Weed infestation during the transition phase from conventional to conservation agriculture

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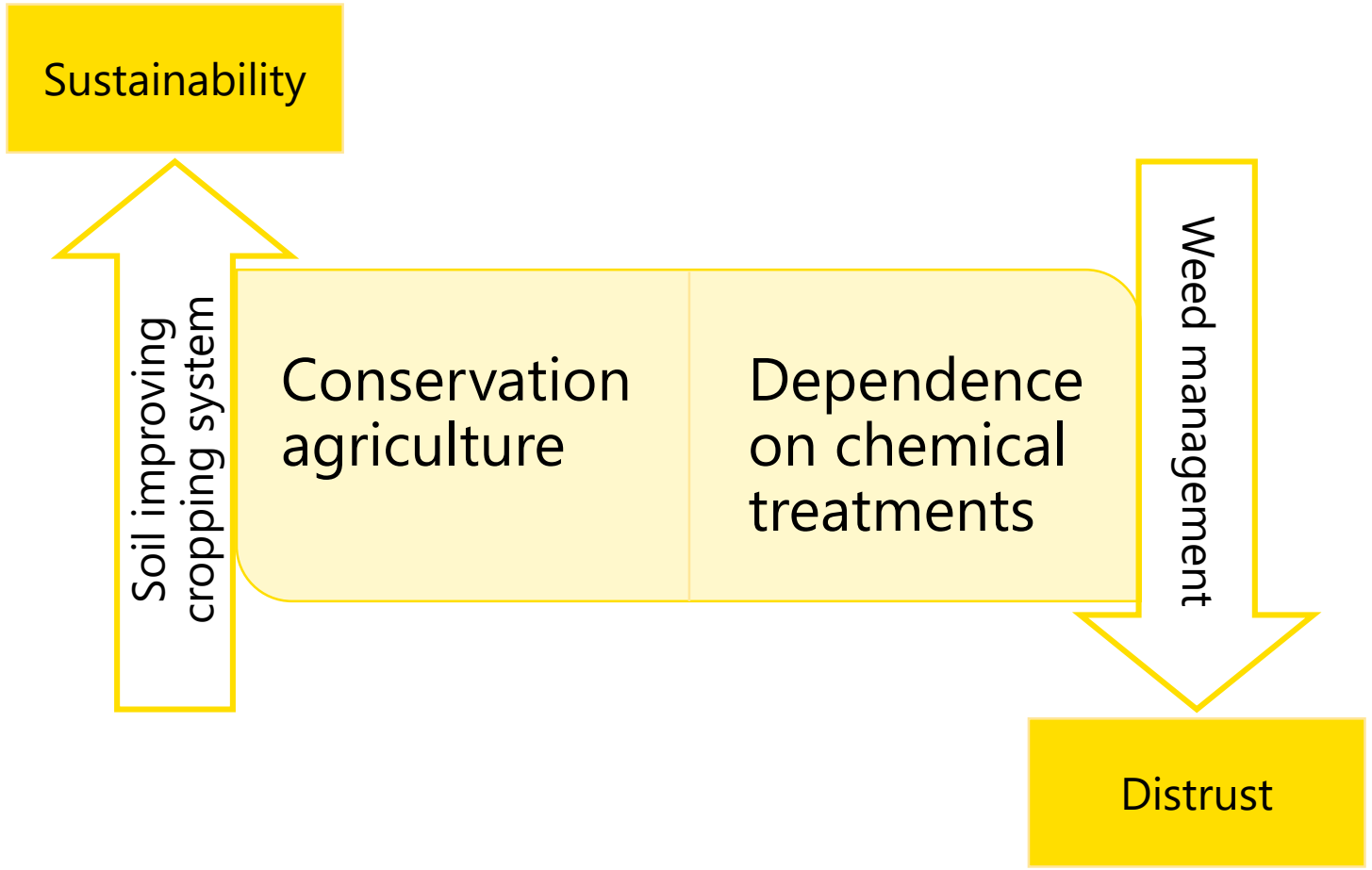
Conservation agriculture and weed management



Introduction

Despite conservation agriculture and, overall, the reduction of soil disturbance are considered soil improving cropping systems, these practices could conflict with weed control. Indeed, reduced tillage is usually linked to increased weed species richness and abundance and, thus, it could increase the dependence on chemical treatments. Weed management is one of the reasons behind the distrust of European farmers in the conservation agriculture, that is still not widespread, despites European subsidies. In fact, conservation agriculture is implemented only in the 2.8% of European cropland.

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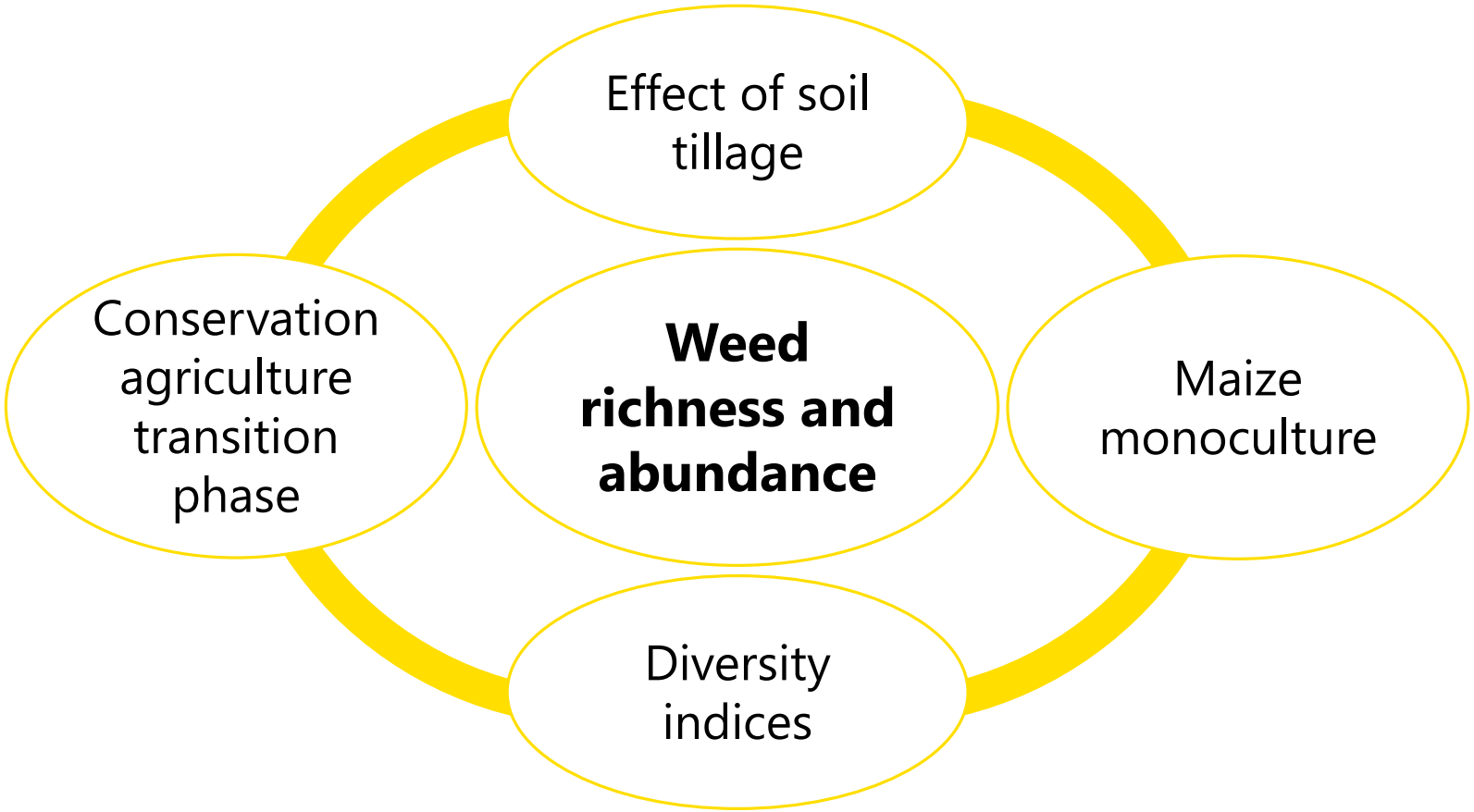
Aim of the study



Introduction

The aim of this study is to evaluate the effect of different tillage intensities on spring-summer weeds richness and abundance in a maize monoculture, during the transition phase from conventional to conservation agriculture.

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Experimental design

Treatments (Factors)

CT

- Conventional tillage
- Spring ploughing (30 cm)
- Harrowing (20 cm)

MT

- Minimum tillage
- Spring harrowing (20 cm)

NT

- No tillage
- Conservation agriculture

Field operations

- 28/03/2019 → Tillage
- 02/04/2019 → Maize seeding
- 03/06/2019 → Weed scouting

Materials and methods

The weed survey was conducted in June 2019 on an experiment comparing three levels of tillage management: conventional agriculture (CT), which represents the most common choice in Veneto region, involving deep ploughing and harrowing in spring; minimum tillage (MT), consisting only in harrowing at 20 cm; and no tillage (NT), namely sod seeding. The experiment started in 2018, at Padova University experimental farm, in a sub-humid area, with a silty clay loam soil.

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The weed survey

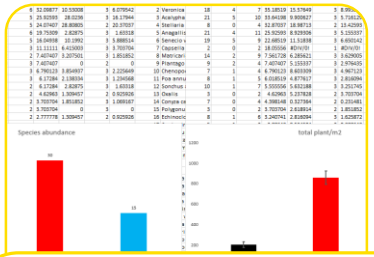
- The frame random throws technique is the same described in *Berti et al., 1992 Weed Research* (doi.org/10.1111/j.1365-3180.1992.tb01860.x)

Random throws

- 6 random sampling point per plot
- 3 replications

Weed observation

- Species determination
- Count of the individuals



Statistical analyses

- Conversion in n° of individuals per m^2
- Indices calculation

Materials and methods

The survey was conducted with a set of random throws of a 30×30 cm square frame in each plot (ca. 3300 m^2). Weed plants found within the frame were classified and counted. Subsequently, data analysis assessed which botanical families were promoted by each treatment.

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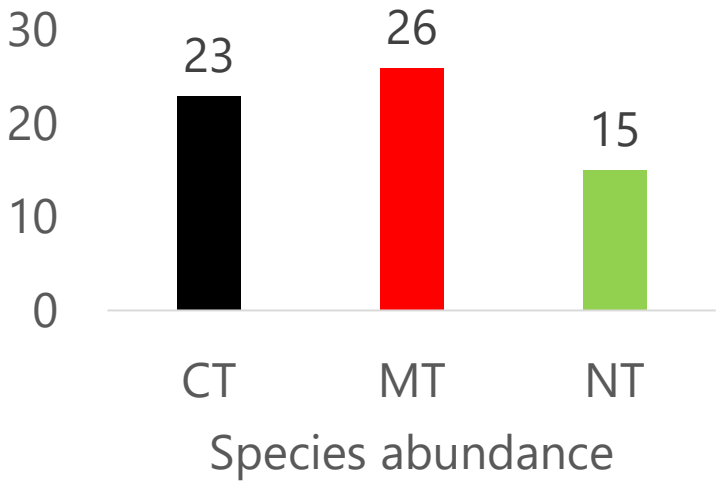
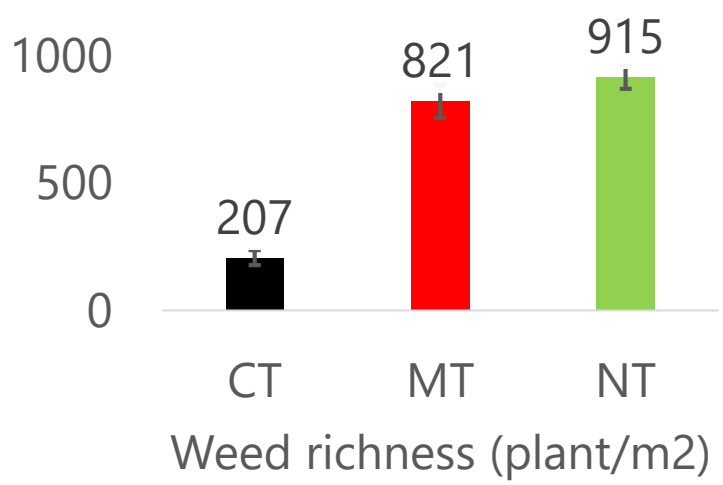
Weed richness and abundance



Species abundance



Weed richness (plant/m2)

	Shannon index	Gini-Simpson index	Evenness
CT	2.64	0.91	0.58
MT	1.22	0.43	0.25
NT	0.67	0.26	0.17

Results

The NT resulted the treatment with the highest weed density (915 plant/m^2): 6% higher than MT (823 plant/m^2) and four-fold more than CT (209 plant/m^2). The latter showed to be the treatment with higher diversity, according to both Shannon and Simpson indices. The survey evidenced higher weed species richness in MT, where both annual and perennial species were identified, while the lowest number of species were detected in NT.

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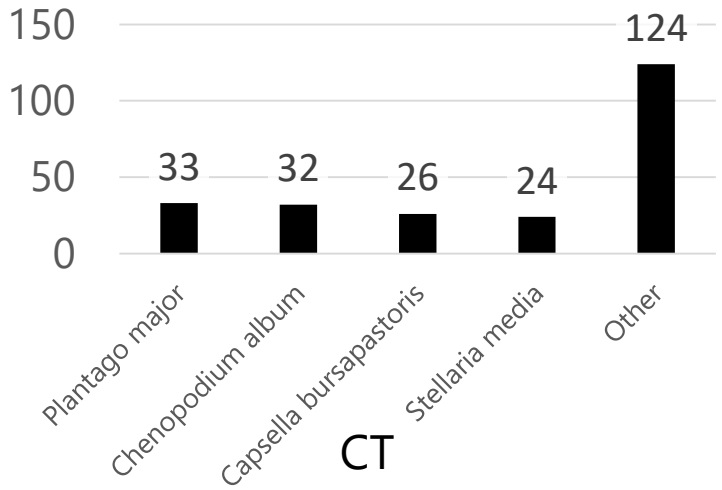
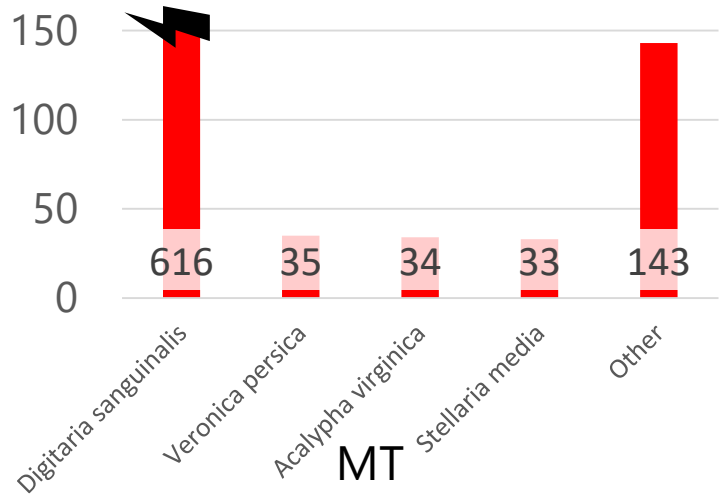
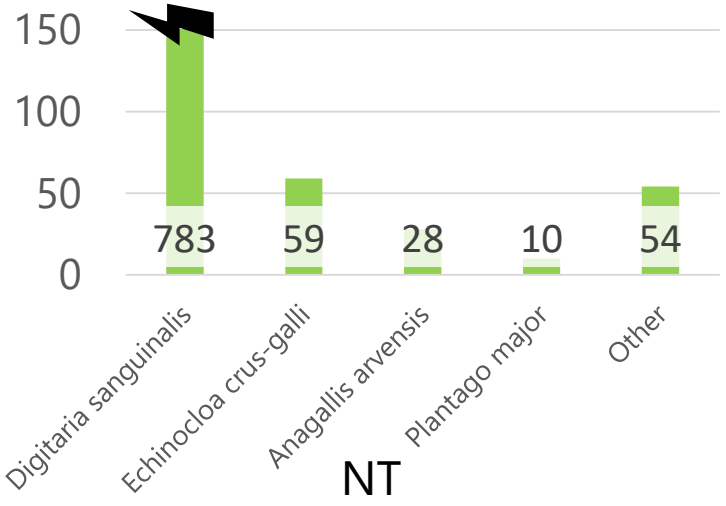
Dominant species







Asterceae		
	n° Species	plant/m^2
CT	5	22
MT	5	43
NT	3	15

Results

Plantago major and *Chenopodium album* were the species with the highest density in CT (>32 plant/m^2) while they are negligible in NT and MT (7 plant/m^2, on average). *Digitaria sanguinalis* was instead the dominant species in MT and NT (>600 plant/m^2) while a lower density was observed in CT (11 plant/m^2). Low levels of *Asteraceae* weeds were measured in all treatments.

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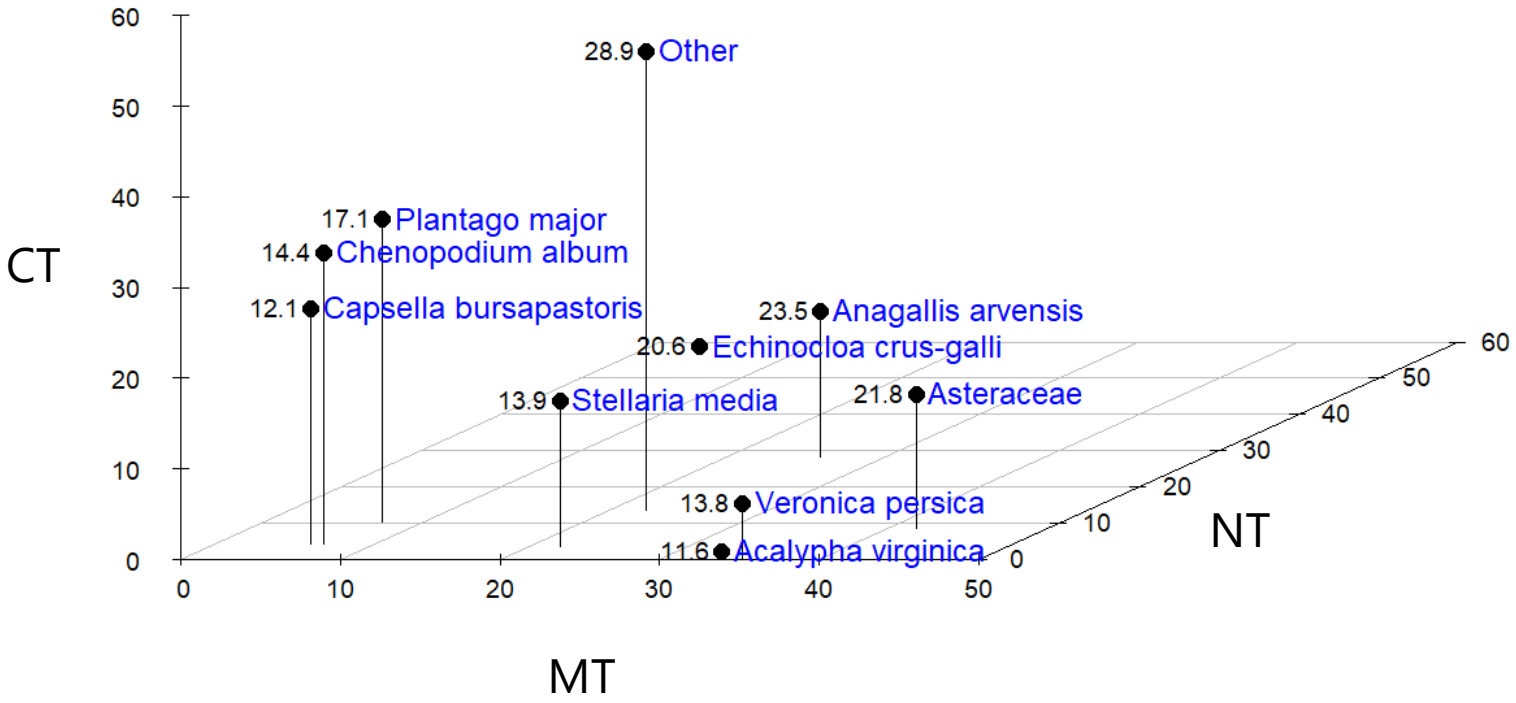
Actual flora differences



Average weed density (plant/m^2) in each treatment (*Digitaria sanguinalis* excluded). The number indicates the average density between treatments.

Discussion

These results show that the actual flora rapidly changes depending on tillage intensity, with an increase of both dominance and number of species in MT. Differently, only a limited number of adapted species germinated in NT, despite higher infestations if compared with the other treatments.

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Main findings

- No significant increase of *Asteraceae* was observed after 2 years
- Selection of adapted species in NT
- Dominance of a *D. sanguinalis* in reduced tillage systems (MT and NT)

Conclusions

It should be expected that other species more adapted to conservation agriculture (namely *Asteraceae*), still marginally present in the seed bank, will spread in the next years. This stresses the importance of a continuous monitoring and effective control of weeds to avoid uncontrolled evolutions of the weed flora and increase of seed bank in the transition phase from conventional to conservation agriculture.

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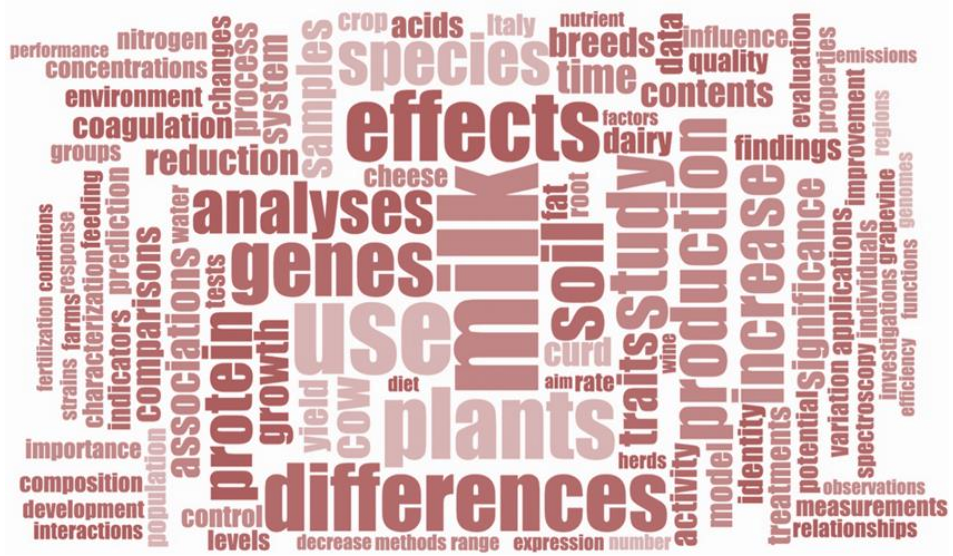

Thanks for your attention

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Supplementary material – diversity indices

Shannon index (H)	Gini-Simpson index ($\bar{\lambda}$)	Evenness (J)
$H = -\sum_{i=0}^{S} \ln p_i^{p_i}$	$\bar{\lambda} = 1 - \sum_{i=0}^{S} p_i^2$	$J = {}^{H}/_{\log_2 S}$
p: proportion of individuals belonging to the ith species *S*: total number of species (richness)		