

## Field observations on *Pachyloidellus goliath* (Opiliones, Gonyleptidae) in Pampa de Achala, province of Córdoba, Argentina

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### Summary

The phenology of the gonyleptid *Pachyloidellus goliath* Acosta was studied in Pampa de Achala, province of Córdoba, Argentina. UV-light sampling was used for the first time in Opiliones. It was found that the surface activity period of the adults extends from October to April, decreasing dramatically during winter. Juveniles were found from April to January, with a peak in October. Observations on general habits, feeding and predators are provided. Some comments on the sampling method, comparing it with pitfall trapping and rock rolling, are also given. With the available data, the probable life cycle of the species is hypothesised.

### Introduction

The so-called “Pampa de Achala”, with an area of about 500 km<sup>2</sup> and an average altitude above sea level of more than 2,000 m, is the most extensive and elevated plateau in the Sierras de Córdoba, central Argentina. It is situated on the Sierras Grandes chain, between Cerro Los Gigantes (2,350 m) in the north and Cerro Champaquí (2,888 m) in the south (Fig. 1). This plateau represents the main nucleus of the granitic “batolite of Achala”, which dates from the Lower Palaeozoic. The toponym “pampa” is also applied to other similar formations in the sierras, and it refers to the noticeable flatness of these areas, although they have numerous irregularities that render the landscape rough and undulating. Together with the surrounding sectors above 1,900 m, the Pampa de Achala forms a peculiar biogeographic unit (the “altas cumbres”=high peaks), that possesses several endemic species, and to which a large number of forms living in lower altitude belts cannot reach (Acosta, 1989).

Among the endemics is the harvestman *Pachyloidellus goliath* Acosta (Gonyleptidae, Pachylinae), which inhabits the whole “altas cumbres” region (Acosta, 1993). This arachnid is known by the people of Pampa de Achala as “chichina”, a name probably referring to the strong odour of their defensive secretions, that recall those of the insect named “chinche molle” or “chinchina” (*Agathemera crassa* Blanchard; Phasmodea). The secretion mechanisms of *P. goliath* and the chemistry of the substances involved were studied by Acosta *et al.* (1993). The minute triaenonychid *Ceratontia centralis* Maury & Roig Alsina (found in all three altitudinal belts of the sierras) is the only harvestman species living together with *P. goliath* in the “altas cumbres” area; because of their size difference a niche overlap between them seems highly improbable (Acosta, 1989).

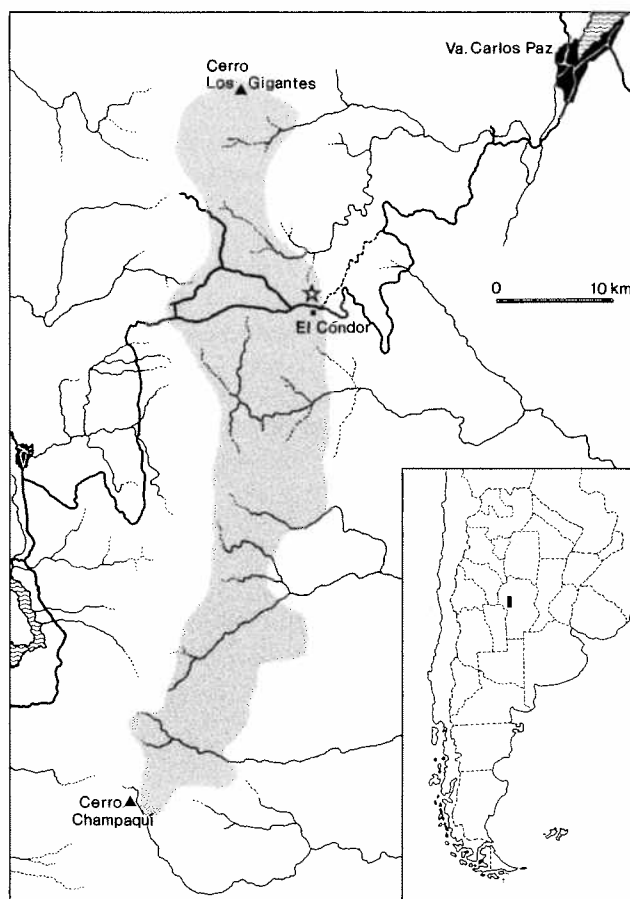


Fig. 1: Map of Pampa de Achala (shaded) and surrounding areas (main roads are shown with heavy lines, streams with thin ones). The star by El Cóndor indicates the study site. Inset: location of the represented sector in the province of Córdoba in Argentina.

This paper reports our field observations on *P. goliath*, that covered a period of 16 months. The main purpose of the work was to study the seasonal changes in surface activity, by monthly sampling on a predetermined transect. During the study we also gathered some general data on the biology of this bizarre species. We employed, for the first time in field studies on harvestmen, a UV-light source to detect the specimens, taking advantage of the faint fluorescence shown by the species (Acosta, 1983)\*. Therefore, the collecting took place at night, which has rarely been done for the order. We found only two references to night sampling: in one case (Todd, 1949) a normal torchlight was employed, while a kerosene lantern was used in the other study (Edgar, 1971). Field studies on Argentinian harvestmen are almost lacking, except for some fragmentary and almost “anecdotal” observations made by Martínez (1974). The nearest work, to some extent relevant to our research, is that of Capocasale & Bruno Trezza (1964), who studied in the field for several months the gonyleptid *Acanthopachylus aculeatus* (Kirby) in Uruguay. In many respects, however, their results are somewhat unclear and difficult to compare with ours.

\*The front covers of *The Journal of Arachnology*, Vol. 14 (1 and 3) (1986) show fluorescence in a related species, *Pachyloidellus butleri* (Thorell), there mentioned with its old combination *Sphaleropachylus butleri* (new combination in Acosta, 1993).

## Description of the area

### Climate

The climatic conditions of the Pampa de Achala are characterised by a low mean temperature (9.5°C), presence of snow in winter, and strong daily and seasonal variations of temperature; the winds are strong and constant. In sum, it is a typical high altitude climate (Capitanelli, 1979). Cabido (1985), using Koeppen's formula, characterises the climate of the area as Cwc (Gk'), which means a rainy, temperate climate, with a dry season in winter and a short, cool summer. The "thermic winter" (i.e. the months with mean temperatures below 10°C) extends between April and October inclusive. The rest of the year corresponds to the "intermediate season", since there is no "thermic summer", i.e. in no month does the mean temperature exceed 20°C (Fig. 2). The frost period extends from mid-March to the end of November. The rains are normally abundant (about 900 mm/yr) but very irregular, and occur mainly in summer. The contribution of fog and dew to the substratum humidity is considerable, although their actual amount is unknown (Capitanelli, 1979). Throughout the year there is no month with hydric deficit (cf. Cabido, 1985: fig. 2).

### Vegetation

The plant cover is mainly composed of the so-called "high-altitude grasslands" (Luti *et al.*, 1979; Cabido, 1985), which grow on thin deposits of argillaceous and micaceous slimes that lie on the bedrock. The natural grasslands occur in the sierras from 1,500–1,600 m and constitute a definite vegetation belt, the highest in these mountains. In the Sierras Grandes, at about 1,900 m

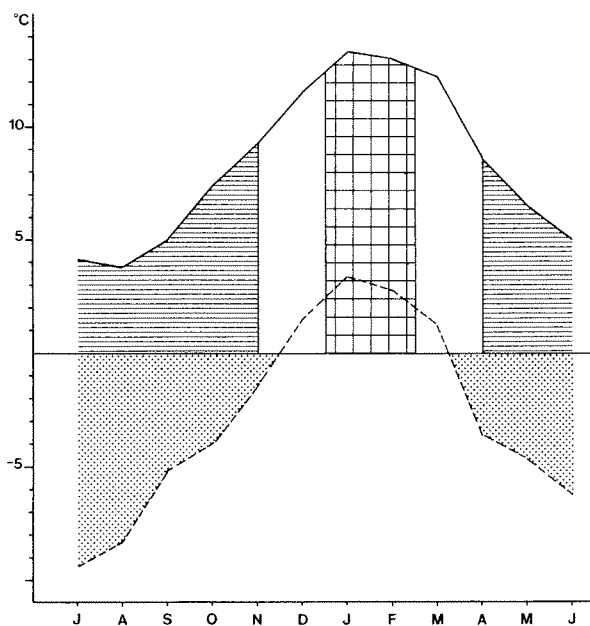


Fig. 2: Climatic diagram for the locality of El Cónдор, Pampa de Achala (1973–1978). Squared area=intermediate season without frosts, white area=intermediate season with frosts, hatched area=thermic winter, dotted area=frost period. Solid curve=mean temperatures, dashed curve=absolute minimum temperatures.

there is a change in the climatic conditions; the environment is more humid and colder, subdividing the grassland belt into a lower and an upper sector (Luti *et al.*, 1979). The "upper" grasslands are, because of their degree of plant and animal endemism, biogeographically distinct and considered a separate unit (Acosta, 1989).

The herbaceous plant cover is normally discontinuous, as it alternates with more or less extensive rocky outcrops. Thus, the grassland consists of several natural meadows of short, evergreen grass, with tall, straw-like grass in patches (Ringuet, 1947). The dominant grasses in Pampa de Achala belong to the genera *Stipa*, *Poa* and *Festuca*; lawns of *Alchemilla pinnata* Ruiz & Pavón (Rosaceae) are also typical of this landscape. Trees are almost absent, except in protected ravines, where forests of *Polylepis australis* Bitter (Rosaceae) develop.

### Study site

The site (Fig. 1) is near El Cónдор (31°36'S 64°44'W; altitude: 2,155 m). There is a remarkable rocky mound, which has on each side slopes of slightly different physiognomy and exposure to sun and winds. On the upper part there are several areas of short grass alternating with hard straws, exposed soil and/or bedrock (caused by overgrazing) and rocky outcrops. The lower part is a gently sloping plain, evenly covered by grass and with a few rocks at the base of the slopes, but almost without outcrops. No native trees are found on the site or in the surrounding area. Non-native trees are also absent at the study site, but a few occur near a few houses 300–500 m away.

### Materials and methods

As already mentioned, the specimens were located using a portable UV-light (6 W "blacklight", long wave, tube), by the fluorescence of their integument. The examples were taken once a month, from February 1987 to May 1988, on a linear transect 700 m long. The transect was marked with tiny dots of fluorescent paint on the rocks. Because moonlight, when intense, might affect the animals' surface activity (as reported in some scorpions: Williams, 1987; Sissom *et al.*, 1990) or the distance over which fluorescence could be detected, we tried to sample on days as near as possible to the new moon. In order to refine our sampling method, two preliminary samples were taken in November and December 1986 (these results were not considered in the analysis). The transect was drawn so as to cover diverse, slight environmental variants of the study site, such as horizontal vs. slope sectors, or rocky areas vs. grasslands, etc. All selected variants are briefly characterised in Table 1.

Walking along the transect, we swung the UV-light to both sides, looking carefully between plants, rock crevices and all field irregularities. Every detected specimen was caught alive. The sampling began regularly at about 22:00 h, and it usually took us from 1.5 to 2 hours to complete the transect. The specimens were

censused in three groups (adult males, adult females and juveniles), recording also the environmental variant where they were found. Then, they were returned to the field at random. It should be noted that males and females do not fluoresce with the same intensity, the former being somewhat brighter under UV-light. Further, the juveniles are detected with difficulty, and the early instars do not fluoresce at all.

Distinguishing adult males from females presents no difficulty, because of the conspicuous armature that characterises the fourth pair of legs of the males (Acosta, 1993). The recognition of juveniles was based upon the size of the specimens. Sometimes we had difficulty differentiating subadult females from small adults. This problem does not arise with males, as the leg armature of "subadults" is remarkably less developed. Unfortunately there are no data about the postembryonic development of this species, which might help us solve the problem. The most closely related species for which there is developmental data is the Chilean gonyleptid *Pachylus quinamavidensis* Muñoz-Cuevas. In that species, the size of subadults is significantly smaller than that of the adult mean (Muñoz-Cuevas, 1971b). Therefore, we adopted the practical criterion of considering females larger than 8 mm (scute length) as adults (see also measurements given by Acosta, 1993).

We also tried pitfall trapping, in order to compare this method with UV-light detection. However, because of many difficulties, sampling with traps was limited to only four months. The proximity of the bedrock to the surface, resulting in a thin soil layer, restricted the use of traps almost exclusively to grass sectors. Thus, our samples obtained by this method came from only 11 traps, that we placed near the transect but not overlapping it. We used 400 cm<sup>3</sup> cans, containing either a saturated solution of potassium dichromate (Chemini, 1983) or ethylene glycol (Levi & Levi, 1971); a raised, flat stone protected the trap opening. Since the study site is about 100 km from the city of Córdoba, we were able to empty the traps only once a month. In Table 2 we

compare the results obtained by both methods during the months in which the traps were used.

## Results

### General observations

Like most harvestmen, *Pachyloidellus goliath* is active at night. The majority of the individuals observed under UV-light were motionless, clinging on to plants or rocks and with their second pair of legs (sensorial) extended sideways. Less frequently they were seen walking slowly, testing the environment with the same legs. They hide during the day in crevices, under rocks and, to a lesser extent, among the bases of straw-like grasses. By turning over rocks we discovered that they normally shelter in groups, which range from 2–3 individuals to large aggregations. This contrasts with the assessment of Holmberg (1986) that harvestmen are mostly solitary. It seems, however, that these groups are only aggregations of unrelated individuals sharing favourable refuges. This situation may correspond to the "communal stage of sociability along the parasocial route" (Wilson, 1975, cited by Polis, 1990). Whether the secretions produced by the scent glands play any role in the mutual attraction, as Wagner (1954) suggested, is not known for *P. goliath* (Acosta *et al.*, 1993).

The close dependence of harvestmen on suitable hiding places is reflected in their environmental variant "preferences", as shown in Table 1. In variant A, which combines many favourable conditions, we caught more than 46% of the total sample. This percentage is somewhat biased by the relative length of the variant, but if this factor is taken into account, the sector is still important (25.4%). The highest "calculated" percentage (i.e. after equalising the lengths of variants) is that of variant C (28.9%), a sheltered rocky slope that contributed 10.5% to the samples, while representing only 5% of the transect length. The other slope (variant G) showed a lower "calculated" percentage compared with variant

Variant	Description	Variant length		No. of individuals	Percentage	
		m	%		Direct	Calc.
A	Large outcrops, with many crevices and cracks; large rock blocks; straw-like grass and short grass in patches (Acosta, 1993: fig. 22).	176	25.1	983	46.4	25.4
B	Outcrops with only few crevices or cracks; short grass and exposed soil/rock; little straw-like grass; no rock blocks.	146	20.9	316	14.9	9.8
C	Rocky slope, with crevices and straw-like grass in sectors (WSW-oriented, protected from winds).	35	5.0	223	10.5	28.9
D	Short grass lawn, with some straw-like grass and rock blocks, nearly without outcrops.	116	16.6	369	17.4	14.4
E	Extensive grassland of short and tall grass; outcrops or blocks nearly absent.	141	20.1	52	2.5	1.7
F	Dense straw-like grassland with small rock pieces.	54	7.7	86	4.1	7.2
G	Rocky slope with few crevices, straw-like grass in sectors (NNW-oriented, exposed to winds).	32	4.6	89	4.2	12.6
<b>Total</b>		<b>700</b>	<b>100</b>	<b>2118</b>	<b>100</b>	<b>100</b>

Table 1: Selected environmental variants along the transect and preferences shown by specimens of *Pachyloidellus goliath* collected by UV-light between May 1987 and May 1988. Percentages of individuals are shown in two ways: a direct percentage, i.e. the number of individuals collected in each variant in relation to the total *n*, and a "calculated" percentage ("calc."), that results from considering the variants as if they were all the same length (100 m).

C, probably because it is differently oriented and thus more exposed to winds. The lowest percentage, both with and without reference to its relative length, came from variant E, a habitat practically devoid of outcrops or stones.

### Feeding

These harvestmen are probably generalist predators on small prey, but they can eat dead animals as well. Acosta (1983) and Mischis (1985) reported the predation of this species on the earthworm *Microscolex dubius* (Fletcher) (Acanthodrilidae). We found an earthworm among the prey again, but it was too damaged to be identifiable. Other observed prey items include winged Formicidae, small adult Scarabaeidae, Lepidoptera (both larvae and adults) and Homoptera. We once found three male *P. goliath* feeding together upon a caterpillar, which was still alive. In captivity, these harvestmen accepted normally only dead prey (*Tenebrio molitor* larvae, house flies), unless these were small and the harvestman had not eaten for a long time. They also ate honey, as reported by Capocasale & Bruno Trezza (1964) for another gonyleptid, *Acanthopachylus aculeatus*. In the field it is common to find individuals drinking water directly from rain pools. We have also frequently seen specimens of *P. goliath* apparently feeding on crustose lichens (in one observation, a group of several individuals on the same lichen), but we were unable to determine for certain whether they really ingested the lichen, or were eating microarthropods or even accumulated water.

### Predators

On one occasion we saw the toad *Bufo achalensis* Cei eating an adult male of *P. goliath*.

### Phenology

Details of the censuses are presented in Fig. 3. This indicates that adult *P. goliath* show surface activity between October and April, decreasing dramatically during the rest of the year. The activity of males and females showed no differences in trend. On the other hand, juveniles appeared in the samples in April and decreased in November, with a peak in October (Fig. 3). Two juveniles, among those found in traps in December and January (Table 2), were very minute, and probably belonged to the second instar. No juveniles were detected by UV-light in February and March.

A remarkable decrease of individuals is to be noted in both November and December 1987, contrasting with the results obtained in October 1987, and with those of a year before based on the preliminary samples (Fig. 3). However, these results could have been biased by the climatic conditions during those "anomalous" months, since a dense mist considerably reduced our ability to locate the specimens (it possibly also altered the specimens' activity).

### Discussion

The surface activity of *P. goliath* is sharply limited to the "intermediate season", with higher temperatures and precipitation. The high number of specimens in the most favourable months is remarkable (almost 500 individuals in April 1988), in a magnitude that was not suspected before we began the work. This striking abundance, considered together with the large size of the animals (up to 11.6 mm scute length; Acosta, 1993), suggests that *P. goliath* may play an important role in the energetics of the invertebrate community of Pampa de Achala.

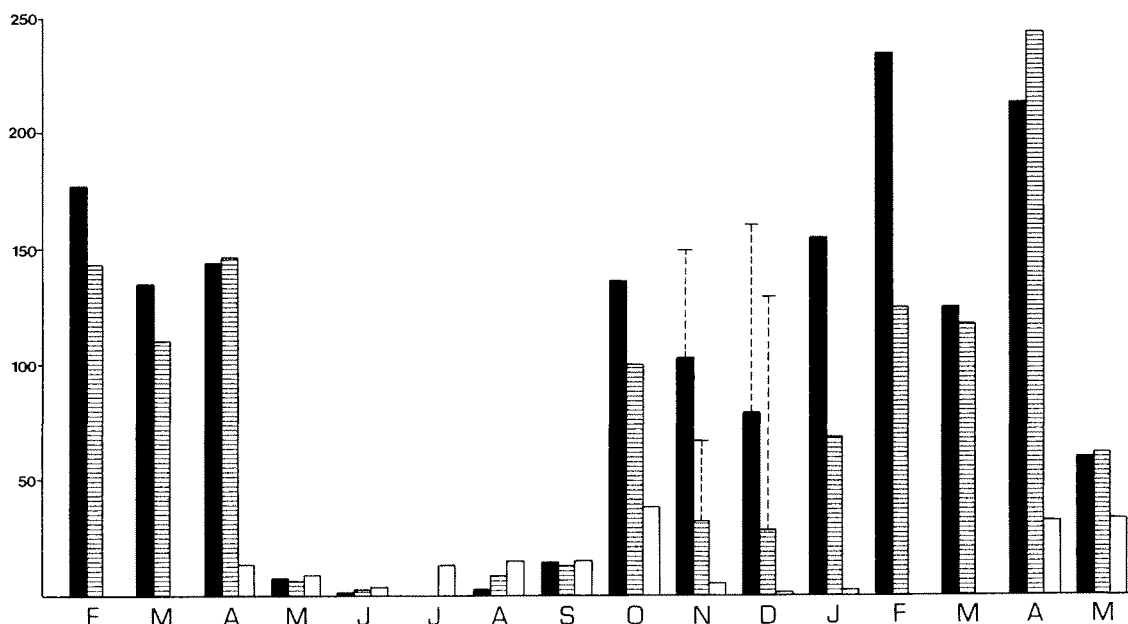


Fig. 3: Phenology of males (black bars), females (hatched bars) and juveniles (white bars) of *Pachyloidellus goliath*, from February 1987 to May 1988, as collected in UV-light samples. The dotted lines that complete the November and December 1987 bars indicate the number of individuals captured in 1986, during the two preliminary samplings.

	October		November		December		January	
	UV	PT	UV	PT	UV	PT	UV	PT
Males	136	23	103	7	79	9	154	7
Females	100	30	32	7	28	1	69	6
Juveniles	38	91	5	4	1	4	2	2
Total	274	144	140	18	108	14	225	15

Table 2: Comparison of the samples made with UV-light and pitfall traps (PT), from October 1987 to January 1988.

### Comments on methods

The UV-light proved to be more advantageous than other current methods, e.g. rock rolling or pitfall trapping. Rock rolling seemed completely inadequate in our case. First, because the great majority of specimens of *P. goliath* hide in cracks or deep crevices of the outcrops, or between large rock blocks, it is obvious that the collections would have been limited to those harvestmen that sheltered under smaller rocks, i.e. those rocks which could be removed manually. This procedure might have provided data for only a small part of the total population, not to mention the progressive disturbance of the environment. Even more importantly, this method could detect specimens that are quiescent, thus providing erroneous information on its surface activity patterns. With respect to pitfall trapping, we already mentioned our difficulties in placing the cans; considering the lithophile habits of the species, it is clear that the traps could not have been buried in the most favourable sites. Not only is the absolute number of individuals caught with UV-light larger (Table 2), but also the method was, in general, easier to use. Nevertheless, in spite of the general inadequacy of pitfall traps in this case, they provided a considerable number of juveniles (hard to detect with UV-light), among them a few second instar specimens, which are not fluorescent.

In spite of the advantages of UV-light sampling, the method has several likely sources of errors, whose importance is difficult to estimate. For example, the more intense brightness of males could result in an oversampling of them. Further, one should not lose sight of the fact that the method relies on one-day samples, as representatives of the whole month, and this may render the results too sensitive to day-to-day variations in the prevailing conditions (as seen in the low samples in November and December 1987).

### Life cycle

Although the research was not intended to study the life cycle of the species, part of the data provided information on some features of it. The finding of juveniles in one definite period of the year (April to November) should indicate that *P. goliath* has only one annual generation. Since with the UV-light we could detect juveniles (the more advanced they are, the easier) but not the early instars, it is probable that the latter occur even earlier. This seems to be in accordance with our finding tiny, non-fluorescent juveniles in pitfall traps in December and January. Their extremely small size suggests that the eggs hatch probably by mid-December.

Supposing an incubation time of 40 days, as reported for *Pachylus quinamavidensis* at 20°C (Muñoz-Cuevas, 1971a), we think that the eggs could be laid in October–November (spring). This is supported by the discovery of freshly-laid eggs of *P. goliath* in October, as well as by the capture of several gravid females, full of eggs, in the same month (T. Poretti and P. Mascarelli, pers. comm.). Furthermore, the highest number of juveniles was found in October (Fig. 3), and this may reflect not only their increased surface activity, but also that they had become large enough to be detected with the UV-light. Their decrease from November onwards (also in the traps) could mean that the majority had moulted to reach adulthood. Juveniles are completely “absent” in February and March (only UV-light data), and begin to be found again in April; these are probably the ones hatched in spring, that have grown large enough to be caught. Martínez (1974) reported that newly-hatched juveniles of the Argentinian gonyleptid *Discocyrtus testudineus* (Holmberg) were found “at the beginning of the temperate season” (spring?).

Interpreting all these data, we propose the following life cycle for *P. goliath*: oviposition in spring; egg hatching at the end of spring and the beginning of summer, with the nymphal period reaching the autumn; juveniles (probably the subadults) would then overwinter to reach maturity and mate in the next spring. A life cycle like this is reported by Edgar (1971) for the North American Palpatores *Leiobunum ventricosum* (Wood) and *L. nigriceps* Weed. Unlike many studied harvestmen, the majority being long-legged Palpatores (Phillipson, 1959; Hillyard & Sankey, 1989; Edgar, 1990), adults of *P. goliath* may not die after egg-laying, and at least some of them can indeed survive the unfavourable season, as evidenced by the recapture in October 1987 of a male that had been marked and released in May 1987. This makes probable a generation overlap.

### Acknowledgements

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## Ecology and phoretic habits of *Anthrenochernes stellae* (Pseudoscorpionida, Chernetidae)

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### Summary

The biology and phoretic habits of the chernetid pseudoscorpion *Anthrenochernes stellae* Lohmander, which had previously been found on only five occasions (in Denmark, Sweden, and Poland), is discussed in the light of new finds from Sweden. It seems to live among loose decaying wood in old hollow, deciduous trees (beech, lime and oak), and is commonly associated with insect or bird nests. The phoretic behaviour of the species is also discussed, and the spermatheca and pedipalpal chela are illustrated.

### Introduction

*Anthrenochernes stellae* was described by Lohmander (1939b) on the basis of material from Gothenburg

(collected 25 November 1938) and from the vicinity of Copenhagen (one specimen, collected 30 May 1886). Since then it has only been reported twice, from Zealand, Denmark (Andersen, 1988) and from Poland (Rafalski, 1967). In Gothenburg, Lohmander found this species in a rather old, hollow lime (originally published as being an elm) growing on a south-facing, sunny slope. The tree cavity had become exposed when the tree was broken by a storm. The species was found together with *Dinocheirus panzeri* (C. L. Koch) among loose decaying wood mixed with debris from a bees' nest and dead honey bees at the bottom of the cavity (Lohmander, 1939a, b). The find in Copenhagen in 1886 was from a hollow oak, in company with *Larca lata* (Hansen), *Pselaphochernes scorpioides* (Hermann), *Allochernes wideri* (C. L. Koch) and *Dinocheirus panzeri* (Lohmander, 1939a, b). Andersen (1988) found *A. stellae* in a large, broken, hollow branch from an old oak in a manor park. Within the hollow branch there were dead wasps and remnants of their nest, as well as some debris that might have been remnants of a bird's nest.

Rafalski (1967) found the species among decaying wood (species of trees not specified) in two areas in south-eastern Poland.

We report here on new records of *A. stellae* from seven different localities in southern Sweden. The