

Myrmecophily in iridescent jumping spiders: two *Cosmophasis* species (Araneae: Salticidae: Chrysillini) associating with dolichoderine ants on Bali and Nusa Penida, Indonesia

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Abstract. Ant association in the genus *Cosmophasis* Simon 1901 is documented for only two species, *C. bitaeniata* (Keyserling) and *C. rakata* Žabka & Waldock. In both cases the partner is the weaver ant *Oecophylla smaragdina* (Fabricius). Here I report observations of two more *Cosmophasis* species interacting with ants and their hemipteran trophobionts in homestay gardens on Bali (*Cosmophasis* cf. *thalassina*) and Nusa Penida (*Cosmophasis* cf. *lami*), Indonesia. The spiders approached aggregations tended by *Dolichoderus* sp. on Bali and by *Tapinoma* cf. *melanocephalum* on Nusa Penida, both members of the Dolichoderinae. Both species expressed behaviours corresponding closely to those defined for *C. rakata* in the Andaman Islands. These are the first records of ant-associated behaviour in *Cosmophasis* outside the weaver ant community, and the first from the Lesser Sunda Islands. Together with the documented myrmecophily of *C. bitaeniata* and *C. rakata*, they raise the possibility that ant association is widespread within the genus.

Keywords. Dolichoderinae, ethogram, iridescent jumping spider, Lesser Sunda Islands, natural history, *Tapinoma melanocephalum*

Introduction

The genus *Cosmophasis* Simon 1901 (Salticidae: Chrysillini) comprises small, iridescent jumping spiders distributed across tropical Australasia (World Spider Catalog 2026). *C. bitaeniata* (Keyserling) and *C. rakata* Žabka & Waldock are closely associated with the arboreal weaver ant *Oecophylla smaragdina* (Fabricius) and the honeydew-producing hemipterans it tends and defends (Allan & Elgar 2001; John 2020, 2026; John & Caleb 2026). Ants harvest carbohydrate-rich honeydew from these hemipterans and defend them against predators and parasitoids, so that tended aggregations form spatially predictable concentrations of resources within the canopy (Way 1963; Blüthgen & Fiedler 2002). *Cosmophasis bitaeniata* acquires the colony-specific cuticular hydrocarbon profile of its host by handling and consuming ant larvae and so moves within weaver-ant nests and foraging areas while evading worker aggression (Allan & Elgar 2001; Allan et al. 2002; Elgar & Allan 2004, 2006). Associations of this kind have arisen repeatedly across spider lineages (Cushing 2012), including other salticids that exploit ant-trophobiont systems (Hill et al. 2021; Khalaf 2022).

Within *Cosmophasis*, however, ant association has been systematically documented for only one other species, *C. rakata*, from the Andaman Islands, India (John 2020; John & Caleb 2026). A recent study of the "Iridescent Sunda Jumper" *C. rakata* in human-modified habitats on Havelock Island, India, established the first structured behavioural account of such an association, defining an ethogram grouped under orientation, scanning, locomotion, avoidance, signalling, maintenance and predation (John 2026). That study also described two characteristic sequences: encounters with hemipteran aggregations at

approximately 10–12 cm typically led to a predatory sequence (*scan* → *stalk* → *lunge* → *feed*), whereas encounters with *O. smaragdina* major workers at approximately 2–3 cm led to an avoidance sequence (*freeze* → *flatten* → *retreat*).

Records of spider–ant association are predominantly occurrence-based or taxonomic, and structured behavioural description, in which discrete acts are defined, remains uncommon (Cushing 2012). Salticid associations with dolichoderine ants are known from elsewhere: *Cotinusa* spp. were recorded in 61% of *Tapinoma melanocephalum* (Fabricius) nests built on leaf undersides in Costa Rica, and marking experiments indicated the spiders' tenacity to those nests (Shepard & Gibson 1972).

Whether these behaviours represent a specialisation of a few lineages or a trait distributed more broadly through the genus remains open, and additional field records are needed to address it. Here I describe four opportunistic focal observations of immatures of two *Cosmophasis* species (*C. cf. thalassina*, *C. cf. lami*) made in July 2025 in homestay gardens on Bali and Nusa Penida, Indonesia, at the eastern margin of the Sunda region. These are human-modified habitats on tropical islands, comparable to those of the Havelock study.

Methods

All observations were made in the planted gardens of homestays, during daylight hours, and were recorded as continuous focal-animal narration (Altmann 1974) lasting 20–30 minutes. Distances were estimated visually and are given as approximations. One species was observed in Ubud, Bali (*Cosmophasis cf. thalassina*, C1_1) and a second species on Nusa Penida (*C. cf. lami*, C2_1–C2_3). *C. cf. thalassina* is dark, with metallic green and gold scales on the carapace and pale transverse banding on the abdomen (Figure 1). *C. cf. lami* is pale straw to cream throughout, with dark spinnerets (Figures 2–4). Behavioural terms follow the ethogram of John (2026) and are given in italics where they correspond to a defined behaviour.

Four focal samples did not lend themselves to any meaningful statistical analysis of behaviours. Recorded behaviours were assigned to categories retrospectively, from notes and photographs.

Identification

The spiders were referred to *Cosmophasis cf. thalassina* and *C. cf. lami*, respectively, based on descriptions and images in Hurni-Cranston & Hill (2021). No specimens were collected. Ants were identified from photographs using AntWiki (2026). The ants attending the aggregation on Bali were referred to *Dolichoderus* sp., and those on Nusa Penida to *Tapinoma cf. melanocephalum*. Both genera belong to the Dolichoderinae. Hemipterans, host plants and fungi were identified only to the level supported by field observation.

Observations

***Cosmophasis cf. thalassina* (C1_1) — Ubud, Bali, 21 July 2025.** A single individual was observed on *Cananga odorata* (Lam.) Hook.f. & Thomson, on foliage adjacent to a floral bud bearing an aggregation of ants tending honeydew-producing hemipterans. The attendant ants were dark brown to black and comparatively robust and were referred to *Dolichoderus* sp. (Figure 1). The spider was initially oriented away from the aggregation (*scanning*; Figure 1.1) and then turned to face it (*orient to ant*; Figure 1.2). The

spider then advanced slowly with its body pressed against the substrate (*stalking, flatten*) to within 1–2 cm of an ant tending a hemipteran (Figure 1.3), and withdrew (*retreat*) when a second worker approached the spider. After moving about the plant and pausing frequently to face and track nearby ants (*scanning, fixate on ant*), it approached the same aggregation a second time, again flattened, to within 2–3 cm (Figure 1.4), and made a short forward strike at a hemipteran (*lunge*). The attempt failed and the spider withdrew once more, settling 5–6 cm away on a floral bud outside the direct line of sight of the nearest ants (Figure 1.5). Throughout, it performed near-continuous *pedipalp drumming and abdomen bobbing*.



Figure 1 (continued on next page). Immature *Cosmophasis* cf. *thalassina* (C1_1) on *Cananga odorata* at Ubud, Bali, 21 July 2025. **1**, Spider on foliage beside a floral bud bearing an aggregation of *Dolichoderus* sp. tending hemipterans, oriented away from the aggregation. **2**, The spider turns to face the aggregation. **3**, first approach, within 1–2 cm of an ant tending a hemipteran, body flattened against the substrate.

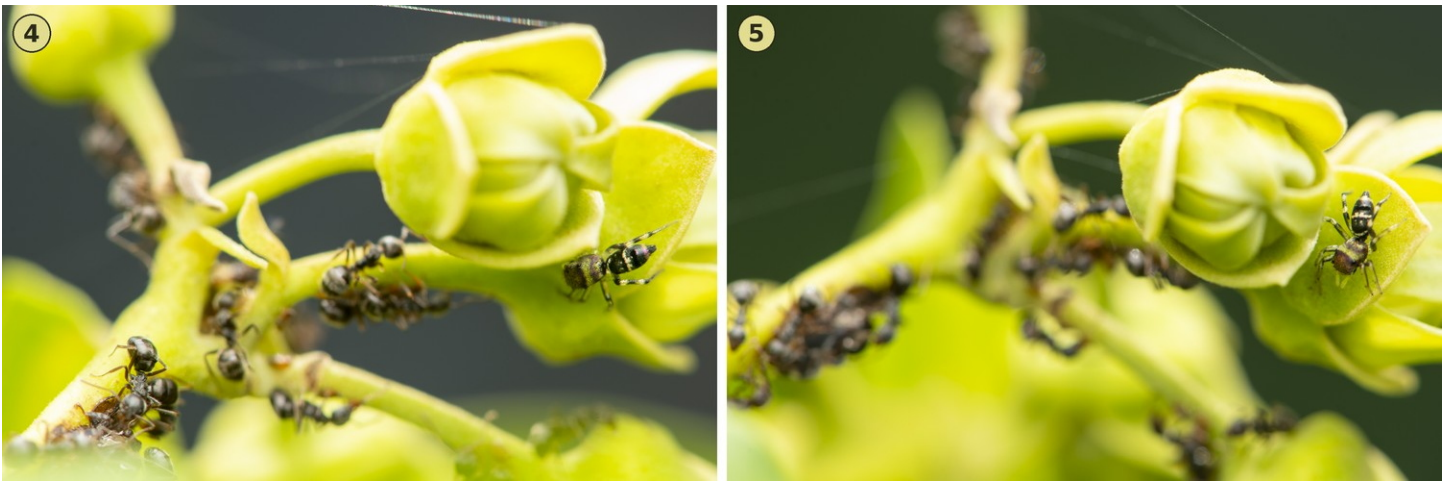


Figure 1 (continued from previous page). Immature *Cosmophasis* cf. *thalassina* (C1_1) on *Cananga odorata* at Ubud, Bali, 21 July 2025. **4**, Second approach to the same aggregation after retreating, within 2–3 cm of ants, body flattened against substrate. **5**, after retreating a second time, the spider rests 5–6 cm away on a floral bud outside the direct line of sight of the nearest ants. Photographs by S. J. John.

***Cosmophasis* cf. *lami* (C2_1) — Nusa Penida, 31 July 2025.** An individual emerged from a retreat inside a bird-of-paradise (*Strelitzia* sp.) flower, moving in short accelerations (*burst walking*) before *walking* slowly to the flower's edge (Figure 2) and *jumping* onto a leaf of the same plant, then onto the stalk of an adjacent flower. On reaching that flower it halted and reoriented continuously without moving from the spot for at least 10 s (*scanning*) before moving onto a lower petal on which three to four ants were active. *Abdomen bobbing* and *pedipalp drumming* occurred throughout and intensified when the spider paused with ants roughly 15 cm away. When it was within about 1–5 cm of the ants and an ant turned to face it, all signalling ceased abruptly (*freeze*) and the body and legs were pressed against the substrate (*flatten*).

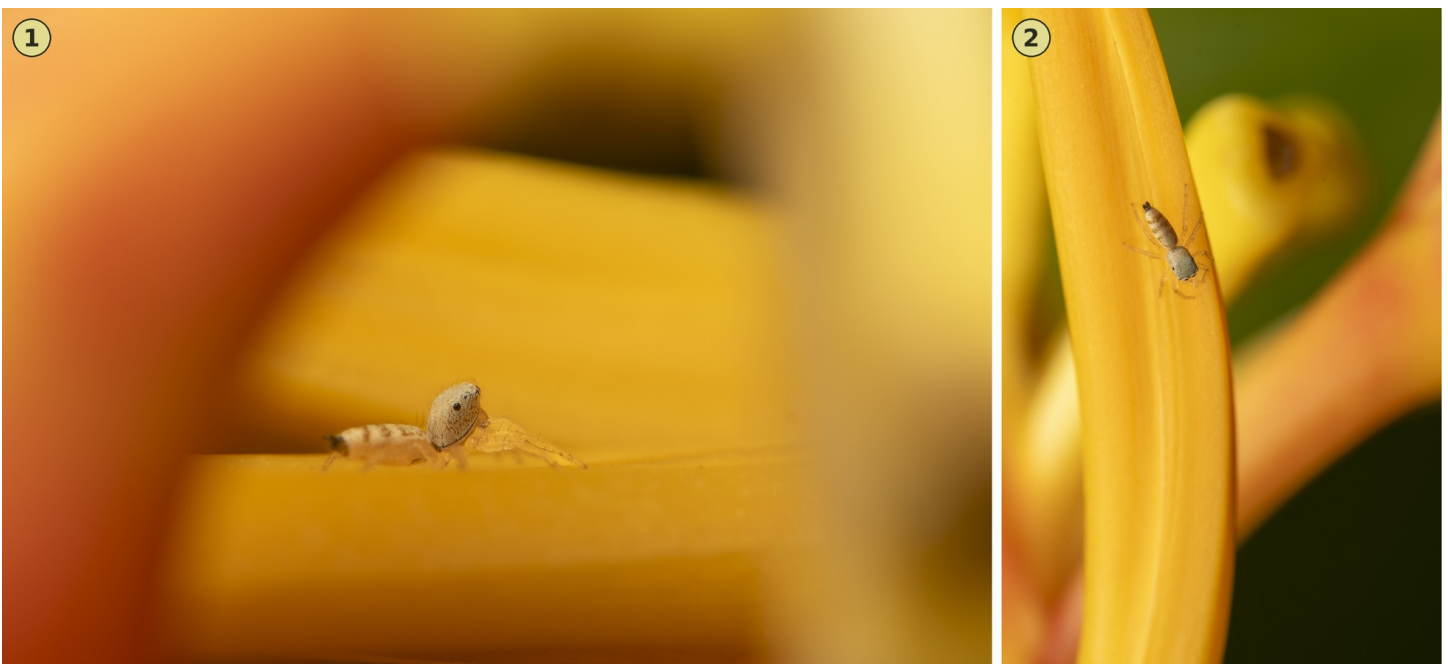


Figure 2. *Cosmophasis* cf. *lami* (C2_1) on *Strelitzia* sp., on Nusa Penida Island, 31 July 2025. **1–2**, The spider moving on the flower after emerging from its retreat. Photographs by S. J. John.

***Cosmophasis* cf. *lami* (C2_2) — Nusa Penida, 31 July 2025.** A second individual was observed on frangipani (*Plumeria* sp.), on leaf undersides densely covered with the rust fungus *Coleosporium plumeriae* Pat. The ants at this site (Figure 3) were small and pale orange-brown, and were referred to *Tapinoma* cf. *melanocephalum*. The spider passed repeatedly across these infected surfaces without orienting toward them, moving in short bursts (*burst walking*) while *bobbing* and *drumming*. It ran up and down seven different leaves, on each following approximately the same route taken by ants scouting the leaf and moving repeatedly between upper and lower surfaces (*reposition leaf side*). On the sixth leaf a dead ant lay on the midrib near the tip. The spider oriented to it from about 5–7 cm (*orient to ant*), signalling stopped (*freeze*) and the body was pressed flat against the substrate (*flatten*). The spider advanced slowly with frequent pauses (*stalking*; Figure 3.1) to within about 2 cm, completed a full circuit around the dead ant over 5–10 s while inspecting it from more than one angle (Figures 3.2–3.3), and made direct physical contact with the ant. Following contact, it resumed *bobbing* and *drumming* and moved at *walking* pace, at times walking directly over the dead ant. After the seventh leaf it climbed back onto the main branch and entered a clump of flower buds containing a silken retreat.



Figure 3. *Cosmophasis* cf. *lami* (C2_2) on *Plumeria* sp. on Nusa Penida Island, 31 July 2025. **1**, The spider approaching a dead ant on the leaf midrib. **2–3**, The spider inspecting the dead ant at close range from two different angles. Photographs by S. J. John.

***Cosmophasis* cf. *lami* (C2_3) — Nusa Penida, 31 July 2025.** A third individual was observed on a lower branch of the same *Plumeria* as C2_2. The spider moved in short bursts (*burst walking*) while *drumming* and *bobbing*, traversing the undersides of three leaves (*reposition leaf side*), two of them densely rust-covered, and running along the midrib on approximately the same route used by scout ants (Figure 4). On returning to the base of a leaf it paused and reoriented in all directions for about 10 s (*scanning*). Approximately 10–15 cm ahead, *Tapinoma* cf. *melanocephalum* were tending brown aphids aggregated at the petiole. The spider advanced to within about 5 cm, at which point signalling ceased (*freeze*). It then turned toward the observer (*orient to human*) and moved rapidly to the underside of the leaf (*retreat*).



Figure 4. *Cosmophasis* cf. *lami* (C2_3) on *Plumeria* sp. on Nusa Penida Island, 31 July 2025, moving along the leaf midrib. *Coleosporium plumeriae* (rust fungus) are visible across the leaf surface. Photograph by S. J. John.

Discussion

A shared behavioural repertoire across regions and ant partners. Fifteen of the behaviours defined for *Cosmophasis rakata* (John 2026) were recognisable in these four short observations (Table 1), spanning every category in the repertoire described for *C. rakata* except maintenance. The hemipteran-tending ants were *Dolichoderus* sp. and *Tapinoma* cf. *melanocephalum*, not the weaver ant *Oecophylla smaragdina*, and the two *Cosmophasis* species were observed on three different host plants in urban and semi-urban garden habitats approximately 2,000 km southeast of the Andaman Islands.

Pedipalp drumming is used here, as in John (2026), for any rapid up-and-down movement of the pedipalps; this is a simplification of a rather elaborate repertoire, possibly including flicker, percussive drumming and other movement patterns that could not be accurately resolved without video recording and focused analysis of the pedipalps. The full repertoire of pedipalp movements in *Cosmophasis* species and their possible functions presents a rich line of inquiry for future studies.

Avoidance behaviour is not specific to weaver ants. The observed avoidance sequences of both *Cosmophasis* species corresponded closely to the avoidance of *C. rakata*. John (2026) reported that *O. smaragdina* major workers at approximately 2–3 cm elicited *freeze* – *flatten* – *retreat*, particularly when a worker oriented toward the spider. In C2_1 the identical trigger and the first two elements were observed at 1–5 cm, precisely when an ant turned to face the spider. C1_1 completed the full sequence twice during each of its two approaches to the same aggregation – the spider advanced flattened against the substrate, closed to within 1–3 cm, and then withdrew, finally settling outside the line of sight of the nearest ants (Fig. 1:3–5). The sequence was observed in two unidentified *Cosmophasis* species in the presence of ants other than weaver ants, which I hypothesize could be a structured response shared by myrmecophilic spiders in close-range proximity of their ant associates.

Table 1. Behaviours observed for *Cosmophasis* cf. *thalassina* (C1) and *C. cf. lami* (C2), referred to the repertoire defined for *C. rakata* by John (2026). Individual spiders are identified in parentheses.

category	behaviour name	corresponding observations (individual)
orientation	<i>orient to ant</i>	turning to face an aggregation; turning toward a dead ant at 5–7 cm (C1_1, C2_2)
	<i>fixate on ant</i>	sustained facing of ants between approach attempts (C1_1)
	<i>orient to human</i>	turning toward the observer immediately before withdrawal (C2_3)
scanning	<i>scanning</i>	continuous reorientation without locomotion for ≈10 s before approaching ants (C1_1, C2_1, C2_3)
locomotion	<i>walking</i>	deliberate forward movement around aggregations (C1_1, C2_1, C2_2)
	<i>stalking</i>	slow, paused, flattened approach to ants; circuit around a dead ant (C1_1, C2_2)
	<i>jumping</i>	leaps between flower, leaf and adjacent flower stalk (C2_1)
	<i>burst walking</i>	short accelerations during general locomotion (C2_1, C2_2, C2_3)
	<i>reposition leaf side</i>	repeated movement between upper and lower leaf surfaces (C2_2, C2_3)
avoidance	<i>retreat</i>	withdrawal after each of two approaches; rapid move to leaf underside (C1_1, C2_3)
	<i>freeze</i>	abrupt cessation of signalling within 1–5 cm of ants (C2_1, C2_2, C2_3)
	<i>flatten</i>	body pressed against substrate during approach and after freeze (C1_1, C2_1, C2_2)
signalling	<i>pedipalp drumming</i>	near-continuous during locomotion (all); ceased within 1–5 cm of ants (C2_1, C2_2, C2_3)
	<i>abdomen bobbing</i>	as above, co-expressed with drumming (all)
predation	<i>lunge</i>	unsuccessful strike at a tended hemipteran (C1_1)

The ant partners here differ from *O. smaragdina* in more than identity. *Dolichoderus* and *Tapinoma* are dolichoderines, and neither builds the defended silken pavilions that structure the weaver ant system. *Tapinoma* cf. *melanocephalum* is of particular interest: the ghost ant is a generalised forager with a marked preference for honeydew that frequently tends hemipterans, is most abundant in disturbed habitats and human settlements, and is probably native to the Indo-Pacific region (Wetterer 2009). Its abundance in gardens of the kind sampled here may make it an accessible partner for spiders exploiting trophobiotic aggregations. Salticids of an unrelated Neotropical genus were found living in *T. melanocephalum* nests on leaf undersides (Shepard & Gibson 1972). It remains to be seen if members of the *Cosmophasis* genus engage in similar levels of association with *T. melanocephalum*.

The behavioural state of the ant matters. Two observations departed from the published sequences. In C2_2 a dead ant elicited *orient to ant* at 5–7 cm followed by *freeze* and *flatten*, but instead of *retreat* the spider switched to *stalking*, circled the ant while inspecting it from more than one angle, and made contact before resuming normal locomotion (Fig. 3). Here the avoidance sequence was replaced by investigation. This presents an important question that must be asked when analysing the behaviour of the spider: What is the behavioural state of the ant that is eliciting a behaviour in the spider?

In C2_3 the spider approached ant-tended aphids to within 5 cm but *froze* instead of proceeding to *lunge*, then oriented to the observer and withdrew. Observer detection appears to have interrupted the sequence.

Signalling and proximity. *Pedipalp drumming* and *abdomen bobbing* were near-continuous during general locomotion and ceased entirely within 1–5 cm. This fits the report that palpal movements in *C. rakata* vary in rate, direction and rhythm by context. John (2026) noted that such fine-scale variation could not be captured adequately in written notes. Signalling characteristics, particularly *abdomen bobbing* and *pedipalp drumming*, may therefore be a variable worth investigating through video recording and formal coding as proposed by John (2026).

What these observations cannot show. Several behaviours in the published repertoire of *C. rakata* were not recorded here, to include *peeking*, *limb vibration*, *slow back step* and the feeding-related categories. Their absence is likely an effect of the sampling method and the observer's unfamiliarity with the study site and is not evidence that the species reported here lack these behaviours in their own repertoire.

Conclusion

Ant association in the genus *Cosmophasis* is at present documented for only two species: *C. bitaeniata* in Australia (Allan & Elgar 2001) and *C. rakata* in the Andaman Islands (John 2020, 2026; John & Caleb 2026). In both, the partner is the weaver ant *Oecophylla smaragdina*. The two species reported here double that count, extend it to a third region and three host plants, and record the association for the first time with ants outside the Formicinae — *Dolichoderus* sp. on Bali and *Tapinoma* cf. *melanocephalum* on Nusa Penida. A substantial portion of the described behavioural repertoire for *C. rakata* recurred in a different geographical region within a similar system – triadic assemblage featuring *Cosmophasis* species, ants and ant-tended hemipteran aggregations within human-modified habitats. It is worth investigating if this assemblage and behavioural repertoire extend to other species of *Cosmophasis*. Examining this will require systematic survey of the genus for ant association across its range, and identification of the spiders and their ant partners. The contexts of their associations can be investigated through chemical analysis to identify mechanisms like those documented in *C. bitaeniata*, if these exist. Alternatively, these interactions can be investigated by examining spatial and behavioural associations between members of these triadic associations. These methods are relatively inexpensive and investigate assemblages that are readily encountered in gardens and other human-modified habitats. Therefore, structured behavioural descriptions like the ones described in this paper may prove rather accessible to practitioners of science looking to explore spider-ant associations.

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