

## ON THE COMPOSITION AND PALAEOECOLOGICAL SIGNIFICANCE OF THE ODONATE FAUNA OF DARFUR, WESTERN SUDAN

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A collection of dragonflies from Darfur, Western Sudan is analyzed. A comparison with literature data is made. In the northern Meidob Hills a significant fraction of Oriental spp. occur, with *Orthetrum sabina* the most interesting one. In the southern mountains of Jebel Marra, a pure Afrotropical fauna is found, with many relics of a rainforest environment, isolated in a Sahel landscape. Both types of relics are related to an early Holocene pluvial epoch. — A record of *Pseudagrion s. sublacteum* is the first for the western Nile valley.

### INTRODUCTION

Only two papers (LONGFIELD, 1936; HAPPOLD, 1966) deal with the dragonfly fauna of Darfur, the large western province of the Republic of the Sudan, and both emphasize the mountainous area of Jebel Marra, West of the town of El Fasher (Fig. 1). One paper (BUCHHOLZ, 1959) deals with the adjacent Ennedi plateau in the republic of Chad.

In October-December 1985, I took part in a multidisciplinary expedition to Darfur, in order to core a crater lake at Malha, in the Meidob hills. The aim was to reconstruct the Holocene palaeoclimate of the Eastern Sahel from this core. At the same time, however, I also collected dragonflies, both in the hitherto unknown Meidob Hills, in Jebel Marra, and in the Northern oasis of Nukheila or Merga.

The results are presented hereunder. Combined with literature data, they provide an excellent material for a biogeographical and palaeoecological evaluation of this key area of the Sahel.

## THE CLIMATE AND PHYSICAL ENVIRONMENT OF NORTHERN DARFUR

Most of the province of Darfur is characterized by a surfacing of the Precambrian basement complex, with local appearances of Nubian sandstone, a formation of probably Mesozoic age. The mountains of Jebel Marra as well as the Meidob Hills, however, were shaped by late-Tertiary to contemporary volcanism. They are part of a volcano-tectonic zone that extends obliquely across Africa from Cameroon in the south-west to the Northern Red Sea Hills of Sudan in the north-east. Basaltic rocks are therefore the dominant landscape feature of both areas.

Climate-wise, Jebel Marra is more directly influenced by the summer monsoon than the Meidob Hills, which lie at the verge of the desert. The site of Malha itself has a long-ranging precipitation average of 114 mm/y (Ibrahim, 1984). At the peak altitudes of Jebel Marra, which are close to 3,000 m a.s.l., a yearly precipitation of 1,000 mm may be reached, but this figure rapidly drops with altitude. At El Fasher, yearly precipitation during recent decades has been around 300 mm/y, which makes this town a typical Sahel site.

### LIST OF LOCALITIES VISITED

#### Figure 1

- (1) Sodiri (en route from Khartoum to Malha): two rainwater-fed man-made basins (hafirs), 3-XI-1985.
- (2) Malha crater: hypersaline lake on floor of 150 m. deep explosion crater. The lake itself is surrounded by freshwater springs, which overflow to form marshy zones at the lake's edges: 5-XI-1985, and the three subsequent weeks.
- (3) Sjachacha: a series of water-filled depressions on a basaltic plateau, connected by a streamlet of running water produced by a powerful spring. The water finally disappears in the sandy bed of an oued at the foot of a basalt cliff, the so-called "waterfall" of Sjachacha, 15-XI-1985.
- (4) Nukheila (Merga) oasis: one of the northernmost and most isolated oases of the Sudan, with a spectacular interdunar salt lake, 25-XI-1985.
- (5) Mellit: man-made lake, 2-XII-1985.
- (6) El Fasher: the "lake", in reality a large artificial water reservoir, 1-XII-1985.
- (7) Wadi Galol: a permanent stream on the flanks of Jebel Marra near the village of Galol, where the river forms a waterfall with a lakelet at its feet. Elsewhere the river is flowing through thick gallery forest, with alternating shadowy and sunny spots. It is the only site where collecting was done for all three papers that deal with the dragonflies of Jebel Marra. 3 and 5-XII-1985.
- (8) Wadi Korunga at Korunga village, Jebel Marra: a slightly saline stream (salt crusts on the edges of the water), much less vegetated than the preceding one and with a much lower odonate diversity. 4-XII-1985.

## DISCUSSION OF THE ODONATE FAUNA

A list of the 28 species recorded is given in Table I.

Jebel Marra is an island of high humidity, with a considerable number of permanent streamlets that drain its flanks. Some of these small rivers, often hidden in deep canyons, are surrounded by relic gallery forest, and are true pockets of equatorial conditions in an otherwise sahelian region.

The Meidob Hills, though not more than ca. 200 km North, constitute a sahelian island inside a desert country. Their number of surface water points is low, and running water occurs over distances of a few hundred meters at best.

This important difference in the nature of both environments is reflected in their respective dragonfly faunas. Not only are the Meidob Hills depauperated in number of species, but even the species themselves are largely different. There are virtually no Zygoptera in the Meidob Hills, and the Anisoptera have a strong Oriental element to them. Both *O. taeniolatum* and *O. sabina* belong to this category, with the latter species by far the more significant. The two colonies encountered were quite vigorous. Inside Malha crater, oviposition as well as the emergence of adults was observed. The density of animals patrolling along the shores of the lake was about one specimen per ten meters of shore. Figure 2 shows

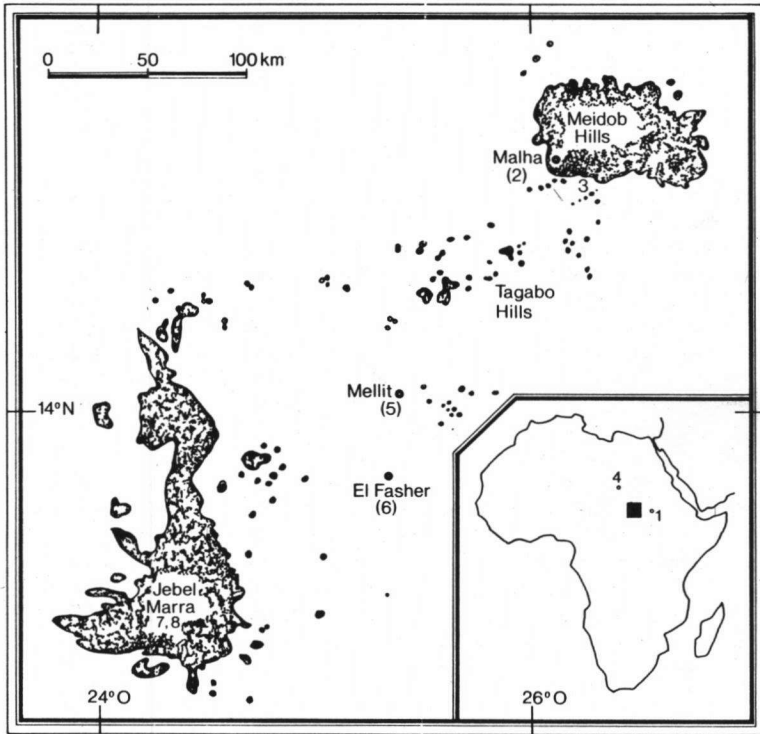


Fig. 1. Situation map of Darfur (inset: Africa), with indication of the dragonfly collecting sites (1-8) in the Meidob Hills, and in Jebel Marra and foothills.

the distribution of *O. sabina* on the Arabian Peninsula and in Africa. Clearly, it has penetrated Arabia via the Levant and the Oman-Jemen axis. The Erithrean-Somalian records are natural extensions of the eastern wave. The western wave, having crossed Sinai, extended well into North Africa, reaching north-western Algeria. A branch descended along the Nile valley, although there are surprisingly few records from the valley itself, save for one from Wad Medani along the

Table I

List of the odonate species recorded from Darfur — [D = present paper, followed by locality numbers; — L = Longfield; — H = Happold; — \* = new record for Darfur]

	D	L	H
<i>Cholorocypha curta</i> (Hag.)	7	x	x
<i>Lestes ictericus</i> Gerst.		x	
<i>Enallagma subfurcatum</i> Sel.		x	x
* <i>Pseudagrion s. sublacteum</i> (Karsch)	7		
<i>P. hamoni</i> Fraser	7		x
* <i>P. massaicum</i> Sjoestedt	7		
<i>P. kersteni</i> (Gerst.)	7	x	x
* <i>P. melanicterum</i> (Sel.)	7		
<i>Ischnura senegalensis</i> Ramb.	2(1)	x	x
* <i>Anax parthenope</i> Sel.	2		
<i>A. speratus</i> Hag.	7	x	x
<i>Aeshna rileyi</i> Calv.		x	x
* <i>Hemianax epippiger</i> (Burm.)	2		
<i>Crocothemis erythraea</i> (Brulle)	2, 3, 5, 6, 7, 8.	x	
<i>C. sanguinolenta</i> (Burm.)	7	x	
<i>Trithemis arteriosa</i> (Burm.)	7, 8	x	x
* <i>T. annulata</i> (P. de Beauv.)	1, 3, 5, 6		
<i>T. kirbyi ardens</i> (Gerst.)	3, 7	x	x
* <i>T. furva</i> Karsch	7		
<i>T. risi</i> Longfield		x	x
<i>T. dichroa</i> (Karsch)	7	x	
<i>T. stictica</i> Burm.		x	
* <i>Orthetrum julia falsum</i>	7, 8		
<i>O. brachiale</i> (P. de Beauv.)		x	
* <i>O. chrysostigma</i> (Burm.)	7, 8		
<i>O. abbotti</i> Calvert		x	
<i>O. caffrum</i> (Burm.)	7	x	x
<i>O. taeniolatum</i> (Schneider)	2, 3	x	
* <i>O. sabina</i> (Drury)	2, 3		
<i>Nesciothemis farinosa</i> (Förster)		x	
* <i>Brachythemis leucosticta</i> (Burm.)	6		
* <i>Sympetrum fonscolombei</i> (Sel.)	3, 4		
<i>Pantala flavesceus</i> (Fabr.)	5	x	
<i>Palopleura lucia</i> (Dru.)	7		x
<i>P. jucunda</i> Ramb.	7	x	x
<i>Zygonyx torrida</i> (Kirby)		x	
<i>Diplacodes lefebvrei</i> (Ramb.)			x

Blue Nile (PINHEY, 1961). I view the Darfur colonies as remnants of this wave, which succeeded in penetrating these, now arid, areas via such tributaries of the Nile as the Wadi Howar and Wadi el Milk. Between 12,000 and 3,000 BP, these dry oueds were perennial rivers during at least three humid spells of the Holocene, and there was thus ample occasion for such an extension to occur. Most likely,

however, it dates back to the 12,000-8,000 BP interval, not only because this was more humid than the subsequent ones, but also because it was more general, and embraced the Sahara, the Middle Eastern deserts, and the Sahel. A certain tolerance to fluctuating salinities of the larva seems to preadapt the species to life in semi-arid and arid environments, as evidenced from the type of habitats where it occurs: the lower courses of desert oueds in the Middle East, and saline oases such as Siwa, Giarabub, Temacin near Touggourt, and Malha. Whether this

habitat selection reflects a true preference, or competitive exclusion from true freshwaters at the edge of its range, remains a matter to be solved by experimental work.

Also remarkable is the occurrence of *Sympetrum fonscolombei* at Malha and Nukheila. There is much

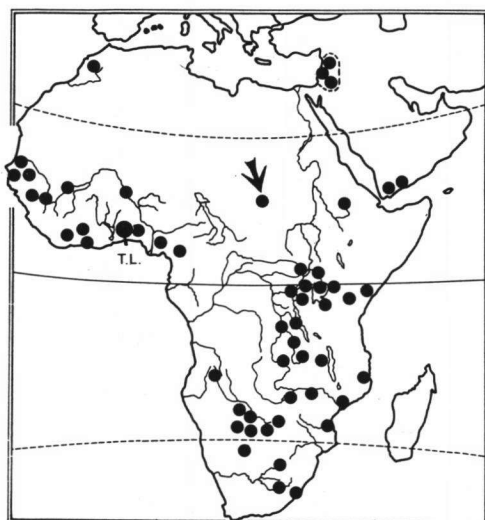


Fig. 2. Distribution in Africa and Arabia of *Pseudagrion sublacteum*. The ssp. *mortoni* is restricted to the Jordan River catchment and possibly to southern Arabia. The nominal subspecies occurs across most of the African continent, but there is no evidence of its presence in the inundated forests of the middle and lower Zaire, and there are few records from the middle Nile. Arrow: Jebel Marra record. T.L. = type locality. Note also the recently discovered relic population on the atlantic coastal plain of Morocco.

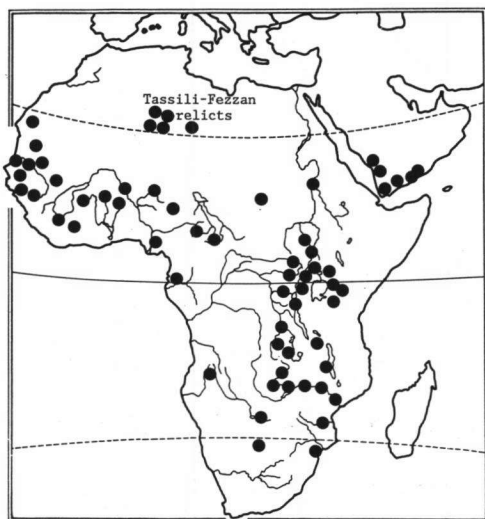


Fig. 3. Distribution in Africa and Arabia of *Pseudagrion hamoni*. In contrast to the preceding, this species has maintained a cluster of flourishing relic populations in the Central Sahara, but not in the Maghreb, although it is still fairly widespread in the north-western Sahel, and reaches the Adrar of Mauretania. Like the preceding species, it is widespread on the upper reaches of numerous tributaries of the Zaire River, but it has not been found on the Lower Zaire, and Nile records north of Khartoum are not available either.

confusion in the literature about the distribution of this mediterranean species in Africa. Statements that this migrant is widespread across the African continent are definitely wrong. A correct statement is found in PINHEY (1981): "...often abundant on pools and streams in dry bush or semi-arid country... it prefers lower elevations and appears to avoid montane areas... (and occurs) in drier localities from Cape Province to North Africa".

Because, in many years of exploration of the Sahara and Sahel, I failed to find *S. fonscolombei* in the West and in the centre, I here present a plot of its certified distribution in Africa and the Arabian Peninsula (Fig.

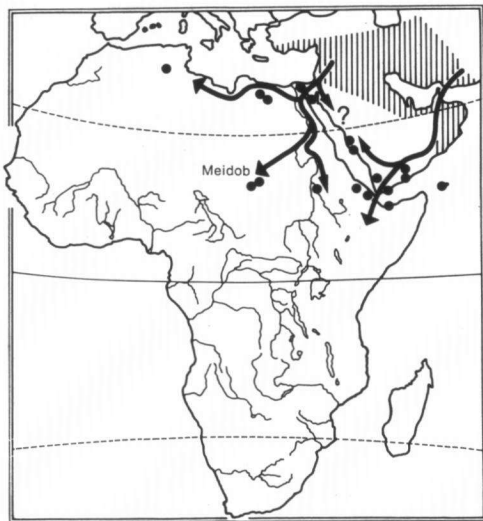


Fig. 4. Distribution of *Orthetrum sabina* in Africa and on the Arabian Peninsula. The hatched area represents the supposedly continuous range of this species in Asia. Arrows indicate different migration routes.

5). Apart from some 19th century, imprecise Selysian records from Senegal, I have been unable to find evidence of its presence south of Rio de Oro (DUMONT, 1976) and the Adrar of Mauretania (FRASER, 1952). From the central Sahara, there is only one record: Wadi Tit (near Tamanrasset, Hoggar mountains) (KIMMINS, 1934). I have seen specimens from the eastern Sahara (Bilma oasis, leg S. Jacquemart), and there are records from the Tibesti (NAVAS, 1936) and Ennedi mountains (BUCHHOLZ, 1959), now supplemented by my Darfur specimens. What causes this peculiar rarity or absence in North-West Africa remains enigmatic, but a close parallel is found in the cladoceran *Chydorus sphaericus* (O.F.M.), another otherwise wide-ranging, ubiquitous species (DUMONT, 1979). As for the rest of Africa, it is evident that Pinhey's statement is entirely correct: in Eastern Equatorial Africa, few records are available, and it seems that the species fringes the coast-line, being excluded from the high plateaus. Only on and south of the Tropic of Capricorn does it again become well represented (in fact, overrepresented, mainly due to the intensive work and numerous papers by Pinhey on various southern African countries). *S. fonscolombei* is totally absent from the Guinean Savanna and from true tropical forest.

The dragonflies of Jebel Marra offer an array of species largely composed of Afrotropical elements, that may be divided into two categories. There are species

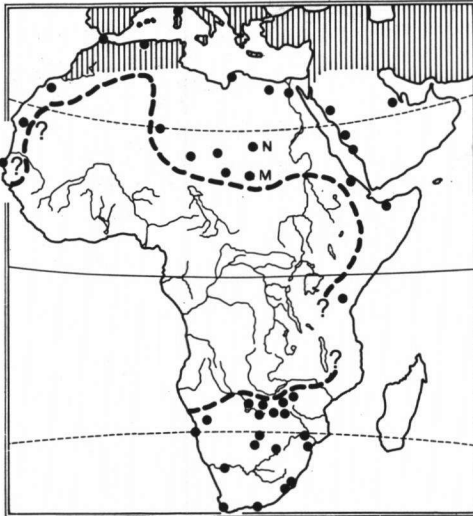


Fig. 5. Distribution of *Sympetrum fonscolombei* in Africa (excluding Madagascar) and on the Arabian Peninsula. Uncertain range boundaries are marked by a questionmark. M = Malha; N = Nukheila. Note that the cluster of records around Zimbabwe does not represent a particular abundance of the species here, but reflects E.C.G. Pinhey's many years of dragonfly recording in this and surrounding countries.

savanna environment, rainforest crossed the plains of southern Darfur and reached Jebel Marra, carrying along insects and other animals under its protective canopy (WICKENS, 1976). Some dragonfly species have survived here until today, in spite of the progressive droughts that slowly degraded the low-lying ecosystems after 6,000 BP.

Finally, it should be pointed out that the Darfur record of *Pseudagrion s. sublacteum* is the second one for the Nile valley (see SCHNEIDER, 1987 for a map), and closes a significant gap in the range of this species across Northern Africa.

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tolerant of relatively dry savanna conditions, and species representative of humid rainforest. The second category is best typified by *Chlorocypha curta* (colour photograph in DUMONT & STEVENS, 1987), *Pseudagrion melanicterum*, and to a lesser degree, *P. kersteni*, but also the non-red *Trithemis*, the two *Palpopleura*-species, *Orthetrum julia*, *O. brachiale*, *Aeshna rileyi*, and *Anax speratus* are not typical of a Sahel environment. A locality like Wadi Galol, where not less than 18 dragonfly species were observed simultaneously, is therefore a relic of a formerly northward extension of forest species, and thus of the humid early-Holocene climate.

Perhaps at the same time when increased humidity permitted oriental immigrants to colonize the Meidob Hills, then a

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