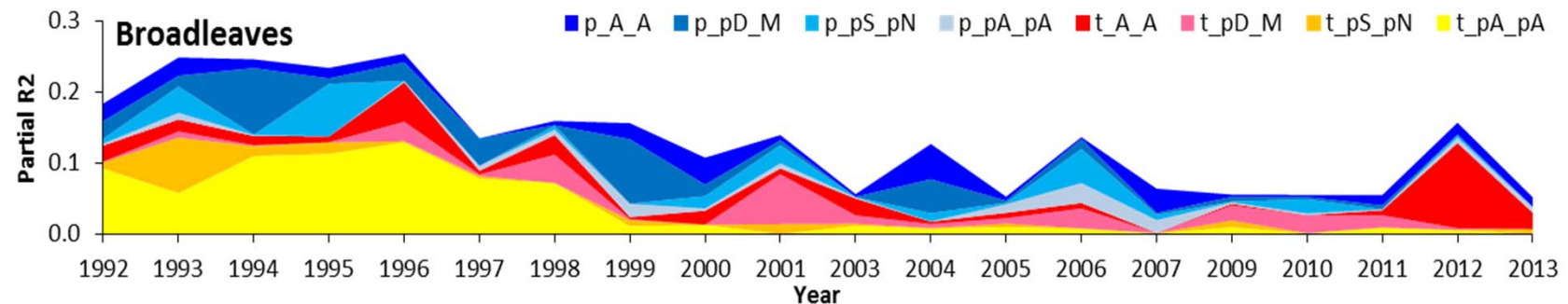
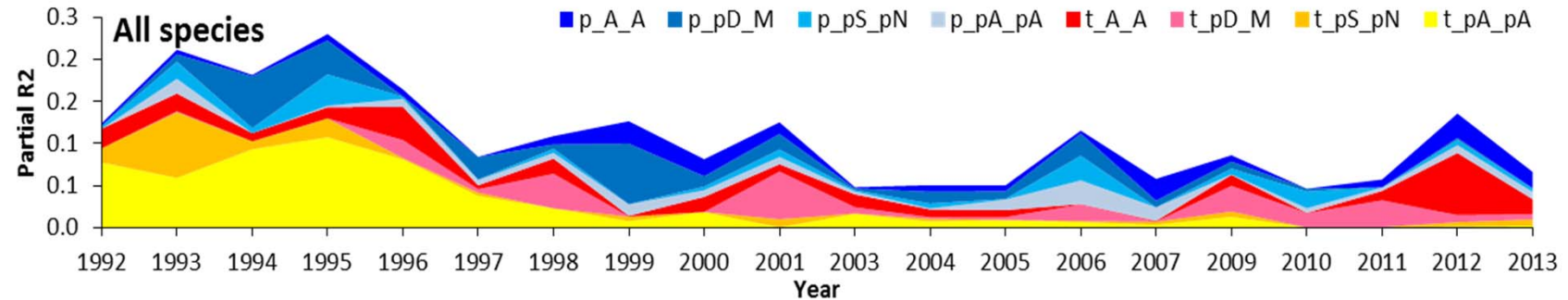
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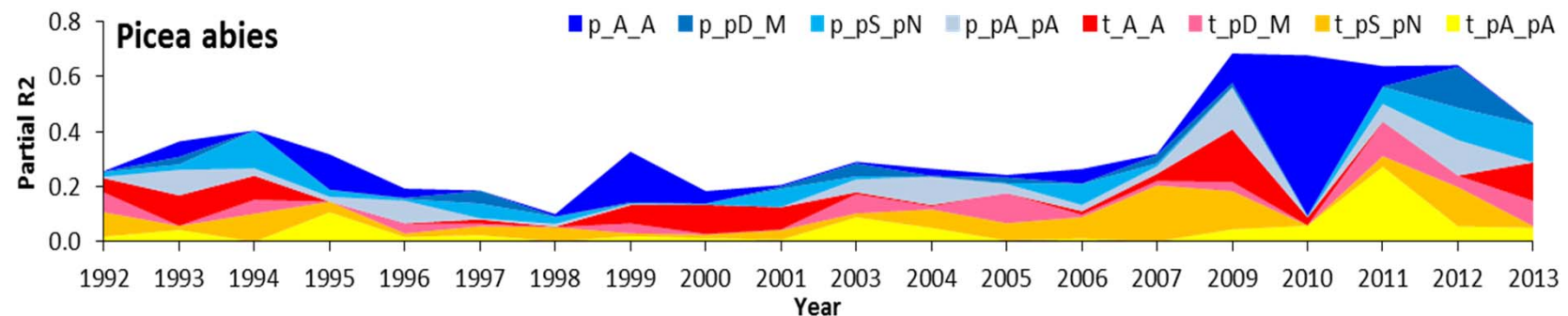
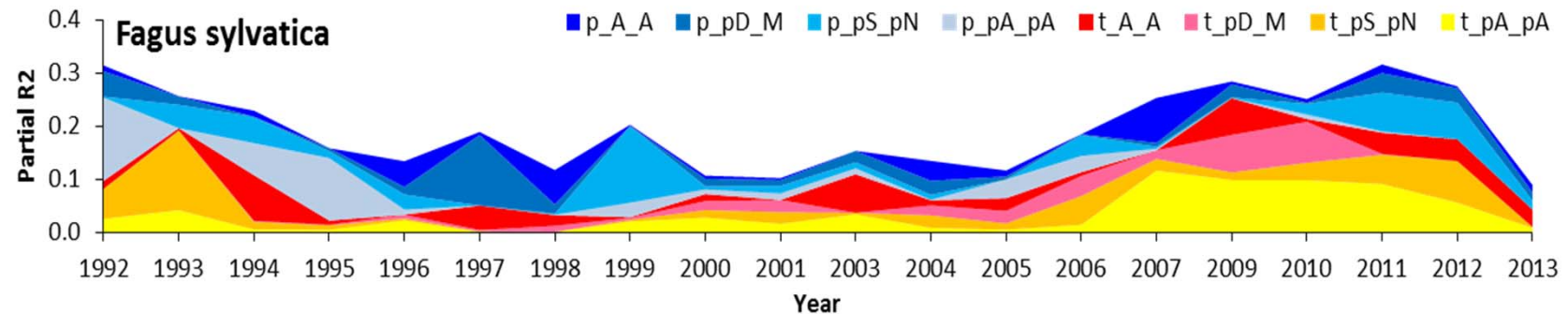
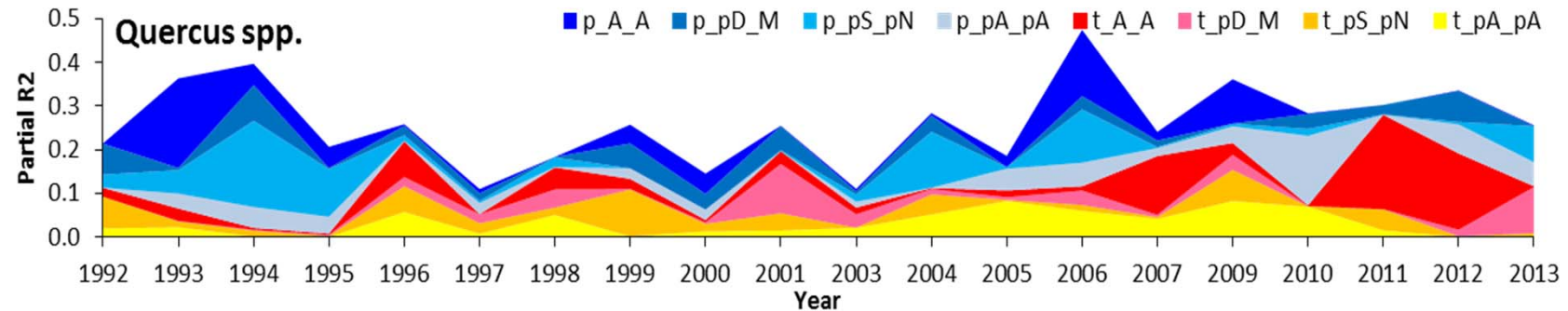
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- Multiple linear regression analysis for all available plots with at least 8 trees of the main species/group of species (share of damaged trees)



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## 5. Conclusions

- Climate influence on tree health status, evaluated by mean defoliation and share of damage trees, is relatively low ( $r_{\max}=0.2-0.3$  at national level and  $r_{\max}=0.3-0.4$  at regional level).
- Generally, precipitation is the main climatic driver on tree defoliation, a negative correlation has been observed for main species/group of species;
- High variability of the correlation among biogeographic regions was revealed;
- The influence of climate on tree health status is maximum in the extreme continental and steppe region (south – south-eastern Romania which is the western border of Eurasian steppe)

## 5. Conclusions

- Variance of defoliation explained by climate decrease in the last years for all species and broadleaves;
- For coniferous the variance explained by temperature increase in the last decade;
- For spruce climate become an important factor in the last years (increase of variance explained over 50%);
- For oak species the variance explained by climate remain over 20% during the analyzed period;
- Generally, the climate explains 10-20% of variance in case of broadleaves and 20-30% for coniferous

## 5. Conclusions

- The significant improvement of forest health condition evaluated by defoliation at level I Romanian ICP network (16x16 km) could be explained by the increase of precipitation combined with a low increase of temperature in the last 10 years.

**Thank you for your attention!**