Biodiversity associated to European sheep grazed pastures

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Biodiversity associated to European sheep grazed pastures

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Abstract. We analysed the biodiversity of foliage arthropods in nine sheep grazed pasturelands in five European countries. During the maximum flowering period in 2018, entomofauna was collected in 4-6 areas within each pasture, performing 6 transects/area and 25 sweeps per transect. Multivariate analyses tested the differences in total arthropod community composition among degrees of intensification, bioregions and types of pastures. A total of 51,474 arthropods from 3 classes, 17 orders and 95 taxonomical groups were recorded. Univariate analyses revealed that total arthropod abundance was higher in extensive than in intensive systems ($P<0.01$). It also differed between bioregions (higher in Alpine than in Continental, $P<0.05$) and between types of pastures (higher in mountain than in lowland pastures where animals are supplemented, $P<0.05$). Total taxa richness was not influenced by any of the three factors. However, multivariate analyses indicated that community composition differed among intensive and extensive systems, bioregions and types of pastures ($P<0.001$). The greatest differences occurred between Alpine and Mediterranean ($P<0.001$), and Mediterranean and Continental pastures ($P<0.05$), as well as between lowland seminatural and improved pastures ($P<0.05$), and seminatural and mountain pastures ($P<0.001$). These results reveal the complex and varied communities associated to the diverse sheep systems and valorise the role of the more extensive, mountain and natural pastures for the conservation of biodiversity in sheep grazed areas.

Keywords. Arthropods – Biodiversity – Sustainability – Management.

Biodiversité associée aux pâturages de moutons européens

Résumé. *Nous avons analysé la biodiversité des arthropodes du feuillage dans neuf pâturages situés dans cinq pays européens et pâturés par des moutons. La faune a été collectée dans 4-6 zones de chaque pâturage, effectuant 6 transects/zone et 25 balayages/transect. 51 474 arthropodes de 3 classes, 17 ordres et 95 groupes taxonomiques ont été enregistrés. Des analyses univariées ont révélé que l'abondance d'arthropodes était plus élevée dans les systèmes extensifs que dans les intensifs ($P<0,01$). Il diffère également entre les bioregions (plus élevées dans les Alpes que dans les Continentales, $P<0,05$) et entre les types de pâturages (plus élevées dans les pâturages de montagne que dans les plaines où les animaux sont supplémentés, $P<0,05$). La richesse totale des taxons n'a pas été influencée par aucun des trois facteurs. Les analyses multivariées ont indiqué que la composition de la communauté différait entre les systèmes intensifs et extensifs, les bioregions et les types de pâturages ($P<0,001$). Les différences les plus marquées ont été observées entre les pâturages alpins et méditerranéens ($P<0,001$), méditerranéens et continentaux ($P<0,05$), ainsi qu'entre les pâturages semi-naturels et améliorés des plaines ($P<0,05$). Ces résultats révèlent les communautés complexes et variées associées aux divers systèmes ovins et valorisent le rôle des pâturages plus étendus, montagnards et naturels, pour la conservation de la biodiversité dans les zones de pâturage ovin.*

Mots-clés. *Arthropodes – La biodiversité – La durabilité – La gestion.*

I – Introduction

Sheep are of great importance as a major source of livelihood of the small farmers and the landless in rural communities, and they also contribute to peri-urban and increasingly to urban households by providing food, income, socio-cultural wealth, clothing, etc. Therefore, their management can have multiple impacts including food safety and security in some areas (Scortichini *et al*., 2017). Additionally, sheep farming systems interact with the environment and the link between animal production and natural environment is acquiring more importance for the sustainability of the farm system (de Rancourt *et al*., 2006). In parallel, consumer awareness about quality and sustainability of the production cycle of animal food products is also increasing. In this paper we evaluated the biodiversity of arthropod fauna in nine sheep grazed pasturelands located in five European countries which include different bioregions, types of pastures and degrees of intensification.

II – Materials and methods

1. Study sites

A total of 9 farms, which had pastures available for sheep grazing, were surveyed to assess their arthropod abundance and diversity. The pastures were located in Germany, Italy, Portugal, Slovenia and Spain. Each site was characterized according to the bioregion, the type of pasture available to sheep (from grasslands and grazed forests to pastures combined with indoor supplementation during the grazing season) and its management system (degree of intensification) (Table 1).

Table 1. Description of the farms according to the country, bioregion, type pasture and type of management. N: number of sampling areas within each site

Country	Site	Bioregion	Pasture	Management	N
Germany	AG	Continental	GF	Extensive	4
Italy	IT	Alpine	MP	Extensive	5
Portugal	ESA	Atlantic	PS	Intensive	4
Portugal	SE	Atlantic	SG	Extensive	4
Portugal	GEO	Mediterranean	GF	Extensive	4
Portugal	IP	Mediterranean	PS	Intensive	4
Slovenia	SL	Alpine	MP	Extensive	4
Spain	SC	Atlantic	IP	Extensive	6
Spain	SS	Atlantic	IP	Extensive	6

GF: grassland-forests; IP: improved pastures; MP: mountain pastures; PS: improved pastures and nearby indoor supplementation, SG: seminatural grasslands.

2. Sampling and statistical analyses

The arthropods were sampled by sweep-netting in 4-6 areas per farm during the maximum blooming period of the pastures in 2018. In each area 6 random transects were established and within each one 25 sweep nets were performed. All the arthropods from each transect were transferred to a re-sealable zipper bag for further analyses in the laboratory. Arthropods were classified to Order level, and within the Orders Araneae, Hemiptera, Orthoptera and Coleoptera, to family level. ANOVA analyses were performed with SPSS 23 version to test differences in abundance and diversity of arthropods between management types, bioregions and types of pastures. To investigate differences in fauna composition among the same factors, we used permutation-based hypothesis testing (ANOSIM analyses) implemented in PRIMER 6.1. Multi-dimensional scaling (MDS) plots were generated to visualize differences in arthropod assemblages among factor levels. Similarity

was determined using the Bray-Curtis similarity coefficient. The sampling areas were the experimental units for the statistical analyses and data were log (x+1)-transformed when necessary to meet ANOVA assumptions. Post hoc comparisons were performed using the Bonferroni adjustment.

III – Results and discussion

The dataset during this first sampling period included 51,474 arthropods from 3 Classes, 17 Orders and 95 taxonomical groups. The most abundant groups were Diptera (34.4% of all individuals), Homoptera (14.9%), Symphypleona (14.9%), Coleoptera (11.7%) and Hymenoptera (9.7%). Univariate analyses revealed that total abundance of arthropods was higher in extensive (mean standard deviation: 1375.5 individuals 843.8) than in intensive (760.4 489.2) farms ($P<0.01$). A general positive trend with arthropod abundance increasing along decreasing stocking rate gradients has been reported in previous studies (Scohier and Dumont, 2012), although taxa-specific responses have been frequently reported (Rosa García *et al*., 2009). Total arthropod abundance also differed between bioregions ($P<0.05$), with the highest differences ($P<0.05$) between Alpine (1771.1 individuals 569.6) and Continental (593.8 185.8) areas. Traditional farming and the related practices in mountain areas are often associated with high biodiversity, and there are increasing efforts to maintain them in order to mitigate the impacts of their decline on mountain landscapes and biodiversity (Pykälä, 2000). The type of pasture was also important ($P<0.05$), and total abundance was higher ($P<0.01$) in mountain pastures (1771.1 individuals 569.6) than in lowland pastures (760.4 489.2). Mountain pastures are characterized by lower degree of specialization and use more environmentally friendly farming practices than more modern systems (Marini *et al*., 2011). Total taxa richness was not influenced by any of the three factors.

Multivariate ANOSIM tests indicated that community composition differed between intensive and extensive systems, bioregions and types of pastures ($P<0.001$). The subsequent pairwise tests for the different bioregions indicated that the greatest differences occurred between Alpine and Mediterranean (R^2: 0.83; $P<0.001$), and Mediterranean and continental pastures (R^2: 0.88; $P<0.05$). The MDS analysis helped to visualize those differences (Figure 1). A gradient from Alpine and Continental sites on the left side was followed by Atlantic conditions and the Mediterranean sites on the opposite right side. Analysing broad biogeographical patterns in species assemblages constitutes a critical step towards elucidating the factors shaping them (Rosenzweig, 1995). Regarding the differences between the types of pastures, the ANOSIM test detected the strongest differences in fauna composition between lowland improved and seminatural pastures (R2: 9.993; $P<0.05$), and between seminatural and mountain pastures (R: 0.952; $P<0.001$). The most similar strategies regarding pasture availability were seminatural pastures and systems where sheep had pastures and additional supplementation available (R: 0.149), and seminatural pastures and grassland-forests (R: 0.156).

IV – Conclusions

The arthropod communities are useful bioindicators to assess differences between farming systems and they can be a valuable tool to valorise the role of traditional extensive, mountain and natural pastures for the conservation of biodiversity in European sheep grazed areas. In this indicative study arthropod community composition was influenced by the type of pasture, bioregion and management, reflecting the diversity of environmental scenarios existing across European pastures. Globally, abundances of foliage arthropods were higher at more extensive, traditionally managed pastures compared to those more intensively managed. Further research with increased replication and sampling periods will clarify these patterns.

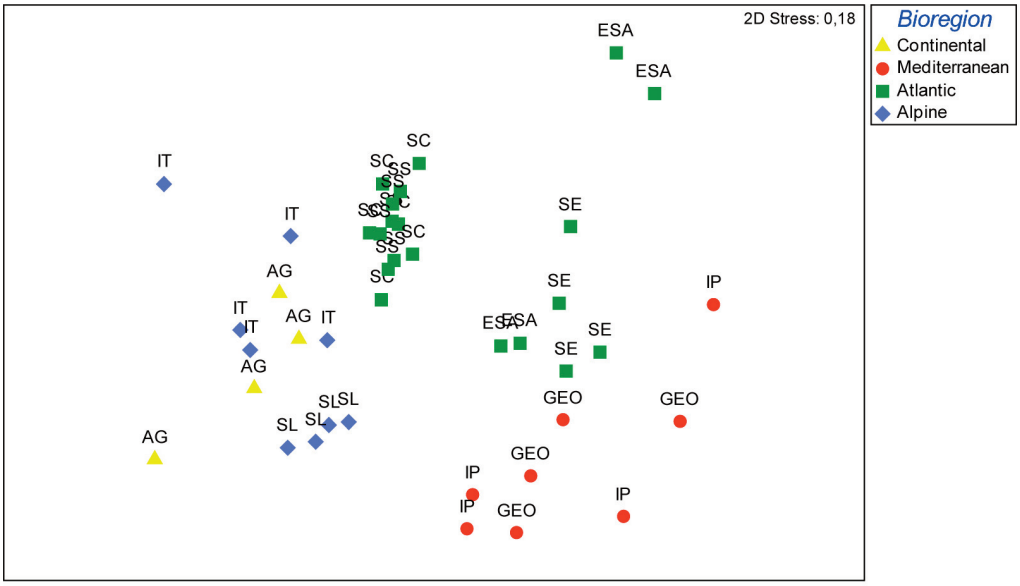

Fig. 1. MDS ordination of the 4-6 areas of each farm according to the arthropod composition and abundance (log (x+1)-transformed). Information about the codes of the farms and the sampling units within each one is included in Table 1.

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References

Scortichini G, Amorena M, Brambilla G, Ceci R, Chessa G, Diletti G, Esposito M, Espositog V and Nardelli V, 2017. Sheep farming and the impact of environment on food safety. Sheep farming and the impact of environment on food safety. *Small Ruminant Research* 135, 66-74.

de Rancourt M, Fois N, Lavín MP, Tchakérian E, Vallerand F, 2006. Mediterranean sheep and goats production: An uncertain future. *Small Ruminant Research* 62,167-179.

Scohier A and Dumont B, 2011. How do sheep affect plant communities and arthropod populations in temperate grasslands? *Animal* 6, 1129-1138.

Pykälä J, 2000. Mitigating human effects on European biodiversity through traditional animal husbandry. *Conservation Biology* 14, 705-712.

Rosa García R, Jáuregui BM, García U, Osoro K, Celaya R, 2009. Effects of livestock breed and grazing pressure on ground-dwelling arthropods in Cantabrian heathlands. *Ecological Entomolog*, 34, 466-475.

Rosenzweig ML, 1995. *Species diversity in space and time*. Cambridge University Press, Cambridge. ISBN 0-521-4995.