The genus *Macrothele* Ausserer (Araneae, Hexathelidae) in Europe

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Summary

Some aspects of the distribution, ecology and behaviour of *Macrothele calpeiana* (Walckenaer, 1805) are discussed. *Macrothele luctuosa* (Lucas, 1855) is confirmed as a synonym of *M. calpeiana*. *Macrothele calpeiana* and *M. cretica* Kulczynski, 1903 are redescribed.

Introduction

The genus *Macrothele* Ausserer comprises 15 species with a distribution from western Europe to eastern China and 5 species in central Africa. According to Raven (1980), the subfamily Macrothelinae contains 3 genera, *Macrothele, Porrhothele* which is endemic to New Zealand, and *Atrax*, a genus widespread in eastern coastal Australia. *Macrothele* is represented in Europe by 3 described species; *M. cretica* Kulczynski, 1903, known only from the island of Crete, and 2 sympatric species, *M. calpeiana* (Walckenaer, 1805), the type species, and *M. luctuosa* (Lucas, 1855), both from the south-west of Spain.

Macrothele calpeiana has for some time been considered to be Europe's largest spider with recorded body lengths reaching 35mm. It has also gained a reputation for being aggressive when disturbed and capable of administering a painful bite. Despite this, very little has been published on the distribution, biology or ecology of this restricted and interesting spider. The following account attempts primarily to describe the distribution of *M. calpeiana* and to reveal something of its habitat requirements. Some observations on its biology and behaviour are included, as are redescriptions of both *M. calpeiana* and *M. cretica*. *Macrothele luctuosa* is also confirmed as a synonym of *M. calpeiana*.

The status of *M. luctuosa*

Lucas (1855) distinguished *M. luctuosa* from *M. calpeiana* by the elongated palpal tarsus in the female, no males having been described, and slight differences in the conformation of the eyes. However, Bacelar (1932a) doubted the status of *M. luctuosa* as a distinct species. After our detailed examination of specimens of *M. luctuosa*, it was considered that these were, in fact, sub-adult males of *M. calpeiana*. Blasco & Ferrandez (1986) arrived at the same conclusion and placed *M. luctuosa* as a junior synonym of *M. calpeiana*. In order to test this further, two of our largest preserved specimens of *M. luctuosa* were dissected. In both cases

the elongated palpal tarsi contained well-formed bulbs and emboli of the *M. calpeiana* type and no female genitalia were present. Finally, three specimens referrable to *M. luctuosa* were reared in the laboratory. All three eventually moulted to adult males and proved to be *M. calpeiana*. These findings support the synonymy by Blasco & Ferrandez (1986) of *M. luctuosa* into *M. calpeiana*.

Macrothele calpeiana (Walckenaer, 1805) (Figs. 1-4, 8)

Mygale calpeiana Walckenaer 1805: 5, figs. 1-2; 1837: 229; Hahn, 1822: 1, T1.
Diplura calpetana [unjustified emendation]: Thorell, 1870: 167.
Macrothele calpetana: Ausserer, 1871: 181; Simon, 1892: 184; Petrunkevitch, 1928: 71; Bacelar, 1932a: 173; 1932b: 23; Roewer, 1942: 205; Bonnet, 1957: 2690 (full bibliography); Blasco & Ferrandez, 1986: 314.
Mygale luctuosa Lucas, 1855: 15; Simon 1864: 67.
Macrothele luctuosa: Ausserer, 1871: 182; Bonnet, 1957: 2691. First synonymised by Blasco & Ferrandez, 1986: 314.

Thorell (1870) altered Walckenaer's original spelling from *calpeiana* to *calpetana*, offering no explanation. Ausserer (1871) followed this, indicating that *calpeiana* was incorrect latinisation. Simon (1892) and many other authors since have followed Thorell, Bonnet (1957) remarking that "le terme *calpeiana* utilisé par Walckenaer . . . est un barbarisme ou une coquille". However, Article 32(c) of the I.C.Z.N. states that the original spelling of the name is to be retained as the "correct original spelling" unless "there is in the original publication itself . . . clear evidence of an inadvertent error . . . (incorrect transliteration or latinisation . . . are not to be considered inadvertent errors)." Thus *calpetana* Thorell, 1870 is an unjustified emendation and *calpeiana* is the correct specific epithet.

Male

Colour: In life, black with purple/violet cast to abdomen. This fades in alcohol to dark brown, more quickly in females than in males. Descriptions are of 5 preserved specimens (all measurements in mm). Total length (excluding spinnerets) 20.3-26.8. *Carapace:* Length 8.8-10.4, width 7.6-8.4, length:width 1.2:1. Dark red-brown with many darker striations radiating from fovea. Sparse fine black hairs mainly on striae. Some weak paler hairs giving sparse pilosity on striae and on posterior margin. Fovea an open circular pit. A few bristles in ocular area and in a central longitudinal line to fovea. Ocular area barely raised. *Eyes:* On very low tubercle, the group occupying 0.3 of width of head. AME circular, rest suboval although PME rather variable in shape. ALE larger than rest. AME:ALE 1:1.7. Anterior line straight, posterior line slightly recurved. Relative eye interspaces: AME-AME 2.8, AME-ALE 1.3, ALE-PLE 2.1, PME-PLE 1.0, PME-PME 8.8. *Chelicerae:* No rastellum. Distally covered with long black hairs. Groove with 10-14 large irregularly-sized teeth on promargin. Retromargin with 10-20 small teeth or denticles in irregular basal row. *Labium:* With numerous (approximately 140-160) cuspules. Fused to sternum by broad labio-sternal sigillum. *Maxillae:* Numerous cuspules on inner angle. *Sternum:*

Oval. Widest between legs II and III, width approximately 0.9 of length. Clothed with long dark erect hairs. Six oval sigilla present, largest pair posterior, smallest anterior, all separated from margin by their own lengths. 9-12 lyriform organs present. *Abdomen:* Very dark grey with up to 3 pairs of reddish impressed dots dorsally. Clothed with strong black hairs interspersed with shorter fine hairs. Ventrally genital area is marked on either side by narrow longitudinal area of sclerotisation which is attenuated anteriorly; area between these lightly sclerotised. *Legs:* Formula, IV, I=II, III. Unmodified, no megaspines or spurs present. Femora densely covered with long fine decumbent hairs. All tarsi with sparse scopula which extends to distal end of metatarsus. Spines present on all tarsi (2 ventral rows and several individuals). Number of spines highly variable, even bilaterally, greatest numbers on legs I and II. Maximum numbers
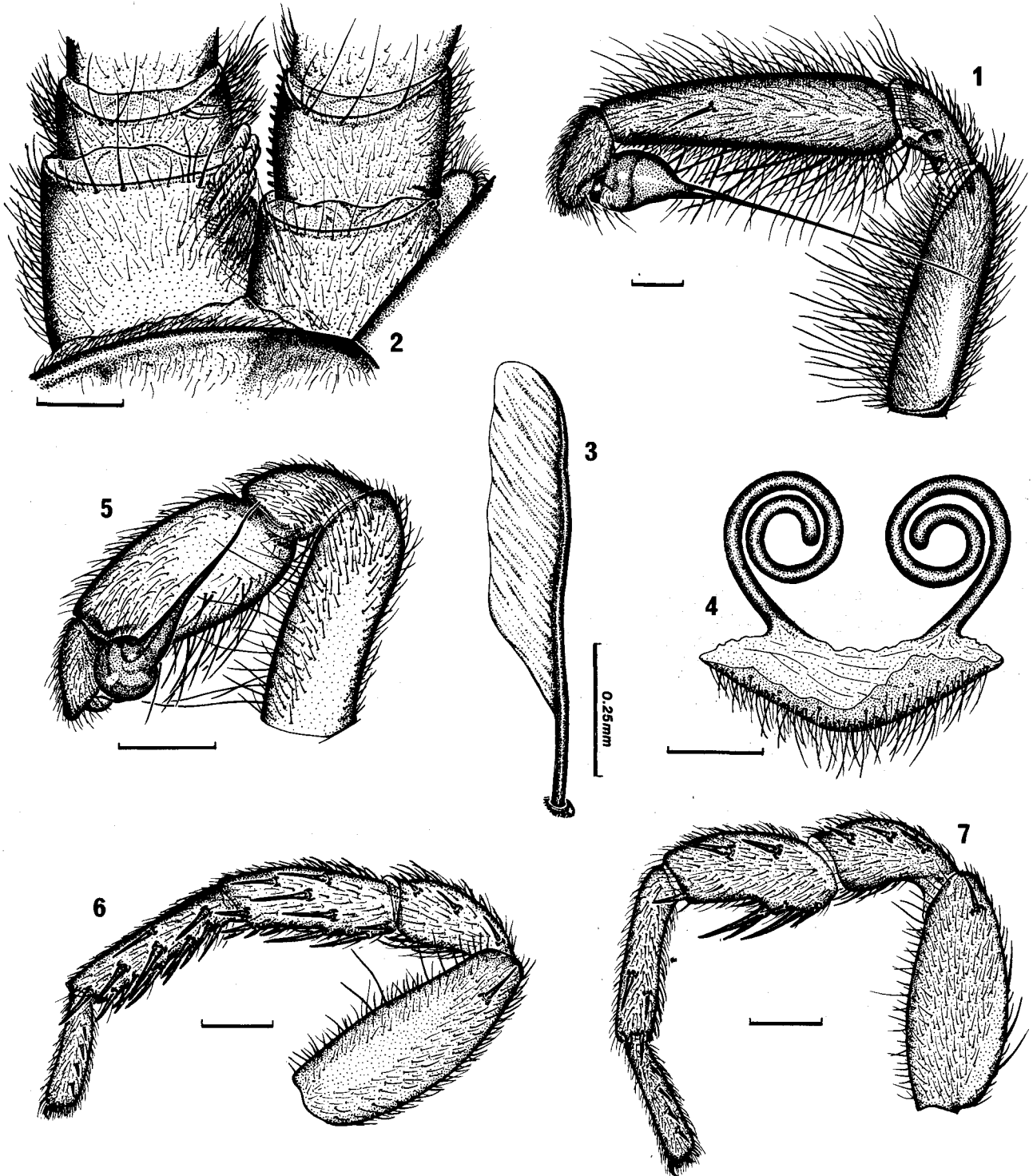
Figs. 1-4: *Macrothele calpeiana* (Walckenaer). **1** Male left palp, lateral view; **2** Lyra, dorsal view; **3** Lyral spine; **4** Vulva.

Figs. 5-7: *Macrothele cretica* Kulczynski. **5** Male left palp, lateral view; **6** Male right leg I, antero-lateral view; **7** Male right leg II, antero-lateral view.

Scale lines = 1 mm, except Fig. 3.

of spines on metatarsi; I, 19; II, 14; III, 24; IV, 31. Spines large, stout, especially on legs I and II, and often slightly sinuous. Metatarsi with comb-like arrangement of 2 or 3 small contiguous spines postero-ventrally and anteroventrally among distal spines. Anterior surface of coxa I carries a large patch of highly modified paddle-shaped spines (Fig. 3) which, together with a row of short peg-like spines on posterior face of palpal trochanter, form a well-developed lyra (Fig. 2). Superior claws with single sigmoid row of 11-12 teeth curving from inner to outer surface. Inferior claws not pectinate. *Spinnerets*: Four. Posterior medians small, single-segmented. Posterior laterals long, three-segmented, with retrolateral subsegmentation of basal segment. Posterior laterals approximately 1.5 times length of labio-sternum. *Palp* (Fig. 1): Ventral surface of tibia and femur densely covered with long erect hairs. A few spines on ventral and anterior surface but very variable in number and position. No dorsal spines on tibia. Bulb simple, pyriform with very long filiform embolus, together 1.25 times length of tibia.

Female

All characters as in male unless otherwise stated. Descriptions are of 17 preserved specimens. Total length 28.2-34.7. *Carapace:* Length 11.0-13.6, width 8.4-12.4. As in male but with rather more pilosity, particularly on posterior margin and in cephalic region. *Labium:* With numerous cuspules (approximately 150-170). *Abdomen:* Relatively larger than in male. Whole of genital region sclerotised. *Legs:* As in male but relatively shorter. Number and position of spines highly variable even bilaterally. Maximum numbers of spines on metatarsi: I, 15; II, 15; III, 34; IV, 34. Spines on legs I and II much less stout than in male, giving appearance of being less spinose. Well-developed lyra on coxa I/ palpal trochanter. *Vulva* (Fig. 4): A pair of long coiled spermathecae.

Material examined

M. calpeiana: Province of Cadiz: Cadiz, Nr Algeciras, 21 May 1977, 1♂ (P. Hillyard, BMNH); Algeciras, 2♀, 3j (BMNH); Algeciras, April 1975, 1♀, 3j (P. Hillyard, BMNH); Spanien seidlitz, 6j (BMNH, Koch coll., 19.9.18.5704-8); Gibraltar, summer 1911, 1♀ (Capt. J. J. Jacobs, BMNH, 1928.IV.10.1); Sierra de Ronda, Grazalema, 4 April 1972, 2♀ (R. Jocqué, MRAC, Tervuren).

South of Sotogrande, 30STF915158, 9 April 1985, 1♀; Dehesa del Cuartòn, 30STE725937, 29 March 1985, 2♀; Nr Grazalema, 30STF968724, 10 April 1985, 2♂, 1♀, 2j; South of El Picacho, 30STF637442, 2 April 1985, 1♀, 2j; Cerro de Torrejosa, 30STF617053, 31 March 1985, 2♀; El Pedregoso, 30STF653036, 31 March 1985, 1♀; Cerro del Acebuchal, 30STF537215, 14 April 1985, 1♂, 1♀, 2j; Cerro del Enemigo, 30STF781543, 5 April 1985, 1♂ (reared from "*M. luctuosa*"). (All leg. RS & RA.)

Province of Malaga: South-west of Carratraca, pine grove by main road, 18 April 1985, 1♀ (leg. RS & RA).

"*M. luctuosa*": Province of Cadiz: Sierra de Ronda,

Grazalema, 4 April 1972, 1♀ (R. Jocqué, MRAC, Tervuren); Nr Grazalema, 30STF968724, 23 April 1985, 1♀; Cerro del Enemigo, 30STF781543, 5 April 1985, 1♀ (leg. RS & RA).

Province of Malaga: South-west of Carratraca, pine grove by main road, 18 April 1985, 1♀ (leg. RS & RA).

Taxonomic affinities

The family Hexathelidae was elevated to family rank by Raven (1980) to include part of the old family Dipluridae, i.e. the subfamilies Plesiothelinae, Macrothelinae and Hexathelinae, the synapomorphy for this group being the presence of numerous labial cuspules. In his major review of the Mygalomorphae, Raven (1985) left the hexathelid subfamilies essentially unchanged but included *Mediothele* Raven & Platnick, 1978 as the sister genus of *Scotinoecus* Simon, 1892. Although it carries no labial cuspules, *Mediothele* was placed in the subfamily Hexathelinae with fewer homoplasies than elsewhere, and it shares with *Scotinoecus* an unusual form of both tibial apophysis and metatarsal preening comb. We have certain reservations with regard to the validity of using comparative numbers of a character such as labial cuspules as an autapomorphy at this level (where does "few" stop and "many" begin?) and therefore to the formation of the family Hexathelidae. However, it was accepted by Main (1985) and will be followed in this work.

Of the other hexathelid subfamilies, the Plesiothelinae Raven is represented by a single species occurring in Tasmania and the Hexathelinae Simon by 4 genera from Australia and New Zealand and 2 from Chile. The subfamily Macrothelinae Simon as delimited by Raven (1980) contained 3 genera; *Atrax* from eastern Australia and Tasmania, *Porrhothele* from New Zealand, and *Macrothele*. Gray (1988) removed *Atrax* from the Macrothelinae and placed it, along with the resurrected genus *Hadronyche* L. Koch, in a separate sub-family, the Atracinae Hogg, characterised by a broad palpal embolic shaft, the conformation of the cheliceral teeth, spines on the leg tarsi and a coniform anterior maxillary lobe. Raven (1980) proposed that *Macrothele* and *Porrhothele* were closely related by their common possession of an incrassate first tibia in the male. This character does not in fact occur in known males of *Macrothele* and the relationship of these two genera remains unclear. According to the hypotheses of historical biogeography and the assumed sequence of fragmentation of Gondwanaland, *Porrhothele* should be more closely related to the atracines of Australia than to *Macrothele* of Eurasia and Africa.

Fourteen species of *Macrothele* are described from south-western Europe to India, south-east Asia, China and Taiwan, and 5 species from West Africa. However, the taxonomic position of some species is uncertain, as in many cases only one sex, usually the female, is known. All 5 of the West African species are known solely from the female. It is possible that when both sexes of all species are known the genus *Macrothele* will be found to be polyphyletic. *Macrothele darcheni*

Benoit, for instance, has recently been transferred to the genus *Heterothele* in the family Theraphosidae (Raven, 1983). The sister group of *M. calpeiana* is unclear owing to the lack of assignable males in the African and some Asian species. In most cases the variability in characters used for specific diagnoses is unknown because of the scarcity of material. Benoit (1965) used the dentition of the cheliceral furrow as a diagnostic character, but this shows considerable variation in better-known groups (e.g. Main, 1957).

Judging by the dentition of the cheliceral furrow, *M. calpeiana* is possibly most closely related to the West African species *M. triangularis* Benoit, *M. incisus* Benoit and *M. abruptus* Benoit. Of these, *M. triangularis* is most similar in the form of the inferior claws and eye group. However, until assignable males of the African species are found these suggestions must remain extremely tentative.

Previously unrecorded in both sexes of *M. calpeiana* is a well-developed lyra. This comprises a dense patch of highly modified spines on the anterolateral face of coxa I which strike against a longitudinal row of short peg-like spines on the posterolateral face of the palpal trochanter. Distally these coxal spines become larger and paddle-shaped. This organ is present in all but the very early instars. This form of lyra corresponds to the type "e" lyra of Legendre (1963) and Starck (1985) which is recorded in several genera of theraphosids.

Lyrae are also present in the diplurid genera *Diplura* and *Trechona* (Raven, 1985). However, these are of the type "d III" of Legendre (1963) and are found on the maxillary and cheliceral surfaces. Within the genus *Macrothele* the only species found to be lyrate are *M. calpeiana* and *M. palpator* Pocock, 1901, which is recorded from south-east China (Hong Kong and Ning Po). In the latter species the "paddles" are of identical form but the lyra is situated on the palpal trochanter and the strikers on the anterolateral face of trochanter I, and the lyra is present only in the female. As the lyra is present in both sexes in *M. calpeiana* and in the female only in *M. palpator* it is unlikely that it serves any function in male courtship behaviour and may function solely as a means of identification between individuals when they live in close proximity. Stridulating organs have been identified in some groups of Salticidae which may serve a similar function (Maddison, 1987).

Distribution and ecology

Blasco & Ferrandez (1986) was the first study of the distribution of *M. calpeiana*. Several new localities for the species were added including confirmation of its presence in North Africa (Ceuta) and 2 new records for the north-west of Huelva province.

The present study was conducted during April 1985
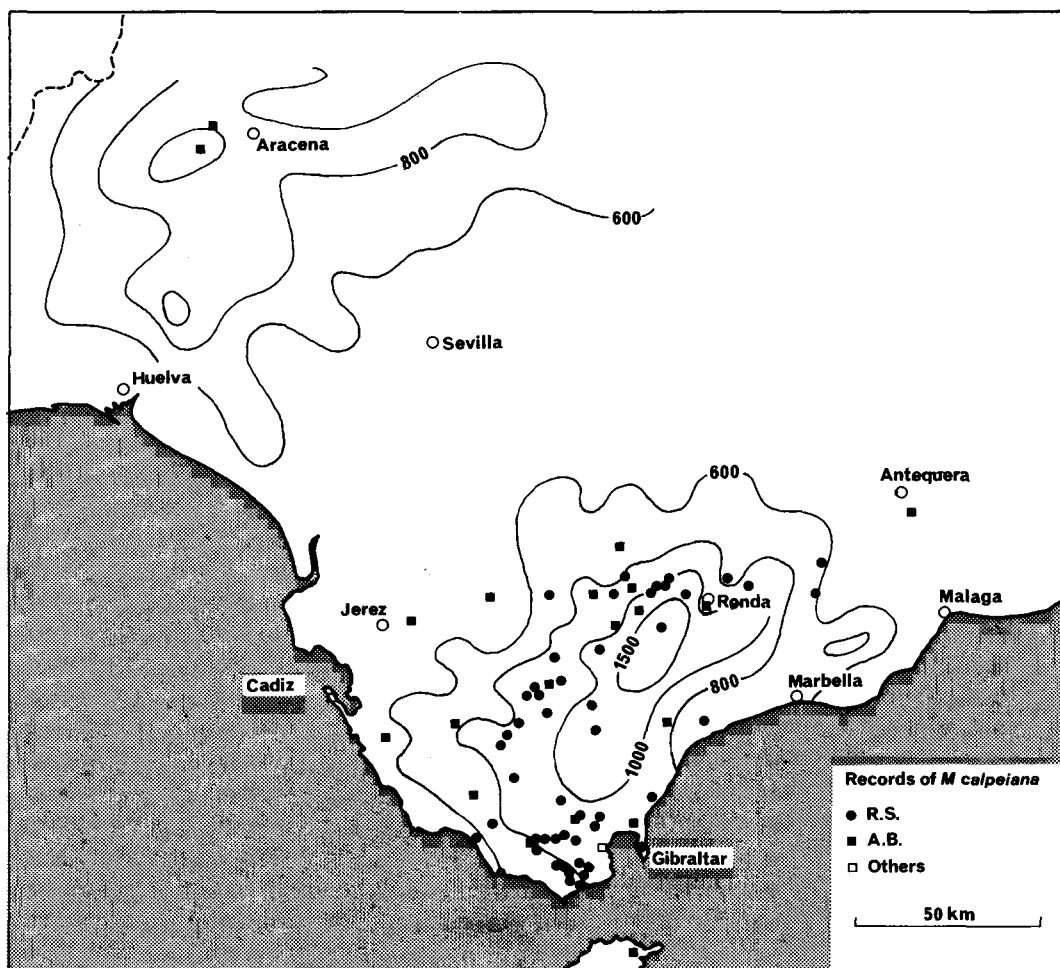
Map 1: Distribution of *M. calpeiana*. Isohyets in mm.p.a. R.S. = R. Snazell & R. Allison, A.B. = A. Blasco & M. Ferrandez.

and, owing to the limited time available, was restricted to an area from Vejer de la Frontera (Prov. Cadiz) in the west to Alora (Prov. Malaga) in the east and from Arcos de la Frontera in the north to Tarifa in the south. Remote areas with no vehicular access and some areas on the south and south-west coasts proscribed by military use were not investigated. However, our results, with those of Blasco & Ferrandez (1986), give a better understanding of the distribution of this species (Map 1).

The spiders were found most commonly in oak-woods, predominantly Cork Oak *Quercus suber,* in the ranges of hills between Tarifa and Ronda (Prov. Malaga). Apart from three sites where a few spiderlings were taken in small areas of degenerate woodland, no spiders were found in the flat agricultural land in the west, although they have been reported from a roadside near Facinas (Prov. Cadiz) (J. A. Murphy, pers. comm.). The species is not known from most of the Guadalquivir/Guadalete basin. In the Aracena (Prov. Huelva) area the spiders are found in upland oakwoods similar to those in the south-east. This distribution corresponds approximately to the areas of relatively high rainfall (80-200cm), warm winters and high summer temperatures.

The optimum habitat seems to be undisturbed *Quercus suber* woodland with a light understorey and many large to medium stones. On several occasions three adult or nearly adult specimens were found in apparently interconnecting webs under stones approximately 0.5 × 0.25 m in size. Webs were occasionally built among the roots of trees. Very rarely were spiders found more than a few metres from the woodland; the surrounding mattoral (often jaral) is possibly too hot and arid during the summer months.

A major exception was a small but dense population of *M. calpeiana* found in a grove of mature pines with large stones and deep pine litter in the hills near Carratraca (Prov. Malaga). Also a population has been reported to us from east of Granada (B. Y. Main, pers. comm.). This was found in the Sierra Harana near Las Mimbres about 1.5 km east of Puerto de la Mora (alt. 1390m). Numerous spiders were present under stones and boulders on a steep roadside bank and in an adjacent grazed area which retained some scrubby trees. This site was not seen by the present authors.

M. calpeiana is not a true burrowing spider, but lives opportunistically in pre-existing holes and crevices, and can form large and sometimes dense populations in high, often bare, banks of roads and streams. In these situations populations of the spider can survive for some time even though the surrounding woodland has almost entirely degenerated. Several of the marginal sites on the western and northern fringes of the study area fall into this category. The species is also common on Gibraltar (Alexander Menez, pers. comm.), occurring in a variety of habitats but often associated with human habitation and where refuse is discarded.

During the course of this study many of the *Macrothele* specimens examined were found with a number of mites on the cephalothorax, usually in and

around the fovea. These mites proved to be a new species of *Androlaelaps* Berlese (Acari, Mesostigmata), a genus normally associated with small mammals and birds. A description of this species is in preparation by Dr Anne Baker of the BM(NH), London.

Web, prey and prey capture

The web of *M. calpeiana* resembles that of certain agelenids, but lacks the sheet structure seen in *Tegenaria* and *Agelena* spp. The subterranean portion comprises a flimsy lining of silk applied to the pre-existing hole or crevice which, in some cases, may have been enlarged to some extent by the spider. This spider is not, however, morphologically adapted for digging, having no rastellum or specialised front legs or palps. The aerial portion of the web is relatively small, up to about 10 cm wide, and is of fine white silk with sometimes one but usually two or three entrances. The whole structure is supported by threads attached to the surrounding vegetation or earth. Occasionally, webs were found with no aerial portion.

In the laboratory, the spiders were often seen waiting in one of the entrances with the first two pairs of legs protruding in a manner similar to that seen in *Agelena* or the larger *Segestria* spp. This feeding posture was not observed diurnally in the field, suggesting that most feeding occurs nocturnally.

The identifiable prey remains from 2 webs contained the following;

(1)	Weevils (Curculionidae)	23
	Beetles (Carabidae)	1
	(Scarabidae)	1
	Heteroptera	1
	Earwigs (Dermaptera)	2
	Ants (Formicidae)	
	Camponotus sp.	17
	Pheidole pallidula (Nyl.)	3
	Formicines (Unidentified)	5
(2)	Weevils (Curculionidae)	3
	Heteroptera	1
	Bees (Apidae)	1
	Millipedes (Myriapoda)	1

In the laboratory, spiders were fed on a variety of prey and, although the spiders caught some more quickly and with less preliminary investigation than others, none was rejected. The prey items ranged from mealworm (*Tenebrio*) beetles and larvae up to 15 mm, moths (Lepidoptera) up to 20 mm, honey bees (males and workers), large flies (Diptera) and several species of spiders including sub-adult *Tegenaria* sp. The web contents probably reflect local prey availability rather than prey selection. During the winter months (approximately November to February) the spiders become less active; the aerial web is allowed to degenerate and the entrances are sealed. However, the spiders respond very rapidly to short periods of hot dry weather at any time throughout the winter by opening up the entrances and repairing the web (Betty Allen, pers. comm.).

Courtship and mating

Most male activity has been recorded during March, April and May, although adult males have been recorded as early as 24 February and as late as 2 June. During the period of this study (April) no females were found with egg sacs, suggesting that egg-laying takes place somewhat later in the year. Although on several occasions males were found under the same stone as females, they were always in separate webs or parts of the web. No courtship or mating was observed in the field.

To observe courtship and mating behaviour, three adult females were housed in separate clear plastic boxes 30 × 18 cm containing peat and a section of tree bark. After one week the spiders had built webs, and an adult male was introduced into each tank. In each case the male approached the entrance to the web and entered with no apparent preliminary courtship display or investigation. Owing to the construction of the sub-terranean portion of the web it proved impossible to observe mating behaviour by this method. The male was left in the female's web overnight. In two cases the male was found alive outside the female's web the following morning. The other male remained in the web for 3 days arid was eventually found dead just out-side the entrance. It had been bitten posterolaterally in the cephalothorax but apparently no attempt had been made to eat the remains.

In order to observe mating behaviour in more detail a female was placed in a transparent plastic box with a stone floor. After an hour for her to acclimatise, an adult male was introduced into the box. After a short time the male encountered the female and immediately attempted to mate. On first contact the female turned to face the male and reared up into the normal mygalo-morph defensive posture with the first two pairs of legs raised, the cephalothorax nearly vertical and the fangs raised. The male then also reared up and a short period (10-20s) of "grappling" ensued, both animals using the first two pairs of legs. The female almost immediately closed her fangs. In nearly all cases a virtually identical

Fig. 8: *Macrothele calpeiana* (Walckenaer). Mating position. Male on right.

mating position (Fig. 8) was achieved within 30s. During this time no obvious stridulation or other vibratory behaviour was seen. However both spiders were possibly stridulating throughout this preliminary activity. In the "typical" mating position the tarsi and metatarsi of legs I of the male were pushed against the sternum and closed fangs of the female while the tibiae and metatarsi II gripped the base of femora II of the female. The first pair of legs of the male in no way appeared to lock the fangs of the female, as neither they nor the second pair carry any of the spurs or other modifications seen in certain other mygalomorphs. As soon as this position was achieved the female became quiescent. The male then inserted the tip of the embolus into the genital aperture. This was done by reaching well beyond the genital aperture, turning the palp extero-laterally through 90° and bringing the tip of the embolus, with a small movement of the bulb, into a dorsal position. This procedure is probably necessitated by the extreme length and relative immobility of the embolus. Following the location of the tip, nearly the entire length of the embolus was pulled into place. At the same time the male pulled with legs II, forcing the cephalothorax of the female even further back. Palpal insertions alternated, each lasting 15-20s. The mating lasted between 30 and 120s although these times may have been affected by the highly artificial environment. When disengaging from the female, the male main-tained contact with at least one leg I while backing away and holding the palps very high. Having broken contact, the male usually ran a short distance but was seldom followed by the female.

It is interesting to note that the mating position of *M. calpeiana* described above is very similar to that of *Atrax* (=*Hadronyche*) *formidabilis* Rainbow (Scott, 1980). In both species, leg II of the female is gripped at the base of the femur by leg II of the male and the first legs of the male press against the female's fangs. In the latter, however, the tarsi/metatarsi of legs I of the male are crossed and force the chelicerae of the female apart. This was not observed in *M. calpeiana*.

Further observations are necessary to determine whether mating normally takes place in the female's burrow or outside. The male will usually first encounter the female in the entrance to the burrow, so mating may take place there. Also the observed mating posi-tion might not be feasible within the confines of the burrow.

Macrothele cretica Kulczynski, 1903 (Figs. 5-7)

Macrothele cretica Kulczynski, 1903: 33, 35; Simon, 1903: 967; Bonnet, 1957: 2691 (full bibliography).

Male

Colour: In life, unknown. Description is of one preserved specimen (all measurements in mm). Total length (excluding spinnerets) 14.4. *Carapace:* Length 6.2, width 5.2. Mid red-brown with many darker stria-tions radiating from fovea. Very few hairs, mostly on striae and central longitudinal line, 3 bristles in ocular area. Some stronger hairs around margin, particularly
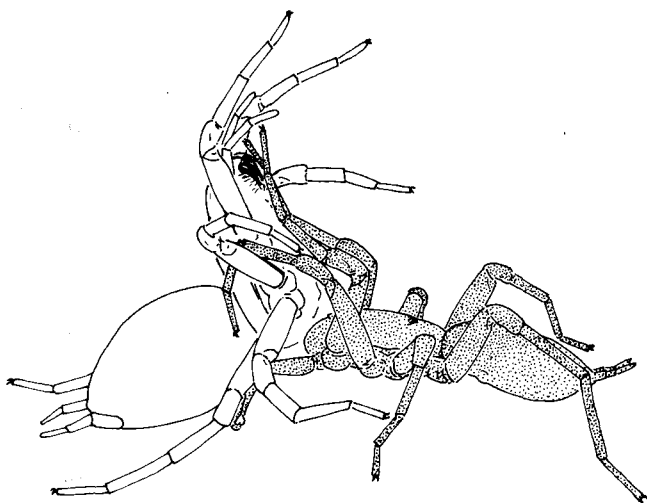
posteriorly. Lacking fine pilosity of *M. calpeiana*. Ocular area scarcely raised. *Eyes:* On very low tubercle, group occupying 0.3 of width of head. AME circular, rest suboval although posterior row rather ill-defined in shape. ALE larger than rest, AME:ALE 1:2.2. Anterior line straight, posterior line slightly recurved. Relative eye interspaces: AME-AME 4.7, AME-ALE 2.7, ALE-PLE 1.0, PME-PLE contiguous, PME-PME 13.3. *Chelicerae:* No rastellum. Distally covered in short strong hairs. Groove with 11 medium to large teeth on promargin. Retromargin with 7-14 denticles in irregular basal row. *Labium:* With 29 cuspules. Fused to sternum by broad labio-sternal sigillum. *Maxillae:* Numerous cuspules on inner angle. *Sternum:* Oval, widest between legs II and III, width approximately 0.9 of length. Sparsely clothed with stout erect hairs, particularly round margins. Six oval sigilla present, largest posterior, smallest anterior, all separated from margin by a little less than their own length. 16 lyriform organs present. *Abdomen:* Pale yellow-grey. Clothed with strong hairs interspersed with fine, decumbent hairs, 3 pairs of impressed dots dorsally. Genital area unsclerotised. *Legs:* Formula IV, I=II, III. All legs relatively shorter than in *M. calpeiana*, particularly I and II. All tarsi with sparse scopula not extending to metatarsus. Spines present on all tarsi (2 ventral rows and several individuals). Mt I with 20-22 very large ventral spines (Fig. 6). Tibia II modified proximally with a low ventral mound on which are 3 extremely large spines plus several smaller ones (Fig. 7). These are not described here as "mega-spines" (*sensu* Raven, 1980) as no cuticular apophysis is present. Metatarsi carry distally a small comb-like arrangement of 3 contiguous spines both postero- and anteroventrally. On Mt IV only the posteroventral "comb" is present, comprising 4 spines. Lyra absent. Superior claws with single sigmoid row of 9 teeth curving from inner to outer surface. Inferior claw with 1-2 very small basal teeth. *Spinnerets:* Four. Posterior medians small, single-segmented. Posterior laterals long, 3-segmented, with retrolateral subsegmentation of basal segment. Posterior laterals approximately 1.5 times length of labiosternum. *Palp* (Fig. 5): Ventral surface of femur with some stout hairs. Tibia swollen, ventral surface with long hairs. Ventral and prolateral surface of tibia with 12 irregularly-placed spines. Bulb simple, pyriform; embolus long, slightly curved, proximally broad but distal 0.6 of length considerably attenuated; together approximately same length as palpal tibia.

Female

No adult females were available for examination.

Material examined

Crete: 1♀ inad. syntype, Homalos±1000m, I.Z.P.A.N., Warszawa, 76/51.U., Coll. L. Kulczynski. Homalos, 1♂, 1 sub.♀, (BMNH 1963.6.6.17).

Remarks

This species, the only other *Macrothele* recorded from Europe, was originally described from a male and a non-adult female and subsequent literature has been extremely sparse. There being no modern description or figures, it was considered that a redescription would be useful and might stimulate interest in this little-known species.

Acknowledgements

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Effects of hunger on prey capture and ingestion in *Dugesiella echina* Chamberlin (Orthognatha, Theraphosidae)

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Summary

The effect of varying levels of food deprivation on prey capture and ingestion in *Dugesiella echina* was investigated. The strike response, capture success, awareness field, tendency to capture consecutive prey and ingestion time improved significantly as a function of increasing hunger levels. The position of the spider relative to that of its prey as well as the running speed of the prey had pronounced effects on capture success. The significance of hunger and its relationship to the feeding behaviour of this spider is discussed.

Introduction

Recent behavioural and neuroethological investigations of predatory behaviour in arthropods have identified numerous parameters which affect its occurrence (see reviews by Curio, 1976; Feder & Lauder, 1986) in addition to characterising the integrative role of the central nervous system in the control of hunting behaviours (Camhi, 1984; Punzo, 1985, 1988; Punzo & Malatesta, 1989). There has been a great deal of interest in identifying those factors which determine when and to what extent a potential predator will initiate the search for prey (Krebs, 1978). Among internal physiological factors, the degree of hunger (food deprivation) often determines when foraging and prey search tactics are initiated (Dixon, 1959), the duration of search and pursuit behaviours (Krebs, 1978), the capture rate (Holling, 1966), the range of prey species acceptable as food (Beukema, 1968; Anderson, 1974), and the distance over which a predator can detect its prey (Drees, 1952; Holling, 1966; Dethier, 1982; Bleckmann & Lotz, 1987). Thus, hunger is a

primary factor in determining the degree of readiness of a predator to respond to the presence of a potential prey organism. This is particularly applicable to spiders in that the amount of food ingested can remain within the digestive system for long periods of time (Anderson, 1974; Foelix, 1982) resulting in a broad spectrum of hunger levels (Nakamura, 1987) even though food deprivation can be tolerated for prolonged periods (Baerg, 1958; Anderson, 1974).

Most of the previous research on predation in spiders has focused on factors influencing the types of prey captured (Morse, 1979; Roach, 1987), primary sensory cues utilised in prey capture (Den Otter, 1974; Forster, 1982; Bleckmann & Lotz, 1987), the sequential analysis of the units of predatory behaviour (Drees, 1952; Robinson, 1969; Lubin, 1980), sites chosen for prey capture (Morse, 1987; Roach, 1987), and ecomorphological factors associated with hunting behaviour (Rovner, 1980; McReynolds & Polis, 1987). Relatively few studies have addressed the relationship between hunger and predation. In an early study on the hunting behaviour of the salticid spider, *Epiblemum scenicum* (Clerck), Drees (1952) showed that the size of acceptable prey increased as a function of increasing food deprivation. Gardner (1964) demonstrated that all behavioural components of the hunting sequence are enhanced by increasing levels of hunger in the salticid, *Phidippus clarus* Keyserling. More recently, Nakamura (1972, 1987) has shown that the amount of food ingested by the wolf spider, *Pardosa laura* Karsch, is largely determined by the degree of distension of the gut.

The purpose of the present study was to investigate the relationship between hunger and prey capture in the tarantula spider, *Dugesiella echina* Chamberlin. North American theraphosid spiders, such as *D. echina,* are excellent examples of sit-and-wait predators (Schoener, 1969). Long-lived females that occupy a single burrow for several years may be periodically exposed to prolonged periods of fasting when prey availability is low (Baerg, 1958; Minch, 1977, 1978). Although little information is available on the feeding