Hungarian University of Agricultural and Life Sciences

Doctoral School of Biological Sciences

Effects of conservation management:

grazing-exclusion and uncut refuge strips

PhD thesis booklet

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BACKGROUND AND OBJECTIVES

Extensively managed grasslands are among the most diverse agricultural habitats. Increasing management intensity (through grazing or mowing) generally reduces biodiversity, while its absence leads to litter accumulation and shrub encroachment, ultimately resulting in habitat degradation and the loss of conservation value. Both grazing and mowing affect arthropods through direct mortality, reduced food availability, and loss of shelter, but their impacts on species diversity and abundance vary depending on management intensity, habitat characteristics, and taxonomic group. Arthropod responses to grazing regimes are difficult to predict.

The practice of leaving uncut refuge strips during mowing has become increasingly common and is now a key element of European agri-environmental schemes, yet its conservation effectiveness remains poorly studied. My aim was to fill these knowledge gaps by (i) synthesizing available literature to assess the global effectiveness of uncut refuge strips, and (ii) conducting field experiments to test how the configuration of refuge strips and grazing exclusion influence arthropod communities in different grassland types.

In the first study, my main goal was to systematically review how refuge strips contribute to maintaining species-rich arthropod communities in mown grasslands. We addressed the following questions:

1. Can all sampling designs reliably detect the ecological effectiveness of refuge strips?
2. Does the shape of refuge strips influence their effectiveness?
3. What proportion of uncut grassland is sufficient to conserve arthropod communities?
4. Do different arthropod groups respond similarly to the presence of refuge strips?

In the second study, we tested the conservation value of refuge strips for arthropods during mowing. Few studies have compared arthropod diversity in refuge strips versus adjacent cut areas, and none have systematically compared the effects of strip width and proportion. We therefore designed a large-scale field experiment in the protected semi-natural grasslands of the Csanád Puszta (southern Great Hungarian Plain). We compared the effects of narrow (3 m) versus wide (9 m) strips, and low (10%) versus high (25%) refuge proportions, on arthropod abundance and richness. Our hypotheses were:

1. Refuge strips host higher arthropod abundance and richness than mown areas.
2. Narrow strips support higher densities than wide strips, due to concentration of individuals moving in from adjacent cut areas.
3. Higher proportions of refuge strips result in higher abundance, as larger areas of uncut vegetation provide more effective refuges.
4. These effects are stronger for vegetation-dwelling taxa than for ground-dwelling taxa, due to their stronger dependence on vegetation structure.

In the third part of the thesis, we examined the effects of grazing and vegetation type on arthropod communities in terms of species richness, abundance, and community structure. We hypothesized that grazing exclusion would increase arthropod diversity and abundance in low-productivity Artemisia steppe, whereas in highly productive salt meadows, low-intensity grazing might even benefit arthropod diversity.

Focusing on selected arthropod groups—spiders, ground beetles, and leafhoppers—and their traits (body size, moisture preference, trophic guild), we tested the following hypotheses:

1. Grazing and grazing exclusion affect leafhoppers more strongly than spiders and ground beetles, since leafhoppers are herbivores closely associated with vegetation, while the latter are predominantly ground-active predators.
2. Grazing exclusion, by increasing vegetation height, shifts community structure toward more hygrophilous species due to the moister microclimate.

3. Grazing exclusion also shifts communities toward larger-bodied species, as larger species tend to be more sensitive to disturbance.

MATERIALS AND METHODS

Literature search and evaluation

We conducted a search in the Web of Science scientific database for articles published up to January 11, 2024. Additionally, we included further studies from our own research that had not yet been published by the date of the search. The search terms were defined according to the PICO (Population, Intervention, Comparator, Outcome) approach to capture all potentially relevant articles. The subject of our study was arthropods living in grasslands; the intervention was unmown refuge strips; the control was mown areas; and the expected outcomes were abundance and diversity data. Accordingly, the search terms were as follows: “beetle*, carabid*, orthoptera*, "leaf hopper*", leafhopper*, grasshopper*, arthropod*, insect*, invertebrate*, spider*, bee, bees, bumblebee*, and butterfl*” as taxa; “unmow*, mow*, uncut, cut, refuge” as interventions; and “biodiversity, diversity, "species number", "species richness", abundance, density” as expected outcomes. The “*” symbol was used for truncation to allow different word endings. This search resulted in a total of 2465 studies. First, titles and abstracts were screened, followed by full-text assessment, to determine whether the studies met our criteria: (i) the subject of the study was one or more arthropod groups, (ii) the sampling site was some type of grassland (field margins left uncut on croplands were excluded from our study), (iii) the intervention was unmown vegetation maintained at least until autumn (thus excluding studies examining only delayed mowing). As a result of this screening, a total of 22 studies were retained.

Therefore, in a qualitative assessment, we summarized the findings and identified knowledge gaps. For the quantitative comparison, we extracted available data from the studies and calculated the relative changes caused by refuge strips. The relative change of the response variables measured in refuge strips compared to mown controls was calculated as follows:

$$\text{relative change (\%)} = [(\text{refuge strip} - \text{mown})/\text{mown}]\times 100,$$

following Litt et al. (2014). Changes smaller than an absolute value of 5% were considered neutral responses.

Study sites and experimental design

Our sampling sites were established in the southern part of the Great Hungarian Plain, within the Csanádi Plains. The 4057-hectare area of the Csanádi Plains is divided into three parts: Királyhegyes Plain, Montág Plain, and Kopáncs Plains. The area is managed by the Körös-Maros National Park Directorate in line with national agri-environmental programs, mainly through low-intensity grazing or annual mowing. The two habitat types included in our study were wormwood steppe, characterized by short-grass vegetation dominated by *Artemisia santonicum* and *Festuca pseudovina*, covering 26.5% of the Csanádi Plains, and saline meadows, dominated by *Alopecurus pratensis*, which account for 22.1% of the protected area.

For the refuge-strip experiment, different treatment types were arranged in a randomized block design. During mowing, unmown strips of 3 m (narrow) and 9 m (wide) in width and 100 m in length were left. Depending on their spacing, the unmown strips covered either 10% of the area (27 and 81 m apart) or 25% of the area (9 and 28 m apart). Sampling was conducted both within the refuge strips and in adjacent mown strips at a distance of 5 m from the refuge strips (Fig. 1).

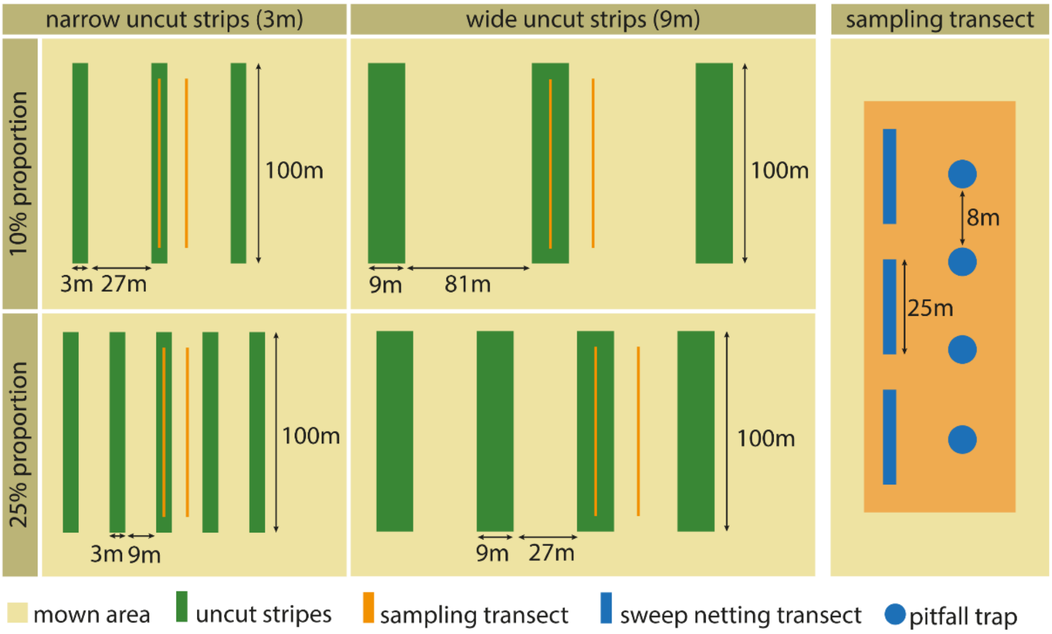

Figure 1: Four types of refuge-strip arrangements: 1) low proportion – narrow strips, 2) low proportion – wide strips, 3) high proportion – narrow strips, 4) high proportion – wide strips, and the sampling layout within a transect.

For the grazing-exclusion experiment, prior to the grazing season in spring 2018, we fenced twelve 50×100 m plots, each at least 100 m apart: six in Királyhegyes Plain and six in Montág Plain (Fig. 2). On both plains, three plots were wormwood steppe and three were saline meadow. Each fenced plot and its adjacent grazed control were considered a single sampling site (N=12). After the one-month grazing period ended, arthropod sampling was conducted at four points within each site: both inside the fenced and grazed areas, at near and far distances from the fence (Fig. 2c).

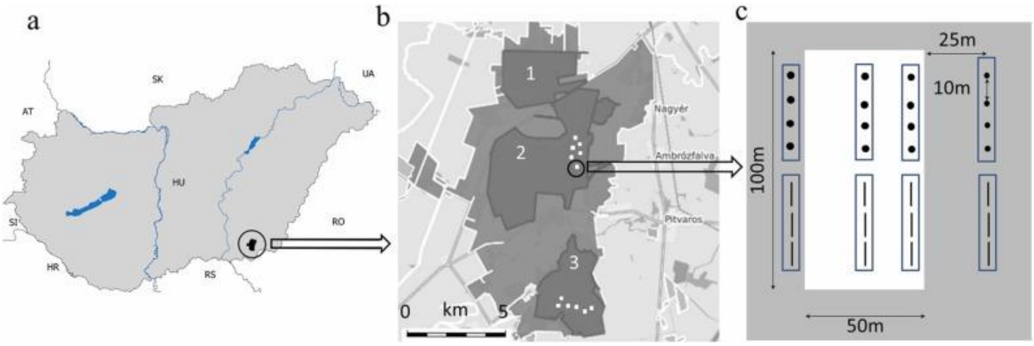

Figure 2: Sampling sites and design for the grazing-exclusion experiment. a) Location of the Csanádi Plains in Hungary, b) Sampling sites within the Csanádi Plains, c) Sampling design at one site. The white square represents the ungrazed area, the grey area the grazed grassland. Transects were placed in grazed-edge, ungrazed-interior, ungrazed-edge, and grazed-interior positions. Black dots indicate the four pitfall traps per transect, and black lines indicate the three sweep-net samples per transect.

Sampling methods

Air temperature and humidity were measured in both refuge strips and adjacent mown areas using Optin ADL (TH3-32) data loggers deployed from July 16–26, 2021 (Kopáncs Plain) and July 27–August 6, 2021 (Montág Plain). Data were recorded every 20 minutes. Soil moisture was measured with a Field Scout TDR 350 device (resolution: 0.1 V/V% water) in the upper 12 cm of soil. At each sampling site, 10 random points were measured and averaged per site.

Arthropods on vegetation were sampled with a standard 40 cm diameter sweep net. Sampling was performed along 25 m transects, with 25 sweeps per transect. Sampling took place 16–18 days after mowing to avoid immediate disturbance effects. In total, 3 samples per transect × 2 treatments (mown and unmown) × 2 refuge-strip widths (narrow: 3 m, wide: 9 m) × 2 refuge-strip proportions (10% and 25%) × 6 replicates = 144 samples were collected. The material was stored in plastic bags containing 70:30 aqueous ethanol.

Ground-dwelling arthropods were collected with pitfall traps made from 9.5 cm diameter plastic cups, filled with 50:50 ethylene glycol solution and a few drops of detergent to reduce surface tension. A plastic funnel was inserted to restrict the opening to arthropod size and to protect vertebrates. A plastic roof was placed over the buried trap to prevent dilution by rainfall. In total, 4 traps per transect × 2 treatments (mown and unmown) × 2 refuge-strip widths (narrow: 3 m, wide: 9 m) × 2 refuge-strip proportions (10% and 25%) × 6 replicates = 192 samples were collected. Pitfall traps were set 16–18 days after mowing and operated for 10 days. Both sweep-net and pitfall-trap samples were sorted by taxonomic groups, and individuals were identified to species level.

Data analysis

All analyses were conducted in R statistical software. To examine the relationship between microclimatic conditions (daily minimum (13.72–20.08 °C) and maximum (37.03–49.64 °C) temperature, average humidity (48.09–73.95%)) and treatments, linear mixed models were used, with treatment (refuge strip vs. mown) as a fixed effect and normally distributed error terms.

For the refuge-strip experiment, the effects of treatment, refuge-strip width, and proportion on the abundance and species richness of the studied taxa (Orthoptera, Heteroptera, vegetation-dwelling spiders, carabids, and ground-dwelling spiders) were analyzed using generalized linear mixed models (GLMM). Data collected with sweep nets and pitfall traps were pooled per transect. For species richness, models with Poisson errors were applied; for abundance data, overdispersion was observed, so models with negative binomial errors were fitted. Fixed effects included (1) refuge-strip proportion (10% or 25%), (2) refuge-strip width (narrow or wide), (3) treatment (refuge strip vs. mown), and their interactions, as well as “grassland” (Kopáncs or Montág) and “year” (2020 or 2021). Random effects were specified as block nested within the strip width–proportion combination, accounting for spatial and temporal dependence.

For the grazing-exclusion experiment, species were characterized by body size, moisture preference, and trophic behavior. Average body length in mm was used to represent size. Moisture preference was classified into 3 or 5 categories (from xerophilous to hydrophilous). Feeding was categorized differently depending on taxonomic group. Trait–habitat interactions were assessed using community-weighted means (CWM), calculated with the FD package in R. Indicator species analysis was used to identify species associated with grazed vs. ungrazed meadows and steppes, using the multipatt function of the indicspecies package in R. Differences in arthropod communities were analyzed with linear mixed models (LMM) and generalized linear mixed models (GLMM) from the lme4 package. Poisson error distributions were applied (glmer), and in the case of overdispersion, negative binomial models were fitted with the glmer.nb function.

RESULTS

Literature review on the effectiveness of uncut refuge strips

All studies were conducted in Europe, across six countries, leaving important knowledge gaps for other geographic regions. Most research was carried out in Switzerland (11 studies), followed by the Czech Republic (4), Germany (3), Hungary (2), Belgium (1), and the United Kingdom (1). Sampling designs varied: (1) sampling within refuge strips (inside and outside combined) and fully mown control plots, (2) sampling within refuge strips and adjacent mown strips, (3) sampling in rotational refuge strips and adjacent mown strips, and (4) sampling exclusively within refuge strips before and after mowing (Fig. 3).

The size of unmown patches ranged from 2 to 2000 m², although in many cases the exact area was not reported. The shape of refuges also varied, most commonly being left as strips, blocks, or circular patches. The proportion of unmown area relative to total plot size ranged between 3 and 50%, with most studies (55%) falling within the 10–25% range. Target taxa included various arthropod groups, such as Orthoptera (12 studies), spiders (9), beetles (7), butterflies (6), bees (5), and other, less frequently studied groups.

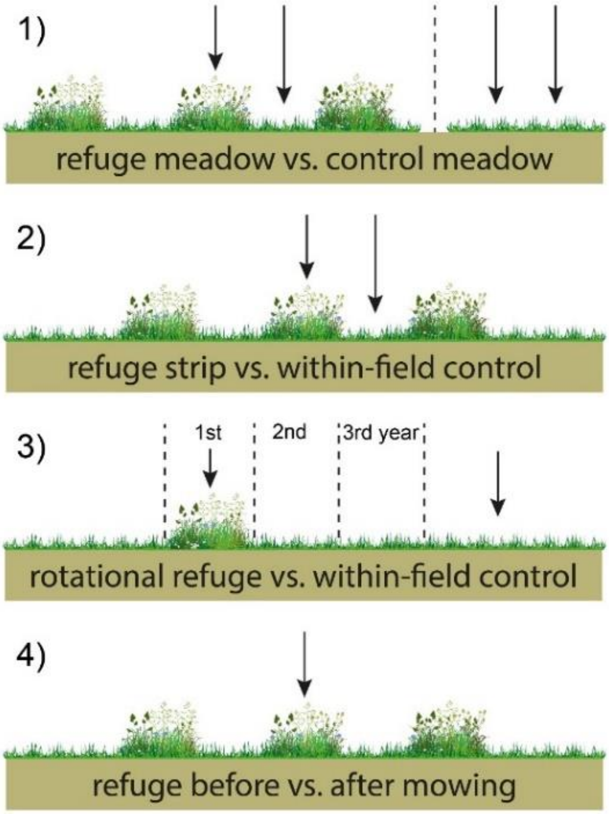

Figure 3: The four characteristic sampling designs used in the reviewed studies.

Across the 22 studies, we compiled 66 datasets reporting arthropod abundance, diversity, or both. Of the 65 abundance datasets, 69% showed an increase in refuge strips compared to controls, 25% showed a decrease, and 6% indicated neutral responses. Diversity data were available in 42 cases, with similar proportions: 64% of observations showed higher diversity in refuge strips compared to controls, 26% reported lower diversity, and 10% no change.

Field study on the effectiveness of refuge strips

Microclimate

Refuge strips and adjacent mown strips exhibited distinct microclimatic conditions: minimum and maximum temperatures, as well as mean humidity, were consistently higher in refuge strips.

Vegetation-dwelling arthropods

Sweep-netting yielded 947 Orthoptera individuals (22 species), 1558 true bugs (34 species), and 4558 vegetation-dwelling spiders (27 species). Species richness was consistently higher in refuge strips than in mown areas across all groups (Orthoptera, true bugs, and spiders). Abundances of true bugs and spiders were also higher in refuge strips compared to mown strips. The effect of strip width on Orthoptera abundance was more pronounced when strips covered 10% of the area than when they covered 25%. Conversely, true bug abundances in mown areas were higher adjacent to narrow strips than next to wide ones.

Ground-dwelling arthropods

Pitfall trapping yielded 1094 ground beetles (36 species) and 2437 ground-dwelling spiders (47 species). Carabid species richness was higher in refuge strips than in mown areas. The width and proportion of strips interacted to affect carabid richness and spider abundance: more species and individuals were found in wide strips when strips made up 10% of the area, and in narrow strips when strips made up 25%.

Field study on the effects of grazing exclusion

Ground beetles

We collected 4241 individuals from 59 ground beetle species. On alkaline meadows, the dominant species were *Brachinus elegans* (21.1%), *Agonum viridicupreum* (15.4%), and *Brachinus psophia* (13.2%). Both species richness and abundance were higher on alkaline meadows than on Artemisia steppes. Assemblages in the steppes were dominated by xerophilic species compared to meadows. Grazing exclusion significantly affected carabid moisture preference: assemblages shifted toward hydrophilic species on fenced alkaline meadows, but not on fenced steppes.

Spiders

In total, 4874 adult individuals from 80 spider species were collected. Dominant species included *Aulonia albimana* (30.0%), *Trochosa robusta* (16.3%), and *Metopobactrus deserticola* (9.0%), in both vegetation types. Both richness and abundance were significantly higher in alkaline meadows, with assemblages dominated by hydrophilic species. As with beetles, moisture-preference CWM values were significantly influenced by grazing and by its interaction with vegetation type: spider assemblages shifted toward hydrophilic species on fenced alkaline meadows, but not on fenced steppes.

Leafhoppers

We collected 4603 individuals representing 54 leafhopper species. The most abundant was *Laburrus handlirschi* (26.3%), a xerophilic specialist feeding exclusively on *Artemisia* spp., confined to steppe habitats. Species abundances, moisture-preference CWM values, and feeding-preference CWM values all differed significantly between alkaline meadows and steppes. Assemblages in steppes shifted toward xerophilic and specialist herbivores relative to meadows.

Grazing significantly affected leafhopper abundance in a vegetation-dependent way: in steppes, abundances were higher in ungrazed plots than in grazed ones, whereas in alkaline meadows the opposite was true. Moisture- and feeding-preference CWM values also differed significantly between grazed and ungrazed plots. In ungrazed areas, assemblages shifted toward less specialized herbivores, irrespective of vegetation type. However, grazing × vegetation interactions pushed assemblages toward hydrophilic species only in fenced alkaline meadows, not in fenced steppes.

CONCLUSIONS AND RECOMMENDATIONS

Literature review on the effectiveness of refuge strips

An increasing number of studies confirm that uncut refuge patches have positive effects on grassland arthropod communities, enhancing both abundance and species richness. This simple management practice can play a key role in maintaining the high biodiversity value of extensively managed grasslands, while being easily integrated into existing agri-environmental schemes. However, the development of optimal management practices requires further research that not only examines the local and short-term effects of uncut refuges but also their long-term, landscape-scale effectiveness, as well as the underlying factors shaping these outcomes.

Comparison of study types, refuge shapes and proportions

Among the four study types, type 1 appears to be the most reliable for evaluating the ecological effectiveness of uncut refuges in arthropod conservation. By contrast, the other types of studies may primarily reflect short-term, local concentration effects, as has been shown in earlier research.

Uncut refuges can promote arthropod persistence in any shape, but geometric forms that maximize edge length are likely to be more favorable, as they facilitate access to refuges within the grassland matrix. Therefore, elongated strip-shaped refuges are recommended, as they maximize edge-to-area ratios and are practical to implement for grassland managers.

The proportion of uncut areas varied considerably across studies and was unevenly distributed. In practice, the required share of uncut refuges under agri-environmental schemes depends on country-specific regulations and program design, typically amounting to around 10%.

Comparison of studied taxa

Most arthropod groups responded positively to the presence of uncut refuges. The positive effects were often stronger for herbivorous taxa than for predators, since herbivores rely on retained vegetation not only as habitat but also as a food resource. Trait-based analyses showed that uncut refuges differentially affected ground-dwelling and vegetation-dwelling arthropods in both type 1 and type 2 studies, with stronger benefits for vegetation-associated species. Given their sensitivity to grassland management, more detailed studies on hemipterans and other underrepresented herbivores are essential for a better understanding of refuge effects.

Future research needs

Existing literature suggests that refuges left in mown grasslands can support arthropod populations both during and after mowing, and may gradually enhance populations over multiple years. However, available data remain limited, especially regarding certain geographic regions and grassland arthropod taxa.

Clarifying the microclimatic conditions of refuges is crucial for understanding which abiotic factors drive biodiversity patterns in particular groups (e.g. Orthoptera). The timing of mowing and subsequent hay harvesting steps may also influence the ecological effectiveness of refuges. Determining the most effective ways of applying refuges in managed grasslands remains a key priority, as their impact may depend strongly on location, proportion, shape, and target taxa.

Field investigations on the effectiveness of refuge strips

Vegetation-dwelling arthropods

In addition to direct effects of vegetation (food and shelter), vegetation-driven humidity and moisture conditions strongly shape diversity patterns of Orthoptera. Refuge strips showed higher humidity than mown areas, and their dense vegetation provided oviposition sites and likely enhanced survival and development of orthopterans.

Hemipterans are sensitive to changes in grassland management and responded positively to taller vegetation in extensively managed grasslands, while reduced biomass can directly lower their population sizes.

Although spiders do not depend on vegetation as a food resource, vegetation-dwelling species exploit the three-dimensional vegetation structure for web construction, prey capture, and shelter. Vegetation structure is therefore a key driver of predator diversity, and vegetation removal has particularly negative effects on spiders inhabiting grassland canopies.

Ground-dwelling arthropods

Ground-dwelling spiders did not benefit from refuge strips, as they are less affected by grassland management. Many ground-dwelling species, such as those in the family Gnaphosidae, are nocturnal and therefore less influenced by daytime microclimatic differences between mown and unmown patches. Furthermore, many of the collected species were xerophilous, and thus less favored by the more humid microclimate of refuge strips.

Carabids in grasslands generally prefer taller vegetation, with some exceptions such as disturbance-tolerant species or certain specialists. Carabids are sensitive to microclimatic conditions (e.g. humidity, temperature), and mowing-induced changes often caused many species to move from dry, mown microhabitats into the more humid refuge strips.

Comparison between vegetation-dwelling and ground-dwelling arthropods

Refuge strips had stronger effects on vegetation-dwelling arthropods than on ground-dwellers. Orthoptera and Hemiptera, closely tied to herbaceous vegetation, responded sensitively to mowing, since both nymphs and adults depend primarily on vegetation as food. For carabids and spiders, however, food availability and microclimatic conditions were more important drivers than vegetation height or cover.

Conclusions and conservation implications

Agri-environmental schemes aim to maintain species-rich grasslands partly by leaving refuge strips. Beyond improving survival, such refuges also facilitate arthropod recolonization of mown areas. Studies comparing different widths and proportions of refuges confirm that even relatively narrow (3 m) strips at low proportions (10%) can partially mitigate negative effects of uniform mowing.

Considering both ecological outcomes and farmer perspectives, two combinations appear most effective for arthropod conservation: (1) wide strips covering 10% of the area, or (2) narrower strips covering 25%. The first option is likely easier to implement and more acceptable to farmers, since wide uncut strips are simpler to create with mowing machinery and involve leaving only 10% of the yield unharvested, making it also economically more favorable.

Field study on the effects of grazing exclusion on arthropods

Vegetation types determine arthropod communities and the effect of management

Our results suggest that arthropod community responses to management depend on vegetation productivity, although individual arthropod groups reacted differently to the presence or absence of grazing. Differences between carabid and spider communities of salt meadows and Artemisia steppes are likely driven by species' differing moisture preferences.

We observed differences in abundance patterns and associated community traits between grazed and ungrazed areas, whereas species richness did not differ. We emphasize that the significant effect of management on arthropods depended on vegetation type, except in the case of the trophic specialization of leafhoppers. Specialized phytophagous insects more closely follow patterns of plant species richness, whereas the abundance of generalist insects is more influenced by the amount of plant biomass. The mechanisms underlying the responses of specialist and generalist insects to grazing or abandonment may differ, since specialists are adapted to their host plants and to the defensive metabolites of these plants.

Effects of grazing on Artemisia steppes

Surprisingly, the indirect effects of grazing—manifested in changes in vegetation characteristics and abiotic conditions—were of limited importance for arthropod communities of Artemisia steppes. Arthropod species are presumably well adapted to the sparse vegetation under dry and warm conditions, and the changes induced by low-intensity grazing are not substantial enough to produce significant differences in arthropod community structure between grazed and grazing-excluded sites. It is assumed that in extremely dry and warm habitats, environmental constraints play a greater role in structuring arthropod communities than management.

Effects of grazing on salt meadows

Indirect effects (e.g. reduced vegetation height due to grazing and associated microclimatic changes) influenced arthropod community structure more strongly in meadow vegetation than in Artemisia steppes. Microclimatic conditions altered by grazing are likely of greater importance in relatively wetter habitats. Several Artemisia-steppe-associated species were able to colonize and use grazed meadow vegetation in large numbers. This likely contributed to the higher leafhopper abundance in grazed compared to ungrazed meadow vegetation. Furthermore, reduced plant biomass as a result of grazing can rapidly regenerate in highly productive, nutrient-rich grasslands, which may have positive effects on phytophagous insects.

Limits of generalizability of management effects

The results of our short-term experiment cannot be generalized to longer time periods without reservations, but they provide important information on which arthropod groups and traits are sensitive to grazing, and which tolerate it or benefit from its absence.

Management implications

We agree with previous studies in concluding that current management systems may be sufficient to maintain arthropod diversity in Pannonian salt steppes. At the same time, this does not exclude the possibility that changes in management may become necessary in the future. Climate change scenarios predict increasing drought and more frequent extreme weather events. Our results suggest that grazing has smaller impacts on arthropod communities in drier, more open vegetation. Further research is needed, particularly on the potential interactions between management and climatic conditions, to evaluate whether current systems can sustain biodiversity in the long term under changing environments.

NEW SCIENTIFIC RESULTS

1. I prepared a unique synthesis in the available international literature on the effects of uncut refuges on arthropods. I found that most arthropod groups respond positively to the presence of uncut refuges, particularly herbivores. I also identified major knowledge gaps, such as the lack of studies outside Europe, limited research on cumulative effects, and insufficient understanding of the underlying microclimatic conditions.

2. The effects of refuge strip width and proportion of area left uncut on arthropods had not previously been studied. In our field experiment, we tested the independent and combined effects of these factors on six arthropod taxa. I found that refuge strips had a warmer and more humid microclimate compared to mown areas. The effects of refuge strips and their configuration more strongly influenced vegetation-dwelling arthropods than ground-dwellers, although effects were detected for all studied taxa. Based on the interaction between strip width and proportion, wider strips are more advantageous when the total proportion of refuge area is low.

3. Based on our grazing-exclusion experiment, I established that vegetation type determines arthropod communities and modulates the effects of grazing. Our results show that moderate disturbance caused by low-intensity grazing may have positive or neutral effects in wetter, more productive vegetation, while in drier, less productive vegetation it may have negative or neutral effects, depending on the arthropod group.

PUBLICATIONS RELATED TO THE DISSERTATION

Révész, K., Gallé, R., Humbert, J. Y., & Batáry, P. (2024). Effects of uncut refuge management on grassland arthropods–A systematic review. *Global Ecology and Conservation*, e03381. https://doi.org/10.1016/j.gecco.2024.e03381

Révész, K., Torma, A., Szabó, M., Korsoveczky, L., Gallé-Szpisjak, N., Batáry, P., & Gallé, R. (2024). Supportive effect of uncut refuge strips on grassland arthropods may depends on the amount and width of strips. *Journal of Applied Ecology*, 61(8), 1894-1904. https://doi.org/10.1111/1365-2664.14699

Gallé, R., Sarok, B., Gallé-Szpisjak, N., Dudás, G., Korsoveczky, L., Torma, A., ... & **Révész, K.** (2024). A búvósávok kialakítása meghatározó fontosságú a kaszálók diverz ízeltlábú-faunájának megőrzésében. *Természetvédelmi Közlemények*, 30, 1-13. https://doi.org/10.20332/tvk-jnatconserv.2024.30.17036

Torma, A., **Révész, K.**, Gallé-Szpisjak, N., Šeat, J., Szél, G., Kutasi, C., ... & Gallé, R. (2023). Differences in arthropod communities between grazed areas and grazing exclosures depend on arthropod groups and vegetation types. *Agriculture, Ecosystems & Environment*, 341, 108222. https://doi.org/10.1016/j.agee.2022.108222