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Review of habitats occupied by *Urocoras longispinus*: a little-known spider species, and responses to grassland management

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Abstract

The main objective of this paper is to report habitat occupancy, naturalness status and phenology of *Urocoras longispinus* (Kulczynski, 1897), a little-known spider species. Sampling was conducted in Natura 2000 habitats of the Mátra Mountains, and four disturbed mainroad verges in Hungary between 2012 and 2015. We recorded 348 adult specimens active throughout the year, but abundance was highest in autumn. In the Mátra Mountains shrub removal negatively affected the abundance of *U. lonsgspinus*: the species preferred shaded habitats. The intensity of mowing maintenance caused changes in the species' abundance in mainroad verges: the number of individual spiders increased as a result of both without maintenance and enhanced maintenance. We conclude that *U. longispinus* is a stenochronous spider species which lives in both human-disturbed and undisturbed habitats. However, the nature of the disturbance influenced the abundance of this species to varying degrees.

Keywords: mowing, shrub control, Mátra Mountain, mainroad verges

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Introduction

Agelenidae C. L. Koch, 1837 is a large family of funnel weaver spiders, including 222 species in Europe (Nentwig et al. 2018). The genus *Urocoras* of this family was established by Ovtchinnikov (1999), which includes four species in Europe (Nentwig et al. 2018). The family is represented in Hungary by 17 species, included in 10 genera. Only one species of the genus *Urocoras* is known from Hungary (Samu and Szinter 1999): *Urocoras longispinus* (Kulczynski, 1897), which is abundant and not threatened, however it is mentioned as a rare species in a study by Lőrinczi et al. (2011). Another study (Antov et al. 2004; Gajdoš 2010; Horak 1992) provides information about the occurrence of this species, but it is considered a rare spider species in

Europe, and little information is available regarding its biology (Nentwig et al. 2018). In the study of Milasowszky and Strodl (2006) *U. longispinus* is included as a rare spider species of Central Europe.
It was described in 1897 from multiple localities in Hungary (Sátoraljaújhely, Szőllőske, Budapest), and Beregszász, and two localities in Romania by Chyzer and Kulczinsky (1897) under the name *Coelotes longispina*. It is found in Central and Eastern Europe: Poland (Kulczynski 1906), Bulgaria (Drensky 1942), Slovakia (Miller 1971), Ukraine (Ovtchinnikov 1999), Austria (Kropf and Horak 1996), Serbia-Montenegro (Nikolic and Polenec 1981), and Romania (Weiss and Urák 2000).
Grassland management is used to preserve the original grassy habitats for several fauna species, thereby preventing the ecological succession within Natura 2000 habitats of the the Mátra Mountains. As a result of deforestation, grasslands dominate the landscape and are subsequently managed by mowing and grazing. The traditional meadow and pasture agriculture has now completely disappeared, and consequently the composition of species in the meadows has changed. It is necessary to suppress the growth of shrubs in order to protect the original condition of the grassland vegetation.
The method and intensity of maintaining management practices usually aligns with the road network, which affects species and ecological processes. There is a well-established relationship between maintenance management of verges for vegetation richness (Schaffers 2002; Sycora et al. 2002) and biodiversity, and the structure of arthopods assemblages (Marini et al. 2009; Humbert et al. 2010; Doležal et al. 2011; Wansink et al. 2016). However, mowing on roadside verges needs to be properly coordinated becasuse intensive management poses risks to meadow insects (Saarinen et al. 2005).
Catalogues of European spiders, such as the Catalogue of Buchar and Růžička (2002), website of Czech Arachnology Society (https://arachnology.cz) and Central European Spiders (Nentwig et al. 2018) do not include *U. longispinus* or provide little information about the naturalness status, habitat preference and phenology of this species. In this context, this study is intended to review the current status of this spider species. Also, our objectives were to describe the effect of different grassland management methods, disturbance, climatic conditions and seasonality on abundance of *U. longispinus*, and how phenology may evolve, considering the different habitats it potentially occupies. Species abundance was examined only in the case of impact assessment of grassland management in the Mátra Mountains and roadside verges. Besides this, we examined the species in relation to habitat-preference, climate and seasonality.

Materials and methods

During our study we used the results of three projects to examine the habitats occupied by *U. longipinus.* Data collection was done in two localities: the Mátra Mountains, situated in northeastern Hungary, and four roadside verges in Cental Hungary.

Project 1. Four localities (1. Sár Hill Nature Reserve, 2. Gyöngyössolymos, 3. Fallóskút, 4. Parád) (Fig. 1) were selected in the Mátra Mountains between 2012 and 2015, and all localities contained a shrub, a treated shrub and a hay meadow to research shrub removal. Sár Hill Nature Reserve is protected and a Special Area of Conservation (SAC), and Gyöngyössolymos, Fallóskút and Parád are protected and Special Protection Areas (SPA) of the Natura 2000 network. Two mountain sites were situated in the Southern part of Mátra, and two in the high-altitude parts of Mátra (Szmatona-Túri et al. 2017).

Project 2. We investigated the species occurrence in the South-Western and the South-Eastern Mátra between 2014 and 2015. Double-glass pitfall traps filled with ethylene glycol were established on eight sampling sites (Fig. 1). Four of these habitats (a, f, e, h, g) were situated in SPA, one habitat (d) was on SPA and protected area, one habitat (b) was a protected and SAC, and one habitat on area does not have conservation status. Five traps were deployed 4-5 m along a transect. The traps were deployed twice (2012 and 2015: May-July, September-November; also 2014 and 2015: March-April, September-October) over a six week period each year (Szmatona-Túri et al. 2017).

Project 3. Along the Hungarian roads data was collected on verges beside four sampling sites representing the main types of verge habitats between 2014 and 2015 (Fig. 1). All localities (I. Pilisjászfalu, II. Herceghalom, III. Mány, IV. Agárd) included three sections representing (1) without maintenance (non mown), (2) normal maintenance (mown once or twice a year) and (3) enhanced maintenance (mown three or four times a year). The distance between two sections was 100 m. In each section five pitfall traps were established which were 5 meters from each other, and they were located 1,5 m from the roads. Double glass pitfall traps filled with ethylene glycol were used which were left in the field for three weeks and three times a year in different seasons (April-May, July-August, October-November). Variancia data in treatments and seasons were analysed by a Two Factor ANOVA without Replication.

Sampling sites:

Project 1.

Shrubs - all four localities: *Pruno spinosae-Crataegetum*

Treated shrubs of localities 1 and 2: *Campanulo-Stipetum tirsae*

Treated shrubs of localities 3 and 4: *Pastinaco-Arrhenatheretum*

Hay meadows of localities 1 and 2: *Campanulo-Stipetum tirsae*

Hay meadow of locality 3: *Anthyllido-Festucetum rubrae*,

Hay meadow of locality 4: *Pastinaco-Arrhenatheretum* and *Festuco ovinae-Nardetum*

Project 2.

a, b*:* Rocky grasslands (*Potentillo-Festucetum pseudodalmaticae*)

c, d: Clearing forests (*Corno-Quercetum pubescentis*)

e: Low forest (*Ceraso mahaleb-Quercetum pubescentis*)

f, g: Forest steppes (*Campanulo-Stipetum tirsae*)

h: Oak forest *(Quercetum petraeae-cerris*)

Project 3.

I. arid grassland (*Seseli leucospermo - Festucetum pallentis*)

II. plantation forest as protective tree line (*Robinia pseudoacacia-Populus sp.- Acer campestre*)

III. agricultural area (arable)

IV. wet plantation forest (*Populus sp*.)

Results

A total of 356 adult specimens of *U. longispinus* were collected in two sampling areas. In the Mátra Mountains we found 312 specimens (48 females, 264 males) over four years of sampling, but in roadside verges we recorded only 44 individuals (7 females, 37 males) in traps over two years. All specimens collected in the Mátra Mountains were recorded from the southern part of the mountains (Sár Hill, Gyöngyössolymos) which are covered by xerotherm oak forests. We found *U. longispinus* in clearings within forests and in forest steppes. In areas located at higher altitudes of Mátra (Fallóskút, Parád) this species was absent (Fig. 1). The highest species abundance was recorded in Gyöngyössolymos, followed by Sár Hill (Fig. 2 a). Along roads, the species was absent in verges near wet forest and agricultural areas. The highest species abundance was recorded in verges near protective forest followed by verges near dry grassland (Fig. 2 b). Abundance of *U. longispinus* increased after shrub control, then decreased in the second and third year thereafter (Fig. 3). Compared to the shrubs with open habitats, therelative abundance of the species was 7, 96% in the shrubs, 4, 52% in the treated shrubs and 4, 84% in the hay meadows. There was a decrease in abundance from shrubs to hay meadows in almost all sampling months (Fig. 4 a). There was a significant difference in the abundance in the seasons studied, but there

was no significant difference in the abundance in treatments at the 95% level of confidence (Table 1). Intensity of maintenance mowing along road verges influenced the species' abundance in all sampling months: abundance was highest in enhanced mowed regimes in October and in without mowing regimes in November (Fig. 4 b). We conclude that there was a significant difference in spider abundance in the seasons studied, but there was no significant difference in abundance in maintenance mowing intensity (Table 2). Considering both study areas and all projects, *U. longispinus* was found in all sampling months (from March to November). The activity peak of this species is typically during October in Mátra Mountain, but along roads activity peaked in November. In the Mátra Mountains this species was found throughout all sampling periods, but its abundance decreased in June, then increased in October. Along roads the species was absent in spring, but its abundance increased from August to November (Fig. 5 a, b).

Discussion

There are many published data concerning *U. longispinus* in Hungary (Samu and Szinetár 1999). But the occurrence of this species has never been documented in the Mátra Mountains, where previously Chyzer and Kulczinsky (1918) and Kolosváry (1935) conducted arachnological research which listed 33 spider species including four species of Agelenidae: *Agelena labyrinthica* (Clerck, 1757), *Histopona torpida* (C. L. Koch, 1837), *Tegenaria domestica* (Clerck, 1757), *Tegenaria silvestris* L. Koch, 1872.

The occurrence of *U. longispinus* in Natura 2000 areas and mainroad verges indicates that this species prefers semi-natural and disturbed areas. But the nature of the disturbance determines the abundance of *U. longispinus*. Examination of verges along roads showed that the species does not tolerate intensive disturbances because it was not present in verges besides agricultural habitats, where the verges were situated between two roads. A higher abundance of *U. longispinus* in verges besides less disturbed areas shows these habitats provide more suitable conditions. According to other studies, this species can be found in agricultural habitats such as winter oilseed rape fields (Drapela et al. 2008) and in arables (Steinberger and Haas 1991). *U. longispinus* maybe absent in verges near agricultural habitats because the verges are isolated by two roads thereby restricting between-verge migration.

Disturbance caused by repeated mowing positively influenced the abundance of *U. longispinus*. The increased abundance may be the result of hay being kept on the sampling sites, which retained humid shelter sites favoured by the species. This result supports the idea the species may prefer warmer climates, and furthermore, it was absent from regions at 700-950 m a.s.l. of the Matra Mountains and was present at lower altitudes and warmer

areas. A mountain climate is typical of the region at higher altitude which outstands in isolation from neighbouring warmer climate regions. This assertion is supported by Hebar (1980), who demonstrated it to be a thermophilic species. But, on occasion, *U. longispinus* occurs in higher mountains, such as the Osogovska Planina Mountain of southwestern Bulgaria (Deltshev 1995). The species is found in mountainous and hilly districts of Hungary: Pető Hill, Péter Hill, Bakony Mountain (Loksa 1966), Somló (Szinetár 1991), Pálházi Hill, Bakonybél (Loksa 1971).

During our study, *U. longispinus* was not found in wet forest, similar to a study by Kropf and Horak (1996) who found that this species prefers dry habitats. Several studies (Malicky 1972; Hebar 1980; Steinberger and Haas 1991) have shown the species occurs in dry grasslands. However, the abundance of *U. longispinus* is lower in meadows compared with forests (Katusic 2008; Lőrinczi et al. 2011). According to our study, *U. longispinus* prefers shrubs and forest because fewer specimens were present in grasslands than in partly shaded and shaded habitats. This result is supported by our observations of the species' lower abundance after shrub removal, which opens the habitats to increased sunshine. The number of specimens increased in only the first year after shrub removal maybe because of persisting disturbance resulting from the treatment. Our hypothesis is supported by the fact that the number of all spider species increased during our examinations. Similarly to our data, Szinetár (1991) found *U. lonsigpinus* in Széki Forest in Hungary. According to some studies, this species is considered an eudominant species of forests in Slovakia (Gajdoš 2010; Eliašová et al. 2015) and Serbia (Gajić and Gordana 2016), where it mainly occurs in beech forest (Horak 1992), pine wood (Schaberreiter 1999), and oak wood (Balogh and Loksa 1948; Steinberger 2004). During our study, this species preferred xerotherm oak forest of the Mátra Mountains, since it was absent in beech forest situated in higher region. Also plantations with *Populus* sp. and *Robinia pseudoacacia* beside roadside verges provided suitable habitat for this species, a similar result to Steinberger and Haas (1991), who found it in *Robinia* planatations.

U. longispinus is an stenochronous species (Kirch 2001). Our results support this, and we found the species during the whole year (from March to November), with one peak of activity in autumn. The active season of this spcies is October in the Mátra Mountains, a location which is colder than in the roadsides we examined, whereas activity in roadside verges peaked in November. The differences between the structure of both habitat types influences the mesoclimate which likely contributed to the shift in the activity peak of *U. longispinus*.

U. longispinus was recorded firstly in the Mátra Mountains. It is a thermophilic spider species which has an activity peak in autumn. This rare and little known European species prefers natural habitats, but also succesfully adapts to disturbed habitats. *U. longispinus* lives principally in shaded habitats mainly in xerotherm oak forest of

the Mátra Mountains, but plantations along mainroads also provide suitable habitat conditions for *U. longispinus*. This species occurs in forest clearings and forest steppes, but shrub control and normal maintenance mowing negatively influenced abundance. While this single species does not represent all spider species, our study showed that there are some spiders that negatively respond to grassland management, and little information is available regarding the biology of species such as *U. longispinus*. Therefore it is essential to further examine the ecological requirements of *U. longispinus*, and to better cordinate shrub control and mowing so that the shaded habitats preferred by this species are conserved. From an ecological perspective, it is worthwhile to reduce the extend of deforestation, and intensity of application of mosaic treatments, and to consider the long-term maintenance of edge habitats in these areas.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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Table 1. Results of variance for the effect of treatment (shrubs, treated shrubs, hay meadows) in the Mátra Mountains and seasons on abundance of *Urocoras longispinus*

Table 2. Results of of variance for the effect of maintenance mowing (without maintenance, normal maintenance, enhanced maintenance) on roadside verges and seasons on abundance of *Urocoras longispinus*

1

	Sum of sqrs	df	Mean square	F	P
Seasons	3101,67	3	1033,89	11,9794	0,006052
Treatments	1101,5	2	550,75	6,3814	0,327
Error	517,833	6	86,3056		
Total	4721	11			

2

	Sum of sqrs	df	Mean square	F	P
Seasons	197,556	2	98,7778	55,5625	0,001207
Maintenance	4,22222	2	2,11111	1,1875	0,3937
Error	7,11111	4	1,77778		
Total	208,889	8			

Fig. 1 Sampling sites in the Mátra Mountains to examine shrub removal (1-4), and to evalute fauna (a-h), and along roadsides (I,-IV.) (●:*U. longispinus* is present, ▲: *U. longispinus* is absent)

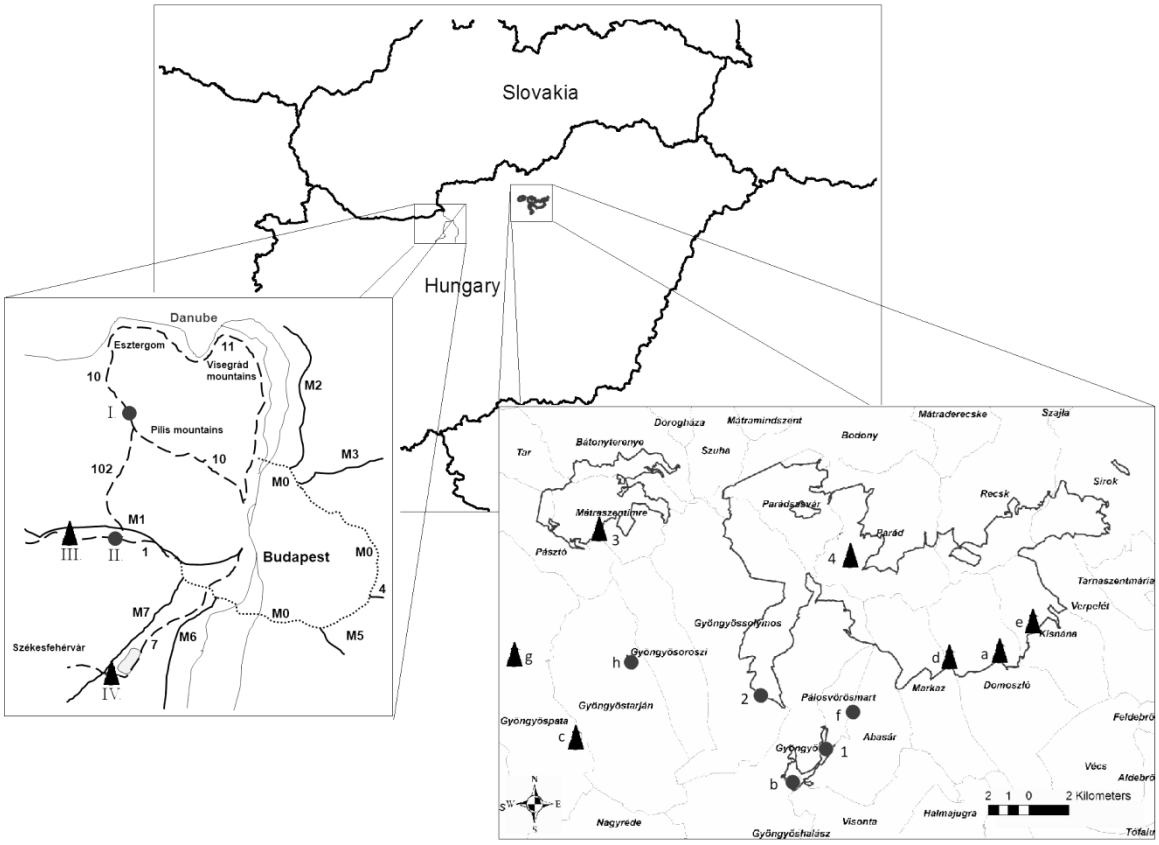
Fig. 2 Abundance of *U. longispinus* in the Mátra Mountains (Southern part of mountain: Sár Hill and Gyöngyössolymos, high-altitude part of mountain: Fallóskút and Parád) (a), and in mainroad verges considering the verge types (b)

Fig. 3 Annual changes in abundance of *U. longispinus* in the Mátra Mountains influenced by shrub removal

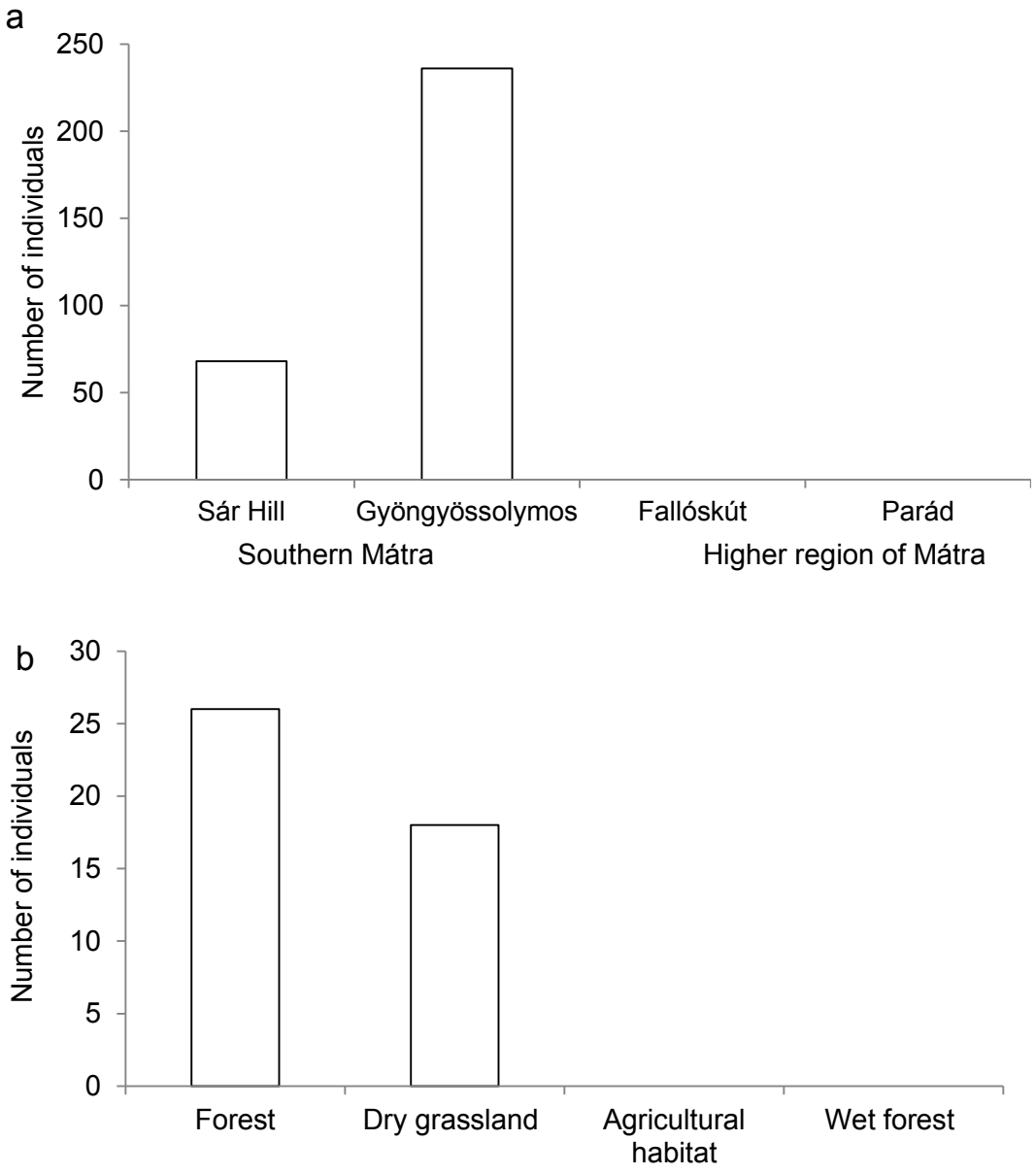
Fig. 4 Abundance of *U. longispinus* in the Mátra Mountains influenced by shrub removal and mowing (a), and in mainroad verges influenced by maintenance mowing in relation to sampling months (b)

Fig. 5 Activity peak of *U. longispinus* between 2012 and 2015 in the Mátra Mountains (a), and in mainroad verges between 2014 and 2016 (b)

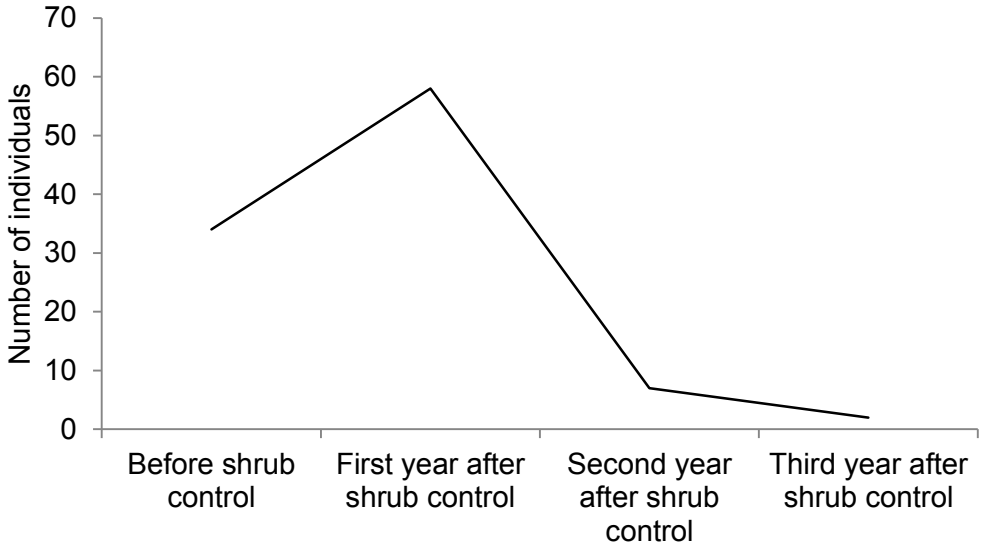
1


Slovakia
Hungary
Danube
Esztergom
Visegrád mountains
Pilis mountains
Budapest
Székesfehérvár
M0
M1
M2
M3
M5
M6
M7
Mátraderecske
Szajla
Dorogháza
Mátramindszent
Bátonyterenye
Bodony
Tar
Szuha
Sirok
Recsk
Parádsasvár
Mátraszentimre
Pásztó
Bárád
Tarnaszentmária
Verpelét
Gyöngyössolymos
Kisnána
Gyöngyösoroszi
Markaz
Domoszló
Gyöngyöstarján
Pálosvörösmart
Gyöngyöspata
Abasár
Gyöngyös
Visonta
Halmajugra
Gyöngyöshalász
Nagyrede
2 1 0 2 Kilometers

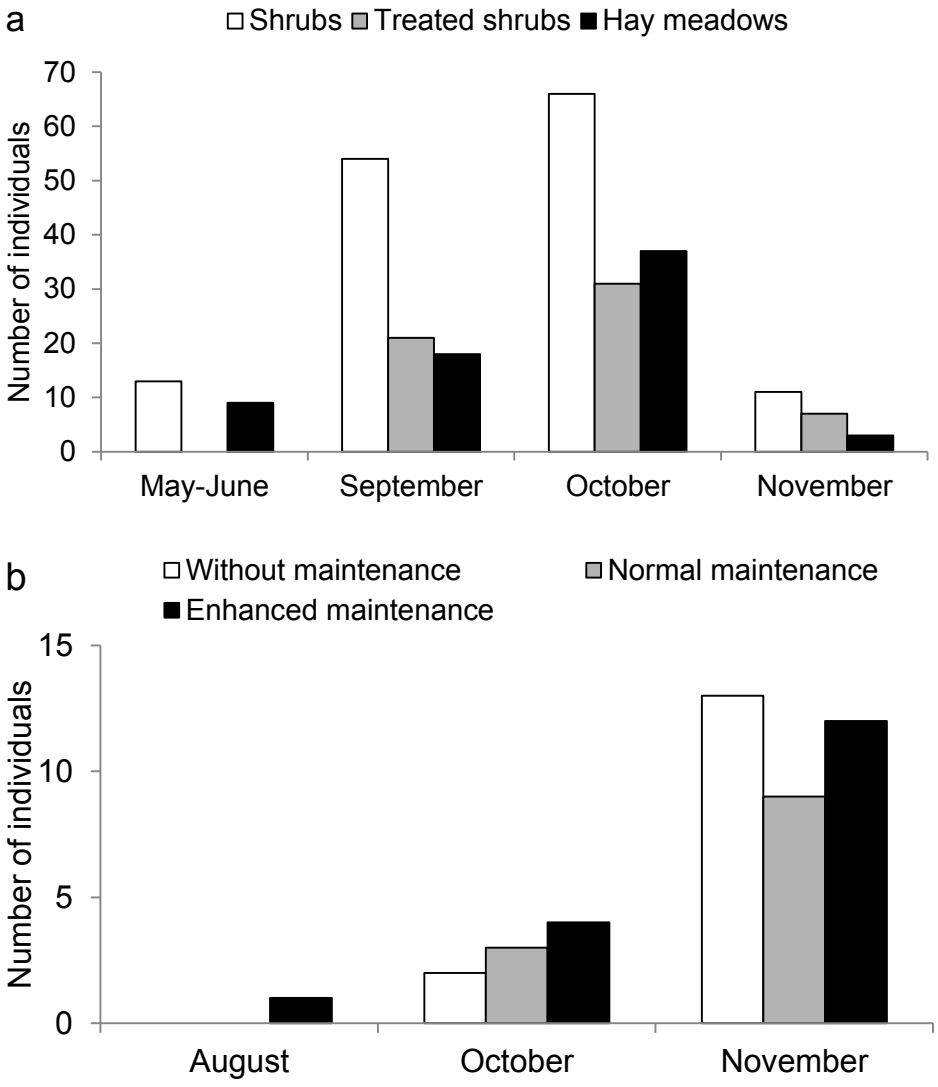
2


a
Number of individuals
250
200
150
100
50
0
Sár Hill
Gyöngyössolymos
Fallóskút
Parád
Southern Mátra
Higher region of Mátra
b
Number of individuals
30
25
20
15
10
5
0
Forest
Dry grassland
Agricultural habitat
Wet forest

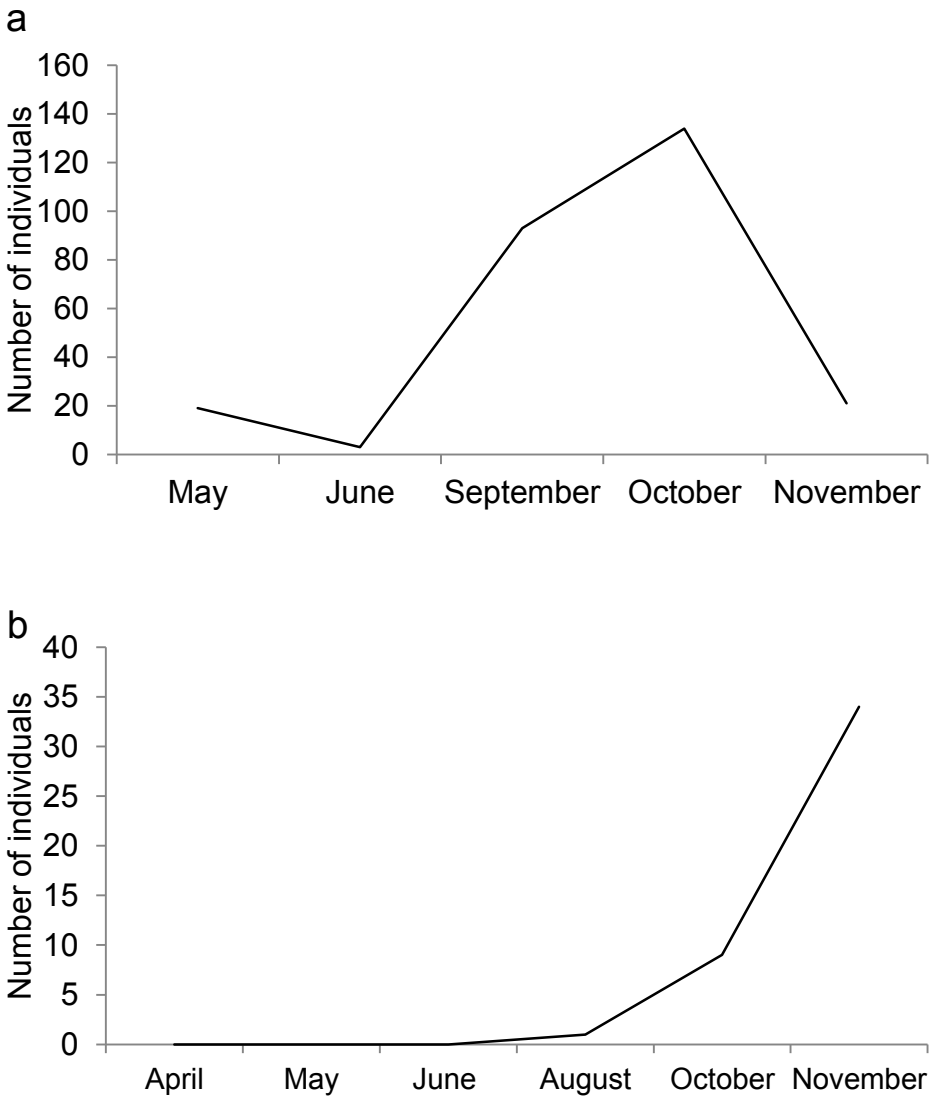
3


70
60
50
40
30
20
10
0
Number of individuals
Before shrub control
First year after shrub control
Second year after shrub control
Third year after shrub control

4


a
Shrubs
Treated shrubs
Hay meadows
Number of individuals
70
60
50
40
30
20
10
0
May-June
September
October
November
b
Without maintenance
Normal maintenance
Enhanced maintenance
Number of individuals
15
10
5
0
August
October
November

5


a
Number of individuals
160
140
120
100
80
60
40
20
0
May
June
September
October
November
b
Number of individuals
40
35
30
25
20
15
10
5
0
April
May
June
August
October
November