

# European Mesofauna Under Drought Stress

## - Evidence from Wheat Fields

Svenja Meyer

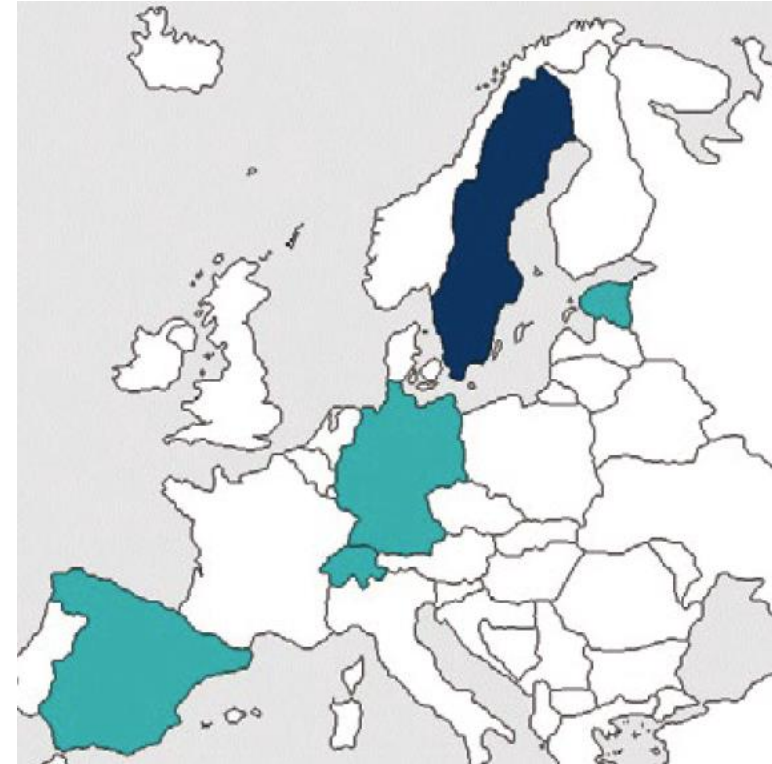


# THE SOILCLIM PROJECT

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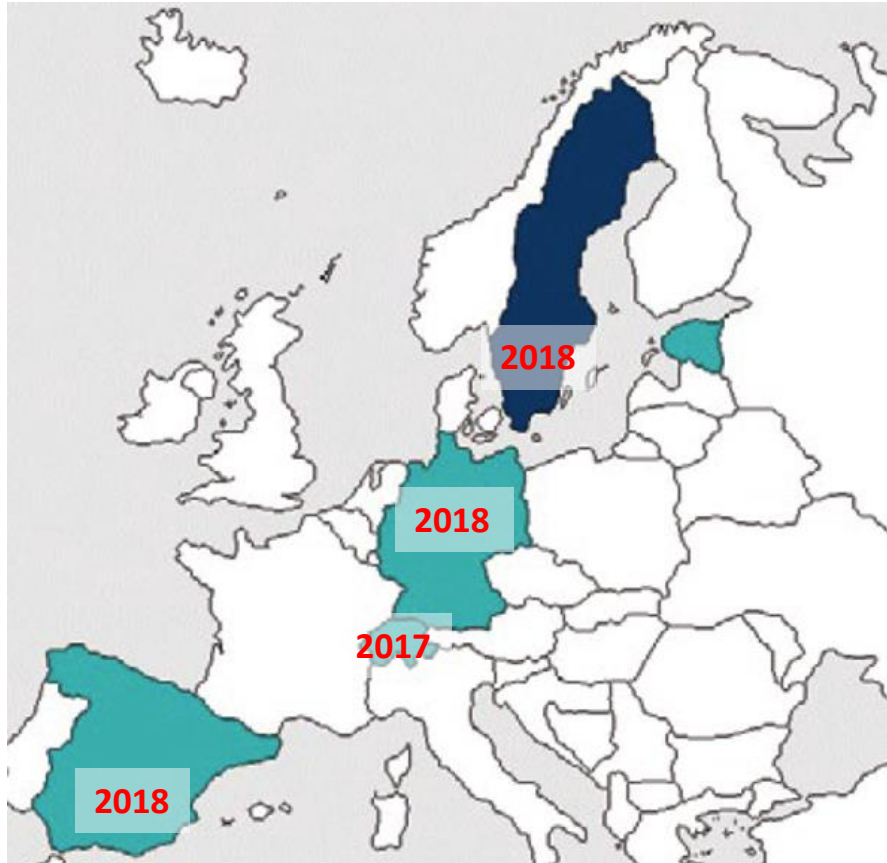


- BiodivERsA-project
- **Soil** system under **climate** change
- Different levels of **soil carbon** content
- Study system: agricultural fields (winter wheat)



# THE SOILCLIM PROJECT

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## Two experiments

### 2017: Switzerland

- Drought effects in conventional and biodynamic farming
- Evaluation of drought simulation

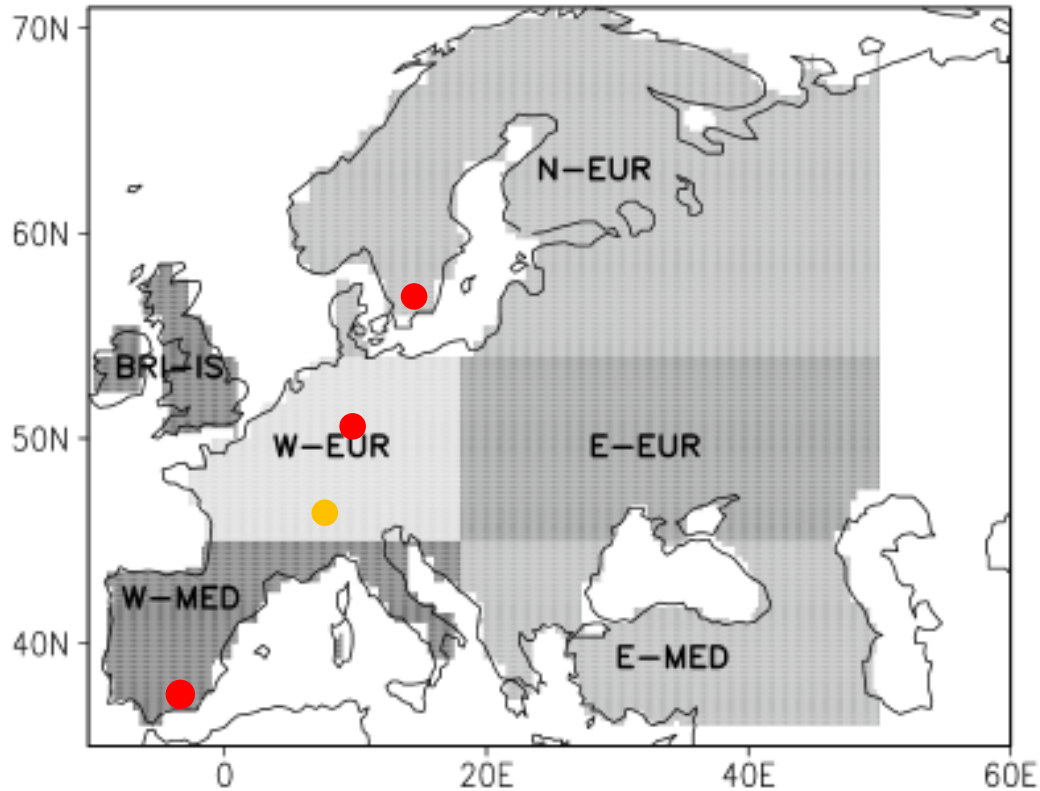
### 2018: Sweden, Germany, Spain

- Drought effect on soils with different organic carbon content

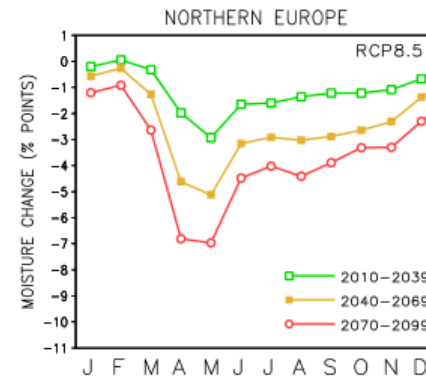
## Climate change models for Europe

- Temperature: increase!
- Precipitation: patterns change
  - Combination of T and precipitation models: **Soil moisture**

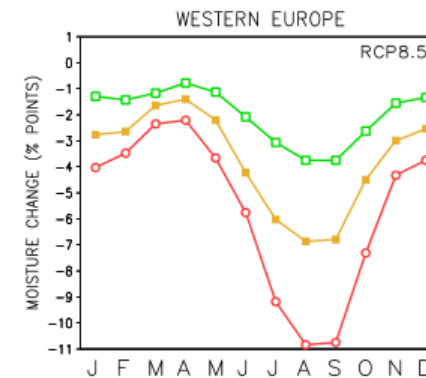
# CLIMATE CHANGE – SOIL MOISTURE



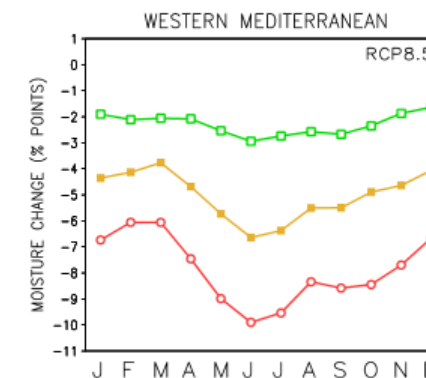
Ruosteenoja, K. et al. (2018) Seasonal soil moisture and drought occurrence in Europe in CMIP5 projections for the 21st century. *Clim Dyn*: 50: 1177.



- Decline, especially during the growing season



- Decline, especially from mid summer to autumn



- Clear decline all year round

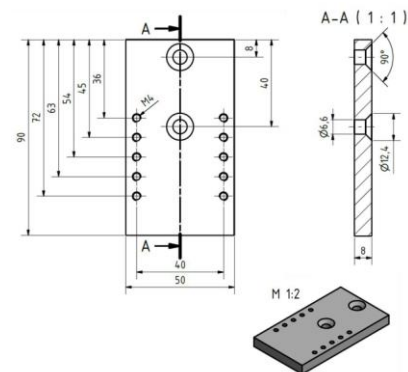
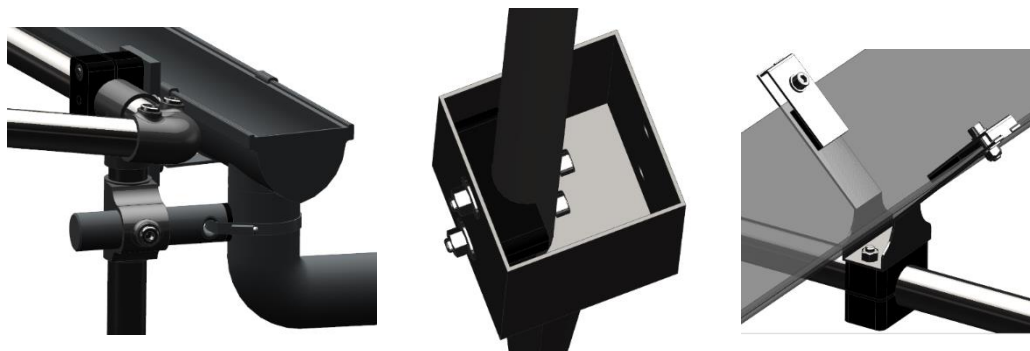
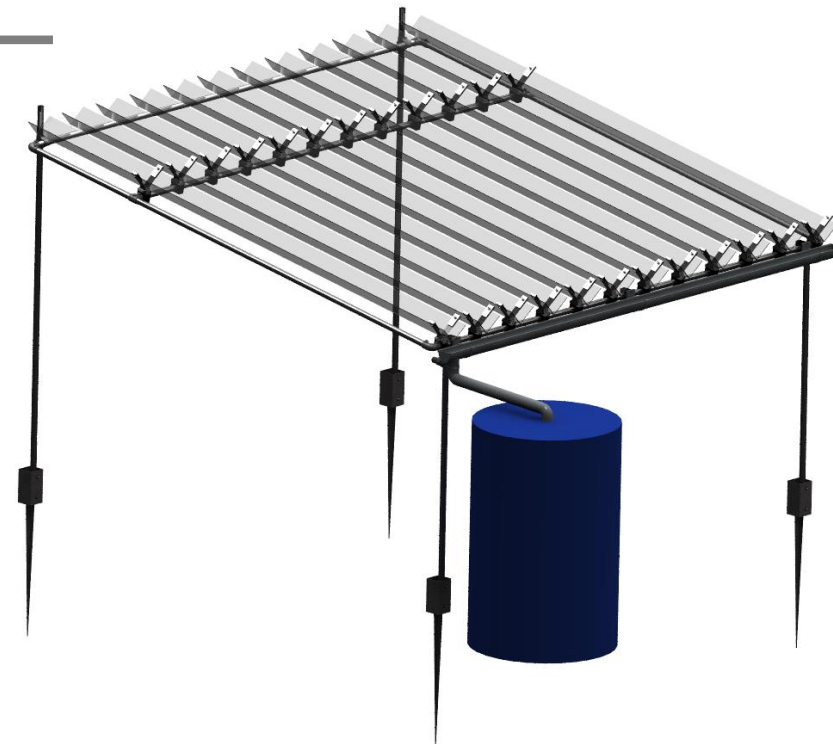
# THE RAINOUT-SHELTERS



## Design and Manual to Construct Rainout-Shelters for Climate Change Experiments in Agroecosystems

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# THE RAINOUT-SHELTERS

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... Reality



## Characteristics

- $2.5 \times 2.5 \times 1.2\text{--}1.7$  m ( $6.25$  m<sup>2</sup>)
- V-shaped acrylic glass bands
- Exclusion of 65% of ambient precipitation
- Edge-effect on soil moisture of max. 0.75 m: 1 m x 1 m sampling area

# THE RAINOUT-SHELTERS

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... Reality



## Three experimental treatments

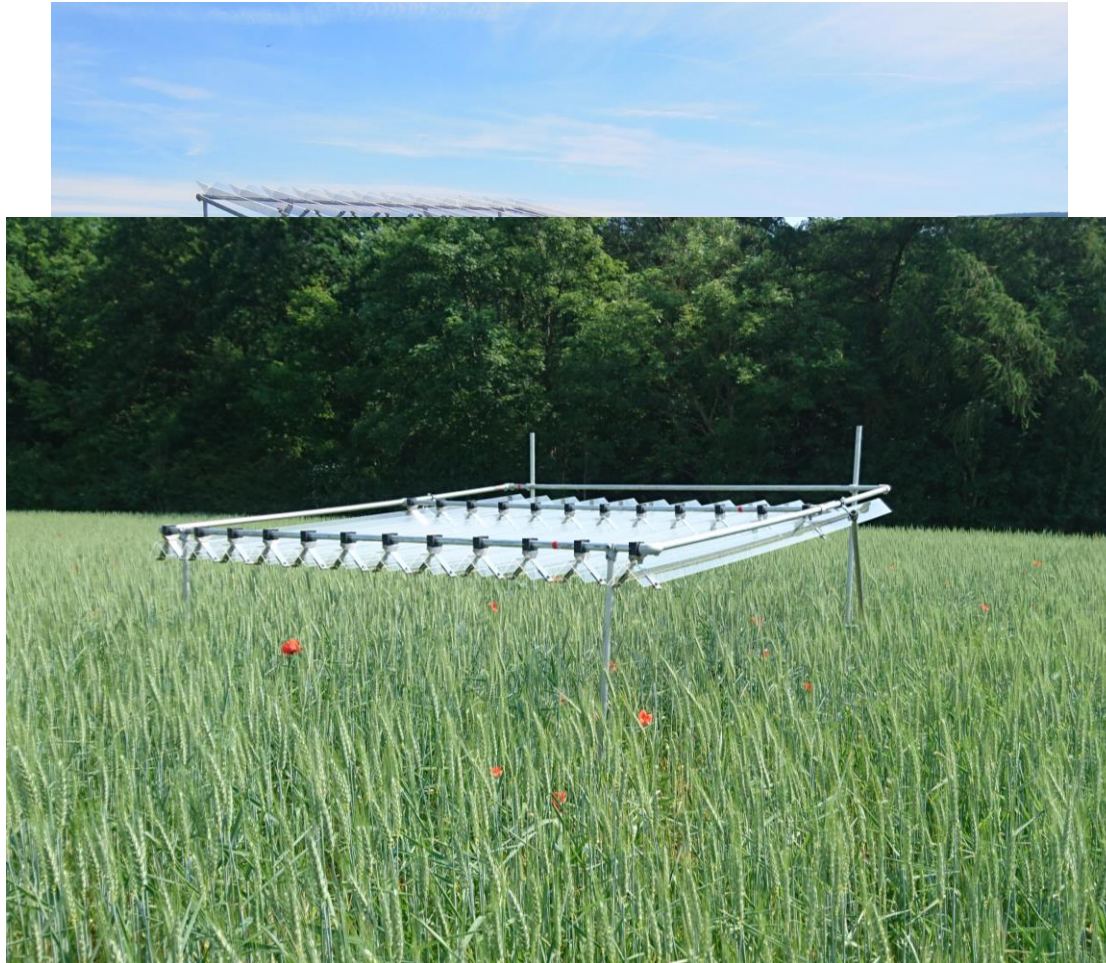
- **Roof ("R"):** Rain exclusion
- **Roof Control ("RC"):** Roof construction without exclusion
- **Control ("C"):** ambient control



# THE RAINOUT-SHELTERS

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... Reality



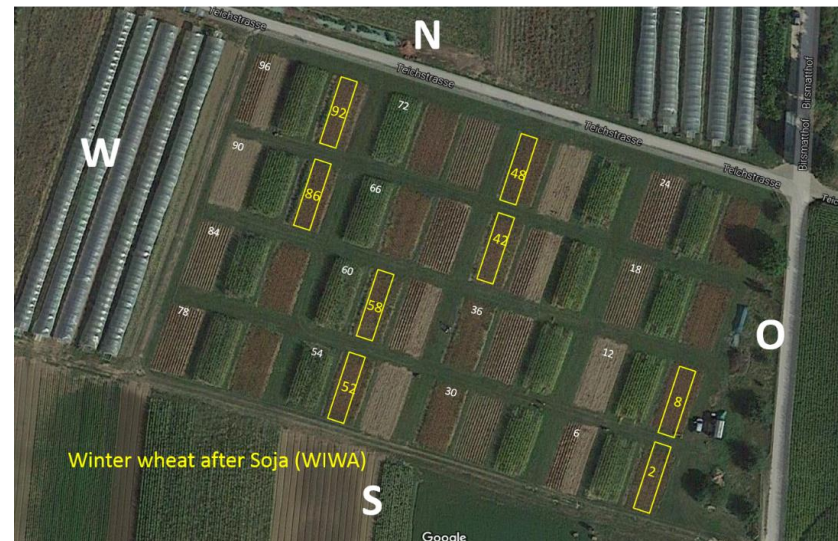
## Two Three experimental treatments

- Roof ("R"): Rain exclusion
- **Roof Control ("RC")**: Roof construction without exclusion
- Control ("C"): ambient control

# FIELD SITES SWITZERLAND

## The DOK trial – a long term experiment

- Close to Basel
- Since 1978
- Comparison of biodynamic, organic and conventional farming
- We used
  - conventional farming with mineral fertilizer (**low carbon content**)
  - biodynamic with organic fertilizer (**high carbon content**)



# SAMPLING



## MacFadyen

- 5 cm  $\emptyset$
- 10 cm depth

➤ Mesofauna



## Kempson

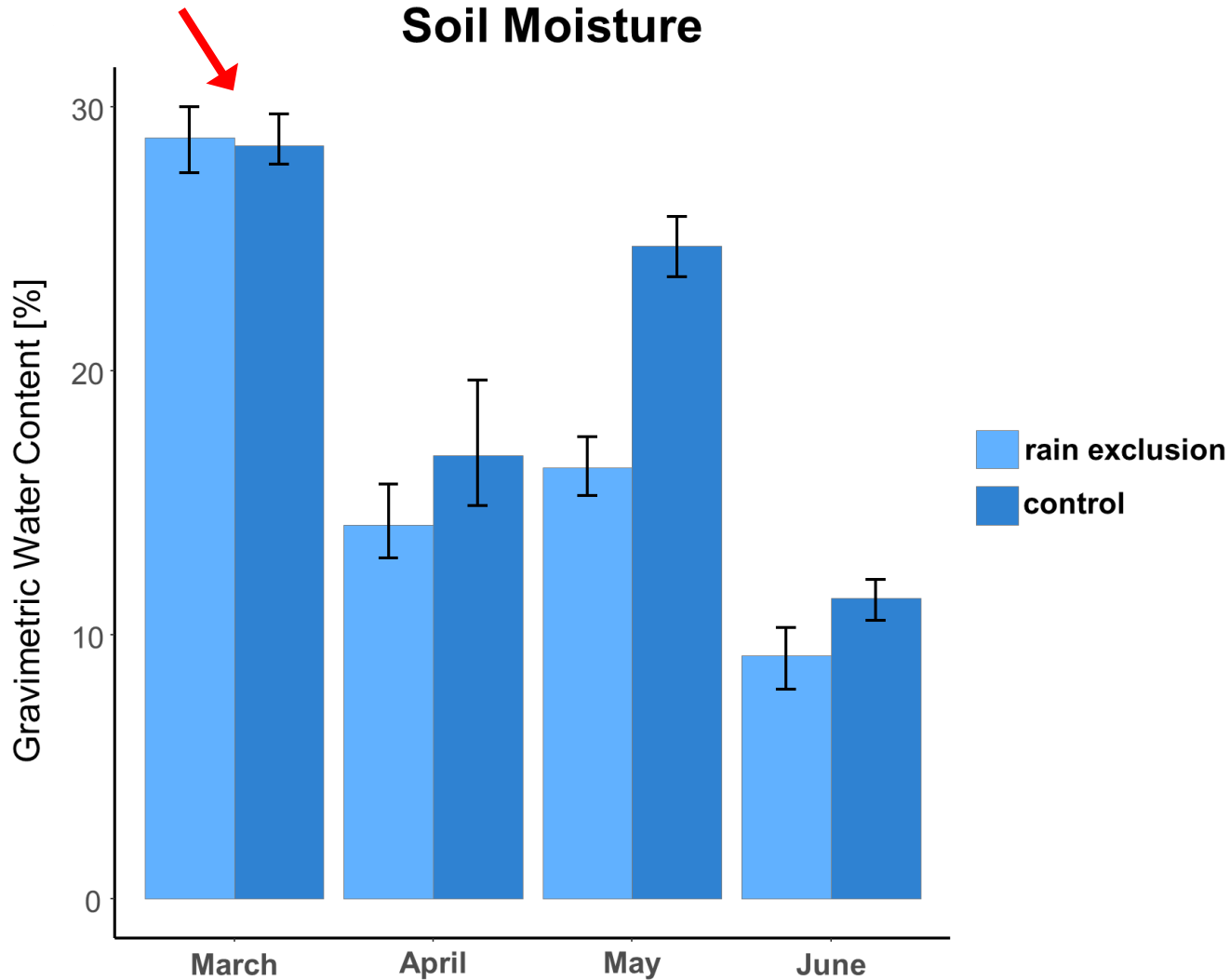
- 20 cm  $\emptyset$
- 10 cm depth

➤ Macrofauna,  
Mesofauna



# RAINOUT-SHELTER PERFORMANCE

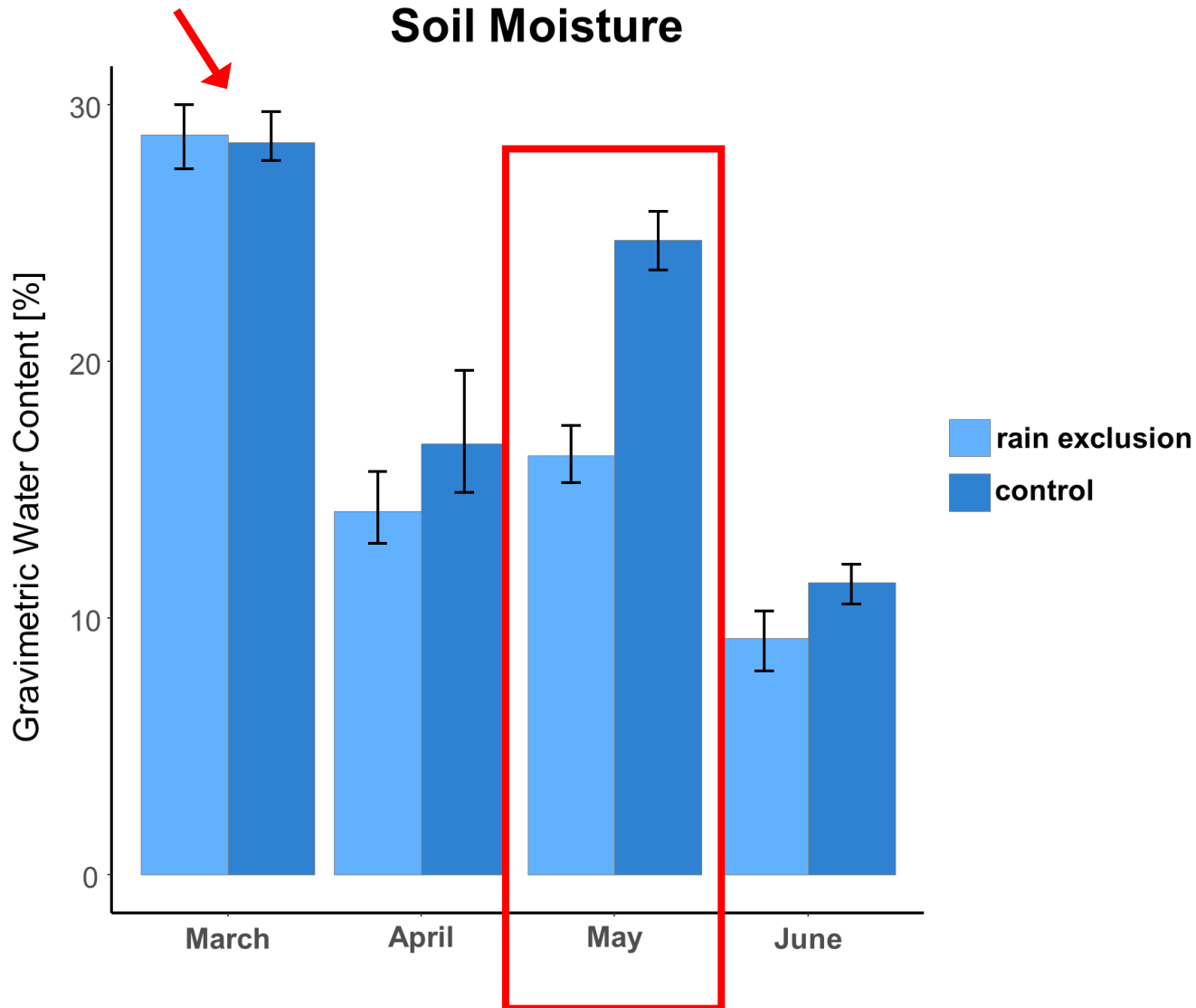
roof establishment



- March: comparable soil moisture
- April: trend
- **May: roof treatment with significantly lower soil moisture**
- June: differences decrease

# RAINOUT-SHELTER PERFORMANCE

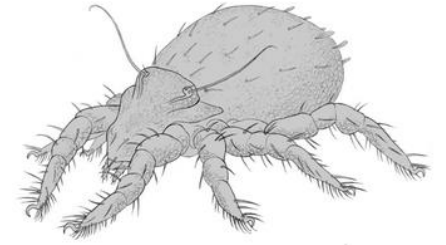
roof establishment



- March: comparable soil moisture
- April: trend
- **May: roof treatment with significantly lower soil moisture**
- June: differences decrease

# RESULTS - Oribatida

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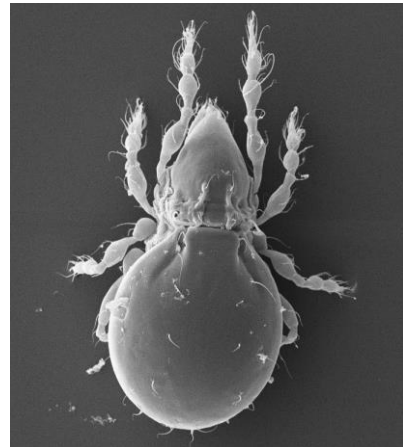
*Scheloribates laevigatus*



*Tectocephus velatus sarakensis*



*Zygoribatula excavata*

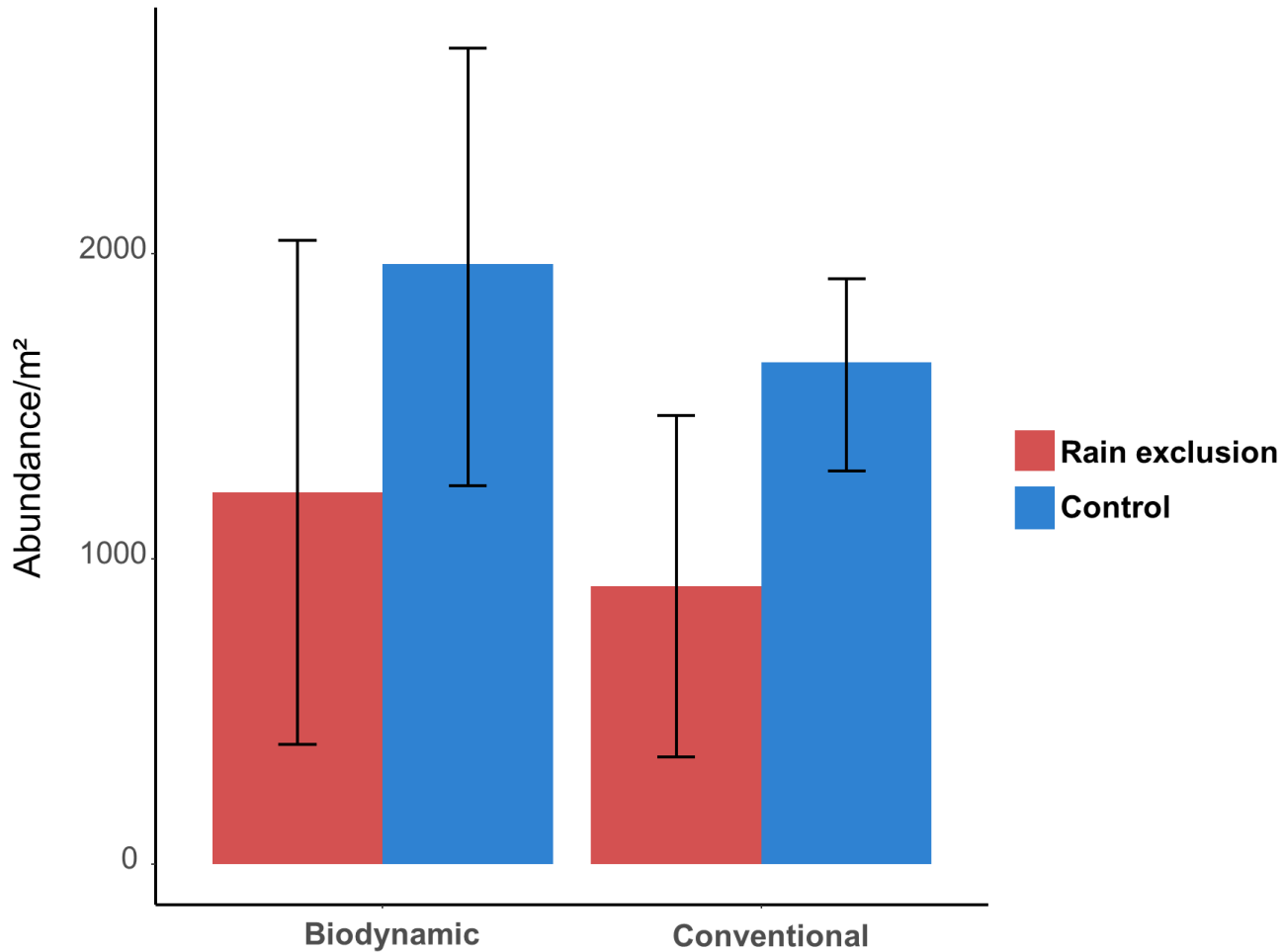
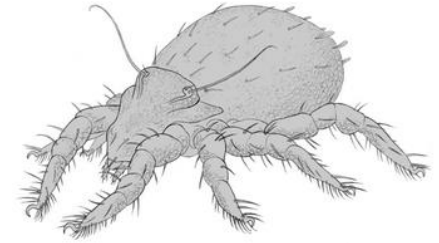


*Oppiella nova*

## 9 species

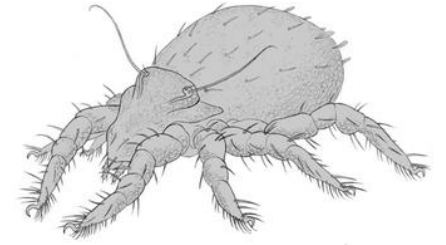
- *Scheloribates laevigatus*
- *Tectocephus velatus sarakensis*
- *Oppiella subpectinata*
- *Oppiella nova*
- *Suctobelbella* sp.
- *Zygoribatula excavata*
- *Phthiracarus compressus*
- *Ceratozetes mediocoris*
- *Ceratozetes gracilis*

# RESULTS - Oribatida

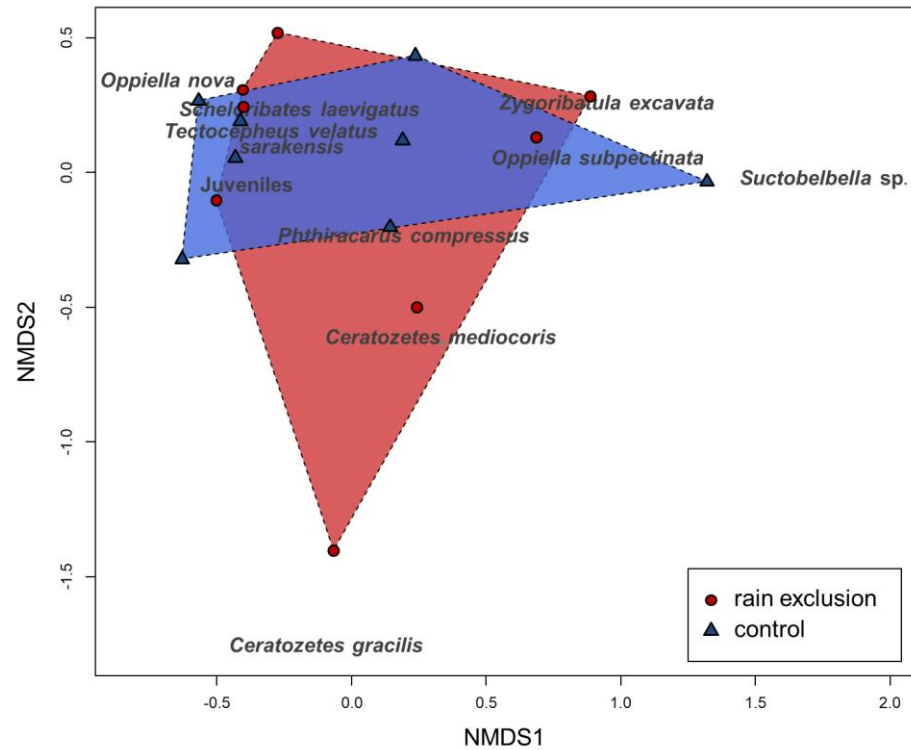


- Rain exclusion decreases Oribatida abundance
- Little decreased abundances in conventional compared to biodynamic system

# RESULTS - Oribatida

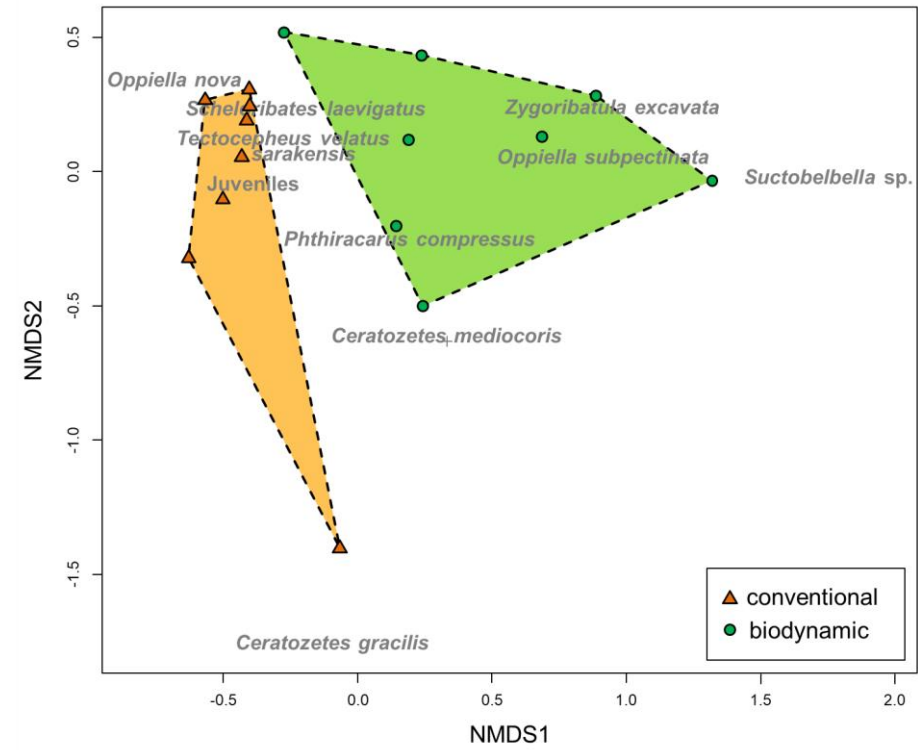


## Drought treatment



reduction to 3 dimensions, stress = 0.069

## Farming system



reduction to 3 dimensions, stress = 0.069



# RESULTS - Collembola



*Orchesella villosa*



*Isotoma viridis*



*Sminthurinus elegans*



*Ceratoophysella denticulata*



*Lepidocyrtus cyaneus*

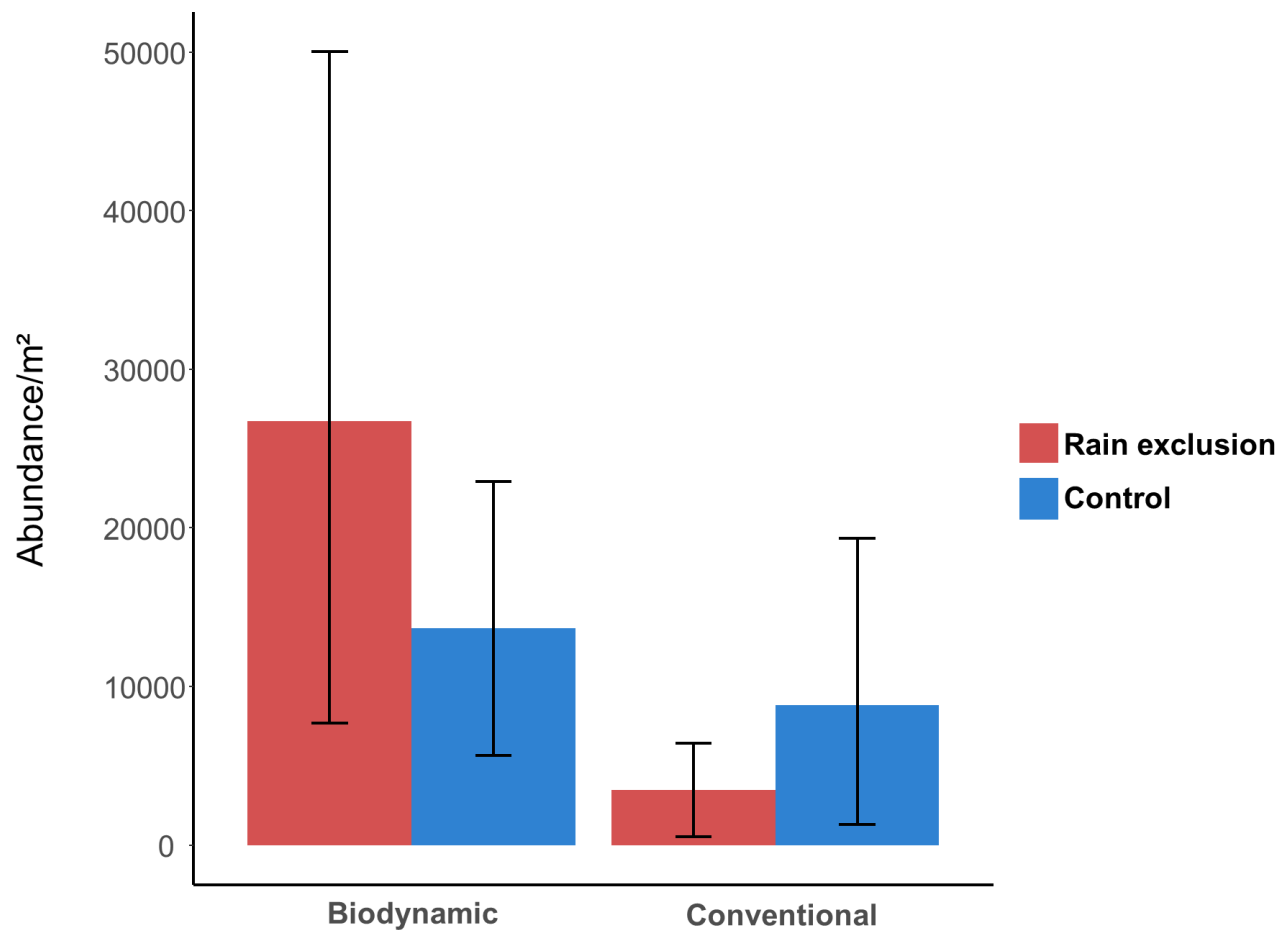


*Mesaphorura* sp.

## 33 species

- *Brachystomella parvula*
- *Neotullbergia crassiscuspis*
- *Neotullbergia tricuspis*
- *Stenophorella quadrispina*
- *Stenophorella parisi*
- ***Ceratoophysella denticulata***
- *Ceratoophysella gibbosa*
- *Paratullbergia macdougalli*
- *Mesaphorura pongei*
- *Mesaphorura kraubaueri*
- ***Mesaphorura macrochaeta***
- *Parisotoma notabilis*
- *Cryptopygus thermophilus*
- *Isotomurus fucicolus*
- ***Isotomurus maculatus***
- *Isotomurus graminis*
- ***Isotoma viridis***
- ***Isotoma caerulea***
- *Folsomia candida*
- ***Orchesella villosa***
- ***Heteromurus major***
- *Heteromurus nitidus*
- ***Sminthurinus elegans***
- *Sminthurinus aureus*
- *Sminthurinus niger*
- *Stenacidia violacea*
- *Sphaeridia pumilis*
- *Deuterosminthurus pallipes*
- ***Lepidocyrtus cyaneus***
- ***Pseudosinella alba***
- *Pseudosinella petterseni*
- *Sinella tenebricosa*
- *Entomobrya lanuginosa*

# RESULTS - Collembola

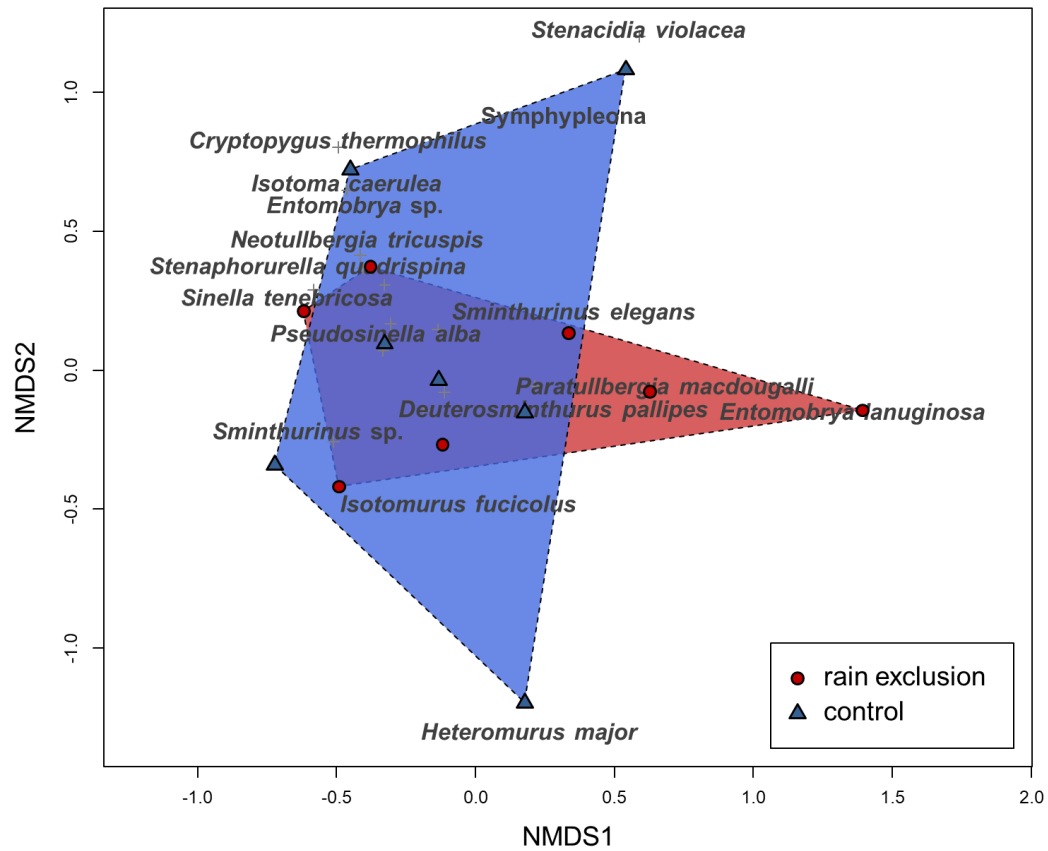


- Drought decreased Collembola in conventional farming
- Drought increased Collembola in biodynamic farming

# RESULTS - Collembola

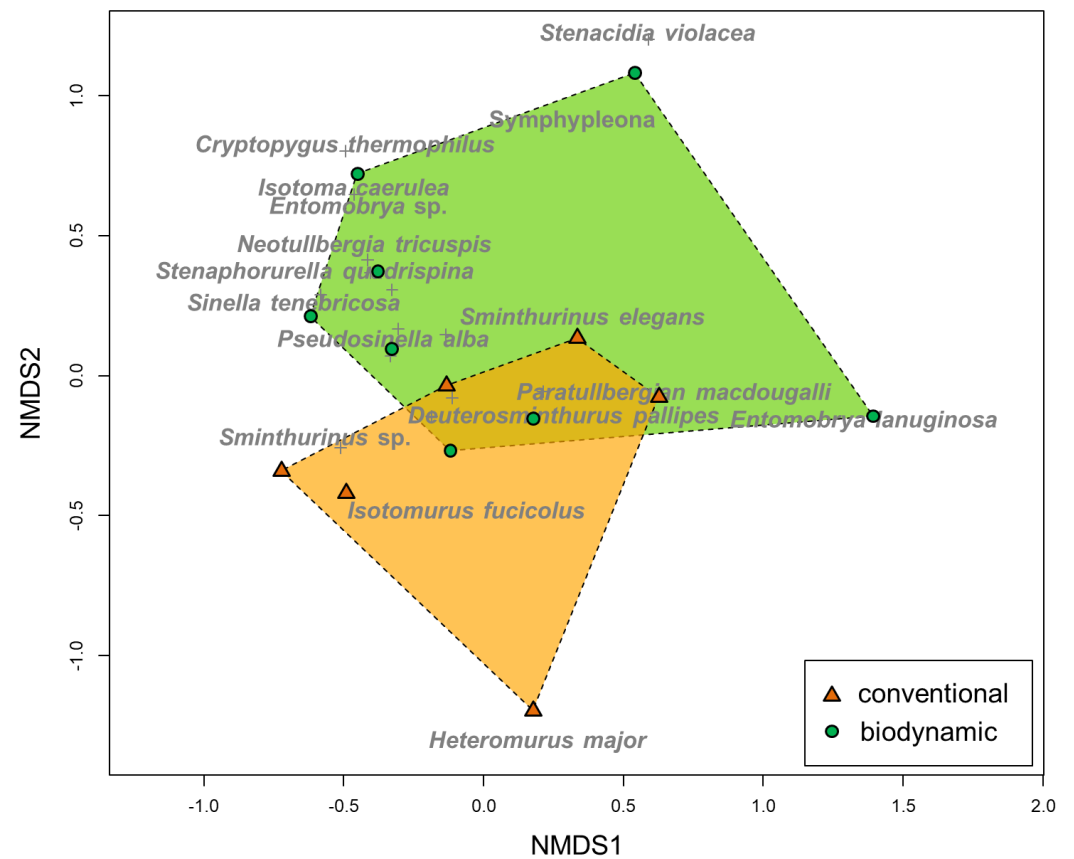


## Drought treatment



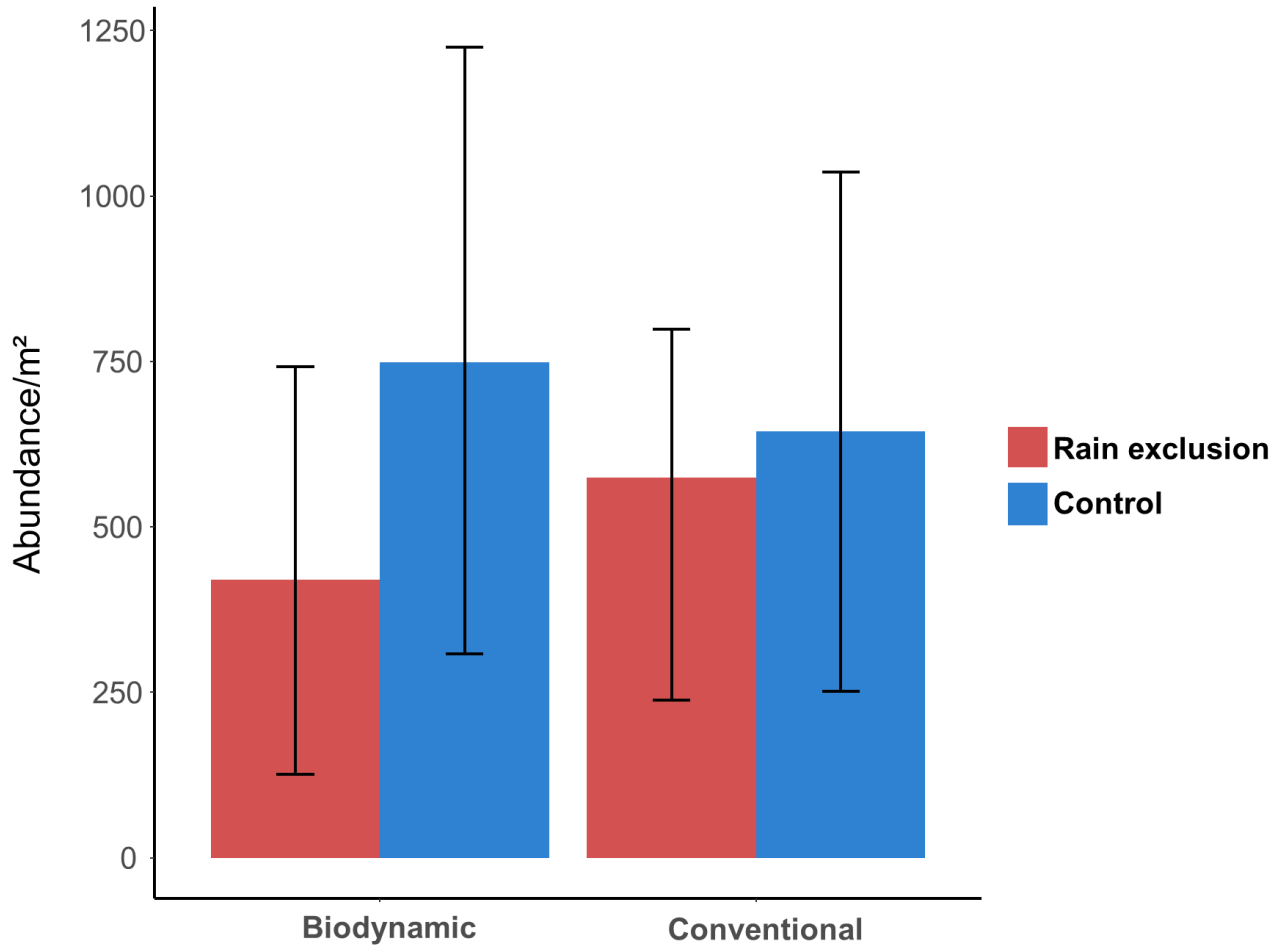
reduction to 3 dimensions, stress = 0.071

## Farming system



reduction to 3 dimensions, stress = 0.071

# RESULTS - Epigeic Collembola

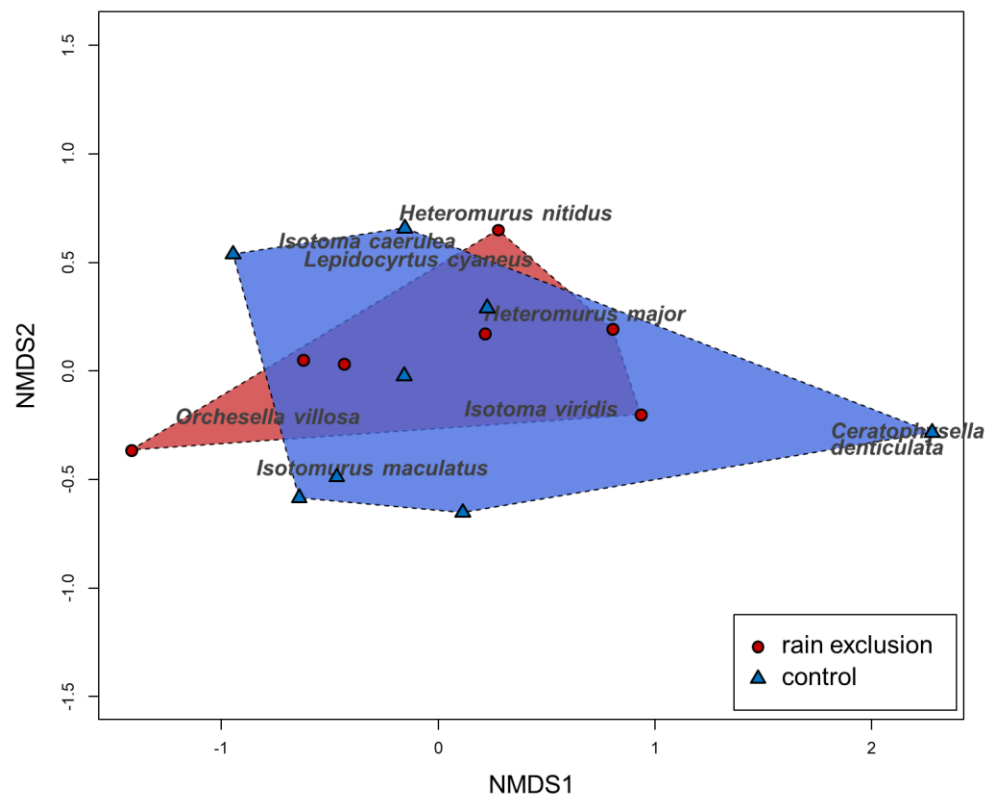


- Drought decreased Collembola in biodynamic farming
- In conventional farming nearly no effect of roof treatment

# RESULTS - Epigeic Collembola

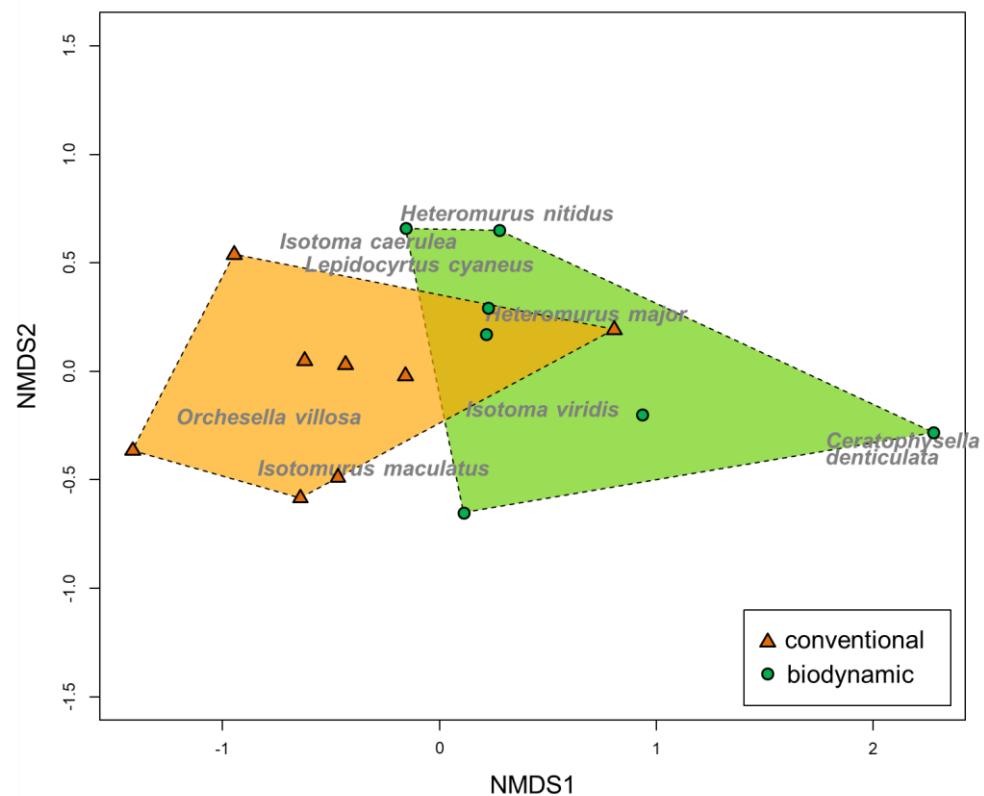


## Drought treatment



reduction to 2 dimensions, stress = 0.095

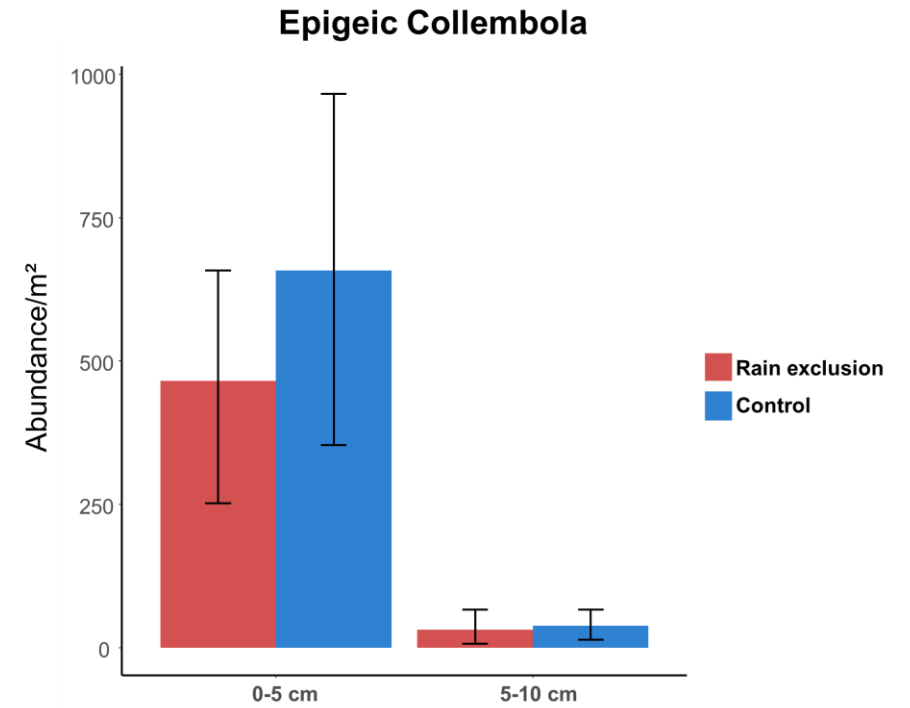
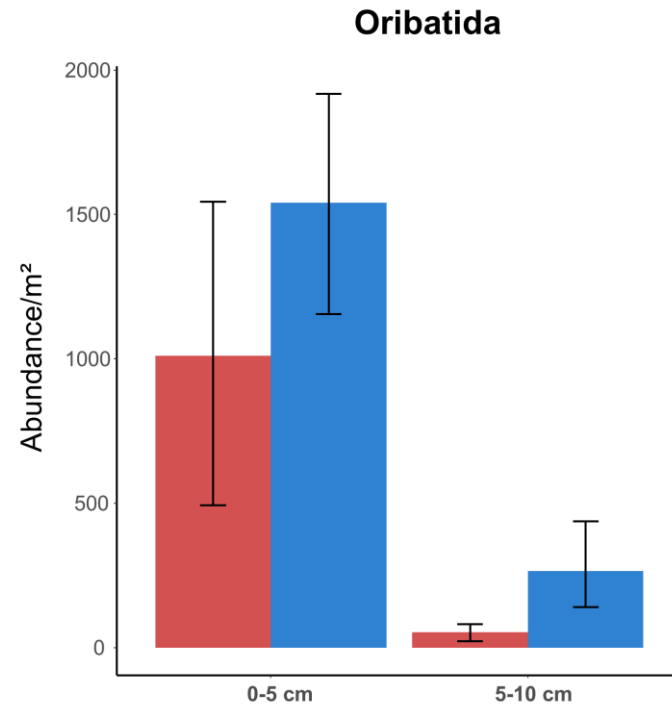
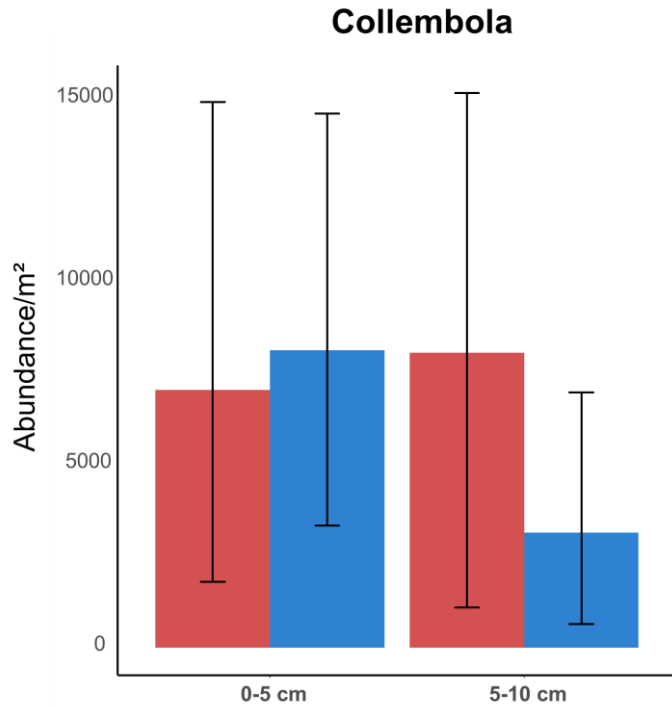
## Farming system



reduction to 2 dimensions, stress = 0.095

# RESULTS

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- Only Collembola escape to deeper soil under drought

# SUMMARY

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- Oribatida:
  - decreased under drought simulation
  - Different communities in the two farming systems

**Drought vulnerability**



- Collembola
  - Different communities in the two farming systems
  - decreased under drought simulation in conventional system
  - increased under drought simulation in biodynamic system



- Epigeic Collembola
  - Different communities in the two farming systems
  - decreased under drought simulation in biodynamic system

# SUMMARY

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- Oribatida:
  - decreased under drought simulation
  - Different communities in the two farming systems

**Drought vulnerability**



- Collembola
  - Different communities in the two farming systems
  - decreased under drought simulation in conventional system
  - increased under drought simulation in biodynamic system

**Drought vulnerability  
(at low  $C_{org}$ )**



- Epigeic Collembola
  - Different communities in the two farming systems
  - decreased under drought simulation in biodynamic system



# SUMMARY

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- Oribatida:



- decreased under drought simulation
- Different communities in the two farming systems

**Drought vulnerability**

- Collembola



- Different communities in the two farming systems
- decreased under drought simulation in conventional system
- increased under drought simulation in biodynamic system

**Drought vulnerability  
(at low  $C_{org}$ )**

- Epigeic Collembola



- Different communities in the two farming systems
- decreased under drought simulation in biodynamic system

**Drought vulnerability  
(at high  $C_{org}$ )**

Thank you for your attention!

