

Aspects of the natural history and behavioural ecology of the tarantula spider *Aphonopelma hentzi* (Girard, 1854) (Orthognatha, Theraphosidae)

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Summary

Studies were conducted on various aspects of the natural history and behavioural ecology of *Aphonopelma hentzi* from the Chihuahuan Desert. In this spider there is strong sexual dimorphism with respect to body size, with females considerably larger than males. Female pedipalps and fangs were also larger; males possessed longer legs and a smaller tibial index. The relative clutch size (number of eggs/egg sac) ranged from 206–911 with a mean of 588.1 ± 49.6 S.E. There was a significant correlation between female carapace length and clutch size, as well as between clutch size and the number of spiderlings hatching from an egg sac. Percent hatching success was variable and ranged from 15–96%. Under controlled laboratory conditions ($25.5 \pm 1.0^\circ\text{C}$, 72% relative humidity) the amount of time required to complete embryonic development ranged from 74–91 days (mean 79.6 ± 4.1 S.D.). These spiders were strictly nocturnal at this study site and were most active between 2000 and 0100 h. Adult male and female activity decreased markedly after 0200 h. Adult males were most active (41%) at the ground surface during July. Females were most frequently observed at their burrow entrances during July as well. A small percentage of males (3%) were observed at the surface as early as March. Surface activity of males decreased markedly in August (15%) and September (7%). No males were observed from the beginning of October to the end of February. This spider feeds on a wide variety of arthropod prey. The diets of females were characterised by a significantly higher proportion of beetles (43.4% vs. 19.1% in males) and sand cockroaches (10.5% vs. 2.1%), whereas males fed on a higher proportion of locusts and grasshoppers (23.4% vs. 11.8% in females) and Lepidoptera (11.2% vs. 0%). Other arachnids (scorpions, wolf spiders, solifuges) comprised between 13 and 17% of the diet. The courtship and mating activities of this spider are similar to those reported for other mygalomorph spiders. However, there is a higher degree of intersexual cannibalism and of mortality resulting from male–male interactions.

Introduction

Although theraphosid spiders (“tarantulas”) have attracted a great deal of attention from arachnologists and amateur arachnophiles owing to their formidable appearance and remarkable longevity, relatively few species have been studied in any detail. Furthermore, although many species have been bred in captivity for the pet trade, there is a paucity of morphometric data on growth rates, allometric relationships, size and age at sexual maturity, and other parameters associated

with post-embryonic development (MacCook, 1887; Petrunkevitch, 1934; Stradling, 1978; Clarke, 1991; Marshall & Uetz, 1993). Individuals who keep and breed theraphosid spiders as pets can be notoriously secretive and frequently do not keep detailed morphometric records. In other cases, recorded data are often not published and are therefore unavailable for comparative analyses. In addition, relatively few comprehensive studies have been conducted on the natural history and ecology of theraphosids in the field (Baerg, 1958; Cloudsley-Thompson & Constantinou, 1985; Charpentier, 1992; Stradling, 1994). Finally, the taxonomy of the Mygalomorphae is poorly understood and has only recently been addressed from a worldwide perspective (Raven, 1985).

Baerg (1928, 1929, 1938, 1958) was among the first to report on the natural history of theraphosids (*Aphonopelma hentzi* (Girard), formerly placed in the genera *Eurypelma* and *Dugesiella*). Minch (1977, 1978a,b, 1979a,b,c) studied various aspects of the ecology and behaviour of *Aphonopelma chalcodes* Chamberlin from the Sonoran Desert. Although theraphosids are predominantly South American in distribution, few tropical species have been investigated. Galiano (1969), Célérier (1986), and Costa & Perez-Miles (1992) reported on some aspects of the life cycle of *Grammostola pulchripes* (Simon), *Scodra griseipes* Pocock (= *Stromatopelma calceatum* (Fabricius)) and *Ceropelma longisternale* Schiapelli & Gerschman. Annual activity patterns have been described for *Dugesiella* (= *Aphonopelma*) *hentzi* from Arkansas (Baerg, 1958), *A. chalcodes* from Arizona (Minch, 1979a), and *Selenocosmia stirlingi* Hogg from Australia (Kotzman, 1990). Diel patterns of activity have been reported for *A. chalcodes* (Minch, 1978b), *Avicularia avicularia* (L.) (Cloudsley-Thompson & Constantinou, 1985), and *Aphonopelma seemanni* (F.O.P.-Cambr.) (Herrero & Valerio, 1986).

In this paper we report on some aspects of the natural history and behavioural ecology of the tarantula spider *Aphonopelma hentzi* from the Trans Pecos region of western Texas. We collected data on the following parameters: morphometric data on adult males and females, relative clutch size (number of eggs per egg sac) and its relationship to female body size (carapace length), the number of spiderlings that emerged from each egg sac (percent hatching success), the time required for egg sac development (gestation period), diel and annual patterns of activity, the relationship between ground surface temperature and burrow temperature, diet composition, courtship behaviour, and interactions between conspecific males. To our knowledge, no detailed studies have previously been published concerning these parameters for *A. hentzi* from the Chihuahuan Desert.

Description of study area

The study area was located in Big Bend Ranch State Park (Brewster County, Texas, USA) which lies within the northern region of the Chihuahuan Desert. We

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chose a 2 km area along Madera Canyon starting at the entrance to the canyon which is located directly off State Road 170 (5.46 km NW of Lajitas, Texas) (29°17'30"N, 103°55'04"W; elevation 814 m). The soils along the canyon floor are a mixture of sand, gravel and adobe, and support a predominantly sotol-lechuguilla plant community. The dominant vegetation includes lechuguilla (*Agave lechuguilla*), sotol (*Dasyllirion leiophyllum*), creosote (*Larrea divaricata*), mesquite (*Prosopis glandulosa*), tarbrush (*Flourensia cernua*), catclaw acacia (*Acacia berlandieri*), false agave (*Hechtia texensis*), cane cholla (*Opuntia imbricata*), prickly pear cacti (*Opuntia engelmannii*), and scattered clumps of grasses including chino gramma (*Bouteloua breviflora*), and fluffgrass (*Erioneuron pulchellum*). Numerous large rocks and boulders are scattered along the canyon floor.

Aphonopelma hentzi occurs throughout this area. Adult females either excavate their own burrows or occupy burrows abandoned by rodents (pers. obs.). Although adult males may occupy a burrow, they are more frequently found within rock crevices or beneath rocks. The early instars, although rarely observed or trapped, are typically found beneath rocks or decaying vegetation in this area. We have never found an early instar spiderling within a burrow. The larger immatures are occasionally found in burrows but appear to prefer rock crevices, and are sometimes found within crevices along the sides of rocky canyon walls up to 4 m off the ground. Previous observations over a 16-year period (unpublished data) have established that although *A. hentzi* is a univoltine species, females may fail to produce an egg sac during years that are unusually dry (pers. obs.).

Methods

Immatures and adult males were collected during 1996 through the use of pitfall traps and by hand as they were encountered walking along the surface of the ground. Plastic pitfall traps (depth 15 cm, diameter 20 cm) were placed along the walls of the canyon at 3 m intervals and at various locations near the bases of mesquite and creosote bushes, as well as in front of prominent rock crevices that opened near the ground surface. We also collected adult females from their burrows. Occupied burrows were marked and identified by the presence of a silk covering over the burrow entrance as described by Punzo (1989, 1991). The following data were recorded for each spider within 5 h after collection: time and location of capture, sex and weight of spider, and various morphometric measurements (see below). Weights were determined using a portable Metler electronic analytical balance. In those instances where a spider had a prey item in its chelicerae, the item was removed and placed in 70% ethanol for subsequent identification as described by Punzo (1995). Data on the time and date of capture were used to determine diel and annual patterns of activity as described by Punzo (1997a). Ground surface temperatures as well as the temperature at the deepest point of 45 burrows were recorded with an Omnitron

thermocouple thermometer (Model 100, Ward's Inc., Rochester, New York).

A Unitron Model 110A dissecting microscope fitted with an ocular micrometer was used to measure a number of morphometric parameters including the length of the body, carapace, palps, legs I and IV, and fangs. The tibial index (Petrunkevitch, 1929), a measure of relative leg thickness, was also calculated for each adult spider (patella width of leg I divided by patella+tibia length of leg I multiplied by 100). Morphometric data were tabulated for 400 males and for 45 females that produced a fertilised egg sac.

Egg sacs were transported back to the laboratory and allowed to develop in a Percival Model 816 environmental chamber. We used a microdissection scissor, fine-pointed forceps, and a thin plastic probe to carefully cut through the outer envelope of the egg sac in order to count the eggs. This was done under a dissecting microscope to ensure that no eggs were destroyed. After counting the eggs the excised silken flap was replaced so that the eggs were no longer exposed. The number of eggs per egg sac was used as a measure of the relative clutch size. We also determined the relationship between clutch size and carapace length. These egg sacs were maintained at $25.5 \pm 1.0^\circ\text{C}$ and 72% relative humidity (RH). This temperature interval and RH value lie within the preferred temperature range and optimal moisture conditions for theraphosids from this region (Punzo, 1991). Upon completion of embryonic development, we recorded the number of spiderlings hatching from each egg sac for comparison with the original number of eggs deposited. The amount of time required for embryonic development was also recorded.

We also observed staged encounters in the field between conspecific adult males ($n=27$) and staged encounters between males and females during courtship (total number of encounters was 178; 84 of these were with females that did not attack the male immediately and engaged in at least the initial stages of courtship). All observations were conducted at night under red light to minimise disturbance to the animals. Courtship data are based on observations made over a three-year period, between late June and early August, 1993, 1995 and 1996. Previous observations had indicated that mating activity occurs most frequently during this period (unpublished data). We recorded the types of

	Males (n=400)	Females (n=45)
Body mass (g)	7.3 \pm 1.1	12.4 \pm 2.3
Body length	39.6 \pm 2.6	53.7 \pm 4.3
Carapace length	13.1 \pm 0.9	19.9 \pm 2.1
Length of palp	29.7 \pm 3.1	38.2 \pm 2.9
Length of leg I	62.1 \pm 5.2	54.1 \pm 3.4
Length of leg IV	66.9 \pm 4.2	59.7 \pm 5.1
Fang length	6.3 \pm 0.7	8.1 \pm 0.4
Tibial index ^a	11.9	12.9

Table 1: Morphometric data for adult males and females of *Aphonopelma hentzi*. Values represent means \pm S.D. All measurements are in mm unless otherwise noted.

^aThe tibial index (Petrunkevitch, 1929) is a measure of relative leg thickness (patella width of leg I divided by patella+tibia length of leg I multiplied by 100).

behavioural acts elicited by males and females during staged mating encounters and determined the phenology of courtship and mating for this species. Burrows occupied by previously identified females were chosen for mating encounters. Each burrow was covered with a dome-shaped hemispherical structure, 20 cm in height and 40 cm in diameter, constructed of fine-mesh aluminium window screening and provided with a gated aperture on top through which a male spider could be introduced. The dome was positioned so that the burrow of the female was at its centre. The dome ensured that the male would remain in the vicinity of the female and that no other animals could move into the area during mating trials. Each male–female encounter was staged only once for any given spider. An adult male (mean mass 7.2 ± 0.2 g) was chosen randomly for each of the 84 mating encounters. During each mating trial a male was introduced into the domed structure covering the occupied female burrow and was observed carefully from the time of entry until all interactions with the female were completed.

Staged encounters ($n=27$) between conspecific males were also conducted under the dome. For each encounter trial, two randomly chosen males were placed at opposite ends of the dome in rapid succession and then allowed to interact. All males were used only once in these trials.

All statistical procedures used throughout this study (t-tests, goodness-of-fit G statistic) follow those described by Sokal & Rohlf (1981) and were conducted using JMP 2.0 for the Macintosh (SAS Institute).

Results

Morphometric data and reproductive parameters

The morphometric data for *A. hentzi* males and females are listed in Table 1. As with many theraphosids, adult females are considerably larger than males in both body length and mass. Female palps ($t=9.8$, $p<0.01$) and fangs ($t=6.2$, $p<0.05$) are larger than those of males. Males possess longer legs and a smaller tibial index.

The relative clutch size (number of eggs per egg sac) ranged from 206–911 with a mean of 588.1 ± 49.6 S.E. ($n=45$ egg sacs). The percentage of egg sacs containing various numbers of eggs is shown in Table 2. The

Number of eggs/egg sac	Percent
206–276	2.2
277–347	0
348–417	11.1
418–488	11.1
489–559	15.6
560–629	4.5
630–700	4.4
701–770	8.9
771–841	33.3
842–911	8.9

Table 2: The percentage of egg sacs ($n=45$) containing various numbers of eggs for *Aphonopelma hentzi*.

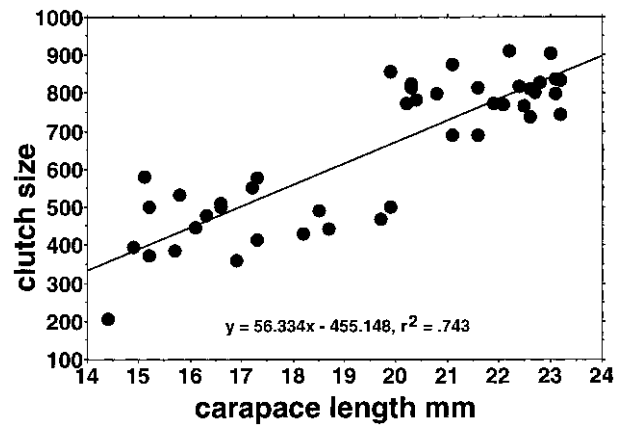


Fig. 1: Relationship between clutch size (number of eggs per egg sac) and carapace length in adult females of *Aphonopelma hentzi* from the Chihuahuan Desert ($n=45$). Regression equation shown on diagram.

relationship between female carapace length and clutch size ($n=45$) is shown in Fig. 1 ($y=56.334x - 455.148$, $r^2=0.743$, $p<0.0001$). The apparent profile of the data into two clusters is a result of the particular size classes sampled in this study. The relationship between the number of eggs in an egg sac and the number of spiderlings hatching from those eggs is shown in Fig. 2 ($y=0.859x - 61.944$, $r^2=0.675$, $p<0.001$). Percent hatching success was variable and ranged from 15–96%. Under controlled laboratory conditions the amount of time required to complete embryonic development ranged from 74–91 days (mean 79.6 ± 4.1 S.D.).

Diel and annual patterns of activity

These spiders are clearly nocturnal in their diel activity patterns and are most active between 2000 and 0100 h (Fig. 3). Males ($n=400$) were most frequently (38.7%) observed wandering over the surface of the ground between 2200 and 2400 h. Females ($n=45$) were most frequently observed (31.3%) at the entrances to their burrows during this time interval as well. Some females (2.3–4.7%) were first observed to position themselves at the burrow entrance between 1400 and 1600 h (no males were active at the surface during this time). Male and female activity decreased markedly after

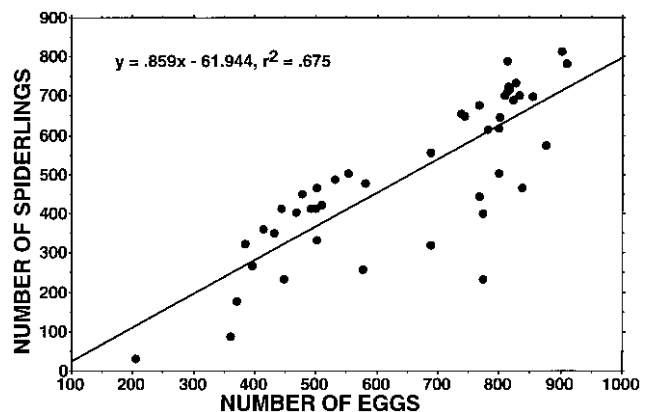


Fig. 2: Relationship between number of eggs per egg sac and number of spiderlings hatching from those eggs for *Aphonopelma hentzi*. Regression equation shown on diagram.

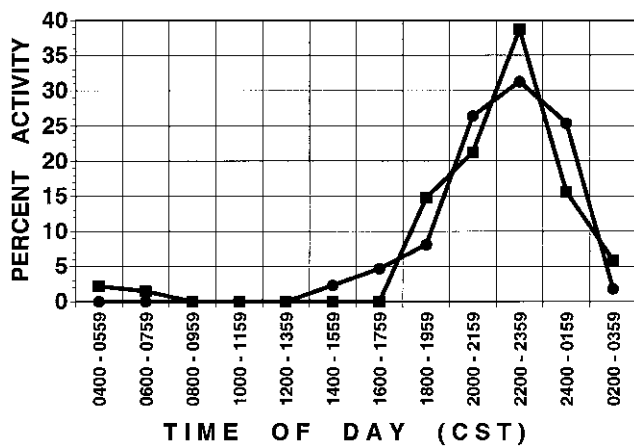


Fig. 3: Diel patterns of activity for *Aphonopelma hentzi*. Data expressed as the percentage of the total number of spiders observed over four 24 h periods during July. Squares represent data for adult males ($n=400$) observed wandering at the ground surface. Circles represent data for adult females ($n=45$) found within the entrances to their burrows.

0200 h. Although a few males were active between 0400 and 0800 h (3.7%), no females were observed at their burrow entrances during this time interval. Males were also more active than females between 0200 and 0400 h.

The phenology of adult male locomotor activity is shown in Fig. 4. Males are most active at the surface of the ground during July (41%) at this study site. Females were most frequently observed at their burrow entrances during July as well. A small percentage of males (3%) were observed at the surface as early as March (these would have been survivors from the previous year). Activity decreased markedly in August (15%, $G=11.1$, $p<0.01$) and September (7%). No males were observed from the beginning of October to the end of February.

Surface and burrow thermal relationships

The relationship between ground surface temperature and the temperature at the deepest region of the burrows (on 3 July 1996) is shown in Fig. 5. Burrow temperatures remained relatively constant, between 26 and 29°C. Even at a high ground surface temperature of 59°C, the concomitant temperature within the burrow was only 29°C (at 1400 h). Between 2200 and 0600 h, surface temperatures were slightly lower than burrow temperatures.

Diet composition

Aphonopelma hentzi feeds on a wide variety of prey (Fig. 6). The diets of females (found with a prey item in their chelicerae at the entrance to their burrows) were characterised by a significantly higher proportion of beetles (Coleoptera, 43.4%; $Z=9.01$, $p<0.01$) and cockroaches (Blattaria, 10.5%; $Z=11.7$, $p<0.01$) than those of males (19.1 and 2.1% respectively) collected while wandering over the ground surface. In contrast, males fed on a higher proportion of Orthoptera (23.4%; $Z=8.6$, $p<0.01$) and Lepidoptera (caterpillars and

adults, 10.6%; $Z=12.4$, $p<0.01$) as compared with females (11.8 and 0% respectively). Other arachnids (scorpions, wolf spiders, solifuges) comprised between 13 and 17% of the diet. None of the spiders in this area were found with vertebrate prey although we have observed *A. hentzi* males and females feeding on the gecko *Coleonyx brevis*, as well as on juvenile snakes (Western Diamondback Rattlesnake, *Crotalus atrox*; Southwestern Black-headed Snake, *Tantilla hobartsmithii*) at study sites further south (unpublished data).

Mating activity and interactions between conspecific males

Males moved around the ground surface under the dome until they came within a short distance (<2 cm) of the burrow entrance. Seventy-nine of the 84 males tested (94%) then exhibited a rapid, synchronous raising and lowering of the first pair of legs so that they made contact with the ground in a forceful manner (referred to as "tapping" behaviour by Coyle & O'Shields, 1990). The remaining 6% of the males tapped the ground with both the first and second pairs of legs. This was followed by a series of up and down alternating movements of the pedipalps which struck the ground at regular intervals ("palpal drumming", 100%) and a subsequent shaking of the entire body. These signals caused receptive females to remove the silken covers from the burrow entrance (if present) and move out of the burrow on to the ground surface with the anterior end of their body facing the male. Males and females then initiated contact with one another by tapping each other's body and legs with their first pair of legs. This behaviour has been referred to as "leg fencing" (Coyle, 1985; Costa & Perez-Miles, 1992). All females responded to the tactile stimuli of the male by exhibiting a classic threat display (elevation of the anterior end of her body as well as raising the first pair of legs and opening her chelicerae). The male would continue to tap the body of the female with his forelegs and then clasped the female's fangs with his tibial spurs. By pushing against the female the male caused a further elevation of her prosoma and

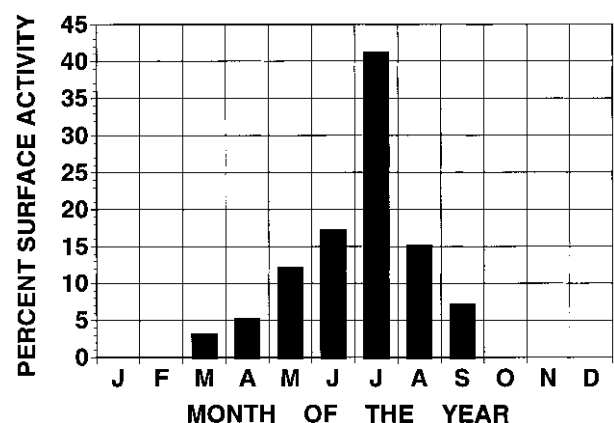


Fig. 4: Seasonal locomotor activity pattern for adult males of *Aphonopelma hentzi*. Data expressed as the percentage of males ($n=400$) observed actively wandering over the ground surface during the course of one year (January through December).

abdomen. To achieve insemination, the male quickly inserted his left and right palpal organs alternately into the female's genital opening. Typically, each male inserted the tip of each organ two or three times; the duration of the insertions ranged from 13–27 s (mean 19.3 s, \pm 2.21 S.D.). The male then withdrew quickly and attempted to leave the vicinity of the female.

During courtship, all males exhibited leg fencing behaviour, and all receptive females exhibited the threat display. Following the threat display, 28 out of 84 females (33.3%) struck at the male with their fangs. In 17 cases (20.2%), the female grasped and killed the male. Seven of these dead males (41.2%) were released with no attempt being made to feed upon them; the remaining 10 males (58.8%) were ingested by the female.

Agonistic interactions between males were observed in 24 out of the 27 staged encounters (88.9%). In the remaining 3 trials, the males rapidly fled away from one another after making initial contact with their forelegs. All male–male agonistic encounters were initiated by vigorous leg fencing, each protagonist pushing forcefully against its opponent. In 18 out of 24 encounters (75%), at least one of the males exhibited a threat display. At least one male exhibited a strike response toward his opponent in 11 out of 24 cases (45.8%). In 8 of these cases (33.3%), one of the males was killed.

Discussion

As a general rule, larger spiders tend to lay more eggs (Bristowe, 1939; Briceño, 1987; Marshall & Gittleman, 1994). Nonetheless, clutch sizes for theraphosid spiders can be quite variable (Table 3). Smaller species such as *Grammostola burzaquensis* Ibarra-Grasso and various species of *Avicularia* are characterised by relatively small clutch sizes (12–221 eggs/egg sac). Large species of *Pamphobeteus* deposit large numbers of eggs (1,200–2,000). However, the goliath birdeater *Theraphosa leblondi* (Latreille) (weighing up to 70 g, with a leg span of 25 cm), one of the largest spiders in the world, lays a surprisingly small number of eggs (78 ± 5.57 S.D.); although clutch size is low, the size of the eggs is considerably larger than that of other theraphosids (210–

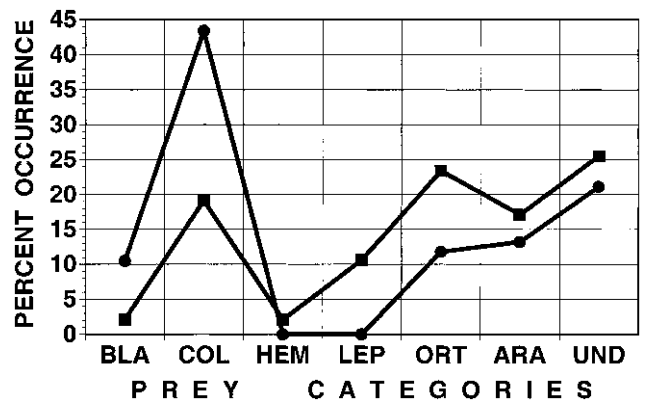


Fig. 6: Percentage of various arthropod prey types in the diet of *Aphonopelma hentzi*. Squares represent data for males: prey items in the chelicerae of male spiders as they were found wandering over the surface of the ground. Circles represent data for females: prey items found in the chelicerae of females at their burrow entrances. BLA (Blattaria — sand cockroaches); COL (Coleoptera); HEM (Hemiptera); LEP (Lepidoptera, caterpillars and adults); ORT (Orthoptera — grasshoppers, locusts and katydids); ARA (Arachnida — spiders, scorpions, solifuges); UND (prey items unidentified owing to advanced stages of digestion).

220 mg each) (Marshall & Uetz, 1993). Apparently, having larger spiderlings developing from larger eggs is one of the primary mechanisms by which this spider achieves its formidable size. Clutch sizes for species of the genus *Aphonopelma* range from 206–1,018 (Table 3). In the present study, clutch sizes for *A. hentzi* from the Chihuahuan Desert ranged from 206–911, and clutch size was a function of female body size (as measured by carapace length). Indeed, clutch size increases with increasing body size for all spider taxa studied thus far (Marshall & Gittleman, 1994). Baerg (1958) reported a clutch size ranging from 500–1,000 for *Dugesiella* (= *Aphonopelma*) *hentzi* from a more mesic habitat.

In spiders, the time required for egg production and incubation can be quite variable (Foelix, 1996). In many tropical species, females may deposit egg masses within a few weeks after mating whereas temperate species may wait for several months. The eggs of spiders mature internally and the time at which they are deposited is influenced by a number of factors including age of the female, the time since the last moult, nutritional factors and temperature (Schaeffer, 1987). The duration of egg sac development (gestation) is also quite variable for various species of theraphosids. Gestation periods ranged from 29 to 62 days for *A. avicularia* from Trinidad (Stradling, 1994). Costa & Perez-Miles (1992) reported a gestation period of 49 days for *C. longisternale* from Uruguay. Comparable gestation periods have been reported for *Grammostola burzaquensis* (Ibarra-Grasso, 1961). A 77-day incubation period has been reported for *T. leblondi* (Marshall & Uetz, 1993).

In the present study, the gestation period for *A. hentzi* ranged from 74–91 days. The percentage of spiderlings that hatched from a given egg mass was also variable, ranging from 15–96%. It is not known whether this discrepancy between the number of eggs deposited and the number of resultant hatchlings is due to the failure of

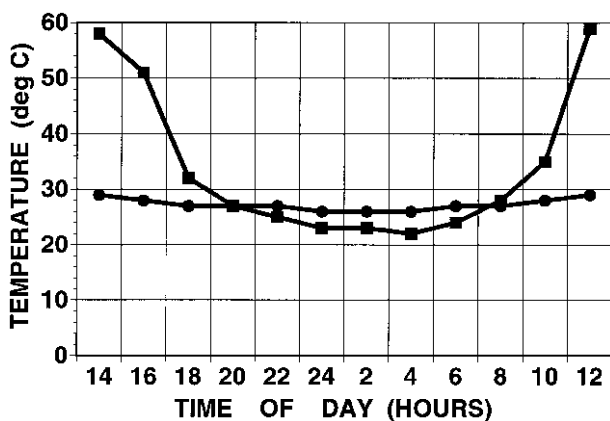


Fig. 5: Relationship between ground surface temperatures (squares) and the temperature at the deepest region of the burrows (circles) of *Aphonopelma hentzi* (n=45 burrows).

some eggs to be fertilised, mortality during embryonic development, or both.

Aphonopelma hentzi is a nocturnal species that is most active during July in this region of the Chihuahuan Desert. This species is more strongly nocturnal in its locomotor activity than *A. chalcodes* from the Sonoran Desert (Minch, 1978b). This is in general agreement with the nocturnal activity patterns reported for other species of theraphosids (Baerg, 1938, 1958; Hjelle, 1972; Minch, 1977; Main, 1982; Herrero & Valerio, 1986; Cloudsley-Thompson & Constantinou, 1985; Formanowicz & Ducey, 1991; Janowski-Bell, 1995; Breene *et al.*, 1996). Theraphosid activity patterns are stimulated by decreasing overhead light intensity (Minch, 1978b), surface temperatures (Minch, 1977; Punzo, 1991), and circadian rhythms (Cloudsley-Thompson, 1981).

Aphonopelma hentzi females often remained in their burrows for extended periods of time; in some cases, females did not approach the burrow entrance for up to six weeks. When active, fossorial female theraphosids will position themselves in the burrow entrance and wait for potential prey to pass by in close proximity. While in this position, females often remain motionless for prolonged periods of time (5–56 min). These spiders line their burrows with silk and maintain contact with the silk around the burrow entrance using their pedipalps and the tarsal claws of legs I and II. Females were rarely observed to move more than a few cm (<7 cm) from their burrow entrance. Some females of *A. chalcodes* were reported to move further away (up to 46 cm) from their burrow entrances (Minch, 1977, 1979c). However, even in these cases, the females always maintained contact with a silk dragline that formed an interlacing network on the ground leading back to the burrow. Although the purpose for leaving the burrow is not clearly understood, it may be associated with burrow maintenance and the removal of soil during burrow enlargement, and probably also serves to establish a network of draglines around the burrow which can be used to detect prey. Females of *A. hentzi* rapidly retreated into their burrow when confronted with any type of strong ground vibrations not associated with

the normal locomotor movements of potential prey. Occasionally, a female would leave her burrow immediately after heavy rain and usually excavated a new burrow or occupied an abandoned burrow.

Burrows were typically plugged with silk by females following diel periods of activity. Burrow plugging has been reported for many species of fossorial theraphosids (Walsh & Riley, 1869; MacCook, 1887; Treat, 1879; Vellard, 1934; Gabel, 1971, 1972; Minch, 1979c; Main, 1982; Cloudsley-Thompson, 1983; Smith, 1994). Burrows are also plugged during winter months when spiders are inactive (Minch, 1979a). All of the burrows of *A. hentzi* were plugged by the end of October. The initiation of spring activity was marked by the unplugging of burrows during the last week of March through the first week of May.

Aphonopelma hentzi is a generalist predator that feeds on a wide variety of arthropod prey. The females pounce on any suitable prey species that approaches the burrow entrance (ambush predator). At this site, females fed on a higher proportion of beetles and cockroaches as compared with males. The majority of beetles that could be identified to family were carabids. Males, which are more cursorial in their habits, fed on a larger proportion of orthopteran insects including grasshoppers, katydids, and locusts. Although no females were observed feeding on lepidopteran adults or larvae, these insects comprised 10.6% of the diet of males. Some males were found feeding on lepidopteran larvae near the bases of various shrubs. There have been previous reports of tarantulas feeding on caterpillars under natural conditions (Lichtenstein, 1874; Baerg, 1958). Both sexes also preyed upon other arachnids including solifuges, scorpions, and other spiders. In several cases, we observed *A. hentzi* males and females feeding on the large wolf spider *Hogna carolinensis* (Walckenaer), as well as on the solifuge *Eremobates marathoni*, the scorpion *Diplocentrus bigbendensis*, and the whipscorpion *Mastigoproctus giganteus*. These large arachnids are formidable predators in their own right and spiders (including theraphosids) are often included in their diets (Polis & McCormick, 1986; Polis & Holt, 1992; Punzo, 1993,

Species	Clutch size	Reference
<i>Acanthoscurria atrox</i> Vellard (Brazil)	1600–2000	Lourenço (1978)
<i>Avicularia avicularia</i> (L.) (Trinidad)	103–145	Stradling (1994)
<i>Avicularia metallica</i> Ausserer (Surinam)	178–182	Charpentier (1992)
<i>Avicularia versicolor</i> (Walckenaer) (Martinique)	12–221	Charpentier (1992)
<i>Dugesiella crinita</i> Pocock ^a (Mexico)	800–1000	Baerg (1958)
<i>Dugesiella hentzi</i> (Girard) ^a (Arkansas)	500–1000	Baerg (1958)
<i>Aphonopelma hentzi</i> (Girard) (west Texas)	206–911	Present study
<i>Aphonopelma chalcodes</i> Chamberlin (Arizona)	454–555	Minch (1979b)
<i>Ceropelma longisternale</i> Schiapelli & Gerschman (Uruguay)	16–111	Costa <i>et al.</i> (1992)
<i>Euathlus smithii</i> (F.O.P.-Cambr.) (Mexico)	>700	Clarke (1991)
<i>Eurypelma californica</i> Ausserer ^a (California)	621–1018	Baerg (1938)
<i>Grammostola burzaguensis</i> Ibarra-Grasso (S. America)	100–200	Ibarra-Grasso (1961)
<i>Pamphobeteus</i> sp. (Brazil)	1200–2000	Bücherl (1951)
<i>Theraphosa leblondi</i> (Latreille) (S. America)	(78 ± 5.57)	Marshall & Uetz (1993)

Table 3: Comparative data on clutch sizes (number of eggs per egg sac) for theraphosid spiders reported in the literature. Data expressed as the range or for an individual spider; data in parentheses represent means ± S.D. ^a*Dugesiella* and *Eurypelma* are now placed in the genus *Aphonopelma* (Raven, 1985, 1990; Levi & Kraus, 1989).

1997a). Thus, theraphosid spiders, which have been reported to include a variety of vertebrates (frogs, lizards, snakes, small rodents and birds) as well as arthropods in their diets, will feed on virtually any prey animal that can be successfully subdued.

Studies on animal mating systems can be valuable in any analysis of life histories because they describe the ways in which males and females locate and court one another, copulate, and provide for their offspring. In spite of this, only a few studies have been published concerning the mating systems of theraphosid spiders (Petrunkevitch, 1911, 1934; Baerg, 1928, 1958; Platnick, 1971; Perez-Miles & Costa, 1992; Shillington & Verrell, 1997). Courtship behaviour patterns in spiders serve a number of functions including the recognition of species and sex, the correct positioning of the sexes with respect to one another in order to ensure insemination, and the reduction or elimination of aggressive behaviour (Bristowe, 1929; Barth, 1993; Foelix, 1996). Theraphosid males transfer sperm to intromittent organs located at the distal ends of the pedipalps where they are stored for subsequent mating activity (Baerg, 1958; Minch, 1977; Coyle, 1985; Foelix, 1996).

The leg fencing and palpal drumming components of courtship as observed in *A. hentzi* have also been reported for other theraphosids (Baerg, 1958; Minch, 1979b; Marshall, 1989; Charpentier, 1992; Costa & Perez-Miles, 1992; Shillington & Verrell, 1997). However, compared with observations on some other theraphosid species, there was clear evidence of female aggression and sexual cannibalism during the mating sequence of *A. hentzi*. This is interesting in view of the fact that previous researchers have remarked on the low levels of intersexual aggression observed in other mygalomorph spiders (Jackson & Pollard, 1990; Shillington & Verrell, 1997) despite the potential for agonistic interactions. In contrast, mating in *A. hentzi* can contribute in a significant way to male mortality. It has been suggested that because of the potential for sexual cannibalism in arachnids, males may have evolved specific behavioural traits which minimise this risk (Newman & Elgar, 1991). For example, it is common for the males of many species of solifuges, scorpions, and spiders, to flee from the female in rapid fashion immediately after insemination has been achieved (Platnick, 1971; Robinson, 1982; Polis & Sissom, 1990; Punzo, 1997b, 1998).

Although agonistic interactions between conspecific males in *A. portale* (from Arizona) involved some leg fencing, these encounters were not characterised by a high level of aggression, and threat postures were exhibited in only a few cases (Shillington & Verrell, 1997). On the other hand, in *A. hentzi*, a threat posture was exhibited by at least one of the males in 75% of the encounters. This escalated to a strike by at least one of the males 45.8% of the time; in one-third of the encounters between males, one of the protagonists was killed. Thus, a significant level of mortality resulting from encounters between males can be expected during the breeding season when males leave refugia and search for females. The results of this study suggest that there are

definitive interspecific differences in levels of aggression between various species of the genus *Aphonopelma*.

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