The dragonflies (Odonata) of Ethiopia, with notes on the status of endemic taxa and the description of a new species

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Abstract. In March 2004 the authors undertook a survey of Odonata in the highlands of central and southwest Ethiopia, as well as along some Rift Valley lakes. The endemic species were the main target, as almost no information other than descriptions existed. Some type localities were visited, as were other habitats, to gather information on the species' distribution, habitat requirements and conservation status. 29 sites were sampled and 69 species recorded. Of eleven known endemics, nine were found, all at sites other than their type localities. One new species assumed to be endemic was found, and is described as *Paragomphus crenigomphoides* sp. nov. A revised checklist of Ethiopian Odonata is presented: 96 species have been reliably recorded. *Ischnura hilli* Pinhey, 1964 and *Enallagma caputavis* Terzani & Carletti, 1998 are considered synonyms of *I. abyssinica* Martin, 1907 and *Pseudagrion niloticum* Dumont, 1978 respectively. The taxonomy and nomenclature of an undescribed *Aeshna* species (near *A. meruensis* Sjöstedt, 1909 and *A. yemenensis* Waterston, 1985), *Notogomphus ruppeli* (Selys, 1857) (frequently spelt as *N. rueppeli*) and *Orthetrum kollmannspergeri* Buchholz, 1995 (probably confused with Asian *O. taeniolatum* (Schneider, 1845)) are discussed. Ethiopia's odonate fauna is compared with that of other East African highlands: It is impoverished (especially forest species) but rich in endemics.

Zusammenfassung. Im März 2004 wurde von den Autoren eine Inventarisierung der Libellenfauna der Hochländer zentral und süd-west Äthiopiens und entlang der Rift Valley Seen durchgeführt. Das Hauptziel waren die endemischen Arten, über die so gut wie keine Information jenseits der Artbeschreibung existierte. Originalfundorte der endemischen Arten, sowie andere Habitate wurden aufgesucht, um Daten zu Verbreitung, Habitatansprüchen und zum Schutzstatus zu bekommen. 69 Arten wurden an 29 aufgesuchten Lokalitäten nachgewiesen. Von elf bekannten endemischen Arten wurden neun gefunden, alle auch an neuen Lokalitäten. Weiterhin wird eine neue Art als *Paragomphus crenigomphoides* sp. nov. beschrieben, die ebenfalls endemisch für Äthiopien scheint. Eine revidierte Artenliste der Libellen Äthiopiens wird aufgeführt: 96 Arten sind bislang zuverlässig für Äthiopien nachgewiesen. *Ischnura hilli* Pinhey, 1964 und *Enallagma caputavis* Terzani & Carletti, 1998 sind Synonyme von *I. abyssinica* Martin, 1907 bzw. *Pseudagrion niloticum* Dumont, 1978. Die Taxonomie und Nomenklatur einer bislang unbeschriebenen *Aeshna* (ähnlich *A. meruensis* Sjöstedt, 1909 und *A. yemenensis* Waterston, 1985), *Notogomphus ruppeli* (Selys, 1857) (häufig *N. rueppeli*) und *Orthetrum kollmannspergeri* Buchholz, 1995 (Verwechselungen mit dem asiatischen *O. taeniolatum* (Schneider, 1845)) werden diskutiert. Äthiopiens Libellenfauna wird mit der anderer ostafrikanischer Hochländer verglichen: es handelt sich um eine verarmte Fauna (vor allem Waldarten), die reich an Endemiten ist.

Key words. Ethiopia, dragonflies, Odonata, endemism, biogeography, taxonomy, synonyma, new species, *Paragomphus crenigomphoides* sp. nov.

Introduction

With about 1,100,000 km² Ethiopia is one of Africa's largest countries. The topography is very diverse, ranging from mountains over 4000 m above sea level to the Danakil Depression 120 m below it. The main topographic feature is the vast and fertile central highland with an average elevation between 1500 and 2400 m; the largest block of land above 1500 m in Africa. The highlands have an annual average temperature of 16–20 °C and an annual average rainfall around 1200 mm, reaching 2400 mm in the southwest. The degree of endemism in Ethiopia's flora and fauna is exceptionally high. This is largely the result of the isolation of the vast highlands by the surrounding dry lowlands. The species that Ethiopia shares with tropical Africa tend to be restricted to the most versatile and mobile forms. These are mainly montane species. Most of Ethiopia's endemic species also belong to the Afrotropical Highlands biome (Kingdon 1989). Despite the many endemic species in Ethiopia, the conservation of their habitats is virtually non-existent. The highlands are among the most densely populated areas in Africa and only minute pockets of semi-natural vegetation remain. The loss of natural habitats has taken place over many centuries in the northern and central highlands, but is a more recent phenomenon in the southwest.

Consiglio (1978a) provided a review of the history of dragonfly research in Ethiopia: The oldest record is one of *Platycypha caligata* by Selys-Longchamps in 1853 from "Le Sémen". In the late 19th and early 20th century various small contributions, including species descriptions, were made – in chronological order – by Selys-Longchamps, Calvert, Förster, Martin, Ris, Campion, Nielsen, Kimmins and other leading odonatologists of the time. Pinhey published several monographic studies on African dragonflies, which still form the

fundament of African odonatology and include Ethiopian records (e.g. Pinhey 1961, 1962, 1964b, 1967, 1970a, 1970b). The Ethiopian Odonata were largely neglected in the second half of the 20th century, although Italian scientists undertook a zoological expedition in the early 1970s (Brignoli, Consiglio *et al.* 1978). The results published by Consiglio (1978a, 1978b) and Pinhey (1982) include the description of three endemic species. These papers form the only relatively comprehensive – though not entirely critical – treatment of the Ethiopian odonate fauna, with only casual records published since (Dumont 1983, Legrand 1984, Telfer 1992, Carfì & Terzani 1993, Prendergast 1998, Terzani & Carletti 1998). In summary, the Ethiopian Odonata require a new assessment.

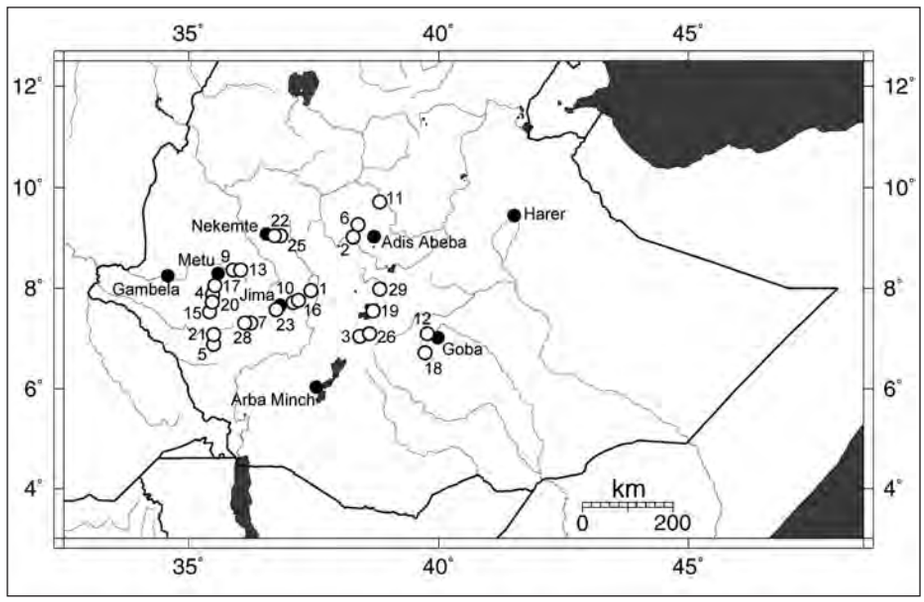


Fig. 1. Southern Ethiopia with location of visited sites (open circles). See Table 1 for site numbers. Several towns are indicated for reference.

Table 1. Sample localities, sorted according to locality code (*: altitude only estimated from the map). The number of species recorded at each locality is given. All dates were in March 2004. See Fig. 1 for map of sites.

	Code	°N	°E	Alt (m)	Date	Site description	Species
1	Abel	7.957	37.439	1750	22	Near Abelti, rocky stream with gallery forest	**6**
2	Adal	9.018	38.285	2080	14	10 km west of Adis Alem, slow, open, grassy stream with pools in meadowland	**8**
3	Awas	7.050	38.417	1700	28	Lake Awasa, swampy lake shore	**14**
4	Baro	7.876	35.479	1630	17	Baro River 30 km south of Gore, broad, shallow river with gallery forest	**9**
5	Bebe	6.882	35.496	1118	18	Bebeka, swampy depression in coffee plantation	**3**
6	Berg	9.266	38.383	2500	11	Berga Valley north of Holeta, grassy stream	**3**
7	Bon1	7.316	36.241	1710	20	Bonga, swampy stream	**4**
8	Bon2	7.330	36.247	1727	20	5 km north of Bonga, swampy stream	**7**
9	Bork	8.371	35.885	1288	21	Borkana River near Yayu, broad, shallow river with gallery forest	**10**
10	Bulb	7.717	37.085	1643	22	Bulbul, 30 km east of Jima, small, open river with grassy verges	**9**
11	Debr	9.717	38.817	2000*	12	Debre Libanos	**6**
12	Dins	7.100	39.767	3200	3	Bale Mts, Dinsho Headquarters, glades in montane (*Hagenia*) forest	**1**
13	Gab1	8.364	36.041	1467	16	Gaba River, 35 km west of Bedele, rocky river with gallery forest	**11**
14	Gab2	8.369	36.034	1507	16	Forest undergrowth near Gaba River	**1**
15	Gech	7.533	35.417	1800*	17	Gecha, 40 km north of Tepi, rocky stream with forest	**3**
16	Gibe	7.762	37.190	1646	22	Gibe, large open river	**4**
17	Gore	8.059	35.524	1775	17	10 km south of Gore, sheltered, swampy stream	**6**
18	Katc	6.721	39.726	2298	2	Harenna Forest, Katcha Camp, shady stream in bamboo and montane forest	**2**
19	Lang	7.551	38.684	1567	27	Lake Langano, alkaline lake with muddy shore and reeds (*Juncus*)	**4**
20	Mash	7.733	35.467	1630*	18	Masha, 45 km south of Gore, swamp	**1**
21	Miza	7.083	35.500	1000*	18	Tepi to Mizan Tafari, forested rocky stream	**3**
22	Neke	9.051	36.710	1729	15	20 km east of Nekemte, small, open river	**9**
23	Sek1	7.583	36.750	1650*	20	Seka (Saka), small river with some gallery vegetation	**13**
24	Sek2	7.626	36.765	1787	20	Seka, 35 km south-west of Jima, open swampy dam	**17**
25	Sire	9.046	36.841	1673	15	Sire, 35 km east of Nekemte, small river with some gallery vegetation	**10**
26	Won1	7.096	38.613	1652	30	Wondo Genet, open swampy stream	**10**
27	Won2	7.096	38.613	1652	30	Wondo Genet, rocky forest stream	**7**
28	Wush	7.312	36.120	1845	19	Wushwush, 13 km west of Bonga, forested rocky stream	**8**
29	Ziwa	7.983	38.817	1636	22	Lake Ziway, ditch near swampy lake shore	**2**

Methods and localities visited

Table 1 lists all sites visited, Fig. 1 shows their location. At every site we attempted to obtain a full species list of adult dragonflies. We also looked for larvae and exuviae in rivers and streams. Adults were identified in the field with a hand lens. Larvae could only be identified to the genus level. Acronyms used for museums are given in Table 2.

Table 2. Acronyms used for collections.

Acronym	Collection	City	Country
BMNH	Natural History Museum	London	U.K.
MNHN	Muséum National d'Histoire Naturelle	Paris	France
MZUF	Museo Zoologico "La Specola"	Firenze	Italy
NHRS	Naturhistoriska Riksmuseet	Stockholm	Sweden
NMKE	National Museums of Kenya	Nairobi	Kenya
UMMZ	University of Michigan Museum of Zoology	Ann Arbor	U.S.A.
ZFMK	Zoologisches Forschungsmuseum "Alexander Koenig"	Bonn	Germany

Results

A total of 69 species was recorded, 72 % of those reliably recorded in the country (Tab. 3). Two species are not yet described, although both have been present in entomological collections for many years. The number of species recorded at each locality ranged between one and 17 (Tab. 1). The number of localities at which a given species was recorded ranged from one (38 species) to 14 (one species).

Notes on taxonomy and biology of selected species, particularly endemics

Elattoneura pasquinii Consiglio, 1978 (Fig. 11)

This species was only known from three specimens collected at the "cascate del Piccolo Ghibiè [= waterfall of the small Gibe]" east of Jima (see also *P. kaffinum*). We found it at the Baro (a broad, shallow and clear river with a rocky bottom, some grassy and reedy borders and dense gallery forest) and at a small muddy river in open farmland near Bulbul (Fig. 2). Latter site is close to the type locality, the former 180 km west of it. The different habitats suggest that *E. pasquinii* does not have a narrow ecological niche: It seems to avoid rocky streams, may require some grassy banks, but does not need forest cover. The altitude of all three sites lies between 1630 and 1650 m a.s.l. Although we found *E. pasquinii* at only two sites, it appears tolerant and unthreatened, although it may be confined to the southwestern highlands.

Ischnura abyssinica Martin, 1907 (Figs 8, 15)

= *Ischnura hilli* Pinhey, 1964 **syn. nov.**

This species was described by Martin (1907) from specimens collected "entre Dire-Daoua et Harrar". Pinhey (1964a) described *I. hilli* from Lake Alemaya, without making reference to *I. abyssinica*. Because the latter site lies between present-day Dire Dawa and Harer (9°24'N 42°00'E) it stands to reason that the two are the same. Martin's series in MNHN of *I. abyssinica* contains three males and three females. Two of the males are labelled as type, one of which lacks the terminal four abdominal segments. The specimens match Pinhey's illustrations and brief description of *I. hilli* in details of the coloration and morphology of pterostigma, prothoracic hindlobe, abdomen tip and appendages. Pinhey (1964a) stated the number of eight forewing postnodal veins in his specimen as low for the genus; the three males have 7–9 of these. These similarities seem sufficient to regard *I. hilli* as a junior synonym of *I. abyssinica*. NMKE possesses two males simply labelled "Dire Dawa, Ethiopia" and "Coryndon [Museum] 253", which may originate from Hill, although Pinhey (1964a) did not refer to them. We found *I. abyssinica* on grassy stream-pools (Fig. 3) in a highland meadow near Adis Alem (Adal), 400 km west of the type locality. This anthropogenic habitat is common in the Ethiopian highlands and the record suggests that the species is widespread. The known altitude range is 2000–2100 m. Males of *I. abyssinica* are paler and more robust than those of the sympatric (but possibly never syntopic) *Ischnura senegalensis* (Tab. 4). Females have the prothoracic hindlobe similar to that of the male. One of the MNHN females is an orangey gynochrome, having the humeral suture and dorsum of abdominal segments 1–2 unmarked, but segments 3–10 dorsally black. The other two are androchrome, having a humeral stripe and appearing to lack dorsal black only (partly) on segments 8–9 (both females are stained). An androchrome female we observed had segments 8–10 largely blue (Fig. 8b).

Pseudagrion guichardi Kimmins, 1958 (Fig. 10)

This species was known from eight localities across the southern highlands, from former Kaffa province to the Bale Mts, ranging between 1700 and 2600 m a.s.l. Our records fall within this geographic and altitudinal range. They show that *P. guichardi* inhabits forested, rocky streams with some open stretches (Figs 4–5). Settled males of *P. guichardi* often lifted the three terminal abdominal segments, which have an unusually bright blue upperside (Fig. 10b). This behaviour is very unusual for a coenagrionid and may function as a declaration of territorial occupancy or as a signal for females.

Pseudagrion kaffinum Consiglio, 1978 (Fig. 9)

This species was known from only two sites on the "Piccolo Ghibiè" east of Jima (see *E. pasquinii*). We found it to be numerous south of Gore (Fig. 6), 180 km west of the type locality, and near Bulbul (Fig. 2) and on the Gibe River, both near the type locality. Although they range from a small stream to a wide river, all three sites are slow-flowing waters in open country with muddy and grassy verges. Thus the habitat requirements of *P. kaffinum* are quite unlike those of its close relative *P. guichardi* and it must be more tolerant to man's influence on the landscape. It may occur at lower altitudes than its counterpart (1600–1800 m a.s.l.) and could be confined to the southwestern highlands.

Pseudagrion niloticum Dumont, 1978

= *Enallagma caputavis* Terzani & Carletti, 1998 **syn. nov.**

Pseudagrion niloticum was separated from *P. acaciae* – formerly thought to

Table 3. Odonata species reliably recorded for Ethiopia, including new records. **Validation (V) of species**: **1.** Records obtained by authors; **2.** Specimens kept in collections (a: identification confirmed by authors in indicated museum; b: not seen but constitute primary types); **3.** Literature records, regarded as reliable because specimens were described well or record agrees with known biogeographic pattern. These records are summarized by CONSIGLIO (1978a) and PINHEY (1982), except *Z. torridus* from TELFER (1992). **Special status (S) in Ethiopia**: E: Endemic; N: Our record is first national record; T: Not endemic, but type locality lies in Ethiopia. See Table 1 for locality codes and Table 2 for acronyms of collections.

	V	S	New records / Museum
ZYGOPTERA			
Calopterygidae			
***Phaon* SELYS, 1853**			
Phaon iridipennis (BURMEISTER, 1839)	1		Bork, Gab1
Chlorocyphidae			
***Platycypha* FRASER, 1949**			
Platycypha caligata (SELYS, 1853)	1		Abel, Baro, Bork, Bulb, Gab1, Sek1, Sire, Wush
Lestidae			
***Lestes* LEACH, 1815**			
Lestes pallidus RAMBUR, 1842	3		
Lestes tridens MCLACHLAN, 1895	1	N	Sek2
Lestes virgatus (BURMEISTER, 1839)	1		Gab1
Protoneuridae			
***Elattoneura* COWLEY, 1935**			
Elattoneura pasquinii CONSIGLIO, 1978	1	E	Baro, Bulb
Coenagrionidae			
***Africallagma* KENNEDY, 1920**			
Africallagma elongatum (MARTIN, 1907)	1		Bon1, Bon2, Debr, Sek1, Wush
Africallagma subtile (RIS, 1921)	1	N	Gab1
***Agriocnemis* SELYS, 1877**			
Agriocnemis exilis SELYS, 1872	1		Gore
Agriocnemis inversa KARSCH, 1899	1		Won1
Agriocnemis sania NIELSEN, 1959	3		
***Azuragrion* MAY, 2002**			
Azuragrion nigridorsum (SELYS, 1876)	3		
Azuragrion somalicum (LONGFIELD, 1931)	2a		BMNH
Azuragrion vansomereni (PINHEY, 1956)	2a		MZUF
***Ceriagrion* SELYS, 1876**			
Ceriagrion glabrum (BURMEISTER, 1839)	1		Awas, Bulb, Lang, Sek2, Won1
Ceriagrion suave RIS, 1921	3		
***Ischnura* CHARPENTIER, 1840**			
Ischnura abyssinica MARTIN, 1907	1	E	Adal
Ischnura senegalensis (RAMBUR, 1842)	1		Awas, Lang, Won1
***Proischnura* KENNEDY, 1920**			
Proischnura subfurcata (SELYS, 1876)	1	T	Adal, Bon1, Bon2, Debr, Gech, Gore, Neke, Sek1, Sek2, Won1
***Pseudagrion* SELYS, 1876**			
Pseudagrion gamblesi PINHEY, 1978	1	N	Baro, Bulb
Pseudagrion guichardi KIMMINS, 1958	1	E	Katc, Wush
Pseudagrion kaffinum CONSIGLIO, 1978	1	E	Bulb, Gibe, Gore
Pseudagrion kersteni (GERSTÄCKER, 1869)	1		Miza, Won1
Pseudagrion massaicum SJÖSTEDT, 1909	1		Awas
Pseudagrion niloticum DUMONT, 1978	3		
Pseudagrion nubicum SELYS, 1876	1		Awas, Ziwa
Pseudagrion spernatum SELYS, 1881	1	T	Abel, Adal, Baro, Bon1, Bon2, Bork, Bulb, Gab1, Gech, Neke, Sek1, Sek2, Sire, Won2, Wush
Pseudagrion sublacteum (KARSCH, 1893)	1		Awas
Pseudagrion torridum SELYS, 1876	1		Awas
ANISOPTERA			
Aeshnidae			
Aeshna FABRICIUS, 1775			
Aeshna ellioti KIRBY, 1896	1		Bon2
Aeshna cf. *yemenensis* WATERSTON, 1985	1		Abel, Debr, Neke, Sek1, Sire, Won2, Wush
***Anaciaeschna* SELYS, 1878**			
Anaciaeschna triangulifera MCLACHLAN, 1896	1		Won2
***Anax* LEACH, 1815**			
Anax ephippiger (BURMEISTER, 1839)	1		Berg, Debr
Anax imperator LEACH, 1815	1		Awas, Berg, Gore, Sek2, Won1
Anax speratus HAGEN, 1867	1		Adal, Baro, Bebe, Bon2, Sek1, Sire
Gynacantha nigeriensis (GAMBLES, 1956)	1	N	Gab2
Gynacantha vesiculata KARSCH, 1891	1	N	Won2
Gynacantha villosa GRÜNBERG, 1902	1	N	Sek1
Gomphidae			
***Crenigomphus* SELYS, 1892**			
Crenigomphus abyssinicus (SELYS, 1878)	2a	E	BMNH
Crenigomphus denticulatus SELYS, 1892	2b	E	
***Notogomphus* SELYS, 1858**			species uncertain (larvae): Gab1, Miza, Won2
Notogomphus cottarellii CONSIGLIO, 1978	1	E	Wush
Notogomphus dorsalis (SELYS, 1858)	1	T	Baro
Notogomphus lecythus CAMPION, 1923	2a	T	BMNH
Notogomphus ruppeli (SELYS, 1858)	1	E	Katc
***Paragomphus* COWLEY, 1934**			species uncertain (larvae): Gab1, Miza
Paragomphus alluaudi (MARTIN, 1915)	1	N	Baro
Paragomphus crenigomphoides sp. nov.	1	E	Won2, Wush
Paragomphus genei (SELYS, 1841)	1		Lang
Corduliidae			
***Phyllomacromia* SELYS, 1878**			species uncertain: Sek1
Phyllomacromia pallidinervis (FÖRSTER, 1906)	2b	T	
Phyllomacromia picta (HAGEN IN SELYS, 1871)	1		Bork, Gibe
Libellulidae			
***Acisoma* RAMBUR, 1842**			
Acisoma panorpoides RAMBUR, 1842	1		Awas, Sek2, Won1
***Atoconeura* KARSCH, 1899**			
Atoconeura aethiopica KIMMINS, 1958	1	E	Abel, Baro, Bork, Gech, Sek1, Won2, Wush
***Brachythemis* BRAUER, 1868**			
Brachythemis lacustris (KIRBY, 1889)	3		
Brachythemis leucosticta (BURMEISTER, 1839)	1		Awas, Lang
***Chalcostephia* KIRBY, 1889**			
Chalcostephia flavifrons KIRBY, 1889	1	N	Gab1
***Crocothemis* BRAUER, 1868**			
Crocothemis erythraea (BRULLÉ, 1832)	1		Adal, Awas, Bebe, Sek2, Won1
Crocothemis sanguinolenta (BURMEISTER, 1839)	1		Neke
***Diplacodes* KIRBY, 1889**			
Diplacodes lefebvrii (RAMBUR, 1842)	1		Awas
***Hemistigma* KIRBY, 1889**			
Hemistigma albipunctum (RAMBUR, 1842)	3		
***Nesciothemis* LONGFIELD, 1955**			
Nesciothemis farinosa (FÖRSTER, 1898)	1		Bulb, Neke, Sek1
***Orthetrum* NEWMAN, 1833**			
Orthetrum abbotti CALVERT, 1892	1		Sek2
Orthetrum brachiale (PALISOT DE BEAUVOIS, 1817)	3		
Orthetrum caffrum (BURMEISTER, 1839)	1		Adal
Orthetrum chrysostigma (BURMEISTER, 1839)	1		Neke
Orthetrum guineense RIS, 1910	1		Neke, Sire
Orthetrum hintzi SCHMIDT, 1951	1	N	Bebe, Sek2
Orthetrum julia KIRBY, 1900	1		Abel, Bon1, Bon2, Bork, Gab1, Sek1, Sek2, Won1

Table 3. Continue

	V	S	New records / Museum
Orthetrum kollmannspergeri Buchholz, 1959	3		
Orthetrum kristenseni Ris, 1911	1	E	Berg, Bon2, Debr, Dins, Mash
Orthetrum machadoi Longfield, 1955	1		Sek2
Orthetrum monardi Schmidt, 1951	2a		MZUF
Orthetrum stemmale (Burmeister, 1839)	3		
Orthetrum trinacria (Selys, 1841)	1		Awas, Sek2, Ziwa
***Palpopleura* Rambur, 1842**			
Palpopleura deceptor (Calvert, 1899)	2b	T	
Palpopleura jucunda radiata Pinhey, 1982	1		Sek2
Palpopleura lucia (Drury, 1773)	1		Bork, Gab1, Neke, Sek1, Sek2
Palpopleura portia (Drury, 1773)	1		Sek2, Sire, Won1
***Pantala* Hagen, 1861**			
Pantala flavescens (Fabricius, 1798)	1		Bulb, Gab1, Sek2
***Philonomon* Förster, 1906**			
Philonomon luminans (Karsch, 1893)	3		
***Rhyothemis* Hagen, 1867**			
Rhyothemis semihyalina (Desjardins, 1832)	1		Awas
***Sympetrum* Newman, 1833**			
Sympetrum fonscolombii (Selys, 1840)	3		
***Tholymis* Hagen, 1867**			
Tholymis tillarga (Fabricius, 1798)	3		
***Tramea* Hagen, 1861**			
Tramea basilaris (Palisot de Beauvois, 1817)	1		southern Rift Valley
Tramea limbata (Desjardins, 1832)	1	N	Sek2
***Trithemis* Brauer, 1868**			
Trithemis aconita Lieftinck, 1969	1	N	Bork
Trithemis annulata (Palisot de Beauvois, 1807)	1		Awas, Gibe
Trithemis arteriosa (Burmeister, 1839)	2a		MZUF
Trithemis dejouxi Pinhey, 1978	3		
Trithemis donaldsoni (Calvert, 1899)	2b	T	
Trithemis ellenbeckii Förster, 1906	1	E	Adal, Bulb, Debr, Gibe, Gore, Sek1, Sire
Trithemis furva Karsch, 1899	1		Bork, Neke, Sire
Trithemis imitata Pinhey, 1961	2a		MZUF
Trithemis kirbyi Selys, 1891	1		Sire
Trithemis stictica (Burmeister, 1839)	1		Adal, Gore
***Urothemis* Brauer, 1868**			
Urothemis assignata (Selys, 1872)	3		
***Zygonyx* Hagen, 1867**			
Zygonyx natalensis (Martin, 1900)	1		Abel, Bar+o, Bork, Sire
Zygonyx torridus (Kirby, 1889)	3		

Table 4. Differences between males of *Ischnura abyssinica* and *I. senegalensis*.

	***Ischnura abyssinica* Martin, 1907**	***Ischnura senegalensis* (Rambur, 1842)**
Hindlobe prothorax	Ridge across lobe is pale and rather straight, fused medially with posterior section of lobe.	Posterior section of lobe is well-separated from strongly sinuous black ridge anterior to it.
Mesostigmal ridge	Pale, low and discontinuous medially.	Black, high and continuous across middorsal suture.
Antehumeral stripe	At least half as wide as humeral stripe.	Often reduced and at most one-fifth as wide as humeral stripe.
Forewing pterostigma	About twice as large as hindwing pterostigma. Pinkish-white for only distal third, but this sharply demarcated from dark two-thirds (Fig. 15a).	Only slightly larger than hindwing pterostigma. About distal half bluish-white with rather smudgy demarcation from dark half.
Abdomen tip	Segment 8–9 largely blue, dorsum 10 at most black to level of cerci.	Only segment 8 largely blue, 9–10 black down to about paraprocts.
Apical process segment 10	Wider than high (Fig. 15d).	Higher than wide.
Paraprocts	Slightly longer than cerci (Fig. 15c).	At least twice as long as cerci.

occur throughout Africa – by Dumont (1978). Records of *P. acaciae* from all across Kenya and further north pertain to *P. niloticum* (own observations). *"Enallagma" caputavis* belongs to the genus *Pseudagrion* (May 2002). It pertains to *P. niloticum* (F. Terzani in litt., 4.II.2004), as is shown by illustrations of penis and appendages by Terzani & Carletti (1998).

Thermagrion webbianum Förster, 1906

The identity of this species and genus, described from a female from the Webbi River, remains a mystery. The type has not been located in UMMZ where other types of Förster (1906) have been found, and thus appears to be lost (Garrison, von Ellenrieder *et al*. 2003). Therefore the enigma can probably not be resolved, and the taxon is not listed.

Aeshna cf. *yemenensis* Waterston, 1985

A species close to *A. meruensis* Sjöstedt, 1909 and especially *A. yemenensis* occurs in the highlands of Ethiopia and western Sudan (Clausnitzer & Peters 2003). Records of *A. rileyi* from Ethiopia (e.g. Pinhey 1982) must pertain to this species. G. Peters labelled specimens of this taxon, which we believe to be a valid species, in BMNH as "*Aeshna meruensis waterstoni*". This name was never published, other than by Telfer (1992) as *nomen nudum* (no description or type designation). As long as this species has not been properly described or named, we refer to it as *Aeshna* cf. *yemenensis*. The species was common in the highlands at 1650–1850 m a.s.l., where we frequently found exuviae on rocks along streams and small rivers with some gallery vegetation or forest. It was seen patrolling over such sites at dusk. Adults can also be found during the day away from water, hunting in open spaces like roads.

Crenigomphus abyssinicus (Selys, 1878) and *C. denticulatus* Selys, 1892

These species have been confused (e.g. Pinhey 1961). Fraser (1960) stated that

of *C. abyssinicus* "only two females and a male [are] known. The former came from Abyssinia, the latter from Uganda and is regarded as the correct male [...] only on supposition". He added "Uganda, swampy borders of Lake Victoria" as the species' habitat. The male – now the allotype (BMNH) – is labelled "E. Abyssinia". Presumably Fraser was in error, misleading later authors such as Pinhey (1962) who stated "Uganda (teste Fraser, ex Carpenter)" for *C. abyssinicus*. We have seen neither *C. abyssinicus* nor *C. denticulatus* from Uganda and consider both as Ethiopian endemics. There are very few (mostly old) records, and we found neither during our survey. All of the geographically more precise records are from north and east Ethiopia, areas we did not visit.

Notogomphus cottarellii Consiglio, 1978 (Fig. 12)

This species was only known from the type pair collected between Bonga and Baca in "degraded forest with coffee plantation" (Brignoli, Consiglio *et al.* 1978, p. 13). A male labelled "Abessinien, Gore 4. 1947, *I. Ambjörn*" was located by the second author in NHRS. We found an emerging female along a clear, rocky forest stream near Wushwush (Fig. 4). This locality lies between the two previous ones. *Notogomphus cottarellii* appears to inhabit streams with some forest in the southwestern highlands (recorded altitude range 1800– 1850 m).

Notogomphus ruppeli (Selys, 1858) (Fig. 14)

This species was introduced as "*Gomphus Ruppeli*" (after Eduard Rüppell) by Selys-Longchamps (1858). The name has been spelt in several ways since, mainly to correct for the vowel mutation and the missing consonant (Tab. 5). These were nonetheless all unjustified emendations. It could be argued that since *N. rueppeli* is in prevailing usage most recently, it is a justified emendation according to article 33.2.3.1 of the International Code of Zoological Nomenclature (2000). On the other hand, that disregards Consiglio (1978b) – the sole reviser of Ethiopian *Notogomphus* – who returned to the original and technically correct spelling. The "prevailing usage" of *N. rueppeli* has only two causes; repetition in species catalogues and by Pinhey. Earlier authors preferred *N. ruppeli* or other alternative spellings and Selys-Longchamps himself never corrected the vowel mutation (Tab. 5). Because "prevailing usage" is not defined in the Code and can be argued for both names, it is best to follow Selys-Longchamps's and Consiglio's preference for the original name. The species was described from "Le Simmen" and reported by Consiglio (1978b) from central Ethiopia (near Mts Wechecha and Chilalo). We found it in the Harenna Forest on the southern slopes of the Bale Mts. The habitat was a stream in montane forest with dense stands of bamboo along it (Fig. 5). The records are from an altitude of about 2300 to 2400 m, suggesting that this is a truly montane species. Small *Notogomphus* exuviae found at a forested stream at Wondo Genet (only about 1650 m a.s.l.) may also pertain to this species.

Paragomphus alluaudi (Martin, 1915)

The taxonomy of the *cognatus*-group of *Paragomphus* – characterised by truncated, apically divergent cerci – is problematic. Owing to its poor description, the identity of *P. alluaudi* has long remained unclear. It is known from the highlands of Kenya and northern Tanzania. The male from Baro River agrees with *P. alluaudi*, although that species is very similar to *P. abnormis* (Karsch, 1890) of west and central Africa.

Paragomphus crenigomphoides sp. nov.

Ris (1921) reported *Paragomphus cognatus* from Ethiopia, stating: "Coll. Ris: 2 males, River Errer, Harrar, Abyssinia (vii, 1911, Kristensen)". A male in ZFMK appears to be one of these two. It is distinct from *P. cognatus* and becomes the holotype of the new species described here. A female and a teneral male matching this species were found at two sites. Both were clear, fast-flowing streams with a rocky bottom, enclosed by forest (Fig. 4). Ris' locality at Harer is 450–700 km northeast of our localities (Fig. 1). It lies in a drier part of the country, suggesting a broader ecological and geographic range of the species. It appears to be endemic to Ethiopia. We have found no evidence that true *P. cognatus* occurs in Ethiopia, assuming that both Ris's males pertained to the new species.

Holotype. ♂, papered, in good condition but abdomen broken at intersections of segments 3–4, 5–6 and 6–7 and right cercus broken off. Handwritten on envelope in black ink: "Harrar [= Harer], Abessinia, Kristensen 1911", "Mesogomphus cognatus ♂" and in green ink: "14975", Zoologisches Forschungsmuseum "Alexander Koenig".

Etymology. The whitish thoracic bands and the pterostigma-costa contrast are reminiscent of *Crenigomphus* species: Indeed the authors debated the generic assignment when first encountering a female of the species.

Description. Entire length: 41 mm, abdomen (approximate, excluding cerci): 27 mm, forewing: 23.8 mm, hindwing: 22.5 mm, forewing pterostigma: 3.0 mm. Underside of head including lower postgenae, labium, mandibles, genae, labrum and anteclypeus uniformly pale creamish beige, except for slight darkening at extreme base of labrum. Postclypeus and frons more yellow, with two dark smudged spots in middle of anterior postclypeus, and antefrons (part of frons anterior to frontal ridge) largely infuscated with dark brown (except along lateral 4/5 of anterior suture). Postfrons yellow with basal half dark brown, with 7–9 black denticles on each side just above frontal ridge. Vertex and

Table 5. Variations and use of the spelling of *Notogomphus ruppeli*.

Ruppeli	Selys-Longchamps (1858), Karsch (1890), Selys-Longchamps (1892), Campion (1923), Consiglio (1978b)
Ruppellii	Selys-Longchamps (1859)
Rueppeli	Kirby (1890), Pinhey (1961), (1962), (1982), (1984), Bridges (1994)
Rueppelli	Ris (1909)
Rüppeli	Martin (1915), Pinhey (1951)
Ruppelyi	Klots (1944)

Figs 2 – 6: Habitats of Odonata in Ethiopia

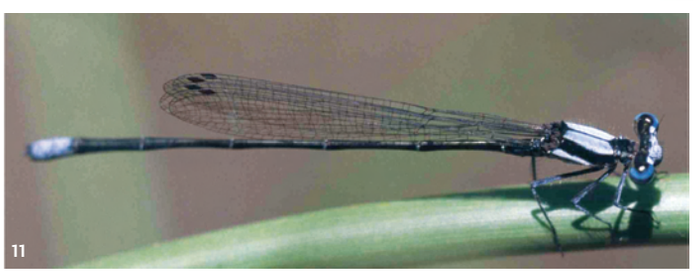
2. Habitat of *Elattoneura pasquinii* Consiglio, 1978, *Pseudagrion kaffinum* Consiglio, 1978 and *Trithemis ellenbeckii* Förster, 1906 near Bulbul, Ethiopia, 22.III.2004 (Bulb).

3. Habitat of *Ischnura abyssinica* Martin, 1907 and *Trithemis ellenbeckii* Förster, 1906 between Ginchi and Adis Alem, Ethiopia, 13.III.2004 (Adal).

4. Habitat of *Pseudagrion guichardi* Kimmins, 1958, *Notogomphus cottarellii* Consiglio, 1978, *Paragomphus crenigomphoides* sp. nov. and *Atoconeura aethiopica* Kimmins, 1958 near Wushwush, Ethiopia, 19.III.2004 Wush.

5. Habitat of *Pseudagrion guichardi* Kimmins, 1958 and *Notogomphus ruppeli* (Sélys, 1857) in the Harenna Forest, Ethiopia, 2.II.2004 (Katc).

6. Habitat of *Pseudagrion kaffinum* Consiglio, 1978 and *Trithemis ellenbeckii* Förster, 1906 south of Gore, Ethiopia, 17.III.2004 (Gore).



Figs 7 – 14: Some Odonata of Ethiopia

7. *Atoconeura aethiopica* KIMMINS, 1958 ♂ (Wush).
8. *Ischnura abyssinica* MARTIN, 1907 ♂ (a) and androchrome ♀ (b) (Adal).
9. *Pseudagrion kaffinum* CONSIGLIO, 1978 ♂ (Gore).
10. *Pseudagrion guichardi* KIMMINS, 1958 ♂ (a: Wush, b: Katc).
11. *Elattoneura pasquinii* CONSIGLIO, 1978 ♂ (Bulb).
12. *Notogomphus cottarellii* CONSIGLIO, 1978 ♀ (Wush).
13. *Orthetrum kristenseni* RIS, 1911 ♂ (Dins).
14. *Notogomphus ruppeli* (SÉLYS, 1857) ♂ (Katc).

antennae dark brown except for indistinct yellowish spots on transverse ridge and on external side of lateral ocelli. Occiput dull yellow, infuscated along ridge. Frontal, vertical and occipital ridges with fine pale hairs. Occipital ridge with 1–2 small black denticles on each side close to eye margin. Dorsal 1/5 of postgenae dark brown. Prothorax concealed by head, dark brown marked with dull yellow as follows: Small central spot in centre of forelobe, sides of middle lobe broadly yellow and large spot in centre of hindlobe. Synthorax dark brown, marked as follows (Fig. 16a): Mesepisternum broadly yellow along collar and middorsal carina, the latter edged blackish from tooth to dorsal end. Yellow postdorsal stripes distinctly separated from other pale markings by dark brown, about 2/3 as wide as the brown area between it and antehumeral stripe. Yellow antehumeral stripes narrow, only 1/4 as wide as dark humeral stripes, broadly interrupted at level of humeral fossae, the dorsal sections extended as triangular spots with their inner corners lying near dorsal ends of postdorsal stripes. Each mesepimeron largely occupied by broad milk-white band that widens and becomes more yellow dorsally (extending onto metepisternum) and is slightly wider than humeral stripe. Metepisternum with elongate yellow spot on posterior side of metastigma and a similar spot between it and posterior end of mesepimeral band. Metepimeron with similar whitish band as mesepimeron, this also more yellow dorsally and widening. Meso- and metakatepisternum both yellow, edged brown anteriorly, posteriorly and dorsally. Antealar sinus pale brown. Synthoracic venter creamish white with dark brown stripe on each metepimeron. Coxae, trochanters and femora pale yellow, browner on underside. Tibiae, tarsi and tarsal claws blackish brown, with pale yellow streaks on outer surfaces of tibiae, these full-breadth on fore tibiae but only a narrow line on hind. Wings clear, venation brown-black except for anterior side of costa, which is contrastingly pale yellow. This colour extends from base, anterior of pterostigmas, to wing tips. Pterostigmas uniformly dark chocolate brown, contrasting strongly with yellow of costa. Forewings with 10–11 antenodal veins and seven postnodal veins, hindwings with nine and 7–8 respectively. Anal loops present, each of one cell. Anal triangles both of four cells, these configured as in *P. cognatus* (see Cammaerts 1968). Abdominal segment 1 yellowish, browner dorsally. Segment 2 yellow, dark brown dorsally, sparing out yellow auricle, apical ring and dorsal streak along entire segment length. Segments 3 to 6 mainly yellowish but progressively darker; dark brown broadly laterally and narrowly along dorsal carina. Segment 7 similar, but dark marking concentrated in terminal 1/3. Segments 8 and 9 with broad foliations. Dorsum of both segments blackish-brown with complete yellowish dorsal streaks, sides to base of foliations yellow, foliations broadly bordered with dark brown on segment 8, narrowly on 9. Segment 10 yellowish, blackish dorso-basally and on apical border. Secondary genitalia dark brown, base of posterior hamules yellowish; morphology typical of *cognatus*-group (see Cammaerts 1968). Appendages yellowish, browner ventrally and terminally. Their morphology also typical of group (Figs 16b–c), but cerci stouter and their tip less coarsely toothed and more strongly curved anteriad.

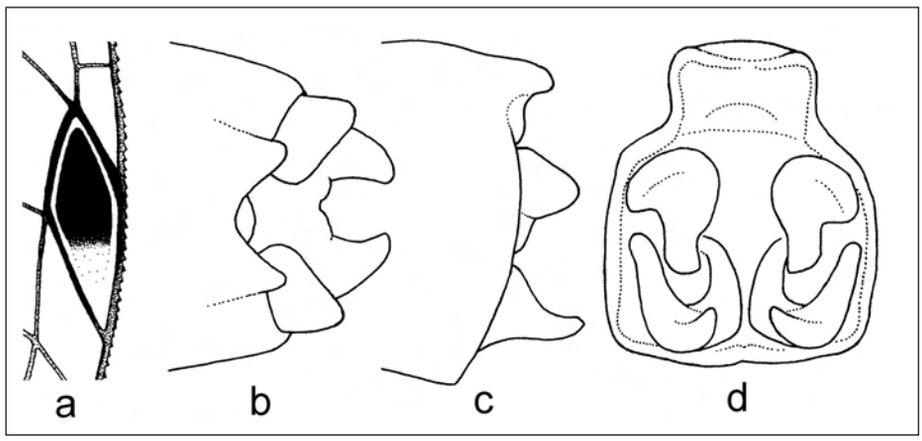


Fig. 15. *Ischnura abyssinica* Martin, 1907 syntype ♂: (a) forewing pterostigma, (b) appendages in dorsal view, (c) appendages in lateral view, (d) appendages in caudal view.

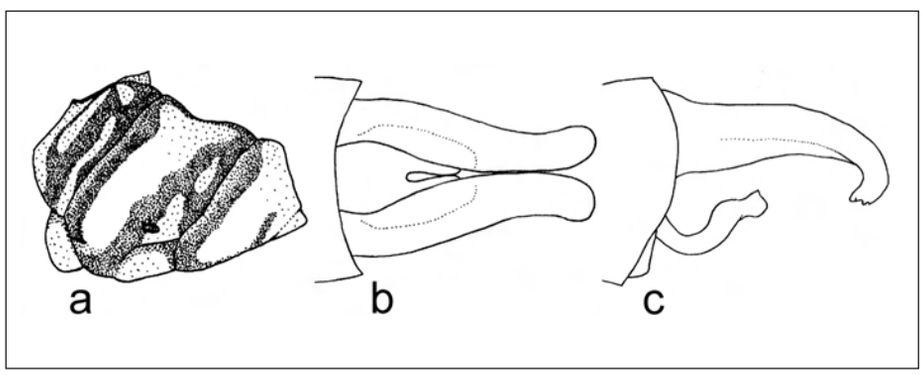


Fig. 16. *Paragomphus crenigomphoides* sp. nov. Holotype ♂: (a) synthorax in lateral view, (b) appendages in dorsal view, (c) appendages in lateral view.

Diagnosis. Mature specimens of both sexes are easily separated from all African *Paragomphus* species by the dark pterostigma contrasting with the pale costa anterior to it, as well as the two cream bands on each thorax side. The male's cerci show it belongs to the *cognatus*-group of *Paragomphus*. This group consists of more than ten very similar species (an unknown number is undescribed), posing one of the greatest taxonomic problems in African Odonata (see Cammaerts 1968, 1969). About eight species occur in eastern Africa, three of which – *P. alluaudi*, *P. cognatus* and *P. viridior* Pinhey, 1961 – are widespread in the nations south of Ethiopia. The new species differs most clearly from other group members in coloration: Its southern relatives have a distinctly and uniformly green ground colour, combined with blackish markings. *Paragomphus crenigomphoides* sp. nov. combines extensive dark thoracic markings enclosing complete pale stripes (e.g. the isolated postdorsals) with very pale ground colours. It has a mostly yellow colour, contrasting with whitish mes- and metepimeral bands, and the dark markings are a fainter brown. In configuration of markings *P. cognatus* is nearest the Ethiopian species, but the dark colours are

deeper and even more extensive. Also the cerci have much thicker and less strongly curved tips. In *P. alluaudi* the dark thoracic markings are reduced, resulting in the fusion of green stripes, while in *P. viridior* these markings are so much restricted that the thorax is almost uniformly green. In *P. alluaudi* and *P. cognatus* the pterostigma is black-brown but the costa is black anterior to it and towards the wing tips. The costa of *P. viridior* is similar, moreover the pterostigma is beige. The cerci of *P. alluaudi* and *P. viridior* are similar to those of *P. cognatus* but slightly sleeker overall. A potential difference (more specimens must be studied) is that *P. crenigomphoides* sp. nov. has blacker tibiae: In the other species there is, besides a pale central streak, a second streak on the external lateral ridge.

Atoconeura aethiopica Kimmins, 1958 (Fig. 7)

This endemic species was formerly considered a subspecies of *A. biordinata*, but it is better regarded as a good species (Dijkstra in prep.). It is not uncommon along clear streams and rivers (often with forest) between 1300 and 2400 m a.s.l. in the highlands south of Addis Abeba (e.g. Fig. 4).

Orthetrum kollmannspergeri Buchholz, 1959

Buchholz (1959) gave an accurate description and illustration of *Orthetrum kollmannspergeri*. These match *O. taeniolatum* (Schneider, 1845), a species that ranges widely in the dry parts of Asia and has been reported as far west as northern Nigeria, although Buchholz only compared his taxon with the co-occurring *O. caffrum*. The type locality Adré, thought to lie in the Central African Republic by Pinhey (1970b), actually lies on the Chad-Sudan border between Abéché and Jebel Marra. Indeed, *O. taeniolatum* was mentioned from the adjacent Darfur (Dumont 1988), including the first African records by Longfield (1936). The second author compared the holotype and a paratype in ZFMK with specimens of *O. taeniolatum* (described from Rhodes) from southern Turkey. They agree in their small size, short pterostigma, parallel-sided abdomen, markings of head, thorax and wings and the shape of the hamule. There is a marked difference in the shape of the lateral lobes (alae) of the penis though, those of *O. kollmannspergeri* being diagnostically T-shaped. "*O. taeniolatum*" from Darfur and Yemen possess T-shaped alae (H.J. Dumont in litt., V.2004 & Verschuren 2004, W. Schneider in litt., 17.V.2004), suggesting all African records of *O. taeniolatum* refer to its western counterpart *O. kollmannspergeri*. It is known from northeast Chad to northern Ethiopia and Yemen, but reports from the drier northern parts of Côte d'Ivoire (Lindley 1974), Nigeria and Central African Republic (Pinhey 1970b) require confirmation. Pinhey (1970b) illustrated secondary genitalia of a so-called paratype of *O. kollmannspergeri*, but these are peculiar for the genus and disagree with the ZFMK males and Buchholz's illustrations. Probably Pinhey's paratype was damaged (H.J. Dumont in litt., V.2004 & Verschuren 2004).

Orthetrum kristenseni Ris, 1911 (Fig. 13)

This endemic species is common in Ethiopia up to 3200 m a.s.l. and appears to occur at least as low as 1700 m. It has been found throughout the highlands, its absence from the north probably reflects under-recording there. Assuming it breeds at 3200 m (suitable habitat was available), *O. kristenseni* is one of the highest venturing odonates in Africa. It favours swampy areas and slow, open grassy streams.

Palpopleura jucunda radiata Pinhey, 1982

The subspecies *radiata* was described by Pinhey (1982) from Ethiopia (Dire Dawa, Jima, Harer) and Jebel Marra in western Sudan: It thus has a similar distribution as *Aeshna* cf. *yemenensis*. Its significantly reduced wing markings are a stable feature. Our discovery of the taxon at a sedge swamp near Jima suggests its habitat is like that of the widespread nominotypical subspecies; stagnant wet areas with grasses, sedges or reeds.

Trithemis ellenbeckii Förster, 1906

This endemic species is common throughout the Ethiopian highlands between 1600 and 2600 m a.s.l. and is the only one to have been recorded from Eritrea. We invariably found it at open, slow-flowing waters (small streams to broad rivers) with muddy and grassy banks.

Diversity and biogeography of Ethiopian Odonata

All Odonata species reliably recorded from Ethiopia are listed in Table 3. Numerous species can still be added, especially in the Gambela lowlands, although the list for the highlands is probably quite definite. The total number of 96 species is low when compared to those of neighbouring countries: Kenya and Uganda have 1.7x and 2.3x as many species respectively (Dijkstra & Clausnitzer in prep.). Table 6 lists the species removed from the Ethiopian list. Many of these errors rest on geographic confusion. Consiglio (1978a) and Pinhey (1982) listed Somalian and Eritrean records in their papers on the Ethiopian Odonata. Tsuda (2000) interpreted "Ethiopian" as meaning "from Ethiopia" where "from tropical Africa" was intended (e.g. Compte Sart 1967). Historic references to Abyssinia may apply to a wider area than the present-day state and thus require confirmation. Specimens published by Carfì & Terzani (1993) and Terzani & Carletti (1998) kept in MZUF were checked by us and found to include some errors.

We surveyed a large area with many and diverse habitats, and the following results were notable:

- The high proportion of endemic species recorded (14.5 %).
- The low total number of species recorded (69).
- The low average of 6.6 species recorded per locality (see Table 1).
- The low average proportion of sites at which each species was recorded (9.2 %): 47 % of the species were found at only one site.
- The scarceness of species known to be common in similar habitats further south (Kenya, Uganda, Tanzania, Malawi).

Endemism

Whereas species numbers in Ethiopia are low, endemism is high at 12 %, versus between 1 and 3 % for Kenya, Tanzania

Table 6. Odonata species listed by Consiglio (1978a), Pinhey (1982) and Tsuda (2000) removed from Ethiopian list because records are regarded as unreliable. Status (S): ?: Species' presence cannot be ruled out completely, as its African range suggests it may well occur in Ethiopia; X: Cause of error appears clear, e. g. species is a synonym, all relevant specimens were incorrectly identified or localities were confused.

Species	S	Reason for exclusion
Chlorocypha gracilis (Karsch, 1899)	X	"Ethiopian" in description of synonym *C. muniensis* Compte Sart, 1967 means Afrotropical.
Mesocnemis singularis Karsch, 1891	?	Identification of old record uncertain.
Elattoneura glauca (Selys, 1860)	?	Identification of Dumont (1983) record uncertain, specimen lost (pers. com. H.J. Dumont).
Africallagma sinuatum (Ris, 1921)	X	Dumont (1983) specimens re-identified as *A. elongatum*.
Enallagma caputavis Terzani & Carletti, 1998	X	See comment on *Pseudagrion niloticum*.
Ischnura evansi Morton, 1919	X	Legrand's (1984) records from Djibouti only, despite his paper dealing primarily with Ethiopian material.
Ischnura hilli Pinhey, 1964	X	See comment on *Ischnura abyssinica*.
Pseudagrion acaciae Förster, 1906	X	See comment on *Pseudagrion niloticum*.
Pseudagrion commoniae (Förster, 1902)	X	Record is from Eritrea.
Pseudagrion lindicum Grünberg, 1902	X	Record is from southern Somalia.
Pseudagrion punctum (Rambur, 1842)	X	Old record of Malagasy species.
Pseudagrion salisburyense Ris, 1921	?	Identification of old record uncertain.
Pseudagrion serrulatum Karsch, 1894	X	"Ethiopian" in description of ssp. *martorelli* Compte Sart, 1967 means Afrotropical.
Pseudagrion sjoestedti Förster, 1906	X	Terzani & Carletti (1998) female pertains to another species, probably *P. spernatum*.
Thermagrion webbianum Förster, 1906	X	See comment on this species.
Aeshna rileyi Calvert, 1892	X	See comment on *A.* cf. *yemenensis*.
Anax tristis Hagen, 1867	?	Historic reference to "Abyssinia" too imprecise.
Heliaeschna raymondi Compte Sart, 1967	X	"Ethiopian" in species description means Afrotropical.
Ictinogomphus ferox (Rambur, 1842)	?	Identification of old record uncertain.
Neurogomphus agilis (Martin, 1908)	X	Historic reference to "Abyssinia" too imprecise.
Notogomphus cataractae Consiglio, 1978	X	Synonym of *N. lecythus*, see Clausnitzer (2003c).
Onychogomphus nigrotibialis Sjöstedt, 1909	?	Identification of old record uncertain.
Paragomphus cognatus (Rambur, 1842)	X	See comment on *P. crenigomphoides*.
Paragomphus pumilio (Rambur, 1842)	?	Historic reference to "Abyssinia" too imprecise.
Phyllogomphus margaritae Compte Sart, 1967	X	"Ethiopian" in species description means Afrotropical.
Phyllomacromia africana (Selys, 1871)	?	Origin of record not traced.
Phyllomacromia congolica (Fraser, 1955)	X	Origin of record not traced.
Phyllomacromia contumax Selys, 1879	X	Historic reference of synonym *P. biflava* Martin 1907 from "Abyssinia" too imprecise.
Aethiothemis palustris Martin, 1912	?	Identification of old record uncertain.
Atoconeura biordinata Karsch, 1899	X	See comment on *A. aethiopica*.
Bradinopyga cornuta Ris, 1911	X	Terzani & Carletti (1998) female reidentified as *Nesciothemis farinosa*.
Bradinopyga strachani (Kirby, 1900)	?	Historic reference to "Abyssinia" too imprecise.
Orthetrum sabina (Drury, 1770)	X	Records are from coastal Eritrea, Somalia and Sudan.
Orthetrum taeniolatum (Schneider, 1845)	X	See comment on *O. kollmannspergeri*.
Trithemis monardi Ris, 1931	X	Carfì & Terzani (1993) male reidentified as *T. imitata*.
Trithemis pluvialis Förster, 1906	X	Carfì & Terzani (1993) male reidentified as *T. arteriosa*.
Trithemis pruinata Karsch, 1899	X	Identification of old record uncertain.
Urothemis thomasi Longfield, 1932	X	Synonym *U. signata aethiopica* was not described from Ethiopia but northeast Somalia.

and Uganda each. Among the fourteen most widespread high-altitude species in Ethiopia are the endemic *Atoconeura aethiopica*, *Orthetrum kristenseni* and *Trithemis ellenbeckii* and the near-endemic *Aeshna* cf. *yemenensis*, while *Pseudagrion bicoerulans* Martin, 1907 is the only regional endemic of that status in Kenya and Tanzania. The origin of the endemics is as informative about the history of the fauna as the absence of other species. *Pseudagrion*, *Paragomphus*, *Orthetrum* and *Trithemis* are among the dominant genera in tropical Africa, both in species as individual numbers. It therefore is not surprising that these genera account for five endemics. *Pseudagrion guichardi* and *P. kaffinum* belong to a group with orange-faced, pruinose males that possess a small tooth on the inside of the cerci. This group has a number of species in eastern African highlands south to South Africa. *Orthetrum kristenseni* and *Trithemis ellenbeckii* each have a close relative in the eastern highlands: *Orthetrum caffrum* and *Trithemis dorsalis* (Rambur, 1842). The situation in *Noto-*

gomphus and *Atoconeura* is similar: Although there are fewer species with smaller ranges, the greatest diversity lies in the highlands of eastern Africa. In Ethiopia *Notogomphus* includes two endemics, whose markings suggest they are sister-species, while *N. lecythus* is otherwise only known from western Kenya and *N. dorsalis* ranges to Lake Albert and Mt Kilimanjaro. *A. aethiopica* is close to *A. kenya* Longfield, 1953 of the Kenyan and north Tanzanian mountains. *Elattoneura*, *Ischnura* and *Crenigomphus* deviate from the east-montane scenario. Two of only five existing *Crenigomphus* species are Ethiopian endemics. The three others have large ranges in open country in tropical Africa. Most *Elattoneura* species occur in central and west African forests, but *E. pasquinii* may be related to two openland species of eastern Africa, *E. glauca* and *E. cellularis* (Grünberg, 1902) (= *E. tropicalis* Pinhey, 1974). *Ischnura abyssinica* is the only endemic species without obvious links further south. The genus *Ischnura* is practically cosmopolitan, well represented in the Holarctic and most poorly in the Afrotropics. *I. senegalensis* occurs throughout the Old World tropics, but is not particularly similar to *I. abyssinica*. Perhaps its affinities lie with the diverse *Ischnura* fauna of northern Africa, Arabia and central Asia. Madagascar and Mauritius each have an endemic *Ischnura* species. This peripheral distribution of the genus in tropical Africa is puzzling; certainly *I. abyssinica* is the only Ethiopian endemic odonate with possible Palaearctic affinities. Such a relationship is dominant in Ethiopia's montane grassland butterflies; all endemics are northern elements (de Jong & Congdon 1993).

Forest species

Ethiopia's impoverishment rests mainly on the paucity of forest species. Most of the additional species in the Kenyan and Tanzanian highlands inhabit forest. Although the forests of Ethiopia are believed to have been connected to those of central Africa in the past (e.g. Clarke 2000), few dragonfly species indicate this: Our records of *Gynacantha nigeriensis* and *G. vesiculata* – both otherwise ranging from near Kampala to western Africa – are the only tell-tale signs. Absent forest genera for which suitable habitat exists are, among others, *Chlorocypha*, *Umma*, *Chlorocnemis*, *Hadrothemis*, *Micromacromia* and *Notiothemis*. All these predominantly west and central African genera have representatives in the Eastern Arc, East Coast forests and some even in the desert-enclosed highlands of Jebel Marra and Mt Marsabit (Clausnitzer 2003a, 2003b).

The forests of Ethiopia are more impoverished than similar biomes elsewhere, like Kenya. Such patterns – deviant species sets due to impoverishment, endemism and extra-Afrotropical elements – have been reported for Ethiopia's flora (Hedberg 1969, Q. Luke, pers. com.), butterflies (Carcasson 1964, de Jong & Congdon 1993) and montane forest avifauna (Stuart *et al.* 1993). All show fewer affinities to the central African forests than may be expected. The montane forest butterfly and bird faunas of Ethiopia do not group closely with those of any other Afrotropical area (de Jong & Congdon 1993, Stuart *et al*. 1993). The greatest phytogeographical disjunction in the eastern African montane flora occurs between Ethiopia and more southern sites (Hedberg 1969). Based on chloroplast DNA of giant lobelias in eastern Africa, Knox & Palmer (1998) suggested that Ethiopian endemics originated from long-distance dispersal, but they concluded that the "pattern of cpDNA distribution in the Ethiopian endemics [of *Lobelia*] is not consistent with predictions based on geography, ecology, or taxonomic identity".

Altitude

The first factor that might explain the observations given above is altitude: The majority of our sites lay above 1450 m. If we examine those species found above this altitude in Kenya and Tanzania (we have data of 102 species from 52 sites) with those from Ethiopia (66 from 26 sites), two main patterns emerge: openland species are generally shared but scarcer in Ethiopia; Ethiopia has much fewer forest species and none are shared.

Most of the species common in open habitats in the Kenyan and Tanzanian highlands above 1450 m were recorded in Ethiopia as well: *Pseudagrion spernatum*, *Proischnura subfurcata* and *Orthetrum julia* are dominant species in both areas. *Platycypha caligata*, *Africallagma elongatum*, *Ceriagrion glabrum*, *Anax imperator*, *A. speratus*, *Crocothemis erythraea* and *Pantala flavescens* are also generally widespread. On the other hand, species like *Pseudagrion kersteni*, *Aeshna ellioti*, *Crocothemis sanguinolenta*, *Orthetrum caffrum*, *Trithemis arteriosa* and *T. furva* seemed scarce in upland Ethiopia compared with Kenya and Tanzania. This paucity may be explained by our timing: The survey took place at the beginning of the warm and (delayed) wet season. Nonetheless a high number of these species is non-seasonal if water is permanent further south (V. Clausnitzer, unpubl.). A more extreme cold and dry season could induce stronger seasonality in the Ethiopian highlands. Possibly many widespread species that are found in nearly every habitat (except dense forest) throughout tropical Africa (and sometimes adjacent Eurasia) have not colonised the highlands for this reason. Some of these species occur in the Rift Valley, where conditions may be more favourable. An example is the genus *Pseudagrion*: Members of Pinhey's (1964b) thermophilous and often stagnicolous B-group (*massaicum*, *niloticum*, *nubicum*, *sublacteum*, *torridum*) are numerous in – and probably restricted to – the Rift Valley, while the remaining species (all A-group) occupy the highland streams. On the other hand it was surprising to find *Lestes tridens* and *Tramea limbata*, predominantly coastal species in East Africa, on a swampy dam near Jima, 1800 m above and 1100 km away from the ocean. We have no records from over 450 m (n = 15) for *T. limbata* or 250 m a.s.l. (n = 9) for *L. tridens* from Kenya and Tanzania. Also for other species (*Gynacantha villosa*, *Orthetrum machadoi*, *Rhyothemis semihyalina*, *Trithemis aconita*) our Ethiopian records are East African altitude records.

Geological and climatic history

The species-poor but endemic-rich Ethiopian fauna may be explained by the area's geological history and its present-day isolation. The Ethiopian dome began to rise some 75 million years ago, well before other African highlands. Up to 25 million years ago tropical forest stretched across Africa, including the Ethiopian highlands (Clarke 2000). Nonetheless this region may have been "devoid of much life" during the worst periods of volcanism, which ended some 4 or 5 million years ago (Kingdon 1989). Moreover, the climatic fluctuations of the Pliocene and Pleistocene were probably relatively severe in Ethiopia's highlands

due to its large mass of land at great altitude: During cooler periods, species adapted to relatively warm and wet conditions (like Odonata!) were literally crushed between the descending cold and arid piedmont. Potential re-colonization of the highlands was hampered by natural barriers; the extensive deserts and semi-deserts of northern Kenya and Somalia to the east and the south, the Red Sea to the north and the grassy floodplains of the White Nile to the west. For example, land at an altitude of 1000 m in Ethiopia and Kenya is now separated by a 250 km wide stretch with a mean annual rainfall below 250 mm. Furthermore Ethiopia's dramatic escarpments are a formidable barrier between the dry plain and the wet plateau, even for openland species.

Nonetheless, in warmer or wetter periods tropical African species must have expanded into the Ethiopian highlands. Perhaps the predecessor of *Ischnura abyssinica* penetrated from the north. Especially those species best adapted to montane conditions survived the climatic vicissitudes following their colonisation. A handful of species requiring warmer conditions, such as the *Gynacantha* species and possibly *Elattoneura pasquinii* survived in the warmer and wetter south and west of the highlands. Perhaps the two *Crenigomphus* species became isolated from their lowland savannah relatives in the drier north and east of the highlands.

Conservation

Deforestation and other human disturbance pose a major threat to Ethiopia's environmental wealth: With few exceptions the natural landscape has been turned into agricultural land. Already 95 % of Ethiopia's original forest has been lost to agriculture and human settlement (Gordon & Carillet 2003). It stands to reason that, having survived climatic and ecological adversity, Ethiopia's endemic Odonata should be relatively tolerant to anthropogenic habitat change, although the perpetual annihilation of forest may be unprecedented. Indeed about a half of the endemics occurs in wholly altered landscapes (Figs 2–3); *E. pasquinii*, *I. abyssinica*, *P. kaffinum*, *O. kristenseni*, *T. ellenbeckii*. These species are vulnerable due to their small ranges, but do not require immediate conservation measures. Unfortunately Ethiopia's yearly population growth rate of 2.5 % (Gordon & Carillet, 2003) is likely to lead to the loss of even their habitats due to afforestation with eucalypts, water extraction and pollution. Of more immediate concern are those endemics that inhabit forested clear rocky streams (Figs 4–5); *P. guichardi*, *P. crenigomphoides* sp. nov., *N. cottarellii*, *N. ruppeli* and *A. aethiopica*. Probably the forest mainly serves to protect watercourse structure (rate of flow, substrate type). Thus even a narrow or degraded strip could warrant the species' survival. These species must have declined drastically due to the heavy deforestation and streambed erosion that Ethiopia has experienced, although they still seem to be reasonably common (a judgment based on insufficient sampling!). If this continues – as is to be expected – these species come under severe threat. More surveys are needed to evaluate the ranges, requirements and threats of Ethiopia's endemic Odonata: For most species we still have only a handful of records. Especially the drier and densely populated highlands in the country's northern half demand research. Conservation recommendations that may follow from such surveys can help Ethiopia to fulfil its commitment to the Convention of Biodiversity.

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