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Journal of Threatened Taxa

10.11609/jott.2025.17.3.26571-26762
www.threatenedtaxa.org

26 March 2025 (Online & Print)
17(3): 26571-26762
ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

Open Access

40 zoOreach Zoo Outreach Organisation Years

ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

Srivari Illam, No. 61, Karthik Nagar, 10th Street, Saravanampatti, Coimbatore, Tamil Nadu 641035, India
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continued on the back inside cover

Cover: A bag worm with its beautiful heap of junk. Acrylics on 300 GSM paper by Dupati Poojitha based on a picture by Sanjay Molur.

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 March 2025 | 17(3): 26731–26736
ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)
https://doi.org/10.11609/jott.9457.17.3.26731-26736
#9457 | Received 19 October 2024 | Final received 27 January 2025 | Finally accepted 14 March 2025
OPEN ACCESS
SHORT COMMUNICATION

Nest predation by *Vespa tropica* (Linnaeus, 1758): observational insights into polistine wasp defense and hornet feeding behavior

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Abstract: *Vespa tropica* (Linnaeus, 1758) is a known predator of polistine wasps, actively hunting them to provision its larvae. This study reports two separate instances of *Vespa tropica* Greater Banded Hornet predation on the nests of two polistine wasp species, the Arabian Paper Wasp *Polistes* (*Gyrostoma*) *wattii* Cameron, 1900 and *Ropalidia brevita* Das & Gupta, 1989, in Uttarakhand, India. While the predatory behavior of *Vespa tropica* on different species of *Polistes* and *Ropalidia* has been well-documented in previous studies, this is the first photographic record of nest predation attempts on *Polistes wattii* and *Ropalidia brevita*. Additionally, the study documents the first known successful defensive counterattack by a prey species *Polistes wattii*, providing novel insight into the defensive capabilities of prey species against hornet predation.

Keywords: Brood raiding, cocoon, exoskeleton, Greater Banded Hornet, *Polistes*, paper wasp, predator-prey dynamics, prepupae, *Ropalidia*.

Vespa tropica (Linnaeus, 1758) (Hymenoptera: Vespidae), known as the Greater Banded Hornet, is widespread across southeastern Asia (Archer 1991; Carpenter & Kojima 1997). Historically, this species was confused with *Vespa affinis* Linnaeus 1764, both of which were initially recorded under *Vespa cincta* Fabricius 1775. Bequaert (1936) clarified their distinction, recognizing eight different color forms. More recently, *Vespa tropica* has been categorized into three species, collectively forming the *Vespa tropica* superspecies group (Archer 1991). The Indian subcontinent houses the subspecies *Vespa tropica haematodes*, which is the subject of this study.

Matsuura & Yamane (1984) conducted extensive research on vespine wasps, primarily focusing on temperate subspecies from Japan. Due to its broad geographic distribution, *Vespa tropica* exhibits notable morphological and behavioral differences between its tropical and temperate subspecies (Matsuura & Yamane 1984). While the ecology of *V. tropica* has been studied by many people, significant knowledge gaps persist regarding its populations in the Indian subcontinent.

Vespine wasps are highly predatory, consuming two primary food sources: carbohydrates (tree sap, nectar) and solid protein-based food (flesh pellets), which are exclusively fed to larvae (Matsuura & Yamane 1984). Among the vespine species, *Vespa tropica* is notably specialized, preying mainly on the larvae and pupae of polistine social wasps (Matsuura & Yamane 1984). Documented prey includes *Ropalidia* spp. Including *Ropalidia fasciata* (Fabricius, 1804); *Parischnogaster mellyi* (de Saussure, 1852); *Stenogaster* spp.; *Polistes stigma* (Fabricius, 1793); *Polistes snelleni* (de Saussure, 1862); *Polistes japonicus* de Saussure, 1858; *Polistes mandarinus* de Saussure, 1853; *Polistes jadwigae*

Editor: P. Girish Kumar, Zoological Survey of India, Kozhikode, India. **Date of publication:** 26 March 2025 (online & print)

Citation: Ojha, S. & V. Negi (2025). Nest predation by *Vespa tropica* (Linnaeus, 1758): observational insights into polistine wasp defense and hornet feeding behavior. *Journal of Threatened Taxa* 17(3): 26731–26736. https://doi.org/10.11609/jott.9457.17.3.26731-26736

Funding: Self-funded.

Competing interests: The authors declare no competing interests.

Acknowledgements: The authors are thankful to HNB Garhwal University, as the site of observation and appreciate the opportunity to study wasp nest in its natural setting without any disturbance.

Dalla Torre, 1904; *Polistes rothneyi* Cameron, 1900; *Polistes chinensis* (Fabricius, 1793); *Polistes hebraeus* Fabricius, 1787 (syn. *Polistes (Gyrostoma) olivaceus* De Geer, 1773); *Polistes jokohamae* Radoszkowski, 1887; *Parapolybia varia* (Fabricius, 1787); and *Parapolybia indica* de Saussure, 1854. There are also instances of *Vespa tropica* preying on the pupae of other *Vespa* species, such as *Vespa simillima* Smith, 1868 (van der Vecht 1957; Matsuura & Yamane 1984; Chakrovorty et al. 2023). On one occasion, this species was observed attempting to break open the mud chambers of a mud dauber wasp *Sceliphron javanum* Lepeletier, 1845 (van der Vecht 1957). Though specialized in wasp predation, *V. tropica* also preys on other insects like Skipper Butterflies (Hesperiidae), pyralid and arctiid moths, and caterpillars of *Tarsolepis sommeri* (Hübner, 1821) (van der Vecht 1957; Matsuura & Yamane 1984). Given the predatory nature of *Vespa* species on bees (Singh 1962) *Vespa tropica* is likely to prey on various bee species in regions where their habitats overlap. While some reports suggest its predation on bees, well-documented scientific studies on this interaction remain limited. Additionally, *V. tropica* feeds on tree sap, fruits, sugary substances, and carrion (van der Vecht 1957). Little is known about the foraging behavior of the Indian subspecies *V. tropica haematodes*, though it has been recorded attacking skipper butterflies, as well as *Polistes hebraceus*, *P. stigma*, and *P. olivaceus* nests in India (Bequaert 1936; van der Vecht 1957; Chakravorty et al. 2023).

Results and Discussion

A combative interaction between a solitary *Vespa tropica* and a *Polistes wattii* was observed on 21 September 2024, around 1030 h. *Polistes wattii* species was identified based on its all yellow body with no black even on the medial part of dorsal sulcus of clypeus as described by Tan et al. (2014) (Supplementary image 1). The hornet, known for its predatory behavior on *Polistes* species, was seen engaging in an intense encounter with the wasp, eventually emerging victorious (Image 1, Video 1). This occurred under an active *P. wattii* nest on the Hemvati Nandan Bahuguna Garhwal Central University, Chauras campus in Uttarakhand (30.228°N, 78.804°E). Based on observations over the next two days, it was inferred that while the hornet managed to subdue multiple adult wasps and larvae, the paper wasps eventually succeeded in neutralizing the hornet by day two.

The interaction between *V. tropica* and *P. wattii* lasted around 10 min, after which the hornet started consuming the thoracic region of the wasp, chewing it into softer pellet (Image 3). Interestingly, unlike prior reports (van der Vecht 1957), the hornet did not sever the wings or transport the wasp, indicating that the hornet was not primarily targeting adults for consumption but

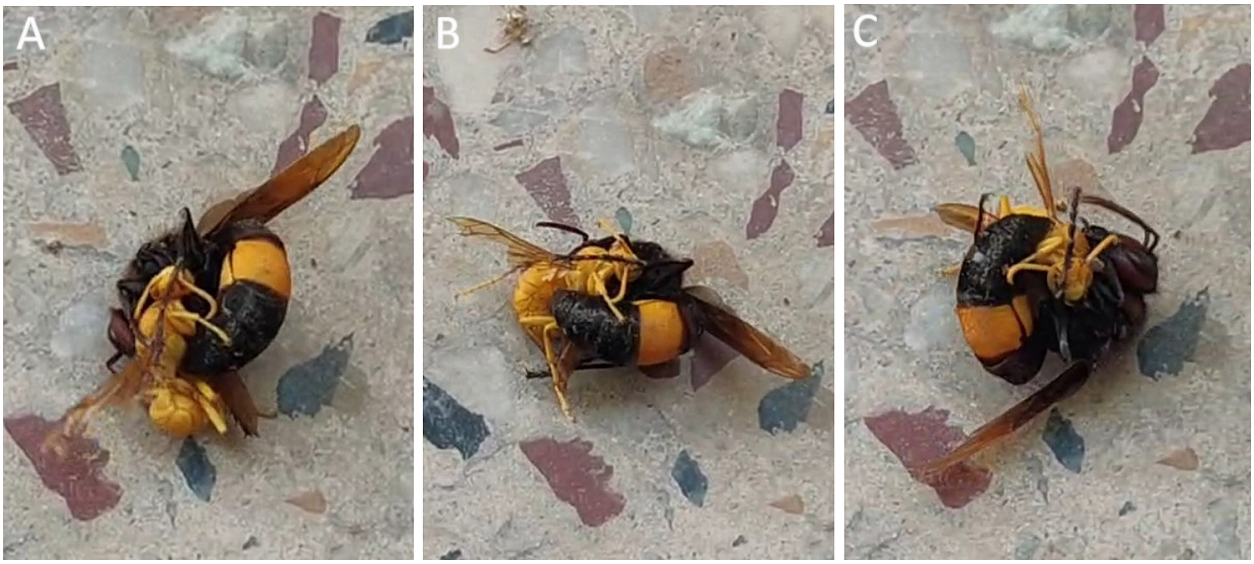

Image 1. Violent interaction of *Vespa tropica* and *Polistes wattii*: A—the *Vespa tropica* can be seen engaging in a physical confrontation with *Polistes wattii*, using its robust mandibles and forelegs to secure the wasp while simultaneously seeking a vulnerable area for stinging | B—despite being overpowered, the *Polistes wattii* maintains a firm grip on one of the hornet's front appendages and attempts to deliver a sting in defense | C—the hornet successfully subdues the wasp, delivering a sting between the sternites, and proceeds to consume the thoracic region by chewing through it. © Vartika Negi.

was rather involved only in the counterattack by the wasp. Additional evidence of resistance was supported by the discovery of four other dead *P. wattii* wasps near the nest. This suggests some level of defensive action on behalf of the wasps during the raid.

The observation revealed that the hornet revisited the nest multiple times over two days, twice on day one and thrice on the second day, seizing larvae every time with minimal resistance from the adult wasps. On the first day, after its initial successful attack, the hornet returned at approximately 1240 h. The wasps displayed panic but did not resist; they vacated the nest (Image 2), allowing the hornet to feed without hindrance, which is consistent with the behavior described by Matsuura & Yamane (1984). The next day we saw the hornet return at 1110 h with the same intent and with the same results repeating its charge two more times taking home five pupae or larvae during the observation period (Image 2). On the third day, the hornet was found dead near the nest, with no visible bite marks. It is hypothesize that

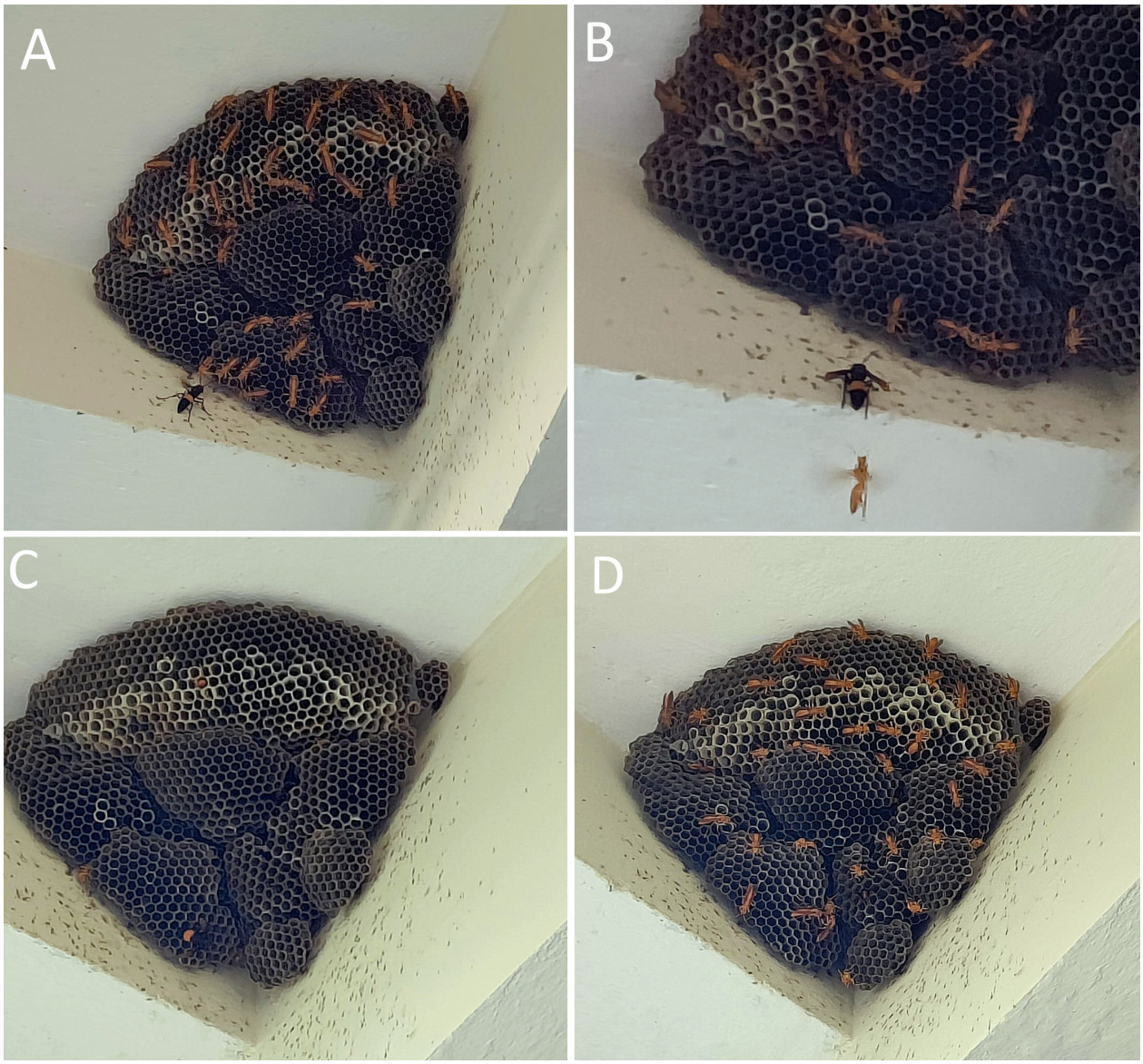

Image 2. Nest predation by Vespa tropica on a huge nest of Polistes wattii: A—the hornet approaches the large Polistes wattii nest cautiously, causing the adult wasps to become highly alert to the impending threat | B—during a subsequent visit, the hornet causes renewed agitation among the adult wasps, which exhibit defensive behavior but do not engage directly | C—the wasps vacate the nest as soon as the hornet starts ripping through the pupae, upon the hornet initiating its attack, tearing open pupal chambers, the adult wasps vacate the nest in an apparent escape response | D—once the hornet has consumed its prey and departs, the wasps gradually return to their nest, resuming normal activities. © Vartika Negi.

Image 3. The dead bodies of both species during the 3-day tussle: A—the deceased body of a *Polistes wattii* wasp that engaged in a fight with the *Vespa tropica* hornet. Note the damage to the thoracic region, which has been partially consumed by the hornet. Also, it was carried away by *Paratrechina longicornis* ants within minutes after its death. B—the remains of the *Vespa tropica* hornet, presumably killed by the *Polistes* wasps during a counterattack. No external bite marks were visible, suggesting death by stinging. © Vartika Negi.

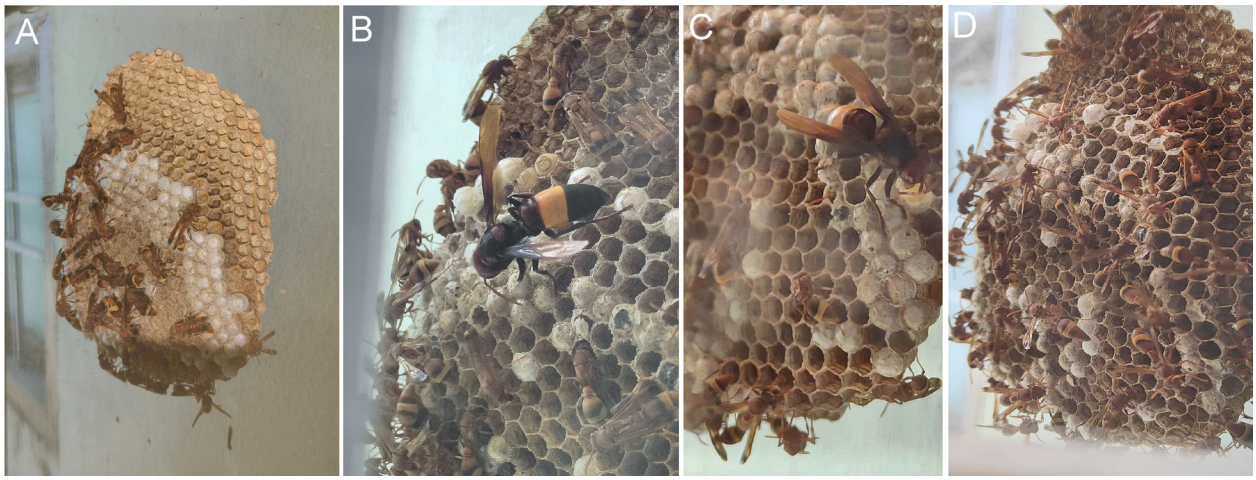

Image 4. Nest predation by *Vespa tropica* on a huge nest of *Ropalidia brevita*: A—the *Ropalidia brevita* nest a week before the hornet attack, showing a healthy, undisturbed colony | B—the large *Vespa tropica* hornet positioned directly over the sealed brood chambers, displaying indifference to the presence of the smaller *Ropalidia* wasps. Notably, the paper wasps remain in close proximity to the hornet without showing any resistance or vacating the nest | C—the hornet using its mandibles and front legs to consume the soft pre-pupa, efficiently breaking down the tissue for ingestion | D—the nest after hornet's departure, note that nest exhibits multiple torn seals on several pupal chambers, clearly illustrating the extent of the damage caused by the predation event. © Vartika Negi.

the hornet may have been fatally stung by a paper wasp, capable of penetrating through its tough exoskeleton, thus successfully defending the colony. Following this event, the nest was repopulated by the paper wasp individuals, and no further hornet incursions were observed for the day.

In another event on 8 October 2023, a *Vespa tropica* was observed raiding the nest of a *Ropalidia brevita*, identified by its proportionally wider first metasomal tergum as described by Kojima et al. (2007) in Chandrabani area of Dehradun, Uttarakhand India (30.278° N, 77.971° E) (Image 4, Video 2). The *Ropalidia* wasps offered no significant resistance, allowing the hornet to repeatedly raid their brood and successfully consume larvae over several visits. As described by Matsuura & Yamane (1984), the hornet appears to

assess the developmental stage of the pupae inside the cocoons using its antennae it was also observed that the hornets preferred the prepupae more than the already developed ones, it was tearing open the cocoon covers to extract the prepupae chewing it into a liquid form, and leaving behind a hollow husk, which fell beneath the nest. Throughout this process, the hornet remained suspended by its two pairs of hind legs, while using its forelegs and mandibles to extract the pupae. Similarly, the hornet made several raids to the nest uninterrupted and consumed the entire young lot until the whole nest was empty in a few days. This predation event ultimately led to the abandonment of the nest by the remaining paper wasps.

Conclusion

Vespa tropica predation on polistine species, particularly targeting pre-pupae, larvae, and pupae, is well-documented. While studies by Matsuura & Yamane (1984) suggests that *V. tropica* typically avoids adult wasps, the study observed the hornet engaging in combat with adult *Polistes wattii*, this inclines well with the observations mentioned by Van der Vecht (1957), in this case the hornet didn't fly away with the wasp and instead both fell from the nest during combat, which offered notable resistance and eventually killed the hornet—an unprecedented event. In contrast, *Ropalidia* wasps showed minimal defense.

These interactions add new prey records for *V. tropica* as predation on *P. wattii* and *R. brevita* is not mentioned in prior studies. Moreover, the observation of *V. tropica* feeding on an adult *P. wattii* is an unprecedented addition to the species' known predatory behavior. Although this behavior might have resulted as a response to the counterattack rather than an intentional predation on adult wasps, it adds a new dimension to the understanding of this hornet's diet. Furthermore, the successful counterattack by *P. wattii* represents a significant and novel observation, indicating that prey species may possess more advanced defensive strategies than previously recognized. This underscores the need for a more detailed study of *Vespa tropica-Polistes* interactions, particularly in the Indian subcontinent, where ecological variations may influence predator-prey dynamics.

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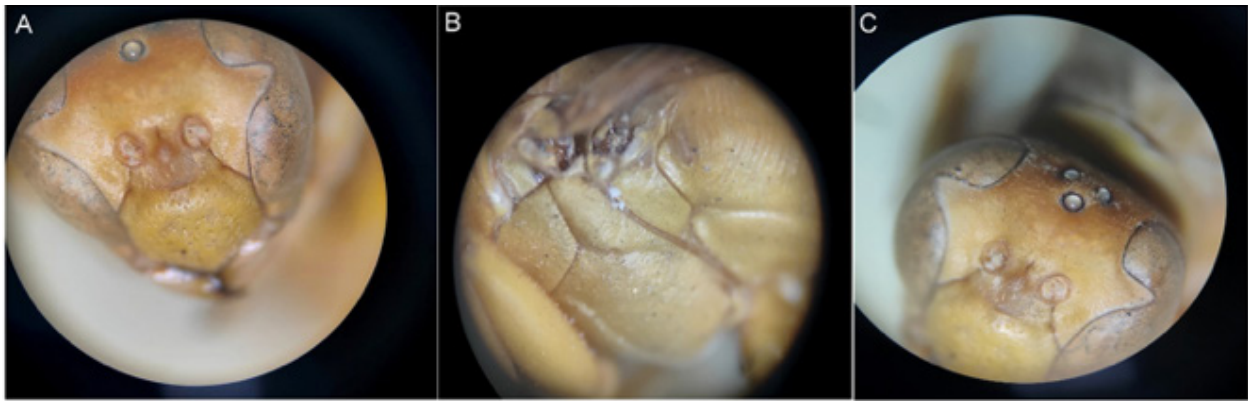
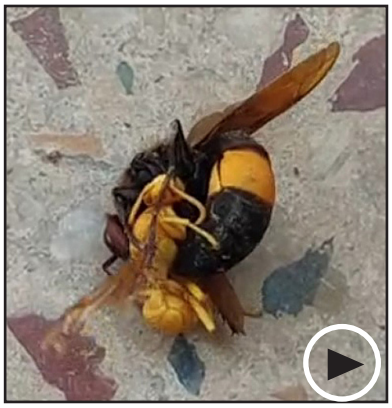


Supplementary Image S1. *Polistes wattii* Cameron, 1900: A–C—No black pattern in the dorsal sulcus of the clypeus | B—The mesopleuron weakly and sparsely punctate medially with no black pattern. © Vartika Negi.



Video 1. Violent interaction between *Vespa tropica* and *Polistes wattii*. © Vartika Negi.

Video 2. Nest predation by *Vespa tropica* on a huge nest of *Ropalidia brevita* © Vartika Negi.

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NAAS rating (India) 5.64

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Journal of Threatened Taxa

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

March 2025 | Vol. 17 | No. 3 | Pages: 26571–26762
Date of Publication: 26 March 2025 (Online & Print)
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