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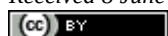
Occurrence of *Lychas armillatus* (Gervais, 1841) (Scorpiones: Buthidae) in a fire-maintained pine forest in Central Cordillera, Luzon Island, the Philippines

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Abstract

We report an incidental field observation of *Lychas armillatus* (Gervais, 1841) in a fire-maintained *Pinus kesiya* community in the Central Cordillera mountain range of Luzon Island, the Philippines. An adult female was documented in situ carrying juvenile exuviae on its dorsum, consistent with the aggregation molting behavior of first-instars previously reported in other buthids. The presence of exuviae further suggests that *L. armillatus* can reproduce in this habitat. The locality is characterized by an open canopy of *P. kesiya* and a dense ground layer dominated by fire-adapted species, which more closely resembles a tropical pine savanna than any of the existing Philippine pine forest descriptions. This occurrence adds a buthid scorpion to the sparsely documented ground-dwelling fauna of Philippine pine communities and contributes habitat and ecological information for a species previously known almost entirely through taxonomic literature.

Keywords disturbance; fire ecology; microhabitat; *Pinus kesiya*; pyrodiversity.

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1 Introduction

Lychas armillatus (Gervais, 1841) is a buthid scorpion species widespread across the Philippine archipelago. Despite its broad geographic range, published information on the species remains confined to taxonomic literature, including the original description by Gervais (1841) and subsequent revisions that resolved its synonymy and updated its morphological diagnoses (Pocock, 1891; Lourenço and Leguin, 2013). Beyond these works, most occurrence records of *L. armillatus* are limited to online biodiversity repositories (Global Biodiversity Information Facility, 2025; iNaturalist, 2025) with little information on its habitat. Herein, we report the occurrence of *L. armillatus* in a fire-maintained pine forest in the Central Cordillera of Luzon Island, the Philippines. This report also includes an incidental observation of first-instar aggregation molting behavior in this species.

2 Materials and Methods

The survey area is in Malico, San Nicolas, Pangasinan, the Philippines (16.15783°N, 120.82916°E; 783 masl) where an adult female *L. armillatus* was opportunistically encountered on 14 December 2025 at around 13:00. To identify the specimen without the need for collection, photographic records were first taken in situ (Xiaomi 15; ISO 100; 60 mm; f/2.0; 1/120 s). Photo vouchers were deposited as a public observation on iNaturalist (observation ID: 381290448). Further species identification through photo vouchers was based on published descriptions (Lourenço and Leguin, 2013; Kovařík, 1997, 2019) and confirmed by an expert in arachnid taxonomy (Acuña D., personal communication, 2025). To ascertain the occurrence records of this species in the country, georeferenced occurrence records of *Lychas armillatus* were obtained from the Global Biodiversity Information Facility (GBIF) and iNaturalist using the *rgbif* and *spocc* packages in R ver. 4.6.0. (R Core Team, 2025). Records lacking coordinate data were excluded from the dataset. The observation from this study (16.15783°N, 120.82916°E) was included as an additional data point. Occurrence points from GBIF and iNaturalist are displayed as black filled circles, while the observation from this study is shown as a red filled circle (Fig. 1).



Fig. 1 Geographic range map of *Lychas armillatus* in the Philippines. Red dot represents the record from this study.

3 Results and Discussion

A female *Lychas armillatus* was found on loose topsoil with leaf litter (Fig. 2a) in an open-canopy pine forest. The individual measured approximately 47 mm from chelicerae to telson. The pedipalps were slender with a narrow manus and elongated, curved fingers (Fig. 2b–c), consistent with the general morphology of buthid scorpions. The pedipalp manus was light brown with sparse dark brown spots, while the patella was predominantly dark brown with lighter markings. The carapace and mesosomal tergites appeared finely

granular with mottled brown pattern. The metasoma was moderately elongated with segmentation and indistinct carination. The telson possessed a moderately swollen vesicle and a distinctly curved aculeus. Pectines were well developed, with a total of 22 pectinal teeth, 11 for each comb.

Upon closer inspection, the white structures attached to the dorsum was identified as juvenile exuviae (Fig. 2a–b). The presence of juvenile exuviae on its dorsum is consistent with the molting behavior of first instars. Newly emerged first-instars climb onto the mother's back, where they may remain in a secure position during ecdysis. This juvenile behavior has also been documented in the first instars of *Mesobuthus martensii* (Guo et al., 2024) and in *Euscorpius italicus* and *E. flavicaudis* (Vannini et al., 1978). In this observation, synchronous molting was not directly observed, and the exuviae likely represent prior molting instances.



Fig. 2 In situ photos of *Lychas armillatus*. Scales = 16 mm. (a) adult female in situ; (b) dorsal view with attached juvenile exuviae; (c) ventral view showing diagnostic characters.

The habitat in which *L. armillatus* was observed provides additional ecological context for the species (Fig. 3). The individual was encountered in a *Pinus kesiya* community in the Central Cordillera, a landscape described as maintained by recurrent low-intensity surface fires (Kowal, 1966; Fernando et al., 2008). However, the vegetation structure of the site, which is dominated by fire-adapted grass species under an open and sparse canopy of *Pinus kesiya*, more closely resembles a tropical pine savanna as described by Ratnam et al. (2016). This savanna type tolerates higher elevations and cooler conditions such as the Central Cordillera of Luzon Island and is analogous to the pine communities of Yunnan, Sumatra, and the Himalayas. Ratnam et al. (2016) further argued that such Asian pine savannas are ancient, fire-maintained ecosystems rather than

degraded forests, an interpretation supported by the fire adaptations of *P. kesiya* itself, including thick bark and subcutaneous meristems (Goldammer and Peñafiel, 1990; Jacobs, 1972). The presence of a dense, fire-adapted grass layer at our site further reinforces this interpretation and adds to a growing recognition that at least some of Luzon's pine communities may represent remnants of an ancient tropical savanna biome rather than derived or degraded forest states.



Fig. 3 Fire-maintained pine forest in Malico, Pangasinan, Luzon Island, the Philippines, showing dense ground-layer vegetation and an open pine canopy.

The ground-layer vegetation of the site was dominated by graminoids, including the tall *Themeda* cf. *villosa*, along with *T. triandra*, *Ophiurus* cf. *exaltatus*, and *Eulalia siamensis*, among other grasses. Ferns such as *Dicranopteris linearis* and *Pteridium aquilinum*, and forbs such as *Elephantopus* and *Osbeckia* were also present. The tree layer consisted almost exclusively of *P. kesiya*. Notably, this vegetation composition does not match any of the Philippine pine forest descriptions in Kowal (1966) or Fernando et al. (2008), further suggesting that pine communities in the Central Cordillera may be more ecologically heterogeneous than previously recognized. Locals report that the site was last burnt in February 2024 during an El Niño-associated dry period (PAGASA, 2024). Many adult pines at the site were dead, apparently from this intense fire, and the sparse distribution of mostly older trees, with an apparent absence of middle-aged individuals, suggests that regular and intense fires have shaped this community for some time. Similar patterns of fire-driven stand structure have been noted in tropical pine savannas elsewhere in the region (Goldammer and Peñafiel, 1990; Ratnam et al., 2016).

The soil at the site consisted of coarse topsoil with a thick pine litter layer, transitioning at approximately 10–15 cm depth to a brown loam with organic matter and grass roots. Despite the open canopy, the dense ground layer likely provides cover and facilitates shallow burrowing, as noted for other arthropods (Ober and DeGroot, 2011; Sheehan and Klepzig, 2022). Pine snags and fallen logs remaining from the 2024 fire were present at the site and may serve as supplementary refugia, as documented for arthropods in *Pinus palustris* savannas in the southeastern United States (Folkerts et al., 1993; Earley, 2004). The exact mechanism by

which *L. armillatus* survives fire in a *P. kesiya* community, however, remains to be explored.

The occurrence of *L. armillatus* in this habitat is noteworthy, as ground-dwelling fauna reported from Philippine pine forests remain sparsely documented and are predominantly murid rodents (Rickart et al., 2011; Reginaldo and Ong, 2020), with a recent addition of an agamid lizard observed exhibiting facultative terrestriality in a post-fire pine forest (Villarubia and Marcaida, 2025). Our observation extends this short list to include a buthid scorpion and raises the possibility that *L. armillatus* may tolerate or persist under fire-influenced environmental conditions. The presence of first-instar exuviae on the female further suggests that *L. armillatus* can reproduce in this habitat, although the mechanisms underlying such persistence remain to be investigated. More field-based studies focusing on habitat use, life history traits, and fire adaptations in frequently burnt habitats should be pursued to further understand ground-dwelling arthropods in the country, given their diverse ecological roles and the growing recognition of Philippine pine communities as potentially ancient, fire-maintained savannas.

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