Bull. Br. arachnol. Soc. (1999) 11 (4), 131–135

Vertical distribution of harvestmen in the Eastern Alps (Arachnida: Opiliones)

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Summary

Arachnological investigations from the montane to the nival zone of the southern parts of the Hohe Tauern, Austria, led to the finding of 27 harvestmen species from 4 families. The vertical distribution of these species is tabulated and compared with literature data. New high altitude records were established for *Nemastoma triste* (2,380 m), *Paranemastoma bicuspidatum* (>2,200 m), *Trogulus closanicus* (1,500 m), *Ischyropsalis kollari* (2,600 m), *Opilio dinaricus* (1,505 m) and *Oligolophus tridens* (1,650 m). The first ecological data are given for *Leiobunum subalpinum*, a recently discovered species in this area.

Introduction

Arachnological investigations in the Hohe Tauern area started in the middle of the 19th century (for brief historical survey concerning Hohe Tauern see Komposch, 1997). Ausserer (1867:137) provides in "Die Arachniden Tirols nach ihrer horizontalen und verticalen Verbreitung" the first data on the vertical distribution of harvestmen in this area, with the purpose "wenigstens einiges Licht zu verbreiten auf einem Gebiete, das namentlich in unserem Vaterland noch so sehr im Dunkeln liegt". Later works came from Heller (1881, 1882) with a tabular overview of occurrences from I "Thalregion (100–650 m)" to VI "Nivale R. (2,700–3,900 m)", Dalla Torre (1882:33), who stressed the importance of such studies, as "die Specialwerke über die horizontale Verbreitung meist nur sehr wenig, über die verticale der einzelnen Arten ganz schweigen" and De Lessert (1917). Continuing the arachnological tradition in Tyrol, Stipperger (1928) gave detailed and reliable information about the "Biologie und Verbreitung der Opilioniden Nordtirols" with an early graphical overview on vertical distribution of harvestmen in the Northern Alps. Since the comprehensive work of Martens (1978), we know much about the systematics and horizontal distribution of middle-European harvestmen. In spite of this there is a paucity of biological and ecological data on these arachnids.

Studies in the southern part of the Hohe Tauern should help to shed light on the micro-spatial distribution and ecological separation of opilionids; the present paper treats the insufficiently known vertical distribution of alpine harvestmen.

	Species	Vertical distribution													Total
		900	1,100	1,300	1,500	1,700	1,900	2,100	2,300	2,500	2,700	2,900	3,100	3,300	
1	*Nemastoma triste*			2	8	82	38	21	1						**152**
2	*Paranemastoma quadripunctatum*	7	1		5										**13**
3	*Paranemastoma bicuspidatum*		30			31	5	11							**77**
4	*Histricostoma dentipalpe*	2	9		1										**12**
5	*Mitostoma chrysomelas*				1	3	46	4	33	16	1				**104**
6	*Trogulus tricarinatus*	1	4		6	2	1								**14**
7	*Trogulus nepaeformis*	3	16		16	14									**49**
8	*Trogulus closanicus*	2	4		1										**7**
9	*Trogulus tingiformis*		7		10	32									**49**
10	*Ischyropsalis kollari*					1	2		6	2	3				**14**
11	*Phalangium opilio*	8	13		53	14									**88**
12	*Opilio saxatilis*		1	2											**3**
13	*Opilio dinaricus*				4										**4**
14	*Platybunus bucephalus*		1	4	8	62	344	24	4						**447**
15	*Rilaena triangularis*	5	1		3	10									**19**
16	*Lophopilio palpinalis*		3												**3**
17	*Oligolophus tridens*	21	14	10	1	7									**53**
18	*Mitopus morio*		4		24	140	918	643	677	304	114	3			**2827**
19	*Mitopus glacialis*									3	1	2	7	6	**19**
20	*Gyas annulatus*				3	13									**16**
21	*Dicranopalpus gasteinensis*								8	37	3	1			**49**
22	*Amilenus aurantiacus*	4	6		11										**21**
23	*Astrobunus helleri*	1	3												**4**
24	*Leiobunum limbatum*	2	14	8											**24**
25	*Leiobunum rupestre*		1		8	2									**11**
26	*Leiobunum subalpinum*				20	23	3	4							**50**
27	*Nelima semproni*	15													**15**

Table 1: Vertical distribution of harvestmen in the southern parts of the Hohe Tauern. Number of specimens for each species at each height between 900 and 3,300 m. Full scientific names of species are given in Table 2. Altitudes shown as 200 m bands (e.g. 1,700 m=1,600–1800 m).

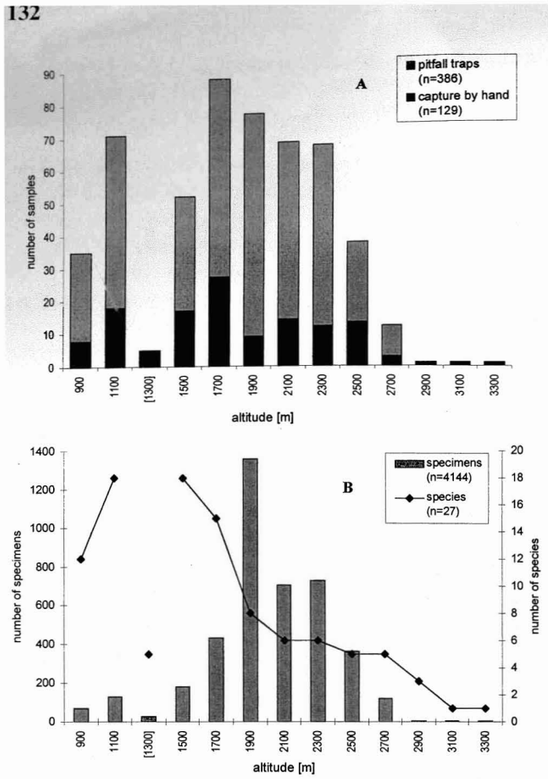

Fig. 1: **A** Collecting intensity in the different altitudinal zones (one sample means capture by hand at one locality on one day and one pitfall trap exposed for one month respectively). **B** Number of specimens and species in the different vertical zones. Altitudes shown as 200 m bands (e.g. 1,700 m=1,600–1,800 m).

Material and methods

Arachnological investigations took place in the Gössnitztal (Komposch, 1997), upper Mölltal (Komposch, 1995, unpublished) and Grossglockner alpine highway area (Jung leg., see Jung, 1981, Gruber det.) in the southern part of the Hohe Tauern in Carinthia, Austria (46°51′–47°04′N/12°44′–59′E; maps ÖK 153–154, 179–180).

The arachnid fauna was studied by means of pitfall traps, soil-sifting and hand-collecting in the vegetation periods (i.e. the time without permanent snow cover) of 1976 (21 May–24 September, Grossglockner, 1,650–2,620 mm), 1994 (3 May–8 October, Mölltal, 850–1,520 m; 11 September, Mohar, 1,800–2,600 m) and 1995 (4 June–6 October, Gössnitztal, 1,280–3,280 m), from the montane (850 m) up to the nival altitudinal zone (3,280 m). The investigated biotope types, mostly on silicate were: meadows, poor grasslands, hedges and extensive stone clusters (Oberes Mölltal), *Picea* and *Larix* forests, stands of *Alnus alnobetula*, dwarf-shrub heaths, spring zones and river banks, pastures, alpine grasslands, rocky heaths, snow coombes and screes (details in Komposch, 1997).

The present analysis of vertical distribution includes altogether more than 4,100 specimens from the southern parts of the Hohe Tauern.

Results and discussion

The vertical distribution of the 27 harvestmen species recorded in the southern parts of the Hohe Tauern between 900 and 3,300 m altitude is given in Table 1. This has to be considered in relation to the collecting intensity in the different altidudinal zones (Fig. 1A). In Figs. 1 and 2 the altitudinal zones are shown in 200 m steps; for example 1,700 m means heights between 1,600–1,800 m. Insufficient data are available at an altitude of about 1,300 m (no pitfall traps) and only a few hand-collected data are available from above 2,800 m.

New high altitude records were established for six species, and several others were found close to their upper limit of vertical distribution (Table 2). The main reason for this is the neglect of intensive collecting in higher alpine regions, especially by means of pitfall traps and soil-sifting.

Figure 1B shows a significant decrease in the number of harvestmen species with increasing altitude, beginning at 1,500 m, whereas the number of specimens has its peak between 1,900 and 2,300 m. The latter is due to the mass occurrence of the common species *Mitopus morio* and *Platybunus bucephalus*, which show their highest densities between 1,800 and 2,000 m (Fig. 2, Table 1). Both of these phalangiids are most numerous in the subalpine zone, but they can also be found (in low densities) in low altitude regions. Similar patterns of distribution are shown by the nemastomatids *Nemastoma triste* (Fig. 2, Table 1) and *Mitostoma chrysomelas* (Table 1), both widespread and common species. Remarkable is the large number of records of *Paranemastoma bicuspidatum*, a stenotopic inhabitant of spring-fed brooks and rivulets; in these wet areas these harvestmen sit under stones and wood, together with mayfly and stonefly larvae. This hygrobiotic species prefers the subalpine zone, and in the Gössnitztal it reaches at least 2,200 m, a new high altitude record.

Leiobunum subalpinum, a recently discovered species, occurs mainly in various *Picea-Larix* and *Pinus cembra* forests in the subalpine zone near the timber line (Komposch, 1998), whereas *L. rupestre* was found mainly in the montane zone.

Ischyropsalis kollari is a typical high-mountain ischyropsalidid which occurs mainly between 1,500 and 2,600 m, although there are isolated cave-inhabiting

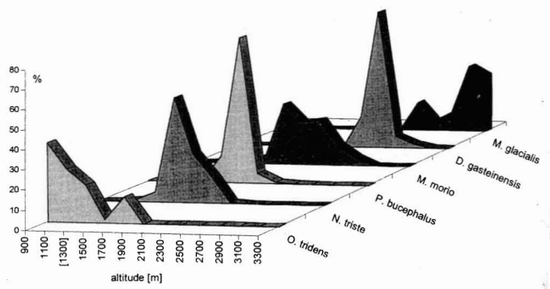

Fig. 2: Pattern of vertical distribution. For total number of specimens for each species see Table 1. Altitudes as in Fig. 1.

Species and families	Previous highest record without citation see Martens (1978)	Highest record in Hohe Tauern and habitat types new high altitude record: bold type
	Nemastomatidae	
1 ***Nemastoma triste* (C.L. Koch)**	2,300m-A (Thaler, 1974, 1989a)	**2380m-Mohar, Oberes Mölltal**; upper alpine grasslands
2 *Paranemastoma quadripunctatum* (Perty)	2,000m-Italy (Marcellino, 1988)	1,580m-Gössnitztal; subalpine *Larix-Picea*-forests
3 ***Paranemastoma bicuspidatum* (C.L. Koch)**	~2,000m-Austria (Thaler, 1974)	**>2,200m-Gössnitztal**; upper alpine spring zones
4 *Histricostoma dentipalpe* (Ausserer)	2,000m-Italy	1,500m-Oberes Mölltal; montane *Larix*-forests
5 *Mitostoma chrysomelas* (Hermann)	2,820m-Switzerland	2,600m-Mohar, Oberes Mölltal; upper alpine screes, snow coombes
	Trogulidae	
6 *Trogulus tricarinatus* (Linne)	1,960m-A (Thaler, 1989a); 2,000m-Switzerland (Lessert, 1917)	1,650m-Gössnitztal; upper montane basiphilic poor grasslands
7 *Trogulus nepaeformis* (Scopoli)	2,200m-Italy (Marcellino, 1988) (? "*T. nepaeformis*" s.l.)	1,700m-Gössnitztal; upper montane basiphilic poor grasslands, *Larix*-forest
8 ***Trogulus closanicus* Avram**	1,000m-Austria (Chemini, 1984)	**1,500m-Oberes Mölltal**; upper montane rough pastures with extensive stone clusters
9 *Trogulus tingiformis* C.L. Koch	1,900m/?2,000m-Austria	1,650m-Grossglockner-Hochalpenstrasse; subalpine rough pastures
	Ischyropsalididae	
10 ***Ischyropsalis kollari* C.L. Koch**	2,550m-A (Thaler, 1989a)	**2,600m-Mohar, Oberes Mölltal**; upper alpine screes, snow coombes
	Phalangiidae	
11 *Phalangium opilio* Linne	2,400m-Italy	1,650m-Gössnitztal & Grossglockner-Hochalpenstrasse; subalpine rough pastures
12 *Opilio saxatilis* C.L. Koch	2,650m-Greece	1,350m-Oberes Mölltal; synanthropic on wall of church
13 ***Opilio dinaricus* Silhavy**	1,350m-Bulgaria	**>1,400m-Gössnitztal**; upper montane less dense *Larix-Picea* forests; **1,505m Oberes Mölltal**; upper montane rough pastures with extensive stone clusters & shrubs
14 *Platybunus bucephalus* (C.L. Koch)	2,650m-A (Kofler, 1984)	2,350m-Gössnitztal; alpine pastures, screes
15 *Rilaena triangularis* (Herbst)	~2,000m-A (Thaler, 1979); ? 2,200m-Italy (Caporiacco, 1927), Martens (1978)[1]	1,700m-Gössnitztal; subalpine high pastures with rocky elements, isolated *Picea* and *Larix*
16 *Lophopilio palpinalis* (Herbst)	1,700m-Austria, Bulgaria, France	1,130m-Oberes Mölltal; upper montane hedges with stone clusters near spring zones
17 ***Oligolophus tridens* (C.L. Koch)**	1,640m-Austria	**1,650m-Grossglockner-Hochalpenstrasse**; subalpine screes
18 *Mitopus morio* (Fabricius)	~3,000m-Austria (Thaler & Knoflach, 1997)[2]; 3,000m-Spain	>2750m-Gössnitztal; subnival rocky heaths and screes
19 *Mitopus glacialis* (Heer)	3,457m-Austria (Thaler, 1984, 1989b); ~3,300m-Austria (Steinböck, 1931)	3,280m-Gössnitztal; nival screes
20 *Gyas annulatus* (Olivier)	2,050m/?2,810m-Austria (Kofler, 1984) >2,300m (Janetschek, 1948)	1,980m-Gössnitztal; stands of *Alnus alnobetula* beside a brooklet
21 *Dicranopalpus gasteinensis* Doleschall	3,280m-Austria (Thaler, 1979)	2,850m-Gössnitztal; subnival screes
22 *Amilenus aurantiacus* (Simon)	1,700m-Austria (Stipperger, 1928)	1,550m-Gössnitztal; rich pastures and less dense *Larix-Picea*-forests
23 *Astrobunus helleri* (Ausserer)	?2,300m-Italy (Marcellino, 1972)	1,070m-Oberes Mölltal; pastures with big stone clusters
24 *Leiobunum limbatum* L. Koch	1,970m-A; 2,008m-Switzerland (Lessert, 1917), ?2,122m-Italy (Caporiacco, 1927)	1,350m-Oberes Mölltal; synanthropic on wall of church
25 *Leiobunum rupestre* (Herbst)	2,160m-Austria, ?2,500/2,680m-Italy (Caporiacco, 1927)	~1,700m-Gössnitztal; on rocks in *Larix*-forests
26 *Leiobunum subalpinum* Komposch	see Komposch, 1998	~2,200m-Gössnitztal; on rocks in dwarf-shrub heaths with isolated *Pinus cimbra, Larix* and *Picea* at timber line
27 *Nelima semproni* Szalay	1,600m-Italy	1,000m-Oberes Mölltal; hedges between pastures with big stone clusters

Table 2: List of species collected, high altitude records (details see Table 1) and comments on life zone and habitat type. Altitudinal zonation after Adler *et al.* (1994). **New high alititude records for the species set in bold type**. Investigated areas in the southern parts of the Hohe Tauern, Carinthia, Austria (=A): "Oberes Mölltal" & mountain "Mohar", Komposch, 1995; "Gössnitztal", Komposch, 1997; "Grossglockner-Hochalpenstrasse", Jung leg. 1976, Gruber det. Uncertain altitude entries marked with a "?" come mostly from Lessert (1917) and Caporiacco (1927), compare Martens (1978); contrary to this K. Thaler (in litt.) takes Lessert for a "very careful observer". Systematics with the exception of *T. closanicus* (after Chemini, 1984) after Martens (1978).
[1]"Die Angaben von Caporiacco (1922) über Nachweise bis 2,200m in den Karnischen Alpen/Carnia erscheinen kaum glaubwürdig." (Martens, 1978: 290).
[2]Martens (1978: 350) already expects: "Die 3,000m-Grenze wird in den Alpen wahrscheinlich lokal erreicht, gewiss aber nicht wesentlich überschritten."

populations in the lower mountains in Styria (Neuherz, 1975). Its presence in humid and moss-covered rock debris at the peak of the mountain Mohar at 2,600 m is the highest known record for this species.

The specialists *Mitopus glacialis* and *Dicranopalpus gasteinensis* are alpine and nival species, which live mainly at altitudes above 2,000 m (Fig. 2, Table 1). In many cases they were found syntopically in screes; both species also show a similar picture of horizontal distribution in the Alps. In the Gössnitztal between 2,450 and 2,750 m there is also a small strip of syntopic localities (Wiener Höhenweg, Roter Knopf) for *Mitopus glacialis* and *M. morio*; the latter species was previously not known from such altitudes in the Alps except for the record by Thaler & Knoflach (1997).

Trogulus tricarinatus, T. nepaeformis and *T. closanicus* are widespread and common in lower regions; nevertheless they also colonise alpine biotopes. As these specialised snail-eaters are dependent on calcareous ground, they occur only in certain places in the area. In the opinion of the authors these trogulid species probably occur higher than the listed altitudes (Table 1, compare Thaler, 1989a), especially the poorly known *T. closanicus*. This species has been distinguished only recently from "*nepaeformis*", therefore earlier records may refer to either species. *T. tingiformis* seems to have its centre of distribution in the subalpine and alpine zones; this may be the reason why this trogulid is considered as the rarest Central European species of the genus.

All other species have their main area of distribution lower down, and reach the Hohe Tauern only peripherally along some warmer valleys. *Opilio dinaricus* (Table 1) and *Oligolophus tridens* (Fig. 2, Table 1) reach their highest altitudes in the whole area near Heiligenblut in the Hohe Tauern (Table 2). Thaler (1989a) found 17 specimens of *Phalangium opilio* in larch pastures at 1,900 m, but his data for the other phalangiids are similar to our own results.

Conclusions

An important fact is the different "ecological behaviour" in the field of the various species in different parts of their range. There is considerable variation between mountain groups and even in the same geographical region the limits of vertical distribution vary, because of different environmental conditions such as climate, exposure, geological substrate and vegetation structure; especially the (mostly anthropogenically lowered) timber line is a major biological limit in the Alps. There is a general trend, that widespread European species in the southern (Mediterranean) part of their range can be found at much higher altitudes — in part they are confined to high mountain zones — than in their middle-European localities (compare Martens, 1978).

The vertical distribution of harvestmen is less known, the more we look at higher regions. In spite of a significant increase in information in recent years, there are still gaps in our knowledge of this aspect of alpine arachnology, and especially concerning many questions about ecology and biology of nival species. Precise and reliable data are necessary to detect the real boundaries of vertical distribution of arachnid species, instead of the boundaries of collecting abilities of particular arachnologists.

Acknowledgements

We are grateful to Dr Konrad Thaler (Innsbruck), Dr Peter Merrett (Swanage) and Dr Reinhart Schuster (Graz) for useful comments on the manuscript.

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