Dynamics of Soil Microarthropod Populations Affected by a Combination of extreme Climatic Events in Tropical Home Gardens of Kerala, India

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Introduction

- Extreme climate events (drought and floods) impact flora and fauna on a regional scale
- The change in climate has effect on soil invertebrate fauna like microarthropods
- Each group of soil microarthopods shows different response to floods
- 25 home gardens (19 flooded, 6 non-flooded) were studied from Kerala, India to understand the effect of drought followed by flash flood event on soil microarthropods

Materials and Methods

The following shows a home garden in the study area (Fig. 1) and an overview of materials and methods (Fig. 2)

Fig 1. A rural home garden in Chengamanad, Kerala, Indiia without intensive soil management

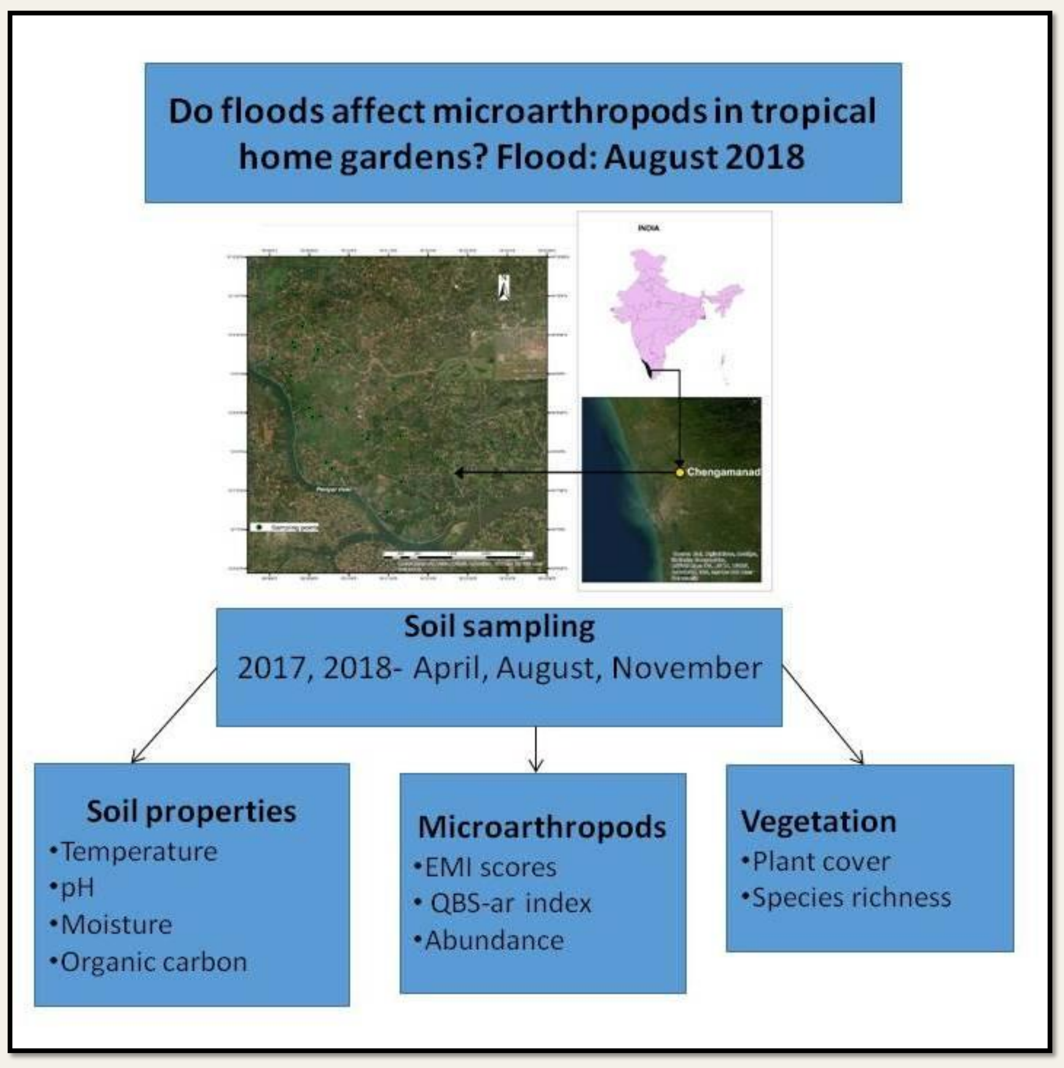

Fig 2. An overview of materials and methods

Results

- Total microarthropod abundance was reduced during drought and showed further decrease following floods (Fig. 3.)

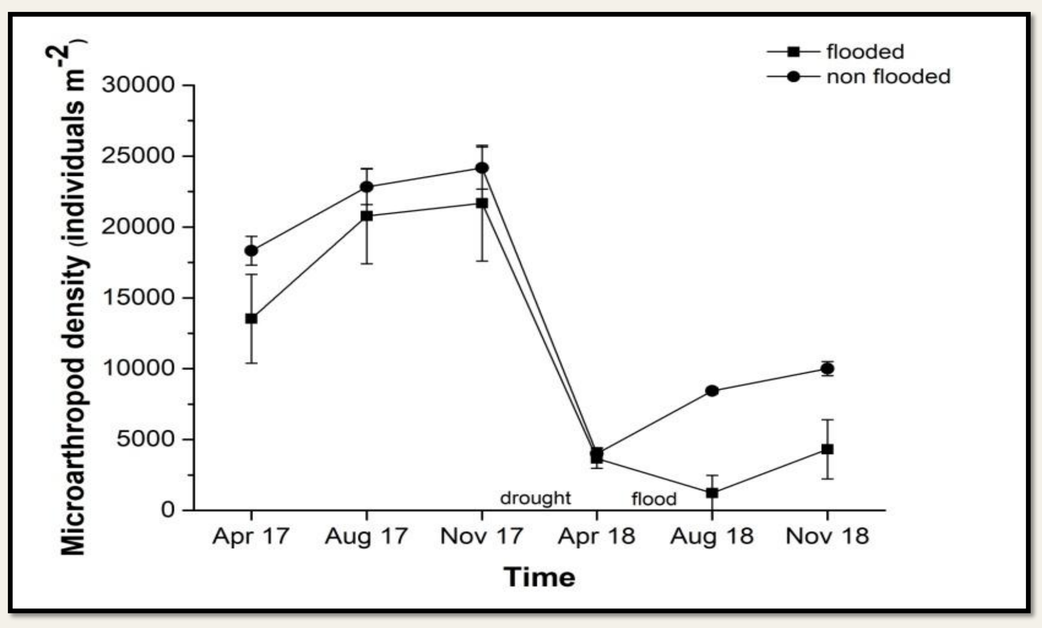

Fig. 3. Microarthropod density before and after floods in the home gardens of Chengamanad, Kerala, India

The groupwise soil microarthropod faunal abundance showed varied response to floods and recovery after floods (Fig 4).

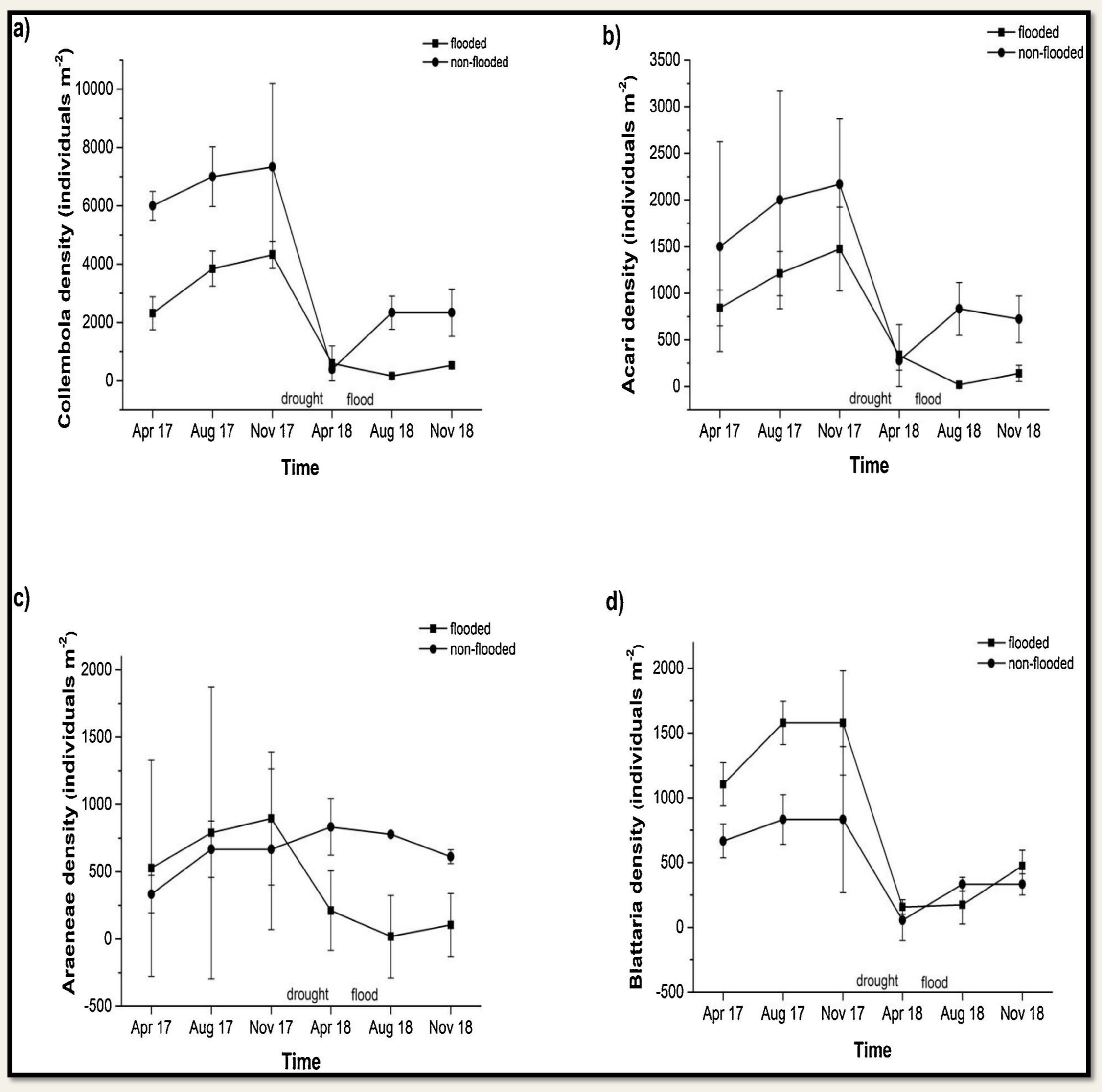

Fig 4. Density of soil microarthropod groups before and after floods in Chengamanad, Kerala, India

- QBS-ar and microarthropod density revealed positive correlation in August 2018 ($r = 0.92$) and November 2018 ($r = 0.91$).
- Regression analysis showed that there is relationship between microarthropod densities and QBS- ar index (Fig. 5)

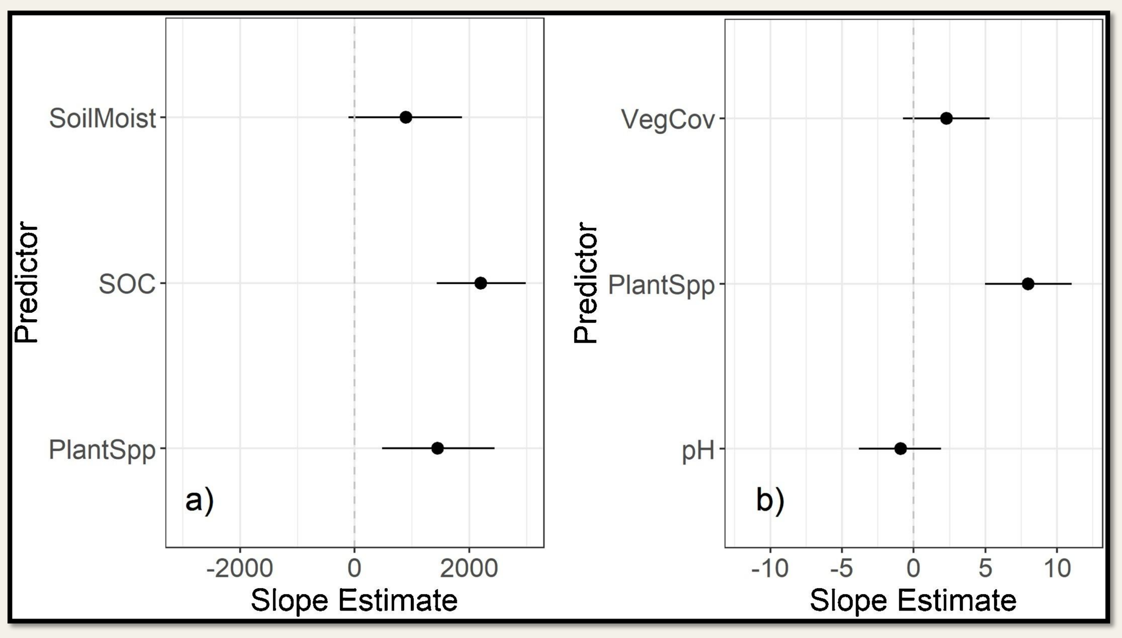

Fig 5. Regression coefficients estimated for the covariates included in the model predicting microarthropod density (a) and QBS-ar (b)

- Microarthropod density in August 2018 was dependent on Soil Organic Carbon, plant cover and plant species richness
- Microarthropod density in November 2018 was dependent on plant cover, plant species richness
- Microarthopod group density reduced immediately after drought and it could not be reestablished to pre-drought conditions.
- Microarthropod density showed reduction immediately after floods but it was then re-established to the pre-flood, post-drought conditions
- Araneae, Coleoptera, Acari, Diptera, Hemiptera,Cicada- were the most affected by flood while Blattaria was the least affected.
- The groups that recovered better after the flood were Coleoptera (larval forms present in soil), Hymenoptera, Cicada while Araneae did not regain pre-flood abundance
- The mean QBS-ar values did not differ significantly between flooded and non-flooded home gardens before drought but drought reduced QBS-ar scores by 50% in flooded and non-flooded home gardens followed by further reduction in flooded home gardens alone in August 2018
- There was change in relative number of home gardens with highest EMI- before flood (April 2018) and after flood (August 2018) as the EMI of microarthropods namely Acari, Hemiptera, Araneae, Coleoptera, Collembola and Cicada were lost in 50% home gardens
- Blattarian EMI was not affected by flood, but reduced during drought
- During November 2018, the euedaphic forms of Coleoptera, Hymenoptera, Blattaria, Cicada, Diptera and Hemiptera were seen in larger numbers, hence high EMI
- In 2018, QBS-ar is best explained by plant species richness, drought and flood and tree cover was more important than grass cover
- Addition of organic carbon through plant litter and roots due to increased plant species richness and cover may have led to an increase in euedaphic microarthropod forms in August 2018 in non-flooded home gardens
- The restoration of QBS-ar values faster than the microarthropod population follows the ecological theory that ecosystem properties can be stable at higher diversity than higher abundance

Conclusion

- There is negative impact of the combination of a severe summer drought followed by a major flood event on soil microarthropods
- The microarthropod population can recover after a natural catastrophe provided there is enough vegetation and litter to support their survival
- The recovery potential of soil microarthropods varies based on microarthropod groups
- There is recovery potential provided by agrobiodiversity, especially the tree diversity in tropical Home gardens.
- The plant diversity in home garden agroecosystems, are very important and have to be maintained as they can mitigate the disastrous consequence of severe climate events in a region.

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