Devagiri Journal of Science 8(1),01-06

www.devagirijournals.com
ISSN 2454-2091

First report of two predatory wasps of the Genus *Carinostigmus* Tsuneki (Hymenoptera: Crabronidae), as natural enemies of Aphids from the tea plantations of Kerala

[1]Girish Kumar, P. *, [2]Souvik Sen, [1]Hegde, V.D., [3]Rabeesh, T.P.&[4]Shamkumar, K.V.
[1]Western Ghat Regional Centre, Zoological Survey of India, Eranhipalam, Kozhikode- 6730006, Kerala, India.
[2]Zoological Survey of India, M-Block, New Alipore, Kolkata-700053, West Bengal, India.
[3]Division of Entomology, UPASI Tea Research Foundation, Tea Research Institute, Nirar Dam P.O., Valparai-642127, Coimbatore, Tamil Nadu, India.
[4] UPASI Tea Research Foundation Regional Centre, Vandiperiyar- 685533, Idukki, Kerala, India.

Received: 06.08.2021

Revised and Accepted: 8.8. 2022

Key words: Pemphredoninae, *Carinostigmus costatus*, *Carinostigmus aterrimus*, tea gardens, Idukki, Southern Western Ghats, India

Abstract
Two species of predatory wasps, namely, *Carinostigmus costatus* Krombein, 1984 and *C. aterrimus (*Turner, 1917) (Hymenoptera: Crabronidae: Pemphredoninae) as natural enemies of tea aphids are reported for the first time from tea plantations of south India. The species *C. aterrimus* is newly recorded from Kerala in the present study.

1. Introduction

Tea (*Camellia sinensis* (L.) Kuntze) is one of the major plantation crops in south India and tea growing areas are distributed across Tamil Nadu, Kerala, and Karnataka part of southern Western Ghats (Sivakumar *et al*., 2018). In Kerala, the tea plantations are mainly confined to Idukki, Wayanad, Thrissur, Malappuram, Palakkad, Kollam and Thiruvananthapuram districts. Tea plantation provides a comparatively stable microclimate, continuous supply of food and suitable reproduction sites for several phytophagous insects and mites (Das *et al.,* 2010). Aphids (*Toxoptera aurantii* Boyer de Fonscolombe, 1841) is one of the important tea pests worldwide (Wu *et al.,* 2022). This hemipteran pest usually attacks tender buds, leaves, and shoots of tea plant and suck the sap leads to reduction of growth. Lady bird beetles, syrphid fly, green lace wing, spiders and few hymenopteran egg parasitoids are common natural enemies of tea aphid (Das *et al.,* 2010). Few studies have been done so far on the natural enemies of tea pests of southern India (Selvasundaram & Muraleedharan, 1986; Muraleedharan *et al*., 1988, 2001). In the present study, we report two species of predatory wasps, namely, *Carinostigmus costatus* Krombein, 1984 and *C. aterrimus (*Turner, 1917) (Hymenoptera: Crabronidae: Pemphredoninae) which are recognized as natural enemies of aphids in tea ecosystem of Idukki district, Kerala. The photographs and the differential diagnosis provided in the text will be useful for easy identification of these two predatory wasps.

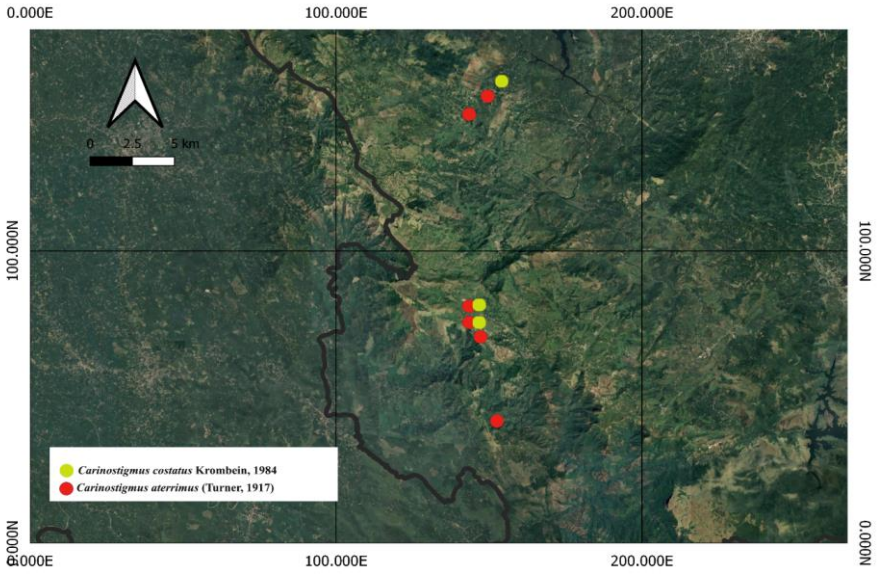
*Corresponding author
E-mail:kpgiris@gmail.com

The genus *Carinostigmus*is having 44 species worldwide, of which 5 species are reported from India (Tessy Rajan *et al*., 2020; Pulawski, 2023). Green (1903), Arnold (1924), Yasumatsu & Watanabe (1964), Iwata (1964) and Tsuneki (1970) studied the biology of some species belonging to the genus *Carinostigmus*. *Carinostigmus* generally hunts aphids to feed their larvae, while the adults feed on nectar from flowering plants (Gracy *et al*., 2019). Females usually make their nest in stems, dried twigs, and wooden logs by making burrows inside them. They construct cells inside these burrows for storing paralyzed aphids (Bohart & Menke, 1976).

2. Methodology

Samples of predatory wasps of tea pests were collected by using yellow pan trap and sweep net during the recent survey conducted at tea gardens of Idukki district, Kerala for studying the natural enemies of tea pests. The collected wasp specimens were studied and photographed with a Leica Stereo zoom microscope model LEICA M 205A with LEICA DFC 450 Camera. Multifocal stacking images were prepared with Auto montage software LAS Version 3.8.0 (Build: 878). All the studied wasp specimens are deposited in the 'National Zoological Collections' of the Western Ghat Regional Centre, Zoological Survey of India, Kozhikode (ZSIK), Kerala, India.

Abbreviations used for the depositories in the text: **NHMUK**: Natural History Museum, London, England, U.K; **USNM**: U. S. National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A.; **ZSIK**: National Zoological Collections, Zoological Survey of India, Western Ghat Regional Centre, Kozhikode, Kerala, India.



Map showing collection localities of *Carinostigmus costatus* Krombein and *Carinostigmus aterrimus* (Turner)

3. Results & Discussion

***Carinostigmus costatus* Krombein, 1984**(Figs 1–2)

Carinostigmus costatus Krombein, 1984: 15, female, male. Holotype: female, Sri Lanka: Western Province, Colombo District, Gampaha Botanical Garden (USNM).

Diagnostic characters:Underside of head with strong longitudinal costae except median area with delicate longitudinal lineolations narrowly (Fig. 2); mandible with narrow ivory streak near base; propodeal enclosure except basal section rugoso-reticulate; apex of clypeus slightly emarginated; petiole stouter, about 5–6.5 × as long as its median width; face with median carina stronger and armed with erect projection near middle; groove along inner eye margin strongly crenulate; mandibles tridentate in female.

Material examined. INDIA: Kerala, Idukki district, Kuttikanam, Stagbrook tea plantation (9.599250 N and 76.963637 E), 1♀, 24.i.2023, Coll. P. Girish Kumar & Party, ZSIK Regd. No. ZSI/WGRC/I.R.-INV.23217; Vagamon, Kothapara tea plantation (9.724068 N and 76.981615 E), 1♀, 29.i.2023, Coll. P. Girish Kumar & Party, ZSIK Regd. No. ZSI/WGRC/I.R.-INV.23218; Kuttikanam, Ashley tea plantation (9.590327 N and 76.963517 E), 2♀, 30.i.2023, Coll. P. Girish Kumar & Party, ZSIK Regd. Nos. ZSI/WGRC/I.R.-INV.23219–23220.

Distribution. India: Goa, Karnataka, Kerala, Uttarakhand. *Elsewhere*: Sri Lanka; China (Tessy Rajan *et al*., 2020; Pulawski, 2023).

***Carinostigmus aterrimus* (Turner, 1917)** (Figs 3–4)

Stigmus aterrimus Turner, 1917:174, female. Holotype: female, India: Tamil Nadu,Nilgiri Hills,Coonoor (NHMUK).

Diagnostic characters: Underside of head moderately densely punctate especially towards middle and usually with few parallel carinae laterally (Fig. 4); mandible with no ivory markings; propodeal enclosure except basal section rugoso-reticulate; apex of clypeus slightly emarginated; petiole stouter, about 5–6.5 × as long as its median width; face with median carina stronger and armed with erect projection near middle; groove along inner eye margin strongly crenulate; mandibles tridentate in female.

Material examined. INDIA: Kerala, Idukki district, Kuttikanam, Stagbrook tea plantation (9.599250 N and 76.963637 E), 1♀, 24.i.2023, Coll. P. Girish Kumar & Party, ZSIK Regd. No. ZSI/WGRC/I.R.-INV.23204; Valakode, Rhythmbara tea plantation (9.716500 N and 76.973642 E), 1♀, 26.i.2023, Coll. P. Girish Kumar & Party, ZSIK Regd. No. ZSI/WGRC/I.R.-INV.23205; Vagamon, Panchalimedu tea plantation (9.5357 N and 76.9785 E), 1♀, 28.i.2023, Coll. P. Girish Kumar & Party, ZSIK Regd. No. ZSI/WGRC/I.R.-INV.23206; Valakode, J.C. Hills tea plantation (9.706623 N and 76.963503 E), 2♀, 29.i.2023, Coll. P. Girish Kumar & Party, ZSIK Regd. Nos. ZSI/WGRC/I.R.-INV.23207–23208; Kuttikanam, Ashley tea plantation (9.590327 N and 76.963517 E), 2♀ & 2♂, 30.i.2023, Coll. P. Girish Kumar & Party, ZSIK Regd. Nos. ZSI/WGRC/I.R.-INV.23209–23212; Kuttikanam, Teyla tea plantation (9.581908 N and 76.969120 E), 4♀, 31.i.2023, Coll. P. Girish Kumar

&Party, ZSIK Regd. Nos. ZSI/WGRC/I.R.-INV.23213–23216.

Distribution. India: Kerala (**new record**), Karnataka, Tamil Nadu (Tessy Rajan *et al*., 2020; Pulawski, 2023).

Major differences between *Carinostigmus costatus* Krombeinand***C. aterrimus*** (Turner)

	C. costatusKrombein, 1984	***C. aterrimus***(Turner, 1917)
1.	Underside of head with strong longitudinal costae except median area with delicate longitudinal lineolations narrowly.	Underside of head moderately densely punctate especially towards middle and usually with few parallel carinae laterally.
2.	Mandible with narrow ivory streak near base.	Mandible with no ivory markings.

4. Conclusion

It is the first report of two predatory wasps, namely, *Carinostigmus costatus* Krombein, 1984 and *C. aterrimus* (Turner, 1917) as natural enemies of tea aphids.

5. Acknowledgements

The authors are grateful to Dr. Dhriti Banerjee, Director, Zoological Survey of India, Kolkata, for providing facilities and encouragements.The first and third authors are grateful also to the authorities of UPASI Tea Research Foundation for providing facilities to conduct studies on various tea plantations of Idukki district. Authors are also thankful to the authorities of Stagbrook tea plantations, Ashley tea plantation, Rhythmbara tea plantations, Teyla tea plantations, etc. for necessary permissions to conduct this study and collect the samples.

6. References

Arnold, G. (1924). The Sphegidae of South Africa. Part V. *Annals of the Transvaal Museum,* 11,1– 73.

Bohart, R.M. & Menke, A.S. (1976).*Sphecid wasps of the world. A generic revision*. University of California Press, Berkeley, Los Angeles, London, 695 pp.

Das, S., Roy, S. & Mukhopadhyay, A. (2010). Diversity of arthropod natural enemies in the tea plantations of North Bengal with emphasis on their association with tea pests. *Current Science,* 99(10): 1457-1463.

Gracy, R., Murthy, K. & Venkatesan, T. (2019). New Record of *Carinostigmus* Tsuneki (Hymenoptera: Crabronidae: Pemphredoninae) species in India and identity of its species using DNA barcoding. *Journal of Biological Control,* 33(1): 70–75.

Green, E.E. (1903). On the nesting habits of *Trypoxylonintrudens* and *Stigmusniger*. *Spolia Zeylanica* 1: 68–70.

Iwata, K. (1964). Bionomics of non-social wasps in Thailand. *Nature Life Southeast Asia,* 3: 323–383.

Krombein, K.V. (1984). Biosystematic studies of Ceylonese wasps, XIV: a revision of *Carinostigmus* Tsuneki (Hymenoptera: Sphecoidea:

Pemphredonidae). *Smithsonian Contributions to Zoology,* 396: 1–37.

Muraleedharan, N., Selvasundaram, R. & Radhakrishnan, B. (1988). Natural enemies of certain tea pests occurring in southern India. *International Journal of Tropical Insect Science,* 9: 647-654.

Muraleedharan, N., Selvasundaram, R. & Radhakrishnan, B. (2001). Parasitoids and predators of tea pests in India. *Journal of Plantation Crops,* 29(2): 1-10.

Pulawski, W.J. (2023). *Catalog of Sphecidae.* Available from: http://research.calacademy.org/ent/catalog_sphecidae [Accessed 10thMay 2023].

Selvasundaram, R. & Muraleedharan, N. (1986). Observations on the larval parasitoids of *Homona coffearia* Neitner (Tortricidae: *Lepidoptera*) in a tea field at the Anamallais (Coimbatore Dt.). *Journal of Plantation Crops,* 16: 185–188.

Sivakumar, S., Saravana, N., Velmurugan, G. & Subashini, R. (2018). Performance of tea industries in South India – a comparative analysis. *International Journal of Pure and Applied Mathematics,*119: 3549–3568.

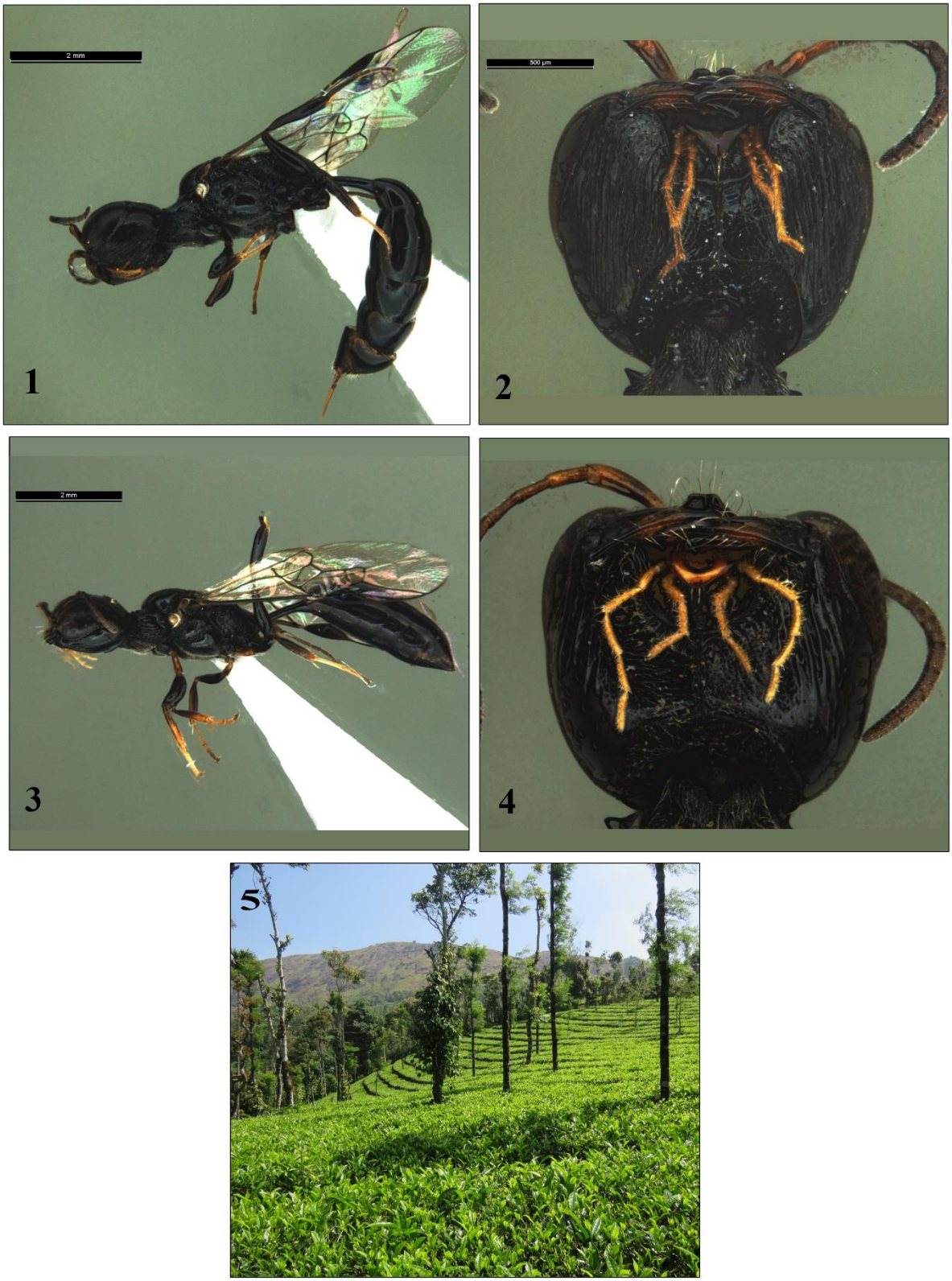
Tessy Rajan, Sureshan, P.M. & Girish Kumar, P. (2020). Additions to the knowledge on the genus *Carinostigmus* Tsuneki (Hymenoptera: Crabronidae: Pemphredoninae) from the Indian subcontinent with the description of two new species. *Zootaxa,* 4881(1): 152–164.

Tsuneki, K. (1970). Gleanings on the bionomics of the East-Asiatic non-social wasps (Hymenoptera). V. Some species of Pemphredoninae. *Etizenia,* 42: 1–20.

Turner, R.E. (1917). On a collection of Sphecoidea sent by the Agricultural Research Institute, Pusa, Bihar. *Memoirs of the Department of Agriculture in India. Entomological Series,* 5: 173–205.

Yasumatsu, K.& Watanabe, C. (1964). A tentative catalogue of insect natural enemies of injurious insects in Japan. Part 1. *Parasite-predator host catalogue. Fukuoka*. pp. 166-172.

Wu, Y., Han, S., Wang, M., Zhang, Q-H. & Han, B. (2022). Control of tea aphids *via* attracting the parasitic wasp, *Aphelinus* sp. with synthetic semiochemicals. *Frontiers in Ecology and Evolution,* 10: 71-88.



FIGURES 1–2. ***Carinostigmus costatus*** **Krombein female. 1. Habitus, lateral view; 2. Under side of head. FIGURES 3–4.** ***Carinostigmus aterrimus*** **(Turner) female. 3. Habitus, lateral view; 4. Underside of head. FIGURE 5. Rhythmbara tea plantation, Valakode, Vagamon.**