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Taxonomic studies on African Gomphidae (Odonata, Anisoptera) 2. A revision of the genus *Neurogomphus* KARSCH, with the description of some larvae

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Abstract

A revision of the genus *Neurogomphus* is presented. Seventeen species and two distinct subspecies are recognised, i.e. *N. fuscifrons* KARSCH, 1890, *N. agilis* (MARTIN, 1908), *N. martininus* (LACROIX, 1921), *N. uelensis* SCHOUTEDEN, 1934, *N. vicinus* SCHOUTEDEN, 1934, *N. wittei* SCHOUTEDEN, 1934, *N. chapini* (KLOTS, 1944), *N. featheri* PINHEY, 1967, *N. pallidus* CAMMAERTS, 1967, *N. pinheyi* CAMMAERTS, 1968, *N. angustisigna* PINHEY, 1971, *N. alius* sp. n., *N. paenuelensis* sp. n., *N. cocytius* sp. n., *N. zambeziensis* sp. n., *N. carlcooki* sp. n., *N. chapini lamtoensis* subsp. n., *N. dissimilis* sp. n. and *N. dissimilis malawiensis* subsp. n. The genus is divided into two subgenera, of which *Mastigogomphus* (type-species: *Oxygomphus chapini* KLOTS, 1944) is new. Of the former described species, all but one (*Karschiogomphus ghesquierei* SCHOUTEDEN, 1934) remain valid, but their names were often erroneously applied to unrelated taxa. Synonymy lists give evidence of this great amount of confusion. Nevertheless, the accurate status of five of the taxa here recognised as well as of some females (*N. sp. cf zambeziensis* from Tanzania and *sp. indet. A, B, C, D*) awaits further collecting of material. Generic larval characters are specified for the first time and the larvae of some species are described, among others that of *N. alius* as well as the supposed larvae of *N. cocytius*, *N. zambeziensis* and *N. featheri*. Information about the biology of the larvae is reviewed.

Key words: *Neurogomphus*, *Mastigogomphus* subgen. n., revision, taxonomy, larvae.

Introduction

The difficulties of the *Neurogomphus* species taxonomy

Of all African gomphid genera, the taxonomy of the genus *Neurogomphus* KARSCH, 1890 is, from the author's experience, by far the most difficult. Progress in this field has mainly been hampered by two factors, the most important one being the fact that some of the species had been described insufficiently or incorrectly.

The greatest problem concerns the identity of *N. vicinus* SCHOUTEDEN, 1934. This taxon is based on an immature (i.e. with colour pattern hardly visible) and partly damaged holotype. Due to real difficulties in characterising this specimen, the name *N. vicinus* was ultimately attributed to two other taxa. In the absence of material that could be related with certainty to this barely useful holotype, I consider it wise to maintain *N. vicinus* as a particular species, distinct from the others due to its high wing index and details of its anal appendages. It is also on the basis of the wing index that SCHOUTEDEN (1934a) established it as a distinct species. According to the present state of our knowledge, it should not be confounded with taxa which are satisfactorily characterised on the basis of well preserved material.

The identities of *N. agilis* (MARTIN, 1908), *N. uelensis* SCHOUTEDEN, 1934 and *N. wittei* SCHOUTEDEN, 1934 were also misunderstood, simply because their holotypes had never been adequately described. This explains the fact that the name *N. wittei* was given to at least three different species, the name *N. uelensis* to four and that of *N. agilis* to five different species. Another taxon, *N. martininus* (LACROIX, 1921), remained also an enigma since its unsatisfactory original description, because the holotype was thought to have been taken to Chile by the odonatologist René MARTIN and consequently lost out of sight (cf LACROIX's correspondence in FRASER, 1936 and my personal inquiry to the late Luis E. PEÑA of Santiago de Chile). Meanwhile, FRASER (1949a: 130) and later on, PINHEY (1967: 68) in a more formal manner, expressed the opinion that *N. ghesquierei* (SCHOUTEDEN, 1934) should be a synonym of *N. martininus*. Thanks to Jean LEGRAND, however, the holotype of *N. martininus* was recovered again in the Paris Museum collection, which enables me to recognise the validity of the latter synonymy.

A second source of difficulty is that most species are similar to each other, morphological differences between *Neurogomphus* species often being slight, while intraspecific variability is far from negligible. This became obvious when, for four of the species, series of specimens from single populations became available. The drawings in the present paper clearly demonstrate this. Moreover, many taxa of the genus *Neurogomphus* are only known from single specimens or from a few individuals caught hundreds or thousands of kilometers apart. Geographic distance and intraspecific variability may thus account for the relatively large differences that are found between individuals considered to be the same species. This suggests the risk of creating new taxa on the basis of isolated individuals while the discriminating criteria are not absolutely certain and clines may exist. However, with the present state of

knowledge of the genus *Neurogomphus*, the taxonomic approach can merely be typological. I thus consider it useful to create or conserve taxa after single, although distinctive, specimens if there are honest reasons for considering that they cannot be merely confused with other taxa. Indeed, rather than considering without satisfying proof that the differences are not significant, giving a distinct taxonomic status to what I suspect to be distinct species or subspecies may attract the attention of researchers. This pragmatic approach may be an incentive for further research. Taxa based on single specimens for which further inquiry is required are: *N. vicinus* SCHOUTEDEN, 1934, *N. paenuelensis* sp. n., *N. carlcooki* sp. n., *N. chapini lamtöensis* subsp. n. and N. *dissimilis malawiensis* subsp. n.

Specimen scarcity remains a characteristic of the genus. It is such that FRASER (1949b), after having published the first review of the genus, which he based on the only thirteen specimens known to him, especially wrote an additional short paper when he became aware of the existence of a fourteenth specimen. Up to this day, I estimate that some 134 imagines have been collected, which I examined (I include in this category a male located in Madrid Museum and kindly studied for me by Klaas-Douwe DIJKSTRA), except for about eight. Those I have not seen are two big females reported as *N. fuscifrons* at a time when probably every large *Neurogomphus* would have received this name. One of them is a female described from Ivory Coast by FRASER (1947) and about which one there's no further information, even in FRASER's review (1949a) and which I failed to locate in collections. It might be that it pertains to another genus. The other is from Congo-Kinshasa and FRASER (1949a) believed that this female described by LE ROI (1915) was located in the Koenigsberg Museum (now Kaliningrad, Russia), which implies that it may have been lost due to war circumstances. There are also two or three specimens reported as *N. featheri*. A male caught in Gambia by Norman M. MOORE in 1948 was lost before any serious identification attempt could be made. It has been doubtfully identified by GAMBLES *et al.* (1995). A female, also from Gambia, collected during a Lund University expedition and identified (*in litteris*), with some doubt, as *N. featheri* by the late Robert M. GAMBLES is also lost. A specimen from Ghana appears to have suffered the same fate as well and information on its existence is more peculiar. This specimen was identified as *N. featheri* by R.M. GAMBLES (verbal communication, 1979) who informed me that he could not enable me to study it, because it was sent to him by a friend and returned. I never heard anymore about it. Finally, the existence of a *Neurogomphus* male collected by V.G.L. VAN SOMEREN, possibly in Uganda, was reported under the name *N. chapini* by PINHEY (1961b), but neither this author nor I have seen it. It is still mentioned as coming from Uganda in CLAUSNITZER's (2001: 58) list of East African Odonata, but under the name *N. pinheyi*, however without justification. Moreover, at least three specimens mentioned from Victoria Falls by PINHEY (1984) could not be found again. They appear to pertain to my new species *N. cocytius* and *N. zambeziensis*, but one of them is likely to be a larva.

(Note: based upon notes made at the time, it was discovered that a female,

which N.W. MOORE had taken together with the male from 1948 and which he had formerly identified (*in litteris*) as *Oxygomphus agilis*, was a *Gomphidia* species. This information, kindly communicated to me by the late Evelyn D.V. PRENDERGAST is quoted from R. M. GAMBLES' unpublished notes (see also GAMBLES *et al.*, 1998).)

The colour pattern, especially that of face and thorax, appears to be a very important species discriminating character. Preserved female specimens often have a body which is badly black or brown stained by post-mortem decay. The rarity of collected material is such that single dark stained females may be impossible to identify with certainty. This was the case of a large female caught in the 19th century at the Stanley Falls (now Boyoma Falls, upstream Kisangani, Congo-Kinshasa) which is located in the Brussels Natural History Museum and bears the identification label '*Phyllogomphus aethiops*' by E. DE SELYS-LONGCHAMPS. CAMMAERTS (1968) correctly identified it as a *Neurogomphus*, but its specific identity remained an enigma until I was able to compare its morphology with the newly accessible female holotype of *Neurogomphus martininus*. Other dark stained single females may or seem to pertain to new species, but should not be named until better, well-preserved, material is discovered, preferably females captured together with males, for the latter bear more distinctive characters. However, it may be worthwhile to describe such females in a revisionary work without naming them, in order to draw attention to the important range of the intrageneric diversity.

The synonymy presented under the heading of each of the here recognised species testifies of the former degree of confusion of the genus contents.

I have to mention two other sources of difficulties, which, however, did not lead to name changes.

A disconcerting situation may arise due to the fact that, especially when they are slender and long, the posterior hamules of the male secondary genitalia may be positioned differently, i.e. they may either stand up, erect almost at a right angle with the abdomen, rest closely apposed along the second abdominal segment or remain in an intermediate position. For this reason, even a skilled odonatologist such as R.M. GAMBLES (personal communication) had doubts concerning the identity of the male he had found in Nigeria with the holotype of *N. featheri*, from Kenya, from which he saw PINHEY's (1967) drawings. An even greater difference in the hamules position is to be seen when comparing the holotype and the paratype of *N. pinheyi*, although both have been found together in the same locality and at the same time (compare Fig. 10 in CAMMAERTS, 1968 with Fig. 44f in the present paper).

An additional and more dramatic source of confusion may be due to dimorphism in some females of the genus *Phyllogomphus*, which have an apparent resemblance to some *Neurogomphus*. Thus, PINHEY (1958: 108; 1961a: 48 and Pl. 2, Fig. a; 1962b: 179 and Pl. VI, Fig. 1) first attributed to *Neurogomphus fuscifrons* a Zambezi female morph of a *Phyllogomphus* with unusually narrow foliations, which he later (PINHEY, 1967: 66) considered to be an aberrant *Phyllogomphus schoutedeni* FRASER, 1957 and ultimately (PINHEY, 1976: 555-558), when males were discovered, recognised as a new

Phyllogomphus species, which he named *P. brunneus*. Formerly (PINHEY, 1961b: 71) he also identified another *Phyllogomphus* female from Uganda as a *Neurogomphus fuscifrons*, just as he did for the Zambezi female. This species, however, is probably *P. orientalis* FRASER, 1957. Nevertheless, it is still mentioned as *N. fuscifrons* in CLAUSNITZER's (2001: 57) list of East African Odonata.

Problems of geographic location

A female specimen in Paris Museum reported as the allotype of *N. agilis* (MARTIN, 1908) is said to come from Abyssinia (in PINHEY, 1962b, 1967). It is in fact labelled 'Assinie', which is a coastal locality situated at the mouth of Lake Abi (Lagune Abi) in the Guinea Gulf. Lake Abi itself is supplied with water by the River Bia, in ancient times called River Assinie. According to its label, this insect thus originates from the eastern coastal part of Ivory Coast. It does not appear to pertain to *N. agilis*, but to another, still unidentified species (see 'Results').

The larvae and the scarcity of adults

The scarcity of *Neurogomphus* adults is only apparent, because larvae sometimes have been found locally in fair numbers. They appear to favour running waters, even small streams, but some of them are known from standing waters. These larvae were discovered a long time ago, although they were not recognised as pertaining to the genus *Neurogomphus*. Their morphology and our knowledge of their biology are presented in the second section of the 'Results'.

A river preference would explain the apparent scarcity of adults. River dragonflies can be notoriously difficult to find at the riverside because the expanse of their habitat. Imagines may be only caught occasionally and randomly in places where they mature, sometimes at a fair distance from the riverbank, thus outside the usual collecting places of most odonatologists.

Material and methods

Location of material

The examined materials are located in the following collections, designated, when necessary, by their acronyms: AMNH: American Museum of Natural History (New York); author's collection; Allen BARLOW's private collection (Budd Lake, NJ, USA); BMNH: British Museum, Natural History (London, UK); Gianmaria CARCHINI's private collection (University of Roma, Italy); Carl COOK's private collection (Center, Kentuky, USA); Thomas.W. DONNELLY's private collection (Binghamton, NY, USA); IRSNB: Institut royal des Sciences naturelles (Brussels, Belgium); MCSN: Museo Civico di Storia Naturale (Genoa, Italy); MNHUB: Museum für Naturkunde der Humboldt-Universiteit (Berlin, Germany); MNHN: Museum National d'Histoire Naturelle (Paris, France); MRAC: Musée royal de l'Afrique Centrale (Tervuren, Belgium); MNCN: Museo Nacional de Ciencias Naturales (Madrid, Spain); NMB:

National Museum (Bulawayo, Zimbabwe); NMN: National Museum (Nairobi, Kenya); NMS: National Museum of Scotland (Edinburgh, UK); NNM: Nationaal Natuurhistorisches Museum (Leiden, The Netherlands); Michael PARR's private collection (Stembridge, Martock, Somerset, UK); Michael SAMWAYS's private collection (University of Natal, RSA); TM: Transvaal Museum (Pretoria, RSA).

For practical purposes, Congo-Kinshasa stands for the present République démocratique du Congo, formerly Zaïre, to be distinguished from Congo-Brazzaville, which is the present République du Congo, formerly known as 'Moyen Congo' or République populaire du Congo. The regions corresponding to localities in Congo-Kinshasa do not correspond to administrative provinces, but to 'natural' regions as defined in the vertebrate collections database used by the Tervuren Museum (MRAC, Dr Danny MEIRTE). The orthograph of the Kelle and Mekoum Forests (Congo-Brazzaville) is that given in PINHEY (1962a, 1967), but they should actually be spelt Kéllé and Mékoum.

Descriptions and measurements applied to imagines

Occipital plate.- Its relative dimensions are taken when the plate is seen in a flat position. Its width is taken at mid-height. Its height is the maximum length, when the posterior ridge is convex, the median notch not being taken into account when it is present. The length is the minimum one when the posterior ridge is concave. Although it is always measured in a flat position, the plate may occasionally be drawn from a frontal position.

Synthorax.- The terminology of the structural parts and colour pattern is indicated in Fig. 1. Structural parts are named after COWLEY (1941), with some exceptions. Thus, *spiracular dorsum* (SNODGRASS, 1909; CHAO, 1953, 1990; WATSON, 1991) is used instead of mesinterepisternum because it is not only the anterodorsal part of the fused anepisterna, but a complex structure formed by the anterior slope of the collar ridge and what is thought to be an acrotergite (MATSUDA, 1970; 1979). The term *interalar sclerite* (ASAHINA, 1954) is preferred to posterior alar process because wing processes are dorsally protruding structures lying at the top of the mesopleural and metapleural sutures, which articulate with the base of the corresponding wings (ASAHINA, 1954; TANNERT, 1958). This is not the case for the interalar sclerites and for a homologous mesepisternal structure, the *antealar sinus*, both being simple pleural sclerifications. For a similar reason, the term interalar sclerite is be preferred to metaparapteron (parapteron is another name given by COWLEY, 1941 for the antealar sinus). Indeed, paraptera are sclerites with attached wing muscles, which is not the case for the antealar sinus and interalar sclerites.

Because of the taxonomic purpose of the colour pattern description, the commonly accepted term 'humeral suture' has advantages over the morphological term 'mesopleural suture', the humeral position being easily visible and memorisable.

To avoid confusion due to contradictions between the nomenclature of the colour pattern as used by different authors (e.g. between CHAO, 1990 and WATSON, 1991), the nomenclature adopted here follows from discussions with Viola CLAUSNITZER and Klaas-Douwe DIJKSTRA. The dark stripes on mesepisternum are named after the structure they are on (e.g. mesepisternal and humeral stripes) or are next to (e.g. middorsal stripes) and the pale stripes are named relative to the dark ones. In most

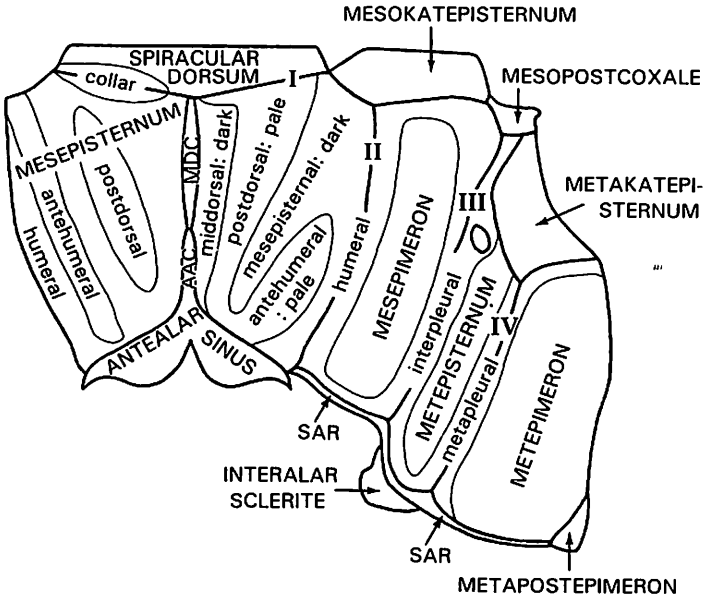

Fig. 1. Nomenclature used for the colour pattern of synthorax. Names of main stripes and spots are in small letters; sclerites are in capitals. (I) collar ridge; (II) mesopleural or humeral suture; (III) interpleural suture; (IV) metapleural suture; (PAC) prealar crest; (MDC) middorsal carina; (SAR) subalar ridge. The middorsal, postdorsal, mesepisternal and antehumeral stripes are of a fixed colour (pale or dark), as indicated. The mesopleural suture usually bears a humeral dark stripe, but in some Gomphid species a more complicated pattern may occur, such as a pale stripe running on the suture, between two narrow dark stripes (e.g. in *N. pallidus*). Mesepimeron, metepisternum and metepimeron may respectively bear a mesepimeral, a metepisternal and a metepimeral pale stripe if these stripes are distinctly narrower than the sclerite on which they are situated.

gomphids the humeral stripe is a dark one, but in some species a complicated humeral pattern may occur, such as a pale stripe running on the humeral suture, between two narrow dark stripes. (e.g. in *Neurogomphus pallidus* and *N. featheri*). In this case, the complex humeral pattern is described without trying to give a formal name to its distinct parts. A dark stripe may run on the interpleural and metapleural sutures and its name is then defined by the suture on which it is found. Mesepimeron, metepisternum and metepimeron are usually largely pale in *Neurogomphus*. It is only useful to name a pale stripe on them if, lying between wide dark sutural stripes, it is distinct enough by its narrowness (e.g. in *N. martininus*). The colour pattern is described in plural when paired spots or stripes are described as seen in dorsal view and in singular when seen in lateral view.

Wing venation (Figs 2 and 3).- Considering that the terminology of the Odonata wing venation is still contentious, NEEDHAM's (1903) ontogenetic system based on the larval tracheation is not used, nor that of RIEK & KUKALOVA-PECK (1984), which is based on a recent interpretation of early odonatoid fossils of Namurian age. For

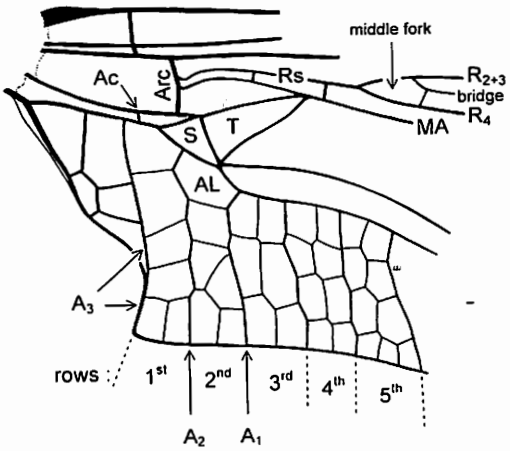

Fig. 2. Marks enabling to characterise the starting level of the third and fourth longitudinal rows of cells in the radial field relative to the pterostigma (pt) hind border (right fore wing of *Neurogomphus vicinus* holotype). Numbering of rows according to their order of occurrence from pectinate common origin of R_2 and R_3. The anterior border of third row of cells is often outlined by the convex IR_2 vein. The fourth row of cells lies between the second and third rows. In this example, the third row (hatched lines) is made up of 12 cells and begins at position –2, *i.e.* 2 cells before the proximal border of the pterostigma. The fourth row (stippled) has 10 cells and begins at position b. The distal margin of radial field has 10 cells and the number of cells lying under pterostigma is 4.6. Further explanation in 'Material and methods'.

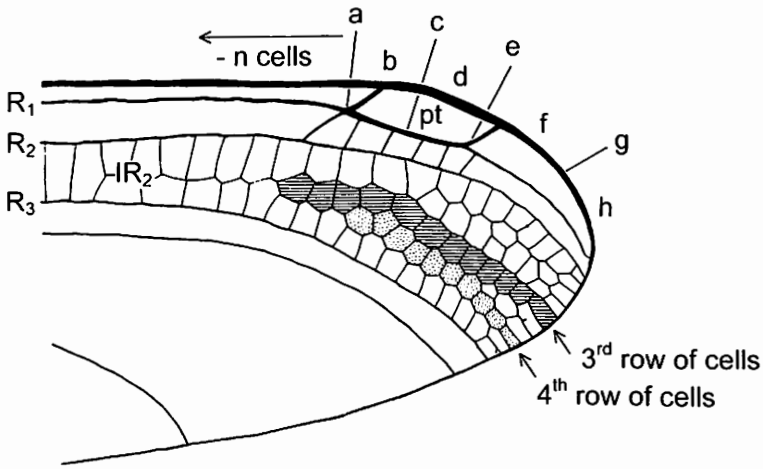

Fig. 3. Hind wing base of *Neurogomphus* male (transposed left hind wing of *N. pallidus* holotype) showing, among other features, the anal field. Thick anal veins delimit parallel transverse rows of cells. The anal field formula express the number of cells in each of these rows (they are separated by a slash) as well as in sub-rows (they are then separated by a comma). In this example, the anal field formula is, from the first till the fifth row: 5, 5 / 4, 5 / 3, 3 / 4, 4 / 4, 4. A_1, A_2, A_3: main anal veins; Ac: anal crossing; AL: anal loop; Arc: arculus; MA: anterior median vein; S: subtriangle; T: triangle; Rs: radial sector or superior sector of arculus; R_{2+3}, R_4: branches of radial sector.

practical reasons, the most widely followed TILLYARD-FRASER modified veinal system (WATSON & O'FARRELL, 1991) is used. The detailed terminology of NEEDHAM & WESTFALL (1955) is used to describe the anal field.

Pterostigma length is measured at mid-height, from proximal to distal border. The number of cells under the pterostigma (Fig. 2) are counted starting from the cell lying under the proximal border of pterostigma (i.e. the brace vein of stigma) to the fraction of the cell lying under the distal border. If we omit the fractional part it indicates the number of cross-veins situated under the pterostigma, excluding the brace vein, but including the vein which may be located under the pterostigma distal border.

Starting level of third and fourth rows of cells in the radial field: Fig. 2. These rows are easy to recognize because they are often straighter than rows that start more distally. The position of the first cell of these rows, relative to the pterostigma (pt) posterior border, is annotated as follows: (-n) = row begins at a distance of n cells before proximal border; (a) = at the level of proximal border; (b) = between proximal end and middle of posterior border; (c) = at middle of posterior border; (d) = between middle and distal end of posterior border; (e) = at the level of distal border; (f) = between distal border and midway between distal border and wing tip; (g) = at midway of distal border and wing tip; (h) = between midway and wing tip; (i) = row absent. The positions g, h and i do not apply to *Neurogomphus*, but may apply to other genera.

The number of cross-veins betwen Rs and MA (the sectors of arculus) is the number of these veins before the middle fork (i.e. in the intermedian space of NEEDHAM & WESTFALL, 1955), thus excluding a cross-vein that may be positioned at the extremity of the fork.

The number of bridge veins is the number of cross-veins between R_{2+3} and R_4, excluding the oblique vein.

Extension of discoidal field. This field extends from 2 to 3 rows of cells at a distance of n cells before (= -n) nodal level, at level of nodus (=0) or after it (+n cells).

Anal field formula of male hind wings (Fig. 3). It refers to the number of cells in the anal field to be found in parallel transverse rows delimited by thick veins (the first and second rows correspond to anal interspaces y and x delimited by veins A_3, A_2 and A_1 as defined in NEEDHAM & WESTFALL, 1955: 17). Partitions in the formula indicate the presence of thicker veins, separating the rows. A comma indicates that a row ends by more than one cell, the number of cells in the sub-rows corresponding to the number of cells along the lateral margins of the row. First and second rows lie partly under the sub-triangle, the second row always beginning with the 1-celled anal loop (AL) (a 2-celled anal loop was found in the allotype of *N. fuscifrons*).

Male superior appendages.- They are drawn in lateral view, positioned in such a manner that their extremities are seen coextensive (i.e. in the same view). The ratio of the distance of the lateroventral tooth or elbow compared to the total length of the appendage was measured on such a drawing (e.g. Fig. 9a: LVTD/SATL). A first measurement (SATL) is made of the length of a line drawn from the appendage tip to the most anterior meeting point of the appendage with segment 10. A line (LVTD) is then drawn parallel to SATL and is measured from the lateroventral tooth to the meeting point of the orthogonal projection drawn from the anterior end of SATL. When the very extremity is broken, the total length of appendage is extrapolated from

its contour lines. Measured in this way, the LVTD/SATL ratio may not exactly measure the real position of the lateroventral tooth. It is, however, a convenient comparative parameter, because it can be used on drawings even if they were made before such a parameter was considered, the only requirement being that the drawings are all made in the same manner. Furthermore, the fact that in *Neurogomphus* the superior appendages are non-mobile, fused to segment 10, and that the angle they make with the abdominal segment 10 thus appears to be invariable in an individual, makes such comparison meaningful. Measuring the ratio from a dorsal view is in some cases impossible because the lateroventral tooth or elbow may not be visible dorsally.

Length of abdomen is measured without the anal appendages.

Length of segment 10 is measured relative to the length of segment 9, the measurement being taken at mid-height of segments seen in lateral view.

Length and width of the posterior hamules are noted in lateral view, respectively at mid-width and at mid-height of hamule, not taking into account the end hook. Drawings of the posterior hamules in ventral view are made with the abdomen axis perpendicular to the optical axis.

The terminology of the four main parts of the penis (Figs 12 and 45) follows that of FRASER (1940) and CHAO (1953). The *vesicle* designates only the first segment (V1 of PFAU 1971's excellent study, in whose work, however, the term *vesica seminalis* designates what is commonly known as the penis, i.e. the four segments together). The *stem* (FRASER, 1940) is the second segment (V2 of PFAU, 1971). It is important to note that the *median segment* (CHAO, 1953), or third segment (V3 of PFAU, 1971) can end dorsally (as seen at rest) and rearwards in the shape of an inflated and weakly sclerotized lobe, the prepuce (FRASER, 1940) or *preputial fold* (CHAO, 1953). In the subgenus *Neurogomphus* this fold has the form of an appendix and runs along the fourth segment (the *glans*), till the end of it (Fig. 12). The preputial fold, however, is absent as such in the subgenus *Mastigogomphus* nov. The *glans* (FRASER, 1940) is the distal or fourth segment (V4 of PFAU, 1971), which is also important in identifying a species. It ends as a partly membranous cupule or collaret, bilobed or not. Each lobe can bear a curled *flagellum* (FRASER, 1940). Another sclerite associated with the penis, but distinct from it, is the ligula of PFAU (1971), which retains here its more common name of *penial sheath* (CHAO, 1953: sheath of the penis) (e.g. the left-hand structure in Fig. 10a).

It should be noted that the scale of the different drawings, made with a *camera lucida* mounted on a stereomicroscope may slightly differ due to the fact that the height of the optical system varies with the dimensions of the insect to be drawn. The pilosity of the male anal appendages was often omitted on the drawings because it does not offer distinctive characters.

Descriptive terms applied to larvae

The terminology for the larval developmental stages is that advocated in CORBET (2002), the final stadium being thus noted as F-0. The terminology used for the labium parts is that of CORBET (1953). Abdominal segments are indicated as S1-S10.

Results

I. Taxonomy (imagines)

Tribe Neurogomphini Carle, 1986 (subfamily Gomphinae sensu Carle, 1986)

The definition and relevance of the tribe Neurogomphini is beyond the scope of the present paper. For details on the suprageneric taxonomy of the family the reader will refer to CARLE's work (1986).

Genus *Neurogomphus* KARSCH, 1890

Neurogomphus KARSCH, 1890: 374 (key of genus), 380 (description of genus and type species, *N. fuscifrons* KARSCH, 1890); SELYS-LONGCHAMPS, 1892: 100 (diagnosis); KARSCH, 1899: 170-171 (comparison with the related genus *Phyllogomphus*); FRASER, 1949a: 129-130 (generic characters); PINHEY, 1951: 138 (key to the genus), 146 (genus is said to be not yet recorded from South Africa); PINHEY, 1961b: 69 (brief description of genus); PINHEY, 1962b: 179 (generic characters); PINHEY, 1967: 64 (*idem*); PINHEY, 1969: 166 (comparison of male appendages and female occiput with those of the genus *Notogomphus* HAGEN in SELYS); DAVIES, 1981: 32 (genus listed in catalogue); DAVIES & TOBIN, 1985: 35; (genus listed in catalogue); CARLE, 1986: 297 (genus designed as type-genus of tribe Neurogomphini CARLE, 1986); TSUDA, 1991: 103 (listed in catalogue); BRIDGES, 1994: part I: 3 (mentioned as type-genus of tribe Neurogomphini CARLE), part III: 24 (in catalogue of genus-group names) and part VIII: 47 (in index of genera of species-group names); STEINMANN, 1997: 138-139 (genus mentioned in catalogue); DIJKSTRA, 2003: Table 1 (stresses the urgent need of a revision).

Oxygomphus TILLYARD, 1917: name mentioned in Table opposite p. 282; FRASER, 1936: 139 (mentions the genus as a *nomen nodum* because it has no description and is only mentioned, without reference to a species, in a faunistic list); FRASER, 1949a: 129 (synonymy); PINHEY, 1951: 146 (*idem*); PINHEY, 1962b: 179 (*idem*).

Oxygomphus MARTIN: MS genus name for *O. agilis* MARTIN, a MS species name for a 'Congo' male, which, according to LACROIX (1921: 49), should have appeared in P. WYTSMAN's Genera Insectorum.

Oxygomphus MARTIN, 1921: incorrect attribution of authorship in a synonymy list published by DAVIES (1981: 32).

Oxygomphus LACROIX, 1921: 48-49 (no generic description given nor any mention of it in his description of *O. martininus* sp.n. and in his reference to *Oxygomphus* MARTIN and *O. agilis* MARTIN [MS names]); FRASER, 1936: 140 (first description of the genus; according to J. COWLEY, *in litt.* in FRASER the type species (genotype) is *Notogomphus agilis* MARTIN, 1908. However, FRASER has some doubts about the validity of the type species identity as MARTIN's *N. agilis* was unknown to LACROIX; he therefore emphasises the need for a decision of the International Commission on Nomenclature); FRASER, 1949a: 129 (genus is a synonym of *Neurogomphus* KARSCH); PINHEY, 1962b: 179 (synonymy); PINHEY, 1967: 64 (*Oxygomphus*, although placed in synonymy, is said to be distinct from *Neurogomphus* because of the (wrong) statement that its occipital plate is straight posteriorly; DAVIES & TOBIN, 1985: 35 (synonym of *Neurogomphus*); TSUDA, 1991: 203 (synonymy); BRIDGES, 1994: III: 37 (synonym of *Neurogomphus*, in catalogue of genus-group names) and VIII: 47 (synonym of *Neurogomphus*, in index of genera of species-group names); STEINMANN, 1997: 138 (synonym of *Neurogomphus*).

Table 1. *Neurogomphus* males: measurements of wings and abdomen and range of wing index. (*): no data for MNCN specimen; (**) Kelle male, left and right appendage.

Species	*fuscifrons*	*angustisigna*	*alius*	*martininus*	*uelensis*	*paenuelensis*	*cocytius*	*vicinus*	*wittei*	*zambeziensis*
N° of specimens examined	*3*	*1*	*6*	*1*	*9*	*1*	*16*	*1*	*2*	*11*
Pterostigma length (mm)	3.5 – 3.9 4.2 – 4.5	3.7 – 3.8 4.3	3.3 – 3.5 3.6 – 4.0	3.0 3.2	2.5 – 2.8 2.7 – 3.3	2.5 2.7 – 2.8	2.3 – 3.0 2.3 – 3.2	2.3 – 2.4 2.4 – 2.5	2.5 – 2.7 2.8 – 3.1	2.9 – 3.6 3.2 – 4.1
N° of cells under pterostigma	4.0 – 6.0 5.1 – 6.0	5.0 – 5.8 6.0 – 6.3	3.4 – 6.0 3.6 – 5.0	3.6 – 4.6 4.9 – 5.0	3.4 – 4.8 3.2 – 5.0	4.0 – 4.2 4.0 – 4.6	3.0 – 5.6 3.0 – 4.8	4.6 – 5.0 4.7 – 5.7	3 – 5 4 – 5	3.2 – 4.8 3.3 – 5.0
N° of Ax veins	17 – 21 14 – 16	18 – 19 14 – 15	16 – 20 12 – 14	19 12 – 13	14 – 17 10 – 12	14 – 15 11	12 – 15 8 – 11	17 12 – 13	11 – 14 7 – 10	13 – 16 8 – 11
N° of Px veins	14 – 17 12 – 17	14 – 15 13 – 15	11 – 14 12 – 14	12 – 15 13 – 15	9 – 12 10 – 12	13 – 15 13	8 – 11 7 – 12	13 11 – 12	8 – 14 9 – 10	8 – 11 8 – 12
N° of secondary Pan veins	6 – 7 (*) 7 (*)	6 – 7 7	5 – 7 5 – 6	7 5 – 6	5 – 6 5 – 6	5 5	4 – 6 4 – 5	5 – 6 5	4 – 6 4 – 5	5 – 6 5 – 6
Starting level of 3rd row of cells in radial field	-3 – -1 -3 – -1	-3 -2	-3 – -1 -3 – a	-3 – -2 -2	-1 – b -3 – b	-1 -3 – -2	a – d -1 – d	-3 – -2 -7 – -5	b – c -1 – b	b – c -1 – b
N° of cells in 3rd row of radial field	14 – 17 13 – 16	17 15 – 17	11 – 13 12 – 14	15 13	10 – 13 10 – 15	13 14 – 15	7 – 10 6 – 10	12 – 15 17 – 20	10 9 – 11	8 – 11 8 – 11
Starting level of 4th row of cells in radial field	a – c a – c	b b – c	c – d a – d	a – c b – c	b – d b – c	b b	c – g c – f	b a	c – d b – d	c – e c – f
N° of cells in 4th row of radial field	8 – 14 10 – 13	11 9 – 13	7 – 9 7 – 8	9 – 11 9 – 10	6 – 11 6 – 11	9 9 – 10	3 – 8 4 – 7	9 – 10 11 – 12	7 – 8 6 – 8	5 – 9 4 – 9
N° of cells in distal margin of radial field	10 – 15 11 – 14	12 11 – 14	9 9 – 10	9 9	7 – 11 8 – 12	10 – 11 11 – 12	6 – 9 7 – 10	9 – 10 10	7 7 – 8	6 – 9 6 – 10
N° of cross-veins between Rs and MA, before fork	2 – 3 1	2 1	3 – 4 1 – 2	3 – 4 1 – 2	2 – 3 1	2 – 3 1	2 – 3 1 – 2	3 1	2 – 3 1	2 – 4 1 – 2
N° of bridge veins	8 – 11 6 – 10	9 – 10 7	8 – 12 6 – 9	7 – 8 7 – 8	7 – 10 5 – 8	9 7	7 – 9 5 – 7	10 6 – 7	7 – 9 5 – 7	5 – 8 4 – 7
N° of cells in distal margin of R_4-MA field	3 – 4 2 – 3	3 2 – 3	2 – 3 2 – 3	3 – 4 3	2 – 4 2 – 4	3 – 4 3	2 – 4 2 – 3	4 – 5 3	2 – 3 2 – 3	2 – 4 2 – 3
Extension level of discoidal field	-3 – -1 -7 – -2	-2 – -1 -5 – -3	-2 – 0 -2 – -1	-3 – -2 -3 – -2	-2 – 0 -4 – -2	-4 – -2 -3	-1 – +2 -2 – +2	-2 – 0 -4 – -3	-2 – +3 -3 – -1	-1 – +1 -4 – +2
N° of cells in discoidal field distal margin	12 – 13 13 – 16	14 – 15 15	10 – 12 11 – 13	12 13	9 – 15 12 – 16	11 – 12 14	7 – 10 10 – 12	12 – 13 15	8 – 9 8 – 12	8 – 11 11 – 14
N° of cells in anal triangle	3 (67%) – 4	3	3	4	3 – 4 (67%)	3	3 (89%) – 4	3	3	3 – 4 (82%)
Wing length (mm)	41.5 – 44.3 ~40 – 42.3	40.7 38.3 – 38.6	38.3 – 40.0 36.6 – 40.5	38.4 37.5	33.0 – 33.8 31.0 – 32.6	~34 32	31.0 – 34.3 28.9 – 32.0	33.8 31.7	32.4 28.6 – 31.7	31.0 – 36.9 31.5 – 34.5
Abd. length, without apps	~45 – 49.2	43.5	43.3 – 45.6	~50	40.9 – 43.7	~45	40.8 – 43.8	39 ?	35.4 – 38.5	41.0 – 45.2
Abdomen/fore wing ratio	~1.08 – 1.16	1.07	1.13 – 1.14	~1.30	1.23 – 1.31	~1.32	1.28 – 1.31	1.15 ?	1.09 – 1.19	1.22 – 1.32
Abd. seg 10 / seg 9 ratio	0.77 – 0.80	0.84	0.78 – 0.80	1.00	1.03 – 1.12	1.22	0.72 – 0.94	0.86	0.85 – 0.88	0.82 – 0.90
Position of lateroventral tooth (% sup. app. length)	71 – 72 (*)	80	76 – 77	65	50 – 59 or 67 – 70 (**)	65	61 – 70	73	79 – 84	65 – 72

Table 1 (continued). *Neurogomphus* males: measurements of wings and abdomen and range of wing index. (***) : paratype data only.

Species	*agilis*	*carlcooki*	*featheri*	*pallidus*	*c. chapini*	*c. lamtoensis*	*pinheyi*	*d. dissimilis*	*d. malawiensis*
N° of specimens examined	*2*	*1*	*8*	*6*	*2*	*1*	*2*	*1*	*1*
Pterostigma length (mm)	2.4 – 2.9 2.7 – 3.0	2.6 2.8 – 3.1	2.3 – 2.8 2.6 – 3.0	3.0 – 3.6 3.3 – 3.7	2.6 2.6 – 2.8	2.5 2.7 – 2.8	2.3 (***) 2.7 (***)	2.4 2.7 – 2.8	2.9 3.2
N° of cells under pterostigma	4.2 – 6.0 4.0 – 5.0	4.0 – 4.3 4.6 – 5.0	2.2 – 4.8 3.3 – 5.7	4.0 – 5.6 4.2 – 6.0	3.4 – 4.3 4.0 – 5.6	4.0 4.0 – 4.3	2.8 – 3.0 (***) 3.3 – 4.0	4.0 3.9 – 4.9	4.0 – 4.2 3.7 – 4.0
N° of Ax veins	14 – 17 11 – 12	14 – 16 10	13 – 16 8 – 11	11 – 14 8 – 10	12 – 14 10 – 11	12 – 13 10	13 – 15 9 – 10	12 8 - 9	13 8
N° of Px veins	12 – 13 11	9 9	9 – 11 8 – 10	9 – 12 8 – 11	9 – 10 9 – 10	9 – 10 9	9 – 11 9 – 10	8 7 - 8	9 8 – 10
N° of secondary Pan veins	4 – 6 4 – 6	5 5	5 – 6 4 – 5	5 – 6 5 – 6	5 5	4 – 5 5	5 5	5 4 – 5	5 4 – 5
Staring level of 3rd row of cells in radial field	a – b a – b	b b	b – c a – c	-1 – c -2 – d	b -1 – b	b a	a – b a – b	b a – b	b a – b
N° of cells in 3rd row of radial field	8 – 11 8 – 11	9 – 10 9	7 – 10 7 – 9	10 – 14 8 – 15	9 10 – 13	? 10 – 11	9 – 10 (***) 8 – 11	9 8 – 9	9 9 – 10
Starting level of 4th row of cells in radial field	c c – d	d – e d	c – e c – g	c – e b – d	d c – d	e e	e – d (***) e – f	e c – d	e – f e – f
N° of cells in 4th row of radial field	6 – 7 6 – 7	7 7	5 – 8 4 – 7	6 – 11 6 – 12	5 – 6 6 – 8	? 4 – 5	5 – 7 (***) 4 – 7	6 6 – 7	4 – 5 5 – 6
N° of cells in distal margin of radial field	7 – 8 7 – 8	8 – 10 8 – 9	7 – 10 7 – 10	6 – 10 6 – 11	6 – 9 6 – 9	? 6 – 7	7 – 8 (***) 6 – 7	7 7	6 – 7 6 – 8
N° of cross-veins between Rs and MA, before fork	2 – 3 1	2 1	2 – 3 0 – 1	2 – 3 1 – 2	2 1	2 1	2 – 3 1	2 – 3 1	2 – 3 1
N° of bridge veins	7 – 11 5 – 8	8 5	5 – 8 4 – 6	6 – 9 4 – 7	6 – 8 5 – 7	5 – 7 5	5 – 7 5 – 6	3 – 4 3 – 4	5 3 – 4
N° of cells in distal margin of R_4-MA field	3 2 – 3	3 1 – 2	2 – 4 2 – 3	2 – 4 1 – 3	2 – 3 2 – 3	2 – 3 2 – 3	2 2	2 ?	2 – 3 3
Extension level of discoidal field	-1 – 0 -4 – -2	0 – +1 -1	0 – +2 -2 – +1	-3 – 0 -4 – -2	0 – +1 -2 – -1	0 -2 – -1	-1 – +2 -2 – +2	-1 -2	-1 -3 – -2
N° of cells in discoidal field distal margin	8 – 10 10 – 11	10 13	7 – 10 10 – 12	8 – 11 12 – 15	10 – 11 11 – 13	8 10	8 – 12 10 – 11	10 ?	11 13 – 14
N° of cells in anal triangle	3 – 4 (50%)	3 – 4	3 (56%) – 4	4 (83%) – 5	3 (75%) – 4	3	3	3	4
Wing length (mm)	32.9 – 33.5 30.5 – 30.7	30.1 28.5 – 28.8	28.8 – 30.0 26.5 – 29.8	34.5 – 36.6 32.3 – 34.1	~26 24.9 – 27	? 24.8	27.5 – ? 26.3 – 27.0	26.7 – 27.0 25.3	30.3 28.7
Abd. length, without apps	41.5	38.8	36.2 – 38.7	40.6 – 44.7	26.2 – ?	31	32.7 – 34.8	33.0	35.1
Abdomen/fore wing ratio	1.24	1.29	1.21 – 1.30	1.21 – 1.23	~1	?	1.19 – 1.27	1.24 – 1.22	1.17
Abd. seg. 10 / seg. 9 ratio	1.00 – 1.03	0.93	0.94 – 1.04	0.88 – 1.08	0.90	0.79	0.74 (***)	0.55	0.63
Position of lateroventral tooth (% sup. app. length)	75 – 76	80	61 – 73	44 – 51	68	– or ~73	64 – 65	–	60

Table 2. *Neurogomphus* females: measurements of wings and abdomen and range of wing index.

Species	*fuscifrons*	*alius*	*martininus*	*uelensis* Makokou	*uelensis* Andok Forest	*sp. indet. A* Eala	*cocytius*	*zambeziensis* Zambezi
N° of specimens examined	*1*	*5*	*2*	*2*	*2*	*1*	*15*	*7*
Pterostigma length (mm)	4.0 4.7	3.2 – 4.0 3.6 – 4.6	3.6 – 3.8 3.7 – 4.0	2.8 – 3.1 2.9 – 3.5	3.0 – 3.2 3.4 – 3.5	3.0 3.2 – 3.3	2.8 – 3.3 3.1 – 4.1	3.2 – 4.0 4.1 – 4.5
N° of cells under pterostigma	6.3 – 7.6 6.4 – 7.6	3.8 – 5.8 4.0 – 5.5	4.6 – 5.4 5.0 – 6.0	4.0 – 5.0 3.6 – 5.8	4.0 – 5.6 4.0 – 6.0	5.4 4.6 – 5.0	3.0 – 5.0 3.8 – 5.8	3.6 – 5.4 3.1 – 5.2
N° of Ax veins	21 14	19 – 22 13 – 15	19 – 20 12 – 14	15 – 18 11	14 – 18 10 – 12	17 – 18 11	12 – 16 9 – 11	13 – 16 9 – 11
N° of Px veins	13 – 15 14	13 – 18 14 – 17	12 – 15 13 – 15	11 – 13 11 – 13	11 – 12 10 – 12	14 11	8 – 11 8 – 11	9 – 12 8 – 11
N° of secondary Pan veins	7 7	6 – 7 5 – 7	6 – 7 5 – 6	5 – 6 5	5 – (6) 5	6 5	4 – 6 3 – 6	5 – 7 5
Starting level of 3rd row of cells in radial field	a -3 – -2	-4 – -1 -4 – -2	-6 – -3 -6 – -2	a -3 – -2	a – b a – b	-1 -3 – -1	a – c a – c	a – c -1 – b
N° of cells in 3rd row of radial field	14 – 15 15 – 19	12 – 15 13 – 16	16 – 19+ 15 – 19	13 – 14 14 – 16	11 – 12 11 – 12	14 13 - 16	8 – 11 7 – 12	10 – 11 9 – 11
Starting level of 4th row of cells in radial field	c b – c	a – c a – c	a a – b	b – c b – c	c – d c – d	c c	c – g c – g	c – e b – d
N° of cells in 4th row of radial field	12 – 13 11 – 13	8 – 10 7 – 12	10 – 14 10 – 13	11 9 – 11	7 – 10 7 – 10	9 9	4 – 8 3 – 8	6 – 8 6 – 8
N° of cells in distal margin of radial field	14 13	8 – 11 9 – 11	11 – 12 8 – 10	9 – 11 9 – 10	9 – 11 8 – 10	10 9	6 – 10 6 – 9	7 – 8 8 – 12
N° of cross-veins between Rs and MA, before fork	2 – 3 1	2 – 2 1 – 2	3 – 4 1 – 2	2 – 3 1	3 1	2 1	2 – 3 1 – 2	2 – 3 1
N° of bridge veins	10 – 12 9	8 – 11 6 – 10	9 – 10 6 – 8	9 – 11 7 – 8	7 – 10 6 – 7	7 – 8 6 – 7	6 – 9 4 – 7	6 – 9 5 – 6
N° of cells in distal margin of R_4-MA field	3 – 4 3 – 4	2 – 4 3 – 4	3 – 4 3 – 4	2 – 4 3	2 – 4 2 – 3	3 – 4 2 – 3	2 – 4 2 – 3	2 – 3 2
Extension level of discoidal field	-1 – 0 -2	-2 – +1 -3 – -1	-5 – -2 -5 – -2	-2 – -1 -4 – -2	0 – +1 -4 – -2	-2 – 0 -4 – -3	-1 – +1 -3 – +1	0 – +2 -2 – 0
N° of cells in discoidal field distal margin	13 – 15 15 – 16	13 – 14 12 – 15	12 – 15 14	12 – 13 14	10 13 – 15	13 13 – 14	8 – 11 10 – 13	8 – 10 8 – 13
Wing length (mm)	47.2 44.7	42.7 – 45.7 41.0 – 42.7	43.5 40.3 – 41.0	36.5 – 37.5 35.0 – 36.0	36.0 – 38.0 34.0 – 36.2	36.7 34.0 – 34.4	34.2 – 36.7 32.0 – 34.0	37.7 – 39.5 35.4 – 37.2
Abd. length, without apps	~48.5	45.8 – 51.2	49 – 50	43.2 – 44.6	42.5 – 43.3	~45	41.0 – 44.7	43.0 – 47.7
Abdomen/fore wing ratio	~1.03	1.07 – 1.12	1.14	1.19	1.14 – 1.18	~1.23	1.20 – 1.22	1.14 – 1.21

Table 2 (continued). *Neurogomphus* females: measurements of wings and abdomen and range of wing index. Only partial data for *N. dissimilis*.

Species	cf. *zambeziensis* Tanzania	*sp. indet. B* Kere-Kere	*sp. indet. C* Assinie	*featheri*	*pallidus*	*dissimilis* Bazeley Bridge	*sp. indet. D* Bambesa
N° of specimens examined	*2*	*1*	*1*	*3*	*7*	*1*	*1*
Pterostigma length (mm)	3.5 – 3.6 3.9 – 4.0	2.8 3.0 – 3.2	3.3 3.4	2.7 – 3.1 3.1 – 3.4	3.7 – 4.3 4.0 – 4.5	3.6 3.7	3.1 3.7
N° of cells under pterostigma	4.6 – 6.0 4.5 – 5.0	4.0 – 4.2 4.8 – 6.0	5.3 5.0 – 5.3	3.8 – 5.3 3.9 – 4.9	4.2 – 6.0 4.6 – 6.8		3.6 – 4.0 5.0
N° of Ax veins	13 – 16 10 – 11	12 – 14 9 – 10	15 11	13 – 15 10	13 – 16 8 – 11	14 – 15 10	14 9
N° of Px veins	8 – 11 8 – 11	11 – 12 10 – 12	11 11	9 – 11 9 – 12	9 – 14 10 – 13	10 – 12 11 – 12	10 – 13 9 – 10
N° of secondary Pan veins	5 5	5 – 6 5	5 5	5 5	5 – 6 5 – 6	4 – 5 5	5 5
Starting level of 3rd row of cells in radial field	b – c b – c	b -1 – a	b b – c	a - c b	b -1 – b		b a
N° of cells in 3rd row of radial field	9 – 10 10 – 11	10 10 – 11	10 10 – 11	9 – 11 9 – 11	12 – 16 11 – 17		12 12 – 15
Starting level of 4th row of cells in radial field	d c – d	c c	d c – d	c – d c – d	c – d b – d		d d
N° of cells in 4th row of radial field	8 7 – 10	9 7 – 9	9 7 – 8	7 – 9 6 – 8	9 – 13 9 – 12		7 – 8 7 – 8
N° of cells in distal margin of radial field	8 8 – 10	7 – 8 8	10 9	8 – 10 7 – 10	7 – 11 8 – 11		7 7
N° of cross-veins between Rs and MA, before fork	2 – 3 1	2 1	3 1 – 2	2 1	1 – 3 1 – 2		3 1
N° of bridge veins	8 – 9 6 – 8	8 – 10 6	9 6 – 7	7 – 8 5 – 6	7 – 9 5 – 8		6 – 8 5
N° of cells in distal margin of R_4-MA field	2 – 3 2 – 3	3 3 – 4	3 3	3 – 4 2 – 3	2 – 5 2 – 4		3 2 – 3
Extension level of discoidal field	-2 – -1 -4 – -3	-2 – 0 -3 – -2	0 – +1 -1	-1 – +2 -1 – 0	-5 – -1 -5 – -2		-1 -3
N° of cells in discoidal field distal margin	9 – 12 11 – 12	13 14	11 12	8 – 10 10 – 12	8 – 11 11 – 14		12 16
Wing length (mm)	37.1 – 37.3 35.1 – 35.8	35.5 – 35.8 33.0 – 33.7	35.1 32.8 – 33.0	31.0 – 32.3 29.4 – 30.4	37.7 – 39.9 35.5 – 37.4	32.7 31	32.8 30.8 – 31.4
Abd. length, without apps	43.2 – 45.5	39.2	~41.8	37.8 – 40.2	43.0 – 45.4	36	37.6
Abdomen/fore wing ratio	1.16 – 1.22	1.09 – 1.10	~1.19	1.20 – 1.26	1.11 – 1.17	1.10	1.15

Karschiogomphus SCHOUTEDEN, 1934a: 235 (type species: *Karschiogomphus Ghesquièrei* SCHOUTEDEN, 1934); FRASER, 1946: 201 (genus and species are synonyms of *Oxygomphus* (as *Notogomphus*) *agilis* (MARTIN, 1908), but by reference to the Paris Museum male from 'Congo'); FRASER, 1949a: 129 (genus is a synonym of *Neurogomphus* KARSCH; PINHEY, 1951: 146 (*idem*); PINHEY, 1962b: 179 (synonymy explained); PINHEY, 1967: 64 (synonymy); DAVIES, 1981: 32 (synonym of *Neurogomphus*); BRIDGES & TOBIN, 1985: 35 (*idem*); TSUDA, 1991: 199 (as a synonym of *Neurogomphus*); BRIDGES, 1994: III: 25 (synonym of *Neurogomphus* in catalogue of genus-group names) and VIII: 47 (synonym of *Neurogomphus*, in index of genera of species-group names); STEINMANN, 1997: 138 (as a synonym of *Neurogomphus*).

First revision: FRASER, 1949a and 1949b, which examined 4 out of the 8 holotypes known at his time. The 8 taxa were briefly described, but FRASER thought that there were probably only 4 valid species: *N. fuscifrons*, *N. agilis*, *N. wittei* and *N. chapini*. Second revision: PINHEY, 1967. None of the 8 existing holotypes were examined, although the *N. fuscifrons* male allotype was examined; 7 species were recognised, of which one new. Present revision: all the holotypes were thoroughly studied; 17 species and 2 distinct subspecies are recognised, of which 8 are new. Moreover, additional materials of uncertain identity or in a poorly preserved state are described but not named. This amounts to a total number of 24 described morphological entities.

Diagnosis of genus

Crest of frons rounded. Posteriorly to the ocelli, the head vertex is flanked by a ridge (here called the *postocellar ridge*), without sexual differentiation. Moreover, externally to the lateral ocelli there is a hemispherical narrow ridge, sometimes bearing a small *callus* (a small knob or protuberance which is sometimes spiniform), without sexual differentiation. The function of the postocellar ridge and of the calli lateral to ocelli is unknown.

One basal subcostal cross-vein in all wings (the holotype of *N. ghesquierei* is abnormal in having two of them, which led SCHOUTEDEN (1934a) to establish a particular genus for it, *Karschiogomphus*).

Hind femurs not markedly elongated, reaching at most mid length of abdominal segment 2. They bear normal-sized spines.

Male secondary genitalia with small anterior hamules, erected or directed backwards and concealed between the posterior hamules. Posterior hamules large and, according to the individuals in the same species, variable in position, from erected at almost a right angle with the abdomen to directed anteriorly and apposed along second abdominal segment. Glans of penis ending with a pair of flagella or by a cupule which in some species bears the vestigiae of such a pair.

Abdomen with segments 7-9 clearly wider than 3-6. Segment 8 with narrow or only moderately developed foliations. Segment 9 with very narrow foliations. Segment 10 cylindrical, without a distinct sternal sclerite and without a dorsal crest. In male, basal half of segment 10 is distinctly narrower than distal half, the widening being abrupt. On the contrary, in female (dorsal view), distal half is slightly narrower than proximal half, the transition being less abrupt than in male.

Superior anal appendages of male approximately half the length of segment 10 and as long as or slightly longer than inferior appendage. The superior appendages are non-mobile, being middorsally fused to the tenth abdominal segment; this is most obvious in teneral and immature specimens (such as in the holotype of *N. vicinus*) and in the adult of *N. chapini*.

Vulvar scale not particularly erect, short, bivalved with a distal triangular incision along ventral midline. The scale measures approximately 0.10 - 0.20 times the length of sternite 8. Sternite 9 slightly excavated.

Species-specific characters

Many morphological and colour characters are useful to discriminate between *Neurogomphus* taxa. The most useful concern the colour pattern, especially that of the face and thorax, some particularities of the wing venation, the morphology of male appendages, of female vulvar scale and that of the extremities of the male posterior hamules. The number of wing cross-veins are obviously more or less correlated with wing size. Some wing characters do not allow specific identification of specimens, such as the number of cells in anal triangle and the level of extension of the discoidal field, although their mean value is characteristic. Furthermore, the number of cells in the distal margin of radial field, the number of cross-veins between Rs and MA (before bifurcation), the number of bridge veins and the number of cells in the distal margin of R_4-MA field are in most cases not very useful discriminating characters. The morphology of the penis, especially that of the preputial fold and of the glans, is useful in the subgenus *Mastigogomphus* nov. and, to a lesser degree, in the largest species of the subgenus *Neurogomphus*. It is least useful in the '*agilis*' group of the latter subgenus. The female postoccipital morphology does not appear to be very useful. The calli external to the lateral ocelli are sometimes present, according to the species. The postocellar ridge of some species may facilitate their identification (this character was not systematically exploited in the present work).

Species grouping

Groups of species may be distinguished, two of them at such a degree that they deserve the status of subgenera (subgenera *Neurogomphus* KARSCH, 1890 and *Mastigogomphus*, subgen. n.). The most distinctive characters appear to be the position of the Ac cross-vein, the form of the glans of penis, the span of inferior appendage compared to that of the superiors and the shape of the vulvar scale.

A) subgenus *Neurogomphus* KARSCH, 1890

(type species: *Neurogomphus fuscifrons* KARSCH, 1890)

Male occipital plate less than 3 times wider than high. Species occipital crest convex. Postdorsal pale stripes of elongated form and not isolated from collar ridge. Ac cross-vein distal to or at level with A_3 vein (however, in a

same species, some individuals may present the Ac cross-vein in a slightly proximal position).

In the dark species (*N. pallidus* being thus an exception) the dorsum of abdominal segment 8 bears a conspicuous large pale basal colour spot which clearly contrasts with the darker rest of the abdomen caudal half. (Note: V. CLAUSNITZER informs me that in most other species of different families (usually forest species of the families Gomphidae, Corduliidae and Libellulidae) the body colour is dark with a yellow mark on segment 7).

Glans of penis ending in a small rounded or ovoid cupule, not bearing a pair of obviously well-developed flagella, but at most the very minute vestigiae of such a pair. At rest, the glans do not extend beyond posterior extremity of vesicle. Preputial fold well-developed, running parallel along ventral side of the glans and extending backwards to about glans' end. Span of inferior appendage not markedly bigger than that of superiors (at the most, like that of *N. angustisigna* or that of the *N. fuscifrons* Bipindi male).

Vulvar scale with a posterior 'V'-shaped or semicircular median indentation not extending proximately over half the scale length.

Species of this subgenus are moderate to large sized gomphids: male fore wing *ca* 29 (*N. featheri*) - 44 mm (*N. fuscifrons*) and male abdomen (without appendages) *ca* 35.5 (*N. wittei*) - 50 mm (*N. martininus*).

Inside this subgenus a natural grouping of species is not obvious. A first 'subgroup' may comprise the three largest species (*N. fuscifrons*, *N. angustisigna*, *N. alius*), and is distinguished by their relatively wide male occipital plate, by elongated pterostigmas, high number of antenodal cross-veins and posterior hamules not very elongated.

By its large size, slender posterior hamules and short pterostigmas, *N. martininus* is a species which may form the transition to the next 'subgroup'. *N. pallidus* also might be an intermediate form, due to its short posterior hamules, its wide occipital plate and to its superior appendages similar to that of *N. uelensis*.

The taxa of the second 'subgroup' are *N. uelensis*, *N. paenuelensis*, *N. cocytius*, *N. vicinus*, *N. agilis*, *N. zambeziensis*, *N. wittei*, *N. carlcooki* and *N. featheri*. They constitute what conveniently may be called the '*agilis*' group of species. Here, species are of lesser size, have slender posterior hamules and narrower occipital plates, less than two times wider than high (except in *N. uelensis* females).

B) subgenus *Mastigogomphus*, subgen. n.

(type species: *Oxygomphus chapini* KLOTS, 1944)

Male occipital plate at least 3 times wider than high. Females may even have relatively wider plates. Occipital crest straight or concave. Postdorsal pale stripes well-isolated from collar ridge (as well as from antealar sinus and antehumeral pale stripes) and in the shape of an ovoid-sinuous spot. Ac cross-vein always well proximal to A_3 level.

No large pale colour mark on the dorsum of the first half of abdominal segment 8 (colour pattern unknown in *N. sp. indet. D*).

Glans of penis ending wide, not in the form of a cupule but of a pavilion and bearing two well-developed flagella. At rest, the glans extends well beyond the extremity of the vesicle. Preputial fold not developed. Span of inferior anal appendage markedly bigger than that of superiors.

Vulvar scale with a posterior 'V'-shaped median indentation, wide and deep, extending proximately at least half beyond the scale length.

Species of this subgenus are small to moderate sized gomphids: male fore wing *ca* 26 (*N. chapini*) – 30 mm (*N. dissimilis malawiensis*) and male abdomen *ca* 26 (*N. chapini*) – 35 mm (*N. dissimilis malawiensis*).

This subgenus comprises *N. chapini*, *N. pinheyi*, *N. dissimilis* and an unnamed female from Congo-Kinshasa (*N. sp. indet. D*).

Descriptions and records

1. *Neurogomphus fuscifrons* Karsch, 1890

Neurogomphus fuscifrons KARSCH, 1890: 380 (original description of a female); KARSCH, 1891: 72 (taxon mentioned); SELYS-LONGCHAMPS, 1892: 101 (description, according to KARSCH); KARSCH, 1899: 170-171 (description of male); SCHOUTEDEN, 1934b: 65 (taxon mentioned); FRASER, 1949a: 131 (short description of holotype and allotype; moreover (p. 130), *N. martininus* (LACROIX) and *N. ghesquierei* (SCHOUTEDEN) are considered 'most probably' as synonyms of *N. fuscifrons*); SCHMIDT, 1951: 168, fig. 24 (drawing of right wings of Bipindi male, erroneously considered as being the allotype); PINHEY, 1951: 146 (taxon mentioned); PINHEY 1962b: 179 (bibliography and distribution); PINHEY, 1967: 65-66 (description of male and female); PINHEY, 1971: 962-963 (comparison with *N. angustisigna*); DAVIES, 1981: 32 (taxon mentioned as type-species); DAVIES & TOBIN, 1985: 35 (*idem*); VICK, 1999: 224, 241 (KARSCH's localities mentioned); TSUDA, 1986: 94; 1991: 103 (taxon listed in catalogue); BRIDGES, 1994: VII: 95 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon mentioned in index of species-group names of the genus *Neurogomphus*); STEINMANN, 1997: 139 (taxon mentioned).

Material

Cameroon: Known from two main localities in the primary forest of the South-West Province. 1♀, holotype, from 'Barombi Station', 04°38'N 09°25'E (presently Kumba, on the crater lake known as Barombi Mbo Lake, alt. 400m), P. PREUSS leg. 1♂, allotype, from 'Station am Elephantensee' in the 'Johannes-Albrechts-Höhe' (also Kumba, on the Lake Barombi Mbo), III.1896, L. CONRADT leg. 1♂, Bipindi, 03°05'N 10°25'E, X-XII.1896, L. ZENKER leg. (MNHUB). 1♂, 'Kamerun',1899, L. CONRADT leg., without further details, ex-coll. ESCALERA and labelled '*Neurogomphus (fuscifrons?)*' in an unknown handwriting (MNCN; this specimen, without head, was kindly examined and identified for me by K.D. DIJKSTRA).

Description

The largest of the known *Neurogomphus* species, particularly for its wings. Mostly black in colour.

Male

Dimensions: Table 1.

Head (Fig. 4a).- Mouthparts ochraceous yellow. Genae and sides of mandibles, yellow. Labrum blackish brown, except for a pair of elongated green or yellow spots along upper border. Anteclypeus greenish. Postclypeus and frons black with, on both sides of their common suture, a complex green pattern extending laterally and along crest of frons. Upper part of frons rounded, with a small prominence in front of median ocellus. Antennae black. Vertex black, except for a yellow fringe along anterior border. A small rounded process at external side of lateral ocelli. Postocellar ridge semicircularly shaped and continuous, without marked median prominence. Occiput black and flat. Occipital plate (Figs 5a-b) 2.38 - 2.40 (holotype) times wider than high, the crest uniformly convex (Bipindi) or only slightly lip-shaped (allotype) and without spines but fringed with numerous black hairs.

Prothorax (Fig. 7a: allotype) black with a pair of yellow and clearly distinct adjacent dorsal small spots and two pairs of laterodorsal yellow spots, in addition to an anterior and a posterior dorsal transverse yellowish area. While the MNCN male has the same small green spots, the prothorax of the Bipindi male is entirely rufus.

Synthorax (Fig. 8a) mostly black, with a very characteristic yellow/green pattern. The allotype shows large and complete postdorsal stripes, somewhat 7-shaped, not reaching antealar sinus, but collar ridge, however not extending over black spiracular dorsum. Humeral area completely black. Middorsal carina yellow, as antealar crest. Mesepimeron black except for a trace of a very narrow dark yellowish brown fragmented stripe. A fragmented and narrow dark yellowish brown stripe on metepisternum, extending into upper part of metakatepisternum. Metepimeron mostly black, with a fragmented and slightly distinct dark yellowish brown area in its middle. Metapostepimeron mostly yellowish brown. Antealar sinus, interalar sclerite, mesokatepisternum and mesopostcoxale black. Thoracic sternum black, dark brown along median suture. The sides of the MNCN male are entirely black with only the centres of the sclerites a bit more dark brown and some tiny pale marks under and just above the metastigma. The sides of the Bipindi male show barely visible pale areas, but they are more or less extended as in the holotype female.

Legs entirely black.

Wings.- Venation black. Pterostigma brown, characteristically elongated. A narrow grey membranula at extreme basis of hind wings (Bipindi) or extending till halfway the external border of anal triangle. Anal loop 1-celled (Bipindi) or 2-celled (allotype). Wing index (Table 1) with overall greatest number of cross-veins, evidently correlated with greater size of wings. Anal triangles 3- or 4-celled (allotype). Ac cross-vein lying slightly distal to A_3 vein. Anal field formula: 3-4 , 4-5 / 3-5 , 4-5 / 3-4 , 4 / 3-4 , 4-5.

Abdomen (Fig. 9e) black, with the exception of segment 1 (greenish, with a laterodorsal blackish brown area on its dorsal posterior half), of segment 2 (yellow, with a laterodorsal anterior pair of blackish brown areas), and of an irregularly shaped yellow pattern on first half of segments 3 and 8. Auricles

dorsally yellowish provided with half a dozen of minute black spines. Segment 10 measures 0.77 (Bipindi male) - 0.80 (allotype) times the length of segment 9.

Anal appendages (Figs 9a-d) black, the superiors longer than the inferior. Superiors with extremities robust and parallel to each other and regularly tapering; the extremities are raised when seen in lateral view. No lateroventral tooth, but an elbow or a kink lying at a distance of about 71% (Bipindi) - 72% (allotype) of the length of appendage. Inferior appendage ending with small hooked-shaped dorsally recurved extremities.

Accessory genitalia.- Hamules and vesicle of penis black. Penial sheath ochraceous. Anterior lamina with posterior part somewhat bilobed. Posterior hamules (Figs 10a-b) very broad in lateral view (*ca* only 2.5 times longer than wide), ending in a narrow (allotype) or robust (Bipindi), but not acute hook. There is a barely distinct subdistal bulging-like process on anterior border, provided with a dozen of minute setae. In ventral view (Figs 11a-b), the posterior hamules are sinuous to very sinuous (allotype), with robust and rounded extremities. Extremity of penial sheath rounded when viewed laterally (Fig. 10a). Penis with a bulky vesicle (Figs 12a-b and 13a). Glans provided with a narrow elongated cupule, ending in a single elongated and fine point (Fig. 13a).

Female (holotype).

Colours black and yellow. The only known female appears to be black stained due to decay, but the visible remains of the thoracic markings (among others on mesepisternum) undoubtely show that it pertains to the same species as the two males described above.

Dimensions: Table 2. Of all the known females of the genus, it has the largest fore wing length in comparison to the abdomen length, thus the smallest abd/fw ratio: 1.03.

Head (Fig. 4b).- Colour and vertex as in male. Occipital plate (Fig. 6a) 2.52 times wider than high. Occipital crest slightly lip-shaped without spines, but fringed with numerous long black hairs directed anteriorly.

Prothorax (Fig. 7b) similar to the male's, except that its main colour is brown and that the anterior pair of laterodorsal small spots appears to be missing. Synthorax (Fig. 8b): the yellow stripe on metepisternum is broad and not fragmented, but complete from dorsum to nearly ventral border of metakatepisternum. There appears to be a large and unfragmented spot or stripe on metepimeron.

Wing index (Table 2).- The holotype has a greater number of cells under the pterostigmas than females of *N. alius* or *N. martininus*. Its third row of cells in fore wing radial field begins more distally, i.e. at the level of the beginning of pterostigma. Anal loop tends to be 2-celled.

Colour pattern of abdomen (Fig. 9f) seemingly as in male, the yellow lateral spot on segment 3 extending till posterior end of segment.

Vulvar scale (Fig. 14a) slightly prominent, with a wide and shallow median V-shaped incision.

Notes

1) FRASER, 1947 (pp. 20 and 31, Fig. 6a) described under the name *N. fuscifrons* a female from Ivory Coast (Le Banco, 05°24'N 04°01'W), 12.VII.1945 (?), which was omitted in his revision of 1949a. Since it has a wide yellow stripe on mesepimeron, it is certainly not *N. fuscifrons*. This specimen was not found again in the collections I studied and is thought to be lost. PINHEY, 1962 (p. 179) mentions *N. fuscifrons* from Ivory Coast according to FRASER's 1947 paper.

2) CORBET (1977) dissected the secondary genitalia of a male larva from a small stream of Cameroon flowing into Lake Kotto (or Barombi-ba-Koto, formerly also called 'Barombi-See', 04°28'N 09°15'E), that died in captivity when ready to emerge. I myself have examined her microscope slides (now in the hands of G. CARCHINI, Roma). The shape of the sharp-ending extremity of the penial glans and the width of the penial vesicle seem to correspond best with those of *N. fuscifrons*, although *N. alius* also has a penial cupule without a pair of flagella. The posterior hamules appear to be less sinuous than those of *N. fuscifrons*, but this may be due to flattening by the glass cover of the slide. Ac is distal to A_3, as in *N. fuscifrons* and *N. alius*. According to CORBET (1977), the fore wings have 3 (or 4 ?) cross-veins between Rs and MA before the middle fork. In comparison, two of the known male imagines of *N. fuscifrons* have 2 cross-veins and the MNCN one has 3 (only one of the fore wings remains in this specimen). The fore wings of *N. alius* have 3 or 4 cross-veins. It is thus not possible to ascribe this larva with certitude to a known species.

2. *Neurogomphus angustisigna* PINHEY, 1971

Neurogomphus angustisigna PINHEY, 1971: 961-963, Figs. 1a-e (original description); KIAUTA, 1981: 29 (taxon mentioned); DAVIES & TOBIN, 1985: 35 (taxon listed in catalogue); BRIDGES, 1994: VII: 13 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon mentioned in index of species-group names of the genus *Neurogomphus*).

Neurogomphus angustisigma: TSUDA, 1986: 94 ; 1991: 103 (listed in catalogue; incorrect subsequent spelling for *N. angustisigna* PINHEY, 1971); BRIDGES, 1994: VIII: 47 (mentioned as unavailable name); STEINMANN, 1997: 139 (listed in catalogue, with TSUDA's incorrect spelling).

Material

Gabon: 1♂, holotype, Mvoum, Montagne de Sable, *ca* 00°14'S 10°07'E, 1-15.XI.1969, A. VILLIERS, leg. (MNHN).

Etymology

The name refers to the characteristic narrow green antehumeral stripes, which are however not so clearly distinct and complete as figured in PINHEY (1971).

Description

A large black and green species.

Male (holotype).

Dimensions: Table 1. Appendages about 1 mm.

Head (Fig. 4c).- Mouthparts yellowish. Genae yellow-green. Labrum brown. Anteclypeus, postclypeus and frons green, the latter parts with a pair of small ochraceous spots. Upper part of frons slightly developed. Antennae brown. Vertex and occiput blackish brown. A small elongated-rounded process externally to lateral ocelli. Postocellar ridge not regularly semicircular, and without a median marked prominence. Occipital plate (Fig. 5c) 2.13 times wider than high. Occipital crest convex, lip-shaped with a median notch and without spines, but fringed with numerous long black hairs.

Prothorax (Fig. 7c) with pattern of paired yellow areas or spots predominant on a black background.

Synthorax (Fig. 8c) with a very characteristic colour pattern. A pair of green collar stripes nearly isolated from the green postdorsal stripes, which are isolated from narrow and elongated antehumeral stripes. The latter stripes are fragmented and do not reach the mesokatepisternum, which is yellow or yellowish brown in its middle. Mesepisternal black area extending well underneath the mesopleural suture and along mesokatepisternum. A complete interpleural black stripe. A faintly marked brownish stripe along the metapleural suture and the ventral border of metepimeron. Except these two dark stripes, the mesepisternum is green. Antealar sinus and interalar sclerite, black. Mesopostcoxale, metakatepisternum, metepisternum, metepimeron and metapostepimeron, yellow. Thoracic sternum, yellow.

Legs entirely black except hind femurs which are brownish black on proximal 2/3.

Wings.- Venation black. Pterostigma characteristically elongated, brown with paler distal third. A possible trace of a very short and narrow, brownish, membranula at extreme basis of hind wings. Anal triangles 3-celled, the two internal veins connecting together before reaching the external border. Ac cross-vein lying at the level with A_3 vein. Wing index with number of cells comparable to that of *N. fuscifrons* (Table 1). Anal field formula: 3 , 4 / 4 , 4-5 / 4 , 4 / 4-5 , 5.

Abdomen (Fig. 15e) black with the exception of segment 2 which is provided with dorsal and lateral yellow areas, of segment 3 with an elongated yellow dorsal spot and a pair of lateral yellow spots on anterior 1/4, and of segment 8 anteriorly provided with a yellow dorsal spot and a pair of lateral yellow ones. Auricles yellowish with a brown border and provided with a dozen of minute non-aligned black spines.

Anal appendages (Figs 15a-b) black, the superiors characteristically not longer than the inferior. Superiors, when viewed dorsally, abruptly narrowing at 8/10 of appendage length, the extremities tending to be parallel. A lateroventral tooth, not visible from dorsal view, lying at a distance of 80% of

length of appendage. Inferior appendage with extremities ending with a recurved hook.

Accessory genitalia black. Anterior lamina ending more or less straight. Posterior hamules very broad in lateral view (*ca* only 2.5 times longer than wide), ending anteriorly in a strong and acute hooked extremity (Fig. 10c). The anterior border is subdistally slightly bended and provided with a dozen of minute setae. In ventral view (Fig. 11c), the posterior hamules are very sinuous, with the subdistal process visible and with wide and slightly acute extremities. Extremity of penial sheath acute when viewed laterally (Fig. 10c). Penis with a bulky vesicle (Figs 12c and 13b). Glans ending in an ovoid cupule with the very minute vestigiae of a pair of flagella (Fig. 13c).

3. *Neurogomphus alius* sp. n.

Neurogomphus fuscifrons: LE ROI, 1915: 345 (a female from Congo-Kinshasa: Yakoma-Angu, Uele). The present study shows that it corresponds best to *N. alius*, by virtue of its size, coloration, wing index and vulvar scale. FRASER (1949a: 131) believes that this damaged alcohol-preserved female 'paratype' (sic) is in the Koenigsberg (now Kaliningrad) Museum. If this location is correct it is most probably lost, due to WWII events.

Neurogomphus uelensis: PINHEY, 1962a: 38 (male, Mekoum Forest, Moyen Congo).

Neurogomphus martininus: PINHEY, 1967: 68, fig. 2a-d ('a short series in the National Museum, Bulawayo, from Mekoum and Kelle Forests, Moyen Congo'); PINHEY, 1969: 166, fig. 22 (female occipital ridge).

Material

Congo-Brazzaville: 1♂, holotype, Mekoum Forest, 01°36'30"N 15°00'20"E, Sonanka District, III.1960 (NMB). 1♀, allotype, 1♂, 1♀, paratypes, Kelle, 00°04'S 14°30'E, VII.1962, B.K. WATULIKI leg. (NMB). Other paratypes: **Central African Republic**: 1♂, La Maboké, 03°54'N 17°53'E, 17.II.1973 (MNHN). **Gabon**: 1♀, Menzalé km 16 (primary forest near Makokou), 00°34'N 12°52'E, 8.XI.1973, J. LEGRAND leg. (MNHN); 1♀ in alcohol with its F-0 exuvia, River Ivindo, at 5 km from Makokou, 25.VIII.1975, J. LEGRAND leg. (MNHN). **Equatorial Guinea**: 1♂, Makomo, Campog[e]b[irg]t[e], 02°03'N 11°15'E, now Mocomo, Kie Ntem Prov., 1-15.IV.1906, G. TESSMANN leg. (MNHUB). **Cameroon**: 2♂♂, 1 incomplete ♀, Yaoundé, 03°52'N 11°31'E; locality spelt 'Jaunde' on the labels, 10.VI.1897, VON GARNAP leg. (MNHUB).

Not seen and considered to be lost: **Congo-Kinshasa**, 1♀ taken between Yakoma (04°05'N 22°27'E, Ubangi Region) and Angu (03°33'N 24°28'E, Uele Region), V.1911, Dr H. Schubotz leg. and identified as *N. fuscifrons* by LE ROI (1915: see synonymy list).

Bionomics

An equatorial forest species. The Yaoundé material bears labels indicating that one of the males and the female were collected in a march (*ein Sumpf*), the other male in a stream (*ein Bach*) near this march. The Ivindo female was reared from a larva dredged from the silty bottom of the large Ivindo River, while the Menzalé female imago was found on a small stream.

Etymology

The species' name means that, although close to *N. martininus* (LACROIX) and *N. angustisigna* PINHEY, the new taxon is well-distinct.

Description

A large black and green species.

Male

Range of dimensions: Table 1. Dimensions of holotype (mm): fore wing 38.3, hind wing 36.6; pterostigma length: fw 3.3, hw 3.6; abdomen 43.3.

Head (Figs 4d-e).- Mouthparts yellowish. Genae yellow-green. Labrum black with lateral borders brownish and anteclypeus black (Congo-Brazzaville holotype and Gabon) or labrum with a pair of large yellowish lateral spots separated by a black vertical stripe which may extend along the inferior border of labrum and anteclypeus entirely dark brown or green in its centre (Cameroon and Equatorial Guinea). Postclypeus green, but black along its lower half, with the exception of a pair of brown spots on lower corners (Congo-Brazzaville and Gabon); or green with only a narrow black area along inferior border (in two of the Cameroon specimens). Fore part of frons green, superior part at least black on its posterior half, this black area medially extending forwards. A male from Yaoundé possess a small rounded prominence in front of the median ocellus. Vertex, including antennae, black, but with a yellow-brown area anterior to the ocelli. A small elongated protuberance external to lateral ocelli. Postocellar ridge shaped in the form of a 'V', with branches largely spread apart; its relief irregular, medially with or without a slight prominence. Occipital plate (Figs 5d-f) 2.12 (in a male from Yaoundé), 2.26 (the Kelle male) or 2.29 (the Makomo male and the holotype) times wider than high. Occiput black, its crest slightly convex, rounded or irregularly sinuous and with a median notch; without spines but fringed with numerous long black hairs.

Prothorax (Fig. 7e) with a pattern of yellow areas on a brown or black background. This pattern is variable in extension, according to the localities.

Synthorax (Figs 8d-e).- Wide postdorsal green stripes extending over spiracular dorsum and connected with small subquadrangular or triangular green antehumeral spots; the whole pattern thus Z-shaped. (These green parts extend the less in the La Maboké male, where the antehumeral spot are disconnected from the postdorsal stripes; the postdorsal stripes are the widest in the holotype from Mekoum.). An irregular narrow green stripe on mesepimeron, nearly complete in Congo-Brazzaville and Central African Republic specimens, interrupted in Cameroon specimens). A green stripe all along metepisternum, confluent with yellow part of metakatepisternum. Metepimeron black or blackish brown with a green stripe or area in its middle (this pale area is the most extended in Congo-Brazzaville specimens). Metapostepimeron green (Kelle and La Maboké), blackish brown (Congo holotype) or mainly black (Cameroon). Antealar sinus black, but yellow along median line in Cameroon specimens. Subalar ridge and interalar sclerite, black. Thoracic sternum brown.

Legs black, tibiae brownish black.

Wings.- Venation black. Pterostigma blackish brown. Membranule grey and very short, almost absent, reduced to the joint between wing basis and anal

triangle. Anal triangle 3-celled, the two internal veins either connecting together or not (holotype) before external border. Ac distal to level of A_3 (14 wings seen).

The range of wing index (Table 1) differs from that of *N. fuscifrons* and *N. angustisigna* by a slightly lower number of cells in 3th and 4th rows and in distal margin of radial field and in the fore wings discoidal field. Compared to *N. fuscifrons* and *N. angustisigna*, but like *N. martininus*, the species thus has a smaller number of cross-veins, with the exception of a larger number between Rs and MA (before fork). The La Maboké male has the Ac cross-vein lying as much distal as to reach subtriangle.

Holotype wing index: 19 (fw) and 13-14 (hw) Ax; 13-14 (fw) and 13 (hw) Px; second Pans: 6 (fw) and 6 (hw); 5-6 (fw) and 3.7-3.8 (hw) cells under pterostigma; radial field with third row beginning at -1 to a (fw and hw) levels, comprising 11 (fw) and 11-12 (hw) cells; with fourth row beginning at c-d (fw) and d (hw) levels, comprising 7 (fw and hw) cells; 3 (fw) and 1 (hw) cross-veins between Rs and MA; 9-10 (fw) and 8 (hw) bridge cross-veins; 2 (fw) and 3 (hw) cells between R_4 and MA at distal margin; discoidal field expanding at -2 to 0 (fw) and at -2 (hw) levels, with 13 (hw) cells at distal margin; anal field formula: 4 , 4-5 / 4 , 4 / 3-4 , 3-4 / 4-5 , 4-5.

Abdomen (Figs 16h-j) black, with the following exceptions: auricles yellow or green (with a dozen of minute black spines), segment 1 mostly green, segment 2 green (the most in Cameroon males), anterior third of segment 3 with a pair of lateral green or yellow quadrangular spots separated by a median dark line in the Congo-Brazzaville males, this line very narrow in the La Maboké male and absent in the Yaoundé and Makomo males, where the lateral spots are thus confluent. Segment 8 with yellow anterior third. Segment 10 measures 0.78 (Mekoum) - 0.80 (La Maboké) times the length of segment 9.

Anal appendages (Figs 16a-g) black. Superiors longer than inferior. In dorsal view their extremities tend to bend inwards, the tips being sharp (very finely acute in the Mekoum holotype; finely in a Yaoundé male). In lateral view the lateroventral small tooth (Mekoum specimen) or hook (Equatorial Guinea specimen) is slightly or hardly (Mekoum) distinguishable or even absent as such in the La Maboké specimen where only an elbow remains. It lies at a distance of 76% (Mekoum) - 77% (for the La Maboké male its virtual position is taken into account) of the appendage length. Inferior appendage, in lateral view, with or without dorsally recurved hook-like extremities (more or less rounded extremities in the La Maboké male).

Accessory genitalia.- Hamules black. Posterior border of anterior lamina convex (thus not ending bilobated as in *N. fuscifrons*). Posterior hamules very broad in lateral view (Figs 10d-h: only 2.2 - 2.5 times longer than wide), with a small and narrow extremity. Subdistal anterior process not or not much differentiated, but minute setae are present at the place where they are found in other species. In ventral view (Figs 11d-g) the posterior hamules are less sinuous than in *N. angustisigna*. Their extremity is narrow and the subdistal process well-visible, bearing setae. Penis (Figs 12d and 13c) and penial sheath,

black. Penial sheath with a rounded extremity when viewed laterally. Vesicle voluminous. Glans (Figs 12d-e) ending in a cupule which itself ends in a single elongated point, without vestigiae of a pair of flagella (Fig. 13c). In the Makomo male the cupule is as elongated as in *N. fuscifrons*, although recurved. The part of glans lying against the ventral face of abdomen is impressive.

Female

Dimensions: Table 2. The females (Congo-Brazzaville and Cameroon) are nearly as large as that of *N. fuscifrons*. Gabon females are somewhat smaller (fw 42.7 (Menzale) – *ca* 43.5 mm (Ivindo); hw 41 mm (Menzale); pt: fw 3.2 (Menzale) – 3.7 (Ivindo); hw: 3.6 mm (Menzale).

Coloration of head as in male, the clear areas of face extended as in the Yaoundé males. The width of the pale stripe of the inferior border of the labrum of the Ivindo female equals the quarter of that of labrum itself.

Postocellar ridge more or less semicircular and without median prominence. Knob-shaped small prominences lateral to ocelli and occipital crest as in male. Occipital plate (Fig. 6d) 2.28 (Yaoundé) – 2.33 (Kelle) times wider than high.

Colour pattern of thorax (prothorax: Fig. 7f) and abdomen similar as that of males, but abdominal segments 1-2 with laterodorsal brown areas, and the yellow lateral area of segment 3 extending more posteriorly (Fig. 16k). However, segment 8 of abdomen the Ivindo (teneral) female seems to be dorsally black, all segments being paler along lateroventral border. (Note that striking differences in abdominal colour pattern are also to be seen between individuals of *N. uelensis* (♂♂ and ♀♀) and of *N. zambeziensis* ♂♂.).

Range of wing index: Table 2. The wings have a great number of cells, comparable to that of *N. fuscifrons*, although radial field has less cells in 4th row and at distal margin. Ac distal to level of A_3.

Vulvar scale (Figs 14b-c) broad and very slightly prominent, the median V-shaped incision very wide and shallow (also figured in LE ROI (1915: 315) for the female from Congo-Kinshasa he identified as *N. fuscifrons*).

Note that except for small peculiarities in the face and abdominal coloration, the teneral Ivindo female entirely agrees with the other known females (prothorax and synthorax colour pattern as well as occipital plate and vulvar scale morphology).

4. *Neurogomphus martininus* (LACROIX, 1921)

Oxygomphus Martininus LACROIX, 1921: 48-49 (original description of a female).

Oxygomphus martininus LACROIX, 1921: SCHOUTEDEN, 1934b: 68 (taxon mentioned); FRASER, 1936: 141 (research concerning the location of holotype which is presumed to be lost); KLOTS (1944): 7 (taxon mentioned); BRIDGES, 1994: VII: 148 and VIII: 47 (original generic attribution mentioned in catalogue; under *Neurogomphus*).

Oxygomphus martinius: STEINMANN, 1997: 139 (mentioned, with incorrect spelling, as type species of *Neurogomphus martinius* [sic] (LACROIX); [both are thus unavailable names]).

Neurogomphus martininus (LACROIX): FRASER, 1949a: 131-132 (brief description of holotype

[according to the original description], believed to have been lost of sight after MARTIN's death); PINHEY, 1962b: 180 (bibliography and distribution, erroneously stated from French Congo); PINHEY, 1967: 66-68 (description; erroneously stated from Moyen Congo); PINHEY, 1971: 963 (comparison with *N. angustisigna*); DAVIES & TOBIN, 1985: 35 (taxon listed in catalogue); TSUDA, 1986: 94; 1991: 103 (taxon listed in catalogue); BRIDGES, 1994: VII: 148 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon mentioned in index of species-group names of the genus *Neurogomphus*); CLAUSNITZER, 2001: 57 (species mentioned from Congo-Kinshasa in a list of Odonata likely to occur in East Africa).

Neurogomphus martinius: STEINMANN, 1997: 139-140 (taxon listed in catalogue, with incorrect subsequent spelling [this name is thus unavailable]; STEINMANN indicates that the holotype [of *N. martininus*] is lost (p. 139) or (p. 140) in Santiago de Chile Museum)

Karschiogomphus Ghesquièrei SCHOUTEDEN, 1934a: 226-227 (original description of a male); SCHOUTEDEN, 1934b: 61-62, fig. 68.

Karschiogomphus ghesquierei SCHOUTEDEN, 1934: FRASER, 1946: 201 (considered to be a junior synomym of *Oxygomphus agilis* (MARTIN, 1908), from a comparison between the characters of *Karschiogomphus* with those of the male of *Oxygomphus agilis* MARTIN (MS name) from 'Congo'); BRIDGES, 1994: VII: 97 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon mentioned in index of species-group names of the genus *Neurogomphus*; synonym of *Neurogomphus martininus*).

Karschiogomphus ghesquievei: STEINMANN, 1997: 139 (considered to be a synonym of *Neurogomphus agilis* (MARTIN, 1908) and with subsequent incorrect spelling [name thus unavailable]).

Neurogomphus Ghesquierei (SCHOUTEDEN, 1934): FRASER, 1949a: 130 and 132 (brief description of holotype, considered to be a synonym of *N. martininus* (LACROIX) because the dorsal markings of thorax are similar; moreover, 'most probably both are synonyms of *N. fuscifrons* KARSCH').

Neurogomphus ghesquierei (SCHOUTEDEN, 1934): PINHEY, 1962b: 179 (bibliography and distribution; considered to be a valid species); TSUDA, 1991: 220 (mentioned in catalogue, as a junior synonym of *N. martininus*); DAVIES & TOBIN, 1985: 35 (mentioned in catalogue as a synonym of *N. martininus*); BRIDGES, 1994: VIII, 47 and VII, 97 (mentioned in catalogue, as synonym of *N. martininus*).

Neurogomphus ghesquieri: PINHEY, 1967: 68 (incorrect subsequent spelling [name thus unavailable] for *N. ghesquierei* (SCHOUTEDEN, 1934), synonym of *N. martininus*).

Neurogomphus sp.: SCHOUTEDEN, 1933: 342 (concerning a female from Stanley Falls, stained black by post-mortem decay, located in IRSNB and formerly identified as *Phyllogomphus aethiops* by E. DE SELYS-LONGCHAMPS; SCHOUTEDEN writes that it is obviously not this species); CAMMAERTS, 1968: 106-107, fig. 11 (comments on this female, considered to be near *N. ghesquierei*).

Material

Central African Republic: 1♀, holotype, Bangui, 04°22'N 18°35'E (MNHN). **Congo-Kinshasa**: 1♂, holotype of *K. ghesquierei*, Stanleyville (now Kisangani), 00°30'N 25°11'E, Tshopo Region, 1925, J. GHESQUIÈRE, leg. (MRAC); 1♀, black stained, Stanley Falls (now Boyoma Falls, near Kisangani), 00°30'N 25°12'E, Tshopo Region, ADANS LEGROS leg. (IRSNB).

Description

A large black and green species. The female is as large as that of *N. alius*.

Male (*N. ghesquierei* holotype).

Dimensions: Table 1. The wings are smaller than in the preceding species, but the abdomen is as long as that of *N. fuscifrons* (hence, a large abd/fw ratio: 1.30).

Head (Fig. 4f).- Mouthparts yellowish. Genae brownish. Labrum, ante- and postclypeus blackish brown. Frons green, except a brownish black stripe along postclypeus and a pair of black lateral and narrow elongated areas along vertex. Upper part of frons rounded and slightly prominent, but crest of frons becomes laterally somewhat angular. Antennae brown. Vertex and occiput greyish black. A pair of relatively large, although rather flat, ochraceous prominences on an half-circling crest, exterior to lateral ocelli. Postocellar ridge shaped in the form of an very widely open 'U', the median transverse part of the ridge not pronounced. Occipital plate (Fig. 5g) 2.24 times wider than high. Occipital crest convex, with a characteristic small half-circle-shaped notch in its middle; without spines but fringed with numerous long black hairs directed anteriorly.

Prothorax (Fig. 7g, dorsal view) predominantly green or yellowish on a black background.

Synthorax (Fig. 8g).- Spiracular dorsum black. Postdorsal green stripes fused with collar stripes and antehumeral triangular spots, therefore Z-shaped. A wide green mesepimeral stripe along most of mesepimeron length. A green metepisternal stripe, somewhat fragmented in the form of a bead string, on dorsal half of metepisternum. A green metepimeral stripe on dorsal half of black metepimeron. Antealar sinus and interalar sclerite black. Mesokatepisternum mostly black, ochraceous along dorsal sutures. Foremost part of mesepimeron brown. Mesopostcoxale, metakatepisternum, foremost part of metepimeron and metapostepimeron ochraceous. Thoracic sternum ochraceous.

Legs entirely brownish black.

Wings.- Venation black, pterostigmas brown, shorter than those of *N. fuscifrons*, *N. angustisigna* or *N. alius*. A very short greyish membranule at extreme base of hind wings. Ac slightly distal to A_3. Anal field formula: 3-4 , 4-5 / 3 , 3 / 3 , 3 / 4 , 4-5. Wing index: Table 1.

Abdomen (Fig. 15f) mostly black, with the exception of a yellowish spot on dorsum of segment 1, of segment 2 mostly greenish or yellowish and laterodorsally ochraceous, of segment 3 with a pair of quadrangular yellow lateral spots on anterior quarter and of segment 8 with a yellow spot on anterior half. Auricles yellow provided with minute black spines. Segment 10 as long as segment 9.

Anal appendages (Figs 15c-d) black. Superiors longer than inferior, straight, their tips not very acute. No lateroventral teeth as such, but at the most a trace of them, at a distance of 65% of appendages length. Inferior appendage, in lateral view, with dorsally recurved hooked-shaped extremities.

Accessory genitalia.- Hamules, vesicle of penis and penial sheath, black. Posterior hamules in lateral view (Fig. 10i) much more elongated than in *N. fuscifrons*, *N. angustisigna* or *N. alius* (*ca* 5 times longer than wide, not

taking into account the end tip), slightly curved and ending in a strong point. Anterior border not differentiated into a subdistal bulged process. In ventral view (Fig. 11h), the posterior hamules are slightly sinuous, with broad extremities. Penial sheath in lateral view, with a rounded extremity (Fig. 10i). Penis (Figs 13d and 17a) black. Glans of penis ending in a perfectly circular cupule, without any vestigiae of flagella (Fig. 13d).

Female

Range of dimensions: Table 2. Dimensions of holotype (mm): fw 43.5; hw 41; hw width 10.9; pterostigma length: fw 3.8, hw 4.0; abdomen about 50.

Head.- Frons rounded as in male. A small knob on the ridge external to lateral ocelli. Occipital plate (Figs 6b-c) 2.35 (Stanley falls) – 2.62 (holotype) times wider than high. Occipital crest lip-shaped or mostly bell-shaped, with (holotype) or without (Stanley Falls) a slight median notch.

Coloration of head, thorax (Fig. 7h) and abdomen as in male (*N. ghesquierei* holotype). Nevertheless, in female (holotype) the foremost dark brown coloured parts of thorax extend more, reaching lateral spiracle and inferior border of metepimeron (the pale stripes are thus narrower). Metepisternal stripe in the form of a string made of two beads. Spiracular dorsum and mesokatepisternum entirely brown.

Range of wing index: Table 2. The wing index thus resembles that of *N. fuscifrons*, but in fore wings the third row of radial field extends more proximally, thus containing a larger number of cells. Also a larger number of cross-veins between Rs and MA. Ac cross-vein lines up with A_3 vein.

Wing index of holotype: 19-20 (fw) and 12-14 (hw) Ax; 12-14 (fw) and 13-15 (hw) Px; second Pans: 7 (fw) and 5-6 (hw); 4.6-5.0 (fw) and 5.0-5.8 (hw) cells under pterostigma; radial field with third row beginning at -3 to -5 (fw) and -2 to -5 (hw) levels, comprising 16-17 (fw) and 10-14 (hw) cells; with fourth row beginning at -1 to b (fw) and -1 to a (hw) levels, comprising 10-14 (fw) and 10-11 (hw) cells; 11-12 (fw) and 8-9 (hw) cells at radial field distal margin; 3-4 (fw) and 1 (hw) cross-veins between Rs and MA; 9-10 (fw) and 6-7 (hw) bridge cross-veins; 4 (fw) and 3-4 (hw) cells between R_4 and MA at distal margin; discoidal field expanding at -3 or -5 levels in fw and at -4 or -5 levels in hw, with 14-15 (fw) and 14 (hw) cells at distal margin.

Vulvar scale (Figs 14d-e) not very prominent, but with a V-shaped cleft, the borders of which together form a right angle.

Comments

By its venation, this species is closer to *N. alius* than to the other large sized species, viz. *N. fuscifrons*, *N. angustisigna* and *N. alius*, but it has shorter pterostigmas. The pterostigma length, the colour pattern and the elongated posterior hamules connects *N. martininus* with the *N. agilis* group of species.

5. *Neurogomphus uelensis* SCHOUTEDEN, 1934

Neurogomphus uelensis SCHOUTEDEN, 1934b: 65-66 (original description); FRASER 1949a: 130 (as a probable synonym of *N. agilis* (MARTIN, 1908); 133, fig. 7 (description of type); PINHEY, 1962b: 180 (bibliography and distribution); PINHEY, 1967: 70 (taxon incorrectly characterised); DAVIES & TOBIN, 1985: 35 (taxon listed in catalogue); TSUDA, 1986: 94; 1991: 103 (taxon listed in catalogue); BRIDGES, 1994: VII: 240 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon mentioned in index of species-group names of the genus *Neurogomphus*); STEINMANN, 1997: 140 (taxon listed in catalogue); CLAUSNITZER, 2001: 58 (species mentioned from Congo-Kinshasa in a list of Odonata likely to occur in East Africa).

Neurogomphus agilis: Pinhey, 1967: 68, fig. 3a-c (a male from Kelle Forest, Congo).

Material

Congo-Kinshasa: 1♂, holotype, Dingila, 03°39'N 26°04'E, near Bambesa, Uele Region, 22.X.1932, J. VRIJDAGH leg. (MRAC). **Congo-Brazzaville**: 1♂, Kelle Forest, 00°04'S 14°30'E, VII.1962 (NMB). **Gabon**: Makokou surroundings, 00°34'N 12°52'E: 1♂, Mpassa, IV-V.1975, G. BERNARDI, leg.; 1♂, *idem*, IV.1977, J. PIERRE leg.; 1♂, route de la source, 17.IV.1978, J. LEGRAND leg.; 1♂, lisière de la vieille route, 28.VI.1975, J. LEGRAND leg.; 1♀, *idem*, 3.IV.1973, G. BERNARDI leg.; 1♀, route de Fang, 3.IV.1973, G. BERNARDI leg.; 2♂♂, layon, IV-V.1975, G. BERNARDI leg.; 1♂, *idem*, 3.III.1977, 1♂, *idem*, 5.IV.1977, J. PIERRE leg. Forêt secondaire d'Andok, 2♀♀, immatures, 12.IV.1972, J. LEGRAND leg. (All the material from Gabon is located in MNHN).

Bionomics

An equatorial forest species. At the time of the holotype discovery Dingila was situated in the mixed evergreen/semi-deciduous dense forest which covered the left bank of the Uele River. At present this locality no longer lies in a forested area.

Description

Male (holotype and Gabon series)

The holotype has a green and black colour pattern of average extension.

Range of dimensions: Table 1. Dimensions of holotype (mm): fore wing 33.8; hind wing 32; pterostigma length: f-wing 2.5, h-wing 2.9; abdomen 43.5. Abdomen/fore wing length ratio: 1.29.

Head (Fig. 4g).- Mouthparts ochraceous yellow. Genae dark greenish (holotype) or brownish (Gabon). Labrum and anteclypeus dark brown or black. Postclypeus blackish brown, with or without (in 4 of the Gabon specimens) a green strip along frons, reaching 1/3 of postclypeus height. Vertical part of frons green, the horizontal part black on its posterior half or entirely black, depending on specimens. Crest of frons slightly angulous opposite antennae. Vertex brown or blackish, anterolaterally dark yellowish. Postocellar ridge in the shape of a very opened 'U', nearly flat and with a low mediolongitudinal ridge. No prominence external to lateral ocelli. Occiput black. Occipital plate (Figs 5h-i) 1.58 – 1.79 (8 specimens measured) times

wider than high (holotype: 1.63). Occipital crest convex, not markedly sinuous, shaped as a reversed 'V'; its edge bordered by a very narrow yellowish brown stripe (inconspicuous in a male from Gabon), bearing a dense fringe of long black hairs and provided with 0-5 stout black spines on a surelevated brown base. These spines are more or less directed vertically compared to the surface of the occipital plate (holotype with 5 spines; Gabon: 1 male with 3 spines, 2 males with 2 spines, 4 males without).

Prothorax (Figs 7i-k) black or blackish brown, with a large green anterior transverse area, medially extending posteriorly and with a pair of large transverse posterodorsal adjacent green spots. A median green spot on posterior lamina.

Synthorax (Figs 18a,d).- Spiracular dorsum green. A black middorsal irregular narrow stripe extends over the spiracular dorsum in the Gabon specimens, thereby isolating two green Z-shaped stripes. Antehumeral elongated green spots connected to postdorsal stripes and extending to about 1/3 or 1/2 of the length of mesopleural suture. Black humeral area extending well below the mesopleural suture. Middorsal carina, black. Interpleural black stripe incomplete in most specimens (in holotype and 6 specimens from Gabon) but complete and sinuous in one of the Gabon's specimens (Fig. 18d). Metapleural black stripe non-existent, incomplete (holotype and 3 specimens from Gabon), nearly complete (1 specimen) or complete (3 specimens). When complete, it forms a black ring along metepimeron borders (Gabon). Mesokatepisternum black on at least its superior half part, the inferior part, brown. Mesopostcoxale and most part of metakatepisternum, brown. Antealar sinus and interalar sclerite, black. Thoracic sternum brown.

Legs.- Trochanters ferrugineous brown. Posterior femora brown, their distal 1/6 blackish (holotype) or only with a very large black lateroexternal stripe (Gabon), except at the fringe along the spiny border. Tibiae and claws black.

Wings.- Venation blackish brown, black around the pterostigma, which is dark brown. Old individuals may have slightly smoked wings. Ac cross-vein is slightly distal to A_3 level (in 8 wings out of 14), at level with it (5 wings) or slightly proximal to it (1 wing). Anal triangle 4-celled in 75% out of 16 wings, 3-celled in 25% of the wings. Membranule grey and short, reduced to the joint between wing basis and anal triangle. Range of wing index: Table 1. Anal field range: 3-5 , 3-5 / 3-4 , 3-4 / 3-4 , 3-5 / 3-4 , 4-5.

Wing index of holotype: 15-17 (fw) and 12-12 (hw) Ax; 9-10 (fw) and 10 (hw) Px; second Pans 5; 3.4-4.0 (fw) and 4.3-4.8 (hw) cells under pterostigma; radial field with third row beginning at b level, comprising 11 (fw) and 10 (hw) cells; with fourth row at d (fw) and c (d) (hw) levels, comprising 8 (fw) and 7 (hw) cells; 9 (fw) and 11 (hw) cells at distal margin; 2 (fw) and 1 (hw) cross-veins between Rs and MA; 8 (fw) and 6-7 (hw) bridge cross-veins; 2-3 (fw) and 2 (hw) cells between R_4 and MA at distal margin; discoidal field expanding at -1 (fw) and -2 to -3 (hw) levels, with 9 (fw) and 12-13 (hw) cells at distal margin; anal triangle 4-celled; Ac distal to A_3; anal field formula: 4-5 , 4-5 / 3 , 3 / 3 , 3 / 4 , 4.

Abdomen (Figs 19a-c) with well contrasted colour pattern. Segment 1 dark brown with a dorsal green spot. Segment 2 dorsally mostly green with laterodorsal paired dark spots in front of auricles and along posterior border. Auricles green, their edge black and posteriorly provided with a dozen of minute non-aligned black spines. Segment 3 with a basal middorsal elongated yellow spot and a pair of rectangular yellow spots on each side. Segments 4 to 7 entirely black. Segment 8 basally yellow till nearly half length. Segments 9 and 10 and anal appendages black. Segment 10, when viewed laterally, with a well-developed right angulated dorsal profile. The only (slightly) immature male specimen from the Gabon series has yellow parts of abdomen more developed (Fig. 19b): the anterior quarter of segments 3 to 6 is entirely yellow. Its segment 8, however, does not have one big yellow spot, but is divided into three spots. Segment 10 measures 1.03 – 1.12 (Gabon) times the length of segment 9 (holotype: 1.08; mean: 1.08; $n = 8$) (Figs 47b-c).

Anal appendages (Figs 20a-j) black. Superiors straight and divergent, ending in a sharp tip. They are characteristically provided with a strong and large lateroventral tooth, very obvious from dorsal view, at a distance of 50 - 59% of their length (mean = 55%, which corresponds to holotype; $n = 8$). Inferior appendage shorter than superiors, the extremities ending in a recurved spiniform process.

Accessory genitalia.- Hamules dark brown. Posterior hamules elongate in lateral view (Figs 21a,c,e), with a recurved and moderately wide tip and a moderate anterior and subdistal tumb-like process bearing 2-6 minute setae. In ventral view (Figs 21b,d,f,g), the posterior hamules have a lanceolate-sinuose form, the holotype's hamules ending less acutely than those of Gabon's specimens. The subdistal thumb-like process is not at all, or hardly, visible in ventral view. Penial sheath, as seen in lateral view, ending somewhat bevel-edged (Figs 21a,c). Vesicle of penis blackish brown. Penis: Figs 17b-d and 13e. Glans ending in a circular (holotype) or ovoid cupule, bearing the very short vestigiae of two flagella (Figs 13e, g-i).

Male (from Kelle only).

There are some differences which are worthwhile to be mentioned:

Synthorax.- Antehumeral green spots less developed, as in the Andok females (*cf* Fig. 18b). The width of the humeral black area is reduced underneath the mesopleural suture, such as in *N. paenuelensis* and in *N. cocytius*.

Segment 2 of abdomen (Fig. 19f) without a pair of dark spots along posterior border. Contrary to holotype and Gabon specimens, segment 10 dorsally bears two stout spines (Figs 20k-l).

Superior anal appendages (Figs 20k-l) with lateroventral tooth situated at a distance of 64 (right) - 67 % (left appendage) of appendage length, thus lying somewhat more posteriorly than in holotype and Gabon males.

Posterior hamules (Figs 21h-i) with subapical thumb-like process less directed anteriorly than in holotype and Gabon males. Penial sheath, in lateral view (Fig. 21h), ending more broadly than in holotype and Gabon males.

Penis: Fig. 17e. Glans without visible vestigiae of flagella, but ending in a single pointed extremity (Fig. 13f).

Other, but non-discriminative characteristics are: head with genae brownish. Occipital plate 1.44 times wider than high and occipital crest with 3 spines. Interpleural and metapleural thoracic black stripes absent. Anal triangles 3-celled. Segments 3-7 of abdomen with a basal yellow area or ring. Segment 8 with yellow area tending to be divided into two isolated spots (this pattern recalls that of the immature Gabon male). Segment 10 about the same length as segment 9. The lateroventral tooth of right superior appendage is somewhat directed posteriorly, a particularity however also found in one of the Gabon males.

Abdomen/fore wing ratio about 1.31.

The wing index of the Kelle male lies within the variability range of the holotype and Gabon specimens.

Female (Gabon).

Dimensions: Table 2.

Face as in typical male, but labrum seems to have a pair of small green spots (Gabon). Occipital plate (Figs 6e-h) 2.44 – 2.49 times wider than high, thus much wider than in male. Occipital ridge more or less straight with a median rounded process provided or not (in 1 out of 4 specimens) with a black spine.

Thorax (synthorax: Figs 18b-c) as in male, the black humeral area also largely extending underneath the mesopleural suture. The green antehumeral spots remain always connected to the large green postdorsal stripes, however, in two out of four specimens (whatever the locality) their size is reduced as in Kelle male.

Wings.- Ac distal (in 3 wings out of 8) or at level (5 wings) with A_3 vein. Wing index: Table 2.

Abdomen: Figs 19d-e.

Vulvar scale (Figs 14f-i) with two rounded lobes, widely separated by a V-shaped cleft.

Note that the two immature females from Andok Forest differ from the Makokou females (i.e. from Mpassa and route de Fang) by a lower wing index (radial field, bridge cross-veins and discoidal field), by pterostigmas of a more elongated form and by the absence of a metapleural black stripe. Contrary to the Makokou females, the Andok females bear a small knob-like process on the semicircular ridge external to the lateral ocelli.

6. *Neurogomphus paenuelensis* sp. n.

Neurogomphus uelensis: FRASER, 1949a: 133-134 (a male from Liketa (sic), formerly identified as *N. agilis* by F.C. FRASER as indicated on one of its labels).

Material

Congo-Kinshasa: 1♂, holotype, Likete-sur-Lomela, 00°43'S 21°24'E (near Boende, Equateur Region), 12.VI.1936, J. GHESQUIÈRE leg. (MRAC).

Bionomics

The holotype was collected in a periodically flooded equatorial evergreen dense forest.

Etymology

The name refers to the species' apparent phenetical proximity.

Description

Male (holotype)

Dimensions and wing index: Table 1. Anal field formula: 4 , 4 / 3 , 4 / 3 , 4 / 4 , 4-5. Abdomen/fore wing length ratio 1.32.

The Likete male differs from the 'typical' *N. uelensis* males by the following characteristics, the most remarkable being the relative length of abdominal segment 10.

Head (Fig. 4h).- Upper half of vertical part of frons brown. Postocellar ridge in the form of two half-circling ridges separated medially.

Synthorax (Fig. 8h).- Very small antehumeral green spots (more reduced than in *N. uelensis*), almost nearly separated from the large postdorsal green stripes. Side pattern with the black humeral area only extending slightly below the mesopleural suture (a characteristic also seen in the *N. uelensis* Kelle male).

Wings with one to three more postnodal cross-veins than in *N. uelensis*. Fore wing discoidal field expanding more proximally than in *N. uelensis*.

Abdomen: Fig. 19g. Abdominal segment 8 with yellow basal area reduced to two dorsolateral spots. Segment 10 much longer than in any other *Neurogomphus* species (Fig. 47a), measuring 1.22 times the length of segment 9 (thus outside the range of any other *Neurogomphus* species). (Note that if measured along the apparent ventral border, we get 1.23 for *N. peanuelensis* and 1.06 - 1.14 (mean 1.11 for $n = 7$) for *N. uelensis* (holotype and Gabon).)

Superior appendages (Figs 20m-o) with lateroventral tooth squat and blunt (this seems not to be due to a wearing process), thus unlike that expected for *N. uelensis*. Moreover, this tooth is situated at a distance of 65% of the length of appendages, a position more posterior than in 'typical' *N. uelensis* males, but which agrees with that of the Kelle male.

Posterior hamules (Figs 21j-k), in lateral view, with the subapical thumb-like process not obviously directed anteriorly, unlike in 'typical' *N. uelensis* males. The extremities are glossy and flat. Penial sheath (in lateral view, Fig. 21j) broadly ending (as in Kelle male).

Other, but non-discriminative characteristics are:

As in *N. uelensis* there are no prominences external to lateral ocelli. Occipital plate (Fig. 5j) 1.63 times wider than high (thus as in *N. uelensis* holotype). Occipital crest brownish yellow, bearing 5 small spines (their extremities, black) directed vertically with respect to the surface of the occipital plate. Prothorax (Fig. 7l): colour pattern similar to that of *N. uelensis*.

- Synthorax (Fig. 8h): no interpleural and metapleural dark stripes, but a somewhat wide black area along subalar ridge. Ac distal to A_3. Anal triangles 3-celled. Posterior 1/4 of hind femurs blackish, with a narrow black stripe along entire exterolateral face. Penis: Figs 17f and 13j. Glans ending with the very short vestigiae of flagella (Fig. 13j).

Comments

This male from Congo-Kinshasa superficially looks like a *N. uelensis*, but however presents such differences that it appears to be exaggerated to consider it a member of this species.

FRASER (1949a) pointed out to the relatively high number of Ax and Px in hind wings of this male from Likete, which amounts to 48 instead of 43 in the *N. uelensis* holotype (41-46 in the other *N. uelensis* specimens here described). The reason is simply that the Likete male bears 13 Px in hind wings instead of 10-12. However, FRASER overlooked more striking differences between the Likete male and typical *N. uelensis* specimens, among which the great length of abdominal segment 10 and the reduced size of the ventrolateral tooth of superior appendages.

Considering that some features of the Likete male are linked to those of the *N. uelensis* male from Kelle Forest and knowing perhaps not enough about the variability in *N. uelensis*, there seems to be some risk in establishing a distinct taxon for a single specimen with few although qualitatively noteworthy differences. However, I suspect the Likete male to represent a sibling species. By creating a new taxon for it, it is hoped to focus the attention of searchers on the problems of the *N. uelensis* complex of forms and to stimulate further collecting, specially in the Congo basin. On the other hand, the reader should bear in mind the possibility of a specific identity between the male here described and a female from the Congo Basin (Eala) described below under *N. sp. indet. A*.

7. *Neurogomphus sp. indet. A* (♀, Eala)

Neurogomphus uelensis: FRASER, 1955: 42 (description of a female from Eala, designated as the allotype of *N. uelensis* SCHOUTEDEN, 1934); PINHEY, 1962b: 180 (bibliography and distribution); PINHEY, 1967: 70 (specimen mentioned as allotype).

Material

Congo-Kinshasa: 1♀, Eala, 00°03'N 18°19'E (near Mbandaka, Equateur Region), XII. 1934, J. GHESQUIÈRE leg. (MRAC).

Description

Female

Dimensions: Table 2.

Head (Fig. 4i) with frons and middle of postclypeus yellow or green; on the whole, the colour pattern of head may agree with that of *N. uelensis*, *N. pae-*

nuelensis or even *N. cocytius* or *N. zambeziensis*. Postocellar ridge in the form of a very wide half-circle, without a different median relief. No prominence external to lateral ocelli, although there exists a very slight relief here. Occipital plate (Fig. 6i) 1.77 times wider than high and with a central hemispherical relief; occipital crest triangular-shaped as in *N. cocytius* (however, entirely brown) and bearing two spines, as seen in *N. cocytius* females.

Prothorax colour pattern (Fig. 7k) similar to that of *N. uelensis* or *N. paenuelensis*.

Synthorax with short antehumeral green spots, distant from the postdorsal green stripes. This may be consistent with a *N. uelensis* female, with a *N. paenuelensis* having larger antehumeral spots or with a *N. cocytius* having reduced antehumeral spots. Black humeral area not extending much below mesopleural suture, thus as in the *N. uelensis* Kelle male, in *N. paenuelensis* and in *N. cocytius*.

Wing index (Table 2) may agree with that of *N. uelensis* from Makokou. The number of Ax (fw) and Px (fw) cross-veins, and the number of cells in third and fourth rows of radial field and at distal margin of discoidal field in fore wings is higher than that of the *N. cocytius* females. Ac cross-vein at level or, in one wing, proximal to A_3.

The abdomen is somewhat damaged and may be as that of typical *N. uelensis* females from Makokou or as that of a *N. cocytius* with extended dark areas.

Vulvar scale (Fig. 14j) as in *N. cocytius*, thus unlike that of *N. uelensis*.

Comments on identity and bionomics

This female with a somewhat damaged abdomen appears not to be that of a typical *N. uelensis*. On the contrary, its colour pattern and form of vulvar scale recall more those of *N. cocytius*. By its colour pattern it may also represent the female of *N. paenuelensis* from which however only a male is known. Indeed, the Eala female comes from a periodically flooded swamp forest, a similar environment to that of the locality where *N. paenuelensis* was found. Concerning a possible identity of this female and *N. cocytius*, it must be taken into account that there exists a tremendous geographical and, apparently, ecological gap between the equatorial swamp forest of Eala and the rapids flowing into the Victoria Falls in the Zambezian woodland region from which *N. cocytius* is known. At present, it is thus impossible to link the Eala female with certainty to one of the named taxa.

8. *Neurogomphus cocytius* sp. n.

Neurogomphus wittei: PINHEY, 1962b: 180 (species mentioned from 'Zambezi'); PINHEY, 1967: 70, fig. 4a-d (brief description of specimens taken in 'April and May, common on the Zambezi River near the Victoria Falls'); PINHEY, 1969: 166-167, fig. 21a-b (occiput, appendages); PINHEY, 1971: 963 (comparison with *N. angustisigna*).

Neurogomphus vicinus: PINHEY, 1976: 555 (localities in Zambezi Valley; biology).

Neurogomphus uelensis: PINHEY (*in litteris* as well as on label attached to one male 'found in

copula while feeding on *Orthetrum brachiale*', NMB).

Neurogomphus CAMMAERTS *N°2*, near *vicinus*: PINHEY, 1984: 24 (brief description and localities, from the Middle Zambezi River).

Material

Zambia: 1♂, holotype, Katombora, 17°50'S 25°21'E, Zambezi River, 31.V.1961, (NMB); 3♂♂, 3♀♀ including allotype, *idem* (NMB), 1♂, *idem* (BMNH); 2♂♂, 3♀♀, Mosi-oa-Tunya, 17°55'S 25°51'E (the Zambian side of the Victoria Falls), Maramba River, 5-7.II.1964, (NMB), 1♂, 1♀, immatures, *idem* (author's collection). **Zimbabwe**: 3♂♂, including one slightly immature, 3♀♀, Victoria Falls, 17°55'S 25°51'E (the Zimbabwëan side of the Falls), 7.IV.1962, (NMB), 3♂♂, 3♀♀, *idem* (BMNH), 1♂, 1♀, *idem* (NMS), 1♂, 1♀, *idem* (DONNELLY's collection.). All this material seems to have been collected by E. PINHEY and except the holotype represent paratypes, including the allotype.

Not seen and not in NMB, BMNH or NMS: Zimbabwe, Victoria Falls, 5.I.1962 (mentioned in PINHEY, 1984: 24).

Distribution

So far, the species is only known from a limited geographic area of the Middle Zambezi River system, upstream the Victoria Falls. PINHEY (1976: 555) states that it is locally common on both sides of the Zambezi Valley, especially near Katombora and Kazungula (17°48'S 25°16'E, i.e. near the western end of the Caprivi Strip), less so at the Victoria Falls and that it will probably be found near the Chobe River (which lies in Botswana).

Bionomics

Flies from January till June, generally common in April and May (i.e. in the second half of rainy season but mostly in the first half of dry season). Immatures were found in February and beginning April. On 31 May 1961, one pair was taken *in copula* and one male was taken while feeding on a *Orthetrum brachiale* male. From PINHEY (*in litt.*, 1976 and 1984) we learn that 'both sexes, juveniles and mature specimens, rest on long grass or other low vegetation within 100 m of the river. They tend to be on wing most of the time, flying low over grassland, frequently settling on twigs of bushes or trees. The flight is rather low and direct, like that of some *Notogomphus*'. From PINHEY also (1978: 728) we learn that, like *N. zambeziensis*, *N. cocytius* is to be found along rivers with strong current, in open country or spare bush. Presumed F-0 exuvia found beginning April at the Victoria Falls (see section II of 'Results': Larvae).

Etymology

Named after the mythological River of the Hades, which is firstly an allusion to the rapids and huge cataract whereby the species is to be found and, to a lesser extent, to the painstaking difficulties the author encountered at the beginning of this study, in order to distinguish between the different taxa considered to be close to *N. vicinus* SCHOUTEDEN, 1934.

Description

Differential characters

This species has a lower venation index than *N. vicinus* and, to a lesser degree, than *N. uelensis* (numbers of antenodal and postnodal cross-veins; number of cells in radial and discoidal fields). It differs from *N. uelensis* by its paler colour pattern and by the more posteriorly positioned smaller lateroventral tooth of superior appendages. It also differs from *N. vicinus* by the form, the greater dimension and the more anterior position of the lateroventral tooth of superior appendages. It differs from *N. zambeziensis*, which flies in *N. cocytius* localities, mostly by its thoracic colour pattern, by its anal appendages, posterior hamules and vulvar scale and by its slightly lesser size, including pterostigma length.

Live coloration

Colour pattern strongly contrasting. On a hand-written insect label, presumably due to E. PINHEY, it is described as 'black and yellow-green, slightly greener in male. Eye of male light green above, paler below. Eye of female olive above, yellow below'.

Male

Dimensions: Table 1.

Head (Figs 4j-k).- Genae and frons, green. Postclypeus green, except a dark stripe on lower half of postclypeus, broadly interrupted in its middle (not totally in one specimen). Labrum, anteclypeus and mandibles brownish. Rest of mouthparts brownish yellow. Vertex green, except region of ocelli and postocellar ridge, which seems to be darker, according to the specimens. Postocellar ridge in the form of a semicircular ridge bearing two lateral bosses, medially separated. No process external to lateral ocelli. Occiput either entirely green or green with its middle or at least its posterior half, black. Occipital plate (Figs 5k-l) 1.53 - 1.74 times wider than high (7 specimens measured). In most specimens a hemispherical relief appears in the middle of a depressed occipital plate. Occipital crest either regularly convex or triangular, narrowly bordered with green and densely fringed with numerous black long hairs, the posterior angle provided with 0 to 4 small black spines (mean = 2; n = 14), which can be supported by pale tubercles.

Prothorax (Fig. 7m) with a green and black pattern recalling that of *N. uelensis*, but medially more extensively green.

Synthorax (Fig. 18f).- Spiracular dorsum green, except on anterolateral corners. Middorsal stripes ending before the collar ridge and, in most specimens, separated in two symmetrical parts by a narrow green middorsal carina. The antehumeral green stripes do not form a small triangle (contrary to *N. vicinus* and some specimens of *N. uelensis*), but extend to halfway the mesepisternum and are parallel to the postdorsal green stripes or even, in some specimens, are nearly connected to them by their anterior extremity or laterally. The large black mesepisternal-humeral stripes extend only slightly

under the mesopleural suture. They extend over the upper part of mesokatepisternum and, coloured brown or yellowish brown, along mesopostcoxale and metakatepisternum. Antealar sinus black, with green median crest. Interalar sclerite and subalar ridge black. A fairly large irregular black stripe running along subalar ridge, extending in the shape of the very short beginnings of interpleural and metapleural stripes (which are noted as missing). Thoracic sternum, yellow.

Legs.- Trochanters yellow. Femurs yellow with a black lateral stripe extending from posterior end to the 1/3 or even to the 4/5 of their length (depending on the specimens). In this last case, the whole basal 1/4 is black. Femoral spines, black. Tibiae, tarsi and claws (including ventral hook) brownish black (yellowish brown in immature specimens, except spines, end of claws and their ventral hooks, which are blackish).

Wings.- Venation and anterior margin of costa blackish brown. Pterostigma brown (pale yellow in immature specimens). Anal triangle 3-celled (holotype and most specimens), but 4-celled in 11% of wings (n= 18). No membranula. Ac cross-vein distal to A_3 level, but in some specimens, one wing or both may have Ac slightly proximal. Anal field formula: 3-4 , 3-5 / 2-3 , 3 / 2-4 , 3-4 / 3-4 , 3-4. Wing index (Table 1) distinguishes from that of *N. vicinus* by lower numbers of Ax and Px, of cells in 3rd and 4th row of radial field and of cells in distal margin of discoidal field.

Abdomen (Figs 22h-i) with a yellow/green and black pattern. Segment 1 blackish brown. Segment 2 green, anteriorly with a pair of laterodorsal black spots. Auricles yellow-green, in some specimens with blackish anterior border; posteriorly provided with 2 to 4 robust (though small) black spines, and 4-6 smaller ones, the spines non-aligned. Segments 3-6 green on anterior half and along most of middorsal line, the posterior half black or blackish, extending or not anteriorly along sides of middorsal line, according to the specimens (compare Fig. 22h and Fig. 22i). Segment 7 black (in mature individuals), with a narrow middorsal pale stripe and, often, the anterior 1/5, pale. Segment 8 black (mature specimens) or brownish red, with a sinuous dark distal zone. Segment 9 black (mature individuals), in some specimens anteriorly reddish brown and with a yellow transverse spot. Anterior half of segment 10 black, the posterior half brown or blackish yellow. Segment 10 measures 0.72 - 0.94 times the length of segment 9 (mean = 0.83; n = 12) (Fig. 47d).

Anal appendages black. Superiors (Figs 22a-g) straight and divergent, ending in a sharp point and provided with a medium-sized lateroventral short tooth at 61 - 70% of their length (mean = 65%; n = 10). This tooth is somewhat visible from above. Inferior appendage shorter than superiors, of simple form, its extremities ending in a simple, recurved tooth-like process (in one specimen, this process is made of two separated spiniform teeth).

Accessory genitalia.- Hamules dark brown. In immature specimens, they are medium coloured, the tip of posteriors distinctly darker. Posterior hamules elongate. In lateral view (Figs 23a-f) the tips have the shape of a large curved triangle of which the external edge is bordered and its base provided with a

small to large-sized blunt thumb-like process with 3-4 minute setae. In ventral view (Figs 24a-c), the distal half of the posterior hamules has a simple lanceolate curved form, not that of a 'S'. Penial sheath, in lateral view (Figs 23a-b), ending bevel-edged. Penis (Fig. 25f) dark brown, with glans ending in an oval-shaped cupule without flagella (Figs 25g-i).

Female

Range of dimensions and of wing index: Table 2.

Coloration of head (Fig. 4l) as in male. In one specimen from Katombora the dark stripe of postclypeus is reduced to two lateral brown areas. Postocellar ridge as in male. No distinct process external to lateral ocelli, but the beginnings of such a process can be distinguished. Occipital plate (Figs 6j-l) 1.79 - 2.04 times wider than high (3 specimens measured). Occipital crest with 0-2 (0 in most specimens, $n = 6$) short black spines, as in male, raised on yellow tubercles. These tubercles are of the kind seen in the females of *N. featheri* (Fig. 6s) or in the *sp. indet. B* from Assinie (Fig. 6r).

Prothorax (Fig. 7n) as in male. Synthorax (Fig. 18e) with the same colour pattern as in the male, but postdorsal stripes may anteriorly be connected to each other and antehumeral stripes may be slightly more reduced.

Wings with Ac cross-vein distal to A_3 level, but proximal in some specimens.

Abdominal colour pattern (Fig. 22j) as in male. Underside of abdominal segment 9 ochraceous yellow except paired tips of vulvar scale.

Vulvar scale (Figs 14k-l) ending with two short lobes widely separated from each other by an undeep indentation, which borders are concavely curved and separated at right angle.

9. *Neurogomphus vicinus* SCHOUTEDEN, 1934

Neurogomphus vicinus SCHOUTEDEN, 1934b: 66 (original description of a male, separated from *N. uelensis* by 'very clear' venational characters); FRASER, 1949a: 134 (holotype not examined, but 'total number of cross-veins in hind wing is only 44 compared to 43 in the type of *N. uelensis*', so that FRASER was inclined to think that *N. vicinus* is only a venational variety of *N. uelensis*); PINHEY, 1984: 25 (theoretical possibility that SCHOUTEDEN's *N. vicinus* taxon might be found in northern Zambia); DAVIES & TOBIN, 1985: 35 (mentioned in catalogue as a junior synonym of *N. uelensis*); TSUDA, 1986: 94; 1991: 103 (taxon listed in catalogue); BRIDGES, 1994: VII: 246 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon mentioned in index of species-group names of the genus *Neurogomphus*; considered to be a synonym of *Neurogomphus uelensis* SCHOUTEDEN); STEINMANN, 1997: 140 (listed in his catalogue as a synonym of *N. uelensis* SCHOUTEDEN).

Neurogomphus uelensis SCHOUTEDEN, var. *vicinus* SCHOUTEDEN: PINHEY, 1961a: 48 (mentions the holotype as 'a variety of *N. uelensis* from Katanga'); PINHEY, 1962b: 180 (bibliography and distribution).

Neurogomphus uelensis SCHOUTEDEN, 1934: PINHEY, 1967: 70 (*N. vicinus* being considered as a variety and a junior synonym of *N. uelensis*); DAVIES & TOBIN, 1985: 35 (*N. vicinus* is listed in their catalogue as a mere synonym of *N. uelensis*).

Material

Congo-Kinshasa: 1♂, holotype, Kibombo, 03°54'S 25°55'E (Kivu Region, Maniema district), 27.VI.1930, CH. SEYDEL leg. (MRAC).

Bionomics

The holotype was found in an area of dense humid semi-deciduous subequatorial forest, possibly with islets of Guinean savannah.

Description

Preliminary remark on taxonomy

The species is known only from the damaged immature holotype which is here described for the first time as accurately as possible. The brown and yellow or green areas of the colour pattern can hardly be distinguished, part of the abdomen is missing, the occiput is damaged and one of the superior appendages is broken. Its condition was so bad that SCHOUTEDEN could only describe the wings whose venation he considered to be sufficiently distinct to justify the creation of a new species.

After a discussion with the author, PINHEY (1984) changed his mind about the validity of the taxon *N. vicinus* SCHOUTEDEN, 1934, which he then considered to be distinct from the Zambezian *N. uelensis* AUCT. (nec SCHOUTEDEN) and *N. wittei* AUCT. (nec SCHOUTEDEN). However, I had to postpone establishing two new taxa (*N. zambeziensis* sp. n. and *N. cocytius* sp. n.) until the present revision.

Male (holotype)

Dimensions: Table 1.

Head (Fig. 26a).- Vertex, occiput, ante- and postclypeus and most of labrum appear to be dark. Areas appearing to be paler are the frons, except on its horizontal part, the areas facing the antennae, a small median spot on the upper border of postclypeus, the lower part of labrum and the sides of mandibles, which seem to be yellow. Genae also seem to be pale, perhaps green. Postocellar ridge in the shape of two slightly half-circling ridges separated medially, as in *N. cocytius*. No process external to lateral ocelli, or at the most its onset. Occipital plate with a low hemispherical relief along its median line, a feature which may also be seen in other species, such as in *N. cocytius* and *N. zambeziensis*. The posterior end of the plate is broken, but extrapolation from what remains of the plate gives a width of 1.56 times its height, a proportion which agrees with the plate of *N. cocytius* as well as with that of other species.

Prothorax (Fig. 7d) dark, but mediodorsally with a clear area, two adjacent elongated spots and a small medial posterior spot. Posterior lamina, dark.

Synthorax (Fig. 18g).- Colour pattern comprises large pale postdorsal stripes anteriorly confluent with a pale spiracular dorsum (leaving its anterior lateral extremities dark) and posteriorly with pale divergent triangular antehumeral

spots. (The interpleural space looks black coloured, but this artefact is due to the dark gap between the two major bundles of alar muscles, which can be seen through the pale cuticle.). The dark mesepisternal-humeral stripes extend somewhat beyond the mesopleural suture. Antealar sinus dark, pale along its middle. Interalar sclerite, subalar ridge and a sinuous stripe along it, dark. Metepimeron and metapostepimeron pale yellow. Thoracic sternum yellow or brown.

Legs.- Posterior femora yellow, their posterior 1/5 or 1/4, brown. Tibiae and tarsi brown. Claws brown with ventral and end hooks black.

A characteristic feature of the wings (Table 1) is the high density of their reticulation which easily differentiates *N. vicinus* from the nearby species, particularly *N. cocytius*. This is expressed, among others, by the high number of antenodal cross-veins in fore wings and by the development of the radial field, expanding in more than 2 rows of cells, beginning well before the level of pterostigma, the third row comprising up to 20 cells and the distal margin comprising about 10 cells. The high density of the reticulation is also expressed in the number of cells ending at the distal margin of the discoidal field, in the number of cells in the rows between the anal veins of the anal field and in the large number of bridge cross-veins. Anal triangles 3-celled. A narrow grey translucent membranula, from base of wing to halfway the external border of anal triangle. Ac distal to A_3 level. Anal field formula: 4-5 / 4 , 4 / 4 , 4 / 4 , 4-5. Hind wing with somewhat curved outlines.

Abdomen (Figs 27c-d) with yellow and brown colour pattern. Segment 1 dorsally brown, ventrally yellow. Segment 2 yellow, with dorsum brown in appearance. Auricles brown, with a series of ten minute black spines at posterior edge. Segments 3 and 4 brown with an elongated yellow spot on main part of dorsum (this spot irregularly shaped on segment 3) and with two successive lateral yellow spots on the sides. Segment 7 brown. Basal half of segment 8 brown with two laterodorsal yellow square spots (except in *N. paenuelensis*, this condition appears to be typical of an immature individual: series of specimens of *N. cocytius* and *N. uelensis* show that the whole basal half of 8th tergum becomes yellow in mature specimens). Segment 9 brown, perhaps yellow ventrolaterally. Anterior half of segment 10, black, its posterior half brown, as are the appendages. After dissection of the distorted abdomen, segment 10 was found to measure 0.86 times the length of segment 9 (Fig. 47e).

Anal appendages (Figs 27a-b). Superiors straight, diverging only 10 degrees with respect to the body axis and ending in a sharp point. A small, but conspicuous stud-shaped lateroventral tooth at 73% of the length of the appendage, thus more distally located than in *N. uelensis*, *N. cocytius or N. paenuelensis*. In dorsal view, this tooth is barely visible and lies at 67% of appendage length. Inferior appendage somewhat shorter than superiors, its extremities ending in a black upturned double tooth-like process.

Accessory genitalia.- Hamules and penis brown. Posterior hamules elongate in lateral view (Fig. 28a), provided with a sharp and narrow curved end hook, having at its base a well distinct anterodistal thumb-like process, which bears

3 or 4 minute setae. In ventral view (Fig. 37a), the distal half of the posterior hamules is slightly divergent, with curved tips. Penial sheath ending bevel-edged when viewed laterally (Fig. 28a). Penis: Fig. 25a. Vesicle blackish brown. Glans ending in a circular-elongated cupule without flagella, but with their prime beginnings (Fig. 25b).

Comments

A good characterisation of the taxon *N. vicinus* awaits the discovery of new material from Congo-Kinshasa. Current knowledge states that there may be taxa with only few interspecific differences. Therefore, it seems preferable to keep *N. vicinus* as a valid taxon, hoping that this position will act as an incentive for further collecting.

By its synthoracic pattern, the holotype of *N. vicinus* agrees with either *N. uelensis* or *N. cocytius* or with the Eala female, the latter being here considered to be near *N. cocytius*. By the position of the ventrolateral tooth of the male superior appendages it more agrees with *N. zambeziensis*. The holotype of *N. vicinus* differs from *N. uelensis* and nearby species by its higher venation index, especially the larger number of cells in radial field, the latter beginning more proximally than in other species. The pterostigma length, particularly in hind wings, is shorter than in *N. uelensis*, *N. cocytius* or *N. zambeziensis*. The holotype of *N. vicinus* differs also by the form and the more distal position of lateroventral tooth in superior appendages. In any case, it cannot be confounded with *N. uelensis*.

10. *Neurogomphus wittei* SCHOUTEDEN, 1934

Neurogomphus Wittei SCHOUTEDEN, 1934b: 67 (original description of a male); FRASER, 1949a: 131 (taxon considered as a good species), 132 (brief description of holotype).

Neurogomphus wittei: PINHEY, 1962b: 180 (bibliography and distribution); PINHEY, 1967: 70 (holotype mentioned from 'Hoba' (sic), but *N. wittei* is confounded with what is here described as *N. cocytius*); PINHEY, 1984: 25 (theoretical possibility that the species corresponding to SCHOUTEDEN's *N. wittei* might be found in northern Zambia); DAVIES & TOBIN, 1985: 35 (taxon listed in a catalogue as a synonym of *N. featheri* PINHEY, 1967, the latter being considered to be the valid name !); TSUDA, 1986: 94; 1991: 103 (taxon listed in catalogue); BRIDGES, 1994: VII: 253 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon name mentioned in index of species-group names of the genus *Neurogomphus*); STEINMANN, 1997: 140 (taxon listed in catalogue); CLAUSNITZER, 2001: 58 (species mentioned from Congo-Kinshasa in a list of Odonata likely to occur in East Africa).

Material

Congo-Kinshasa: 1♂, holotype, Moba, 07°03'S 29°47'E (Tanganika Region), VI.1931, G.F. DE WITTE leg. (MRAC); 1♂, Uvira, 3°24'24"S 29°08'45"E (Kivu Region), 13.VIII.1952, G. MARLIER leg. (MRAC).

Bionomics

This species is so far only known from the western shores of Lake Tanganyika and thus may be lacustrine. Indeed, in the years 1950 Georges MARLIER (personal communication) found *Neurogomphus* larvae offshore, at Uvira, on the bottom of this lake, at the place where he caught a male imago. However, there is a possibility that this imago came from one of the small tributary rivers which run through a dry forest with patches of savannah.

Description

Male

Range of dimensions: Table 1. Dimensions of holotype (mm): hind wing 28.6; pterostigma length: f-wing 2.5 - 2.6, h-wing 2.8 - 2.9; abdomen 35.4.

General colour pattern well contrasted, green and black.

Head (Fig. 26b).- Genae and base of mandibles greenish brown or grey. Frons and 1/3 of upper part of postclypeus green (the latter with only a faint median green spot in the upper third of the dark postclypeus in the Uvira male). Labrum, anteclypeus and lower 2/3 of postclypeus (nearly all the postclypeus in the Uvira specimen), blackish brown. Rest of mouthparts brownish. Vertex and occiput brownish black. Postocellar ridge in the form of two slightly semicircular bosses medially separated (by a large flat separation in the Uvira male). No process external to lateral ocelli. Occipital plate (Fig. 5m) depressed in its centre, 1.39 (Uvira) - 1.44 (holotype) times wider than high. Occipital crest rounded, without spines and fringed with black hairs, mainly laterally.

Prothorax (Figs 7o-p) brown, green along middorsum, as in *N. uelensis*, but with smaller paired posterior spots. The Uvira male has somewhat more reduced green middorsal areas, but additional small green spots postero-laterally.

Synthorax (Fig. 18h).- Spiracular dorsum black on middorsum and irregularly green on sides. Middorsal black area narrowly confluent with black of spiracular dorsum. Middorsal carina black (holotype) or green (Uvira). Postdorsal green stripes confluent with green of spiracular dorsum. Antehumeral green stripes extending to half the length of mesopleural suture (holotype) or nearly to its anterior end, in which case they are largely confluent with the green postdorsal stripes (Uvira). Humeral black stripe extending well underneath the mesopleural suture. An incomplete interpleural black stripe. Metapleural black stripe nearly complete (holotype) or complete (Uvira). In the latter case, it extends as a brown stripe circling all around metepimeron sides. Metapostepimeron, mesopostcoxale, meso- and metakatepisternum, brown. Antealar sinus and interalar sclerite, black. Thoracic sternum brown.

Legs.- Trochanters brown. Femurs entirely brown, with black spines, except their base. Tibiae and tarsi brownish black.

Wings.- Range of index: Table 1. Venation blackish brown, black around pterostigmas, which are brown (their distal quarter is lighter in holotype). Anal triangle 3-celled. Ac distal to A_3 vein. A narrow translucent membranula from

wing base to first 1/3 of (holotype) or halfway (Uvira) anal triangle external border. Anal field formula: 3 , 3-0 / 3 , 0-3 / 2-3 , 2-3 / 3-4 , 3-4.

Wing index of holotype: 11 (fw) and 7-9 (hw) Ax; 8-10(fw) and 9 (hw) Px; second Pans 4 (fw) and 4-5 (hw); 3-4 (fw) and 4-4.3 (hw) cells under pterostigma; radial field with third row beginning at c (fw) and a-b (hw) levels, comprising 9 (hw) cells; fourth row at d (fw) and c-d (hw) levels, comprising 6 (hw) cells; distal margin with 7 (hw) cells; 2-3 and 1 cross-veins between Rs and MA; 8-9 (fw) and 6-7 (hw) bridge cross-veins; 2-3 (fw) and 3 (hw) cells between R_4 and MA at distal margin; discoidal field expanding at +2 and +3 (fw) and -1 (hw) levels, with 8 (fw) and 8-10 (fw) cells at distal margin; anal field formula: 3 / 3 / 2 , 2 / 3 , 3.

Abdomen (Figs 27i-j) with well-contrasted colour pattern. Segment 1 dorsally green, laterally blackish brown, with a median greenish spot. Segment 2 green with a pair of blackish brown laterodorsal stripes, extending all along the segment. Auricles green, ending with about ten minute black spines. Segments 3-7 black, with a yellow narrow middorsal stripe extending nearly to posterior limits of segments and confluent (Uvira) or not (holotype) with a yellow basal ring. The clear markings are also more reduced in holotype. Segment 8 blackish, its basal half nearly entirely covered with a yellow area. Segment 9 blackish brown, basally with a laterodorsal pair of yellowish spots. Segment 10 blackish. Segment 10 measures 0.85 (holotype) - 0.88 (Uvira) times the length of segment 9.

Anal appendages (Figs 27e-h) blackish. Superior appendages in dorsal view straight and divergent, distinctly narrowing at the distal 1.5/10 of their length, ending strong. In lateral view, the recurved extremity is robust and short. The superiors are provided with a barely visible lateroventral squat and blunt tooth, at a distance of 79% (Uvira) or 84% (holotype) of their length. Inferior appendage with basis slightly thicker than its two branches, the latter ending in simple recurved tips.

Accessory genitalia.- Hamules dark brown. Posterior hamules elongate. In lateral view (Figs 28b-c), end hook in holotype ends with distal half straight and narrow, this hook being shouldered by a slightly prominent subdistal process provided with a few short setae. In the Uvira specimen the end hook is less narrow, the subdistal process being stronger and thumb-shaped. In ventral view (Figs 37b-c), the distal half of posterior hamules is somewhat sinuous. Penial sheath dark brown, with rounded extremity when viewed laterally (Figs 28b-c). Penis (Fig. 25c) dark brown. Glans (Figs 28b-c) with an ovoid-elongated cupule, ending with the very short vestigiae of two flagella (Fig. 25d: holotype; Fig. 25e: cupule broken in Uvira male).

11. *Neurogomphus zambeziensis* sp. n.

Neurogomphus uelensis: PINHEY, 1958: 98, 108 (Katombora, Zambezi River); PINHEY, 1961a: 48 (*idem*, a solitary female); PINHEY, 1962b: 180 (bibliography and distribution, Zambezi specimens); PINHEY, 1967: 70, fig. 5a-e (brief description of specimens from the Zambezi River, near Victoria Falls); PINHEY, 1969: 167 (occiput); PINHEY, 1971: 963 (taxon [in fact

N. zambeziensis sp. n.] confused with *N. uelensis* SCHOUTEDEN and compared with *N. angustisigna* PINHEY).

Neurogomphus ?uelensis: PINHEY, 1961b: 70 (female at rest on a twig, *cf* PINHEY, 1961a: 48).

Neurogomphus CAMMAERTS N°3: PINHEY, 1984: 24 (Zambezi Valley; brief description, with localities).

Neurogomphus ? vicinus: PINHEY, 1985: 3 (mentioned from Krüger National Park; type of *N. vicinus* erroneously mentioned as being from Katanga); SAMWAYS, 1992: 168-169 (Krüger National Park, without further details); SAMWAYS, 1999: 42 (*idem*, spelled *vicinis*); HEDGE & CROUCH, 2000: 44 (mentions PINHEY's 1985 temptative identification concerning the Krüger National Park).

Neurogomphus zambeziensis [CAMMAERTS, 2002]: SAMWAYS, 2001: unavailable name in a list of South African dragonflies with level of endemism (11th P.H.A.O.N. electronic newsletter, 4 May 2001).

Neurogomphus zambesiensis [CAMMAERTS, 2002]: SAMWAYS, 2002: 47 (unavailable name and incorrect spelling of a taxon which has not yet been described, but only mentioned in a list of South African dragonflies which comments the level of species endemism).

Neurogomphus zambeziensis: TARBOTON & TARBOTON, 2002: 18 (unavailable name, with brief description and comments on geographical distribution. [see my comments on page 141].

(The) Zambezi siphontail: SAMWAYS, 2001 (vernacular name proposed in the 11th P.H.A.O.N. electronic newsletter, 4 May 2001); SAMWAYS, 2002: 47 (vernacular name proposed); TARBOTON & TARBOTON, 2002: 18 (idem).

Hewelstert: TARBOTON & TARBOTON, 2002: 18 (vernacular Afrikaans name [Hewel = siphon; stert = tail] proposed for the presently described taxon).

Material

Zambia: 2♂♂, 3♀♀, including holotype and allotype, Katombora, 17°50'S 25°21'E, Zambezi River, 1-2.II.1965, E. PINHEY leg., (NMB; one ♀ paratype in author's coll.); 1♀, *idem*, I.1956, E. PINHEY leg. (*cf* PINHEY, 1961a: 48 and 1961b: 70; NMB); 1♀, Maramba River, 17°54'S 25°51'E, 5.II.1964, E. PINHEY leg. (NMB); 2♂♂, Mosi-oa-Tunya, 17°55'S 25°51'E, Maramba River, 3.II.1965 (NMB and author's collection). **Zimbabwe**: 3♂♂, 1♀, Katombora Rapids, forested margins of the Zambezi River near Kazungula Camp (17°48'S 25°15'E), 1-10.XII.1982, Falcon College Expedition, D. HANCOCK & R. CHAHWANDA leg. (NMB). **South Africa**: 2♂♂, Pafuri, 22°25'S 31°18'E, (Limpopo Prov.: Krüger National Park), 1.XII.1964, VARI & POTGIETER leg. (TM); 1♂, Ndumu (now Ndumo), 26°55'S 32°16'E (Kwa-Zulu-Natal Prov., nature reserve), 10-12.II.1968, POTGIETER & JONES leg. (TM). **Mozambique**: 1♂, Vila Nova near Marromeu, 18°23'42"S 35°54'27"E, VI.1999, on a swamp, R. KINVIG leg.(SAMWAYS collection). Except holotype, all this material represents paratypes, including the allotype. Note that holotype identity is not as stated in PINHEY (1984: 24).

Not seen and not in NMB, BMNH or NMS: Victoria Falls, I.1956 (mentioned in PINHEY, 1984: 24).

Distribution

The species is known with certainty from the Middle Zambezi Valley and near the mounding of this river (in Mozambique); also from northern Transvaal near the Limpopo River and northern Natal. The species very probably further extends into Tanzania: two females which seem to pertain to

N. zambeziensis are known from the surroundings of Morogoro and are described below. The species perhaps even extends into the east of Congo-Kinshasa, in which case the female taken at Kere-Kere would represent a geographical form of this taxon.

Bionomics

The Middle Zambezian and South African *N. zambeziensis* individuals were only taken in the middle of the rainy season, which lasts from December till February. On the contrary, the male from Mozambique was taken at the beginning of the dry season . While the Middle Zambezian imagines appear to favour running water, the male from Mozambique was found in a swamp, nevertheless not far from the Zambezi river. Presumed F-0 exuvia found in January at Victoria Falls (see section II of 'Results': Larvae).

Description

Male

Range of dimensions: Table 1. The range of pterostigma and hind wing dimensions is higher than in *N. cocytius* and *N. vicinus* (Table 1). Dimensions of holotype (mm): fore wing 34.4; hind wing 32.5; pterostigma length: fw 3.5, hw 4.1; abdomen 42.

Head (Fig. 26d).- Mouthparts yellowish brown, except base of mandibles, which is green. Genae and frons green. Postclypeus green with a wide dark stripe on lower 2/3. This stripe can be nearly or fully interrupted (in some specimens from Katombora) by green in its middle. Anteclypeus and labrum brownish. Vertex yellow-green (pale brown in the Mozambique male), except ocelli and region of postocellar ridge, which are brown. Postocellar ridge formed by two semicircular rounded bosses medially separated by an incomplete depression (thus of the kind seen in *N. cocytius*) and giving the impression of a V-shaped ridge with separated rounded branches. No typical small callus external to lateral ocelli, but a slight beginning of it may be distinguished in some specimens. Anterior half of occiput green, posterior half blackish green or brown, this dark area tending to extend forwards in its middle. Occipital plate (Figs 5n-o) 1.59 (Katombora, extreme form) - 1.75 (Ndumo and Mozambique) times wider than high. As in *N. cocytius* and *N. vicinus*, the depressed plate often bears a median hemispherical relief; Occipital crest angulated, without spines and densely fringed with numerous black long hairs; the crest is often anteriorly turned up, as in *N. cocytius*. In the Mozambique male it has a slight notch in its middle.

Prothorax (Fig. 7r) mostly blackish, except a moderately-sized green anterior transverse area, not extending posteriorly and a small green posteromedian spot made of paired, adjacent areas. This paired spot is even absent in the Mozambique male. Posterior lamina black, with a small median green spot.

Synthorax (Figs 29a, right side and 29b).- Spiracular dorsum black, except a narrow green collar stripe. Middorsal carina black. Postdorsal green stripes, in

their middle, narrower than the green antehumerals. The latter diverge somewhat from the postdorsals, are sinuous and large, and end acutely near the anterior end of mesepisternum. In South Africa and Mozambique males, the postdorsal green stripes tend to be or can be separated from the antehumerals. Humeral black stripe extending well underneath the mesopleural suture and rejoining, by means of a brown area, an incomplete black stripe running along the anterior half of interpleural space. Subalar ridge black, but not bordered on thoracic sides by a black stripe, if we except a small spot on posterior end of interpleural space. A complete metapleural black stripe, lying mostly below the suture and extending as a brown and blackish brown stripe anteriorly and ventrally along the borders of metepimeron. In some specimens of the Zambezian localities and in the males from South Africa, this dark stripe circles along metepimeron borders and produce a posterior diverticulum nearly fused with the ventral part of the stripe. Metapostepimeron brown, its middle yellow. Mesokatepisternum dorsally black, the rest brown, as are mesopostcoxale and metakatepisternum. Antealar sinus, its median crest and interalar sclerite, entirely black. Thoracic sternum, yellow.

Legs.- Trochanters brown. Posterior femur brown, its 1/3 posterior end black, extending in the shape of a narrow black lateral stripe to anterior 1/3. Anterior fore femur mostly blackish. Tibiae, tarsi and claws, black.

Wings.- Venation black, the costal vein blackish brown, except at pterostigma. Pterostigma brown, between black veins. Membranula narrow and light grey, extending to 1/3 or half of alar triangle border. Ac cross-vein lies slightly proximal to, at level with or distal to A_3 vein, in about equal proportions. Anal loop 1-celled. Anal triangle 4-celled (however, 3 cells in 18% out of 22 wings: in 7% of Middle Zambezi wings and in 38% of South African and Mozambique wings). Range of wing index: Table 1. As far as can be inferred from 3 specimens, the South African males tend to have somewhat more cross-veins than the Middle Zambezi males: antenodals in hw 8-10 (Zambezi) and 9-11 (SA); postnodals in hw 8-11 (Zambezi) and 8-12 (SA); cells in fw fourth row of radial field: 5-8 (Zambezi) and 7-9 (SA), in hw 4-8 (Zambezi) and 6-9 (SA); fw bridge cross-veins 5-7 (Zambezi) and 6-8 (SA); in hw 4-5 (Zambezi) and 5-7 (SA). The numbers of Ax and Px as well as of cells in third row of radial field and in distal margin of discoidal field in *N. zambeziensis* are as in *N. cocytius*, thus unlike those in *N. vicinus*. Anal field formula range (except Mozambique male) 4-5, 4-5 / 3-4, 3-4 / 2-3, 3-4 / 3-4, 3-4. The Mozambique male has a lower formula: 1-3, 2-4 / 3, 0-4 / 2-3, 0-3 / 3, 3. It has also a lower number of cells under hind wing pterostigmas: 3.3 - 3.7 (3.7 - 5.0 in the specimens from other regions) as well as a smaller pterostigma length: 2.9 - 3.0 mm (fw) and 3.2 - 3.3 mm (hw) instead of respectively 3.0 - 3.6 and 3.4 - 4.1 mm in the specimens from other regions.

Abdomen (Figs 30a-b) with well contrasted colour pattern. Segment 1 green. Segment 2 green except a pair of posterior laterodorsal black triangular spots extending the most in the Mozambique male, where they reach anterior border of segment (such as in the female from Turiani, Tanzania: Fig. 30d). Auricles yellow-green, posteriorly provided with 5 to 13 small non-aligned

black spines. Segment 3-6 black, except anterior 1/4 or 1/3. Segment 7 black. Segment 8 black with a green or yellow anterior irregular area (Middle Zambezi Valley and Mozambique) or two distinct laterodorsal yellow spots (South Africa). Segment 9 and 10 black (Middle Zambezi Valley and Mozambique), but in South Africa specimens brown with basal half of segment 10 black. Segment 10 measures 0.86 (0.82 - 0.90) times the length of segment 9 ($n = 9$).

Anal appendages (Figs 31a-n) black. Superiors divergent and straight, ending in a sharp tip, which can be as fine and acute as a needle (in the Pafuri males). The superior appendages are provided only with a very small, in some specimens nearly inconspicuous, lateroventral short tooth, at a distance of 69% (65 - 72%) of their length (Middle Zambezi: 67 - 72%; South Africa and Mozambique: 69 - 71%) ($n = 9$). Dorsally, the lateroventral tooth can be not visible (in the South African and Mozambique specimens) or barely so, but in one specimen from Katombora it clearly appears as a forward directed small spine (Fig. 31b). Inferior appendage shorter than superiors, its extremities ending with a small and slightly recurved simple spiniform process.

Accessory genitalia black or blackish brown (vesicle of penis blackish green in the Zambezi Valley males). Posterior hamules in lateral view (Figs 23g-k) elongate, with curved tips well separated from an antero-subdistal strong thumb-like process which is provided, on its inner edge, with a dense tuft of minute (but relatively long) golden setae. The subdistal thumb-like process is slightly more rounded in the South Africa males than in the Zambezi Valley ones. Thus, in lateral view, the distal part of the posterior hamules has a shape somewhat intermediate between that of the hamules of *N. vicinus* and *N. cocytius*. In ventral view (Figs 24d-i), the distal half of the posterior hamules has a sinuous form, with the extremity obviously tending to diverge and the subdistal thumb-like hook well visible. Penial sheath (in lateral view, Figs 23g,i,k), ending bevel-edged or somewhat truncated (South Africa). Penis: Fig. 25j. Glans with an ovoid cupule ending in the short vestigiae of two flagella (Figs 25k-o).

Female (Middle Zambezi Valley).

Dimensions and wing index: Table 2. As in male, the length of the wings and pterostigmas are longer than those of *N. cocytius*.

Head (Fig. 26e) as in male, including the occipital crest, which lacks spines. Occipital plate (Figs 6m-n) 1.71 - 1.76 times wider than high (2 specimens measured).

Coloration of thorax (Figs 7s and 29a, left side) as in male.

Anal loop of wings 1-celled. Ac distal to A_3.

Coloration of abdomen (Fig. 30c) as in male, but green parts more extended on segments 3-6.

Vulvar scale (Figs 14m-n) ending with a pair of obvious triangular acute tips, separated from each other by a deep triangular indentation which (inner) borders tend to be straight or convex.

Comments

1) Neurogomphus zambeziensis *in 'A fieldguide to the Dragonflies of South Africa' - TARBOTON & TARBOTON (2002)*

The field guide to the Anisoptera of South Africa by TARBOTON & TARBOTON (2002) gives a short and inadequate description of a taxon named *Neurogomphus zambeziensis*. This description contains no authorship, date, nor indication that the taxon is a new one. Reference is made however to records of two of the three Pafuri and Ndumo males, which are the only known South African records of this taxon. The use of the name *N. zambeziensis* evidently takes its origin from the identification labels which accompany the specimens located in the Transvaal Museum collection and which clearly indicate that they are (potential) paratypes of a new species named *Neurogomphus zambeziensis* by R. CAMMAERTS.

The last edition of the International Code of Zoological Nomenclature (1999, with effect from 1 January 2000) states that, after 1999, to be available, new nominal taxa must be explicitly indicated as being intentionally new (ICZN, 1999: Article 16.1). This is not the case for the name *N. zambeziensis* in TARBOTON & TARBOTON (2002) and means therefore that it is unavailable as a zoological name and cannot bear their authorship. Furthermore, the authors state that the "type [of *N. zambeziensis* is] from Katanga, Congo in 1934", which can therefore only refer to one of SCHOUTEDEN's taxa. It should be noted that treating a name as a junior synonym of a valid name also makes it unavailable (ICZN, 1999: Article 11.6).

Despite the unavailability of the species name *Neurogomphus zambeziensis* as it appears in TARBOTON & TARBOTON (2002), this name becomes valid in the present paper with CAMMAERTS as author, because the taxon is now described with the intentional and explicit indication that it is a new one.

As a consequence of the invalidity of the name *N. zambeziensis* as it is mentioned in TARBOTON & TARBOTON (2002), the identity of the type to which they refer becomes a problem of secondary interest. Nevertheless, it might be interesting to discover what type this is. Coming from the Katanga Province as it was known from 1933 onwards, SCHOUTEDEN (1934b: 67) described only his *N. wittei* (holotype from Moba, Tanganika district), which by no means resembles to the taxon described here. However, I strongly suspect that TARBOTON & TARBOTON refer to *N. vicinus* SCHOUTEDEN (1934b: 66-67), a more related taxon described as being from the Kivu Province (holotype from Kibombo, Maniema district). The reason for this argument appears to be in PINHEY (1985: 3) who in his survey of the South African Anisoptera mentions the Pafuri record(s) under the heading "*N. ? vicinus* SCHOUTEDEN, 1934: 66 (Shaba = Katanga)". PINHEY's questionable identification of the Pafuri material dates from a time where it was persistently believed that the two most common *Neurogomphus* species of the Zambezi river system were either *N. wittei*, *N. uelensis* or even *N. vicinus*, simply because SCHOUTEDEN's holotypes were inadequately characterised. The statement that *N. vicinus* is from Katanga is evidently incorrect.

Finally, I would like to comment on some morphological features of the genus *Neurogomphus* as presented in TARBOTON & TARBOTON's valuable field guide. Although the drawing of the male terminalia in the key to the genera on page 89 correctly identifies the 10th segment as being constricted, the drawing on page 19 misidentifies the abdominal segments: the abrupt constriction indicated as being the 9th segment represents in fact the anterior half of segment 10, so that the foliations indicated as being those of segment 8 are in fact the narrow foliations of segment 9. (Segment 8, which has larger foliations, has not been drawn.).

2) *Relations with other taxa*

The venation of this species is closest to that of *N. cocytius*. *N. zambeziensis* has a slightly larger size, including pterostigma length. The dimension and position of the lateroventral tooth of superior appendages agrees with that of *N. vicinus*. However, venation index is lower and thoracic colour pattern differs greatly.

Although the face and especially the prothorax of the three known males from South Africa are stained due to post-mortem decay, their colour pattern appears not to differ significantly from that of the Zambezi Valley specimens and their morphology and dimensions fall within the range of variation of the latter, with the slight exception of some aspects of wing index.

12. *Neurogomphus cf zambeziensis* (Tanzania females)

Neurogomphus uelensis: PINHEY, 1958: 108 (mentions a female from central Tanganyika); PINHEY, 1961a: 48 (*idem*); PINHEY, 1962b: 180 (bibliography and distribution: Tanganyika); PINHEY, 1967: 70 (mentions a female from Turiani, Tanzania); CLAUSNITZER, 2001: 58 (species mentioned from Tanzania in a list of East African Odonata); CLAUSNITZER, 2003: 346 (concerns the Turiani female which is erroneously mentioned as being from the Usambara Mountains).

Neurogomphus ?uelensis: PINHEY, 1961b: 70 (mentions a female from Turiani).

Neurogomphus (spec. indet.): PINHEY & PINHEY, 1984 : 132 (mention a female from Mikumi National Park).

Material

Tanzania: 1♀, Turiani Forest, five miles south of Turiani T.T., 06°09'S 37°36'E, thus north of Morogoro, IV.1954, E. PINHEY leg. (NMN); 1♀, Mikumi National Park, *ca* 07°25'S 36°15'E, thus south of Morogoro, V.1970, J. KIELLAND, leg. (NNM).

Bionomics

The Tanzania females appear to have been taken at the end of the rainy season (which may last from November till May) or at the beginning of the dry season.

Preliminary comments

These two Tanzania females taken in the surroundings of Morogoro most likely pertain to the taxon *N. zambeziensis* sp. n., although apparently to a somewhat different population. In some respects, the colour pattern of the *N. zambeziensis* male from Mozambique seems to link these two females to those of the Middle Zambezi Valley. These Tanzania females are provisionally left under the name *N. zambeziensis* awaiting the discovery of males. Because of uncertainties about their exact status, these females are not considered to be paratypes.

Description

Dimensions of abdomen and wings, including pterostigmas, as in Middle Zambezi Valley females.

The coloration of the Turiani female is well preserved and enables a full comparison with the Middle Zambezi Valley females. On the contrary, the Mikumi female, except its head, is too much darkened owing to decay process.

Head (Fig. 26f).- Upper part of frons, black, instead of green in typical *N. zambeziensis*. Postocellar ridge V-shaped with branches widely spread apart and with a median depression, the hiatus being the wider in the Turiani female. An obvious knob-like process on the semicircular ridge external to lateral ocelli. Occiput greener than in *N. zambeziensis*, its crest angulous in the Turiani female (recalling the form of the crest in Middle Zambezi females) and smoothly rounded in the Mikumi female. Occipital plate (Figs 6o-p) 1.88 (Turiani) and 2.22 (Mikumi) times wider than high.

Prothorax (Fig. 7t) coloration may correspond to that of the Middle Zambezi Valley females, although darker. The green anterior transverse area remains, but like in the Mozambique male there is a black area instead of a pair of clear posteromedian spots and a black posterior lamina.

Synthorax (Fig. 29c) as in Middle Zambezi Valley specimens, but with antehumeral green stripes well separated from the postdorsal ones, as in some of the South Africa males.

Legs (Turiani).- Posterior femurs entirely ochre-black, the most dark distally. Same pattern for anterior and median femurs, with a more marked difference between proximal and distal parts. Tibiae and tarsi black.

Wing index (Table 2) as in Zambezi females, except that in hind wing there can be more cells in fourth row of radial field, one or two more bridge cross-veins and that the discoidal field extends more proximally. Up to three cross-veins between Rs and MA, but this third vein is incomplete (Turiani female). Ac cross-vein distal to A_3 (one wing of the Mikumi female has Ac proximal to A_3 vein).

Abdomen (Fig. 30d) with colour pattern recalling that of the Middle Zambezi females, but dark areas more extended on segment 2 (also in the male from Mozambique).

Vulvar scale (Figs 14o-p) with prominent tips, such as that of the Middle Zambezi females.

13. *Neurogomphus sp. indet. B* (♀, Kere-Kere)

Neurogomphus Wittei: FRASER, 1949a: 132-133 (description of a female from Kere-Kere, designated as the allotype of *N. Wittei* SCHOUTEDEN).
Neurogomphus wittei: PINHEY, 1962b: 180 (mentions FRASER's female); PINHEY, 1967: 70 (mentions the Kere-Kere female).

Material

Congo-Kinshasa: 1♀, Kere-Kere, 02°40'N 30°30'E (Kilo, Ituri Region), 1934, Dr. TURCO leg. (MRAC, with label R Det G 5272)

Description

Dimensions, including pterostigmas length, smaller than those of *N. zambeziensis* (Table 2).

Face (Fig. 26c) and synthorax (Fig. 29d) , though quite different, recall those of *N. wittei* (from which only two males are known) or *N. zambeziensis*. Prothorax, however, of a different colour pattern (Fig. 7u).

Vertical part of frons green, as is a spot on medioposterior part of postclypeus. Horizontal part of frons green, but posterior half, black. The rest of face ochraceous light brown, vertex and occipital plate brown. A semicircular postocellar ridge, laterally more elevated. No process on semicircular ridge external to lateral ocelli. Occipital plate (Fig. 6q) 1.55 times wider than high. Occipital crest angular-rounded, with a small notch in its middle and without spines.

Wing index, although slightly higher, might be compatible with that of *N. wittei* (as inferred from the males). Ac distal to level of A_3 vein.

Colour pattern of abdomen (Fig. 30e) may agree with that of the *N. wittei* males.

Vulvar scale (Fig. 14q) with tips not really prominent (thus not as in *N. zambeziensis*), separated by a wide and shallow cleft.

Comments

This single female, which was established as the allotype of *N. wittei* by FRASER (1949a) appears not to belong to this species, at least because of the obviously larger size of its face (compare Figs 26b and 26c where the face of this female and that of the male holotype of *N. wittei* are drawn at the same scale). This female, which might be placed near *N. zambeziensis* has in fact an uncertain taxonomic status.

14. *Neurogomphus sp. indet. C* (♀, Assinie)

Neurogomphus agilis: PINHEY, 1962b: 179 (mentioned, but not described, as the female allotype; locality erroneously mentioned as 'Abyssinia'); PINHEY, 1967: 68 (*idem*).

Material

Ivory Coast: 1♀, Assinie, 05°07'N 03°17'W, (labelled "*Oxygomphus agilis* R. MARTIN / Type Assinie", in MNHN).

Description

This female from Ivory Coast (see Introduction concerning its locality) has the prothorax (Fig. 7v) and facial (Fig. 26c) colour pattern distinct from those of *N. zambeziensis*, but the synthorax pattern (Fig. 29e) recalls that of the latter species. However, face, prothorax and synthorax might also confer to this female the status of a geographical form of *N. wittei* (as inferred from the *N. wittei* males). Meanwhile, the occipital crest is triangular, its ridge being provided with three strong raised spines (Fig. 6r). Identity with *N. agilis* is unlikely because of differences in face and thoracic colour pattern.

Dimensions (Table 2) are compatible with those of the female from Kere-Kere (*Neurogomphus sp. indet. B*) and wing index (Table 2) may agree with that of the Middle Zambezian population of *N. zambeziensis*. Ac cross-vein at level with A_3 vein.

Colour pattern of abdomen resembles that of *N. uelensis* females from Forêt de Andok (Gabon).

Vulvar scale (Fig. 14r) is of the *N. zambeziensis* kind.

Other characteristics are: a semicircular postocellar ridge, laterally more elevated. No process on semicircular ridge external to lateral ocelli. Occipital plate (Fig. 6r) 1.78 times wider than high.

Comments

As inferred from its thoracic colour pattern and shape of vulvar scale, this female might pertain to a *N. zambeziensis* complex of geographic forms. However, *N. zambeziensis* appears to be an oriental taxon inhabiting relatively dry woodlands. Assinie lies, on the contrary, on the coastal edge of the West African humid forest belt. Although the locality Assinie appears on its label, we cannot exclude the possibility that it was incorrectly written for 'Abyssinie'.

At this stage, no identification is possible with sufficient confidence.

15. *Neurogomphus agilis* (MARTIN, 1908)

Notogomphus agilis MARTIN, 1908: 657-659 (original description; from 'Guinée portugaise', without further precision); RIS, 1909: 25-26 (expressed the opinion that it is not a *Notogomphus*); FRASER, 1936: 140 (considered it as the type-species of *Oxygomphus* LACROIX although it was unknown to LACROIX); FRASER, 1949a: 134 (see under *Neurogomphus agilis*); BRIDGES, 1994: VII: 5 and VIII: 47 (listed in catalogue as type species of a genus in synonymy with *Neurogomphus*); STEINMANN, 1997: 139 (taxon listed in catalogue, with synonyms).

Oxygomphus agilis MARTIN [MS name]: LACROIX, 1921: 49 (uses this name to describe a male from 'Congo' in MARTIN's collection [later on deposited in the Paris Museum]. It should have appeared in P. WYTSMAN's Genera Insectorum, but the part concerning the Gomphidae was never published; comparison of its hind wing and abdomen lengths to that

of the female holotype of *Oxygomphus martininus* LACROIX); SCHOUTEDEN, 1934b: 68 (wonders if it is not conspecific with *Notogomphus agilis* (MARTIN, 1908); FRASER, 1949a: 134 (see under *Neurogomphus agilis*).

Oxygomphus agilis LACROIX, 1921: FRASER, 1936: 139 (gives to MARTIN MS name LACROIX's authorship); STEINMANN, 1997: 139 (synonym of *Neurogomphus agilis* (MARTIN, 1908) in catalogue).

Oxygomphus agilis MARTIN: FRASER, 1940: 545, fig. 10 of pl. 3 (drawing of the extracted penis of a *Neurogomphus* which may be the 'Congo' male, but there is no mention of a locality; however, I found the penes of the two only known males of *Neurogomphus agilis* still *in situ* when I examined them and without the two clearly separated and relatively long flagella drawn by FRASER in his 1936 and 1940 papers !).

Oxygomphus agilis (MARTIN, 1908): FRASER, 1936: 139-141, fig. 2 (consequently to the fact that FRASER discovered the synonymy of *O. agilis* MARTIN [MS name for the 'Congo' male in Paris Museum] with *Notogomphus agilis* MARTIN, 1908 [which holotype is located in Genoa Museum], and to the opinion of COWLEY (*in litt.*, in FRASER, p. 140), MARTIN's *Notogomphus agilis* (1908) is considered to be the type species (genotype) of *Oxygomphus* LACROIX, 1921; however, FRASER has some doubts about the validity of the type species identity as MARTIN's *N. agilis* was unknown to LACROIX; he therefore emphasises the need for a decision of the International Commission on Nomenclature; the appendages, secondary genitalia and occiput of the Paris Museum male are drawn; three specimens are considered to belong to this species: the Genoa and Paris Museums males and a third male, in MORTON's collection (Edinburgh), erroneously stated as being from Nigeria [and which shall later on become the holotype of *Neurogomphus featheri* PINHEY, 1967]); KLOTS, 1944: 6-8 (compares his *Oxygomphus chapini* with FRASER's (1936) description and figures of the Paris Museum male; in his footnote of p. 6 an erroneous translation of MARTIN's (1908) description led him to state that *Notogomphus agilis* has the last three segments of the abdomen fused); FRASER, 1946: 201 (*Karschiogomphus ghesquierei* SCHOUTEDEN, 1934 is considered to be a junior synonym of *O. agilis* (MARTIN, 1908) [note that this opinion is the result of a comparison between the characters of *Karschiogomphus* and those of the male of *Oxygomphus agilis* MARTIN (MS name) from 'Congo']; SCHMIDT, 1951: 167-169 (the male from Paris Museum, erroneously considered as being the type of *Oxygomphus agilis* (MARTIN, 1908), is compared to a male of *Neurogomphus fuscifrons* from Bipindi [which SCHMIDT erroneously considers to be the allotype of this species] and its wings drawn).

Neurogomphus agilis (MARTIN, 1908): FRASER, 1949a: 134, 136, figs. 15, 18 (the Genoa Museum male is considered to be the holotype, not the Paris Museum male, which is conspecific. Brief description of both, placed for the first time in the genus *Neurogomphus*); FRASER, 1949b: 301 (comparison with *Oxygomphus chapini* KLOTS); PINHEY, 1962b: 179 (bibliography and distribution); PINHEY, 1967: 68 (description of holotype); PINHEY, 1971: 963 (comparison with *N. angustisigna*, but mention of specific character incorrect); DAVIES & TOBIN, 1985: 35 (taxon listed in catalogue); TSUDA, 1986: 94; 1991: 103 (taxon listed in catalogue); BRIDGES, 1994: VII: 5 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon mentioned in index of species-group names of the genus *Neurogomphus*); STEINMANN, 1997: 139 (taxon listed in catalogue); CLAUSNITZER, 2001: 57 (species erroneously mentioned from Congo-Kinshasa in a list of Odonata likely to occur in East Africa).

Material

Guinea-Bissau: 1♂, holotype, 'Guinée portugaise', L. FEA leg., without further indications

(MCSN). **Congo-Brazzaville**: 1♂, male from 'Congo', without further indications (MNHN); this male is erroneously stated in FRASER (1936) as being from Nigeria.

Bionomics

The two known males seem to have been collected in the semi-deciduous dense forest which extends from Guinea-Bissau to equatorial Africa.

Description

A dark species with well-contrasted colour pattern, which numbers of antenodal and postnodal cross-veins are close to those of *N. vicinus*, but which radial field contains less cells. Lateroventral tooth of superior appendages at the same place as in *N. vicinus* but less or almost (holotype) inconspicuous.

Male

Range of dimensions: Table 1. Dimensions of holotype (mm): fore wing 33.5; hind wing 31.0; pterostigma: fw 2.9; hw 3.0; max. width of hw 9.3; abdomen 41.5; hind femur 6.3.

Head (Fig. 26h).- Labium yellow, mandibles yellow-brown. Genae dark green. Labrum brown. Ante- and postclypeus blackish brown. Frons green except a blackish strip along vertex. Crest of frons well rounded. Vertex and occiput black. Postocellar ridge in the form of a pair of semicircular bosses separated medially. No process external to lateral ocelli (thus, as in *N. cocytius* and *N. vicinus*). Occiput concave, the plate (Figs 5p-k) 1.74 times wider than high (holotype only). Occipital crest with a very narrow yellowish strip, V-shaped and provided with 2 black spines and numerous long black hairs.

Prothorax (Fig. 7w) brown and black, with a pair of adjacent yellow spots, a yellow anterior transverse area, a yellow spot on posterior lamina and with paired laterodorsal ochraceous yellow areas.

Synthorax (Fig. 29f) with a well-contrasted colour pattern, the yellow parts of the sides more extended in holotype. Postdorsal green stripes slightly extending beyond and along the collar border of the black spiracular dorsum, thus 7-shaped, and separated from antehumeral green spots. Humeral black stripe extending well underneath the mesopleural suture and partly along the pale brown (Congo-Brazzaville) or yellow-brown (holotype) anterior part of mesepimeron, where it tends to join a large interpleural black stripe via a dark brown area. A well-distinct green stripe in the middle of mesepimeron. A large blackish or black (Congo-Brazzaville) stripe along metapleural suture extending as a brown stripe encircling the metepimeron borders in the Congo-Brazzaville male, leaving a yellow area in the middle of the metepimeron. The pattern as a whole gives the impression of a succession of black and green or yellow stripes on the sides of synthorax. Mesokatepisternum brown, darker on upper part. Mesopostcoxale and metakatepisternum yellow in holotype, brownish in Congo-Brazzaville male. Antealar sinus and interalar sclerite, black.

Legs entirely brown with tibiae and tarsi black (Congo-Brazzaville) or with posterior femurs blackish on their distal half and fore femurs brownish black

with a large green stripe along internal face (holotype).

Range of wing index: Table 1. Venation blackish brown. Pterostigmas dark brown, the bordering veins, black. A narrow grey membranula, reduced to a short section extending from basal trunk of hind wing to beginning (holotype) or basal third (Congo-Brazzaville) of alar triangle. Ac distal to A_3 (however, in one of the wings of holotype, at level with A_3 which has an aberrant course); at level with first Ax. The number of Ax and Px recalls that in *N. vicinus*, but not the numbers of cells in 3rd and 4th row of radial field.

Holotype wing index: 14-15 (fw) and 11-12 (hw) Ax; 12 (fw) and 11 (hw) Px; second Pans 5-6 (fw) and 5 (hw); 4.2-6 (fw) and 4.6-5 (hw) cells under pterostigma; radial field with third row beginning at b level, comprising 8 cells; fourth row at c (fw) and d (hw) levels, comprising 7 (fw) and 6-7 (hw) cells; 7 cells at radial field distal margin; 2 (fw) and 1 (hw) cross-veins between Rs and MA; 10-11 (fw) and 7-8 (hw) bridge cross-veins; 3 cells between R_4 and MA at distal margin; discoidal field expanding a little before nodal level (fw: -1; hw: -2), with 9-10 (fw) and 10-11 cells at distal margin; anal field formula: 4 , 4 / 3 , 0-3 / 3 , 3 / 3-4 , 4; anal triangle 4-celled.

Abdomen (Figs 32e-f) mostly black, with well-contrasted colour pattern. Segments 1 and 2 with a dorsal yellow elongated spot and with black and laterodorsal yellow-brown areas. Auricles yellowish, ending with a dozen of minute yellow spines, dorsally black. Segment 3 black with an almost complete laterobasal yellow ring. Segments 4 to 7 black, anteriorly with a middorsal yellow spot and, on each side, underneath and separated from it, a yellowish brown spot. These lateral spots fade towards the end of the abdomen; they disappear on segments 6 and 7. Segment 8 black with anterior quarter (holotype) or nearly half of its length (Congo-Brazzaville), yellow. Segment 9 black, its ventrolateral sides ochraceous. Segment 10 black, in lateral view, with a well-developed angulated dorsal profile. Segment 10 measures 1.00 (Congo-Brazzaville) - 1.03 (holotype) times the length of segment 9.

Anal appendages (Figs 32a-d) black. Superiors divergent and straight, their extremities conspicuously curved upwards and ending in a sharp point. They are provided with a very weak (barely visible in holotype) lateroventral spiniform process, at a distance of 75 (holotype) - 76% (Congo-Brazzaville) of their length. Inferior appendage with inwards and forwards recurved spiniform tips.

Accessory genitalia.- Hamules and penis black. Posterior hamules elongated, in lateral view (Figs 28d-e) with a very fine distal hook, well separated from an anterior subdistal slightly bulging process, which is provided with a few short setae. In ventral view (Figs 37d-e), the distal half of posterior hamules is slightly sinuous, with nearly fine extremities. Penial sheath, in lateral view, with a rounded truncated extremity (Figs 28d-e). Penis: Fig. 38a. Glans ending in an elongated cupule which clearly ends with the very short vestigiae of two flagella (Figs 38b-c).

16. *Neurogomphus carlcooki* sp. n.

Neurogomphus fuscifrons: COOK (on identification label).

Material

Ivory Coast: 1♂, holotype, Tiassale area, 05°54'N 04°50'W, 17.III.1950, O. REINACH leg. (COOK's collection; will ultimately be deposited in the Florida State Collection of Arthropods).

Bionomics

This male was found in the Guinea-Congolian West African forest, which is of a wet semi-deciduous dry type.

Etymology

Named in honour of the well-known American odonatologist Carl COOK who kindly submitted the specimen for study.

Description

Easily distinguished from other species by the curved hook-shaped thumb-like process of posterior hamules, the pattern of synthorax and the form of extremities of superior appendages.

Male (holotype)

Dimensions and wing index: Table 1. Anal field formula: 3-4, 3 / 3 , 3 / 3 , 3 / 3-4 , 4.

Head (Fig. 26i).- Mouthparts and genae yellow. Face green, except for a pair of elongated brown areas on the lower half of postclypeus and some pale brownish staining on parts of anteclypeus and along upper and lower borders of labrum. Vertex, antennae and occipital plate brown. A pair of brown postocellar elongated and curved prominences widely separated medially and provided with long brown hairs (prominences as in *N. featheri*). The summit of these prominences is slightly paler. No process external to lateral ocelli. Occipital plate (Fig. 5r) 1.67 times wider than high. Postoccipital crest mid-brown, triangular, the angle rounded and surmounted by 4 robust yellow spines with black extremities. The crest is also fringed with numerous long brown hairs.

Prothorax (Fig. 7x) with a blackish and brown background. Anterior border yellow. Anterior transverse area green. A pair of confluent adjacent medio-posterior green spots. Posterior lamina with a middorsal green spot. Posterior dorsum laterally green.

Synthorax (Fig. 29g) with a green and brownish black pattern. The green postdorsal stripes extend, 7-shaped, over the blackish spiracular dorsum and are isolated from the long, straight and oblique antehumeral green stripes. The humeral area itself is entirely blackish, except for a very narrow, pale green stripe along the underside of the mesopleural suture. Sides yellow, with the humeral blackish stripe extending well underneath the first lateral suture and

along mesokatepisternum. A complete, sinuous, interpleural blackish stripe and a nearly complete metapleural blackish stripe. Antealar sinus black, interalar sclerite blackish. Metapostepimeron and thoracic sternum, yellow.

Legs uniformly medium coloured brown (tarsi blackish brown) on outer face. Coxae yellow.

Wings.- Costal vein medium coloured brown, blackish around pterostigma; the rest of venation brownish black. Pterostigmas somewhat elongated, medium coloured brown. A narrow brownish membranula all along anal border of hind wing from wing basis to tornus. Triangles 3-celled (left) or 4-celled (right). Ac cross-vein lying almost at level with A_3 vein.

Abdomen (Fig. 33c) black and yellow or green. Segment 1 yellow, except brown dorsal posterior third. Segment 2 dorsally brown with a great green middorsal elongated spot only narrowly reaching the posterior border of segment; the sides yellow. Auricles green ending with half a dozen very minute black spines. Segment 3 to 7 black with the following yellow areas: a middorsal stripe all along the length and, separated from it, a pair of lateral yellow quadrangular spots on anterior 1/5. Also, an isolated lateral elongated yellowish stripe which, on segment 3, joins the anterior lateral quadrangular yellow area. Segment 8 black but its anterior half yellow. Segment 9 black with an elongated ochraceous red area along lateral tergal borders. Segment 10 black. Intersegmental membranes between segments 2-3, 6-7 and 7-8, laterodorsally ochraceous yellow. Segment 10 measures 0.93 times the length of segment 9.

Anal appendages (Figs 33a-b) black. Superiors straight, their extremities robust. No actual lateroventral tooth but a squat and blunt process, of which the prominent part lies at a distance of 80% of the length of appendages. Inferior appendage ending, in lateral view, by a dorsally recurved hook.

Accessory genitalia.- Hamules blackish brown. Posterior hamules elongate. In lateral view (Fig. 36a), they are slightly curved and end with a curved triangular hook, well separated from a small although obvious anterodistal sharp spur-like process. This process is provided with minute setae on its internal side. In ventral view (Fig. 37k), the posterior hamules are simply curved and have large blunt extremities. Penial sheath, in lateral view (Fig. 36a), ending sharp and bevel-edged; its basal half yellow, its distal half blackish brown. Penis (Fig. 38f) brown. Glans ending in a somewhat circular cupule, which bears two distinctly separated short vestigiae of flagella (Fig. 38g), such as in some *N. pallidus* specimens

Comments

The nearest relative of *N. carlcooki* seems to be *N. featheri*, with which it shares the colour pattern of face and abdomen, the shape of the postocellar ridge, that of the posterior hamules, the number of cross-veins and cells in wings and the dimensions. However, *N. carlcooki* distinguishes from *N. featheri* by its very long, straight and narrow pale antehumeral stripes, by the pattern of sides of synthorax (which is that seen in *N. agilis*) and by the shape of anal appendages (stout extremities instead of finely curved ones and

absence of an actual lateroventral tooth). We may hypothesize that the synthoracic colour pattern of *N. carlcooki* may have evolved from that of *N. featheri* (or the reverse), by the extension of the two narrow black humeral stripes of the latter on either side of the mesopleural suture and by that of the black markings along the interpleural and metapleural sutures.

It would be daring to claim that *N. carlcooki* bears some likeness with the female from Kere-Kere described as *N. sp. indet. B*. They seem to agree by the synthorax colour pattern (compare Figs 29d and 29g), but the face and prothorax patterns are well-distinct (compare Figs 26c and 26i as well as 7u and 7x). Other species also, although distinct, bear some likeness, if only one or two characters are taken into account.

17. *Neurogomphus featheri* PINHEY, 1967

Oxygomphus agilis: FRASER, 1936: 141 (places under this name a male from MORTON's collection (Edinburgh Museum), erroneously stated as being from Nigeria. This specimen shall later on become the holotype of *N. featheri*).

Neurogomphus Wittei?: FRASER, 1949a: 131 and 133 (brief description of the male specimen from MORTON's collection, erroneously located from 'Mt. Gori' and considered to be 'either a new species or a variety of *N. Wittei*, probably the last').

Neurogomphus wittei: PINHEY, 1961b: 69 (refers to the 'Mount Gori' male, which was not examined); GAMBLES, 1980: 26 (taxon mentioned as being from Nigeria; it concerns the Makurdi male); CLAUSNITZER, 2001: 58 (species mentioned from Western Kenya in a list of East African Odonata).

Neurogomphus featheri PINHEY, 1967: 72, fig.7a-d (original description); CAMMAERTS, 1967: 76 (comparison of holotype with *N. pallidus*); PINHEY, 1971: 962 (comparison with *N. angustisigna* PINHEY); DAVIES & TOBIN, 1985: 35 (mentioned in a catalogue as having priority over *N. wittei* SCHOUTEDEN, 1934, which is thus considered to be its synonym !); TSUDA, 1986: 94; 1991: 103 (taxon listed in catalogue); BRIDGES, 1994: VII: 84 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon mentioned in index of species-group names of the genus *Neurogomphus*); STEINMANN, 1997: 140 (listed in catalogue as a synonym of *N. wittei*); PRENDERGAST, 1998: 169 (further records for Gambia; identification by R. CAMMAERTS); CLAUSNITZER, 2001: 57 (species mentioned from Western Kenya in a list of East African Odonata).

Neurogomphus sp. (? featheri PINHEY): GAMBLES *et al.*, 1995: 100 (records from Gambia).

Neurogomphus sp.: GAMBLES *et al.*, 1998: 31 (records from Gambia).

Material

Kenya: 1♂, holotype, Suna, M'Gori River, South Kavirondo, 01°05'S 34°26'E, 7.IV.1931, W. FEATHER leg. (NMS). **Nigeria**: 1♂, Makurdi, 07°44'N 08°32'E, 20.X.1962, R. GAMBLES leg. (BMNH). **Chad**: 1♀, N'Djamena, Chari-Baguirmi, 12°07'00"N 15°03'00"E, 4.VIII.1992; 2♂♂, 1♀, *idem*, 24.VIII.1992; 1♂, *idem*, 5.IX.1992, all H.R. Feijen leg. (NNM; 1♂ in author's coll.). **Gambia**: 2♂♂, Bantanto, just east of Bansang, 13°25'N, 14°39'W (UTM Grid Zone 28, reference 538483; arbitrary square 92), 31.X.1996, E.D.V. PRENDERGAST leg. (PARR's collection); 1♂, 1♀, *idem*, 1.XI.1996, P.M. ALLEN leg. (PARR's collection).

The following material from Gambia is thought to be lost. One male recorded as '*Oxygomphus agilis*' by Norman W. MOORE in 1948 (the late Robert M. GAMBLES (*in litt.*) informed me that 'the specimen, identified as such at a time when any *Neurogomphus* would

probably have been called *Oxygomphus agilis*, is lost, so we shall never know what it really was'). GAMBLES *et al.* (1995) identified it possibly as *N. featheri*. From GAMBLES *et al.*, 1998 and my personal correspondence with the late Col. Evelyn D.V. PRENDERGAST (24.II.2001), it appears that it was captured near Kuntaur, 13°40'N 14°54'W (UTM grid zone 28, reference 512511, arbitrary square 13) during the first week of September 1948. The species was seen on several occasions along the south bank of the river near Wassu, the hill of Kassang and in the bush near Kuntaur during late July to early September 1948 (not 1980 as stated in GAMBLES *et al.*, 1998). One female from Sankuli Kunda, 13°31'N, 14°46'W (UTM grid zone 28, reference 525493; square 60) was captured by the Lund University Expedition, in 1977 (*cf* GAMBLES *et al.*, 1998). The late R.M. GAMBLES (*in litt.*) informed me that the markings of this female are the same as those of his Nigeria male.

A specimen from **Ghana** might also have been in the hands of R.M. GAMBLES (see 'Introduction').

A young larva dredged in the river Gambia, opposite Brikama Ba, may be attributed to this species and is described in section II of 'Results': 'Larvae'.

The only details so far published on Gambia *Neurogomphus* are the localities of the above-mentioned specimens. In this country, the species is only known from the region between Central and Upper Gambia (arbitrary squares 13, 33, 60 and 92 in PRENDERGAST, 1998).

Bionomics and live colour pattern

The geographical distribution and the somewhat poorly contrasted colour pattern of the species reveal that it is an inhabitant of either clear woodland or open landscapes. The Chad specimens were caught in the middle of the rainy season.

Some information about the Gambia captures was kindly forwarded to me by the late Evelyn PRENDERGAST. The female taken by the Lund University Expedition was swept from long herbage. Two of the Bantanto males were caught by E. PRENDERGAST as they flew along the side of a path running along the embankment of a shallow muddy pool amidst rice fields (Fig. 34c). The male and the female caught by Peter M. ALLEN were found perched in the shade near the bottom of the tall vegetation, alongside the same path, about 1/2 m above ground level; the sky was cloudless and the air temperature about 32°C. The shallow Bantanto pool was part of a small seasonal stream which was drying up, as the rain season period had already ended six weeks earlier. An interesting fact is that the species was not observed again in November 2000 when Michael PARR and Evelyn PRENDERGAST returned to the site where it was found four years earlier, although the conditions appeared similar. The species wasn't seen anywhere else either (E. PRENDERGAST, personal commu-nication, 1.II.2001). We may hypothesize that *N. featheri* may be a wandering species alternating breeding places. The same behaviour perhaps applies to other *Neurogomphus* species and may explain why adults are so scarcely seen, although F-0 exuviae can be found without seeing adults.

From slides made in the field by Peter ALLEN (Figs 34a-b), the live colours of the male are as follows: eyes blue, dorsum of synthorax with a yellowish green and black pattern, sides of synthorax and abdomen with a yellow and black pattern. The bright yellow basal half of abdominal segment 8, which contrasts with the black colour of the subsequent half and of segments 9 and

10, catch the observer's attention. This contrasted clear spot may perhaps function as a focusing device for predators, enabling to deceive them. The female has a similar colour pattern.

Description

A pale and moderately sized species. Despite some differences in anal appendages, in posterior hamules shape and in abdomen colour pattern, all the specimens described here are considered as belonging to the same species. The differences may be explained by the great geographical distances between their localities.

Male

Range of dimensions and of wing index as in *N. carlcooki* (Table 1). Dimensions of holotype (mm): hw 29.8; pterostigma length: fw 2.3, hw 2.6. The holotype is badly damaged.

Colour pattern yellow and black, the Gambia specimens being the darkest.

Head (Figs 26k-m).- Genae, base of mandibles, anteclypeus, frons and occipital plate green or yellow. Labrum mostly green or yellow with a limited dorsomedian brown pattern, extending the most in the Nigeria and Chad specimens. Postclypeus mostly yellow (Nigeria) or green (Gambia) (it appears brown in the Kenya holotype). Vertex and basal segments of antennae, yellow (Nigeria) or with brown and yellow areas. A pair of postocellar arched and widely separated prominences, greyish brown, their summit yellowish and provided with long brown hairs (prominences thus like those of *N. carlcooki*). No process external to lateral ocelli. Occipital plate (Fig. 5t-w) yellow or yellowish grey (Chad) 1.54 - 1.87 times wider than high (8 specimens measured: 1.67 (Kenya holotype), 1.60 (Nigeria), 1.63, 1.72, 1.87 (Chad) and 1.54, 1.65, 1.77 (Gambia)). Occipital crest triangularly shaped, with a rounded angle, fringed with numerous blackish brown hairs and provided, on its middle, with 2 (Gambia), 3 (Nigeria and two of the Gambia males), 5 (with a minute additional one: holotype) or 6 (Chad) conspicuous robust black spines raising from a yellow protrusion in a forward or vertical (in one of the Gambia males) direction.

Prothorax (Figs 7y, z^1, z^3) mostly yellow with black and brown markings, those of the Gambia specimens most closely resembling the prothoracic pattern of *N. pallidus* and the prothorax of the Nigeria specimen differing the most, being almost completely yellow.

Synthorax (Figs 40a-b) yellowish green (dorsum) and yellow (sides), with black or blackish brown (Gambia) markings. Spiracular dorsum yellow (holotype) or brownish black with its posterior half, yellow or green. Middorsal area, black. Middorsal carina brownish. Antealar crest and sinus, black. The green wide postdorsal stripes anteriorly and posteriorly confluent or almost confluent with the complete green antehumeral stripes, the two kinds of pale stripes thus surrounding a sinuous or more or less quadrangular mesepisternal dark stripe, the latter slightly extending on mesokatepisternum. Humeral pattern complex: a poorly contrasted (holotype and Nigeria) or a well-defined

(Gambia and Chad) narrow black or brownish black stripe runs dorsally along the yellow mesopleural suture, and another narrow stripe runs ventrally along this yellow-coloured suture. The two narrow dark stripes are separated from each other all along their length, but join together posteriorly in holotype. In one of the Gambia specimens (Fig. 40b, left side) the dorsal narrow humeral black stripe gives the impression of being a diverticulum of the longer ventral stripe. Sides of synthorax entirely yellow (Kenya and Chad) or with a faint dark greenish stripe in middle of interpleural and metapleural sutures (Nigeria) or a dark spot along posterior end of interpleural suture (Gambia). Subalar ridge, yellow. Interalar sclerite black with a small ventral yellow spot (holotype and Gambia) or entirely green or yellow (Nigeria and Chad). Metapostepimeron and thoracic sternum, yellow.

Legs.- Tibiae and tarsi blackish brown. Holotype (Kenya) with coxae, trochanters and femurs yellow, except the external face of femurs I and II, blackish brown and that of femurs III, brown. The same is true for the Nigeria and Chad males, except for the external face of femurs III with only a narrow dark stripe in one of the Chad males. The legs of the Gambia males are the darkest: trochanters brownish yellow, the posterior ones with a black spot on the external face of distal half part; femurs III brown, black on at least 1/3 of their external face.

Wings.- Venation dark black in the Gambia specimens, the costal vein brownish yellow in holotype and yellow in Nigeria and Chad males, becoming blackish at pterostigma level. Ac lying distal to A_3 level (however at A_3 level in Nigeria male) and at level of first Pan. A short narrow greyish membranula, from wing base to basal fifth of external border of anal triangle. Anal triangle 3- (in the Nigeria, the Chad and one of the Gambia males) or 4-celled (in the holotype and two of the Gambia males). One incomplete basal subcostal cross-vein. Anal field formula: 3-4 , 3-4 / 2-3 , 2-3 / 2-3 , 2-3 / 2-4 , 3-4 / 3-3 , 3-4.

Holotype wing index.- 14 and 10 (hw) Ax; 10 and 10 (hw) Px; second Pans 5; 2.2-2.6 (fw) and 3.3 (hw) cells under pterostigma; radial field with third row beginning at b (hw) level; 2 (fw) and 1 (hw) cross-veins between Rs and MA; 6 (hw) bridge cross-veins; anal field formula: 4 , 3 / 3 , ? / ?; anal triangle 4-celled. Ac distal to A_3 cross-vein, at level with first Pan. A short narrow translucent membranula till mid-length of anal triangle external border.

Abdomen (Figs 33d-f).- Yellow or green, with black markings. The Nigeria specimen serves as the basic description of the abdominal colour pattern. The black markings extend the least in the Nigeria and Chad specimens. Segment 1 yellow with a pair of laterodorsal black spots. Segment 2 yellow with a pair of black laterodorsal markings delimiting a large yellow spot widely reaching the posterior border of segment, except in holotype. Auricles yellow, provided with about half a dozen minute black spines. Segments 3-7 yellow, with a pair of laterodorsal black markings, narrowest anteriorly, posteriorly ventrally bending and extending forwards. Segments 8-9 yellow with a pair of wide laterodorsal black markings, separated by a yellow middorsal longitudinal stripe which is the least developed in the Gambia specimens. One of these males even lacks the small middorsal yellow appendix which tends to divide

the distal half of segment 8 into two black lateral areas. Dorsum of segment 10 with its basal half black, its distal half, paler (holotype and Nigeria) or not (Gambia). Segment 10 measures 0.94 (Gambia and two males from Chad) - 1.04 (Gambia), 0.97 (Nigeria) or 1.0 (holotype and a male from Gambia and from Chad) times the length of segment 9.

Anal appendages (Figs 35a-j) blackish brown. Superior appendages straight and divergent, ending right and sharp in the Nigeria and Chad males and in a finely inwards recurved point in the holotype and Gambia specimens. They are provided with a lateroventral tooth slightly directed rearwards in holotype and Nigeria male. It is located at a distance of 61 – 73% (mean: 67.5%) of the appendage length (Chad: 61, 62, 63%; Nigeria: 67%; Gambia: 69, 72, 73%; holotype: 73%). In dorsal view, this tooth is most visible in the Nigeria and Chad specimens and least visible in the Gambia specimens. Inferior appendage ending in simply recurved tips.

Accessory genitalia.- Posterior hamules elongate, yellow (holotype, Nigeria and one of the Chad males), dark brown (Gambia) or brown or yellowish grey with distal half black (the other Chad males). In lateral view (Figs 36b-h), the hooked extremity (which is black in one of the Chad males) is relatively narrow, its very extremity more curved; the subdistal anterior thumb-like hook has the shape of a short and robust spur in holotype and in Gambia specimens (except that in one of the Gambia males it has the shape of a very minute black spine (Fig. 36f) and that in another male one of the hamules lacks such a process). In the Nigeria male, the subdistal thumb-like hook ends not sharply, but rounded. This process ends with some short setae. In ventral view (Figs 37f-j) , the distal half of posterior hamules is slightly sinuous, the extremities looking sharp or not. Penial sheath (Figs 36b-f) yellowish (in one of the Chad males), brownish or black (in another of the Chad males) and ending bevel-edged in lateral view. Penis: Fig. 38h. Vesicle brownish black or yellow in the Nigeria male and one of the Chad males. Glans (Figs 38i-k) with an ovoid-elongated cupule, ending with the short vestigiae of two flagella (vestigiae short and close together in the Nigeria and two of the Chad males; short and separate in another Chad male; well-distinct and separate in Gambia males; accidentally broken in holotype).

Female

Dimensions and wing index: Table 2. The female is smaller in these respects than that of *N. zambeziensis*.

Head coloration (Fig. 26n) as in male. Occipital plate yellowish (Figs 6s-t), 1.85 (Gambia) - 1.96 (Chad) times wider than high. Occipital crest fringed with numerous yellowish brown hairs and provided in its middle with two forwardly directed conspicuous robust yellow spines, ending black.

Synthorax colour pattern (Figs $7z^2$, 34b and 40c) as in male, but postdorsal green stripes not confluent with the antehumerals in the Gambia female. A yellow middorsal crest. A nearly complete but faint dark stripe along interpleural suture (Gambia female), this stripe being barely visible in the Chad females. Interalar sclerite entirely black (Gambia) or blackish with a

green posterior spot (Chad).

Leg colouring as in male.

Colour pattern of abdomen as in male, with dark pattern more extended on segment 8 (Figs 33g and 34b).

Vulvar scale either provided with two small lobes, each ending in a minute nipple and separated by a narrow V-shaped cleft (the Gambia female, Fig. 14s) or with two large rounded lobes, separated by a wide V-shaped cleft (the two Chad females; in one of these the lobes are poorly prominent: Figs 14t,u).

Comments

By their thoracic markings and their well-developed lateroventral tooth on superior anal appendages the *N. featheri* males from Chad appear to have the closest resemblance to the one collected in Nigeria. With their colour pattern and small lateroventral tooth of superior anal appendages the *N. featheri* males from Kenya (holotype) and Gambia bear some resemblance to those of *N. zambeziensis* sp. n. which suggests that these two taxa, the first inhabiting the Guinean and the latter the Zambezian woodlands, might have had a common ancestor. However, another relative of *N. featheri* may well be *N. carlcooki* sp. n., an inhabitant of the relatively humid Guinean forest, with which it shares the dimensions, wing venation and colour pattern of face and abdomen (but the latter pattern may well be common to more than two species). Nevertheless, the synthoracic colour pattern and superior anal appendages differ markedly. Though it has not at all been proved, it is not impossible that *N. featheri* might be a species with distinct subspecific forms or one component of a superspecies complex including *N. carlcooki* or *N. zambeziensis*.

18. *Neurogomphus pallidus* CAMMAERTS, 1967

Neurogomphus agilis (MARTIN): hand-written by F.C. FRASER on identification label dated 1955, on BMNH specimen.

Notogomphus praetorius (SELYS-LONGCHAMPS, 1878): printed F.C. FRASER's identification labels dated 1957, on MRAC specimens collected in the years 1951-1953.

Neurogomphus pallidus CAMMAERTS, 1967: 70-76 (original description); PINHEY, 1971: 963 (comparison with *N. angustisigna* PINHEY); DAVIES & TOBIN, 1985: 35 (taxon listed in catalogue); TSUDA, 1986: 94; 1991: 103 (taxon listed in catalogue); BRIDGES, 1994: VII: 178 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon mentioned in index of species-group names of the genus *Neurogomphus*); STEINMANN, 1997: 140 (taxon listed in catalogue).

Material

Congo-Kinshasa (Katanga Region): 1♂, holotype, Lubumbashi (Elisabethville), 11°40'S 27°28'E, 18.XI.1959 (MRAC); 1♀, allotype, *idem*, 21.XI.1959 (MRAC); 1♂, 4♀♀; *idem*, XI.1951 (MRAC); 1♂, *idem*, XII.1951 (MRAC); 1♂, *idem*, I.1952 (MRAC); 1♂, *idem*, 21.XI.1952 (BMNH). 1♂, Karavia (Elisabethville) (same coordinates as Lubumbashi), XII.1953 (MRAC). 2♀♀, paratypes, Kiamalale, 11°36'S 27°30'E, 10.XII.1959 (MRAC and author's coll.). All this material was collected by Ch. SEYDEL.

Bionomics

This pale, but large species, is only known from material collected in the region of Lubumbashi. This part of the Katanga Plateau is at *ca* 1250 m alt., and was covered with a dense forest of a dry type, often degraded in open forest with patches of Zambezian savannah. The specimens were collected during the first half of the rainy season, mature individuals dating from 21 November till January.

Description

Male

Range of dimensions: Table 1. Dimensions of holotype (mm): fw 35.5, hw 33.5; pterostigma length: fw 3.3, hw 3.6; abdomen 42.5.

Head (Fig. 26j).- Face, genae and frons, entirely yellow or yellow-green, except a double-shaped greyish or greenish area in the middle of labrum upper half. Crest of frons well-developed, rounded. Vertex yellow, except the black ocelli and a black area posteriorly to postocellar crest. Postocellar crest yellow, more or less straight, with well-developed lateral extremities, the crest itself fringed with black setae. A small but obvious rounded yellow knob-like process on a yellow ridge externally flanking the ocelli. Occipital plate (Fig. 5s) yellow, except posterior 1/4 or 1/5, brown. The plate is about 2.2 – 2.3 (n = 5) times wider than high. Occipital crest dark, slightly convex, fringed with a dense row of black hairs and provided with three (one male), four (BMNH male) or five (two males) black spines (number unknown on damaged holotype crest).

Prothorax mostly yellow, with a characteristic dorsal darker pattern (Fig. $7z^4$: immature specimen), extending only somewhat in old individuals (Fig. $7z^5$: mature specimen).

Synthorax (Fig. 29h, right side) with markings not well-contrasted, the pattern somewhat diffusely yellow or green and brown. Spiracular dorsum greenish yellow. Postdorsal yellow or green stripe confluent with a yellow collar stripe and a small antehumeral triangular spot, the latter diffusely extending in a somewhat darker ill-defined antehumeral stripe, more or less continuing on mesokatepisternum. Humeral pattern complex: mesopleural suture green, dorsally bordered by a narrow dark stripe and ventrally by an almost complete brownish upper mesepimeral stripe. A faint brownish interpleural stripe and a brownish stripe along upper border of metepimeron. Antealar sinus brown, its median fold yellow. Interalar sclerite brownish, its posterior border, yellow. Metapostepimeron and thoracic sternum yellow.

Legs mostly yellow, except some brown staining on distal 1/5 of external face of posterior femurs and on most of internal face of anterior legs. Tarsi blackish brown.

Wings.- Costa yellow, but black along pterostigma and brown distally. Pterostigmas yellow, the lining veins, black. Other veins, brown. Membranula translucent, greyish and narrow, extending at least to 2/3 of external border of anal triangle and even, but then becoming very narrow, to tornus. Ac distal or

well distal to A_3 level. Anal field formula: 4-6 , 5 / 4-5 , 4-5 / 3-4 , 3-4 / 3-4 , 4. Range of wing index: Table 1.

Holotype wing index: 11-12 (fw) and 9 (hw) Ax; 10-11 (fw) and 10-11 (hw) Px; second Pans: 5 (fw and hw); 4.0-4.4 (fw) and 5.0-5.4 (hw) cells under pterostigma; radial field with third row beginning at a-b (fw) and a (hw) levels, comprising 12 (fw and hw) cells; with fourth row beginning at b-c (fw and hw) levels, comprising 8-9 (fw) and 10 (hw) cells; 10 (fw and hw) cells at distal margin; 2 (fw) and 1-2 (hw) cross-veins between Rs and MA (there is a third cross-vein at the extremity of the middle fork in one fw); 6-7(fw) and 4-5 (hw) bridge cross-veins; 3 (fw) and 2-3 (hw) cells between R_4 and MA at distal margin; discoidal field expanding at -1 level in fw and at -3 level in hw, with 9 (fw) and 12 (hw) cells at distal margin; anal field formula: 5-6 , 5 / 4 , 4-5 / 3-4 , 3-4 / 4, 4; anal triangle 5-celled.

Abdomen (Figs 39e-f).- Each segment yellow, with a pair of black dorsolateral areas or stripes. However, in two of the mature males segments 1 - 2 are entirely yellow, with the exception of a pair of small laterodorsal dark spots on posterior half of segment 2 (Fig. 39f). In all specimens, segments 3 – 10 bear a broad yellow dorsal stripe, so that the abdomen looks as it has, all along, a continuous yellow dorsal stripe framed by two black ones (Fig. 39e). Auricles yellow, in lateral view with about twenty very minute black spines. Segment 10 measures 0.9 (immature) – 1.1 (mature) times the length of segment 9.

Anal appendages (Figs 39a-d) brownish black, 1.3 mm in length. Superiors straight and divergent, ending in a sharp tip. They are provided with a strong and large lateroventral tooth, at a distance of 44 - 51% of their length (mean = 48%; n = 3). This tooth looks like that in *N. uelensis*, but in some specimens it appears even more robust in dorsal view. Inferior appendage shorter than superiors, its extremities ending in a recurved spiniform process and diverging in such a measure that they are visible in dorsal view.

Accessory genitalia.- Anterior hamules dark brown. Posterior hamules yellowish, in lateral view broad and moderately short (2.4 – 2.8 times longer than wide) and ending in a strong dark hook (Figs 28f,h), which however is more slender in one immature specimen (Fig. 28j). On the anterior edge of the base of this hook there is a rounded, slightly prominent thumb-shaped process provided with a dozen minute setae. In ventral view, the posterior hamules are broad and more or less straight, the extremities widely triangular and slightly diverging (Fig. 28g) or, in some specimens, with the tips somewhat turned outward (Fig. 28i). Anterior lamina yellow. Penial sheath brown, in lateral view, ending bevel-edged (Fig. 28f). Penis (Fig. 38d) with a yellow or greyish yellow vesicle. Glans ending in a round cupule provided with the very short vestigiae of two flagella, widely separated (in four specimens: Fig. 38e) or not (two specimens).

Female

Range of dimensions and of wing index: Table 2.

Body colour pattern as in male (synthorax: Fig. 29h, left side), including the

distinctive abdominal pattern (Fig 39g).

Same rounded process on ridge flanking the ocelli as in male. Occipital plate (Fig. 6u) yellow, posteriorly brown on less than 1/5 of its length. The plate is 2.9 - 3.0 (n = 7) times wider than high. Occipital crest bearing 1-6 black spines (n = 7) on its median part. Some females bear additional spines on the plate itself, in a position a little anterior to the spines situated on the crest, so that the total amounts from 3 to 6 (3, 3, 4, 5, 5, 5 or 6, according to the specimens).

Prothorax colour pattern of immature female as in male, but dark areas extend in mature individuals (Fig. $7z^6$)

Colour of wing venation and pterostigmas, as in male. Ac at level with (3 wings) or distal (8 wings) to A_3.

Cerci black, *ca* 1.2 mm in length.

Vulvar scale (Figs 14v and 39h-i) ending in two prominent acute processes, each laterally flanked by a slight swelling; its cleft is a widely rounded opening and may reach but not exceed half the scale length.

Comments

1) The position of *N. pallidus* inside the genus is unclear. The posterior hamules refer to that in the '*fuscifrons*' subgroup of species, but the superior appendages are more like those of *N. uelensis*. The colour pattern recalls that of *N. featheri*, it may be because the two species live in dry habitats.

2) As pointed out by CAMMAERTS (1967), the colour pattern, especially that of the abdomen, gives the insect an overall remarkable resemblance to another member of the family, *Notogomphus praetorius* (SELYS-LONGCHAMPS). This superficial resemblance may explain that F.C. FRASER confused *Neurogomphus* specimens of the present species that were sent to him for identification, with the common *N. praetorius*. Both taxa were recently found by K.D. DIJKSTRA, mixed up and labelled as *N. praetorius* by F.C. FRASER, in the same drawer of the Tervuren Museum collection.

The two species live in the same region (Lubumbashi). However, *N. praetorius* has a greater extension: it ranges from South Africa to Angola and Katanga and to Zimbabwe and Zambia. There is no precise information about the biotopes frequented by *N. pallidus*. Concerning *N. praetorius*, it is known that it frequents the verges of wooded streams, especially in forests (TARBOTON & TARBOTON, 2002, concerning the species in South Africa) or is to be found in reedy or grassy streams in grassland or in rivers in open or bush country, even in pools (PINHEY, 1984: 24, concerning the species in Zimbabwe and Zambia).

19. *Neurogomphus (Mastigogomphus) chapini chapini* (KLOTS, 1944)

Oxygomphus chapini KLOTS, 1944: 7-8, figs. 1-4 (original description); BRIDGES, 1994: VII: 48 and VIII: 47 (original generic attribution mentioned in catalogue; under *Neurogomphus*); STEINMANN, 1997: 139 (*idem*).

Neurogomphus chapini (KLOTS 1944): FRASER, 1949b: 301 (comments on original

description); PINHEY, 1962b: 179 (bibliography and distribution); PINHEY, 1967: 70 (holotype mentioned); CAMMAERTS, 1968: 105-106, figs. 3-7 (holotype redescribed and compared to *N. pinheyi* CAMMAERTS); PINHEY, 1971: 962 (comparison with *N. angustisigna* PINHEY); DAVIES & TOBIN, 1985: 35 (taxon listed in catalogue); TSUDA, 1986: 94; 1991: 103 (taxon listed in catalogue); BRIDGES, 1994: VII: 48 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon mentioned in index of species-group names in genus *Neurogomphus*); STEINMANN, 1997: 139 (taxon listed in catalogue).

Material

Congo-Kinshasa: 1♂, holotype, Lukolela [Lukeala on accompanying wings slide], 01°03'S 17°12'E, left bank of the River Congo, Equateur Region, Tshuapa District, 13.X.1930, J.P. CHAPIN leg. (AMNH, Ac-31300); 1♂, somewhat teneral, slightly deformed by desiccation and lacking most of abdomen, Banzyville (now Mobayi-Mbongo, at the left bank of the River Ubangi, Ubangi Region), 04°18'N 21°11'E, 24-29.I.1932, H.J. BRÉDO leg. (MRAC).

Bionomics

The two known localities lie at the banks of large rivers. At the time of their discovery, these regions were densely covered with subequatorial and periguinean semi-deciduous humid forests, either mixed with islets of swamp forest (Lukolela) or in the form of forest galleries (Banzyville).

Description

Male

Range of dimensions: Table 1. Dimensions of holotype (slightly damaged, mm): hw *ca* 27; pterostigma length (hw): 2.6; abdomen, *ca* 26.2.

Head (Fig. 41a).- Mouthparts yellow, the outer border of mandibles brownish red at their extremity. Face entirely green, genae yellow. Frons rounded, but slightly pronounced. Vertex brown, except a transverse yellow area at level of median ocellus. Intersegmental membrane at base of antenna, yellow. Postocellar ridge slightly pronounced, in the shape of a 'U' with widely opened branches, the branches shorter than the basis (holotype) or semicircular (Banzyville). An obvious (holotype) or barely visible (Banzyville) spiniform process on a yellowish brown semicircular ridge external to lateral ocelli. Occiput brown, occipital plate (Fig. 41g) *ca* 3.4 times (holotype) (2.8 for Banzyville teneral specimen) wider than high. Occipital crest straight, without spines and provided with numerous hairs, also in its middle.

Prothorax (Fig. 7z[7]) dorsally blackish brown, with a pair of posteromedian adjacent yellow spots. Sides yellow.

Synthorax (Fig. 40e).- Spiracular dorsum and most of interalar sclerite, black. Antealar sinus blackish, yellow on internal edge. Postdorsal yellow stripes reduced to elongated spots isolated from large yellow collar stripes and from yellow, wide and straight antehumeral stripes. The latter stripes extend on mesokatepisternum and do not border the mesopleural suture. A large blackish, straight, humeral stripe extending well underneath mesopleural

suture. Interpleural blackish stripe reduced to a short posterior stump, confluent with the black subalar ridge (in the Banzyville male, the dark interpleural stripe continues until the mesopostcoxale, in the shape of a light brownish area.). Metapleural dark stripe extending from subalar ridge to level of metakatepisternum, where it diffusely continues on metepimeron towards sternal border. Metapostepimeron and thoracic sternum, yellow.

Legs brown, except inner face of fore femurs, which is yellow, as are the coxae. Tibiae and tarsi, black.

Wings.- Costal vein brown. Pterostigma surrounded by black veins. The pterostigma itself is bicolourous, its proximal 2/3 blackish, the rest yellow. Anal triangle 3-celled (one wing of the holotype has a fourth, but triangular cell). Ac lying distal to A_3. In fore wing, Ac lies at level with and in hind wing, proximal to first Pan level. A short membranula extending between base of wing and basal 1/5 of external border of anal triangle. Anal field formula range: 2-3 , 0-4 / 3-4 , 0-4 / 3-4 , 3-4 / 3-4 , 4. Range of wing index: Table 1.

Holotype wing index: 13-14 (fw) and 10-11 (hw) Ax; 10 (hw) Px; second Pans: 5 (fw and hw); 4.0-5.6 (hw) cells under pterostigma; radial field with third row beginning at a or b (hw) levels and comprising 10 cells; fourth row beginning at c (hw) level and comprising 7-8 (hw) cells; 9 (fw) and 8-9 (hw) cells at distal margin; 2 (fw) and 1 (hw) cross-veins between Rs and MA; 6-7 (fw) and 5 (hw) bridge cross-veins; 3 (fw and hw) cells between R_4 and MA at distal margin; discoidal field expanding at 0 and +1 levels in fw and at -1 level in hw, with 11 (fw) and 13 (hw) cells at distal margin; anal field formula: 3 , 4 / 4 , 4 / 3-4 ,4 / 3-4 , 4; anal triangles 3- and 4-celled (see above, under 'wings').

Abdomen (Fig. 42a).- Segment 1 dorsally brown, laterally yellow. Segment 2 laterodorsally blackish brown, with elongated yellow dorsal spot over whole length of segment; sides yellow. Auricles yellow, with about half a dozen of very minute black spines. Segment 3 blackish brown with yellow dorsal stripe over whole length of segment and with a lateroventral yellow area (the largest anteriorly). Segments 4 - 6 blackish brown, without a dorsal stripe, but with a basal yellow ring. Segment 7 dorsally black with a narrow yellow anterior or middorsal longitudinal stripe extending until half length; anteriorly and lateroventrally yellowish. Segments 8 and 9 black, lateroventrally ochraceous yellow. Segment 10 green or ochraceous yellow on anterior half, except a greyish brown basal ring, extending lateroventrally; reddish yellow on posterior half. Segment 10 measures about 0.90 times the length of segment 9.

Anal appendages (Figs 43a-b) ochraceous brown. Superiors obviously fused with segment 10, straight, parallel and of about the same length as inferior appendage. In dorsal view, the extremities are not very sharp. In lateral view the appendages are running concave until the point where they reach their greatest thickness, at a distance of about 68% of length of appendage. There, they make an elbow without having a lateroventral hook. Inferior appendage in dorsal view with branches at 45° from body axis and with extremities deflected in a backwards direction, ending in a black dorsally curved hook.

Accessory genitalia.- Posterior hamules brown (yellowish brown in the

immature Banzyville male), in lateral view (Figs 44a,c) at the most 2.0 – 2.5 times longer than wide, quadrangular and ending in a stout black hook situated on anterior corner. The edges are provided with short brown setae. No subdistal thumb-like process. In ventral view (Fig. 44b), the posterior hamules are convergent and slightly curved with end hooks parallel to each other. Anterior hamules and anterior lamina yellow. Penial sheath brown, ending bevel-edged in lateral view (Figs 44a,c). Penis: Figs 45a-d. Penial vesicle blackish, posteriorly provided on each side with a tuft of long hair. Glans black, at rest extending beyond vesicle extremity, ending in a wide pavilion provided with two long flagella of which the visible part in lateral view is a little more longer than glans (1.19 times longer). In lateral view the glans' pavilion extends somewhat dorsally.

20. *Neurogomphus (Mastigogomphus) chapini lamtoensis* subsp. n.

Material

Ivory Coast: 1♂, Lamto, 06°13'N 05°02'W, forêt galerie, 15-30.VII.1968, GERARD leg. (MNHN).

Bionomics

Found in the forest gallery of the River Bandama.

Preliminary comments

This single adult male individual is evidently linked to *N. chapini*, from which I suspect it represents at most a distinct subspecies.

Description

Male (holotype)

Dimensions: Table 1.

Similar to *N. chapini chapini*, but with the following differences:

Head (Fig. 41b).- Face yellow. Dorsal half of mandibles blackish brown, the rest yellow. Vertex with black interocellar and yellow postocellar areas. No process on ridge external to lateral ocelli. Occiput greenish, with a brown stripe along occipital crest. Occipital plate (Fig. 41h) 3.06 times wider than high.

Prothorax (Fig. $7z^8$) dorsally with two small yellow separated posteromedian spots.

Synthorax (Fig. 40f) with brownish black and yellow pattern, as in *N. c. chapini*, but the postdorsal yellow spots wider and the collar stripes middorsally confluent in a single point. Dorsal edge of yellow antehumeral stripes not straight but sinuous, with a short appendix at the level of the anterior end of the postdorsal yellow spots, reminiscent of the form seen in *N. dissimilis*. Interpleural and metapleural blackish stripes complete from anterior to posterior edge, the metapleural stripe running below the suture. Antealar

sinus blackish with a yellow middorsal area and posterior edge.

Legs black (hind femurs and trochanters, blackish brown), except inner face of fore femurs and coxae, which are yellow.

Wing index: Table 1. The wings are smoked over their distal two-thirds. (As in the nominotypical form the pterostigma are bicolourous, the proximal 2/3 brownish yellow and the distal rest yellow. Also, Ac lies distal to A_3 and a little before first Pan level.) A narrow brown-grey membranula extending until half length of external border of anal triangle. Anal field formula: 3 , 4 / 4 , 0-4 / 3 , 3 / 3 , 3.

Abdomen (Fig. 42b) with about the same colour pattern as in *N. c. chapini*, the main difference being segment 10, dorsally black. Segment 10 measures 0.79 times the length of segment 9.

Anal appendages (Figs 43c-d) blackish brown. In dorsal view, the superiors end with narrower extremities than in nominotypical form. In lateral view their ventral side runs convex and reach greatest thickness at *ca* 73% of appendage length, but without a prominent elbow or tooth. As in *N. c. chapini*, in dorsal view, the inferior appendage has its branches at 45° from body axis.

Accessory genitalia.- Anterior hamules and lamina yellow. Posterior hamules yellow, seemingly shorter than in *N. c. chapini*: in lateral view (Fig. 44d) only 1.5 times longer than wide and distinctly provided with a boss near distal end. (Ventral view (Fig. 44e) as in nominotypical form, the end hook being also situated on anterior corner.) Penial sheath blackish brown (Fig. 44d). Penis (Figs 45e-f) as in *N. c. chapini*, but dorsal part of glans (as it is seen at rest) differs; moreover, penial vesicle is posteriorly provided on each side with two distinct tufts of long greyish hair. In lateral view, the visible part of the flagella is only 0.93 times as long as the glans. The glans' pavilion extends dorsally (as seen at rest) more than in the nominotypical form.

21. *Neurogomphus (Mastigogomphus) pinheyi* CAMMAERTS, 1968

Neurogomphus chapini: PINHEY, 1961b: 69-70 (mentions a male from escarpment above the Broderick Falls, Kenya); PINHEY, 1962b: 179 (bibliography and distribution: mentions Western Kenya); PINHEY, 1967: 70-71 (description of a male from Broderick Falls), 72 (comparison with *N. featheri*).

Neurogomphus pinheyi CAMMAERTS, 1968: 101-102, figs. 1-2, 8-10 (original description; comparison with holotype of *N. chapini* KLOTS); PINHEY, 1971: 962 (comparison with *N. angustisigna* PINHEY); DAVIES & TOBIN, 1985: 35 (taxon listed in catalogue; erroneously mentioned from Central Africa); TSUDA, 1986: 94; 1991: 103 (taxon listed in catalogue); BRIDGES, 1994: VII: 186 (species-group name mentioned with original generic attribution and reference) and VIII: 47 (taxon name mentiond in index of species-group names of the genus *Neurogomphus*); STEINMANN, 1997: 140 (taxon listed in catalogue; erroneously mentioned from Central Africa); CLAUSNITZER, 2002: 58 (species mentioned from Kenya in a list of East African Odonata).

Material

Kenya: 2♂♂, Broderick Falls Escarpment, 00°36'N 34°50'E (Western Kenya), V.1951, T.H.E. JACKSON, leg. (holotype in NMB, paratype in BMNH).

Note on distribution

PINHEY (1961b: 70) mentions also, without having seen it, a '*N. chapini*' male collected in Uganda by V.G.L. VAN SOMEREN. This specimen could not be located.

Description

A mostly black species.

Male

Dimensions (data mainly from paratype): Table 1. Dimensions of holotype (mm): hind wing *ca* 27; pterostigma length: 2.7 (hw); abdomen 34.8.

Head (Fig. 41c).- Mouthparts yellow, the extremity of mandibles brown. Face and genae entirely yellow-green. Vertex brownish, with yellow area between ocelli. Intersegmental membrane of extremity of first antennal segment, yellow. Postocellar ridge in the form of a 'U' with branches widely spread apart (thus as in *N. c. chapini*). A small ovoid knob-like process on ridge external to lateral ocelli. Occiput brownish, the plate (Fig. 41i) about 4 times wider than high. Occipital crest nearly straight, without spines and provided with numerous brown hairs, also in its middle.

Prothorax (Fig. $7z^9$) entirely brownish black, except a pair of medioposterior adjacent yellow-green spots.

Synthorax (Fig. 40d) with a yellow and blackish pattern, similar to that found in *N. chapini*. Interpleural black stripe nearly complete, stopping shortly before respiratory spiracle. Metapleural blackish stripe complete and wide, extending also along posterior border of metepimeron and on part of metapostepimeron. Antealar sinus black, clearer in its middle. Interalar sclerite blackish.

Legs.- Femurs yellow-green. Outer face of hind femurs darker on distal 1/5. Tibiae and tarsi, black.

Wings slightly transparent green from base to nodus in fore wings and until midway between nodus and pterostigma in hind wings. Pterostigma yellowish brown, surrounded by darker brown veins. The rest of venation is black. A short greyish membranula extending unto basal quarter of external border of anal triangle. Ac proximal to A_3 vein. Discoidal field extending before nodal level in holotype and after nodal level in paratype. Anal field formula range: 3-4 , 3-4 / 3-4 , 3-4 /3 , 3 / 3-4 , 3-4. Range of wing index (data mainly from paratype: Table 1).

Holotype wing index: 14-15 (fw) and 10 (hw) Ax; 11 (fw) and 9 (hw) Px; second Pans: 5 (fw and hw); anal triangle 3-celled. Anal field formula: 4, 4 / 4 , 4 / 3 , 3 / 4 , 3-4.

Abdomen (Fig. 42c).- Segment 1 laterally and dorsally green, with pair of laterodorsal black spots. Segment 2 laterodorsally black, with yellow elongated dorsal spot on entire length; laterally, green. Auricles green, bearing about half a dozen very minute black spines. Segment 3 black and brown with a yellow narrow dorsal stripe over whole length, confluent with a large yellow

basal ring. Segments 4-6 the same, without a dorsal yellow stripe. Segments 7-8 black with a narrow yellow basal ring (the narrowest in segment 8), which lateroventrally extends until posterior segmental limit. Segment 9 *ibidem*, without a dorsal stripe. Segment 10 black, lateroventrally ochraceous red. Intersegmental membranes between segments 7, 8, 9 and 10, yellow. Segment 10 measures 0.74 (paratype) times the length of segment 9.

Anal appendages (Figs 46a-b) black. Superiors elongated, straight and not divergent, their extremities sharp. The superiors are slightly shorter than the branches of inferior. In lateral view, they are slightly upwards directed. They taper into an acute point and bear a small lateroventral spine-shaped prominence or spiny 'wait' lying at a distance of about 64% (holotype) - 65% (paratype) of the length of appendage. Branches of inferior appendage at 45° with body axis, the sides of the branches parallel, the branches ending in dorsally recurved hook-shaped extremities.

Accessory genitalia.- Posterior hamules yellow on their basal, brown on their distal half. In lateral view (Fig. 44f), the posterior hamules are elongated and straight, 4 times longer than wide, exclusive of a distinct black end hook situated medially on their extremity. Anterior and posterior shoulders of end hook densely provided with minute setae. In ventral view (Fig. 44g), the posterior hamules are straight and almost parallel, the extremities slightly outwardly curved. Penial sheath black, in lateral view ending nearly obtuse-rounded (Fig. 44f). Penis: Figs 45g-h. Vesicle black, provided with a fringe of long and stout hairs. Glans black, elongated, extending well beyond vesicle extremity. The glans ends not in a typical cupule but bears two sinuous and moderately long flagella which visible part, as viewed laterally, is 0.60 times as long as glans. Contrary to *N. chapini*, the extreme part of the glans is not developed in a typical pavilion and does not extend dorsally (as seen at rest).

22. *Neurogomphus (Mastigogomphus) dissimilis dissimilis* sp. n., subsp. n.

Neurogomphus dissimilis: PINHEY, 1978: 728 (unavailable name of a taxon which was not described, based on a female labelled as such by CAMMAERTS and located in the Bulawayo Museum collection; PINHEY only mentions it from Mas[h]onaland).

Neurogomphus CAMMAERTS N°1: PINHEY, 1984b: 24 (brief description of this female 'holotype' found in the vicinity of Bazeley Bridge). (Author's note: a male having been discovered since, this female is here designated as the allotype, not as the holotype.)

Material

Zambia: 1♂, holotype, Katombora, 17°48'S 25°15'E, Katombora Rapids, Zimbabwe River, 10.XII.1982, Falcon College Expedition, D.L. HANCOCK and R. CHAHWANDA leg. (NMB). **Zimbabwe**: 1♀, allotype, Mashonaland, near Bazeley Bridge, 19°15'S 32°29'E, *ca* 33 km SW of Umtali (now Mutare), 10.XI.1965, E. PINHEY leg. (NMB).

Bionomics

The male holotype was caught at rapids of the Zimbabwe River, at the beginning of the rainy season. The female was caught at a distance of *ca* 770

km in Mashonaland, when it 'flew down from a tree into the grass on the banks of the Odzi River' (*cf* PINHEY, 1984b). The latter region forms the northern part of the South African central plateau, covered with *Brachystegia* or *Colophospermum* woodland (PINHEY, 1978).

Description

Male (holotype)

Dimensions: Table 1.

Head (Fig. 41d).- Mouthparts yellow, the extremity of the outer border of mandibles dark brown. Face and genae entirely green. Vertex black with the area between the ocelli and before the occiput, yellow. Intersegmental membrane of extremity of first antennal segment, yellow. Postocellar ridge curved. A small ovoid process on the semicircular ridge external to lateral ocelli. Area posterior to postocellar ridge, yellow. Occiput yellow, with posterior third black, except in its middle. Occipital plate (Fig. 41k) 4.85 times wider than high. Occipital crest (as seen from a frontal position) slightly concave in its middle, without spines but fringed with numerous pale brown hairs, except in its middle.

Prothorax (Fig. $7z^{10}$) black with anterior lamina yellow, with yellow sides and a pair of large adjacent medioposterior yellow spots.

Synthorax (Fig. 40g).- Postdorsal green stripes reduced to elongated and wide spots, isolated from a pair of wide green collar stripes extending on both sides of collar ridge. The wide antehumeral green stripes run all along mesepisternum side. They are anteriorly bordered by the mesopleural suture and are provided with a characteristic dorsally-directed appendix coming up towards the postdorsal green spots. Mesokatepisternum yellow with an anterodorsal black area. The rest of the synthorax side is yellow with only a faint greyish stripe along the interpleural suture and another one along the underside of the metapleural suture. Antealar sinus black, interalar sclerite mostly green. Thoracic sternum yellow.

Legs.- Outer face of femurs black, their dorsal face yellow as is most of their inner face. Tibiae and tarsi, black. Coxae, yellow.

Wings.- Venation brown, the costa yellowish brown. Pterostigmas yellow, encircled by black veins. A narrow brown and translucent membranula along basal 2/3 of anal triangle margin. Anal triangle 3-celled. Ac vein well proximal to A_3 vein, at level of first Pan. The only known male of *N. dissimilis* s. str. differs from the other species of the subgenus *Mastigogomphus* by having 1 or 2 fewer antenodals in hind wings and fewer postnodals. Also, bridge veins are less numerous (3-4 instead of 5-8). Anal field formula: 3 , 4-5 / 4-5 , 3-4 / 3,4. Wing index: Table 1.

Abdomen (Figs 42d and 47f).- Segment 1 dorsally brown, laterally yellow. Segment 2 laterodorsally black with yellow sides and a yellow dorsal elongated spot. Auricles yellow provided with half a dozen very minute black spines. Segments 3-7 black with a yellow stripe along middorsum, confluent with the yellow basal ring which lateroventrally extends distally in yellow

areas nearly reaching the posterior segmental limits. Segments 8-10 black, without a yellow basal ring, but their lateroventral areas yellow and segment 8 with a middorsal narrow yellow stripe until midlength of segment. Segment 10 dorsally with a pair of yellow small spots. Intersegmental membranes 2-3 until 9-10 black, except 7-8 which is ventrally yellow, 8-9 which is lateroventrally yellow and has a middorsal and a pair of laterodorsal minute yellow spots and 9-10 which has a pair of laterodorsal minute yellow spots. Segment 10 measures 0.55 times the length of segment 9. The last segment bears dorsally a transverse depression and, laterally, a kind of rounded depression (Figs 43e,g).

Anal appendages (Figs 43e-g) black. Superiors as long as inferior; in dorsal view parallel, elongated, straight and with sharp ends. In lateral view, they are slightly directed downwards and have a very characteristic S-shaped profile (partly concealed by inferior appendage), without a lateroventral tooth. In caudal view they are vertically keel-shaped. Inferior appendage with slightly diverging slender branches (they form an angle of only 18°-21° with body axis) ending in a dorsally recurved hook-shaped extremity.

Accessory genitalia.- Posterior hamules yellow with a brown base and ending in a blackish hook. In lateral view (Fig. 44h) they are elongated and straight, 4.6 times longer than wide, exclusive of the blackish hook situated medially on their extremity. Before this final hook, the hamule is somewhat 'swollen', its anterior edge bearing minute setae. In ventral view (Fig. 44i) the posterior hamules are straight and parallel, only becoming sinuous at their extremities, the end hooks parallel and close to each other. Anterior lamina brown. Penial sheath blackish brown, in lateral view ending bevel-edged (Fig. 44h). Penis (Figs 46c-d) black, its vesicle brownish black and bearing posteriorly on each side a tuft of pale long hair. Glans of penis elongated, extending at rest beyond vesicle extremity. Glans not ending in a typical cupule and bearing two nearly straight flagella which visible part, as viewed laterally, is *ca* 0.7 times as long as glans length. Contrary to *N. chapini*, the pavilion at the glans extremity is dorsally not well-developed (as seen at rest).

Female (allotype) (there is no certitude that this specimen pertains to the nominotypical form; it might be that it lies within a cline which extremes could be represented by the holotype of *N. d. dissimilis* and the form here described as the subspecies *N. d. malawiensis*).

Dimensions and wing index: Table 2.

Body colour pattern as in male.

Head (Fig. 41e) as in male holotype, with yellow areas of vertex and occiput extended. Postocellar ridge U-shaped, with widely spread out branches, the basis straight and as long as the branches. Semicircular ridge external to lateral ocelli with a slightly pronounced knob-like process. Occipital plate (Fig. 41j) 4.75 times wider than high. Occipital crest slightly concave, its edge finely serrated.

Synthorax pattern as in male holotype, but the dorsally-directed processes of the broad antehumeral yellow stripes are narrower, somewhat tapering off to a point. Interpleural and metapleural greyish stripes as wide as in male, but more

distinct, the interpleural stripe rejoining the humeral dark stripe. Interalar sclerite mostly brownish grey, whereas the antealar sinus bears a large yellow spot.

Abdominal coloration (Fig. 42e) recalls that of the Malawi male (*N. d. malawiensis*), the segments 8 and 9 having a complete basal yellow ring, but the intersegmental membranes 8-9 and 9-10 are black.

Vulvar scale (Fig. 41m) with a very widely opened and deep V-shaped cleft.

23. *Neurogomphus (Mastigogomphus) dissimilis malawiensis* subsp. n.

Neurogomphus chapini: BARLOW, 1996: 223 (a male from Malawi; brief description and comparison with *N. wittei* AUCT.).

Material

Malawi: 1♂, holotype, Mulanje, 16°02'S 35°30'E, Sayama Tea Estate, Southern Malawi, elev. approx. 2,000 ft, 30.I.1993, R.J. MURPHY leg. (BARLOW's collection; will eventually be deposited in the Smithsonian Research Institute).

Preliminary comments

This male from Malawi, caught at the beginning of the rainy season, at *ca* 500 km from Bazeley Bridge (the allotype locality of *N. dissimilis*) and at *ca* 1,130 km from Katombora (the holotype locality of *N. d. dissimilis*) distinguishes mainly from the latter holotype by the form of the anal appendages and the length of the penial flagella. There are less important differences in the colour pattern of synthorax, of the abdominal terminalia and in the colour of the posterior hamules. On the whole, there is such an overall similarity between the two male specimens that I am inclined to think that the Malawi male does not represent more than a distinct subspecies. It pertains to future discoveries to demonstrate if there exists a cline between the various populations of *N. dissimilis*. For the moment I consider it to be of more heuristic value to place the only two known *N. dissimilis* males in distinct subspecies.

Description

Male (holotype)

Dimensions: Table 1.

Head (Fig. 41f).- Coloration black and yellow as in *N. d. dissimilis*, the distal half of mandibles dark brown. Anteclypeus greyish green, just like a narrow stripe along anterior and posterior border of labrum. Postocellar ridge in the form of a 'U' with branches spread out, the basis straight and as long as the branches (thus, as in the Bazeley Bridge female). Semicircular ridge external to lateral ocelli with a small black spiniform process. Occiput black, its anterior quarter greyish. Occipital plate (Fig. 41l) 4.07 times wider than high. Occipital crest as in the nominotypical form.

Prothorax (Fig. 7z[11]) as in the nominotypical subspecies, the yellow spots slightly more extended.

Synthorax (fig. 40h) as in nominotypical male, with the following differences: dorsal-directed appendix of antehumeral stripe more reduced; interpleural and metapleural blackish stripes narrow but well-marked; antealar sinus black with a pair of conspicuous yellow spots; thoracic sternum greyish yellow. The differences are less marked with the female from Bazeley Bridge because this female has a large yellow spot on each lateral lobe of antealar sinus and better marked interpleural and metapleural dark stripes than the holotype of *N. d. dissimilis*.

Legs entirely black except the coxae and the external face of anterior legs (as seen at rest), which are yellow.

Wings.- Venation black, the costa blackish brown. Pterostigmas uniformly pale yellow-brown, encircled by black veins. A very narrow and greyish membranula extending on to nearly halfway the anal triangle basal margin. Anal triangle 4-celled. Ac vein lying well proximal to A_3 vein and slightly before level of first Pan. Anal field formula: 4 , 3-5 / 4 , 0-4 / 3 , 3-4 / 3-4 , 4. Wing index: Table 1.

Abdominal coloration (Figs 42f and 47g) as in *N. d. dissimilis*, but segments 8-9 with dark dorsolateral areas extending less and of a dark rufous colour instead of black. Auricles as in nominotypical taxon. Segment 10 entirely black (lateroventrally blackish red) and intersegmental membranes 7-8, 8-9 and 9-10 dorsally yellow instead of black. Segment 10 measures 0.63 times the length of segment 9. The segment 10 bears the two kinds of depressions of the nominotypical form, but with a slightly different form (Figs 43h,j).

Anal appendages (Figs 43h-j) blackish brown, as in *N. d. dissimilis*, but in dorsal view, posterior half of superiors tend to diverge slightly. Contrary to the nominotypical taxon the inferior border of the superior appendages, which in caudal view is also keel-shaped, is clearly less sinuous and, in lateral view, has an angular bend which bears a minute ventral spine at 60% of the appendage length. Inferior appendage with branches at *ca* 35°-38° with body axis, thus diverging more than in the nominotypical form.

Accessory genitalia.- Posterior hamules as in nominotypical taxon, but blackish brown. In lateral view (Fig. 44j), their extremity is less swollen before the black end hook, which ends sharper. The length of posterior hamules is 3.8 times that of their width. Ventral view: Fig. 44k. Anterior hamules mid-brown. Anterior lamina yellow. Penial sheath (Fig. 44j) nearly black. Penis (Figs 46e-f) black, vesicle brownish black and bearing posteriorly on each side a rather diffuse tuft of pale long hair. Glans of penis elongated, at rest extending beyond vesicle extremity. The glans ends in a wider pavilion than in the nominotypical form, bearing two shorter and more widely separated flagella. When viewed laterally, the length of the visible part of the flagella is only half that of the glans.

24. *Neurogomphus (Mastigogomphus) sp. indet. D* (♀, Bambesa)

Material

Congo-Kinshasa: 1♀, Bambesa, 03°28'N 25°43'E, Uele Region, VII.1938, J. VRIJDAGH leg. (MRAC).

Description

Dimensions and wing index: Table 2.

The useful characters are the following:

Dorsal part of head: Fig. 41o.- Postocellar ridge not marked. A conspicuous stout spine-shaped process on the ridge external to the lateral ocelli. Occipital plate very narrow, 7.09 times wider than high, of pale colour (yellow or light brown), the occipital crest concave with a slight convexity in its middle, the edge not markedly serrated and provided with yellow-brown hairs.

Synthorax (Fig. 41p) with colour pattern of the kind seen in the other members of the subgenus. The antehumeral pale stripe has a small dorsally-directed process such as the one seen in *N. chapini lamtoensis*.

Wings slightly but uniformly yellowish grey, smoky. Venation dark brown, the pterostigmas yellow, surrounded by black veins. Ac well proximal to A_3 vein.

Vulvar scale (Fig. 41n) with two, but weak, rounded distal processes and with a wide V-shaped indentation, only half so deep as in the *N. dissimilis* female from Bazeley Bridge.

Comments

This adult female of the subgenus *Mastigogomphus* is too badly dark brown stained by post-mortem decay to allow a description under a specific name. It might be a female of *N. chapini*, but more probably, because of its larger size and narrowness of occipital plate, a distinct species, different from the known members of the subgenus.

A key to the *Neurogomphus* taxa

The present key does not include the Tanzanian females supposed to represent a form of *N. zambeziensis* (p. 142) as well as other still unnamed females (*N. sp. indet A*: p. 126; *B*: p. 144; *C*: p. 144; *D*: p. 170), described in the above text. *N. vicinus* is only known from a damaged immature specimen.

The colour pattern of face and thorax of females corresponds with that of conspecific males. The females of eight species are still unknown, viz. those of *N. angustisigna*, *N. paenuelensis*, *N. vicinus*, *N. wittei*, *N. agilis*, *N. carl-cooki*, *N. chapini* and *N. pinheyi*.

1 Postdorsal stripes long, fused to or nearly confluent with collar ridge or (frequently reduced) antehumeral stripes. Occipital plate less than 3× wider than high, the crest convex. Face with at least slight

darkening on base of labrum. Hw Ac distal or at most at level with A_3 vein (Ac may be slightly proximal in some individuals). Superior appendages divergent, the span of inferior appendage not obviously larger. Glans of penis ventrally flanked by a well-developed preputial fold and ending in a cupule without well-developed flagella. Median indentation of vulvar scale not extending over half the scale length .. .. (subgenus *Neurogomphus* KARSCH, 1890) 2

Postdorsal stripes short, in the form of elongated spots, well separated from collar stripes and (complete and broad) antehumeral stripes. Occipital plate at least 3× wider than high, the crest straight or slightly concave. Face entirely pale (anteclypeus may appear greenish grey). Hw Ac well proximal to A_3 vein. Superior appendages parallel, the span of inferior appendage markedly wider. Glans of penis without a preputial fold and bearing two well-developed flagella. Median indentation of vulvar scale extending at least till half the scale length ..... (subgenus *Mastigogomphus* nov.) 15

2 (1) Posterior hamules (lateral view) at most 2.8× longer than wide 3

Posterior hamules (lateral view) at least 3× longer than wide 6

3 (2) Face and vertex mostly pale. Occipital plate yellow, crest with spines. Thoracic markings predominantly pale and not well-contrasted, but rather diffuse. S4-7 with a pair of laterodorsal black stripes separated by a wide middorsal yellow stripe all along dorsum .... *N. pallidus* CAMMAERTS, 1967 (p. 156)

Face and vertex mostly dark. Occipital plate black, crest without spines. Thoracic markings predominantly black, well-contrasted. S4-7 entirely black 4

4 (3) Spiracular dorsum dark, only pale on collar crest. Postdorsal stripes either straight or fused with collar; in the later case, therefore 7-shaped. Antehumerals either absent or elongated and very narrow .. 5

Spiracular dorsum mostly green. Postdorsal stripes fused with collar and antehumerals, therefore Z-shaped. Antehumerals reduced to small triangular spots ..... *N. alius* sp. n. (p. 114)

5 (4) Postclypeus and vertical surface of frons, mainly black. Occipital plate at least 2.3× wider than high. Occipital crest uniformly convex or slightly lip-shaped. Postdorsal stripes reaching collar ridge (collar stripes absent or poorly developed). No antehumerals, the humeral area being entirely black. Mesepimeron entirely or mostly black. Metepimeron dark yellowish brown in its middle, a wide black stripe running all along its borders. Superior appendages (dorsal view) evenly tapering ..... *N. fuscifrons* KARSCH, 1890 (p. 109)

Postclypeus and vertical surface of frons mainly green. Occipital plate less than 2.2× wider than high. Occipital crest obviously lip-shaped.

Postdorsal stripes not obviously confluent with well-developed collar stripes. Antehumeral stripes very narrow and fragmented. Mesepimeral stripe yellow and complete. Metepimeron mostly yellow. Superior appendages (dorsal view) tapering after an abrupt narrowing at 8/10 of appendage length ..... *N. angustisigna* PINHEY, 1971 (p. 112)

6 (2) Posterior hamules *ca* 5× longer than wide. Male occipital plate at least 2.2× wider than high. Occipital crest markedly convex, with (♂) or without (♀) a conspicuous median rounded notch or slightly lip-shaped (♀). Metepimeron predominantly dark with an incomplete distinct pale stripe ..... *N. martininus* (LACROIX, 1921) (p. 117)

Posterior hamules not exceeding 4.5× their width. Male occipital plate less than 1.8× wider than high. Occipital crest more or less angular, never notched or lip-shaped. Metepimeron predominantly pale 7

7 (6) Face with dark and pale pattern, the labrum always entirely dark ... 8

Face mostly pale, i.e. sometimes with slight darkening on postclypeus and base of labrum, the latter however never entirely dark 14

8 (7) Antehumerals well-isolated from postdorsal stripes and reduced to sinuous spots. Sides of synthorax with a succession of parallel dark and pale stripes ..... *N. agilis* (MARTIN, 1908) (p. 145)

Antehumerals slightly confluent with postdorsal stripes and either in the form of very small or elongated triangular spots or of well-defined stripes. Sides of thorax mostly pale 9

9 (8) Superior appendages with a little stud-shaped lateroventral tooth. Third row of radial field with as much as 15 cells in fw and 17-20 cells in hw ..... *N. vicinus* SCHOUTEDEN, 1934 (p. 131)

Superior appendages with lateroventral tooth not stud-like shaped. Third row of radial field with no more than 13 cells in fw and 15 cells in hw 10

10 (9) Upper half of vertical part of frons dark, with a median stripe connecting to the postclypeus dark lower half. Antehumerals as minute spots. S10 1.22× longer than S9 ..... *N. paenuelensis* sp. n. (p. 124)

Upper half of vertical part of frons entirely or almost entirely pale. Antehumerals either short and triangular or elongated. S10 less than 1.15× S9 11

11 (10) Lower half of postclypeus with complete dark stripe 12

Lower half of postclypeus with a dark stripe interrupted in its middle 13

12 (11) Antehumeral stripes shorter than half length of mesepisternum. S8 with a yellow area on basal half, not extending posteriorly. S10 1.03-

1.12× longer than S9. Superior appendages with a very strong lateroventral tooth, well visible from dorsal view and situated at 50-59% of appendage length (in lateral view, perpendicularly to body axis) ..... *N. uelensis* SCHOUTEDEN, 1934 (p. 121)

Antehumeral stripes at least half as long as mesepisternum; they may tend to coalesce with the postdorsal stripes and to obliterate the mesepisternal dark space between them. S8 yellow on basal half, this pale area laterally extending posteriorly. S10 0.85-0.88× longer than S9. Superior appendages with a barely visible lateroventral squat and blunt process at about 80% of appendage length (in lateral view, perpendicularly to body axis) .. *N. wittei* SCHOUTEDEN, 1934 (p. 134)

13 (11) Antehumeral stripes short, not extending over half the mesepisternum length. They are not obviously triangular, may even be quadrangular and are close to postdorsal stripes. Postdorsal stripes, wide. Interpleural and metapleural stripes absent. S8 basally yellow on more than half its length. Superior appendages with a strong lateroventral tooth. Posterior hamules with a shallow subapical notch. Vulvar scale ending with a pair of short lobes, separated by a triangular indentation which inner borders tend to be concavely curved .... *N. cocytius* sp. n. (p. 127)

Antehumeral stripes very long, reaching the anterior border of mesepisternum. They are wide, sinuous and tend to be separated from the postdorsal stripes. Their anterior end is acute. Postdorsal stripes narrow, except at their collar extremity. Interpleural stripe incomplete, extending dorsally to metastigma. Metapleural stripe complete. Basal half of S8 yellow (Zambezi and Mozambique specimens) or only with two distinct laterodorsal yellow spots (South African specimens). Superior appendages with a very small or nearly absent lateroventral tooth. Posterior hamules with a deep subapical notch. Vulvar scale ending with a pair of triangular acute tips, separated by a deep triangular indentation which inner borders tend to be convexly curved ..... *N. zambeziensis* sp. n. (p. 136)

14 (7) Occipital plate brown. Antehumeral stripes narrow but complete. Humeral area entirely black except for a very narrow pale stripe under the whole length of humeral suture. Complete interpleural and metapleural dark stripes. Superior appendages (dorsal view) with stout and blunt apices; lateroventrally they lack a tooth, but have a very weak, rounded, blunt process ..... *N. carlcooki* sp. n. (p. 149)

Occipital plate yellow. Antehumeral stripes wide. Humeral suture covered by a narrow pale stripe bordered anteriorly and posteriorly by narrow dark stripes. Interpleural and metapleural dark stripes incomplete or absent. Superior appendages (dorsal view) with acute apices; lateroventrally, they are provided with a small, but conspicuous tooth ..... *N. featheri* PINHEY, 1967 (p. 151)

15 (1) Posterior hamules at most 2.5× longer than wide (lateral view), with end hook situated on anterior corner of square-cut apex. Flagella about as long as glans. Superior appendages (dorsal view) abruptly pointed before apex 16

Posterior hamules at least 3.8× longer than wide (lateral view), with end hook situated medially on rounded apex. Flagella shorter than glans (0.4 - 0.6× the length). Superior appendages (dorsal view) gradually tapering into an acute point 17

16 (15) Posterior hamules 2.0-2.5× longer than wide (lateral view). Superior appendages reaching greatest thickness at 2/3 of appendage length. Antehumeral stripe straight. An incomplete interpleural stripe .... *N. chapini chapini* (KLOTS, 1944) (p. 159)

Posterior hamules 1.5× longer than wide (lateral view). Superior appendages reaching greatest thickness at 8/10 of appendage length. Antehumeral stripe sinuous with a small dorsal appendix at the level of anterior end of postdorsal stripe. A complete interpleural stripe ... . *N. chapini lamtoensis* subsp. n. (p. 162)

17 (15) Antehumeral stripes straight. Superior appendages straight and slightly upwards directed, tapering off to an acute point (lateral view) ..... *N. pinheyi* CAMMAERTS, 1968 (p. 163)

Antehumeral stripes sinuous with a dorsal appendix at level of anterior end of postdorsal stripes. Superior appendages sinuous and slightly downwards directed (lateral view) 18

18 (17) Flagella (lateral view) *ca* 0.7× the length of glans. Branches of inferior appendage (dorsal view) forming an angle of less than 45° with body axis. Superior appendages keel-shaped, the inferior border regularly S-shaped. Lateral and ventral sides of S10 yellow .... *N. dissimilis dissimilis* sp. n. (p. 165)

Flagella (lateral view) *ca* 0.5× the length of glans. Branches of inferior appendage (dorsal view) forming an angle of 45° with body axis. Superior appendages with inferior border angular and with a minute spiny 'wart'. Lateral and ventral sides of S10 black and dark rufous .. .. *N. dissimilis malawiensis* subsp. n. (p. 168)

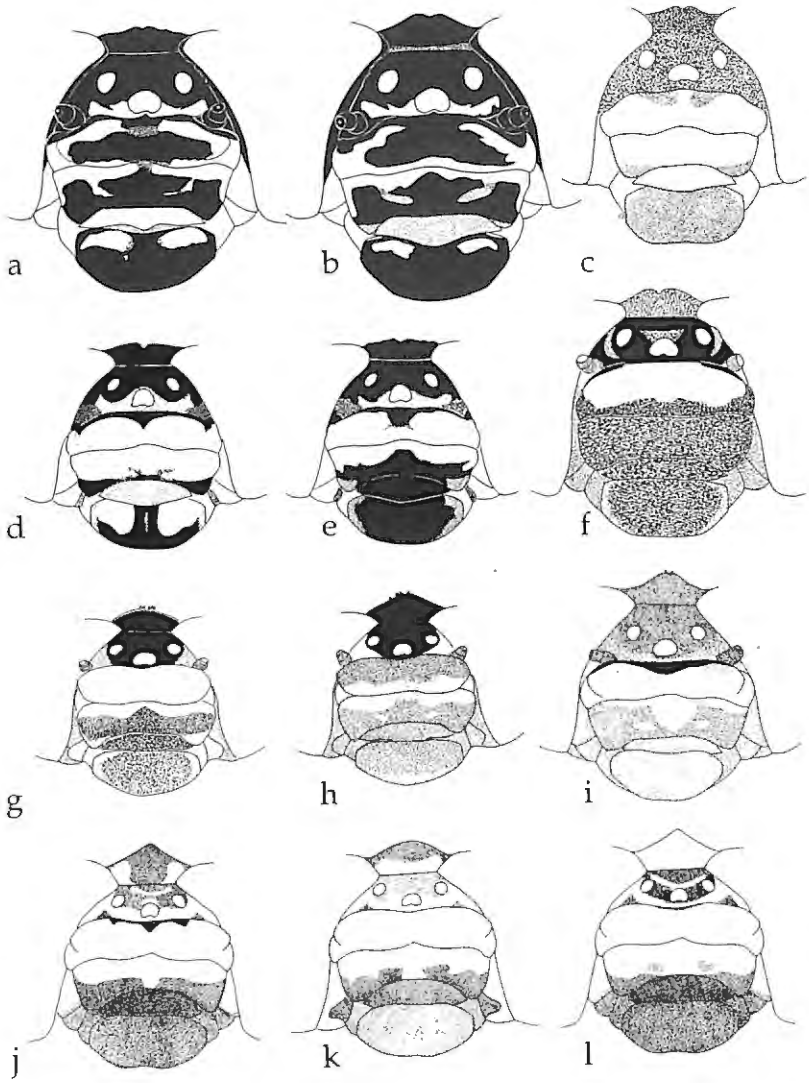

Fig. 4. Head colour pattern of *Neurogomphus spp.*, frontal view. a: *fuscifrons*, allotype ♂; b: *fuscifrons*, holotype ♀; c: *angustisigna* , holotype ♂; d: *alius*, paratype ♂, Yaoundé; e: *alius*, holotype ♂; f: *martininus*, ♂ (*ghesquierei* holotype); g: *uelensis*, holotype ♂; h: *paenuelensis*, holotype ♂; i: *sp. indet. A*, Eala ♀; j: *cocytius*, Katombora ♂; k: *idem*, Victoria Falls ♂; l; *idem*, Katombora ♀.

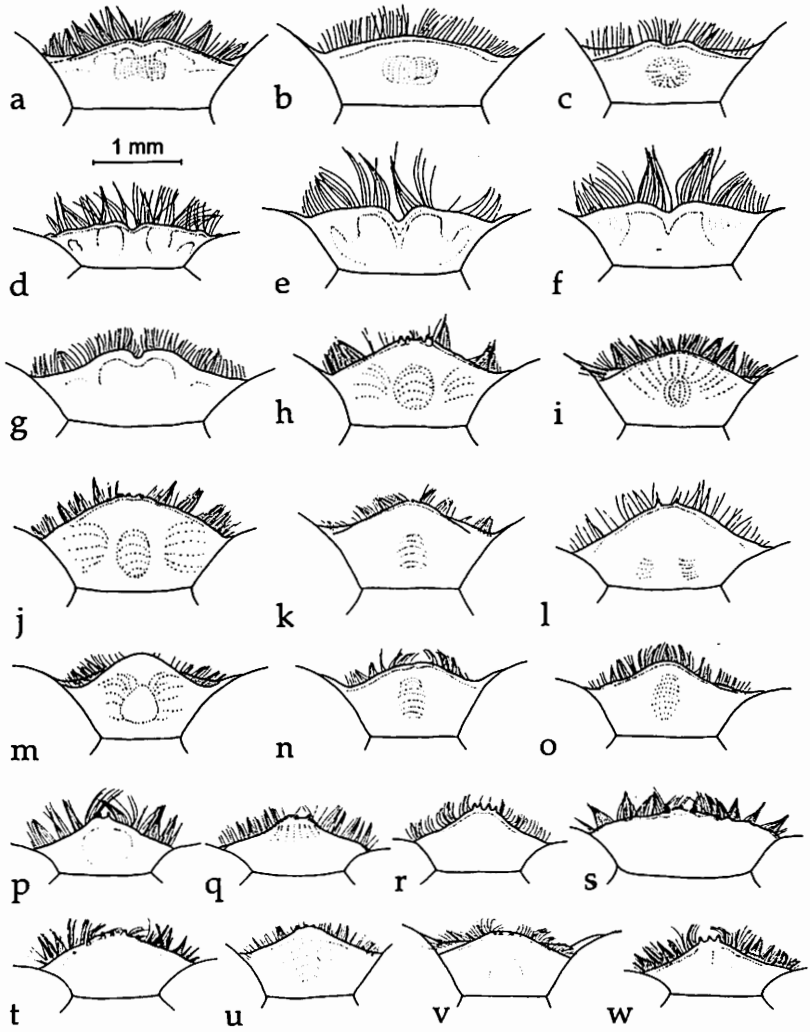

Fig. 5. Occipital plates of *Neurogomphus* ♂♂ (seen in a flat position and colour pattern omitted). a: *fuscifrons*, allotype; b: *idem*, Bipindi; c: *angustisigna*, holotype; d: *alius*, holotype; e: *idem*, Yaoundé; f: *idem*, Makomo; g: *martininus* (*ghesquierei* holotype); h: *uelensis*, holotype; i: *idem*, Makokou; j: *paenuelensis*, holotype; k: *cocytius*, Katombora; l: *idem*, Victoria Falls; m: *wittei*, Uvira; n: *zambeziensis*, Katombora; o: *idem*, Ndumo; p: *agilis*, holotype; q: *idem*, Congo-Brazzaville; r: *carlcooki*, holotype; s: *pallidus*, Lubumbashi; t: *featheri*, holotype; u: *idem*, Makurdi; v-w: *idem*, Bantanto (w: frontal view of v).

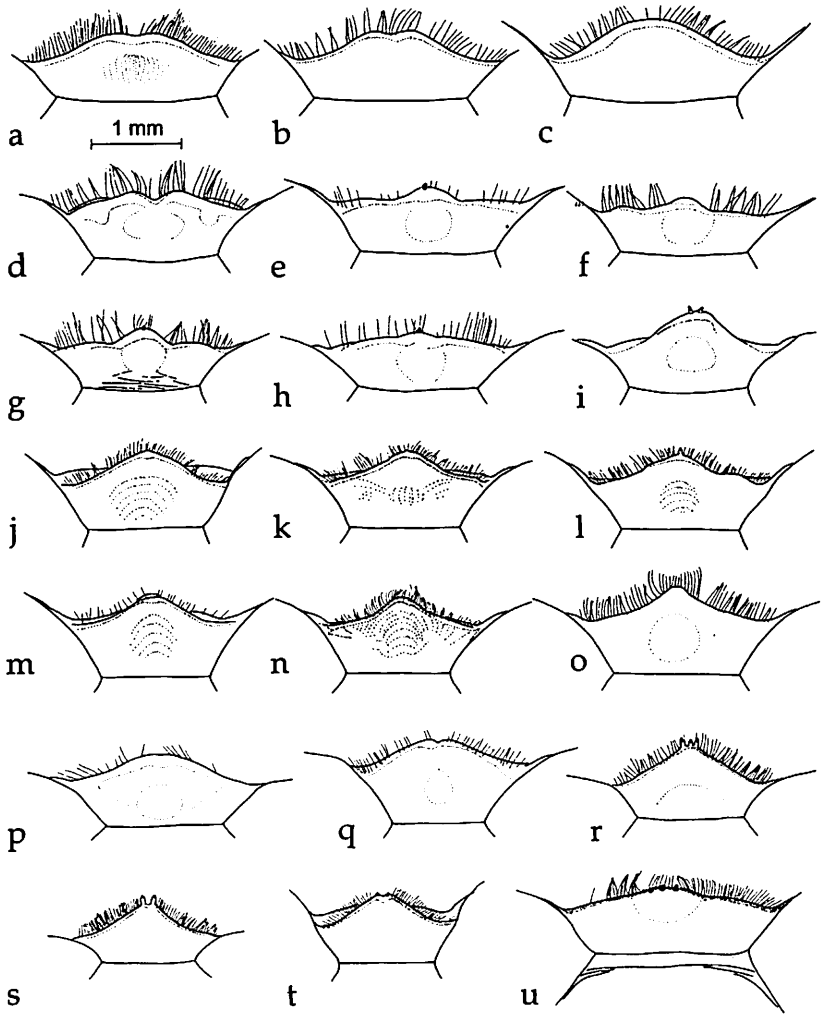

Fig. 6. Occipital plates of *Neurogomphus* ♀♀ (seen in a flat position and colour pattern omitted). a: *fuscifrons*, holotype; b: *martininus*, holotype; c: *idem*, Stanley Falls; d: *alius*, Yaoundé; e, f: *uelensis*, Makokou, two specimens; g, h: *idem*, Andok Forest, two specimens; i: *sp. indet. A*, Eala; j, k, l: *cocytius*, Victoria Falls, three specimens; m-n: *zambeziensis*, Katombora, two specimens; o: *cf zambeziensis*, Turiani; p: *idem*, Mikumi; q: *sp. indet. B*, Kere-Kere; r: *sp. indet. C*, Assinie; s-t: *featheri*, Bantanto (s: frontal view); u: *pallidus*, Lubumbashi.

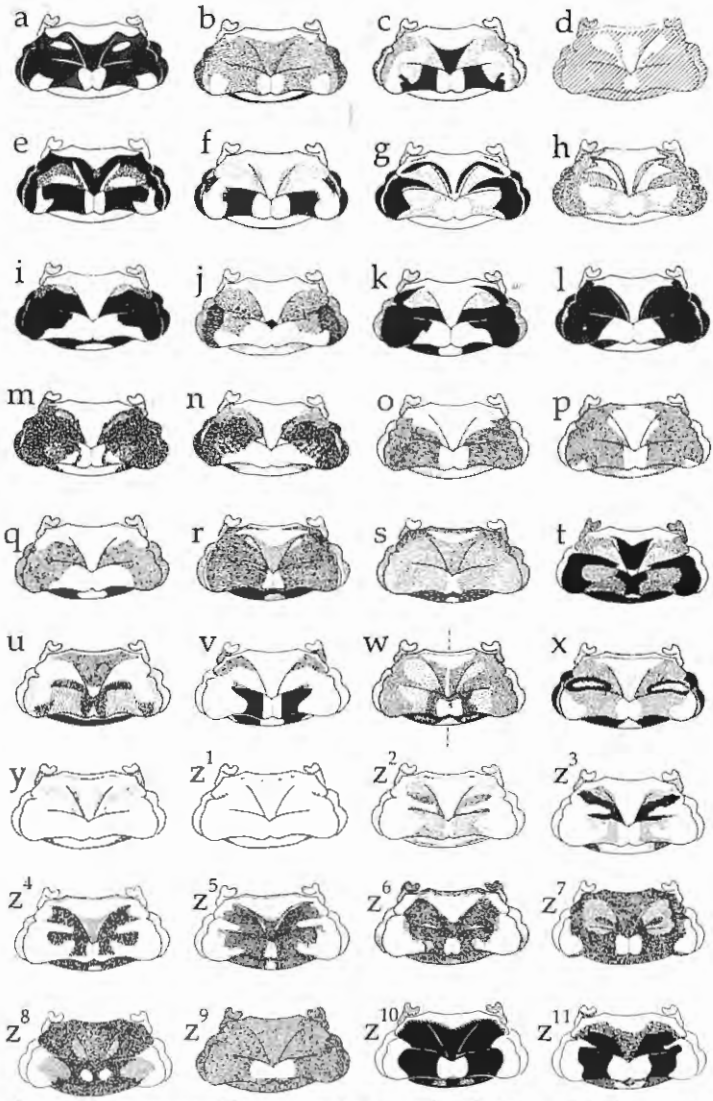

Fig. 7. Prothorax colour pattern of *Neurogomphus spp.*, dorsal view. a: *fuscifrons*, allotype ♂; b: *idem*, holotype ♀; c: *angustisigna*, holotype ♂; d: *vicinus*, holotype ♂; e: *alius*, Yaoundé ♂; f: *idem*, Yaoundé ♀; g: *martininus* ♂ (*ghesquierei* holotype); h: *idem*, holotype ♀; i: *uelensis*, holotype ♂; j-k: *idem*, Makokou, two ♂♂; l: *paenuelensis*, holotype ♂; m: *cocytius*, Katombora ♂; n: *idem*, Katombora ♀; o: *wittei*, holotype ♂; p: *idem*, Uvira ♂; q: *sp. indet. A*, Eala ♀; r: *zambeziensis*, Mosi-oa-Tunya ♂; s: *idem*, Katombora Rapids ♀; t: *cf zambeziensis*, Turiani ♀; u: *sp. indet. B*, Kere-Kere ♀; v: *sp. indet. C*, Assinie ♀; w: *agilis*, Congo-Brazzaville ♂ (left side) and holotype ♂ (right side); x: *carlcooki*, holotype ♂; y: *featheri*, holotype ♂; z^1: *idem*, Makurdi ♂; z^2: *idem*, Bantanto ♀; z^3: *idem*, Bantanto ♂; z^4: *pallidus*, Lubumbashi, immature ♂; z^5: *idem*, Lubumbashi, mature ♂; z^6: *idem*, Kiamalale, mature ♀; z^7: *chapini chapini*, holotype ♂; z^8: *chapini lamtoensis*, holotype ♂; z^9: *pinheyi*, paratype ♂; z^{10}: *dissimilis dissimilis*, holotype ♂; z^{11}: *dissimilis malawiensis*, holotype ♂.

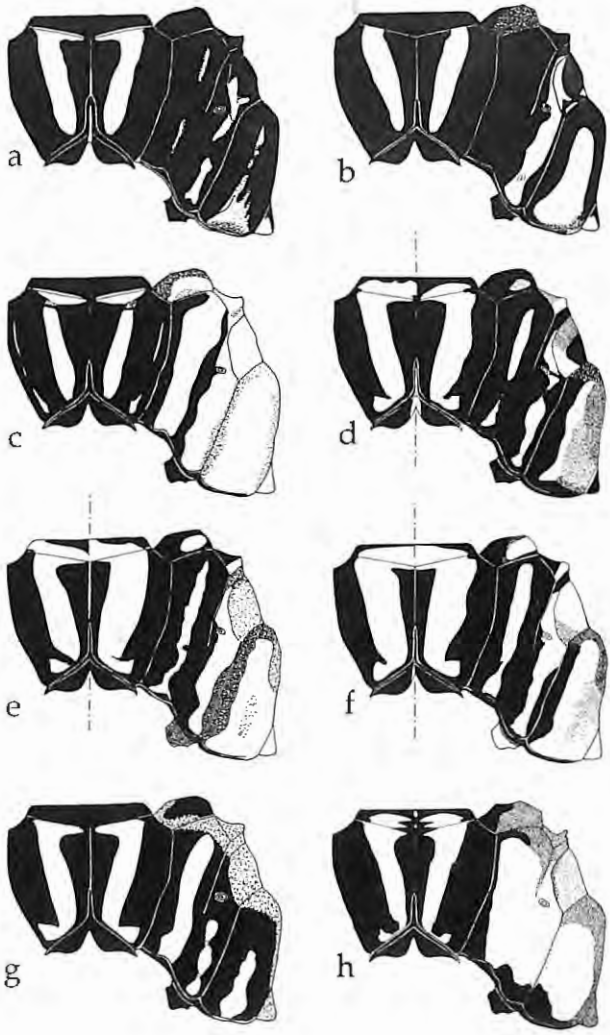

Fig. 8. Synthorax colour pattern of *Neurogomphus spp.* a: *fuscifrons*, allotype ♂; b: *fuscifrons*, holotype ♀; c: *angustisigna*, holotype ♂; d: *alius*, Yaoundé ♂ (separate specimens for left and right side); e: *alius*, La Maboké ♂ (left side) and holotype ♂ (right side); f: *alius*, Menzalé ♀ (left side) and Kelle ♀ (right side); g: *martininus* ♂ (*ghesquierei* holotype); h: *paenuelensis*, holotype ♂.

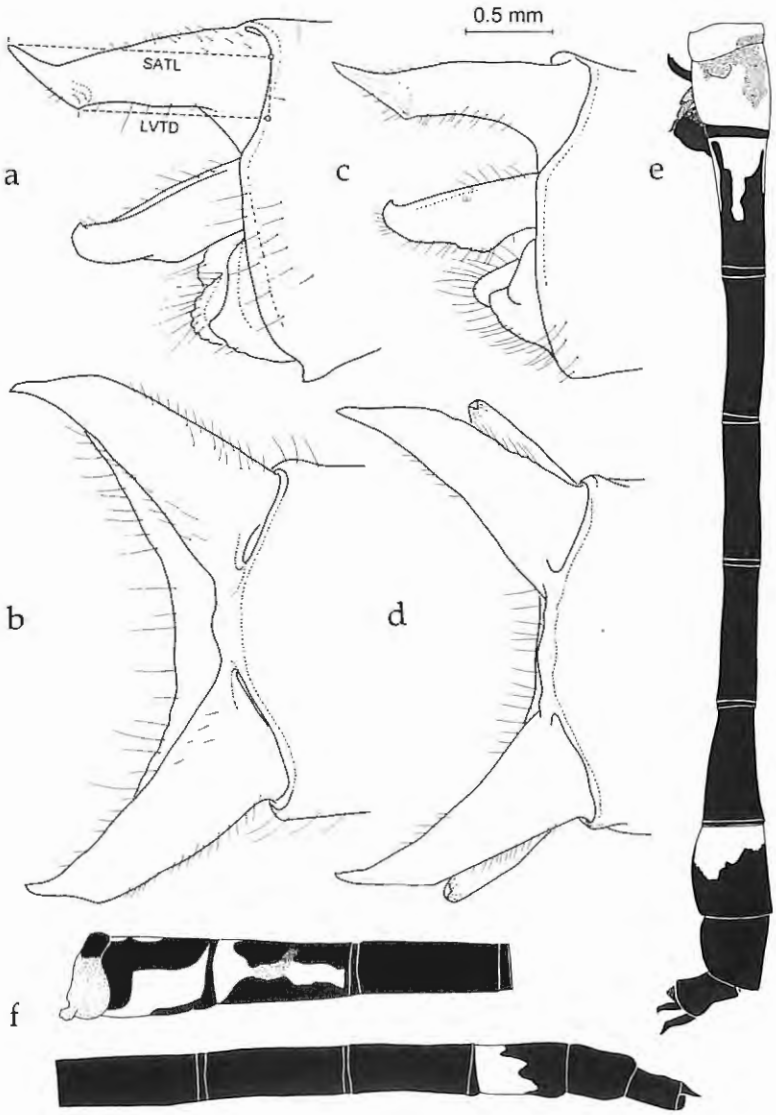

Fig. 9. *Neurogomphus fuscifrons*, anal appendages and abdomen colour pattern. a-b: allotype ♂, lateral and dorsal view of appendages; c-d: Bipindi ♂, idem; e: allotype ♂, lateral view of abdomen; f: holotype ♀, lateral view of abdomen. SATL: superior appendage total length. LVTD: lateroventral tooth distance. The relative position of the lateroventral tooth is given by the ratio LVTD/SATL (further explanation in 'Material and methods').

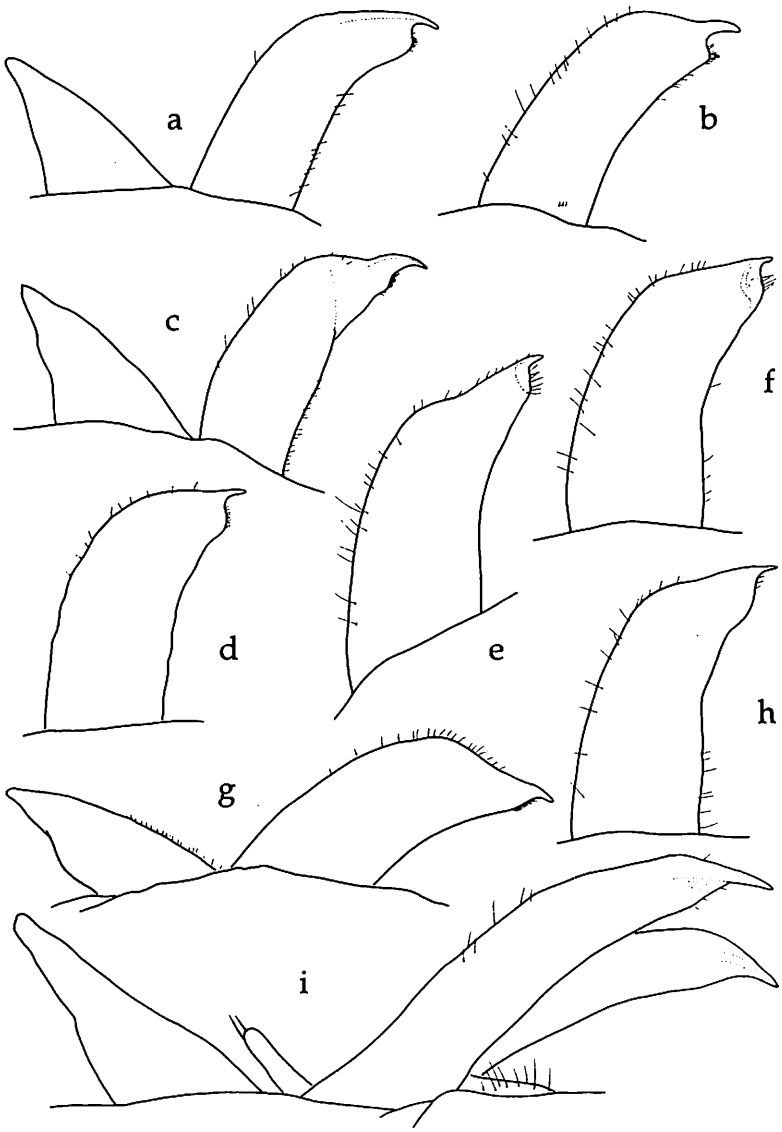

Fig. 10. Hamules and penial sheath of *Neurogomphus spp.*, left lateral view. a: *fuscifrons*, allotype; b: *idem*, Bipindi; c: *angustisigna*, holotype; d: *alius*, Kelle; e: *idem*, Yaoundé; f: *idem*, Makomo; g: *idem*, holotype; h: *idem*, La Maboké; i: *martininus* (*ghesquierei* holotype).

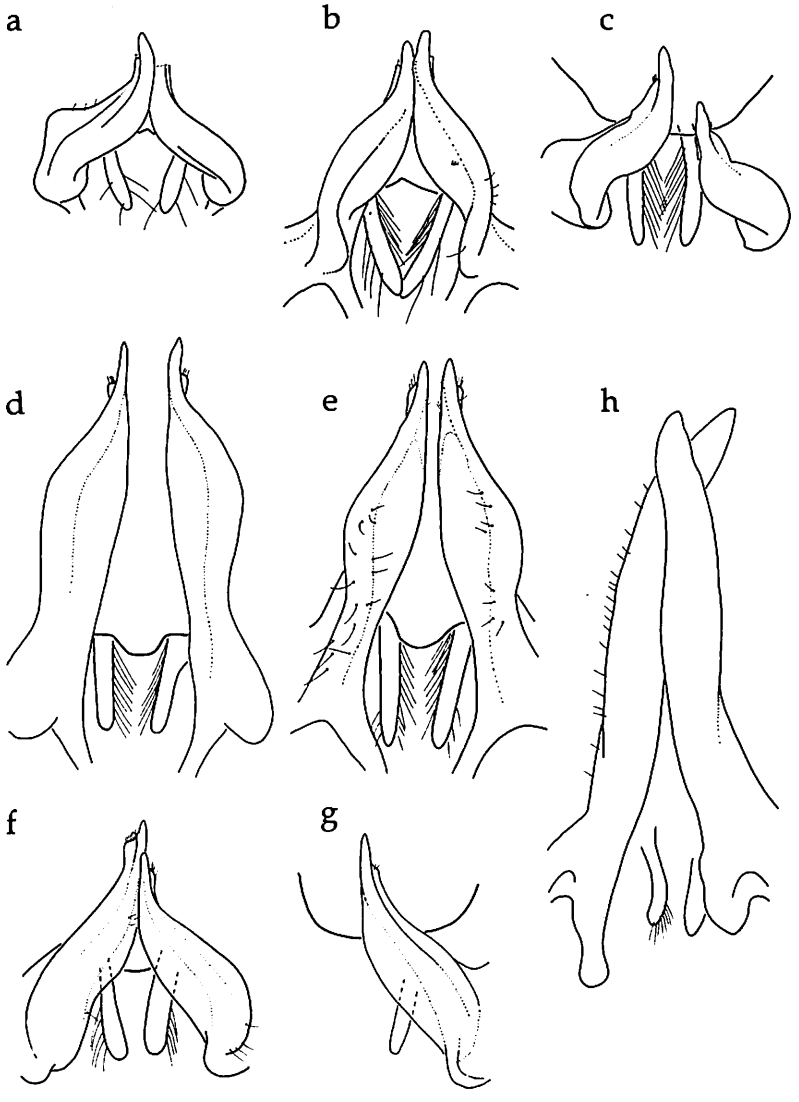

Fig. 11. Hamules of *Neurogomphus spp.*, ventral view. a: *fuscifrons*, allotype; b: *idem*, Bipindi; c: *angustisigna*, holotype; d: *alius*, holotype; e: *idem*, Yaoundé; f: *idem*, Makomo; g: *idem*, La Maboké (left hamules); h: *martininus* (*ghesquierei* holotype).

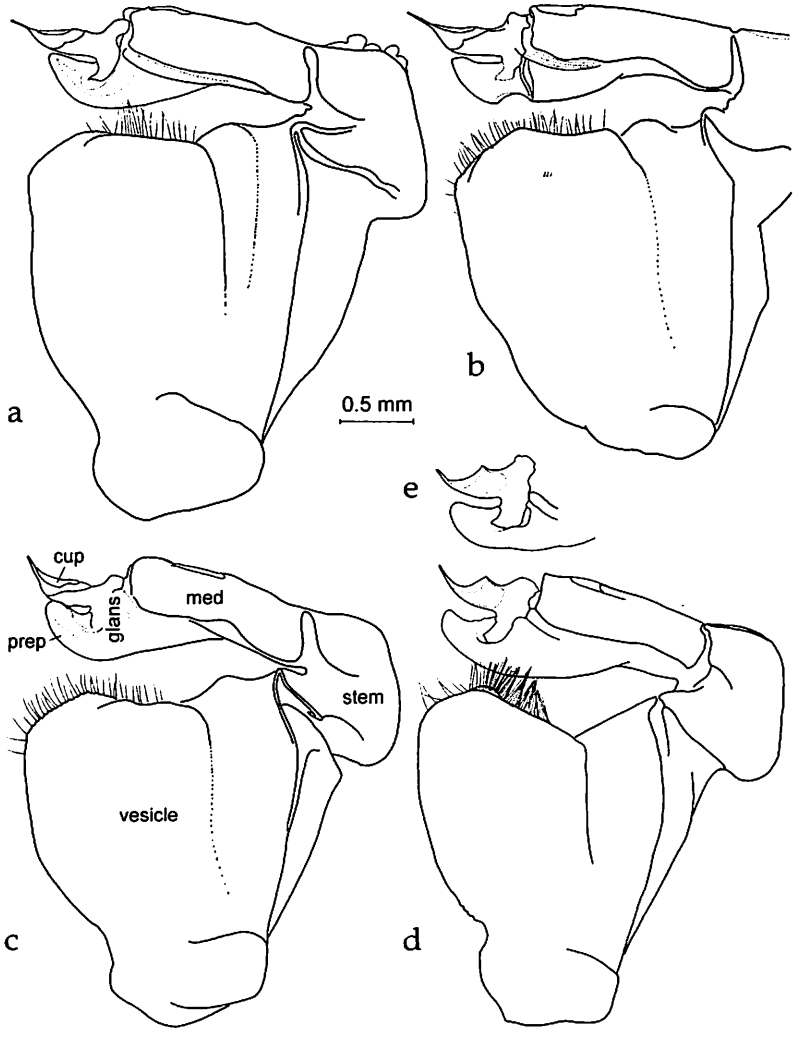

Fig. 12. Penis of *Neurogomphus spp.*, left lateral view. a: *fuscifrons*, allotype; b: *idem*, Bipindi; c: *angustisigna*, holotype; d: *alius*, Kelle; e: *idem*, Yaoundé, extremity of penis. cup: cupule; med: median segment; prep: preputial fold.

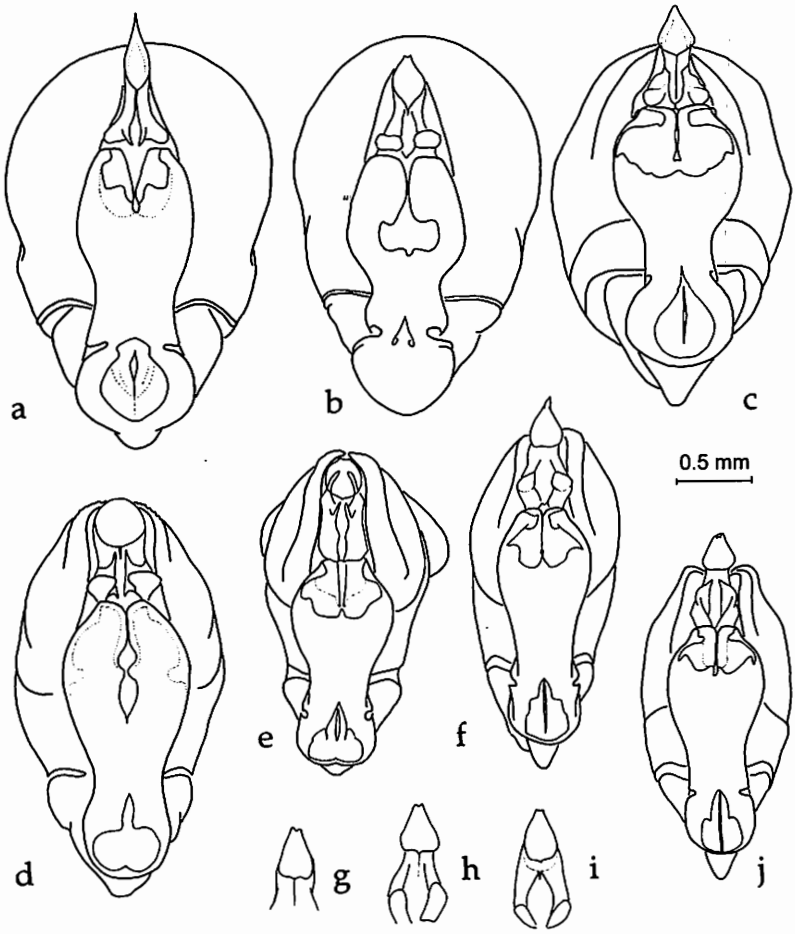

Fig. 13. Penis of *Neurogomphus spp.*, ventral view. a: *fuscifrons*, Bipindi; b: *angustisigna*, holotype; c: *alius*, Kelle; d: *martininus* (*ghesquierei* holotype); e: *uelensis*, holotype; f: *idem*, Kelle; g-i: *idem*, glans of three specimens from Makokou; j: *paenuelensis*, holotype.

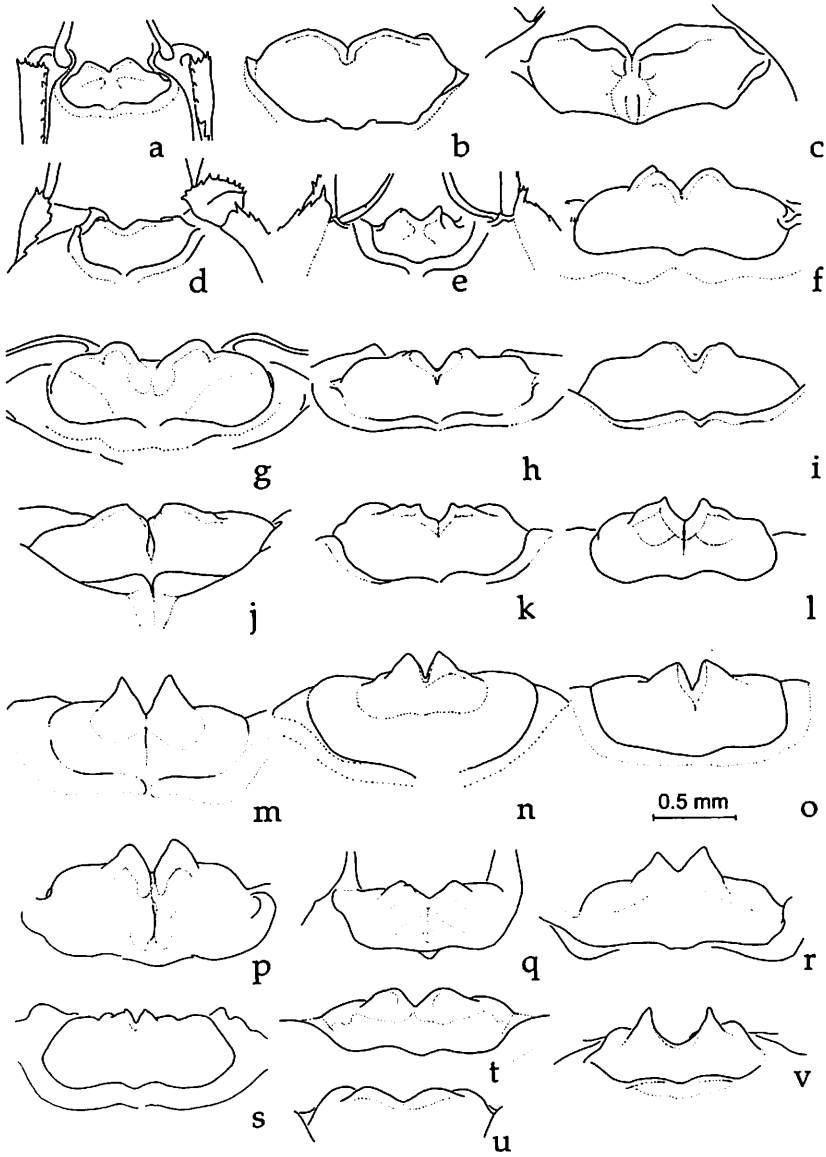

Fig. 14. Vulvar scale of *Neurogomphus spp.* a: *fuscifrons*, holotype; b: *alius*, allotype; c: *idem*, Menzalé; d: *martininus*, holotype; e: *idem*, Stanley Falls; f, g: *uelensis*, Makokou, two specimens; h, i: *idem*, Andok Forest, two specimens; j: *sp. indet. A*, Eala; k, l: *cocytius*, Katombora, two specimens; m, n: *zambeziensis*, Katombora, two specimens; o: *cf zambeziensis*, Turiani; p: *idem*, Mikumi; q: *sp. indet. B*, Kere-Kere; r: *sp. indet. C*, Assinie; s: *featheri*, Bantanto; t, u: *idem*, N'Djamena, two specimens; v: *pallidus*, Kiamalale, paratype. Scale of a is half that of b-v.

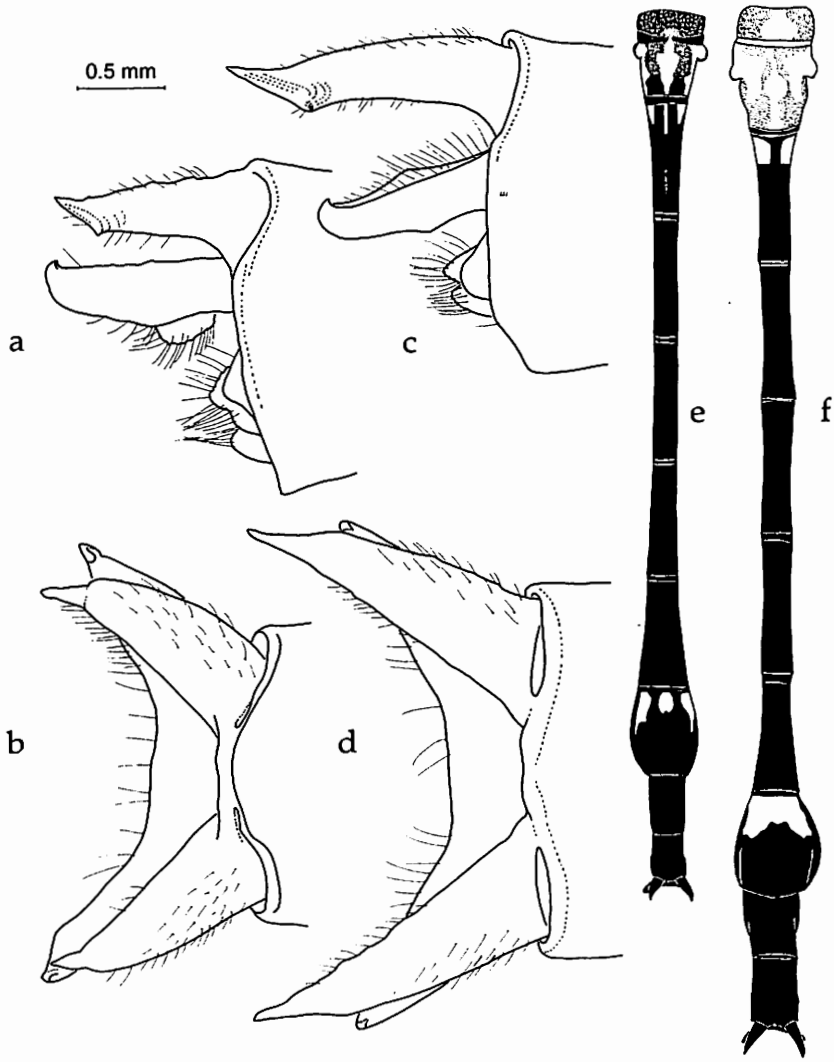

Fig. 15. Anal appendages and abdomen colour pattern of *Neurogomphus* ♂♂. a-b: *angustisigna* holotype, appendages, lateral and dorsal view; c-d: *martininus* (*ghesquierei* holotype), idem; e: *angustisigna* holotype, abdomen, dorsal view; f: *martininus* (*ghesquierei* holotype), idem.

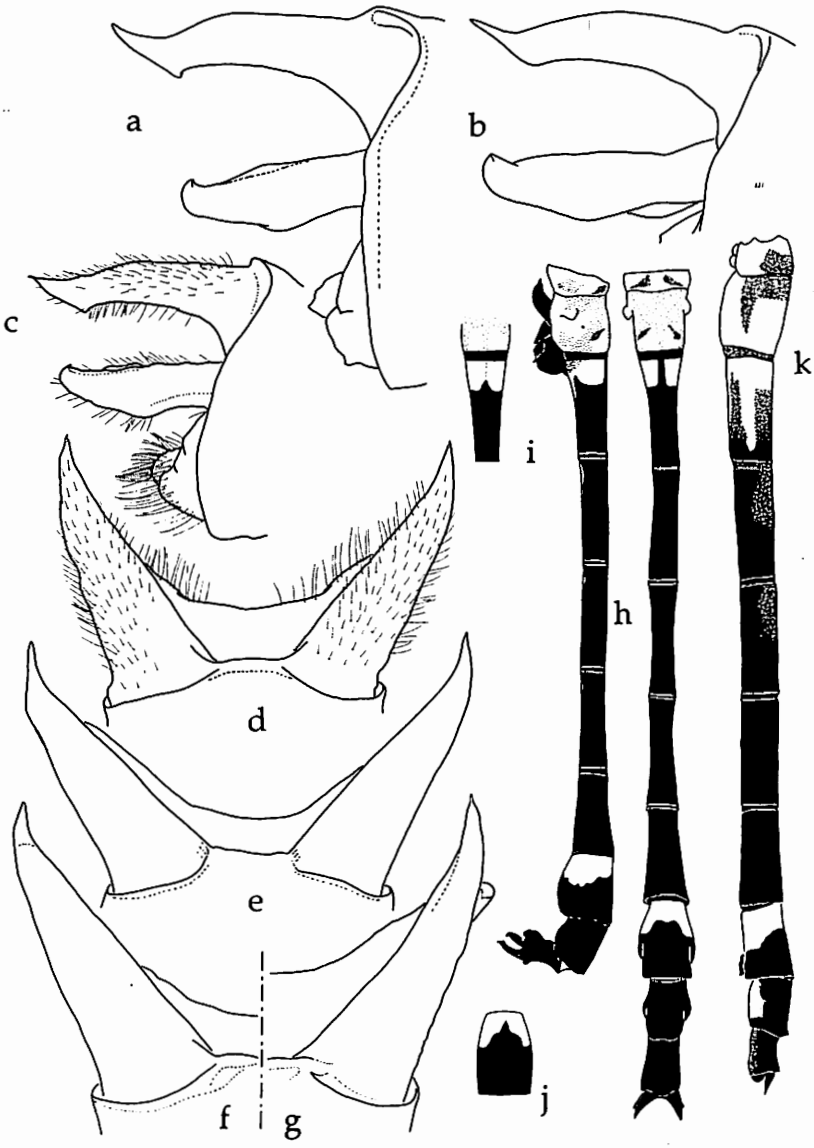

Fig. 16. *Neurogomphus alius* male anal appendages (a-g, side and dorsal view) and abdomen colour pattern (h-k). a, f: Makomo; b, e: La Maboké; c-d: holotype; g: Yaoundé; h: holotype ♂, dorsal and lateral view; i-j: La Maboké ♂, dorsal view of segments 1-2 and 8; k: Kelle ♀.

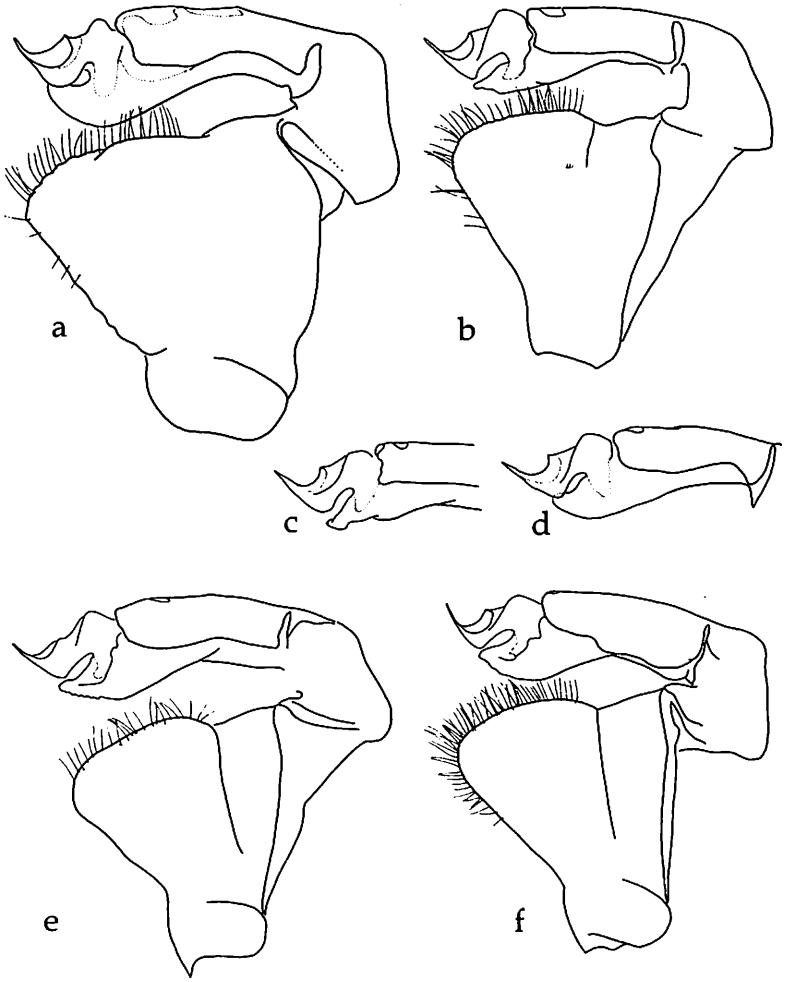

Fig. 17. Penis of *Neurogomphus spp.*, lateral view. a: *martininus* (*ghesqueirei* holotype); b: *uelensis* holotype; c-d: *idem*, Makokou, extremity of penis of two specimens; e: *idem*, Kelle; f: *paenuelensis* holotype.

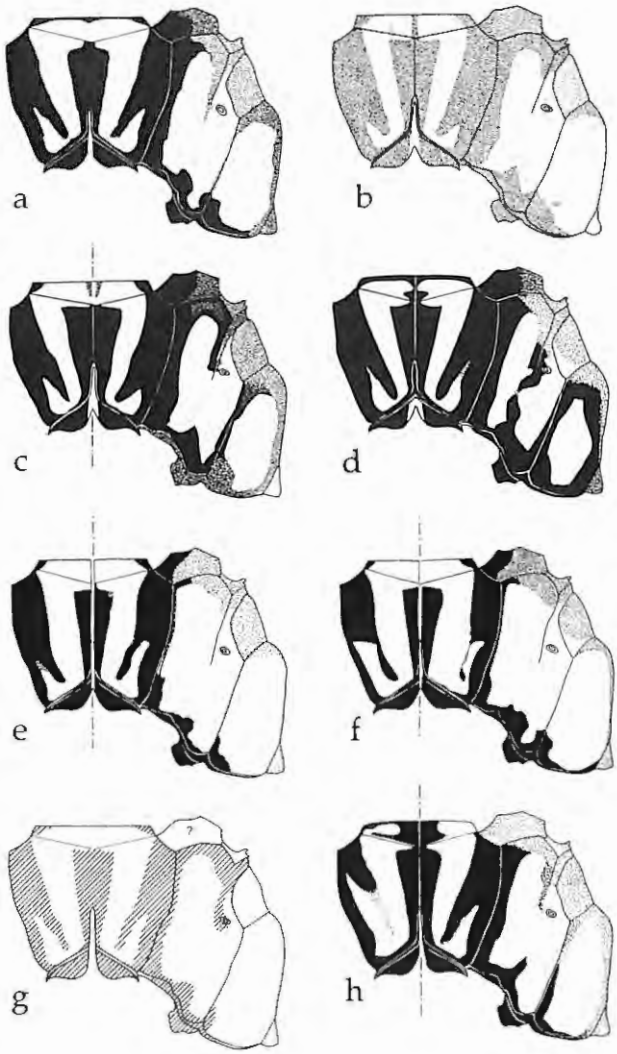

Fig. 18. Synthorax colour pattern of *Neurogomphus spp.* a: *uelensis*, holotype ♂; b: *idem*, Andok Forest ♀; c: *idem*, Makokou ♂ (left side) and ♀ (right side); d: *idem*, Makokou ♂, another specimen; e: *cocytius*, Victoria Falls ♀ (left side) and Katombora ♀ (right side); f: *idem*, Katombora ♂ (left and right side from two specimens); g: *vicinus*, holotype ♂; h: *wittei*, Uvira ♂ (left side) and holotype ♂ (right side).

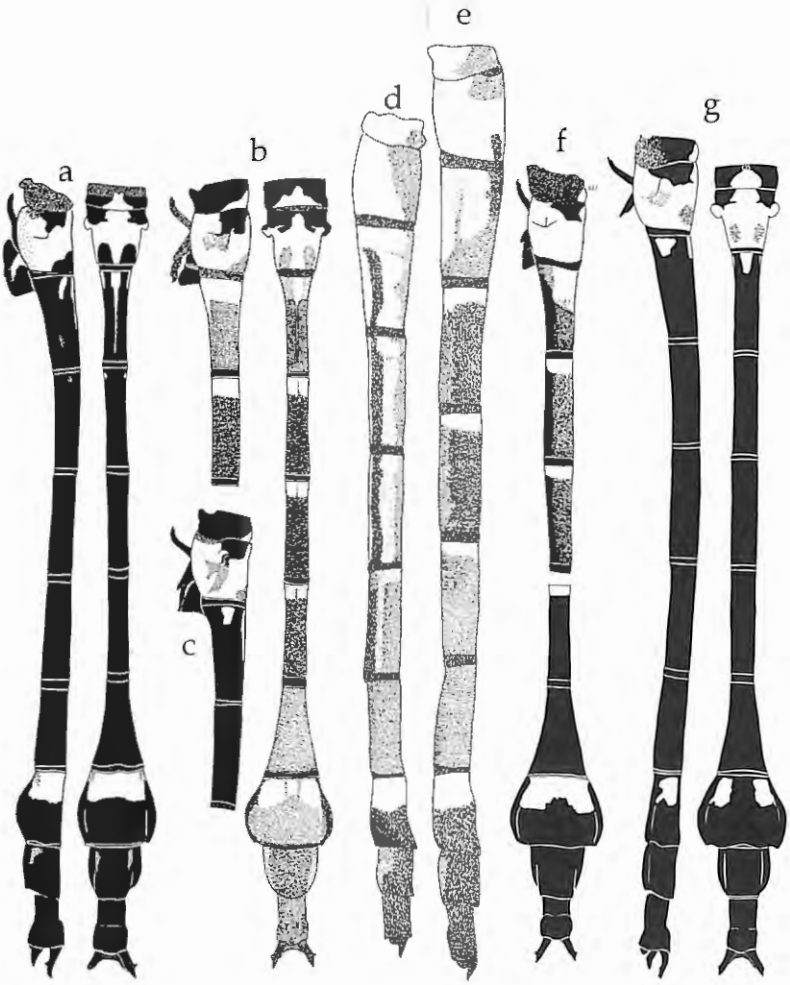

Fig. 19. Abdomen colour pattern of *Neurogomphus spp.* a: *uelensis*, holotype ♂, lateral and dorsal view; b: *idem*, Makokou ♂; c: *idem*, Makokou ♂, another specimen, lateral view of segments 1-4; d: *idem*, Andok Forest ♀, lateral view; e: *idem*, Makokou ♀, lateral view; f: *idem*, Kelle ♂, lateral view of segments 1-5 and dorsal view of segments 6-10; g: *paenuelensis*, holotype ♂, lateral and dorsal view.

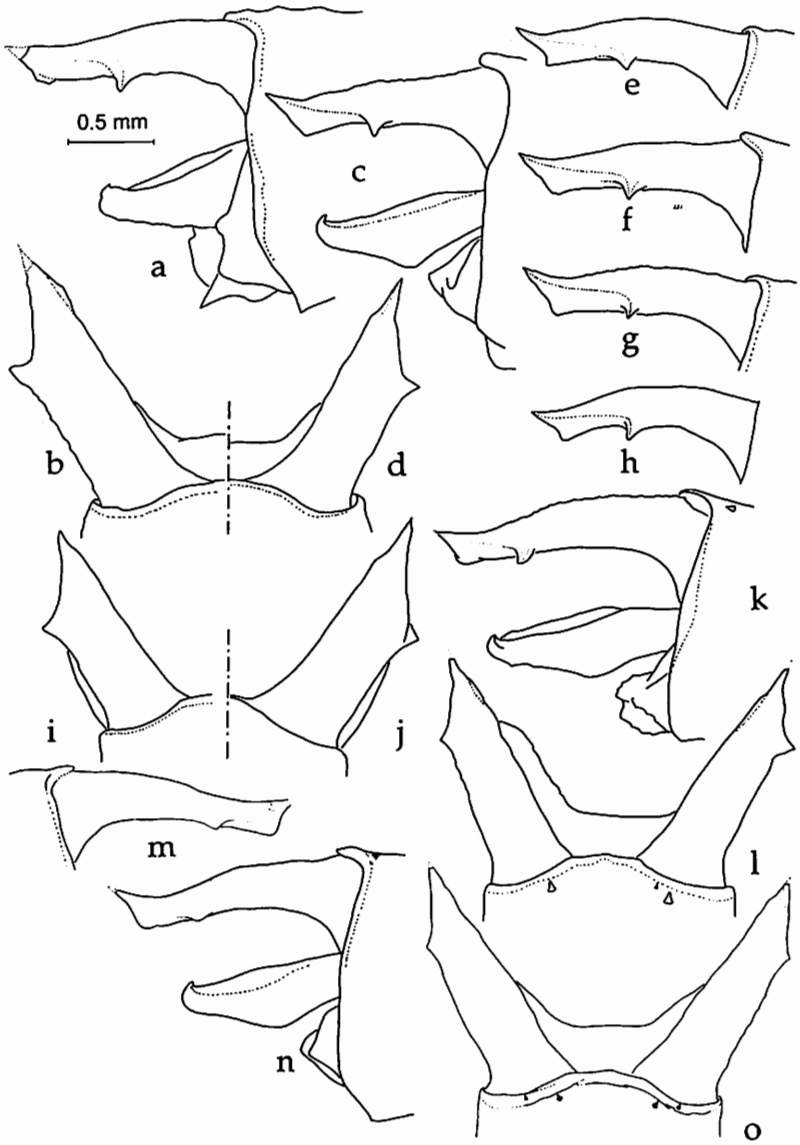

Fig. 20. Anal appendages of *Neurogomphus spp.* ♂♂, lateral and dorsal view. a-b: *uelensis*, holotype; c-j: *idem*, Makokou, five specimens (c-d and f, j pertain to the same specimens); k-l: *idem*, Kelle; m-o: *paenuelensis*, holotype (m: left superior appendage).

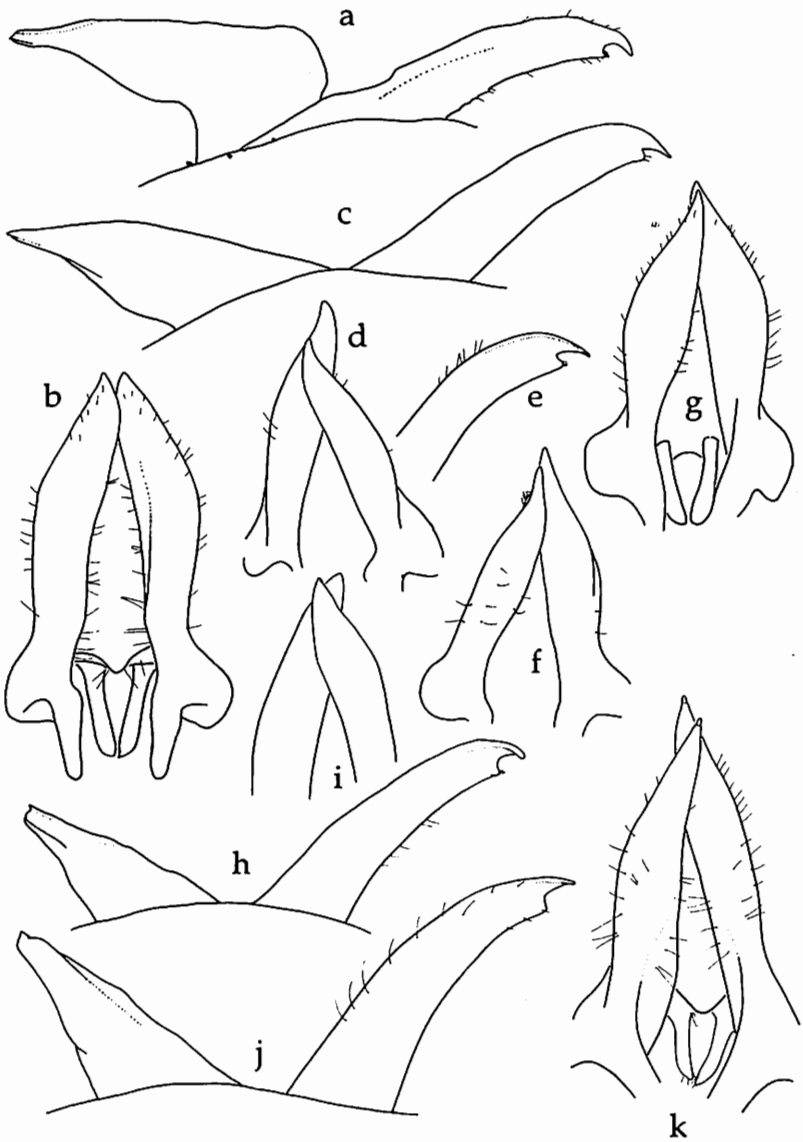

Fig. 21. Hamules and penial sheath of *Neurogomphus spp.* a-b: *uelensis*, holotype, left lateral and ventral view; c-d, e-f and g: *idem*, Makokou, three specimens; h-i: *idem*, Kelle; j-k: *paenuelensis*, holotype.

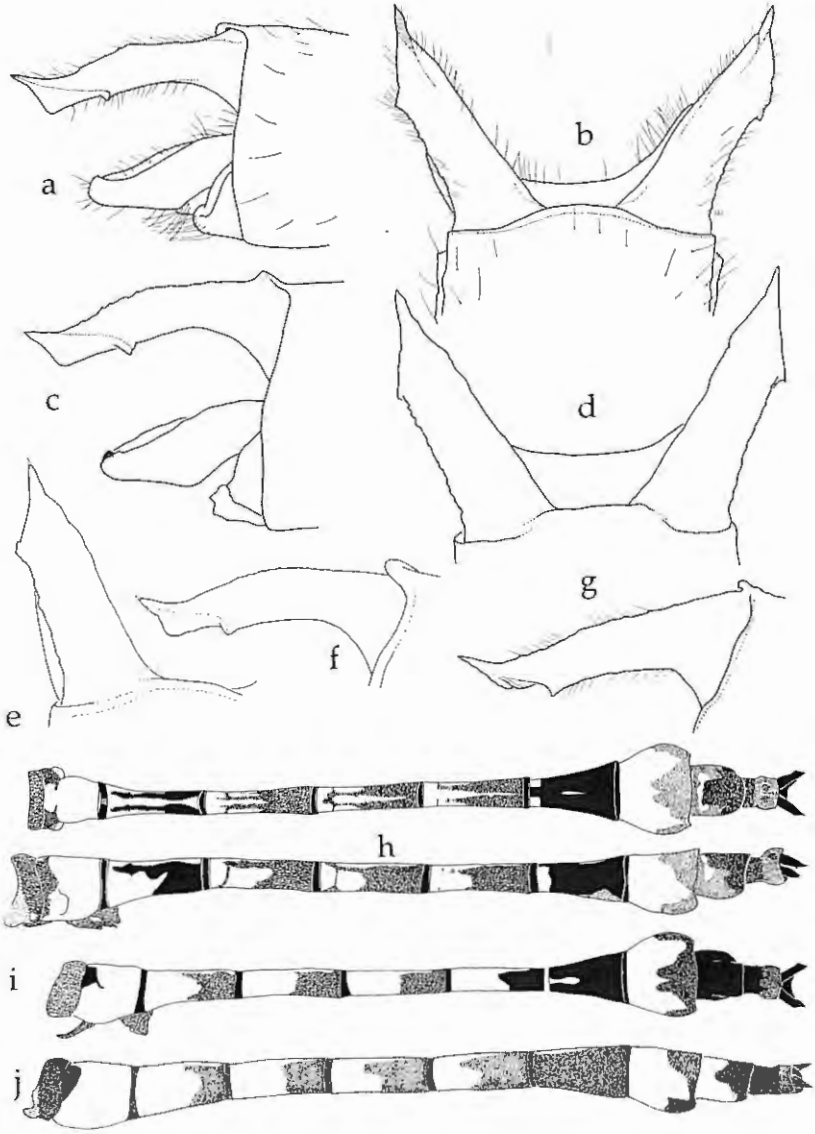

Fig. 22. *Neurogomphus cocytius*, anal appendages of male and abdomen colour pattern. a-b: Katombora, lateral and dorsal view of appendages; c-d, e-f and g: Victoria Falls, idem, three specimens (f and g: right superior appendage); h: Katombora: dorsal and lateral view of male abdomen; i: Katombora: lateral view of segments 1-6 and dorsal view of segments 7-10 of another male; j: Katombora, lateral view of female abdomen.

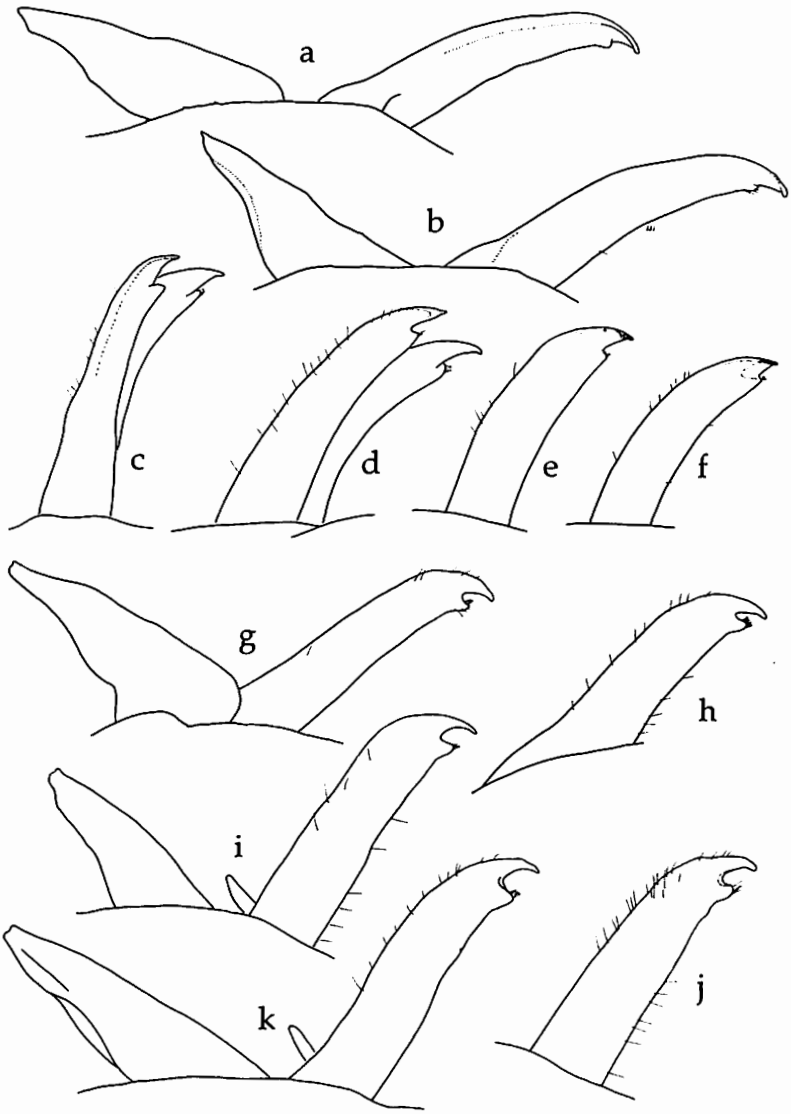

Fig. 23. Hamules and penial sheath of *Neurogomphus spp.*, left lateral view. a-f: *cocytius* (a, b: two Katombora specimens; c-f: four Victoria Falls specimens); g-k: *zambeziensis* (g: Katombora; h: Maramba River; i, j: Pafuri, two specimens; k: Ndumo).

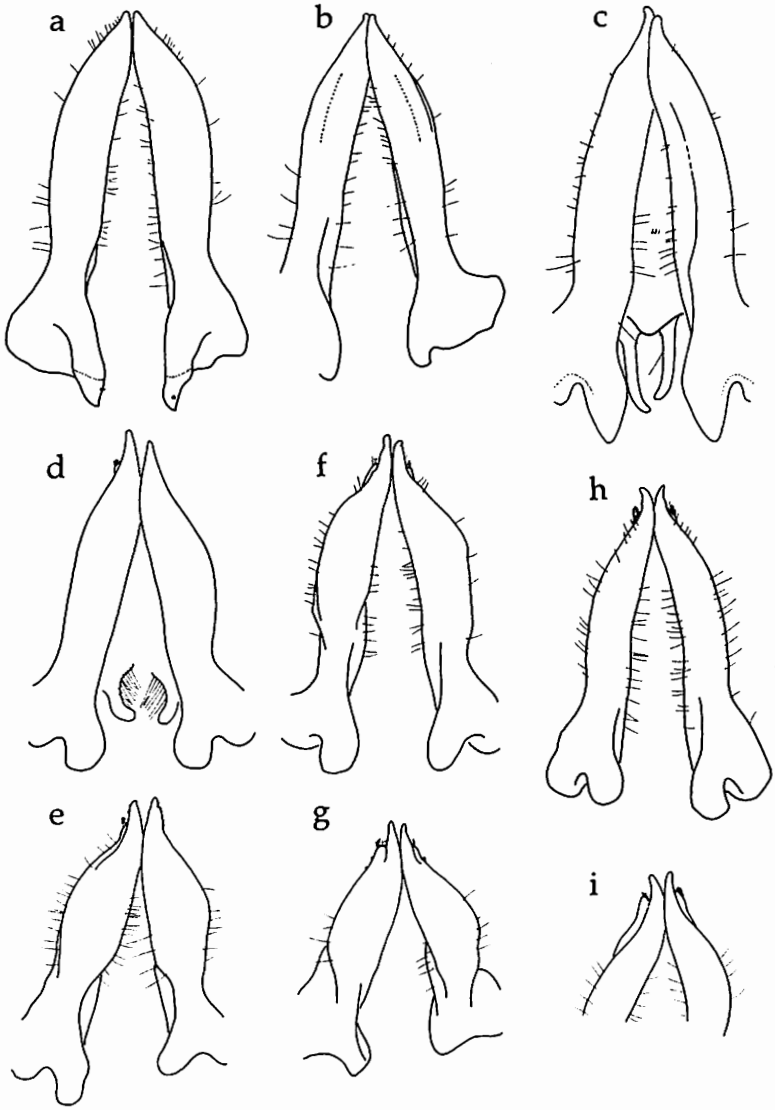

Fig. 24. Posterior hamules of *Neurogomphus spp.*, ventral view. a-c: *cocytius*, hamules seen flat (Victoria Falls, three specimens); d-i: *zambeziensis* (d, f, h: hamules seen flat; e, g, i: hamules at 45° with abdomen horizontal. d: Ndumo; e: Pafuri; f-g: Pafuri, another specimen; h-i: Katombora, one specimen).

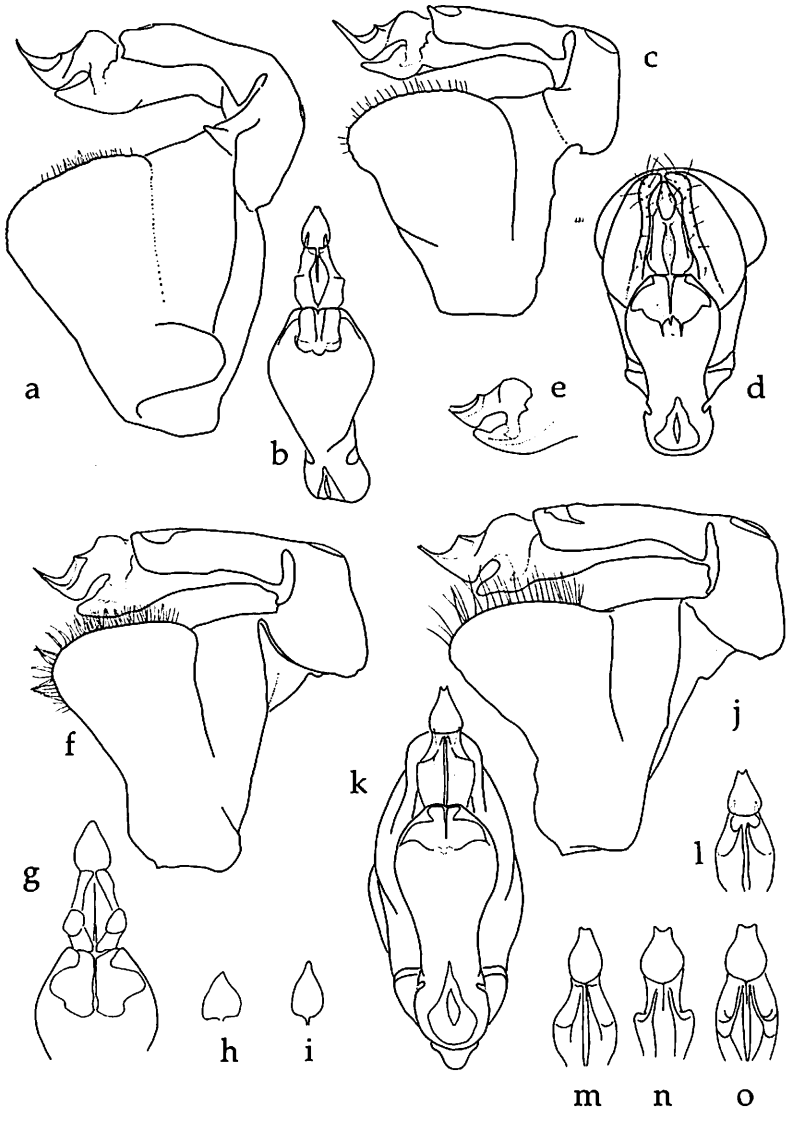

Fig. 25. Penis of *Neurogomphus spp.*, lateral and ventral view. a-b: *vicinus*, holotype; c-d: *wittei*, holotype; e: *idem*, Uvira; f-g: *cocytius*, Katombora; h-i: *idem*, glans cupule of two other Katombora specimens; j-k: *zambeziensis*, Katombora; l: *idem*, glans of another Katombora specimen; m: *idem*, glans of Ndumo specimen; n-o: *idem*, glans of two Pafuri specimens.

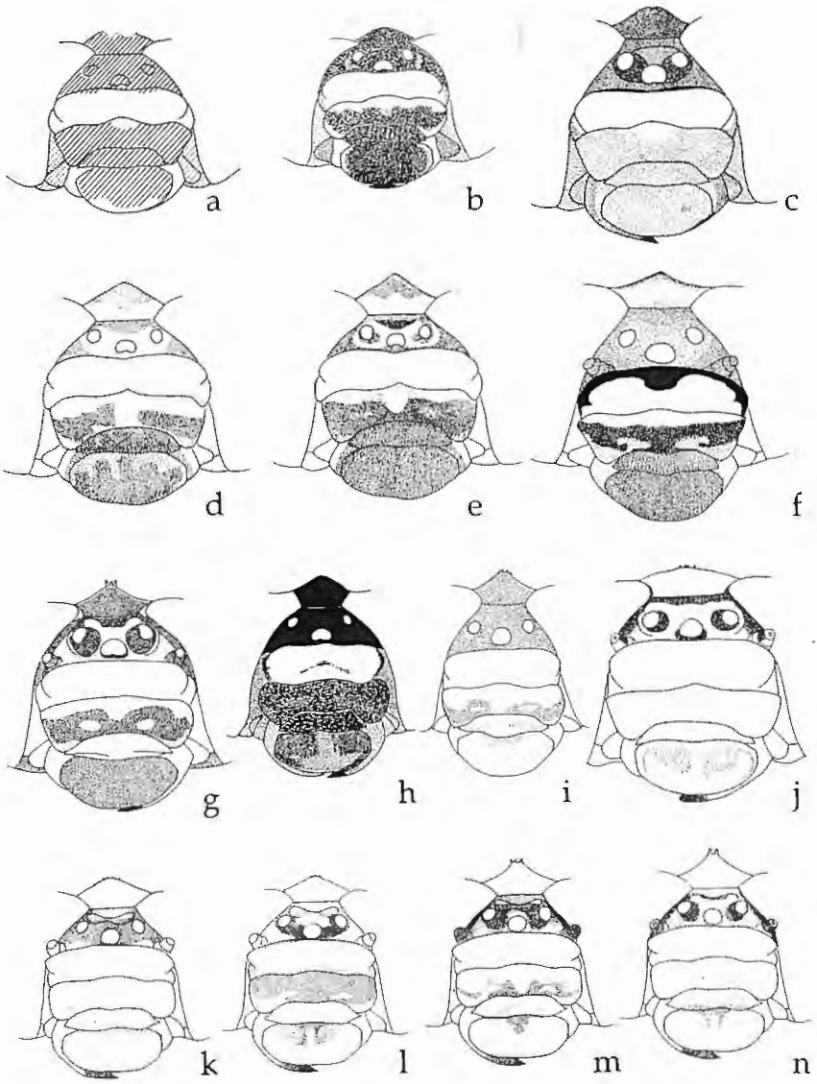

Fig. 26. Head colour pattern of *Neurogomphus spp.* a: *vicinus*, holotype; b: *wittei*, holotype; c: *sp. indet. B*, Kere-Kere ♀; d: *zambeziensis*, Katombora ♂; e: *idem*, Katombora ♀; f: *cf zambeziensis*, Turiani ♀; g: *sp. indet. C*, Assinie ♀; h: *agilis*, holotype; i: *carlcooki*, holotype; j: *pallidus*, Lubumbashi ♂; k: *featheri*, holotype; l: *idem*, Makurdi ♂; m: *idem*, Bantanto ♂; n: *idem*, Bantanto ♀.

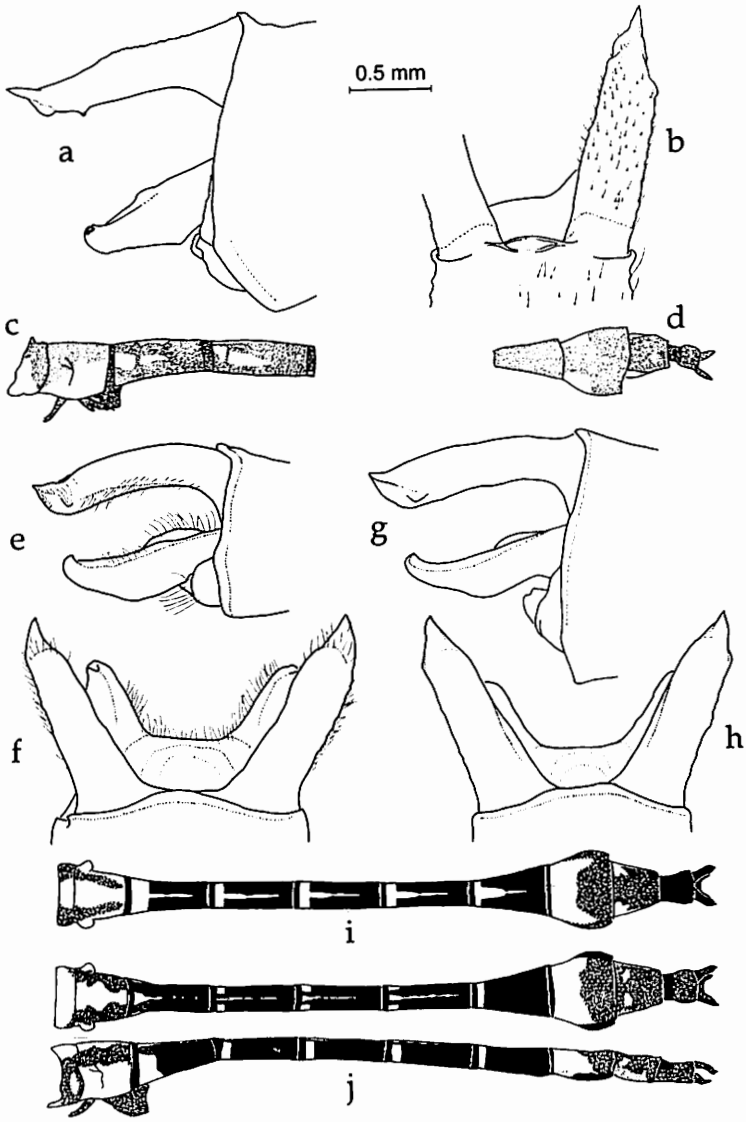

Fig. 27. Male anal appendages and abdomen colour pattern of *Neurogomphus spp*. a-b: *vicinus*, holotype, anal appendages, lateral and dorsal view; c: *idem*, segments 1-4 of abdomen, lateral view; d: *idem*, segments 7-10 of abdomen, dorsal view; e-f: *wittei*, holotype, anal appendages, lateral and dorsal view; g-h: *wittei*, ibidem, Uvira; i: *idem*, Uvira, abdomen, dorsal view; j: *wittei*, holotype, abdomen, dorsal and lateral view.

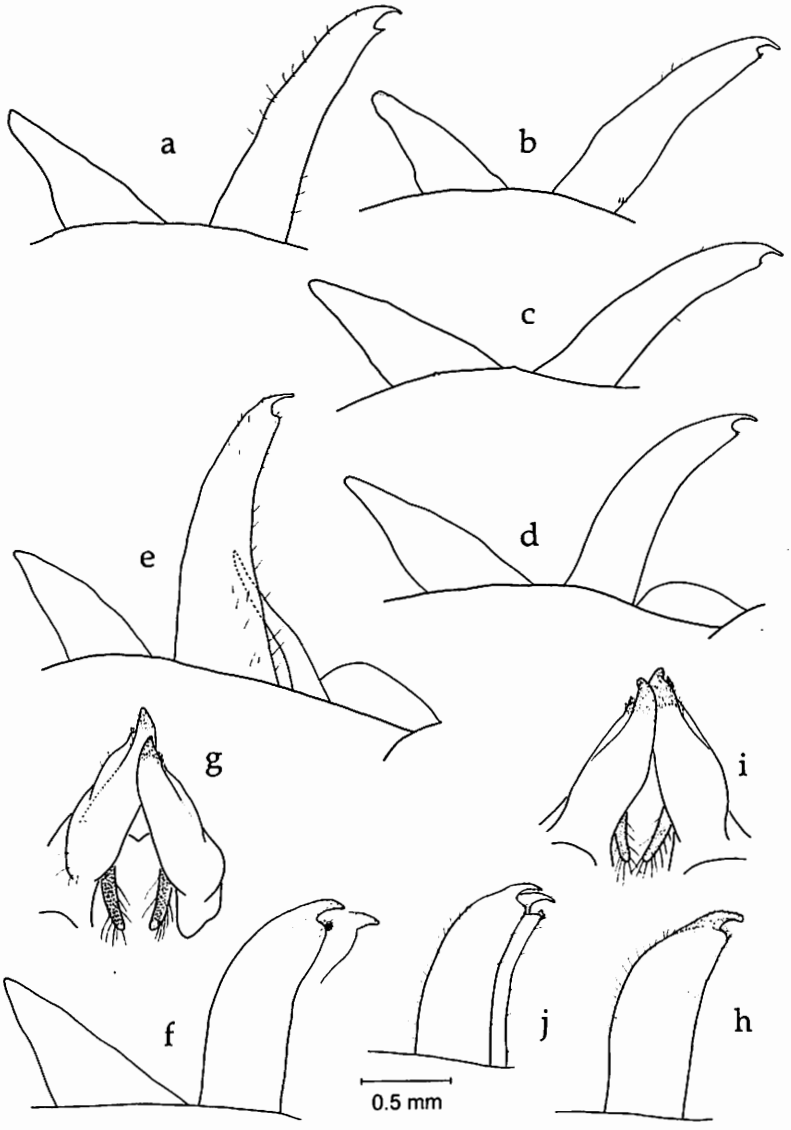

Fig. 28. Hamules and penial sheath of *Neurogomphus spp.*, (a-f: left lateral view; g, i: ventral view). a: *vicinus*, holotype; b: *wittei*, Uvira; c: *wittei*, holotype; d: *agilis*, Congo-Brazzaville; e: *agilis*, holotype; f-g: *pallidus*, Lubumbashi; h-i: *idem*, Karavia; j: *idem*, Lubumbashi, immature.

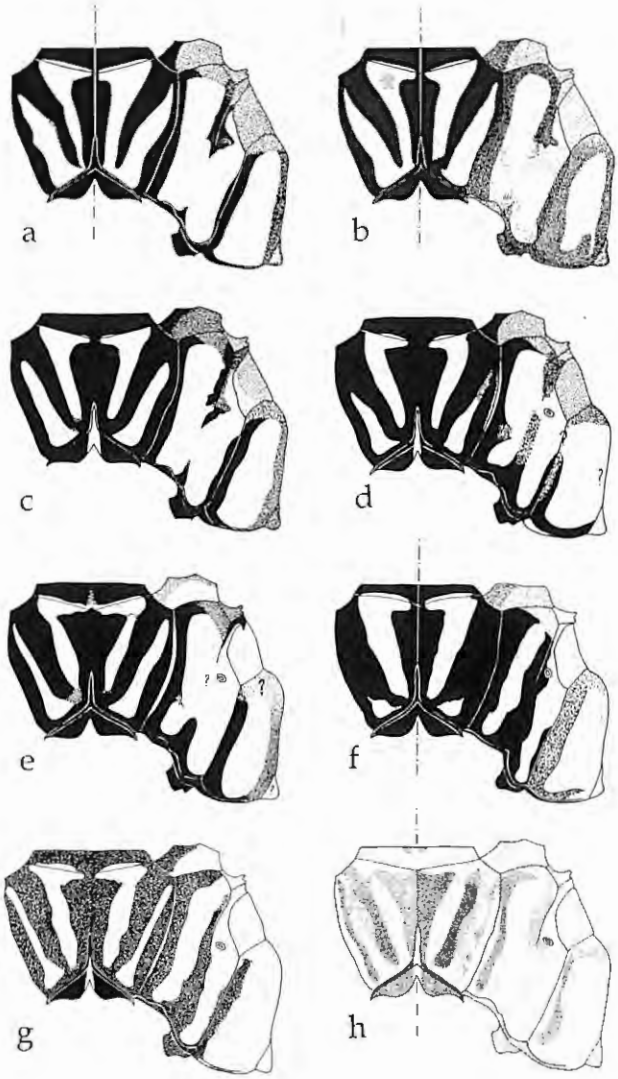

Fig. 29. Synthorax colour pattern of *Neurogomphus spp.* a: *zambeziensis*, Katombora (♀: left side; ♂: right side); b: *idem*, Ndumo ♂ (left side) and Pafuri ♂ (right side); c: *cf zambeziensis*, Turiani ♀; d: *sp. indet. B*, Kere-Kere ♀; e: *sp. indet. C*, Assinie ♀; f: *agilis*, Congo-Brazzaville (left side) and holotype (right side); g: *carlcooki*, holotype; h: *pallidus*, Kiamalale ♀ (left side) and Lubumbashi ♂ (right side).

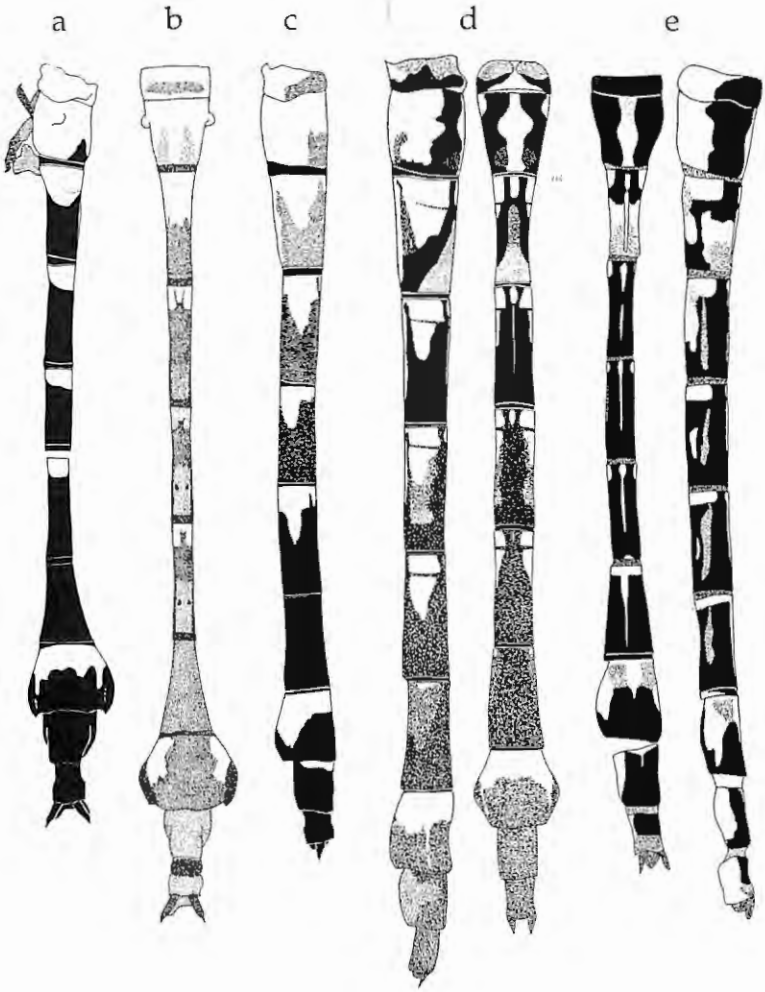

Fig. 30. Abdomen colour pattern of *Neurogomphus spp.* a: *zambeziensis*, Katombora ♂ (left lateral view of segments 1-5 and dorsal view of segments 6-10); b: *idem*, Pafuri ♂, dorsal view; c: *idem*, Katombora ♀; d: *cf zambeziensis*, Turiani ♀, left lateral and dorsal view; e: *sp. indet. B*, Kere-Kere ♀, dorsal and left lateral view.

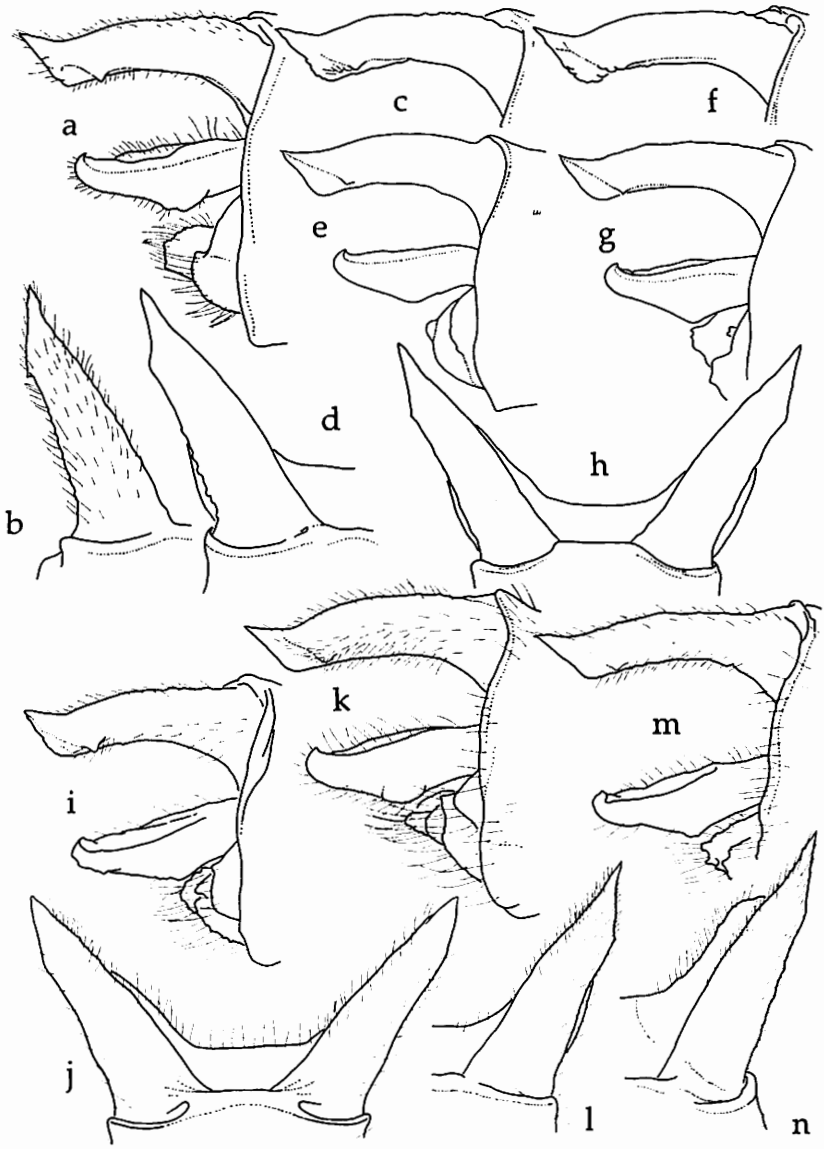

Fig. 31. *Neurogomphus zambeziensis*, male anal appendages (lateral and dorsal view). a-b: Katombora; c-d and e: Katombora Rapids, two specimens; f: Katombora, another specimen; g-h: Maramba River; i-j: Ndumo; k-l and m-n: Pafuri, two specimens.

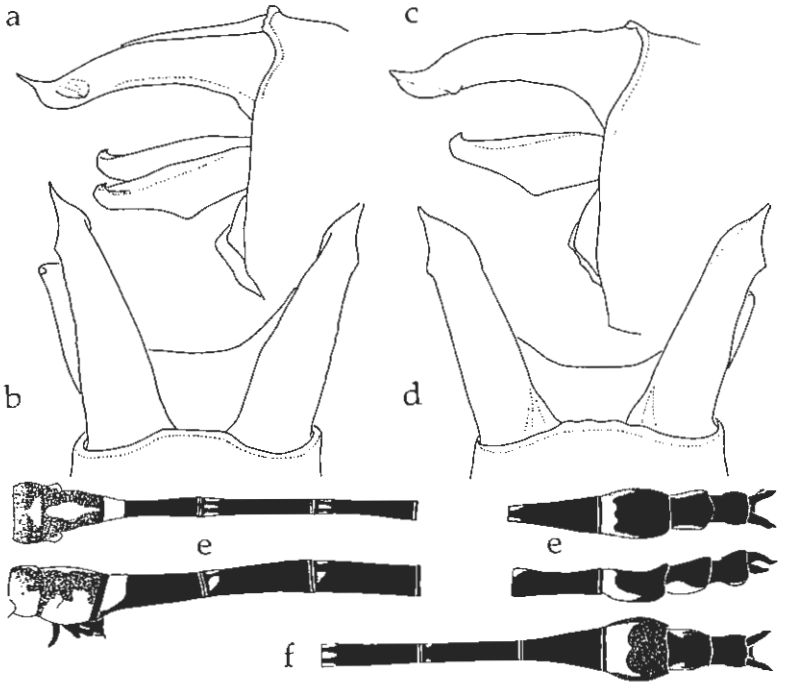

Fig. 32. *Neurogomphus agilis* ♂♂. a-b: holotype, anal appendages, lateral and dorsal view; c-d: Congo-Brazzaville, ibidem; e: holotype, abdomen, dorsal and lateral view, segment 6 missing; f: Congo-Brazzaville, abdominal segments 5-10, dorsal view.

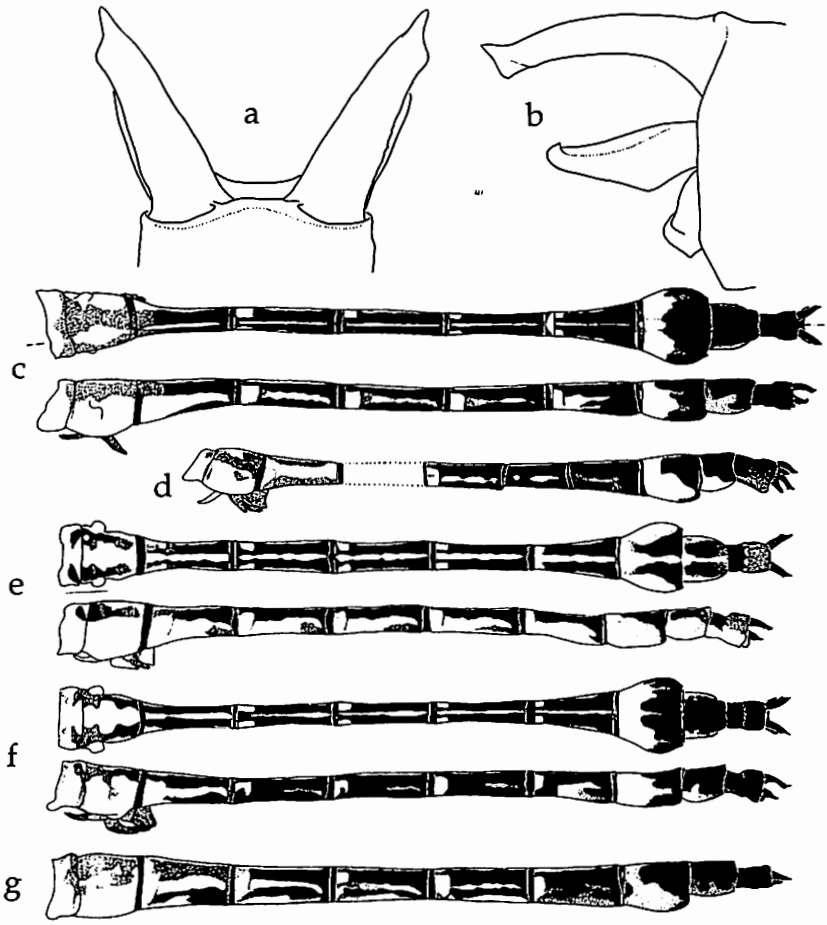

Fig. 33. Anal appendages (a-b) and abdominal colour pattern (c-i) of *Neurogomphus spp.* a-b: *carlcooki*, holotype, dorsal and lateral view; c: *idem*, dorsal and lateral view; d: *featheri*, holotype, lateral view (segment 4 missing); e: *idem*, Makurdi ♂, dorsal and lateral view; f: *idem*, Bantanto ♂; g: *idem*, Bantanto ♀.

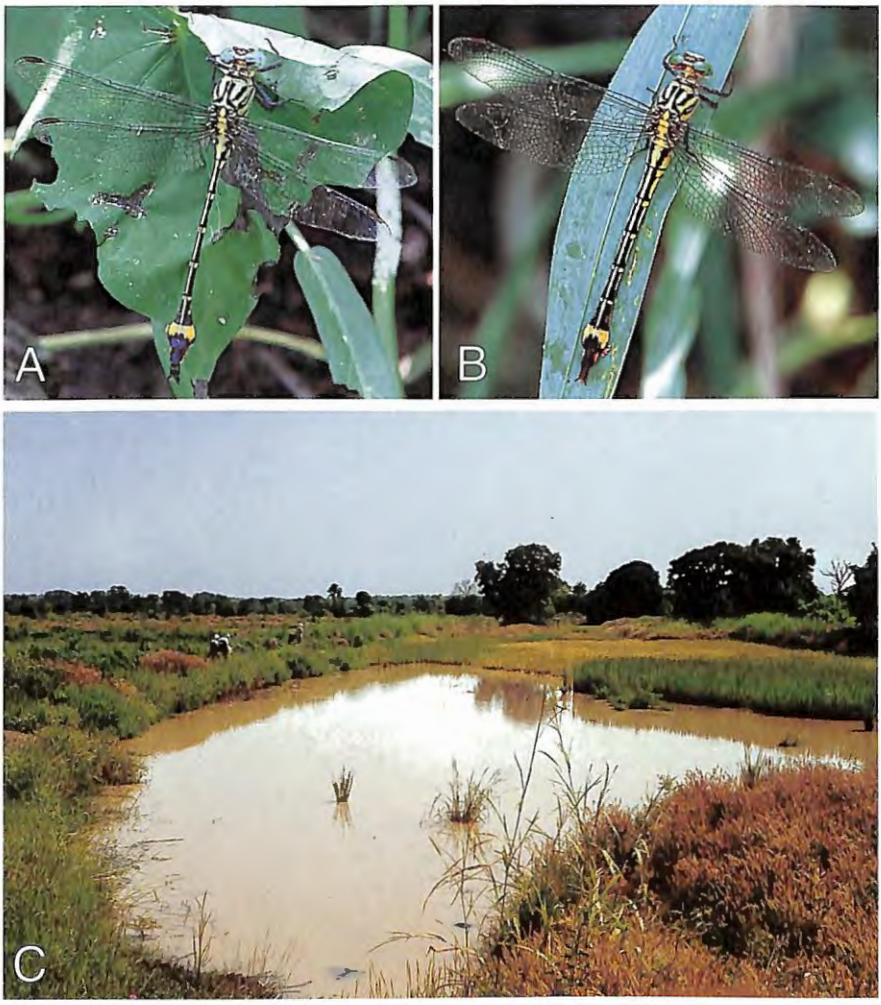

Fig. 34. *Neurogomphus featheri* live male (A) and female (B) on low vegetation, at Bantanto, east of Bansang, Gambia, 1.XI.1996 (from transparencies taken by Peter Allen). (C) The bank of the pond on which the species was photographed and collected on low vegetation (photograph taken by the late Evelyn Prendergast).

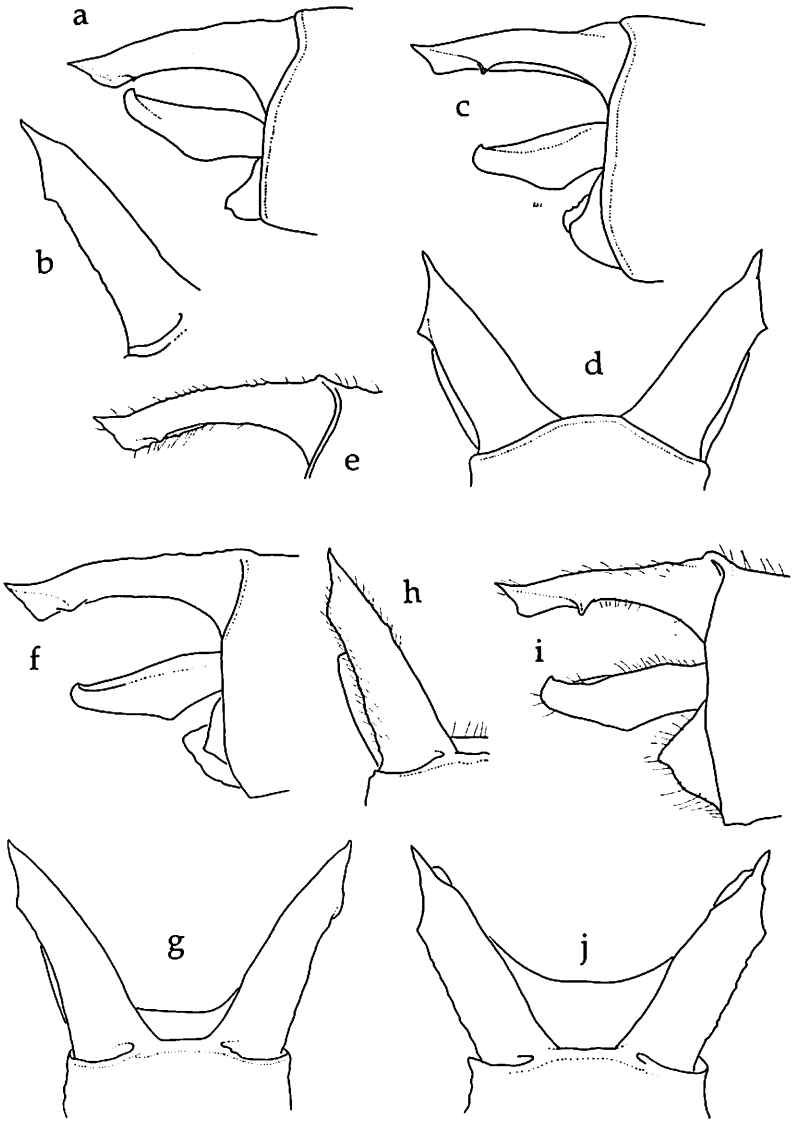

Fig. 35. *Neurogomphus featheri*, male anal appendages (lateral and dorsal view). a-b: holotype; c-d: Makurdi; e, f-g, h: Bantanto, three specimens; i-j: N'Djamena.

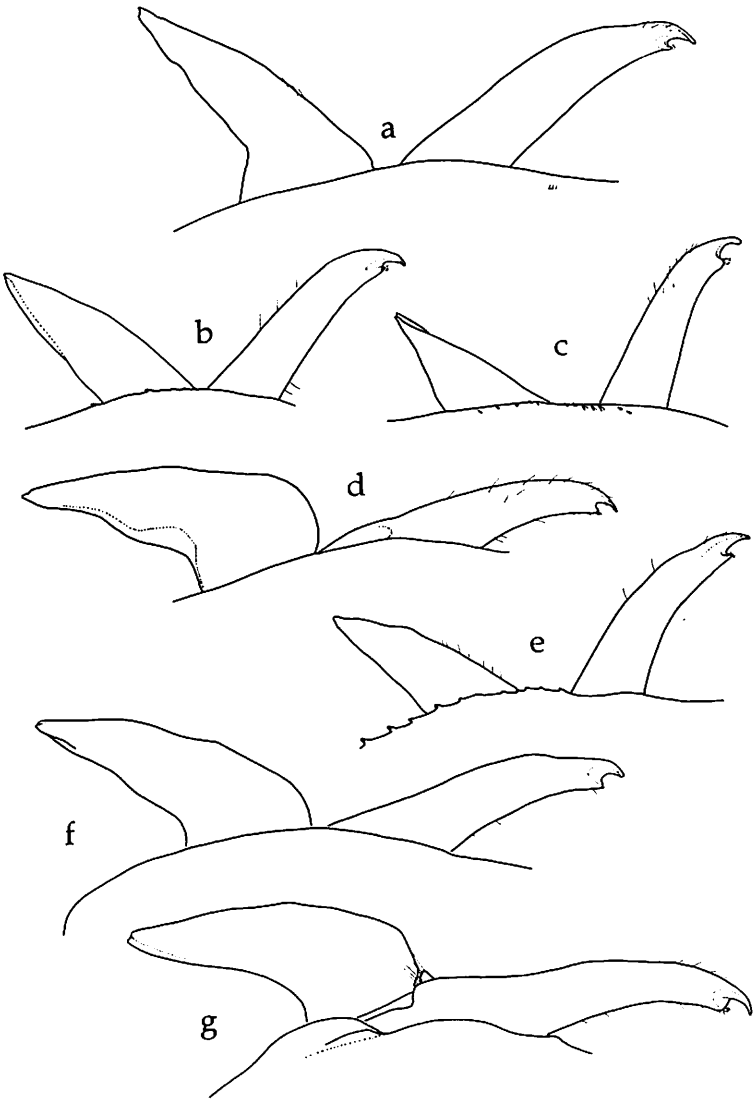

Fig. 36. Hamules and penial sheath of *Neurogomphus spp.*, left lateral view. a: *carlcooki*, holotype; b: *featheri*, holotype; c: *idem*, N'Djamena; d: *idem*, Makurdi; e-g: *idem*, Bantanto, three specimens.

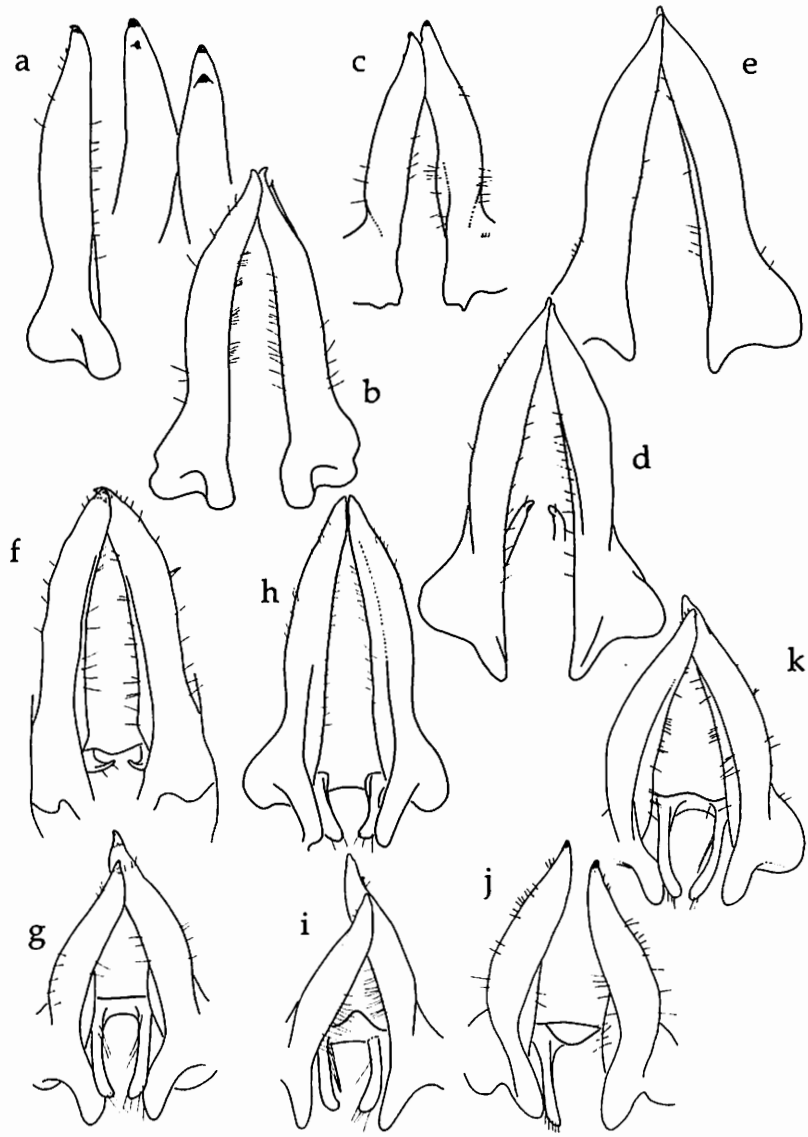

Fig. 37. Posterior hamules of *Neurogomphus spp.*, ventral view. a: *vicinus*, holotype (right hamule and dorsal side of extremity of hamules); b: *wittei*, Uvira; c: *wittei*, holotype; d: *agilis*, holotype; e: *idem*, Congo Brazzaville; f-g: *featheri*, holotype (f: seen flat; g: seen at 45°); h: *idem*, Bantanto, seen flat; i: *idem*, Bantanto, another specimen, seen at 45°; j: *idem*, Makurdi; k: *carlcooki*, holotype, seen at 45°.

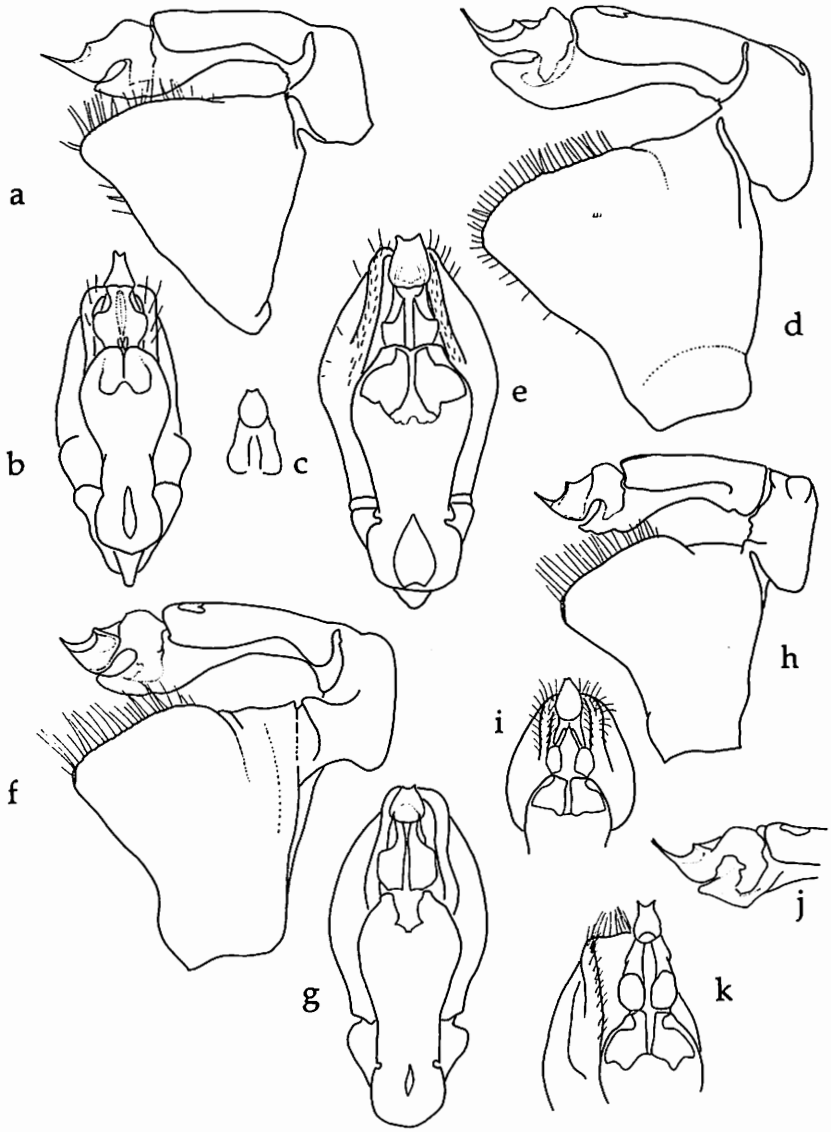

Fig. 38. Penis of *Neurogomphus spp.*, lateral and ventral view. a-b: *agilis*, holotype; c: *idem*, Congo Brazzaville, ventral view of glans; d-e: *pallidus*, Lubumbashi; f-g: *carlcooki*, holotype; h: *featheri*, holotype; i: *idem*, Makurdi; j-k: *idem*, Bantanto, extremity of penis.

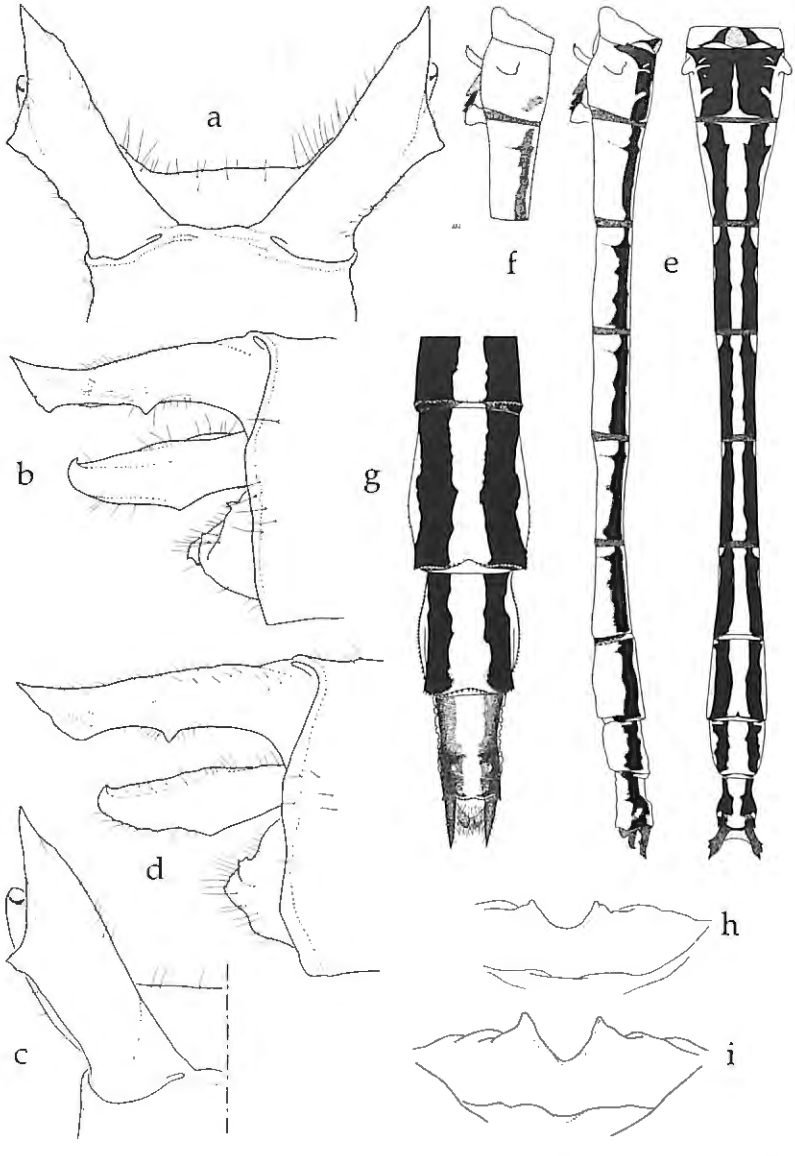

Fig. 39. *Neurogomphus pallidus*. a-b: anal appendages of a Lubumbashi ♂ (dorsal and lateral view); c-d: ibidem, Karavia ♂; e: abdomen colour pattern of a Lubumbashi ♂ (lateral and dorsal view); f: abdominal segments 1-3 of another ♂ (lateral view); g: last abdominal segments of a Kiamalale ♀ (paratype, dorsal view); h, i: vulvar scale of two Lubumbashi specimens. Scale of g is twice that of e-f.

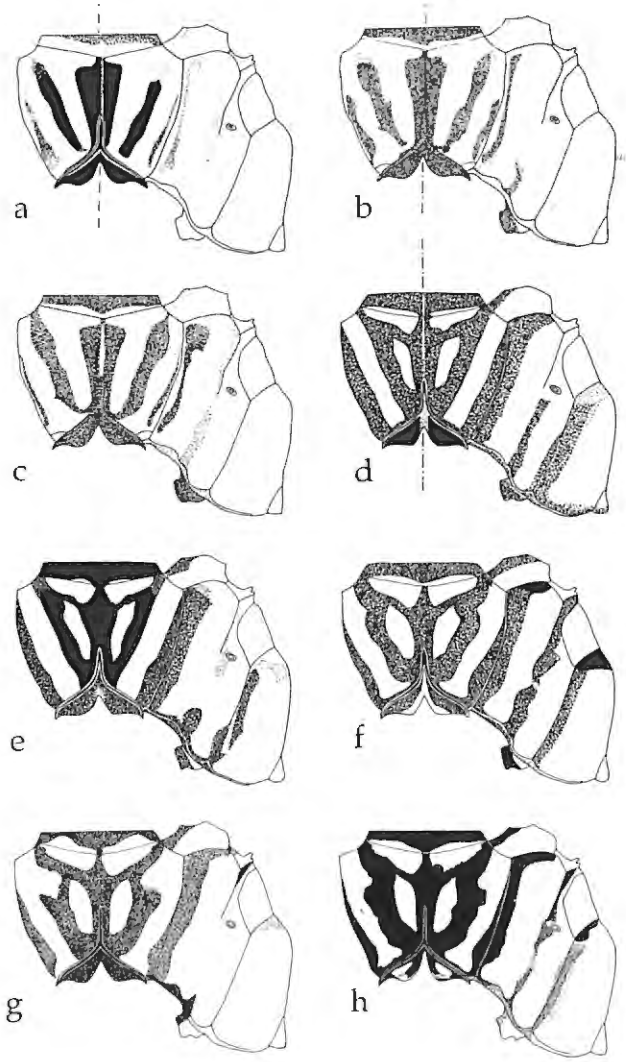

Fig. 40. Synthorax colour pattern of *Neurogomphus spp.* a: *featheri*, holotype ♂ (left side) and Makurdi ♂ (right side); b: *idem*, Bantanto ♂♂ (left and right side from two separate specimens); c: *idem*, Bantanto ♀; d: *pinheyi*, holotype ♂ (left side) and paratype ♂ (right side); e: *chapini chapini*, holotype ♂; f: *chapini lamtoensis*, holotype ♂; g: *dissimilis dissimilis*, holotype ♂; h: *dissimilis malawiensis*, holotype ♂.

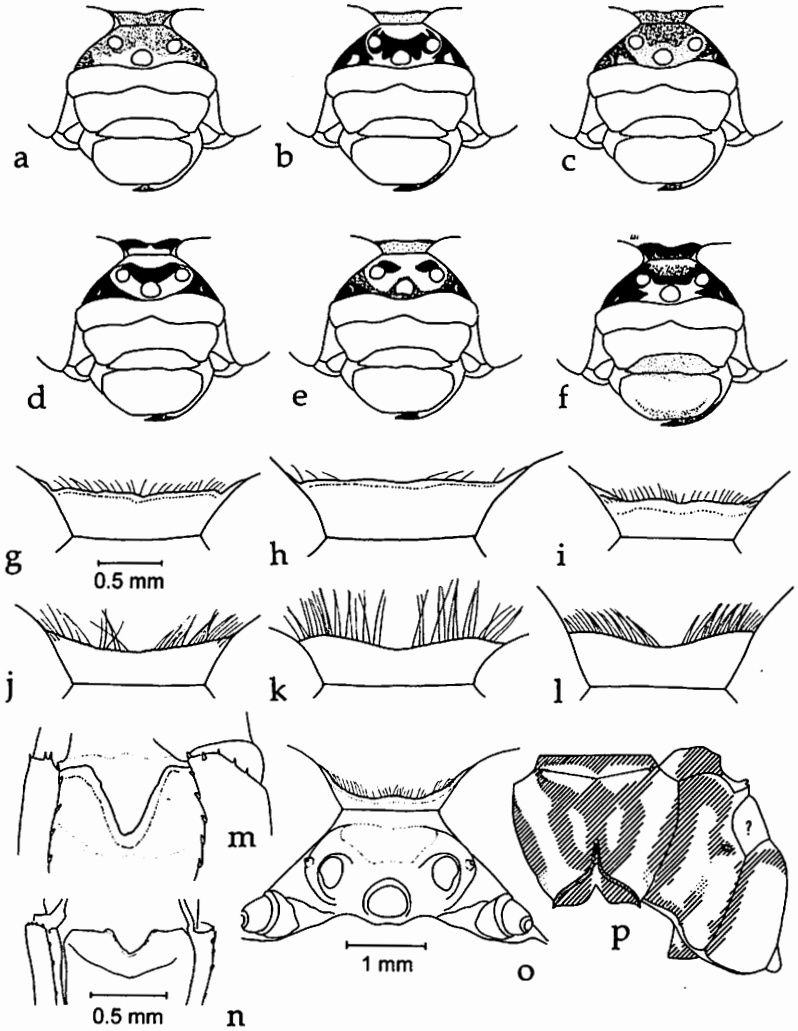

Fig. 41. *Neurogomphus (Mastigogomphus) spp.* head colour pattern (a-f), occipital plate (g-l), vulvar scale (m-n), vertex and occiput (o) and synthorax colour pattern (p). a: *chapini chapini*, holotype ♂; b: *chapini lamtoensis*, holotype ♂; c: *pinheyi*, paratype ♂; d: *dissimilis dissimilis*, holotype ♂; e: *dissimilis*, Bazeley Bridge ♀; f: *dissimilis malawiensis*, holotype ♂; g: *chapini chapini*, holotype ♂; h: *chapini lamtoensis*, holotype ♂; i: *pinheyi*, paratype ♂; j: *dissimilis* Bazeley Bridge ♀; k: *dissimilis dissimilis*, holotype ♂; l: *dissimilis malawiensis*, holotype ♂; m: *dissimilis*, Bazeley Bridge ♀; n-p: *sp. indet. D*, Bambesa ♀.

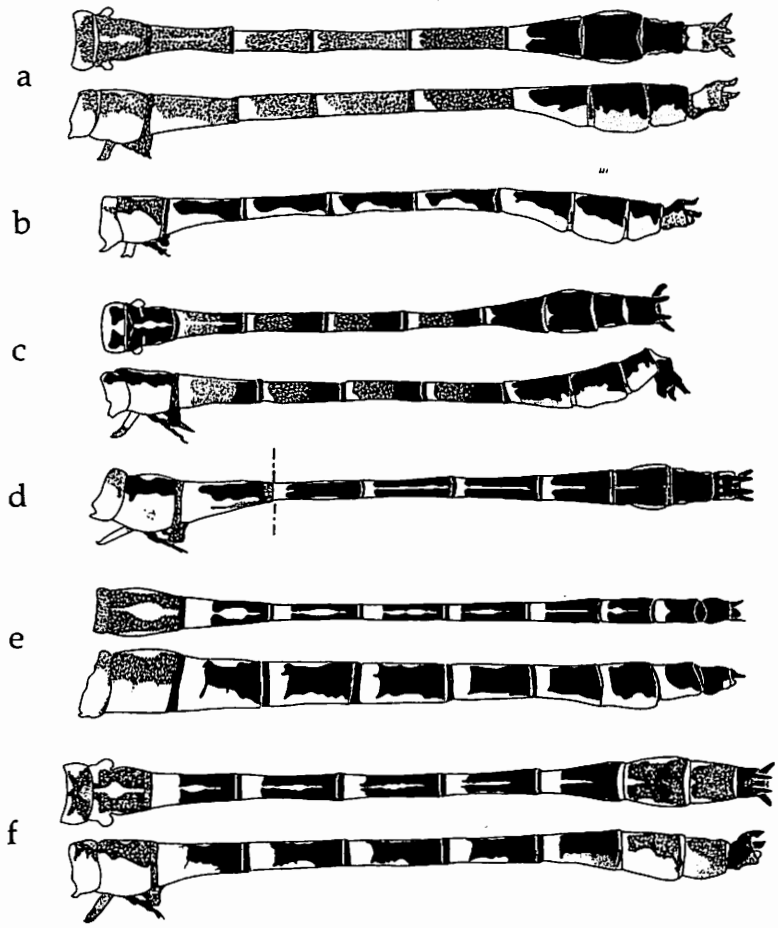

Fig. 42. Abdomen colour pattern of *Neurogomphus (Mastigogomphus) spp.* a: *chapini chapini*, holotype ♂, dorsal and lateral view; b: *chapini lamtoensis*, holotype ♂, lateral view; c: *pinheyi*, paratype ♂, dorsal and lateral view; d: *dissimilis dissimilis*, holotype ♂, left lateral view of segments 1-3 and dorsal view of segments 4-10; e: *dissimilis*, Bazeley Bridge ♀, dorsal and lateral view; f: *dissimilis malawiensis*, holotype ♂, dorsal and lateral view.

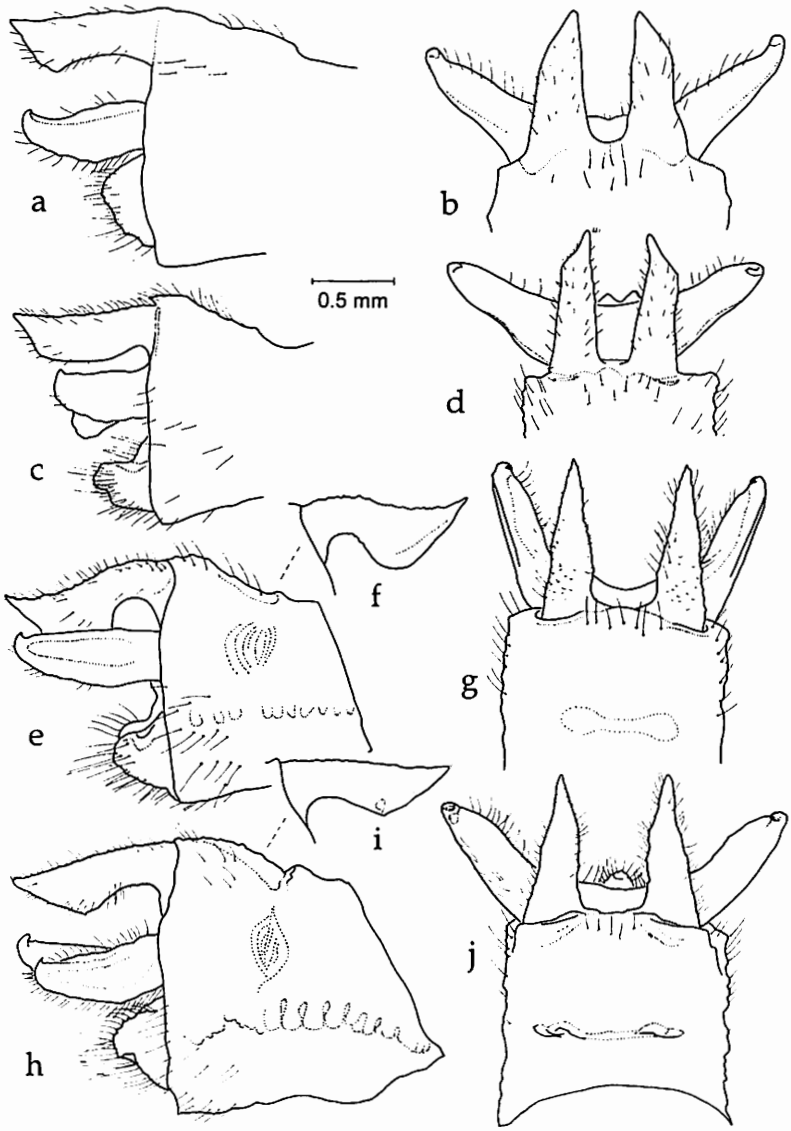

Fig. 43. Male anal appendages of *Neurogomphus (Mastigogomphus) spp.*, right lateral and dorsal view. a-b: *chapini chapini*, holotype; c-d: *chapini lamtoensis*, holotype; e-g: *dissimilis dissimilis*, holotype (f: left view of right superior appendage); h-j: *dissimilis malawiensis*, holotype (i: left view of right superior appendage).

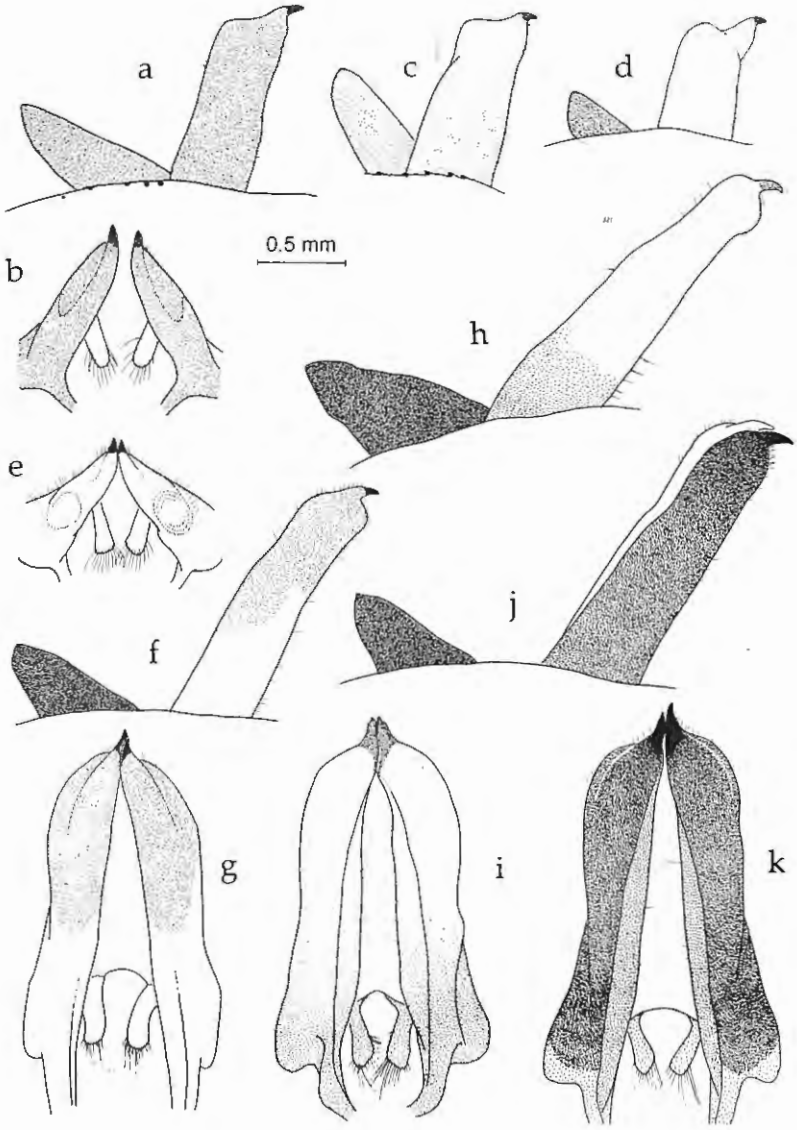

Fig. 44. Hamules and penial sheath of *Neurogomphus (Mastigogomphus) spp.*, left lateral view (a, c, d, f, h, j) and ventral view (b, e, g, i, k). a-b: *chapini chapini*, holotype; c: *chapini chapini*, Banzyville; d-e: *chapini lamtoensis*, holotype; f-g: *pinheyi*, paratype; h-i: *dissimilis dissimilis*, holotype; j-k: *dissimilis malawiensis*, holotype.

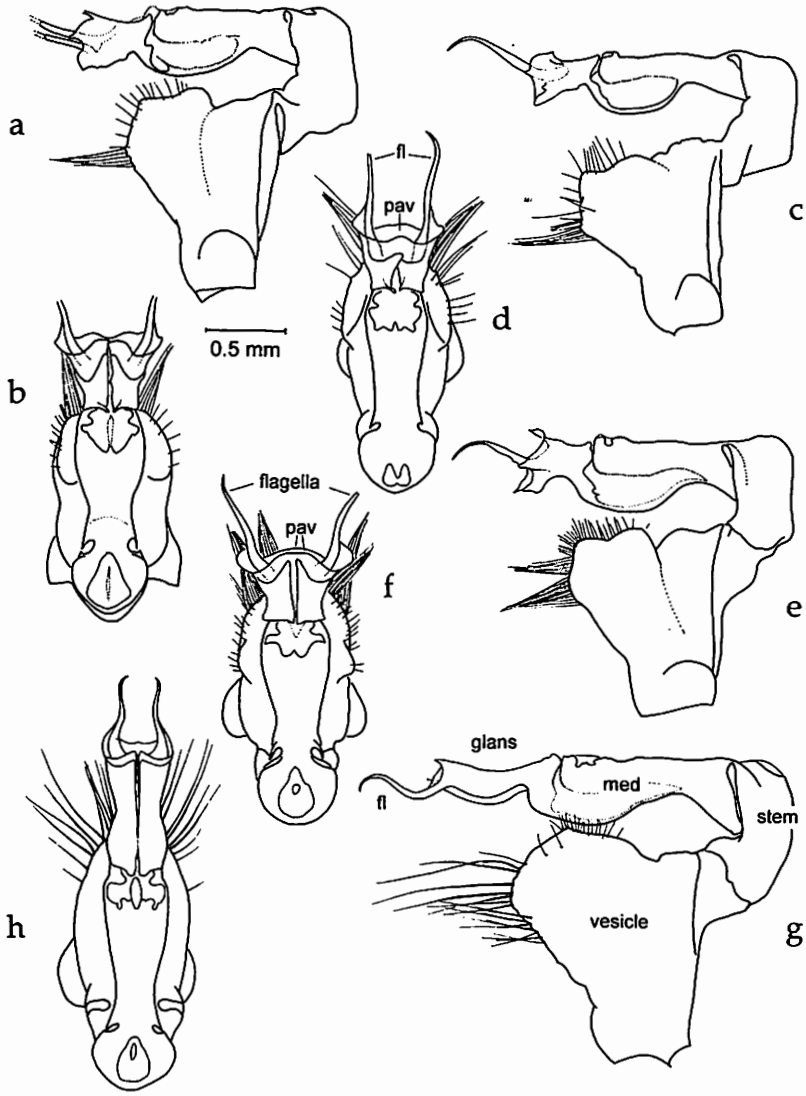

Fig. 45. Penis of *Neurogomphus (Mastigogomphus) spp.*, lateral and ventral view. a-b: *chapini chapini*, holotype; c-d: *chapini chapini*, Banzyville; e-f: *chapini lamtoensis*, holotype; g-h: *pinheyi*, paratype. fl: flagella; med: median segment; pav: glans pavilion.

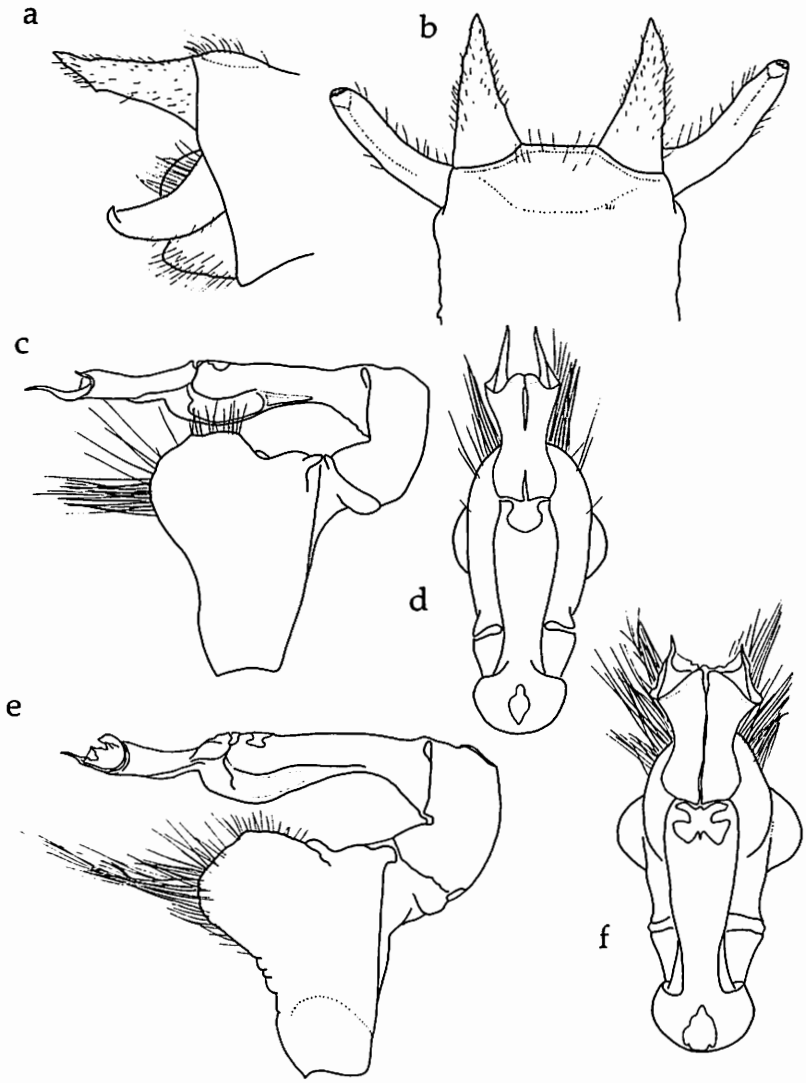

Fig. 46. Male anal appendages (a-b) and penis (c-f) of *Neurogomphus (Mastigogomphus) spp.*, lateral and ventral view. a-b: *pinheyi*, paratype; c-d: *dissimilis dissimilis*, holotype; e-f: *dissimilis malawiensis*, holotype.

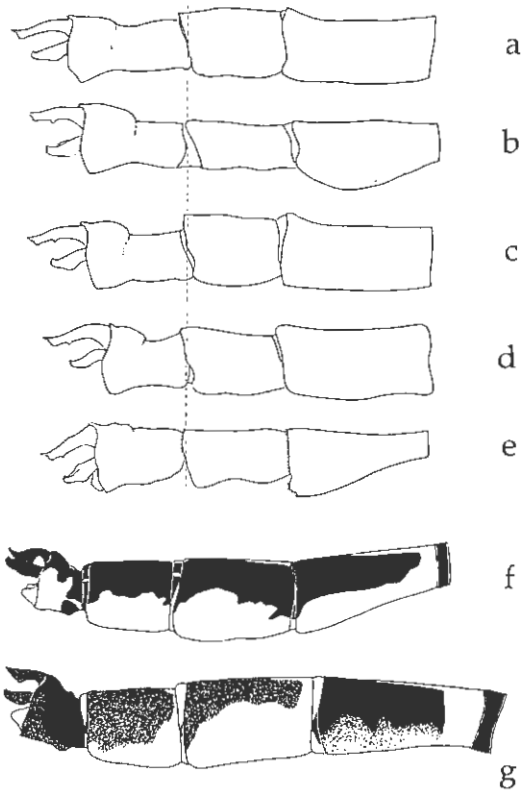

Fig. 47. a-e: male last abdominal segments of *Neurogomphus (s. str.) spp.*, showing the relative proportions of segments 9 and 10. a: *paenuelensis*, holotype; b: *uelensis*, holotype; c: *uelensis*, Makokou; d: *cocytius*, Katombora; e: *vicinus*, holotype, after dissection. f-g: male last abdominal segments of *Neurogomphus (Mastigogomphus) spp.*, showing the colour pattern. f: *dissimilis dissimilis*, holotype; g: *dissimilis malawiensis*, holotype. a-e and f-g are not at the same scale.

II. Larvae

History and biology

When previously collected, larvae pertaining to the genus *Neurogomphus* were qualified as 'enigmatic' gomphid larvae or attributed to the genera *Lestinogomphus* MARTIN or *Tragogomphus* SJOESTEDT.

Thanks to the successful rearing of a *Neurogomphus* female imago from a final-stadium larva by Jean LEGRAND, and the fact that the morphology of at least one species of each of the continental African gomphid genera (if we exclude the doubtful taxon *Cornigomphus* MARTIN and perhaps *Nepogomphoides* FRASER) is known either from literature or from still unpublished material, we are in a position to confirm that the continental gomphid larvae which possess an elongated cylindrical and spineless narrow body ending in a very long respiratory siphon pertain to the genus *Neurogomphus*.

MARLIER (1958) appears to be the first one to have published a drawing of a *Neurogomphus* larva. This drawing shows an exuvia which however differs somewhat from the other known larvae of the genus in that it has the shortest tenth abdominal segment, stronger legs, larger claws and antennae. MARLIER took larvae of this species from the bottom of Lake Tumba, Congo-Kinshasa. They were found under a floating field of *Echinochloa pyramidalis* (LAM.) and *Panicum parviflorum* (LAM.) grasses and among their roots. Such a vegetation association is typical of water bodies bordered by forest that are becoming filled-in, particularly at the end of bays. Most of the insect fauna of Lake Tumba can be found under this herbaceous cover where the water is at its calmest, with organic sedimentation occurring over a very fine sandy silt bottom. The waters of this shallow forest lake are acidic and of the 'black equatorial' type. No *Neurogomphus* adults were captured at the lake site, only adults of *Gomphidia bredoi* (SCHOUTEDEN) and *Ictinogomphus regisalberti* (SCHOUTEDEN), whose larvae were not found.

A *Neurogomphus* F-0 exuvia with an 'extremely long' (11 mm) terminal segment was found in 1956 on the bank of the Zambezi River near the Victoria Falls and tentatively identified as that of *Lestinogomphus africanus* (FRASER, 1926) by PINHEY (1959: 474). Later on, PINHEY (in a letter to the author, dated 5 August, 1966) re-assigned it, by supposition, to the genus *Neurogomphus*. In 1980, after having examined LEGRAND's material, I could confirm (*in litteris*) this generic attribution. In his check-list of the Odonata of Zimbabwe and Zambia, PINHEY (1984: 24) then re-identified his exuvia as that of *Neurogomphus Cammaerts n°3*, obviously according to the flight period of the imagines found at the site. For this reason, the attribution of this exuvia to the taxon which is here named *N. zambeziensis* sp. n. seems to be correct. PINHEY (1984) also mentions another 'larva', collected at Victoria Falls in 1962, which he identifies as that of *Neurogomphus Cammaerts n°2*. The reason is again that the date of its discovery matches the phenology of the adults. This F-0 exuvia is here described as that of *N. cocytius* sp. n.

More recently, at the end of 1994, LEHMANN & WENDLER (1996) found F-0 exuviae with a very long respiratory tube (9 to 11mm), on the bank of the

Zambezi River, upstream from the Victoria Falls. They tentatively placed them in the genus *Tragogomphus*, owing to the great confusion that existed around larvae of this kind (they refer to CORBET, 1977). Unfortunately, this material could not be included in the present revision as I became aware of their paper too late. Nevertheless, knowing that they pertain to the genus *Neurogomphus* and according to the locality and collecting date (10-19 December), the six largest exuviae of LEHMANN & WENDLER's (their species n°6) may be attributed to *N. zambeziensis* sp. n. Moreover, their two smallest exuviae (species n°7) might pertain to *N. dissimilis* sp. n., another *Neurogomphus* species present in the region, because of their size, collecting date and the fact that the ratio between the abdomen length of the *N. dissimilis* imago and the total length of these exuviae corresponds to a normal value (i.e. < 1.00) for a *Neurogomphus* larva. Based on the *N. zambeziensis* or *N. cocytius* imagines, this ratio would exceed 1.00, outside the range of values for a *Neurogomphus*.

The most well-known discovery of a *Neurogomphus* larva is that which Philip S. CORBET made in Uganda, in 1959 and of which he published the drawing of a F-0 exuvia (CORBET, 1962 and facsimile of 1983, Fig. 61; the same figure also appears as Fig. 157D in HUTCHINSON, 1993). This exuvia had a characteristic elongate abdomen and long respiratory tube which led CORBET to conclude, perhaps after reading PINHEY's (1959) paper, that it might be that of *Lestinogomphus africanus* (FRASER, 1926). After corresponding with me he named it *Neurogomphus sp.* in his latest book (CORBET, 1999, Fig. 5.19A). *Neurogomphus* F-0 exuviae of this kind were collected along the Ugandan White Nile, i.e. the Albert Nile (*cf* CORBET, 1977: 66-67), but no adult *Neurogomphus* has so far been identified from this country. No living larva was collected, only some exuviae which were close to a bottom substrate of fine, deep silt (P.S. CORBET, personal communication, 23.V.1998). CORBET (1962) puts forward the interesting idea that the long siphon indicates a deep-burrowing habit which may have evolved in order to avoid predation by bottom-feeding fishes. This hypothesis is in agreement with the fact that larvae of *Neurogomphus* were found by Georges MARLIER (personal communication) during the 1950's when diving in Lake Tanganyika, which is rich in fish, and sieving its bottom substrate near the shore, at Uvira (Congo-Kinshasa), from where *N. wittei* is known.

Later, Sarah A. CORBET (1977) reported the existence of 'enigmatic gomphid larvae' of this kind in Cameroon, which were found in 1970 by sieving deep accumulations of muddy silt from small streams. She found a larva of the last stadium in the process of metamorphosing to an adult, but the insect was not sufficiently developed to allow for a reliable generic identification; however, see my note at the end of the description of the imago of *N. fuscifrons*.

A young *Neurogomphus* larva was dredged in 1974 from deep silt in the River Gambia by M.T. GILLIES, who also noted a number of exuviae of the same floating down the river (E. PRENDERGAST, personal communication). The larva was identified as that of a *Neurogomphus* by R.M. GAMBLES,

following a discussion this author had with me; it is most probably that of *N. featheri*.

Finally, significant progress was made in 1975 by Jean LEGRAND. He successfully reared a female imago of *N. alius* sp. n. from a F-0 larva, which was dredged from the very fine silt bottom of the River Ivindo, in Gabon.

It should be mentioned that some *Neurogomphus* larvae were collected much earlier, but were left unidentified in the alcohol-preserved collections of the Central African Museum in Tervuren (Belgium). Young and half-grown *Neurogomphus* larvae, covered with fine silt, were dredged in 1911 in the Luapula River, at Kasenga (Congo-Kinshasa) by Dr STAPPERS. There is also a young larva doubtfully noted as being found in 'Tanganyika' and collected by the same Dr STAPPERS, the well-known pioneer of the study of this lake. In order to offer a complete overview, I should also mention a F-0 exuvia collected in 1937 from Boma (Congo-Kinshasa) by Dr DARTEVELLE and deposited dry in the same museum.

Generic characters (Figs 48-52)

Body fusiform, thorax no wider than its length (width/length: *ca* 0.6 in Pakwach exuvia up to 1 in Luapula larvae).

Antennae cylindrical, 4-segmented, the first two segments no longer than their width, the third elongate and the fourth minute, forming a small tip.

Labium.- Prementum robust, without spines or hairs at sides. Distal margin of median lobe slightly concave. This concavity may only exists in the middle of the median lobe, the sides of the distal margin being then slightly convex (e.g. in the exuvia of Boma, Fig. 51g). Labial palps armed with a robust movable hook. Incurvated blade of palps ending in a strong hook; proximal to it, the inner margin is strongly indented.

The prementum distal margin is provided with a remarkable structure. Except in its middle, the distal margin is edged with what at first seems to be a row of paired closely apposed and upwardly curved short and relatively wide setae. However, careful examination with a photonic microscope shows that the ventral lying "setae" of each pair have no lumen, which is contrary to the dorsal lying setae. Indeed, an examination with a scanning electron microscope shows that the base of each ventral lying process is confluent with the median lobe margin while the dorsal lying process of each pair is inserted into a socket via a basal membranous ring. The distal margin of the prementum median lobe is thus provided with a double row of apposed seta-like processes, each ventral process being a fixed process and the dorsal one a movable one (Fig. 48i).

Maxillae with two rows of teeth, a ventral row of 4 strong teeth and a dorsal row of 3 slender and longer teeth.

Mandibles with a distal outer row of large teeth and a mesial row of smaller teeth, the two rows widely separated. Distal row of 5 teeth (1 minute and 4 large) in right mandible, 4 in left mandible. Mesial row different in right and left mandibles, but in right mandible the outermost dorsal tooth is always the largest.

Legs short, the hind legs about the same length as anterior and middle legs. Tibiae without a distal lateral expansion. Fore and middle tarsi 2-segmented, hind tarsi 3-segmented. Fore and middle tarsi are directed externally and rearwards, not downwards. Claws provided with setae, the more numerous in the fore legs, were they form conspicuous tufts (Fig. 49a).

Abdomen long, narrow (73% [oldest Kasenga larva] - 81% [Pakwach exuvia] of body length) and subcylindrical, without spines. S10 forms a long respiratory tube (19% [Tumba exuvia] - *ca* 40% [oldest Kasenga larva] of body length), ending in a poorly developed anal pyramid (from 5% of S10 length in Kotto larvae till 16% in Tumba exuvia). The tube bears no trace of interscleral sutures, except in the caudal tenth of its length, where a faint trace of suture can be seen in some alcohol-preserved specimens (e.g. in the F-0 exuvia of *N. alius* –see Fig. 48f– and in the young larva of *N. featheri*. This trace of suture should not be confounded with the paraproct extensor tendon, which lies parallel). Cerci slightly shorter than epiproct, the latter itself slightly shorter than paraprocts. S8 slightly shorter than S9 (however not in MARLIER's (1958) drawing of the Lake Tumba exuvia).

Generic differential diagnosis

Neurogomphus larvae differ from the other genera of African gomphid larvae having an elongated tenth abdominal segment by the absence of abdominal spines. Laterodistal tibial extensions are lacking, as in *Lestinogomphus* and unlike in *Phyllogomphus*. The *Neurogomphus* larvae differ also by the slightly concave distal margin of the prementum median lobe (deeply concave in *Phyllogomphus* and slightly convex in *Lestinogomphus*), by the presence of a double row of apposed seta-like processes on the distal margin of the prementum (a row of marginal indentations each with a spiniform seta at their base in *Phyllogomphus* and only a single row of spiniform setae in *Lestinogomphus*) and by the presence of strong teeth-like indentations on the inner margin of the labial palp incurvated blade (as in *Phyllogomphus* and unlike in *Lestinogomphus* where there is only a weakly serrated border).

The presence of hairs on the claws was found in all the larvae of the genus *Neurogomphus* (I examined all the preserved material: young larvae as well as half-grown larvae and F-0 exuviae), but although this presence is apparently unusual in insects, it is not an attribute of this genus: such hairs are also present in larvae of the genus *Phyllogomphus* and in the unrelated genus *Lestinogomphus*. In Europe, the claws of the larva of *Gomphus vulgatissimus* (LINNAEUS, 1758), a shallow-burrower in fine organic sediments, are hairy, contrary to the larva of *Onychogomphus forcipatus* (LINNAEUS, 1758) which lives in clean sand or fine gravel (unpublished personal observations). Hairy claws may thus be the result of an adaptation to burrowing in fine sediments.

Specific characters

Larvae of *Neurogomphus* can be distinguished at the species level by the relative proportion of their elongated tenth abdominal segment, the number and form of the dentations of the labial palp incurvated blade as well as by those of the mesial row of teeth of the right and left mandibles. There are only slight differences in the shape of the anal appendages. According to the taxa the paired seta-like processes of the prementum distal margin may have a somewhat distinct form, either that of scaly or narrow bristles. Due to the bad state of conservation of some of the larvae, this aspect could not be detailed in the present paper. The maxillae are similar in all species: although the distance between the teeth of the dorsal row appears to vary somewhat according to the species, it probably does not provide a useful difference, since the distance also varies according to the angle by which it is viewed.

It should be taken into account that the number of teeth on the inner margin of the incurvated blade of the labial palp as well as on the mesial row of mandibles appears to vary depending upon the age of the larvae (see the Kasenga larvae).

Larvae are here reviewed according to decreasing number of dentations on labial palp.

Descriptions and records

a. *Neurogomphus sp.* [Kotto, *cf* CORBET, 1977]. (Fig. 51a)

Material.- **Cameroon** : 4 F-0 exuviae and 3 larvae from two small streams (Tung Nsuia and Tung Nsuria) which flow into Lake Kotto, 11.IV.1970 (*ca* 04°28'N 09°16'E). I have seen a microscope slide, now in the collection of G. CARCHINI.

Dimensions of exuviae: 56.8 (56.0 – 58.0) mm. S10 *ca* 30% of abdominal length.

Labium.- 10 (11 in one of the six observed palps) dentations on inner margin of palp blade. Thirteen or 14 groups of paired seta-like processes on each side of the distal border of prementum median lobe. The setae of the dorsal row appear to be narrower than the processes of the ventral row (see Fig. 8g in CORBET, 1977).

Mandibles.- Mesial row of right mandible bearing 6 weak indentations (CORBET, 1977).

Remark.- By the dimensions of the exuviae, this material refers to a species probably as large as one of the '*fuscifrons* subgroup' (*N. fuscifrons*, *N. angustisigna* and *N. alius*). Examination of the genitalia and of the venation of the wing rudiments of a larva which died when ready to emerge could not enable to ascribe it with certitude to either *N. fuscifrons* nor *N. alius* (see p. 112). Meanwhile, it should be noted that the labium of the Kotto larvae differs somewhat from that of *N. alius* by the number of indentations on the palps and the number of scaly hairs on the distal margin of the prementum.

b. *Neurogomphus alius* sp. n. (Figs 48a-i, 49a-e, 52a)

Material.- **Gabon**: a F-0 exuvia from a larva dredged in the River Ivindo, at 5 km from Makokou (00°34'S 12°52'E), 25.VIII.1975, and reared to a female adult by J. LEGRAND (MNHN, in alcohol).

Dimensions (mm).- Total length 61.3 (58.5 without antennae and appendages). This length corresponds to that of the emerged imago (61.0, also in alcohol). S10 length 16.3 (14.7 without appendages), i.e. 32% of abdominal length. Anal appendages length 11% of that of S10.

Labium.- 9 dentations on inner margin of palp blade, the 5 most proximal conspicuously long. Eleven to 12 paired seta-like processes on each side of the distal border of prementum median lobe. The setae of the dorsal row are narrower than the processes of the ventral row.

Maxillae: Fig. 49d-e.

Mandibles.- Mesial row bearing 6 teeth on right mandible; 9 distinct teeth on left one, the most dorsal being the widest and showing the beginning of a division.

c. *Neurogomphus cocytius* sp. n. (by presumption)
(Figs 49f, 50a-b, 51b, 52b)

Material.- **Zimbabwe**: a F-0 exuvia from Victoria Falls, near Maramba River (upstream the Falls, *ca* 17°55'S 25°51'E), 7.IV.1962 (NMB).

As only *N. cocytius* imagines were present when this exuvia was collected (i.e. 8 males and 8 females, among which some were immature) and as the flying period of the only other species to be found in the region of the Falls (*N. zambeziensis*) markedly differs (December till February instead of mostly April and May), this exuvia may be attributed to *N. cocytius*.

Dimensions (mm).- Total length 51.3 (49.2 without antennae and anal appendages). S10 length 11.0 (without appendages), i.e. 28% of abdominal length. Anal appendages 1.2.

Labium.- 7 dentations on inner margin of palp blade, the 4 most proximal conspicuously long. 9 (or 10) groups of paired seta-like processes on each side of the distal border of prementum median lobe, some of the dorsal setae being narrower than the ventral lying processes.

Mandibles.- Mesial row of right mandible bearing 5 distinct teeth. Mesial row of left mandible in the shape of a lamella bearing weak indentations.

d. *Neurogomphus sp.* [Pakwach, *cf* CORBET, 1962 and CORBET, 1977]
(Figs 50e, 51c)

Material.- **Uganda:** F-0 exuviae (number unknown to me) from Pakwach (02°28'N 31°30'E), on the White Nile, 3.IX.1959. I have seen a microscope slide, now in CARCHINI's collection.

Dimensions.- Length 60 mm (CORBET, 1977 states 49.0, with S10 length 10.5). S10 *ca* 40% of abdominal length.

Labium.- 7 dentations on inner margin of palp blade. About 10 groups of

paired seta-like processes on each side of the distal border of prementum median lobe (from CORBET, 1977).

Mandibles.- According to the drawing of the lateral view of right mandible (CORBET, 1977) and the original slide before me, the outermost teeth of the mesial row are well-developed.

e. *Neurogomphus sp.* [Kasenga] (Figs 51d-e, 52e-f)

Material.- **Congo-Kinshasa**: Kasenga, Katanga region (10°22'S 28°38'E). Five young and one half-grown larvae, dredged on 27.VII.1911 in the Luapula River (a tributary of Lake Moero) by Dr STAPPERS (alcohol, MRAC).

Dimensions (mm).- Half-grown larva: total length (without antennae and appendages) 41.5; abdomen *ca* 33; S10 length 12.3 (without appendages). Length of the youngest larvae respectively 27, 22 and 9. S10 *ca* 38% of abdominal length in half-grown larva and *ca* 41% in youngest larva.

Labium.- Half-grown larva: 6 dentations on inner margin of palp blade, the 3 most proximal being long. Youngest larva: only 4 teeth, the three most proximal long. 10 groups of paired seta-like processes on each side of the distal border of prementum median lobe (half-grown and youngest larva). An investigation using a scanning electron microscope shows that the processes of each pair are identical, apposed to each other but not in close contact and that they are up- and backwards curved.

Mandibles.- Mesial row of half-grown larva right mandible with 6 teeth. Five teeth can be seen in the youngest larva. Mesial row of left mandible with 4 or 5 simple teeth set between wider compound teeth (half-grown and young larvae).

f. *Neurogomphus zambeziensis* sp. n. (by presumption) (Figs 50c, 51f, 52c)

Material.- **Zimbabwe**: a slightly damaged F-0 exuvia from Victoria Falls (17°55'S 25°51'E), I.1956 (NMB). This exuvia was briefly described and partly figured by PINHEY (1959) as being probably that of *Lestinogomphus africanus*.

The data of this exuvia correspond to those of the flying period of *N. zambeziensis* and not to that of *N. cocytius*.

Dimensions (mm).- Total length *ca* 48.5 (*ca* 47.0 without antennae and appendages). S10 length 10.0 (without appendages), i.e. *ca* 28% of abdominal length. Appendages *ca* 1.2.

Labium.- 6 indentations on inner margin of palp blade, the most distal only weakly developed. 10 groups of paired seta-like processes on each side of the distal border of prementum median lobe, the setae of the dorsal row about the same size as the processes of the ventral row.

Mandibles.- Mesial row of right mandible bearing 4 distinct teeth. Mesial row of left mandible in the form of a lamella with 5 weak indentations.

g. *Neurogomphus sp.* [Boma] (Figs 51g, 52g)

Material.- **Congo-Kinshasa**: Boma, Bas-Congo region (05°51'S 13°03'E) 1937, Dr DARTEVELLE leg. A F-0 exuvia, preserved dry, missing S9-S10 (MRAC).

Dimensions (mm).- Length without S9 and S10: 39.4 (38.5 without antennae). Total length probably *ca* 58 (56) or 55 (53) if similar in proportions to *N. alius* or *N. cocytius*. It is therefore the exuvia of a large species.

Labium.- 6 indentations on inner margin of palp blade, the two most distal ones only weakly developed and the two most proximal ones confluent. A row of 10 or 11 groups of paired seta-like processes on each side of the distal border of prementum median lobe, the setae of the dorsal row about the same size of the processes of the ventral row. Two of the pairs of processes consist in fact of a ventral seta-like process framed by two dorsal setae.

Mandibles.- Mesial row of right mandible with 4 (and a fifth, minute) teeth. Mesial row of left mandible with 6 teeth, the dorsal one the widest.

h. *Neurogomphus featheri* Pinhey, 1967 (by presumption) (Figs 51h, 52d)

Material.- **Gambia:** a young larva dredged from the River Gambia opposite Brikama Ba, 15.IX.1974 (13°34'N 14°56'W; UTM grid 28, reference 508499; mentioned in GAMBLES *et al.*, 1995, 1998 and PRENDERGAST, 1998 as the capture of square 33). This larva, preserved in alcohol, is now in CARCHINI's collection.

As *N. featheri* is the only known *Neurogomphus* species from Gambia, this larva should most probably be attributed to this species.

Dimensions (mm).- Total length *ca* 18. Abdomen *ca* 14.5. S10 length *ca* 5.3 (without appendages). S10 *ca* 36% of abdominal length.

Labium.- 4 indentations on inner margin of palp blade. 10 or 11 groups of paired seta-like processes on each side of the anterior border of prementum median lobe.

Mandibles with weakly developed teeth on mesial row.

Epiproct somewhat larger than cerci.

i. *Neurogomphus sp.* ['Tanganyika']

Material.- **Congo-Kinshasa:** a young larva collected by Dr STAPPERS, from 'Tanganyika (?)' (alcohol, MRAC).

Dimensions (mm).- Total length *ca* 20 mm. S10 *ca* 35% of abdominal length.

Not further examined.

j. *Neurogomphus sp.* [Lake Tumba, *cf* MARLIER, 1958] (Fig. 50d)

Material (not located in collections).- **Congo-Kinshasa**: Lake Tumba, Equateur region (00°48'S 18°03'E).

Dimensions unknown. S10 only 25% of abdominal length. Antennae and claws larger than in the other known larvae.

Mouthparts unknown.

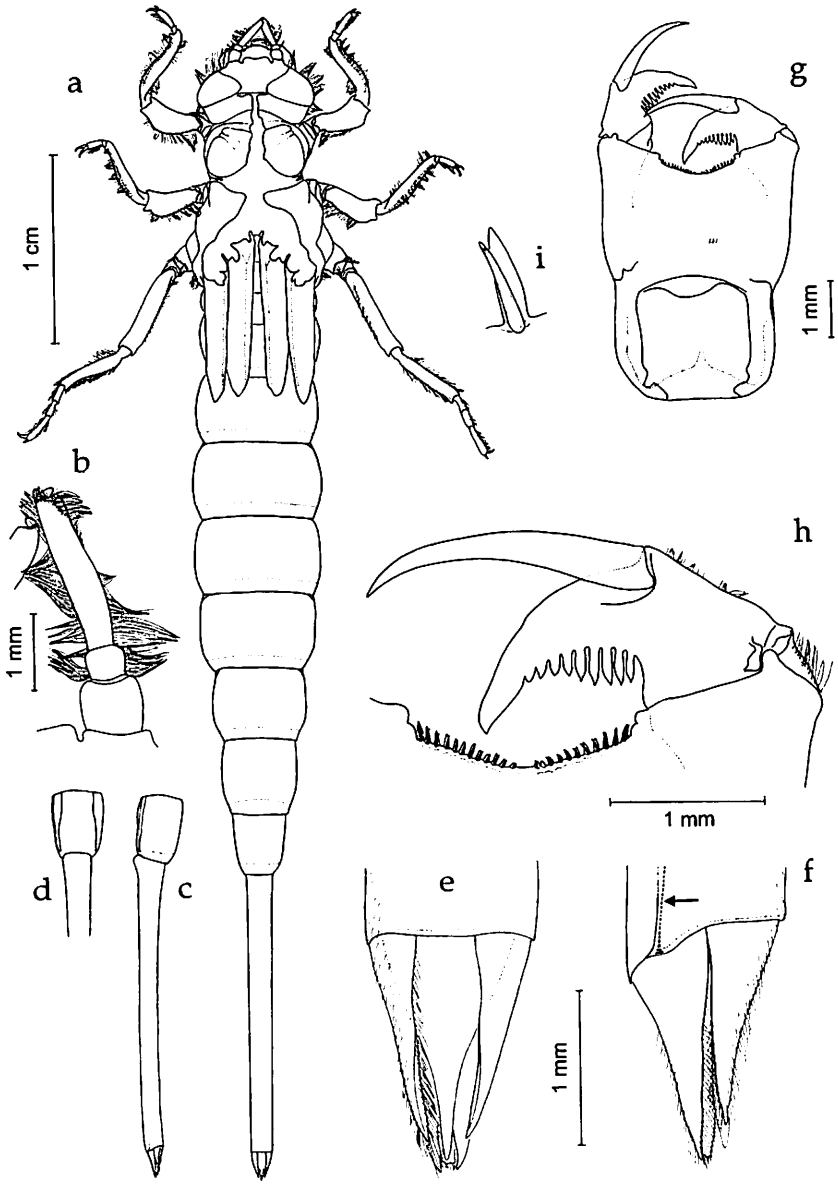

Fig. 48. *Neurogomphus alius*, F-0 exuvia, Ivindo River (Gabon). a: habitus, dorsal view; b: right antenna; c: abdominal segments 9-10, left lateral view; d: segment 9 and beginning of segment 10, ventral view; e-f: anal appendages, dorsal view (e) and left lateral view (f), showing also remnant of interscleral suture on end of segment 10 as well as, running parallel to it, the paraproct extensor tendon (dotted and indicated by an arrow); g: prementum; h: right labial palp and distal margin of prementum; i: a set of paired seta-like processes of the prementum distal margin (dorsal view).

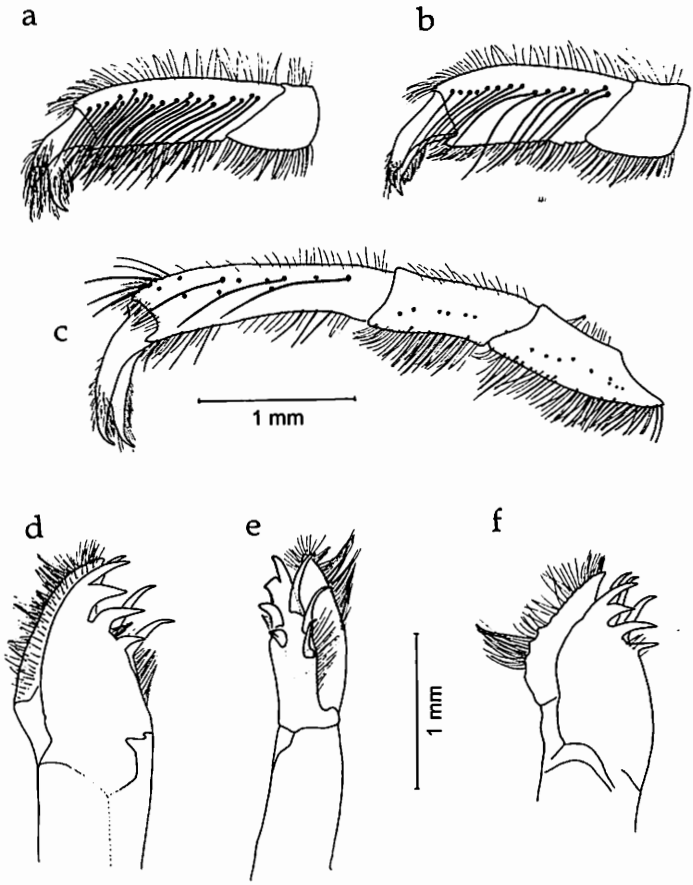

Fig. 49. a-e. *Neurogomphus alius*, F-0 exuvia, Ivindo River (Gabon). a-c: left fore (a), middle (b) and hind (c) tarsi, showing among other details hairy claws; d-e: right maxilla, ventral and medial view. f. *Neurogomphus cocytius* [by presumption], F-0 exuvia, Victoria Falls (Zimbabwe): right maxilla, ventral view.

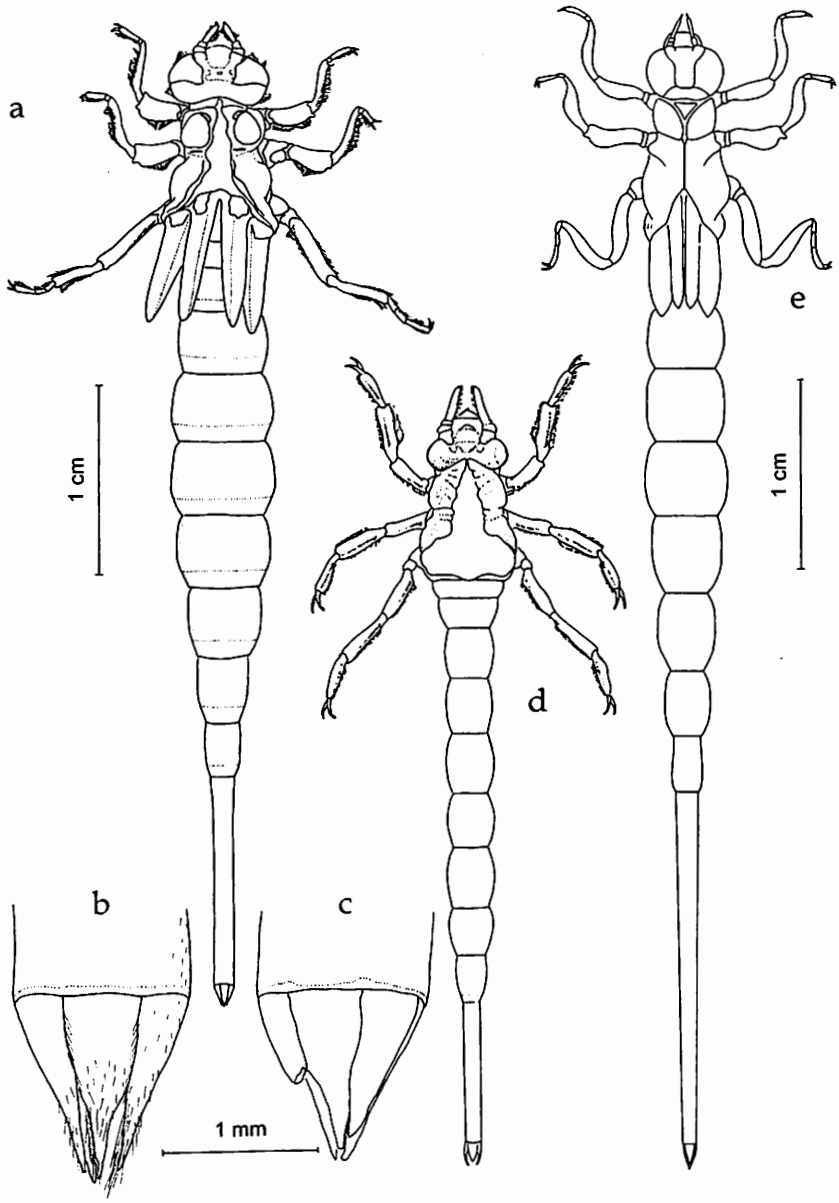

Fig. 50. *Neurogomphus spp.*, F-0 exuviae. a: *cocytius* [by presumption], Victoria Falls (Zimbabwe), habitus, dorsal view; b; *idem*, anal appendages, dorsal view; c: *zambeziensis* [by presumption], Victoria Falls (Zimbabwe), anal appendages, dorsal view; d: *sp.*, Lake Tumba (Congo-Kinshasa), dimensions unknown, habitus from MARLIER, 1958; e: *sp.*, Pakwach (Uganda), habitus from CORBET, 1962.

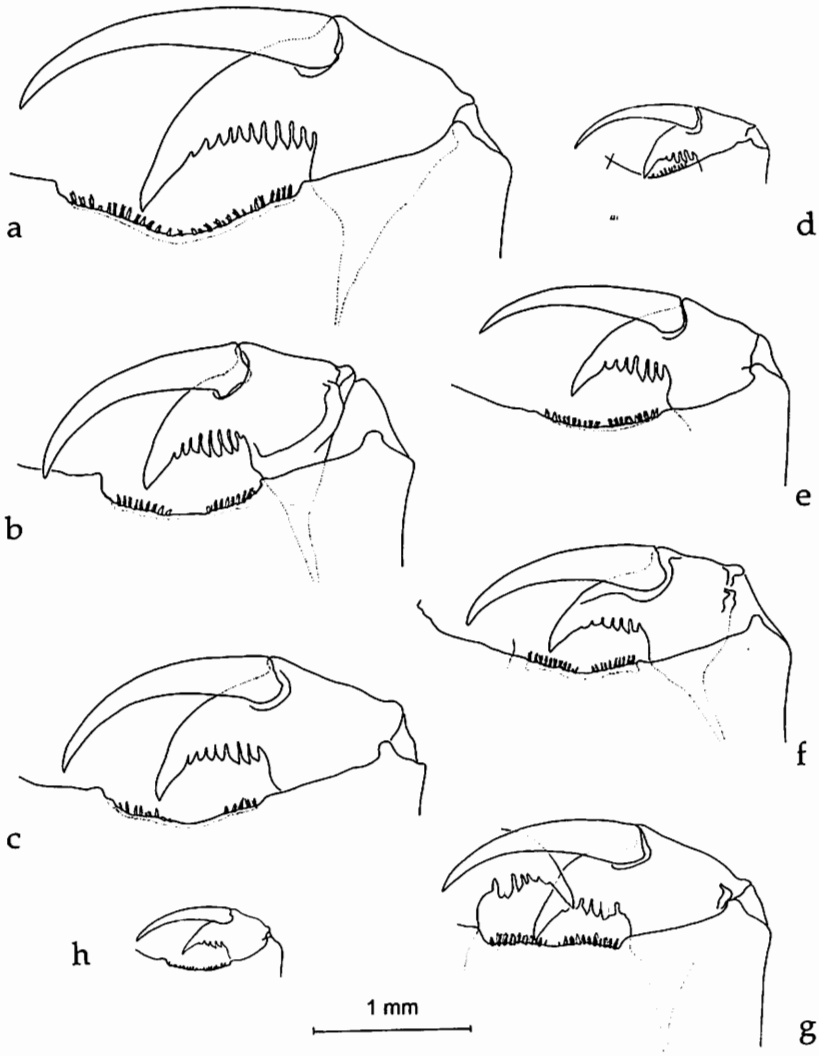

Fig. 51. *Neurogomphus spp.* larvae, right labial palp and distal margin of prementum. a: *sp.*, full-grown larva from stream flowing into Lake Kotto (Cameroon); b: *cocytius* [by presumption], Victoria Falls (Zimbabwe), F-0 exuvia; c: *sp.*, Pakwach (Uganda), F-0 exuvia, d-e: *sp.*, Kasenga (Congo-Kinshasa), young (d) and half-grown (e) larvae; f: *zambeziensis* [by presumption], Victoria Falls (Zimbabwe), F-0 exuvia; g: *sp.*, Boma (Congo-Kinshasa), F-0 exuvia; h: *featheri* [by presumption], Gambia river (Gambia), young larva.

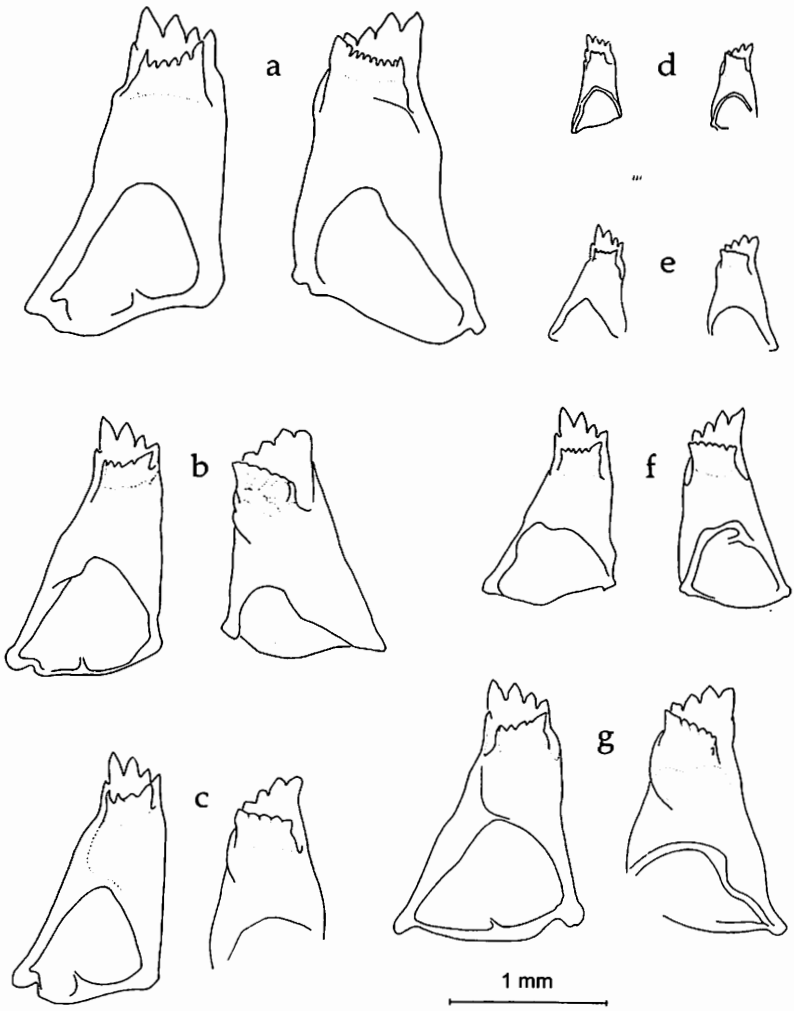

Fig. 52. *Neurogomphus spp.* larvae, right and left mandibles, medial view. a: *alius*, Ivindo River (Gabon), F-0 exuvia; b: *cocytius* [by presumption], Victoria Falls (Zimbabwe), F-0 exuvia; c: *zambeziensis* [by presumption], Victoria Falls (Zimbabwe), F-0 exuvia; d: *featheri* [by presumption], Gambia river (Gambia), young larva; e-f: *sp.*, Kasenga (Congo-Kinshasa), young (e) and half-grown (f) larvae; g: *sp.*, Boma (Congo-Kinshasa), F-0 exuvia.

Conclusions and discussion

Taxonomy

The present revision of the genus *Neurogomphus* recognises 17 species and 2 subspecies, of which 8 are new. Most of these taxa represent clearly distinct species, while the exact status of 5 taxa requires further research, based on new field collecting. Moreover, some female specimens where the specific identity is uncertain or where they are too stained by post-mortem decay are described but not formally named.

Although *N. vicinus* SCHOUTEDEN, 1934, is an ill-defined taxon based on a single damaged immature specimen, it is kept as a valid taxon because of some of its characters which, in the present state of our knowledge, are considered to be significantly distinct. It is hoped that this position will act as an incentive for further collecting.

The Congo basin taxon *N. paenuelensis* sp. n. is established on a specimen which shares an undoubtedly overall resemblance to *N. uelensis* SCHOUTEDEN, 1934, but appears to be too distinct to be simply included into the latter species. I honestly think it is a more useful and heuristic decision to separate it from *N. uelensis*, of which it might be a sibling species. Further characterisation of *N. paenuelensis* thus also awaits collection of new material.

Although well-distinct, the Ivory Coast humid forest inhabitant, *N. carlcooki* sp. n. clearly shows affinities with *N. featheri* PINHEY, 1967, a species which seems to be largely distributed in the dryer subsahelian woodlands. *N. featheri* however might be a species with distinct subspecific forms or one component of a superspecies complex including *N. carlcooki* sp. n. or *N. zambeziensis* sp. n.

The exact taxonomic status of the subspecific forms, *N. chapini lamtoensis* subsp. n. and *N. dissimilis malawiensis* subsp. n., should be specified by further collection of material, even in regions intermediate between those where they were found and those of the nominotypical forms *N. c. chapini* (KLOTS, 1944) and *N. d. dissimilis* sp. n.

The description of some single unnamed females (*sp. indet. A, B, C, D*) also draws the attention to our poor, still fragmentary and unsatisfactory knowledge of the taxonomy of the genus *Neurogomphus*.

The genus *Neurogomphus* is divided into two subgenera, on the basis of the morphology of penis, span of male inferior appendage relative to superiors, width/length ratio of occipital plate, shape of its crest, morphology of vulvar scale and extension of pair of synthorax antehumeral pale stripes. This leads to the creation of a new subgenus, *Mastigogomphus*. This subdivision offers a useful tool in the grouping of the species, although such an approach might not be essential. However, our present knowledge of the taxonomic diversity seems to be small in comparison to the species which exists, and future discoveries may very well entice us to revise the here proposed generic subdivision. No cladistic study of the species should be attempted at this stage.

A future challenge would be to acquire better knowledge of the status of some of the *Neurogomphus* taxa.

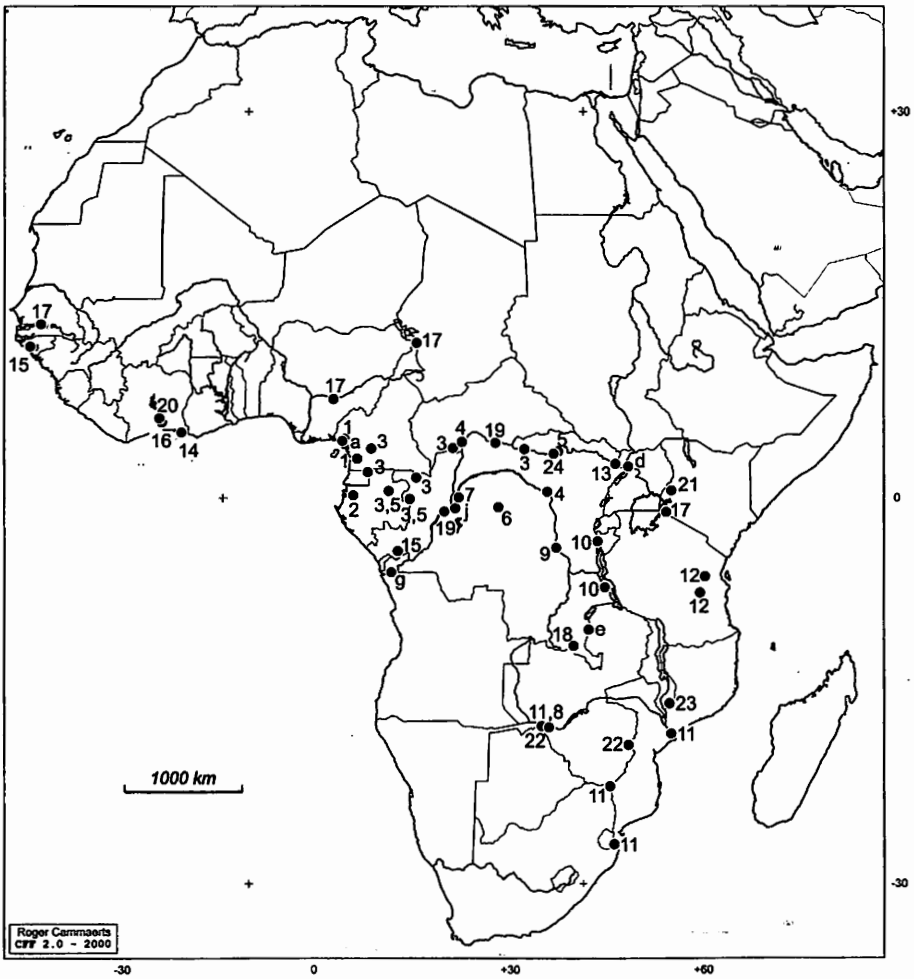

Fig. 53. Geographical distribution of *Neurogomphus* imagines (numbers) and unidentified larval material found outside the localities from where adults are known (letters). Numbers and letters follow the numbering of taxa and larvae in the descriptive text. (1) *fuscifrons* KARSCH, 1890; (2) *angustisigna* PINHEY, 1971; (3) *alius* sp. n.; (4) *martininus* (LACROIX, 1921); (5) *uelensis* SCHOUTEDEN, 1934; (6) *paenuelensis* sp. n.; (7) *sp. indet. A*; (8) *cocytius* sp. n.; (9) *vicinus* SCHOUTEDEN, 1934; (10) *wittei* SCHOUTEDEN, 1934; (11) *zambeziensis* sp. n.; (12) *sp. cf zambeziensis*; (13) *sp. indet. B*; (14) *sp. indet. C*; (15) *agilis* (MARTIN, 1908) [the 'Guinée portugaise' record is arbitrarily located at Bissau and the 'Congo' record, between Loango and Brazzaville]; (16) *carlcooki* sp. n.; (17) *featheri* PINHEY, 1967; (18) *pallidus* CAMMAERTS, 1967; (19) *(Mastigogomphus) chapini chapini* (KLOTS, 1944); (20) *(Mastigogomphus) chapini lamtoensis* subsp. n.; (21) *(Mastigogomphus) pinheyi* CAMMAERTS, 1968; (22) *(Mastigogomphus) dissimilis dissimilis* n. sp.; (23) *(Mastigogomphus) dissimilis malawiensis* subsp. n.; (24) *(Mastigogomphus) sp. indet. D*; (a) larvae from lake Kotto; (d) F-0 exuviae from Pakwach; (e) larvae from Kasenga; (g) F-0 exuvia from Boma; (j) larvae from lake Tumba.

Geographical distribution (Fig. 53)

The present study shows that the genus *Neurogomphus* is spread throughout sub-Saharan continental Africa, from northern Natal (South Africa) to Gambia, with the exception of Ethiopia. Some species have a large geographic range, e.g. *N. featheri*, known from western Kenya to Nigeria, Chad and Gambia. The known range of *N. zambeziensis* sp. n. seems to extend from Natal to Tanzania. *N. chapini* can be found in the swampy forest of Congo as well as in the forest galeries of the Ivory Coast, were it is represented by a distinct form (here described as a subspecies) whereas *N. agilis* is known from Congo-Brazzaville and Guinea-Bissau. *N. wittei*, however, is only known from the western bank of Lake Tanganyika. Logically the genus should be present in Angola. From Uganda only exuviae are known.

According to the species, the genus *Neurogomphus* ranges from the dense evergreen and humid equatorial rainforest to the drier northern and southern woodlands. At the extremities, *N. zambeziensis* occurs in the undifferentiated and shrubs woodland of northern Natal and *N. featheri* occurs in Gambia, in an area of formerly undifferentiated woodland which nowadays is largely a semi-permanent farming area with bush fallow, with at the most the appearance of a park-like savannah. The genus is thus distributed in regions with sufficient rainfall allowing for the existence of permanent freshwater.

Larvae

Larvae pertaining to the genus *Neurogomphus* are characterised for the first time. Attention is drawn to particular morphological features such as pairs of seta-like processes on the prementum distal margin and hairy claws. The latter feature exists also in other gomphid genera. The larvae of ten species are described, of which the larva of *N. alius* sp. n. could be named with certitude and those of *N. cocytius*, *N. zambeziensis* and *N. featheri* named with sufficient confidence.

The present knowledge of the larval biology is reviewed.

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