

Arctic tree expansion leads to more efficient N cycling due to changed mycorrhizal functioning

Karina Clemmensen

Forest Mycology & Plant Pathology
Swedish University of Agricultural Sciences

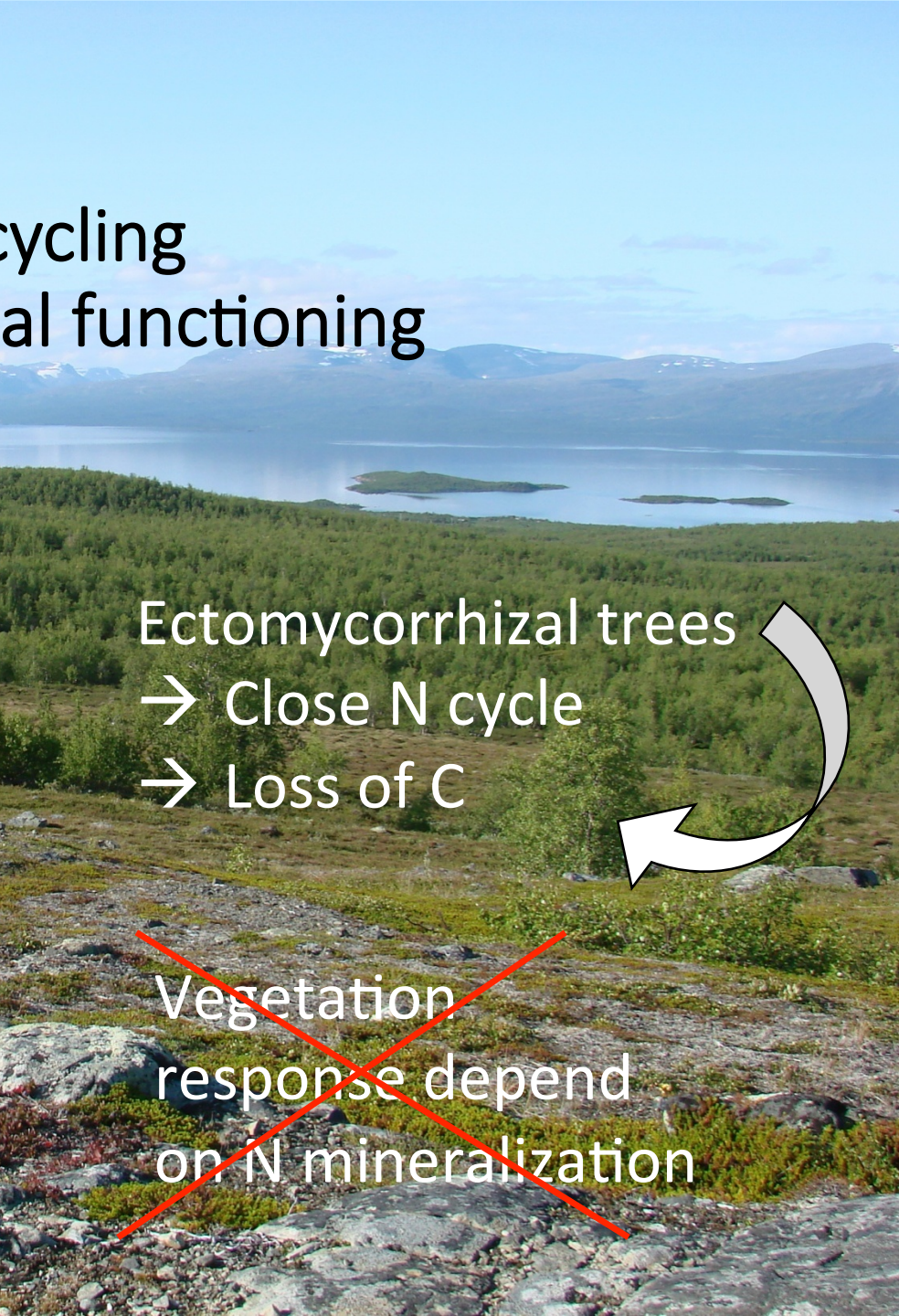
Björn Lindahl

Sara Hallin

Anders Michelsen

Roger Finlay

ITEX Stirling 25-27. April 2018



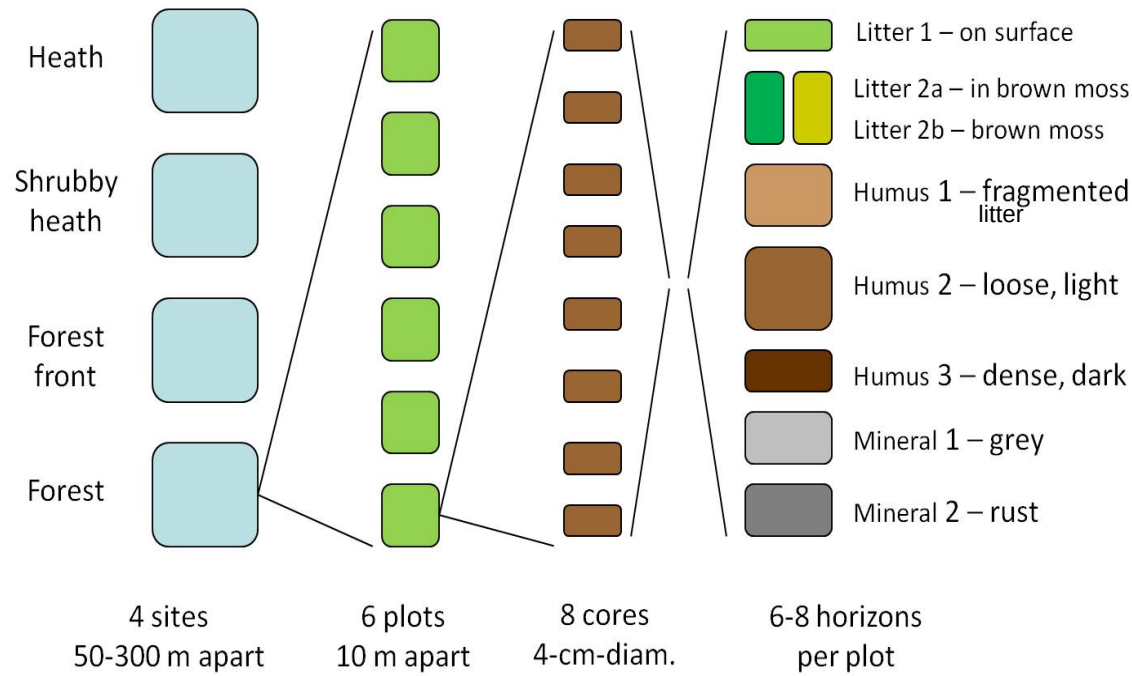
Ectomycorrhizal trees

→ Close N cycle

→ Loss of C

~~Vegetation
response depend
on N mineralization~~

Study design

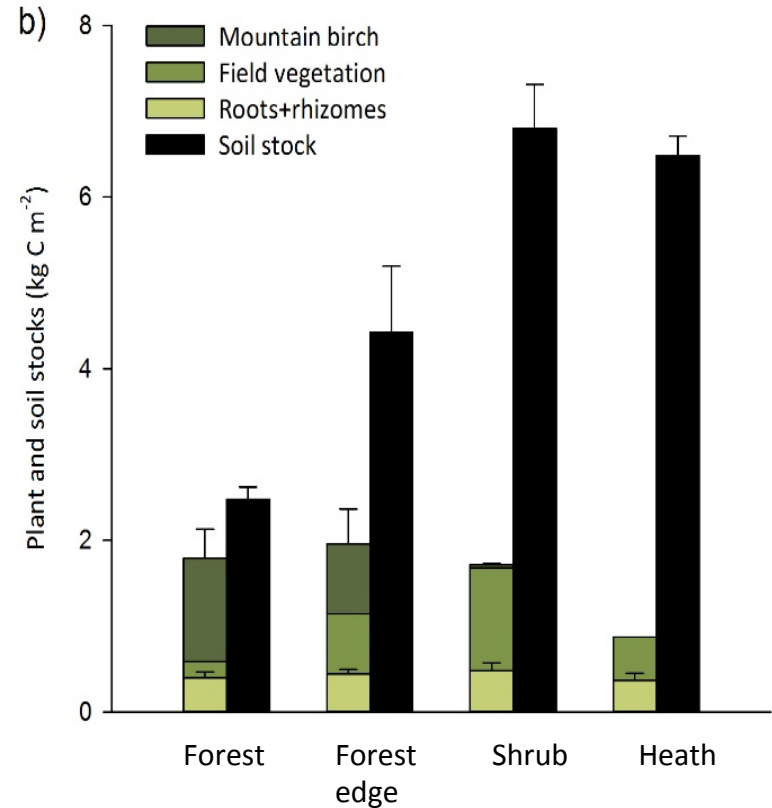
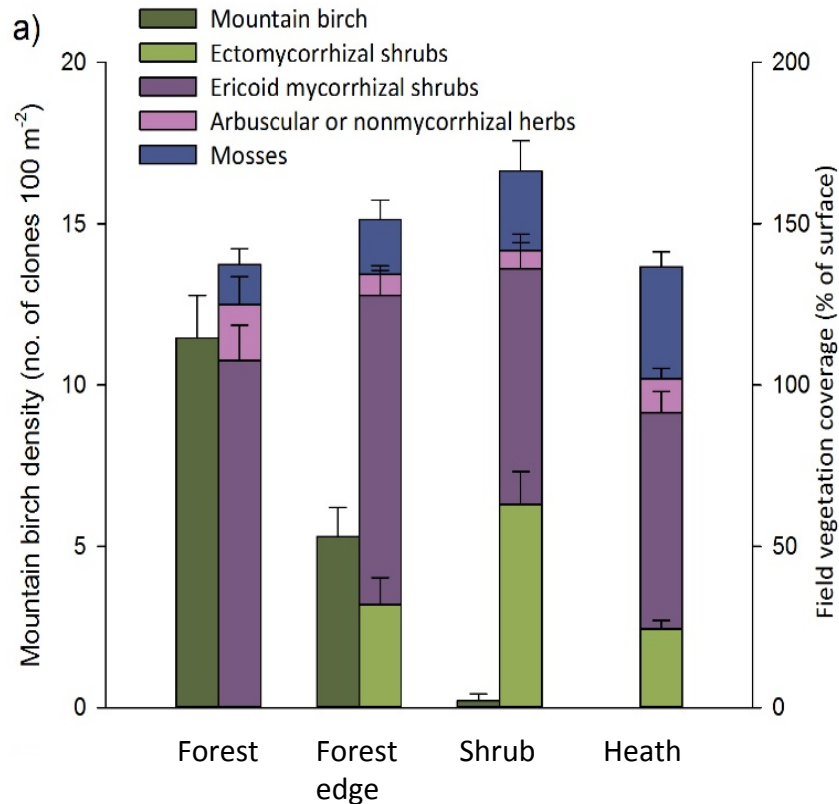


→ HUMUS
→ /area

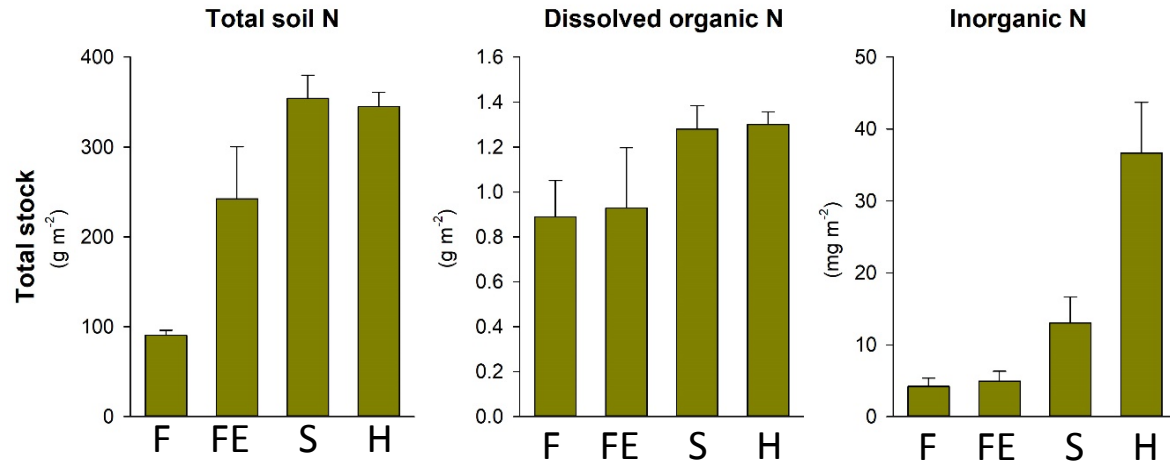


Tree density & soil C inversely related

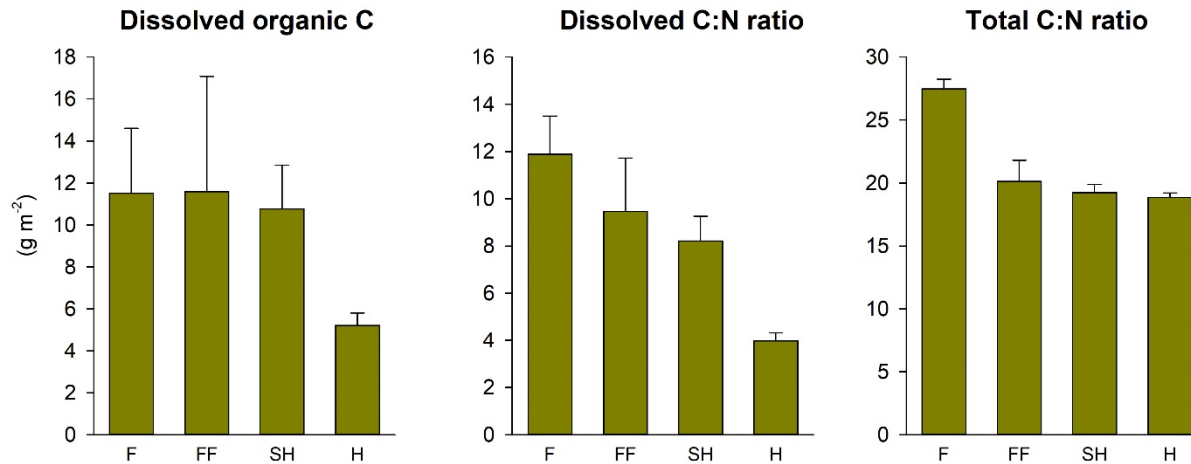
(c.f. Hartley *et al* 2012,
Parker *et al* 2015)



N stocks



Organic N
cycling



Inorganic
N cycling

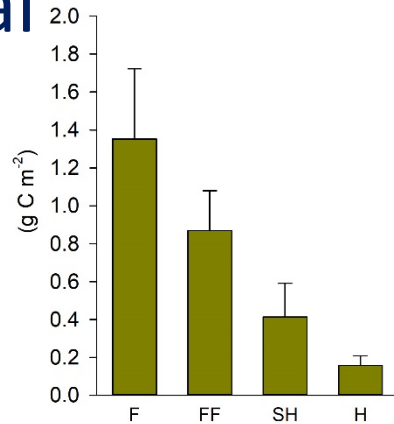


Microbial pools

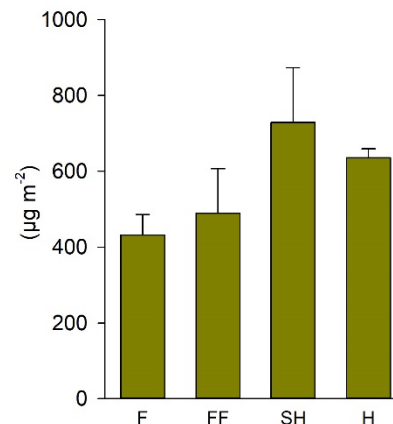
Fungal

Organic N cycling

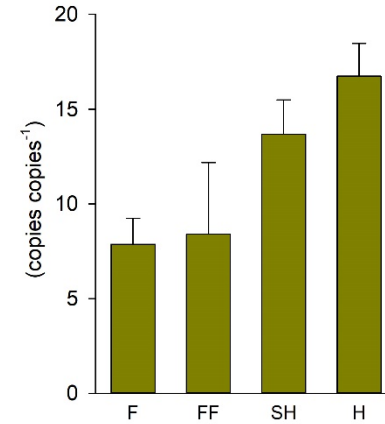
Mycelial growth



Ergosterol

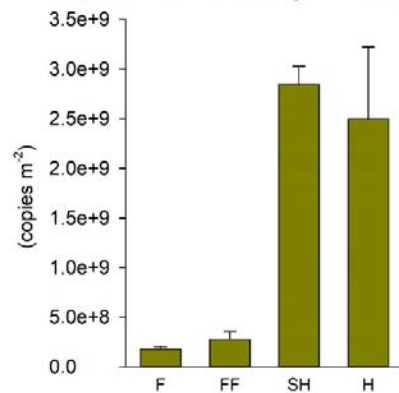


Bacterial 16S : Fungal ITS

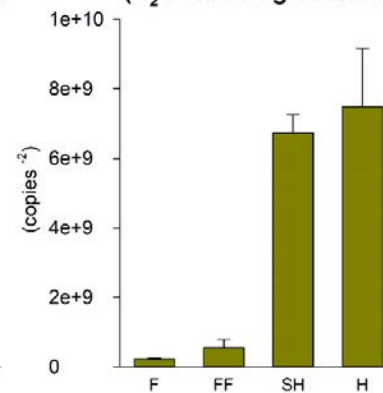


Bacterial
Inorganic N cycling

AOB gene copies (ammonia oxidizing bacteria)



nosZ I+II gene copies (N₂O reducing bacteria)



Forest



Forest edge

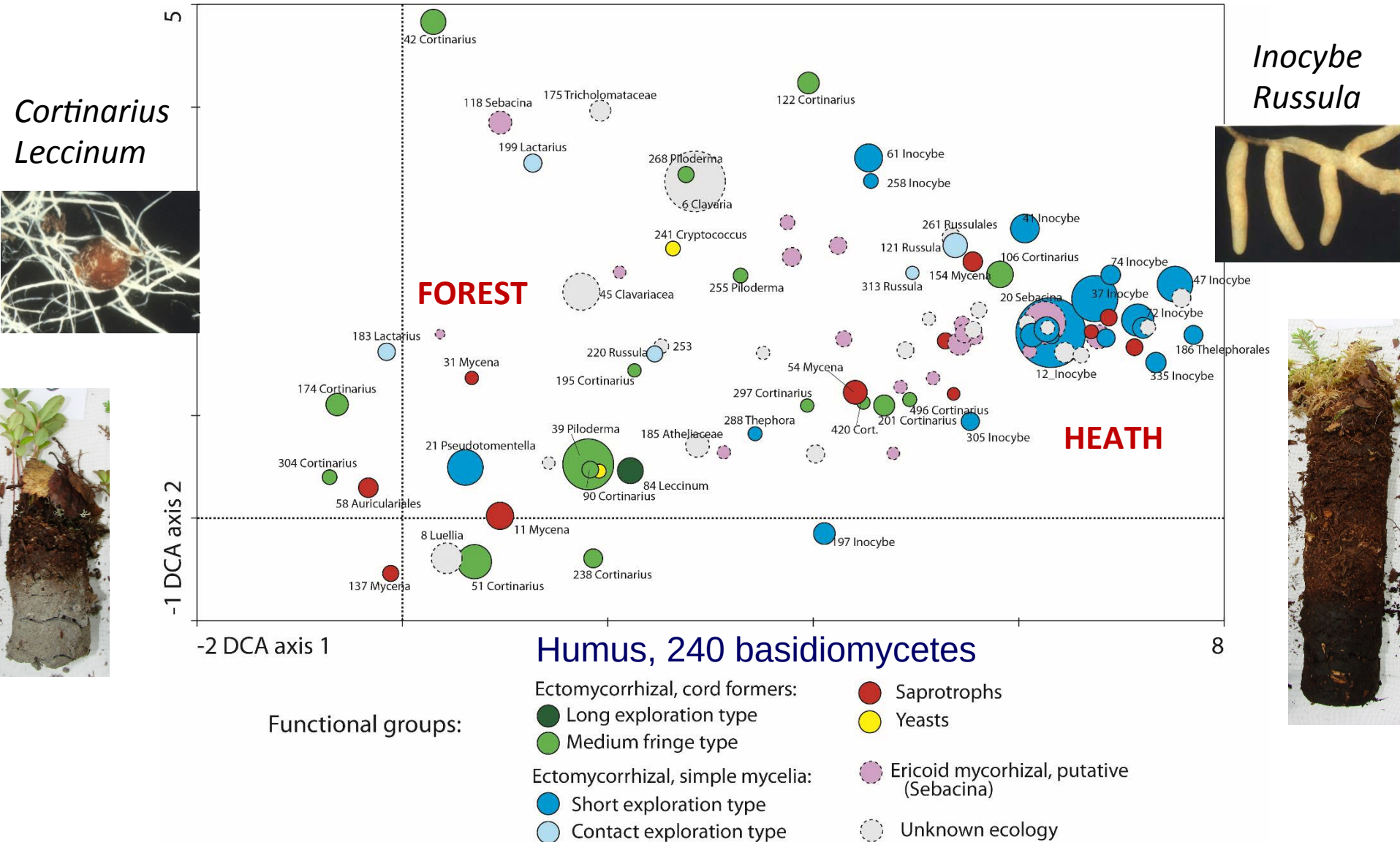


Shrub



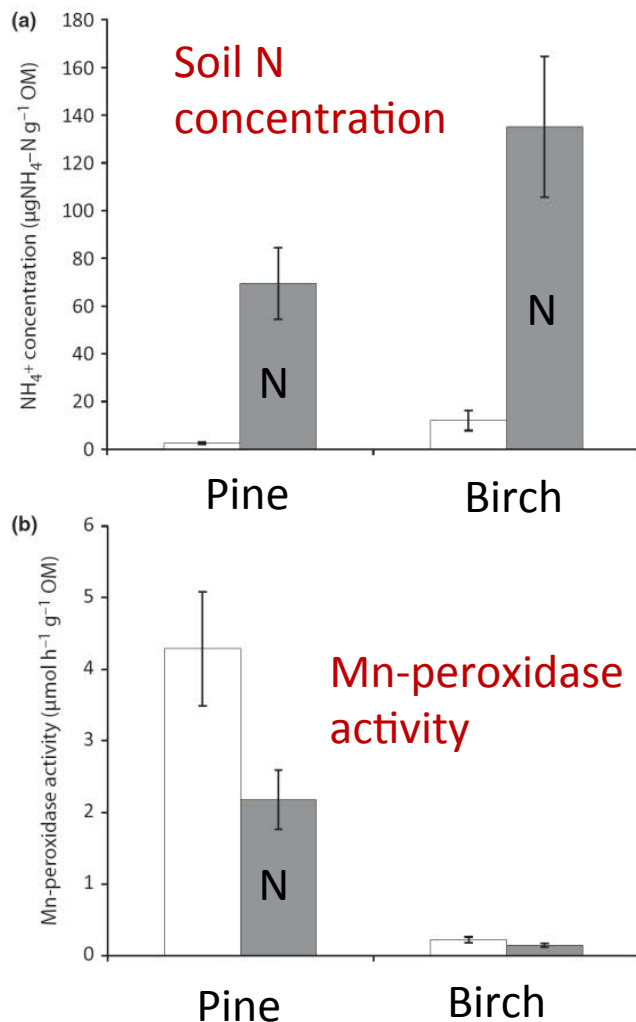
Heath

Ectomycorrhizal fungal communities



Ectomycorrhizal *Cortinarius* species participate in enzymatic oxidation of humus in northern forest ecosystems

(2015)

Inga T. M. Bödeker^{1,2}, Karina E. Clemmensen¹, Wietse de Boer³, Francis Martin⁴, Åke Olson¹ and Björn D. Lindahl¹


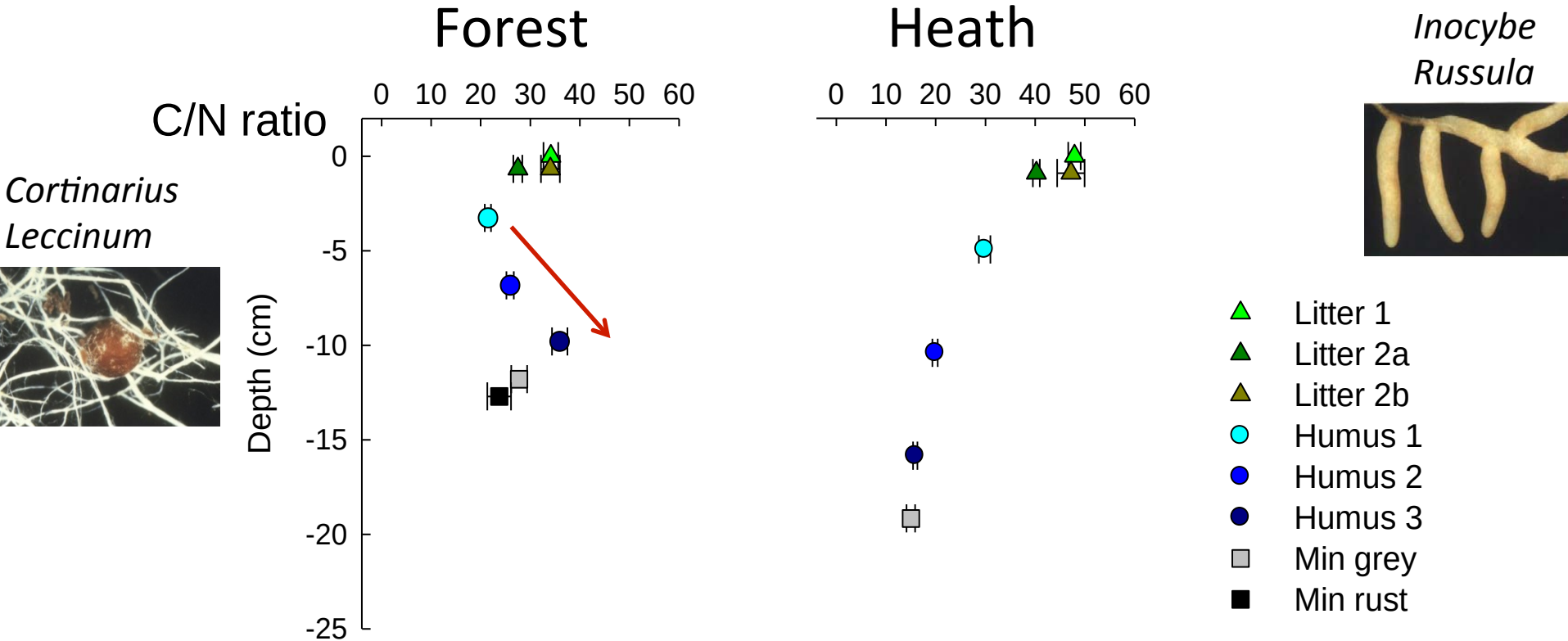
Birch forest, co-localization fungi-enzyme:

OTU affiliation	Phylum ¹	Mn- peroxidase activity ²	Abundance ³
<i>Cortinarius obtusus</i>	B	0.78	0.8
<i>Cortinarius acutus</i>	B	0.72	0.5
<i>Coniozyma leucospermi</i>	A	0.36	0.4
<i>Cortinarius armillatus</i>	B	0.35	0.7
<i>Lactarius vietus</i>	B	0.32	0.3
<i>Pezizomycotina</i>	A	0.32	0.3
<i>Pezizomycotina</i>	A	0.29	1.5
<i>Helotiales</i>	A	0.25	0.5
<i>Meliniomyces</i>	A	0.25	0.4
<i>Sebacina</i>	B	0.24	0.4
<i>Ascomycota</i>	A	0.23	0.9
<i>Luellia recondita</i>	B	0.22	1.3
Unidentified	—	0.22	0.3
<i>Eurotiomycetes</i>	A	0.21	0.6
<i>Helotiales</i>	A	0.21	0.4
<i>Oidiodendron</i>	A	0.21	1.3
<i>Cudonia</i>	A	0.21	0.5
<i>Ascomycota</i>	A	0.21	1.3
<i>Pseudotomentella tristis</i>	B	0.20	0.6
<i>Helotiales</i>	A	0.20	8.4
<i>Helotiales</i>	A	0.20	0.6
<i>Pezizomycotina</i>	A	0.20	0.2
<i>Cenococcum</i>	A	0.20	0.8



Cortinarius armillatus

Mycorrhizal N mobilization!



Reciprocal transplant + Trenching experiment



F-LIT

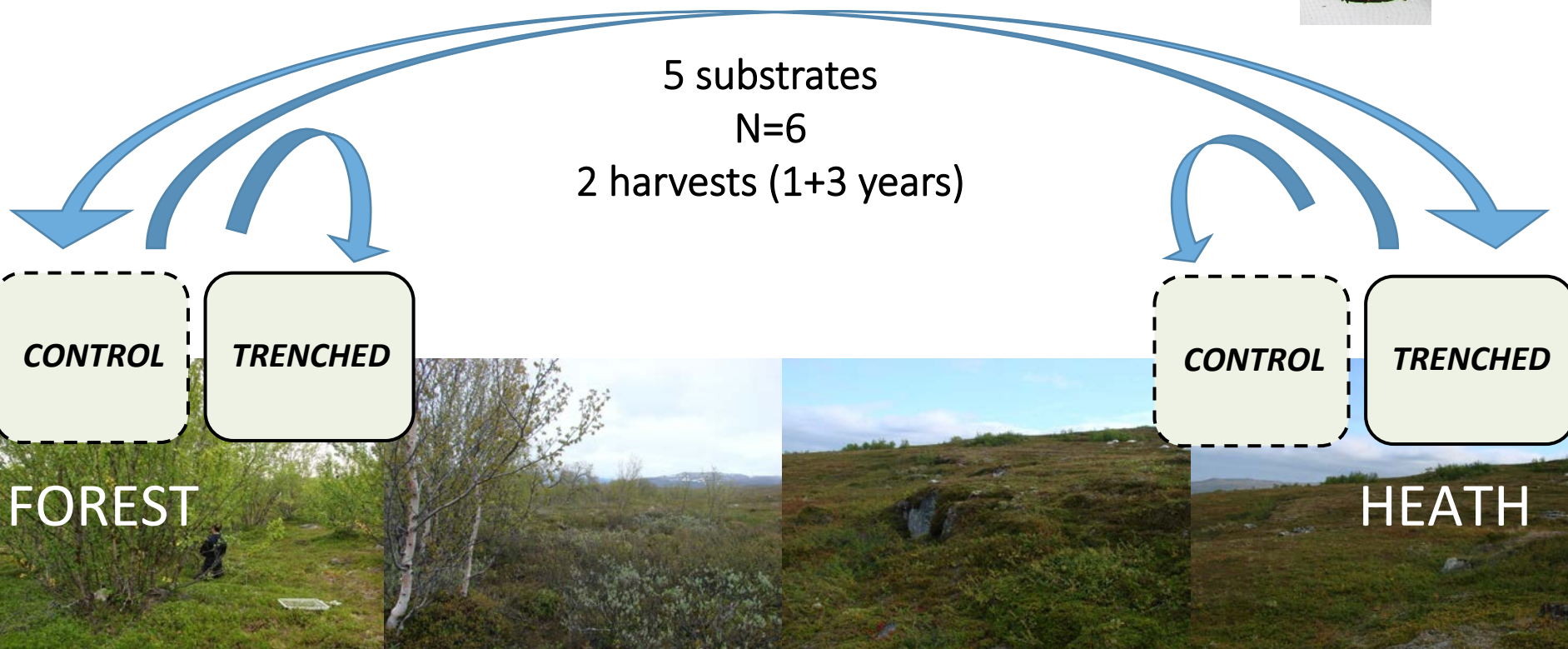
F-HUM



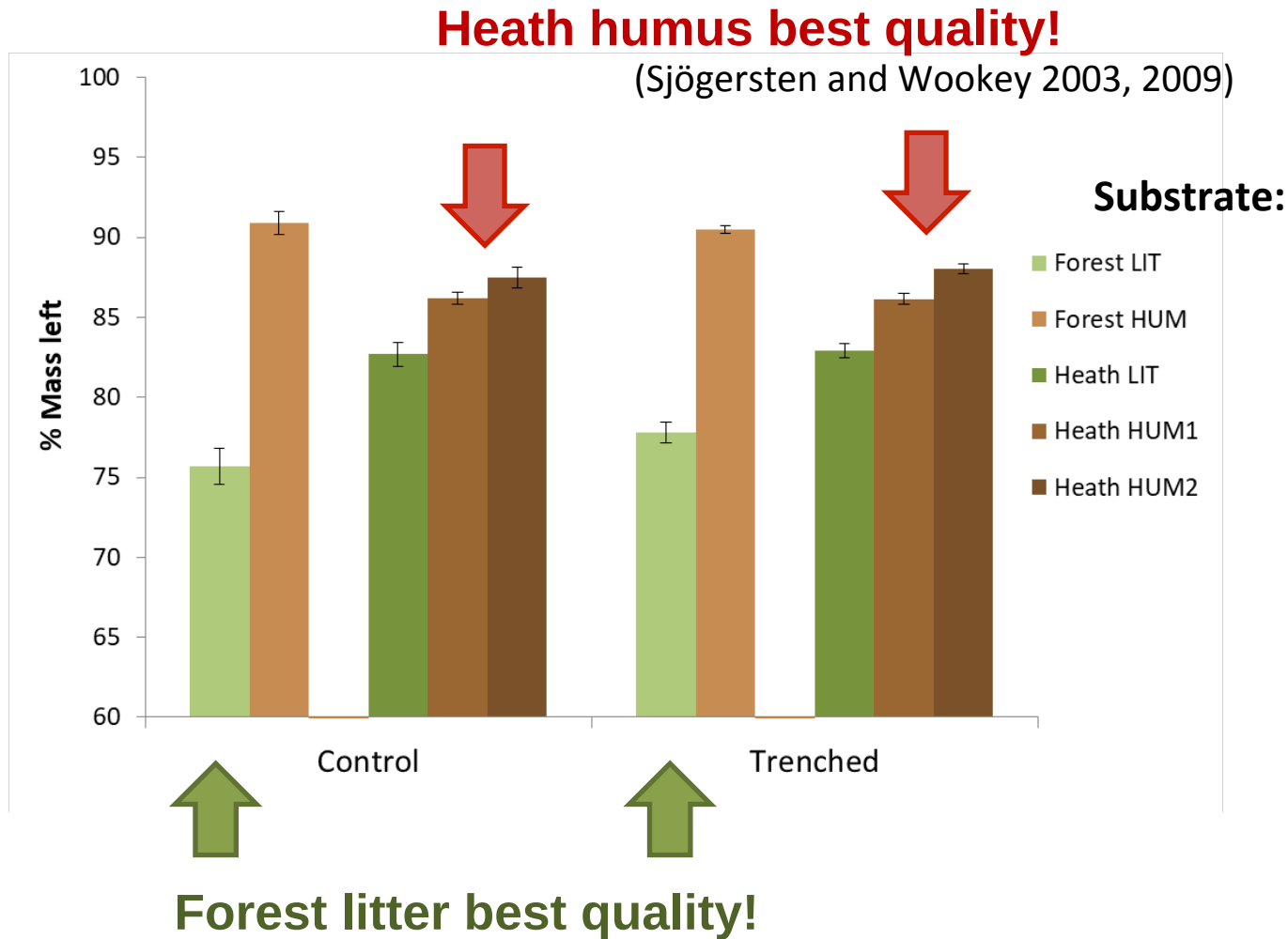
H-LIT

H-HUM1

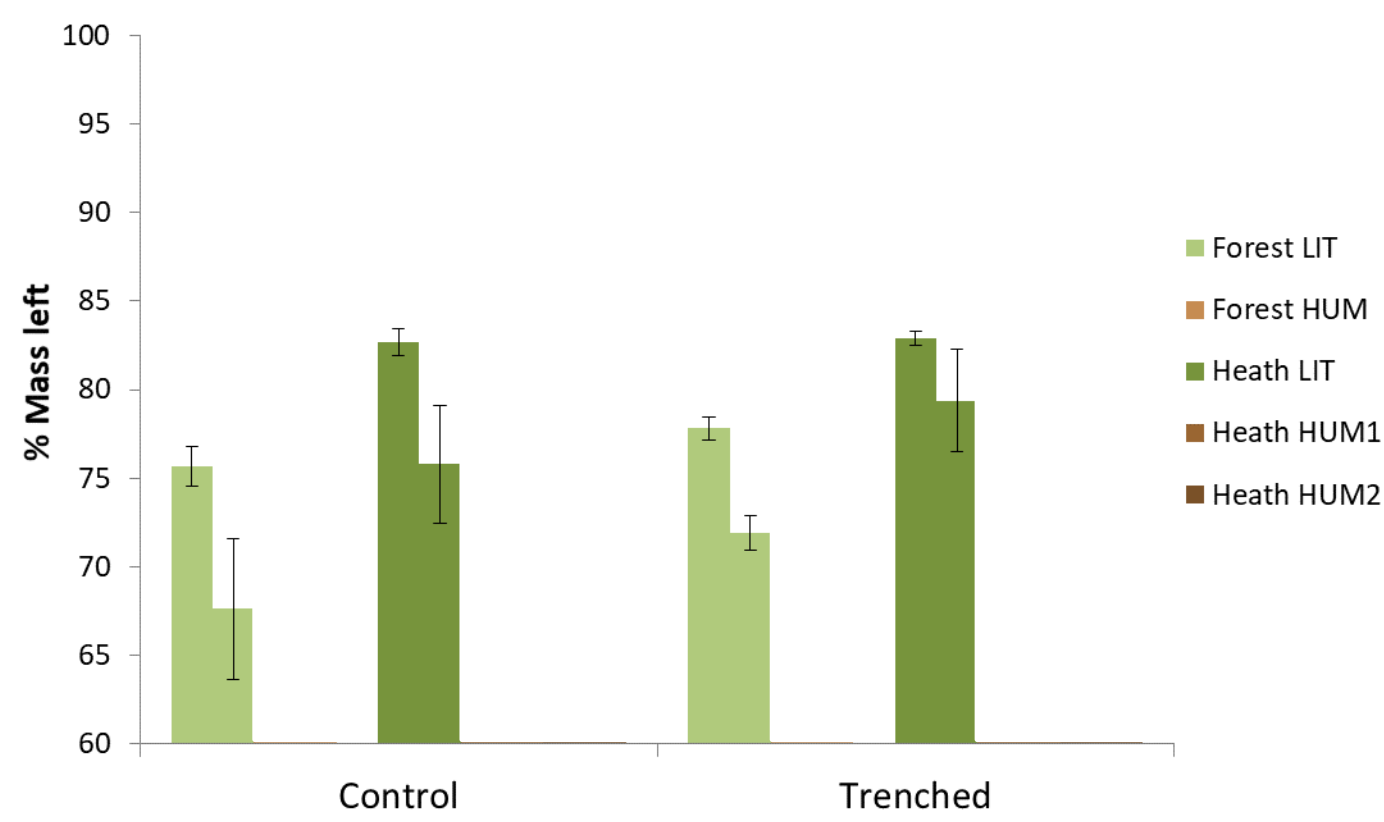
H-HUM2



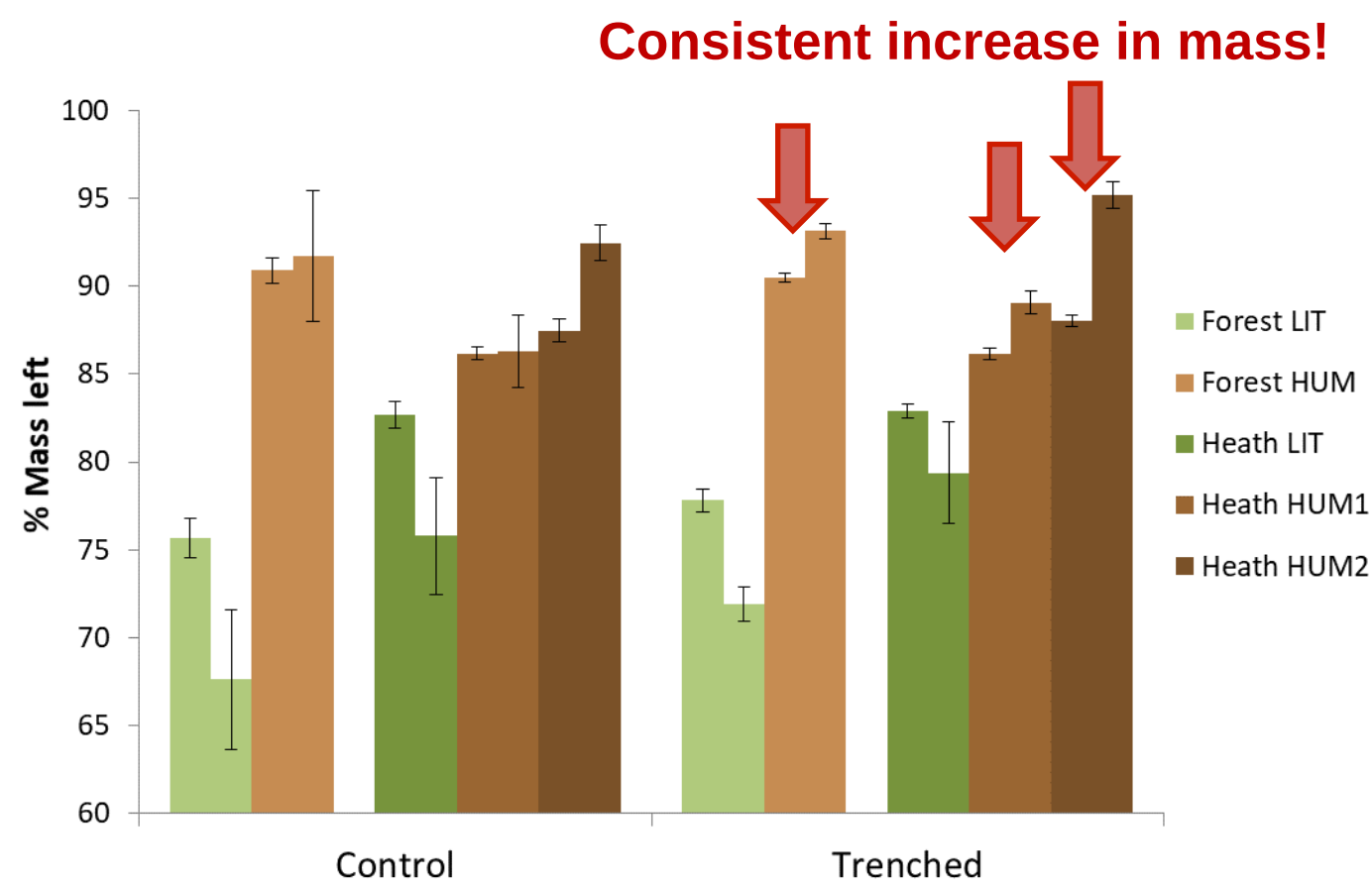
Decomposition – after 1 year – forest plots:



Decomposition – after 1 and 3 years - forest plots:



Decomposition – after 1 and 3 years - forest plots:

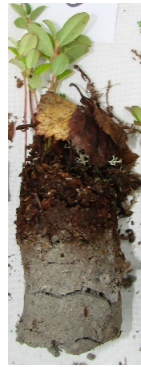


Trenched plots:
→ Sustained ericoid ingrowth
→ Lost ectomycorrhizal decomposition

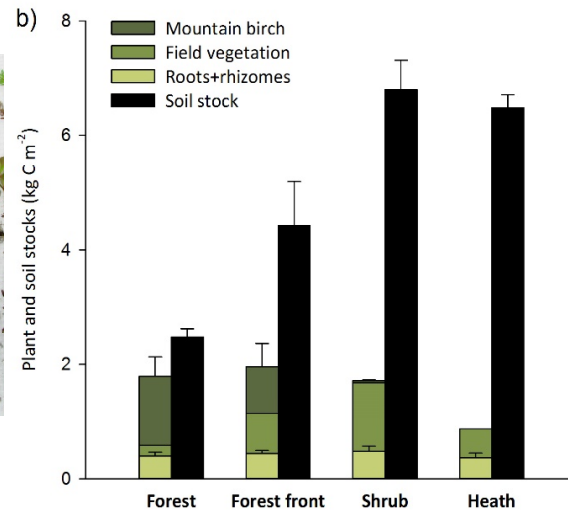


Efficient
oxidative
enzymes

Fungal
Organic
N cycling



Low C



High C

Hydrolytic
enzymes

Bacterial
Inorganic
N cycling

Cortinarius
Leccinum

Inocybe
Russula

Ericoid fungi and plants:
persistent organic matter inputs

FOREST

HEATH

*Swedish University of
Agricultural Sciences:*

Björn Lindahl

Sara Hallin

Roger Finlay

Maria Helman

Mikael Brandström Durling

University of Copenhagen:

Anders Michelsen

Abisko Scientific Research Station

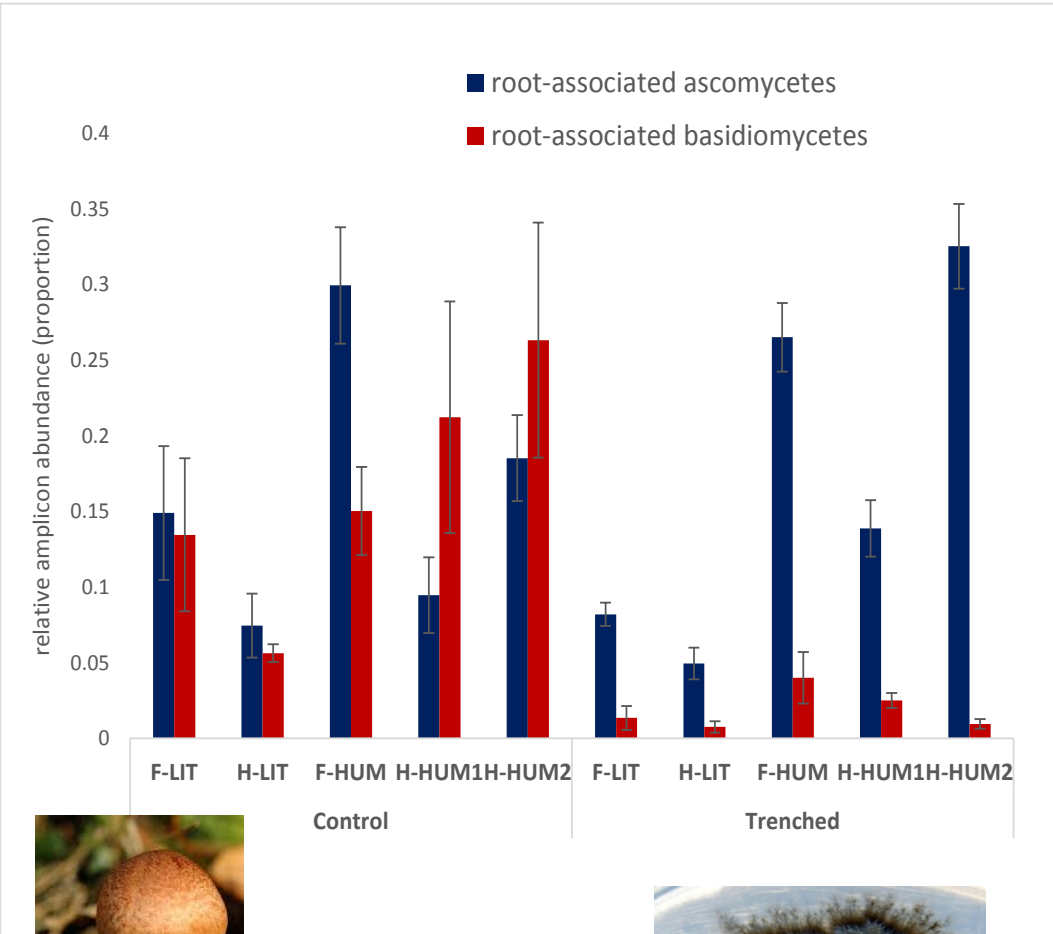
*Department of Forest Mycology
& Plant Pathology, SLU*



*Soil organic matter build-up
depend on input-decomposition
balance in the older humus layer!*



Fungal communities in bags - forest site:



Trenched plots:
→ Sustained ericoid ingrowth
→ Lost ectomycorrhizal decomposition



Cortinarius



Rhizoscyphus