

A new species of *Cheilosia* MEIGEN (Diptera: Syrphidae) from high mountains of India

[Eine neue Art der Gattung *Cheilosia* MEIGEN (Diptera: Syrphidae)
aus dem Hochgebirge Indiens]

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Abstract

A new species of the subgenus *Cheilosia* (*Montanocheila*) BARKALOV, 2002 is described from the Ladakh region, in the Jammu and Kashmir State, northwest India. The new species, *Cheilosia christiani* **spec. nov.**, is described in full and adult habitus and male genitalia images are provided, together with DNA barcodes and drawings of the female head.

Key words: hover flies, flower flies, *Montanocheila*, DNA barcode, Jammu and Kashmir, Ladakh

Zusammenfassung

Eine neue Art von der Untergattung *Cheilosia* (*Montanocheila*) BARKALOV, 2002 wird aus der Region Ladakh, im Bundesstaat Jammu und Kaschmir im Nordwesten Indiens, beschrieben. Die neue Art, *Cheilosia christiani* **spec. nov.**, wird in vollem Umfang beschrieben und Bilder des erwachsenen Habitus und der männlichen Genitalien werden zusammen mit DNA-Barcodes und Zeichnungen des weiblichen Kopfes bereitgestellt.

Stichwörter: Schwebfliegen, *Montanocheila*, DNA-Barcode, Jammu und Kaschmir, Ladakh

Introduction

The genus *Cheilosia* MEIGEN, 1822 (Diptera: Syrphidae) is the most species-rich hover fly genus in the world with approximately 420 described species (THOMPSON et al. 2010; STÄHLS & BARKALOV 2017), a number that is still growing (BARKALOV 2020). It belongs to the monophyletic tribe Rhingiini (subfamily Eristalinae) (VUJIĆ et al. 2019) and has been divided into 13 subgenera (BARKALOV 2002, 2007). The Palaearctic Region is the most diverse biogeographic region for *Cheilosia* species, with more than 310 species (BARKALOV 2020). In comparison, the Indomalayan Region is relatively poor in number of *Cheilosia* species with 30 species described (KNUTSON et al. 1975; BARKALOV & CHENG 2004; EVENHUIS & PAPE 2021).

India is a large country, sometimes considered a subcontinent. Zoogeographically, the western border of India and the high mountains and valleys in the north and northwest represent transition zones between the Palaearctic and the Indomalayan Regions (WIKRAMANAYAKE et al. 2002). Nine *Cheilosia* species have been reported from India, namely *Cheilosia apicalis* BRUNETTI, 1913, *C. grossa* (FALLÉN, 1817), *C. himalayensis* (BRUNETTI, 1915); *C. hirticincta* BRUNETTI, 1915; *C. kalatopensis* NAYAR, 1968, *C. nigroaenea* BRUNETTI, 1915, *C. pilipes* (BIGOT, 1884), *C. plumbiventris* BRUNETTI, 1915, and *C. songarea* (BECKER, 1894) (GHORPADÉ 2014, 2015). In the present study, we describe a new species of *Cheilosia* (*Mon-*

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tanocheila) BARKALOV, 2002 collected in the high mountains of the Ladakh region, northwest India.

Material and methods

Area of study. Specimens were collected near the Tso Moriri lake (32°54' N 78°18' E) in the region of Ladakh, northwest India in the Jammu and Kashmir State. Hover flies were collected using a hand net between 5685 and 5747 m a.s.l.

Taxonomy protocols. Adults were kept in alcohol and brought to the laboratory, where they were dried using an automated Critical Point Dryer (CPD) Leica EM CPD300 after removing the legs used for the DNA extraction (see below). Only the female ZFMK-DIP-00082456 was kept in alcohol. Male genitalia were detached before the drying process with the CPD. Later, dried specimens were mounted using minuten pins for their morphological study.

Morphological terminology follows THOMPSON (1999), in addition to those relating to male genitalia that follow CLAUSSEN (1998).

Identification and locality labels are indicated with double quotation marks (“ ”), and each line on the label is separated by a double forward slash (/). Handwritten information on labels is indicated in italics. For the paratypes, at the end of each record, between square brackets ([]) and separated by a comma, the number of specimens and sex, the holding institution, and the unique identifier or number are given.

The following acronyms were used for the entomological collections where the studied material was deposited:

- ISEA – Institute of Systematics and Ecology of Animals, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia.
- ZFMK – Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany.

Habitus and genitalia photographs of pinned specimens were taken with a Canon EOS 7D camera mounted on a P-51 Cam-Lift (Dun Inc., VA, U.S.A.) and with the help of Adobe Lightroom (version 5.6), and they were composed using the Zerene Stacker 1.04 (Richland, Washington, U.S.A.) software. All measurements are in millimeters and were taken using a reticule in a Leica M165 C microscope. Body length was measured from the anterior oral margin to the posterior end of the abdomen, in lateral view. Wing length was measured from the wing tip to the basicosta.

DNA sequences. One leg from the ethanol preserved specimens (before drying) was used for DNA extraction. Extractions were carried out using the NucleoSpin Tissue DNA Extraction kit (Machery-Nagel, Düren, Germany) following the manufacturer's instructions; samples were resuspended in 100 µl ultra-pure water. Entire specimens were preserved and labelled as DNA voucher specimens for the purpose of morphological studies and deposited in the entomological collections as cited below.

DNA primers and PCR amplification protocols for the mitochondrial protein-coding cytochrome *c* oxidase subunit I (COI) gene were the same as described in MENGUAL et al. (2012) and ROZO-LOPEZ & MENGUAL (2015). The sequences were edited for base-calling errors and assembled using Geneious R7 (version 7.1.3, Biomatters Ltd.). All new sequences were submitted to GenBank (see 'Genetics' section below for the accession numbers).

Results

Cheilosia (Montanocheila) christiani MENGUAL & BARKALOV, spec. nov.

(Figs 1–15)

Differential diagnosis. From all species known from the Indomalayan Region, the new species differs by the following characters: legs completely black (tibia broadly yellow basally in *C. hirticincta* and *C. nigroaenea*), female frons with long yellow pile and thorax covered with long erect black and yellow pile (in *C. plumbiventris*, female frons with thick black pile and scutum with very short brownish yellow pile).

In the key to *Cheilosia* species of China (BARKALOV & CHENG 2004), *C. christiani* spec. nov. keys out as *C. altimontana* BARKALOV & CHENG, 2004 but differs in many characters. The male of *C. christiani* spec. nov. has two vittae of grey pollinosity on the scutum (absent in *C. altimontana*) and scutum and pleuron entirely black pilose (pale and black pilose in *C. altimontana*); while the female of *C. christiani* spec. nov. has the frons with long, erected yellow (medially) and black (laterally) pile (frons with long, forward directed, white pile in *C. altimontana*). In the key to *Cheilosia* species of Central Asia (BARKALOV 2020), the female of *C. christiani* spec. nov. goes to *C. teneripilosa* BARKALOV, 2020, but it differs by the completely black basoflagellomere and black tibiae (postpedicel basoflagellomere brownish postero-ventrally and tibiae brownish in basal 1/3–1/2 in *C. teneripilosa*). In the same key (BARKALOV 2020), the male of *C. christiani* spec. nov. keys out to couplet 19 and it can be distinguished from *C. milkoi* BARKALOV, 2005 and *C. zlotini* PECK, 1969 by the shape and size of the gonostylus (Figs 10–13).

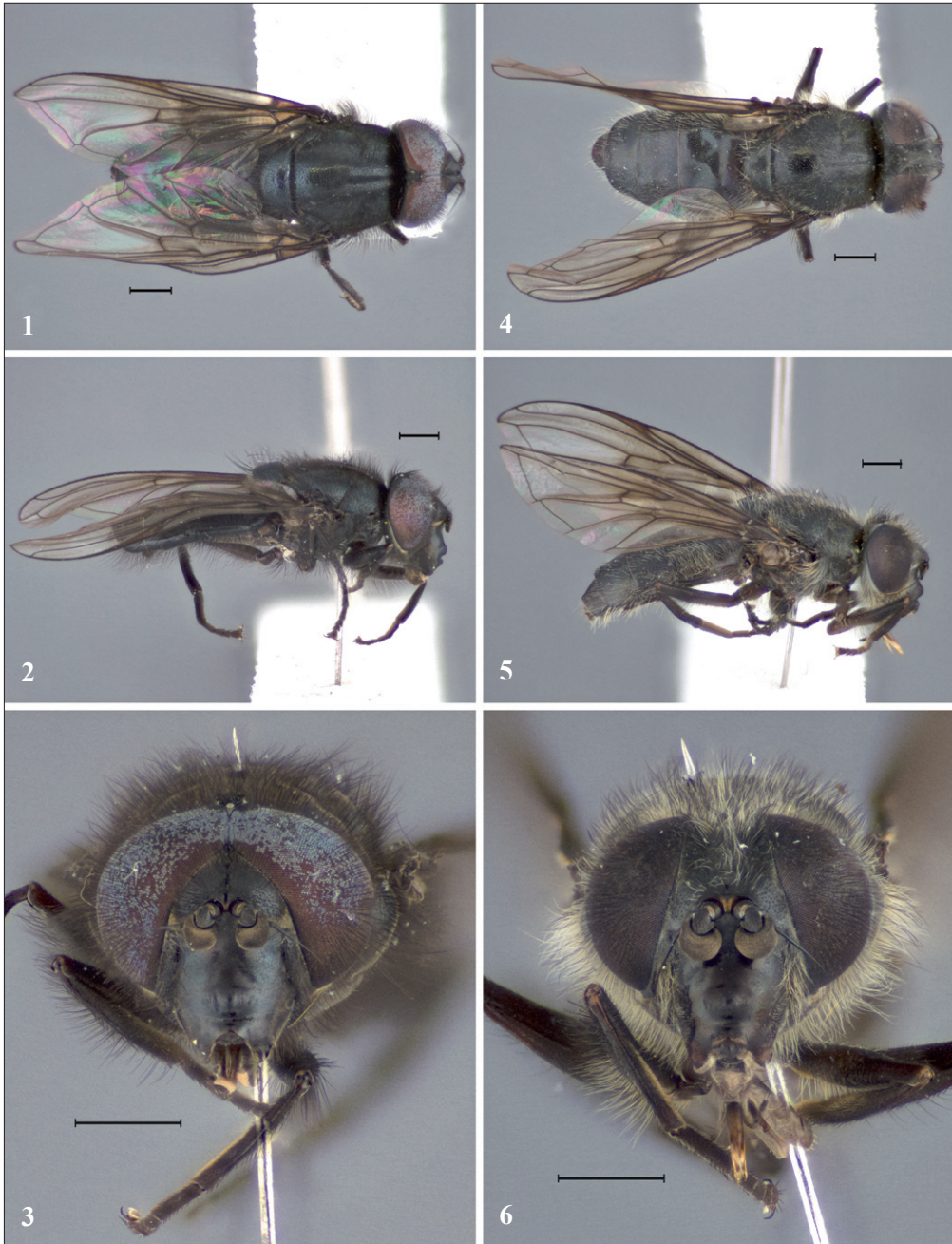
Type locality. INDIA: Jammu and Kashmir State, Ladakh region, near Lake Tso Moriri, 32°59.876' N 78°26.537' E, 5747 m.

Examined material. Type material. *Holotype*, male, pinned with genitalia in microvial, deposited in the ZFMK, Bonn, Germany, and labelled: “INDIA: Jammu and Kashmir State // Ladakh, near Tso Moriri (lake) // 32°59.876' N 78°26.537' E, // 5747 m., 21–23.viii.2010. // Leg.: I. ABELA-HOFBAUEROVÁ” “DNA voucher specimen // ZFMK, lab code // D532 // Bonn, Germany” “HOLOTYPE // *Cheilosia christiani* // MENGUAL & BARKALOV, 2021” [red] “ZFMK-DIP-00082458” [barcode]. *Paratypes*: **INDIA: Jammu and Kashmir State**: the same information as the holotype [1 ♀ 1 ♂, ZFMK; ZFMK-DIP-00082456, ZFMK-DIP-00082457]; Ladakh, near Tso Moriri (lake), 5685 m., 20–23.viii.2010. Leg.: I. ABELA-HOFBAUEROVÁ [1 ♀, ZFMK; ZFMK-DIP-00082459]; Ladakh, near Tso Moriri (lake), 32.9° N, 78.3° E, 5053 m., 25–28.viii.2010. Leg.: I. ABELA-HOFBAUEROVÁ [1 ♀, ISEA; ZFMK-DIP-00015972].

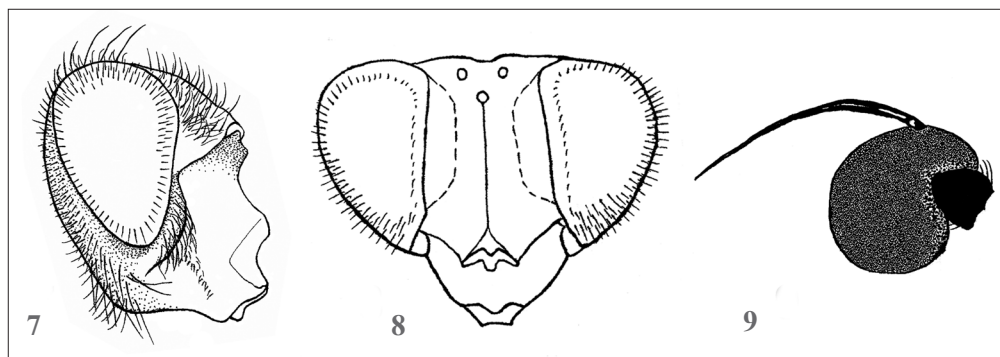
Description

MALE. Size (N = 1): Length of body: 8.4 mm; length of wing: 7.8 mm.

Head: Face shiny black, with fine grey pollinosity under the antennal bases, with a stripe of short black pile running from the middle paraface to oral margin; facial tubercle well developed, rounded; paraface very broad, finely grey pollinose near eye, shiny medially, black, with fine brownish pollinose fascia near the level of the antennal base, covered with long dark brown pile; gena broad, covered with grey pollinosity and long dark pile, with some paler pile ventrally. Frontal triangle shiny black, distinctly punctate with grey pollinosity on puncta and ventro-laterally, with a distinct longitudinal groove, with long dark pile; lunule shiny black, antennal pits distinctly separated. Antenna black, basoflagellomere rounded, slightly broader than long, black, with light pollinosity; arista long, shiny, black, without pile. Eyes covered entirely with dense, comparatively long black pile. Ocellar triangle slightly isosceles, covered with black pile. Occiput dark covered with grey pollinosity, broad ventrally and narrowing dorsally, with a dense pollinose vitta along posterior margin of the eye, from the most ventral point to 2/3 of the eye. Vertex with long black pile (Figs 1–3).



Figs 1–3: *Cheilosia christiani* spec. nov., male holotype (ZFMK-DIP-00082458). – 1: Habitus in dorsal view; – 2: Habitus in lateral view; – 3: Head in frontal view. **Figs 4–6:** *Cheilosia christiani* spec. nov., female paratype (ZFMK-DIP-00082459). – 4: Habitus in dorsal view; – 5: Habitus in lateral view; – 6: Head in frontal view. Scale bars = 1 mm.



Figs 7–9: *Cheilosia christiani* spec. nov., female paratype (ZFMK-DIP-00015972). – 7: Head in lateral view; – 8: Head in dorsal view; – 9: Antenna.

Thorax: Scutum and scutellum shiny black with fine grey pollinosity, finely punctate, covered with long erect and semi-erect black pile, without distinct bristles, except long, thin black bristles on posterior margin of the scutellum and shorter, thin black bristles on postalar callus. Scutum with two vittae of pale grey pollinosity reaching 2/3 of the scutum from the anterior margin, but not reaching the posterior margin. Scutellum fringe with long black pile. Pleuron black with fine grey pollinosity and long black pile. Katepisternal pile patches narrowly separated anteriorly and broadly separated posteriorly. Metasternum with long black pile. Calypters grey; ventral calypter with long pale pile fringe and dorsal calypter with shorter black pile fringe; plumula short, dark pilose basally and paler pilose apically; posterior spiracular fringes dark. Halter pedicel and capitulum dark. **Wing:** entirely covered with microtrichia, slightly infuscated basally and along veins on basal half; pterostigma dark, long; alula entirely microtrichose; inner angle between veins R_{4+5} and M_1 smaller than 90° . **Legs:** entirely black, with long black pile; procoxa without baso-lateral spur. Metafemur with short pile dorsally on basal 1/2, with long pile (longer than hind femur width) on apical 1/2, ventrally with short pile (shorter than hind femur width) with scattered very long pile (longer than hind femur width) (Figs 1–2).

Abdomen: slightly oval, glossy shiny black, finely punctate, with long black pile and (Figs 1–2). Sternites brown, lightly grey pollinose, with long and a few short black pile. **Genitalia:** surstylus approximately two times longer than broad, larger than cercus; gonostyli slightly asymmetrical, with right gonostylus with ventral lobe a little bent dorsally (Figs 11, 13); ventral lobe of the gonostylus (= postgonite) longer than the dorsal lobe of the gonostylus, curved distally inward; sclerite of the distiphallus with two ventral spurs (Figs 10–15).

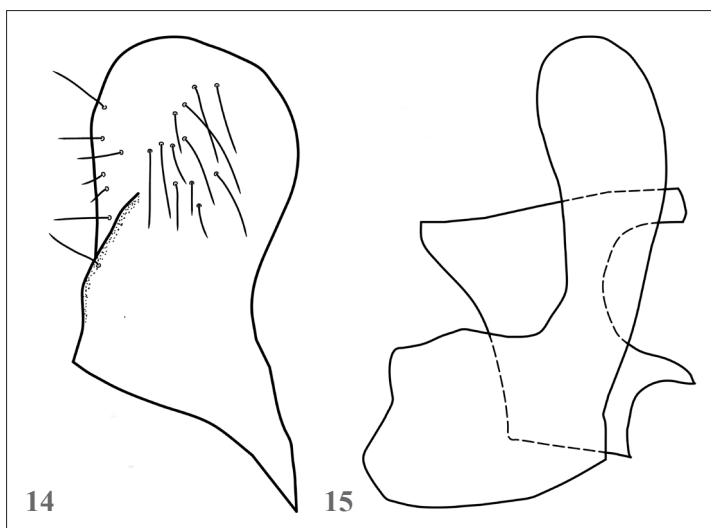
FEMALE. Size (N = 2): Length of body: 8.0 mm; length of wing: 7.8 mm.

Overall quite similar to male, except for normal sexual dimorphism and as follows (Figs 4–9): paraface, gena and ventral half of the occiput with long yellow pile; face shiny black, except a small pale marking on oral margin and a smaller pale macula ventrad to eye, with a stripe of short yellow pile in lower half. Frons comparatively broad, finely narrowed posteriorly, shiny black, with distinct central suture and almost invisible lateral furrows, covered with dense, long yellow pile with scattered black pile laterally; lunula yellowish medially. Vertex with long black and yellow pile. Scutum and scutellum shiny black with fine grey pollinosity, covered with long erect yellow and black pile, without distinct bristles; scutellum fringe with long yellow pile. Scutal pollinosity on anterior margin forming one medial thin vitta and two submedial broader vittae, but with not clear pattern as in the male. Pleuron with long yellow



Figs 10–13: *Cheilosia christiani* *spec. nov.*, male genitalia of the holotype (ZFMK-DIP-00082458). – **10:** Epandrium, surstylus and cercus in lateral view; – **11:** Hypandrium and gonostylus in lateral view; – **12:** Hypandrium, sclerite of the distiphallus and gonostylus in ventral view; – **13:** Hypandrium, sclerite of the distiphallus and gonostylus in latero-dorsal view.

pile. Katepisternal pile patches broadly separated. Metasternum with long yellow pile. Legs dark brown, with coxae, trochanters and basal part of femora, and apex of femora and very basal part of tibiae brown; femora with yellow and black pile, the rest black pilose. Abdominal pilosity entirely yellow.



Figs 14–15: *Cheilosia christiani* **spec. nov.**, male genitalia of the holotype (ZFMK-DIP-00082458). – **14:** Surstylus, outline, lateral view; – **15:** Gonostylus and distiphallus, outline, lateral view.

Remarks. Female specimens of *C. christiani* **spec. nov.** have abundant yellow pile on the body, but males only have black pile.

Etymology. The new species is named after our mentor and colleague F. Christian THOMPSON to honor and celebrate his immense contribution to the study of flies, especially Syrphidae. Species epithet to be treated as a noun in the genitive case.

Geographical distribution. Only known from the type locality in the Ladakh region, in northwest India.

Ecology. The female ZFMK-DIP-00082459 was collected in an area with *Potentilla pamirica* TH. WOLF, *Astragalus confertus* BUNGE, and *Thylacospermum* sp.

Genetics. We successfully sequenced the 5'-end of the COI gene for the holotype (GenBank accession number: OL665125) and two paratypes (ZFMK-DIP-00082457, ZFMK-DIP-00082459; GenBank accession numbers: OL665128, OL665126), with a length of 660–702 bp. In addition, we also obtained the whole COI gene sequence for one female paratype (ZFMK-DIP-00082456), with a length of 1506 bp (GenBank accession number: OL665127). All the obtained sequences were identical in the overlapping region. A blast in BOLD (www.bold-systems.org) revealed that the DNA barcode of our new species is similar to other species, such as the Palearctic *C. subpictipennis* CLAUSSEN, 1998 (96.13 % similarity), *C. montana* EGGER, 1860 (96.12 %) or *C. illustrata* (HARRIS, 1779) (96.58 %), but also quite similar to *C. lashiophthalmus* WILLISTON, 1882 from North America (96.96 %). The closest taxa present in BOLD to *C. christiani* **spec. nov.** are three unidentified specimens of *Cheilosia* collected in Sichuan Province, China (between 97.11 % and 97.43 % similarity).

Discussion

Our new *Montanocheila* species is morphologically similar to *C. altimontana* and *C. teneripilosa* known from China (Xinjiang and Qinghai Provinces) and from Kirgizstan respectively. All these three species inhabit in high mountains from 4190 to 5747 m a.s.l., with *C. christiani* **spec. nov.** reported at the highest altitude. *Cheilosia christiani* **spec. nov.** is genetically close to other species of the subgenera *Montanocheila* and *Floccocheila* BARKALOV, 2002, and a

close relationship between these two subgenera was already suggested by CLAUSSEN (1998) and found by STÅHLS & NYBLOM (2000), STÅHLS et al. (2004) and VUJIĆ et al. (2019).

The type locality of *C. christiani* **spec. nov.** is the same as for *Rohdendorfia bella* MENGUAL in MENGUAL & BARKALOV, 2019. As mentioned by MENGUAL & BARKALOV (2019), *R. bella* and *C. christiani* **spec. nov.** are oréal elements of the Palaearctic Region, present nowadays in high mountains ecosystems. The dynamics of these ecosystems are poorly understood, but there is consensus on considering them, together with paramos and other high altitude ecosystems, seriously endangered (TERZIOĞLU et al. 2015; ZAMORA et al. 2017; MONTOYA et al. 2021), including their flora and fauna.

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