

Red wood ants (*Formica rufa* group): their contribution to soil C and N pools and CO₂ emissions in subalpine conifer forests

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Ants are important components of soil invertebrate community



Biodiversity

Ecosystem engineers

Provider of habitat

Red wood ants (*Formica rufa*-group) build large aboveground nests composed of organic material (twigs, needles, wood, resin)



Wood ants (*Formica rufa*-group) are ubiquitous in many European forests



Little is known on the contribution of these mounds to ecosystem C and N pools and CO₂ fluxes in forest ecosystems

Study area



Switzerland



Swiss National Park

Climate (Inner-alpine, continental)

Mean annual temperature

0.2 ± 0.7 °C

Mean annual precipitation

925 ± 162 mm

Elevation

1650 to 3150 m a.s.l.

Tree species

Mountain pine (*Pinus montana*)

Stone pine (*Pinus cembra*)

European larch (*Larix decidua*)

Norway spruce (*Picea abies*)

Scots pine (*Pinus sylvestris*)

Four forest ecosystem in different successional stages

Mountain pine (MP)



Mountain pine/Larch (MP/L)



Mixed (Mix)



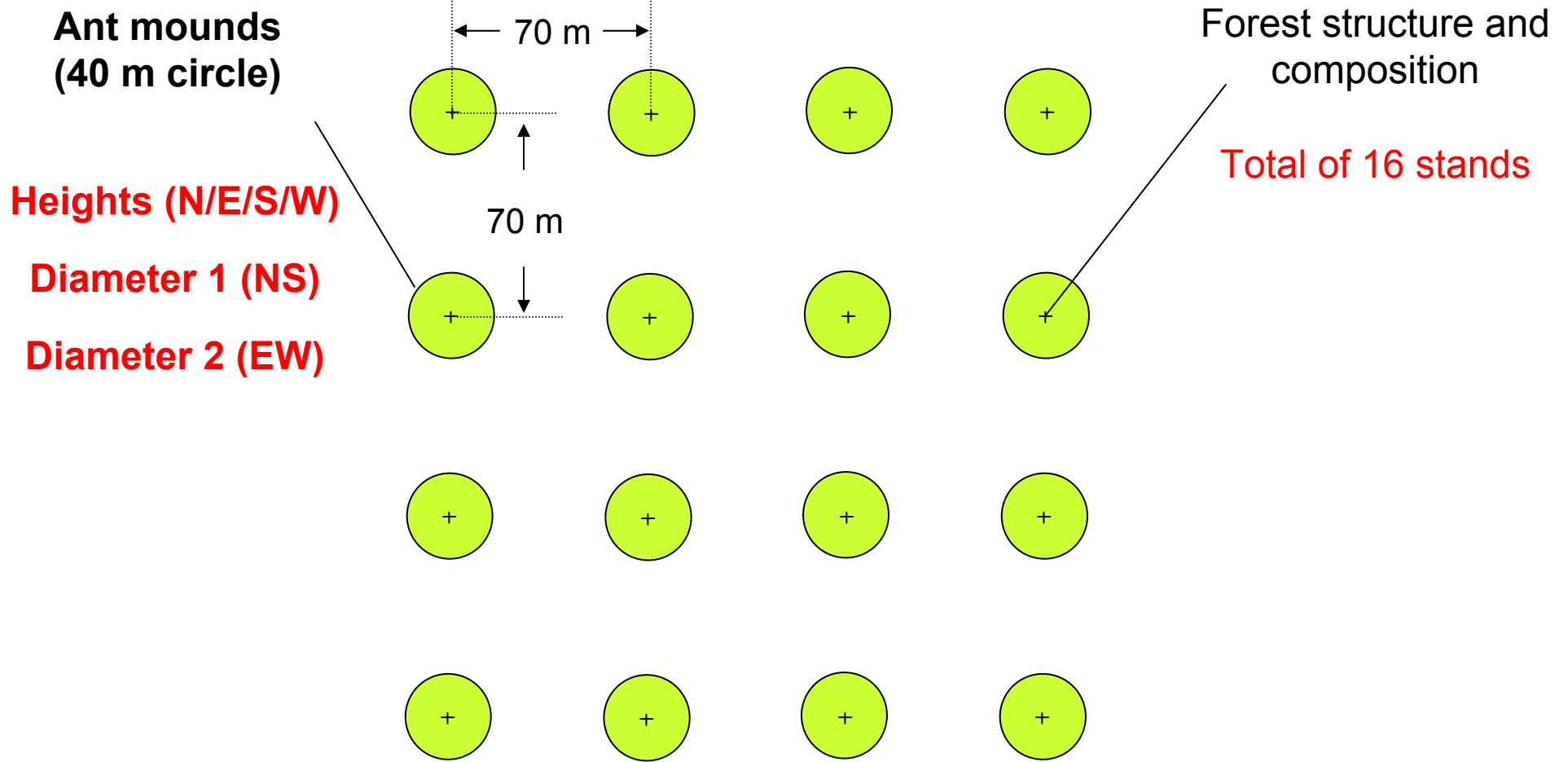
Stone pine/Larch (SP/L)



Successional development

Methods

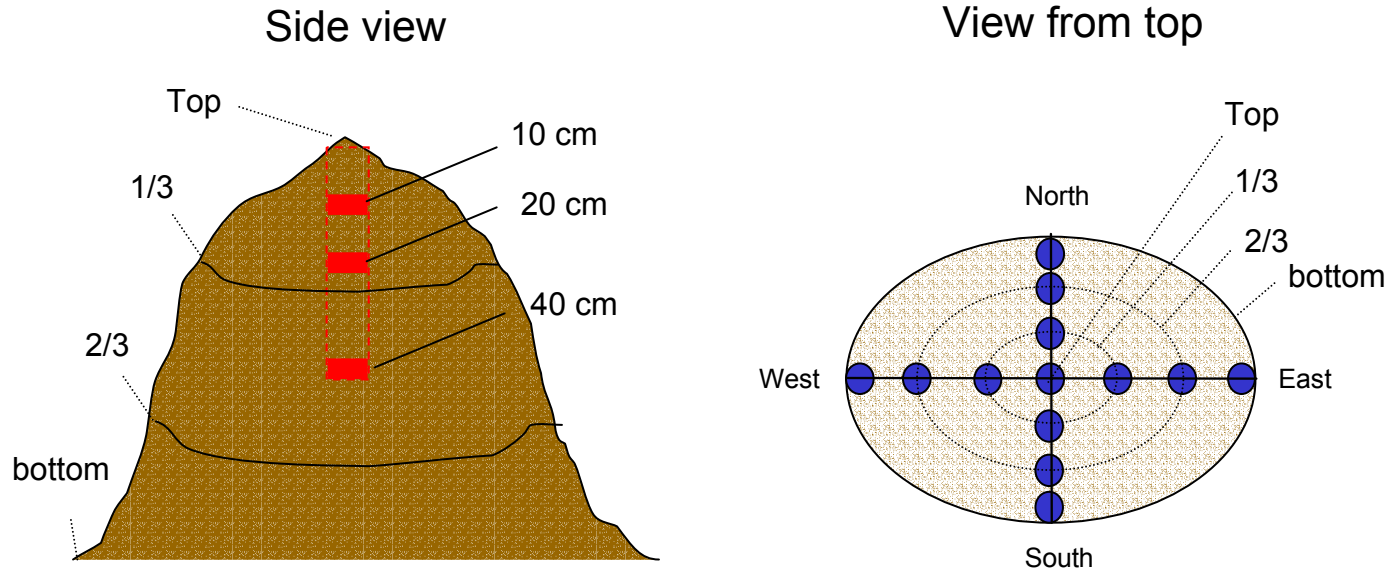
Ant mound survey: same stands/plots as forest survey



Methods

Mound C/N and CO₂ sampling

Two mounds closest to stand center

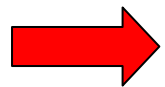
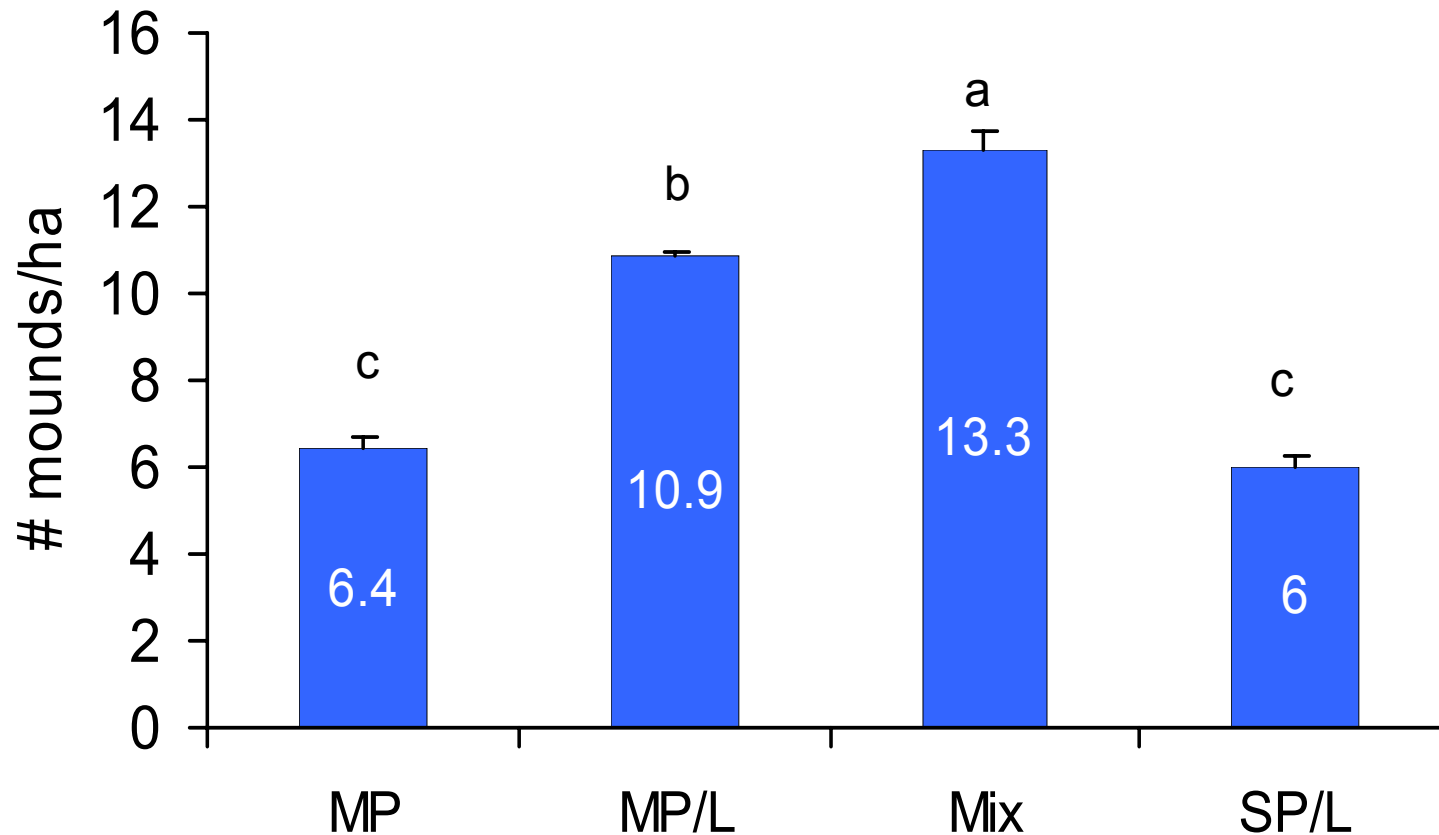


- = Samples for C and N analyses
- = CO₂ emission (bi-monthly, June – September)



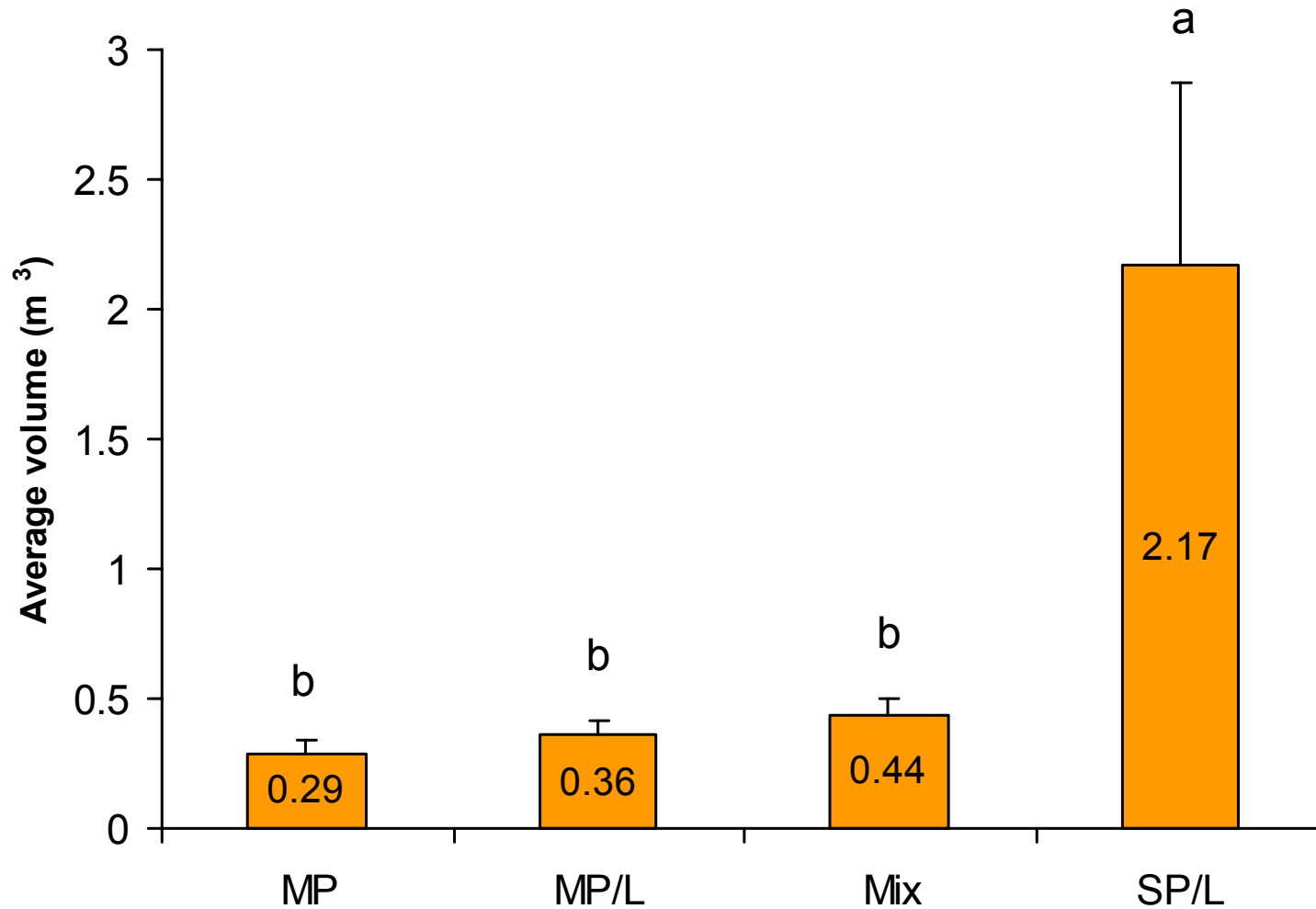
Mound C and N pools

Number of mounds per hectare



Number of mounds dependent on tree species composition, canopy closure and exposition

Mound volume



Highest volume in oldest SP stands

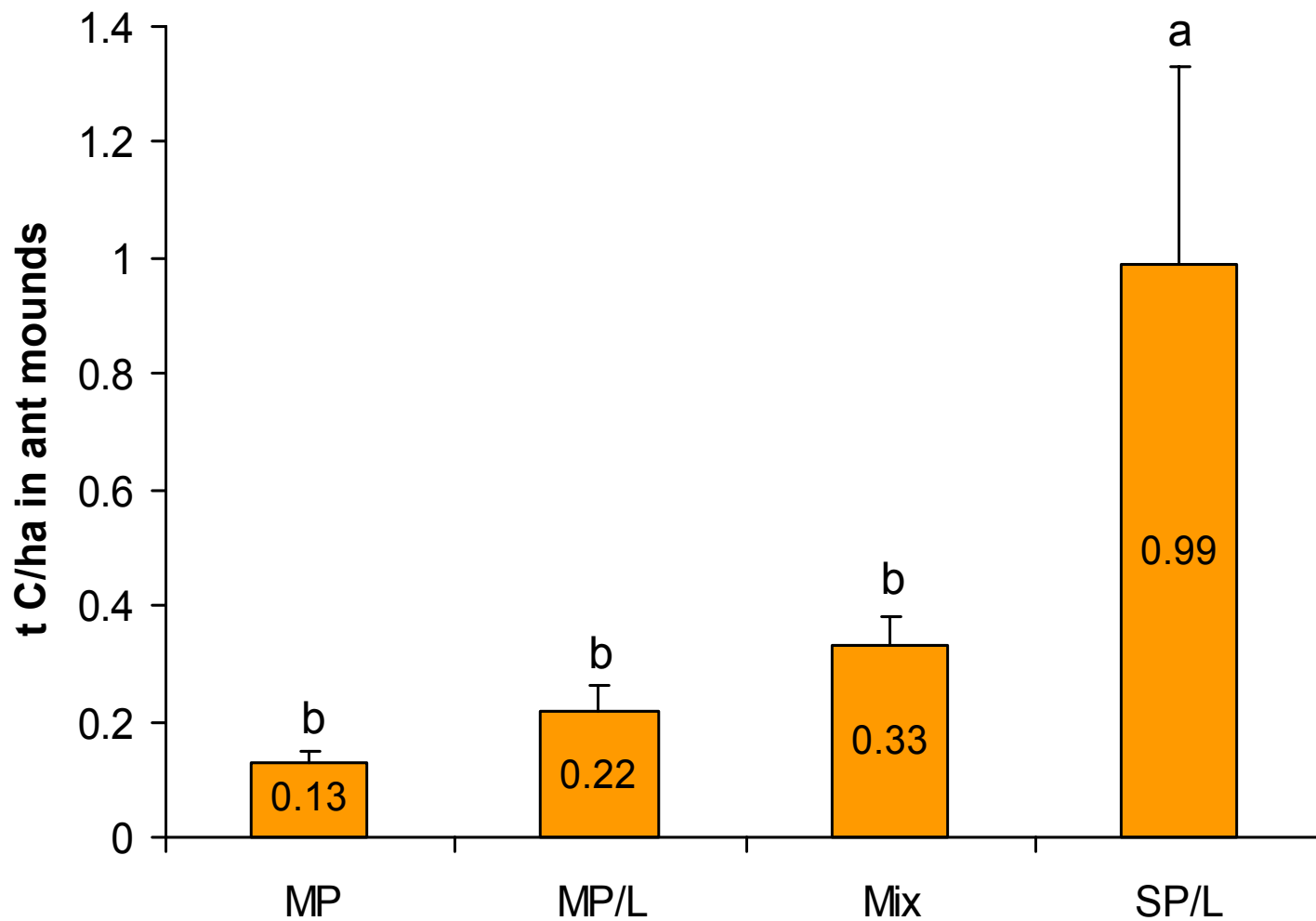
C/N concentrations of mound material



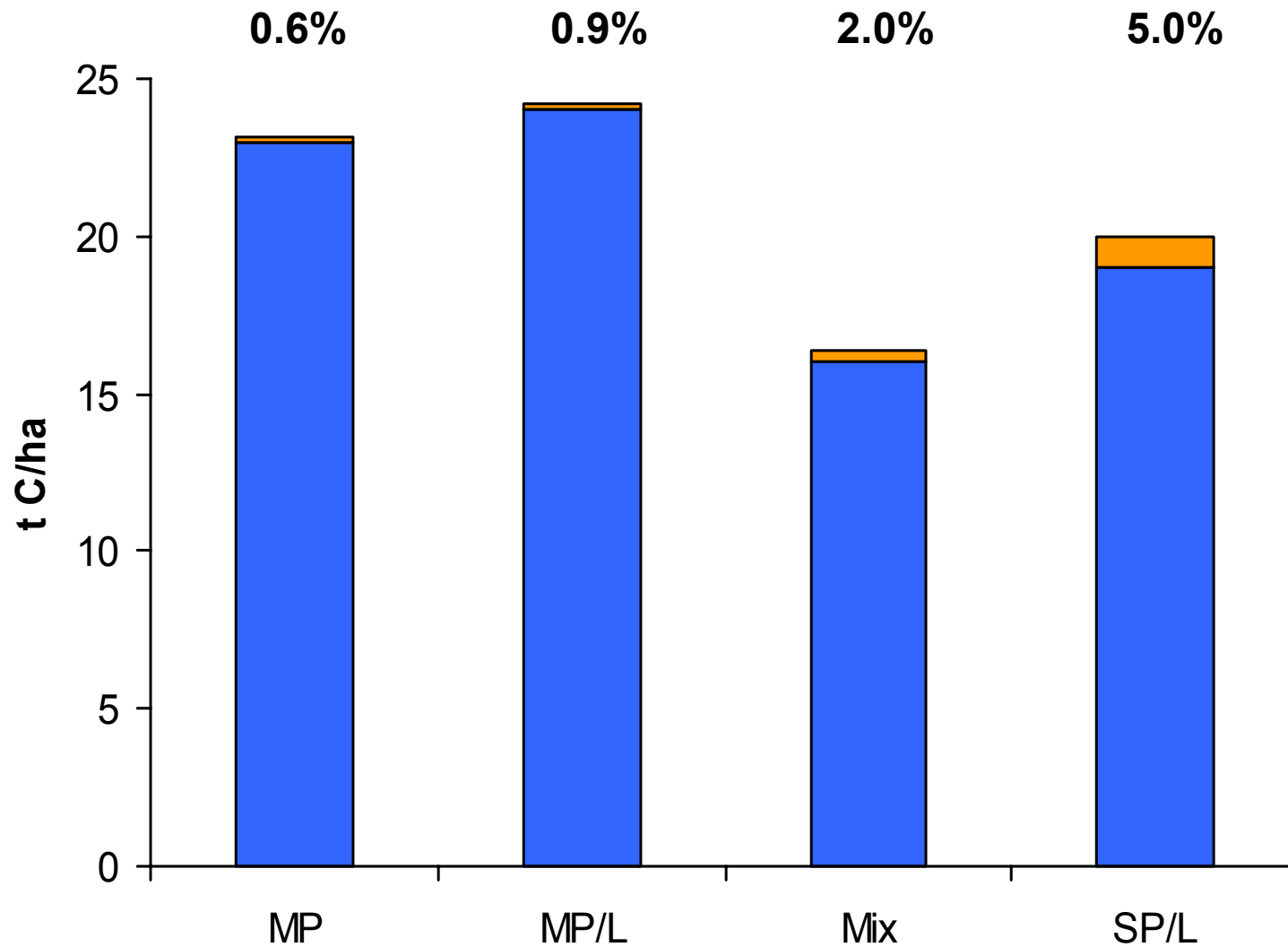
**Mound C and N concentration
not different (46.9%, 1.02%),
but higher than
forest floor (38.5%, 0.88%)**

**Mound C:N ratios not different,
and similar to forest floor (47)**

Mound C pools



Contribution of mounds to forest floor C pools



Contribution of mounds to forest floor N pools

MP: 3 kg/ha

MP/L: 4 kg/ha

Mix: 7 kg/ha

SP/L: 21 kg/ha

Only 0.8 to 4.8%





Mound CO₂ emissions

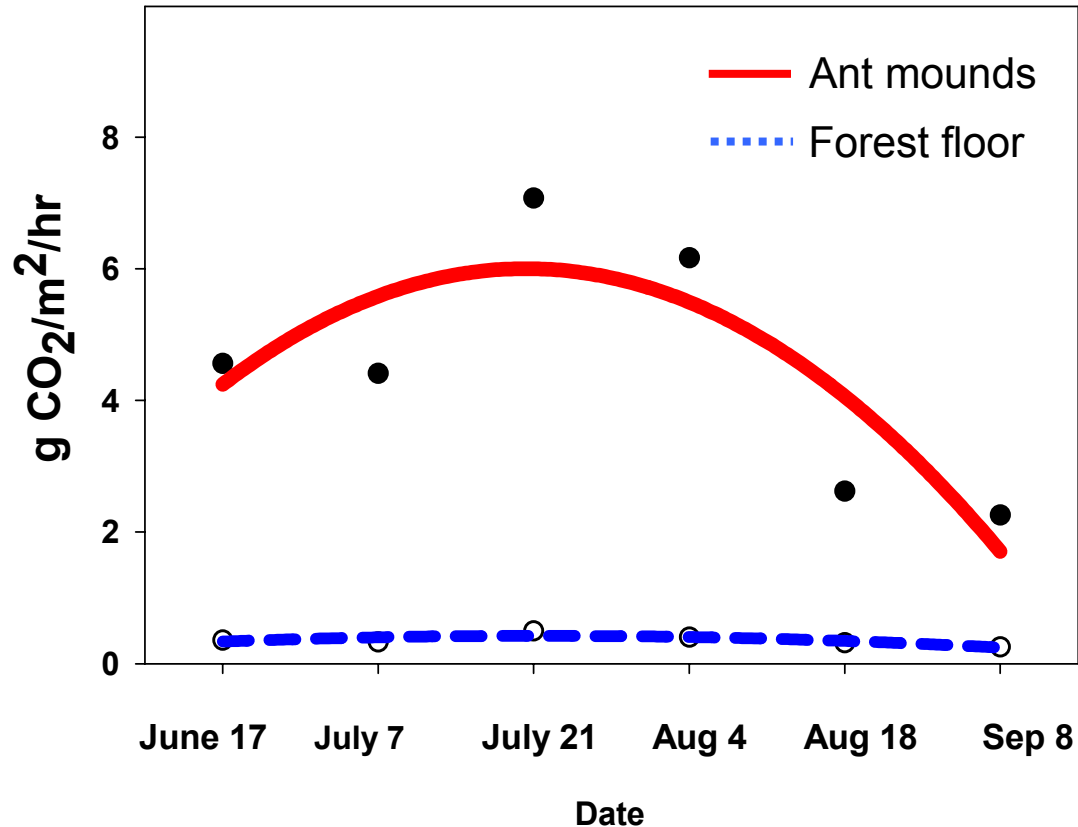
Mound CO₂ emissions

Range 0.8 to 8.6 g CO₂/m²/h average for the individual mounds over the entire period (Max 15.3)

No difference in emission among stand types



Mound vs forest floor CO₂ emission



Mounds are „hot spots“ (3.5 to 12.4 times higher than FF)

On a hectare basis underestimation of 0.7 to 2.5%

Potential sources of CO₂

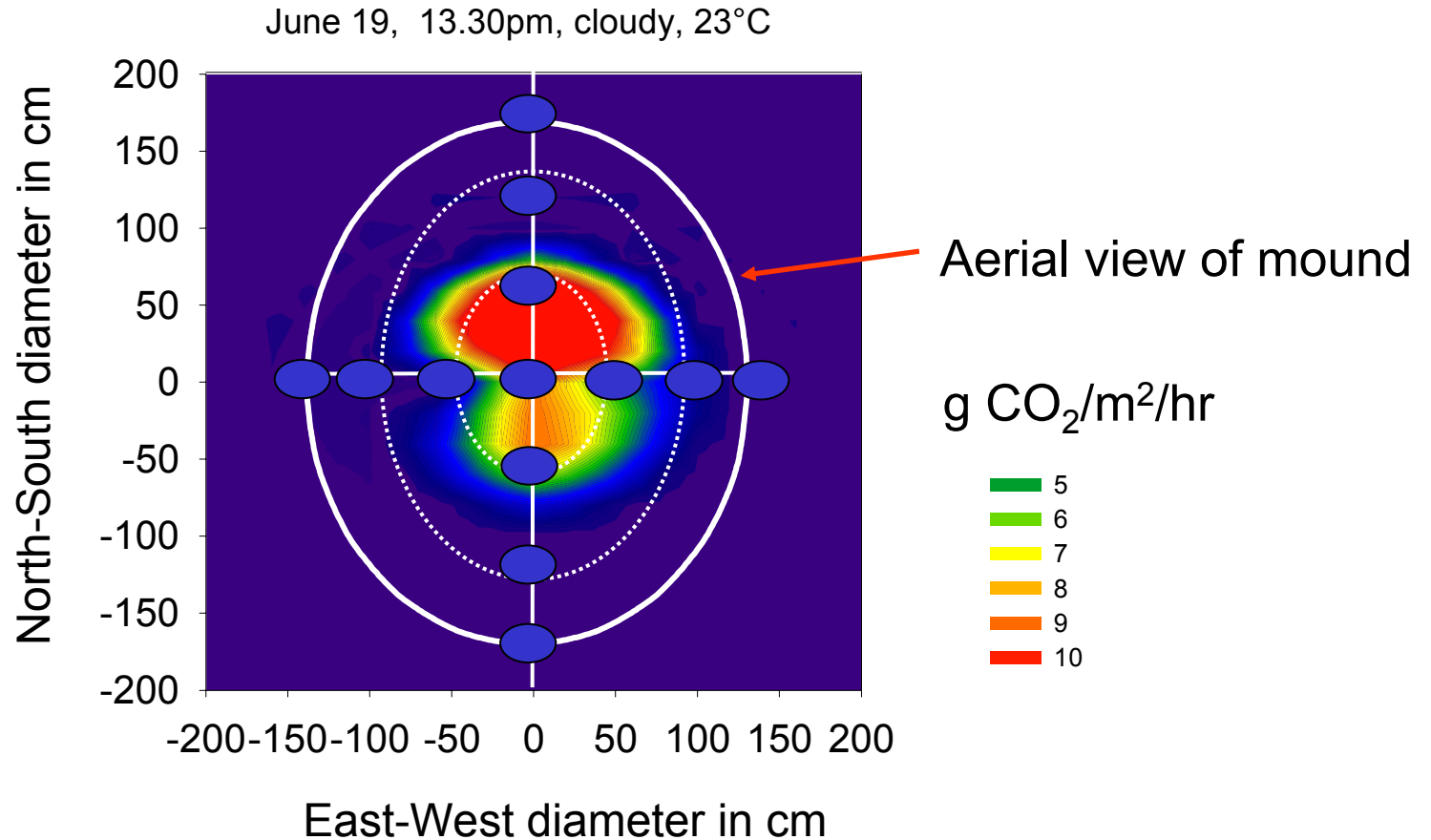
Respiration of ants and other invertebrates



Organic matter decomposition

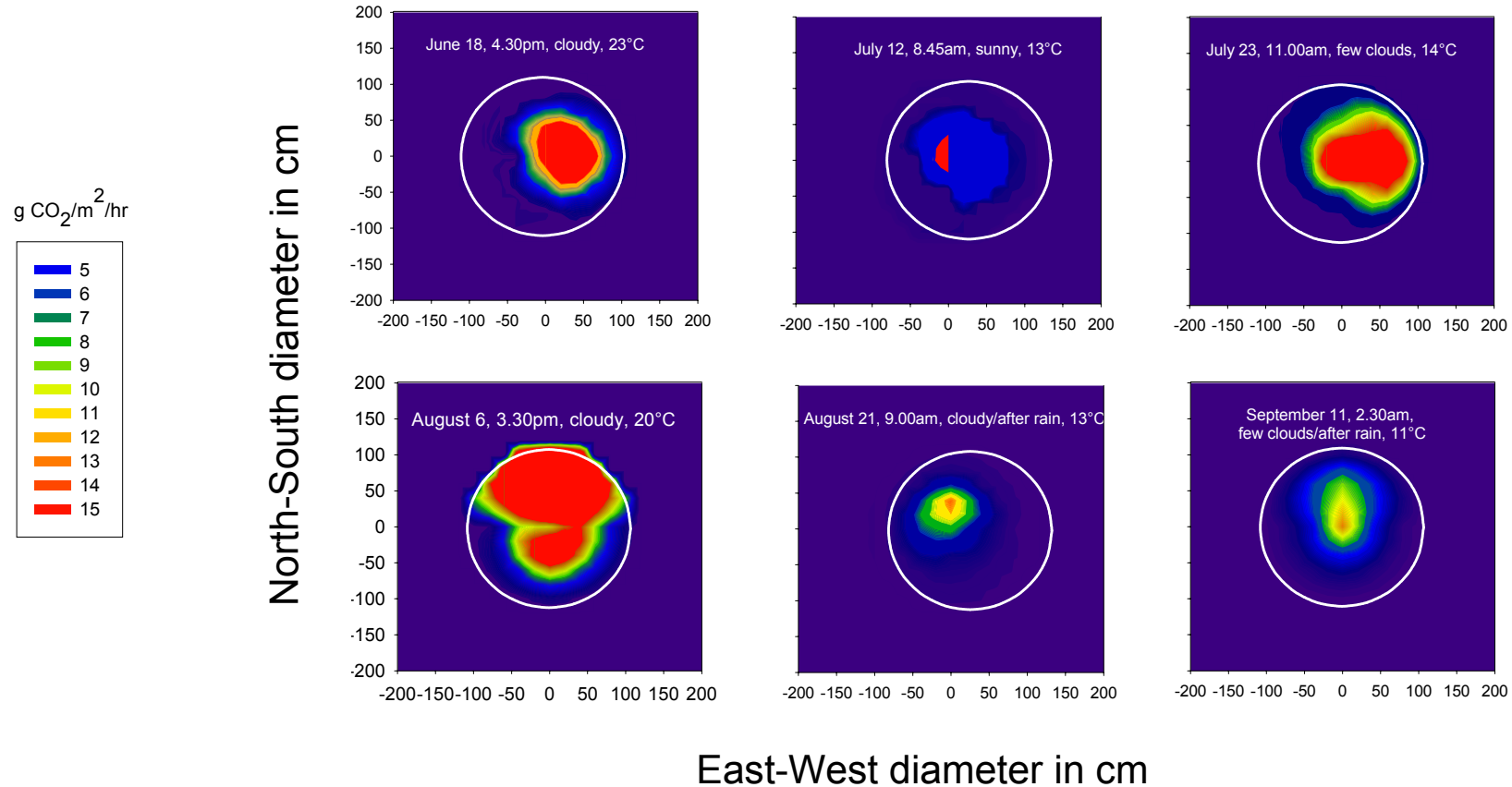
Root respiration

Mound CO₂ emissions



Top 3rd is location of „breeding chamber“

Changes in CO₂ emission



Ant respiration seems to be the dominate source of CO₂

Overall conclusions



Conclusions

Red wood ant mounds do NOT

- ➔ Contribute much to ecosystem C and N pools
- ➔ Contribute much to ecosystem CO₂ fluxes

Red wood ant mounds are

- ➔ CO₂ „hot spots“
- ➔ Increasing spatial heterogeneity / patchiness
- ➔ „Keystone structures“ Tews et al. 2004

Questions?



