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Psyllids (Hemiptera: Psylloidea) associated with *Ficus vallis-choudae* (Moraceae) in southern Cameroon: taxonomy and biology

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Abstract: *Homotoma chlamydodora* Hollis & Bromfield, 1989 (Homotomidae) and *Pauropsylla tatrichea* Hollis, 1984 (Triozidae) are two poorly known psyllid species that develop on *Ficus vallis-choudae*. Based on material collected within the framework of biodiversity studies of psyllids (Hemiptera: Psylloidea) associated with *Ficus* spp. (Moraceae) in Cameroon, the taxonomy of the two psyllid species is revised and information on the biology is provided. In particular the previously unknown immatures of both species and the male of *P. tatrichea* are described and illustrated here. A tubercular process on the mesocoxa of *P. tatrichea*, a putative autapomorphy of *Pauropsylla* Rübsaamen, 1899 is described here for the first time. Both species are polyvoltine with overlapping generations. Immatures of *H. chlamydodora* develop under the stipules whereas those of *P. tatrichea* induce pit galls on the leaves. Both species appear to be restricted to *Ficus vallis-choudae*, at least locally.

Keywords: Homotomidae - Triozidae - *Homotoma chlamydodora* - *Pauropsylla tatrichea* - waxy pit-galls - buds.

INTRODUCTION

Non-wood forest products (NWFPs) play an important role in the everyday life of rural people in tropical countries around the world (Sorrenti, 2017). NWFPs provide food that helps reduce the shortages suffered during the 'hunger periods' of the agricultural cycle (Arnold, 2002). There is also increasing evidence that these foods are of great importance for the dietary quality of people in close proximity to forests, especially in communities with poor access to markets (Rowland *et al.*, 2016). Some NWFPs are sold in local markets, which stimulates the rural economy, but with the negative effect that, in order to maximize profits, harvesting methods are generally not sustainable. In order to protect these valuable resources, the participative domestication tried and tested by the ICRAF (World Agroforestry Centre) in Cameroon is a possible way (Tsobeng *et al.*, 2016). When trying to domesticate wild plants, insects can become a problem and sometimes even prevent this endeavour. Whereas there is a lot of literature on insect pests on cash crops, virtually nothing is known about insect communities of plants considered NWFPs. The tropical African fig *Ficus vallis-choudae* is such an example.

From Cameroon, 62 *Ficus* species have been recorded (van Noort & Rasplus, 2020), some of which are components of local agrarian systems (Gautier, 1996). These fig species are infested by various hemipterans including psyllids, viz. species of *Homotoma* Guérin-Méneville, 1844 (Homotomidae) and *Pauropsylla* Rübsaamen, 1899 (Triozidae). *Homotoma* comprises 33 species worldwide (2 in the Palaearctic Region, 4 in the Afrotropical Region, 23 in the Oriental Region and 4 in the Australo-Oriental Region), all associated with *Ficus* species (Burckhardt *et al.*, 2018). The tropical and subtropical *Pauropsylla* comprises 26 Old World species associated with *Ficus* (Burckhardt *et al.*, 2018) and two undescribed species in the New World (Brown & Hodkinson, 1988). Apart from their original descriptions based upon limited material (Hollis, 1984; Hollis & Broomfield, 1989), little is known about the Afrotropical species of both genera, such as host range, immature morphology or ecology.

To study the taxonomy, diversity and biology of psyllids on local *Ficus* species, surveys were undertaken by members of the Laboratory of Zoology of the University of Yaoundé I (LZUY) in southern Cameroon. Two

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of the observed species, *Homotoma eastopi* Hollis & Broomfield, 1989 and *Pauropsylla trichaeta* Hollis, 1984 are oligophagous on a number of fig species (Aléné *et al.*, 2014). Another two species, viz. *Homotoma chlamydodora* Hollis & Bromfield, 1989 and *Pauropsylla tatrichea* Hollis, 1984, appear to be locally restricted to a single host species, viz. *Ficus vallis-choudae*. This is a shrub or small tree of 18-30 m height. The fruits are edible and the pulp of the fruits is much appreciated by local people. Among the edible figs in Cameroon, these are the largest, the best tasting and the most used, as they are similar to common figs (Vivien & Faure, 1996).

Homotoma chlamydodora is widely distributed throughout the Afrotropical region (Angola, Burundi, Cameroon, Kenya, Nigeria, South Africa, Tanzania and Uganda) and adults were collected on *Ficus natalensis*, *F. petersii* [regarded as synonym of *F. thonningii* by WFO (2020) but as good species by van Noort & Rasplus (2020)] and *F. thonningii* (Hollis & Broomfield, 1989) but the immatures were not previously known. *Pauropsylla tatrichea* was described from three females from Cameroon and the Ivory Coast (Hollis, 1984) without additional information.

The present study describes the previously unknown last instar immatures and supplements the descriptions of

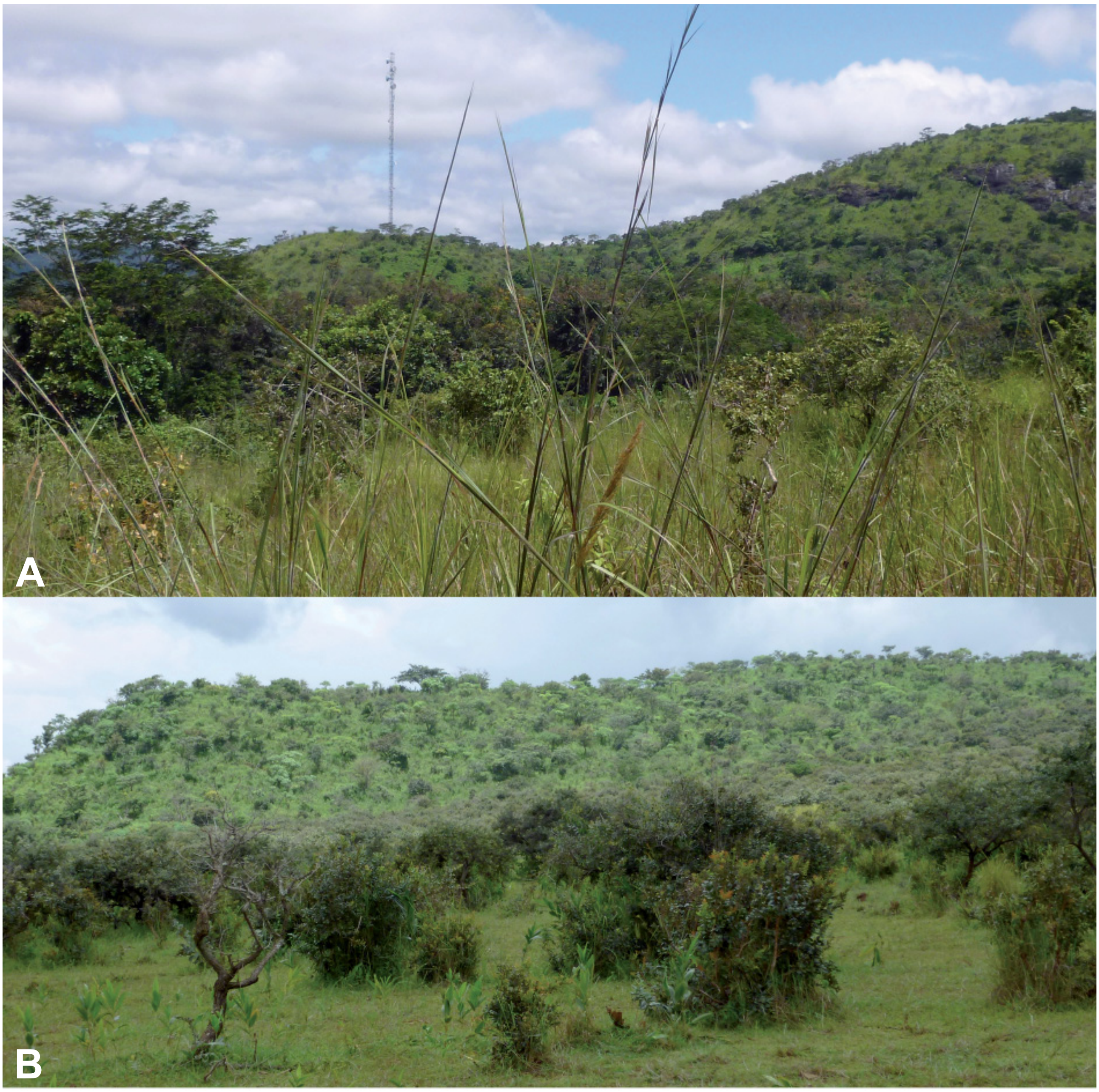

Fig. 1. Study sites. (A) Bapé (Bafia). (B) Tchouffa (Koutaba).

the adults, in particular the previously unknown male of *P. tatrichea*. Information is also provided on the biology of the two psyllids species.

MATERIAL AND METHODS

Field observations and samplings of psyllids were carried out on two sites, Bapé (04°49′25″ N, 11°10′35″ E; 610 m a.s.l.), a neighbourhood of Bafia (Centre Region of Cameroon), and Tchouffa (05°39′45″ N, 10°47′25″ E; 1200 m a.s.l.), a neighbourhood of Koutaba (West Region of Cameroon). The site at Bapé (Fig. 1A), with an annual mean temperature of 25.2 °C (20 °C min., 33 °C max.), is characterized by a tropical bimodal rainfall regime with a long dry season from mid-November to early March, a short rainy season from mid-March to early June, a short dry season from mid-June to late August and a long rainy season from early September to mid-November. The vegetation is bushy savannah. The site at Koutaba (Fig. 1B), with an annual mean temperature of 19.5 °C (16.5 °C min., 23.1 °C max.) undergoes a highland tropical unimodal rainfall regime with a short dry season from November to February and a long rainy season from March to October. The vegetation is shrubby and grassy savannah. In both sites, the savannah usually dries off during the dry season and regularly suffers from bush fires set for plantations or pasture and/or hunting.
Potential psyllid feeding sites on host plants were carefully examined monthly, by direct visual observations, during a year from October 2015 to October 2016. The *Ficus* species sampled are listed in Table 1. The *Ficus* plants were identified in the field and, in case of incertitude, samples were collected and brought to the National Herbarium in Yaoundé for confirmation. Psyllids encountered were collected and kept alive or fixed in 75% ethanol for further study at the Laboratory of Zoology of the University of Yaoundé I (LZUY).
In the laboratory, samples were sorted and preserved in 75% ethanol in vials stored in a freezer, or mounted dry or on slides. Vouchers are deposited in the collections of the LZUY and the Naturhistorisches Museum Basel, Switzerland (NHMB). Photographs were taken from dissected and slide-mounted specimens at the "Unité Mixte de Recherche (UMR)" of the "Centre de Biologie pour la Gestion des Populations (CBGP)" – "Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD)" at Montpellier (France) and NHMB using a compound microscope (Leica DMLB) and an auto-montage device (Keyence). Drawings and measurements were taken from slide-mounted and ethanol-preserved specimens at the LZUY (Olympus microscope) and NHMB (Leica DMLB microscope). The morphological terminology used here is combined from Hollis (1984) and Ossiannilsson (1992).

TAXONOMY

Homotoma chlamydodora Hollis & Broomfield, 1989

Figs 2, 3, 7C-E

Material examined: LZUY, NHMB NMB-PSYLL0006885 to NMB-PSYLL0006889; 35 males, 39 females, 74 immatures; Cameroon, West Region, Tchouffa, near Koutaba, 5°39′45″ N 10°47′25″ E, 1200 m; 11.xi.2015; on apical buds of *Ficus vallis-choudae*; D.C. Aléné, #PF2; dry and slide mounted, and stored in 70% ethanol.

Description of fifth instar immature (Fig. 2)
Coloration: Body with light brown sclerites, antennae, wing pads and caudal plate; membrane milky white; eyes pink (Fig. 2A).
Structure: Body dorso-ventrally flattened, oval, 2-3 mm long and 1.5-1.9 mm wide (Fig. 2A). Antenna (Fig. 2B) short, thick, three-segmented; segment 1 wider than the

Table 1. *Ficus* species examined at the two study sites.

Ficus species	Bafia (Bapé)	Koutaba (Tchouffa)
Ficus bubu Warb.	x	
Ficus exasperata Vahl	x	x
Ficus gnaphalocarpa (Miq.) Steud. ex Miq.		x
Ficus mucuso Welw. ex Ficalho	x	
Ficus ?*polita* Vahl	x	
Ficus sur Forssk.	x	x
Ficus sycomorus L.	x	x
Ficus ?*thonningii* Blume	x	
Ficus trichopoda Baker	x	x
Ficus vallis-choudae Delile	x	x
Ficus sp. 1	x	
Ficus sp. 2	x	

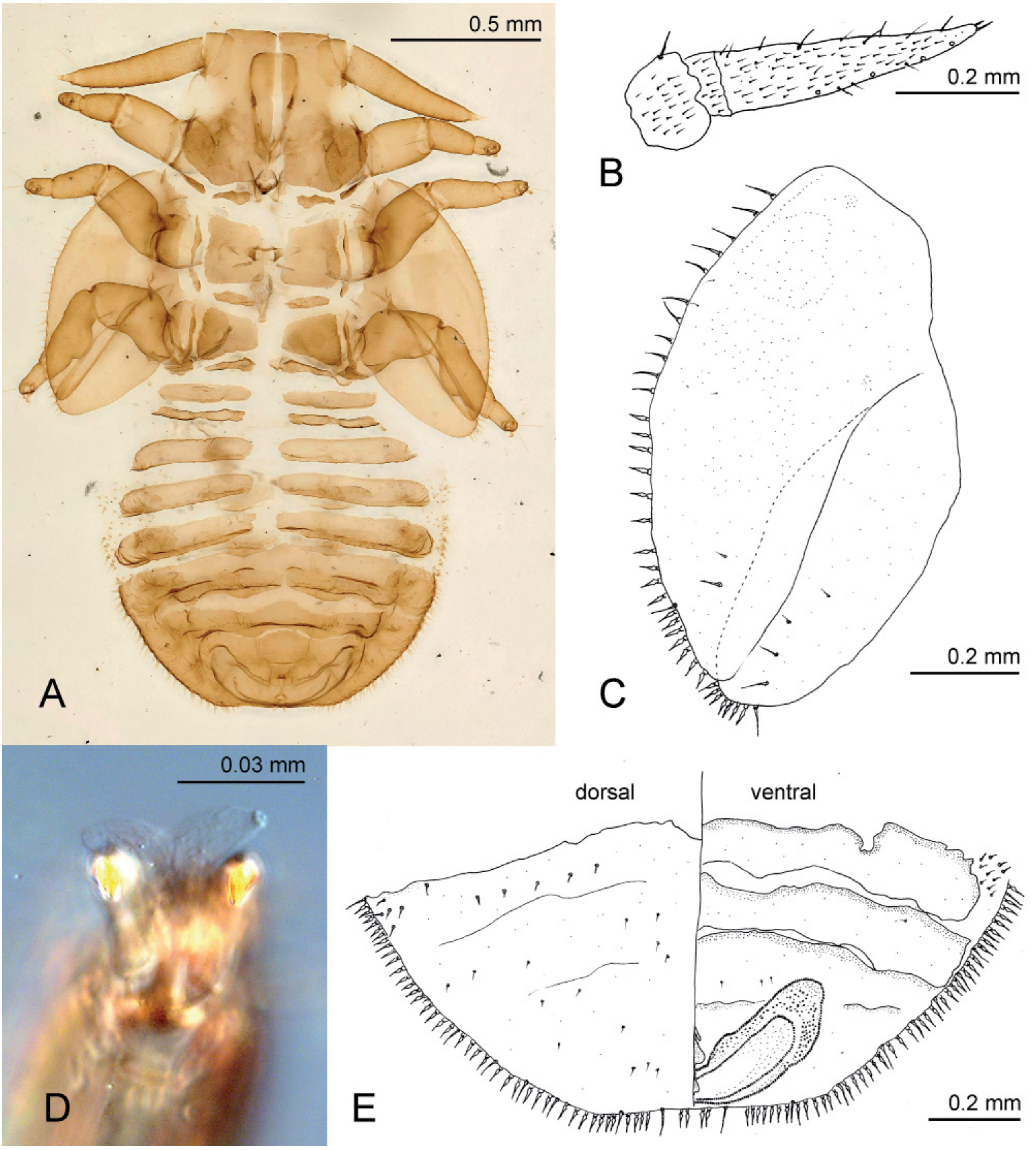

Fig. 2. Fifth instar immature of *Homotoma chlamydodora*. (A) Habitus, cleared specimen, in dorsal view. (B) Antenna. (C) Wing pads. (D) Tarsal apex with claws and arolium. (E) Caudal plate.

other two segments, 1.5 times wider than long, 2.5 times longer than segment 2, and bearing one moderately long seta on the dorsal side; segment 2 almost 3 times wider than long; segment 3 very weakly widening basally and tapering apically, 3.5-4.0 times longer than segment 1, bearing four small rhinaria ventrally and covered in moderately long and short setae, with two strong, unequal terminal setae. Dorsal cephalo-prothoracic sclerite well-developed, margined caudally by two narrow sclerites, one transverse submedian and one oblique submarginal. Meso and metanotum consisting each of three sclerites, a large trapezoidal one in antero-median position, a longitudinal narrow elongate one between wing pad and large sclerite, and a transverse narrow elongate one caudad to the large sclerite. Forewing pad almost 2.5 times longer than wide, lacking humeral lobe, margin bearing usually simple setae in basal quarter and pointed lanceolate setae or indistinct sectasetae in apical three quarters (Fig. 2C). Legs four-segmented. Metatibiotarsus strongly constricted just beyond the middle on the underside and bearing two to three long setae on the upper side. Metatarsus bearing sparse short simple setae dorsally and two long setae above the claws; tarsal arolium almost triangular, slightly longer than claws, without petiole but with unguitractor (Fig. 2D). Abdomen rounded, with five tergites proximal to caudal plate; the second one being the narrowest; these sclerites scarcely covered in short simple setae with marginal long setae; marginal and sub-marginal membrane near the two last sclerites densely covered in moderately long simple setae and lanceolate setae or indistinct sectasetae. Caudal plate more than twice wider than long, truncate caudally; densely bordered with pointed sectasetae and a few simple long setae, sparser caudally with one long simple seta and two sectasetae on either side of body axis (Fig. 2E). Anus ventral; outer circumanal ring irregularly, narrowly oval, consisting of several rows of pores.

Description of adult (Fig. 3)
Coloration: Body light-brown; head darker; antennal flagellum dark-brown to black (Fig. 3A). Forewing (Fig. 3G) hyaline, with dark veins and indistinct pattern, consisting of a narrow light brown band along apical third and a broader darker band in apical two thirds along anal margin; hindwing hyaline and uncoloured.
Structure: Described by Hollis & Broomfield (1989: 160, 161, figs 68, 69, 103, 104).
Body length (measured from anterior head margin to tip of forewings when folded over the body) in specimens from Cameroon 3.5-4.0 mm in male and 4.0-4.5 mm in female; body width (measured across mesoscutum between insertions of forewings) 1.5-2.0 mm in male and 1.7-2.2 mm in female. Integument of head and thorax moderately densely covered in long setae. Head almost as wide as mesoscutum, weakly inclined from longitudinal body axis, bearing long setae dorsally and ventrally (Fig. 3B); lateral margins of vertex weakly rounded caudally, occipital margin angular; vertex divided by a deep median suture. Compound eyes hemispherical. Median ocellus in front on oblong frons; lateral ocelli near hind margin of vertex. Genae weakly swollen, extending to antennal sockets, giving the head a cleft appearance. Antennae (Fig. 3C) thick, long (2.2-2.3 mm in male, 2.4-2.5 mm in female), densely setose; flagellum circular in cross-section with eight flagellomeres; flagellomere 1 about twice as long as 2; flagellomere 8 very short, less than half as long as 7, bearing two terminal setae, one short, truncate and one long, pointed, at least 5 times longer than shorter one (Fig. 3D); with each a subapical rhinarium on flagellomeres 2, 4, 6, and 7. Thorax weakly arched in profile. Pronotum visible from above, without anterior tubercles. Forewing 3.2-4.5 mm long, oblong, 3.3 times as long as wide, subacute apically (Fig. 3G); vein R+M+Cu at least twice as long as R and more than twice as long as M+Cu; vein Cu almost twice as long as M+Cu and Cu_{1b}, cu_1 cell elongate with a value of 2.5, M 3.5 times as long as M_{1+2} and twice as long as M_{3+4}; R 1.3 times as long as R_1, Rs weakly curved towards fore margin and 4.5 times as long as R. Hindwing almost as long as the forewing, widest medially, narrowly rounded apically; veins R and M with common stem, vein Cu indistinct at base; costal vein with 3-4 pointed setae proximal to costal break, setae distal to costal break divided into two groups with 1-3 pointed setae adjacent to costal break and 4-5 hook-shaped setae in the middle in addition to hamulus at the end of vein (Fig. 3H). Metacoxa bearing a well-developed thumb-like meracanthus (Fig. 3F); metatibia lacking basal spine, with 5 densely spaced, inner apical spurs (Fig. 3E), metabasitarsus with a single outer lateral spur (Fig. 3E). Male terminalia (Fig. 3I) with bipartite proctiger; proximal segment narrow in basal third, broad in apical two thirds with broadly rounded posterior lobe, in profile; distal portion tubular, inserted between the posterior lobes of proximal segment; sparsely covered in moderately long setae. Paramere in profile lamellar, weakly curved; inner surface with a sub-marginal rim in apical third and a sclerotized tooth in apical third near fore margin, and moderately long marginal setae (Fig. 3J). Proximal segment of aedeagus basally strongly curved, swollen medially; distal segment of aedeagus clavate with sclerotized end-tube of ductus ejaculatorius short and weakly sinuate (Fig. 3K). Female terminalia (Fig. 3L) cuneate. Dorsal margin of proctiger almost straight, narrowly rounded apically, beset with moderately long setae and an irregular longitudinal row of submedian setae in apical half on either side; circumanal ring oval, consisting of two unequal rows of pores. Subgenital plate pointed apically, ventral margin with a bend in the middle. Dorsal and ventral valvulae weakly curved (Fig. 3M).

Pauropsylla tatrichea Hollis, 1984
Figs 4-6, 7F, G

Material examined: LZUY, NHMB NMB-PSYLL0006890, NMB-PSYLL0006891; 41 males, 40 females, 54 immatures; Cameroon, West Region, Tchouffa, near Koutaba, 5°39′45″ N 10°47′25″ E, 1200 m; 11.xi.2015; in pit galls on leaves of *Ficus vallis-choudae*; D.C. Aléné, #PF3; dry and slide mounted, and stored in 70% ethanol. – NHMB NMB-PSYLL0006892 to NMB-PSYLL0006897; 17 males, 16 females, 41 immatures, 26 skins; Cameroon, Centre Region, Bapé, near Bafia, 4°49′25″ N 11°10′35″ E, 610 m; 18.xi.2015; in pit galls on leaves of *Ficus vallis-choudae*; D.C. Aléné, #PF3', #PF4; dry mounted and stored in 70% ethanol.

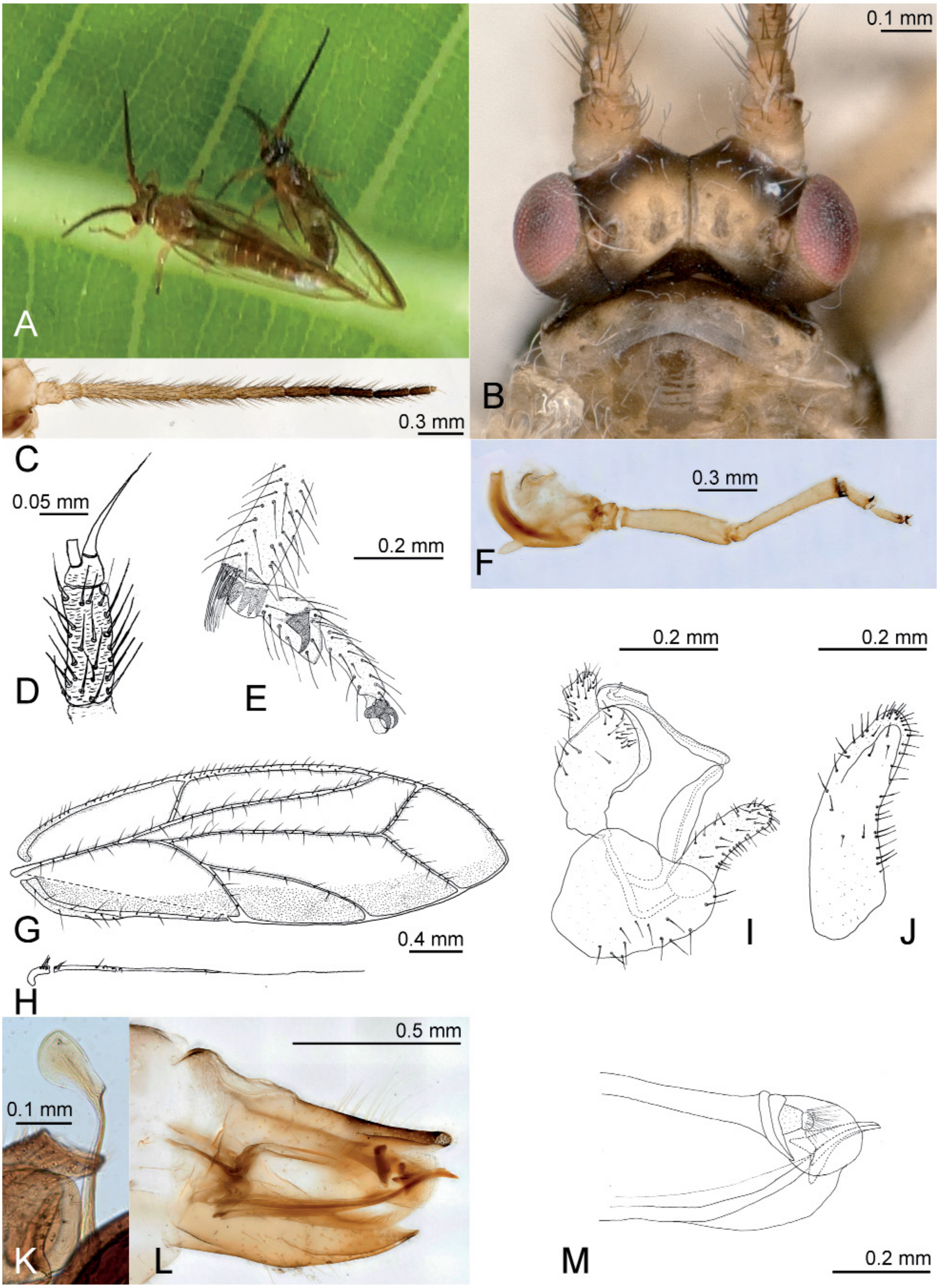

Fig. 3. *Homotoma chlamydodora*. (A) Male and female mating on a leaf of their host plant. (B) Head dorsal view. (C) Antenna. (D) Flagellomeres 7 and 8. (E) Apex of metatibia and metatarsus. (F) Hind leg. (G) Forewing. (H) Costal vein of hindwing. (I) Male terminalia, in profile. (J) Paramere, inner surface. (K) Distal segment of aedeagus. (L) Female terminalia, in profile. (M) Female valvulae.

Description of fifth instar immature (Fig. 4)
Coloration: Yellow to light brown.
Structure: Body, in dorsal view, sub-circular, 1.1 times as long as wide, flat and sclerotized dorsally, convex and membranous ventrally; ventral membrane covered in tubercular sculpture particularly along margins; surrounded by a fringe of evenly, closely spaced truncate sectasetae (Fig. 4A, B). Cephalothorax entire, 1.6 times longer than the abdomen along midline, beset with sparse short simple setae or sectasetae on the disc and denser subacute sectasetae submarginally. Postocular sectaseta absent. Antenna short (0.1-0.2 mm), reaching slightly beyond anterior head margin, tapering apically, eight-segmented with a single apical rhinarium on each of segments 3, 4, 6 and 7; the last segment bearing two terminal setae of unequal length. Forewing pad with a humeral lobe well developed, extending forward to anterior margin of eye. Caudal plate 0.5 times as long as wide, bearing some scattered simple short setae and sectasetae dorsally and groups of denser sectasetae submarginally. Anus ventral, distant from posterior abdominal margin; outer circumanal ring transverse, consisting of one row of pores (Fig. 4C).

Description adult (Figs 5, 6)
Coloration: Head, thorax dorsally and abdomen anteriorly dark-brown to black (Fig. 5A). Compound eyes purple. Younger specimens yellow to light-brown (Fig. 5B).
Structure: Described by Hollis (1984: 30, fig. 79). Body length (including folded wings) of male 1.8-2.4 mm, of female 2.0-2.8 mm. Head width in male 0.5-0.6 mm, in female 0.6-0.7 mm; in profile, strongly inclined at almost 90° from longitudinal body axis; from above as wide as mesoscutum; compound eyes laterally; median ocellus on subcircular frons, lateral ocelli on raised tubercles near hind margin of vertex; genae rounded, weakly prominent ventrally; vertex almost pentagonal, 0.2 mm long, without medial suture, with short setae (Fig. 6A). Antennal sockets largely circular above genae. Antenna (Fig. 6B) 0.8-1.0 mm long, ten-segmented; flagellum slender with weakly widened segments 6-8; first flagellomere more than half as long as flagellomeres 2-8 together; flagellomeres 2, 4, 6, and 7 bearing each a subapical rhinarium; flagellomere 7 with a short, strong subapical seta; terminal setae on flagellomere 8 strongly unequal, one pointed, more than twice as long as flagellomere 8 and one shorter and truncate apically (Fig. 6C). Thorax strongly arched dorsally. Mesothorax larger than pro and metathorax. Forewing (Fig. 6D) about twice as long as wide (length 2.3-2.7 mm in male, 2.4-3.1 mm in female) oval, widest in the middle, broadly, irregularly rounded apically; vein R+M+Cu branching into R and short M+Cu, M 1.8 times longer than R+M+Cu and 5.6 times longer than its branches M_{1+2} and M_{3+4}, Cu 1.5 times longer than Cu_{1a} and 3.0 times longer than Cu_{1b} branch; radular spinules present in the middle of cells m_1, m_2 and cu_1 along wing margin. Hindwing (Fig. 6E)

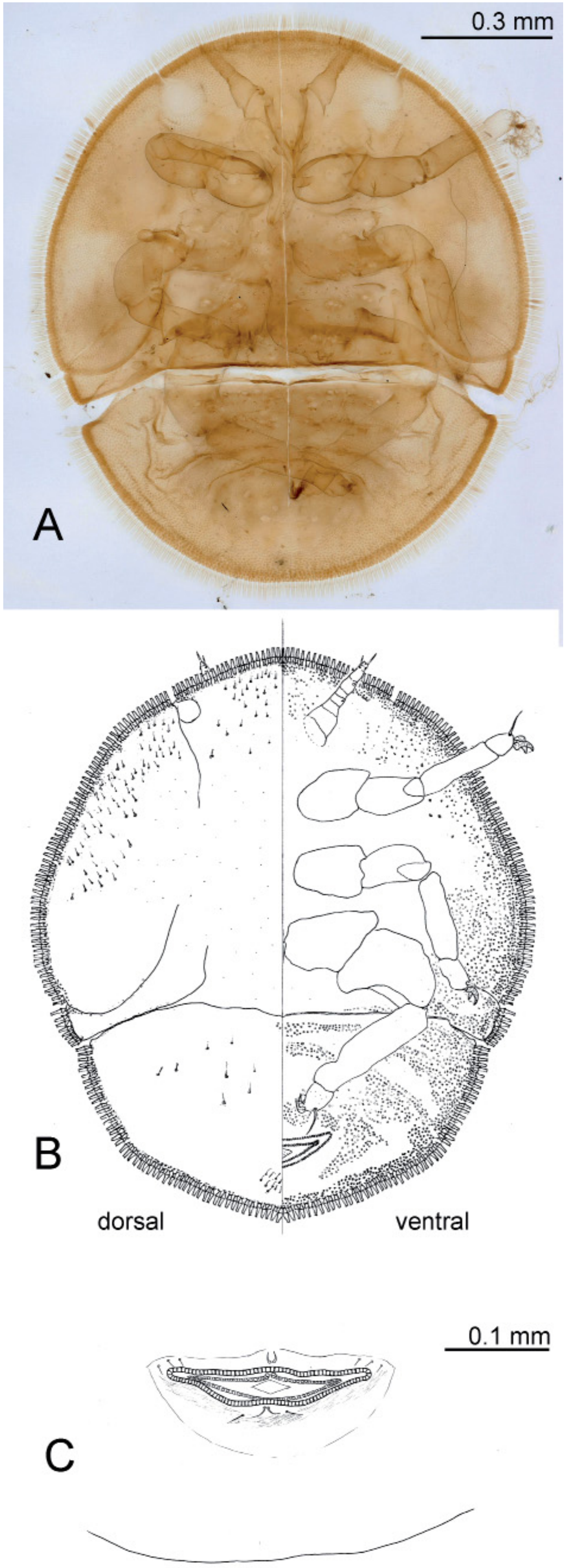

Fig. 4. *Pauropsylla tatrichea*, fifth instar immature. (A) Habitus, cleared specimen, in dorsal view. (B) Habitus with detail of setae and surface sculpture. (C) Anus and transverse circumanal ring.

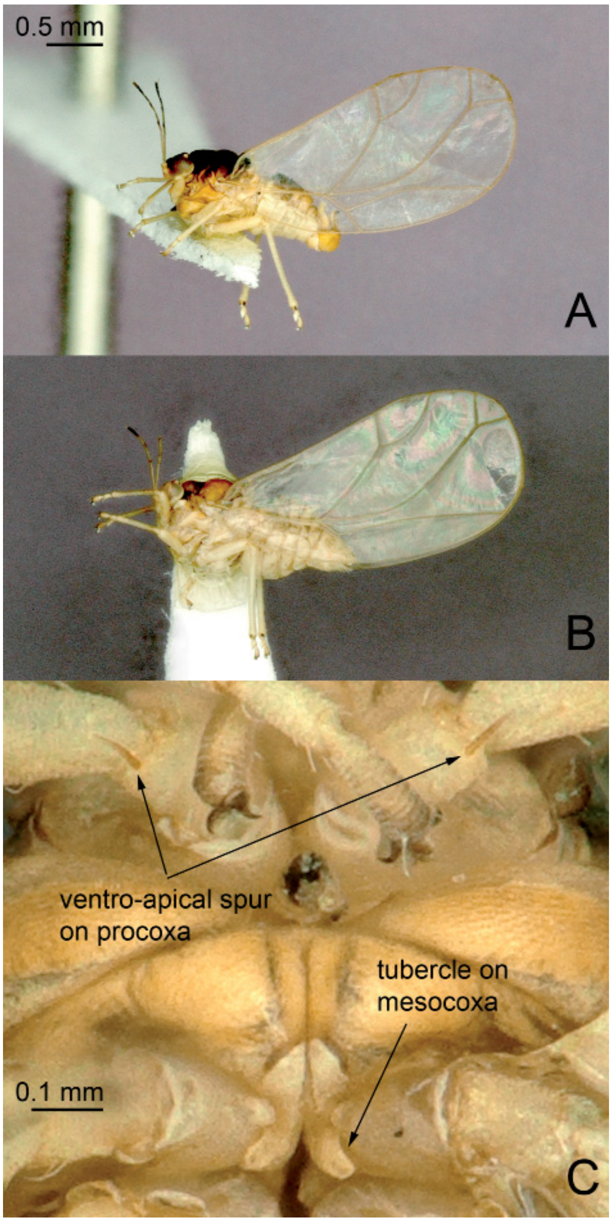

Fig. 5. *Pauropsylla tatrichea*, adult. (A) Male, habitus, in profile. (B) Female, habitus, in profile: (C) Thorax, ventral view.

two thirds as long as forewing with indistinct venation; costal vein (Fig. 6F) with three simple setae proximal of costal break, the setae distal to costal break grouped in a basal group with one seta and a median group with three setae in addition to hamulus. Mesocoxa with an inward-pointing tubercle and a long seta on its outer base (Figs 5C, 6G). Hind leg (Fig. 6H) slender; metacoxa bearing small pointed meracanthus; metafemur bearing three longitudinally arranged ventral sensilla in the middle and long bristles apically; inner apical edge angular (Fig. 6I); metatibia bearing a group of small genual spines (Fig. 6I) and 1+2 or 1+3 apical spurs (Fig. 6J); metabasitarsus lacking spurs (Fig. 6J). Abdomen with setae on tergites 2 and 3 on male and on tergites 3 and 4 on female. Male terminalia (Fig. 6L) with unsegmented proctiger which is, in profile, broadly rounded posteriorly; inner side of posterior lobes bearing two symmetrical areas of 15 peg-like setae (Fig. 6K). Paramere, in profile, lamellar, slightly S-shaped, truncate apically with sclerotized ridge and backward directed small tooth (Fig. 6M). Proximal segment of aedeagus narrowly curved, basally almost twice as long as distal segment which is weakly swollen basally and strongly inflated apically; sclerotized end-tube of ductus ejaculatorius moderately long, sinuate (Fig. 6N). Female terminalia short, cuneate (Fig. 6O); proctiger covered in moderately long setae on caudal two thirds; circumanal ring suboval consisting of two rows of pores (Fig. 6P); subgenital plate triangular, in profile, without ventral transverse groove, subacute apically. Dorsal and ventral valvulae as in Fig. 6Q.

BIOLOGY

Among the 12 *Ficus* species examined at the two sites (Table 1), *Homotoma chlamydodora* and *Pauropsylla tatrichea* were found exclusively on *Ficus vallis-choudae* (Fig. 7A, B); they appear, therefore, locally monophagous on *F. vallis-choudae*. Immatures of *H. chlamydodora* are covered in white flaky wax and infest the terminal buds (Fig. 7C) sitting under the stipules (Fig. 7D) where they pass the whole development until adult emergence. Often, the attacked buds die back (Fig. 7E). Immatures of *P. tatrichea*, on the other hand, colonise the underside of young leaves inducing pit-galls which are covered in abundant white wax strands (Fig. 7F, G). Adults of both species were observed feeding, mating and laying eggs on the same plant.

Homotoma chlamydodora was encountered only at Koutaba (Western Highland) whilst *Pauropsylla tatrichea* was present both at Bafia (Southern Plateau) and Koutaba. Adults and immatures of both psyllid species were present during the entire year (from October 2015 to October 2016) with the highest infestation rates noted in April, corresponding to the early rainy season. This suggests a polyvoltine life cycle with overlapping generations.

DISCUSSION AND CONCLUSIONS

The previously unknown last instar of *Homotoma chlamydodora* resembles that of *H. eastopi* Hollis & Broomfield, 1989 in the general body shape, the three-segmented antennae, a generic feature, and the multi-layered circumanal ring (Aléné *et al.*, 2014), but is less hairy, particularly on the antennae, has a more slender antennal segment 3 and narrower forewing pads which completely lack a humeral lobe (rather than bearing a weakly produced lobe) and differs in the marginal

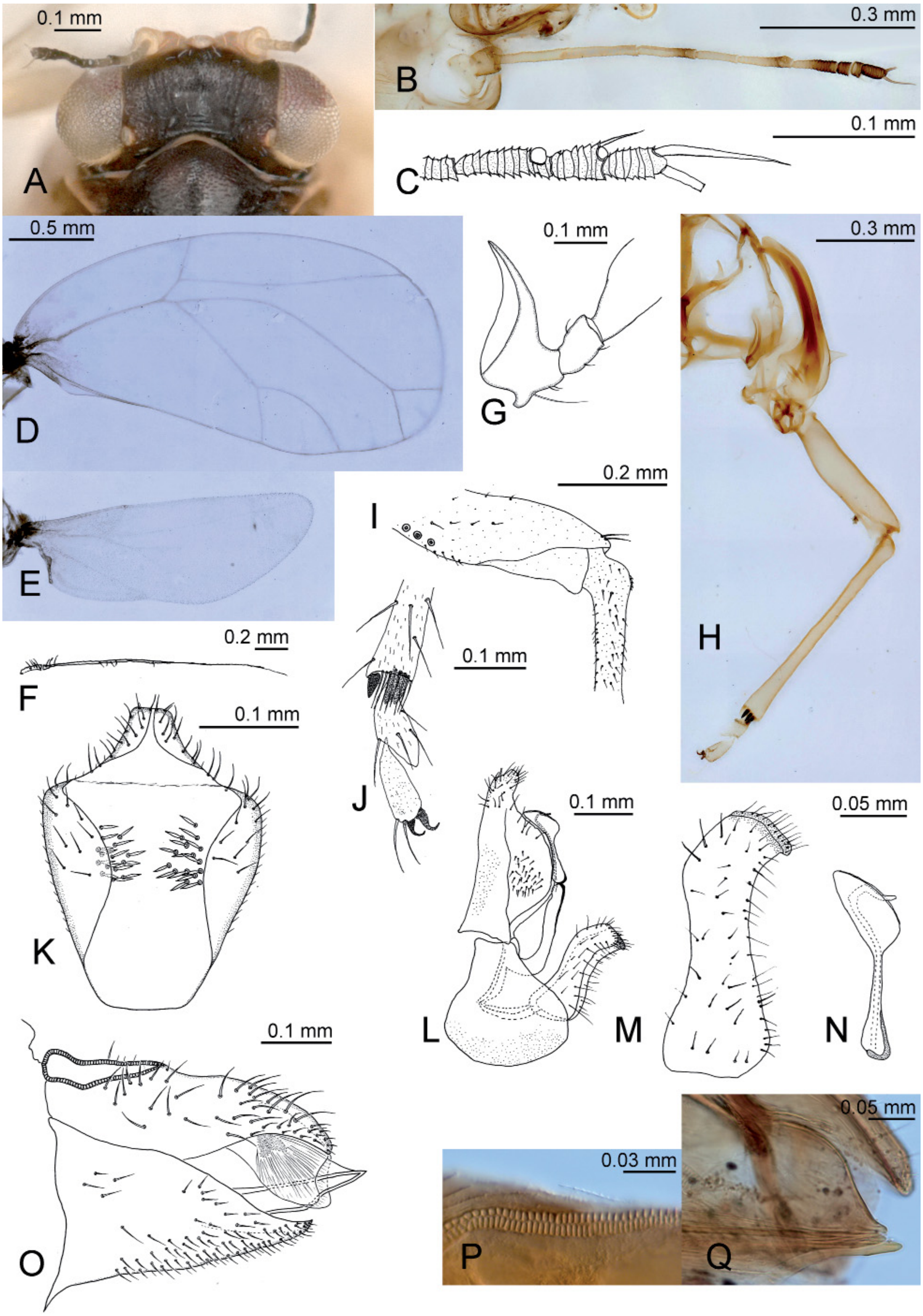

Fig. 6. *Pauropsylla tatrichea*, adult. (A) Head, dorsal view. (B) Antenna. (C) Antennal flagellar segments 6-8. (D) Forewing. (E) Hindwing. (F) Costal vein of hind wing. (G) Mesocoxa showing inward pointing tubercle. (H) Hind leg. (I) Apex of metafemur and basis of metatibia showing sensilla and genual spines. (J) Apex of metatibia with apical spurs and metatarsus. (K) Male proctiger, in rear view (inner face). (L) Male terminalia, in profile. (M) Paramere, inner face. (N) Distal segment of aedeagus. (O) Female terminalia, in profile. (P) Circumanal ring, detail. (Q) Female valvulae.

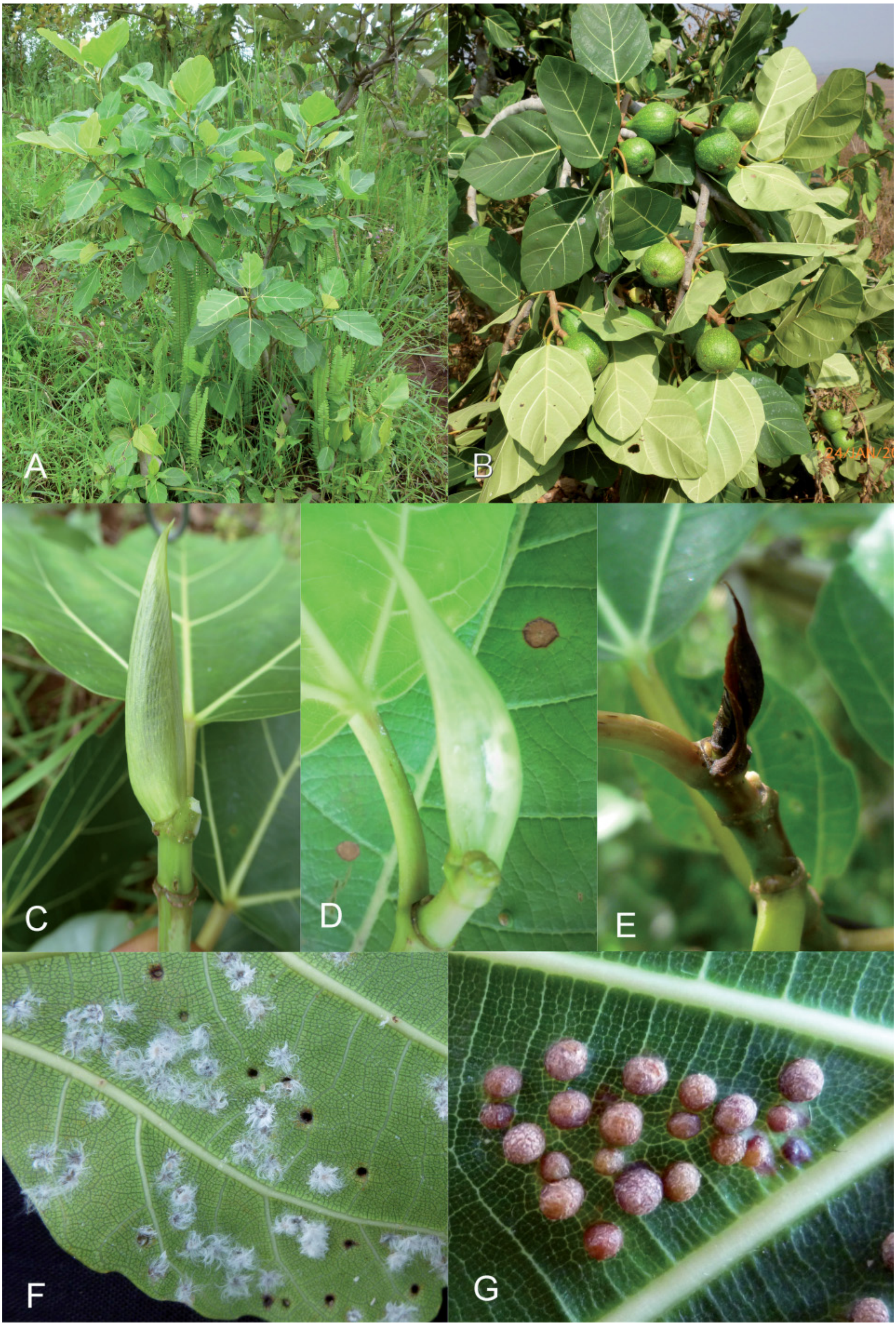

Fig. 7. *Ficus vallis-choudae*. (A) Young plant. (B) Branch with fruits. (C) Healthy bud. (D) Bud infested by an immature of *Homotoma chlamydodora*. (E) Bud withering after being infested by *H. chlamydodora*. (F) Lower surface of a leaf showing pit galls of *Pauropsylla tatrichea* immatures covered with wax. (G) Upper surface of a leaf showing the same galls.

setae of the forewing pad which usually consist of simple setae anteriorly and sectasetae posteriorly (rather than sectasetae throughout). From *Homotoma ficus* (Linnaeus, 1758) it differs in the absence of humeral lobes (rather than large humeral lobes) and the multi-layered circumanal ring (rather than single-layered) (Jerinić-Prodanović, 2011). Adults of *H. chlamydodora* differ from other Afrotropical and Palaearctic *Homotoma* species in the antennal flagellum which is not compressed laterally, and the metabasitarsus which has only one spur. From the closely related *H. eastopi* they differ also in the anteriorly less incised vertex and in details of the venation and pattern of the forewing. *Homotoma chlamydodora* resembles *H. ficus* in the head shape but differs in the narrower forewings and details of the venation.

Hollis (1984) defined three species groups and several ungrouped species within *Pauropsylla*. He assigned *P. tatrichea* to the *P. willcocksi*-group, along with *P. trichaeta* Pettey, 1924, *P. willcocksi* Dçbski, 1918 and two poorly described species from Israel based on the presence of a strong ventro-apical spur on the procoxa (Fig. 5C). The last instar immature of *P. tatrichea* is similar to that of *P. trichaeta* in the almost circular body outline and the dense marginal sectasetae but differs in the presence of dorsal sectasetae, the longer marginal sectasetae and the eight-segmented antenna (rather than 7). The last instar immature of *Pauropsylla tatrichea* differs from *P. willcocksi* in the almost circular body outline, the eight-segmented antenna (rather than 6), the anteriorly strongly produced humeral lobe and the densely spaced marginal sectasetae which are all of the same size (rather than sparsely spaced and of different sizes). *Pauropsylla tatrichea* differs from both *P. trichaeta* and *P. willcocksi* in the absence of a postocular sectaseta. Adults of *P. tatrichea* resemble those of *P. trichaeta* and *P. willcocksi* but are larger, with the clypeus bearing a pair of setae (rather than several setae), with the costa of the hindwing bearing 3-4 (rather than 1-2) setae proximal to costal break and lacking a ventral transverse grove on the female subgenital plate. The males of *P. tatrichea* differ from those of the other species of the *P. willcocksi*-group in the distinctly longer proctiger with two groups of 15 peg-like setae on the inner surface of the posterior expansions (rather than with 25-30 in *P. trichaeta* and up to 22 in *P. willcocksi*), the lamellar, S-shaped, apically truncate paramere (rather than curved backwards and apically blunt) and the apically more inflated distal portion of the aedeagus. An interesting feature is the inward pointing tubercle on the mesocoxa (Figs 5C, 6G). This character is present also in other *Pauropsylla* species and may constitute an autapomorphy of the genus.

In *H. chlamydodora*, the entire immature development takes place under stipules. This is in contrast to the development of *H. eastopi* and *H. ficus*. In *H. eastopi*, the infestation starts on the apical buds from where the immatures progressively spread onto young leaves and twigs (Aléné *et al.*, 2014). The development of immatures of *H. ficus* is similar. In late summer or autumn the eggs are laid in the buds were these overwinter. In spring, the first and sometimes the second instars sit under the stipules. The second and third instars move onto leaf pedicels, leaf blades or fruits where the development continues. In summer the last instars are mostly on the underside of the leaves but also on other structures (Jerinić-Prodanović, 2011; D. Burckhardt, unpublished data). *Homotoma chlamydodora* and *H. eastopi* are polyvoltine and their hosts are evergreen, in contrast to *H. ficus* which is univoltine and its host is deciduous.

Gall inducing psyllids tend to be monophagous while free living species are often narrowly or widely oligophagous (Burckhardt, 2005). *Homotoma chlamydodora* and *Pauropsylla tatrichea* seem to fit this general pattern though the available data are not conclusive. Whereas for *P. tatrichea* we have confirmed data from two localities in Cameroon, for *H. chlamydodora* there are confirmed host records from only one locality in Cameroon, in addition to records of *Ficus natalensis*, *F. petersii* and *F. thonningii* from Angola and South Africa on which adults were collected (Hollis & Broomfield, 1989). Whether these constitute host or casual plants (Burckhardt *et al.*, 2014) should be further investigated. Although this species was found locally on only one host, being considered monophagous, it is possible that, while looking at the entire distributional range, the species could be oligophagous.

It is interesting to note that while *Pauropsylla tatrichea* could be found both at Bafia (Southern Plateau) and Koutaba (Western Highland), *Homotoma chlamydodora* was encountered only at the latter locality. More research will be necessary to determine the factors influencing its distribution.

It is well documented that particular plant species can host several psyllid species such as some species of *Salix* (Salicaceae) (colonised by species of *Bactericera* Puton, 1876 and *Cacopsylla* Ossiannilsson, 1970) (Ossiannilsson, 1992), *Schinus* (Anacardiaceae) (*Calophya* Löw, 1879 and *Tainarys* Brèthes, 1920) (Burckhardt & Basset, 2000), *Eucalyptus* (Myrtaceae) (Spondyliaspidinae and Triozidae) (Hollis, 2004) or *Copaifera* and *Hymenaea* (Fabaceae) (*Apsyllopsis* Burckhardt & Queiroz, 2020; *Colophorina* Capener, 1973; *Jataiba* Burckhardt & Queiroz, 2020; *Mitrapsylla* Crawford, 1914; *Platycorypha* Tuthill, 1945) (Burckhardt & Queiroz, 2020). Sympatric occurrence of closely related psyllids is recorded from *Diclidophlebia eastopi* Vondráček, 1964 and *D. harrisoni* Osisanya, 1969 developing on the leaves of *Triplochiton scleroxilon* (Malvaceae) (Osisanya, 1974), or from *Pseudophacopteron eastopi* Malenovský, Burckhardt & Tamesse, 2007, *P. serrifer* Malenovský & Burckhardt, 2009 and *P. tamessei* Malenovský & Burckhardt, 2009 inducing galls on the leaves of *Dacryodes edulis* (Burseraceae) (Malenovský & Burckhardt, 2009; Nsangou & Tamesse, 2014). There are also examples of plant species which are colonised by not closely related psyllid species, e.g. *Copaifera langsdorffii* which can host sympatrically up to six psyllid species of three genera, some free living, some gall inducing (Burckhardt & Queiroz, 2020). Percy (2003) suggested that for several psyllid species to share the same host, resources should be partitioned by ecological specialisation, such as free living versus gall inhabiting, or different phenology. We find this pattern in the present study: *H. chlamydodora* and *P. tatrichea* develop on the same tree but occupy different ecological niches, i.e. their immatures are free living and in pit galls, respectively.

Ficus vallis-choudae is a wild fruit tree, fruits of which are consumed by the people of the savannah zones in Cameroon. If this plant should be cultivated in the framework of projects of domestication of some NWFPs in Cameroon (Tsobeng *et al.*, 2016), *Homotoma chlamydodora* and *Pauropsylla tatrichea* are potential pests, especially on saplings. Thus, more studies on the biology of the two psyllid species should be undertaken to guarantee a successful cultivation of this fruit tree.

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REFERENCES

Aléné D.C., Djiéto-Lordon C., Burckhardt D. 2014. The immatures and host plant range of the *Ficus*-feeding jumping plant-louse *Homotoma eastopi* (Hemiptera: Psylloidea) in southern Cameroon. *African Entomology* 22(4): 880-887.

Arnold M. 2002. Clarifying the links between forests and poverty reduction. *International Forestry Review* 4(3): 231-233.

Brèthes J. 1920. Las agallas del Molle de Incienso. *Aspiraciones* 2: 124-134.

Brown R.G., Hodkinson I.D. 1988. Taxonomy and ecology of the jumping plant-lice of Panama (Homoptera: Psylloidea). *Entomonograph* 9: 1-304.

Burckhardt D. 2005. Biology, ecology, and evolution of gall-inducing psyllids (Hemiptera: Psylloidea). *In*: Raman A., Schaefer C.W., Withers T.M. (eds). Biology, ecology, and evolution of gall-inducing arthropods. *Science Publishers, Inc., Enfield, NH*. pp. 143-157.

Burckhardt D., Basset Y. 2000. The jumping plant-lice (Hemiptera, Psylloidea) associated with *Schinus* (Anacardiaceae): systematics, biogeography and host plant relationships. *Journal of Natural History* 34: 57-155.

Burckhardt D., Queiroz D.L. 2020. Neotropical jumping plant-lice (Hemiptera, Psylloidea) associated with plants of the tribe Detarieae (Leguminosae, Detarioideae). *Zootaxa* 4733(1): 1-73.

Burckhardt D., Ouvrard D., Queiroz D., Percy D. 2014. Psyllid host-plants (Hemiptera: Psylloidea): resolving a semantic problem. *Florida Entomologist* 97(1): 242-246.

Burckhardt D., Cho G., Lee S. 2018. *Moriphila furva* gen. and sp. nov. (Hemiptera: Psylloidea: Homotomidae), a new jumping plant-louse from Korea associated with *Morus australis* (Moraceae). *Zootaxa* 4444(3): 299-315.

Capener A.L. 1973. Southern African Psyllidae (Homoptera) – 3: A new genus and new species of South African Psyllidae. *Journal of the Entomological Society of South Africa* 36(1): 37-61.

Crawford D.L. 1914. A monograph of the jumping plant-lice or Psyllidae of the New World. *Smithsonian Institution, United States National Museum, Bulletin* 85: 186 pp.

Dębski B. 1918. Liste des cécidies signalées en Egypte jusqu'à ce jour. *Mémoires de la Société entomologique d'Egypte* 1(4): 3-38.

Gautier D. 1996. *Ficus* (Moraceae) as part of Agrarian systems in the Bamileke region (Cameroon). *Economic Botany* 50(3): 318-326.

Guérin-Méneville F.-E. 1844. Iconographie du règne animal de G. Cuvier. Insectes. *Baillière, Paris*, 576 pp.

Hollis D. 1984. Afrotropical jumping plant lice of the family Triozidae (Homoptera: Psylloidea). *Bulletin of the British Museum (Natural History), Entomology Series* 49: 1-102.

Hollis D. 2004. Australian Psylloidea. Jumping plant lice and lerp insects. *Australian Government, Australian Biological Resource Study, Canberra, Australia*, 216 pp.

Hollis D., Broomfield P.S. 1989. *Ficus*-feeding psyllids (Homoptera), with special reference to the Homotomidae. *Bulletin of British Museum (Natural History), Entomology Series* 58(2): 131-183.

Jerinić-Prodanović D. 2011. The first finding of the fig psylla *Homotoma ficus* L. (Hemiptera, Psylloidea, Homotomidae) in Serbia. *Pesticidi i fitomedicina* 26(3): 205-212.

Löw F. 1879. Zur Systematik der Psylloden. *Verhandlungen der zoologisch-botanischen Gesellschaft in Wien* 28: 586-610.

Linnaeus C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis. Edition decima, reformata. *Laurentii Salvii, Holmiae,* ii + 824 pp.

Pettey F.W. 1924. South African psyllids. *Memoirs of the Entomological Society of Southern Africa* 2: 21-30.

Puton A. 1876. Notes pour servir à l'étude des Hémiptères. Description d'espèces nouvelles ou peu connues. *Annales de la Société entomologique de France* 6: 275-290.

Malenovský I., Burckhardt D. 2009. A review of the Afrotropical jumping plant-lice of the Phacopteronidae (Hemiptera: Psylloidea). *Zootaxa* 2086: 1-74.

Malenovský I., Burckhardt D. & Tamesse J.L. 2007. Jumping plant-lice of the family Phacopteronidae (Hemiptera: Psylloidea) from Cameroon. *Journal of Natural History* 41(29-32): 1875-1927.

Osisanya E.O. 1969. A new species of *Diclidophlebia* (Homoptera: Psyllidae) from Nigeria. *Journal of Natural History* 3: 71-77.

Nsangou I.M., Tamesse J.L. 2014. Populations dynamic of *Pseudophacopteron* spp. (Hemiptera: Phacopteronidae), psyllids pest of *Dacryodes edulis* (Burseraceae) in Cameroon. *International Journal of Agronomy and Agricultural Research* 5(1): 56-73.

Osisanya E.O. 1974. Aspects of the biology of *Diclidophlebia eastopi* Vondracek and *D. harrisoni* Osisanya (Homoptera, Psyllidae). *Bulletin of Entomological Research* 64: 9-17.

Ossiannilsson F. 1970. Contributions to the knowledge of Swedish psyllids (Hemiptera: Psyllidae). *Entomologica Scandinavica* 1: 135-144.

Ossiannilsson F. 1992. The Psylloidea (Homoptera) of Fennoscandia and Denmark. *Fauna Entomologica Scandinavica* 29: 1-346.

Percy D.M. 2003. Radiation, diversity, and host-plant interactions among island and continental legume-feeding psyllids. *Evolution* 57(11): 2540-2556.

Rowland D., Ickowitz A., Powell B., Nasi R., Sunderland T.C.H. 2016. Forest foods and healthy diets: quantifying the contributions. *Environmental Conservation* 44(2): 102-114.

Rübsaamen E.H. 1899. Mitteilungen über neue und bekannte Gallen aus Europa, Asien, Afrika und Amerika. *Entomologische Nachrichte*n 25: 225-282.

Sorrenti S. 2017. Non-wood forest products in international statistical systems. *Non-wood Forest Products Series* no. 22. Rome, FAO.

Tsobeng A., Tchoundjeu Z., Degrande A., Asaah E., Takoutsing B., Sado T. 2016. Contribution de la domestication participative à la culture des PFNL: le cas des groupements paysans des zones de forêts et savanes humides au Cameroun. *In:* FAO, *Vivre et se nourrir de la forêt en Afrique centrale,* Rome, Italy, chapter 15, pp. 147-157.

Tuthill L.D. 1945. Further observations on the Psyllidae of Cuba (Homoptera). *Entomological News* 56: 235-238.

van Noort S., Rasplus J.Y. 2020. Fig web: figs and fig wasps of the world. URL: www.figweb.org (accessed on 15 March 2020).

Vondráček K. 1964. *Diclidophlebia eastopi* sp. n., a remarkable Psyllid from West Africa. *Annals and Magazine of Natural History* 13(6): 289-295.

Vivien J., Faure J.J. 1996. Fruitiers sauvages d'Afrique (Espèces du Cameroun). *Ministère Français de la Coopération, Centre Technique de Coopération Agricole et Rurale (CTA). Nguila-Kerou, Clohars Carnoet France.*

WFO 2020. World Flora Online. Published on the Internet; http://www.worldfloraonline.org (accessed on 20 March 2020).