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First report of two parasitengone larvae on mantids *Bolivaria brachyptera*, and *Rivetina inermis* (Insecta: Mantodea) from Iran

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Until now, larvae of 23 species of the genus *Eutrombidium* Verdun, 1909 have been found associated with orthopterans species worldwide (Feider 1977; Southcott 1993; Saboori *et al*. 2000; Saboori and Nemati 2001; Haitlinger 2003; Mayoral and Barranco 2004; Felska *et al*. 2018). Only a few species have been reported from mantids (such as *E. feldmanmuhsamae* Feider, 1977 on *Rivetina baetica* Rambur, 1839 from Cyprus and Israel (Feider 1977), *E. robauxi* Southcott, 1993 on *Geomantis larvoides* Pantel, 1896 from Greece and Turkey (Southcott 1993), *E. sorbasiensis* Mayoral & Barranco, 2004 on *Iris oratoria* (Linnaeus, 1758) from Portugal and Spain (Haitlinger 2007), *E. trigonum* (Hermann, 1804) on *Mantis* sp. from Germany (Oudemans 1912). Moreover, all of the *Eutrombidium* species that have been reported from Iran, mostly collected on Orthoptera, Acrididae and Gryllidae (Karimi Iravanlou *et al.* 2000; Saboori *et al*. 2000; Saboori and Nemati 2001; Azimi *et al*. 2011).

Dolichothrombium species seems to be host restricted to Thysanoptera and Hemiptera, but Saboori *et al.* (2005), reported *Dolichothrombium raphanicum* as a parasite of an undetermined aphid species (Mąkol and Sevsay 2011).

Bolivaria brachyptera (Pallas, 1773) and *Rivetina inermis* Uvarov, 1922 which examined here belong to the family Rivetinidae, and have been recorded from Iran frequently (Mirzaee and Pashaie Rad 2017; Mirzaee and Sadeghi 2020), but no report of parasitengone mite has been found by the authors.

The study area is located at Tang-e-Mehrian village, Kohgiluyeh and Buyer Ahmad province in Iran in 30° 42' 47.952" N and 51° 37' 08.8824" E (Fig. 1). The mantids were collected by hand catching. To examine the effects of mites on mantids movement in their wild habitat we watched four mantids without mites and four which had mites on their thorax and abdomen for four hours in the noon which is the active time for mantids and it was repeated four times in four days all at 12 pm till 4 pm. For examining impacts of mites on their reproduction, four females were kept in separate terrariums (45 × 30 cm) with the controlled condition (room temperature 25 ± 1 □, the relative humidity 32–50%, and a daily cycle of 16 h light: 8 h dark) which contained some soil, rocks, and

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woods inside to resemble their habitat. After 30 days mantid specimens were preserved in 96% ethanol and deposited in the Zoological Museum of Shiraz University (ZM-CBSU). 132 of the parasitengone mite larvae with red-orange color were detached from the prothorax, the metathorax, under their wings, and lateral side of the abdomen of the mantids (*Bolivaria brachyptera*, *Rivetina inermis*) by a fine needle then preserved in 70% ethanol. Mites were identified by the experts, Dr. A. Saboori and Dr. M. Arbabi. They were identified as *Dolichothrombium* sp. Feider, 1945 (Trombidiidae) and *Eutrombidium aegyptium* Karimi Iravanlou, Kamali & Talebi, 2000 (Microtrombidiidae) according to the larval stage. Mite larvae abundance (mean = 6.75 per host) on the thorax and abdomen may emphasize an impact on their movement, survival and reproduction. The degree of effects depends on the relative size of host and parasite, the number of mites per host and mite species complex (Zhang 1999). This is the first occurrence of parasitengone larvae on mantids of Iran which is reported here.

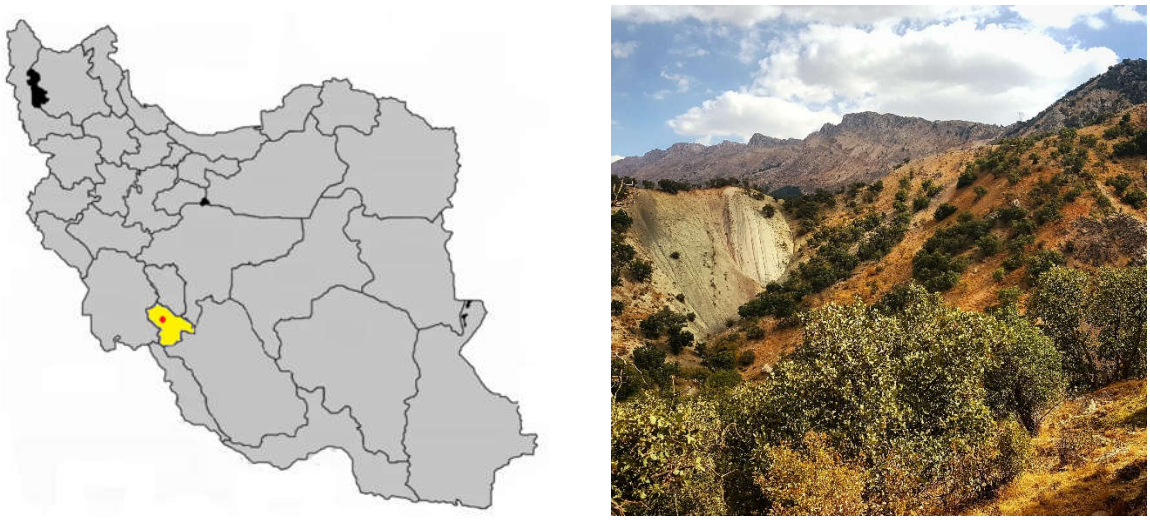

Figure 1. Kohgiluyeh and Buyer Ahmad province in Iran map (left), and collection site habitat (right).

Figure 2. *Dolichothrombium* larva attaching to abdomen (left), and *Eutrombidium* larvae attaching to metathorax (right).

Table 1. Measures of host-parasite interactions between mites and their mantid hosts. IH = Infected Host; Lv = Larva; Mn = Mean; Mx = Maximum

Parasite	Host	No. IH	Mn Lv/IH	Mx Lv/IH
***Dolichothrombium* sp.**	*Rivetina inermis*	2	4.5	5
	Bolivaria brachyptera	3	7.6	8
Eutrombidium aegyptium	*Bolivaria brachyptera*	7	7.14	8
	Rivetina inermis	4	7.75	8

16 infested and four uninfested mantids were collected (Table 1). The infested ones were four females and two males of *Rivetina inermis*, and six females and four males of *Bolivaria brachyptera*. Five to eight mites were found attached to their abdominal (Fig. 2) and thoracic segments (Fig. 2). According to our observation and the past literature (Pérez-Espinoza and Salas 2016), we assume that attaching to these preferred body parts may provide more protection and space for the parasite to colonize the host. The examined insects are ground mantids that walk on the ground and being in touch with the soil and hiding under rocks and stones, make them in contact with the mites that live in the soil. According to our observations, the parasitic mites have an impact on the host mantids' reproduction, by not egg laying and ootheca deposition. The movement of parasitized mantids being so slower than normal as it becomes so easy to catch. As a result, these mantids may have higher mortality rates because they are unable to escape their predators in addition to their short wings and lack of an efficient flight organ. Larval stage of these mites are ectoparasites of these kinds of mantids as well as using the host for distribution.

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