



Short note

Co-occurrence of *Amblyomma cordiferum* Neumann and *Amblyomma helvolum* Koch (Ixodida: Ixodidae) on *Elaphe carinata* (Günther) (Squamata: Colubridae) from Orchid Island, Taiwan

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Abstract. *Elaphe carinata* (Günther), the Taiwan stink snake, is a colubrid species native to East Asia and Southeast Asia, where it is known to host various Asiatic tick species. This study provides the first published account of the co-occurrence of two reptile ticks, *Amblyomma cordiferum* Neumann and *A. helvolum* Koch, on *E. carinata* from Orchid Island, southeast of Taiwan. Further research is recommended to determine whether additional tick species co-occur on reptiles in the Taiwan area and to document their associated pathogens.

Key words: Amblyomminae, Ixodidae, Reptilia, Taiwan.

Introduction

Orchid Island, also known as Botel Tobago or Lanyu, is a small volcanic island southeast of mainland Taiwan (Fig. 1A), characterized by andesitic and tuffaceous agglomerates (Juang & Chen, 2002). Situated within the Taiwan-Luzon volcanic belt (Ye *et al.*, 2022), this island is known for its rich biodiversity, including several endemic plants (Hsu & Wolf 2009), vertebrates (Ota 1987), and invertebrates (Shen & Tsai, 2002; Buchsbaum *et al.*,

2020; Ballarin *et al.*, 2021), making it an ecological hotspot for the study species interactions. Of particular interest is the island's diverse herpetofauna, comprising 16 species representing 15 genera (Uetz & Hallerman, 2023), including such endemics as the Taiwan japalure, *Diploderma swinhonis* (Günther), and the Formosa kukri, *Oligodon formosanus* (Günther).

The Taiwan stink snake, *Elaphe carinata* (Günther), a colubrid species native to East and Southeast Asia, is

common and widespread in Taiwan, including Orchid Island (Xiang & Li 2009). This species chiefly inhabits lowland secondary forests or forest edges but may also be found in agricultural areas and open fields. Because of its broad distribution and varied habitats, *E. carinata* is a useful subject for ecological studies (Uetz & Hallerman 2023), playing a significant role in the local ecosystem, as evidenced by its interactions with a diverse range of parasitic organisms, such as Apicomplexa (Han *et al.*, 2015), Pseudophyllidea (Wang *et al.*, 2014), Ascaridoidea (Li *et al.*, 2014), and Ixodidae (Amarga *et al.*, 2023a, b). Here, we describe the co-occurrence of two reptile ticks, *Amblyomma cordiferum* Neumann and *A. helvolum* Koch, on *E. carinata* collected from Orchid Island. Although ours is not the first collection of these two tick species on *E. carinata* in Taiwan, we believe it to be the first published report of this phenomenon.

Material and methods

On 08 June 2023, an adult Taiwan stink snake was collected at Yungshing Farm, Yehyin Village, Orchid Island (22.030744, 121.580077), where upon closer inspection it was observed to be hosting 12 tick specimens (Fig. 1B). The ticks were carefully collected using fine-tipped forceps and sent to the Herpetology Laboratory at National Taiwan Normal University (Taipei, Taiwan). Tick specimens were examined under a dissecting microscope (Nikon SMZ645) and identified using the key of Voltzit & Keirans (2002).

Results and Discussion

Order Ixodida Leach
Superfamily Ixodoidea Leach
Family Ixodidae Koch
Subfamily Amblyomminae Koch
Genus *Amblyomma* Koch

Amblyomma cordiferum Neumann (Fig. 2A)

Amblyomma cordiferum Neumann, 1899: 218. Type locality: Indonesia (Banda Islands).

Material examined: Taiwan: Taitung County: Orchid Island: on *Elaphe carinata*: 10♀♀, Yungshing Farm, Yehyin Village, 08.VI.2023, local collector.

Amblyomma helvolum Koch (Fig. 2B)

Amblyomma helvolum Koch, 1844: 230. Type locality: Philippines (Manila).

Material examined: Taiwan: Taitung County: Orchid Island: on *Elaphe carinata*: 2♂♂, Yungshing Farm, Yehyin Village, 08.VI.2023, local collector.

In Taiwan, there are three species of *Amblyomma* ticks ectoparasitic on *E. carinata*: *A. cordiferum*, *A. helvolum*, and *A. varanense* (Supino). Parasitism by *A. cordiferum* on Taiwan *E. carinata* was first recorded by Voltzit & Keirans (2002), with subsequent reporting by Amarga *et al.* (2023a). In the case of *A. helvolum* on *E. carinata* in Taiwan, Chao *et al.* (2013) provided the first report, followed by Amarga *et al.* (2023b). In addition, Robbins (1996) reported *A. varanense* on *E. carinata* collected in Makung, Penghu Islands. Our collection, from an adult *E. carinata*, contained 12 specimens: 10 female *A. cordiferum* (9 partly engorged, 1 fully engorged) and *A. helvolum* (2 males) (Fig. 1B).

This is the first published report of *A. cordiferum* and *A. helvolum* co-infesting a single host on Orchid Island or elsewhere in Taiwan. However, it is not the first record of this phenomenon. In March 1959, R. E. Kuntz collected two *E. carinata* on Orchid Island; both snakes were infested with a single female specimen of *A. cordiferum*, while the first snake also yielded 9 males and 5 females of *A. helvolum*, and the second snake carried 4 males and 1 female of

this species. Most specimens from the two collections were subsequently deposited in the U.S. National Tick Collection and bear accession numbers 047037 and 047042.

Multi-species co-occurrence of parasites on a single host has been reported across several vertebrate taxa. Ticks are known to co-occur with other ectoparasitic arthropods, such as lice (Phthiraptera), fleas (Siphonaptera), and mites (Caron-Lévesque & Careau 2023; Fernández-Muñoz *et al.*, 2023), especially on mammals and birds. In snakes, this finding has also been documented by Kumar (2022), who reported unidentified *Amblyomma* and *Rhipicephalus* ticks on a single specimen of *Naja naja* (Indian cobra). Our account of the co-occurrence of *A. cordiferum* and *A. helvolum* suggests that these tick species are ecologically sympatric. Additionally, recent reports by Amarga *et al.* (2023a, b) imply that both tick species parasitize a broad range of reptiles in

Taiwan and may therefore be expected to occur together on additional hosts.

Co-occurrence of parasites on a particular host group can be attributed to several biological and environmental factors. For example, polyxenous species, such as *A. helvolum*, are more likely to be found in association with reptile tick species that have a narrower host range. Additionally, host attributes, such as habitat preferences, phenology, foraging capacity, and age or sex, may determine ectoparasite load and co-occurrence (Sáez-Ventura *et al.*, 2022). On the other hand, parasite species that are ecologically sympatric or highly host specific may be subject to greater competition and consequent negative interactions (Kuris & Lafferty, 1994; Veitch *et al.*, 2020), leading to the decline of less competitive species (Herrmann *et al.*, 2013), although tick host specificity has long been regarded as a limited phenomenon (Hoogstraal & Aeschlimann, 1982).

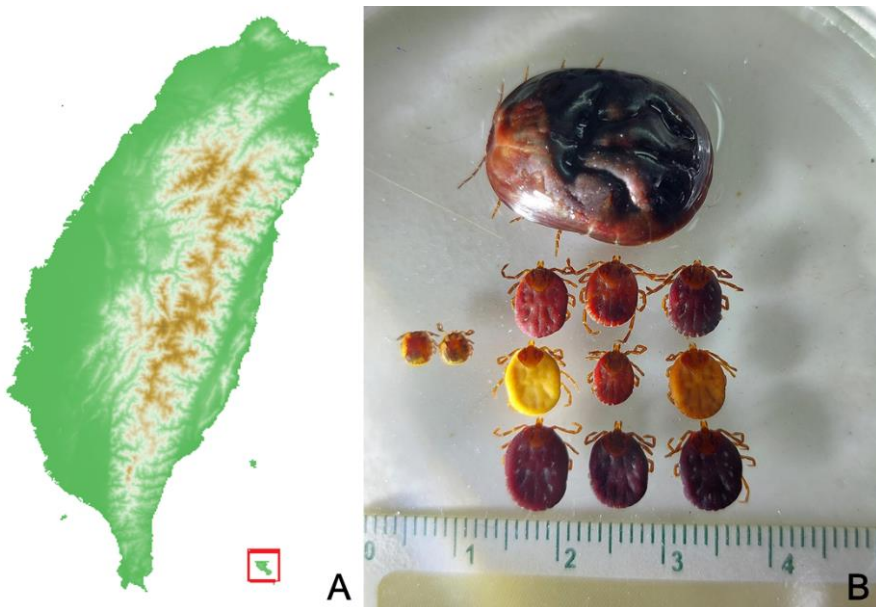


Fig. 1A. Map showing the location of Orchid Island in relation to Taiwan. **B.** Two male *Amblyomma helvolum* (left) and 10 female *Amblyomma cordiferum* (right) collected from an adult *Elaphe carinata* on Orchid Island, Taiwan.

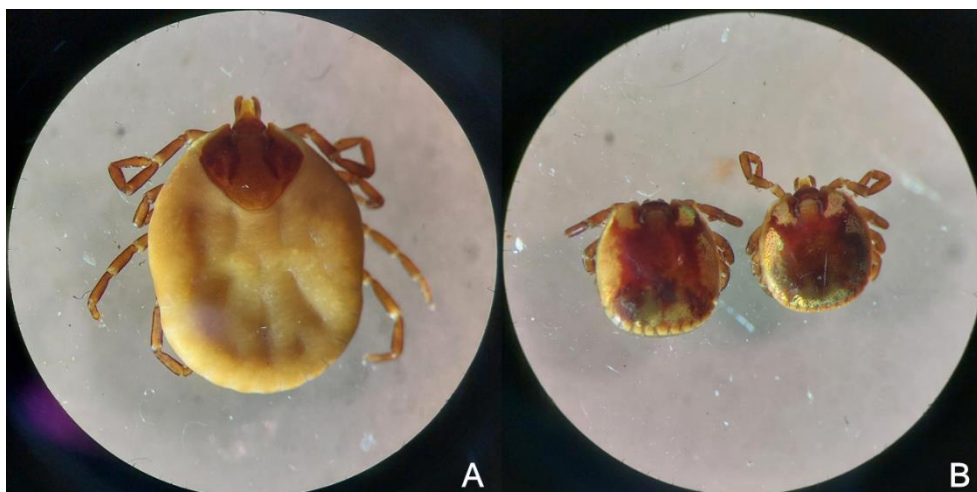


Fig. 2A. A partly engorged female of *Amblyomma cordiferum*. **B.** Males of *Amblyomma helvolum*

It should also be borne in mind that tick co-feeding may result in the passage of pathogens from infected to uninfected vectors, significantly impacting the transmission dynamics of tick-associated microbes, as well as host symptomatology (Thompson *et al.*, 2001; Tomanović *et al.*, 2010; Voordouw, 2015). For this reason, all cases of multi-species parasitism warrant reporting and further study.

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