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Predatory behaviour of the spider *Vigdisia praesidens* on *Nasutitermes canaliculatus* termites during nest repair

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Abstract

Specialized predator-prey interactions are key to understanding ecological and evolutionary dynamics. We document the predatory behaviour of *Vigdisia praesidens*, a theridiid spider recently discovered to feed on *Nasutitermes canaliculatus* termites during nest repair in Marojejy National Park, Madagascar. We induced damage to *N. canaliculatus* mounds in Analamazaotra National Park, >500 km south of Marojejy, promptly followed by mass arrival of *V. praesidens* to the nest. Based on direct observations and 800+ photographs and videos, we detail the predatory strategies of *Vigdisia*. Spiders arrive soon after termite nest disturbance, construct a silken scaffold, then hunt by flicking sticky silk towards termites at cavity edge or by fishing: casting silk into the nest interior. Spiders capture both workers and soldiers, the latter without eliciting defensive response, then haul them to nearby vegetation via the scaffold. Spiders aggressively competed for captured prey, with captors successfully defending their catch. *Pheidole spinosa* ants successfully stole dead termites temporarily abandoned by *Vigdisia*, in a three-way species interaction similar to the one documented in Marojejy. Male *Vigdisia* arrived in abundance to nearby vegetation, presumably seeking mating opportunities, but did not hunt. Our findings extend the known range of *V. praesidens*, support its specialized predation, and underscore that inducing termite-nest damage may reveal additional spider stenophagy worldwide.

Keywords: heterospecific interaction • Madagascar • prey specialization • stenophagy • termitophagy

Introduction

Prey specialization is the tendency of an animal to consume a narrow range of taxa, and represents one of the fundamentals of ecological diversity and evolutionary adaptation

(Begon, Townsend & Harper 2006; Futuyma & Kirkpatrick 2017). Specialist predators often evolve intricate behavioural, morphological, and physiological traits that enable efficient exploitation of specific prey (Elgar 1993; Pekár, Coddington & Blackledge 2012; Begon, Townsend & Harper 2006). Across ecosystems, prey specialization is observed in all animal groups and is typically associated with coevolutionary dynamics among taxa (Begon, Townsend & Harper 2006; Futuyma & Kirkpatrick 2017).

Spiders are abundant in most ecosystems and form the largest clade of true predators (Agnarsson, Coddington & Kuntner 2013). While most species are generalists, some are specialists preying on locally abundant taxa, for example other spiders, ants, termites, dipterans, lepidopterans, and woodlice (Pekár, Coddington & Blackledge 2012; Pekár & Toft 2015), while others specialize on stealing prey from larger spider hosts (Agnarsson 2025). Predominant termitophagy (myrmecophagy) occurs in several cursorial spider families, including Gnaphosidae (*Ammoxenus*), Caponiidae, Cryptothelidae, Salticidae, and Zodariidae, as well as in Theridiidae, a primarily web-building family (Marshall *et al.* 2015; Pekár & Toft 2015; Pekár, García & Viera 2017). Within Theridiidae, the subfamily Spintharinae includes termitophagous genera such as *Chrosiothes* (Eberhard 1991), *Janula* (Marshall *et al.* 2015), and *Vigdisia* (Gregorič *et al.* 2025). A recently discovered three-way predator-prey-kleptoparasite system presents a particularly interesting case of heterospecific interactions (Gregorič *et al.* 2025). In this system, a newly described spintharine spider, *Vigdisia praesidens* Agnarsson, Kuntner, Yu & Gregorič, 2025, exploits damaged nests of *Nasutitermes canaliculatus*, preying on termites after they become exposed during nest repair. *Pheidole* ants, in turn, act as kleptoparasites, stealing termite prey from the spiders. Some ants raid spider webs to collect food (Drisya-Mohan, Kavyamol & Sudhikumar 2019) or to save nest-mates (Kwapich & Hölldobler 2019), and raiding ants may steal prey, especially in social spider webs (Griswold & Meikle 1990; Fowler & Venticinque 1996; Fernandez-Fournier & Aviles 2018). Some spiders also steal prey from ants (Jackson, Salm & Pollard 2008). However, ants stealing freshly captured prey directly from individual spiders was previously unobserved (Gregorič *et al.* 2025).

Gregorič *et al.* (2025) established several preliminary observations and predictions about this system: that spiders do not reside near termite nests but arrive from the surrounding forest, likely alerted by airborne termite semiochemicals; that upon arrival, they invest in constructing a silken scaffold before hunting; that they selectively target worker termites while avoiding the chemically defended soldiers; that soldiers appear to be unable to detect the spiders; and that *Pheidole* ants exploit the system through, perhaps specialized, kleptoparasitism. Male behaviour was not observed.

In nature, termite nests may sustain damage from falling branches, heavy rain, or the activity of other organisms such as lemurs and invertebrate foragers. Induced nest damage mimics such natural disturbances and offers insight into

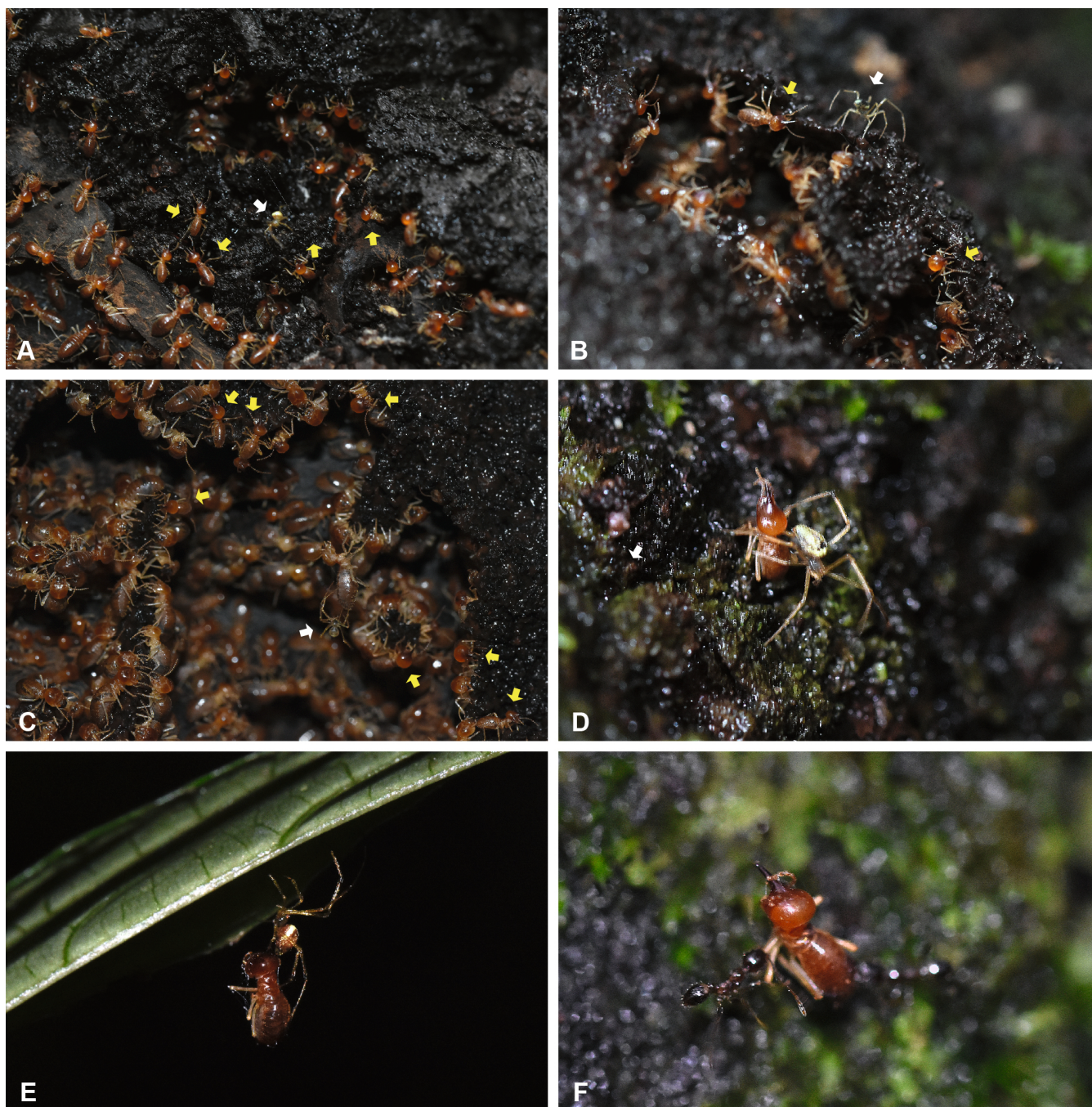


Fig. 1: **A** termites and spiders at a nest damage site, workers are repairing the hole, while soldiers (yellow arrows) monitor and spiders (white arrow) hunt; **B** a female *Vigdisia praesidens* (white arrow) scouring for *Nasutitermes canalicularis* prey, directly in front of a soldier termite (yellow arrow), without inducing any antagonistic behaviour from the soldier; **C** *V. praesidens* on a silk line above the termite nest cavity (white arrow) surrounded by termites; **D** female *V. praesidens* with a captured *N. canalicularis* soldier; **E** *Vigdisia* completing the transport of a captured termite to vegetation over 2 m from the damage site; **F** two *Pheidole spinosa* ants stealing a termite prey that had been dropped as a newly arrived *V. praesidens* female challenged a conspecific that had captured the termite.

responses of other species to sudden availability of potential termite prey. During a short and intense student course in the Analamazaotra National Park, Madagascar, we induced termite nest damage to further explore this predator–prey–kleptoparasite system. We aimed to: 1) test whether such a three-way interaction is more widespread in Malagasy forests, and whether the same players are involved at a site >500 km from the original discovery; 2) document in detail the predatory behaviour of *Vigdisia*, including its hunting strategies and interactions with termite soldiers, thus testing the prediction of selective worker hunting; 3) assess

whether ants exploit the system at the new site and, if so, whether their behaviour parallels that observed in Marojejy; and 4) describe male behaviour for the first time.

Methods

We conducted field work in the Analamazaotra National Park, a montane rainforest reserve in eastern Madagascar (25.5 km², between 900 m and 1050 m elevation, centre *c.* latitude -18.936111, longitude 48.428333), between 21 and

28 May 2024. Following Gregorič *et al.* (2025), we damaged termite nests to observe the interactions among spiders, termites, and ants. In total, we conducted nest-damage trials on three separate termite nests.

Each morning, we first carefully inspected the chosen termite mound for spiders. Using a knife, we then cut a hole, 5–10 cm in diameter, into the side of the mound. We then monitored the mound, recording the arrival of spiders, the duration and behaviour of scaffold construction (Gregorič *et al.* 2025), the interactions among spiders and with termites and ants. Our focus was on gaining a better understanding of the interactions of spiders with termite workers versus soldiers, the silken scaffold construction, and spider post-capture behaviour. Termites typically repaired holes of this size within 24–48 hours.

In the laboratory, we identified all species from the investigated system morphologically and using DNA barcodes of the following spider, termite, and ant specimens (organism identification, specimen code, specimen sex or caste, and DNA barcode accession code: *Vigdisia praesidens* [VIA1], 1♀ [PZ268056]. *Vigdisia praesidens* [VIA3], 1♂ [PZ268057]. *Pheidole spinosa* [VIA9], 1 worker [PZ268060]. *Nasutitermes canaliculatus* (Wasmann, 1902) [VIA7, VIA8], 2 workers [PZ268058, PZ268059].

For DNA extraction, we used the EZNA® Tissue DNA kit from Omega Biotek (Omega, GA, USA) using standard protocols. We amplified the 658 bp mitochondrial cytochrome c oxidase subunit I (COI barcode) using the LCO1490 (5'-GGT CAA CAA ATC ATA AAG ATA TTG G-3') and HCO2198 (5'-TAA ACT TCA GGG TGA CCA AAA AAT CA-3') primer pair (Folmer *et al.* 1994), under standard PCR-conditions (98°C for 30s; 35 cycles of 98°C for 10s, 44°C for 30s, 72°C for 45s; 72°C for 2 min), using Q5 polymerase from NEB. We compared the obtained DNA barcodes, to “Species level barcode records” at the BOLD Identification System tool (Ratnasingham & Hebert 2007) to infer the closest sequence identity and check for differences between populations from the Analamazaotra (our study) and Marojejy (Gregorič *et al.* 2025) forests.

Supplementary material. All supplementary videos are accessible via <https://zenodo.org/records/16573429>. Video S1: *Vigdisia praesidens* spider hunting from the edge of the damaged termite nest, with some threads of the silken scaffold visible. Video S2: *Vigdisia praesidens* spiders competing for caught termite prey. Video 3 *Vigdisia praesidens* spider transporting caught termite prey to nearby vegetation.

Results

Molecular identification based on DNA barcodes confirmed the termite species (>99.5% sequence identity) as *Nasutitermes canaliculatus*. The identification of the spider (*Vigdisia praesidens*) and the ant (*Pheidole spinosa*) were confirmed both through DNA matching (>99.5% sequence identity) and expert morphological identification (I. Agnarsson, Dr Brian Fisher, California Academy of Sciences,

USA). The ant reported in Gregorič *et al.* (2025) as *P. spinosa* is likely an undescribed close relative from Marojejy (Fisher pers. comm., DNA sequence distance ~5% from confirmed *P. spinosa* GenBank sequences).

No *V. praesidens* individuals were found on or near termite mounds prior to nest damage. After damage, juveniles and adult females started to arrive at the mounds, sometimes within minutes, but up to more than an hour after the initial nest rupture. Arrival appeared to involve both aerial dispersal (ballooning on silk threads) and walking. Adult males were never seen on the mounds but were found in abundance on nearby vegetation. More than 100 *Vigdisia* were observed in vegetation near one termite nest a day after damage was incurred.

The spiders displayed the same sequence of behaviours across the three nest-damage trials, but the timing of these behaviours differed. The time from nest damage to the arrival of the first spider ranged from 14 to 86 minutes. The spiders in all trials then began the construction of a silken scaffold around the nest damage, lasting 6 to 27 minutes. 60 to 102 minutes into the trials, the spiders started capturing termites (Fig. 1B–D, Video S1). Across the three trials, the timeline was: Trial 1: first arrival 14 min, scaffold building 14–20 min, first capture 60 min; Trial 2: first arrival 86 min, scaffold 86–113 min, first capture 102 min (interrupted); Trial 3: first arrival 25 min, scaffold 25–40 min, first capture 101 min.

Spiders primarily hunted from the edge of the mound hole, here termed ‘edge hunting’, and rarely also from the silken scaffold directly above the mound hole, here termed ‘fishing’ (Fig. 1B–D). During hunting, spiders were always in contact with the silken scaffold. The hunting strategy involved two distinct modes. In the first, edge hunting, a spider approached the rim of the cavity while maintaining contact with the scaffold, probed with its forelegs to locate termites, then rotated and flicked sticky silk with its hind legs towards the prey (Fig. 1B, Video S1). If a termite was caught, the spider hauled it away, applied further wrapping silk, and delivered a bite. In the second mode, fishing, spiders cast silk into the nest cavity, snagging termites within the nest that they had not previously located or touched (Video S1). *Vigdisia* preyed on both the termite workers and soldiers, without an obvious preference. Generally, no antagonistic behaviour from termite soldiers toward spiders was observed. In a single observation, an airborne spider approaching the mound landed in the middle of the hole, agitating the termites, who displayed antagonistic behaviours. After capture, spiders used the silken scaffold to haul termites and transport them to sites completely off the mound on nearby vegetation, where they wrapped the prey further and consumed it over extended periods of time (beyond observation duration; Fig. 1E, Video S3). Prior to feeding, spiders did not display obvious antagonistic behaviour toward each other when they crossed paths. However, aggressive interactions over wrapped termites were regularly observed (Video S2). We carefully followed six such contests, and the captor successfully defended its prey in all. These contests occurred only on the mound or the silken

threads near the mound and never on the surrounding vegetation.

Ant workers were occasionally seen on and around the termite mound but did not attack termites at the damage site, nor did they actively steal termites from the spiders. However, ants were observed picking up termites dropped by spiders during intraspecific fights (Fig. 1F).

Discussion

This study provides the first detailed account of the predatory behaviour of *Vigdisia praesidens* on *Nasutitermes canaliculatus* termites, expanding observations from a new site over 500 km from the original discovery. The spider *Vigdisia praesidens*, termite *Nasutitermes canaliculatus*, and a species of *Pheidole* ants are involved at both sites.

We corroborate and extend the findings of Gregorič *et al.* (2025) and add detail on the varied foraging strategy of *V. praesidens* and new insights into interactions with termite soldiers and the local ants. In sum, we document: 1) Post-damage arrival: we confirm that *Vigdisia praesidens* spiders do not reside at termite mounds but arrive en masse after nest disturbance. The rapid arrival of spiders and their high numbers (up to 100 individuals found near one damaged termite nest) imply that the spiders are alerted to the nest damage by airborne semiochemicals, likely volatile alarm pheromones released by termites following nest disturbance (Costa-Leonardo & Hafig 2010, 2014; Marshall *et al.* 2015) and/or the increased odour of the nest gallery at the damage site (Yusuf, Crewe & Pirk 2014; Mitaka & Akino 2021). The time it took spiders to arrive to the damage site varied considerably (14–86 minutes post nest rupture), suggesting that aerial dispersal of the spiders might be influenced by environmental conditions like air circulation and wind. Anecdotal observations suggest that the spiders generally arrived against the direction of the wind. 2) Silken scaffolds and delayed predation: upon arrival to the termite nest and prior to any predation attempts (earliest documented prey capture occurred 60 minutes after rupture), the spiders construct silken scaffolds (Fig. 1C), providing a platform supporting their predatory ventures. The scaffolds also serve as transport routes: spiders haul captured prey via scaffold lines to nearby vegetation for further wrapping (Fig. 1E, Video S3), likely reducing competition from conspecifics and ants. 3) Indiscriminate predation and silent soldiers: Gregorič *et al.* (2025) did not observe hunting of termite soldiers and hypothesized that, since defensive adaptations of *Nasutitermes* soldiers include the spraying of terpene hydrocarbons from their snouts to immobilize predators (Prestwich 1983), soldiers might be too dangerous for the spiders to prey on. However, we reject this hypothesis, as we observed spiders indiscriminately preying on both workers and soldiers (Fig. 1D), without eliciting any defensive response from the soldiers. The complete lack of soldier aggression, even at close range, strongly suggests that *Vigdisia* evades the termites' detection system, most plausibly through chemical mimicry, a strategy well documented

in other termite-associated arthropods (Howard, McDaniel & Blomquist 1980). Testing this hypothesis through chemical analysis of the spider's cuticular compounds is an important avenue for future research. 4) Dual hunting strategies: We describe two distinct predatory modes: edge hunting, in which spiders probe and locate termites with their forelegs and flick silk at them from the cavity rim, and fishing, whereby silk is cast into the nest cavity to snag termites remotely (Fig. 1B, Supplementary videos S1–S2: <https://zenodo.org/records/16573429>). Both strategies involve initial immobilization with sticky silk, hauling of the prey away from capture site to nearby vegetation, and then prey wrapping and delivering a bite. The wrap attack and prey hauling behaviours are similar to those described in other spintharine termite hunters, *Chrosiothes tonala* and *Janula* sp. (Eberhard 1991, Marshall *et al.* 2015) and parallels the capture techniques of *Euryopsis episinoides* on ant prey (Liznarová & Pekár 2019). 5) Conspecific fights: *Vigdisia* females were observed trying forcefully to take a prey from conspecifics, but the captor defended its prey vigorously and successfully in all observed instances (Supplementary video 2). 6) Ant kleptoparasites: ants in Analamazaotra were scarce (contrary to Marojejy) but were observed stealing a dropped prey (Fig. 1F). 7) Males on standby: male *Vigdisia* were not seen capturing prey, but accumulated in large numbers on nearby vegetation, presumably awaiting mating opportunities.

Predominant termitophagy occurs in several spider families, mostly cursorial hunters such as Gnaphosidae (Ammoxenus), Caponiidae, Cryptothelidae, Salticidae, and Zodariidae, but also in Theridiidae, a primarily web-building family (Pekár & Toft 2015; Pekár, García & Viera 2017). Within Theridiidae, the subfamily Spintharinae, termitophagy appears to have arisen convergently within *Chrosiothes*, *Janula*, and *Vigdisia*, with some striking predatory parallels. *Chrosiothes tonala* preys on *Tenuirostritermes briciae* during their brief above-ground foraging, detecting them via a horizontal silken network and constructing vertical structures for capture and transport (Eberhard 1991). A second species, *C. portalensis*, is similarly termitophagous (Pérez-De La Cruz *et al.* 2007). An even closer parallel is *Janula* sp. from Ecuador which, like *Vigdisia*, does not reside near termite nests but arrives swiftly when *Nasutitermes ephratae* nests are damaged, capturing soldiers and hauling them to nearby vegetation (Marshall *et al.* 2015). All three genera appear to rely on chemical cues to detect exposed termites, all use silk-based hauling mechanisms, all prey on both workers and soldiers, and in all cases soldiers seem unable to detect the spiders (Eberhard 1991; Marshall *et al.* 2015; Gregorič *et al.* 2025). Differences in detail mark convergence: *Chrosiothes* grasps termites with its forelegs while *Vigdisia* and *Janula* use sticky silk wrap attacks; *Vigdisia* captures and hauls single prey items, while *Chrosiothes* and *Janula* amass multiple termites into silken bundles for storage. In all three systems, kleptoparasites exploit the hunting spiders: *Pheidole* ants in *Vigdisia*, ceratopogonid flies in *Janula*, and a salticid spider along with cecidomyiid and phorid flies in *Chrosiothes*. The

convergent evolution of silk-based termite specialization, complete with kleptoparasitic associations, is both striking and underexplored: it may represent a globally widespread yet understudied phenomenon involving spintharine (and perhaps hadrotarsine) theridiids, termites, and an array of kleptoparasites.

We extend the known range of *V. praesidens* over 500 km across montane forests of eastern Madagascar. Because humid tropical forests occur almost along the entire 1600 km of Malagasy eastern coast (Antonelli *et al.* 2022; Ralimanana *et al.* 2022), the distribution of *V. praesidens* is predicted to be even wider. Additionally, the complex mountain systems of eastern Madagascar are known to promote speciation through repeated habitat contraction and expansion during climatic cycles (Agnarsson, Coddington & Kuntner 2016; Goodman *et al.* 2022; Hazzi & Wood 2025), and close relatives of *V. praesidens* likely remain to be discovered.

Finally, we provide new insights into spider-ant dynamics. *Pheidole spinosa* appears to represent a complex of cryptic species (Fisher pers. comm.) as also suggested by the considerable molecular difference between the Analamazaotra and Marojejy populations that exceeds expected intraspecific differences (Smith, Fisher & Hebert 2005; Ng'endo, Osiemo & Brandl 2013). A significant behavioural difference between the two ant populations is that, unlike the ants in Marojejy, those in Analamazaotra did not actively steal wrapped termites, but benefitted opportunistically by occasionally picking up lost prey. This difference may be explained simply by ant abundance, where few ant workers might approach termite nests cautiously, while larger groups more boldly. Alternatively, the two ant species may differ in kleptoparasitic behaviours.

In conclusion, we provide the first detailed behavioural account of termite predation by *Vigdisia praesidens*, documenting two distinct hunting modes, the role of silken scaffolds in prey capture and transport, and the absence of soldier defence against these spiders. We confirm key predictions and reject others from Gregorič *et al.* (2025), extend the known range of the species, and highlight the broader significance of termite-associated spider stenophagy. Future research should focus on: 1) the chemical ecology underlying *Vigdisia*'s apparent invisibility to termite soldiers, 2) documenting *Vigdisia* life style away from termite nests, 3) the distribution and diversity of this interaction across Madagascar's eastern forests, and 4) inducing termite nest damage in diverse tropical ecosystems to uncover novel species and interactions worldwide.

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