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A CHECKLIST OF THE ODONATA OF THE SOUTH-WEST PROVINCE OF CAMEROON, WITH THE DESCRIPTION OF *PHYLLOGOMPHUS CORBETAE* SPEC. NOV. (ANISOPTERA: GOMPHIDAE)

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A checklist of the dragonflies of the South-West Province of Cameroon, based upon field work undertaken between 1995 and 1998, and a survey of historical records, is given. Notes on seasonal occurrence, habitat requirements and taxonomy are provided. As new is described: *P. corbetae* sp.n. (holotype ♂: Kumba, outlet stream from Barombi Mbo, 20-IX-1997; allotype ♀: Limbe, Bimbia, Elephant River, 4-VII-1996).

INTRODUCTION

POLITICAL. – Cameroon occupies an area of about 475000 km² and is therefore approximately the same size as France or Spain. It covers latitudes between 2° and 13° N and longitudes of 8° and 16°E. The South-West Province occupies about 5% of the national territory and lies adjacent to the Nigerian border and the Gulf of Biafra (Fig.11). Its area is approximately equal to that of Belize, or half that of Costa Rica or Switzerland; this is roughly equivalent to about six English counties. Before independence and reunification in 1960-61, it was part of the British Cameroons and, together with the North-West Province, it forms the anglophone part of the country. The population is 0.82 million, giving an average density of 33 people/km² (MINISTRY OF PLANNING & REGIONAL DEVELOPMENT, 1989).

For the purpose of a dragonfly survey, it forms a very workable homogeneous recording unit over which the climatic regime is relatively constant, apart from the natural local variations due to orographic uplift associated with mountains and topographic diversity.

PHYSICAL. – GEZE (1943) discusses the physical geography of the region; NGWA (1967) and NEBA (1987) provide excellent summaries. The basement rock of the region is part of the great pre-Cambrian African shield which consists of granite and metamorphic rock (mica schists, quartzite, gneiss and migmatites). A large tectonic trough which runs across the Province from SW to NE is marked out by isolated volcanos and pre-quaternary volcanic deposits stretching from Mount Cameroon (active six times this century) to Mount Kupe (2070m) and the Rumpi Hills (1760m) to Mount

Table I
Rainfall figures in mm: various dates and durations of records

Station	J	F	M	A	M	J	J	A	S	O	N	D	*Total*	Source
Mamfe	33	79	160	206	325	437	513	465	564	452	152	38	*3424*	HAWKINS & BRUNT, 1965
Nyasoso	21	107	230	182	298	402	822	720	645	453	77	45	*4002*	EJEDEPANG-KOGE, 1986
Tombel	53	121	248	240	267	507	489	480	554	474	160	65	*3658*	EJEDEPANG-KOGE, 1986
Ndian	40	127	258	300	395	715	887	952	752	544	319	93	*5382*	NDIAN ESTATE, 1987
Kumba	17	70	197	206	194	225	276	335	390	264	78	46	*2298*	FAO-UNDP-ONAREST, 1977b
Debundsha	242	314	500	520	743	1285	1424	1371	1619	1158	610	358	*10144*	NGWA, 1967

Manenguba (2250m) and the Mamfe region in the West. These form the southern part of the Cameroon Highlands. Recent basalts are present.

Crater lakes are present, including Debundsha, Barombi Mbo, Edib and the Twin Lakes of Manengouba.

The Province is drained by the Manyu-Cross River system in the Mamfe Depression in the north, and by the Rivers Ndian, Mungo and Wouri and their tributaries in the south. All flow into the Atlantic. There are extensive sedimentary deposits in these valleys.

On the whole, it appears that climate is more significant than geology in determining dragonfly distributions in the tropics and our preliminary work would support this. We have not yet found any correlations between dragonfly distributions and geology or soil type.

CLIMATE. – [See Tables I and II]. – The climate in this part of Cameroon is usually described as 'monsoon-equatorial': rain falls in virtually every month but there is a single rainfall maximum which occurs in the northern hemisphere summer. This is different from the climate in the rest of southern Cameroon which is closer to the equatorial pattern with two double rainfall peaks. The climate of northern Cameroon is different again in that there is a strongly monsoonal, or tropical, pattern with a prolonged severe dry season.

In South-West Cameroon, the prevailing moisture-laden south-west monsoons deposit heavy rainfall on the windward side of the mountain massifs. The effect of the dry harmattan which blows from the north is minimal. In the lowlands, Tombel and Ndian usually have no month with less than 40mm rain, although recently there appears to have been a tendency for longer periods without rain.

Table II
Sunshine figures in hours/month

Station	J	F	M	A	M	J	J	A	S	O	N	D	*Total*	Source
Mamfe	169	184	171	148	153	108	85	65	81	139	175	180	*1658*	HAWKINS & BRUNT, 1965
Ndian	135	159	150	157	151	87	11	1	44	109	124	128	*1256*	NDIAN ESTATE, 1987

Debundsha, on the windward side of Mount Cameroon, receives about 10000mm rain (approximately 400") and is one of the wettest place in the world, usually regarded as second only to Cherrapunji in Assam. The mean annual temperature in the lowlands is about 25°--26°C and there is little fluctuation during the year. Even Kumba, which lies in the rain-shadow, of Mount Cameroon receives nearly 2300mm and usually only has one month with below 40mm.

The mountainous areas, lying at altitudes over 700m, have a modified version of this climate with lower average temperatures, but a similar rainfall pattern (see figures for Nyasoso), with a general trend for higher precipation.

Table III
Summary of seasonal pattern

Season	Month	Character of climate	
dry	November	fairly wet	sunny
	December	dry	sunny
	January	dry	sunny
	February	dry	sunny
transition	March	wet	sunny
	April	wet	cloudy
	May	wet	cloudy
wet	June	very wet	very cloudy
	July	very wet	very cloudy
	August	very wet	very cloudy
	September	very wet	very cloudy
	October	very wet	cloudy

The relative humidity at all stations is above 80% even in the driest months and reaches 88% in the wettest months; in cloud forest above 1000m it approaches 100%. Almost all stations have at least 40mm of rain per month and as the relative humidity is so high, the term 'dry season' is only a relative term: in most areas trees are evergreen, and rivers and the larger streams are perennial, although very small streams may dry up. Watercourses reach their highest levels in September and October and their lowest levels in February and March.

Table III shows in simplified form the climatic characteristics of each month, and a very broad breakdown into the seasons: dry (occasional rainfall in most months); transition (short, heavy storms in most weeks); wet (prolonged rainfall and overcast conditions).

NATURAL VEGETATION. – LETOUZEY (1968a,1968b) discusses the vegetation of the Province. Apart from the coastal mangroves, dense evergreen equatorial 'Biafran' forest is the natural vegetation at low and medium altitudes (0-1200m), dominated by the Caesalpinioidae. These forests are part of a larger association which extends from south-eastern Nigeria and east towards the R. Congo and the Sangha River (MINISTRY OF PLANNING & REGIONAL DEVELOPMENT, 1989). The Province lies at the core of this region: gradients of increasing species-poverty extend from the core in all directions; this has been observed for plants, birds, mammals, reptiles, amphibians and butterflies. From our preliminary observations it also appears to be true for Odonata.

The rainforest was drastically reduced during the Pleistocene. During glacial periods in the North, Africa cooled and became drier. A few areas persisted as lowland rainforest refuges. These are generally coastal and are presumed to be in regions which have the heaviest rainfall now: Mount Cameroon, Korup, Mount Kupe and the Bakossi Mountains. The fauna and flora have radiated out again from these foci as the climate became wetter and warmer (HAMILTON, 1976; LIVINGSTONE, 1982; GRUBB, 1982).

It is believed that the evergreen forest at Korup could have persisted even when temperatures were reduced by an average of 5°C and the rainfall reduced by as much as 70%. It is richer botanically than any other African forest for which data are available (MINISTRY OF PLANNING & REGIONAL DEVELOPMENT, 1989). However, recent work by the Royal Botanical Gardens (Kew) also suggests that Mount Kupe is comparatively rich. Probably the entire Province forms a fairly dense centre of endemism for most moisture-adapted organisms.

Above 1600m, a dense humid submontane forest occurs with a very different plant ensemble. Mount Kupe (2050m) provides an excellent example of this association. On Mount Cameroon, there is a full altitude zonation which is summarised by LETOUZEY (1968a,1968b) as: 0-1200m dense evergreen equatorial forest; 1200-1800m submontane forest; 1800-2600m montane scrub and savannah; 2600m and above subalpine and alpine.

As far as the odonate fauna of the Province is concerned we have observed a lowland fauna and a distinct 'montane' fauna, which is found in cool streams at altitudes of above 700-800m. The cool streams investigated (on Mounts Cameroon and Kupe) arise at much higher altitude than this and I have referred to these species as montane even though this appears to be contradicting the botanical evidence where the lower limit would be 1800m. They do however show a lower altitudinal limit and as they are associated with mountainous areas, the term 'montane' is justified; a similar situation has been observed with certain amphibians, according to recent work carried out by C. W i l d of WWF (Cameroon). We have not explored at altitudes higher than 2000m - an endemic dragonfly fauna at this altitude is unlikely. In general, tropical Africa does not appear to possess a genuinely montane species assemblage of odonates.

There has been extensive clearing for agriculture throughout the region, especially for the cultivation of oil-palm (native to the region), cocoa, rubber, banana/plantain, and coffee. However, compared with many parts of the equatorial regions of the world, there are still extensive areas of pristine forest present.

WATER TEMPERATURES. – In an equatorial climate in which there is so little change in the average daily temperature it is useful to measure stream temperatures. The daily fluctuations in air temperature are greater than the monthly changes in average air temperature and as the heat capacity of water is high, buffering diurnal changes, it is not crucial to measure water temperature at exactly the same time of day in order to gain a useful measure of the character of the stream.

It is fairly easy to divide the habitats into lowland and highland, with the faunistic border for Odonata being at about 700m in altitude. But water temperature is the crucial factor: lowland streams can have montane species if cool. This usually occurs when a montane stream enters the lowlands and maintains its character, especially when flowing through primary forest.

The water temperature of montane streams in dense primary forest is within a range of 19° - 23°C (altitude range 700-1200m). In the lowlands, the figure is about 25°-26° in heavy forest, rising to 27°-28° in secondary forest with farm bush. The large crater lake near Kumba, Barombi Mbo (altitude 380m) had water at 29°C; the crater lake at Debundsha at about 50m altitude was 30.5°C. In open habitats very much higher temperatures are recorded, e.g. 35°C at the lowland coastal marshes at Debundsha. All of the above temperatures were measured at about noon.

LOCAL NAMES FOR DRAGONFLY

In the areas of survey, we asked the local people what was their word for dragonfly. In the village of Nyasoso, centre of the territory of the Bakossi tribe, they used the word *n'sisag* for the adults and *n'gon* for the larval stages. In fact, one of the older men in the village described how, when he was a boy, they used to collect dragonfly larvae for food from the streams in Mount Kupe. We assume that they were eating the larvae of *Phyllomacromia* spp. which are the only large species which are at all common; certainly aeshnid spp. are only rarely obtained in these streams.

In the region around Debundsha, on the south-west side of Mount Cameroon, the

local tribe is the Bakweri and local men identified dragonfly adults as *ecuve ecuve* (presumably a plural). The isolated Barombi tribe, who fish the lake of that name near Kumba, used the term *mbang mbang*. All of these tribes speak true Bantu languages.

HISTORY OF RECORDING IN THE SOUTH-WEST PROVINCE

When the kings of the coastal Duala tribes agreed to give sovereignty to Germany in 1884 this only meant that a small coastal strip became the German colony of Kamerun (MBUAGBAW, BRAIN & PALMER, 1987). After 1885, and the 'award' to Germany of a larger area at the Berlin Conference, there was an intense period of exploration, searching for the best routes from the coast into the 'useful' interior (e.g. the grassfields of the Bamenda Uplands) through the dense forests of what is now the South-West Province. The Germans planned a line of 'stations' which ran from Mount Cameroon to the interior. A 'factory' was established at Mundame (Mungo River) and a 'station' was set up at Barombi. The latter became the administrative centre of Johann Albrechtshöhe There was severe resistance from the Bakweri tribe at Buea on Mount Cameroon between 1891 and 1894, but a 'station' was eventually built there and it became the capital of Kamerun from 1901-1909.

During the German period of colonialisation, much odonate material was sent back to Europe. SELYS (1879, 1886) described material from Cameroon, including *Umma mesostigma*, Chlorocypha glauca*, C. cancellata** and *Chlorocnemis nigripes** from Mount Cameroon (locally called Mongo-Ma Loboh). Also *Acanthagyna sextans** was described from the mountain by McLACHLAN (1896). At this time, species were sometimes described with data 'Kamerun' and, if they are not further localised, it is not possible to include them in the records of the Province.

McLachlan's material, representing many species, in the NHM collection was collected in this period (about 1880-1890), but unfortunately the data labelling is perfunctory: Camaroons River (now called the lower Wouri River which flows into the Atlantic near Douala and thus just outside the Province); merely 'Camaroons' which generally referred to 'Old Camaroon' which was the settled area which developed between Victoria (now usually called Limbe) , Tiko and Douala and probably mostly in our area and Mongo-Ma-Loboh (entirely within the South West Province). I have included all of these records which are represented by specimens in the NHM in Table V.

KARSCH in a series of papers (1890, 1891a, 1891b, 1892, 1893, 1894, 1896, 1899) laid the foundations for the study of the dragonflies of Cameroon and many of his records are from areas which are now within the Province. He reported on

* Described as new to science from material taken in the region.

the findings of Dr Paul Preuss (KARSCH, 1890, 1891b) at Barombi Station and Kribi (now in S Province). From Barombi Station he records 18 species, including *Mesocnemis singularis*, Pseudagrion epiphonematicum*, Paragomphus abnormis*, Neurogomphus fuscifrons** (type female), *Notogomphus spinosus*, Phyllomacromia caneri* (as *sophia*), *Zygonyx speciosa**, and *Z. pretiosa** (female sex described as different species, now synonymised with *speciosa*), *Hadrothemis coacta*, H. camarensis,* and *Allorrhizucha klingi**.

He described a female taken by Dr Preuss at Buea on Mount Cameroon as *Phyllomacromia paula** (KARSCH , 1892) and added *Sapho orichalcea, Heliaeschna fuliginosa** (KARSCH, 1893) from Preuss' specimens taken near Victoria (now Limbe).

The next contribution (KARSCH, 1894) dealt with material from Yaunde (Yaounde), now in Central Province. KARSCH (1899) dealt with Leopold Conradt's material from Johann-Albrechthöhe (now called Kumba). He recorded 26 species taken at Elephantsee (now called Barombi Mbo) and includes: *Chlorocypha gracilis*, C. lacus-elephantum** (described from a female), *Stenocnemis pachystigma, Pseudagrion flavipes* (as *hemicolon**), *Enallagma camerunense*, Neurogomphus fuscifrons* (first male), *Diastatomma tricolor, Phyllomacromia caneri* (as *sophia*) and *Idomacromia proavita.*

Ingve SJÖSTEDT was resident in Cameroon from 1890-1892 and he collected many groups of insects. In 1899, he published a useful list of 41 species found in the coastal area between Mount Cameroon and the Nigerian border, and northwards to Itoki (perhaps the village of that name situated at 5°01'N, 9°15'E). He refers to Kitta (probably Kita) and Bonge (probably the German 'station' of Mbonge), both in or near the lower reaches of the R. Meme; Kottasee = Richardsee (now Lake Kotto) SW of Kumba; N'dian (the village Ndian in Korup on the Ndian River which becomes the Rio del Rey) and Ekundu. I cannot place his site Wewoka. Most notable of the records are *Thermochoria picta** (ssp. of *equivocata), Zygonyx flavicosta*, Allorrhizucha preussi, Tetrathemis camerunensis*, Idomacromia proavita, Diastatomma tricolor, Acanthagyna bullata, Heliaeschna fuliginosa, Phyllomacromia melania* (as *Hylaeschna paludis), Tragogomphus aurivillii*, Phaon camerunensis*, Chlorocypha cyanifrons* (as *glaucifrons*), C. neptunus*, C. selysi* (as *camerunensis*), C.a gracilis* (as *grandis*), Prodasineura vittata, Pseudagrion flavipes*, Pseudagrion nubicum* (as *Coenagrion glaucum**).

By 1900, the groundwork had been done and a total of 51 presently recognised species had been recorded for our area, if one includes unpublished material in the NHM Collection. Later, FÖRSTER (1906) described *Pseudagrion sjoestedti** from Bipindi (Mount Cameroon) and the amphipterygid *Pentaphlebia stahli** from the same mountain (FORSTER, 1909). GRUNBERG (1914) described *Chlorocypha hintzi* from Ekona-Bavinga. LE ROI (1915) reported on the German Central Africa

* Described as new to science from material taken in the region.

Expedition. FÖRSTER (1916) described *Umma saphirina* and SJOSTEDT (1917) described *U. puella*, from Kamerun but neither gave precise locations.

After the First World War, Cameroon was split into French and British sectors and governed by mandate. The Province formed the southern part of British South Cameroon until independence and reunification in 1960-61. During this period, the amount of dragonfly work seemed to slacken. In 1926 Miss M.E.Fountaine collected *Chlorocypha selysi* at Ekona (GAMBLES, 1975) and in 1931, Miss Steele captured a female *Heliaeschna* in a cave on the first plateau of Mount Cameroon and this was described but not named by LONGFIELD (1936). It was later named by GAMBLES (1967) as *H. longfieldae**.

SCHMIDT (1943) described the perilestid *Nubiolestes diotima** (from Essossung in the Bakossi Mountains, on the north flank of Kupe), as *Eolestes diotima*. In 1951, he added *Chlorocnemis contraria** from Ekona-Bavinga on Mount Cameroon, although it had been taken in 1910. LONGFIELD (1951) described *Microgomphus camerunensis** from a female taken near Kumba.

FRASER (1956) reported on the Danish expedition to Cameroon.

In 1958, just prior to independence of these regions, the leading expert on African Odonata, Elliot Pinhey, and T. Coffin-Grey made a Land Rover journey from Bulawayo, via the Belgian Congo and the French Equatorial territories and Cameroon to Ikom in Nigeria. Odonata were collected at many sites on the route and these papers, although they contain errors, must rank as some of the most exciting in the literature (PINHEY, 1961a, 1961b). In the Province, the region around Mamfe was surveyed, and the Gorilla Mountain (Nta Ali) was visited. Widdicombe is just on the border between the South-West and North-West Provinces; the village is actually in the latter but I have included the records in Table V.

He records *Chlorocypha greyi** and its synonym *C. ntaali** (both later synonymised with *A. lacuselephantum*), *C. rufitibia**, *Pentaphlebia stahli, Phaon camerunensis, Umma purpurea, Tragogomphus mamfei**, *Idomacromia proavita, Phyllomacromia aeneothorax, Phyllomacromia funicularia, Neodythemis gorillae**, *Orthetrum angustriventre, Trithemis grouti**, *Stenocnemis pachystigma, Neurolestes trinervis, Pseudagrion superbum* (syn. of *serrulatum*),

PINHEY (1962a) lists *Sapho bicolor* (as *superba*) and *Acanthagyna cylindrata* from Mamfe. In PINHEY (1971), he mostly details records from Fernando Po but adds records of five species from Malende, Koto Barombi See, Mueli, and Diebo-Efote in the Province, including the elusive *Thermochoria equivocata picta* from Malende.

Odonates collected by W. Hartwig are recorded by PINHEY (1974) in a report on the Eisentraut Expedition to Cameroon. Sites visited were: Nyasoso (Lager I), Manenguba Lake, Dikume-Balue in the Rumpi Hills and from Victoria (now Limbe). A total of 27 species was listed. Most notable were *Neurolestes trinervis* (Nyasoso),

* Described as new to science from material taken in the region.

Pentaphlebia stahli (Nyasoso, Dikume-Balue), *Onychogomphus* sp. (*?styx* or *?supinus*) (Nyasoso), *Phyllomacromia aeneothorax* (as *camerunica* n.sp.) (Nyasoso, Dikume-Balue), *Chlorocnemis eisentrauti** (Dikume-Balue), *Enallagma buchholzi* (Manenguba), *E. vansomereni* (Manenguba), *Umma saphirina* (Dikume-Balue), *Heliaeschna cynthiae* (Dikume-Balue), *Neodythemis africana* (Dikume-Balue), *Orthetrum camerunense* (Manenguba), *Zygonyx regisalberti* (Dikume-Balue) and *Trithemis furva* (Manenguba).

Robert GAMBLES was resident at Vom, Nigeria in the 1950s and 1960s. He spent a considerable time working on the fauna of the region and he was preparing a text on the Dragonflies of Nigeria to include the anglophone regions of Cameroon. Sadly, this was never completed, but he gave me a draft copy in 1980 and I have found it to be invaluable. His many contributions to the taxonomy of the region have been seminal and he made two trips into the Province during his stay in Nigeria: the first in December and January 1957/58; the second on October 1962. In 1959, he described *Orthetrum camerunense* from the grassfields of Bamenda, now North-West Province and 20 km from the border of our region, but later found in the Province (see above). On his 1962 visit to the Province he collected *Chlorocypha glauca, Cyanothemis simpsoni* and *Diastatomma tricolor* from the Mamfe area, and *Pseudagrion sjoestedti* (Mamfe and sites 30 mi E and W) (GAMBLES, 1975). He took *Chlorocnemis flavipennis (= nubilipennis)* on Gorilla Mountain (18 October 1962). In 1967, he studied the type specimens of *C. nigripes* and *C. contraria*, both having their type localities on Mount Cameroon (=Mongo-ma Lobah), and clarified their status. He recorded *nigripes* from Dechang, near Mamfe. He revised *Phyllomacromia* of the *picta* and *sophia* groups (GAMBLES, 1979) and added more sites, but no new species to the list, for the Province. He clarified the status of *P. aeneothorax* as the correct name for *P. selysi* Kirby, 1900, *P. lieftincki* (Fraser, 1954) and *P. camerunica* (Pinhey, 1974) ; and *P. melania* as the correct name for *P. contumax* (Selys, 1879), *P. biflava* (Martin, 1906), and *Hylaeschna paludis* Sjöstedt, 1899. The Gambles' Collection in NHM contains many uinpublished records and I have extracted these data from the specimens and incorporated them into Table V.

Interesting work was done on the crater lakes of Barombi Mbo, Mboandong, Lake Kotto, Lake Soden and Lake Debundsha in the 1970s by a group whose focus was primarily ecological and ichthyological, but dragonflies were recorded. GREEN (1972) provides an introduction to the ecology of the first four lakes.

Dragonfly records are given for Lake Kotto and Mboandong (CORBET et al., 1973) and for the crater lake at Cape Debundsha (GREEN et al., 1974). CORBET (1977) describes a collection of gomphids from Lake Kotto and Barombi Mbo. There is material of *Acanthagyna sextans* from Barombi Kotto in the NHM collection taken by Sarah Corbet.

* Described as new to science from material taken in the region.

VICK (1996) reported on studies made in the areas of Mount Cameroon and Mount Kupe in 1995 and gives a description of the habitat of Mount Kupe as well as a checklist of 72 species recorded in the 1995 expedition. *Umma mesumbei** was described from Kupe. As this visit was in effect the first CDP survey, I have included the records again in this paper (i.e. not as 'historical' records).

The larvae of *Nubiolestes diotima* and *Stenocnemis pachystigma* (assumption) were described in VICK (1998); notes were also provided on the larva of *Pentaphlebia stahli* in the same paper.

D'ANDREA & CARFI (1997) record 35 species from four sites in the Province in addition to making a number of valuable records and observations. These are shown in a separate column in Table V. The sites of importance here are Barombi Mbo and three sites near Mount Cameroon: Ikata (400m), Malende (300m) and Munyenge (400m). The most significant records are: *Umma puella* (Munyenge), *Chlorocypha neptunus* (Barombi Mbo, Ikata), *C. rubida* (Ikata), *C. victoriae* (Barombi Mbo), *Ellatoneura balli* (Munyenge), *Mesocnemis singularis* (Ikata, Barombi Mbo), *Pseudagrion angelicum* (Ikata, Barombi Mbo), *Heliaeschna cynthiae* (Malende), *Orthetrum austeni* (Malende), *O. kalai* (as *brachiale*) (Malende, Barombi Mbo, Munyenge), *Oxythemis phoenicosceles* (Ikata), *Tetrathemis bifida* (Ikata, Malende, Munyenge), *T. grouti* (Malende), *Zygonyx fallax* (Malende), *Z. torrida* (Munyenge).

METHODS

The first visit was made in March and April of 1995. The staff at the Birdlife International (ICBP) project at Mount Kupe were keen to instigate some odonate survey work and my wife and I decided to concentrate on this area. We stayed in the village of Nyasoso with a local family. Two local guides, Otto Mesumbe and Elvis Njume, were made available and we spent much of the time teaching them about Odonata: basic biology and life histories, fieldcraft and specimen processing

The scientific coordinator, O'kah Ebwekoh also helped with habitat information and Ebong Harrison provided us with a detailed map of the stream system on the Nyasoso-side of the mountain.

It is extremely difficult to record adequately the dragonfly fauna of a tropical forest. Many species are easily recorded and a strong sunny spell often brings adults of these species to the stream. However, it is interesting to note how infrequently some species have been seen over the three years of intensive recording at Mount Kupe. For example, two females of *Aeshna scotias* were taken on Shrike Trail by M.C. Vick in 1995 while flying in heavy shade, looking for oviposition sites; the species has not been recorded since then at the time of writing (August 1998), although larvae were found in 1997. *Anax chloromelas* has been found only once in the forest. On the seepage at Max's Trail, a female of *Idomacromia proavita* was caught in March 1997; again this is the only adult that has been seen, although larvae have been found. A single male of the montane forest species *Trithemis pruinata* has been taken in the three years. We suspect that many of these species spend most of their time in the tree canopy and the females only come to water to oviposit. Males may wait for females at a height too great for the human observer to see them. Also, the lack of seasonality undoubtedly makes the numbers of individuals per species at any given time fairly low. How many species have not been seen at all ?

In order to overcome some of these problems we instigated two additional modes of recording;

these are not unusual in temperate regions, but appear to have only rarely been carried out in a tropical country owing to the difficulty of continuous manning. Fortunately, the ability and enthusiasm of Otto Mesumbe made him an ideal person to do this. Larvae have been collected using metal sieves and reared in buckets by Otto and his helpers in the village. The local farm stores have provided us with many suitable sieves , called 'shifters' in Pidgin English. This work has enabled us to make associations between larvae and the adults which have emerged. Both adult and exuviae have been preserved together in 70% ethanol. We are now able to record the presence of certain species from larval collections. Another innovation was the use of an emergence trap on the seepage at Max's Trail. We used a large rectangle of cheap curtain netting (approximately 5m x 5m) which was suspended over the seepage. A supporting framework was constructed using available branches and the netting was held down at ground level using large rocks. This has been so successful that other traps are now planned in the lowlands, where it will be possible to target small streams in dense forest.

In 1995, we decided that this would be a long-term project and we set up the Cameroon Dragonfly Project; this was formalised in 1996 with Professor Philip Corbet as president, Otto Mesumbe as Cameroon coordinator, David Chelmick as treasurer, and myself as secretary. Our aim is to further knowledge about dragonflies in Cameroon in order to assist their conservation. We have decided to concentrate our efforts in the South-West Province initially. Our objectives are to produce a species list for the region; to publish a key to the adults; to identify areas of greatest conservation importance; to describe as many larvae as possible and to write larval keys, at least to restricted areas where we know the fauna well. Perhaps most important of all is to gain the interest of local people. This contribution is the first of these objectives; the second is now in draft form awaiting illustrations; other objectives are in progress.

A Magellan 2000 global positioning system device (GPS) was used in the 1997 survey: latitude and longitude is therefore quoted for many sites visited in 1997 and this is given to the nearest second (accurate to about 1/60 of a nautical mile or about 30m in each direction). The data from the Takamanda Survey conducted by C. Wild of World Wildlife Fund were also obtained using a GPS device and these positions are quoted to the nearest minute (accurate to about 1 nautical mile in each direction).

DESCRIPTION OF SITES SURVEYED 1995-1998

Sites (8)-(9) are on the eastern flanks of Mount Kupe and located in Littoral Province, although on the border with South-West Province; the rest are all in South-West Province. The numbering is somewhat irregular owing to the need to add sites to the paper while it was being prepared.

Mount Kupe and adjacent premontane lowland (1995-1998)

(1) Nyasoso, Mount Kupe
(a) water catchment and Shrike Trail 920m, GPS 04°49'18"N, 09°41'29"E
(b) Max's Trail and seepage 1000m
(c) Nature Trail 980m
Primary forest with montane streams, fast flow, rocky bed, locally sandy with coarse silt, heavy shade. Seepage on Max's Trail with slow flow, pebbly bed with fine silt, heavy shade

(2) Nyasoso village, GPS 04°49'45"N, 09°41'13"E

(5) Nsuke - R. Muawane, R. Kengele 450m, farmbush and secondary forest.

(6) Ndom - Ebul Kack 850m, open farmbush.

(8) Lala - R. Ndibe 400m, lowland stream, nutrient rich, sand and silty bed, in open farmbush GPS 04°46'48"N, 09°45'33"E.

(9) Nlohe - Nyelle Stream 400m, open farmbush.

(10) Tombel - R. Peng 400m, open farmbush.

(12) Ngusi - R. Tubere 300m

Secondary forest with farm bush, stream with moderate flow, sandy bed, locally with sand and mud, moderately nutrient rich, GPS 04°51'16"N, 09°38'57"E

(19) Atop - Taw Stream 250m, farmbush and secondary forest.

(20) Ndom Essosong - Nweh Stream 850m, farmbush and young secondary forest.

(22) Mbabe 300m, rocky and sandy stream, farm bush/secondary forest.

Bakossi Mountains (1995-1998)

(3) Kodmin (= Kumin) village, 1450m, muddy pool in otherwise fast clear rocky stream, open to sun on village edge in farmbush, grassland, forest mosaic, GPS 04° 59'N, 09° 42'E.

(4) Ngombo (= Ngombo-Aku), R. Nkincho, R. Mbombe 800m
Fast, rocky stream with gravel and sandy substrate, some mud locally, GPS 04°55'30"N, 09°42'42"E, farmbush and secondary forest.

(7) Mbomekoged - Ngwese Stream 200m, rocky and sandy stream

(13) Edib village - Bakossi Mountains, 1100m, large fast rocky stream in primary forest.

(14) Bangem - R.Mbwe, R.Mukwene, 1150m, small rivers in primary and secondary forest.

(39) Baseng to Edib road.

(40) Messaka

(41) Molongo

(42) Muambong (1 km west of), 1100m, Jide River, large fast rocky river and its tributaries, primary forest, GPS 04°58'N, 09° 43'E.

Bakossi Lowlands and upper Mungo River (1995-1997)

(11) Ebonji - Sandwater Falls, Blackbush Water, Ekom River 300m
Secondary forest, stream moderate to fast flow, sandy bed, some parts rocky with waterfalls

(15) Etam: Camp Water

(16) Etam - first stream W of Mungo River, GPS 04°43'48"N, 09°33'45"E

(17) Etam - second stream W of Mungo River, GPS 04°42'43"N, 09°32'36"E
Sites (15)-(17) - primary and secondary forest with farmbush in parts; streams with slow flow and sandy beds, with silt and mud locally, all about 300m

Kumba-Mungo River (1998)

(18) Kumba - Barombi Mbo 380m
Crater lake, deep, surrounded by dense primary forest GPS 04°38'57"N, 09°24'43"E

(21) Kumba - Barombi Mbo outlet stream 300m

Mount Cameroon premontane coastal lowlands (1995 - 1997)

(23) Batoke - streams descending from Little Mount Cameroon 50m, GPS 04°01'47"N, 09°05'49"E

(24) Seme Beach - marshes and pools 10m, GPS 04°03'10"N, 09°03'16"E

(25) Bimbia - lowland forest reserve near Limbe 50m

(26) Debundsha - marsh at Njonji 2m
Lowland marsh, almost dry in dry season, no shade, surrounded by farm bush and oil-palm but primary forest in vicinity on slopes of Mount Cameroon.
GPS 04°05'03"N, 08°59'45"E

(27) Debundsha Crater Lake - 50m, surrounded by primary forest, GPS 04°05'48"N, 08°58'43"E

(28) Limbe Botanical Gardens 10m, open habitat, fast stream

(29) Mutengene - Catholic Mission

Korup National Park (29-31 January 1997)

(30) Mundemba - stream near Park HQ and stream at Iriba Inene Camp

Takamanda Forest Reserve (720 km²)- north of Mamfe
(all 11 December 1997 to 22 February 1998)

(31) Assam - 140m. GPS 06° 01'N, 09° 18'E
(32) Takpe - 500m. GPS 06° 02'N, 09° 21'E
(33) Mfakwe - 200m. GPS 06° 04'N, 09° 26'E
(34) Kekpane - stream Manita. GPS 06° 06'N, 09° 24'E
(35) Obony III - stream Meyigepung, 115m. GPS 06° 08'N, 09° 18E
(36) Takamanda - village 568m, GPS 06° 02'N, 09° 17'E
(37) Bache - 200m. GPS 05° 57'N, 09° 18'E (just south of Reserve border)
(38) Matene - 'montane', GPS 06° 17'N, 09° 22'E

PUBLISHED HISTORICAL RECORDS prior to 1980)

Mount Cameroon premontane coastal lowlands

(60) Mount Cameroon = Mongo-Ma Loboh (SELYS, 1879, 1886; KARSCH 1892, 1893; McLACHLAN, 1896; FÖRSTER, 1906, 1909; LONGFIELD 1936; SCHMIDT, 1951)
(61) Lake Debundsha (GREEN et al., 1974)
(62) Kitta (now Kita ?) (SJÖSTEDT, 1899)
(63) Bonge (now Mbonge) (SJÖSTEDT, 1899)
(64) Ekundu (SJÖSTEDT, 1899)
(65) N'dian (now in Korup NP, on N'dian River) (SJÖSTEDT, 1899)
(67) Wewoka (cannot place) (SJÖSTEDT, 1899)
(68) Itoki (possibly = Itoki at 5° 01'N, 9°15'E) (SJÖSTEDT, 1899)
(69) Mueli 550m (PINHEY, 1971)
(70) Diebo-Efoye 130m (PINHEY, 1971)
(71) Malende 125m (PINHEY, 1971)

Kumba and district

(72) Kumba = Johann-Albrechthöhe: Barombi Mbo = Elephantsee 400m (KARSCH, 1899; CORBET, 1977; GAMBLES, 1979; D'ANDREA & CARFI, 1997)
(73) Kumba: Barombi Station (KARSCH, 1891b; LONGFIELD, 1951)
(74) Mukonje Farm (between Kumba and Nguti) (RIS, 1909-1919)
(75) Lake Kotto = Richardsee 110m (SW of Kumba) (SJÖSTEDT, 1899; PINHEY, 1971)
(76) Lake Kotto (Tung Nsuia, Tung Nsuria inlet streams) 110m (CORBET et al, 1973; CORBET, 1977)
(77) Mboandong 130m(CORBET et al., 1973)

Bakossi Mountains including Mount Kupe and adjacent premontane lowland

(77a) Bakossi Mountains - Essossong 1060 or 1600m, Carl Rathke leg. Specimen in Hamburg Museum (SCHMIDT, 1943)
(86) Nyasoso (Lager 1) 900m (PINHEY, 1974)
(87) Manenguba Lake 1900m, open grassland and scrub (PINHEY, 1974)
(88) Dikume-Balue (Rumpi Hills) 1100m, secondary forest (PINHEY, 1974) (86-88 are Eisentraut Expedition records)

Mamfe and district

(78) Nta Ali = Gorilla Mountain, summit = 1266m, primary forest (PINHEY 1961a,b;1962a)
(79) Mamfe (PINHEY 1961a,1961b;1962a)
(80) Mamfe (30 mi E of) (PINHEY 1961a,1961b;1962a)
(81) Mamfe (30 mi W of) (GAMBLES, 1975)

(82) Mamfe (40-50 mi E of) (PINHEY 1961a,1961b;1962a)
(83) Widdicombe (Mamfe Road) - on border of SWP and NWP - possibly in latter (PINHEY 1961a,1961b;1962a)
(84) Ajassor (PINHEY 1961a,1961b;1962a)
(85) Dechag, 5 mi from Mamfe (GAMBLES, 1967)

PAPERS PUBLISHED SINCE 1980

VICK (1996): all records included under heading of Sites Surveyed 1995-1998 (CDP records) in this paper.

D'ANDREA & CARFI (1997): from vicinity of Mount Cameroon, records of collections made in 1979:

(89) Ikata 400m
(90) Malende 300m
(91) Munyenge 400m
(92) Barombi Mbo 400m

UNPUBLISHED RECORDS

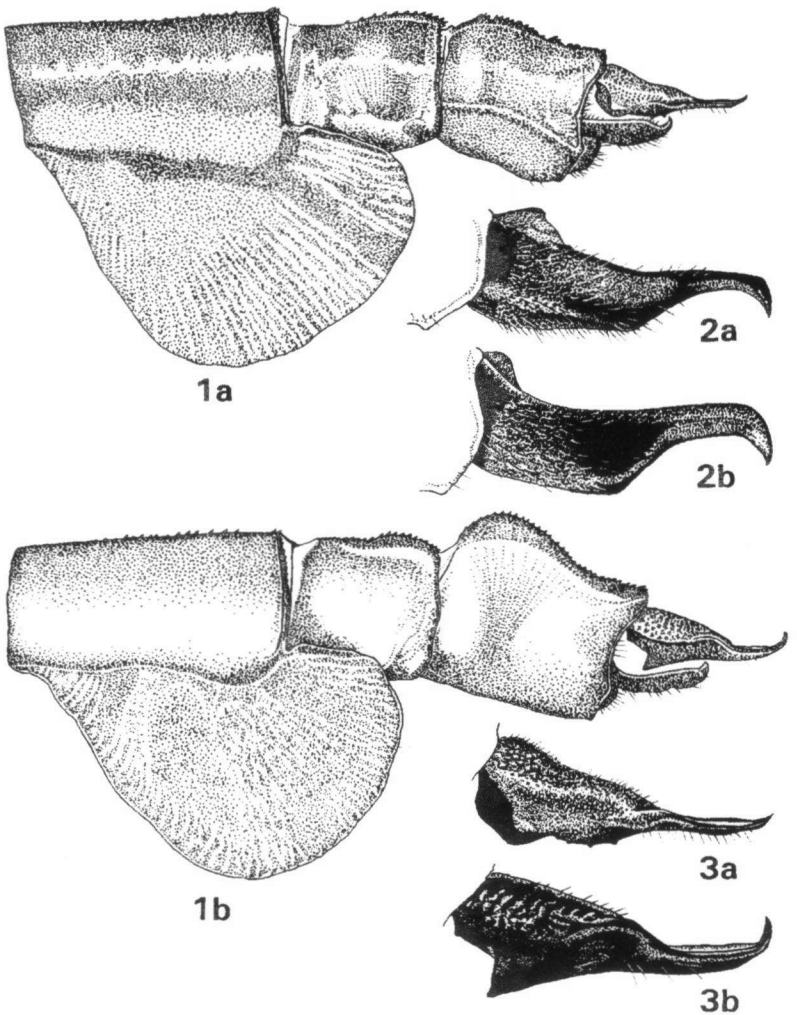
The following sites are represented by material in the collections of the NHM (London)

(93) 'Camaroons' (McLachlan Collection)
(94) 'Camaroons River' (McLachlan Collection)
(95) Isubu, Cameroons (paratype of *Phyllogomphus montanus*, collector unknown)
(96) Mongo-Ma-Lobah (McLachlan Collection)
(97) Port Victoria (=Limbe)
(98) Old Tal, 'Camaron'(McLachlan Collection) (*Acanthagyna africana* - no data)
(99) Kumba -without further details
14 October 1949, H. Oldroyd leg., *Tetrathemis camerunensis, Sapho orichalcea*
23 October 1962, R.M.Gambles leg., *Cyanothemis simpsoni*
20-24 March 1970, S.A.Corbet leg., *Chlorocypha gracilis*
10 April 1970, no collector, *Acanthagyna sextans*
22 December 1973, G. Popov leg., *Palpopleura lucia*
(100) Barombi Kotto
Tholymis tillarga 28 October 1963, C.A.Wright leg.
Acanthagyna sextans 11 April 1970, S.A.Corbet leg.
(101) Korup National Park - R. Mana and The Rock
2-3 February 1989, G. Spiers leg.
(102) Kunde Bassum - 3 May 1914
(103) Bipindi (F.C.Fraser bequest) (*Chlorocypha neptunus* - no data)
(104) Mamfe and district (within 40 miles of Mamfe), 24 December1957 - 5 April 1958; 6-19 October 1962, R.M.Gambles leg. & det.
(105) Nta-Ali = Gorilla Mountain, Bakabe, 18 October 1962, R.M.Gambles leg. & det.
(106) Widdicombe (Mamfe road) - borders of South-West and North-West Provinces, 31 December 1957 - 4 January 1958; 9 -12 October 1962, R.M.Gambles leg. & det.
(107) Manyemen (south of Nguti on Kumba road) - no date (1958 or 1962)
(*Chlorocnemis contraria*) R.M.Gambles leg. & det.

PHYLLOGOMPHUS CORBETAE SP. NOV.

Figures 1a - 10a

M a t e r i a l (all from South West Province of Cameroon). – **Holotype:** ♂, Kumba, Etam, 4-IV--1997. O. Mesumbe leg. – **Paratypes:** 1 ♀, Kumba, Lake Kotto, Starker's Crossing, 11-IV-1970, S.A.Corbet leg. (now damaged by *Anthrenus*); – 1 ♂, Kumba, Barombi Mbo (outlet stream) 20-IX--1997, O. Mesumbe leg.; – **Allotype** ♀: Limbe, Bimbia, Elephant River, 4 July 1996, G.S.Vick leg.; – **Paratype** ♀: Kumba, Barombi Mbo (outlet stream) 20 September 1997, Otto Mesumbe leg.



Figs 1-3. *Phyllogomphoides corbetae* sp.n., holotype ♂ (a) and *P. montanus*, ♂ with large abdominal foliations, from Bakossi lowlands, near Kumba, SW Cameroon (b): (1) abdominal segments 8-10, lateral view; – (2) detail of superior appendage, dorsal view; – (3) the same, lateral view.

Etymology. – Named after Dr Sarah Corbet who took the first male specimen in 1970 (described as *P. montanus*)

MALE (**Holotype**), adult. – Colour preservation fairly good, acetone used but drying difficult in high humidity. Difficult to distinguish between yellow and green markings.

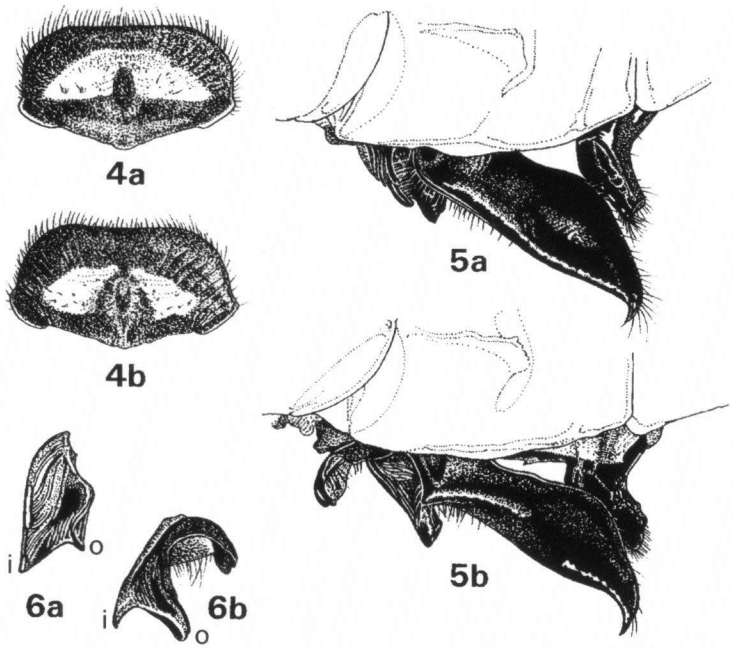
Head. – Width across eyes 11.0mm. Labium (median and lateral lobes) brown, extensively marked with black on apical and lateral margins. Mandibles brown, bases greenish yellow, shading to brown basally. Labrum (Fig. 4a) black with single median yellow marking occupying about 50% of area. Anteclypeus green. Postclypeus brown with one central and two lateral green spots. Frons brown with greenish yellow stripe on ridge, extending over anterior and dorsal surfaces to occupy about 50% of each. Vertex and epicranium black. Antennal bases black and antennae brown tipped with yellow. Occiput black bearing dense black hair fringe. Rear of head black.

Thorax. – Prothorax black. Synthorax black marked with well-defined greenish yellow markings on each side as follows. Dorsum (mesepisternum) with antehumeral stripes confluent with separated stripes on mesothoracic collar, forming pair of inverted 7s. Spot on lower part of carina. Distinct dorsal mesepisternal spot. Side of thorax with two broad (about 1.6mm wide) subparallel bands, one of fairly constant width on mesepimerum, the other widening centrally on metepimerum. Dorsal spot (about 0.6mm circular) on metepisternum adjacent to the second lateral suture. Spot on metasternum. Ventral surfaces of thorax brown. Antealar triangles black and axillaries of wings yellow.

Legs. – Coxae brown. Trochanters brown. Femora, tibiae and tarsi entirely black.

Wings. – Forewings clear. Hindwings with tawny suffusion, strongest between base and nodus. Veins black. Nodal index 14.19.19.14 / 16.14.13.16. First and fifth Ax strengthened in all wings. Prefurcal crossveins between sectors of arculus 2.2 / 1.1 . Discoidal field commencing 3-celled in forewing, 3 or 4-celled in hindwing. Mspl distinct in all wings, arising 2-3 cells proximal to level of nodus. Anal triangle 3-celled. Anal loop 4 or 5-celled and 5 cells between loop and posterior margin. Pt black surmounting 4-5 cells. Membranula full length, very narrow, white.

Abdomen. – Tergites 1-2 reddish brown, 3-7 black and 8-10 reddish brown, marked as follows. Tergite 2 with ventral yellow band extending the full length of the segment, a green spot above the auricle and a minute dorsal streak at base of tergite. Tergite 3 with ventral band, forming a continuation of that on tergite 2, extending to middle of segment; dorsum with paired yellow longitudinal streaks extending over basal quarter of the segment. Tergites 4-6 with paired yellow longitudinal streaks on dorsum, extending over the basal fifth of the segment. Tergite 7 with large basal yellow spot on dorsum extending over basal quarter of segment,



Figs 4-6. *Phyllogomphoides corbetae* sp.n., holotype ♂ (a) and *P. montanus*, ♂ from Bakossi lowlands, near Kumba, SW Cameroon (b): (4) labrum; – (5) accessory genitalia, lateral view; – (6) apex of anterior hamule (i = inner branch, o = outer branch).

the spot consisting of a larger basal spot joined by a narrow neck to a smaller apical spot; ventrally with narrow longitudinal yellow stripes adjacent to sternite. Tergites 8-10 without markings.

Lateral foliations on segment 8 massive, reaching to end of tergite 9, coloured deep black. Length of tergites 8,9,10 as measured on dorsum in ratio 1.6:1.0:1.0. Weak lateral ridge on tergite 8. Dorsal ridges absent on 8; very small, and in apical half of, 9; very small, and mostly in basal half, of 10 (cf. extensive ridges of *montanus*).

Appendages. – Superiors brown basally and darker apically. In lateral view (Fig.3a) with basal swelling forming a ventral ridge which bears a weak basal tooth. In dorsal view, apical half very narrow and strongly recurved (Fig.2a). Inferior visible in dorsal view, widely divaricate, about half length of superiors.

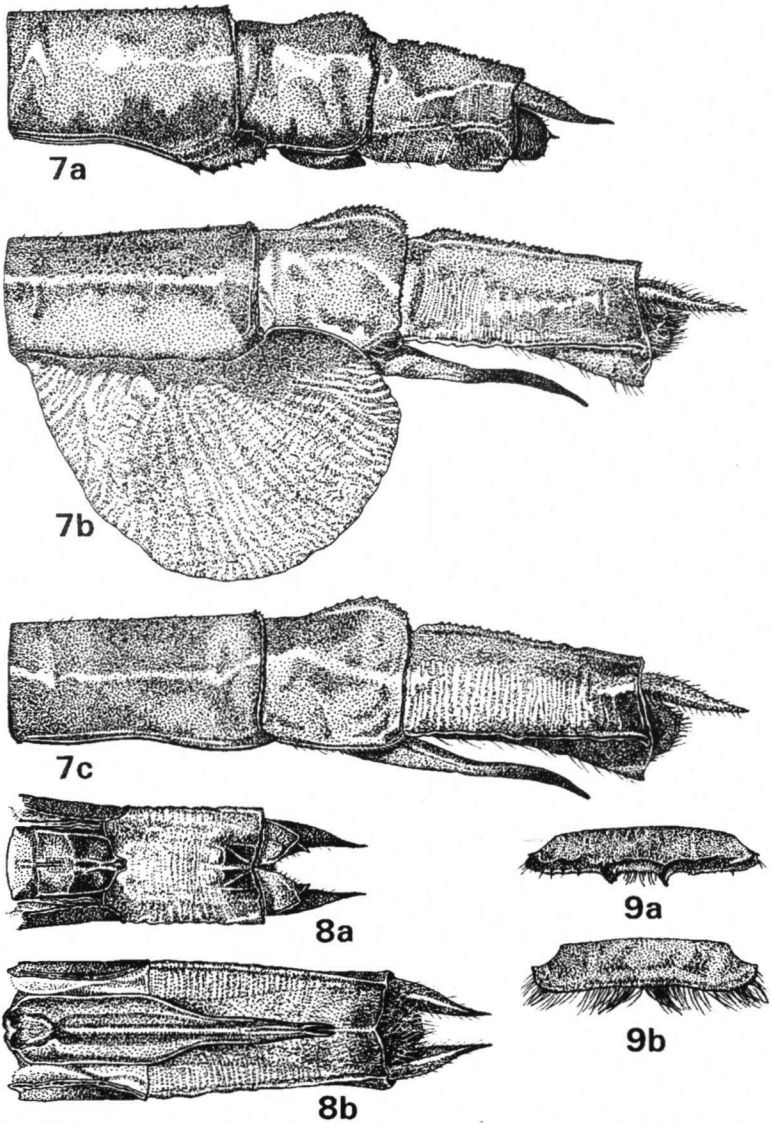
Accessory genitalia (see Fig.5a). – Note anterior hamule (Fig.6a) with wide inner branch which is much thicker and longer that the outer branch (cf. *montanus* which has outer branch larger.)

Measurements (in mm). – Abdomen with appendages 64mm, hindwing 46mm.

FEMALE (**Allotype**), adult. – Colour preservation very good, acetone used, dried in hot air stream. – Extremely similar in all markings to holotype, except that all

pale head markings are clearly seen to be green, and all thoracic and abdominal markings are yellow; these are likely to be the true living colours of the male also.

H e a d. – Width (across eyes) 11.5mm. Occipital ridge at rear of head very



Figs 7-9. *Phyllogomphoides corbetae* sp.n., allotype ♀ (a) and *P. montanus*, ♀ with large abdominal foliations, from Bakossi lowlands, near Kumba, SW Cameroon (b) and *P. montanus*, ♀ with vestigal foliations, locality as above (c): (7) abdominal segments 8-10, lateral view; – (8) abdominal segments 9-10, ventral view; – (9) occipital ridge, caudal view.

characteristic (Fig.9a), bearing two spines and sparse black hairs, especially between the spines. This is very distinct from *montanus* which lacks the spines and has a uniform mantle of long black spines (Fig.9b).

Wings. – All with extensive tawny suffusion. Veins black. Nodal index 15.19.18.16 / 16.13.14.17. Strengthened Ax 1st and 5th (4th in one wing). Prefurcal cross veins between sectors of arculus 2.2 / 1.1. Discoidal field starting with 3 rows in all wings. Mspl beginning 3-4 cells proximal to the level of the nodus. Anal loop 4-celled, 5-6 cells between loop and posterior margin. Pt black, surmounting 4-5 cells. Membranule very narrow, white, 4 cells long.

A b d o m e n. – Lengths of tergites 8,9,10 in ratio 1.5:1.0:1.2. Only vestigial foliation on tergite 8, overlapping slightly onto 9 (true of paratype also, but presumably females exist with full-size foliations). Dorsal ridges absent on tergite 8, present in apical half of 9 and scarcely detectable on 10 (Fig.7a).

Appendages. – Pointed, conical, pale with black apices, about half the length of segment 10. Vulvar scale short, scarcely overlapping onto tergite 10 (Fig.8a).

M e a s u r e m e n t s (in mm). – Abdomen with appendages 60.5, hindwing 50.

DISCUSSION. – This is a very difficult genus to study as the species are so elusive, living in the tree tops and rarely visiting water. Material in collections is scarce and often in bad condition. Also several of the taxa are poorly known and in some cases described from females. I have been fortunate to have reasonably good material which has been collected in forest streams of the Province since 1995 and I possess five males and eight females. All are large insects with hindwing lengths of at least 44mm, and they all have three lateral thoracic stripes on each side. They clearly belong to two different species. It has been possible to associate males and females because of the close similarity of colour patterns of thorax (especially the antehumeral stripes), head (especially labrum), and the relative lengths of abdominal segments 9 and 10. Finally one male and one female which resemble each other in the characters stated above have been collected at the same time at the same stretch of stream - the outlet from Barombi Mbo. Deciding on the correct names to be used for these two species, however, has presented me with an interesting puzzle which I believe I have now resolved. One species has females with a hypertrophied vulvar scale, reaching the full length of segment 9 and three-quarters the length of segment 10 (Figs 7b, 8b). These agree exactly with both Fraser's description of the holotype female of *P. montanus*

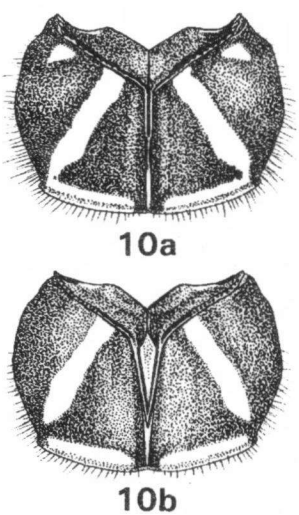


Fig. 10. *Phyllogomphoides corbetae* sp.n., allotype ♀ (a) and *P. montanus*, ♀ with large abdominal foliations, from Bakossi lowlands, near Kumba, SW Cameroon (b): mesepisternum, dorsal view.

Table IV
Comparison of *Phyllogomphus corbetae spec. nov.* with *P. montanus*

Character (male/female)	*corbetae*	*montanus*
antehumeral stripe (m/f)	confluent with prothoracic collar, forming pair of 7s	separated from prothoracic collar
separated upper humeral spot	yes	no
labrum (m/f)	black with one extensive yellow spot occupying 50% of area	black with two separated yellow spots occupying 30% of area
genital hamule (m)	inner branch>>outer branch	outer branch>>inner branch
superior appendage (m)		
lateral aspect	basal swelling with weak tooth on ventral surface	strong basal tooth on ventral surface
dorsal aspect	narrower in apical half, weakly recurved at apex	broader in apical half, strongly recurved at apex
segment 10		
(m)	weakly formed dorsal ridge scarcely rising any higher than that on segment 9	strongly formed dorsal ridge rising at least twice as high as the ridge on segment 9
(f)	dorsal ridge vestigial for whole length of segment	dorsal ridge present but weak, extending three quarters of length of segment
ratio length of seg 10 to seg 9		
(m)	1.0	1.3
(f)	1.2	1.7
vulvar scale (f)	full length of segment 9 just overlapping onto base of segment 10	full length of segment 9 and three quarters of segment 10
occipital ridge (f)	2 central spines, sparse hairs	no spines, even distribution of long black hairs
Illustrations in literature		
(m)	CORBET (1977) as *P. montanus*	BUCHHOLZ (1958) as *P. hartwigi spec.nov.*
(f)	not previously figured	FRASER (1957) - holotype
larva	CORBET (1977) as *P. montanus*	FRASER (1957) - poor figure

and the lectotype specimen in the NHM collection and I have no doubt in determining them as such. Males which are clearly conspecific, however, do not match the description of *P. montanus* given by CORBET (1977). In fact they agree exactly with the description of male *P. hartwigi* given by BUCCHOLZ (1958), based upon material from Koto Barombi See. In particular, the superior appendages, with strong basal spine (Fig. 3b), the extended abdominal segment 10 (Fig. 1b), the pronounced dorsal ridges of segments 9 and 10 (Fig. 1b), and the accessory genitalia (Fig. 5b) all match perfectly. I am sure that this is indeed the male of *montanus* as quoted in PINHEY (1962b) and I agree with his synonymy.

The other species is very different as the female lacks the hypertrophied vulvar scale of *montanus*: it only just reaches the base of segment 10 (Figs 7a, 8a). Male material which I believe also belongs to this species is identical to Corbet's description of material from Lake Kotto which she incorrectly attributed to *montanus*. The superior appendages lack the strong basal tooth, only possessing a swelling with a weak tooth at this site (Fig. 3a); the dorsum of segments 9 and 10 is only weakly ridged (Fig. 1a) and the accessory genitalia (Fig. 5a) match her figures. This is a very distinctive species which differs from all others of the genus and which I call *P. corbetae* in appreciation of the contribution of Sarah Corbet to the odonatology of Cameroon. I list in Table IV the main characters which separate these two taxa.

The new species is clearly distinct from all other described taxa with respect to the morphology of the superior appendages, abdominal segments 9 and 10 or the accessory genitalia.

An interesting observation is that female specimens received of *montanus* are dimorphic : some have the enormous lateral foliations (Fig. 7b) on segment 8 which reach the end of segment 9 and closely resemble those in the male; another only has vestigial foliations (Fig. 7c). Of my six females, five have the large foliations and one has not. Of *corbetae*, I only have two females and both have vestigial foliations. This dimorphism has also been noted in other taxa of the genus: in the NHM there are two females of *P. dundomajoricus* Fraser 1957 (1 ♀, Belgian Congo, Ituri Forest, 4000 ft, 21-IV-1930, Howard de Walden Expedition; 1 ♀ N.Angola, Lunda Province Dundo February 1948) which both lack foliations. Also *P. brunneus* Pinhey, 1976 is known to have females without foliations.

CHECKLIST OF DRAGONFLIES FROM SOUTH-WEST CAMEROON

The checklist is summarised in Table V. Column 1 shows all taxa which have been recorded from the area of the South West Province. Column 2 shows historical records for each species. I have attempted to trace the first record of each taxon from the area and provide useful historical site data. I do not claim that these data are complete, although I have tried to be as inclusive as possible. Citations to 'Kamerun' which are not localised to this region cannot be included. Column 3 shows separately the records of D'ANDREA & CARFI (1997) because their data all refer to specimens collected in 1979. Column 4 shows all 'recent records', i.e. the records made by the Cameroon Dragonfly Project which started in March 1995. These include the data in VICK (1996), which although appearing before D'ANDREA & CARFI (1997) , refers to more recently collected material. Finally the last three columns show very basic ecological information (where known) for most of those species recorded between 1995 and the present. I have attempted to divide the requirements of each species into broad categories: montane or lowland; primary forest, secondary forest and 'bush' and open country; the type of water

Table V

Summary of records by species, with summary of altitude, forest cover and habitat. – Key: M = montane (> 700m), – L = lowland (< 700m), – F = mature forest, dense shade, – S = secondary forest/farm bush, – O = open country, – 1 = rocky stream, gravel bed, – 2 = silty or sandy stream, – 3 = seepage - no open water , – 4 = pond, – 5 = marsh with open water, – 6 = crater lake

Family/species	Historical records (prior to 1980)	D'ANDREA & CARFI, 1997	Records by CDP (1995-1998)	Altitude	Forest	Habitat
PROTONEURIDAE						
Chlorocnemis contraria Schmidt, 1951	77,78,96,104,106,107		1,5,6,11,17,25,31	M	F	1
C. eisentrauti Pinhey, 1974	88					
C. flavipennis Selys, 1863	78,105					
C. nigripes Selys, 1886	60,65,73,78,85,104	91	1,3,5,8,11,12,25,30,35	M/L	F/S	1
Elattoneura balli Kimmins, 1938	93,104	91	8,11,12,17,23	L	F/S	2
E. nigra Kimmins, 1938			8	L	S	2
E. pruinosa (Selys, 1886)	65,68,69,70,71,72,73,79,82 93,96,104		1,5,6,8,10,11,14,16,17,19,23,25,26, 31, 35	M/L	F/S	1,2
Isomecocnemis cyanura (Förster, 1909)	85,104					
I. subnodalis (Selys, 1886)	83,106					
Prodasineura vittata (Selys, 1886)	62,63,79,93,94,96,104		35			
COENAGRIONIDAE						
Agriocnemis maclachlani Selys, 1877			23,24,25,26,28	L	F/S	2,4,5
Ceriagrion glabrum (Burmeister, 1839)		89	6,13,21,25,26	L	S/O	2
C. rubellocerinum Fraser, 1947			11	L	S	2
Enallagma buchholzi Pinhey, 1971	61,87		27	L	F	6
E. camerunense Karsch, 1899	72					
E. vansomereni Pinhey, 1955	87					
Ischnura senegalensis (Rambur, 1842)			23,24,26	L	O	4,5
Pseudagrion angelicum Fraser, 1947		89,92	23,24,26,28	L	S	4
P. epiphonematicum Karsch, 1891	72,73,78,79,82,83,88,96,104		4,5,6,8,9,10,11,12,19	L	F/S	2
P. flavipes Sjöstedt, 1900	62,63,65,68,72		16,17,35	L	F	2
P. kersteni (Gerstacker, 1869)		91	8,12,17	L	S/O	2

Table V, continued

P. melanicterum Selys, 1876	72,73,79,82,87,88,102		4,8,9,10,11,12,15,17,23,24,33,35	L	S/O	2,4
P. nubicum Selys, 1876	63					
P. risi Schmidt, 1936	104		11,14	L	S	2
P. serrulatum Karsch, 1893	60,82,96		31	L	F	2
P. s. sjoestedti Förster, 1906	60,79,80,81,82,104		11,16	L	S	2
P. sublacteum doualae Pinhey, 1961			36			
PLATYCNEMIDIDAE						
Mesocnemis singularis Karsch, 1891	67,73	89,92	7,8,16,17,18,21,30	L	S/O	2,6
Platycnemis congolensis Martin, 1908			19,32	L	F	2
Stenocnemis pachystigma (Selys, 1886)	71,72,78,79		1,5,6,10,11,23	M	F	1,3
PERILESTIDAE						
Nubiolestes diotima (Schmidt, 1943)	93,106		1,3,6	M	F	1
MEGAPODAGRIONIDAE						
Neurolestes trinervis Selys, 1885	78,86		1,11,31,32,34	M	F	1
AMPHIPTERYGIDAE						
Pentaphlebia stahli Förster, 1909	60,78,79,86,88,106		1,3,5,6,11,19,20,34,42	M/L	F	1
CHLOROCYPHIDAE						
Africocypha lacuselephantum (Karsch, 1899)	72,78,79,83,106		1,4,5,19,20	M/L	F	1,2
Chlorocypha cancellata (Selys, 1879)	60,76,79,82,83,96,104,105	91	4,8,10,11,12,19,23,24,25,30,34,38,42	L	F/S/O	2,4,5
C. centripunctata Gambles, 1975			1,3	M	F	1
C. curta (Hagen, 1853)	62,72		8,11,14,16,18,30,36	L	F/S	2
C. cyanifrons (Selys, 1873)	62,68,72,102					
C. dispar (P. de Beauvois, 1805)	73					
C. glauca (Selys, 1879)	60,72,79,96,104		11,16,17,18,23,34,35,36	L	F/S	2,6
C. gracilis (Karsch, 1899)	67,72,79,83,99,104,106		4,6,42	M	F/S	1
C. hintzi (Grunberg, 1914)	82					
C. neptunus (Sjöstedt, 1900)	63,103	89,92				
C. rubida (Hagen, 1853)	73,93	89				
Chlorocypha sp.2 (nr *rubida*)			30	L	F	2
C. selysi Karsch, 1899	60,63,72,78,79,93,96,106	91	3,4,8,10,11,12,17,19,42	L	F/S	2

Table V, continued

C. victoriae Förster, 1914		92				
Platycypha lacustris (Förster, 1914)			4	M	S	2
P. rufitibia (Pinhey, 1961)	80,83,104,106		15,17,34,36	L	F	2
CALOPTERYGIDAE						
Phaon camerunensis Sjöstedt, 1900	63,79		7,8,11,15,17,22,32,34,38	L	F	2
P. iridipennis (Burmeister, 1839)	70,73,75	90,92	8,9,11,12,21,23,25,28,30,31,32,34, 35,38,42	L	S/O	2
Sapho bicolor Selys, 1853						
S. orichalcea McLachlan, 1869	60,62,63,65,67,72,73,76,78 82,83,86,88,93,97,99,101,106		1,8,11,12,13,16,22,38,42	M/L	F	1
S. orichalcea (small)			15,17	L	F	2
Umma longistigma (Selys, 1869)	62,63,65,68,72,73,93,95,102		8,11,15,17,19,22,41	L	F	2
U. longistigma (narrow inf.)	83(?),104(?)		30,31,32,34,35,36,38	L	F	2
U. mesostigma (Selys, 1879)	60,72,78,88,93,95,96,104,105,106		1,3,5,6,10,11,12,13,15,19,20,22,34,41,42	M/L	F/S	1,2
U. mesumbei Vick, 1996			1,3,42	M	F	1,3
U. puella Sjöstedt, 1917	91		33,35,38			
U. purpurea Pinhey, 1961	79,83,104		32,34,35,36			
U. saphirina Förster, 1916	88,102					
GOMPHIDAE						
Crenigomphus sp.	79					
Diastatomma multilineata Fraser, 1949			19	L	F	2
D. tricolor (P. de Beauvois, 1805)	63,72,104		15,17,35	L	S	2
Gomphidia gamblesi Gauthier, 1987	75,76		8,11,15,16,17,38	L	F/S	2
Ictinogomphus fraseri Kimmins, 1958	72,76,77		18	L	F	6
Lestinogomphus angustus Martin, 1911			36			
Microgomphus camerunensis Longfield, 1951	72,73		11	L	S	2
Neurogomphus fuscifrons Karsch, 1890	72,73					
Notogomphus spinosus (Karsch, 1890)	73					
Notogomphus sp.1			8	L	S	2
Notogomphus sp.2			1	M	F	1

Table V, continued

Notogomphus sp.3			42			
Onychogomphus sp.1			1	M	F	1
Onychogomphus sp.2			1	M	F	
Paragomphus abnormis Karsch, 1890	72,73,83,104		1,4,7,12,13,22	M/L	F/S	1,2
P. genei Selys, 1841			37			
P. nigroviridis Cammaerts, 1969			11,15,17	L	F/S	2
Paragomphus sp.1			1	M	F	1
Paragomphus sp.2			15	L	S	2
Paragomphus sp.3			4			
Phyllogomphus montanus Fraser, 1957	95		8,11,12,19,34,40	L	F/S	2
P. corbetae sp.n.	72,76		16,21,25	L	F	2
Tragogomphus aurivillii Sjöstedt, 1900	63					
T. mamfei Pinhey, 1961	78,83					
AESHNIDAE						
Aeshna scotias Pinhey, 1952			1	M	F	1
Anax chloromelas Ris, 1911			1,26,40	M/L	F	1,5
A. congoliath Fraser, 1953			9,12,32	L	S	2
A. imperator Leach, 1815			18,23,24,26,27	L	S/O	2,4,5,6
A. tristis Hagen, 1867			1,2,10,11,19,26,32	M/L	S	2,5
Acanthagyna africana (P. de Beauvois, 1805)	98					
A. bullata (Karsch, 1891)	62,63,96		6,17	L	F/S	2
A. cylindrata (Karsch, 1891)	79,93					
A. nigeriensis Gambles, 1956			23	L	F/S	2
A. sextans (McLachlan, 1896)	60,96,99,100					
Heliaeschna cynthiae Fraser, 1939	88	90				
H. fuliginosa Karsch, 1893	60,63,68,93		17	L	F	4
H. lanceolata LeRoi, 1915			38			
H. longfieldae Gambles, 1967	60					
H. trinervulata Fraser, 1955			1	M	F	1
Hemianax ephippiger (Burmeister, 1839)			26	L	S/O	5

Table V, continued

CORDULIIDAE						
Idomacromia proavita Karsch, 1896	65,72,79		1,15,17,19	M/L	F	2,3
Phyllomacromia aeneothorax (Nunney, 1895)	79,86,88		1	M	F	1
P. bicrustulata (Legrand, 1975)			9,15,32,35	L	F	2
P. caneri (Gauthier, 1987)	72,73		1,9,10,11,12,15,17,19,34,35	M/L	F/S	1,2
P. funicularia (Martin, 1907)	83,104		8,9,11,12,15,17,19,35	L	F/S	2
P. insignis (Kirby, 1889)	93					
P. melania (Selys, 1871)	62,73		18	L	F	6
P. paula (Karsch, 1892)	60					
LIBELLULIDAE						
Acisoma panorpoides Rambur, 1842		89	12,24,25,26	L	S/O	2,5
Acisoma trifidum Kirby, 1889	79	89,90				
Allorhizucha klingi Karsch, 1890	69,70,72,73,75,78,79,96		4,5,8,10,11,15,16,19,22,23,24,25, 33,35,37	L	S	2
A. preussi Karsch, 1891	62,63,68,94					
Allorhizucha sp. nr *campioni* Ris, 1915			11	L	S	2
Atoconeura b. pseudeudoxia Karsch, 1899	78,79		7,8,19	L	F/S	2
Bradinopyga strachani (Kirby, 1900)	94		42			
Chalcostephia flavifrons Kirby, 1889		89,90	8,26,31,34	L	F/S	2,5
Crocothemis divisa Karsch, 1898	79					
C. erythraea (Brullé, 1832)	87		8	L	O	2
C. sanguinolenta (Burmeister, 1839)	79		17	L	S/O	2
Cyanothemis simpsoni Ris, 1915	99,104		15,16,17	L	F	2
Diplacodes lefebvrii (Rambur, 1842)			24,26,28	L	S/O	2,4,5
Eleuthemis buettikoferi Ris, 1910			8,16,21,32	L	F/S	2
Hadrothemis camarense (Kirby, 1889)	60,65,72,73,94,96		15,37	L	F	2(?)
H. coacta (Karsch, 1891)	63,65,72,73,74		7,13,17,19,25	L	F/S	4(?)
H. defecta (Karsch, 1891)			16	L	S	2(?)
H. infesta (Karsch, 1891)	73,94					
H. versuta (Karsch, 1891)	62,65,74					

Table V, continued

Hemistigma albipuncta (Rambur, 1842)			26,31,34,35,36	L	S	5
Lokia incongruens (Karsch, 1893)	62,94					
Malgassophlebia nigeriae Pinhey, 1961			11,19,34	L	F	2
Micromacromia camerunica Karsch, 1890	62,63,64,72,73,88		8,11,12,15,16,17,22,23,24,42	L	F/S	2
Neodythemis africana Fraser, 1954	88		39			
N. gorillae Pinhey, 1961	78,79			M	F	1
Notiothemis robertsi Fraser, 1944			19	L	F	2
Olpogastra lugubris (Karsch, 1895)	79,86,94		8,16,28	L	S/O	2
Orthetrum africanum (Selys, 1887)	93		8,25,30	L	S	2
O. angustriventre (Rambur, 1842)	78					
O. austeni (Kirby, 1900)	77		17,19,26	L	F/S	2,5
O. brachiale (P.de Beauvois, 1805)	62,63,68,86		1,12	L	S	2
O. camerunense Gambles, 1959	87		3,14,37,42	M	S	4(?)
O. chrysostigma (Burmeister, 1839)	68,73	91	31,35			
O. guineense Ris, 1910	86	89	5,8,10,11,12,16,17,30	L	S	2
O. julia Kirby, 1900	88	91,92	1,3,8,10,11,12,17,19,23,32,34,35, 36,37,42	M/L	F/S	1,2,5
O. kalai Longfield, 1936	79,83	90,91,92	8,11,12,15,17,23,26,30	L	F/S	2,5
O. machadoi Longfield, 1955	79		1,11,12	M/L	F/S	1,2
O. microstigma Ris, 1911		90,91	12,17,25,37	L	F/S	2
Oxythemis phoenicosceles Ris, 1910	77	89	17,18,30	L	F/S	2,4,6
Palpopleura deceptor (Calvert, 1899)	79		11	L	S	2
P. lucia (Drury, 1773)	62,63,65,68,73,87,88,99	90,91	3,8,10,11,12,21,23,25,26,30,33,34,35	L	S/O	2,5
Pantala flavescens (Fabricius, 1798)	68,73		6,8,11,12,17,23,24,26,28	L	O	2,5
Porpax asperipes Karsch, 1896	78,79					
P. bipunctus Pinhey, 1966			11	L	S	2
Rhyothemis notata (Fabricius, 1781)	65,66,73					
R. semihyalina (Desjardins, 1832)			26	L	S	5
Sympetrum fonscolombii (Selys, 1840)			6,8	L	O	2
Tetrathemis bifida Fraser, 1941		89,90,91	17,19,24	L	F	2,4

Table V, continued

T. camerunensis Sjöstedt, 1900	62,99					
Tetrathemis sp. nr. *godiardi* Lacroix, 1921			17	L	F	4
Thermochoria equivocata Kirby, 1889	63,68,71,94,96					
Tholymis tillarga (Fabricius, 1798)	63,64,68,100		23,26	L	S/O	2,5
Trapezostigma basilaris (P.de Beauvois, 1805)	86		12,23,26	L	S/O	2,5
Trithemis aconita Lieftinck, 1969			10,11,12,15,23,30,31	L	S	2
T. annulata (P.de Beauvois, 1805)	64,68		24	L	S	4
T. arteriosa (Burmeister, 1839)	72,73,77,79,87	89,90,91	4,11,12,17,18,24,34,35,36	L	O	2,4
T. basitincta Ris, 1912	79					
T. dichroa Karsch, 1893	63,83	91	8,9,12,15,17,21,35	L	S	2
T. furva Karsch, 1899	87					
T. grouti Pinhey, 1961	79	90				
T. hartwigi Pinhey, 1970			26	L	S	2
T. nuptialis Karsch, 1894			8,12,15,31	L	S	2
T. pruinata Karsch, 1899			1,31,32,36	M	F	1
Urothemis assignata (Selys, 1872)		90	23,24,26,28	L	S/O	2,4,5
U. edwardsi (Selys, 1849)			26	L	S/O	5
Zygonyx fallax (Schouteden, 1934)		90				
Z. flavicosta (Sjöstedt, 1900)	78,82,83		4,7,8,10,11,12,17,21,35,42	L	S	1,2
Z. regisalberti (Schouteden, 1934)	88					
Z. speciosa Karsch, 1891	73,83,94		4,7,8,11,12,16,17,19,21,22,38,42	L	S	1,2
Z. torrida (Kirby, 1889)		91	21	L	S	1,2
Zyxomma atlanticum Selys, 1889			16,24,30	L	S	2,5

body. These appear to me to typify the species' requirements using information based mostly on adult collecting. I hope they will be useful for further studies.

The list given comprises 179 species, including a few unnameable specimens which nevertheless belong to additional taxa and should be counted into any total. I have included the two different forms of both *Umma longistigma* and *Sapho orichalcea* as additional species.

NOTES ON CERTAIN SPECIES

CERIAGRION RUBELLOCERINUM. – The material has been compared with NHM material from Nigeria determined by R.M.Gambles (e.g. a ♂ from Vom 2-XI-1959 R.M. Gambles leg.) and another ♂ from Ikoyi 8-IX-1955 standing under this taxon.

PSEUDAGRION F. FLAVIPES. – This distinctly marked taxon was found on two lowland forest streams near Etam in April 1997. The material agrees well with NHM material from Cameroon (a ♂ 39.5 mi E. of Mamfe, 9-X-1962, R.M.Gambles leg./det.)

PSEUDAGRION S. SJOESTEDTI. – Material taken agrees with Cameroon material in the NHM (e.g. a ♂ 20 mi E of Mamfe, 19-X-1962, R.M.Gambles leg./det.)

PSEUDAGRION RISI. – The specimens from Ebonji and Bangem agree with NHM material from Cameroon collected and determined by R.M.Gambles (a ♂ from Bambui, 27-XII-1957 and a ♂ from Bamberi 27-XII-1956)

PLATYCNEMIS CONGOLENSIS. – I have compared my material with NHM material from Uganda (Kamengo Forest - van Someren, June 1953). The male inferior appendage is longer than the superior, and the latter bears a long ventral tooth.

SAPHO. – *S. orichalcea* is the dominant calopterygid on rocky montane streams in the Province, provided there is some surviving riparian forest cover . *S. bicolor* should still occur in the Mamfe region where Pinhey had found it. To the south of the Province, *S. orichalcea* is replaced by *S. gloriosa*, e.g. a specimen in NHM from Batouri District (4 30'N, 14 15'E) taken in 1935 by the 'gorilla collector', F.G.Merfield.

In the lowlands around Etam, we have found very small specimens of *Sapho* which appear to belong to *orichalcea* (hindwing 33mm compared with an average of 44mm for normal *orichalcea*). I have listed them separately in the checklist as they may be specifically distinct.

UMMA. – The presence of six species of this genus is impressive and the South-West Province is an important centre of diversity for these forest-adapted calopterygids. The newly-described *U. mesumbei* (VICK, 1996) is a very distinctive species of large size which has only so far been found on Mount Kupe and at Kodmin in the Bakossi Mountains. It is possibly endemic to the region. *U. mesostigma and U. longistigma* appear to be occur more generally in Bakossiland, especially in the lowlands. In the Takamanda region, north of Mamfe, we have recorded four species: *longistigma*, *mesostigma*, and apparently very local *puella*

and *purpurea*. The sixth species, *saphirina* has only been found so far from the area of the Rumpi Hills near the Nigerian border. There appear to be two different forms of *U. longistigma*, based on the shape of the inferior appendage: the narrower forms occurring in Korup and north of Mamfe.

DIASTATOMMA MULTILINEATA. – A male taken at Atop (26-XI-1997, near Etam) belongs to this taxon and it agrees with a Fraser male from Eala (Belgian Congo) in the NHM Collection in markings, superior appendages (with basal section and apical projection making 100°) and shape of Hagen's tubercle. GAMBLES (1987) published an interesting paper on this genus and its distinction from *Gomphidia*. The species of *Diastatomma* possess a ' Hagen's tubercle, the shape of which is constant and specifically diagnostic'. However, another male which is almost certainly conspecific, having similar markings, accessory genitalia and appendages, from the same site, has a much shorter tubercle. It appears that the shape of the tubercle is not an absolutely reliable character for identification.

DIASTATOMMA TRICOLOR. – This species appears to be fairly common in the forested lowlands around Etam. Specimens concord with material in NHM from Calabar Road, South Cameroons, (R.M.Gambles leg. 17-X-1962).

GOMPHIDIA GAMBLESI. – My material is clearly conspecific with Nigerian specimens in the NHM standing under the manuscript name *G. nigeriensis* Gambles. These specimens include 2 ♂ from Sobo plain, near Sapele (25/30-XI-1957, B.J. MacNulty leg., R.M.Gambles det. 1973) and one ♂ (labelled 'type') from Sapoba Forest Reserve, nr Benin (10/12-III-1972, J.T.Medler leg., R.M.Gambles det.). The name was never published. GAUTHIER (1987) described the same species from Togo as *G. gamblesi* . The appendages and accessory genitalia are identical to the Nigerian and Cameroonian material, but the Togo material appears to be smaller and there are a few minor wing venational differences. There is actually some variation in anal appendage morphology and specimens from Takamanda differ slightly from more southern material (e.g. Kumba area).

NOTOGOMPHUS sp.1, sp.2, sp.3. – There are three species of *Notogomphus* which are characterised by the very long hind legs (reaching to middle of second abdominal segment), bearing long spines . Two have been taken at Kupe, and are represented by single females: the larger species (sp. 1) in the lowlands at Lala; the smaller species (sp. 2) in the submontane forest above Nyasoso. Species 2 seems to be closest to *dendrohyrax* (Förster, 1906) from the Usambaras of Tanzania: the vulvar scale is close; the markings are close but there are differences in the size of the Pt and the leg spination. Species 3 is a teneral male from Takamanda, softened in KOH, preserved in alcohol but I have not been able to identify it.

ONYCHOGOMPHUS sp.1, sp.2. – A female (sp.1) from Mount Kupe is similar to *O. supinus,* with similar markings, but the abdomen widens slightly; there is a similar very dark Pt; the antehumerals are clearly detached, unlike *O. septemflavum* from Congo to which it is otherwise close. There is also another female of this genus from Kupe which appears to be distinct (sp.2)

PARAGOMPHUS ABNORMIS. – I discussed the difficulties of deciding whether material collected at and near Mount Kupe belonged to this taxon or to the later taxon, *P. moka* Longfield, in my earlier paper (VICK, 1996). In the last three years I have received a very large series of specimens (50+) and I find that all of the characters described by CAMMAERTS (1969) to separate the two taxa intergrade or break down. However, the type of *abnormis*, and the single specimen used by Cammaerts, both possess a basal subcostal nervure, which is not present in *moka*, nor any of my specimens. I do not feel this character is sufficient to separate the two taxa and therefore regard my material as *abnormis*.

PARAGOMPHUS NIGROVIRIDIS. – I have material from lowland forest streams at Etam which agrees well with Cammaerts' description. It is a dark species, with antehumeral stripes joined to the prothoracic collar in a pair of 7s. Kimmins has determined a male in the NHM from the Belgian Congo (Bambesa, February 1958) as this species and my male agrees with that one.

PARAGOMPHUS sp.1, sp.2, sp.3. – A number of gomphid species have been obtained which cannot be determined as they are represented only by females; in this genus even males can be very difficult. Sp.1 is a female from the forest on Mount Kupe; sp.2 is a male from Etam; and sp. 3 is a female from Ngombo-Mbong.

ANAX CHLOROMELAS. – This taxon is normally considered to be rare. At the lowland marsh near Debundsha, three females were captured in July 1996 flying rapidly over the water, which was about 60cm deep at this time of the year. A larva (which later emerged in the UK) was also collected. The *chloromelas* were flying with *A. tristis* which was much commoner. On 27 March 1997, at the start of the rains, we returned to the marsh to find it almost entirely dry and no larvae could be found. Males of *A. chloromelas* were flying rapidly over the few pools of water that had formed. Other less common species which have been found at this interesting site are *Orthetrum austeni* and *Trithemis hartwigi*. The waterbody is temporary and some parts are inundated fields, partly planted with crops. The larva must grow rapidly during the wet season so that it can emerge before the desiccation of the habitat and the dry season must be passed as an adult in the forest. The presence of the lowland rainforest on the lower slopes of Mount Cameroon in the vicinity of the marsh may be an important factor which is responsible for the richness of this habitat. To some extent this is supported by the record of another specimen, a male, which was taken by O. Mesumbe in the forest at Mount Kupe in the dry season on 17 February 1997. There do not appear to be suitable habitats for the species on the mountain and I assume that it breeds in an undiscovered marsh in the nearby lowlands.

HELIAESCHNA FULIGINOSA. – A male which was taken above a shaded forest pool at Etam on 5 April 1997 agrees well with NHM material from Nigeria (det C. Longfield) and Congo, Eala (det. F.C. Fraser). In particular, the pattern of denticles around the genital fossa distinguishes the taxon from the otherwise similar *H. lanceolata*. The anal appendages also match well, but there is a trace of a black T-

marking of the frons. We also have a female of *lanceolata* with strongly-marked T on the frons from montane forest in Takamanda (27 January 1998).

HELIAESCHNA TRINERVULATA. – I am unable to place for certain a female which was taken on 29 December 1995 Mount Kupe. It is a medium-sized species but again there is a trace of a black T-mark on the frons, which *trinervulata* should not have. The size and shape of the pterostigma, the anal loop and other details of venation suggest *trinervulata*; this resemblance is strengthened by the shape and smaller size of the two-pronged process in my specimen which differs from that in *fuliginosa, cynthiae*, and *libyana*. Perhaps the trace of the black T on the frons is due to post-mortem decomposition ?

IDOMACROMIA PROAVITA. – The two species of this genus are specialised forest insects and are probably under-recorded rather than being rare. In April 1997, we observed a female of *proavita* ovipositing in a damp seepage in upland rainforest on Kupe at an altitude in excess of 1200 m. This seepage had a gradient of about 1 in 20 and a width of 2m. The substrate was fine gravel and silt. Water depth varied from 0 to 6mm and the midday temperature was 20°C. It was situated in heavy shade of the submontane forest and only shafts of sunlight penetrated through the canopy. Later, a male, flying in a most erratic manner, was seen patrolling a small shaded stream, in lowland forest near Etam, at an altitude of approximately 300 m. The stream varied from 60 to 120 cm in width and about 20cm deep; the water temperature was 26°C at midday. The bed was sandy with some gravel and much silt and leaf litter in the region where the male was taken. Both insects were observed in the middle of the day. Other observers have also mentioned the erratic flight of *Idomacromia* males. It appears that *proavita* is not exclusively a seepage-breeder and it appears to be one of the few species which can cope with both montane and lowland conditions.

PHYLLOMACROMIA. – I have followed the convincing opinion of MAY (1997) in regarding the African species of *Macromia* s.l. as belonging to a separate genus, *Phyllomacromia,* which appears to be monophyletic.

PHYLLOMACROMIA BICRUSTULATA. – Material which I have placed in this taxon has been found at Etam, near Kumba. It is one of the species with twin tufts on either side of the swelling on segment 10. My male agrees well with a male in NHM (from Ikom, S. Nigeria 1956) determined by Fraser in 1957 as *P. pinheyi* sp.n. This was never described: Gambles later determined the specimen as *bicrustulata.* I have compared my specimen with *P. lamottei* Legrand, 1993 which is very close to *bicrustulata,* and it agrees more precisely with the latter, especially in the shape of the ventral surface of the hamule. However, I am not totally convinced that my determination is correct.

PHYLLOMACROMIA MELANIA. – Identified using the key in GAMBLES (1979).

CYANOTHEMIS SIMPSONI. – Several males were perching on bushes bordering a sluggish meandering lowland- forest stream at Etam. They were extremely wary and difficult to secure. The male abdomen bears a striking pale blue pigment which

disappears on death; this is quite unlike the more permanent pruinose blue of *Orthetrum* and *Hadrothemis*. Material agrees with paratypes in the NHM det. Ris (and det. Kimmins 1967) from Sierra Leone (Mongheri, 15-XI-1912, J.J.Simpson leg.) and with Gambles' material from Calabar Road, South Cameroons (taken 17 -X-1962).

MALGASSOPHLEBIA NIGERIAE. – I have one male and two females of this taxon. The male from Ebonji (13 September 1997) agrees well with the taxon *nigeriae* Pinhey, 1960. This is separated from *bispina* Fraser, 1958 as the dorsal spine on the appendages is situated at three-quarters of the length from the base in *bispina* and only one-half in *nigeriae*. The genus is keyed in LEGRAND (1986) and my specimen runs through to the '*bispina* group', but this is not keyed further. Pinhey describes *nigeriae* as a subspecies of *bispina* but it seems to me that the difference is sufficient to warrant specific status, and I have recorded it thus in the checklist.

NEODYTHEMIS AFRICANA. – A female specimen of this rare taxon was found in the emergence trap over the extensive seepage on Max's Trail on 29 April 1997. This female has appendages, vulvar scale, thoracic markings and specialised shape of segment 10 which agree with a female in Fraser's collection, now in NHM (London), from Moyen Congo (Ketta Forest October 1959) determined by Fraser as *africana*. This is distinct from *gorillae* (Pinhey) especially with regard to thoracic markings and *gorillae* lacks the specialised shape of segment 10 as is shown by a Gambles specimen from Nigeria (Obudu, 25 February 1971). The teneral adult was preserved with its exuviae. A male of this genus was later taken at Kodmin on 19 November 1997 in primary montane rainforest and it agrees fairly closely with material of *africana* in NHM.

ORTHETRUM CAMERUNENSE. – Material from the drier parts of South-West Cameroon, in the rain shadow areas, belongs to this taxon which appears to be a good species (GAMBLES, 1959). It is probably commoner in the grasslands of the Bamenda Highlands of the North-West Province.

PORPAX ASPERIPES. – A male from Ebonji agrees well with material in NHM collection from the Congo (Bambesa, Uela, XII-1938, J. Vrijdagh leg., F.C.Fraser det.)

TETRATHEMIS BIFIDA and *T. GODIARDI*. – The first species was found at two lowland sites. At Etam, males were seen in bushes above a shady pool in a partially dried up stream bed ; it was also caught flying over a shallow shady stream on the edge of rainforest. At Seme Beach, a male was found in dense vegetation near coastal marshes. The specimens agree well with material in the NHM from Nigeria (R. Idodo, 21-III-1954, R.M.Gambles leg./det.). At Etam, another species of *Tetrathemis* close to *godiardi* was flying with *bifida*. Comparing my single male specimen with a series of *godiardi* from northern Nigeria (Jemaa, 21-II-1960 and 12-III-1961) determined by R.M.Gambles in the NHM, mine appears to have the tips of the superior appendages more strongly divergent, although less so than in Fraser's *denticauda* but as I only have one specimen I cannot be sure that this

difference is of importance.

TRITHEMIS HARTWIGI. – A single male of this taxon was taken at Debundsha marsh on 14 July 1996. It has previously only been recorded from the type locality of Fernando Po (Bioko). Several features are diagnostic: black wing venation, large black Pt, the shape of the accessory genitalia, black labrum, wide body, and the thoracic markings. There is no material in the NHM but the agreement with Pinhey's description is excellent; this record is the first from mainland Africa.

ZYGONYX F. FLAVICOSTA. – This species is common in the Bakossi lowlands of the Kumba-Kupe area wherever there are fast rocky streams; it does not seem to need forested surroundings and it is often found in farm bush. The material agrees well with NHM material from Nigeria (e.g. a ♂ Oshun Bridge, Oshogbo I/III-1913, Dr H. Strachan leg., and another ♂ (Ibadan, 1960, Mound leg., R.M.Gambles det).

ZYGONYX S. SPECIOSA. – This larger species is also found in similar habitats to *Z. flavicosta*. The females are magnificent insects with their large wings marked extensively with golden-yellow and dark brown; the males have only basal patches of brown in the wings. My males agree with NHM material from the 'Camaroons River' in the McLachlan Collection and labelled *Pseudomacromia speciosa* Karsch. The females agree perfectly with the female of *pretiosa* in the NHM. This was described with a female holotype as a different species by Karsch although the locality is the same: Cameroons River; it is easy to see why the sexes were not believed to belong to the same species. Gambles has labelled the specimen of *pretiosa* 'this is a female of *speciosa*'. Pinhey (1964) has synonymised the two taxa.

SEASONALITY

With records available from three years' surveying, it is now possible to look for seasonal patterns in sightings of adults. For each species the months recorded were listed. There is a danger of an artefact here. If one believes a time to be good, one may go out to look - and find ; a time believed to be poor may mean little recording takes place. However, the following are put forward as tentative suggestions.

Generally, in this part of Cameroon all months are wet and most species can be found at all times of the year. However, the months from November to February are relatively dry and the sunshine figures are highest then. The usual pattern is for the numbers of each species to increase during these dry and sunny months; the numbers remain high in March and April, which although wetter, tend to be sunny. Numbers fall off as the wet season progresses but most species are still to be found, albeit in smaller numbers. There are some interesting exceptions to this pattern.

There is a widespread belief amongst local people that November is the time to see dragonflies. I believe that this is based upon the fact that the common libellulids, breeding in temporary pools which dry out at the end of the wet season, emerge in large numbers then. They are often seen in the villages at this time, before either

moving to forests during the drier months, or migrating. When we arrived in March 1995, villagers expressed surprise that we had come at the 'wrong time'; an impression that was borne out by the absence of almost all Odonata, except *Anax tristis*, in the villages. However, in the montane streams in the shady forests numbers are high at this time.

The rarer species may only be recorded in the sunnier months owing to the lower numbers; they may be missed in the main wet season. For example, *Neurolestes trinervis* has not been found between June and November on Kupe, although the other, commoner, specialist montane stream species (*Stenocnemis pachystigma*, *Pentaphlebia stahli*, *Nubiolestes diotima*) have been found in all months.

There is a fairly strongly marked tendency for the chlorocyphids to be absent from records at the end of the wet and the early dry season (October to December), appearing in January, February and March (when many tenerals are found), but most records are for the first part of the wet season, April to July. This pattern applies to *C. cancellata, glauca* and *curta*, although the commoner *selysi* has only been missed from records in December.

The gomphids are particularly difficult to record at all and several species are only known from a single female specimen (which cannot usually be named). The species diversity appears to be greatest between April and July, in the early wet season; none has been recorded in the early dry season (November and December) and numbers build up as the wet season approaches. Even the time of the heaviest rains produces interesting rarities: *Phyllogomphus montanus* and *P. corbetae* sp.n. are good examples.

CONSERVATION

The species list of 180 is impressive when one considers the size of the area surveyed. Additions to this list are to be expected, especially in the Gomphidae which are so hard to collect; a total of at least 200 species can be confidently expected. For comparison, Belize which is of a similar area has 170 recorded species (PAULSON, 1998). I suspect that few parts of Africa of equivalent area can match this. For example, Kenya which has an area of 580.000 km^2 or 24 times the area of the Province, has a recorded total of 194 spp. with a higher intensity of study. It is worth noting that many of the very common and widespread African taxa are absent from the list of species from the South-West Province owing to the lack of savanna habitat and this serves to stress even more the importance of the more specialised species which do occur.

In general, Africa has an impoverished tropical fauna compared with that of South-East Asia and South and Central America. However, in this part of the Continent, around the Bight of Biafra, the dragonfly fauna approaches the levels of richness of the best parts of these two areas. There is a rich mix of ancient relicts and endemics at genus and species levels, with the addition of a large number of

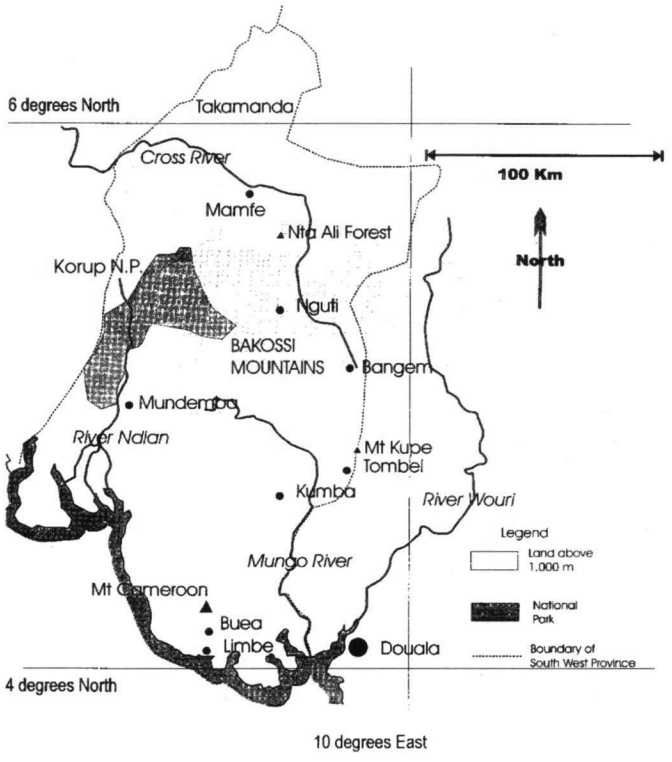


Fig. 11. Map of South-West province of Cameroon.

more widespread Congolian species. Certain species, such as *Pentaphlebia stahlii* and *Nubiolestes diotima*, have their nearest relatives in South America, recalling ancient Gondwanaland connections. Certain genera such as *Umma* appear to have their 'headquarters' here. The dragonflies therefore support the data obtained from many other groups that South West Cameroon forms a crucial 'centre of biodiversity' of the highest level of importance from a conservation viewpoint. Certainly, the extensive well-forested area of the Bakossi Mountains, including Mount Kupe, are of great importance for conservation. Takamanda to the north, also appears to be very rich, with a possibly distinct fauna. Korup is insufficiently worked but can be expected also to be important. Mount Cameroon and the associated lowlands are also very rich. It is to be hoped that efforts by such bodies as the World Wildlife Fund and Birdlife International will continue to safeguard these areas.

The World Wildlife Fund has recently instigated a programme of stream monitoring in the Bakossi area and Christopher Wild and Otto Mesumbe are investigating which dragonflies can be used as water-quality indicators.

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