Gli effetti della selvicoltura sulla biodiversità “invisibile”: i microorganismi del suolo

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SelPiBioLife (LIFE13 BIO/IT/000282)

The main purpose of the project is to evaluate the effects of a selective thinning on soil biodiversity in young black pine stands.

SelPiBio Life

http://www.selpibio.eu/

SelPiBio*Life*: objectives

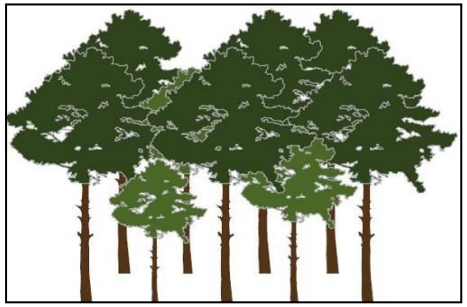
Demonstrate the positive effects of selective thinning in black pine stands

increase soil biodiversity

SelPiBioLife research hypotheses: 3 silvicultural treatments

control

No intervention is realized

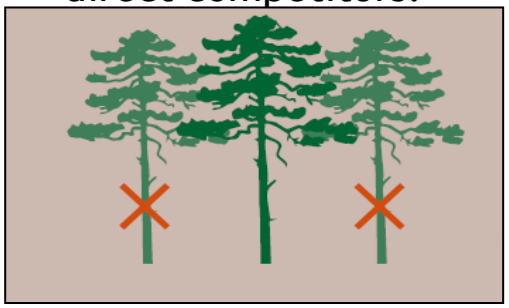


traditional

Dominated trees are removed. No significant effect on canopy cover.

selective

Selection of 100 candidate trees per hectare and removal of direct competitors.



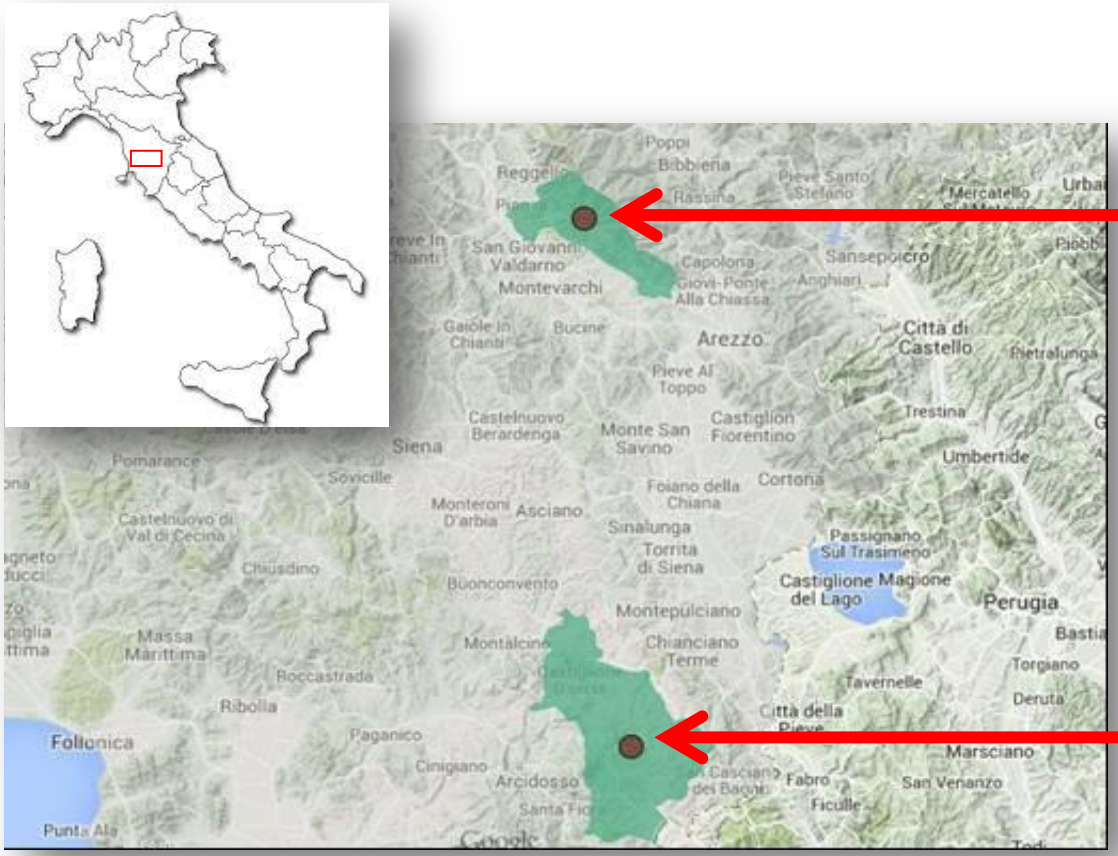
The selective thinning

The selective thinning is conceptually based on the identification of the dominant plants and the removing of the plants around. This approach provides the following results:

1. Enhance the pine succession and increase the economic value of the product
2. Enhance the pine dendrometric stability
3. Reduce the canopy cover and enhances the rate of light, water and temperature at the soil level

The global effect is an increasing of the functionality of the ecosystem and of the soil biodiversity

Monitoring areas

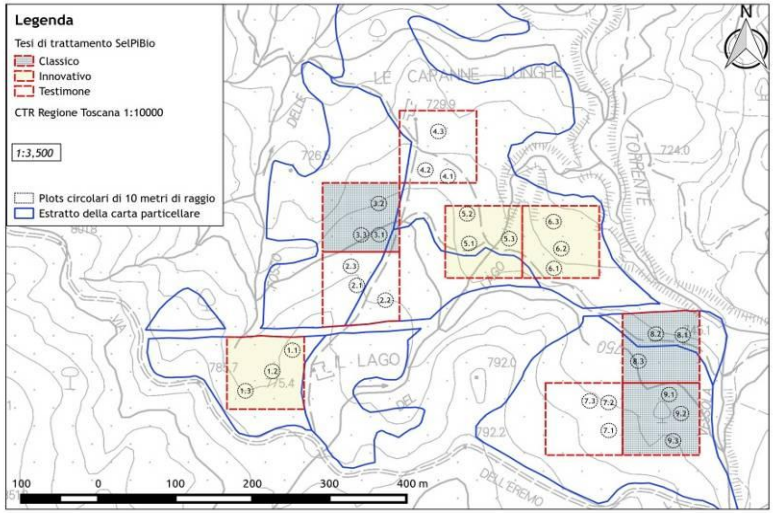


"Pratomagno-Valdarno"- «Pian della cucina» Municipality: Loro Ciuffenna (AR) PRATOMAGNO

«Madonna delle Querce» - «Il Lago» Municipality: Castiglione d'Orcia (SI) AMIATA

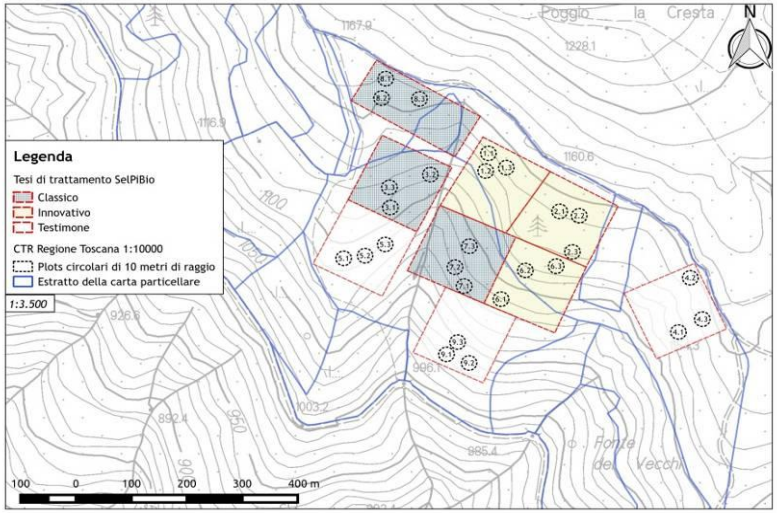
Brief description of the areas

Amiata



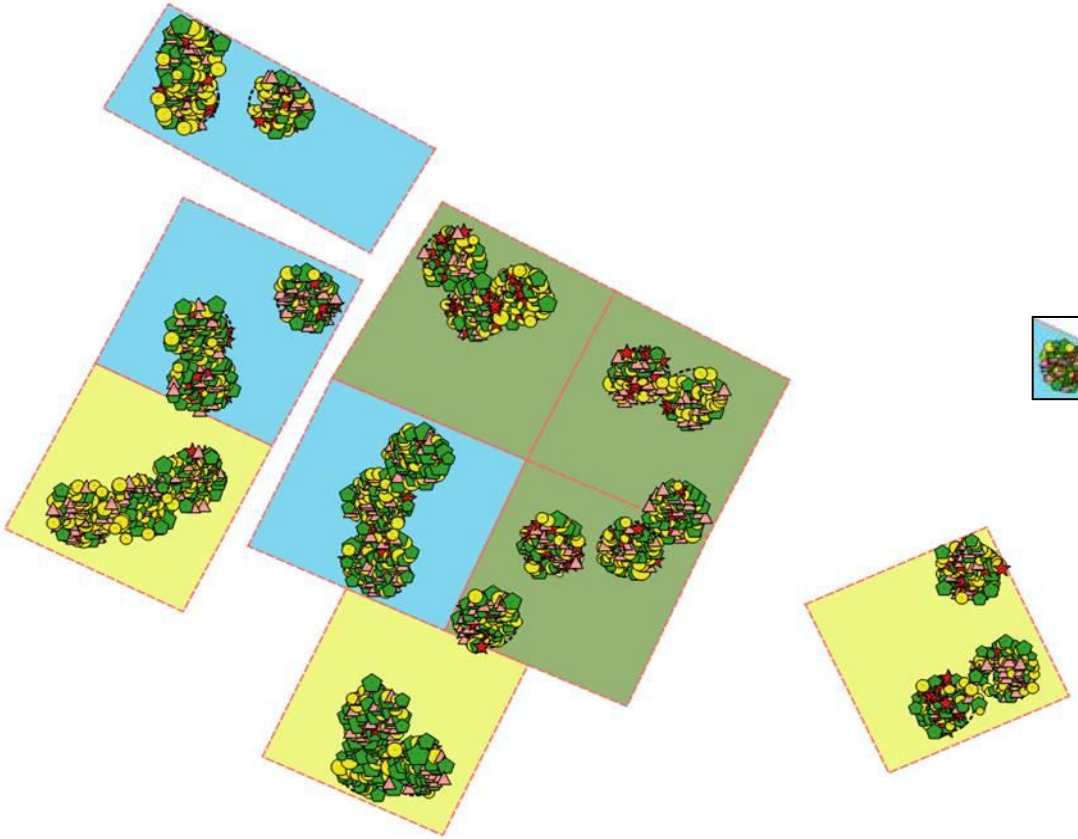
- Altitude: about 800 m a.s.l.
- Exposition: North-North-West
- Average slope: 3-6%.
- Vegetation: high
- pH : 6,9
- Total organic carbon (TOC): 1,73%

Pratomagno



- Altitude: about 1100 m a.s.l.
- Exposition: South- West
- Average slope: 20-25%
- Vegetation: low
- pH : 5,5
- Total organic carbon (TOC): 1,76%

Experimental scheme



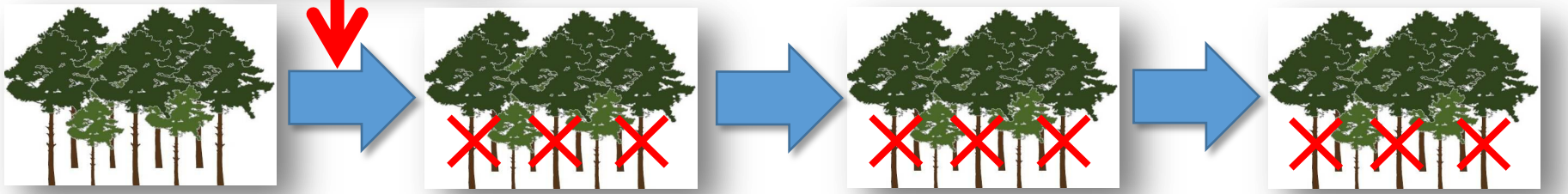
9 areas (1ha each) for each experimental site, with 3 replicates of each silvicultural thesis

3 *plots* (10 m diameter – 314 mq) for each area were selcted for sampling and three thesis applied

- ✓ selective thinning
- ✓ traditional thinning
- ✓ control

A total of 27 *plots* for each site

Soil sampling



2015 2016 2017 2018

Soil Biodiversity | Soil Biodiversity | Soil Biodiversity | MAY-OCT 2018

http://www.selpibio.eu/

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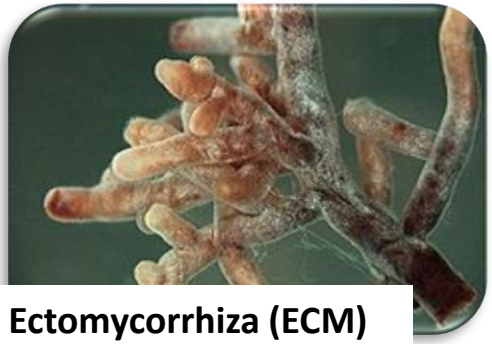
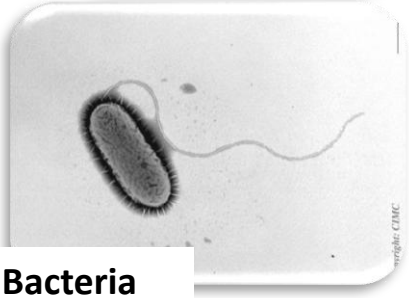
Assessment of soil biodiversity

Plants

Macro-fungi



Ectomycorrhiza (ECM)



Bacteria

“SOIL” BIODIVERSITY

Carabids

Micro-fungi

Nematodes

Microarthropods

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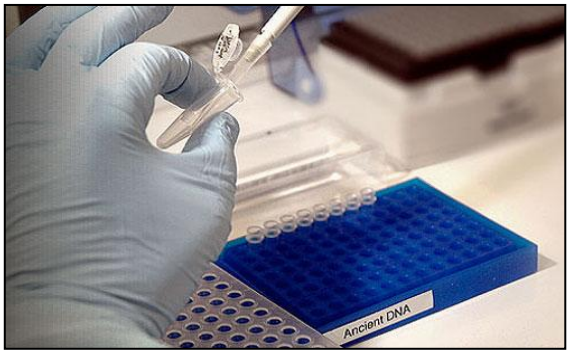
Microorganisms

SOIL

Analysis of the microbial community structure (Miseq, Illumina)

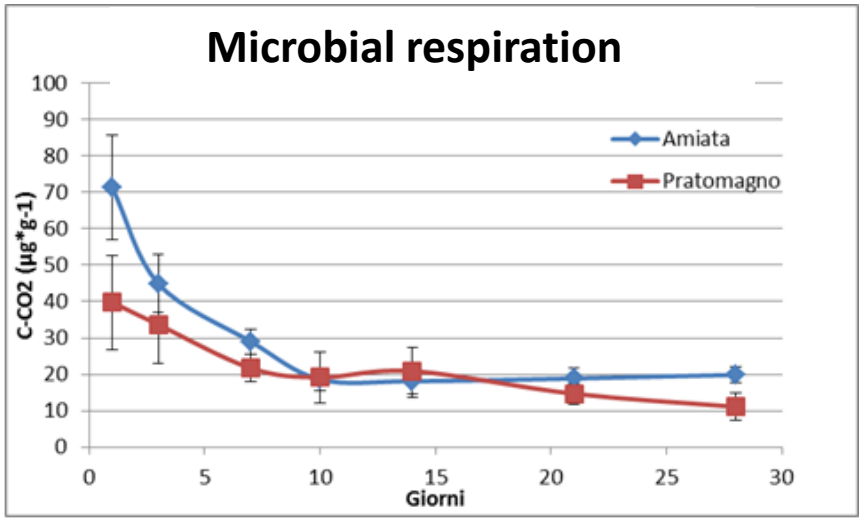


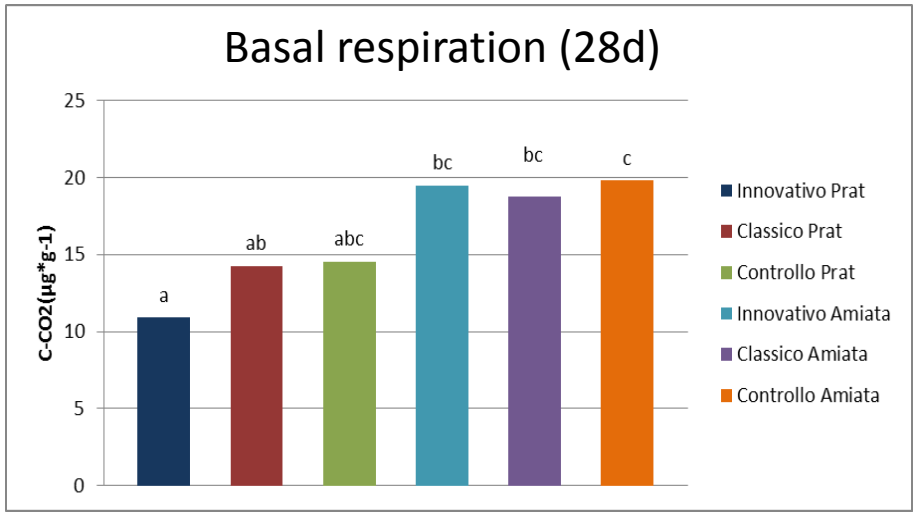
Soil microbial respiration (Alef, 1995)

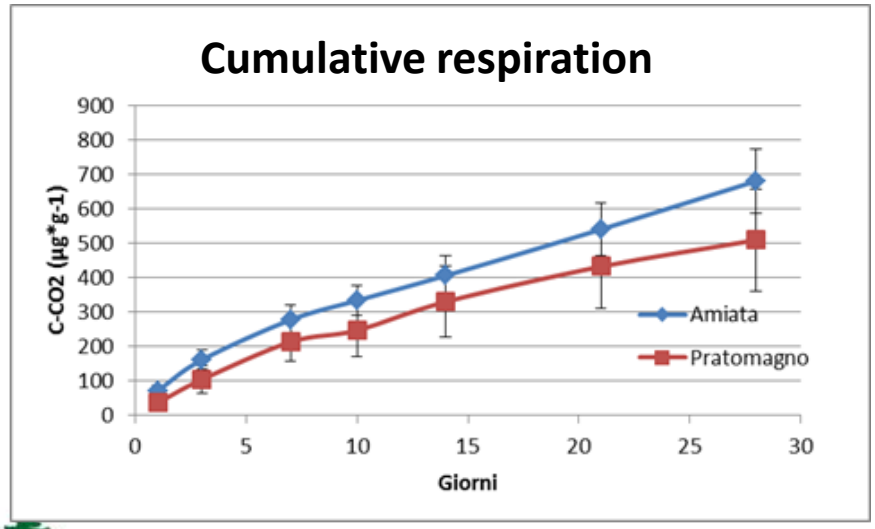
Microbial C biomass (Vance et al., 1987)

1. Assessment of microbial diversity before thinning (2015)

Microbial respiration (2015)



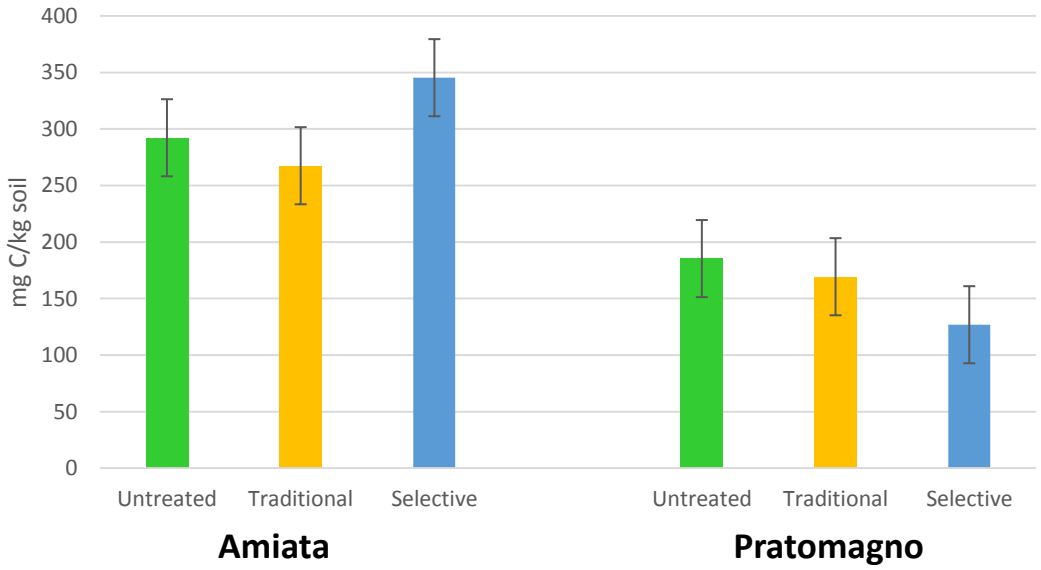




- In general, soils of AMIATA showed higher values than PRATOMAGNO

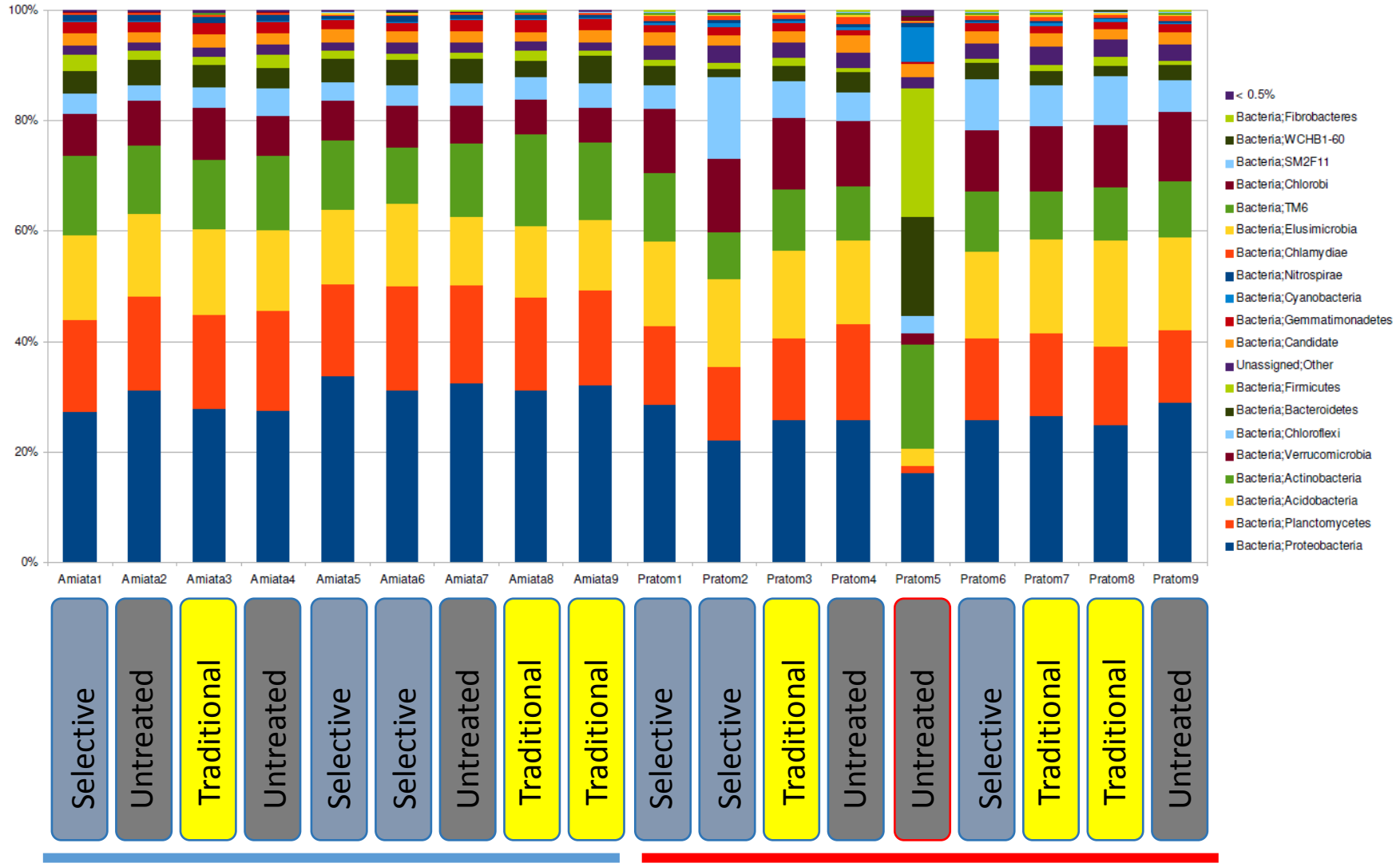
- Furthermore, values of basal respiration of Pratomagno soils are much more heterogeneous than those of Amiata

Microbial biomass (2015)

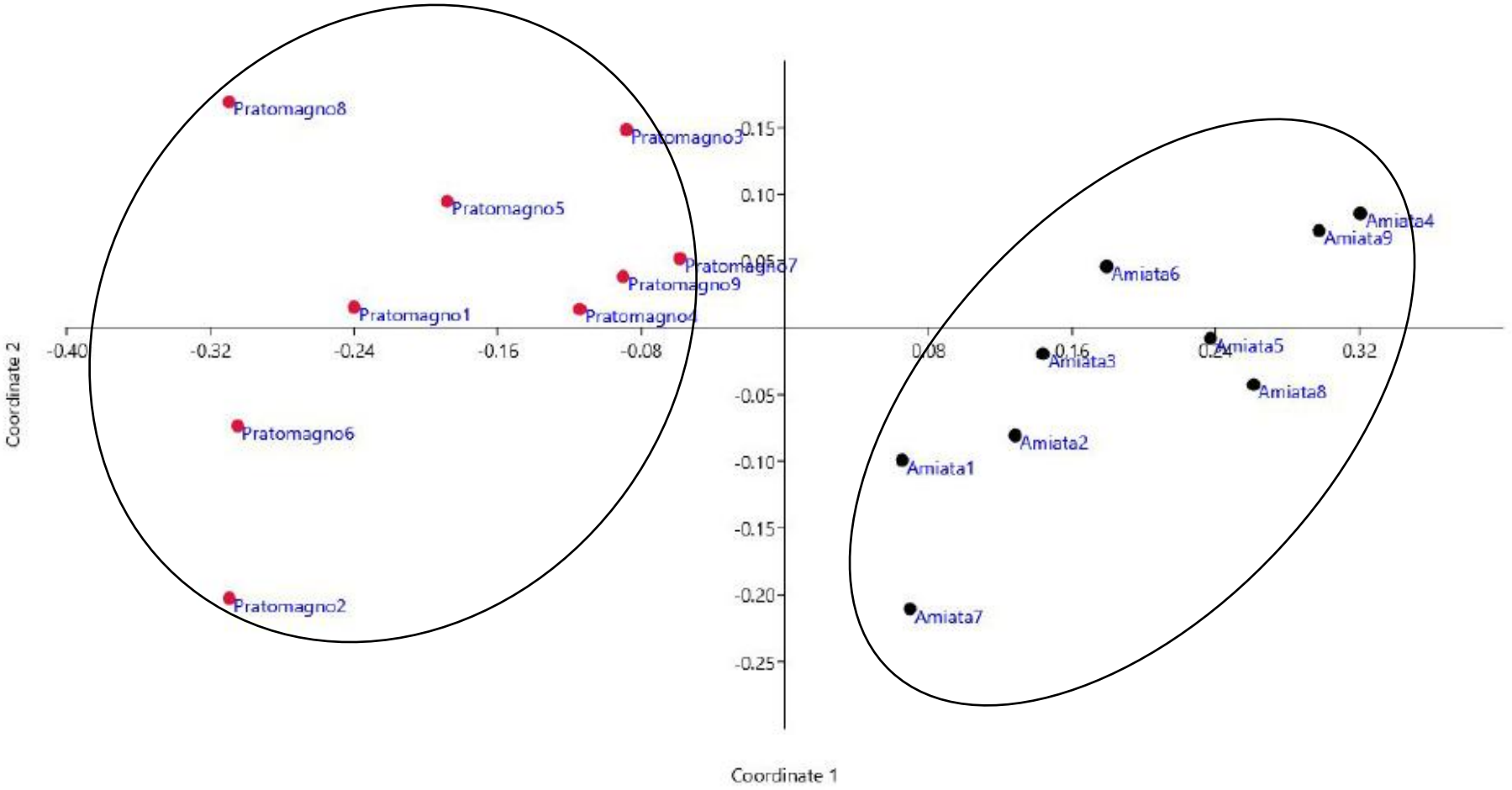


- **There is a higher content of microbial biomass in Amiata soils than in the pratomagno ones**

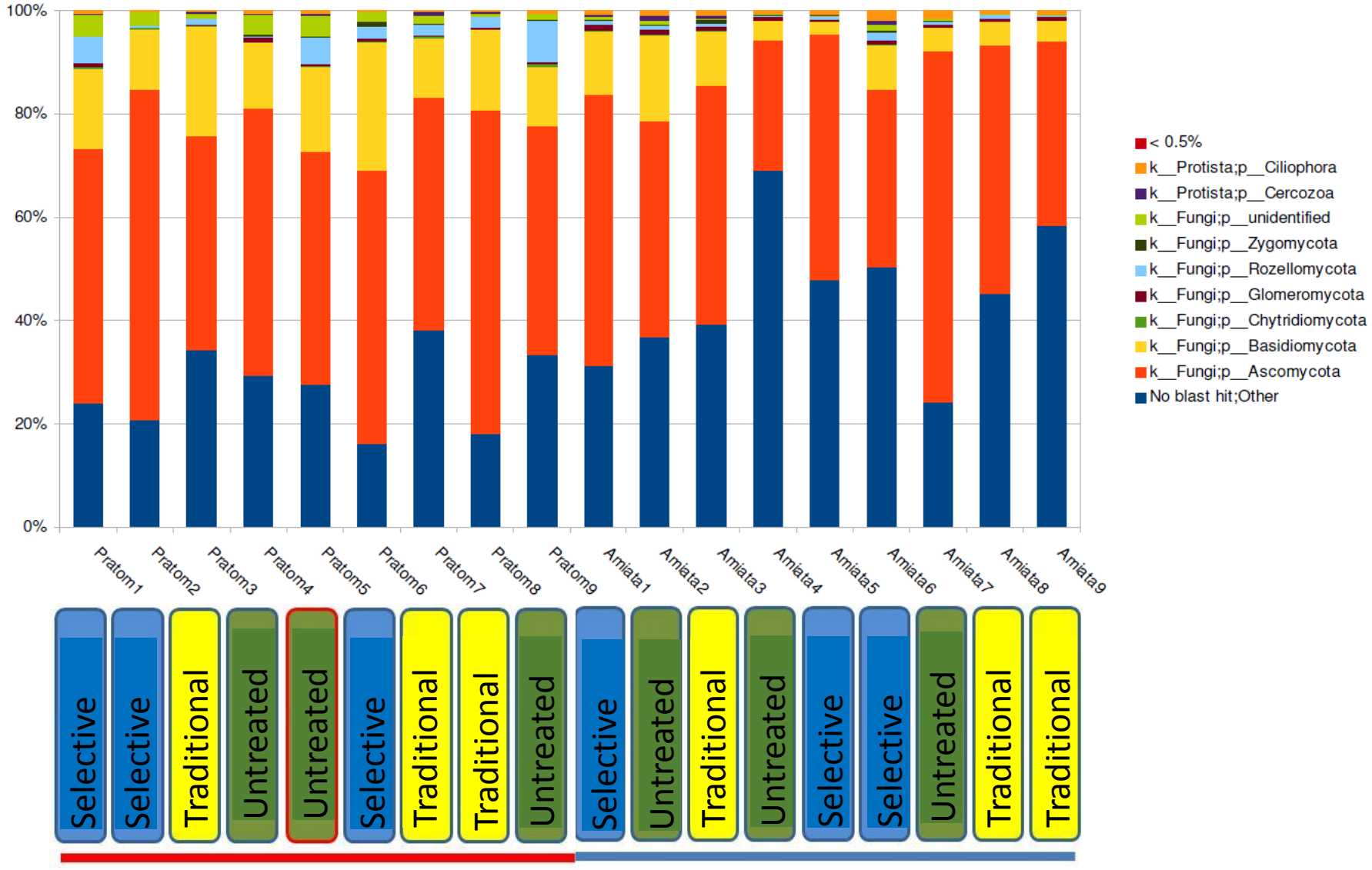
Bacterial diversity (2015)



NMDS analysis (Bacteria)



Fungal diversity (2015)



Pratomagno **Amiata**

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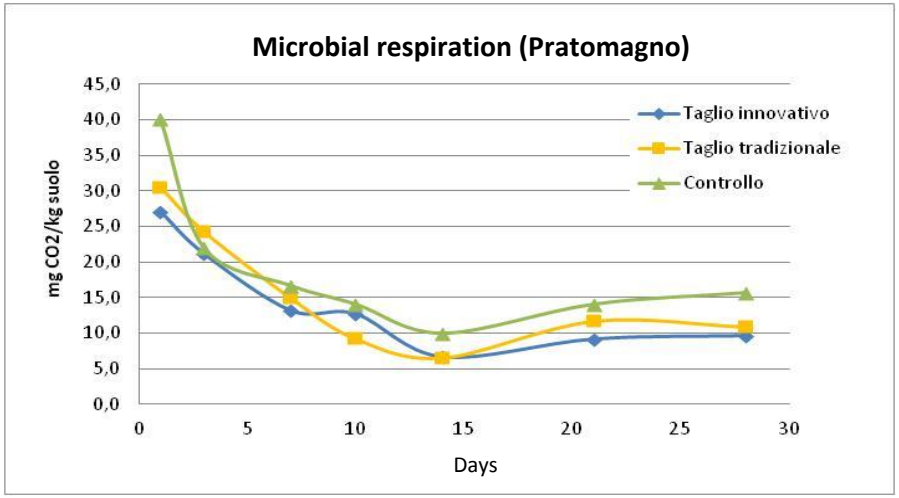
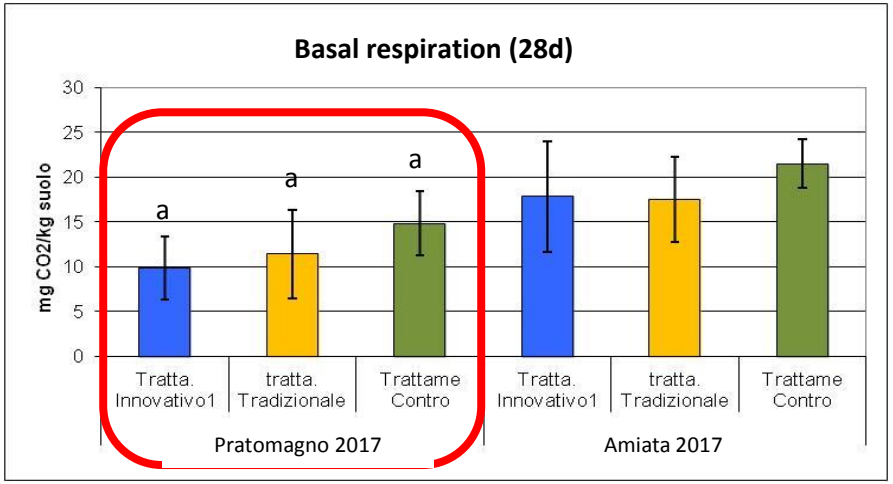
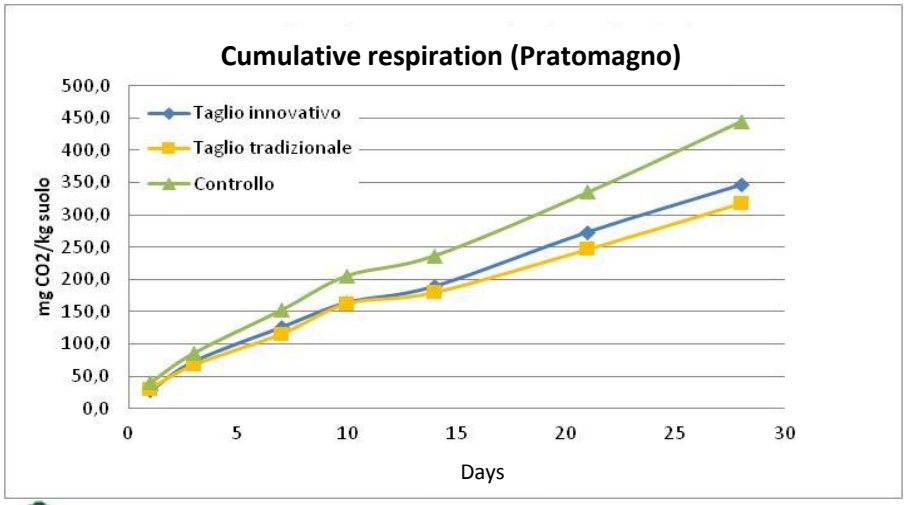
2. Assessment of microbial diversity two years after thinning (2017)

Microbial respiration (Pratomagno)



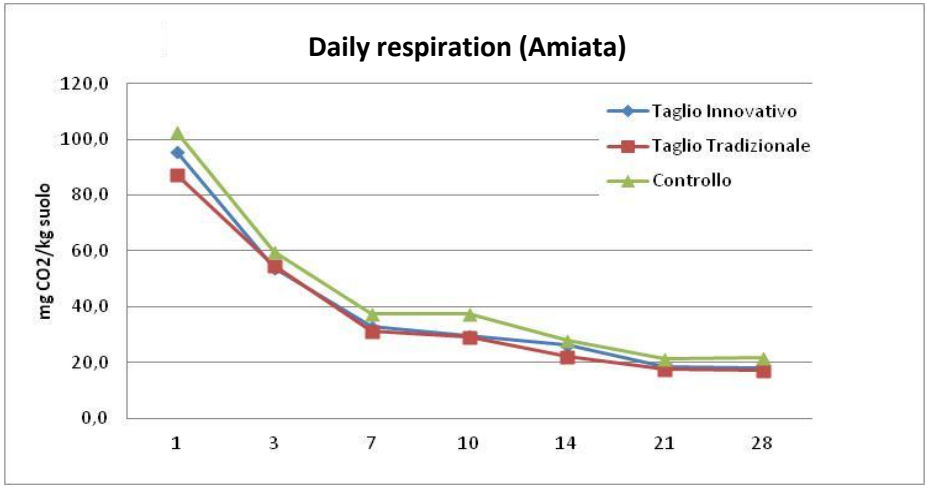


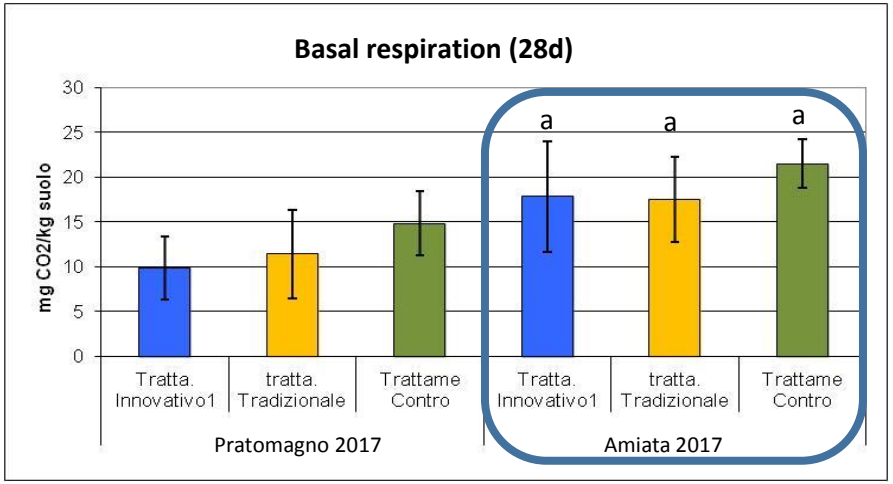


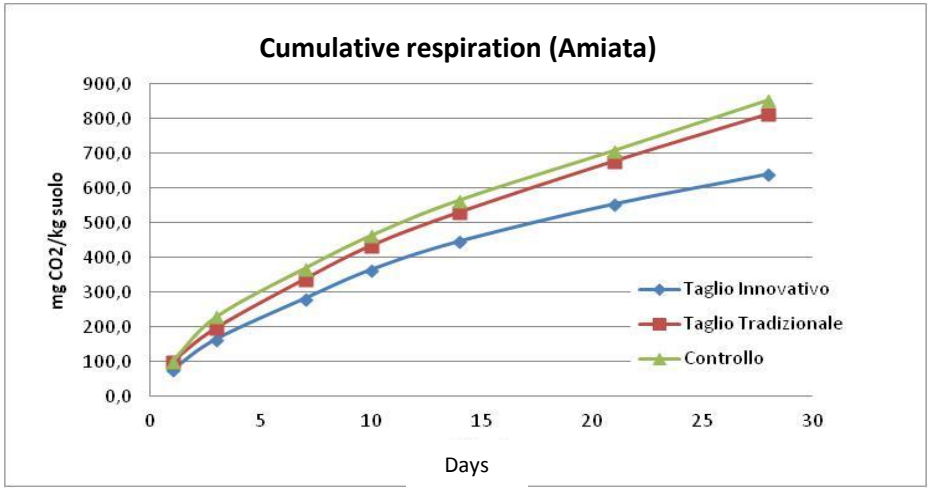
- In general, soils of AMIATA showed higher values than PRATOMAGNO (as observed in 2015 and 2016)

- Cumulative respiration resulted higher in the CTRL plots, as compared to treated plots (not significant)

Microbial respiration (Amiata)



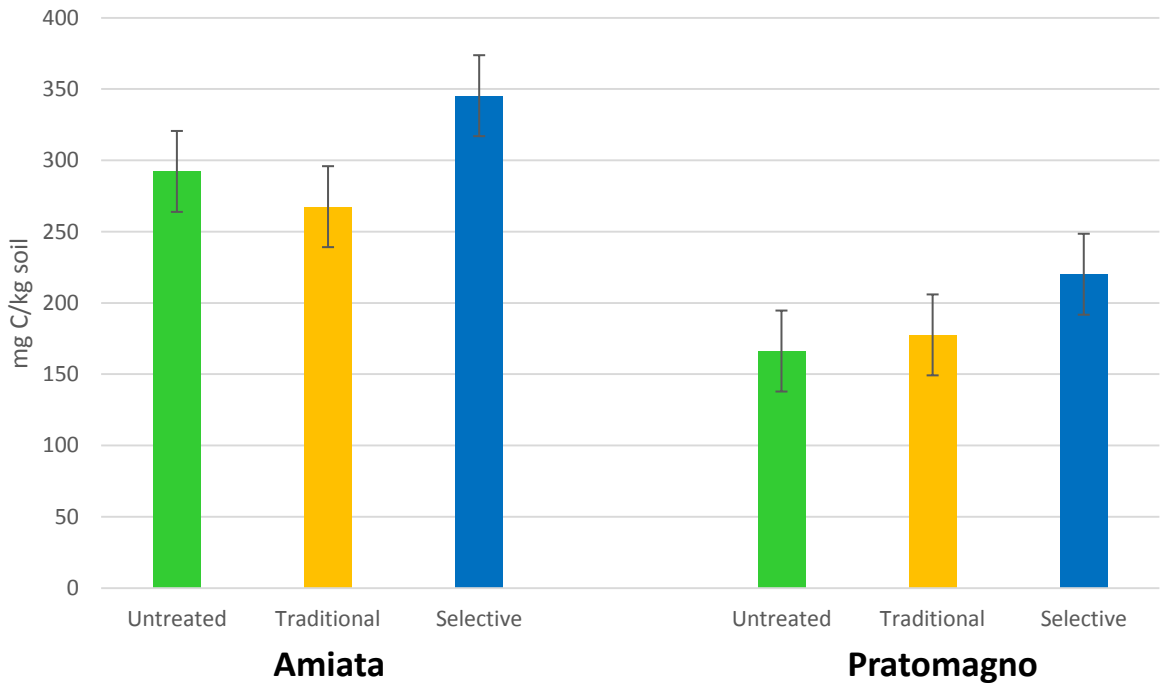




- In general, soils of AMIATA showed higher values than PRATOMAGNO (as observed in 2015 and 2016)

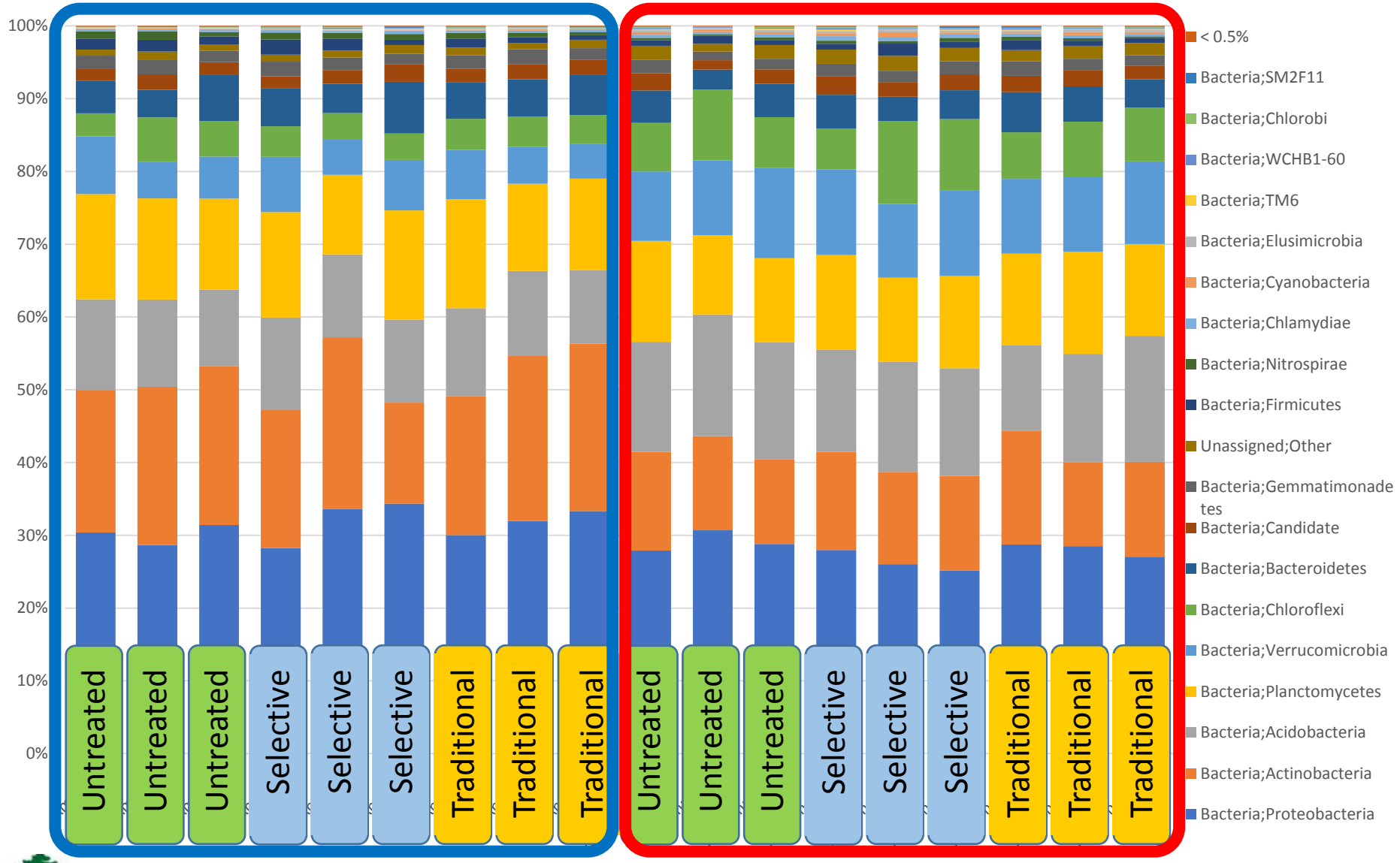
- Basal respiration of the three treatments did not show any significant difference. Samples of selective thinning provided the lowest Ccum values (not significant)

Microbial biomass (2017)



- **There are not significant effects of thinning on the microbial biomass**
- **There is a higher content of microbial biomass in Amiata soils than in the pratomagno ones**

Bacterial diversity (Phyla)



AMIATA **PRATOMAGNO**

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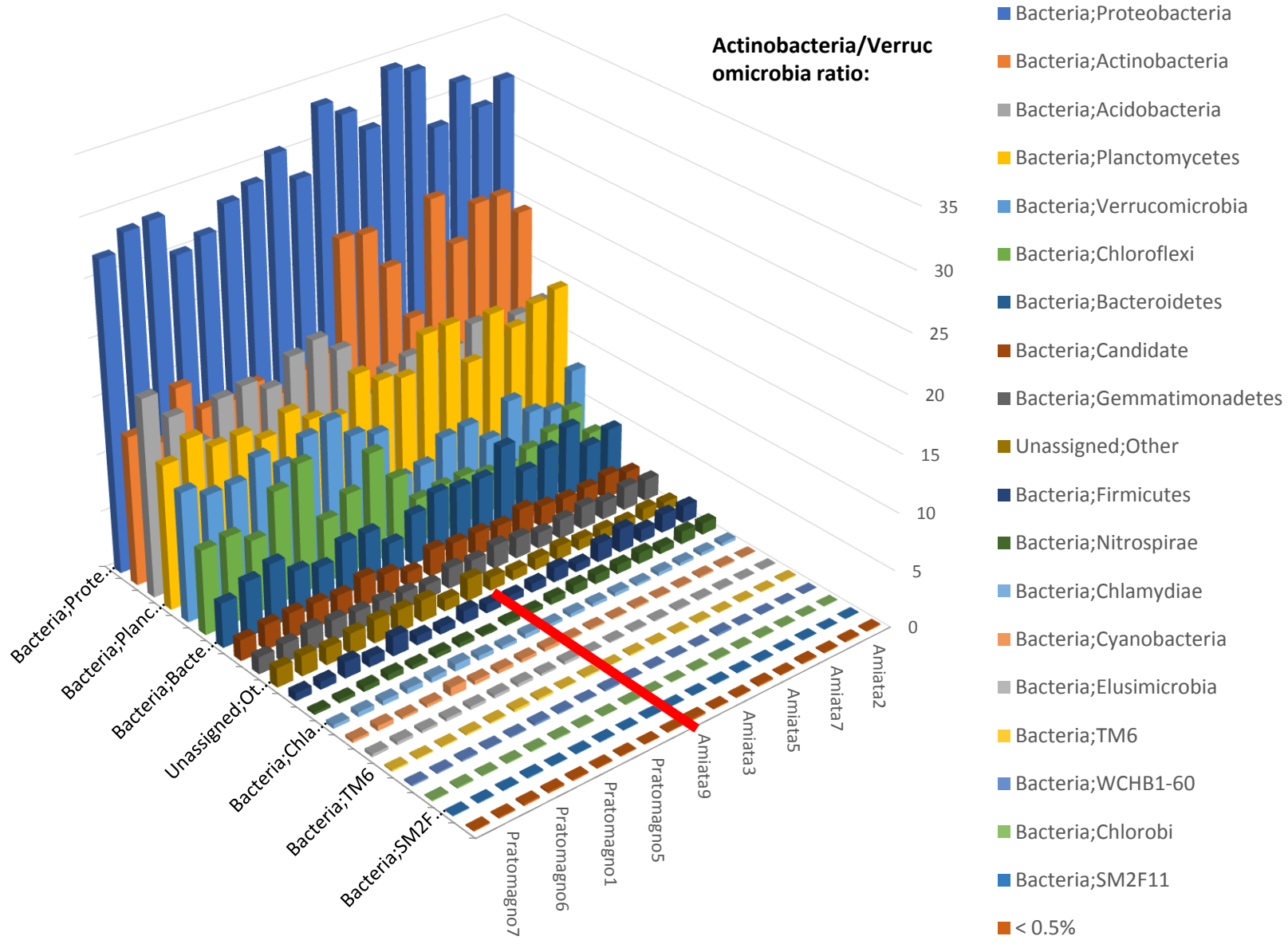
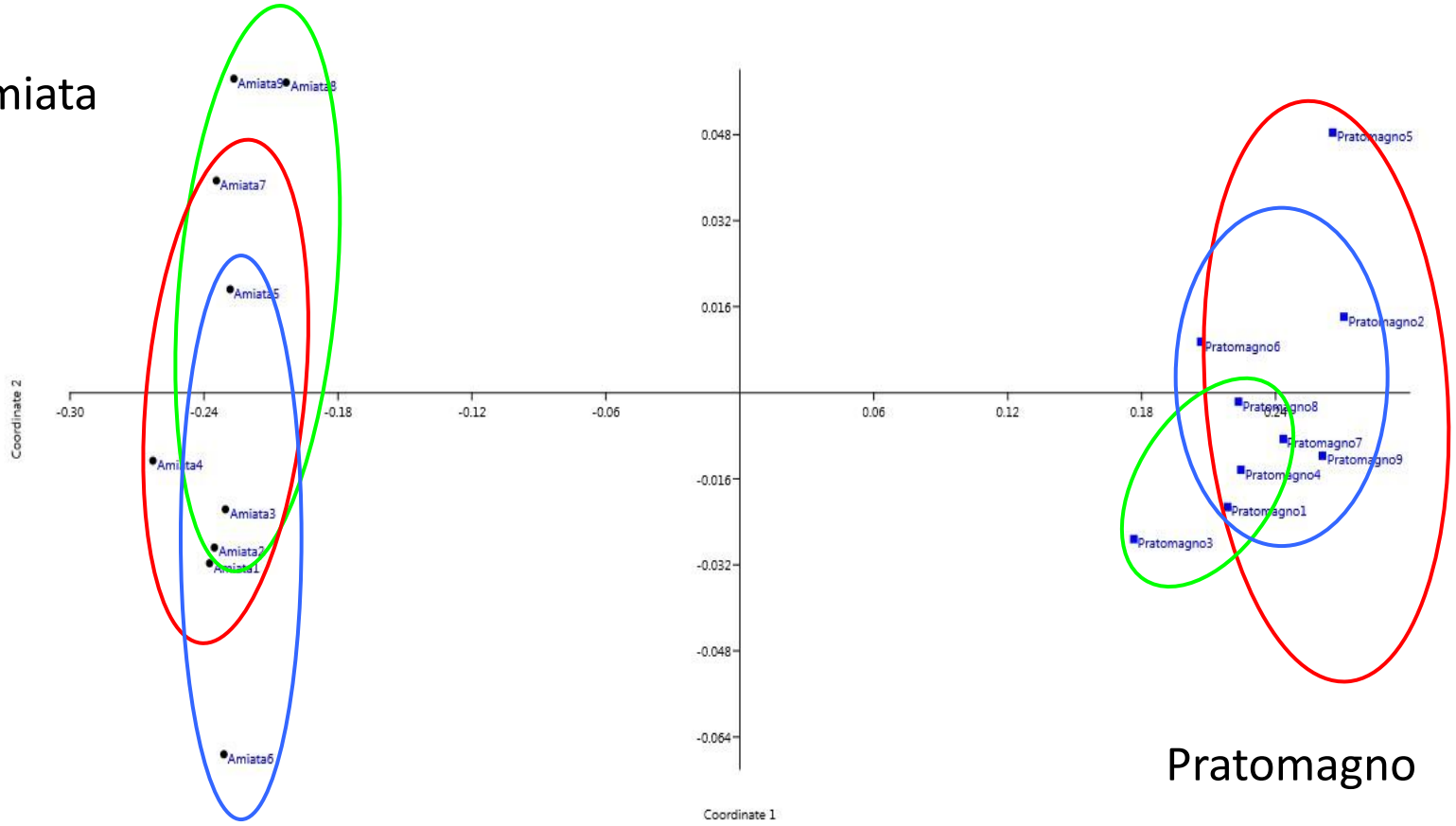
Relative abundances Bacterial diversity (Phyla)



NMDS analysis (Bacteria)

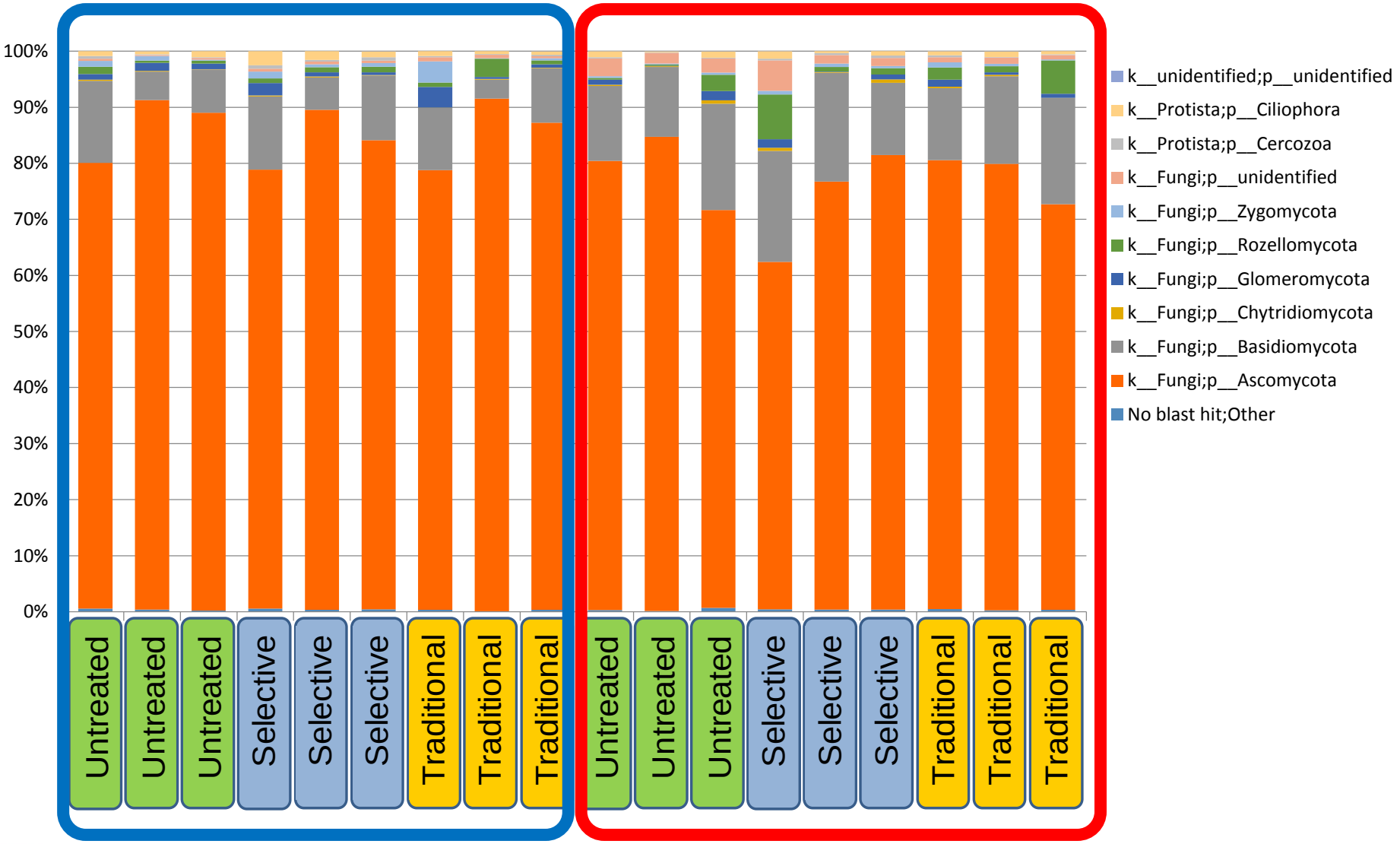
Amiata



Pratomagno

NMDS analysis (Non Metric Dimensional Scaling) of bacterial communities (Phyla) of AMIATA (1, 5, 6: selctive thinning (blu); 3,8,9: traditional (green); 2,4,7: control (red) and PRATOMAGNO (1,2,6: selective thinning (blu); 3,7,8: traditional (green); 4,5,9: control (red) in 2017.

Fungal diversity



AMIATA **PRATOMAGNO**

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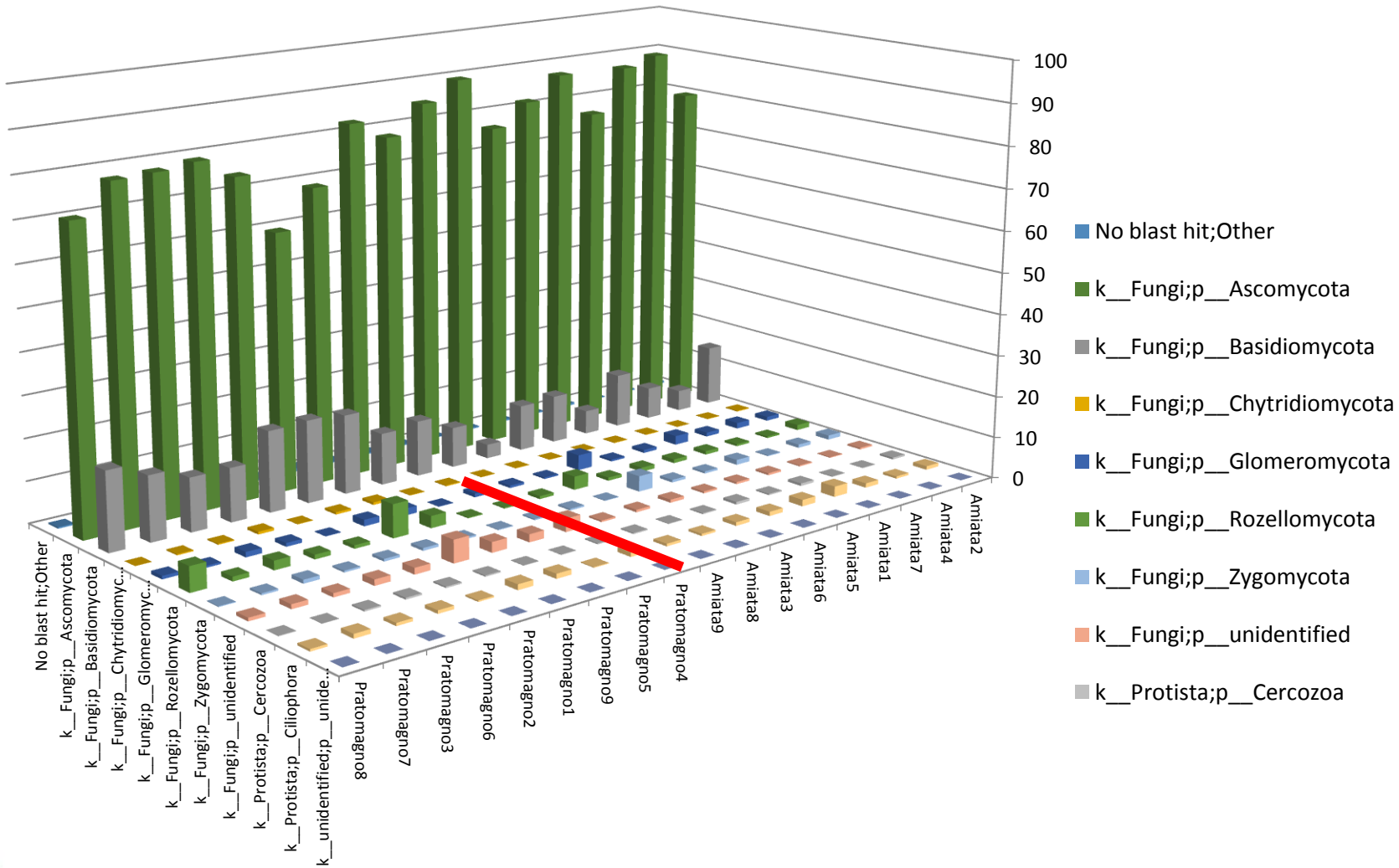
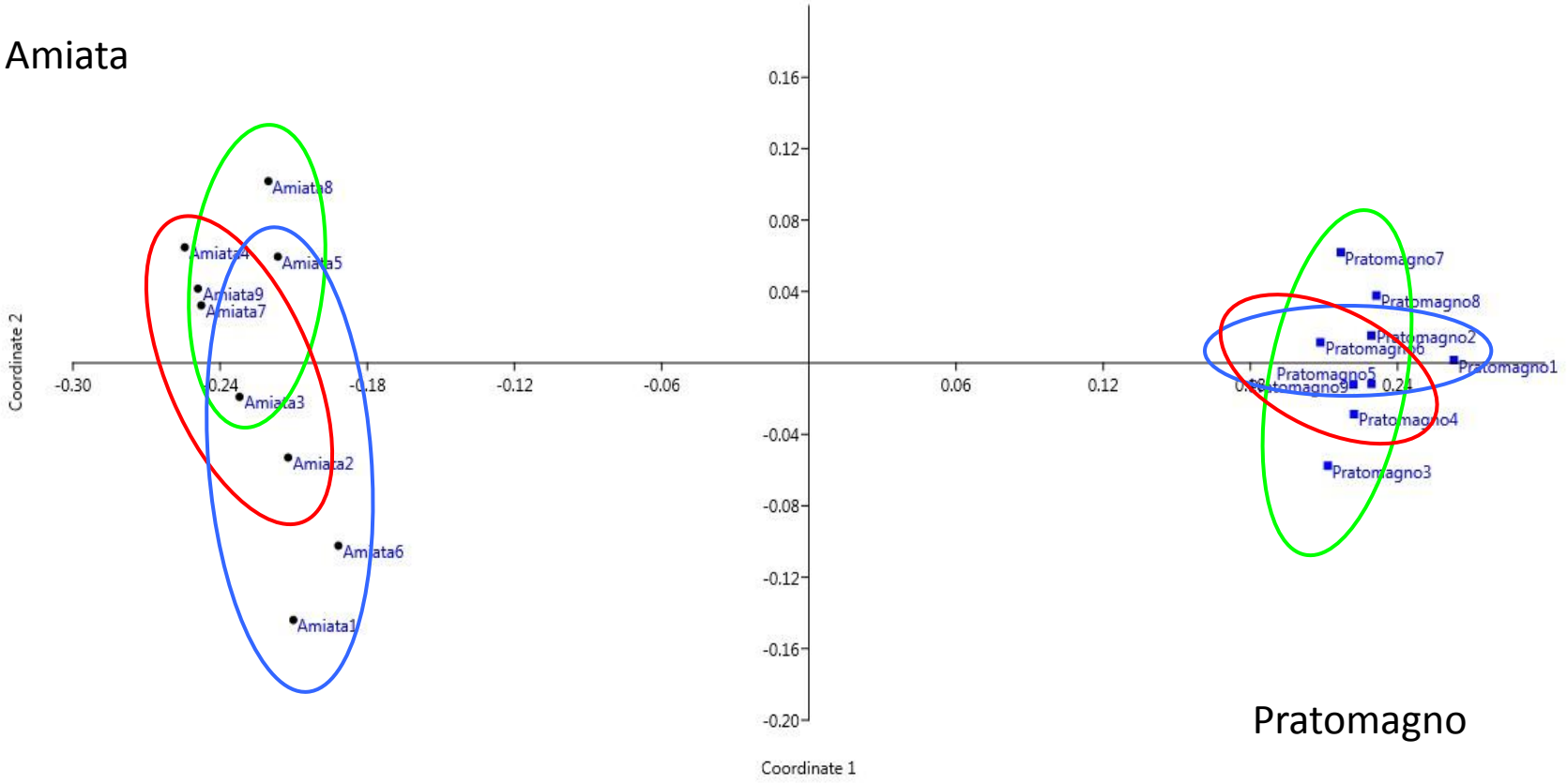
Fungal diversity



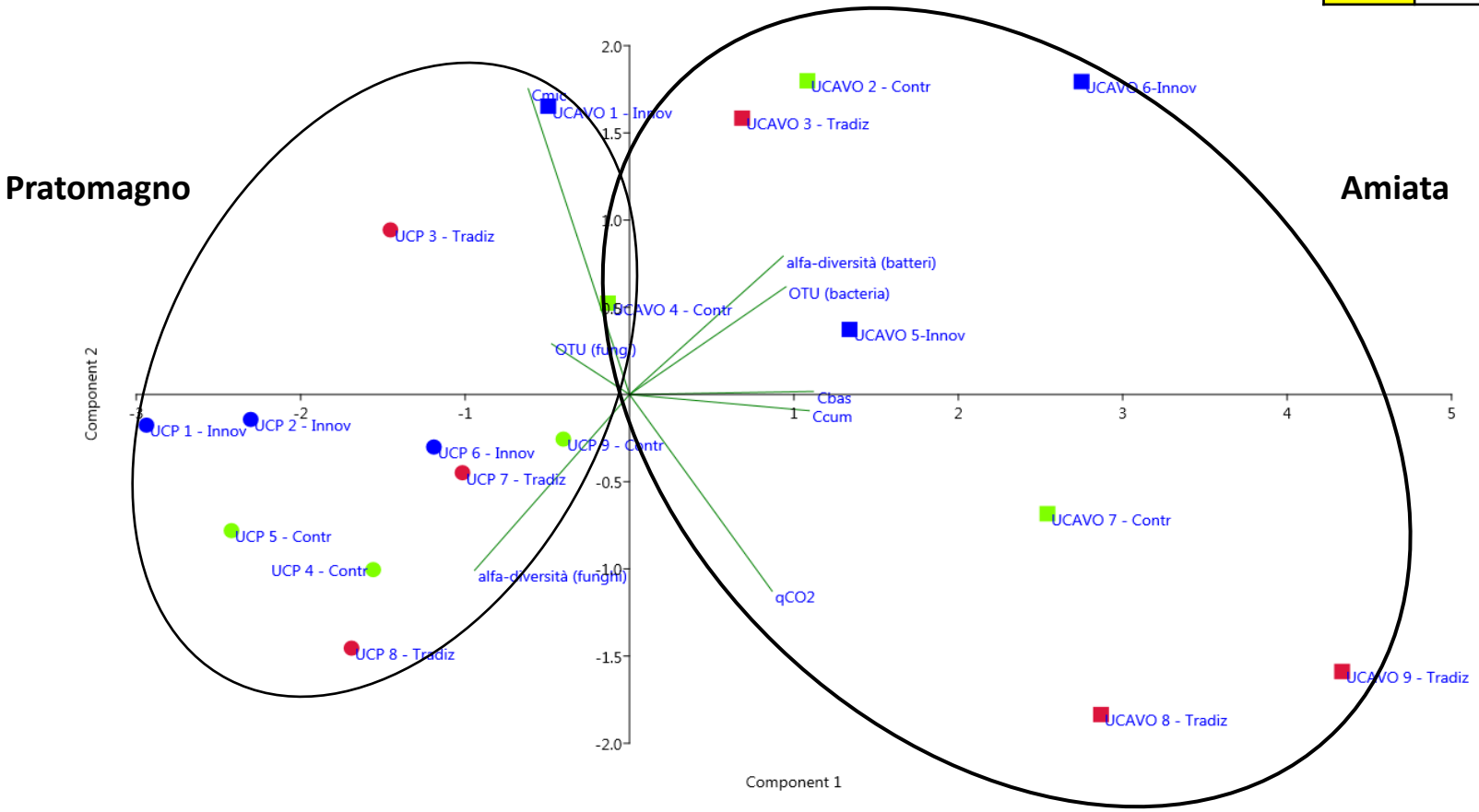
NMDS analysis (Fungi)

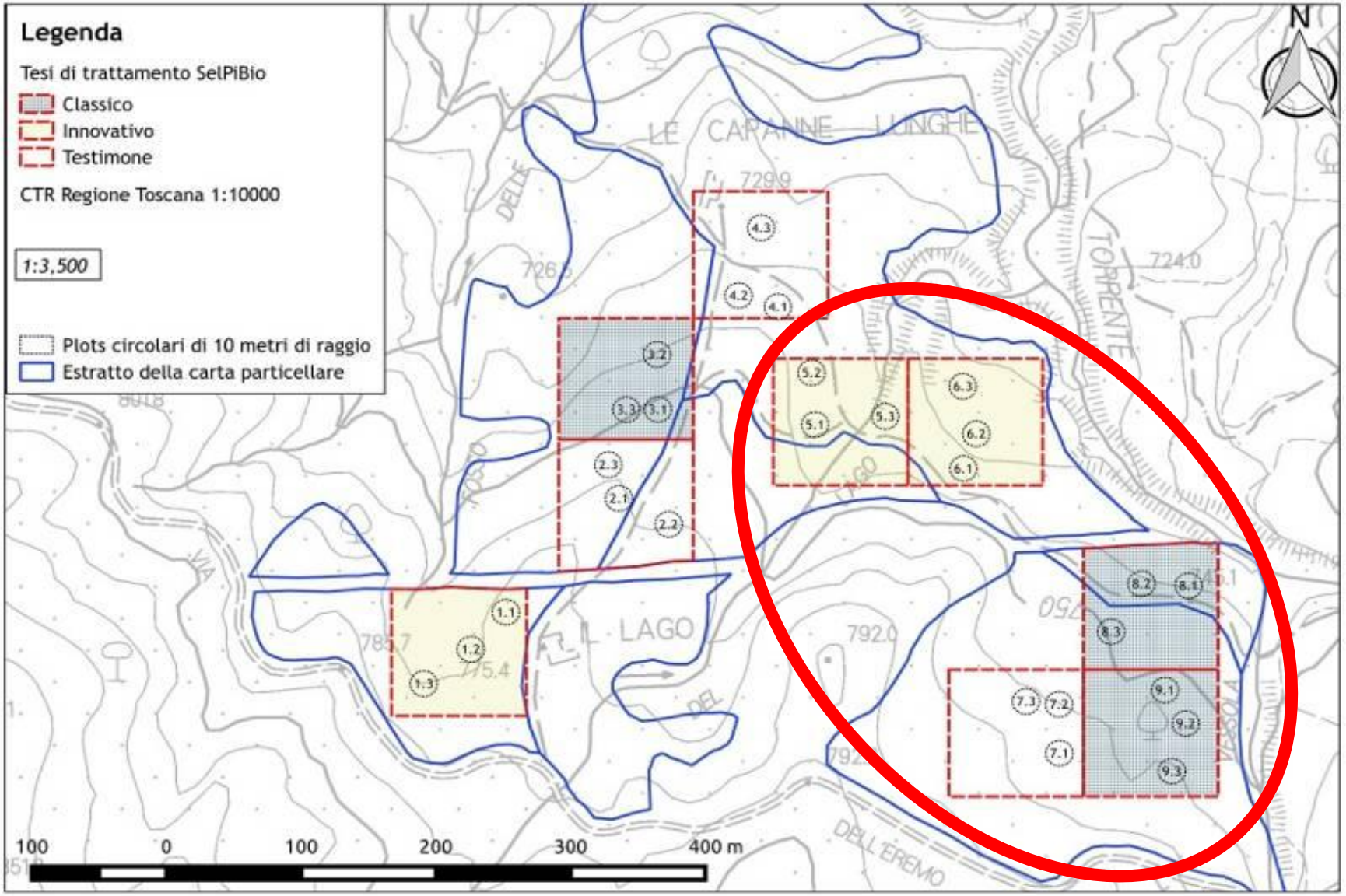


NMDS analysis (Non Metric Dimensional Scaling) of fungal communities (Phyla) of AMIATA (1, 5, 6: selctive thinning (blu); 3,8,9: traditional (green); 2,4,7: control (red) and PRATOMAGNO (1,2,6: selective thinning (blu); 3,7,8: traditional (green); 4,5,9: control (red) in 2017.

Principal Component Analysis (PCA)

PC	% variance
1	54,8 %
2	17,3 %





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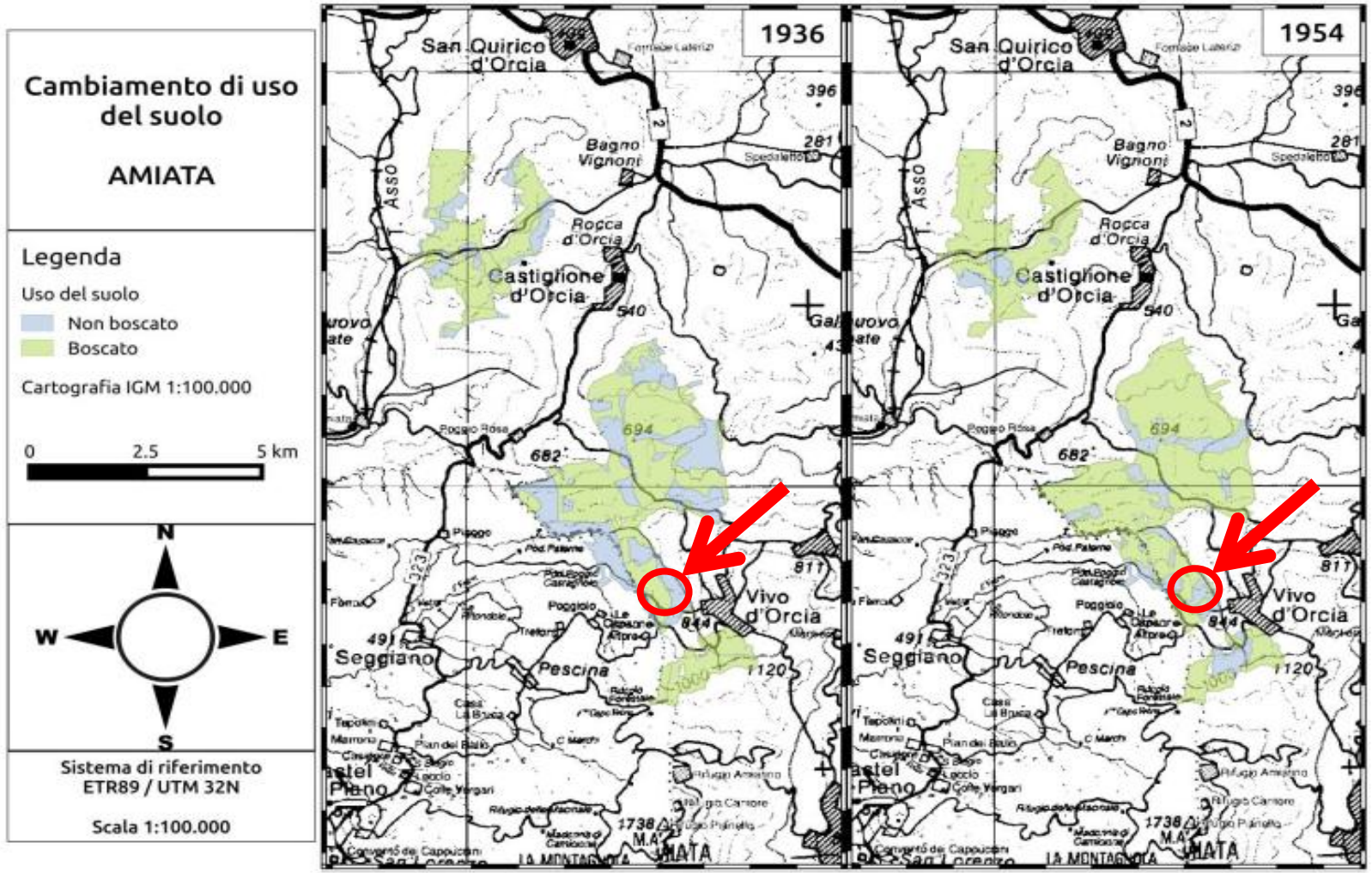
1936-1954: map of land use indicating the spatial distribution of forest (green) and grassland/meadow (blu). Red arrows indicate the area where plots 1-4 (green) and 5-9 (blu) were located



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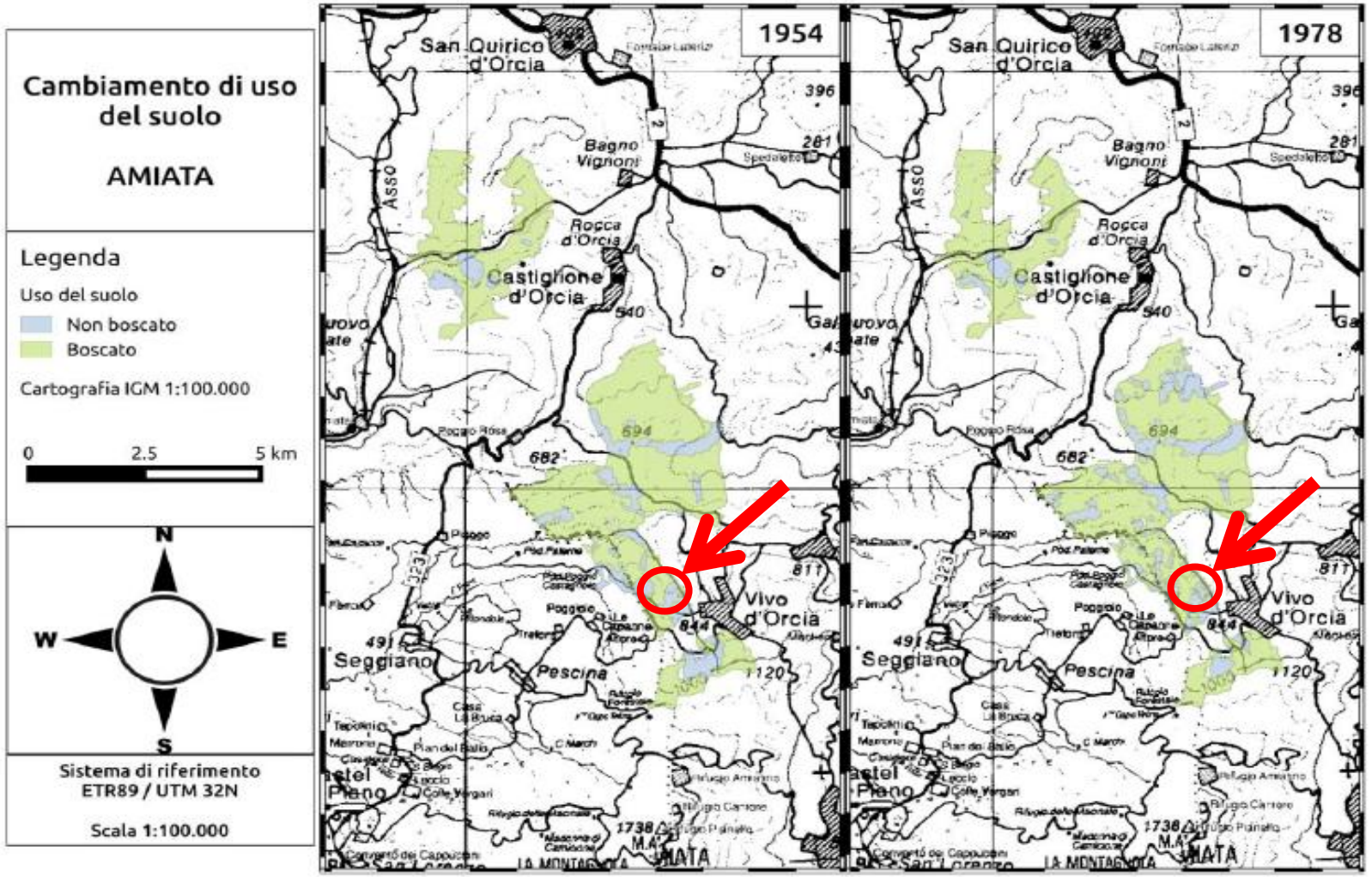
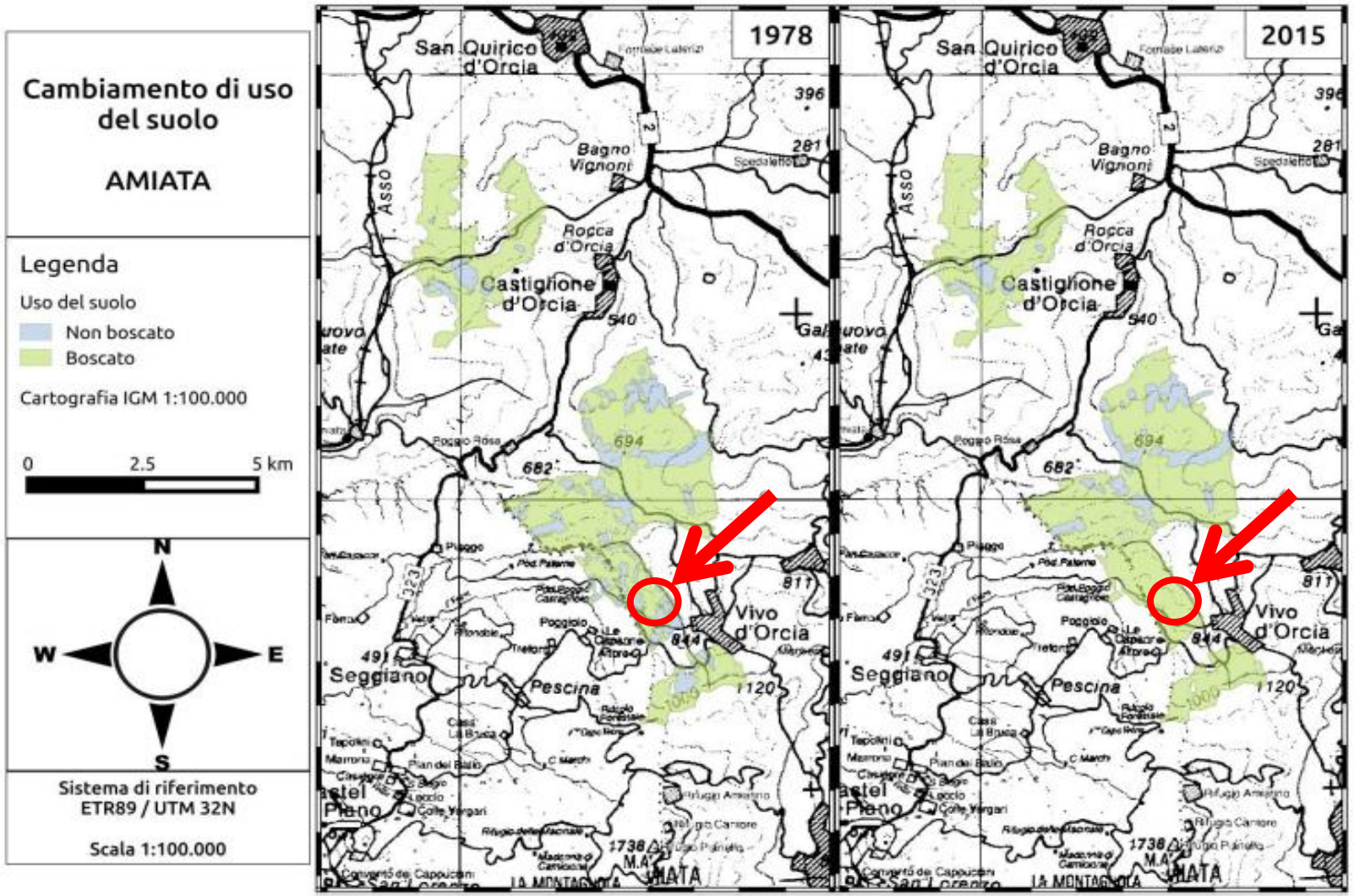
1954-1978: map of land use indicating the spatial distribution of forest (green) and grassland/meadow (blu). Red arrows indicate the area where plots 1-4 (green) and 5-9 (blu) were located



1978-2015: map of land use indicating the spatial distribution of forest (green) and grassland/meadow (blu). Red arrows indicate the area where plots 1-4 (green) and 5-9 (blu) were located



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Principal Component Analysis (PCA)

PC	% variance
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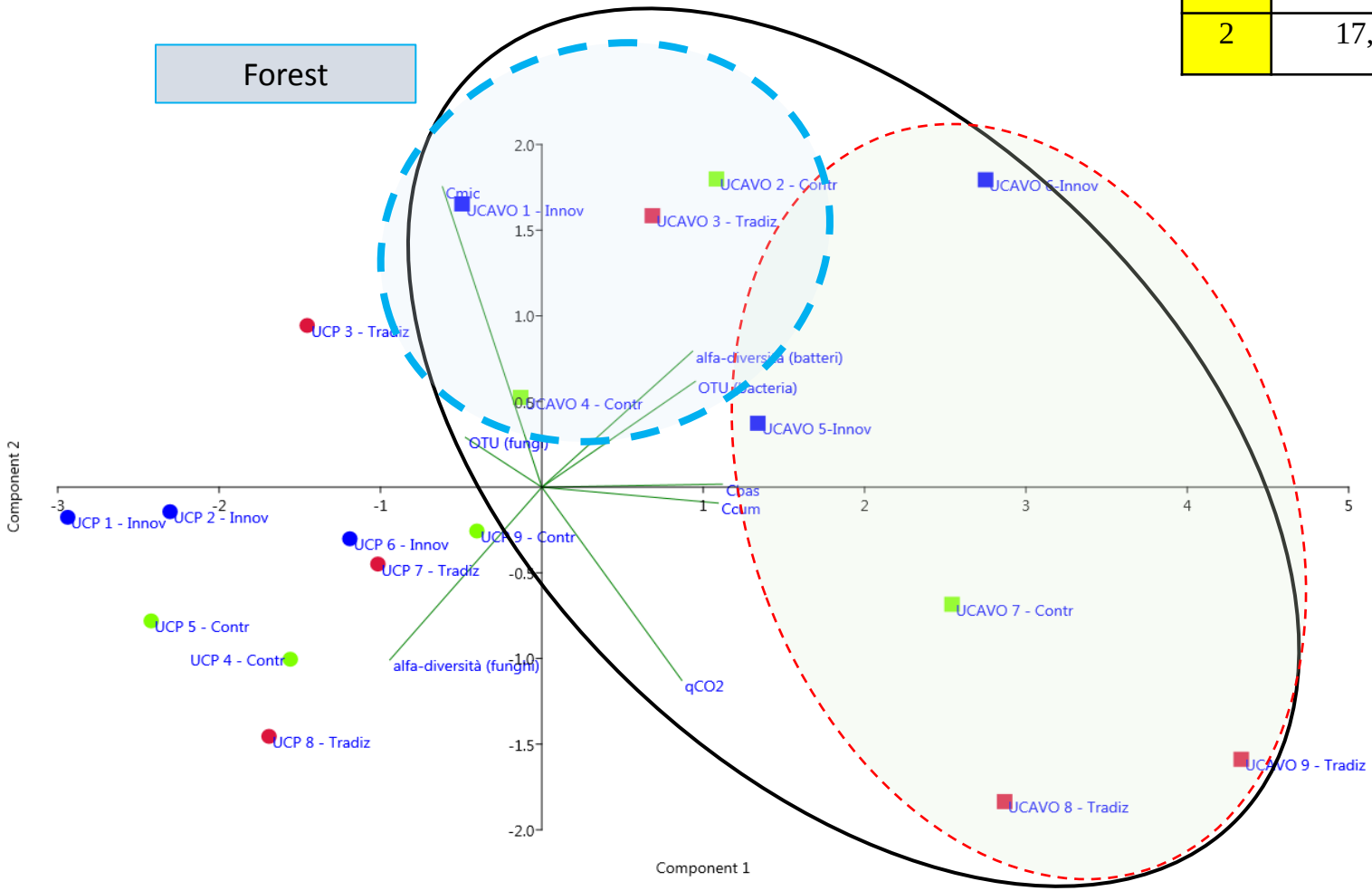

CONCLUSIONS

- **After two years from thinning, soil microbial activity and community structure of the two experimental areas is significantly different. However, the thinning did not significantly affect neither microbial activity or diversity.**

- **Moreover, the results shown that the Amiata complex is characterized by greater microbial biodiversity in terms of soil, also thanks to milder climatic conditions, which provide better conditions for the development of microbial communities.**

- **Remarkably, PCA of microbial data of AMIATA clustered samples according with their different land use over the last decades….a legacy from the past?**

Thank you

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