INCREASE HOVERFLY FUNCTIONAL BIODIVERSITY TO IMPROVE ECOLOGICAL SERVICES IN AGROECOSYSTEMS



Francesco Lunardelli

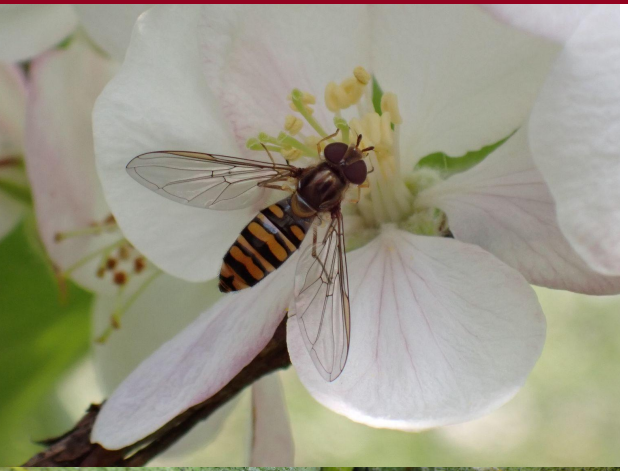
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13th International Symposium on Syrphidae (ISS13)
Fiera di Primiero (TN)
22-27/VI/2026

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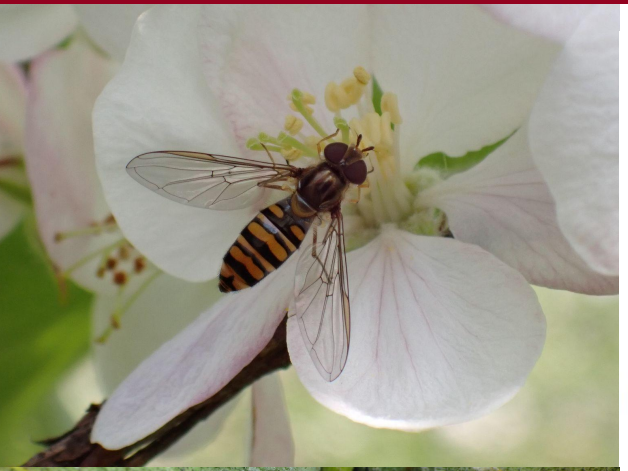
A PROBLEMATIC RELATIONSHIP





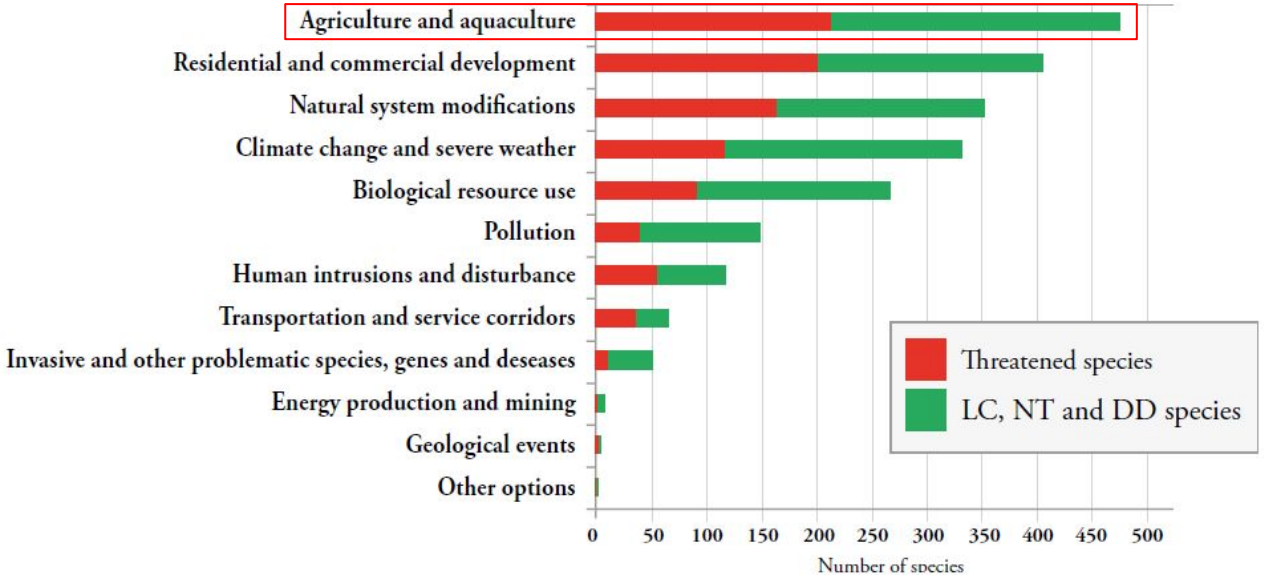
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A PROBLEMATIC RELATIONSHIP





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Major threats to hoverflies in Europe (Vujic et al., 2022)

- **Ob.1: Assess the effect of orchard management on hoverfly communities**

  - Which management strategy supports the highest richness?

  - Does species composition differ among management types?

- **Ob.2: Evaluate the influence of landscape on hoverfly diversity**

- **Ob.3: Compare the sampling methods: transect surveys vs. Malaise traps**



LOCATION: Friuli-Venezia Giulia region



SAMPLING SITES

19 APPLE ORCHARDS

- 10 Organic
- 9* Integrated



SAMPLING SITES

19 APPLE ORCHARDS

- 10 Organic
- 9* Integrated

*1 orchard excluded because of lack of samplings



SAMPLING METHODS: Transects vs. Malaise traps





SAMPLING METHODS: Transects vs. Malaise traps

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March - September
2024-25



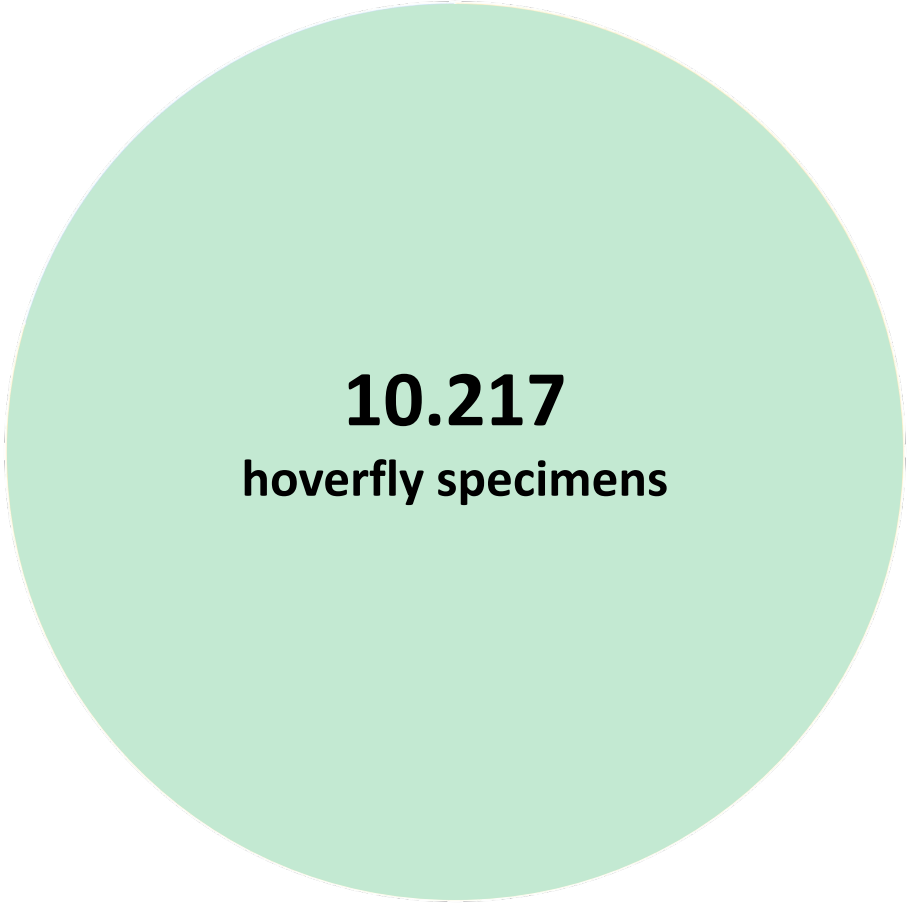
Edge (250 m x 45 min)
+
Inter-row (250 m x 45 min)

1 x 4 weeks



2 weeks ON
+
2 weeks OFF

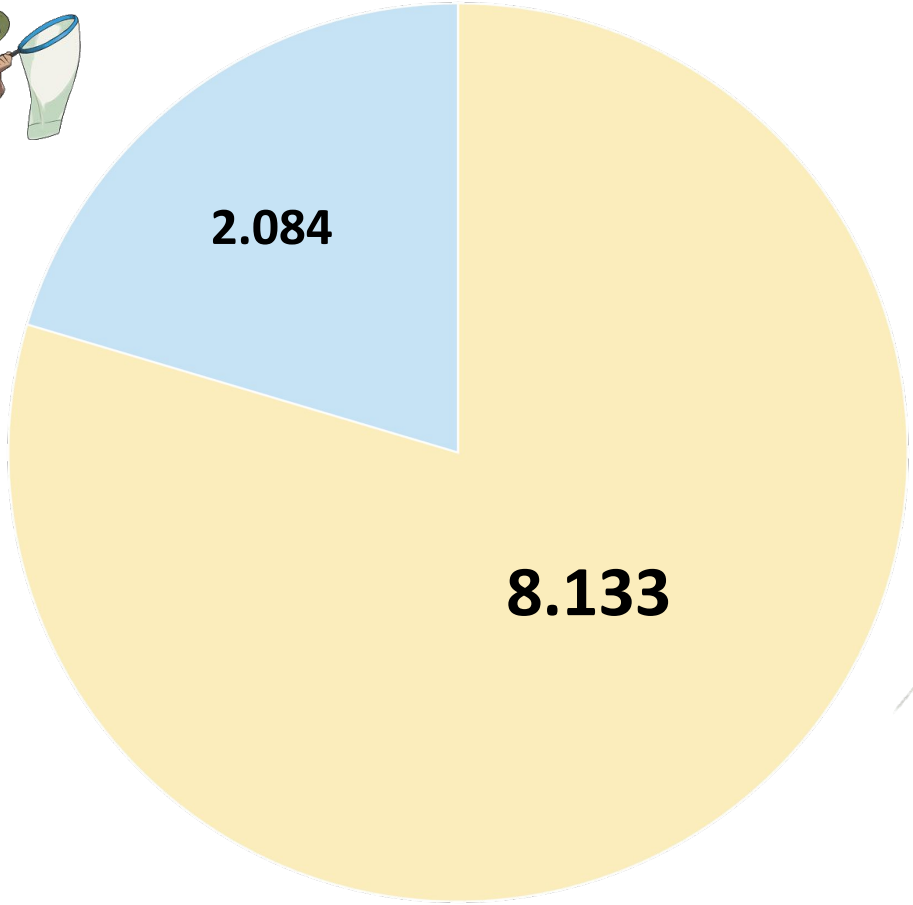
SAMPLING METHODS: Number of specimens collected



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TRANSECTS





MALAISE TRAPS



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TRANSECTS

66 total
8 exclusive

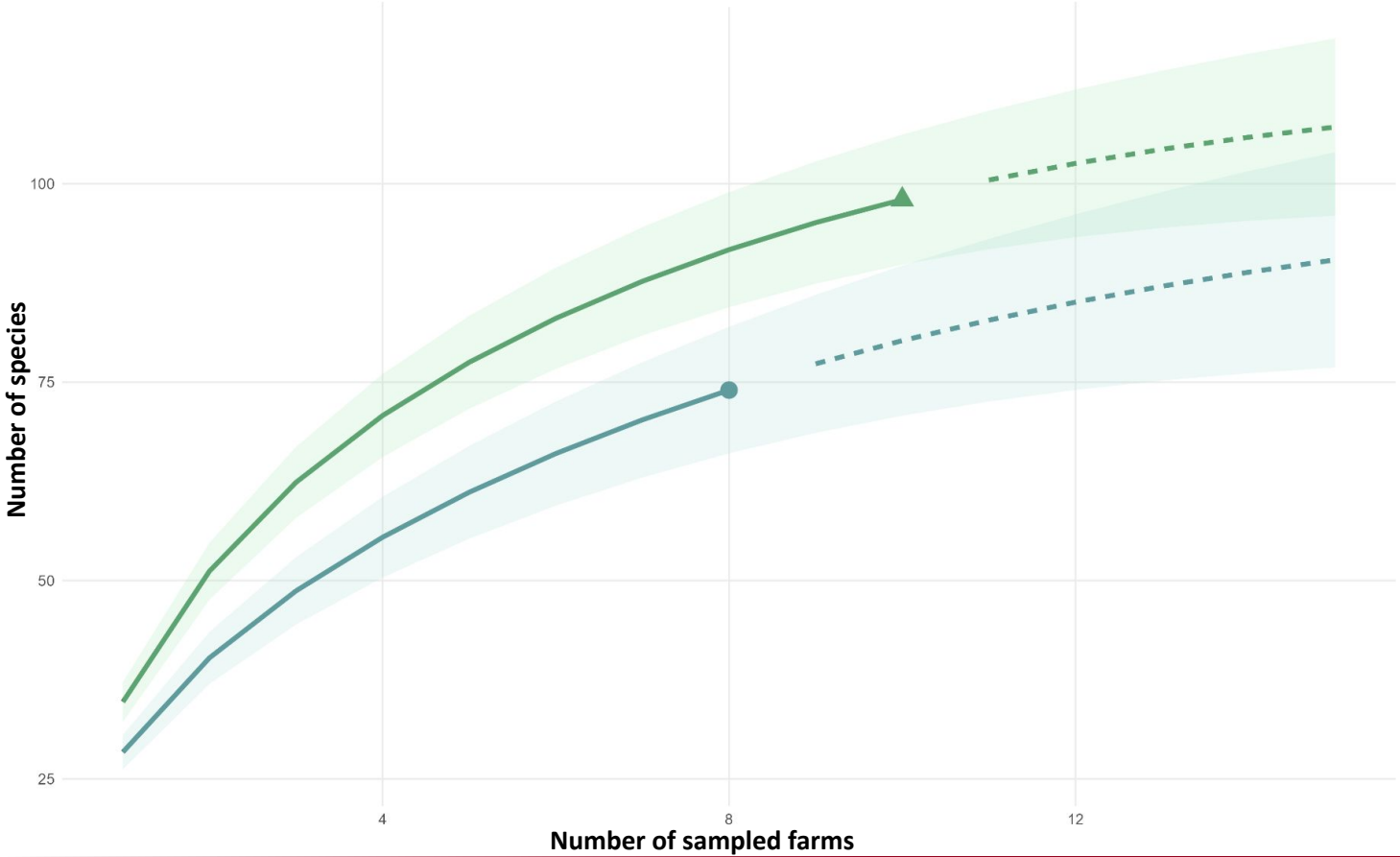


MALAISE TRAPS

97 total
39 exclusive



SAMPLING EFFORT: Integrated vs. Organic



Organic orchards support a larger potential species pool than **integrated** orchards.

INTEGRATED

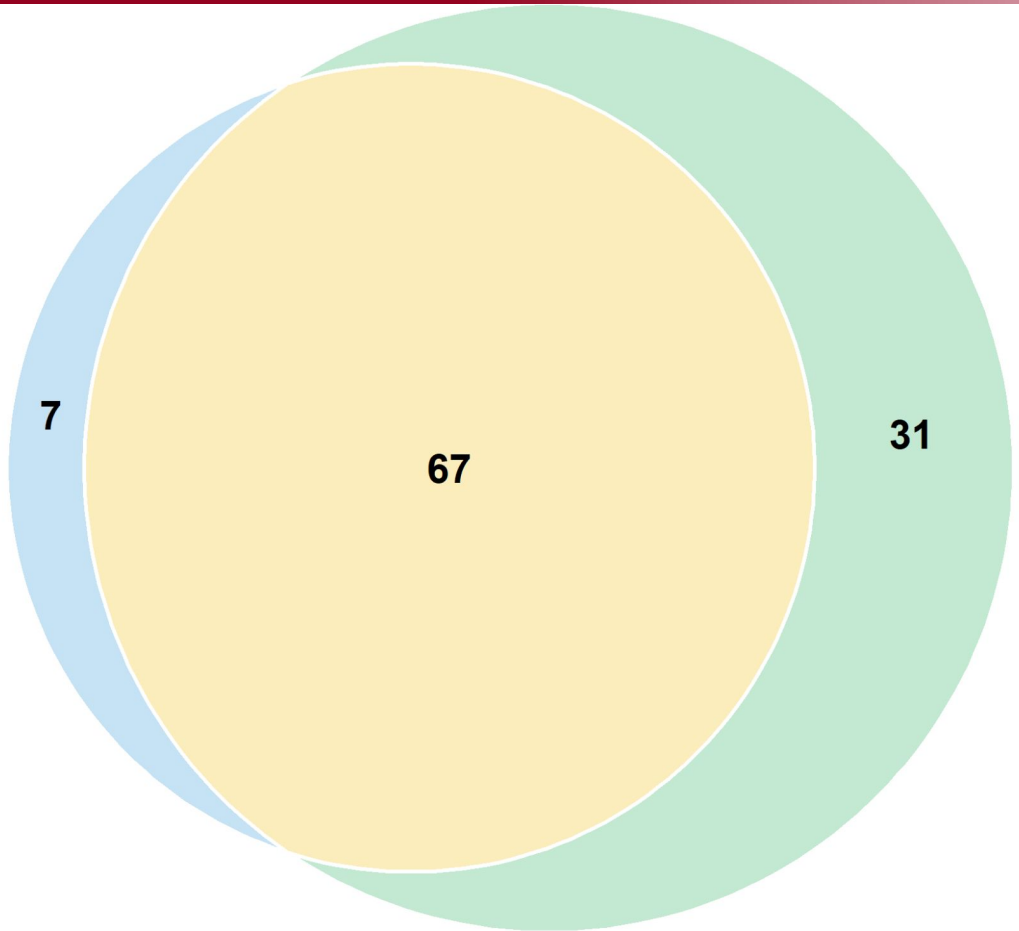
74 total

7 exclusive

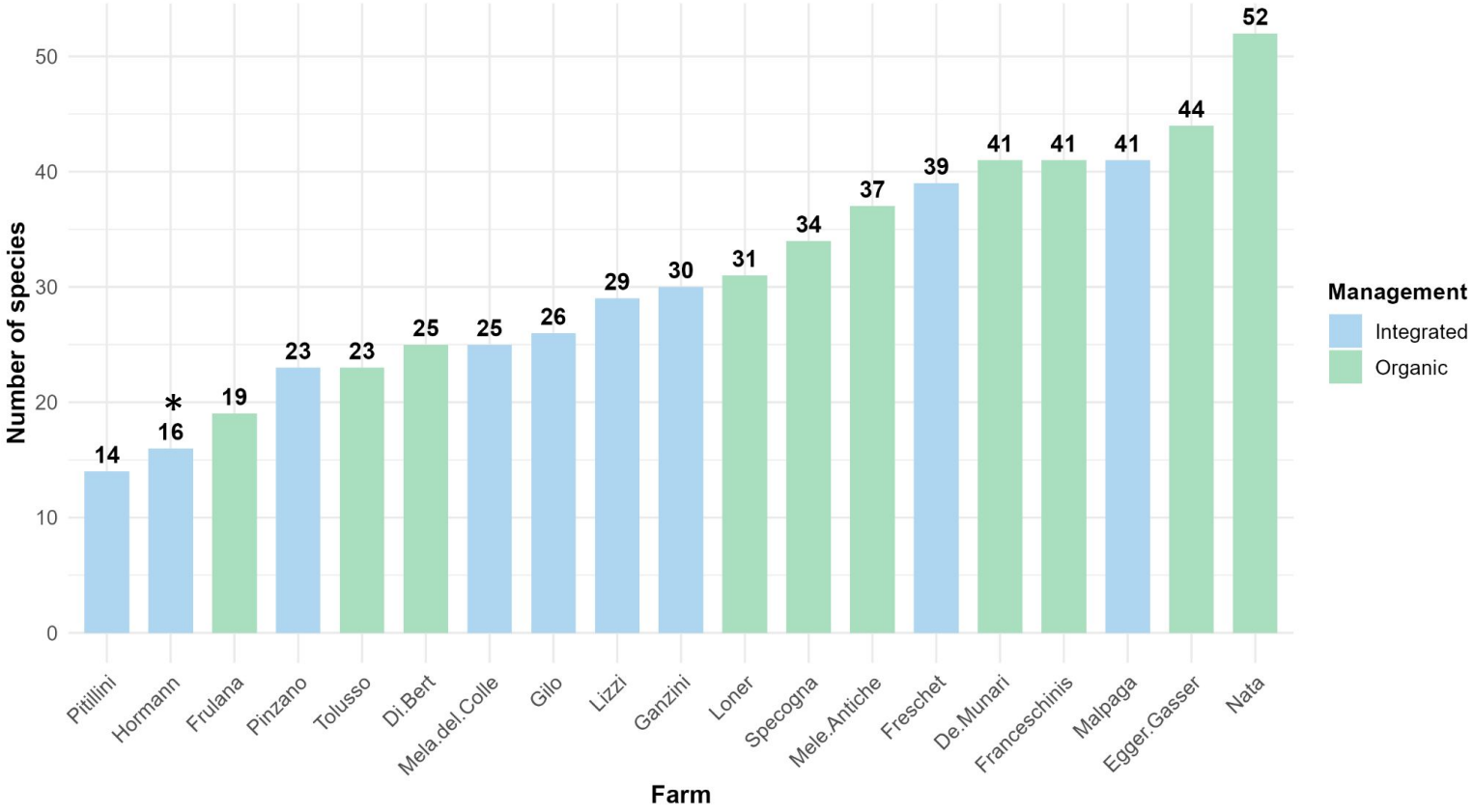
ORGANIC

98 total

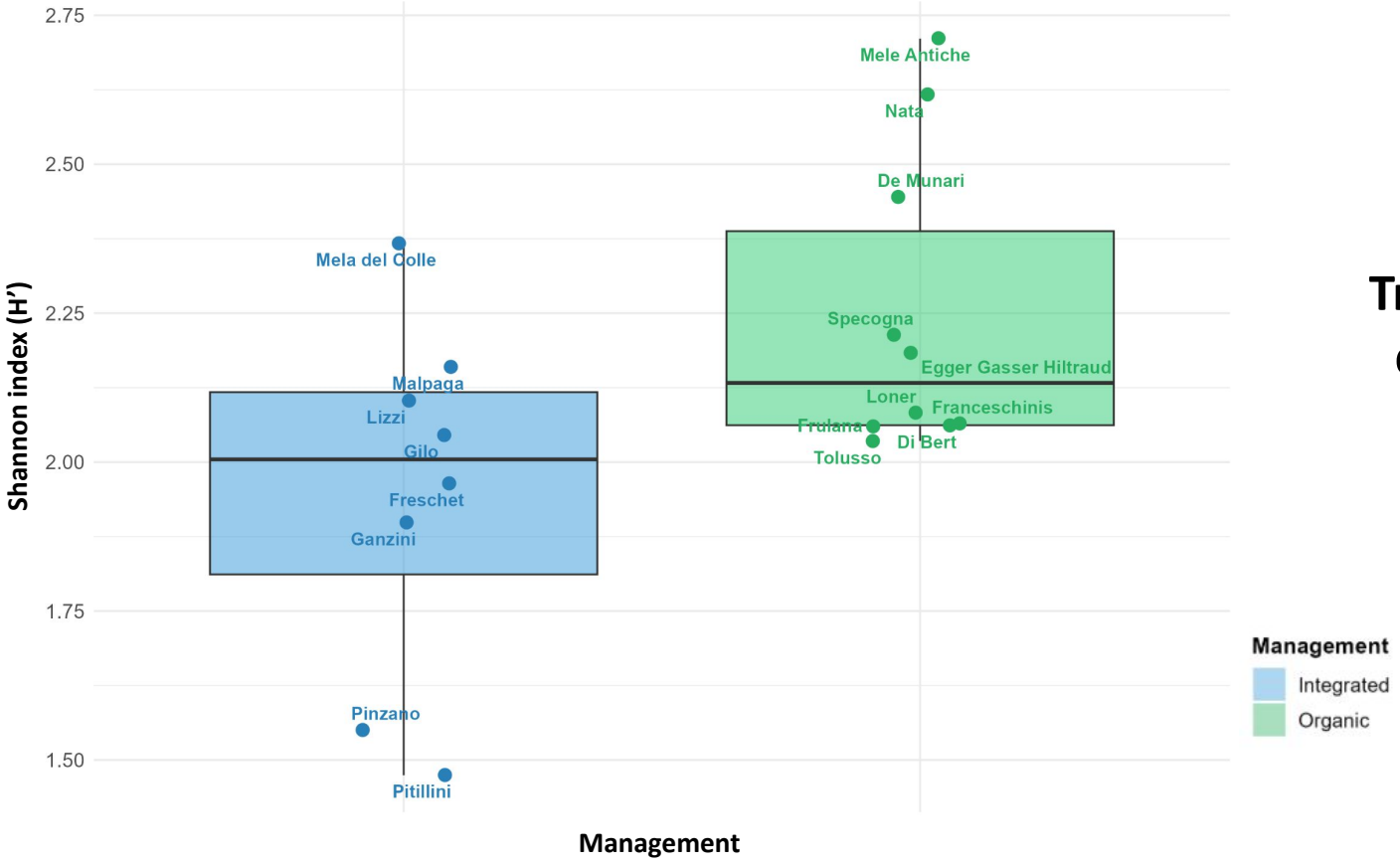
31 exclusive



MANAGEMENT: Species richness by farms



MANAGEMENT: Shannon diversity



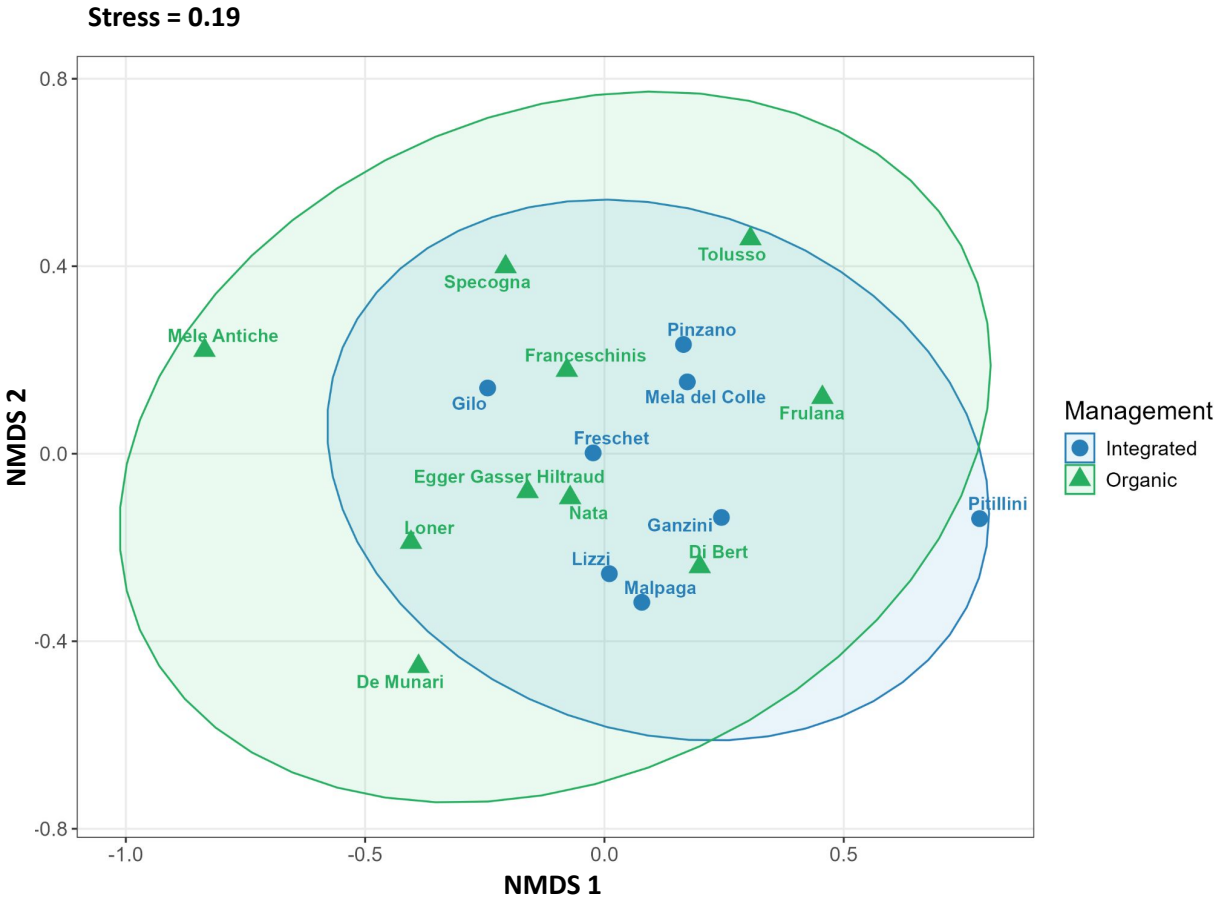
Trend toward greater diversity in organic orchards

MANAGEMENT: Simpson diversity



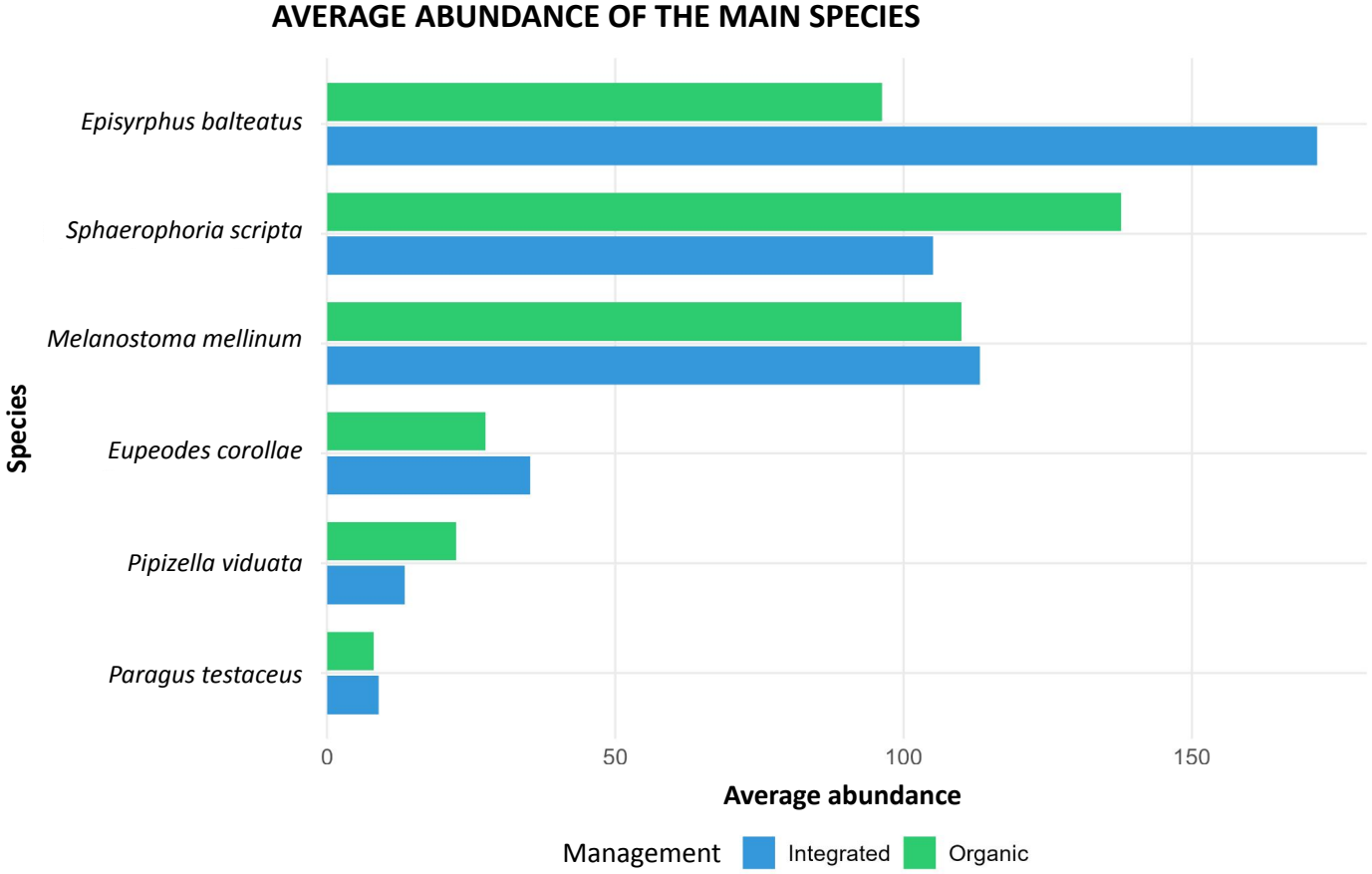
More balanced communities in organic orchards

MANAGEMENT: NMDS + PERMANOVA



No effects of management on community composition

MANAGEMENT: Dominance

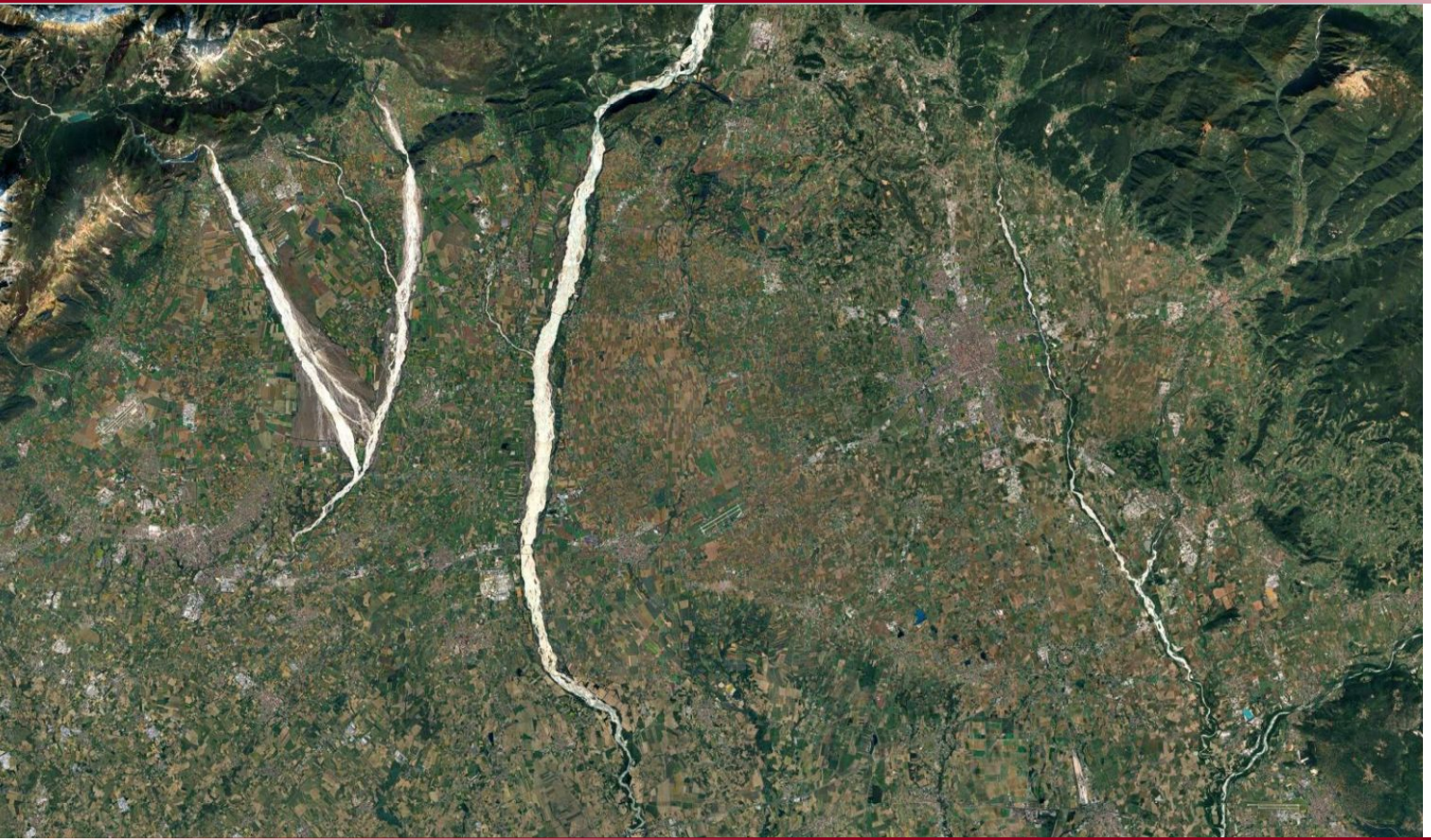


20.7%

19.2%

17.4%

3 species explains the **57.3%** of total diversity



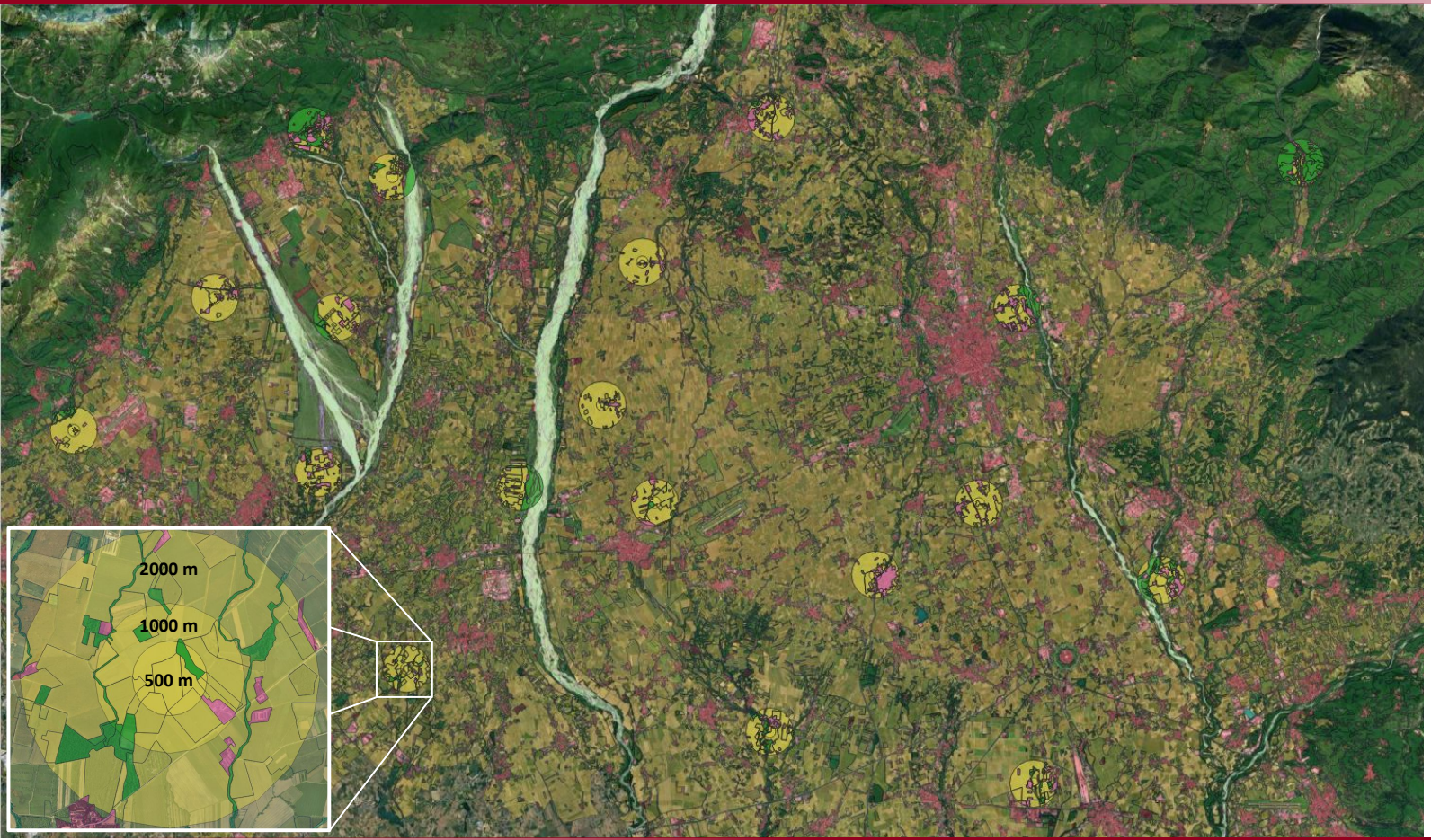
LANDSCAPE: Land usage



3 CATEGORIES OF LAND USAGE

- Natural and seminatural
- Agricultural and rural
- Urban and anthropised

LANDSCAPE: Land usage



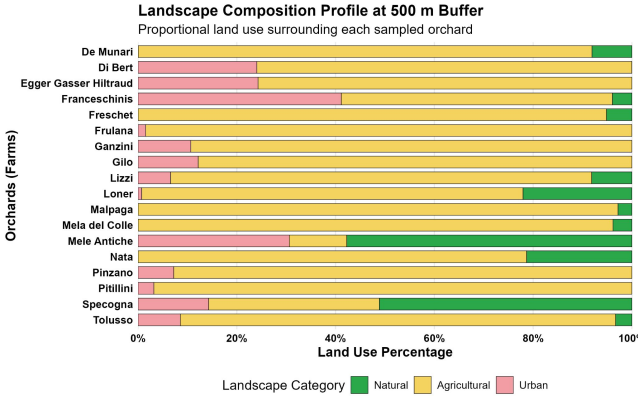
3 CATEGORIES OF LAND USAGE

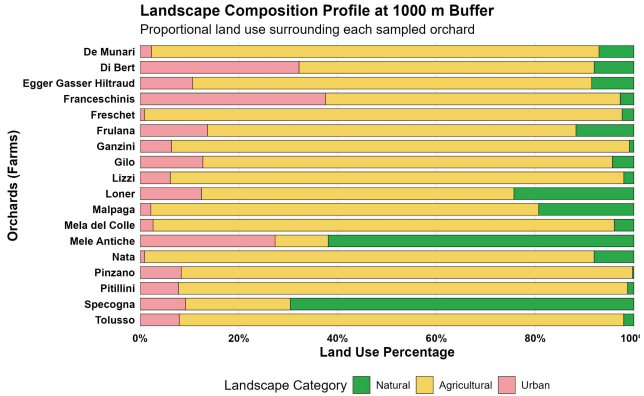
- Natural and seminatural
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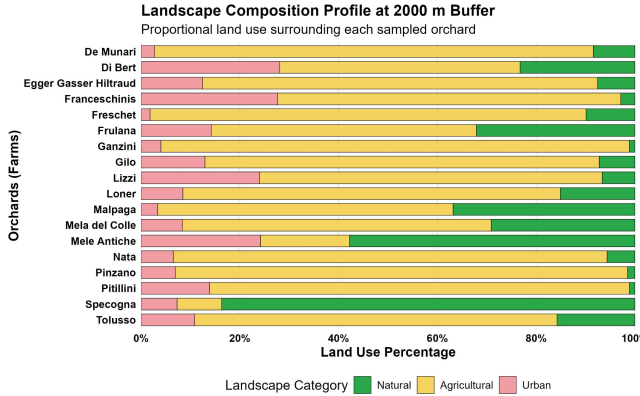
3 BUFFERS

500 m (short range)
1000 m (medium range)
2000 m (long range)

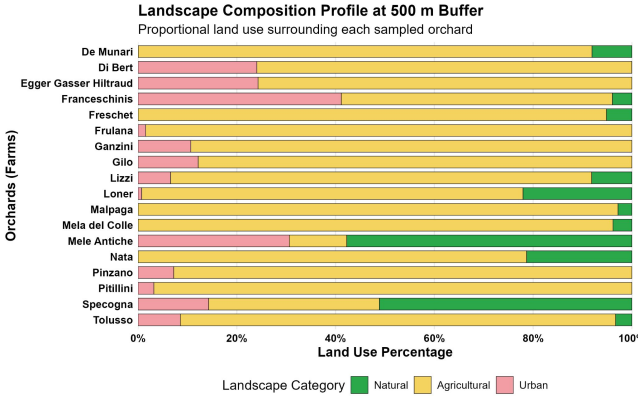
LANDSCAPE: Land usage

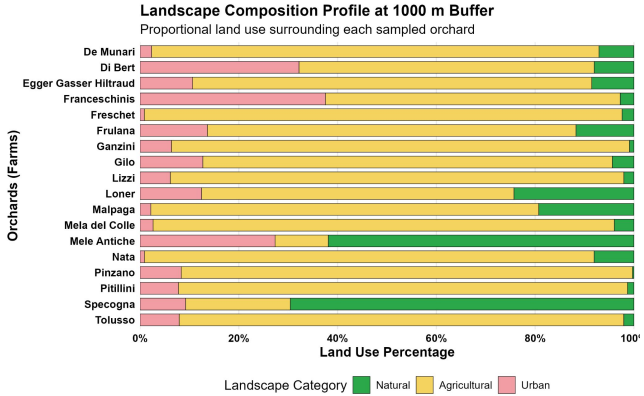


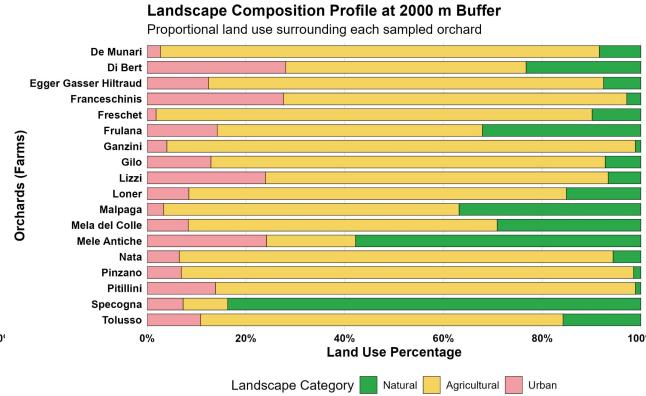




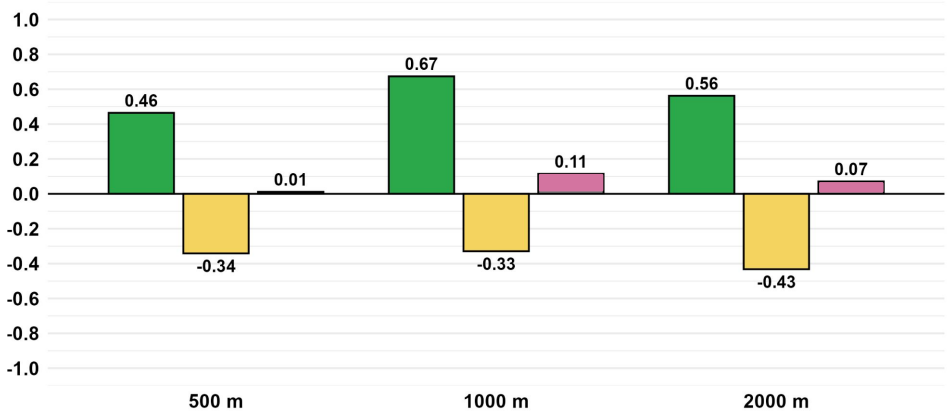
LANDSCAPE: Land usage



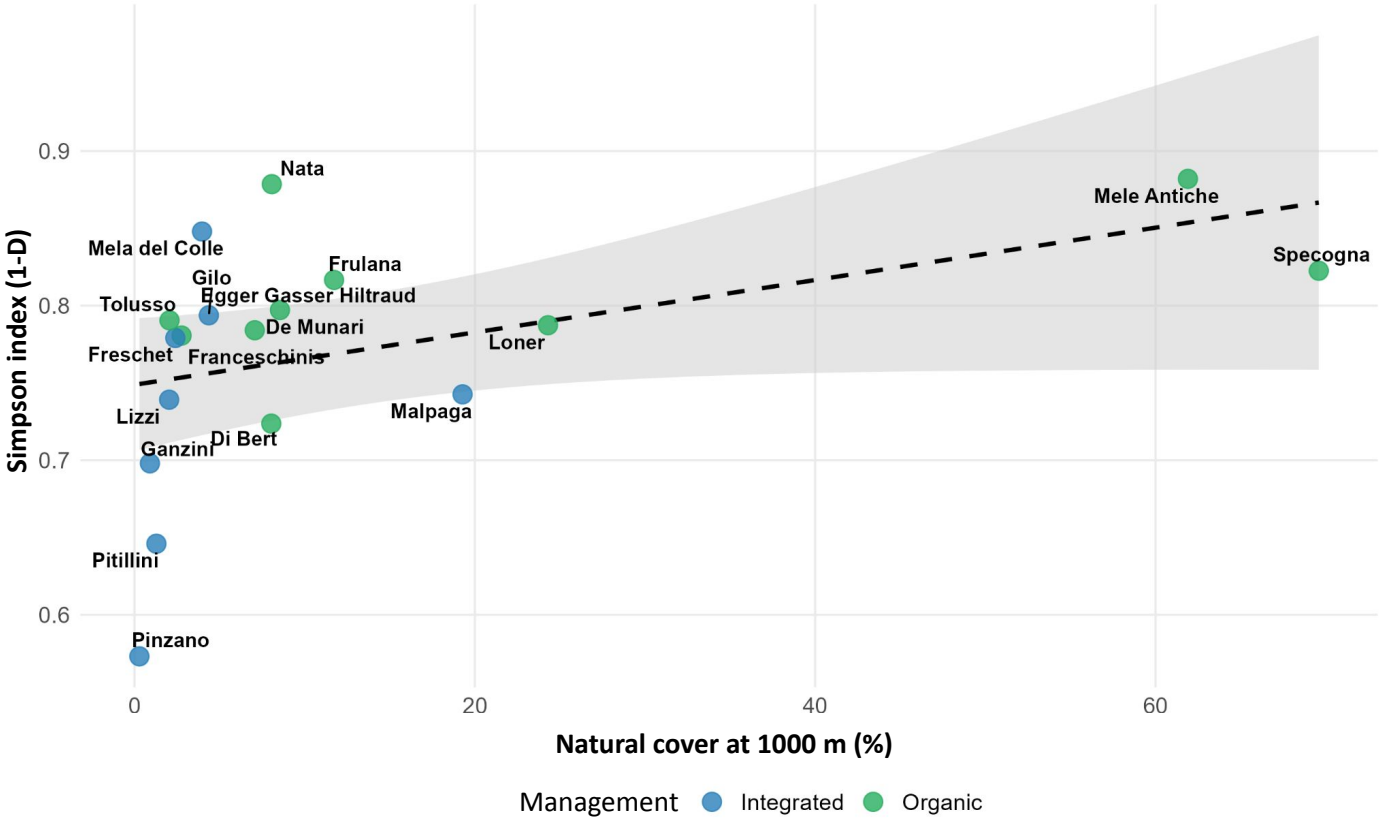




Simpson diversity vs. Landscape structure



Simpson diversity vs. Landscape structure (1000 m)

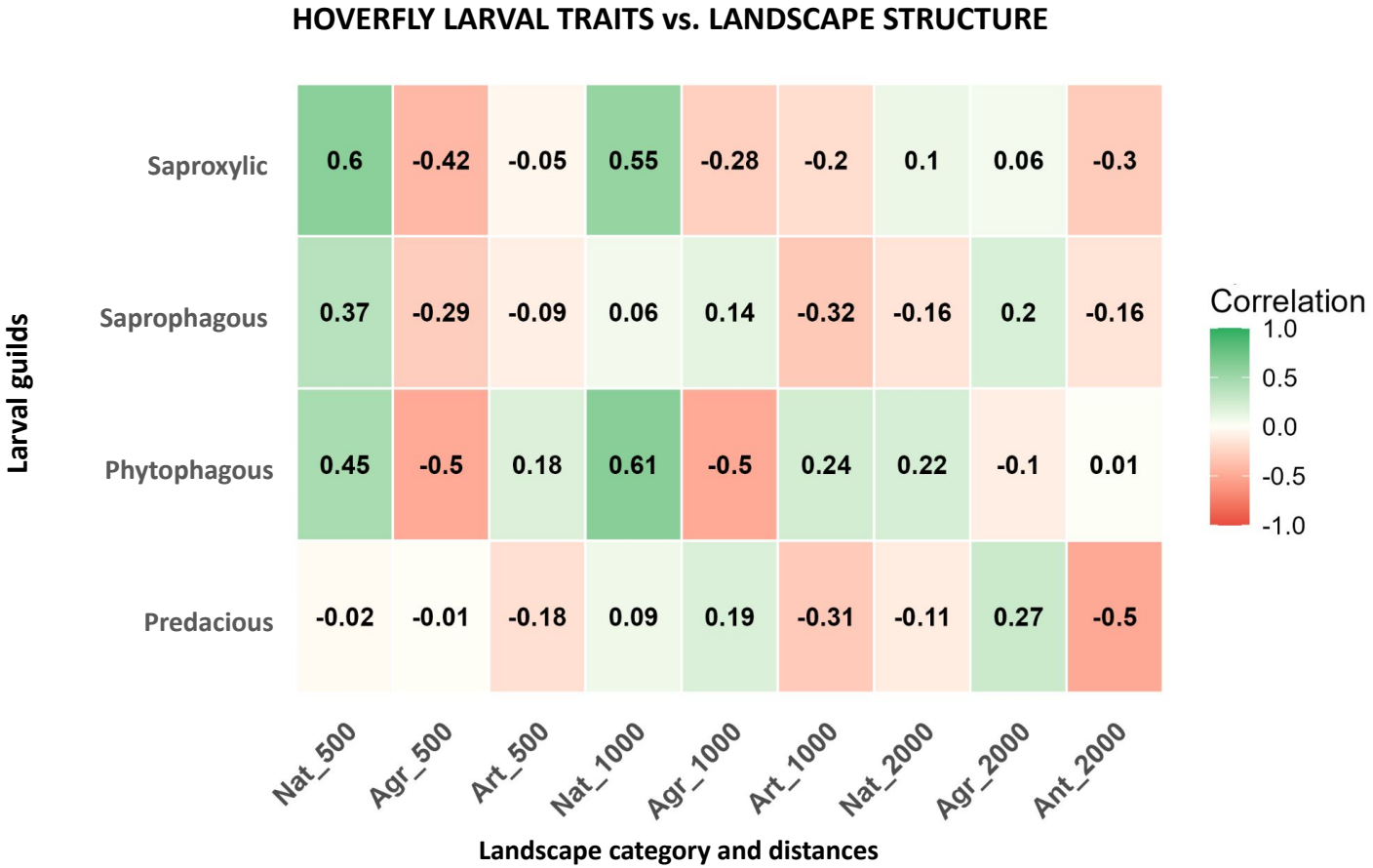


Strong positive correlation between natural cover and diversity.

No segregation: both organic and integrated farms are distributed across the gradient.

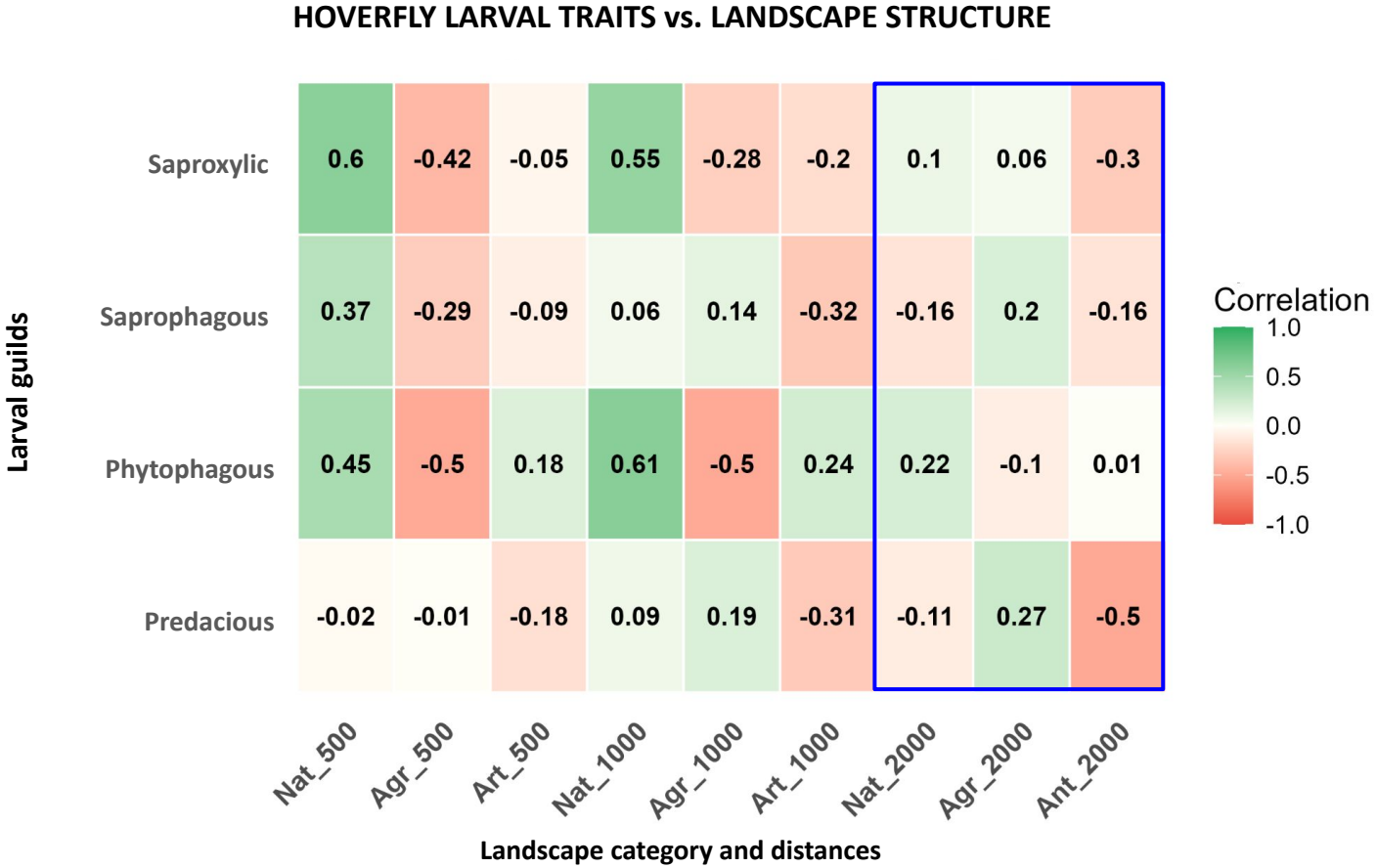
The buffer role of organic management: in less natural landscapes organic farms maintain higher diversity.

LANDSCAPE vs. LARVAL BIOLOGY (Abundance)

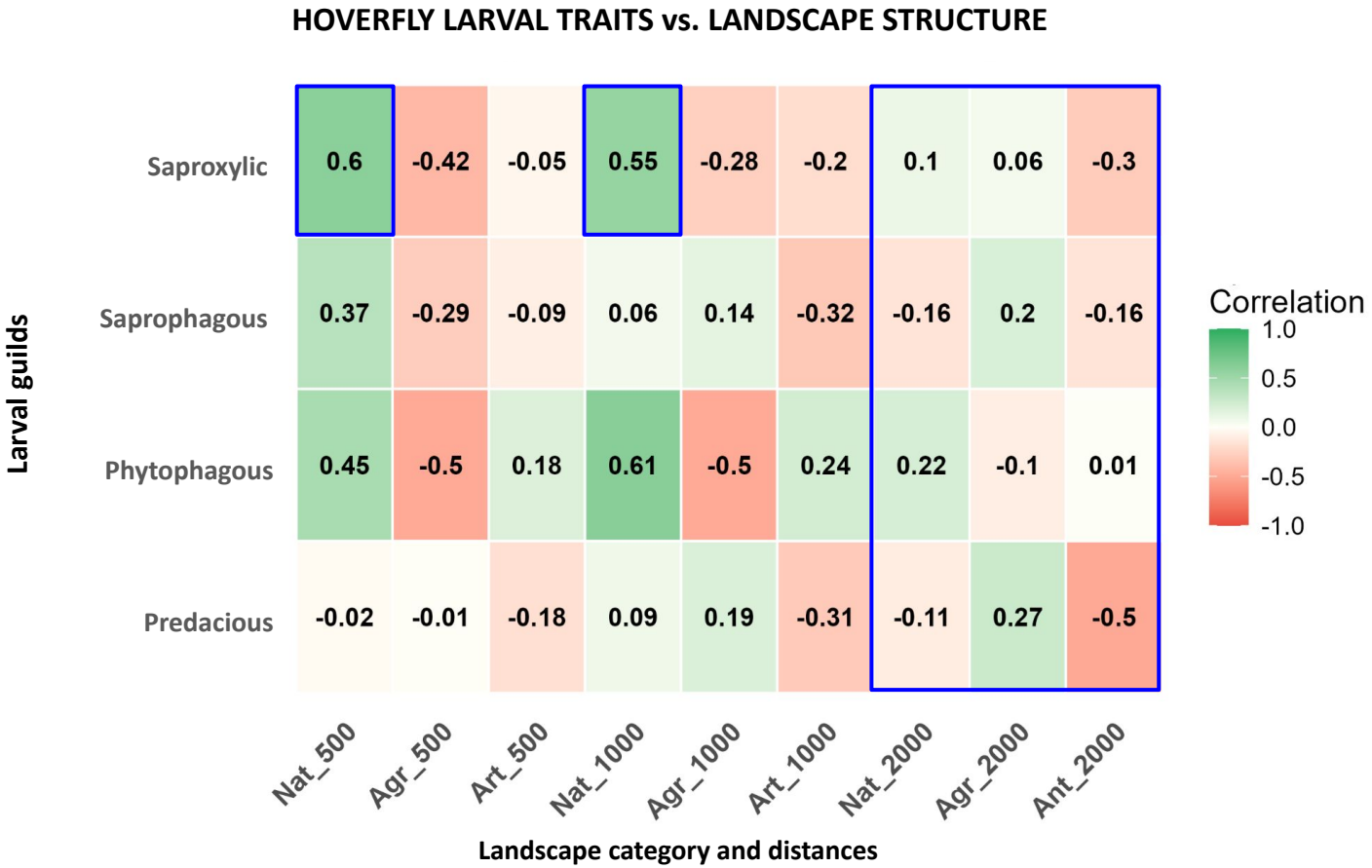


LANDSCAPE vs. LARVAL BIOLOGY (Abundance)

Long-range: low correlation.



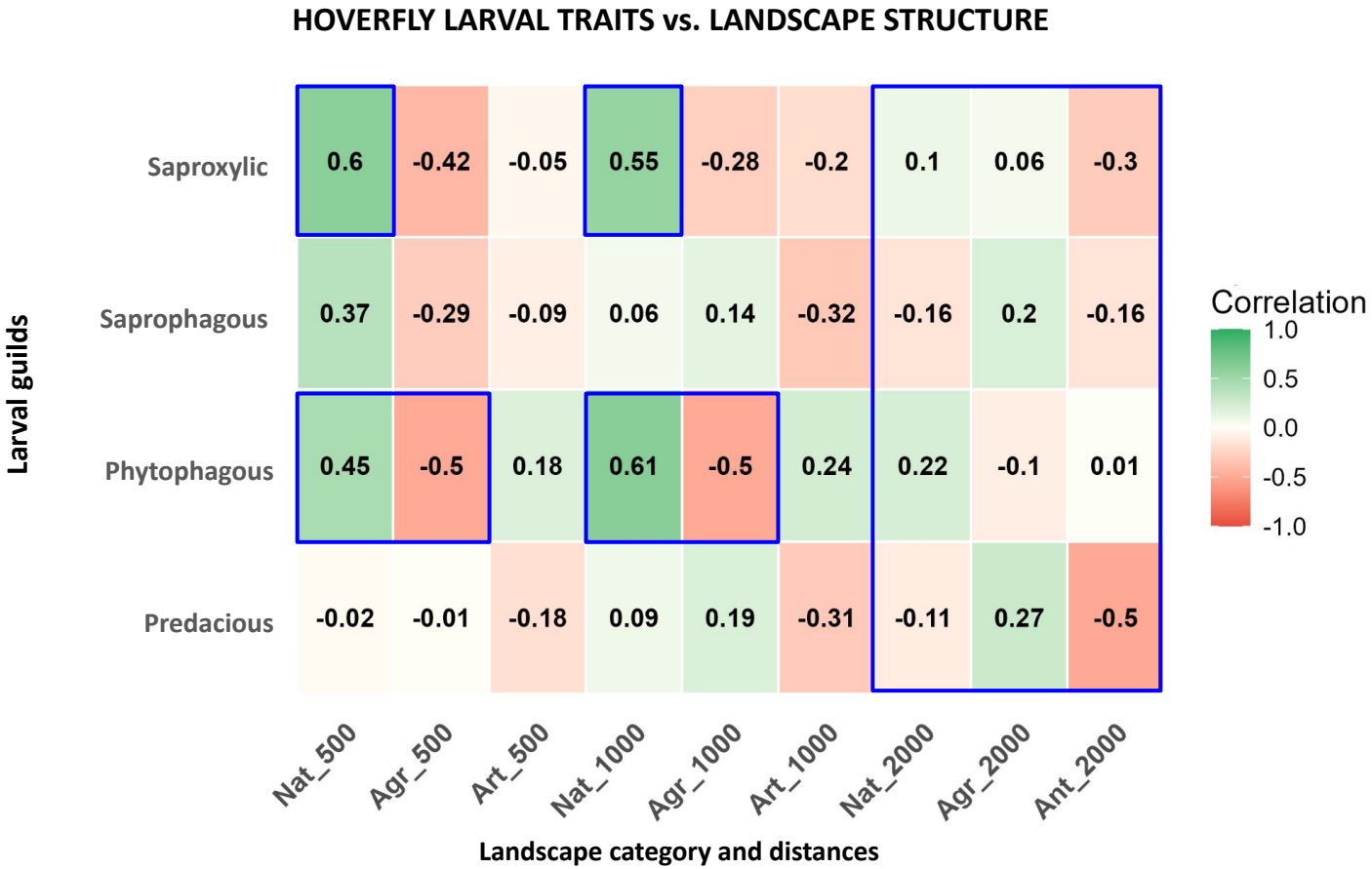
LANDSCAPE vs. LARVAL BIOLOGY (Abundance)



Long-range: low correlation.

Saproxylics: depends on natural habitats at short/medium range.

LANDSCAPE vs. LARVAL BIOLOGY (Abundance)

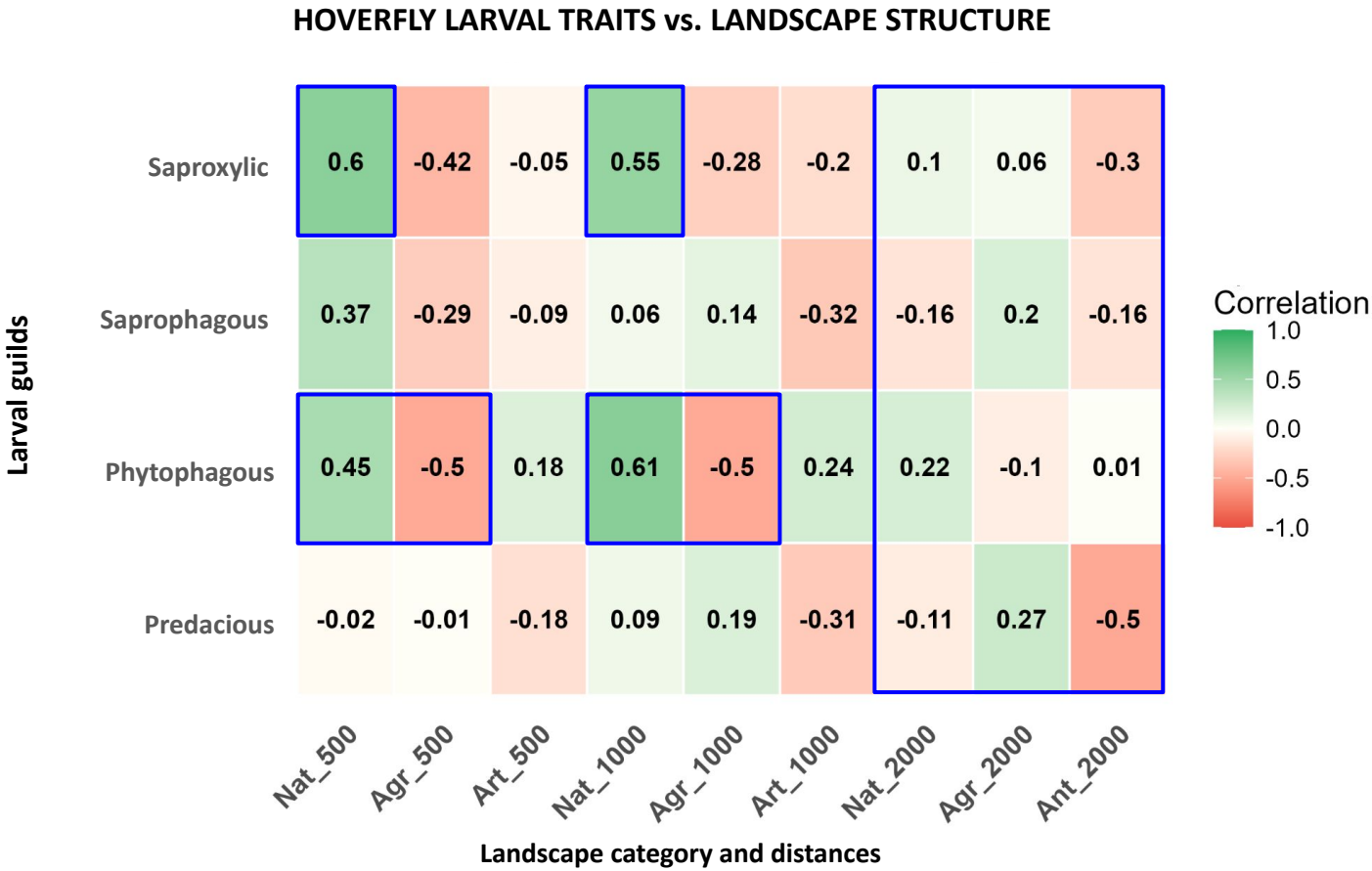


Long-range: low correlation.

Saproxylics: depends on natural habitats at short/medium range.

Phytophagous: highest abundance in natural habitats at short/medium range, but negatively affected by agricultural landscape.

LANDSCAPE vs. LARVAL BIOLOGY (Abundance)



Long-range: low correlation.

Saproxylics: depends on natural habitats at short/medium range.

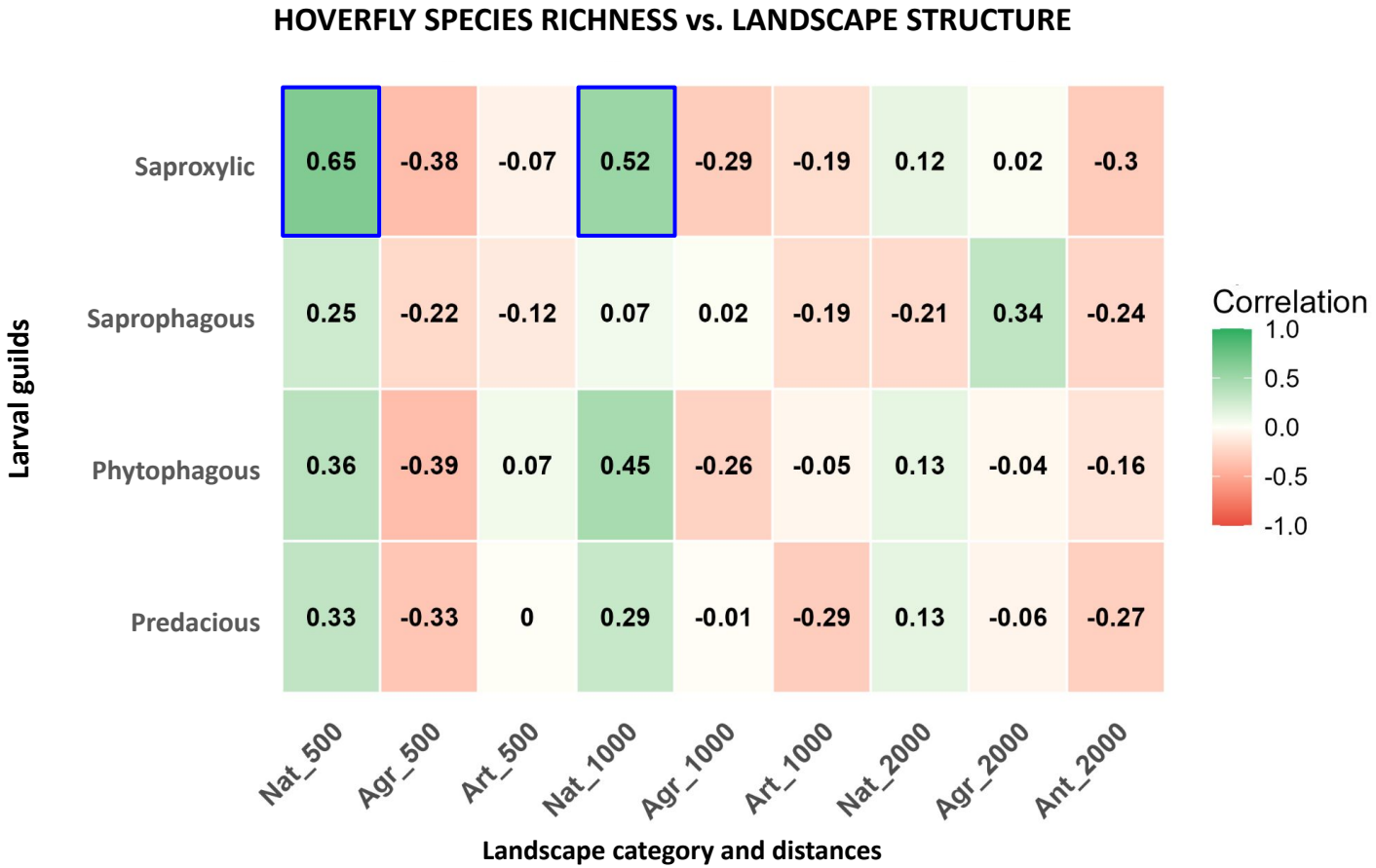
Phytophagous: highest abundance in natural habitats at short/medium range, but negatively affected by agricultural landscape.

Predacious: not affected by natural/agricultural habitats, but may be penalised in urban landscapes.

LANDSCAPE vs. LARVAL BIOLOGY (Richness)

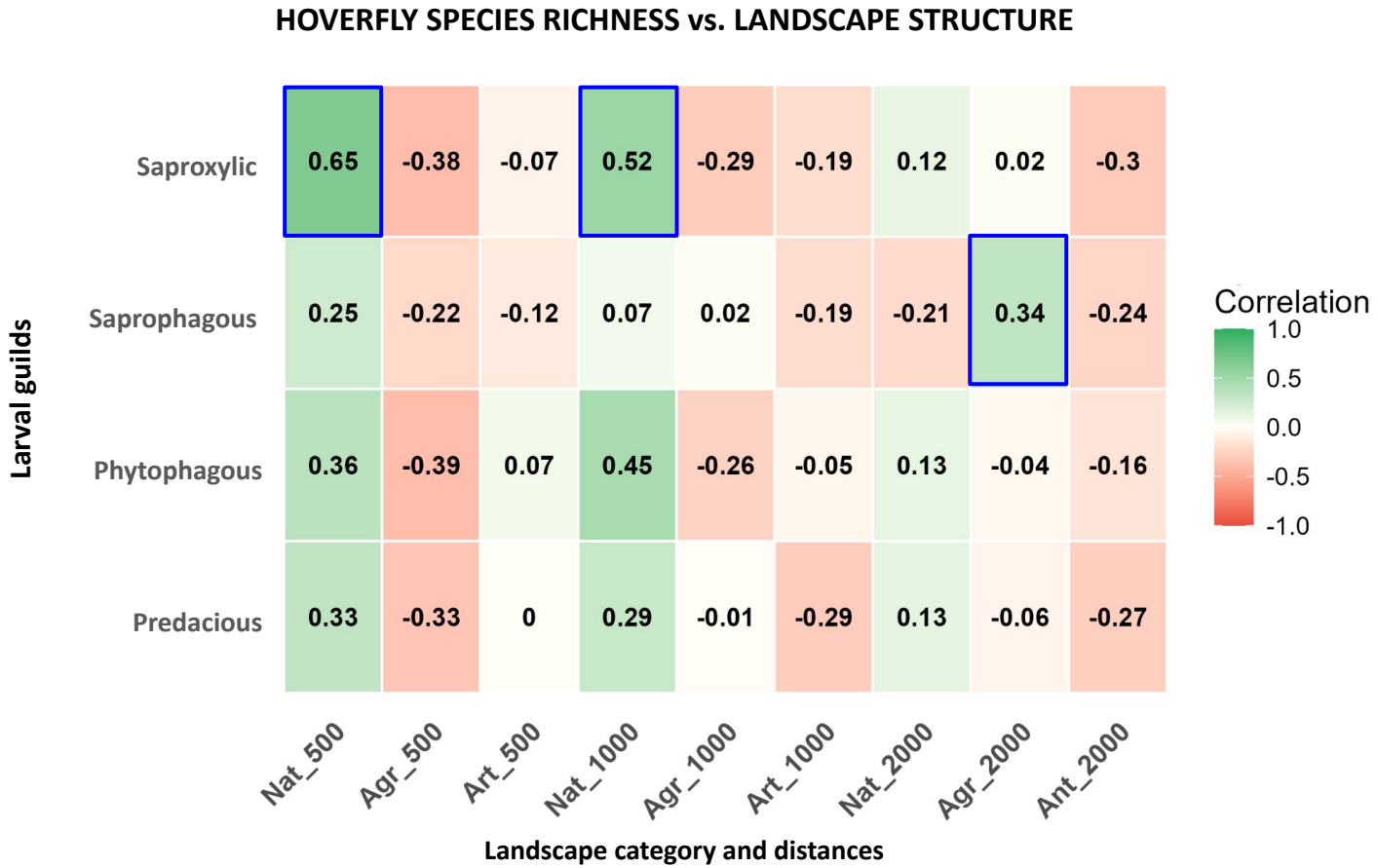
HOVERFLY SPECIES RICHNESS vs. LANDSCAPE STRUCTURE





Saproxylics: depends on natural habitats at short/medium range.

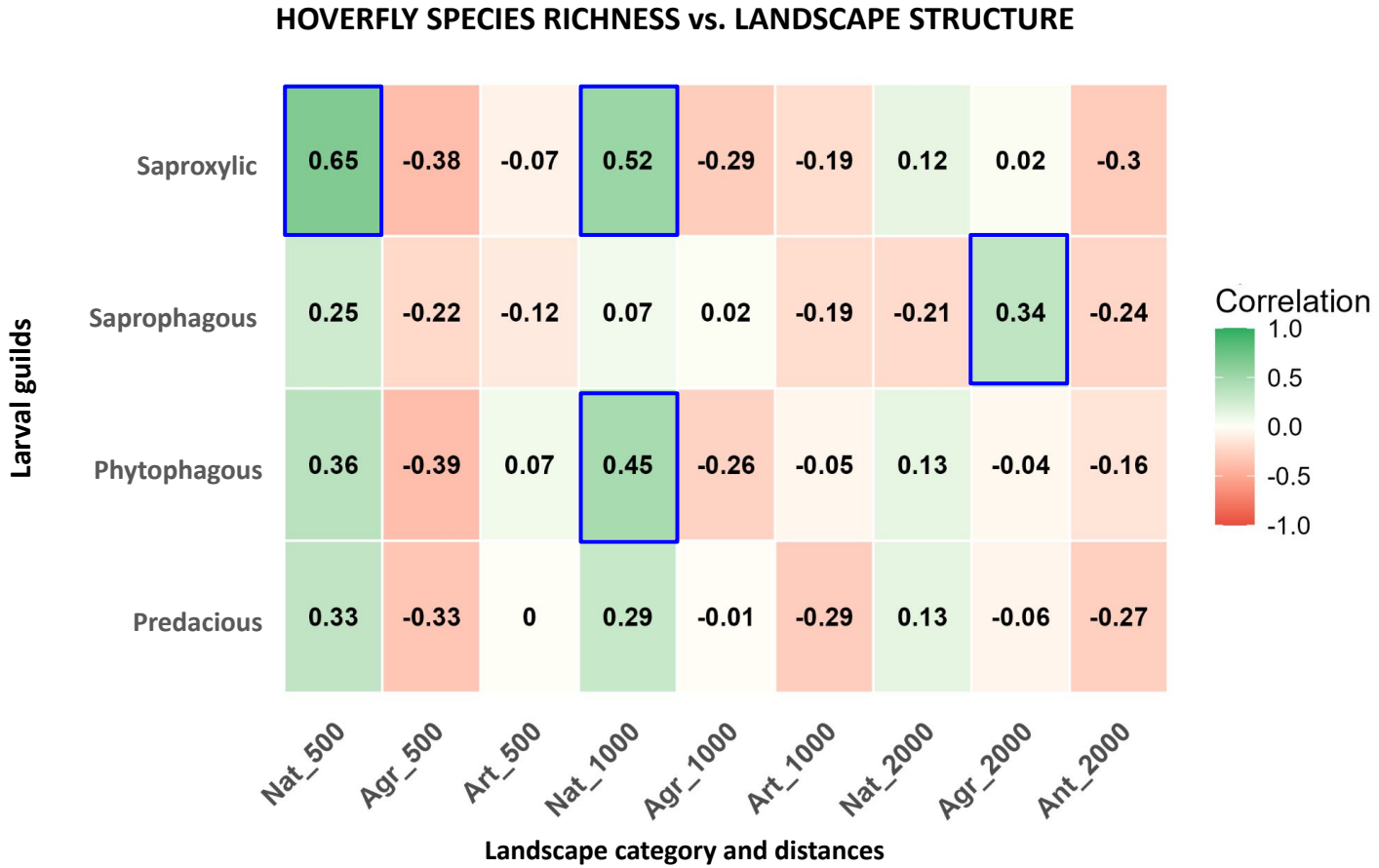
LANDSCAPE vs. LARVAL BIOLOGY (Richness)



Saproxylics: depends on natural habitats at short/medium range.

Saprophagous: related to agricultural landscape at long range.

LANDSCAPE vs. LARVAL BIOLOGY (Richness)

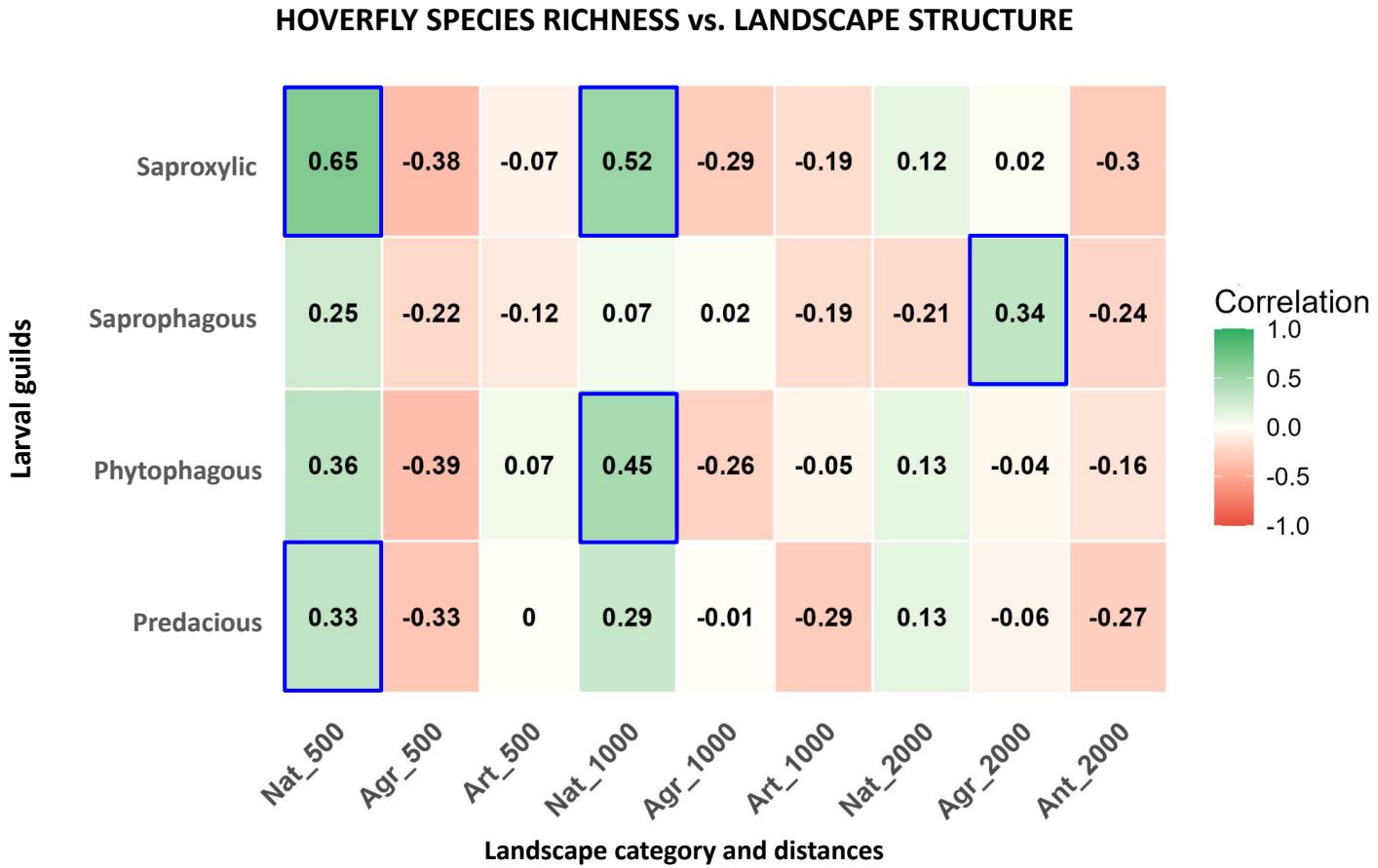


Saproxylics: depends on natural habitats at short/medium range.

Saprophagous: related to agricultural landscape at long range.

Phytophagous: highest diversity in natural habitats, especially at medium range.

LANDSCAPE vs. LARVAL BIOLOGY (Richness)



Saproxylics: depends on natural habitats at short/medium range.

Saprophagous: related to agricultural landscape at long range.

Phytophagous: highest diversity in natural habitats, especially at medium range.

Predacious: increase in natural habitats within short range.

NOTICEABLE SPECIES

Saproxylic species

1. ***Brachyopa bicolor*** (Fallén, 1817)
2. ***Brachyopa scutellaris*** Robineau-Desvoidy, 1843
3. ***Brachypalpus valgus*** (Panzer, 1797)
4. ***Caliprobola speciosa*** (Rossi, 1790)
5. ***Chalcosyrphus (Xylotina) nemorum*** (Fabricius, 1805)
6. ***Criorhina floccosa*** (Meigen, 1822)
7. ***Ferdinandea cuprea*** (Scopoli, 1763)
8. ***Ferdinandea ruficornis*** (Fabricius, 1775)
9. ***Myolepta obscura*** Becher, 1882
10. ***Xylota segnis*** (Linnaeus, 1758)

Endangered species (Vujić et al., 2022)

11. ***Eumerus ovatus*** Loew, 1848
12. ***Orthonevra plumbago*** (Loew, 1840)
13. ***Paragus (Paragus) albifrons*** (Fallén, 1817)
14. ***Pipiza carbonaria*** Meigen, 1822

Others

15. ***Orthonevra atlantica**** Żóralski & Van de Meutter, 2024

*first record in Italy!



CONCLUSIONS

- **Sorry transects… the Malaise wins**, but the two methods aren't completely redundant.
- **Same teams, more players**: organic orchards supports higher diversity without changing the community.
- **Management matters, landscape matter more**: landscape composition emerged as main driver of diversity.
- **Hoverflies don't see the same landscape**: their larvae decide what matters.

WE CAN MANAGE AN ORCHARD, BUT WE MUST CONSERVE THE LANDSCAPE

Thank you!

ANY QUESTION?

Special thanks to



Prof. **D. Sommaggio**



Prof. **L. Maistrello**

Francesco Lunardelli

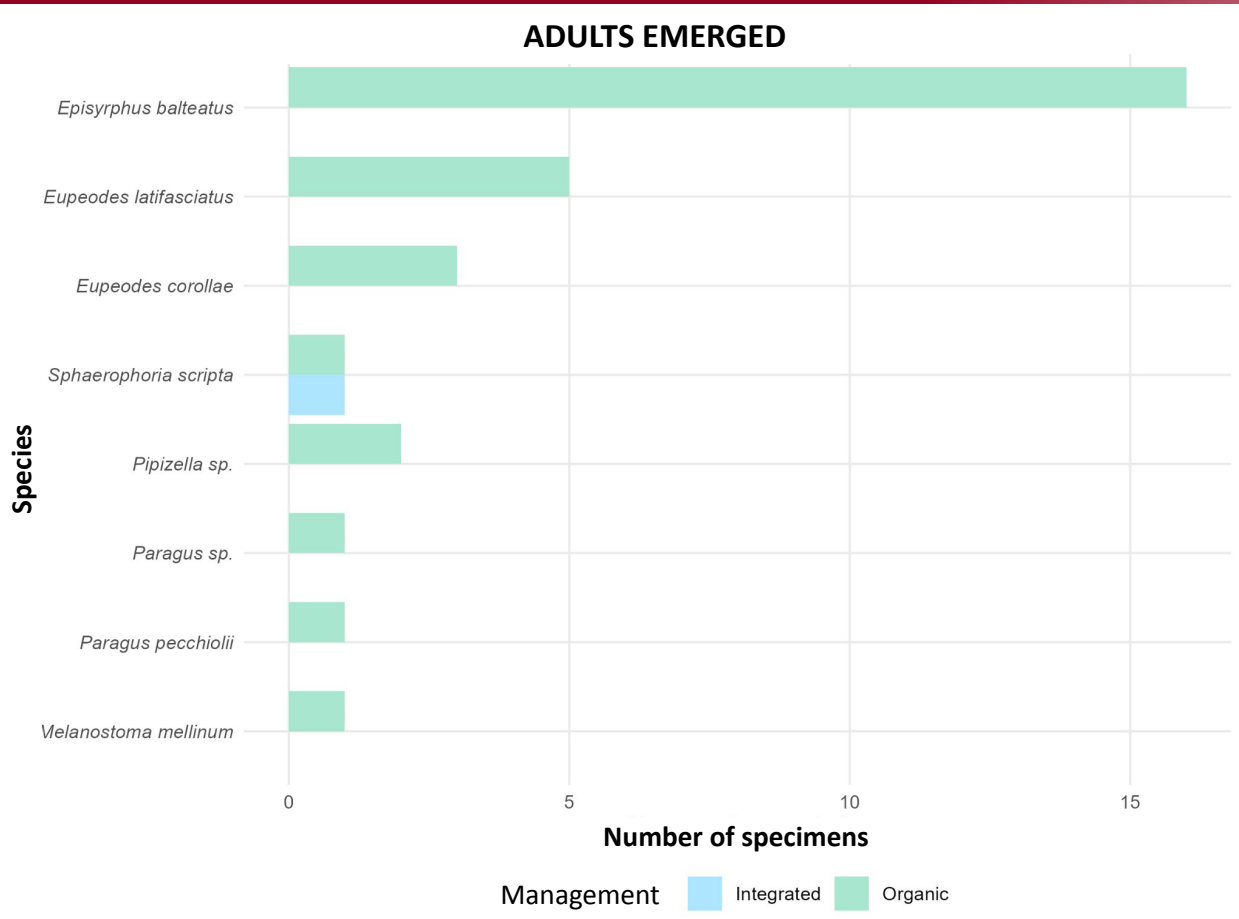
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MANAGEMENT: the case of the emergency traps





Integrated management impact hoverfly development?

OPERATION	TEST	VALUE
Shannon diversity vs. Management	Wilcoxon Test (Mann-Whitney)	***p* = 0.054**
Simpson diversity vs. Management	Wilcoxon Test (Mann-Whitney)	***p* = 0.034***
Community composition vs. Management	NMDS	**Stress = 0.19**
Community composition vs. Management	PERMANOVA	***p* = 0.727**
Dominant species	SIMPER	
Simpson diversity vs. Landscape	Spearman's Rank Correlation	