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The hunter becomes the hunted: a predation of *Pepsis* sp. (Hymenoptera: Pompilidae) by *Aphonopelma gabeli* Smith, 1995 (Araneae: Theraphosidae) in New Mexico

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Abstract: A remarkable predation of a pompilid wasp *Pepsis* sp. by the tarantula *Aphonopelma gabeli* Smith, 1995 is reported from New Mexico, with historical literature reporting similar observations discussed.
Key words: Araneae, Theraphosidae, Hymenoptera, Pompilidae, tarantula hawk, predation, United States, New Mexico.

El cazador se convierte en cazado: una depredación de *Pepsis* sp. (Hymenoptera: Pompilidae) por *Aphonopelma gabeli* Smith, 1995 (Araneae: Theraphosidae) en Nuevo México
Resumen: Se reporta una depredación notable de una avispa pompílida *Pepsis* sp. por la tarántula *Aphonopelma gabeli* Smith, 1995 en Nuevo México, con comentarios sobre la literatura histórica que describe observaciones similares.
Palabras clave: Araneae, Theraphosidae, Hymenoptera, Pompilidae, avispa cazadora de tarántulas, depredación, Estados Unidos, Nuevo México.

Introduction

The pompilid genus *Pepsis* Fabricius, 1804 currently contains over one hundred and thirty species, fourteen of which have a distribution range which includes areas of the United States (Vardy, 2000, 2002, 2005).

Of the twenty nine species of the theraphosid genus *Aphonopelma* Pocock, 1901 presently recognised within the United States (World Spider Catalog, 2021), six occur in the state of New Mexico: *Aphonopelma gabeli* Smith, 1995; *Aphonopelma hentzi* (Girard, 1853); *Aphonopelma marxi* (Simon, 1891); *Aphonopelma parvum* Hamilton, Hendrixson & Bond, 2016; *Aphonopelma peloncillo* Hamilton, Hendrixson & Bond, 2016 and *Aphonopelma vorhiesi* (Chamberlin & Ivie, 1939).

Whilst the capture of theraphosid spiders by pompilid wasps is well documented (Lincecum, 1867; Petrunkevitch, 1926, 1952; Passmore, 1936; Williams, 1956; Cazier & Mortenson, 1964; Cooke, 1985; Punzo & Garman, 1989; Punzo, 1994a, 1994b, 2005a, 2005b, 2005c, 2006, 2007; Punzo & Ludwig, 2005; Costa, Pérez-Miles & Mignone, 2002; Rego, Rheims & Venticinque, 2004; Copperi *et al*., 2011; Kurczewski & Edwards, 2012; Kurczewski, Edwards & Pitts, 2017), the converse successful predation of a wasp by a theraphosid in nature is mentioned only once in the literature. Punzo (1994a: 238) notes: "*In over 400 encounters observed between a female wasp and its tarantula host in the field, on only one occasion have I witnessed a spider successfully biting, penetrating, and killing a wasp*.". Two studies have mentioned an outcome where both spider and wasp die of their wounds (Kellogg, 1908; Baerg, 1958), and one states that pompilid wasps placed in an enclosure with specimens of a non-host theraphosid species during captive experiments can be killed by the spiders (Foelix, 2011).

In this work, we report a successful predation of *Pepsis* sp. by the theraphosid spider *A. gabeli* in the wild. This represents the second known record of successful predation of a pompilid wasp by a theraphosid spider in nature in the United States, and the first to be fully illustrated.

Observation

On 12th August 2019 the first author (DH) observed a medium sized *Aphonopelma* specimen predating a large *Pepsis* at approximately 19:50 Mountain Daylight Time, in the vicinity of Eddy County, New Mexico. The spider had attacked the wasp at some point prior to being observed and the wasp was immobile and possibly dead. It is unknown how long had elapsed since the spider and the wasp came into contact. Every effort was made to not disturb the specimens other than a few photographs in the failing light to document the observation.

The predation event occurred in open ground adjacent to a desert shrub habitat dominated by Mesquite (*Prosopis glandulosa*) and Creosote bush (*Larrea tridentata*). A search the next day revealed an established burrow nearby with a reduced diameter that reflected the possibility of occupation by a sub-adult sized *Aphonopelma* (DH pers. obs.).

A number of photographs were taken of the event (Figs. 1–3) two of which were originally uploaded to the website "iNaturalist" where they were noticed by the second author (DS) who was able to identify the theraphosid as *A. gabeli*.

Aphonopelma gabeli Smith, 1995

Based on the colouration of the leg pubescence (beige and with faint striping on the patellae and tibiae, dark and without striping on the femora, metatarsi and tarsi), the beige colouration of the carapace pubescence, and the robust chelicerae, the habitus of the specimen is consistent with *A. gabeli*. It is also congruent with what is stated and figured in Hamilton *et al*. (2016: 113, Fig. 45) who redescribed this species. The only other species which occurs in sympatry with *A. gabeli* in Eddy County is *A. hentzi* which possesses dark brown/black leg pubescence with a dense covering of long red setae on all legs, and comparatively less robust chelicerae – visual features clearly distinguishable from those of *A. gabeli*. DH has observed both *A. gabeli* and *A. hentzi* within the immediate area where the observation was made, with these identifications being confirmed by DS.

The absence of tibial apophyses on the ventral face of legs I and the absence of modified palpal tarsi, in addition to the colouration, indicate the spider is not an adult male, however, we cannot confirm the sex of the specimen since it was not possible to examine the ventral opisthosoma. It is possible that it could have been an immature male, but equally it could have been a small female. No voucher specimens were taken, so both options are of equal possibility. The observation was made towards the end of the breeding season for *A. gabeli* (see Hamilton *et al*., 2016) and immature females of US *Aphonopelma* are known to occasionally roam at the same time as adult males (see Steinman & Sherwood, 2018) but the reasons for this are not entirely clear. We are not aware of any records of immature males roaming during the breeding season at present but again, cannot eliminate this possibility.

Pepsis sp.

The wasp can be assigned to *Pepsis* based on the apical division between the marginal cell and the wing margin (see Fig. 1) but since the rest of the wing venation is not obvious from the photographs taken, no voucher specimens were taken, and the fact several *Pepsis* species are sympatric in the general area (Vardy, 2000, 2002, 2005),



Figs. 1–3: *Aphonopelma gabeli* Smith, 1995 predating a male of *Pepsis* sp., in situ, New Mexico. Photo credit: David Heckard.



Figs. 4–6: Adult female of *Pepsis* sp. attacking an adult male of *A. gabeli*, in situ, New Mexico. Photo credit: David Heckard.

we prefer to leave our identification at the generic level. The elongate and straight antennae, consisting of thirteen segments (encompassing the scape, pedicel and eleven flagella) indicates the specimen is a male (see Fig. 3) and eliminates the possibility of the wasp being *Pepsis grossa* (Fabricius, 1798) as males of this species can be differentiated from all other *Pepsis* species in the area by having only twelve segments on the antennae (Vardy, 2002: 60).

Discussion

Punzo & Garman (1998) noted that theraphosid spiders rarely retaliated when attacked by pompilid wasps, whereas Williams (1956) reports specimens of *Aphonopelma* from his study area in California to have attempted (unsuccessfully) to bite and kill pompilids on a number of occasions. It is possible that the individual temperament and condition of the spider affects the level of defence it may exhibit towards the attacking wasp. However, this theory is not concretely established with presently available data. Punzo (1994a) noted that the significant scletorisation of the body segments of *Pepsis* wasps may prevent most attempts by theraphosids to penetrate the body with their fangs. This may explain the extremely high rate of *Pepsis* successfully attacking theraphosids versus the opposite outcome. Kellogg (1908) notes in detail an attempted predation by *Pepsis* on "*Eurypelma*" [= *Aphonopelma* sp.] in California in which both the wasp, and later the spider, died from wounds sustained from the opposing taxon. Baerg (1958: 44) notes students bringing to him dead *Pepsis* and *Aphonopelma* specimens they had captured, presumably after they had witnessed attempted predation of the spider(s) by the wasp(s). Foelix (2011: 305) notes that in laboratory studies where pompilid wasps were placed experimentally with theraphosid species unknown to them (i.e. not known prey species within their natural ranges) that the wasps would not attack the spiders but the latter could attack and kill the wasps.

Punzo (1994a) mentions a single successful capture of a *Pepsis* wasp by a specimen of *Aphonopelma* in nature and notes the wasp to be female. Williams (1956) mentions unsuccessful attempts by theraphosids to attack *Pepsis*, presumably meaning female wasps, although this is not explicitly stated and is open to interpretation. In the present contribution, we determined the *Pepsis* wasp which was caught by the specimen of *A. gabeli* was a male and thus had no sting to defend itself. It is well known that stinging apparatus in wasps evolved as a modification of the ovipositor (e.g. Kumpanenko, Gladun & Vilhelmsen, 2019 and references therein) and thus can only be present in females. This is significant as it indicates that the wasp, in this particular instance, was not attempting to attack the spider in order to parasitise it (a behaviour only exhibited and possible by females), which changes the dynamic between the interaction of the two organisms. How they came to interact is now not entirely clear, and it is hoped the present contribution will stimulate further research in this area. Given the thin opisthosoma of the *A. gabeli* specimen, it is possible that extreme hunger could have caused the theraphosid to attempt predation of the wasp, but this is purely speculative.

The present contribution shows an interaction outside of the norm for these two taxa. As mentioned above, almost all prior studies have shown that in the overwhelming number of instances, pompilids successfully attack theraphosids. DH has observed this more typical type of interaction in the past, in the same vicinity as the above observation. In that instance, on 9th July 2018 at approximately 17:50, an adult male of *A. gabeli* (identification confirmed by DS) was observed being attacked by a female of *Pepsis* sp. (Figs. 4–6). Sherwood & Gabriel (2020), in their review of historical records of *Pepsis* attacking *Aphonopelma*, previously noted that several studies by Punzo (2005a, 2005b, 2005c, 2007) probably involved *A. gabeli*, but since specimens were not figured in those works, the identifications were presumptive. In contrast, the record presented herein provides no doubts as to the identification of the host species.

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