

Taxonomic Study on the Darwin Wasp Genus *Dicamptus* Szépligeti, 1905 (Hymenoptera: Ichneumonidae: Ophioninae) With Description of Two New Species from India

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Abstract. Two new species of the Darwin wasp genus *Dicamptus* Szépligeti, viz., *D. neosinuatus* and *D. keralicus* are reported from Keralam, India. Descriptions of the new species with illustrations and the affinities of the new species to the closely related species are included. A key to the Oriental species of *Dicamptus* and a distribution map of the species described is also provided..

Key words: *Dicamptus neosinuatus*, *Dicamptus keralicus*, New species, Key, Distribution map, Oriental, Keralam

Introduction

Dicamptus Szépligeti, 1905 is a moderately species rich genus of the subfamily Ophioninae of the family Ichneumonidae that comes under Order Hymenoptera. It comprises of 34 described species and is distributed in Afrotropical, Australian, Oriental and Palaearctic region (Yu *et al.*, 2016; Pham *et al.*, 2020). They are generally known as solitary koinobiont endoparasitoids of Lepidoptera larvae (Gauld and Mitchell, 1981). Species of *Dicamptus* can be easily recognized by the combination of following morphological characters: mandible not twisted; occipital carina complete; scutellum weakly to moderately convex with strong lateral longitudinal carina; fore wing with 1m-cu evenly curved to sinuous; ramulus absent; disco-submarginal cell with a large glabrous area bearing proximal and sometimes distal sclerites; hind wing with 5–13 uniform hamuli on RA; fore tibial spur without a membranous flange; mid and hind trochantelli simple. Ten species of *Dicamptus* are known from India (Yu *et al.*, 2016). In Kerala, only one species viz., *D. indicus* Nikam has been reported. Here we describe two new species viz., *D. neosinuatus* sp. n. and *D. keralicus* sp. n. from Kerala, India. Distribution map and key to the Oriental species are also provided.

Materials and Methods

Specimens for the present study were collected from the Kozhikode and Palakkad district of Keralam State employing light trap. The collected specimens were then dried, pinned using entomological pin and the morphology of specimen was examined under LEICA M205 stereozoom microscope. The image was captured using LEICA MC 170 HD digital camera attached to LEICA M205 stereozoom microscope and stacking done using LAS X Software. This study is based on single female specimens, and the type specimens of new species are deposited in the collection of Prof. T.C. Narendran Biodiversity Research laboratory, The Zamorin's Guruvayurappan College, Calicut (NBRL) for the time being and will be later transferred to the Western Ghats Regional Centre of Zoological Survey of India, Kozhikode. The Distribution map was prepared with the help of location taken from the field itself using Mobile GPS and coordinate values of field sites imported into the GIS software platform. Open-source software like QGIS and Google Earth Pro was used for mapping.

Morphological terminology, abbreviations and indices

Morphological terminology follows Broad *et. al.* (2018), Shimizu *et. al.* (2020) and Shimizu and Maeto (2023). The morphological indices used in this paper follows Gauld and Mitchell (1981) and Shimizu *et al.*, (2016 and 2020) and Shimizu and Maeto (2023).

Abbreviations used: FWL = fore wing length; FWW = fore wing width; HWL = hind wing length; HWW = hind wing width.

Indices for head

GOI (Geno-orbital index) = maximum breadth of eye in profile/ maximum breadth of gena in same line.

Indices for wing

AI (Alar Index) = length of 1m-cu&M between 2m-cu and bulla / length of 2rs-m; CI (Cubital Index) = length of CU between 1m-cu&M and 2cu-a / length of 2cu-a; DI (Discoidal Index) = maximum vertical distance of a straight line connecting 1m-cu&M and CU between 2cu-a and 2m-cu / length of CU between 2cu-a and 2m-cu; ICI (Intercubital Index) = length of 2rs-m / length of M between 2m-cu and 2rs-m; SDI (Second Discoidal Index) = length of CU between 2cu-a and 2m-cu / length of CU between M&RS and 1m-cu&M; SI (Sinuous Index) = maximum length between 1m-cu&M and a straight line connecting the intersection of M, 2m-cu and 1m-cu&M and the intersection of 1m-cu&M and CU / distance between the intersection of M, 2m-cu and 1m-cu&M and the intersection of 1m-cu&M and CU; SRI (Second Recurrent Index) = length of 2m-cu / length of CU between 2cu-a and 2m-cu; NI (Nervellar Index) = length of CU between M and cu-a / length of cu-a.

Indices for metasoma

DMI (Dorsal Metasomal Index) = length of dorsum of T2 / length of dorsum of T3; LMI (Lateral Metasomal Index) = length of dorsum of T2 / posterior depth of T2; PI (Petiolar Index) = distance between base of T1 and anterior margin of spiracle / distance between margin of spiracle and apex of T1.

Results**Systematic Status**

Family : Ichneumonidae
 Subfamily : Ophioninae
 Tribe : Enicospilini
 Genus : *Dicamptus*

GENUS ***DICAMPTUS*** SZÉPLIGETI, 1905

Dicamptus Szépligeti, 1905: 21. Type-species: *Dicamptus giganteus* Szépligeti, by monotypy.

Diagnosis

Medium to large-sized insects; antennae usually longer than fore wing; mandible barely narrowed apically, not twisted; mandibular teeth subequal; occipital carina complete; scutellum weakly to moderately convex with strong lateral longitudinal carina; posterior transverse carina of mesosternum complete; propodeum usually with a single anterior transverse carina; fore wing with 1m-cu&M evenly curved to sinuous; ramulus absent; disco-submarginal cell with a large glabrous area bearing proximal and sometimes distal sclerites; hind wing with 5–13 uniform hamuli on RA. Fore tibial spur without a membranous flange; mid and hind trochantelli simple.

Key to the Oriental species of *Dicamptus* Szépligeti

1. Fore wing with ICI and CI small, less than 0.55 2
 - Fore wing with ICI and CI large, greater than 0.60 7
2. Fore wing with proximal sclerite confluent with a narrow distal sclerite; ICI = 0.25–0.47; CI = 0.30–0.55 ***D. fuscicornis*** (Erichson)
 - Fore wing with proximal sclerite not confluent with distal sclerite; ICI = 0.13–0.22; CI = 0.08–0.22 3
3. Fore wing without distal sclerite 4
 - Fore wing with distal sclerite 5
4. Lower face less than $0.79 \times$ as broad as long; antennae with 20th segment $2.10 - 2.20 \times$ as long as broad ***D. indicus*** Nikam
 - Lower face more than $0.80 \times$ as broad as long; antennae with 20th segment $1.50 \times$ as long as broad ***D. brevicornis*** Tang
5. Clypeus medially projecting; forewing with AI = 0.85 ***D. bicarinus*** Nikam and Kanhekar
 - Clypeus convex in profile; forewing with AI always greater than 1.10 6

6. Mandible with outer surface uniformly and finely pubescent; gena strongly constricted behind eye; GOI = 3.50; mesosoma black and metasoma yellowish brown *D. atratus* Tang
 - Mandible with outer surface bears a conspicuous brush of setae; gena slightly constricted behind eye; GOI = 2.00–2.50; mesosoma and metasoma yellowish-brown *D. ishikki* Uchida
7. Clypeus strongly convex; fore wing with AI = 0.85; ICI = 0.65 *D. lambai* Nikam and Kanhekar
 - Clypeus flat to moderately convex; fore wing with AI and ICI variable ... 8
8. Fore wing with M&RS concavely curved, without a trace of sinuous; proximal sclerite carduate *D. carduatus* Gauld and Mitchell
 - Fore wing with M&RS sinuous; proximal sclerite more or less triangular 9
9. Fore wing with marginal cell adjacent to 2r&RS with a distinct glabrous patch 10
 - Fore wing with marginal cell uniformly hirsute or rarely with setae slightly sparse adjacent to 2r&RS, never with glabrous patch 12
10. Setae on disco-submarginal cell slightly broadened distally; propodeum without posterior transverse carina; clypeus in profile strongly protuberant, virtually nasute, hind wing with NI = 1.10–1.70 11
 - Setae on disco-submarginal cell evenly tapered; propodeum with posterior transverse carina; clypeus flat in profile; hindwing with NI = 4.25 *D. neosinuatus* sp. nov.
11. Metasoma strongly slender with tergite 2 in profile $3.50 \times$ as long as posteriorly deep; scutellum with two very strong median longitudinal ridges *D. gracillus* Tang
 - Metasoma less slender with tergite 2 in profile $2.50 \times$ as long as posteriorly deep; scutellum without conspicuous median longitudinal ridges *D. nigropictus* (Matsumura)
12. Mandible with a pronounced proximal concavity margined distally by an angular raised ridge; inter-ocellar area black *D. reticulatus* (Cameron)
 - Mandible flat or with a weak proximal concavity and never with such a concavity margined by a raised ridge; inter-ocellar area variable 13
13. Mandible moderately tapered so that distal apex is about $0.50 \times$ as broad as base; metapleuron usually entirely strongly reticulate *D. giganteus* Szepligeti
 - Mandible weakly tapered so that distal apex is at least $0.60 \times$ as broad as base; metapleuron at most with strong reticulations only on most posterior part, usually entirely puncto-coriaceous 14
14. Propodeum with posterior transverse carina distinct at least laterally 15
 - Propodeum without posterior transverse carina 16
15. Mesopleuron with coarse longitudinal striations; scutellum subquadrate, about $1.20 \times$ as long as broad anteriorly *D. zoracius* Gauld and Mitchell
 - Mesopleuron punctate entirely; scutellum elongate $1.40 \times$ as long as broad *D. keralicus* sp. nov.

16. Fore wing with 1m-cu&M curved at distal 0.7, not sinuous; SDI less than 1.05; small species; forewing length 13–14 mm *D. flavoplagiatus* (Cushman)
- Fore wing with 1m-cu&M sinuous; SDI more than 1.06; larger species; fore wing length always more than 15 mm 17
17. Inter-ocellar area yellowish-brown; head in dorsal view constricted behind eye; B& with sternite 6-8 bearing long stout erect pubescence *D. sinuatus* (Morley)
- Inter-ocellar area black; head in dorsal aspect with genae somewhat inflated; B& with sternite 6-8 with fine short pubescence *D. cantoni* Gauld and Mitchell

Dicamptus neosinuatus sp. n.

[Figs. 1–10]

Material examined: **Holotype:** Female. India: Kerala, Kozhikode district, Chappanthottam (N11°67'29"- E75°76'73"), Coll. Soumya T.K, 11.i.2023, Reg. No. NBRL 355.

Description: Body length = 27 mm; Antennae length = 28 mm; Ovipositor length (beyond metasomal apex) = 2.59 mm.

Head (Figs. 2 & 3): Antennae as long as body with 65 flagellomeres; length of first flagellar segment $2.10 \times$ as long as second, 20th flagellar segment $2.10 \times$ as long as broad; lower face smooth, $0.80 \times$ as wide as long; clypeus flat in profile, in anterior aspect clypeus $1.60 \times$ wider than length; malar space $0.10 \times$ longer than basal width of mandible (Fig. 3); mandible relatively long, uniformly narrowed, not twisted, long hairs on outer surface, proximal concavity, without a groove on outer surface, flat with scattered punctures; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 3.00.

Mesosoma: Mesoscutum (Fig. 6) slightly rounded in profile; scutellum weakly convex in profile, dorsally $1.50 \times$ longer than width anteriorly, lateral longitudinal carina of scutellum (Fig. 4) extending its entire length; mesopleuron indistinctly polished, upper part punctate to puncto-striate, lower part puncto-striate; epicnemial carina not extending anterior margin of mesopleuron; metapleuron rugose; submetapleural carina evenly anteriorly widened; propodeum (Fig. 5) with anterior area striate, posterior area coarsely irregularly wrinkled tending to become sub-concentrically wrinkled, anteriorly with a strong transverse carina, posterior with a transverse carina, margin of propodeal spiracle joined to lateral longitudinal carina.

FWL = 18.25 mm; FWW = 5.60 mm; HWL = 12.45 mm; HWW = 3.08 mm; disco-submarginal cell with proximal sclerite triangular; distal sclerite linear; AI = 1.25; CI = 0.95; DI = 0.40; ICI = 0.92; SDI = 0.95; SI = 0.14; SRI = 0.24; vein Rs+2r sinuous (Fig. 7); 1m-cu&M sinuate; 1cu-a proximal to M&RS by $0.20 \times$ its own length; M&RS slightly curved; marginal cell with proximally gla-

brous area; outer hind corner of second discal cell 120° ; first abscissae of RS in hind wing straight, second abscissae more or less straight (Fig. 8); RA with 12 hamuli (Fig. 9); NI = 4.25.

Legs slender; tibia with scattered spines on outer surface; fore tibial spur $0.80 \times$ as long as tarsus 2; hind coxa $1.70 \times$ longer than deep.

Metasoma: Metasoma long and slender (Fig. 10); third tergite $1.80 \times$ as long as posteriorly deep; ovipositor apically elongately acute; DMI = 1.30; PI = 2.72; THI = 4.05.

Colour: Generally yellowish-brown; inter-ocellar area infusate; mandibular teeth black; posterior part of mesoscutum black; dorsal part of tergite 3, tergite 5 and above dark brown; wings hyaline; pterostigma dark brown.

Male: Unknown

Host and Biology: Unknown

Distribution: India: Kerala.

Etymology: The new species is named after *Dicamptus sinuatus* (Morley), due to its close resemblances. Masculine gender.

Comparative diagnosis:

The new species *D. neosinuatus* is erected based on a single female specimen and due to rarity of the genus, further attempts did not yield any additional material. *D. neosinuatus* closely resembles *D. sinuatus* (Morley) in general appearance and morphology, but it differs from *D. sinuatus* as follows: fore wing with marginal cell adjacent to Rs+2r with a glabrous area (in *D. sinuatus* evenly setose); hind wing with 12 hamuli on R1 (in *D. sinuatus* hind wing with 9–10 hamuli); propodeum with posterior transverse carina strongly raised laterally (in *D. sinuatus* propodeum with posterior transverse carina absent); SDI = 0.95 and NI = 4.25 (in *D. sinuatus* SDI = 1.15 and NI = 1.90–2.95); pterostigma dark brown (in *D. sinuatus* pterostigma yellowish-brown)

The new species also closely resembles *D. nigropictus* (Matsumura) in general appearance and morphology. However, it differs from *D. nigropictus* as follows: disco-submarginal cell between proximal sclerite and base of pterostigma glabrous (in *D. nigropictus* hirsute); setae on the disco-submarginal cell evenly tapered (in *D. nigropictus* setae slightly broadened distally); SDI = 0.95 and NI = 4.25 (in *D. nigropictus* SDI = 1.15–1.50 and NI = 1.10–1.50).

Dicamptus keralicus sp. n.

[Figs. 11–20]

Material examined: Holotype: Female. India: Kerala, Palakkad district, Silent Valley (N11°08'00"-E76°28'00"), Coll. Prasanth & Rajesh, 19.v.2016, Reg. No. NBRL 356.

Description. Body length = 22.80 mm; Antennae length = 21.10 mm; Ovipositor length (beyond metasomal apex) = 0.60 mm.

Head (Figs. 12–14): Antennae as long as body with 65 flagellomeres; length of first flagellar segment $2.10 \times$ as long as second, 20th flagellar segment $2.00 \times$ as long as broad; lower face finely punctate, $0.60 \times$ as wide as long; clypeus slightly convex in profile, in anterior aspect clypeus $1.50 \times$ wider than length; malar space $0.10 \times$ longer than basal width of mandible; mandible relatively short, weakly narrowed, not twisted, setae on outer surface, weak proximal concavity, without a groove on outer surface; posterior ocelli almost close to eye; genae behind eye constricted; occipital carina complete; GOI = 2.90.

Mesosoma: Mesoscutum slightly rounded in profile (Fig. 15); scutellum weakly convex in profile, dorsally $1.40 \times$ longer than width anteriorly, lateral longitudinal carina of scutellum extending entire its length; mesopleuron indistinctly polished, punctate throughout; epicnemial carina inclined towards anterior margin of mesopleuron; metapleuron punctate; submetapleural carina anteriorly strongly widened; propodeum (Fig. 16) with anterior area striate, area between anterior and posterior transverse carina reticulate, anteriorly with a transverse carina; margin of propodeal spiracle joined to lateral longitudinal carina.

FWL = 16.50 mm; FWW = 5.20 mm (Fig. 17); HWL = 11.35 mm; HWW = 2.50 mm (Fig. 18); disco-submarginal cell with proximal sclerite triangular; distal sclerite linear; AI = 1.12; CI = 0.90; DI = 0.37; ICI = 0.66; SDI = 1.20; SI = 0.10; SRI = 0.20; vein 2r&RS sinuous, moderately convex in middle (Fig. 17); 1m-cu&M sinuate; 1cu-a proximal to M&RS by $0.20 \times$ its own length; M&RS slightly curved, marginal cell with proximally setose; outer hind corner of second discal cell 100° ; R1 with 10 hamuli (Fig. 19).

Legs slender; tibia with scattered spines on outer surface; fore tibial spur $0.40 \times$ as long as tarsus 2; hind coxa $1.50 \times$ longer than deep.

Metasoma: Metasoma (Fig. 20) long and slender; third tergite $1.40 \times$ as long as posteriorly deep; ovipositor apically elongately acute; DMI = 1.23; PI = 2.23; THI = 5.10.

Colour: Generally yellowish-brown; inter-ocellar area yellow; mandibular teeth black; posterior part of mesoscutum black; tergite 3, tergite 5 and above are dark brown; wings hyaline (Figs. 17 & 18); pterostigma yellowish-brown.

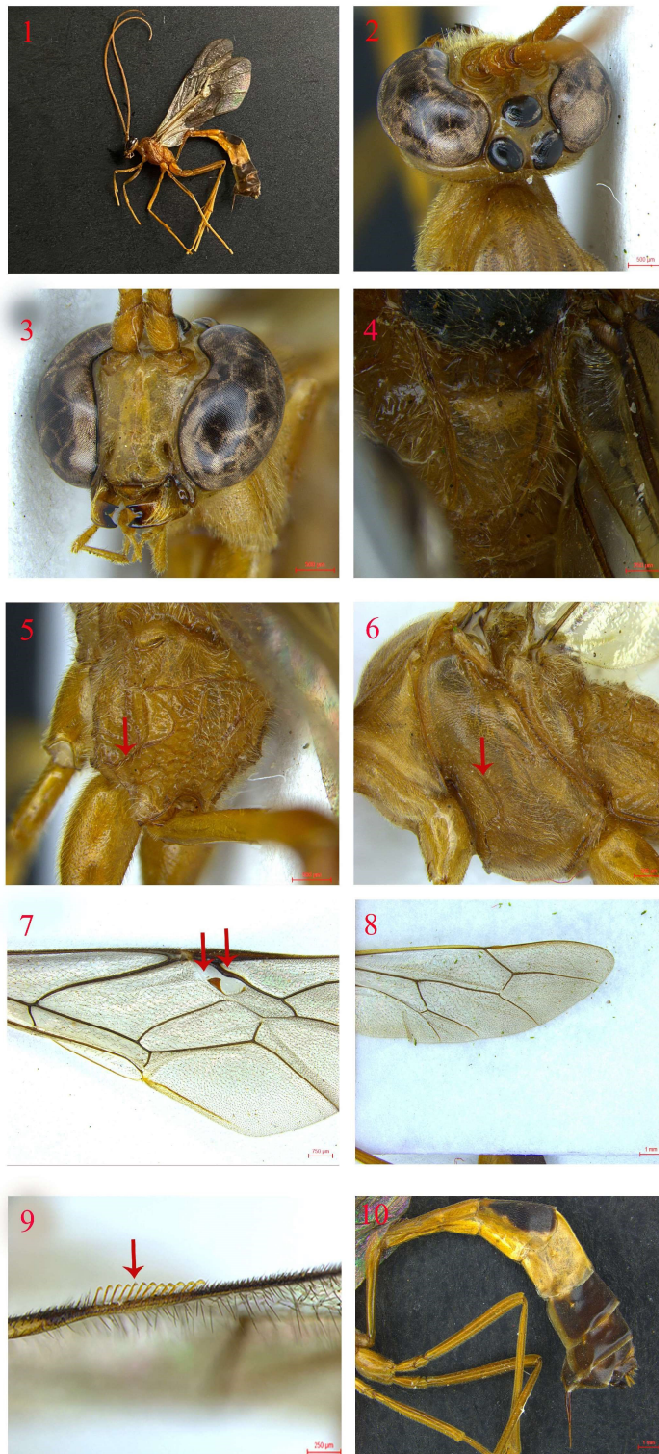
Male: Unknown

Host and Biology: Unknown

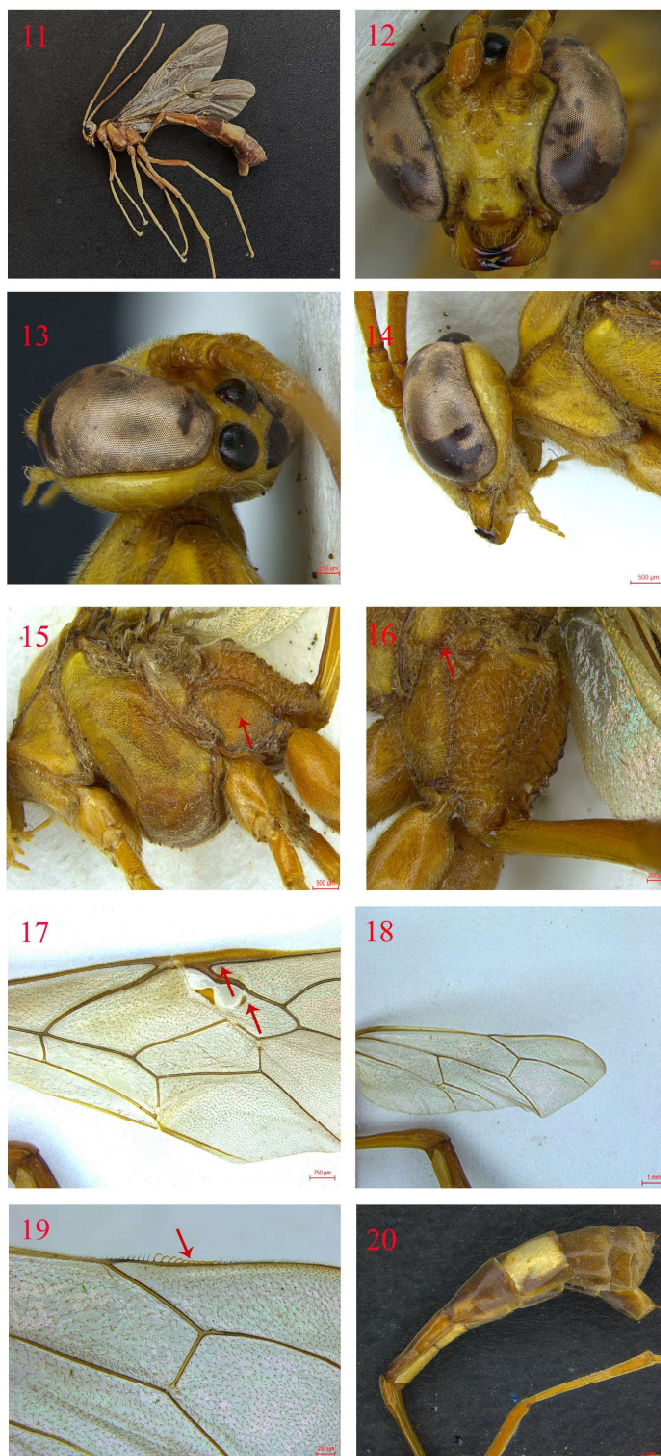
Distribution: India: Kerala.

Etymology: The species name refers to the Indian state of Kerala, from where the holotype was collected. Masculine gender.

Comparative diagnosis: The new species *D. keralicus* closely resembles *D. sinuatus* (Morley) in general appearance and morphology. However, it differs from *D. sinuatus* as follows: disco-submarginal cell with distal sclerite present (in *D. sinuatus* distal sclerite absent); propodeum with posterior transverse carina strongly raised laterally (in *D. sinuatus* posterior transverse carina absent); metapleuron punctate (in *D. sinuatus* metapleuron wrinkled).



Figures 1-10. *Dicamptus neosinuatus* sp. nov. Holotype @&: 1. Habitus lateral view, 2. Head dorsal view, 3. Head - Mandible and Malar space, 4. Scutellum dorsal view, 5. propodeum showing carina and sculptures; 6. Mesosoma lateral view, 7. Disco-cubital cell of fore wing; 8. Hind wing venation; 9. Hind wing hamuli ; 10. Metasoma lateral view.



Figures 11-20. *Dicamptus keralicus* sp. nov. Holotype @&: **11.** Habitus lateral view, **12.** Head frontal view, **13.** Head dorso-lateral view, **14.** Head lateral view, **15.** Mesosoma lateral view, **16.** propodeum with carina and sculptures **17.** Disco-cubital cell of fore wing; **18.** Hind wing venation; **19.** Hind wing hamuli; **20.** Metasoma lateral view

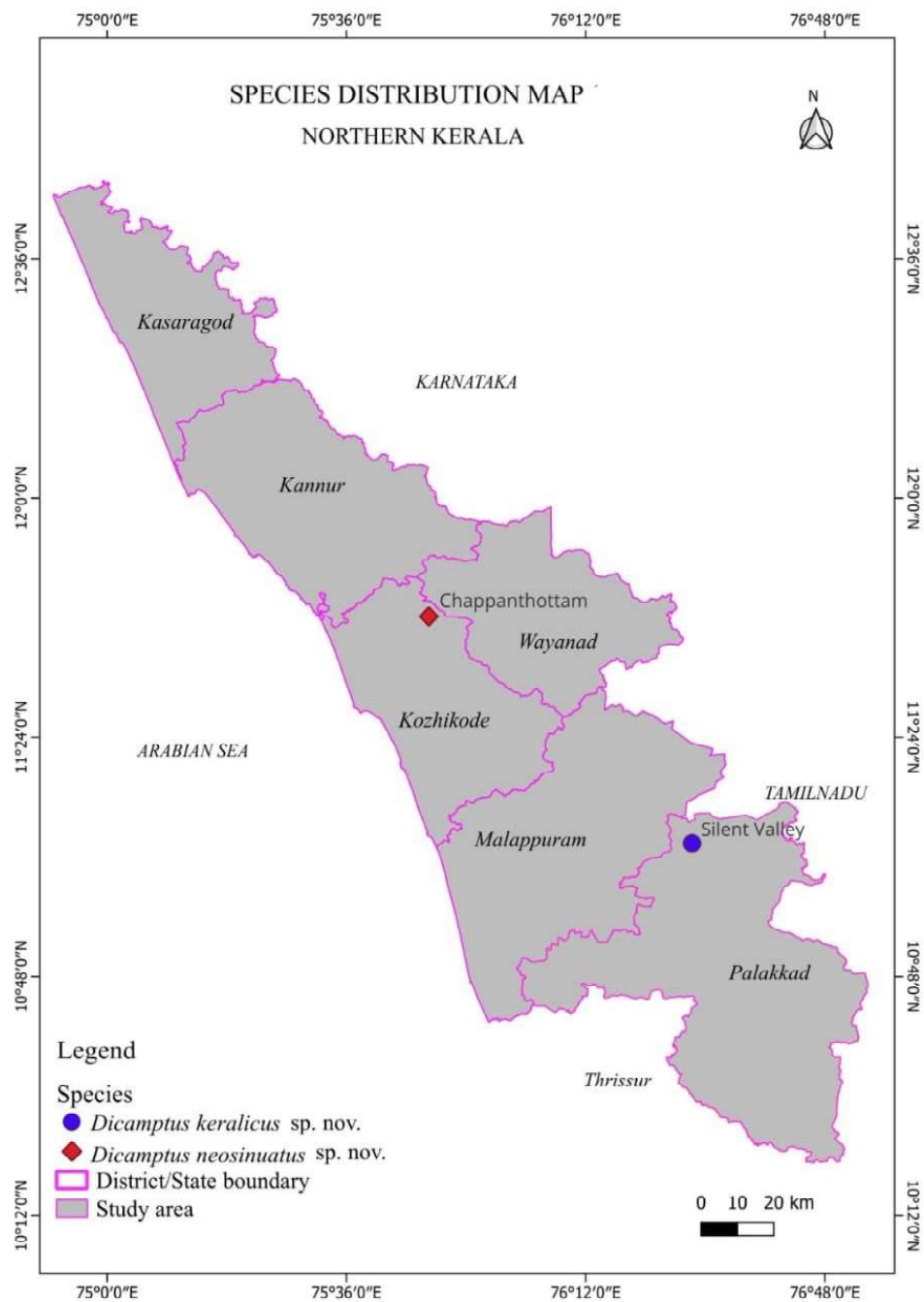


Figure 21. Map of North Kerala showing collection localities of the new species of *Dicamptus*

The new species closely resembles *D. neosinuatus* sp. nov. but it differs from *D. neosinuatus* as follows: marginal cell with proximally setose (in *D. neosinuatus* marginal cell with proximally glabrous); hind wing with 10 hamuli on RA (in *D. neosinuatus* hind wing with 12 hamuli); mesopleuron punctate (in *D. neosinuatus* mesopleuron punctate to puncto-striate); epicnemial carina inclined towards anterior margin of mesopleuron (in *D. neosinuatus* epicnemial carina not extending to anterior margin of mesopleuron); SDI = 1.20 and ICI = 0.66 (in *D. neosinuatus* SDI = 0.95 and ICI = 0.92).

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