Supplementary material
for
Yeasts, arthropods, and environmental matrix: a triad to disentangle the multi-level definition of biodiversity

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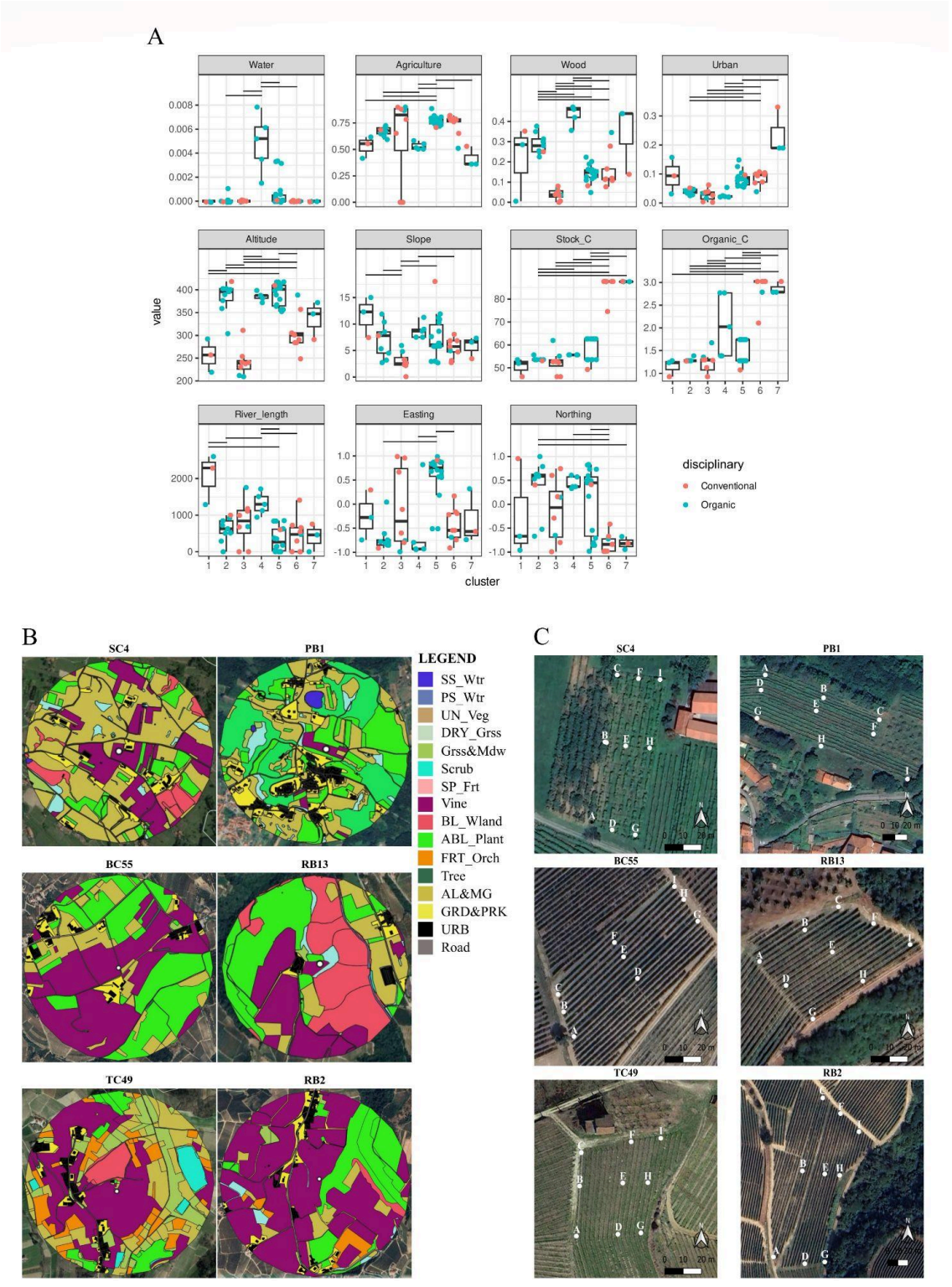
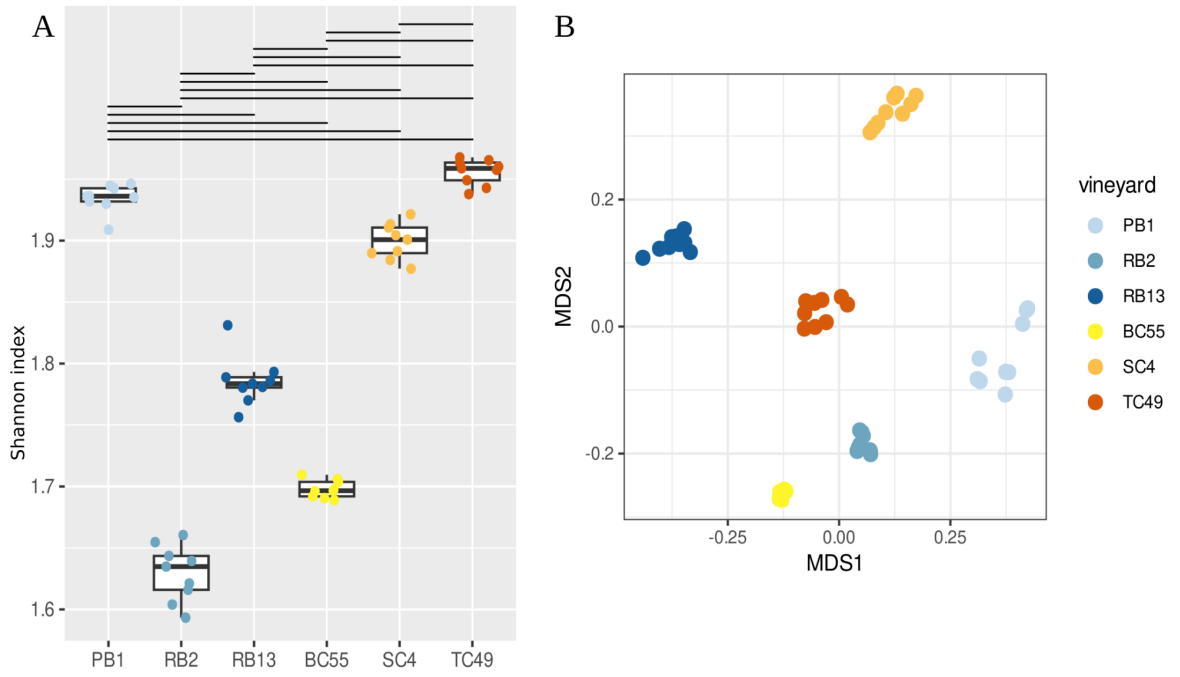
Additional supplementary documents include:
Supplementary Table 1: Details on sites
Supplementary Table 2: Information on invertebrates monitored with the different techniques.
Supplementary Table 3: List of yeasts isolated from the microbiologically investigated invertebrates.

Supplementary Figure 1: Details on selected sites. A) Significative difference between the seven clusters for each characteristic of the environmental matrix analyzed. **B)** GIS environmental matrix for each of the six selected vineyards. The legend description is provided in **Supplementary Table 1**. **C)** Details on the distribution of the pitfalls in each vineyard.



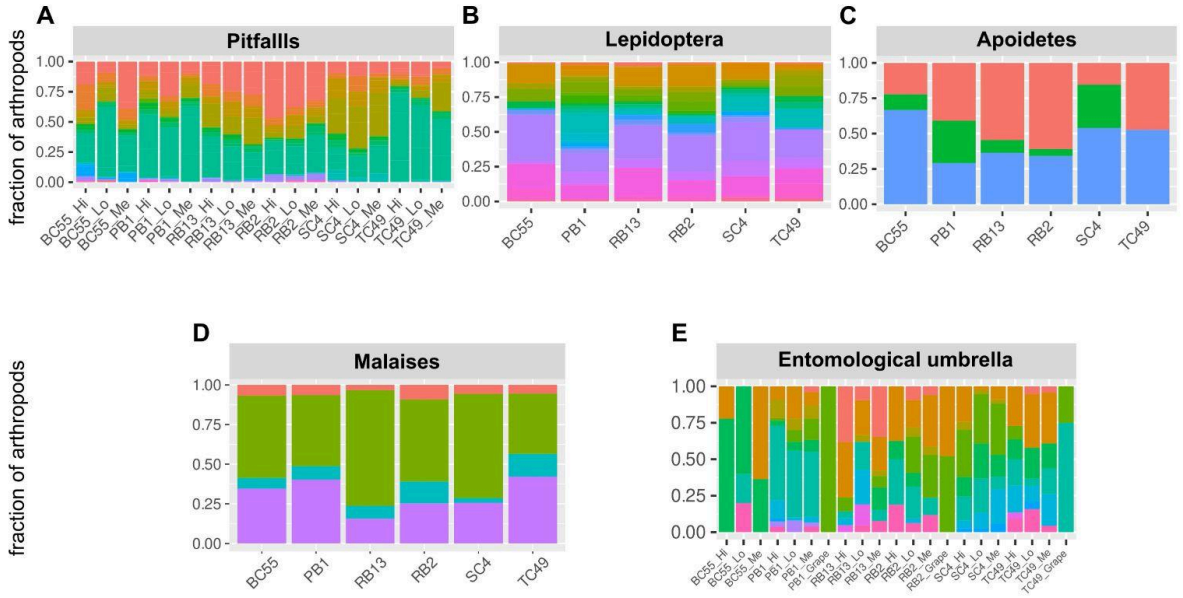
Supplementary Figure 2

Comparison of the composition of the environmental matrix among the selected vineyards. A) boxplot indicating the sites' Shannon indexes, quantified according to the number of distinct entities composing the environmental matrix per sampling point. horizontal black lines= Wilcoxon-Mann-Whitney fdr<0.05 (values reported in **Supplementary Table 1**). **B**) NMDS representation of environmental matrix Bray-Curtis diversity (permAnova on samples grouped by vineyard and management fdr< 0.05).



Supplementary Figure 3

Invertebrates monitored and/or sampled through different sampling approaches. Approaches were adopted according to the targeted invertebrates: A) pitfall traps to explore soil invertebrates, and visual census for gathering information on Lepidoptera (B), Apoidetes (C), (D) malaises for flying insects, entomological umbrella (E) for collecting invertebrates directly from the vine plant.



Legend Pitfalls (A)

- Acarina
- Araneae
- Chilopoda
- Coleoptera
- Collembola
- Dermaptera
- Diplopoda
- Diptera
- Hemiptera
- Hymenoptera
- Lepidoptera
- Neuroptera
- Opiliones
- Ortoptera
- other Gasteropoda
- other Isopoda
- other Nematoda
- other Pseudoscorpionida
- Psocoptera
- Thysanoptera
- Unknown

Legend Lepidoptera (B)

- *Argynnis_paphia*
- *Celastrina_argiolus*
- *Carcharodus_alceae*
- *Coenonympha_pamphilus*
- *Colias_crocea*
- *Cupido argiades*
- *Gonopteryx rhamni*
- *Iphiclides podalirius*
- *Issoria lathonia*
- *Lasiommata megera*
- *Leptidea sinapsis*
- *Leptidea sinapsis reali*
- *Limenitis reducta*
- *Lycaena phlaeas*
- *Lycaena tityrus*
- *Maniola jurtina*
- *Melanargia galatea*
- *Melitaea athalia*
- *Melitaea didyma*
- *Melitaea_phoebe*
- *Melitaea_trivia*
- *Ochlodes_venatus*
- *Papilio_argiolus*
- *Papilio_machaon*
- *Pieris brassicae*
- *Pieris mannii*
- *Pieris napi*
- *Pieris rapae*
- *Plebejus argus*
- *Plebejus idas*
- *Polygonia c. album*
- *Polyommatus icarus*
- *Pontia edusa*
- *Pyrgus armoricanus*
- *Thymelicus lineola*
- *Vanessa atalanta*
- *Vanessa cardui*

Legend Apoidetes (C)

- *Apis mellifera*
- *Bombus* sp.
- other Apoidetes

Legend Malaises (D)

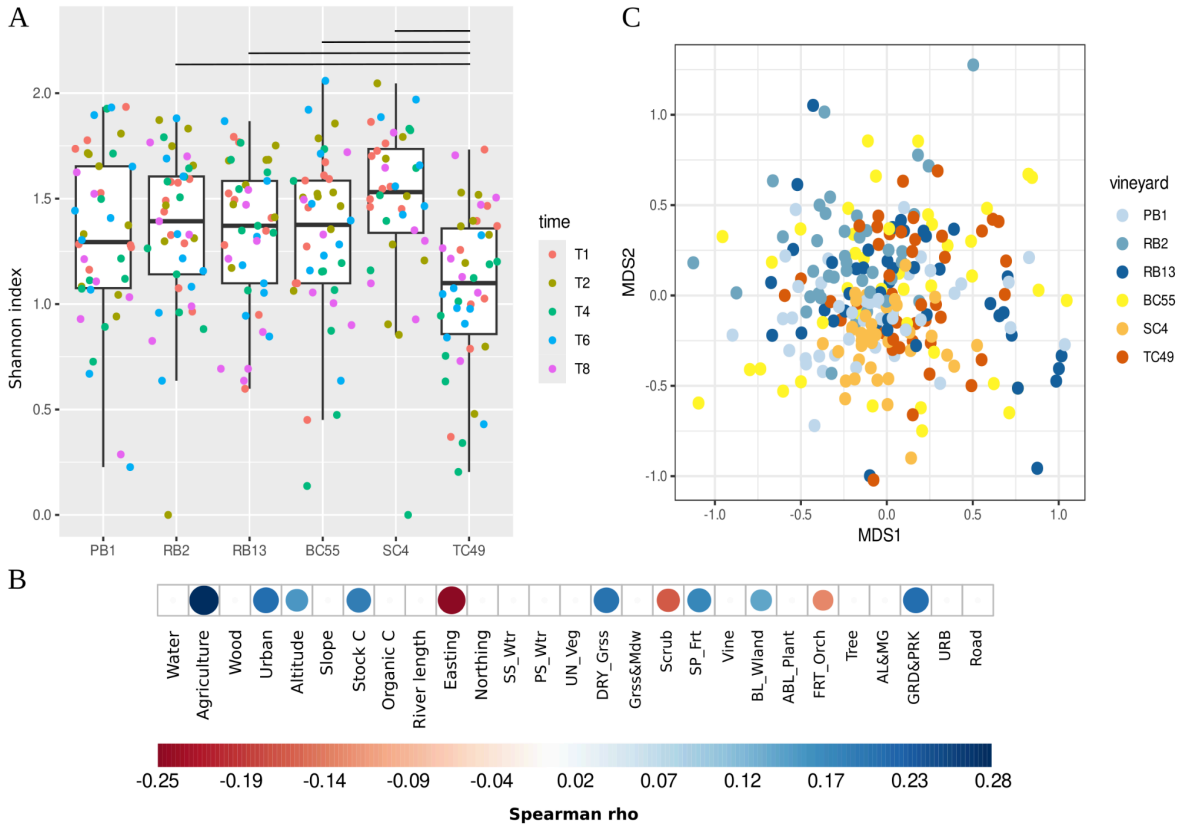
- Coleoptera
- Diptera
- Hemiptera
- Hymenoptera

Legend entomological umbrella (E)

- Acarina
- Araneae
- Coleoptera
- Dermaptera
- Diptera
- Hemiptera
- Hymenoptera
- Lepidoptera
- Odonata
- Opiliones
- Ortoptera

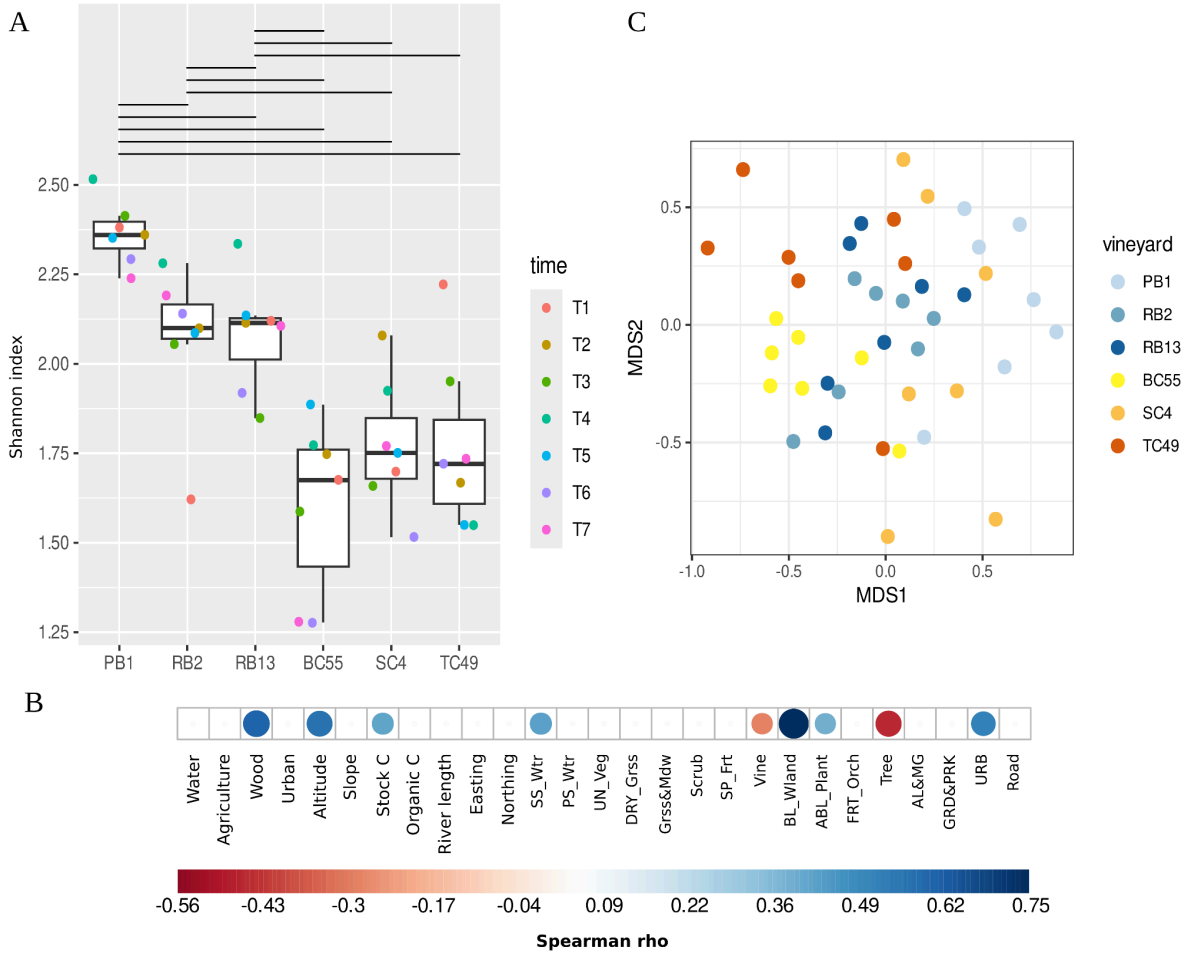
Supplementary Figure 4

Comparison of the arthropods monitored through pitfall analysis. A) boxplot indicating the sites' Shannon indexes, quantified according to the number of distinct Orders monitored per sampling point (3 different vineyard rows each with 3 pitfalls). Horizontal lines indicate Wilcoxon-Mann-Whitney fdr<0.05 (statistics reported in **Supplementary Table 2**). **B)** Spearman correlations between the pitfall alpha diversity and environmental features. **C**) NMDS representation of monitored arthropods' Bray-Curtis diversity (permAnova statistics in **Supplementary Table 2**).



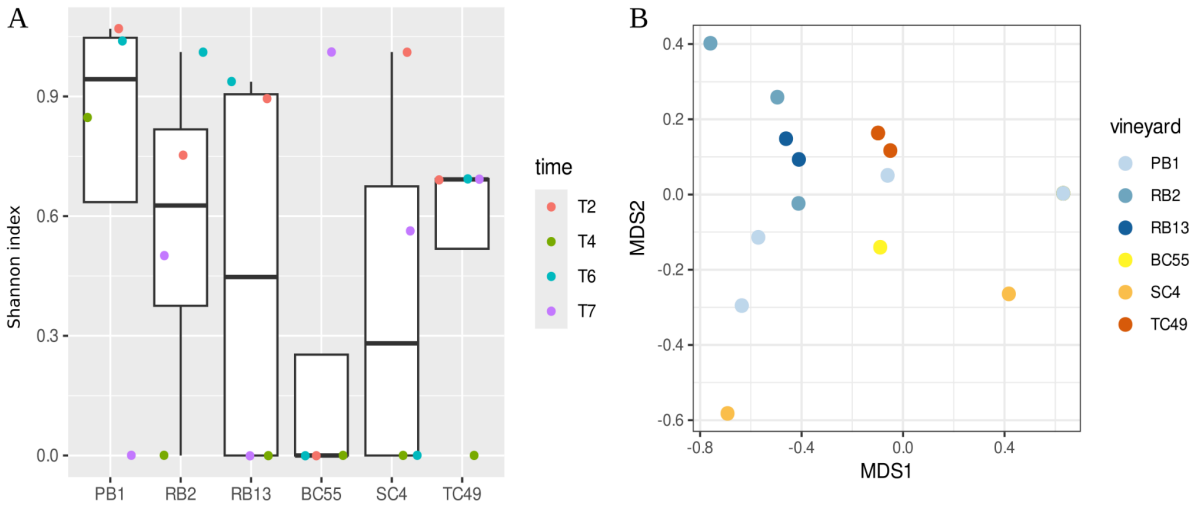
Supplementary Figure 5

Comparison of the Lepidoptera monitored through visual census. A) boxplot indicating the sites' Shannon indexes, quantified according to the number of distinct Lepidoptera species monitored per sampling point (1 sampling for 7 time-points). Horizontal lines indicate Wilcoxon-Mann-Whitney fdr<0.05 (statistics reported in **Supplementary Table 2**). **B)** Spearman correlations between the pitfall alpha diversity and environmental features. **C**) NMDS representation of monitored Lepidoptera Bray-Curtis diversity (permAnova statistics in **Supplementary Table 2**).



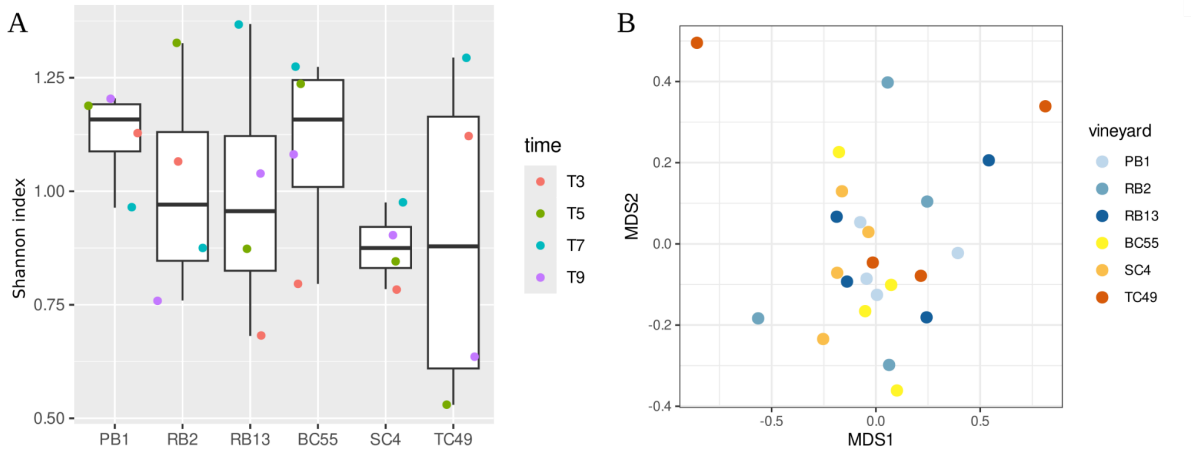
Supplementary Figure 6

Comparison of the Apoidetes monitored through visual census. A) boxplot indicating the sites' Shannon indexes, quantified according to the number of distinct Apoidetes monitored per sampling point (1 sampling for 4 time-points). **B**) NMDS representation of monitored Apoidetes Bray-Curtis diversity (permAnova on samples grouped by management fdr< 0.05).



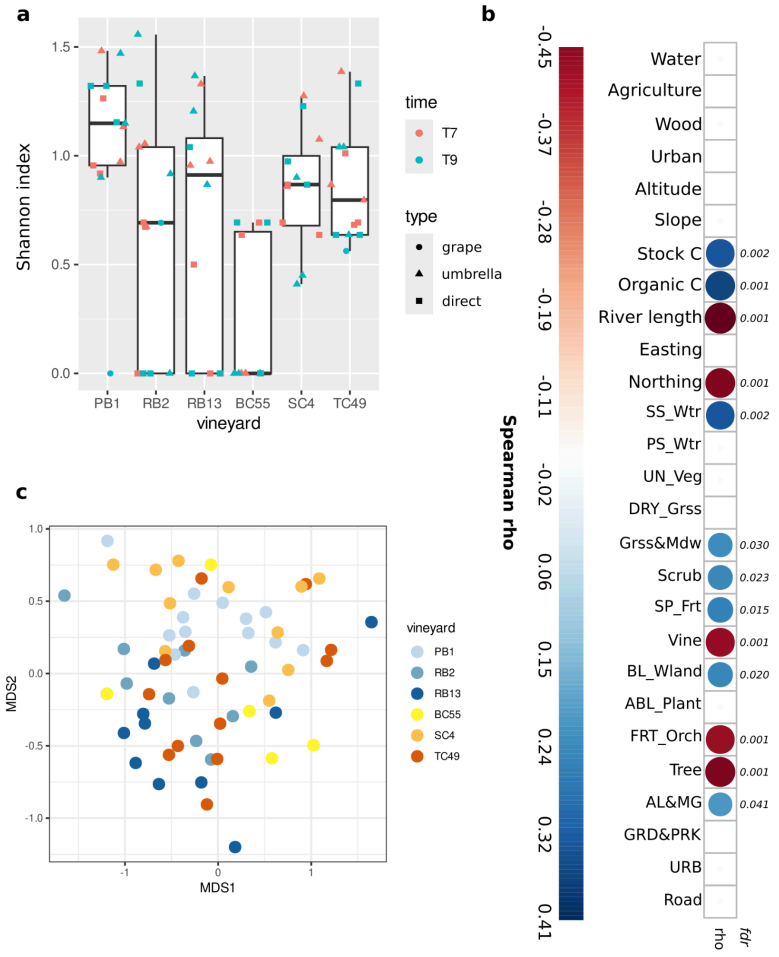
Supplementary Figure 7

Comparison of arthropods monitored through malaise approach. A) boxplot indicating the sites' Shannon indexes, quantified according to the number of distinct arthropods monitored per sampling point (1 sampling for 4 time-points). **B**) NMDS representation of monitored arthropods Bray-Curtis diversity.



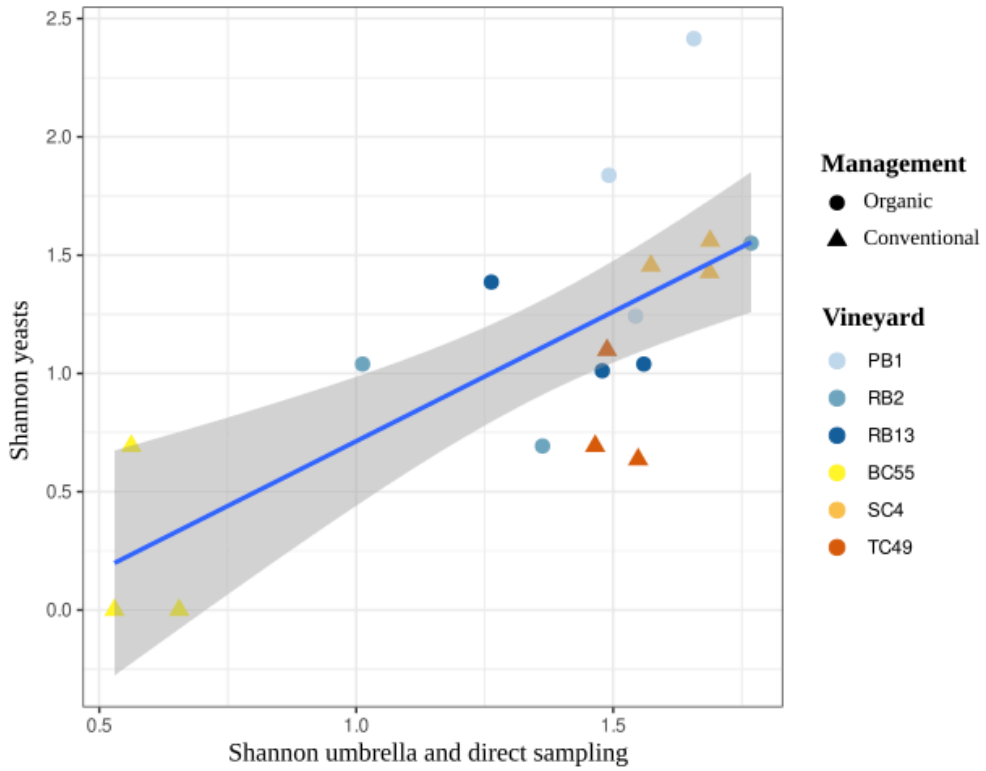
Supplementary Figure 8

Comparison of arthropods monitored through direct sampling and entomological umbrella approaches. a) boxplot indicating the sites' Shannon indexes, quantified according to the number of distinct Orders monitored per sampling point (3 different vineyard rows for two time-points). **b**) Spearman correlations between the pitfall alpha diversity and environmental features. Italics numbers indicate the correlation frd (only significant correlations are shown). **c**) NMDS representation of monitored arthropods' Bray-Curtis diversity (permAnova on samples grouped by vineyard and management fdr< 0.05).



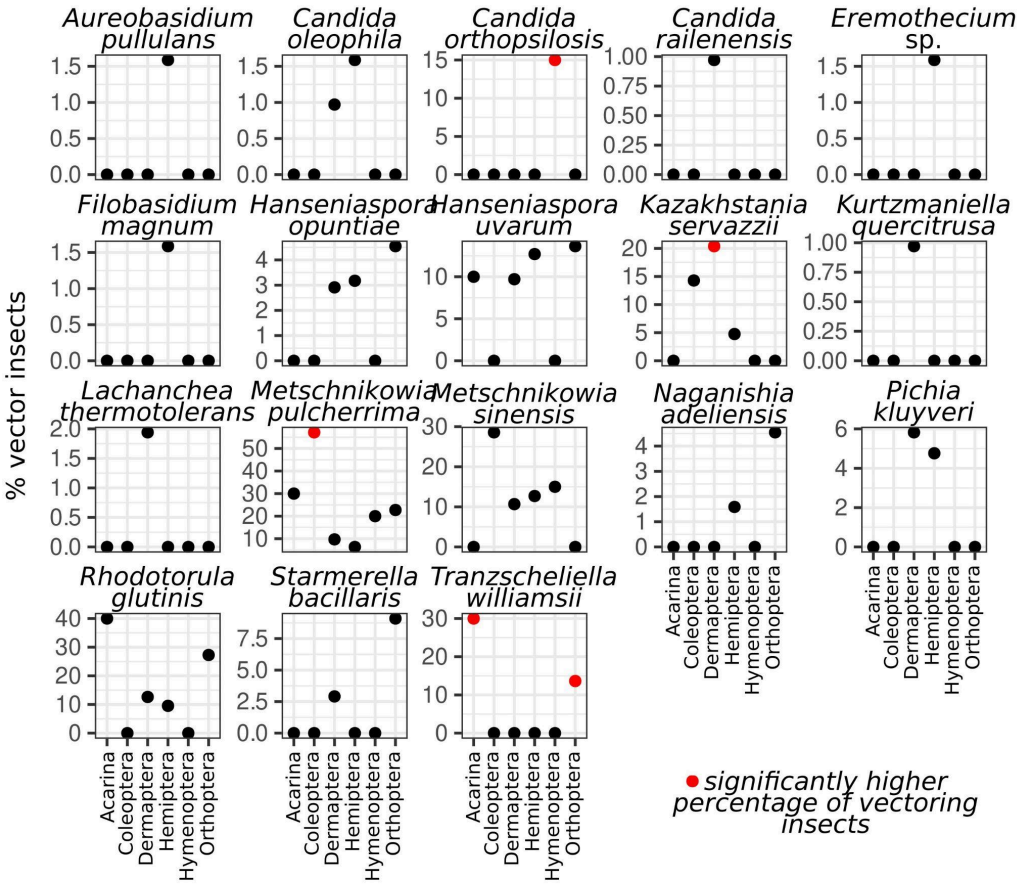
Supplementary Figure 9

Relationship between yeast and source arthropods alpha diversities. The blue line represents the glm fitting with the relative error (gray shadow).



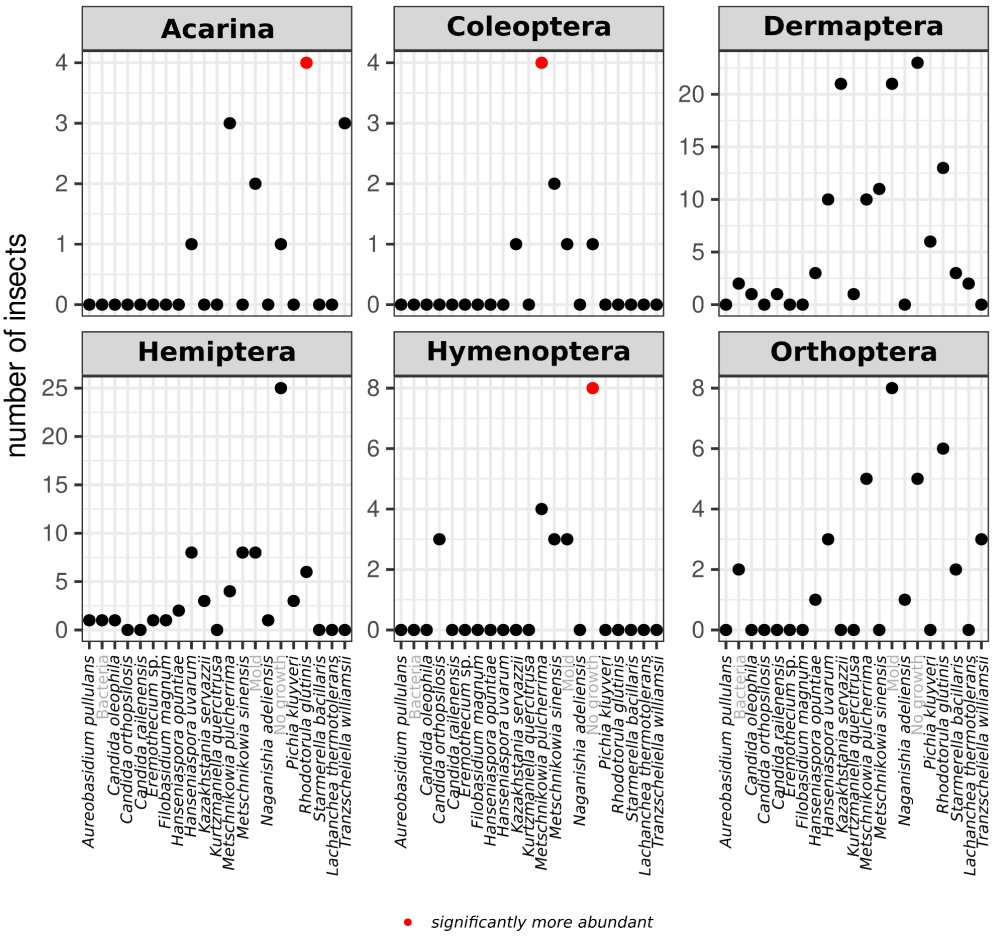
Supplementary Figure 10

Yeast vectoring potential of insects. The plot shows, for each isolated yeast species, the % of vector insects, calculated as the percentage of individuals providing strains of the 18 isolated yeast species (% vector insects). Red dots indicate the insect order showing a % of insects vectoring the corresponding yeast species significantly higher than the % of insects belonging to other orders vectoring the same yeast species (Wilcoxon-Mann-Whitney test, fdr<0.05).



Supplementary Figure 11

Associations between insect vectors and yeast species. The plot shows, for each insect microbiologically analyzed, the number of microorganisms isolated. Red dots indicate the microorganisms most frequently isolated from the corresponding insect order (Wilcoxon-Mann-Whitney test, fdr<0.05).



Supplementary Figure 12

Multi-level correlations among orthoptera and environmental matrix features.

Correlations between orthoptera monitored through direct sampling, orthoptera monitored through malaise sampling, and Lepidoptera monitored through visual census and environmental matrix features.