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Original papers

Spinturnix dasycnemi (Acari: Spinturnicidae) – a poorly known Palaearctic bat mite: first records in Poland and morphometric separation from two other species of the *myoti* group

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ABSTRACT. *Spinturnix dasycnemi* (Kolenati, 1856), an ectoparasite considered to be specific to rare and local bat species *Myotis dasycneme* (Boie, 1825), is reported for the first time in the fauna of Poland. Specimens were collected from *M. dasycneme* at two localities in the north and central parts of the country. In Europe, only two males of that poorly known mite species have been recorded recently from the Netherlands and Slovakia, while spinturnicids from pond bats were identified as *S. andegavina* and/or *S. myoti* in most of previous studies. The exact geographic distribution of *S. dasycnemi* is unknown, mainly due to the possibility of its common confusion with other mite species, but it may occur in all countries hosting populations of *M. dasycneme*. We show that specimens of both sexes of *S. dasycnemi* are morphometrically clearly separable from those of *S. myoti* and *S. andegavina*, even based on a combination of idiosoma length and dorsal shield length.

Key words: Mesostigmata, ectoparasites, Chiroptera, *Myotis dasycneme*, PCA

Introduction

Spinturnicid mites are ectoparasites of bats that occur mainly on wing membranes. In Europe, ca 13 species of the genus *Spinturnix* von Heyden, 1826 have been recorded [1–5]. However, there are still taxonomical problems to be solved e.g. specific status of *S. helvetiae* [6,7] or the possible presence of a cryptic species within *S. myoti* [7].

S. dasycnemi (Kolenati, 1856), redescribed by Estrada-Peña and Sanchez [8], is considered an ectoparasite specific to *Myotis dasycneme* (Boie, 1825) (Chiroptera: Vespertilionidae) and from that host species it was described in its type locality, now in the Czech Republic [9,10]. Dutch specimens from the Oudemans Collection [11] were reported as collected from *Myotis nattereri* (Kuhl, 1817) and *Plecotus auritus* (Linnaeus, 1758) [8], but the identification of bat hosts in these cases should be treated with caution.

S. dasycnemi is a member of the *myoti* species group, which is actually recognized as also containing: *S. myoti* (Kolenati, 1856), *S. andegavina* Deunff, 1977, *S. bechsteini* Deunff et al. 2004, *S. emarginata* (Kolenati, 1856), and *S. mystacina* (Kolenati, 1857) [5]. Besides the measurements of the two sexes of *S. dasycnemi,* females can be distinguished by the shape of sternal shield, which is very narrow anteriorly and by the lower number of opisthosomal and opisthogastric setae; males are characterized by the strong, conical scale-like pattern of the dorsal surface [8]. Before Estrada-Peña and Sanchez's redescription of *S. dasycnemi*, no obvious diagnostic features were known, so the few authors that mentioned the species either considered a possibility that it is a junior synonym of *S. myoti*

[12] or that its validity needed further investigation [13,14].

Here, we report the first records of *S. dasycnemi* in Poland and review the state of knowledge of this rarely recorded European species. We also applied multivariate morphometrics, which seems to be a useful tool in separation of morphologically similar bat mite species [5,15], to test whether individuals of *S. dasycnemi* are separable from those of *S. myoti* and *S. andegavina* (both species reported from *M. dasycneme*) based on selected idiosomal measurements.

Materials and Methods

In total, we collected eight mites (1♂, 7 ♀♀) from seven individuals of *M. dasycneme* netted in the north and central parts of Poland. The mites were preserved in 70% ethanol and mounted on permanent slides in Swan's fluid [16]. The mite material is deposited in the collections of the Institute of Zoology of Slovak Academy of Sciences, Bratislava, Slovakia.

We obtained, using a measurement scale in an Amplival binocular microscope (Carl Zeiss, Jena, Germany), the following measurements (all in µm): idiosoma length (from the tip of hypostome to the caudal margin) and width (at the peritremes level), dorsal shield length and maximum width, sternal shield length and maximum width. To assess the variation of the measured elements we calculated the mean, SD and ranges. Measurements of one *S. dasycnemi* female were not included as the specimen was damaged in processing. For comparison, we obtained the same measurements of *S. myoti* (35 specimens) collected in Albania on four bat species (*M. nattereri* 16, *M. oxygnathus* 4, *M. myotis* 13 and *M. capaccinii* 2) [15], and *S. andegavina* (8 specimens) collected in Poland on *M. daubentonii* (author's data). For *S. dasycnemi*, we also recorded the number of dorsal opisthosomal and ventral setae for the females and the form of the integument surrounding the dorsal shield in the male. We used Principal Component Analysis (PCA) to test if individuals of *S. dasycnemi* are separable from those of *S. myoti* and *S. andegavina* based on reduced number of measurements. For analyses we used PAST ver. 2.17 [17].

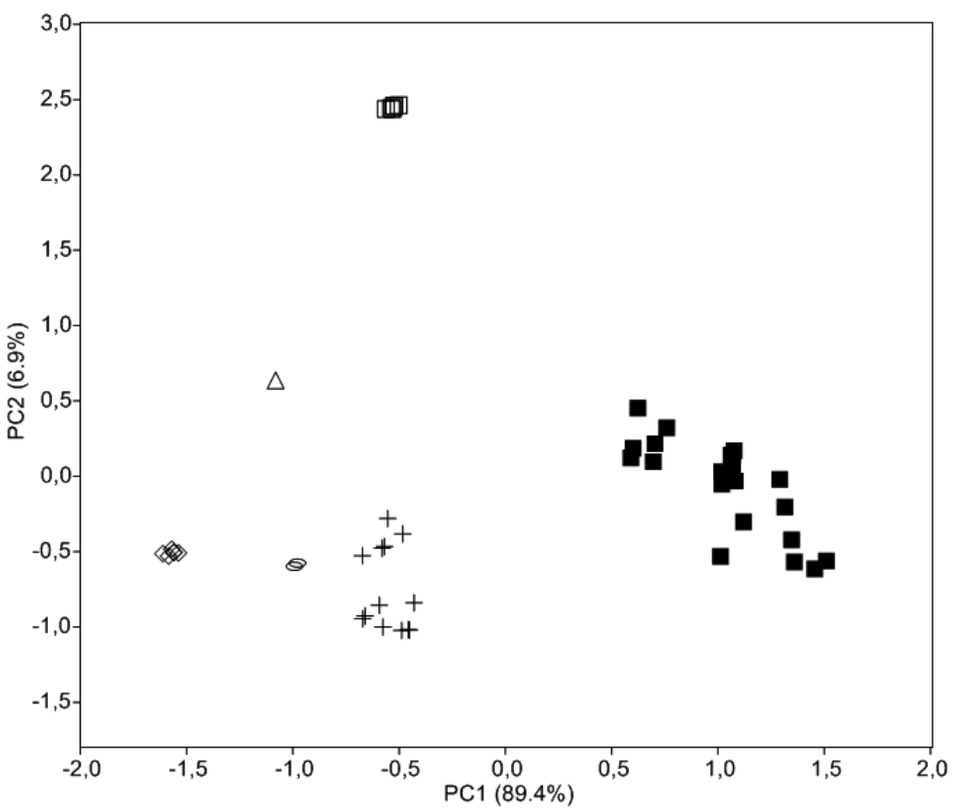

Fig. 1. Scatter plot of PC1 and PC2
Explanations: □ *S. dasycnem*i females, Δ a male; ■ *S. myoti* females, + males; ellipses *S. andegavina* females, ◊ males.

Table 1. Measurements (µm) of *S. dasycnemi* and *S. andegavina* (from Poland) and *S. myoti* (from Albania)

Species/sex	n	idiosoma length		idiosoma width		dorsal shield length		dorsal shield width		sternal shield length		sternal shield width	
		mean ± SD	min-max	mean ± SD	min-max	mean ± SD	min-max	mean ± SD	min-max	mean ± SD	min-max	mean ± SD	min-max
S. dasycnemi													
Females	6	1044.0 ± 4.9	1036-1051	841.2 ± 4.3	83-847	953.2 ± 1.8	951-956	732.8 ± 3.0	728-737	208.2 ± 1.0	207-210	170.5 ± 1.0	169-172
Male	1	–	934	–	733	–	816		667		371		259
S. myoti													
Females	22	1471.1 ± 96.4	1320-1644	1246.3 ± 44.2	1180-1311	890.9 ± 16.8	851-910	643.5 ± 11.3	621-658	245.4 ± 24.4	220-337	226.9 ± 7.0	216-239
Males	13	1090.2 ± 31.1	1037-1132	871.1 ± 12.1	856-890	775.1 ± 17.9	750-803	558.0 ± 25.6	536-602	365.2 ± 4.4	356-370	273.2 ± 3.7	268-279
S. andegavina													
Females	2	–	935-938	–	840-843	–	645-649	–	501-502	–	170	–	143-144
Males	6	818.3 ± 4.6	811-825	663.3 ± 8.0	651-672	640.3 ± 1.8	638-643	548.0 ± 4.2	542-553	289.0 ± 2.1	287-293	200.7 ± 2.7	197-205

Table 2. PCA results (coefficients) for *S. dasycnemi*, *S. myoti* and *S. andegavina* (both sexes combined, n=50) using six variables

Variables	PC1	PC2	PC3	PC4	PC5	PC6
idiosoma length	0.7263	–0.1763	0.1514	–0.6157	–0.1777	0.0886
idiosoma width	0.6461	–0.1233	–0.2634	0.6305	0.2844	–0.1402
dorsal shield length	0.208	0.6608	0.421	0.2795	–0.4912	–0.153
dorsal shield width	0.0872	0.5717	0.1457	–0.2165	0.7522	0.1778
sternal shield length	–0.0631	–0.3711	0.7252	0.0565	0.2832	–0.4989
sternal shield width	0.0134	–0.2292	0.4281	0.3087	–0.0147	0.8176
% of variance explained	89.44	6.89	3.03	0.43	0.17	0.04

Results

Material examined. 1♀ collected from wing membranes of 1♂ *M. dasycneme*, Poland, Silesia Prov., Cracow-Wieluń Upland, Szachownica I cave (51°03’12”N, 18°48’28”E, 215 m a.s.l.), 21.08.2011, leg. K. Piksa, det. J. Krištofík; 6♀♀, 1♂ collected from wing membranes of 6♀♀ *M. dasycneme*, Poland, Pomerania Prov., Lubnia forester’s lodge (53°56’10.86”N, 17°48’18.75”E, 149 m a.s.l.), 28.04.2012, leg. A. Zapart, det. J. Krištofík.

Of the 17♀♀ of *M. dasycneme* captured, specimens of *S. dasycnemi* were found only on 6

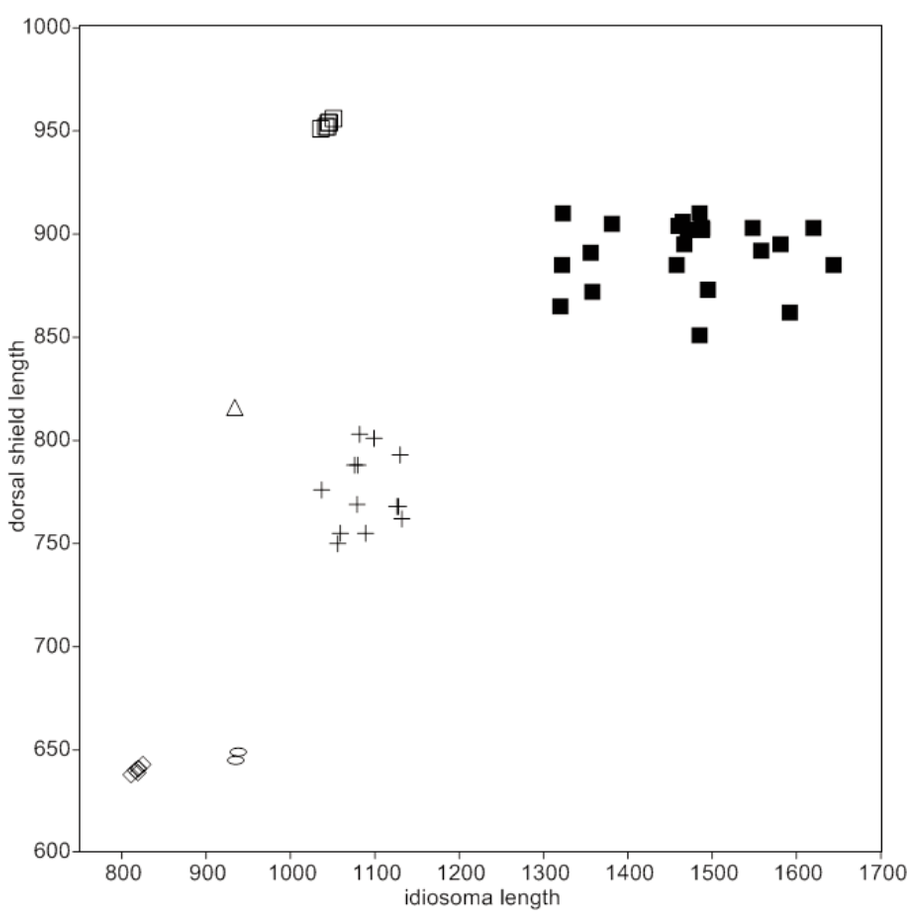

Fig. 2. Scatter plot of idiosoma length against dorsal shield length. Symbol explanations as in Fig. 1.

Table 3. Comparison of measurements (µm) and non-metric features of *S. dasycnemi* with *S. andegavina* and *S. myoti*, compiled from literature sources (review in Pocora et al. 2013 and Estrada-Peña and Sanchez 1989) and our study

Species	Sex	Idiosoma length	Idiosoma width	Dorsal shield length	Dorsal shield width	Sternal shield length	Sternal shield width	Number of dorsal setae	Number of ventral setae	Dorsal pattern
S. dasycnemi	Females	1025-1075	821-855	945-960	721-745	205-215	165-174	62-67	50-54	scale-like
	Males	930-940	730-739	812-820	661-674	370-374	257-261	28-30	20-22	strong and conical
S. myoti	Females	1100-1829	829-1458	800-1107	512-1023	189-337	186-256	71-136	57-105	denticulate scales
	Males	829-1162	636-952	643-821	450-607	351-468	243-399	32-55	17-28	smooth, conical scales
S. andegavina	Females	907-1559	714-1178	600-843	490-643	160-270	130-224	70-110	65-85	denticulate scales
	Males	729-1095	586-869	571-660	429-560	280-468	195-292	16-44	20-30	smooth, conical scales

bats (1 mite on 5♀♀ and 2 mites on 1♀).

In the male of *S. dasycnemi* dorsal integument was with strong, conical scale-like pattern, whereas in females, number of dorsal opisthosomal setae was 63–65, number of ventral setae pairs was 50–53 (J. Krištofik, pers. comm.). Measurements of *S. dasycnemi*, *S. myoti* and *S. andegavina* are given in Table 1.

In PCA, on both sexes combined and using six idiosomal measurements as variables, the first two components cumulative explained 96.3% of variance in measurements.

Idiosoma length and dorsal shield length had the highest loadings in PC1 and PC2, respectively (Table 2). The scatter plot of PC1 and PC2 separated six distinct groups of specimens (Fig. 1), corresponding to their earlier identification to species and sex with no overlaps between groups. The simple scatter plot of idiosoma length against dorsal shield length separated all specimen groups (Fig. 2) analogously as in PCA.

Discussion

Although the range of *M. dasycneme*, covering mainly central and eastern Europe, is well known [18], the distribution of *S. dasycnemi* remains poorly studied. Except old records from its type locality [9], a male from unknown locality and host in Vienna Museum of Natural History [14], and the Netherlands (Maastricht, Utrecht) [8,11] only two males of this mite were recently collected on *M. dasycneme* from Heikant (the Netherlands) and Nitra (Slovakia) [6,19].

Spinturnicids collected from *M. dasycneme* in Hungary [12], Latvia [20] and Russia [21–23] – countries supporting the largest European populations of the pond bat [24] – were determined as *S. myoti*, while those from Germany were reported as *S. andegavina* [25] or as *S. myoti* [23]. The mites collected in 2009–2011 on pond bats from breeding colony in Lubnia (n=12), our locality of *S. dasycnemi* from the present paper, as well as those from the nearby locality in Płęsno (n=32), were identified as *S. myoti* [23]. In these latter cases, the species determination should be treated with caution as the authors seemed unaware of the specific status of *S. dasycnemi*, what is supported by mistakenly quoted Estrada-Peña and Sanchez [8] as: "According to Stanyukovich [26] and Estrada-Peña and Sanchez [8], *Spinturnix dasycnemi* (Kolenati, 1859) and *Spinturnix daubentoni* (Kolenati, 1857) are not regarded as separate species, and require more research for confirm independence of both these species". Orlova and Zapart [23] quoted, among others, identification keys by Stanyukovich [26], which do not include either these two mentioned species or comments on their taxonomy. This last author listed *S. acuminata*, *S. myoti* and *S. mystacina* as parasites of *M. dasycneme*. The name *S. andegavina* was introduced by Deunff [1] and is treated as a synonym of *S. daubentoni* (Kolenati, 1857).

Since *S. dasycnemi* appears to be overlooked or not recognized by most of researchers of bat mites, even after its redescription, it is quite likely that the regularly reported occurrence of *S. myoti* and *S. andegavina* on *M. dasycneme* in central and eastern Europe is a result of species misidentification. Except Dusbábek [14], only Beron [12] appeared to be aware of the specific status of *S. dasycnemi*, but he excluded its occurrence among spinturnicids (2♂♂ from Abaliget cave and Töserdö, Hungary) collected from *M. dasycneme*, based on the only diagnostic features he relied on, i.e. the number of setae on the hysterosoma and between sternal and anal shields. Spinturnicids (n=6) reported previously from the pond bat in Poland, most likely representatives of *S. dasycnemi*, were doubtfully assigned to *S. daubentoni* (=*S. andegavina*), since no characters allowing for other determination of those specimens could be established by the author and their "body length and width" placed some of them between *S. andegavina* and *S. myoti* [27].

Dusbábek [14] noticed that *S. dasycnemi* resembles much *S. myoti*, but is smaller and differ in patterns of dorsal and ventral chaetotaxy. These conclusions were based on a single male from unknown host (treated as *S. dasycnemi* solely due to original labelling of the Viennese specimen). More comprehensive review of body measurements of *S. andegavina* and *S. myoti* (only minimum and maximum values) from various literature sources across Europe was provided by Pocora et al. [28]. Our measurements for that two species fit well into much broader ranges given in the latter paper (except sternal shield length in female *S. myoti*, with our maximum much higher – 337 vs. 262 μm). Ranges of most measurements of *S. dasycnemi* overlap with either *S. myoti* or *S. andegavina* (Table 3), thus separation of that intermediate taxon appeared to be possible either based on our approach (i.e., combination of more measurements or multivariate statistics), unavailable in earlier

literature or supported by non-metric features. Although the sample size was limited, we show that all individuals included in the present study of three species (which could be confused in most of previous studies), are clearly separable morphometrically, even using a combination of two measurements – idiosoma length and dorsal shield length. Measurements of *S. myoti* and *S. andegavina* from some earlier literature must be treated with caution, especially if a particular author denies a status of *S. dasycnemi* as a separate species or some measured specimens, identified as either of the first two species, are collected from *M. dasycneme* [27]. Such misidentification can be a reason for extremely wide, overlapping ranges of measurements given for *S. myotis*, *S. andegavina* and *S. dasycnemi.*

S. dasycnemi is newly recorded species in the fauna of Polish spinturnicids, of which 12 species have been reported so far [29–32, this work]. Its presence may be expected in all parts of Poland as *M. dasycneme*, thought rare and local, is distributed across the country [33]. *S. dasycnemi* probably occurs in all countries hosting populations of *M. dasycneme*, particularly Denmark, Germany, Hungary, Baltic States and Russia [24], but verification of that hypothesis requires either re-evaluation of existing collections or sampling in the known nursery colonies and swarming sites of the pond bat.

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