

# The dragonflies and damselflies (Odonata) of Angola

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## Abstract

Prior to 2012, only 158 species of Odonata were known from Angola. Surveys in 2012 and 2013 added 76 species and two further additions in 2016 brought the national total to 236 species. We provide a revised checklist with taxonomic notes and discuss the history of research, the biogeography of the fauna, and the potential for further discoveries. The national total is likely to be above 300 species. This would make Angola one of the richest countries for Odonata in Africa. The endemic species formerly classified in *Chlorocypha* are transferred to *Platycypha*.

## Resumo

Até 2012, apenas eram conhecidas 158 espécies de Odonata em Angola. Levantamentos feitos em 2012 e 2013 acrescentaram 76 espécies que, em conjunto com dois novos registros de 2016, elevaram a lista nacional a 236 espécies. Apresentamos uma lista de referência revista, com notas taxonômicas e discussão histórica da investigação, a biogeografia da fauna e o potencial de novas descobertas. É provável que o número total de espécies no país seja superior a 300. Se assim for, Angola será um dos países africanos com maior riqueza em Odonata. As espécies endêmicas anteriormente classificadas como *Chlorocypha* foram transferidas para *Platycypha*.

**Keywords**

Africa, biogeography, checklist, diversity, conservation

**Palavras-chave**

África, biogeografia, checklist, diversidade, conservação

**Introduction**

Covering nearly 1,250,000 km<sup>2</sup>, Angola is the largest African country not dominated by the Sahara after the Democratic Republic of Congo. It has an accordingly high diversity of habitats, ranging from Namib Desert in the southwest through grassland, woodlands and montane forest to Congolian lowland rainforest in the northeast. Moreover, a great highland of up to 2,620 m asl (above sea level) is contained completely within Angola's borders, leading to substantial endemism. Therefore, the country is likely to be one of the richest in species in Africa. However, Angola's biodiversity is very poorly known, with comparatively limited research before independence in 1975 halting altogether in the three decades of unrest that followed. Research coverage is also limited for Odonata (Fig. 1), with much of the north and east never surveyed at all (Clausnitzer et al. 2012). The potentially very species-rich highland catchments of the Congo, Cuanza, Cubango (Okavango) and Zambezi Rivers are almost unknown and may hold many undescribed species. The whole Angolan part of the extensively marshy Cuando River and almost the entire Cuito river system are also unsurveyed.

**History of Odonata research in Angola**

Research began in July 1928, when the Swiss zoologist Albert Monard embarked on the first of his two expeditions to Angola, which lasted until February 1929. Monard was a curator at the Natural Museum of La-Chaux-de-Fonds in Switzerland with a broad interest in nature who mainly collected vertebrates and plants. Ris (1931) identified 27 and described four species from Monard's first expedition.

With the death of Friedrich Ris, Monard submitted the Odonata from his second expedition (April 1932 to October 1933) to Cynthia Longfield at the British Museum (now the Natural History Museum) in London, who had published several records obtained by Karl Jordan from Mt Moco in 1934 (Longfield 1936). Longfield (1947) identified 77 species from Monard's new material and described 13 new species and two new genera. She also dealt with the Odonata held at the Dundo Museum in northern Angola, first revising the genus *Orthetrum* based on the long series available (Longfield 1955) and later listing 61 species from the collection, including three new ones (Longfield 1959).

Pinhey (1961a, b) described five new species of Gomphidae from northern Angola received from A. de Barros Machado of the Dundo Museum. While Longfield (1959)

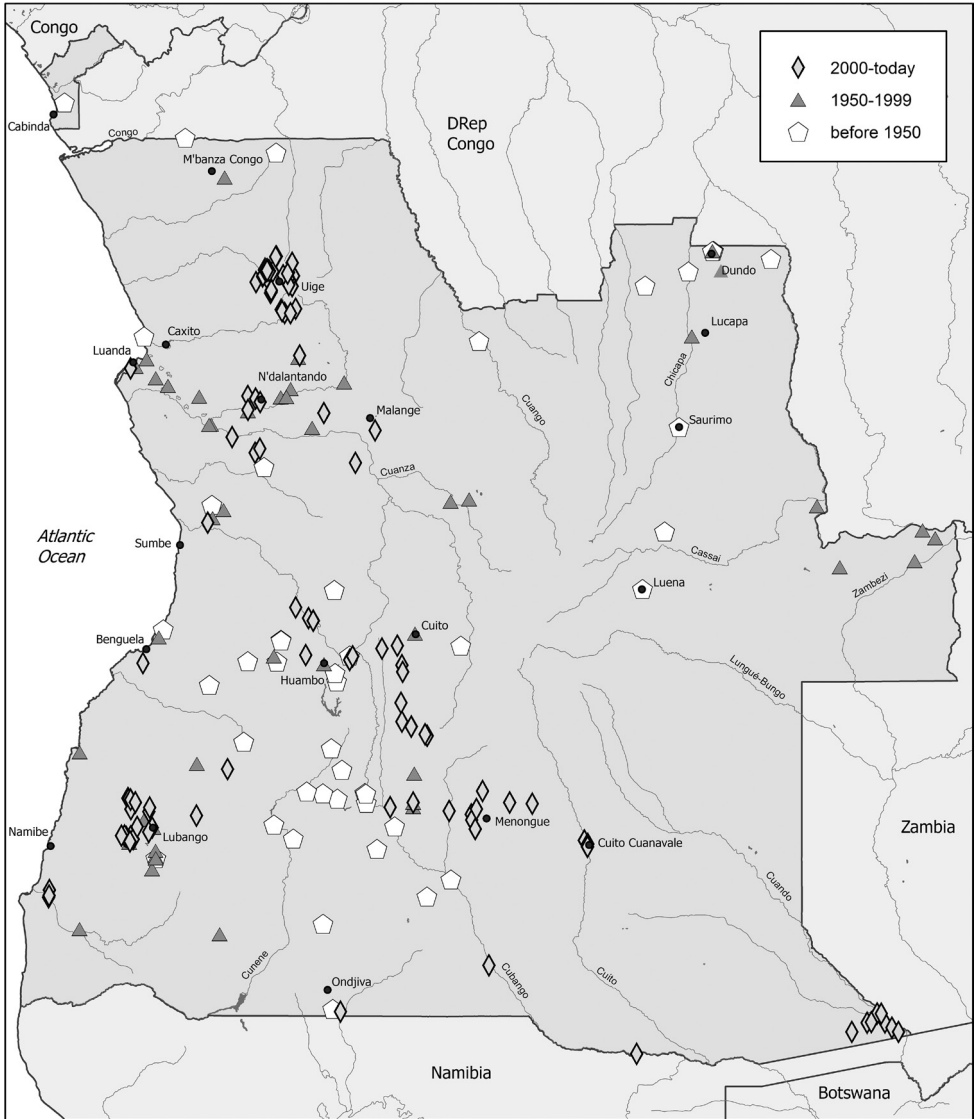


Figure 1. Records of Odonata from Angola before 1950, before 2000 and up to 2016.

stated that the Dundo collection “shows the usual scarcity of the genera Gomphidae”, Pinhey (1961a) noted it “was particularly notable for the number of Gomphids.” Possibly Machado split the material between the two authors. It is uncertain whether the material was collected in Dundo or only held there, as most records lack details on collector, date and precise locality. However, Pinhey (1961b) did detail collecting localities around Dundo, suggesting that all material came from this part of Lunda Norte Province. The collector was probably Machado himself. No-one has worked on this collection since and its state is thus unknown.

Elliot Pinhey was curator at the National Museum of Zimbabwe from 1955 until 1975 and while he collected intensively in adjacent countries, only visited Angola twice (Vick et al. 2001). In April and May 1963 Pinhey participated in an expedition to north-western Zambia, also visiting an area east of Caianda and the Lutchigena River in Angola directly adjacent to the Ikelenge Pedicle of Zambia, where he recorded 26 species (Pinhey 1964, 1974, 1984). His second excursion into Angola went to an area between Luanda and the Duque de Bragança Falls on the Lucala River (now known as Kalandula Falls) in October 1964 with records of 32 species (Pinhey 1965).

Pinhey further treated the material of three collectors, describing a species in honour of each of them. Edward S. Ross of the California Academy of Sciences collected between Cuchi and Dondo in 1957 and 1958 (Pinhey 1966), the famed expert of mammal behaviour Richard Estes in central Angola in 1970 (Pinhey 1971a), and Ivan Bampton around the Serra da Chela and Tundavala in 1973 (Pinhey 1975). In the 1975 paper he also repeated records from Pinhey (1964, 1965) and Longfield (1947), and provided a gazetteer, causing confusion about the precise locality of some sites. The correct historic collecting sites could be verified with the gazetteer of Mendes et al. (2013).

After Angola's independence in 1975 there was a long break in field research, with only a few records by various collectors. In January 2009, an expedition led by Brian Huntley visited the Serra da Chela in south-western Angola and the Namib Desert to the south: Warwick Tarboton recorded 47 species of Odonata around Humpata, of which five were recorded in Angola for the first time and one was new to science (Tarboton 2009, Dijkstra et al. 2015).

## Methods

Jens Kipping surveyed the upper catchment of the Okavango (Cubango) River on the SAREP (Southern African Regional Environmental Program) Expedition from 5 to 22 May 2012 (18 field days). Specimens collected during a second SAREP expedition in April 2013 were also handed to Jens Kipping. Viola Clausnitzer and KD Dijkstra in collaboration with the Universidade Kimpa Vita (Uíge) and the Technical University of Dresden (Germany) surveyed around Uíge, Negage and N'dalantando in northern Angola in the wet season from 13 November to 1 December 2012 (19 days). Dijkstra revisited this area in the dry season, from 26 September to 5 October 2013 (10 days). Sara Fernandes Elizalde and Chris Hines provided photographic records in 2016. Adult dragonflies were usually caught with an aerial net and either identified in the field using Dijkstra and Clausnitzer (2014) or collected and identified later in the laboratory.

The authors also examined the Angolan collections and type material in the Natural History Museum in London, the National History Museum of Zimbabwe in Bulawayo

(Dijkstra 2007a, b), the Royal Museum for Central Africa in Tervuren, Belgium and the Instituto de Investigação Agronómica in Huambo, Angola. All records are kept in the Odonata Database of Africa – ODA (Kipping et al. 2009) and mapped per species on African Dragonflies and Damselflies Online – ADDO (<http://addo.adu.org.za/>).

Specimens are currently at the Naturalis Biodiversity Center in Leiden, The Netherlands, including type material of eight species described by Dijkstra et al. (2015). Material must become available for study in the country of origin. Currently no facilities for permanent preservation and research of entomological specimens exist in Angola. As international scientific collaboration continues, natural history collections should be developed locally to receive and study this material.

The All Odonata Barcode Initiative at Naturalis Biodiversity Center generated sequences of the mitochondrial COI gene of the 4,260 specimens from sub-Saharan Africa, of which about 400 were from Angola. See Dijkstra et al. (2015) for details, including on DNA extraction, amplification (including primer combinations) and sequencing.

## Results

The first SAREP Expedition yielded 87 species, 17 of them new to the country list and two new to science (Kipping 2012, Dijkstra et al. 2015). One additional species new for the country came from the second SAREP Expedition. The first expedition to Uíge, Negage and N'dalantando resulted in 138 species, of which 43 were recorded for the first time in Angola and five were new to science. The second visit produced 86 species, adding another 15 to the national list.

With the surveys in 2012 and 2013 and a careful review of the historic data, the known odonate fauna of Angola has increased from 158 species in the year 2011 to 234 species in 2013: an increase of about one-third with only 47 days in the field. Two species were added in 2016: Chris Hines photographed *Tetrathemis camerunensis* in Bengo Province and some male specimens of *Bradinopyga strachani* from N'dalantando were found in the collection of the Instituto de Investigação Agronómica in Huambo. ODA now holds 2,820 Angolan records from more than 250 localities.

The checklist of the Odonata of Angola is provided in Table 1, with notes on several species provided in the discussion. Table 2 lists 20 species that were removed from the country list. These were mentioned in one or more historic papers but represent likely misidentifications, taxonomic mix-ups, synonyms, etc. Table 3 lists species that should be present although reliable records are lacking. These are mostly found in border-rivers, especially on the well-studied Namibian bank of the Okavango (Suhling and Martens 2007). Many additional species occur in the well-surveyed Ikelenge Pedicle around the Zambezi source in north-western Zambia (Pinhey 1984, own surveys) immediately on the Angola border, but listing those species as likely to occur in the neighbouring Moxico Province of Angola would be speculative.

**Table 1.** Checklist of Odonata recorded from Angola.

Species	English Name	V	RL
<b>Lestidae</b>			
<i>Lestes amicus</i> Martin, 1910	Yellow-winged Spreadwing	1	LC
<i>Lestes dissimulans</i> Fraser, 1955	Cryptic Spreadwing	1	LC
<i>Lestes pallidus</i> Rambur, 1842	Pallid Spreadwing	1	LC
<i>Lestes pinheyi</i> Fraser, 1955	Pinhey's Spreadwing	1	LC
<i>Lestes plagiatus</i> (Burmeister, 1839)	Highland Spreadwing	1	LC
<i>Lestes tridens</i> McLachlan, 1895	Spotted Spreadwing	1	LC
<i>Lestes virgatus</i> (Burmeister, 1839)	Smoky Spreadwing	3	LC
<b>Calopterygidae</b>			
<i>Phaon camerunensis</i> Sjöstedt, 1900	Emerald Demoiselle	1!	LC
<i>Phaon iridipennis</i> (Burmeister, 1839)	Glistening Demoiselle	1	LC
<i>Sapho orichalcea</i> McLachlan, 1869 #	Mountain Bluewing	1!	LC
<i>Umma electa</i> Longfield, 1933	Metallic Sparklewing	1	LC
<i>Umma femina</i> Longfield, 1947	Angola Sparklewing	1**	VU
<i>Umma longistigma</i> (Selys, 1869)	Bare-bellied Sparklewing	1	LC
<i>Umma mesostigma</i> (Selys, 1879)	Hairy-bellied Sparklewing	1!	LC
<b>Chlorocyphidae</b>			
<i>Chlorocypha cancellata</i> (Selys, 1879)	Exquisite Jewel	1!	LC
<i>Chlorocypha curta</i> (Hagen in Selys, 1853)	Blue-tipped Jewel	1!	LC
<i>Chlorocypha cyanifrons</i> (Selys, 1873)	Blue-fronted Jewel	1!	LC
<i>Chlorocypha fabamacula</i> Pinhey, 1961	Spotted Jewel	1	LC
<i>Chlorocypha victoriae</i> (Förster, 1914)	Victoria's Jewel	1	LC
<i>Platycypha angolensis</i> Longfield, 1959	Angola Dancing Jewel	1**	NT
<i>Platycypha bamptoni</i> (Pinhey, 1975) #	Highland Blue Jewel	1**	NE
<i>Platycypha</i> cf. <i>bamptoni</i> (Pinhey, 1975) #	(near Highland Blue Jewel)	1!**	NE
<i>Platycypha caligata</i> (Selys, 1853) #	Common Dancing Jewel	2	LC
<i>Platycypha crocea</i> (Longfield, 1947) #	Angola Blue Jewel	1**	LC
<i>Platycypha rubriventris</i> (Pinhey, 1975) #	Red-bellied Blue Jewel	2**	DD
<i>Platycypha rufitibia</i> (Pinhey, 1961)	Beautiful Jewel	1	LC
<b>Platycnemididae</b>			
<i>Allocnemis nigripes</i> (Selys, 1886)	Rainbow Yellowwing	1	LC
<i>Allocnemis pauli</i> (Longfield, 1936)	Orange-tipped Yellowwing	1!	LC
<i>Copera congolensis</i> (Martin, 1908)	Congo Featherleg	1!	LC
<i>Elattonaura acuta</i> Kimmins, 1938	Red Threadtail	1!	LC
<i>Elattonaura cellularis</i> (Grünberg, 1902) #	Zambezi Threadtail	3	LC
<i>Elattonaura</i> cf. <i>glauca</i> (Selys, 1860) #	(near Common Threadtail)	1	LC
<i>Elattonaura lliba</i> Legrand, 1985	Eastern Stream Threadtail	1!	LC
<i>Elattonaura tarbotonorum</i> Dijkstra, 2015 #	Stout Threadtail	2**	DD
<i>Mesocnemis</i> cf. <i>singularis</i> Karsch, 1891 #	(near Common Riverjack)	1!	NE
<b>Coenagrionidae</b>			
<i>Aciagrion africanum</i> Martin, 1908	Blue Slim	1	LC
<i>Aciagrion macrootithenae</i> Pinhey, 1972	Awl-tipped Slim	3	DD
<i>Aciagrion nodosum</i> (Pinhey, 1964)	Cryptic Slim	1!	LC
<i>Aciagrion rarum</i> (Longfield, 1947)	Tiny Slim	2	DD
<i>Aciagrion steeleae</i> Kimmins, 1955	Swamp Slim	3	LC

Species	English Name	V	RL
<i>Aciagrion zambianse</i> Pinhey, 1972	Zambia Slim	3	DD
<i>Africallagma fractum</i> (Ris, 1921)	Southern Slender Bluet	1	LC
<i>Africallagma glaucum</i> (Burmeister, 1839)	Swamp Bluet	1	LC
<i>Africallagma vaginale</i> (Sjöstedt, 1917)	Forest Bluet	1!	LC
<i>Agriocnemis angolensis</i> Longfield, 1947	Blue Wisp	1*	LC
<i>Agriocnemis bumbhilli</i> Kipping, Suhling & Martens, 2012	Bumhill Wisp	1!*	LC
<i>Agriocnemis canuango</i> Dijkstra, 2015	Bog Wisp	1!**	DD
<i>Agriocnemis exilis</i> Selys, 1872	Little Wisp	1	LC
<i>Agriocnemis forcipata</i> Le Roi, 1915	Greater Pincer-tailed Wisp	1	LC
<i>Agriocnemis</i> cf. <i>maclachlani</i> Selys, 1877 #	(near Forest Wisp)	1!	LC
<i>Agriocnemis ruberrima</i> Balinsky, 1961	Orange Wisp	1!	LC
<i>Agriocnemis toto</i> Dijkstra, 2015	Bruno's Wisp	1!**	DD
<i>Agriocnemis victoria</i> Fraser, 1928	Lesser Pincer-tailed Wisp	1	LC
<i>Azuragrion nigridorsum</i> (Selys, 1876)	Sailing Bluet	1	LC
<i>Ceriagrion annulatum</i> Fraser, 1955	Green-eyed Citril	1!	LC
<i>Ceriagrion bakeri</i> Fraser, 1941	Blue-fronted Citril	3	LC
<i>Ceriagrion corallinum</i> Campion, 1914	Green-fronted Citril	1	LC
<i>Ceriagrion glabrum</i> (Burmeister, 1839)	Common Citril	1	LC
<i>Ceriagrion junceum</i> Dijkstra & Kipping, 2015	Spikerush Citril	1!	LC
<i>Ceriagrion platystigma</i> Fraser, 1941	Variable Citril	1	LC
<i>Ceriagrion sakejii</i> Pinhey, 1963	Cream-sided Citril	1!	LC
<i>Ceriagrion suave</i> Ris, 1921	Plain Citril	1	LC
<i>Ceriagrion whellani</i> Longfield, 1952	Yellow-faced Citril	1!	LC
<i>Ischnura senegalensis</i> (Rambur, 1842)	Tropical Bluetail	1	LC
<i>Pinheyagrion angolicum</i> (Pinhey, 1966)	Pinhey's Bluet	1	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>angolense</i> Selys, 1876	Angola Sprite	1**	NT
<i>Pseudagrion</i> ( <i>A</i> ) <i>coeruleipunctum</i> Pinhey, 1964	Pretty Sprite	3	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>estesi</i> Pinhey, 1971	Estes's Sprite	1**	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>fisheri</i> Pinhey, 1961	Dark-tailed Sprite	3	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>greeni</i> Pinhey, 1961	Clasper-tailed Sprite	1	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>inconspicuum</i> Ris, 1931	Little Sprite	1	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>kersteni</i> Gerstäcker, 1869	Powder-faced Sprite	1	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>kibalense</i> Longfield, 1959	Forest Sprite	1	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>makabusiense</i> Pinhey, 1950	Green-striped Sprite	3	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>melanicterum</i> Selys, 1876	Farmbush Sprite	1	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>salisburyense</i> Ris, 1921	Slate Sprite	1	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>sarepi</i> Kipping & Dijkstra, 2015	Sarep Sprite	1!**	DD
<i>Pseudagrion</i> ( <i>A</i> ) <i>serrulatum</i> Karsch, 1894	Superb Sprite	1!	LC
<i>Pseudagrion</i> ( <i>A</i> ) <i>simonae</i> Legrand, 1987	Wide-striped Sprite	1!	LC
<i>Pseudagrion</i> ( <i>B</i> ) <i>acaciae</i> Förster, 1906	Acacia Sprite	1	LC
<i>Pseudagrion</i> ( <i>B</i> ) <i>coeleste</i> Longfield, 1947	Catshead Sprite	1	LC
<i>Pseudagrion</i> ( <i>B</i> ) <i>deningi</i> Pinhey, 1961	Dark Sprite	1!	LC
<i>Pseudagrion</i> ( <i>B</i> ) <i>dundoense</i> Longfield, 1959	Dundo Sprite	2**	DD
<i>Pseudagrion</i> ( <i>B</i> ) <i>glaucescens</i> Selys, 1876	Blue-green Sprite	1	LC
<i>Pseudagrion</i> ( <i>B</i> ) <i>hamoni</i> Fraser, 1955	Swarthy Sprite	1!	LC
<i>Pseudagrion</i> ( <i>B</i> ) <i>helenae</i> Balinsky, 1964	Little Blue Sprite	1!	LC



Species	English Name	V	RL
<i>Pseudagrion (B) isidromorai</i> Compte Sart, 1967	Large Blue Sprite	1!	LC
<i>Pseudagrion (B) massaicum</i> Sjöstedt, 1909	Masai Sprite	1	LC
<i>Pseudagrion (B) rufostigma</i> Longfield, 1947	Ruby Sprite	1	LC
<i>Pseudagrion (B) sjoestedti</i> Förster, 1906	Variable Sprite	1	LC
<i>Pseudagrion (B) sublacteum</i> (Karsch, 1893)	Cherry-eye Sprite	1	LC
<b>Aeshnidae</b>			
<i>Afroaeschna scotias</i> (Pinhey, 1952)	Shadow Hawker	1!	LC
<i>Anax congoliath</i> Fraser, 1953	Dark Emperor	1!	LC
<i>Anax ephippiger</i> (Burmeister, 1839)	Vagrant Emperor	1	LC
<i>Anax imperator</i> Leach, 1815	Blue Emperor	1	LC
<i>Anax speratus</i> Hagen, 1867	Eastern Orange Emperor	1	LC
<i>Anax tristis</i> Hagen, 1867	Black Emperor	1	LC
<i>Gynacantha (A) sextans</i> McLachlan, 1896	Dark-rayed Duskhawker	3	LC
<i>Gynacantha (A) vesiculata</i> Karsch, 1891	Lesser Girdled Duskhawker	3	LC
<i>Gynacantha (B) manderica</i> Grünberg, 1902	Little Duskhawker	3	LC
<i>Heliaeschna fuliginosa</i> Karsch, 1893	Black-banded Duskhawker	1	LC
<i>Heliaeschna ugandica</i> McLachlan, 1896	Uganda Duskhawker	3	LC
<i>Pinheyschna rileyi</i> (Calvert, 1892)	Bullseye Hawker	3	LC
<b>Gomphidae</b>			
<i>Crenigomphus cf. cornutus</i> Pinhey, 1956 #	(near Horned Talontail)	1!	LC
<i>Diastatomma selysi</i> Schouteden, 1934	Common Hoetail	3	LC
<i>Diastatomma soror</i> Schouteden, 1934	Painted Hoetail	3	LC
<i>Gomphidia quarrei</i> (Schouteden, 1934)	Southern Fingertail	3	LC
<i>Ictinogomphus dundoensis</i> Pinhey, 1961	Swamp Tigertail	1	LC
<i>Ictinogomphus ferox</i> (Rambur, 1842)	Common Tigertail	1	LC
<i>Ictinogomphus regisalberti</i> (Schouteden, 1934)	Congo Tigertail	3	LC
<i>Lestinogomphus calcaratus</i> Dijkstra, 2015	Spurred Fairytail	1!	LC
<i>Libyogomphus tenaculatus</i> Fraser, 1926	Large Horntail	1!	LC
<i>Mastigogomphus chapini</i> (Klots, 1944) #	Western Snorkeltail	2	LC
<i>Microgomphus cf. nyassicus</i> (Grünberg, 1902) #	(near Eastern Scissortail)	1!	LC
<i>Neurogomphus alius</i> Cammaerts, 2004	Large Siphontail	1!	LC
<i>Notogomphus kimpavita</i> Dijkstra & Clausnitzer, 2015	Angola Longleg	1!**	DD
<i>Notogomphus praetorius</i> (Selys, 1878)	Yellowjack Longleg	2	LC
<i>Notogomphus cf. spinosus</i> (Karsch, 1890) #	(near Jungle Longleg)	1!	LC
<i>Onychogomphus rossii</i> Pinhey, 1966	Angola Claspertail	2**	DD
<i>Onychogomphus cf. styx</i> Pinhey, 1961#	(near Northern Dark Claspertail)	1!	LC
<i>Paragomphus abnormis</i> (Karsch, 1890)	Humdrum Hooktail	1!	LC
<i>Paragomphus cf. darwalli</i> Dijkstra, Mézière & Papazian, 2015 #	(near Darwall's Hooktail)	1!	DD
<i>Paragomphus genei</i> (Selys, 1841)	Common Hooktail	1	LC
<i>Paragomphus machadoi</i> Pinhey, 1961	Forest Hooktail	2	LC
<i>Paragomphus cf. nigroviridis</i> Cammaerts, 1969 #	(near Black-and-green Hooktail)	1!	LC
<i>Phyllogomphus annulus</i> Klots, 1944	Crested Leaftail	1	LC
<i>Phyllogomphus selysi</i> Schouteden, 1933	Bold Leaftail	3	LC
<b>Macromiidae</b>			
<i>Phyllomacromia aureozona</i> (Pinhey, 1966)	Golden-banded Cruiser	1!	LC



Species	English Name	V	RL
<i>Phyllomacromia contumax</i> Selys, 1879	Two-banded Cruiser	1!	LC
<i>Phyllomacromia hervei</i> (Legrand, 1980)	River Cruiser	1!	LC
<i>Phyllomacromia melania</i> (Selys, 1871)	Sombre Cruiser	1	LC
<i>Phyllomacromia overlaeti</i> (Schouteden, 1934)	Clubbed Cruiser	3	LC
<i>Phyllomacromia paula</i> (Karsch, 1892)	Greater Double-spined Cruiser	3	LC
<i>Phyllomacromia picta</i> (Hagen in Selys, 1871)	Darting Cruiser	3	LC
<i>Phyllomacromia unifasciata</i> (Fraser, 1954)	Golden-eyed Cruiser	3	LC
<b>Libellulidae</b>			
<i>Acisoma inflatum</i> Selys, 1882	Stout Pintail	1	LC
<i>Acisoma trifidum</i> Kirby, 1889	Pied Pintail	1	LC
<i>Aethiothemis bequaerti</i> Ris, 1919	Skimmer-like Flasher	1	LC
<i>Aethiothemis ellioti</i> (Lieftinck, 1969)	Plump Flasher	1!	LC
<i>Aethiothemis mediofasciata</i> Ris, 1931 #	Orange Flasher	2	LC
<i>Aethiothemis solitaria</i> Martin, 1908	Pearly Flasher	1	LC
<i>Aethriamanta rezia</i> Kirby, 1889	Pygmy Basker	1	LC
<i>Brachythemis lacustris</i> (Kirby, 1889)	Red Groundling	1	LC
<i>Brachythemis leucosticta</i> (Burmeister, 1839)	Southern Banded Groundling	1	LC
<i>Bradinopyga strachani</i> (Kirby, 1900)	Red Rockdweller	2	LC
<i>Chalcostephia flavifrons</i> Kirby, 1889	Inspector	1!	LC
<i>Crocothemis brevistigma</i> Pinhey, 1961	Spotted Scarlet	1!	LC
<i>Crocothemis divisa</i> Baumann, 1898	Rock Scarlet	1	LC
<i>Crocothemis erythraea</i> (Brullé, 1832)	Broad Scarlet	1	LC
<i>Crocothemis sanguinolenta</i> (Burmeister, 1839)	Little Scarlet	1	LC
<i>Cyanothemis simpsoni</i> Ris, 1915	Bluebolt	1!	LC
<i>Diplacodes deminuta</i> Lieftinck, 1969	Little Percher	1	LC
<i>Diplacodes lefebvreii</i> (Rambur, 1842)	Black Percher	1	LC
<i>Diplacodes luminans</i> (Karsch, 1893)	Barbet Percher	1	LC
<i>Diplacodes pumila</i> Dijkstra, 2006	Dwarf Percher	1!	LC
<i>Eleuthemis eogaster</i> Dijkstra, 2015	Sunrise Firebelly	1!**	DD
<i>Eleuthemis libera</i> Dijkstra & Kipping, 2015	Free Firebelly	1!	DD
<i>Hadrothemis camarensis</i> (Kirby, 1889)	Saddled Jungleskimmer	3	LC
<i>Hadrothemis coacta</i> (Karsch, 1891)	Robust Jungleskimmer	1!	LC
<i>Hadrothemis defecta</i> (Karsch, 1891)	Scarlet Jungleskimmer	3	LC
<i>Hemistigma albipunctum</i> (Rambur, 1842)	African Piedspot	1	LC
<i>Malgassophlebia bispina</i> Fraser, 1958	Ringed Leaf-tipper	1!	LC
<i>Micromacromia camerunica</i> Karsch, 1890	Stream Micmac	1!	LC
<i>Micromacromia flava</i> (Longfield, 1947)	Angola Micmac	1**	NT
<i>Neodythemis afra</i> (Ris, 1909)	Seepage Junglewatcher	1!	LC
<i>Neodythemis klingi</i> (Karsch, 1890)	Stream Junglewatcher	1!	LC
<i>Nesciothemis cf. farinosa</i> (Förster, 1898) #	(near Eastern Blacktail)	1	LC
<i>Nesciothemis fitzgeraldi</i> Longfield, 1955	Lesser Peppertail	1!	LC
<i>Notiothemis robertsi</i> Fraser, 1944	Western Forestwatcher	1!	LC
<i>Olpogastra lugubris</i> Karsch, 1895	Bottletail	1	LC
<i>Orthetrum abbotti</i> Calvert, 1892	Little Skimmer	1	LC
<i>Orthetrum austeni</i> (Kirby, 1900)	Giant Skimmer	1	LC
<i>Orthetrum brachiale</i> (Palisot de Beauvois, 1817)	Banded Skimmer	1	LC

Species	English Name	V	RL
<i>Orthetrum caffrum</i> (Burmeister, 1839)	Two-striped Skimmer	1	LC
<i>Orthetrum chrysostigma</i> (Burmeister, 1839)	Epaulet Skimmer	1	LC
<i>Orthetrum guineense</i> Ris, 1910	Guinea Skimmer	1	LC
<i>Orthetrum hintzi</i> Schmidt, 1951	Dark-shouldered Skimmer	1	LC
<i>Orthetrum icteromelas</i> Ris, 1910	Spectacled Skimmer	1	LC
<i>Orthetrum julia</i> Kirby, 1900	Julia Skimmer	1	LC
<i>Orthetrum machadoi</i> Longfield, 1955	Highland Skimmer	1	LC
<i>Orthetrum macrostigma</i> Longfield, 1947	Sharkfin Skimmer	1	LC
<i>Orthetrum microstigma</i> Ris, 1911	Farmbush Skimmer	1	LC
<i>Orthetrum monardi</i> Schmidt, 1951	Woodland Skimmer	1	LC
<i>Orthetrum robustum</i> Balinsky, 1965	Robust Skimmer	1!	LC
<i>Orthetrum saegeri</i> Pinhey, 1966	Mushroom Skimmer	1!	LC
<i>Orthetrum stemmale</i> (Burmeister, 1839)	Bold Skimmer	1	LC
<i>Orthetrum trinacria</i> (Selys, 1841)	Long Skimmer	1	LC
<i>Oxythemis phoenicosceles</i> Ris, 1910	Pepperpants	1!	LC
<i>Palpopleura albifrons</i> Legrand, 1979	Pale-faced Widow	1!	LC
<i>Palpopleura deceptor</i> (Calvert, 1899)	Deceptive Widow	3	LC
<i>Palpopleura jucunda</i> (Rambur, 1842)	Yellow-veined Widow	1	LC
<i>Palpopleura lucia</i> (Drury, 1773)	Lucia Widow	1	LC
<i>Palpopleura portia</i> (Drury, 1773)	Portia Widow	1	LC
<i>Pantala flavescens</i> (Fabricius, 1798)	Wandering Glider	1	LC
<i>Porpax asperipes</i> Karsch, 1896	Powdered Pricklyleg	1	LC
<i>Porpax risi</i> Pinhey, 1958	Highland Pricklyleg	1	LC
<i>Rhyothemis fenestrina</i> (Rambur, 1842)	Skylight Flutterer	1	LC
<i>Rhyothemis mariposa</i> Ris, 1913	Butterfly Flutterer	2	LC
<i>Rhyothemis semihyalina</i> (Desjardins, 1832)	Phantom Flutterer	1!	LC
<i>Sympetrum fonscolombii</i> (Selys, 1840)	Nomad	2	LC
<i>Tetrathemis camerunensis</i> (Sjöstedt, 1900)	Forest Elf	2	LC
<i>Tetrathemis fraseri</i> Legrand, 1977	Treefall Elf	1!	LC
<i>Tetrathemis polleni</i> (Selys, 1869)	Black-splashed Elf	2	LC
<i>Thermodoria equivocata</i> Kirby, 1889	Dash-winged Piedface	1!	LC
<i>Tholymis tillarga</i> (Fabricius, 1798)	Twister	1	LC
<i>Tramea basilaris</i> (Palisot de Beauvois, 1817)	Keyhole Glider	1	LC
<i>Trithemis aconita</i> Lieftinck, 1969	Halfshade Dropwing	1!	LC
<i>Trithemis annulata</i> (Palisot de Beauvois, 1807)	Violet Dropwing	1	LC
<i>Trithemis anomala</i> Pinhey, 1956	Striped Dropwing	1!	LC
<i>Trithemis apicalis</i> (Fraser, 1954)	Furtive Dropwing	1!	LC
<i>Trithemis arteriosa</i> (Burmeister, 1839)	Red-veined Dropwing	1	LC
<i>Trithemis basitincta</i> Ris, 1912	Jungle Dropwing	1!	LC
<i>Trithemis dichroa</i> Karsch, 1893	Black Dropwing	1	LC
<i>Trithemis dorsalis</i> (Rambur, 1842)	Highland Dropwing	1	LC
<i>Trithemis</i> cf. <i>dubia</i> (Fraser, 1954) #	(near Sleek Dropwing)	1!	DD
<i>Trithemis furva</i> Karsch, 1899	Navy Dropwing	1	LC
<i>Trithemis imitata</i> Pinhey, 1961 #	Northern Fluttering Dropwing	1!	LC
<i>Trithemis integra</i> Dijkstra, 2007	Albertine Dropwing	1!	LC
<i>Trithemis kirbyi</i> Selys, 1891	Orange-winged Dropwing	1	LC

Species	English Name	V	RL
<i>Trithemis leakeyi</i> (Pinhey, 1956)	Mealy Dropwing	1!	LC
<i>Trithemis monardi</i> Ris, 1931 #	Southern Fluttering Dropwing	1	LC
<i>Trithemis nuptialis</i> Karsch, 1894	Hairy-legged Dropwing	1	LC
<i>Trithemis palustris</i> Damm & Hadrys, 2009 #	Marsh Dropwing	1!	LC
<i>Trithemis pluvialis</i> Förster, 1906	Russet Dropwing	1	LC
<i>Trithemis pruinata</i> Karsch, 1899	Cobalt Dropwing	1!	LC
<i>Trithemis stictica</i> (Burmeister, 1839)	Jaunty Dropwing	1	LC
<i>Trithemis weneri</i> Ris, 1912	Elegant Dropwing	3	LC
<i>Urothemis assignata</i> (Selys, 1872)	Red Basker	1	LC
<i>Urothemis edwardsii</i> (Selys, 1849)	Blue Basker	1	LC
<i>Zygonoidea fueleborni</i> (Grünberg, 1902)	Southern Riverking	3	LC
<i>Zygonyx denticulatus</i> Dijkstra & Kipping, 2015	Pale Cascader	1!	LC
<i>Zygonyx eusebia</i> (Ris, 1912)	Imperial Cascader	3	LC
<i>Zygonyx flavicosta</i> (Sjöstedt, 1900)	Ensign Cascader	1	LC
<i>Zygonyx natalensis</i> (Martin, 1900)	Blue Cascader	1	LC
<i>Zygonyx regisalberti</i> (Schouteden, 1934)	Regal Cascader	1	LC
<i>Zygonyx torridus</i> (Kirby, 1889)	Ringed Cascader	1	LC

# – see Taxonomic comments in the discussion

(V) Validation of species: “1!” new national record made by the authors; “1” records obtained by authors and confirming existing records; “2” specimens kept in collections (identification confirmed or primary types); “3” literature records, regarded as reliable because specimens were described well or location agrees with known biogeographic pattern; \*\* - range restricted to Angola; \* - range restricted to Angola with very few exceptions (see Endemism in the discussion).

(RL) Global status according to the IUCN Red List of Threatened Species (2016): “CR” critically endangered, “DD” data-deficient, “EN” endangered, “NT” near-threatened, “VU” vulnerable, “LC” least concern, “NE” not evaluated.

**Table 2.** Odonata species that have been removed from the list for Angola.

Species	English name	Reason for exclusion
<b>Platycnemididae</b>		
<i>Elattonaura frenulata</i> (Hagen in Selys, 1860) #	Sooty Theadtail	See discussion.
<i>Mesocnemis singularis</i> Karsch, 1891 #	Common Riverjack	See discussion.
<b>Coenagrionidae</b>		
<i>Aciagrion gracile</i> (Sjöstedt, 1909)	Graceful Slim	Pinhey (1972) reidentified a series collected at Caianda (Pinhey 1964) as <i>A. macrootithenae</i> .
<i>Agriocnemis zerafica</i> Le Roi, 1915	Sahel Wisp	Sahelian species unlikely to occur in Angola; probably misidentification.
<i>Ceriagrion varians</i> (Martin, 1908)	Orange-red Citril	Taxonomic confusion with <i>C. platystigma</i> ; see Dijkstra et al. (2015).
<i>Pseudagrion (A) hageni</i> Karsch, 1893	Painted Sprite	All Angolan records might refer to <i>P. angolense</i> Selys, 1876 as that was formerly considered a synonym of <i>P. hageni</i> , although the latter occurs in DRC and Zambia close to the Angolan border.

Species	English name	Reason for exclusion
<i>Pseudagrion (A) spernatum</i> Selys, 1881	Upland Sprite	Three records under the synonym <i>Pseudagrion gerstaeckeri</i> Karsch, 1899 from highlands around Huambo are far outside the known range. The species might occur near the Zambian border.
<i>Pseudagrion (A) monardi</i> Longfield, 1947	-	Synonym of <i>P. angolense</i> Selys, 1876.
<b>Gomphidae</b>		
<i>Crenigomphus hartmanni</i> (Förster, 1898)	Clubbed Talontail	A female from Cubango (Longfield 1947) cannot be reliably identified and falls outside the known range.
<i>Gomphidia bredoi</i> (Schouteden, 1934)	Northern Fingertail	A female from Dundo (Pinhey 1961a) cannot be reliably identified and falls outside the known range.
<i>Microgomphus bivittatus</i> Pinhey, 1961	-	Treated as a synonym to <i>Mastigogomphus chapini</i> (see discussion).
<i>Paragomphus cognatus</i> (Rambur, 1842) #	Rock Hooktail	See discussion.
<i>Phyllogomphus dundomajoricus</i> Fraser, 1957	-	Synonym of <i>Phyllogomphus annulus</i> (Dijkstra et al. 2006).
<i>Phyllogomphus dundominusculus</i> Fraser, 1957	-	Synonym of <i>Phyllogomphus annulus</i> (Dijkstra et al. 2006).
<i>Phyllogomphus latifasciae</i> Pinhey, 1961	-	Synonym of <i>Phyllogomphus selysi</i> (Dijkstra et al. 2006).
<b>Macromiidae</b>		
<i>Phyllomacromia aequatorialis</i> Martin, 1906	-	A small series from Dundo (Pinhey 1961a) of this poorly known species may have belonged to another species such as <i>P. hervei</i> .
<b>Libellulidae</b>		
<i>Acisoma panorpoides</i> Rambur, 1842	Grizzled Pintail	Mens et al. (2016) showed that <i>A. panorpoides</i> is an Asian species replaced in continental African by two species of which <i>A. inflatum</i> has been recorded in Angola.
<i>Eleuthemis buettikoferi</i> Ris, 1910	Western Firebelly	Genus thought to be monotypic until new species were described by Dijkstra et al. (2015), of which two from Angola. <i>E. buettikoferi</i> is exclusively West African.
<i>Trithemis donaldsoni</i> (Calvert, 1899)	Denim Dropwing	The record of two females from Dundo (Longfield 1959) is doubtful as this sex is not easily identified and the location falls outside the species' known range.
<i>Zygonoides occidentis</i> (Ris, 1912)	Congo Riverking	Known from the Congo River basin. What Longfield (1947) mentioned as <i>Olpogastra fueleborni occidentis</i> from Kakindo (Caquindo) is most likely <i>Zygonoides fueleborni</i> .
<i>Zygonyx speciosus</i> Karsch, 1891	Specious Cascader	A rainforest species known mainly from Cameroon and confused with <i>Z. regisalberti</i> .

for species marked with # see Taxonomic comments in discussion

**Table 3.** Odonata recorded from bordering rivers that most likely occur in Angola too.

Species	English name	Nearest occurrence
<b>Platycnemididae</b>		
<i>Mesocnemis singularis</i> Karsch, 1891	Common Riverjack	Cunene, Okavango and Kwando Rivers in northern Namibia.
<b>Coenagrionidae</b>		
<i>Africallagma subtile</i> (Ris, 1921)	Fragile Bluet	Okavango and Oshikango Rivers in northern Namibia.
<i>Agriocnemis gratioiosa</i> Gerstäcker, 1891	Gracious Wisp	Okavango and Kwando Rivers in Namibian Caprivi Strip.
<i>Pseudagrion (A) spernatum</i> Selys, 1881	Upland Sprite	At Jimbe and other rivers in Ikelenge Pedicle of north-western Zambia.
<i>Pseudagrion (B) assegaii</i> Pinhey, 1950	Assegai Sprite	Kwando River in Namibian Caprivi Strip.
<i>Pseudagrion (B) sudanicum</i> Le Roi, 1915	Blue-sided Sprite	Okavango and Kwando Rivers in Namibian Caprivi Strip.
<b>Aeshnidae</b>		
<i>Anax bangweuluensis</i> Kimmins, 1955	Swamp Emperor	Common in the Okavango Delta (Kipping 2010) and also known from the Okavango and Kwando Rivers in the Namibian Caprivi.
<b>Gomphidae</b>		
<i>Crenigomphus kavangoensis</i> Suhling & Marais, 2010	Kavango Talontail	Okavango River in Namibia.
<i>Lestinogomphus angustus</i> Martin, 1911	Common Fairytail	Cunene, Okavango and Kwando Rivers in northern Namibia.
<i>Lestinogomphus silkeae</i> Kipping, 2010	Silke's Fairytail	One locality on the southern bank of the Okavango River near Rundu, Namibia.
<i>Mastigomphus cf. dissimilis</i> (Cammaerts, 2004)	(near Southern Snokeltail)	Larvae found at two places on the Namibian bank of the Okavango (Suhling and Martens 2007).
<i>Paragomphus cataractae</i> Pinhey, 1963	Cataract Hooktail	Waterfalls and rapids of the Cunene and Okavango Rivers in northern Namibia.
<i>Neurogomphus cocytius</i> Cammaerts, 2004	Kokyts Siphontail	Okavango River in northern Namibia.
<i>Paragomphus elpidius</i> (Ris, 1921)	Corkscrew Hooktail	Cunene, Okavango and Kwando Rivers in northern Namibia and the Ikelenge Pedicle of Zambia.
<i>Paragomphus sabicus</i> Pinhey, 1950	Flapper Hooktail	Okavango and Kwando Rivers in northern Namibia.
<b>Libellulidae</b>		
<i>Parazyxomma flavicans</i> (Martin, 1908)	Banded Duskdarter	Okavango and Kwando Rivers in northern Namibia.
<i>Trithemis aequalis</i> Liefstinck, 1969	Swamp Dropwing	Okavango and Kwando Rivers in the Namibian Caprivi.
<i>Trithemis donaldsoni</i> (Calvert, 1899)	Denim Dropwing	Okavango and Cunene Rivers in northern Namibia.
<i>Trithemis hecate</i> Ris, 1912	Silhouette Dropwing	Common along the Cunene, Okavango and Kwando Rivers in northern Namibia.
<i>Trithemis morrisoni</i> Damm & Hadrys, 2009	Rapids Dropwing	Okavango and Kwando Rivers in the Namibian Caprivi (see note on <i>T. palustris</i> above).
<i>Trithetrum navasi</i> (Lacroix, 1921)	Fiery Darter	Cunene, Okavango and Kwando Rivers in northern Namibia.

## Discussion

### Taxonomic comments

*Sapho orichalcea* – This species has been separated from *S. gloriosa* McLachlan, 1873 by the absence of a matt band on the otherwise wholly dark wings of both sexes (Pinhey 1971b). However, this band's extent and position is variable and the validity of these species is untested (Dijkstra unpub.). Angolan populations lack the band, consistent with *S. orichalcea* as currently defined.

*Chlorocypha* and *Platycypha* – *Platycypha* Fraser, 1949 is distinguished from *Chlorocypha* Fraser, 1928 only by the largely coloured and often widened male tibiae (Dijkstra and Clausnitzer 2014). However, COI sequences indicate that the blue Angolan species classified as *Chlorocypha* (*bamptoni*, *crocea*, *rubriventris* and a possible fourth species) and *Platycypha angolensis* (formerly a subspecies of *P. caligata*, see below) are closer to each other than to any *Chlorocypha* species, grouping nearer *Platycypha* (Dijkstra unpub.). While *P. angolensis* (Fig. 6a) has legs typical of *Platycypha*, the blue Angola “*Chlorocypha*” males have black tibiae with white anterior faces, found also in many *Chlorocypha* species, but lack the yellow to red tibial markings found in other *Platycypha*. However, this area is paler than the femora and tarsi in females and fresh males of *bamptoni* and *crocea*. While the tibiae appear slender, those of the three species examined are actually expanded slightly and more than in *Platycypha picta* (Pinhey, 1962) and *P. rufitibia*. The black on the dorsum of the second abdominal segment (S2) shifted centrally onto the segment and covering its full extent also recalls typical *Platycypha*. Females have the black line on the entire dorsal abdominal carina present in all *Platycypha* but rare in *Chlorocypha*. The male of *rubriventris* has a red wash on the sides and underside of the thorax and abdomen, which is common in *Platycypha* but not found in *Chlorocypha*. Finally the resting behaviour with exposed tibiae as shown in Figure 5b is also more typical of *Platycypha* than *Chlorocypha* (A. Günther in litt.). It thus seems warranted to transfer *P. bamptoni*, *P. crocea* and *P. rubriventris* to *Platycypha* (new combinations). Separating *Platycypha* may make *Chlorocypha* paraphyletic, but the species transfer itself does not affect that.

*Platycypha angolensis* and *P. caligata* – While described as a subspecies of *P. caligata*, COI sequences of *angolensis* are nearer (but not identical) to those of *crocea* and cf. *bamptoni* than typical *caligata* from eastern and southern Africa. Moreover, *angolensis* males have the thorax sides greenish with hardly a red tinge at maturity, the fore tibiae more abruptly widened at the base, the (especially hind) femora apically reddish and not contrasting with the tibiae, and black apical bars present on the abdominal segments up to S6 rather than S4 or S5. *P. angolensis* is thus treated as good species, which is widespread on and around the Angolan plateau. True *P. caligata* appears to extend into Angola from Zambia.

*Platycypha bamptoni*, *Platycypha* cf. *bamptoni* and *P. crocea* – The former was described as a subspecies of the latter but is easily separated in the field by its larger size, more



robust build and distinct thoracic and abdominal markings. We propose to treat them as distinct species. Specimens like *P. bamptoni* from the upper Cubango differ from those of Tundavala and might represent an undescribed species.

*Platycypha rubriventris* – This species is only known from two males collected in 1965 at Teixeira de Sousa in north-eastern Angola. This should refer to the modern town of Luau on the DRC border, although its altitude (about 1,000 m) and location well to the east of the central plateau are surprising for an Angolan endemic.

*Elattonneura cellularis*, *E. frenulata* and *E. tarbotonorum* – Pinhey (1961b) reported a specimen from Lóvuá near the Zambian border in eastern Angola as *E. frenulata*. The latter is confined to the Cape of South Africa, an error he corrected with the description of *E. tropicalis* Pinhey, 1974. That species, common in Zambia adjacent to Angola, was synonymised with *E. cellularis* by Dijkstra (2007b). Pinhey's (1975) record of *E. frenulata* from Serra da Chela, however, pertains to the recently described Angolan endemic *E. tarbotonorum*.

*Elattonneura* cf. *glauca* – Dijkstra et al. (2015) showed that *E. glauca* is genetically heterogeneous, specimens from Angola being most distinct and closer to specimens identified as *E. cellularis* from Katanga and Zambia. *E. glauca* males collected near Kinshasa, directly north of Angola, differ in penis morphology from typical East African males (Dijkstra unpubl.). As with other widespread species of southern and eastern Africa like *Platycypha angolensis* and *Nesciothemis farinosa* (see below), the geographically relatively isolated populations in the west may represent a distinct taxon.

*Mesocnemis* cf. *singularis* – Longfield (1947) and Pinhey (1965) reported a female of *M. singularis* from near Cubango in 1932. However, we doubt the identification because we found a species at localities across Angola that differs from typical *M. singularis* by the COI sequences and male appendages. Similar males are known from Gabon and Cameroon. Preliminary data suggest these and presumed *M. singularis* form a complex of three or more species (Dijkstra unpubl.).

*Agriocnemis* cf. *maclachlani* – Females in this genus are difficult to identify morphologically. The COI sequence of one collected near Uíge is nearest (but not identical to) that of males of *A. maclachlani* from central and western Africa.

*Crenigomphus* cf. *cornutus* – Females of this genus are difficult to identify. Those collected recently near N'dalantando and Cuchi are morphologically similar to females caught in copula with males of *C. cornutus* in Zambia close to the Angolan border.

*Mastigomphus chapini* – Pinhey (1961b) described *Microgomphus bivittatus* from a female from Dundo. Dijkstra (2007a) suggested that it might belong to *Lestignomphus*, but Pinhey's drawings actually match the female of *Mastigomphus chapini* and is considered synonymous (Dijkstra et al. 2015).

*Microgomphus* cf. *nyassicus* – *Microgomphus* identification is uncertain as long as the status of the potentially synonymous *M. schoutedeni* Fraser, 1949 is unresolved.

*Notogomphus* cf. *spinus* – The larvae of this genus have not been treated taxonomically. The COI sequences of two collected near Uíge are nearest (but not identical to) those of six adults of *N. spinus* from Gabon.



*Onychogomphus* cf. *styx* – The taxonomy of the Afrotropical species placed in *Onychogomphus* is problematic, especially the dark species (Dijkstra 2007a). *O. seydeli* (Schouteden, 1934) from Zambia and Katanga and *O. styx* known mainly from Uganda cannot be separated reliably at present (Dijkstra and Clausnitzer 2014). Identification of Angolan specimens thus awaits revision of the group.

*Paragomphus cognatus* – Despite progress made by Dijkstra et al. (2015), the taxonomy of the *cognatus*-group of *Paragomphus* is problematic: especially older records of *P. cognatus* cannot be considered reliable, such as a female from Ebanga (Longfield 1945). Longfield (1959) stated that a male *P. cognatus* from Dundo differed from (topotypical) South African specimens by its markings, suggesting it belonged to another species. Pinhey (1961a) described *P. machadoi* from the same collection, but the holotype's collection dates differ from Longfield's (1959) male. Pinhey also mentioned *P. alluaudi* (Martin, 1915) from Dundo, but that is an eastern African species. Possibly he had the similar *P. abnormis* (Karsch, 1890) before him, which we recorded recently near Uíge. True *P. cognatus* is known from the Okavango and Cunene Rivers in northern Namibia and thus expected in southern Angola (Suhling and Martens 2007).

*Paragomphus* cf. *darwalli* and *P.* cf. *nigroviridis* – The larvae of this genus have not been treated taxonomically. The COI sequence of one larva collected near Uíge is nearest (but not identical to) that of ten adults described recently as *P. darwalli* from Gabon, while another from there is nearest (but not identical to) eight adults identified as *P. nigroviridis* from Liberia, Gabon and DRC (Dijkstra et al. 2015).

*Aethiothemis mediofasciata* – This species was described from a single female collected by Monard at Chimporo in southern Angola in 1928. While the holotype agrees with females associated with a species found from Liberia to Gabon and Congo-Brazzaville, the recent rediscovery of *A. gamblesi* (Lieftinck, 1969) in Zambia casts doubt on its taxonomic status. Males are almost identical, the abdomen being orange with maturity in *A. mediofasciata* (as now known) and grey pruinose in *A. gamblesi*. No characters to separate females are known as yet. The Angolan type locality is highly isolated: 1,300 km south of the nearest recorded orange male and 900 km west of the nearest pruinose male. Likely only further records of males from Angola can resolve the issue.

*Nesciothemis* cf. *farinosa* – Large black-tipped *Nesciothemis* are currently classified as two species that differ mainly in the extent of pruinosity on the mature male abdomen: at most to the base of S4 in *N. pujoli* Pinhey, 1971 from western Africa, but up to the very base of S7 in *N. farinosa* from southern and eastern Africa, although usually it does not extend beyond S5 and (more rarely) S6. However, in Angola and adjacent Namibia and Botswana mature males invariably have even the entire dorsum of S7 pruinose and sometimes the extreme base of S8 as well. COI sequences of Angolan specimens differ more from those of both *N. pujoli* and *N. farinosa* sampled across Africa, than these two differ from each other (Dijkstra unpubl.). Thus, an unnamed taxon may be present in south-western Africa.

*Trithemis* cf. *dubia* – Males from eastern Angola and Zambia differ in the shape of the hamule from those collected in Gabon, while the thoracic pattern differs from

the female holotype of *T. dubia* from Lake Asebbe in Gabon. They belong to the *longistyla*-group of *Trithemis* with several species placed formerly in *Anectothemis*, *Congothemis*, *Lokithemis* and *Porpacithemis* (see Dijkstra et al. 2015).

*Trithemis imitata* and *T. monardi* – It is unclear whether these are distinct species or if *T. imitata* is a paler and generally more northerly variety of *T. monardi*. Both are currently listed for Angola.

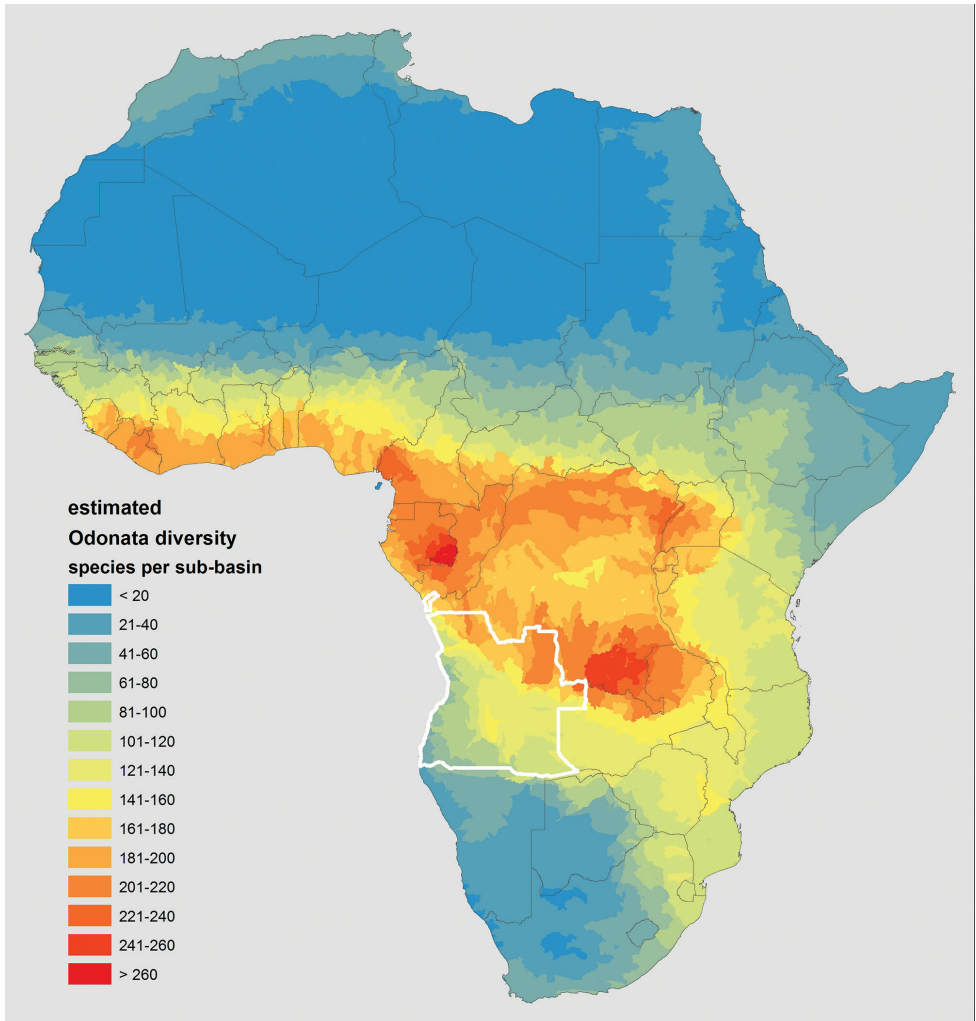
*Trithemis palustris* – Damm and Hadrys (2009) separated two species from *T. stictica* (Burmeister, 1839) on genetic and morphological grounds. However, they only provided genetic characters to distinguish *T. palustris* from its alleged sister species *T. morrisoni* Damm & Hadrys, 2009. Our records may thus represent both taxa, but given the limited geographic scope of the 2009 study, these may also be synonymous.

## Composition

Angola's rich dragonfly fauna expresses its geographic position, size and diversity (Fig. 2). Dijkstra et al. (2011) observed that roughly half of tropical African species occur predominantly within the extensive lowland forests of the western and central continent, a quarter is associated with the eastern and southern part dominated by highlands, while the remaining quarter occurs in open habitats throughout much of the Afrotropics. Indeed, about half of Angola's species are widespread across the continent and its exceptional diversity can be attributed to two major sources:

Almost 30% are confined to forest habitats in the north, mostly below 1,000 m asl, e.g. *Phaon camerunensis*, *Umma longistigma*, *Chlorocypha cancellata*, *Allocnemis pauli*, *Elattonaura lliba*, *Africallagma vaginale*, *Agriocnemis forcipata*, *Ceriagrion annulatum*, *Pseudagrion kibalense*, *Anax congoliath*, *Neurogomphus alius*, *Paragomphus machadoi*, *Phyllomacromia aureozona*, *Acisoma trifidum*, *Cyanothemis simpsoni*, *Hadrothemis camarensis*, *Malgassophlebia bispina*, *Micromacromia camerunica*, *Neodythemis klingi*, *Notiothemis robertsi*, *Orthetrum austeni*, *Oxythemis phoenicosceles*, *Porpax asperipes*, *Thermochoria equivocata*, *Trithemis basitincta* and *Zygonyx regisalberti*. Nine species confined to the Lower Guinea, the forest area that stretches between the Congo Basin and Atlantic Ocean from Cameroon to Gabon and western Congo, reach their southern limit in north-western Angola: *Sapho orichalcea*, *Chlorocypha cyanifrons*, *Platycypha rufitibia*, *Copera congolensis*, *Pseudagrion simonae*, *Paragomphus abnormis*, *P. cf. darwalli* and *Tetrathemis fraseri*.

Nearly 20% favour the swamps, grasslands, miombo woodlands and gallery forests that stretch eastwards, mostly above 1,000 m asl. This fauna is concentrated in Katanga and northern Zambia, but has now been proven to extend across to the Angolan upland with species like *Umma electa*, *Chlorocypha fabamacula*, *Aciagrion steeleae*, *Ceriagrion sakejii*, *Pinheyagrion angolicum*, *Pseudagrion greeni*, *P. inconspicuum*, *P. deningi*, *Phyllomacromia unifasciata*, *Aethiothemis ellioti*, *Crocothemis brevistigma*, *Eleuthemis libera*, *Nesciothemis fitzgeraldi*, *Orthetrum macrostigma*, *Porpax risi*, *Rhyothemis mariposa*,

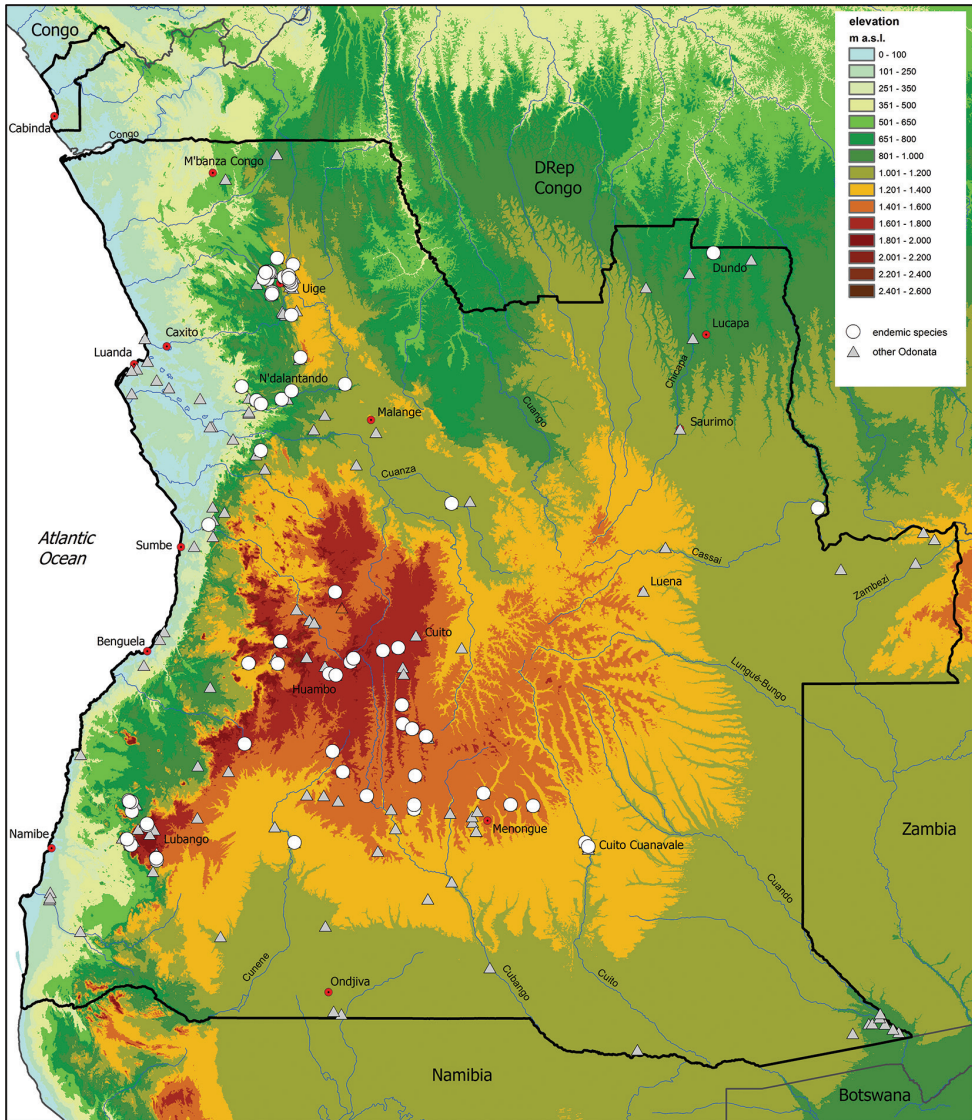


**Figure 2.** Distribution of Odonata diversity in continental Africa. Mapped as the number of species per Hydro1K basin (adapted from Clausnitzer et al. 2012), Angola outlined in white.

*Trithemis anomala*, *T. leakeyi* and *Zygonyx denticulatus*. The discovery of *Trithemis integra* near Uíge is of special interest, as it seemed endemic to the Albertine Rift, being known previously only from western Tanzania and Uganda and eastern DRC.

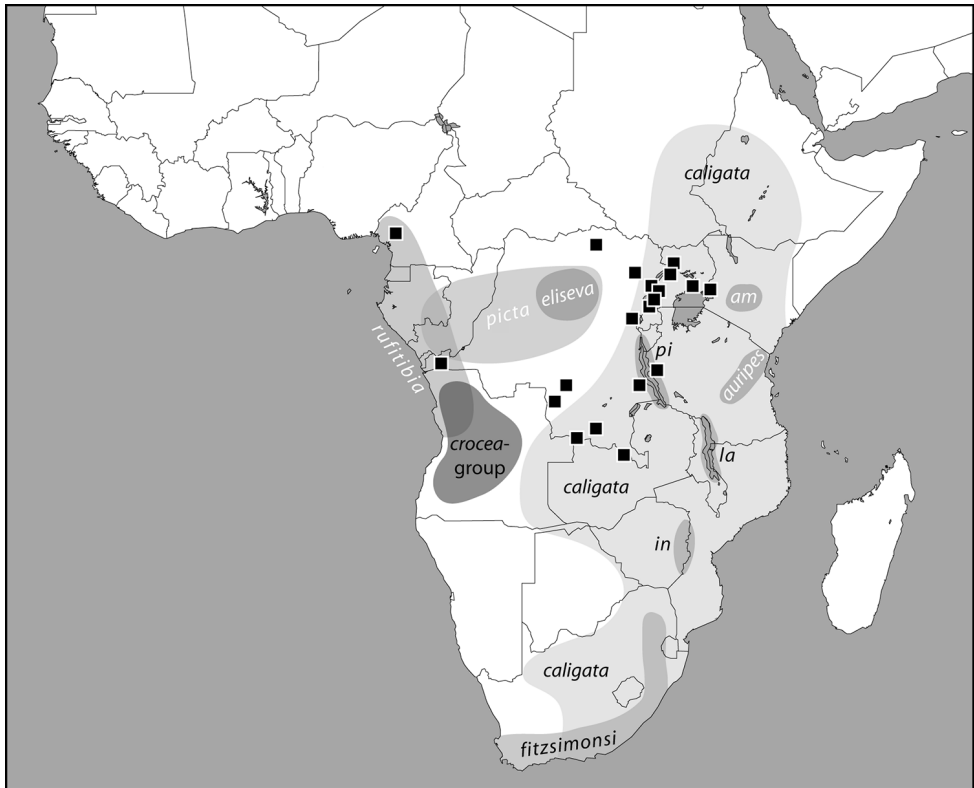
### Endemism

Sixteen species have so far only been found in Angola. With the exception of two known only from their type locality, all are limited to the central plateau (Figs 3, 5): the type locality for *Platycypha rubriventris* is questionable (see comment above) as



**Figure 3.** Records of 16 endemic Odonata species in Angola relative to altitude. White dots: endemic species (marked \*\* in Table 1); grey triangles: other species. Elevation follows the GTOPO30 model of the U.S. Geological Center for Earth Resources Observation and Science (EROS).

may that of *Pseudagrion dundoense* from the extreme north-east, which could also be a river species from the very poorly sampled southern Congo Basin. No endemics have been found below 1,200 m asl in the east, although some drop down to about 500 m asl west of the escarpment. While the proportion of endemics (7%) is lower than for Ethiopia (12 endemics; 11%) and South Africa (30 endemics; 18%), countries that also enclose distinct highland areas, this still ranks Angola as one of Africa's greatest



**Figure 4.** Distribution of the endemic *crocea*-group of *Platycypha* species and all congeneric taxa. Names of taxa that favour open habitats are in black, those tending toward forest in white (although *P. rufitibia* occurs on very open rivers); abbreviations: am — *P. amboniensis*, in — *P. inyangae*, la — form “lacus” of *P. caligata* which may represent a distinct species, pi — *P. pinheyi*. The rather dispersed forest species *P. lacustris* is shown with black squares (adapted from Dijkstra 2008).

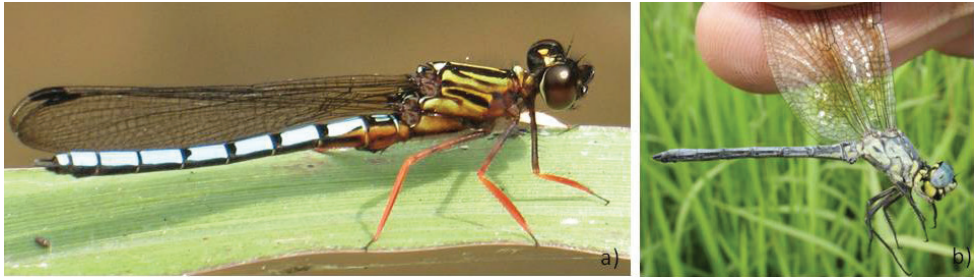
centres of endemism for Odonata, rivalling the highlands of Cameroon (13 endemics) and the Albertine Rift, Eastern Arc and Katanga. Moreover, the number stands to increase, as almost two-fifths were described since exploration was reinitiated and at least another probable *Platycypha* species is already known to us.

Only *Platycypha* presents an endemic radiation. While the genus *Chlorocypha* has diversified with almost 30 species largely in the forested lowlands of west and central Africa, *Platycypha* is more varied and includes at least four open-land species (Fig. 4): *P. caligata* occurs widely from South Africa to Ethiopia, two species are limited to cooler parts of South Africa and Zimbabwe, one to Lake Tanganyika’s shores, and another possibly to Lake Malawi. Two species of submontane forest are endemic to Tanzania and Kenya. Four species are mostly in forest, three in the Lower Guinea and Congo Basin, while *P. lacustris* stretches around that basin and is thus expected in Angola too. The Angolan endemics are found mainly between 1,300 and 1,800 m asl in open habitats. Such a local radiation of a group that has otherwise diversified in





**Figure 5.** Photographs of some of Angola's (near) endemic dragonflies and damselflies. **a** Angola Sparklewing (*Umma femina*) **b** Highland Blue Jewel (*Platycypha bamptoni*) **c** Angola Blue Jewel (*Platycypha crocea*) **d** Blue Wisp (*Agriocnemis angolensis*) **e** Sarep Sprite (*Pseudagrion sarepi*) **f** Estes's Sprite (*Pseudagrion estesi*) **g** Angola Sprite (*Pseudagrion angolense*) **h** Sunrise Firebelly (*Eleuthemis eogaster*) (**a** S. Fernandes Elizalde **b-f** J. Kipping **g** W. Tarboton, **h** K.D. Dijkstra).



**Figure 6.** Photographs of Angola’s endemic **a** Angola Dancing Jewel (*Platycypha angolensis*) and **b** Angola Micmac (*Micromacromia flava*) (K.D. Dijkstra).

the highlands to the east, and forests to the north, fits the overall affinities of Angola’s endemic Odonata both geographically and ecologically.

The four endemic *Pseudagrion* species, for example, have separate origins but similar links: morphology and COI data suggest that the nearest relatives of *P. angolense* and *P. estesi* are the rainforest species *P. grilloti* Legrand, 1987 and *P. kibalense* respectively. The former is limited to Congo and Gabon but the latter extends to Cameroon and Uganda. *P. sarepi* is closely related to *P. fisheri* and *P. greeni*, both of which extend from Angola into Zambia. While these species belong to the genus’s A-group, the B-group species *P. dundoense* is known only from Dundo and (as noted above) may not be endemic at all. *Notogomphus kimpavita* is the sister-species of *N. praetorius* found in highlands across southern Africa (including Angola), while *Eleuthemis eogaster* is nearest to an unnamed species from Gabon (Dijkstra et al. 2015). Molecular data for *Umma femina* and *Onychogomphus rossii* are lacking, but their morphology is close to *U. electa* and pale *Onychogomphus* species, both from the open plateaus stretching from Angola to Zambia and Katanga.

Thus, like the majority of Angola’s Odonata, most endemics probably originated quite recently and proximally from the forests to the north and open habitats to the east. However, some affinities are unresolved and potentially more distant: *Agriocnemis toto* and especially *A. canuango* have no obvious close relatives (Dijkstra et al. 2015), while the near-endemic *A. angolensis* and *A. bumhilli* are probably related to each other but even more distinct overall (Dijkstra unpubl.). Indeed, Angola may be the centre of diversification of Africa’s smallest damselflies. *Micromacromia flava* (Fig. 6b) is morphologically nearest *M. miraculosa* (Förster, 1906), known only from the East Usambara Mountains of north-eastern Tanzania (Dijkstra and Vick 2006), and the only one of four *Micromacromia* species adapted to non-forest habitats, being strongly pruinose with maturity. *Elatoneura tarbotonorum* may be closest to *E. frenulata* of south-western South Africa (Dijkstra et al. 2015).

### Potential for discovery

If we compare the tallies for the well-studied neighbours Zambia and Namibia, the total number of species in Angola should lie somewhat above 300, meaning that less



than 80% of the fauna is currently known. Additions can be expected throughout the country, but especially on the eastern and particularly northern border. Appropriately, the province of Lunda Norte should be the richest area of discovery, around Dundo where exploration began in the 1950s. On the other hand, the central highlands could expect more surprises, like the discovery of additional endemic species, with three areas being especially notable.

Firstly, despite having most records, the north-south directed range that lies entirely above 1,600 m asl and includes the Serra do Chilengue, Serra da Chela and Angola's highest peak at Mt Moco (2,620 m asl) is poorly sampled as the large gaps in Fig. 1 and 3 illustrate. Secondly, except for at its extreme northern and southern ends, the western escarpment has not been surveyed at all. Finally, a huge plateau at 1,200-1,600 m asl stretches east from the Bié Highlands. Except for its southern edge, this area shared between Bié and Moxico Provinces, which is almost as large as Uganda (or the United Kingdom), has no records. These deep Kalahari sands are the 'watertower' of Angola and its neighbours, incorporating the headwaters of the Cuito, Cuando, Chicapa, Cuanango, Cuanza and large tributaries of the Congo and Zambezi like the Cassai and Lungué-Bungo. The vast catchments of the Congo, Cuanza, Okavango and Zambezi meet in small area between Munhango and Cangonga. Watersheds are prone to endemism (Dijkstra et al. 2011) and this region is the top priority for further research.

New species are most likely to be found among genera prone to narrow (highland) ranges, i.e. with known Angolan endemics like *Platycypha* and *Pseudagrion*, but also *Agriocnemis*, *Elattoneura*, *Notogomphus* and perhaps *Paragomphus*. However, given the biogeographic diversity of Angola's fauna and endemics, we could expect greater surprises. Among forest genera with no known Angolan endemic, *Allocnemis* seems most likely to reveal one, e.g. on the escarpment. The presence (or local endemism) of distinctly Lower Guinean genera like *Neurolestes*, *Africocypha*, *Pentaplebia* and *Stenocnemis* seems less likely, but the Lower Guinean *Stenocypha gracilis* (Karsch, 1899) has four endemic relatives in the Albertine Rift and the sister-taxon of the Upper and Lower Guinean *Tragogomphus* is *Nepogomphoides stuhlmanni* (Karsch, 1899) in the Eastern Arc, suggesting an Angolan taxon is possible.

Three typical African highland genera are notably absent from Angola. *Atoconeura* is most likely to be present, being found in Zambia, Katanga, the Lower Guinea and Albertine Rift. However, its absence also from South Africa suggests historical factors may have been limiting, e.g. that the highlands were uninhabitable in cooler periods and unreachable when habitats were suitable (Dijkstra 2006). This might not apply to *Proischnura*, present in South Africa as well as Cameroon and the Albertine Rift. However, that genus is absent from Katanga and northern Zambia, which lies lower and thus possibly provided no stepping-stone to the mountains of Angola. Similarly, *Zosterateschna* extends from the Cape to the Albertine Rift, Ethiopia and even northern Namibia, but is absent from Katanga, northern Zambia and also Cameroon, potentially providing no route to Angola.

If these genera do occur in Angola, they might only occur above 1,400 m asl and could constitute endemic species. More probable, however, is the discovery of endem-

ics in genera that are well-represented across the country and continent, and that have highland endemics elsewhere but not in Angola, such as *Africallagma*, *Neodythemis* and *Orthetrum*. The only record of *Pinheyschna rileyi* in upland Angola is of a female, which might also turn out to represent a distinctive population. Finally, there is a remote chance that a (mainly) South African genus like *Syncordulia* or *Ceratogomphus* is present. As the family Synlestidae is also represented by *Nubiolestes* in the Lower Guinea, while *Chlorolestes* is also probable.

## Conservation

Our findings show that Angola's wealth of aquatic habitats harbours a rich freshwater fauna. Although large areas are relatively untouched, Angola's rapid economic and population growth will have a tremendous impact on the environment and thus human well-being in the future. In the light of this, Angola's development should consider (1) establishment of sewage works in cities and larger villages; (2) a stop on deforestation, especially along stream courses; (3) restoration of deforested water catchments; (4) village-level awareness campaigns for sustainable use of freshwater sources, e.g. no detergents and waste dumping in rivers; (5) biodiversity surveys and monitoring to feed into a national conservation plan.

Angola has agreed to the Aichi Targets of the Convention on Biological Diversity, including Target 12 that ensures that populations of threatened species do not decrease. Figure 3 shows where endemic species are found that should be taken into consideration for the National Biodiversity Strategy and Action Plan. However, their conservation status is uncertain at present. With the exception of four species, all endemics are currently considered Data Deficient for the IUCN Red List of Threatened Species. *Platycypha angolensis*, *Pseudagrion angolense* and *Micromacromia flava* are Near Threatened because, while they seem fairly widespread, their dependence on relatively natural habitats may put them at risk as human development progresses. Only *Umma femina* is now listed as threatened: known from only a few sites in the fairly densely populated highlands, it is thought to be Vulnerable to extinction. More research on all endemic species' statuses and ecology is required.

Angola has an exceptional fauna of dragonflies and damselflies, as well as many valuable rivers and wetlands. Odonata are excellent indicators of the health and biodiversity of both the freshwater and terrestrial realm. As the biological survey of Angola advances, they should be a priority taxon. Dragonflies are also positive symbols, as one soldier sent to Angola during the civil war wrote (Greg Bridges in litt.):

*A memory that will never fade is watching dragonflies, in their variegated splendour of colour and dazzle, hovering and darting over stagnant pools. They helped me to transport to better things than war. If we found water to fill our canteens and I saw these little creatures, I would always try to get back to the pool later, by myself. And I would find a little piece of heaven.*

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