

Prevailing trophic relations between spiders (Araneae) and ants (Formicoidea) in Slovakia

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This paper summarises the knowledge of prevailing trophic relations between spiders (Araneae) and ants (Formicoidea) in Slovakia. Mutual relations between spiders and ants are mostly indifferent, but several species appear to be an exception. Three types of ecological relations between spiders and ants can be distinguished: 1. Spiders feeding on ants more-or-less regularly, involving several species from the families Theridiidae and Zodariidae. 2. Myrmecophilous spiders, living almost always nearby or in the ant colonies; in Slovakia represented by five species: *Acartauchenius scurrilis*, *Evansia merens*, *Syedra myrmicarum*, *Thyreosthenius biovatus* and *Mastigusa arietina*. 3. Ant-mimetic spiders, involving several elongate-bodied jumping spiders (*Myrmarachne formicaria*, *Leptorchestes berolinensis* and *Synageles* spp.). The mentioned spiders mostly rank among rare species, deserving attention of arachnologists and conservationists.

Keywords: Spiders, ants, myrmecophiles, trophic relations, Slovakia.

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Introduction

Although spiders and ants are not closely related invertebrate groups (belonging to different subphyla of arthropods), they occur together very often in the majority of terrestrial ecosystems. Relations between spiders and ants are mostly indifferent – both groups are predaceous: ants prevailing so and spiders exclusively. Nevertheless, several spiders have more-or-less close ecological relations to ants. This topic is only sporadically discussed in literature, despite the fact that such spiders often rank among rare and remarkable invertebrate species. The recent knowledge of relations between myrmecophilous spiders and ants was summarised by the present author (Franc, 2003). Information on the wider range of relations between spiders and ants is very sporadic; the paper published by Cushing (1997) being an exception. Therefore the present paper calls attention to ecological relations between these two prevailing soil-dwelling arthropod groups.

Methods

The research of spiders and myrmecophilous beetles has been carried out during the last ten years in suitable habitats, especially in Central Slovakia. I applied current methods of collecting, especially sifting of detritic ant colonies of the genus *Formica*, hand

collecting under stones and on the vegetation. The spiders were collected more-or-less accidentally in well-preserved habitats mostly, especially in spring and summer (in the case of mountain habitats); apparently myrmecophilous spiders were collected directly in the ant colonies. The material was identified according to Miller (1971) and Heimer and Nentwig (1991); ants were identified according to Samšínák (1957). The following chapter includes discussion about ecological relations between spiders and ants, including accessible recent records of several most remarkable spider species in Central Slovakia especially.

Their conservation status (ecosozological status - "ESS") is also discussed. The data from the Red Lists of Slovenia (Polenec, 1992), Slovakia (Gajdoš and Svatoň, 2001), Czech Republic (Buchar and Růžička, 2002), Germany (Platen et al., 1996), Bavaria (Blick and Scheidler, 2003), Belgium (Maelfait et al., 1998), Finland (Rassi et al., 1992), Great Britain (Merrett, 1991), Sweden [Gärdenfors (ed.), 2000] and Finland [Rassi (ed.), 1992] will be compared. For other countries the Red Lists of spiders or data concerning the species of interest are not available. A review of the ESS of the mentioned species is summarised in Table 1.

Results and discussion

We can distinguish the following three main groups of spiders having relations to ants.

1. Spiders feeding on ants more-or-less regularly

Ants are mostly not attractive prey for spiders due to the formic acid. Nevertheless, several spiders feed on ants often or even prevalingly. This concerns especially several species from the families Theridiidae and Zodariidae (Baum and Buchar, 1973; Miller, 1971; Jones, 1983). The spiders are living on the soil surface, lower vegetation and shrubs especially in xerothermic habitats. Ant-predation is usually mentioned for the following spider species:

Family: Theridiidae

Achearanea riparia (Blackwall, 1834) – occurs quite abundantly in low vegetation and along paths and walls in meadows, gardens, parks, open forests, quarries etc.

Species of the genus *Dipoena* Thorell, 1869 are difficult to identify (especially females) and mostly scarce or even very rare; I have recorded only two of them in Central Slovakia:

Dipoena inornata (O. P.-Cambridge, 1861) – the town of Banská Bystrica: Jakub (7280b/d^{*}), xerothermic limestone grassland April 9, 2004, 1 ♂, V. Franc lgt. A little-known and very rare species, known from five old records from Eastern Slovakia – the end of the 19th century, Chyzer and Kulczyński lgt. (Gajdoš et al., 1999). Another recent record is available from the Zvolenská kotlina basin (Gajdoš and Krištín, 1997).

Dipoena prona (Menge, 1868) – the Cerová vrchovina Mts.: the Dunivá hora Mt. (7885a), scree slope May 16, 2001, 1 ♂; the Muránska planina Mts.: the Šarkanica Nature Reserve (“NR”) (7286c), xerothermic limestone slope May 4, 2002, 2 ♂, 1 ♀; the Strážovské vrchy Mts.: the Hradištnica valley (7276c), xerothermic rocky grassland, June 19, 2002, 1 ♂; all records V. Franc lgt.

A scattered species of warm, rocky habitats, in the Czech Republic considered to be very rare (Buchar and Růžička, 2002). Several old and also recent records from Slovakia are available (Gajdoš et al., 1999).

Species of the genus *Euryopis* Menge, 1868 mostly rank among the rarest spiders of xerothermic habitats. Only one of them has been recorded by the present author:

Euryopis quinqueguttata Thorell, 1875 – the village of Nedelište (7682a/b), xerothermic andesite slope June 28, 2000, 1 ♀.

A very rare species, occurring sporadically in warm habitats of Central and Southern Europe. Only few records from Slovakia are available: the Devínska Kobyla NR (Gajdoš, 1981), surroundings of the Beckov village (Gajdoš, 1986), the Kováčovské kopce NR (Gajdoš, 1998), and surroundings of the town of

Humenné (Thomka, 1996). Further unpublished and undated records were also cited from the Turčianska kotlina basin, R. Prídavka lgt.; the Borská nížina and Podunajská rovina lowlands, P. Gajdoš lgt. (Gajdoš et al., 1999).

Family: Zodariidae

Zodarium germanicum (C. L. Koch, 1837) – a species of scattered distribution, occurring quite abundantly in warmer open forests, heathlands, meadows, etc.

Zodarium rubidum Simon, 1914 – the town of Banská Bystrica: Graniar (7280d), xerothermic grassland above the hospital, June 30, 2004, 1 ♀ V. Franc lgt. The first record of this little-known species was published from a mining dump (!) near the town of Nováky (7277c), April 1, 1989 – October 31, 1992, 21 ♂, 5 ♀ and 9 juveniles (Pekár, 1994). The second record comes also from strongly disturbed environment: nickel leach dump near the town of Sered' (7772a), (Krajča, 1996). Moreover, two undated records from the Malé Karpaty Mts. and the Považské podolie valley are mentioned by Gajdoš et al. (1999). This obviously thermophilous species may live in a wide range of habitats, including strongly disturbed and relatively well-preserved ones. Its distribution in Slovakia and ecology remain unknown.

2. Myrmecophilous spiders

Myrmecophily is a very interesting ecological adaptation of arthropods. The vast majority of myrmecophiles belongs to insects, especially to the order of beetles, and a high number of papers dealing with this topic is known (Franc, 1992). Surprisingly, very little is known about the occurrence of spiders in ant-colonies. Nevertheless, five apparently myrmecophilous spider species occur in Slovakia.

Family: Linyphiidae

Acartauchenius scurrilis (O. P.-Cambridge, 1872) – occurs sporadically, but sometimes not rarely in xerothermic grasslands. **Host ants:** *Lasius niger*, *L. flavus*, *Formica rufa* and *Tetramorium caespitum* (Buchar and Růžička, 2002; Cushing, 1997). Obenberger (1949) and Miller (1971) mentioned only *T. caespitum*. Apparently it highly prefers this ant species.

A relatively large number of records from Slovakia is available. Recent finds were always made in colonies of *T. caespitum* under stones: the Boky NR (7480a), February 1, 1992, 1 ♂ V. Franc and A. Hanzelová lgt. and May 2, 2002, 1 ♂ V. Franc lgt.; the Bystrická vrchovina Mts. – the Stará kopa Mt. (7281c), April 24, 2000, 1 ♂ and June 14, 2002, 1 ♂; the village of Dolné Vestenice (7276c) April 28, 2002, 1 ♂, 1 ♀ V. Franc lgt. Several individuals were found in the Cerová vrchovina Mts. (430), spring 1995 (Franc and Hanzelová, 1995) and more than 10 individuals in the Krupinská planina Mts. (350), spring 1992, 1993 and later (Franc, 1999); the Borová village (7467d), sand

* the grid mapping code of the Databank of the Slovakian Fauna, the letter indicates 1st, 2nd, 3rd or 4th quadrant of the mapping square. Three-digit codes are the codes of orographic units.

Table 1. Ecosozological status of mentioned species. Countries: Sl – Slovenia, Sk – Slovakia, Cz – Czech Republic, G – Germany, G: B – Bavaria, B – Belgium, GB – Great Britain, Sw – Sweden, F – Finland; Categories of ESS: EN – endangered, VU – vulnerable, R – rare, D – decreasing, DD – data deficiency, LR – lower risk (least concern); * a different system of ESS categories is used in Germany (including Bavaria, of course): Sg – ‘stark gefährdet’ (meaning EN according to IUCN criteria), ‘G – ‘gefährdet’ (≅ VU according to IUCN), U – ‘Arten, deren Gefährdungsstatus unsicher ist’ (species with uncertain ESS), ■ unspecified species.

Species	Countries:	Ecosozological status (ESS)								
		Sl	Sk	Cz	G*	G: B*	B	GB	Sw	F
<i>Achearanea riparia</i>		-	-	-	■	-	VU	-	-	-
<i>Dipoena inornata</i>		-	EN	DD	Sg	Sg	CR	-	-	-
<i>Dipoena prona</i>		-	VU	EN	Sg	-	EN	-	-	-
<i>Euryopsis quinqueguttata</i>		-	VU	EN	G	G	-	-	-	-
<i>Acartauchenius scurrilis</i>		-	LR lc	VU	G	G	EN	-	-	D
<i>Evansia merens</i>		-	VU	DD	■	U	-	-	-	-
<i>Syedra myrmicarum</i>		-	VU	EN	U	Sg	-	-	-	-
<i>Thyreosthenius biovatus</i>		-	VU	DD	U	G	CR	-	-	-
<i>Mastigusa arietina</i>		-	VU	VU	■	U	EN	VU	-	-
<i>Zodarion germanicum</i>		VU	-	-	G	G	-	-	-	-
<i>Zodarion rubidum</i>		-	-	-	■	-	R	-	-	-
<i>Leptorchestes berolinensis</i>		-	-	VU	U	G	-	-	-	-
<i>Myrmarachne formicaria</i>		-	-	VU	■	G	-	-	-	-
<i>Synageles hilarulus</i>		-	VU	EN	G	Sg	R	-	DD	-

dunes, June 26, 1995, 1 ♀ (Gajdoš and Majzlan, 2001); the Ruský Potok – Kamenistý village (6900c), rocky meadow, September 22, 1999, 1 ♂, 1 ♀ (Svatoň et al., 2003).

Evansia merens O. P.-Cambridge, 1900 – this scattered and rare species occurs particularly in mountain habitats. **Host ants:** *Manica rubida*, *Formica fusca* and *F. sanguinea* (Miller, 1971; Buchar and Růžička, 2002). Obenberger (1949) mentions only *F. fusca*. Actually, it apparently prefers *Formica lemami*, which had been formerly considered a subspecies of *F. fusca*. The ant *F. fusca* lives in warmer habitats of lower altitudes, while *F. lemami* is a frequent montane and even sub-alpine species (Bondroit, 1917).

Only several records from Slovakia are available: the Veľká Fatra Mts. – the Kozia skala Mt. (7079b), under a stone near the colony of *F. lemami* July 12, 2001, 1 ♀ V. Franc lgt., P. Gajdoš det.; the Kremnické vrchy Mts. – the Skalka Mt. (7280c), in the colony of *F. lemami*, May 17, 2002, 2 ♀; the Muránska planina Mts.: the Veľká Stožka NR (7285b), in the colony of *F. lemami* near the edge of cliffs, August 4, 2003, 1 ♀ – every findings V. Franc lgt.; the Poľana Mts.: Žiarec (7382a) in the colony of *F. lemami* under a rotten log, July 24, 2005, 1 ♂, 1 ♀ V. Franc and M. Mardiaková lgt.; the Starohorské vrchy Mts.: Panský diel (7280b) near a rotten log below the peak, September 3, 2005, 1 ♀ V. Franc and S. Korenko lgt.; the Malá Fatra Mts. – the Rozsutec NR (7680d) (Svatoň and Miller, 1979), and the Suchý NR (6879b) (Svatoň, 1985a), the High Tatras Mts. – the Kriváň NR (6886a) (Svatoň, 1983). Unpublished record from the Poľana Mts. (320), R. Pridavka and J. Svatoň lgt.

(Gajdoš et al., 1999) and old records from the Oravská Magura Mts. (580) and the surroundings of the town of Žilina (6778) (Kratochvíl and Miller, 1937) are also available.

Syedra myrmicarum (Kulczyński, 1882) – occurs sporadically and rarely in grasslands and open forests at higher altitudes especially. **Host ants:** *Formica fusca*, *Manica rubida* (Miller, 1971; Buchar and Růžička, 2002). Obenberger (1949) mentioned only *F. fusca*.

Only few records from Slovakia are available: the Cerová vrchovina Mts. – the Pohanský hrad NR (7785d), in the litter near a colony of *F. fusca*, September 26, 1995, 1 ♀ (Franc and Hanzelová, 1995); the Malá Fatra Mts. – the Suchý NR (6879b), together with *M. rubida* (Kratochvíl and Miller, 1937). Gajdoš et al. (1999) give further undated records from the Žilinská kotlina basin (220) P. Gajdoš lgt., the Krupinská planina Mts. (350) J. Vachold lgt. and the Oravské Beskydy Mts. (550), several authors.

Thyreosthenius biovatus (O. P.-Cambridge, 1875) – occurs sporadically and very rarely in open forests of warmer habitats. **Host ants:** *Formica polyctena*, *F. pratensis*, *F. fusca* and *F. sanguinea* (Buchar and Růžička, 2002; Cushing 1997). Miller (1971) mentioned the same ant species except *F. polyctena*, while Obenberger (1949) gave only *F. pratensis* and *F. rufa*.

Only a few records from Slovakia are available: the town of Banská Bystrica – Radvaň (7280d), in a colony of *F. rufa* near the Manor house, March 27, 1994, 1 ♀ V. Franc and A. Hanzelová lgt.; the Hronská pahorkatina hills (804), Dudich et al. 1940 (in Gajdoš et al., 1999); Malanta near the town of Nitra (7674d)

(Gajdoš, 1993) and the Žilinská kotlina basin (220) (Kratochvíl and Miller, 1937).

Family: Dictynidae

Mastigusa arietina (Thorell, 1871) – this scattered species occurs rarely in warm habitats, especially open forests and on xerothermic slopes. **Host ants** are not specified in the literature, it obviously may live together with a large range of ant species.

The following records from Slovakia are available: the Rohy NR near the town of Detva (7482a/c), in a under-stone colony of *Lasius niger*, March 3, 1991, 1 ♂; the village of Plášťovce (7879b), in the colony of *Messor muticus* on a xerothermic slope, April 1, 1994, 2 ♀ [together with the very rare leiodid-beetle *Attaephilus arenarius* (Hampe, 1852)!]; the Rykyně village (7779d), in the same circumstances, April 9, 1994, 2 ♂, 1 ♀, all records V. Franc and A. Hanzelová lgt.; the village of Nedelište (7682a/b), in a colony of *Lasius alienus* in a xerothermic oak forest, April 22, 2000, 1 ♂ V. Franc lgt.; the Zobor NR near the town of Nitra (7674), April 29, 1978 (Gajdoš and Krumpál, 1987). Known also from undated records from the Slovenský kras Mts. (060) J. Svatoň lgt. (Gajdoš et al., 1999) and the Urpín hill near the town of Banská Bystrica (7280d) (Svatoň, 1985b). Its present occurrence in Urpín is improbable, because the xerothermic character of this locality has been totally altered by afforestation with pine.

Older records of the very similar species *Mastigusa macrophthalma* (Kulczyński, 1897) from Slovakia (the Devínska Kobyla NR and the Sninský kameň NR) are sporadically given as well (Gajdoš et al., 1999). Roberts (1985) suggested that *M. arietina* and *M. macrophthalma* are mere forms of the same species, as their genitalia were identical and the only noticeable differences were the eye size. Buchar and Růžička (2002) agree with this opinion indirectly: “We have both macrophthalmous and microphthalmous specimens (of *M. arietina*) from one locality.”

The discussed five species of myrmecophilous spiders are rare and interesting from the ecological point of view as well. The type of symbiotic relation between spiders and ants is a specific (and not often discussed) problem. Among beetles (more than 100 myrmecophilous species are known in Slovakia!) we can distinguish three main types of myrmecophiles – synoecious ones, synecthricans and symphiles. The above-mentioned spiders cannot be synecthricans – they are too little and therefore ant-predation is nearly impossible. Certainly they cannot be listed among symphiles – any kind of symbiotic glands (typical for the beetle genera *Lomechusoides* Tottenham, 1939; *Claviger* Preyßler 1790, etc.) is out of the question in the case of spiders. The spiders living in ant colonies are synoecious – obviously they are predators of tiny mites (Acarina) or springtails (Collembola). How they manage to survive among ants (preying on a large range

of arthropods including spiders) remains an open question.

3. Ant-mimetic spiders

Some jumping spiders distinctly resemble ants. They may be mentioned as myrmecophiles, but in fact, they have no connection to ants except for their appearance, including the way they move. It is not very difficult to explain the roots of this ant-mimicry. Ants are, due to the formic acid, usually unpalatable food for birds and other entomophagous predators.

Family: Salticidae

Leptorchestes berolinensis (C. L. Koch, 1846) – occurs sporadically, but not rarely in warmer habitats: open forests, shrubby slopes, ecotones etc.

Myrmarachne formicaria (De Geer 1778) – occurs singularly, but not rarely in warmer, both dry and wet habitats. This species is an example of the most conspicuous ant-mimicry: Its movement is an agitated ‘zig-zag’, while the first pair of legs is not used for running, but held in front of the body, waving like antennae.

Synageles hilarulus (C. L. Koch, 1846) – a scattered and rare species of warm habitats: the Veľká Fatra Mts.: the Zvolen Mt. (7181a), xerothermic rocky pasture June 27, 2001, 1 ♀ V. Franc lgt. (a very remarkable record at montane altitude!). Known also from several further records: the Starý hrad NR (6879a) (Bartoš, 1938), the Devínska Kobyla NR (7867b/7868a) summer 1978, 9 individuals! (Gajdoš et al., 1984); the Zobor NR (7674d) (Gajdoš and Sloboda, 1995), the bank of the Malý Dunaj river (7869) (Gajdoš et al., 1992). Unpublished records are available from the Slovenský kras Mts. (060), J. Svatoň lgt., the Kováčovské kopce NR (8178d), J. Buchar lgt. and the Zemplínske vrchy Mts. (7596), P. Gajdoš lgt. (Gajdoš et al., 1999).

Note: Several further spiders (species of the genera *Phrurolithus* C. L. Koch, 1839 and *Micaria* Westring, 1851) may also resemble ants, but their ant-mimicry is not so obvious.

Conclusions

This paper presents data concerning several spiders whose life is more-or-less connected with ants. Relations between spiders and ants may be trophic (ant-predation) or even symbiotic (myrmecophily), or they merely concern appearance and behaviour (ant-mimicry). The distribution and ecology, including conservation (ecosozological) status of several infrequent or even very rare species is discussed in this paper. Myrmecophilous spiders (*Acartauchenius scurrilis*, *Evansia merens*, *Sydera myrmicarum*, *Thyreosthenius biovatus* and *Mastigusa arietina*) require more attention of arachnologists and conservationists. Every species mentioned above deserves our attention to learn more about its way of life and conservation needs.

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