The Chimarra minima group in West Africa and Madagascar (Trichoptera, Philopotamidae)

François-Marie Gibon
IRD, Centre de Biologie pour la Gestion des Populations, (UMR INRA / IRD / CIRAD / Montpellier Supagro), Campus de Baillarguet, CS 30016, F-34988 Montferrier-sur-Lez Cedex (France)
francois-marie.gibon@ird.fr

Published on 26 June 2015

ABSTRACT
Among Afrotropical representatives of the genus Chimarra Stephens, 1829 (Trichoptera: Philopotamidae), the minima group is defined to include a number of closely related species that lack the mesal lobe of tergum X, have a membranous tergum IX, and also have characteristic structures of the inferior appendages and phallic apparatus. A preliminary list of the species is proposed. The descriptions of Chimarra ambaja Mosely, 1939, Chimarra callasae Gibon, 1982, Chimarra sasandae Gibon, 1982 and Chimarra toubaensis Gibon, 1985 are supplemented. One synonymy is established Chimarra petri Gibbs, 1973 as a junior synonym of Chimarra minima Ulmer, 1907. Five new species are described: Chimarra loffae n. sp. from Guinea, Chimarra sanagae n. sp. and Chimarra asambae n. sp. from Cameroon, Chimarra vulgaris n. sp. and Chimarra antsymeloka n. sp. from Madagascar. New citations for West Africa, Cameroon and Madagascar, new distribution and ecological data are included and analysed.

KEY WORDS
Chimarra, Biogeography, new citation, Ivory Coast, Mali, Guinea, Togo, Burkina Faso, Cameroon, Madagascar, new synonymy, new species.

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RÉSUMÉ
INTRODUCTION

In the Afrotropical region, the richness of the genus Chimarra Stephens, 1829 (with a little less than a hundred species) is only surpassed by that of the genus Cheumatopsyche Wallengren, 1891 (more than one hundred and ten species). All the species belong to the sub-genus Chimarra Stephens, 1829, as defined by Blahnik (1998). In order to make sense of the distributions of these remarkable ecological indicators, a phylogenetic approach would be very useful. It will require the examination of many type specimens, some of which are in poor condition or lost. It will also require a joint study of the Asian fauna, because several colonizations have occurred from this continent (Ross 1956). Meanwhile, in order to facilitate the identifications and the descriptions of new taxa, it is possible to recognize some putative monophyletic lines among new species, defined by hypothesized synapomorphies. In this paper, I describe the Chimarra minima group, based on the absence of the mesal lobe of tergum X, presence of a membranous tergum IX and the homogeneity within the group of structures of the inferior appendages and phallic apparatus. A preliminary list of species is also provided. This led to improved descriptions for several described species and also the descriptions of three new species from Western Africa and two from Madagascar. A study of the phylogeny of Chimarra, using molecular data, has been recently published (Wahlberg & Johanson 2014). They confirm that the sub-genus Chimarra colonized the Afrotropical region from the Oriental region, as proposed by Ross (1956). For the moment, the position of the C. minima group in the proposed phylogeny remains hypothetical because some species, particularly the Malagasy ones, are still undescribed. The absence of morphological characters prevents to position the C. minima group. Nevertheless, the lineage N6, predominantly Australian and Melanesian, includes a group of African species (Chimarra calundoensis Marlier, 1965, Chimarra lukawei Jacquemart, 1961) similar to the C. minima group, but distinct by characters of the phallic apparatus and of inferior appendages. Future studies are necessary to check the relationship of C. minima group with this lineage.

MATERIAL AND METHODS

The continental material was collected during an ecological monitoring carried out for the Onchocerciasis Control Programme in Western Africa (Yameogo 1994; Yameogo et al. 1988; Resh et al. 2005). The Malagasy material was collected during the project “Biodiversité et Biotypologie des eaux continentales malgaches” jointly conducted by the ORSTOM and the CNRE (Antananarivo). The equipment, the sampling method and areas studied were described by Elouard & Gibon (2001). Specimens were captured using a portable light trap which was composed of a black light and a gas lamp. They were subsequently preserved in ethanol (75%). The male genitalia of some specimens were cleared using a gas lamp. They were subsequently preserved in ethanol (75%). Th e male genitalia of some specimens were cleared using a gas lamp. They were subsequently preserved in ethanol (75%). Th e male genitalia of some specimens were cleared using a gas lamp. They were subsequently preserved in ethanol (75%). Th e male genitalia of some specimens were cleared using a gas lamp. They were subsequently preserved in ethanol (75%).
Ross, 1956 was close to the “asiatic ancestor” that initiated one of the colonization movements from Asia to Africa. It was formally described by Bláhnik et al. (2009), who listed 130 species from Japan to Pakistan (subsequently, Bláhnik et al. (2012) described five more species from Vietnam). In the Chimarra group, the lateral lobes of tergum X are secondarily subdivided into sclerotized lateral and mesal lobes, and the dorsal lobes, and sometimes the mesal lobes, bear numerous sensilla. In the Chimarra minima group, the lateral lobes of tergum X are secondarily subdivided into sclerotized dorsal and ventral lobes (subsequently referred to as latero-dorsal and latero-ventral lobes), and the dorsal lobes usually have two sensilla. Moreover, the long inward deformation of the dorso-distal angle of the inferior appendages and the phallotheca ending in two long, lateral and spear-shaped processes are characteristic of the Chimarra minima group. Finally, in the Chimarra tsudai-group, both veins 2A and 3A of the forewing are looped to 1A, in the Chimarra minima group, 2A appears to be Y-shaped apically (Fig. 2).

**DESCRIPTION**

Adults yellow or pale yellow, wings without patch or pattern. Ocelli 3. Labial palps 3-segmented. Maxillary palps 5-segmented. Spur formula 1/4/4. Forewing (Fig. 2): Rs sinuous, with node before discoidal cell, R1 and stem of M1+2 slightly sinuous; forks 1 and 2 present, sessile; fork 3 present, petiolate; fork 4 absent; fork 5 present; extremity of Cu2 curved and joining wing margin a little beyond 1A; sc-r, r, s, r-m, m, m-cu and cu present. Hindwing (Fig. 2): R1 apparently fused to subcosta, forks 1 and 2 present, sessile; fork 3 present, petiolate; fork 4 absent; fork 5 present; 2A looped to 1A.

Abdominal segment IX distinctly produced anteroventrally, with short posteroventral process, dorsally membranous (U-shaped when viewed caudally). Preanal appendages, short, simple. Inferior appendages bulky, almost rectangular or trapezoidal in lateral view and C-shaped in caudal view; heavily sclerotized, with inward directed elongation of the dorso-distal edge and spine-shaped protuberance or small bump on the inner side. Mesal lobe of tergum X absent. Lateral lobes distally split, over most of their length. Latero-dorsal lobes highly sclerotized, rod, sickle or hook-shaped; lateral-ventral rod, plate or sheet-shaped, sometimes absent. Phallotheca tubular, arising from bulbous base, ending in two long, lateral, pointed rods. Endotheca with phallotremal bump on the inner side. Mesal lobe of tergum X absent.

**REMARKS**

Two subgroups and two isolated species may be distinguished, based on the shape of the latero-ventral lobes of tergum X. In most species, this latero-ventral lobe forms a lateral sheet or a plate along the phallic apparatus (subgroup 1). This plate is sometimes thin, membranous and, for this reason, not visible after clearing in KOH; it is consequently missing from the original descriptions, at least in the case of Chimarra ambaja Mosely, 1939, *C. callasa* Gibon, 1982, *C. sassa* Gibon, 1982 and Chimarra tsudai Gibon, 1985. I give new figures (lateral view) for the male genitalia of these species (Figs 3E, F; 5G). In some species, the latero-ventral lobe is, like the latero-dorsal lobe, heavily sclerotized, branch or sword-shaped (subgroup 2). In Chimarra minima, the latero-ventral lobe is an elongated and narrow plate with a more strongly sclerotized spiny distal thickening. In Chimarra intexta Mosely, 1931, the latero-ventral lobe is absent.

**Table 1. — Preliminary List Of The Chimarra minima Group**

<table>
<thead>
<tr>
<th>Species</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chimarra ambaja Mosely, 1939</td>
<td>Democratic Republic of the Congo, Cameroon n. cit.</td>
</tr>
<tr>
<td>Chimarra angolensis Marler, 1965</td>
<td>Angola</td>
</tr>
<tr>
<td>Chimarra assambae n. sp.</td>
<td>Cameroon</td>
</tr>
<tr>
<td>Chimarra berndvici Scott, 1974</td>
<td>Zimbabwe</td>
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<tr>
<td>Chimarra ceraris Barnard, 1934</td>
<td>Zimbabwe</td>
</tr>
<tr>
<td>Chimarra cognita Kimmins, 1957</td>
<td>Angola, Zimbabwe, Namibia</td>
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<tr>
<td>Chimarra antsymlakea n. sp.</td>
<td>Guiana, Cameroon</td>
</tr>
<tr>
<td>Chimarra lofiae n. sp.</td>
<td>Democratic Republic of the Congo, Zimbabwe, South Africa</td>
</tr>
<tr>
<td>Chimarra lufrae Jaquemart, 1961</td>
<td>Guinea, Cameroon</td>
</tr>
<tr>
<td>Chimarra vulgaris n. sp.</td>
<td>Madagascar</td>
</tr>
<tr>
<td>Chimarra prodhoni Gibon, 1985</td>
<td>Ivory Coast, Guinea n. cit.</td>
</tr>
<tr>
<td>Chimarra sanagaee n. sp.</td>
<td>Cameroon</td>
</tr>
</tbody>
</table>

**Chimarra minima Ulmer, 1907**

**Chimarra petri Gibbs, 1973: 369 n. syn.**

**Chimarra volacae Marler, 1978: 288 (synonymized by Gibon 1985: 23).**

**ARGUMENTATION**

The examination of the holotype of Chimarra minima revealed its synonymy with Chimarra petri. The genitalia of this specimen are figured for the first time (Fig. 3C-D). Both the latero-dorsal and latero-ventral lobes of tergum X have their distal extremities more sclerotized than their basal parts, which are thinner and difficult to distinguish from each other. Gibbs (1973) already noted the relationship of Chimarra petri to Chimarra intexta, Chimarra cognata and Chimarra infrate. Besides the differences in tergum X, Chimarra minima differs from other species of the group in the absence of a process on the inner face of the inferior appendage and the reticulated appearance of the prolongations of the phallic apparatus.

**Chimarra assambae n. sp.**

(Fig. 4A-E)


Paratypes: Same data, 1♂ (ethanol), 1♂ (1 slide) (CBGP).
Gibon F-M.

**TYPE LOCALITY.** — Cameroon, Assamba River (Sanaga bassin) near Ndjoré, 4°23’59”N, 11°49’11”E.

**DISTRIBUTION.** — Cameroon. This species is only known from the type locality.

**ETYMOLOGY.** — Named after the Assamba River, tributary of the Sanaga.

**DIAGNOSIS.** — *Chimarra assambae* n. sp. belongs to subgroup 1, with a latero-ventral lobe sheet or leaf-shaped. It is distinguished from most other species (*C. bertrandi*, *C. lofii* n. sp., *C. lepis*, *C. prodoni* Gibon, 1985, *C. sassandrei*, *C. touaerisi*) by the absence of the endothecal spine. It is distinguished from *C. callasae* and *C. cerasi*, also devoid of an endothecal spine, by its ax-shaped latero-dorsal lobe (hook-shaped in the other species).

**DESCRIPTION**
Size: forewing 4.3 mm, hindwing 3.5 mm. Preanal appendages small, setose and oval in lateral view. Inferior appendages roughly quadrangular in lateral view, dorsal branch strong and long, ventral protruding process small. Latero-dorsal lobe of tergum X strong, distal part projected ventrad and extended in a characteristic ax-shaped extremity (dorsal view). Latero-ventral lobe of tergum X plate-like, long and relatively narrow. Lateral rods of Phallotheca long, thin, distally curved. Endotheca devoid of internal spine; phallotremal sclerite present, reduced.

*Chimarra antsymeloka* n. sp.
(Fig. 5A-F)

**TYPE MATERIAL.** — **Holotype**: Madagascar, Ambatandrano River (tributary of the Namorona) at Ambatandrano, 47°26’32”E, 21°14’45”S, 775 m. a.s.l., 17.IV.1994, 1 ♂ (2 slides: Phallic apparatus / abdominal segments VII-X, head and thorax in alcohol) (MNHN).


**TYPE LOCALITY.** — Madagascar, Ambatandrano River (tributary of the Namorona) at Ambatandrano, 47°26’32”E, 21°14’45”S, 775 m. a.s.l.
The Chimarra minima group in West Africa and Madagascar (Trichoptera, Philopotamidae)

FIG. 2. — A-C, wings: A, Chimarra vulgaris n. sp.; B, Chimarra antsymeloka n. sp.; C, Chimarra assambae n. sp. Scale bar: 1 mm. Abbreviations: A, anal vein; Cu, cubitus; M, medius; R, radius; Sc, subcosta.
**DISTRIBUTION.** — Madagascar.

**ETYMOLOGY.** — Named after the Malagasy words *antsy* = knife and *meloka* = curved, in reference to the shape (sickle) of tergum X in dorsal view.

**DIAGNOSIS.** — The two Malagasy species, *C. antsymeloka* n. sp. and *C. vulgaris* n. sp., belong to subgroup 1, with a latero-ventral lobe sheet or leaf-shaped. Both have an endothecal spine, straight (not curved as in continental species. The two lateral rods of the phallotheca are smaller than in the other species; they are thick with a wrinkled appearance in *C. antsymeloka* n. sp., thinner and spine-shaped in *C. vulgaris* n. sp. The apex of the latero-dorsal lobes of the tergum X are acute in *C. antsymeloka* n. sp., truncate in *C. vulgaris* n. sp.
Size: forewing 4.5 mm, hindwing 3.7 mm. Preanal appendages small, setose, wineskin-shaped. Inferior appendages massive in lateral view, dorsal branch strong, short, triangular when viewed dorsally; internal process long and narrow, inserted just below the dorsal branch. Latero-dorsal lobe of tergum X strong, distal part curved, with pointed distal extremity; small pointed projection inserted at mid-length on the outer edge; sickle-shaped when viewed dorsally. Latero-ventral lobe of tergum X sheet like, long, somewhat triangular on lateral view. Lateral rods of Phallotheca short, strong, curved ventrad with a wrinkled appearance. Endothecal spine present small, straight. Phallotremal sclerite large; when dorsally viewed, trident-shaped with two symmetric latero-dorsal branches and one slightly shorter, centro-ventral branch.

**DESCRIPTION**

**FIG. 4.** — Chimarra assambae n. sp.: A, segments IX and X, caudal view; B, segments IX and X, lateral view; C, segments IX and X, dorsal view; D, phallic apparatus, lateral view; E, inferior appendage, dorsal view. Abbreviations: ai, inferior appendage; db, dorsal branch; ib, inferior branch; pa, preanal appendage, sg, abdominal segment; t, tergite; vb, ventral branch. Scale bar: 0.1 mm.
Fig. 5. — **A-F**, Chimarra antsymeloka n. sp.: **A**, inferior appendage, dorsal view; **B**, segments IX and X, lateral view; **C**, tergum X, dorsal view; **D**, Chimarra antsymeloka n. sp., specimen from the Efaho River (near Ifarantsa), tergum X, dorsal view; **E**, Chimarra antsymeloka n. sp., specimen from the Menarandra River (near Tranoroa), tergum X, dorsal view; **F**, phallic apparatus, lateral view; **G**, Chimarra ambaja Mosely, 1939, segments IX and X, lateral view. Scale bar: 0.1 mm.
Fig. 6. — A-E, Chimarra loffae n. sp.: A, B, segments IX and X, lateral view (A), dorsal view (B); C, D, phallic apparatus, lateral view (C), dorsal view (D); E, inferior appendage, dorsal view. Scale bar: 0.1 mm.
FIG. 7. — A-D, Chimarra sanagae n. sp.: A, B, segments IX and X, lateral view (A), dorsal view (B); C, inferior appendage, dorsal view; D, phallic apparatus, lateral view. Scale bar: 0.1 mm.
FIG. 8. — A-D, Chimarra vulgaris n. sp.; A, B, segments IX and X, dorsal view (A), lateral view (B); C, inferior appendage, dorsal view; D, phallic apparatus, lateral view. Scale bar: 0.1 mm.
**Chimarra loffae** n. sp.  
(Fig. 6A-E)

**TYPE MATERIAL.** — **Holotype:** Guinea, Loffa River near Macenta, 8°30′2.62″N, 9°27′27.82″W, 524 m. a.s.l., 21.I.1987, F.-M. Gibon, 1 (ethanol); Guinea, small tributary of the Saint-Paul River, 22 km North/North-West from Ndjekoko, 7°55′55.18″N, 8°56′32.80″W, 420 m. a.s.l., 30.I.1988, F.-M. Gibon, 1 (ethanol); Guinea, Makona River at Bofossou, 8°39′23.29″N, 9°40′39.55″W, 21.I.1987, F.-M. Gibon, 2 (ethanol), 1 (2 slides: abdomen / head and thorax) (CBGP).

**Paratypes:** Same data, 1 (1 slide), 1 (1 slide: abdomen, head and thorax in alcohol); Guinea, small tributary of the Saint-Paul River, 22 km North/North-West from Ndjekoko, 7°55′55.18″N, 8°56′32.80″W, 420 m. a.s.l., 30.I.1988, F.-M. Gibon, 1 (ethanol); Guinea, Makona River at Bofossou, 8°39′23.29″N, 9°40′39.55″W, 21.I.1987, F.-M. Gibon, 2 (ethanol), 1 (2 slides: abdomen / head and thorax) (CBGP).

**ADDITIONAL MATERIAL.** — **Cameroon.** Noun River (Sanaga River basin), a few kilometres upstream from Bafia, 4°47′52″N, 11°16′20″E, 440 m. a.s.l., 21.XII.1989, F.-M. Gibon, 1 (1 slide), 1 (1 slide: abdomen / head and thorax), 1 (2 slides: abdomen / head and thorax), 1 (1 slide: alcohol); Sanaga at Ngokoué, 4°2′3″N, 10°32′44″E, 9.III.1989, F.-M. Gibon, 1 (1 slide: wings and genitalia / head and thorax) (CBGP).

**TYPE MATERIAL.** — **Holotype:** Guinea, Loffa River near Macenta, 8°30′2.62″N, 9°27′27.82″W, 524 m. a.s.l., 20.II.1987, J.-F. Agnèse, 1 (2 slides: phallic apparatus / abdominal segments VII-X, head and thorax in alcohol) (MNHN).

**Paratypes:** Same data, 1 (1 slide), 1 (1 slide: abdomen, head and thorax in alcohol); Guinea, small tributary of the Saint-Paul River, 22 km North/North-West from Ndjekoko, 7°55′55.18″N, 8°56′32.80″W, 420 m. a.s.l., 30.I.1988, F.-M. Gibon, 1 (ethanol); Guinea, Makona River at Bofossou, 8°39′23.29″N, 9°40′39.55″W, 21.I.1987, F.-M. Gibon, 2 (ethanol), 1 (2 slides: abdomen / head and thorax) (CBGP).

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**TYPE LOCALITY.** — Guinea, Loffa River, near Macenta, 8°30′2.62″N, 9°27′27.82″W, 524 m. a.s.l.

**DISTRIBUTION.** — Guinea, Cameroon.

**ETYMOLOGY.** — Named after the Loffa River (Guinea and Liberia).

**DIAGNOSIS.** — *Chimarra loffae* n. sp. belongs to the subgroup 1, with a latero-ventral lobe sheet or leaf-shaped. It is distinguished from *C. prodhoni*, the other species of the subgroup, by the wide base of the latero-ventral lobe of tergum X and by the absence of an endothecal spine.

**DESCRIPTION.**

Size: forewing 3.9 mm, hindwing 3.2 mm. Preanal appendages small, setose with wrinkled aspect. Inferior appendages massive, dorsal branch strong, elongate, with a line of stout setae; internal process protruding, ventrally inserted, small but larger than in *C. loffae* n. sp. Late-rotal-dorsal lobes of tergum X stout, hook-shaped, curved outward, shorter than latero-ventral lobe. Late-rotal-ventral lobes of tergum X: base wide, almost triangular in lateral view, apically extending as a sclerotized, slightly ventrad curved, finger-shaped rod. Lateral rods of phallotheca, long, stout, strongly curved ventrad, distal third with a wrinkled appearance. Endothecal spine absent. Phallothremal sclerite small, with indiscernible structure.

**Chimarra vulgaris** n. sp.  
(Fig. 8A-D)

**TYPE MATERIAL.** — **Holotype:** Madagascar, Marokoto River near Mananara (Mandrare River basin), 46°38′50″E, 24°44′02″S, 275 m. a.s.l., 03.VI.1994, F.-M. Gibon, 1 (ethanol) (MNHN).

**Paratypes:** Same data, 10 (CBGP). — Ankazomanga, tributary of the Sohitay (Mandrare River basin), 46°37′23″E, 24°02′37″S, 430 m. a.s.l., 26.IV.1995, 1 (4 slides: wings / phallic apparatus and inferior appendages / abdominal segments I-VI / abdominal segments VII-X, head and thorax) (CBGP).

**TYPE LOCALITY.** — Madagascar, Marokoto River near Mananara 46°38′50″E, 24°44′02″S, 275 m. a.s.l.

**DISTRIBUTION.** — Madagascar.

**ETYMOLOGY.** — Named after the Latin word *vulgaris* = common.

**DIAGNOSIS.** — *Chimarra vulgaris* n. sp. is a close relative of *C. antsymeloka* n. sp. The two lateral rods of the phallotheca are smaller than in the continental species; they are thick with a wrinkled appearance in *C. antsymeloka* n. sp., thinner and spine-shaped in *C. vulgaris* n. sp. The lateral-dorsal lobes of the tergum X are similar, with an acute extremity in *C. antsymeloka* n. sp., a truncate one in *C. vulgaris* n. sp.

**DESCRIPTION.**

Size: forewing 4.8 mm, hindwing 3.9 mm. Preanal appendages small, setose, wine-skin-shaped. Inferior appendages almost quadrangular in lateral view; dorsal branch strong, wide, with an acute apex, when dorsally viewed, as long as the width of the appendage; internal process fold-shaped,
inserted just below the dorsal branch. Latero-dorsal lobe of tergum X strong, curved outward, with truncate apex; boomerang-shaped when viewed dorsally. Latero-ventral lobe of tergum X sheet like, long, wide with rounded extremity. Lateral rods of phallotheca short, slightly curved ventrad. Endothecal spine present small, straight. Phallotrema sclerite large; trident-shaped when viewed dorsally, with two symmetric latero-dorsal branches and one, slightly shorter centro-ventral branch.

GEOGRAPHIC DATA

As they were captured during aquatic environment monitoring, informations on the distributions of these species and on the ecological conditions in which they occur are more abundant than the usual knowledge on the African species. These informations are exposed and discussed below.

WEST AFRICA

Described in 1907, *C. minima* is still the smallest species; the other species of the region, described later, are all larger. It is also the most widely distributed (Fig. 9). First recorded from Togo, it is common in the savannahs from the Senegal River (in the Malian part of the watershed) to the Logone River. In Guinea, it is present further upstream on the Niger and Sassandra River than the other savannah species (*C. sassandrae* and *C. callasae*). In Ivory Coast, it occurs in the North of the Sassandra and the Comoé watersheds. But, in the centre of the country, it is present on almost all the Bandama basin, from the northern tributaries around Korhogo to the region of Tiassalé, not very far from the coastal lagoons. This is probably a consequence of the lower rainfall in this area, known as the “V Baoulé” (Gibon 1985). In Togo, it occurs on all the Mono watershed and is very abundant on the Kara River. In Burkina Faso, it occurs at least on the Nazinon (region of Po) and on the headwaters of the Comoé. It is generally the most abundant species in the transition zones between the forest and the savannah, but is absent from the evergreen forest. Its presence on the headwaters of some coastal basins (Kolenté, Konkoué and Little Scarics) can be interpreted as an effect of the deforestation that has occurred in these regions. From this ecological point of view, the most atypical capture of this species took place on the Cavally at Lieupleu (Côte d’Ivoire, 3.ii.1988), an assumed consequence of land clearing and intensive cultivation of cacao. The colonization of this area of the Cavally river basin by savannah species, for example *Leptocerus clavatus* Kimmins, 1961 for example has already been reported (Gibon 1992).

Also recorded from the Senegal to the Logone River basins, *Chimarra sassandrae* appears to be more confined to dry regions than *C. minima* (Fig. 10). On the Bandama River basin, we had noticed that it was more abundant than *C. minima* on the small northern tributaries, but scarcer in the forest/savannah transition area around Yamousoukro and Tiassalé (Gibon & Statzner 1985). On the Niger and Senegal River basins, it is common in the lowland areas, but, upstream, it does not reach the Ridge Loma/Man, or the Fouta-Djalon. In Togo, it occurs on all the Mono River watershed, on the Sio (region of Kati) and on some northern tributaries of the Volta. In Burkina Faso, it has been reported from the Leraba River along the boundary with Ivory Coast.
Chimarra callasae is a typical savannah species, widely distributed on the Niger and Senegal River basins (Fig. 11). It is also present, but scarce, in the upper reaches of some coastal streams (Kolenté, Rio Corubal, Little Scarcies) and in Sierra-Leone (Seli River at Katik). Chimarra callasae has never been captured on the Bandama, Comoé, Sassandra, Mono, Volta or Comoé river basins. Its abundance and its frequency are such that, if present, it could hardly have been missed by Gibbs (1973) during his study of the Trichoptera of Ghana or by Guenda (1986) during his study of the Nasinon (Volta basin). The eastern limit of its known distribution is the River Bagoué (Niger basin), while C. minima and C. sassandrae, which coexist with C. callasae throughout most of its range, reach the basin of Lake Tchad and are probably present further east. These
differences are probably not due to ecological factors but to historical ones. They imply that, at least for some species, the limits between hydrographical basins are not easily crossed.

*Chimarra prodhoni* has been found from Guinea to Cameroon. In Guinea, its distribution includes the Fouta Djalon and the Guinean Ridge (Fig. 12). In Ivory Coast and Togo, *C. prodhoni* is representative of two distinct ecological situations. The first is the typical savannah/forest transition. A good example is the Bandama River, south of Tiassalé, flowing from the savannahs of northern Ivory Coast (mean annual rainfall below 1,200 mm) to the coastal forests (mean annual rainfall above 1,600 mm), *C. prodhoni* is there a potamic species. The second ecological situation is composed of savannah areas, which are more elevated than the surrounding areas. Their vegetation is favoured by increased rainfall and protected by steep slopes, rocky lands or religious beliefs. They constitute small wooded islands. The springs give birth to small brooks, which are clearer and cooler than the streams of the region. The induced faunistic changes are often important. The Plateau of Banfora (region of Bobo-Dioulasso, Burkina Faso), with the headwaters of the Black Volta and those of the Comoé is a good example of these refuges (Gibon *et al.* 1994). Here, *C. prodhoni* is a rhytrophic species: present near springs, it quickly disappears downstream in the true Sudanese savannahs. Quillévére (1979) observed similar distribution patterns for *Simulium squamosum*, which is a forest species, but “frequently found in relatively humid, shady savannah areas (such as Bobo-Dioulasso, Natitingou, Lama-Kara)”. The distribution of *C. prodhoni* on the Mono River basin is restricted to the headwaters. This is the inverse of its distribution on the Bandama River basin. At this inversion, corresponds the inversion of the rainfalls distribution (Fig. 13). On the Mono, the pluviometry is higher in the North (headwaters area), this is an exception in this area where it is higher in the South, near the Gulf of Guinea (L’Hôte & Mahé 1996). So, the distribution of this species appears more dependent on climate-induced hydrological conditions, than on the longitudinal axis of the stream.

The distribution of *C. toubaensis* is centred on the Guinean Ridge, but does not reach the highest sites (Fig. 11). Like *C. prodhoni*, *C. toubaensis* is a species of secondary or disturbed forest in the savannah/forest transition zone, but, unlike this latter, it has never been captured in the refuge areas.

The third species of the savannah/forest transition areas, *C. loffae* n. sp. is found at slightly higher altitudes than the other species, which may explain its more restricted distribu-
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It was captured on the Upper Cavally, the Saint-Paul, the Moa and the Loff a rivers, i.e. a large part of the south-western slopes of the Guinean Ridge and the most humid area (Fig. 12).

Chimarra intexta was described from Sierra-Leone and reported as a forest species from Ivory Coast (Gibon 1985). It is common in the Cavally River basin where it colonizes small tributaries in the primary forest as well as the main river channel. It is also found on the Bandama, south of Tiassalé, and on the Agneby in secondary or disturbed forest areas. Its presence on the small, coastal basins of Guinea, particularly the Rio Corubal, the Konkouré, and the Kolenté is interesting to note (Fig. 10).

Chimarra intexta remains in these regions even though severe vegetation changes resulting from human activity have occurred. The mean annual rainfall, however, is over two metres and despite widespread deforestation, the cultivated and secondary vegetation remain dense. This is confirmed by the presence of C. prodhoni and C. toubaensis, which are characteristic of such situations. However, the sympatric occurrence of C. intexta with C. callasae, a typical sahelian species, on the Upper Kolenté, is more surprising; in this case, the species richness is due to the global environmental disturbance of the basin.

CAMEROON

Four species of Chimarra are described from Cameroon: C. camerunensis Marlier, 1980, C. cara Mosely, 1936, C. fallax Ulmer, 1912 and C. leia Mosely, 1936. They all belong to other species-groups. However, a few environmental studies conducted in 1989 have allowed the discovery of seven species of the C. minima group in Cameroon, including two new species described above (Figs 14; 15). Chimarra sassaendrae is the only species reported from the north of the country (Mayo Boki and Mayo Ilou). It is also present on the North Vina River, on the northern edge of the Adamaoua, where we also encountered C. minima (near Vogzom and Touboro). The geographical distribution of these two savannah species extends from Senegal to north Cameroon and probably more eastward. Chimarra sanagae n. sp. is the only species reported from the south western forests and particularly from the lower reaches of the Sanaga River. The four remaining species were captured in the centre of the country, around Yaoundé. A gently undulating region covered by a mosaic of cultivated land, plantations and secondary forests, whose climate and landscape recall the Guinean Ridge. The presence of C. prodhoni on the Assamba River (tributary of the Sanaga), and that of C. loffae n. sp.
on the Noun and on the Sanaga (Nachtigal falls) confirm the ecological requirements of these species. *Chimarra assambae* n. sp. is only known from the type locality on the Assamba and *C. ambaja* described from Congo was captured on the Sanaga.

**MADAGASCAR**

*Chimarra vulgaris* n. sp. is present throughout the island, below one thousand meters a.s.l. and outside forest and heavily wooded areas, on both large rivers and small streams (Fig. 16). It is scarce near the western coast. In this region, watercourses...
are slow or heavily loaded with sediments, frequently intermittent and generally unfavourable to rheophilic insects. *Chimarra antsymeloka* n. sp. has an ecological profile and a distribution map very similar to those of *C. vulgaris* n. sp. *Chimarra antsymeloka* n. sp. is more common on the eastern watersheds (two thirds of the capture sites) than on the western ones (one third of the sites) (Fig. 16). The ratio is reverse for *C. vulgaris*, more frequent on the western watersheds. Climatic contrast between these two regions (Chaperon et al. 1993) explains this difference and indicates that *C. vulgaris* n. sp. might be better adapted to aridity.

**CONCLUSION**

There are still many species of Philopotamidae to be discovered in western Africa, particularly at higher elevations and in evergreen primary forests. The results of Kjaerandsen (2005) indicate that they offer higher diversity and richness than lowlands and savannahs. The information available today indicates that this mountain fauna belongs to other lineages than the *C. minima* species-group (for example *C. philipponi* Gibon, 1986, *C. dioni* Gibon, 1986 and *C. beylaenensis* Gibon, 1986 in Guinea; *C. divergena* Gibbs, 1973 and *C. bipinosa* Gibbs, 1973 in Ghana; *C. togoana* Ulmer, 1907 in Togo, *C. leta* and *C. cara* in Cameroon). The *C. minima* group is particularly diverse in the forest transitions. It includes the only species of *Chimarra* commonly present in the Sahel (outside refuges and springs areas). In Madagascar, the group is absent from the forests and from the transition areas. These lower taxonomic and ecological diversities could result from a colonization from Africa to Madagascar.

**Acknowledgements**

I am grateful to Dr W. Mey, for their welcome in the MNHN and in Berlin. I am grateful to all the participants in the program Biodiversity and Biotypology of the Malagasy continental waters. Dr J. Schorschter considerably improved a first English version of this work. I thank also two anonymous referees for their remarks and comments.

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Submitted on 16 October 2014; accepted on 14 January 2015 published on 26 June 2015.