

On the genus *Chaetocladius* (*Chaetocladius*) Kieffer, 1911
(*laminatus*-group). I. Taxonomic notes with description
of *C. guisseti* sp.n. (Diptera, Chironomidae, Orthoclaadiinae)
from glacial springs and streams in Eastern Pyrenees

К роду *Chaetocladius* (*Chaetocladius*) Кьеффер, 1911
(группа *laminatus*). I. Таксономические замечания,
с описанием нового вида *C. guisseti* sp.n. (Diptera, Chironomidae,
Orthoclaadiinae) из ледниковых родников
и ручьёв Восточных Пиренеев

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Keywords: Diptera, Chironomidae, *Chaetocladius* genus (*laminatus*-group), new species, Eastern Pyrenees.

Ключевые слова: Diptera, Chironomidae, род *Chaetocladius* (группа *laminatus*), новый вид, Восточные Пиренеи.

Abstract. The genus *Chaetocladius* (*Chaetocladius*), *laminatus*-group (male adults and pupal exuviae) is reviewed and diagnosed based on material composed of male pharate adults, male adults and pupal exuviae recently collected in some glacial springs and small streams located in both France (Pyrenees) and Slovakia (Tatra mountains). Taxonomic notes provided in this paper include a supplemented diagnosis of the *laminatus*-gr. based on some relevant characters found in the male adult of some sibling species. Description of *C. guisseti* sp.n. as male adult and male pupal exuvia, short redescription of *C. laminatus* Brundin, 1947 and additional short descriptions and illustrations of four undescribed species (*C. sp.A*, as male adult; *C. sp.B*, as male adult and pupa; *C. sp.1* and *C. sp.2* as pupa) are adduced. Remarks, taxonomic position, ecology and geographical distribution of the new described species are given.

Резюме. Приведён обзор группы видов *laminatus* рода *Chaetocladius* (*Chaetocladius*), основанный на материале выведения имаго самцов, а также имаго и экзувиях куколок, собранных в ледниковых родниках и ручьях Франции (горы Пиреней) и Словакии (горы Татры). Таксономические замечания в настоящей статье включают дополненный диагноз группы видов *laminatus*, основанный на новых признаках имаго самцов некоторых сиблинговых видов. Дано описание нового вида *C. guisseti* sp.n. по имаго самцу и экзувии куколки самца, а также краткие описания вида *C. laminatus* Brundin, 1947 и четырёх неопределённых видов (*C. sp.A*, по имаго самцу; *C. sp.B*, по имаго самцу и куколке; *C. sp.1* и *C.sp.2* по куколке). Также приведены замечания, таксономическое положение, экология и географическое распространение всех описанных видов.

Introduction

Knowledge on the taxonomy, geographical distribution and ecology of the known *Chaetocladius* (*Chaetocladius*) species from Europe and the Palearctic Region have been extensively highlighted by: Goetghebuer [1940–1950], Brundin [1947, 1956], Pankratova [1970], Sæther [1990], Caspers [1987], Cranston et al. [1989], Moubayed [1989], Langton [1991], Makarchenko, Makarchenko [2001, 2003, 2004, 2006a, b, 2007, 2009, 2011a, b, 2013a–c], Makarchenko et al. [2017], Langton, Pinder [2007], Zelentsov [2007], Stur, Spies [2011], Ashe, O'Connor [2012], Kobayashi [2012]; Wang et al. [2012]; Sæther, Spies [2013]; Baranov, Przhiboro [2014]. In this paper a supplemented diagnosis of the *laminatus*-group is provided based on some main relevant characters found in the male adult and pupal exuviae of several sibling species occurring in Europe and some neighbouring areas. Both male adult and pupal exuviae of *C. guisseti* sp.n. are diagnosed and described based on a material recently collected in some glacial cold springs and streams located in Eastern and Western Pyrenees (France). Additional taxonomic notes include: short descriptions and illustrations of: *C. laminatus* Brundin 1947 (male adult); *C. sp.A* (male adult); *C. sp.B* (male adult and pupal exuvia); *C. sp.1* and *C. sp.2* (male pupal exuviae).

At present, it is not feasible to provide keys for known male adults and pupae until current work on the genus is complete and more material can be examined.

Although some resemblance found between some members of the *laminatus*-gr., their taxonomic position needs to be more clarified based on current comprehensive work on the genus to be done. As many members of the *laminatus*-gr., *C. guisseti* sp.n. and the other undescribed taxa/species can be considered as relevant biogeographic representative of the global warming and climate change. Their presence in such glacial springs and streams highlights the importance of some high mountain ranges, considered as hotspots of endemism, in the preservation and persistence of autochthonous relic species.

For a better examination of the specific features and for a more accurate description of the various taxonomic details of the pupae, the pupal abdomen were mounted not only in dorsal and ventral view but separately in lateral view, which seems to illustrate all the necessary relevant taxonomic characters.

Terminology and measurements follow that of Sæther [1980] for the imagines and pupal exuviae. Remarks and discussion on some related *Chaetocladius* species and comments on the ecology and geographical distribution of the new species are given.

Descriptions

THE *LAMINATUS*-GROUP: DIAGNOSIS

Both of the male adults and the pupal exuviae of species belonging to the *laminatus*-group can be separated from other members of the *Chaetocladius* s.str. by the following main differentiating specific characters, which are summarized as follows.

Male adult. Last flagellomere with or without 1 preapical seta; clypeus broadly semi-circular or sub-triangular bearing 6–12 setae placed in 3–4 rows; palpomere 3 with sparsely distributed sensilla clavata, including or not other tubule-like sensilla clavata (4–6) grouped on a ring-like placed distally; antepnotum well developed, with gaping or fused lobes; humeral pit ovoid to sub-circular, bearing or lacking reticulation and contrasting brown to dark brown with minute whitish spots. Legs with sensilla chaetica present on tarsomeres ta_1 – ta_3 and occasionally on tibia. Tergite IX semi-circular to sub-rectangular, broad or narrowed distally; anal point triangular and pointed apically, pointed-beak shaped, straight or curved downwards in lateral view; virga consists of 3 separated parts (1 central with 2–3 teeth and 2 lateral branched expansions (nearly diplodocus-like) composed of 1 long elongated tail-like spine bearing 1 orally or posteriorly directed median claw-like projection. Gonocoxite with truncate or rounded apex, bearing or not a distinct tubercle; inferior volsella sub-triangular or lobe-like occupying 1/4 to 1/3 (occasionally 1/2) of the gonocoxite, consists of 2 contrasting part, proximal one brownish, distal part whitish, inner apex beak-like, distal part marsupial pouch-like shaped or differently figured. Gonostylus typically triangle-like shaped, medially spherical in general; posterior tip smoothly rounded or distinctly pointed, covered with macrotrichia or hyaline and bare, presence or absence of 2–3 smooth teeth placed close to the megaseta, 1–2 rows of setae are often present on anterior and median area; crista dorsalis mostly composed of 1 single low and long lobe or of 2–3 moderately domed lobes of similar size extended medially and apically along the ante-

rior margin.

Male pupal exuvia. In general the pupal exuviae of the *laminatus*-gr. are markedly pale to transparent except for the abdominal posterior transverse rows of spines on tergites and sternites. Frontal apotome weakly to strongly wrinkled, domed and bearing frontal tubercles; frontal setae inserted on prefrens ventral to antennal sheath. Thoracic horn linearly elongated to club-like shaped; precorneals sub-equal in general. Dorsocentrals, of 2 types, are all setae-like or mixed with bristle-like setae, nearly sub-equal in general, distance between dorsocentrals represents a relevant specific key. Tergite I bare or densely covered with spinulae, tergites II–VIII entirely covered with small spines; sternites I–III/IV bare or partly covered with spinulae, sternites IV–VIII entirely covered with spinulae. Posterior transverse rows of spines present on tergites II–VIII and sternites III/IV–VIII, spines are smaller on sternites; distal part of tergites II/III–VIII and sternites III/IV–VIII bearing rows of short spines of variably projecting (orally and posteriorly). Lateral abdominal setae consist of 3 types: a (spine-like), b (setae like), c (bristle-like); distribution pattern on segments I–VIII represents a relevant character to separate the various species within the *laminatus*-gr. Pedes spurii B absent. Male genital sac with 1–2 apical swollen lobes, overreaching apical margin of anal lobe. Anal macrosetae (AM_1 – AM_3 , after Makarchenko et al., 2017) are spine-like and generally sub-equal, long or medium sized, always sharply pointed apically; AM_1 and AM_2 are well separated, AM_2 and AM_3 placed close together; distance between AM_1 , AM_2 and AM_3 represents a relevant key.

Chaetocladius guisseti Moubayed, sp.n.

Figs 1–7, 10–25, 30–32.

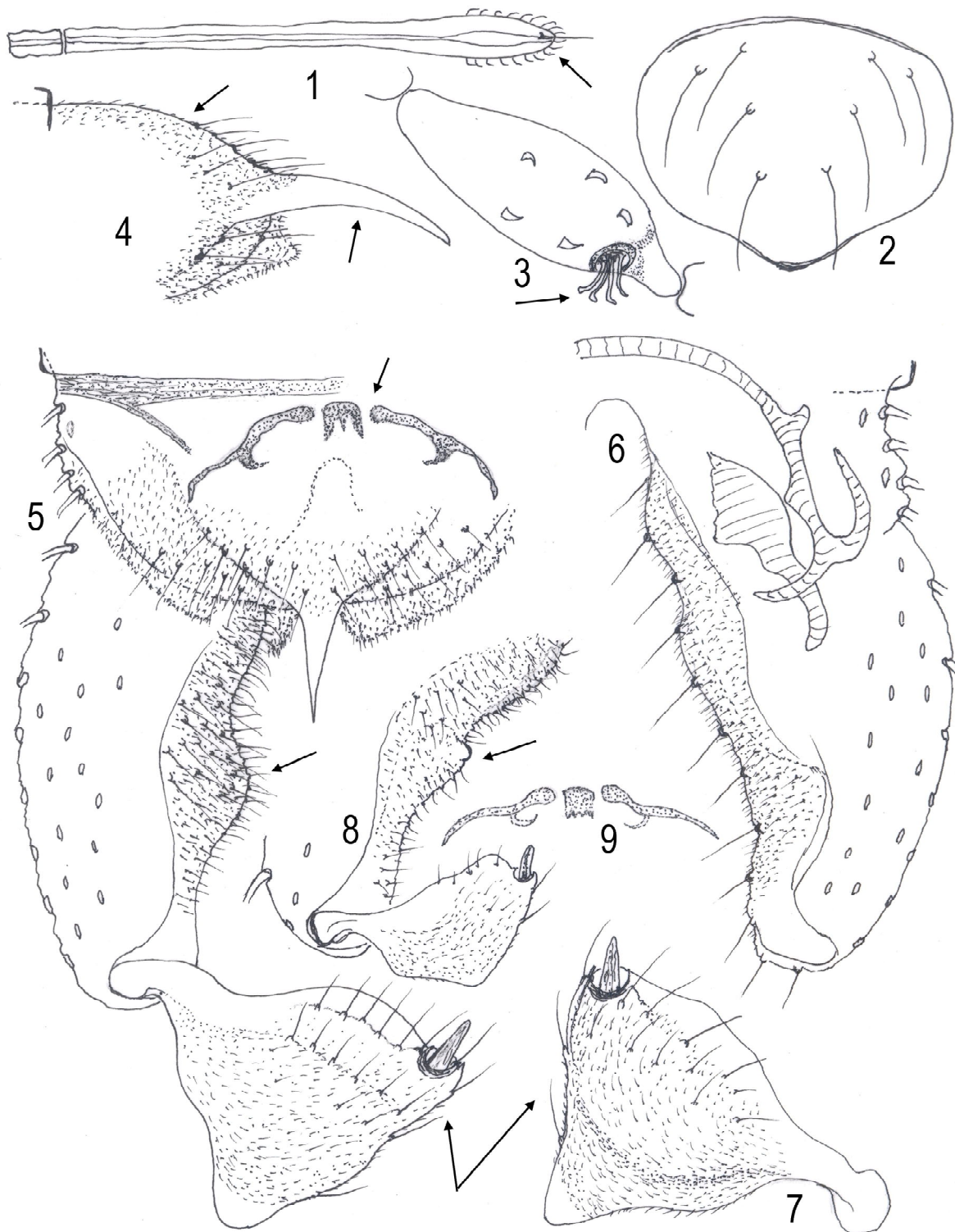
Material. *Holotype.* Continental France. Callau springs, Mantet Nature Reserve, Eastern Pyrenees, S-W France; glacial rheocrenes, altitude 2000–2200 m, 1♂ pharate — leg. J. Moubayed-Breil, 5.VIII.2008. Environmental data of water are: crystalline water, conductivity (Cd) 20–25 μ S/cm; temperature (T, °C), 7.5–10.5 during late spring till Jun, 8–12 during the late summer till September; pH acid, 5.1–5.5. Pharate adult: 1♂ — leg. J. Moubayed-Breil, 14.IX.2014. *Paratypes.* Continental France. All leg. J. Moubayed-Breil. Soques upper basin; same locality and same environmental data as the holotype, 1♂ adult, 1♂ pharate adult, 2 Pe (1♂, 1♀) — 5.VIII.2005, 8.VIII.2008. Alemany stream, spring zone and upper basin including lateral springs, rhithral and waterfalls, alt. 1600–1800 m (Cd 15–20 μ S/cm, T °C 6.5–10.5), 1♂ adult, 2 Pe (1♂, 1♀) — leg. K. Chevrot, A. Arasa, Cl. Guisset, J. Moubayed-Breil, 10.VIII.2015.

Notes. Holotype mounted on 2 slides (male adult and its pupal skin) is deposited in the collections of the National Museum of Ireland, Kildare Street, Dublin 2, Ireland. Remaining paratypes are deposited in the author's collection.

Type material was preserved in 80 % alcohol, and later mounted in polyvinyl lactophenol. For each adult, the head, thorax and abdomen were cleared in 90 % lactic acid then washed in 80 % ethanol before mounting on slides.

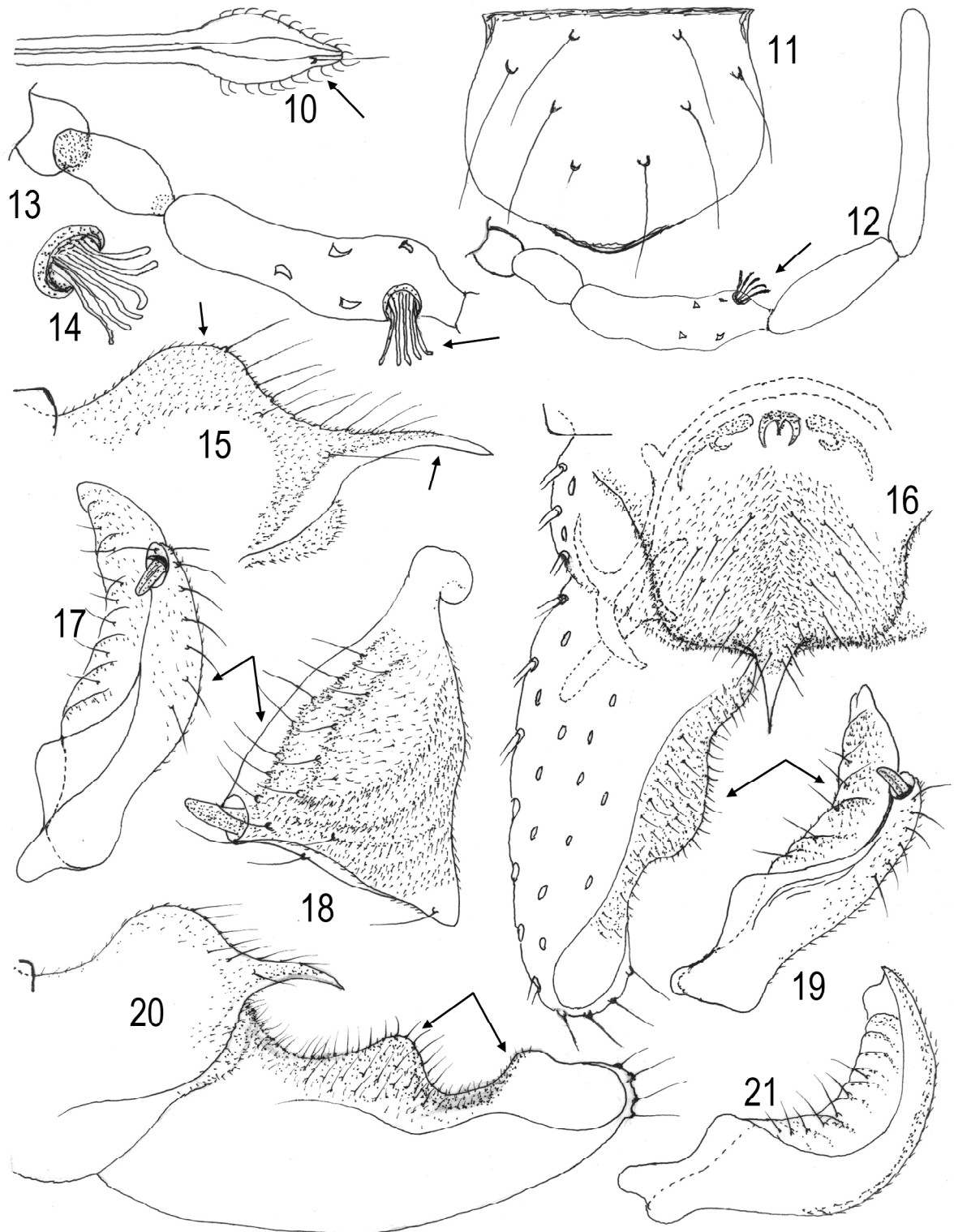
Etymology. The new species is named *guisseti* in honour to Claude Guisset (Head director of Mantet and Py Nature Reserves, Eastern Pyrenees) who kindly provided hospitality and support on the ground to collect the material of the new species. He remains active in contributing to preserving the biological quality of aquatic habitats and endemism in the protected area of Mantet and Py.

Diagnostic characters. Nearest species to *C. guisseti* sp.n currently include *C. lopatinskyi* Makarchenko et al., 2017 and *Chaetocladius* sp. from Russia (pers. comm. of E.A. Makarchenko). However, this new species can be dis-



Figs 1-9. Male adult of *Chaetocladius guisseti* sp.n. (holotype) (1-7) and *Chaetocladius* sp. (E.A. Makarchenko, pers. com.) (8-9). 1 — last flagellomere; 2 — clypeus; 3 — palpomere 3 with sensilla clavata; 4 — anal point and tergite IX in lateral view; 5 — hypopygium in dorsal; 6 — the same in ventral view (tergite IX and anal point removed); 7 — gonostylus in ventral view; 8 — inferior volsella and gonostylus, dorsal; 9 — virga.

Рис. 1-9. Имаго самец *Chaetocladius guisseti* sp.n. (голотип) (1-7) and *Chaetocladius* sp. (неопубликованные данные Е.А. Макаrenchенко) (8-9). 1 — последний флагелломер; 2 — клипеус; 3 — пальпомер 3 с сенсилью клавата; 4 — анальный отросток и тергит IX, сбоку; 5 — гипопигиум, сверху; 6 — то же, снизу (тергит IX и анальный отросток удалены); 7 — гоностил, снизу; 8 — нижний придаток гонококситы, сверху; 9 — вирга.



Figs 10-21. Male adult of *Chaetocladus guisseti* sp.n. (paratype). 10 — last flagellomere; 11 — clypeus; 12 — general shape of palp segments; 13-14 — palpomeres 1-3 with sensilla clavata; 15 — anal point and tergite IX in lateral view; 16 — hypopygium, dorsal; 17 — gonostylus at an acute angle, ventral; 18 — gonostylus at an obtuse angle, dorsal; 19 — gonostylus at an acute angle, dorsal; 20 — tergite IX, anal point and gonocoxite, lateral; 21 — gonostylus, lateral.

Рис. 10-21. Имаго самец *Chaetocladus guisseti* sp.n. (паратип). 10 — последний флагелломер; 11 — клипеус; 12 — общая форма члеников максиллярного щупика; 13-14 — пальпомеры 1-3 с сенсилла клавата; 15 — анальный отросток и тергит IX, сбоку; 16 — гипопигий, сверху; 17 — гоностиль под острым углом, снизу; 18 — гоностиль под тупым углом, сверху; 19 — гоностиль под острым углом, сверху; 20 — тергит IX, анальный отросток и гонококсит, сбоку; 21 — гоностиль, сбоку.

tinguished from all members of *laminatus*-gr. by the following combination of characters.

In the male adult: last flagellomere of antenna bearing preapical seta; lobes of anteprepronotum not gaping; palpomere 3 bearing 6–7 tubule-like sensilla clavata which are grouped on a ring-like placed distally. Tergite IX not contrasting, broadly semi-circular to weakly sub-rectangular, bearing 20–24 dorsal setae. Legs with sensilla chaetica present on tarsomeres ta_1 – ta_4 of PI, tibia and ta_1 – ta_3 of PII, tibia and ta_1 – ta_4 of PIII. Anal point triangular, slightly bent downwards and pointed-beak shaped in lateral view. Virga consists of 3 separated parts, median one with 3 small unequal teeth, the 2 lateral parts are linearly elongated and tail-like, nearly diplococus-like, bearing 1 posteriorly directed median claw-like projection. Gonocoxite rounded apically in both dorsal and ventral view; inferior volsella large lobe-like shaped, lacking inner beak-like apex and distal marsupial pouch-like lobe. Gonostylus typically triangular, moderately to strongly spherical medially, markedly projecting posteriorly; posterior tip rounded, hyaline and bare; presence of 2 rows of 5–7 setae each, linearly extended along the anterior and median area; crista dorsalis long, smooth and well domed on the preapical part.

In the pupal exuviae: frontal apotome domed and heavily wrinkled, frontal tubercles small but distinct, frontal setae inserted on prefrons ventral to antennal sheath. Dorsocentrals nearly sub-equal, Dc_1 and Dc_2 well separated, Dc_3 placed close to Dc_4 , distance between Dc_3 and Dc_4 1/3 that of Dc_1 and Dc_2 . Thoracic horn 115–120 μ m long, arc-like shaped, densely toothed on its 3/4 distal half; precorneals sub-equal. Field of spinulae present on tergite I–VIII, absent on sternites I–III. Posterior rows of spines present on tergites II–VIII and sternites IV–VIII (spines on sternites smaller). Distal part of tergites II–VIII and sternites III–VIII bearing rows of short spines of variably projecting (orally and posteriorly). Lateral setae on segments I–VIII consist of 3 types: a (spine-like), b (setae like), c (bristle-like); segment I with 2 setae (b-type); segments II–VII with 4 setae (2 a-type, 1 b-type, 1 c-type); segment VIII with 2 setae (b-type). Male genital sac with only 1 apical swollen lobe placed on outer side. Anal macrosetae (AM_1 – AM_3 , after Makarchenko et al., 2017) about 100–110 μ m long and spine-like; 2 proximal spines AM_1 and AM_2 are separated by 75 μ m, AM_2 and AM_3 by 10–15 μ m.

Male imago (n = 4, 2 male pharate adults + 2 male adults; Figs 1–7, 10–21).

Big sized *Chaetocladius* species. Total length 4.10–4.40 mm. Wing length 2.00–2.10 mm. General colouration contrasting brown yellowish to dark brown. Head dark brown; antennae brownish; thorax contrasting brown yellowish to dark brown, mesonotal stripes distinctly dark brown; wing pale; legs brownish. Tergites I–VIII and anal segment brown to dark brown; inferior volsella slightly contrasting dark brown to whitish.

Head. Eyes bare, hairs absent on inner eye margin. Temporals consist of 11–13 setae including 7–9 inner and 4 outer verticals, inner verticals placed in 2 rows. Antenna 925–945 μ m long, 13-segmented, markedly linear and thick with an

average of 30–35 μ m maximum width; segments 1 to 12 nearly sub-equal and well separated; last flagellomere (Figs 1, 10) 450–560 μ m long; apex of last flagellomere moderately clubbed, bearing numerous sensilla chaetica and 1 preapical seta; antennal groove beginning on segment 5 and reaching ultimate flagellomere; AR 1.15–1.35. Clypeus (Figs 2, 11) 100–115 μ m maximum length, 120–130 μ m maximum width, sub-rectangular, with rounded sides and bearing 8 setae in 3–4 rows. Palp 5-segmented; length (μ m) of segments 1–5: 20–25, 35, 110, 105, 145; palpomere 3 (Figs 3, 13–14) with sensilla clavata including: 3 sparsely distributed and 6–7 (tubule-like) grouped on a ring-like which is placed on distal part.

Thorax. Anteprepronotum well developed with anteprepronotal lobes not gaping, lateral anteprepronotals 5–6 grouped close together; acrostichals consist of 15–18 short setae starting close to anteprepronotum and placed in 1–2 rows; dorsocentrals 9–10 in 1–2 rows; prealars 4 in 1 row; supraalars absent. Humeral pit sub-oval and bearing contrasting brown to dark brown with pale minute spots. Scutellum with 8 uniserial setae. Wing. Brachiolum with 1 seta. Distribution of setae on veins: R, 17–19; R_{1+2} , 5–7; R_{2+3} , 3–5; remaining veins bare. Squama with 8–9 uniserial setae. Legs. Length (μ m) of tibial spurs: 70 (PI); 30, 15 (PII); 75, 30 (PIII). Sensilla chaetica present on: tarsomeres ta_1 – ta_4 of PI, ti and ta_1 – ta_3 of PII, ti and ta_1 – ta_4 of PIII. Length (μ m) and proportions of legs see in the Table 1.

Hypopygium in dorsal, ventral and lateral view as in Figs 5–7 (holotype) and 15–21 (paratype); ventral view (Fig. 6) with tergite IX and anal point removed. Tergite IX 160–170 μ m maximum width, broadly semi-circular (holotype, Fig. 5) to sub-rectangular (paratype, Fig. 16), slightly (Fig. 4) to strongly domed medially (Figs 15, 20), bearing 20–24 dorsal setae. Anal point (Figs 4–5, 15–16) about 30–35 μ m long, 20–25 μ m maximum width at base; triangular and pointed apically (Figs 5, 16); slightly bent downwards and pointed-beak shaped in lateral view (Figs 4, 15, 20). Virga (Figs 5, 16) consists of 3 separated parts, median one with 3 small unequal teeth, the 2 lateral parts are linearly elongated and tail-like, nearly diplococus-like and bearing 1 posteriorly directed median claw-like projection. Gonocoxite in dorsal, ventral and lateral view (Figs 5–6, 16, 20) 250–260 μ m long, rounded apically in both dorsal and ventral view; inferior volsella large lobe-like shaped, 70–75 μ m maximum length, 30–35 μ m maximum width, not contrasting and lacking inner beak-like apex and distal marsupial pouch-like lobe. Gonostylus (Figs 5, 7, 17–21) 125–130 μ m long, about 120 μ m maximum width, typically triangular, moderately to strongly spherical medially, markedly projecting posteriorly; posterior tip rounded, hyaline and bare; differently shaped in obtuse or in acute angle (paratype, Figs 17–21), presence of 2 characteristic rows of setae (6–7 setae each) placed dorsally: the first one is extended linearly below the anterior margin, the second is placed near the median area, shape of the. Crista dorsalis apparently long and low, swollen on its preapical part.

Male pupal exuvia (n = 4; Figs 22–25, 30–32, 35).

Table 1. *Chaetocladius guisseti*, sp.n.: length (μ m) and proportions of legs
Таблица 1. *Chaetocladius guisseti*, sp.n.: длина (μ m) и пропорции ног

P	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
PI	810	940	630	310	215	170	120	0.67	2.92	2.78	2.30
PII	860	870	390	245	190	120	110	0.38	3.19	4.44	1.50
PIII	910	1190	595	335	255	140	120	0.50	3.17	3.53	2.50

As in many *Chaetocladus* pupal exuviae, that of *C. guisseti* sp.n. is markedly pale to transparent except for the posterior transverse rows of spines on tergites and sternites; frontal apotome strongly wrinkled, cephalothorax with faint wrinkles near base of thoracic horn and between Dc_2 and Dc_3 ; abdomen, anal segment and genital sacs little darker than remaining parts of the exuvia.

Total length 4.00–4.20 mm. Frontal apotome (Fig. 22) domed, frontal tubercles small but distinct, frontal setae 85–90 μ m long, inserted on prefrons ventral to antennal sheath, distance between setae about 50 μ m. Dorsocentrals (Figs 23–24) 50–60 μ m long, nearly sub-equal, Dc_1 and Dc_2 well separated, Dc_3 placed close to Dc_4 ; distance between: Dc_1 – Dc_2 45 μ m, Dc_3 – Dc_4 10–15 μ m. Thoracic horn (Fig. 25) 115–120 μ m long, 20 μ m maximum width, arc-like shaped, densely toothed on its $\frac{3}{4}$ distal half; precorneals sub-equal. Abdomen (Figs 30–32). Armament and distribution pattern of shagreen, patches of spinules and points, chaetotaxy and lateral setation of abdominal segments and anal segment as illustrated in Figs. 30–32. Field of spinulae present on tergites I–VIII, and sternites IV–VIII. Posterior rows of spines present on tergites II–VIII and sternites IV–VIII; spines on sternites are smaller. Distal part of tergites II–VIII and sternites IV–VIII bearing rows of short spines of variably projecting (orally and posteriorly). Lateral setae on segments I–VIII consist of 3 types: a (spine-like), b (setae like), c (bristle-like). Distribution pattern of lateral setae on abdominal segments as in Figs 27, 30, 32: segment I with 2 setae (b-type); segments II–VII with 4 setae (2 a-type, 1 b-type, 1 c-type); segment VIII with 2 setae (b-type). Pedes spirii B absent. Male genital sac (Figs 31, 32) 220–230 μ m long, 100 μ m maximum width, bearing only 1 apical swollen lobe placed on outer side, overreaching apical margin of anal lobe by 85 μ m. Anal macrosetae (AM_1 – AM_3) about 100–110 μ m long and spine-like; proximal spines AM_1 and AM_2 are separated by 75 μ m, AM_2 and AM_3 by 10–15 μ m.

Larva unknown.

Taxonomic position. *Male adult.* Nearest species to *C. guisseti* sp.n. includes: *C. lopatinskiy* and *C. sp.* (known from Moscow Region, Russia) from which it can be separated in having: last flagellomere of antenna with pre-apical seta; palpomere 3 bearing 6–7 tubule-like sensilla clavata grouped on a ring-like placed distally; legs with sensilla chaetica present on tarsomeres ta_1 – ta_4 of PI, tibia and ta_1 – ta_3 of PII, tibia and ta_1 – ta_4 of PIII; anal point slightly bent downwards in lateral view (Figs 4, 15); virga, inferior volsella and gonostylus (Figs 5, 7, 9, 16, 17–21) are differently shaped in *C. lopatinskiy* (Makarchenko et al., 2017, Figs 19–20) and *C. sp.* (Figs 8–9). *Pupal exuvia.* The main distinguishing characters found in the male pupal exuvia of *C. guisseti* sp.n.

include: frontal apotome (Fig. 22) domed and heavily wrinkled, frontal tubercles small, frontal setae inserted on prefrons; dorsocentrals (Figs 23–24) nearly sub-equal, Dc_1 and Dc_2 well separated, Dc_3 placed close to Dc_4 , distance between Dc_3 and Dc_4 $\frac{1}{3}$ that of Dc_1 and Dc_2 ; thoracic horn (Fig. 25) arc-like shaped, densely toothed on its $\frac{3}{4}$ distal half; field of spinulae on abdominal segments (Figs 30–32) present on tergite I–VIII, absent on sternites I–III; posterior rows of spines present on tergites II–VIII and sternites IV–VIII; lateral setae on segments I–VIII consist of: 2 setae (segment I, b-type); 4 setae (II–VII, 2 a-type, 1 b-type, 1 c-type); 2 setae (VIII, b-type); apex of male genital sac (Figs 31–32, 35) and both shape and size of anal macrosetae (AM_1 – AM_3) are differently represented in *C. lopatinskiy* [Makarchenko et al., 2017, Figs 27–28], *C. sp. 1* and *C. sp. 2* (Figs 33–34, 36–37).

Ecology and geographical distribution. *C. guisseti* sp.n. is only known from its type locality (Eastern Pyrenees, France). It belongs to a rheophilic species inhabiting glacial relic springs and streams. Environmental data of water are: typically crystalline water, conductivity < 30 μ S/cm; temperature: 4–8 °C during early and late spring to 8–12 °C during early and late summer. Emergence recorded from Jun till early September.

Chaetocladus laminatus Brundin, 1947

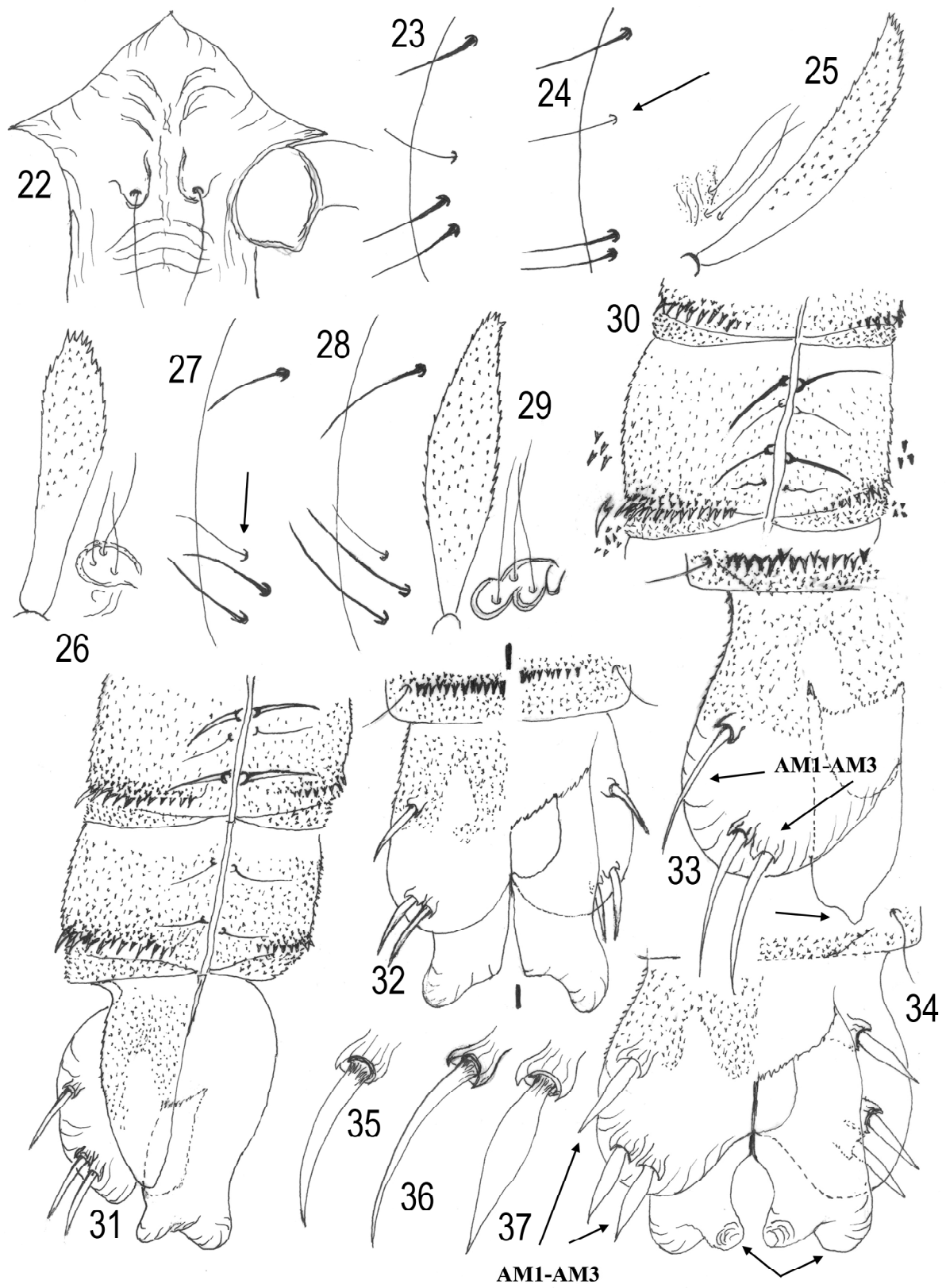
Рис. 38–43, 52.

Material. *France.* 2♂♂ adults — leg. J. Moubayed-Breil; springs, upstream with waterfalls along the River Saison located in Western Pyrenees, altitude 1500–1800 m, 16.VI.1987. 2♂♂ adults — mounted on 2 slides, are deposited in the author's collection. Studied material was preserved in 80 % alcohol, and later mounted in polyvinyl lactophenol; for each adult, the head, thorax and abdomen were cleared in 90 % lactic acid then washed in 80 % ethanol before mounting on slides.

Diagnosis. Last flagellomere of male adult without 1 preapical seta; clypeus broadly semi-circular bearing 6 setae placed in 3 rows; palpomere 3 with 4–5 sparsely distributed sensilla clavata; antepromptum well developed, with fused lobes; sensilla chaetica present on tibia and tarsomeres ta_1 – ta_3 of PI, PII and PIII. Tergite IX semi-circular, bearing 28–30 short to medium sized setae placed near the posterior margin; anal point triangular and pointed apically, typically straight pointed-beak shaped in lateral view; virga consists of 3 separated parts (1 central with 3 teeth and 2 branched expansions placed laterally which are composed of 1 long elongated tail-like tooth bearing 1 median claw-like orally directed; inferior volsella occupying about $\frac{1}{3}$ of the gonocoxite, consists of a large contrasting sub-triangular lobe, proximal part darker, inner apex beak-like to curved nose-like, distal part marsupial pouch-like shaped; gonostylus broadly sub-trian-

Figs 22–37. Male pupal exuvia of *Chaetocladus guisseti* sp.n. (22–25, 30–32), *Chaetocladus sp.1* (26–27, 33, 36) and *Chaetocladus sp.2* (28–29, 34, 37). 22 — frontal apotome; 23–24 — distribution pattern of dorsocentrals on thorax; 25 — thoracic horn; 30 — abdominal segment III–IV in lateral view with details of spines on tergites, sternites and conjunctives; 31 — segment VII (distal half), segment VIII and anal segment in lateral view; 32 — segment VIII (distal part) and anal segment in dorsal (left) and ventral (right) view; 26 — thoracic horn; 27 — dorsocentrals; 33 — segment VIII (distal part) and anal segment in dorsal view; 36 — anal macroseta; 28 — thoracic horn; 29 — dorsocentrals; 34 — segment VIII (distal part) and anal segment in dorsal and ventral view; 37 — anal macroseta.

Рис. 22–37. Экзувий куколки самца *Chaetocladus guisseti* sp.n. (22–25, 30–32), *Chaetocladus sp.1* (26–27, 33, 36) и *Chaetocladus sp.2* (28–29, 34, 37). 22 — фронтальная апатома; 23–24 — расположение дорсоцентралей на груди; 25 — торакальный рог; 30 — абдоминальные сегменты III–IV, сбоку; 31 — сегмент VII (дистальная половина), сегмент VIII и анальный сегмент, сбоку; 32 — сегмент VIII (дистальная часть) и анальный сегмент сверху (слева) и снизу (справа); 26 — торакальный рог; 27 — дорсоцентралей; 33 — сегмент VIII (дистальная часть) и анальный сегмент, сверху; 36 — анальная макрощетинка; 28 — торакальный рог; 29 — дорсоцентралей; 34 — сегмент VIII (дистальная часть) и анальный сегмент, сверху и снизу; 37 — анальная макрощетинка.



gular, spherical medially, projecting and tapering downwards posteriorly, posterior tip often distinctly pointed; crista dorsalis composed of 3 distinct smooth lobes of nearly similar size placed on median and pre-apical part of anterior margin.

Male imago (n = 2 male adults; Figs 38–43).

Big to medium sized *Chaetocladius* species. Total length 3.90–4.20 mm. Wing length 1.10–1.20 mm. General colouration contrasting brown to dark brown. Head dark brown; antennae pale brown; thorax contrasting brown to dark brown, mesonotal stripes distinctly dark brown; wing pale; legs dark brown; abdominal segments and anal segment dark brown. Head. Eyes bare, hairs absent on inner eye margin. Temporals consist of 14–16 setae including 10–11 bi-serial inner and 4–5 outer verticals. Antenna 1150–1200 μm long, 13-segmented; ultimate flagellomere (Fig. 38) 730–750 μm long, distinctly clubbed distally and bearing a dense brush of curved sensilla chaetica apically, apex lacking preapical setae; antennal groove beginning on segments 3–4 and reaching ultimate flagellomere; AR 1.55–1.75. Clypeus (Fig. 41) broadly semi-circular ending with a small drop-like apex, bearing 6 setae placed in 3 rows. Palp 5-segmented, first and second segments are fused and unequal, segment 4 shorter than segment 3, length (μm) of segments: 40–45, 95–105, 150–160, 130–140, 170–175; palpomere 3 (Figs 39–40) with 5–6 sparsely distributed sensilla clavata.

Thorax. Antepnotum well developed, with fused lobes, presence of 3–4 median and 6–7 lateral antepnotals; acrostichals consist of 21–23 minute mostly bi-serial setae; dorso-centrals 9–10 in 1 row, prealars 4, supraalars absent. Humeral pit ovoid to ellipse-like, well developed and bearing contrasting brown to dark brown with small whitish spots. Scutellum with 7 setae in 1 row. Wing. Brachiolum with 1 seta. Distribution of setae on veins: R, 16–17; R₁, 6–7; remaining veins bare. Squama with 10–11 setae in 1 row. Legs. Femur and tibia of PII and PIII almost sub-equal; sensilla chaetica present on tibia and tarsomeres ta₁–ta₅ of PI, PII and PIII. Length (μm) of tibial spurs: 90 (PI); 35 and 21 (PII); 65–70 and 35 (PIII). Length (μm) and proportions of legs see in the Table 2.

Hypopygium in dorsal view as in Fig. 42. Tergite IX broad and semi-circular with 28–30 dorsal setae placed close to the posterior part including 2–3 near the base of anal point. Anal point (Figs 42–43) about 30–35 μm long, 20–25 μm maximum width at base; triangular and pointed apically; typically straight pointed-beak shaped in lateral view (Fig. 43). Virga (Figs 42, 52) consists of 3 separated parts: 1 central with 2 large teeth and 1 smaller placed medially; 2 branched expansions placed laterally which include 1 orally directed claw-like projection; inferior volsella occupying about 1/3 of the gonocoxite, nearly triangular with swollen posterior margin, bearing a beak-like to curved nose-like inner apex; gonostylus broadly sub-triangular, slightly spherical medially, projecting and tapering downwards posteriorly to a pointed apex; crista dorsalis composed of 3 distinct large and smooth domelike lobes of nearly similar size placed medially

and pre-apically along the anterior margin.

Remarks. *C. laminatus* can be easily separated from the other sibling species of the *laminatus*-gr., based on detailed and accurate examination of the morphological features. However, main distinguishing characters found in the male adults collected in Eastern Pyrenees (Nat. Res. Mantet) include: humeral pit well developed and bearing contrasting small spots; lateral expansions of virga (Figs 42, 52) bearing each an orally directed claw-like projection; inferior volsella nearly triangular bearing a swollen posterior margin, inner apex nose-like; gonostylus triangular and projecting posteriorly, crista dorsalis consists of 3 sub-equal domelike lobes placed on median and apical part of the anterior margin.

Ecology. Cold stenothermic species occurring in high mountain springs and streams. Emergence mainly observed in early summer till late autumn.

Geographical distribution. *C. laminatus* is a widespread element throughout Europe and other neighbouring geographic areas, where some sibling species are reported as morphological variations of the *laminatus*-gr. France (Pyrenees, Alps); Swiss Alps; Tatra mountains (Slovakia); Moscow Region (E. Makarchenko, pers. com.).

Chaetocladius sp.A

Рис. 44–51.

Material. France. 1 σ° adult, 1 σ° pharate adult — leg. J. Moubayed-Breil; Soques glacial springs located in Eastern Pyrenees (Mantet Nature Reserve), altitude 2000 m, 10.VIII.2010. 1 σ° adult — leg. J. Moubayed-Breil, Saison River (springs, upstream and waterfalls) located in Western Pyrenees, altitude 1700–1800 m, 16.VI.1987. 2 σ° adults — mounted on 2 slides, are deposited in the author's collection. Studied material was preserved in 80% alcohol, and later mounted in polyvinyl lactophenol; for each adult, the head, thorax and abdomen were cleared in 90% lactic acid then washed in 80% ethanol before mounting on slides.

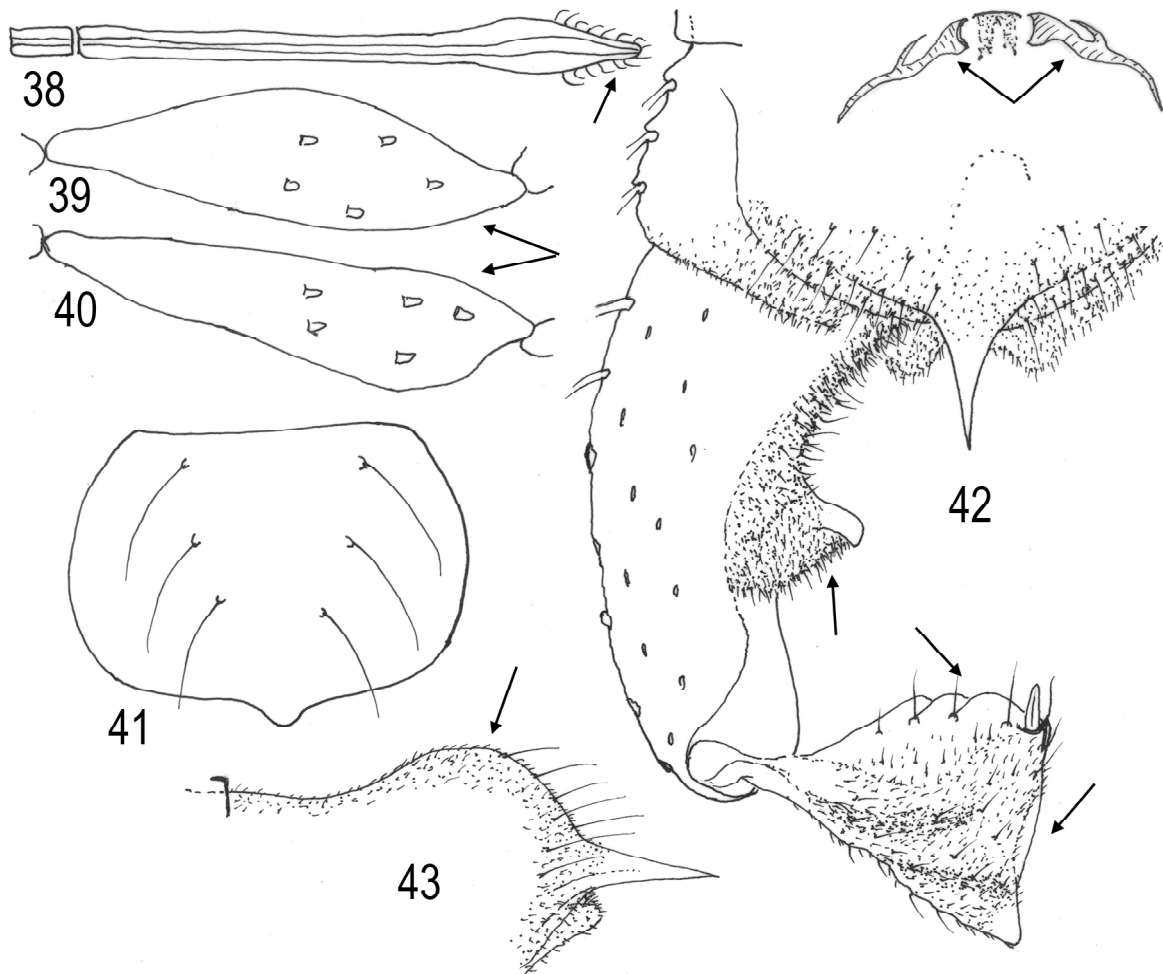
Description. Male imago (n = 2 male adults; Figs 44–52).

Head. Temporals consist of 11 setae including 7 inner and 4 outer verticals; last flagellomere without preapical seta; clypeus broadly semi-circular bearing 8 setae placed in 4 rows; palpomere 3 (Fig. 46) with sensilla clavata including: 3 sparsely distributed and 4–5 (tubule-like) grouped on a ring-like which is placed distally; clypeus (Fig. 45) semi-circular with 8 setae placed in 3 rows. Thorax. Antepnotum well developed and contrasting, lobes are not gaping, presence of 2 median and 7 lateral antepnotals; humeral pit oval to semi-circular, contrasting brown to dark brown with minute whitish spots. Wing. Squama with 15–17 setae in 1 row. Legs. Femur and tibia of PII sub-equal; sensilla chaetica present on tibia and tarsomeres ta₁–ta₅ of PI, PII and PIII. Length (μm) of tibial spurs: 90 (PI); 75 and 30 (PII); 95 and 35 (PIII). Length (μm) and proportions of legs see in the Table 3.

Hypopygium. Tergite IX typically semi-circular with a truncate anterior margin markedly visible in lateral view (Fig. 49), presence of 24–26 short to medium sized setae including 10–12 placed dorsally and 12–14 placed close to

Table 2. *Chaetocladius laminatus*: length (μm) and proportions of legs
Таблица 2. *Chaetocladius laminatus*: длина (μm) и пропорции ног

P	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	BV	SV	BR
PI	1150	1270	880	510	370	230	150	0.70	2.62	2.75	2.20
PII	1170	1180	540	340	260	160	130	0.46	3.25	4.35	4.00
PIII	1370	1380	790	450	330	190	150	0.60	3.16	3.48	3.80



Figs 38–43. Male adult of *Chaetocladius laminatus*. 38 — last flagellomere; 39–40 — sensilla clavata on palpomere 3, 2 aspects; 41 — clypeus; 42 — hypopygium in dorsal view with virga; 43 — anal point and tergite IX in lateral view.

Рис. 38–43. Имаго самец *Chaetocladius laminatus*. 38 — последний флагелломер; 39–40 — сенсилла клавата на пальпомере 3 в 2 положениях; 41 — клипеус; 42 — гипопигиум с виргой, сверху; 43 — анальный отросток и тергит IX, сбоку.

the posterior margin. Sternapodeme markedly arc-like; phallopodeme nearly sickle-like. Anal point triangular and sharply pointed apically, typically straight and pointed-beak shaped in lateral view (Fig. 49). Virga consists of 3 separated parts: 1 central with 3 teeth; 2 branched expansions placed laterally, which are composed of 1 long elongated tail-like tooth bearing 1 median claw-like projection orally directed. Gonocoxite rounded apically; inferior volsella occupying about ¼ of the gonocoxite, consists of a large contrasting sub-

circular lobe placed distally, proximal part darker, inner apex nose-like, distal part marsupial pouch-like shaped. Gonostylus broadly sub-triangular, spherical medially; posterior margin winding, posterior tip smoothly rounded, distinctly hyaline and bare; 3 characteristic long and smooth teeth of nearly similar size are placed close to the megaseta and prolonged by an undulated row of setae which is extended parallel to the anterior margin; crista dorsalis consists of a very long and strongly swollen lobe which is placed pre-apically.

Table 3. *Chaetocladius* sp.A: length (µm) and proportions of legs
Таблица 3. *Chaetocladius* sp.A: длина (µm) и пропорции ног

P	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	BV	SV	BR
PI	1070	1215	790	465	340	190	150	0,65	1,60	2,90	2,40
PII	1080	1090	510	310	240	150	135	0,47	2,00	4,25	2,17
PIII	1230	1315	760	420	330	185	150	0,58	1,80	3,35	3,15

Taxonomic position. *C. laminatus* can be considered as the nearest species to *C. sp.A*, based on similar characters of the hypopygium [Brundin 1947, Fig. 50], while *C. dissipatus* and *C. holmgreni* appears to have only a similar shape of inferior volsella but a different shape of gonostylus [Brundin 1956, Figs 92–93]. However, *C. sp.A* can be distinguished by the following main characters: clypeus semi-circular (Fig. 45); palpomere 3 (Fig. 46) nearly linear, truncate apically and bearing tubule-like sensilla clavata; tergite IX semi-circular and markedly truncate medially (Fig. 49); anal point sharply pointed (Figs 47, 49); gonocoxite rounded apically, lacking an apical sclerotized tubercle; gonostylus ending posteriorly at a rounded bare and hyaline apex, bearing 3 characteristic smooth teeth placed close to the megaseta; crista dorsalis long, linearly low and distinctly swollen apically.

Ecology and geographical distribution. A typical crenophilous species occurring in glacial springs and streams; emergence from July to September. Known from both Eastern and Western Pyrenees (France).

Chaetocladus sp.B

Рис. 53–58.

Material. Slovakia. 1♂ pharate adult, 3 pupal exuviae (2♂♂, 1♀) — leg. P. Bitusik; Tatra mountain, glacial springs and small waterfalls located between two high mountain lakes. Lake, altitude 1800–2000 m, 23.VIII. 2008. Environmental data of water are: crystalline water. 1♂ adult and its skin, mounted on 2 slides, are deposited in the author's collection. Studied material was preserved in 80 % alcohol, and later mounted in polyvinyl lactophenol; for each adult, the head, thorax and abdomen were cleared in 90 % lactic acid then washed in 80 % ethanol before mounting on slides.

Description. *Male imago* (n = 1 male adult; Figs 53–58).

The male adult of *C. sp. B* belongs to the *laminatus*-group and keys in particular close to *C. laminatus*, *C. dissipatus* (Edwards, 1929), *C. holmgreni* (Jacobson, 1998) and *C. lopatinskiy* Makarchenko et Makarchenko, 2017. However, this species can be separated the other sibling species of the *laminatus*-gr. by the following combinations of characters.

Small to middle sized species. Total length 3.80–3.90 mm. Wing length 1.20–1.30 mm. This species is particularly characterized by a small size of femurs, tibiae and tarsomeres. Head. Temporals consist of 14 setae including 9 inner and 4 outer verticals; palpomere 3 (Fig. 53) with 4–5 sparsely distributed sensilla clavata, tubule-like sensilla clavata absent; clypeus (Fig. 54) cup-like and broadly rectangular with 8 setae placed in 3 rows; last flagellomere about 550 µm long, lacking pre-apical seta. Thorax. Anteprotum well developed, with fused lobes, presence of 2 median and 7 lateral anteprototals; dorsocentrals 10–11; preallars 4; humeral pit oval, not contrasting and lacking minute spots. Wing. Squama with 14–15 setae in one row. Legs. Sensilla chaetica present on tibia and tarsomeres ta_1 – ta_4 of PI, PII and PIII. Length (µm) of tibial spurs: 80 (PI); 75 and 40 (PII); 90 and 35 (PIII). Length (µm) and proportions of legs see in the Table 4.

Hypopygium in dorsal, ventral and lateral view as in Figs 55–58; ventral view includes only sternapodeme and phal-

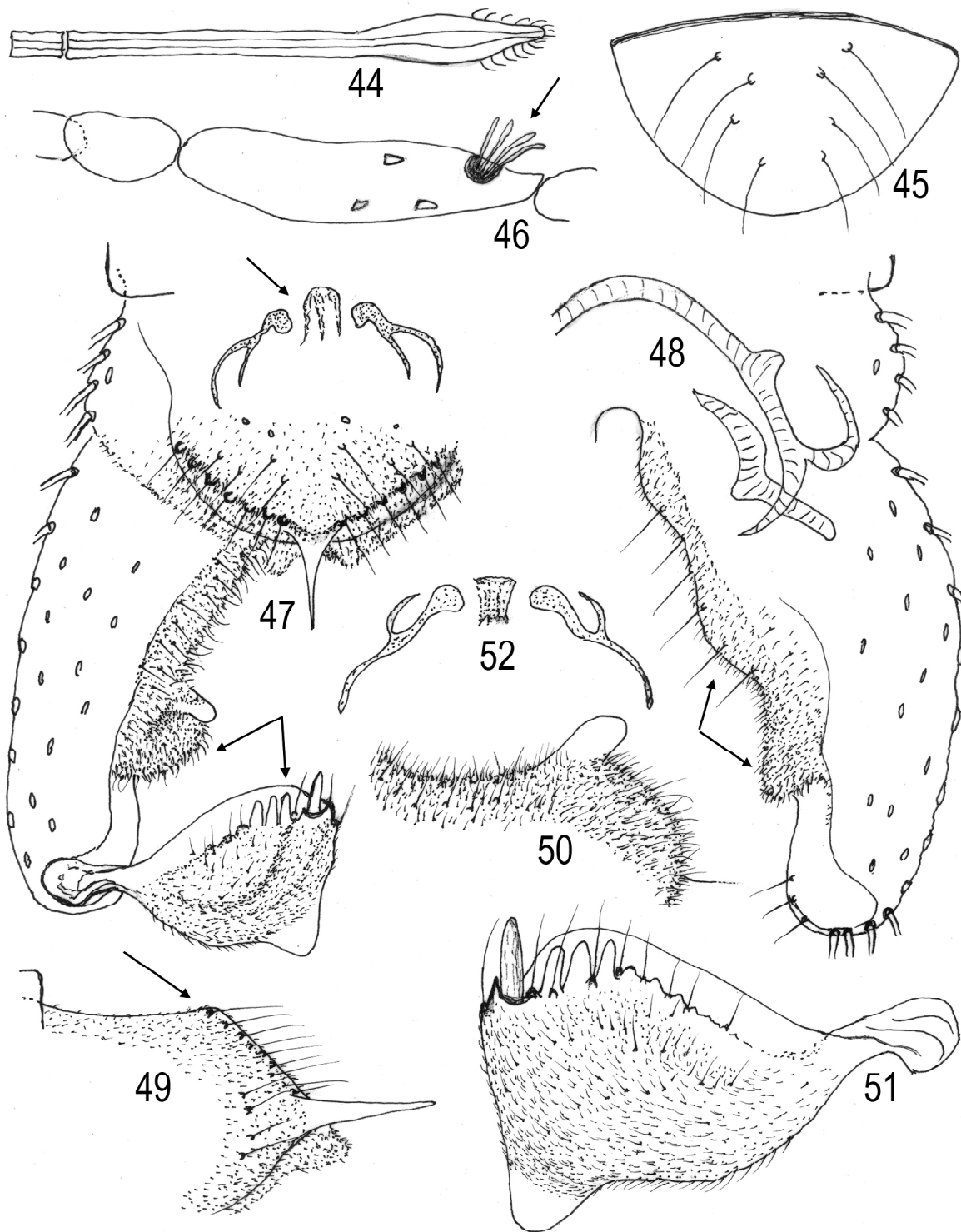
lapodeme (Fig. 57). Tergite IX broadly semi-circular with a nearly straight posterior margin, bearing 28 dorsal setae placed on distal area and close to the posterior margin, in lateral view (Fig. 55) the dorsal margin is slightly swollen medially. Phal-lapodeme (Fig. 57) nearly sickle-like shaped. Anal point (Figs 55–56) triangular, sharply pointed apically and straight in lateral view. Virga consists of 3 separated parts: median part with 3 small sub-equal teeth, the 2 lateral parts include 1 long elongated tail-like tooth bearing 1 median claw-like which is orally directed. Gonocoxite typically truncate with a nearly linear posterior margin, a distinct sclerotized tubercle is placed near the inner apical part; inferior volsella broadly triangular and distinctly projecting inwards, contrasting and bearing a markedly inner nose-like apex, distal part bent downwards along a straight line. Gonostylus triangular, spherical medially, markedly projecting posteriorly at a rounded bare and hyaline apex; posterior margin nearly straight; 2 typical and characteristic large smooth teeth of nearly similar size are placed close to the megaseta and prolonged by an undulated row of setae which is extended parallel to the anterior margin; crista dorsalis long, low and winding, with 2 lobes placed on median and apical parts.

Male pupal exuvia (n = 2; Figs 59–64). Entirely pale to transparent except for the posterior transverse rows of spines on tergites and sternites; frontal apotome weakly wrinkled and domed, cephalothorax with faint wrinkles near base of thoracic horn and between Dc_1 and Dc_2 ; abdomen, anal segment and genital sacs little darker than remaining parts of the exuvia.

Total length 3.85–3.95 mm. Cephalothorax. Frontal apotome domed, frontal tubercles indistinct, frontal setae 80–85 µm long, inserted on prefrons ventral to antennal sheath, distance between setae about 40 µm. Anteprototals consist of 2 thick median laterals (95 and 160 µm long) and 1 thin lateral (50 µm long; thoracic horn (Fig. 59) 205–210 µm long, 30–40 µm maximum width, wider at base and slightly narrowing distally with a rounded apex; densely toothed on its 1/3 distal half; precorneals include 1 thick of 150 µm long and 2 sub-equal of 90–95 µm long each. Dorsocentrals (Fig. 60) 40–50 µm long, Dc_1 and Dc_2 well separated, Dc_2 – Dc_4 placed close together; distance between: Dc_1 – Dc_2 45 µm, Dc_2 – Dc_3 and Dc_3 – Dc_4 about 15 µm. Abdomen. Field of spinulae present on tergites I/II–VIII, and sternites III/IV–VIII; posterior rows of spines present on tergites II–VIII and sternites III/IV–VII, spines on sternites are smaller; distal part of tergites II–VIII and sternites IV–VIII bearing rows of short spines of variably projecting (orally and posteriorly). Distribution pattern of armament and lateral setae on segments VII and VIII as in Figs 61–62. Lateral setae on segments I–VIII: I (2, b-type); II–VII (4 including 2 a-type, 1 b-type and 1 c-type or bristle-like); segment VIII (Fig. 62) with 2 setae b-type. Anal segment (Fig. 63) 290–300 µm long, 340–350 µm maximum width. Male genital sac (Fig. 63) 210–220 µm long, 90–100 µm maximum width, bearing 2 apical swollen lobe placed on inner and outer side, overreaching apical margin of anal lobe by 40–45 µm. Anal macrosetae (AM_1 – AM_3) about

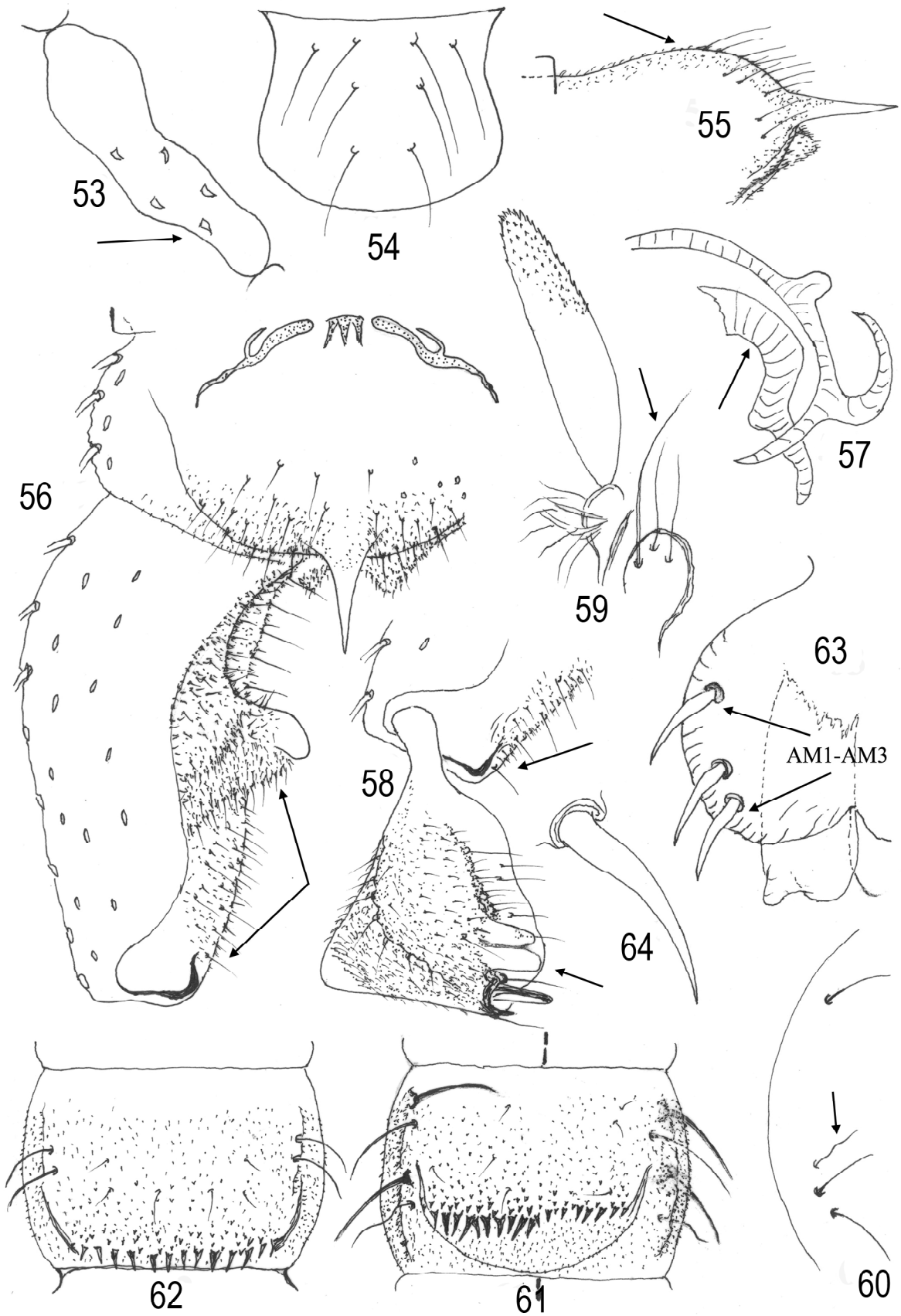
Table 4. *Chaetocladus* sp.B: length (µm) and proportions of legs
Таблица 4. *Chaetocladus* sp.B: длина (µm) и пропорции ног

P	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
PI	710	690	470	280	230	175	130	0.68	2.30	2.98	2.00
PII	680	710	320	205	180	140	120	0.45	1.77	4.34	1.60
PIII	760	810	440	280	230	170	130	0.54	2.48	3.57	3.20



Figs 44-52. Male adult of *Chaetocladius* sp.A (44-51) and *C. laminatus* (52). 44 — last flagellomere; 45 — clypeus; 46 — palpomeres 2-3; 47 — hypopygium in dorsal view; 48 — the same, in ventral view (tergite IX and anal point removed); 49 — anal point and tergite IX in lateral view; 50 — inferior volsella in lateral view; 51 — gonostylus in ventral view; 52 — virga.

Рис. 44-52. Имаго самец *Chaetocladius* sp.A (44-51) и *C. laminatus* (52). 44 — последний флагелломер; 45 — клипеус; 46 — пальпомеры 2-3; 47 — гипопигий, сверху; 48 — то же, снизу (тергит IX и анальный отросток удалены); 49 — анальный отросток и тергит IX, сбоку; 50 — нижний придаток гонококсита, сбоку; 51 — гоностиль, снизу; 52 — вирга.



130–140 µm long and spine-like; proximal spines AM₁ and AM₂ are separated by 90–100 µm, AM₂ and AM₃ by 15–20 µm.

Taxonomic position. *C. sp.B* is keyed close to *C. dissipatus*, *C. holmgreni*, *C. egorych* from which it can be separated in having: palpomere 3 distinctly swollen and rounded apically, lacking tubule-like sensilla clavata; tergite IX semi-circular and slightly domed medially (Fig. 55); anal point triangular and straight in lateral view; gonocoxite markedly truncate apically, with a sclerotized tubercle placed apically; gonostylus triangular, spherical medially, markedly projecting posteriorly at a nearly pointed apex, 2 characteristic smooth teeth placed close to the megaseta; crista dorsalis long, winding, bearing 2 lobes placed on proximal and apical parts.

Ecology and geographical distribution. Rheophilic and crenophilous species inhabiting high mountain springs and lakes; emergence from July to September. Known only from the inflow and outflow of glacial lakes located in the Tatra Mountains (Slovakia).

Acknowledgements

I am much indebted to the staff responsible for the Nature Reserve of Mantet in Eastern Pyrenees (Karine Chevrot, Claude Guisset, Alain Arasa) for facilities provided during the campaigns of sampling. I am also grateful to my son Charlie for his assistance in achieving the measurements of the leg ratios.

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Figs 53–64. Male adult (53–58) and pupal exuvia (male) (59–64) of *Chaetocladius* sp.B (Tatra Mountain, Slovakia). 53 — sensilla clavata on palpomere 3; 54 — clypeus; 55 — anal point and tergite IX in lateral view; 56 — hypopygium, dorsal; 57 — sternapodeme and phallopodeme; 58 — apical part of gonocoxite and gonostylus; 59 — thoracic horn; 60 — distribution pattern of dorsocentrals on thorax; 61 — armaments on segment VII, dorsal and ventral view; 62 — segment VIII, dorsal; 63 — anal segment, dorsal; 64 — anal macroseta.

Рис. 53–64. Имаго самец (53–58) и экзувий куколки (самец) (59–64) *Chaetocladius* sp.B (Горы Татры, Словакия). 53 — сенсилла клавата на пальпомере 3; 54 — клипеус; 55 — анальный отросток и тергит IX, сбоку; 56 — гипопигий, сверху; 57 — поперечная стернанодема и фаллопоема; 58 — апикальная часть гонококсита и гоностилус; 59 — торакальный рог; 60 — расположение дорсоцентралай на груди; 61 — вооружение сегмента VII, сверху и сбоку; 62 — сегмент VIII, сверху; 63 — анальный сегмент, сверху; 64 — анальная макрощетинка.

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Поступила в редакцию 11.4.2017