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FOREWORD

African Odonatology - past, present and future

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"The female rests on a twig in seemingly bored contemplation while the male performs a little aerial dance, backwards and forwards in the arc of a circle, orientated towards the female and dangling the white surfaces of the tibiae below his head like a beard. If competition is keen, however, such formalities are generally omitted and he merely pounces on her without any prelude." **Elliot Pinhey** (1965) describing the reproductive behaviour of *Platycypha caligata* (Selys, 1853). The species has been the subject of many behavioural studies making it the best studied endemic African odonate.

INTRODUCTION

The First PHAON (Pinhey's Heritage African Odonata Network) Meeting on African Odonata was held on 26th July 2001 in Gällivare, Sweden, as part of the 2nd International Symposium of the Worldwide Dragonfly Association and was attended by approximately 35 delegates. The distribution range of the Glistening Demoiselle *Phaon iridipennis* (Burmeister, 1839), which occurs throughout tropical Africa and Madagascar, reflects the study area of this network.

The main aim of the meeting was to provide an overview of the current knowledge of African Odonata and to exchange thoughts on research priorities for African odonatology as a whole. Six lectures were presented during the meeting by: Viola Clausnitzer, Philip S. Corbet, Klaas-Douwe B. Dijkstra, Andreas Martens, Mike J. Parr and Frank Suhling, and the proceedings are presented in this issue of *Cimbebasia*.

This foreword serves as an introduction, firstly providing a brief history of African odonatology, and then going on to summarise priorities for future collaboration and research in Africa.

HISTORY OF AFRICAN ODONATOLOGY

The founder of modern systematics, Carl von Linné, described the first African 'dragonfly' in 1767, which he named *Libellula capensis* (*vide* Linnaeus 1767). As recently as 1957, Kimmins showed this species to in fact represent a lacewing of the genus *Palpares* (Neuroptera: Myrmeleontidae). Drury's (1773) *Libellula lucia* must, therefore, be regarded as the first named African odonate. Today known as *Palpopleura lucia*, this species is often the first dragonfly noted by the layman in the African bush. It is ironic that Drury also gave the taxon name *portia*, the status of which either as a strongly divergent form of *lucia* or as a true species is unresolved to this day. Thus Drury shuffled the pieces of the oldest puzzle in African odonatology (*vide infra*).

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Just prior to the close of the 18th century, Johann Christian Fabricius described four African species. These included *Pantala flavescens*, the most widespread and abundant odonate on Earth, and the beautiful West African demoiselle *Sapho ciliata*. A few additional African species were later described by Ambroise M. F. J. Palisot de Beauvois (1805) and Julien François Desjardins (1835) in the first half of the 19th century. The foremost contributors during this period were Hermann Burmeister and Jules Pierre Rambur. In his entomological handbook, Burmeister (1839) described such well-known African species as *Anax ephippiger*, *Brachythemis leucosticta*, *Ceriagrion glabrum*, *Orthetrum chrysostigma*, *Trithemis arteriosa* and the figurehead of African odonatology, *Phaon iridipennis*. Rambur (1842), in his natural history of 'neuropterous' insects, introduced such familiar species as *Acisoma panorpoides*, *Hemistigma albipunctum*, *Ictinogomphus ferox* and *Ischnura senegalensis*, as well as a relatively large number of Malagasy and Mascarene species.

In the last six decades of the 19th century, Baron M. Edmond de Selys-Longchamps and, to a lesser degree, Hermann Hagen, classified and described countless odonates worldwide. Selys' published work, and the catalogues based on his collection by René Martin and Friedrich Ris, laid the foundation for the taxonomy of Odonata. Martin and Ris were part of a generation of odonatologists that commenced publishing in the last decade of the 19th century, continuing roughly to the first three decades of the 20th century. Contemporaries who published much on African Odonata were: Ferdinand Karsch, William F. Kirby, Friedrich Förster and Yngve Sjöstedt. Lesser contributions from the 1870s to the 1930s were made by, in more or less chronological order, Carl E.A. Gerstäcker, Robert McLachlan, Philip P. Calvert, Karl Grünberg, Kenneth J. Morton, Herbert Campion, Otto Le Roi, J.-L. Lacroix and John Cowley.

A new generation of odonatologists were active in the 1920s and 1930s, most continuing their contributions to about the 1960s. Their work was much more lavishly illustrated than that of their predecessors. This is especially true of Erich Schmidt, whose exceptional work on the Madagascar Zygoptera was destroyed by fire during the Russian bombardment of Neubrandenburg in 1945. Only in 1951 was his work to appear in an English translation of the proofs. Keppel H. Barnard's (1937) monograph of the Odonata of the Cape of South Africa was the first African work to include substantial information on larvae. Despite their indispensable work, their compatriot Frederic Charles Fraser overshadowed both Cynthia E. Longfield and Douglas E. Kimmins.

Following Drury's initial work, Burmeister and Rambur's first investigation and Selys' classification, Fraser instigated the fourth revolution in African odonatology: bulk description. Between 1928 and 1962 Fraser named more African taxa than any other odonatologist. Especially important was his work on the vast collections amassed by the former 'Musée Royale de Congo Belge' in Tervuren, Belgium, and first catalogued by Henri Schouteden. Maurits A. Lieftinck, champion of oriental Odonata taxonomy, also made some contributions to the African fauna in the 1960s.

Boris I. Balinsky, Robert M. Gambles and Elliot C.G. Pinhey published their first papers in the 1950s and their last in the 1970s and 1980s. Balinsky focused on South Africa and Gambles on his beloved Nigeria, naming almost all new species '*nigeriensis*'. Sadly, Gambles' planned Nigerian monograph never materialised, and much useful information still resides only in his unpublished manuscripts, notebooks and collection.

Pinhey (Figure 1), through his extraordinary energy, enthusiasm and skill, did more to advance the study of African dragonflies than any other researcher. Without the publication of his detailed regional and taxonomic monographs, most research on African Odonata today would be, if not impossible, considerably more difficult and tentative. Pinhey's (1962) '*A Descriptive Catalogue of the Odonata of the African Continent*' summarised two centuries of taxonomic research development and may be seen as the starting point of modern African odonatology. In the 23 years that followed, he published almost a hundred papers. If the number of printed pages and described species

are considered alone, then Elliot Pinhey should be remembered as the greatest contributor to African odonatology, rivalled only by Fraser.

Many authors have added to the wealth of biogeographic and taxonomic knowledge largely established by Pinhey, or entered more contemporary fields of research, such as conservation biology and behavioural ecology. Unravelling the relations between genital morphology and reproductive behaviour, Peter Miller studied numerous African species. A few of the many other researchers are: Pierre Aguesse, Karl F. Buchholz, Carlo Consiglio, Roger Lindley, Cesare Nielsen and Evelyn Prendergast. Finally, of course, there are the numerous researchers still active today, who shall undoubtedly further our knowledge of the African Odonata in the future.

Figure **1**. Elliot C.G. Pinhey (1910-1999) giving a presentation at the 1981 Symposium of Odonatology in Chur, Switzerland. He spoke on the Lake Malawi form of the riverine species *Platycypha caligata* (Selys, 1853), the proceedings of which were one of the last of his countless contributions to African Odonatology (Photograph M.J. Parr).

FUTURE RESEARCH

Attempting to identify key action plans for research is a difficult task, as much remains to be done. Virtually all taxonomic groups, for example, require at least some degree of revision. While the taxonomy of many groups is not secure, a primary aim should be to rectify this situation. Until we are able to reliably recognise species, the quantity and quality of behavioural, ecological, physiological and biogeographic studies on particular taxa is limited. The status of taxonomic knowledge of African Odonata is summarised by Dijkstra (2003). In this paper it is noted that taxonomic revision, the production of identification keys and the study of larvae and exuviae are the main areas requiring attention. Furthermore, biogeographic and phylogenetic considerations have scarcely been explored for species on the African Continent and such studies would help augment the knowledge of the evolutionary history of Africa's dragonflies.

Relatively little is known about the behaviour of African dragonflies. Martens (2003) reviews current knowledge of their reproductive behaviour. Various morphological peculiarities are known, the function of which would be interesting to investigate. The best-known unsolved problem – one that links taxonomy, ecology and behaviour – is encompassed in *Palpopleura lucia* and the two male forms, *lucia* and *portia*. Both taxa are often abundant in suitable habitats, but differ in size and degree of blackness on the wings. Slight behavioural and habitat differences have been noted anecdotally, and it is surprising that a detailed study of the two forms has never been undertaken. Similarly, *Eleuthemis buettikoferi* Ris, 1910, has two distinct male forms, differing mainly in the colour of the abdomen venter, which is used in courtship (J. Lempert pers. comm.). Are these forms with different reproductive strategies ecological forms, or cryptic species? Other enigmas are the remarkable colour variation in both sexes of *Africocypha lacuselephantum* (Karsch, 1899) and the strong likeness of *Coryphagrion grandis* Morton, 1924, to neotropical giant damselflies (Pseudostigmatidae).

A case where females appear not to be 'feminine' is found in the genus *Zygonyx* Hagen, 1867. Females of several species of this genus have broad, strongly marked wings, whereas males have narrow, clear wings. Females have been observed flying prominently, and in these cases their wings make them extremely visible. This is an interesting analogy to the unrelated Chlorogomphidae of South Asia, which occur in similar forest stream habitats. If female appearance and behaviour are connected to attracting males, this may involve an as yet unknown mating system in Odonata.

The ecology and habitat requirements of African dragonfly species are also poorly known. Extremes are perhaps the most rewarding to study. Members of the genus *Zygonyx*, for example, breed in torrential waters such as waterfalls. Only very few African species are known to utilise such extreme conditions as in phytotelmata, warm springs, dripping rock faces, seepages and alkaline or brackish lakes. Species that have adapted to very ephemeral environments are among the most successful on the African Continent. Such ephemeral habitats are associated with broad yearly climatological variation that characterises large parts of the continent. Unfortunately, few details have been amassed on seasonal patterns of dragonfly occurrence, both in ephemeral and more stable environments, and we are far from an understanding of how dragonflies survive strong seasonal variation. Many species are thought to migrate or siccatate. Siccatation is surviving the dry season as an adult, but virtually nothing is known about how and where this occurs. The sudden appearance of teneral odonates at the end of a half-year drought suggests that some species at least are able to survive for long periods in the late larval stages, buried in the damp substrate of dry riverbeds. This is another possibility that could easily be investigated. Corbet (2003) deals with the above subjects.

Some species, especially the savanna representatives of the genus *Trithemis* Brauer, 1868, appear to demonstrate tolerance to extreme heat, even relative to other sun-loving Odonata. Males of *Orthetrum ransonneti* (Brauer, 1865) have been seen in the Sahara defending territories in the full heat of the sun at a temperature of 40°C in the shade. Physiological studies on these genera would be very revealing.

Another extreme is isolation. Relict species are often confined to special ecological conditions, usually small rainforest streams. There are three main centres for such relicts in Africa: Cameroon, Madagascar and South Africa. The Cameroon highlands harbour genera such as: *Neurolestes* Selys, 1882, *Nubiolestes* Fraser, 1945, *Pentaphlebia* Förster, 1909 and *Stenocnemis* Selys, 1886, some of which have their closest relatives in South America. *Chlorolestes* Selys, 1862, *Ecchlorolestes* Barnard, 1973, and *Syncordulia* Selys, 1882, in the Cape Region, South Africa, have their closest relatives in Australia. Madagascar, among others, boasts three species-rich megapodagrionid genera, *Nesolestes* Selys, 1891, *Protolestes* Förster, 1899, and *Tatocnemis* Kirby, 1889. Other phylogenetic and ecological enigmas include very isolated monotypic genera such as *Amanipodagrion gilliesi* Pinhey, 1962, of the Tanzanian Usambara Mountains, *Coryphagrion grandis* of the coastal forest of East Africa (*vide infra*) and *Oreocnemis phoenix* Pinhey, 1971, of Mount Mulanje in Malawi.

It has often been suggested that Odonata may play a rôle in the control of various blood-feeding Diptera, both in the larval and adult stages. Examples are mosquitoes (Culicidae) and black flies (Simuliidae), vectors of the human diseases malaria and river blindness respectively. It is doubtful, however, that Odonata have a considerable impact on vector numbers. The value of Odonata as controllers of malarial mosquitoes is particularly questionable, as few Odonata species have larvae that develop in the type of water bodies favoured by these insects. Due, however, to their sensitivity to habitat structure and water quality, especially when combined with their attractive appearance, dragonflies may be promoted as guardians of watersheds. Dragonflies may indicate a healthy habitat in which human disease vector densities are at a more natural, lower level. Black fly infestation, for example, may increase in places where the river environment is affected by damming. Nonetheless, the ever-valued rôle of dragonflies as environmental sentinels has not prevented them from being under-studied. Besides individual species as indicators, species diversity and assemblages may also provide indices of habitat health. Desertification, pollution, deforestation, erosion and invasion of alien weeds are just a few

of the threats posing aquatic habitats. Protection of water-catchments is becoming more urgent with the growing demands of an increasing human population.

Distribution data are the basis for ecological, taxonomic, biogeographic and conservation research, but distribution ranges of many African odonates are still insufficiently known. The forest areas are richest in species and endemics. For this reason alone, special inventory work is required, as discussed by Clausnitzer (2003). The Lower Guinea Forest, within its heart the Cameroon highlands, is probably the richest region in Africa. According to Jonathan Kingdon the Congo Basin is the main centre of speciation for riverine organisms in Africa. To the South is a very broad and gradual transition to the miombo country of the Zambezi basin. Pinhey's work in northern Zambia has shown this mosaic of aquatic and forest habitats to be very rich in Odonata. Study of the adjacent areas in Angola, Tanzania and especially the Democratic Republic of Congo would prove to be very fruitful. On the eastern rim of the basin lie the east Congo refugia and the Albertine Rift Highlands. This is likely to be the second most species-rich region for odonates in Africa. The highlands of Angola have affinities to those of Cameroon and the Albertine Rift and are, therefore, of particular interest.

Other regions of great odonatological potential are the Eastern Arc Mountains of Tanzania, forests on the Indian Ocean coast and the Ethiopian Highlands. The last mentioned appears relatively poor in Odonata, probably due to its Ice Age history and isolation by deserts. Madagascar and the Comoros have remained surprisingly under-studied in recent years, despite their biological wealth and the degree of threat posed on natural habitats. Almost 80% of Odonata species in Madagascar and the Comoros are endemic.

Researchers of Odonata have for the obvious reason of paucity of aquatic habitats, largely ignored dryer regions. These areas are often on biogeographic 'crossroads', variably functioning as barriers or bridges. Northeast Africa and the Sahel Region are the link to the Palearctic and Oriental Regions *via* oases and the Nile River. The Somali and Namib Deserts have high endemism among arid-adapted taxa, to which Odonata generally do not belong. Suhling *et al.* (2003) summarise our knowledge of Odonata in the arid parts of the continent. The Dahomey Gap of Togo and Benin is an interesting savanna barrier between the Upper and Lower Guinea forest blocks. Many new records may be acquired in the field, but much also lies dormant in collections and must become accessible.

Analysis of distribution data may be used to identify 'hot spots': centres of endemism and diversity. By combining geological, climatological and phylogenetic data, attempts may be made to reconstruct the evolutionary history of Africa's dragonfly fauna, and *vice versa*. Records may also be used to model species ranges and diversity, based on geography and climate. This may then be used to pinpoint areas with research priority.

PHAON A WAY FORWARD FOR AFRICAN COLLABORATION?

In order to achieve more, professional and amateur work must be stimulated and expanded, building capacity both in and outside the African Continent. Local expertise should be called upon to widen the scope of African odonatology. Good communication among students of African Odonata is a prerequisite to furthering knowledge. Popularisation, i.e. raising of public awareness of dragonflies, can strengthen the basis on which odonatologists are working. Initiatives that are required are the creation of field guides with colour plates, identification keys, websites, standard lists of popular names for species and dragonfly workshops.

Regional projects may achieve these goals at a local level. The *Cameroon Dragonfly Project* has noted great success in Cameroon, working together with local communities (G. S. Vick pers. comm.). A means to initiate local activities is by co-operation with universities and museums. Few academics are working on African Odonata, and therefore the value of dragonflies as research objects should be advocated. The most important collections of African Odonata are in museums in Berlin, Bulawayo, London, Tervuren and Paris. Only the last mentioned is currently under the care of a specialised curator, and only one (Bulawayo)

resides on the Africa Continent itself. Museums should be aided in the conservation, expansion and research of their collections, and further reference collections should be created in museums and institutes in Africa.

Progress in the study of African Odonata may be stimulated and reported through a number of activities. The basis is open communication among people interested in African Odonata, embodied by an interest group. For this reason. PHAON was founded as an e-mail network, and the first meeting was held. There are future plans for PHAON meetings and a PHAON website. Forwarding knowledge may be achieved in subsequent phases, each phase forming the basis for the next. The first step is to produce a taxonomically sound and up-to-date checklist of African Odonata. Ideally this would be in a form similar to Pinhey's 1962 catalogue, and would be a sequel, adding almost half a century of research, including, for example, 90% of Pinhey's work and all progress published by authors such as Gambles. A solid species list can be the basis of a record database, which could then be used to produce distribution maps. This requires compilation of all published records and as many as possible from museum collections (focusing on Berlin, Bulawayo, London, Paris and Tervuren). In anticipation, a format for a record database must be agreed upon. Eventually, the future may bring a handbook of African Odonata in which all taxonomic, ecological and biogeographic knowledge is compiled.

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