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Harvestmen (Arachnida, Opiliones) in disturbed forest ecosystems of the Low and High Tatras Mts

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Abstract

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The work presents a summary of harvestmen findings from area of the Low and High Tatras Mts. Total 17 harvestmen species were recorded in the 11 studied localities. This amount represents almost 51.5% of the total species diversity of harvestmen fauna in Slovakia. There were recorded thermophilous species such as *Dicranolasma scabrum* and *Egaenus convexus*, a typically mountainous species *Ischyropsalis manicata* and a Carpathian endemite *Paranemastoma kochi*. Discussed is use of the species spectrum of harvestmen in the Low and High Tatras Mts in biomonitoring of structural changes in forest ecosystems affected by the extensive wind disturbance in year 2004 causing damage to both mountain ranges.

Key words

faunistics, harvestmen, High Tatra Mts, Low Tatra Mts, Opiliones, Slovakia

Introduction

Opiliones in area of Central Slovakia have been studied to various extents in various geomorphological areas. Certain areas have been surveyed thoroughly; about others there exist only scarce, old dated information. Several records have not been published yet. It is a paradox that also the fairly large mountain range of the Low Tatras Mts belongs to areas in which research on harvestmen was considered only of marginal importance.

The literature concerning harvestmen of the Low Tatras Mts contains incomplete data from the past, recorded by several collectors and summarised by Kratochvíl (1934). The most recent partial data about harvestmen diversity in the Low Tatras Mts can be found in Mihál and Mašán (2006), Stašiov (1999, 2004), Stašiov and Snopková (2002) and Stašiov et al. (2003). The mentioned works, however, have summarized only 6 harvestmen species – a very low number in context of the large size of the Low Tatras Mts, a wide variety of habitats and opportunities for on-harvestmen-oriented research. On the other hand, there exist 129 spider species documented from this geographic area (Benová and Svatoň, 2009).

We are considering this number of documented spider species also as a insufficient, because from Slovakia on the present is documented more than 927 spider species (Gajdoš et al., 1999).

It is necessary to notice that research on Opiliones in the neighbouring geomorphological units was performed more thoroughly and brought more results. Opiliones in the High Tatras Mts were studied by Mihál et al. (2010a), in the Popradská kotlina basin by Mihál and Mašán (2006), in the Podtatranská kotlina basin by Kratochvíl (1934) and Stašiov (2004), in the Kozie chrbty Mts Astaloš et al. (2004) and Mihál et al. (2010b), in the Slovenský raj National Park by Košel (1984) and Stašiov (2004), on the Muránska planina mountain plateau by Mihál (2005), in the Veporské vrchy Mts by Stašiov (2004), in the Horehronské podolie river valley by Mihál and Gajdoš (2010), in the

Starohorské vrchy Mts by Mihál and Korenko (2010) and in the Veľká Fatra Mts by Astaloš (2002) and by Jarab and Kubovčík (2002).

This work summarises the hitherto reported harvestmen findings from the Low Tatras Mts, with the aim to enhance the number of harvestmen occurrence records in this area. The work represents also harvestmen diversity known from the High Tatras Mts. Discussed is possibility of using harvestmen in the High and Low Tatras Mts in biomonitoring of structural changes in forest ecosystems occurring in both mountain ranges after the serious wind and snow disaster in 2004.

Material and methods

Harvestmen (Opiliones) in various localities in the Low Tatras Mts were sampled at irregular intervals in field trips made during the growing seasons 2009 and 2010. Further data on harvestmen occurrence in this area were obtained from works published by several authors (Kratochvíl, 1934; Mihál and Mašán, 2006; Stašiov, 1999, 2004; Stašiov and Snopková, 2002; Stašiov et al., 2003).

Material was sampled by hand searching from soil surface, under stones, lying wood, stumps and ground vegetation and also by extraction (sieving) from leaf litter and by catching in soil pitfall formaline traps. The major part of the material collected in years 2009 and 2010 was identified by the authors of this work, following the identification keys assembled by Martens (1978) and Šilhavý (1956, 1971), as well as by comparing with material from the deposit of the first author. The majority of the sampled material has been conserved in 70% ethanol and stored in the collection of the first author of this paper in the IFE SAS Zvolen.

Description of localities

We studied harvestmen occurrence at 11 localities situated on northern and southern slopes of the Low Tatras Mts. The brief description of selected localities is following. Abbreviations used in the description are: L1–L11, locality; CA, cadastral area; DFS, quadrate code in the Databank of Fauna in Slovakia; ALT, altitude; EXP, exposition; H, type of habitat; sampling person: leg., ?: no record/record was not at disposal.

L1 – Iľanovská dolina Valley, CA: Iľanovo, DFS: 6983, ALT: 680, EXP: NE, H: forest spring area in Norway spruce-fir forest stand, leg. B. Astaloš, I. Mihál

L2 – Poludnica, CA: Iľanovo, DFS: 6983, ALT: 1,300–1,500, EXP: ?, H: Norway spruce forest stands, leg. P. Fenďa, A. Šestáková

L3 – Rohačka, CA: Iľanovo, DFS: 6983, ALT: 800–825, EXP: E, H: secondary grazing pastures, leg. A. Šestáková

L4 – Suchá dolina Valley, CA: Závažná Poruba, DFS: 6983, ALT: 700, EXP: N, H: forest spring area in Norway spruce forest stands, leg. B. Astaloš, A. Krajča, I. Mihál

L5 – Ždiarska dolina Valley, CA: Liptovská Teplička, DFS: 7086, ALT: 680–1,220, EXP: ?, H: mountain pastures and Norway spruce forest stands, leg. P. Fenďa, P. Gajdoš

L6 – Snežná jama Hole, CA: Liptovská Štiavnica, DFS: 7082, ALT: 1,359, EXP: ?, H: dysphotic zone 9 meters from entrance of the cave, leg. S. Stašiov

L7 – Ďumbier, CA: Liptovský Ján, DFS: 7083, ALT: ?, EXP: ?, H: ?, leg. S. Hrabě, V. Šilhavý

L8 – NNR Ďumbier, CA: Bystrá, DFS: 7083, ALT: 1750, EXP: E, H: alpine meadows, leg. P. Bitušík, P. Novikmec

L9 – Mýtňanská jaskyňa Cave, CA: Mýto pod Ďumbierom, DFS: 7184, ALT: ?, EXP: ?, H: cave and entrance of cave, leg. V. Franc

L10 – Pod Čertovicou, CA: Jarabá, DFS: 7084, ALT: 1200, EXP: ?, H: Norway spruce forest stands, leg. J. Kleinert, S. Stašiov

L11 – NNR Príboj, CA: Slovenská Ľupča, DFS: 7281, ALT: 350–490, EXP: SW, H: oak-hornbeam forest stands, leg. E. Snopková, S. Stašiov.

Results and discussion

Summarising the data obtained in our sampling as well as the data from literature, we can declare that in the Low Tatras Mts occur together 17 harvestmen species belonging to 5 families.

The list below gives the identified species. In the list, the following abbreviations are used: F, female; M, male; subad., subadult; juv., juvenile.

Palpatores Thorell, 1879

Nemastomatidae Simon, 1879

1. *Nemastoma lugubre* (Müller, 1776)
   Published data: **L11** – 1M, 3F, 19 October 1999, 2M, 3F, 5 May 2000, 2M, 2F, 5 June 2000, 2M, 2F, 5 July 2000 (Stašiov and Snopková, 2002)
   Unpublished data: **L5** – 1F, 22 May 2009, 1M, 1F, 19 June 2009, 1M, 25 July 2009, 2M, 2F, 23 August 2009, 4M, 3F, 23 October 2009
2. *Paranemastoma kochi* (Nowicki, 1870)
   Unpublished data: **L1** – 1M, 1F, 22 October 2010
3. *Mitostoma chrysomelas* (Hermann, 1804)
   Unpublished data: **L5** – 1M, 23 October 2009

Dicranolasmatidae Simon, 1879

4. *Dicranolasma scabrum* (Herbst, 1799)
   Published data: **L11** – 1F, 5 June 2000, 1M, 5 October 2000 (Stašiov and Snopková, 2002)

Trogulidae Sundevall, 1833

5. *Trogulus nepaeformis* (Scopoli, 1763)
   Published data: **L11** – 1M, 2F, 2 May 1999, 1F, 2

September 1999, 1F, 1 October 1999, 1M, 4F, 5 May 2000, 3F, 5 June 2000, 1M, 7F, 5 July 2000, 1M, 5 August 2000, 1M, 1F, 5 September 2000, 2F, 5 November 2000 (Stašiov and Snopková, 2002)
Unpublished data: **L5** – 1M, 1F, 22 May 2009, 1M, 25 July 2009, 1M, 1F, 23 August 2009, 2F, 2M, 1 subad., 25 September 2009, 23 October 2009, 1 subad., 21 June 2010

6. *Trogulus tricarinatus* (Linnaeus, 1767)
Unpublished data: **L5** – 1F, 19 June 2009, 1M, 25 July 2009, 1F, 25 September 2009, 4M, 2F, 23 October 2009, 1M, 21 June 2010

Ischyropsalididae Simon, 1879

7. *Ischyropsalis manicata* L. Koch, 1865
Published data: **L6** – 1F, 17 August 2002 (Stašiov et al., 2003), **L10** – 4M, 2F, from July to September 1987 (Stašiov, 1999)

Phalangiidae Simon, 1879

8. *Phalangium opilio* Linnaeus, 1761
Unpublished data: **L5** – 2M, 6F, 14 subad., 25 July 2009, 8M, 8F, 23 August 2009, 7M, 23F, 25 September 2009, 9M, 3F, 23 October 2009
9. *Platybunus bucephalus* (C. L. Koch, 1835)
Published data: **L7** – ?M, ?F, ? subad., ? juv., 1934 (Kratochvíl, 1934), **L11** – 2F, 5 May 2000 (Stašiov and Snopková, 2002)
Unpublished data: **L2** – 1M, 23 June 2010, **L4** – 1M, 23 June 2010, **L5** – 2 juv., 9 August 2003, 1 juv., 19 June 2009, 1M, 23 August 2009, 20 juv., 21 June 2010
10. *Rilaena triangularis* (Herbst, 1799)
Unpublished data: **L5** – 1F, 3 subad., 5 juv., 19 June 2009, 2M, 3F, 28 subad., 14 juv., 25 July 2009
11. *Lophopilio palpinalis* (Herbst, 1799)
Unpublished data: **L5** – 7 subad., 17 juv., 22 May 2009, 7M, 6F, 6 juv., 19 June 2009, 2F, 3 juv., 25 July 2009
12. *Egaenus convexus* (C. L. Koch, 1835)
Published data: **L11** – 1M, 1F, 2 May 1999, 4M, 5F, 5 June 2000 (Stašiov and Snopková, 2002)
13. *Oligolophus tridens* (C. L. Koch, 1836)
Unpublished data: **L4** – 1 subad., 23 June 2010, **L5** – 16 subad., 14 juv., 19 June 2009, 1M, 1F, 4 subad., 25 July 2009, 2M, 6F, 25 September 2009, 9M, 16F, 23 October 2009
14. *Lacinius ephippiatus* (C. L. Koch, 1835)
Unpublished data: **L3** – 1M, 22 June 2010, **L5** – 6 subad., 1 juv., 19 June 2009, 4M, 4F, 25 July 2009, 13M, 5F, 2 subad., 23 August 2009, 5M, 1F, 25 September 2009, 1M, 1 subad., 21 June 2010
15. *Mitopus morio* (Fabricius, 1799)
Published data: **L7** – ?M, ?F, ? subad., ? juv., 1934 (Kratochvíl, 1934), **L8** – ?M, ?F, ? subad., ? juv., 24 October 2001 (Stašiov, 2004)
Unpublished data: **L2** – 2 subad., 23 June 2010, **L5** – 1M, 2 subad., 25 July 2009, 13M, 6F, 23 August 2009
16. *Gyas titanus* Simon, 1879
Published data: **L9** – ?M, ?F, ? subad., ? juv., 30 January 1999 (Stašiov, 2004)
17. *Leiobunum* aff. *rupestre* (Herbst, 1799)
Published data: **L5** – 1 juv., 9 August 2003 (Mihál and Mašán, 2006)
Unpublished data: **L3** – 1 juv., 22 June 2010.

The mentioned 17 harvestmen species from the Low Tatras Mts represent 51.5% of the total diversity of harvestmen species hitherto identified in Slovakia (S = 33, according to Bezděčka, 2009; Stašiov, 2004). The highest species numbers were indentified in localities No. 5 (Ždiarska dolina Valley, Liptovská Teplička = 12 species) and No. 11 (NNR Príboj, Slovenská Ľupča = 5 species). The highest occurrence frequency has been documented by the species *Platybunus bucephalus* (identified in 5 localities) and *Mitopus morio* (identified in 4 localities).

From this species spectrum it is necessary to notice especially *Ischyropsalis manicata* and *Paranemastoma kochi* which are the typical mountainous species and their occurrence in the Low Tatras is expected and their distribution in this area is more extended. Moreover, *P. kochi* is considered as a Carpathian endemic species (Stašiov, 2004). On south-facing foothills of the Low Tatras Mts were also recorded two termophilous, originally Euromediterranean and Pontic species *Dicranolasma scabrum* and *Egaenus convexus*, occurring in the locality NNR Príboj in optimum conditions of an open oak-hornbeam forest stand situated on a SW-facing slope (Stašiov and Snopková, 2002). Occurrence of these species, having in the Carpathians the northernmost part of their distribution area is not a genuine surprise in the Low Tatras Mts, as their occurrence in Slovakia has been reported from even more northward situated localities such as the Malá Fatra Mts, the Ondavská vrchovina Mts and the Bukovské vrchy Mts (Stašiov, 2004).

In conditions of submountainous and mountainous forest and non-forest habitats of the Low Tatras Mts can be expected in the future occurrence of more harvestmen species such as *Siro carpaticus* Rafalski, 1956, *Opilio parietinus* (De Geer, 1778), *Platybunus pallidus* Šilhavý, 1938, *Zacheus crista* (Brullé, 1832), *Astrobunus laevipes* (Canestrini, 1872), *Leiobunum rotundum* (Latreille, 1798), *Nelima semproni* Szalay, 1951.

Tables 1 and 2 summarise the hitherto obtained knowledge of the species composition of harvestmen in the Low and High Tatras Mts. These are the two highest mountain ranges in Slovakia, manifesting many common features concerning their geology, geomorphology, climate, soil, structure of flora, fauna and structure of forest habitats. Remarkable similarity between these two mountain units is reflected also in their opiliofauna spectrum, consisting mostly of the same species. Three species listed in Table 2 as hitherto recorded only in the High Tatras Mts (*Opilio parietinus*, *Platybunus*

pallidus, *Leiobunum rotundum*) without doubt occur also in the Low Tatras Mts and are waiting for confirmation by the next research. On the other hand, the occurrence of thermophilous species *Dicranolasma scabrum* and *Egaenus convexus*, hitherto recorded in the Low Tatras Mts only (Table 1), on southern foothills of the High Tatras Mts is dubious, as these harvestmen species are thermophilous, preferring warmer habitats situated at lower altitudes. Occurrence of *E. convexus* in the submountainous zone of the High Tatras Mts has been reported by Šilhavý (1974), other authors, however, (Mihál et al., 2010a, Stašiov, 2004) speculate that the finding is dubious, requiring confirmation with another finding *in situ* in the future. Moreover, as a dubious finding from the past has been reported a non-verified record of occurrence of the species *Nelima aurantiaca* (Roewer, 1923) = *Amilenus aurantiacus* (Simon, 1881) in the locality Ďumbier in the Low Tatras Mts. To prove the occurrence of this species so long later would be an interesting fact, as the above-mentioned record was not considered as dubious even by Kratochvíl (1934) and Martens (1969). According to the latest opinions, *Nelima aurantiaca* was determined erroneously as *Gyas titanus*, as juvenile individuals of the both species exhibit similar identification features.

Extensive, even catastrophic wind disturbance in the Low and High Tatras Mts in 2004 affected especially complexes of submountainous and mountainous spruce forests. The harvestmen species spectres on the affected plots in these two mountain units are almost identical and seem as an appropriate invertebrate group meeting the needs of biomonitoring of structural changes in such disturbed forest ecosystems. As for the role of harvestmen of Tatras as a bioindicator invertebrate group, they can be sorted according their ecotrophic and ecotopic demands in three basis bioindicator groups specified in Tables 1 and 2: typical forest with closed canopy, ecotone or variously disturbed forest, and open habitat without connected forest cover. For these three habitat groups are listed dominant and accompanying harvestmen species typical for the given habitat, which means occurring at the highest abundance at all developmental phases or occurring in more than one habitat as accompanying species.

For mountain forests or submountain waterlogged spruce stands are typical: *Paranemastoma kochi*, *Mitostoma chrysomelas*, *Ischyropsalis manicata*, *Platybunus pallidus*, *Gyas titanus* and others. These species indicate undisturbed site conditions of climax mountain spruce stands in both Low and High Tatra Mts (Mihál et al., 2010a; Stašiov, 2004; Šilhavý, 1956).

On the other hand, the harvestmen group typical for forest communities also involves species diffusing frequently towards forest edges or clear cuts, for example:

Table 1. Harvestmen (Opiliones) of the Low Tatra Mountains and their preference for particular habitats

Species	Forest	Ecotone	Open habitat
Nemastoma lugubre (Müller, 1776)	●	●	
Paranemastoma kochi (Nowicki, 1870)	●		
Mitostoma chrysomelas (Hermann, 1804)	●	○	
Dicranolasma scabrum (Herbst, 1799)	●	○	
Ischyropsalis manicata L. Koch, 1865	●		
Trogulus tricarinatus (Linnaeus, 1767)	●	●	
Trogulus nepaeformis (Scopoli, 1763)	●	●	
Phalangium opilio Linnaeus, 1761		○	●
Platybunus bucephalus (C. L. Koch, 1835)	●	●	○
Rilaena triangularis (Herbst, 1799)	○	●	●
Lophopilio palpinalis (Herbst, 1799)	●	○	
Egaenus convexus (C. L. Koch, 1835)	○	●	●
Oligolophus tridens (C. L. Koch, 1836)	●	●	○
Lacinius ephippiatus (C. L. Koch, 1835)	●	○	○
Mitopus morio (Fabricius, 1799)	○	●	●
Gyas titanus Simon, 1879	●		
Leiobunum aff. *rupestre* (Herbst, 1799)		●	●

Forest – closed canopy forests, virgin forests, monocultures, forest spring stands.
Ecotone – forest edges, hedgerows, open canopy forests.
Open habitat – mountains meadows, clear cuts, burnt areas after fire, human settlements.
● a dominant species.
○ an incidental species.

Table 2. Harvestmen (Opiliones) of the High Tatra Mountains and their preference for particular habitats (according to Mihál et al., 2010a)

Species	Forest	Ecotone	Open habitat
Nemastoma lugubre (Müller, 1776)	●	●	
Paranemastoma kochi (Nowicki, 1870)	●		
Mitostoma chrysomelas (Hermann, 1804)	●	○	
Trogulus tricarinatus (Linnaeus, 1767)	●	●	
Trogulus nepaeformis (Scopoli, 1763)	●	●	
Ischyropsalis manicata L. Koch, 1865	●		
Phalangium opilio Linnaeus, 1761		○	●
Opilio parietinus (De Geer, 1778) *		○	●
Platybunus bucephalus (C. L. Koch, 1835)	●	●	○
Platybunus pallidus Šilhavý, 1938	●		
Rilaena triangularis (Herbst, 1799)	○	●	●
Lophopilio palpinalis (Herbst, 1799)	●	○	
Oligolophus tridens (C. L. Koch, 1836)	●	●	○
Lacinius ephippiatus (C. L. Koch, 1835)	●	○	○
Mitopus morio (Fabricius, 1799)	○	●	●
Gyas titanus Simon, 1879	●		
Leiobunum rotundum (Latreille, 1798)	○	●	●
Leiobunum aff. *rupestre* (Herbst, 1799)		●	●

Forest – closed canopy forests, virgin forests, monocultures, forest spring stands.
Ecotone – forest edges, hedgerows, open canopy forests.
Open habitat – mountains meadows, clear cuts, burnt areas after fire, human settlements.
● a dominant species.
○ an incidental species.
* a synanthropic species, frequent in ecotones and open habitats.

Nemastoma lugubre, *Trogulus nepaeformis*, *T. tricarinatus, Platybunus bucephalus*, *Oligolophus tridens*, *Mitopus morio*. According to observation by Mihál (1997), Mihál et al. (2010a) and Stašiov (2001) in submountain forest ecosystems, these harvestmen can occur even massively in different ecotonal assemblages and easily respond to abrupt changes to the forest environment (clear cuts, regeneration cuts). The harvestmen are fairly mobile Arachnida, and as such, they belong to the food opportunists with possible seasonal massive occurrence, thus representing a permanent component of soil zoo-edaphon in almost all ecotonal assemblages in which they can occur with typical forest species and the species associated with open habitats.

On the other hand, ecotonal assemblages may enter the species typical for sun-heated habitats, forest meadows, clear cuts, borders of agricultural land and even for human settlements: *Phalangium opilio*, *Opilio parietinus*, *Rilaena triangularis*, *Egaenus convexus*, *Mitopus morio*, *Leiobunum rotundum*, *L.* aff. *rupestre*. These and some other species indicate open, well illuminated and mostly warmer biotopes of all types (often also the human settlements), which has been confirmed also by Kromp and Steinberger (1992), Mihál (1997), Stašiov et al. (2010).

The knowledge of the bioindicator value of harvestmen as well as their species richness in the given habitat is, in case of abrupt structural changes, an efficient tool for fast recognition of sorting or concentration of the animals in certain groups. These groups next colonise only the parts of the habitat that meet their food and habitat demands. Today, this fact seems of interest for bio-monitoring of post-calamity changes in the forest and non-forest ecosystems in the Low and High Tatra Mts.

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Kosce (Arachnida, Opiliones) v kalamitných lesných ekosystémoch Nízkych a Vysokých Tatier

Súhrn

Práca podáva súhrn doposiaľ známych nálezov koscov z Nízkych Tatier, čím chce prispieť k obohateniu chudobných faunistických záznamov o výskyte koscov na tomto území. V práci sa zároveň prezentuje aj druhová diverzita koscov Vysokých Tatier, pričom sa diskutuje o možnostiach využitia koscov Nízkych a Vysokých Tatier pri biomonitoringu štrukturálnych zmien v lesných ekosystémoch, ktoré v obidvoch pohoriach nastali po vetrovej a snehovej kalamite z roku 2004. Po sumarizácii výsledkov našich zberov koscov, ako aj údajov z literatúry, možno konštatovať, že doposiaľ je z územia Nízkych Tatier známych celkovo 17 druhov koscov, patriacich do 5 čeľadí, čo tvorí 51,5 % z celkovej druhovej diverzity koscov doposiaľ determinovaných z územia Slovenska. Zistil sa výskyt typicky horského druhu *Ischyropsalis manicata* ako aj karpatského endemita *Paranemastoma kochi*. Na južných predhoriach Nízkych Tatier boli zaznamenané teplomilné euromediteránne a pontické druhy *Dicranolasma scabrum* a *Egaenus convexus*. V tabuľkách 1 a 2 uvádzame doposiaľ známe druhové zloženie koscov Nízkych a Vysokých Tatier, nakoľko ide o naše najvyššie pohoria, s množstvom spoločných znakov. Výraznú podobnosť obidvoch blízkych pohorí potvrdzuje aj zloženie ich opiliofauny, kde je prevažná väčšina spoločných druhov. V obidvoch pohoriach možno v budúcnosti očakávať výskyt ďalších druhov koscov, napr. druhy *Siro carpaticus*, *Opilio parietinus*, *Platybunus pallidus*, *Zacheus crista*, *Astrobunus laevipes*, *Leiobunum rotundum*, *Nelima semproni* a iné.

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