

# A review of the distribution of Odonata in the Macaronesian Islands, with particular reference to the *Ischnura* puzzle

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Best regards,  
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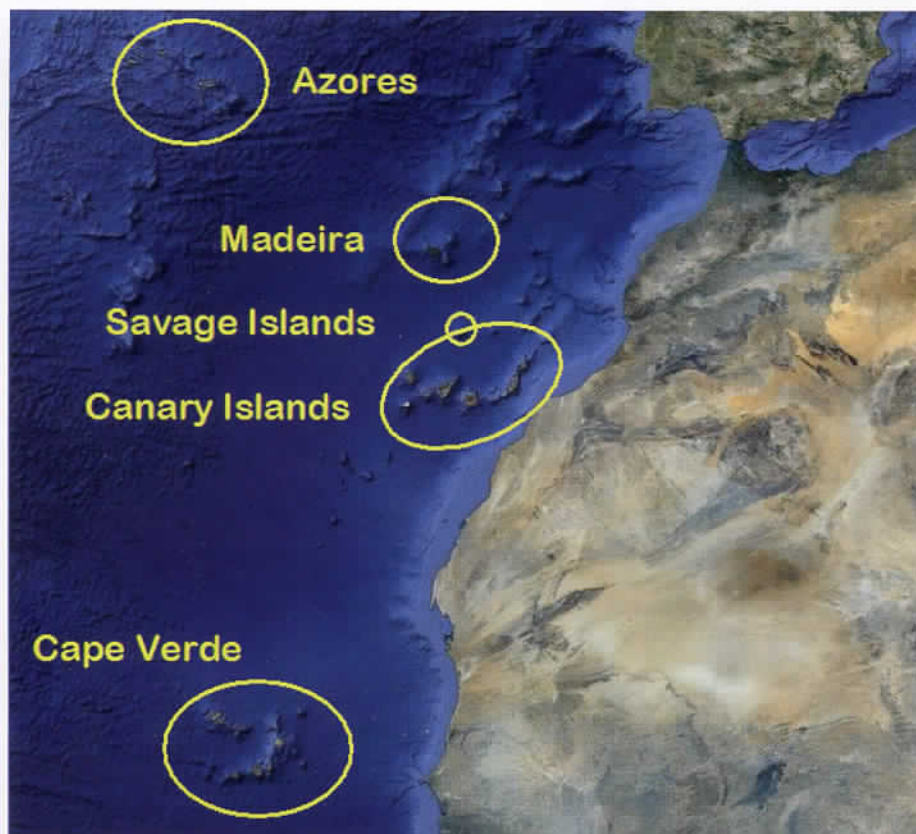
## Summary

The Macaronesian Islands, comprising five archipelagoes in the North Atlantic Ocean (Azores, Madeira, Savage Islands, Canary Islands and Cape Verde Islands), do not harbour many species of Odonata. Acknowledged records of 20 species (7 Zygoptera, 13 Anisoptera) are known today from Macaronesia. However, a unique mixture of one endemic and 19 species that originated from three continents makes these islands a very attractive travel destination for odonatologists. In this study, the existing literature on the occurrence of Odonata in Macaronesia is summarised and evaluated. Special account is given concerning the historical development of the knowledge of the distribution of *Ischnura* species in Macaronesia.

## Introduction

The Macaronesian Islands consist of five groups of islands of volcanic origin in the North Atlantic Ocean that were formed during the Miocene Age, roughly 20 to 3 million years ago. Politically, the Macaronesian Islands belong to three countries: Portugal, Spain, and Cape Verde. These five archipelagoes are, from north to south: The Azores (Portugal); Madeira with the island of Porto Santo and the Desertas Islands (Portugal); the Savage Islands (Portugal), administratively part of the Madeira Autonomous Region; the Canary Islands (Spain); and the Cape Verde Islands, which achieved independence from Portugal in 1975 (Fig. 1).

The Macaronesian Islands are characterised botanically by the natural occurrence of *Laurisilva* forest at higher altitudes, from 300 m up to approximately 1,300 m above sea level. It is dominated by evergreen, glossy-leaved hardwood trees that predominantly are members of the Lauraceae family. In Madeira it covers about 16 % of the island and its contribution to biodiversity is extremely high with over 500 endemic invertebrate species being associated with the *Laurisilva*. As all these archipelagoes were never part of a continent, the level of endemism is very high and several distinct plant and animal communities have developed. Other native plants and animals reached the islands via long-distance dispersal.



**Figure 1.** Overview of the Macaronesian region with the five archipelagos. North faces up. The distance from the Azores to the Cape Verde islands is about 2,300 km. © 2011 Google – Grafiken ©2011 TerraMetrics, NASA.

Regarding the Odonata, this scenario becomes clearly visible: In Macaronesia we find one endemic species, *Sympetrum nigrifemur* (Plate 1), alongside 19 other species that originated from three continents – Europe, Africa and America. Hence, although the absolute number of odonate species on the Macaronesian archipelagos is not very high, this unique mixture makes these islands a most attractive travel destination for odonatologists and other nature lovers. Consequently, the number of odonatological publications that pertain to the Macaronesian Islands is relatively high, compared to other regions where many more species are present.

In this study I give a review of today's knowledge on the occurrence and the distribution of Odonata in Macaronesia (Table 1). Several publications already exist that have summarised, annotated and discussed the existing literature and

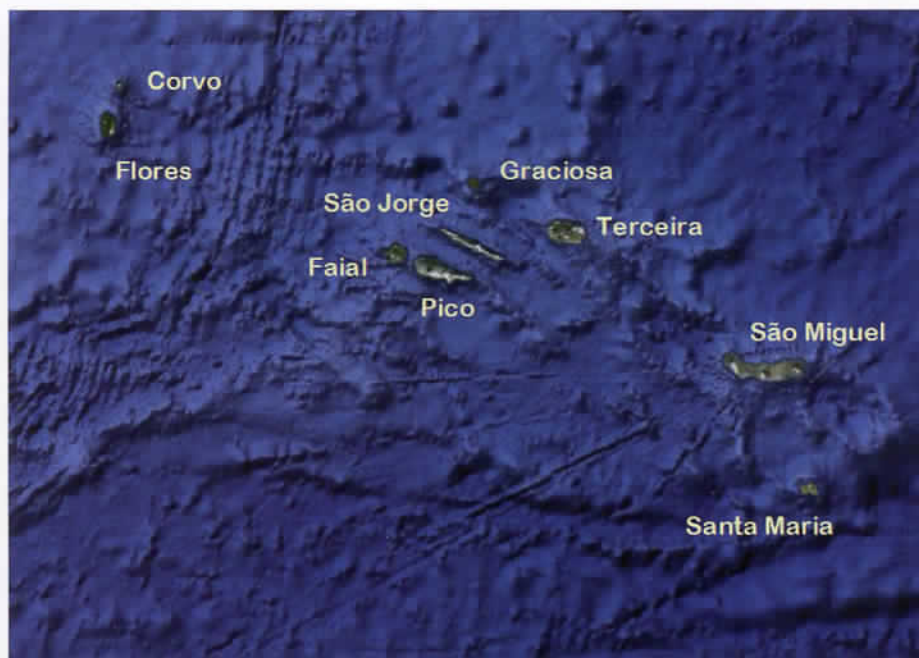
other recording data from Macaronesia, and these have been considered in this review. However, these publications either pertain only to certain countries or archipelagoes (e.g., McLachlan, 1882; Navás, 1906; Ferreira & Weihrauch, 2005; Ferreira et al., 2006; Aistleitner et al., 2008) or to a particular species (Cordero Rivera et al., 2005b; Lorenzo Carballa et al., 2009; Malkmus & Weihrauch, 2010). In this paper, a general, up-to-date overview of all Macaronesian Islands is presented. A special account is given of *Ischnura* in these archipelagoes, and the development of knowledge of the occurrence and distribution of *Ischnura* species in Macaronesia is provided chronologically in sections entitled 'The *Ischnura* puzzle'.



**Plate 1.** Male *Sympetrum nigrifemur*, the only Macaronesian endemic odonate. Ponds near Erjos, Tenerife, Canary Islands. 21 March 2006. Photograph by Mike Averill.

### The Azores

Considering the prevailing climatic conditions it is not surprising that the Odonata found on the nine islands of the Azores – from west to east: Flores, Corvo, Faial, Pico, São Jorge, Graciosa, Terceira, São Miguel and Santa Maria (Fig. 2) – is species poor. Only four species, two zygopterans and two anisopterans, have been recorded (Table 1). Although the occurrence of Odonata in the Azores had been mentioned during the 19<sup>th</sup> century (Drouët, 1861; Guerne, 1888), the first records of three of the four Azorean species – *Ischnura pumilio*, *Anax imperator* and *Sympetrum fonscolombii* – were only listed in 1933 (Navás, 1933). However, it should be noted that, earlier, Sampaio (1904) erroneously mentioned *Libellula grandis* as common on the island of Terceira, but his detailed drawing proves



**Figure 2.** Names and position of the nine islands of the Azores Archipelago. North faces up. São Miguel is about 63 km long. © 2011 Google – Grafiken ©2011 TerraMetrics, NASA.

that he had actually described *A. imperator*.

### The *Ischnura* puzzle, part I

The fourth Odonata species from the Azores belongs to a population unique in the world. Its occurrence there was first published by Valle (1940), who identified 63 specimens collected during 1938 on five Azorean islands as *Ischnura senegalensis*, and added, with an exclamation mark, that all of these specimens unfortunately were females but that due to the shape of the pronotum he regarded the identification as safe. Gardner (1960) judged a series of larvae collected during 1957 in Santa Maria and Flores as belonging to *I. senegalensis* as well. However, Belle (1982) had the opportunity to recheck ten of Valle's specimens, which were stored in the Zoological Museum of the University of Helsinki, and found that they "proved to belong to another species as judged by the very small vulvar spine" (Belle 1982). To shed more light on this mysterious case, Jean Belle travelled to the Azores in 1988 and searched three islands for this damselfly. In Pico, he captured more than 30 female specimens but again a male of the species was not encountered. The true identity of this enigmatic

**Table 1.** Checklist of Odonata in the archipelagoes of the Macaronesian Islands and their probable origin (Af, African; Am, American; Eu, European; ME, Macaronesian endemic). Some additional taxa that have been reported from Macaronesia in the odonatological literature have been omitted in this checklist but are discussed in the text. Status: ●, established species or regularly occurring migrant; ○, only single records; M, typical migrant with only sporadic occurrence, or recorded in a clearly migrating situation; ?, status as yet unclear or questionable.

	origin	Azores	Madeira	Savage Islands	Canary Islands	Cape Verde
<i>Lestes pallidus</i>	Af					●
<i>Ischnura hastata</i>	Am	●				
<i>I. pumilio</i>	Eu	●	●			
<i>I. saharensis</i>	Af		?		●	
<i>I. senegalensis</i>	Af				?	●
<i>Pseudagrion glaucescens</i>	Af					?
<i>Platycnemis subdilata</i>	Af				○	
<i>Anax ephippiger</i>	Af		M		M	M
<i>A. imperator</i>	Eu/Af	●	●	M	●	●
<i>A. parthenope</i>	Eu		○		●	
<i>Crocothemis erythraea</i>	Af				●	●
<i>Orthetrum chrysostigma</i>	Af				●	
<i>O. trinacria</i>	Af				●	●
<i>Pantala flavescens</i>	Af					●
<i>Sympetrum fonscolombii</i>	Af	●	●		●	●
<i>S. nigrifemur</i>	ME		●	M	●	
<i>Tramea limbata</i>	Af					○
<i>Trithemis annulata</i>	Af				●	●
<i>T. arteriosa</i>	Af				●	?
<i>Zygonyx torridus</i>	Af				●	●

species was unravelled only when Belle's specimens from Pico were compared by Jan van Tol with the collection in the former National Museum of Natural History in Leiden, The Netherlands (today named 'Naturalis'), and were identified as the American species *Anomalagrion hastatum* (Belle & van Tol, 1990), a taxon that today is referred to the genus *Ischnura* and the species listed as *Ischnura hastata* (Say, 1839). Furthermore, Belle & van Tol (1990) were the first to hypothesize that the Azorean *I. hastata* belonged to a parthenogenetically reproducing population. This finding, which is unique within the whole order, was later analysed and substantiated in detailed studies by Cordero Rivera *et al.* (2005a, b) and has reached an according significance in evolutionary biology. Based on the case of *I. hastata*, Sherratt & Beatty (2005) discuss the concept of 'geographic parthenogenesis', which proposes that, due to the different selection pressures that organisms face, the parthenogenetic form of a species is more likely to occur in areas such as higher latitudes and altitudes and on islands. If a species can include both sexual and parthenogenetic forms, on arriving on a remote island it is possible that the latter is favoured, at least initially, owing to the difficulty of finding mates.

### The Madeira Archipelago

The Madeira Archipelago consists of the two main islands of Madeira and Porto Santo and the three small Desertas Islands (in Portuguese *Ilhas Desertas*) – from north to south: Ilhéu Chão, Deserta Grande and Bugio (Fig. 3). The Desertas Islands are no more than a chain of long and narrow, uninhabited rocks in the sea, lacking permanent freshwater, and therefore are not colonised by Odonata. Madeira and Porto Santo are permanently inhabited or regularly visited by six odonate species (Ferreira & Weihrauch, 2008): *Ischnura pumilio* (the only zygopteran), *Anax ephippiger*, *A. imperator*, *A. parthenope*, *Sympetrum fonscolombii* and *S. nigrifemur* (Table 1).

The first Odonata species from Madeira was reported by Bowdich (1825: 169), referring to an "*Aeschna* approaching *grandis*, and greatly resembling the species figured by Roesel, t.2, Insect. Aquat. tab. ii fig. 1", i.e., *A. imperator*. The occurrence of *I. pumilio* in Madeira was first mentioned by Rambur (1842: 278): "*Agrion pumilio* ... il se trouve aussi à Madère". Selys & Hagen (1850: 396) wrote "*A Madeire on trouve Libellula striolata*...", which is the first indication of the occurrence of *S. nigrifemur* on Madeira. The first record of *S. fonscolombii* was given by Hagen (1865) and, in a footnote, Gardner (1963) mentions that in February 1958 he collected specimens of *A. ephippiger* in Porto Santo. However, the first published record of *A. ephippiger* in Madeira itself was by Smit (1998) during a mass influx of the species in spring 1998. The last odonate addition to the Madeiran fauna is *A. parthenope*, which was recorded for the first time on 30 August 2005 in Porto Santo (Pelny, 2006) and on 5 October



**Figure 3.** Names and position of the five islands of the Madeira Archipelago. North faces up. Madeira is about 45 km long. © 2011 Google – Grafiken ©2011 TerraMetrics, NASA.

2008 in Madeira (Malkmus & Weihrauch, 2010). From the Desertas Islands, only records of migrating *S. fonscolombii* (Gardner, 1968) and *S. nigrifemur* (Malkmus & Weihrauch, 2010) have been published.

Of particular interest is a gomphid species that in the 19<sup>th</sup> century was noted on three occasions to occur in Madeira. Selys & Hagen (1858: 138) refer to a specimen reported by T. Vernon Wollaston by the name *G. lucasii*. Hagen (1865), who drew up this paper for Wollaston, based on his Madeiran Neuroptera material (McLachlan, 1882), writes "I have not seen the *Gomphus* taken by M. Hartung in Madeira, and deposited in the collection of Professor Heer; it is probably *G. simillimus*". On the other hand, Selys (1887: 66) writes: "*Gomphus* sp? - D'après une larve de Madère. Probablement le *G. Lucasii* d'Algérie", indicating that here he explicitly refers to a larval gomphid specimen. This may be regarded as contradictory to the interpretation of McLachlan (1882), Gardner (1963) and Ferreira *et al.* (2006), who all consider the reported *Gomphus* from Madeira to pertain to a single adult specimen, because neither Selys & Hagen (1858) nor Hagen (1865) alluded to a larval specimen. However, Selys' indication (Selys, 1887) may simply have been a mistake and, as the true identity of the lost gomphid specimen(s) is unclear, it was consequently deleted from the

Madeiran checklist by Ferreira *et al.* (2006) and Ferreira & Weihrauch (2008).

## The *Ischnura* puzzle, part II

A particular case has been discussed in detail by Ferreira *et al.* (2006) and here I repeat the chronology of events, which Reinhard Jödicke and I had prepared together for that publication: There is an, as yet unidentified second, *Ischnura* species in Madeira, in addition to *I. pumilio*. It was first mentioned by Selys & Hagen (1850), who referred to a species labelled *Agrion Maderae* (nom. nud.) in the collection of Rambur that had been acquired by Selys. For many years further information was sparse. Hagen (1865) wrote that he did not know the "A. Maderae" of Selys, while Selys (1876) listed the locality "Madeire?" for *I. graellsii* – the first speculation about the identity of the Madeiran species. McLachlan (1882) stated that his knowledge "of this African species as Madeiran is based solely on 1 ♂ and 1 ♀ in De Selys's collection. The ♂ is from Rambur's collection, and is labelled by him "*Agrion maderae*", an unpublished name; it is in bad condition, but is certified as *senegalensis* by De Selys". Selys (1887) himself was unsure because he first (p. 46) put a question mark behind Madeira as a locality for *I. senegalensis* but later (p. 66) he added it to the list of records: "Madère, d'après une exemplaire de la collection Rambur". Although Le Roi (1915) doubted the occurrence of a species in Madeira that is absent from northwestern Africa, this identification seemed to be confirmed when Gardner (1963) reported the species in a footnote on a series of *I. senegalensis* captured during an expedition to the island of Porto Santo in February 1958. Unfortunately, the specimens from the collection of Selys are lost today, and the series of Gardner has not yet been located.

Based on the knowledge of the distribution of *Ischnura* spp. in Macaronesia at that time, Ferreira *et al.* (2006) exhaustively discussed the case and came to the conclusion that "the identity of the enigmatic ischnuran in Madeira is most probably *I. saharensis*". From today's viewpoint, only five years later, I would not dare to go that far. When considering the new findings in Macaronesia (see 'The *Ischnura* puzzle, part III') all that can be said is that the true identity of a second *Ischnura* species from Madeira can only be unravelled by the examination of Gardner's – as yet not traced - series caught in 1958 in Porto Santo, or by catching new specimens of the same species from the Madeira Archipelago.

## The Savage Islands

The Savage Islands (in Portuguese *Ilhas Selvagens*), comprising three large and 18 small islands of volcanic origin, are situated almost centrally between Madeira, 230 km away, and the Canary Islands 165 km away. The archipelago

consists of two groups of islands: the northeastern group, including the main island of Selvagem Grande and three small islets, and the southwestern group, including Selvagem Pequena, Ilhéu de Fora and a group of ten very small, rocky islets. Due to its marine biodiversity, a unique flora with ten endemic species and a breeding ground for many avian species, especially shearwaters (*Calonectris* spp.), the Savage Islands were converted stepwise into a nature reserve by the Portuguese government from 1971 onwards. There are no human inhabitants on the islands, with the exception of two permanent wardens on Selvagem Grande, and access is allowed to authorised visitors only.

The Savage Islands, like the Desertas Islands, lack freshwater except for ephemeral puddles after rainfalls, and the presence of Odonata is restricted to visits by migrating individuals (Table 1). Observations of only two species have been published: Báez (1985: 39) observed an *Anax* cf. *imperator* during a visit to Selvagem Grande in 1976, and Malkmus & Weihrauch (2010) list three records of *Sympetrum nigrifemur* from the same island: One is a specimen in the Museo Municipal do Funchal that was collected by Weinreich on 24 July 1963; the other two were observations by M.J. Biscoito during October 1984.

### The Canary Islands

There are 14 species of Odonata that can be considered today for the checklist of the seven Canary Islands (Table 1) – from west to east: El Hierro, La Palma, La Gomera, Tenerife, Gran Canaria, Fuerteventura and Lanzarote (Fig. 4). Probably the first publication that contained any reference to dragonflies was published by Bory de St.-Vincent (1803: 369) who listed three species from Tenerife: "75. Demoiselle rouge. *Libellula rubicunda*. L. 77. Demoiselle déprimée. *Libellula depressa* ? L. 78. Demoiselle variée. *Libellula variegata*. Fab. Drury T. II. Pl. XLV, fig. 1." As for item 76, only a fourth "Demoiselle ...." is listed without any additional information. From Bory's list, today only the observation of *Crocothemis erythraea*, under the synonym *L. rubicunda*, can be acknowledged as a first record from the Canaries. An observation of *Libellula depressa*, that Bory himself had added a question mark to, and otherwise has never been reported from the Canaries, was already regarded as doubtful by McLachlan (1882) and Navás (1906). The same applies to *Palpopleura lucia* (Drury), a common southern African species listed by Bory under the synonym *Libellula variegata*. Consequently, Báez (1985) deleted these two species from the checklist of the Canary Islands.

A comprehensive opus on the natural history of the Canary Islands, edited by Philip Barker Webb and Sabin Berthelot and issued to subscribers in 106 parts between 1835 and 1850, is the second publication with reference to Canarian Odonata. The section on "Neuroptera" (Webb & Berthelot, 1837-1840: 82 f.) was actually worked on by Gaspard Auguste Brullé and includes five odonate species.



**Figure 4.** Names and position of the seven Canary Islands. North faces up. Tenerife is about 81 km long. © 2011 Google – Grafiken ©2011 TerraMetrics, NASA.

Unfortunately I was not able to check that book personally and therefore have to rely on McLachlan's (1882) information here, who credits the following species to Webb & Berthelot (1837-1840): *Anax imperator* (sub *Aeschna formosa*), *C. erythraea* (sub *Libellula ferruginea*), *Orthetrum chrysostigma* (sub *Libellula olympia*), *Sympetrum nigrifemur* (sub *Libellula vulgata*) and *Trithemis arteriosa* (sub *Libellula rubella*). Therefore, the mention of *A. imperator* and *T. arteriosa* has to be regarded as the first records of these species from the Canary Islands. The first mention of *S. nigrifemur* for the Canaries was previously credited by Malkmus & Weihrauch (2010) to Selys (1884) ("Je donne ce nom aux exemplaires que j'ai reçus de Madère et probablement à ceux des Canaries"). However, as the record by Webb & Berthelot (1837-1840) clearly occurred earlier, the credit should be attributed to them. Indeed, they were the first to record this species anywhere in the Macaronesian Islands. As for *O. chrysostigma*, the first record from the Canaries cannot be awarded with certainty. Thus Burmeister's (1839: 857) description of the species was based on a specimen from Tenerife ("Von Teneriffa, in v. Winthem's Sammlung"), whereas Webb & Berthelot's mention of the species occurred virtually simultaneously (Webb & Berthelot, 1837-1840).

*Anax parthenope* was first listed for the Canaries by Brauer (1866: 61) from Tenerife, and Hagen (1867: 31) refers to a specimen of *A. ephippiger* in his

collection, which was taken at sea, three German miles (22.6 km) off the coast of the Canaries: "...auch ich besitze ein Stück mit der Signatur: im atlantischen Meere drei Meilen von den canarischen Inseln von Afrika kommend gefangen." However, the first record of *A. ephippiger* from the islands themselves is listed by Navás (1906) from Tenerife. The first documented Canarian record of *S. fonscolombii* pertains to three females collected by the Rev. Alfred Edwin Eaton on 6 December 1880 in Gran Canaria near Las Palmas (McLachlan, 1882) and *Zygonyx torridus* was first mentioned from the Canaries in the species' description by Kirby (1889), which amongst others was based on a male from Tenerife.

Hence, at the end of the 19<sup>th</sup> century, nine anisopteran species were known that plausibly occurred in the Canary Islands and this status remained unchanged for more than a century. During that period, merely occasional faunistic studies were published that increased the knowledge of the distribution of species on single islands or on their phenology (e.g., Brauer, 1900; Valle, 1935; Lieftinck, 1949; Belle, 1982; Peters, 1988; Bemmerle, 2005; Brauner, 2007). It was only in the first decade of the 21<sup>st</sup> century when Boudot *et al.* (2009) reported the occurrence of two more anisopterans in Fuerteventura, which probably can be traced back to a recent expansion from the African continent: *Orthetrum trinacria* and *Trithemis annulata*. Both species were recorded in July 2003 by Mike Crewe, a British tour guide, during a birdwatching trip (Clarke & Crewe, 2003). It has to be noted though that a record of *O. trinacria* in Fuerteventura had been signalled already in October 2000 in another birdwatching trip report on the internet (Hill, 2000). However, although I was able to contact Mike Crewe during the editing of the atlas by Boudot *et al.* (2009), I did not succeed in contacting Paul Hill in order to verify – however absolutely plausible – that record.

As regards the occurrence of Zygoptera on the Canary Islands, three species from two genera have to be taken into account, of which one pertains to a single specimen only: Kalkman & Smit (2002) detected a male of *Platycnemis subdilatata* in the collection of the Zoological Museum of Amsterdam, labelled "Canary Islands, Tenerife, Puerto de la Cruz, 28 March 1971, J.H. Stocks". Kalkman & Smit (2002) regard a mislabelling of the specimen as unlikely and discuss potential ways how this Maghreb endemic may have reached Tenerife over a distance of approximately 500 km. As I have already experienced the unforgettable incidence of dust-bearing *Calima* winds from the Sahara in the Canaries, like Kalkman & Smit (2002) I regard a wind-borne transport of this individual as absolutely plausible.

### The *Ischnura* puzzle, part III

The first record of any zygopteran species from the Canary Islands was reported

by Valle (1955), referring to four males and one female of *Ischnura* that had been collected by Håkan Lindberg on 1 March 1949 near Aldea San Nicolas in Gran Canaria and which were classified by Valle (1955) as pertaining to *Ischnura senegalensis*. Belle (1982) gave notice of many individuals of another species, *Ischnura saharensis*, from the south of Gran Canaria, including several collected specimens in February 1981, and listed that species as new to the fauna of the Canary Islands. However, in the same publication, Belle already doubted the correctness of Valle's (1955) determination of *I. senegalensis* from Gran Canaria. This doubt was substantiated by Hämäläinen (1986), who checked Valle's specimens in the collection of the Zoological Museum of the University of Turku, Finland and found that they were in fact misidentified *I. saharensis*. Since then, *I. saharensis* was unanimously regarded as the only zygopteran species that occurred in the Canaries and has been reported from all other islands of the archipelago except El Hierro (e.g., Bacallado Aránega, 1984; Bemmerle, 2005; Brauner, 2007).

However, with respect to a recent finding, this seemingly clear-cut situation now has to be scrutinised again. According to Rosa Ana Sánchez-Guillén and Adolfo Cordero Rivera, University of Vigo, Spain (pers. comm.), preliminary results from DNA analyses of a specimen that was collected near Teganana in Tenerife have confirmed the presence of *I. senegalensis* in the Canary Islands. Hopefully, that intriguing record will be published with more details soon. Considering this new finding, records of *Ischnura* species from the Canaries should be regarded critically and the collection of a – preferably male – voucher specimen for any new record is strongly recommended.

### The Cape Verde Islands

The southernmost archipelago of Macaronesia comprises the Cape Verde Islands (in Portuguese Cabo Verde), a cluster of ten islands and nine small islets, which are divided into two groups: The Windward Islands (Ilhas de Barlavento) - Santo Antão, São Vicente, Santa Luzia, São Nicolau, Sal and Boa Vista and the Leeward Islands (Ilhas de Sotavento) - Maio, Santiago, Fogo and Brava (Fig. 5). Compared to the other Macaronesian Islands, only little is known about the occurrence of Odonata in Cape Verde. Today's knowledge has been reviewed thoroughly by Aistleitner *et al.* (2008), supported by recent studies by Martens (2010) and Martens & Hazevoet (2010), and the information I give here is based chiefly on these papers.

Records of 14 species of Odonata have hitherto been published from the Cape Verde Islands (Table 1). The first two species from Cape Verde are listed by Calvert (1894) and were collected in São Vicente, near Porto Grande, the deep-water port of Mindelo, during the U.S. solar eclipse expedition to West Africa



**Figure 5.** Names and position of the ten Cape Verde Islands. North faces up. Santiago is about 57 km long. © 2011 Google – Grafiken ©2011 TerraMetrics, NASA.

1889-1890, when the U.S.S. Pensacola called there from 10 to 12 November 1889. During the time of steam navigation, Porto Grande was an important port of call with a coal station. However, both of the species listed by Calvert (1894), viz *Pseudagrion glaucescens* and *Brachythemis leucosticta*, have not been confirmed for more than 100 years and therefore have to be regarded critically. *Pseudagrion glaucescens* belongs to a large African genus that underwent many taxonomic changes during the 20<sup>th</sup> century. Furthermore, Calvert mentions an acephalic, unclassified male *Pseudagrion* specimen from the same site. As regards *B. leucosticta*, this taxon was recently split by Dijkstra & Matushkina (2009) into two cryptic, but clearly separable, species, *B. leucosticta* s.str. (Burmeister, 1839) and *B. impartita* (Karsch, 1890). Only a check of Calvert's (1894) missing male specimen could resolve which of the two species he referred to when he mentioned "*Libellula (Cacergates) unifasciata* Oliv. (*leucosticta* Burm.)". Since Cape Verde is situated in the overlapping zone of both species, I have deleted this unconfirmed ancient record from the checklist until further notice. It is strongly advised that all of the addressed specimens listed by Calvert (1894) should be checked, if the material can be traced; probably they are stored in the Smithsonian National Museum of Natural History in Washington, D.C.

From the same locality, Porto Grande, Kirby (1897) mentioned two species collected by Ernest Edward Austen during a stopover on 26 December 1895 of the cable S.S. Faraday on its way to the Lower Amazon, which he accompanied as a scientific representative of the British Museum to make collections from the Amazon. These are *Crocothemis erythraea* and *Pantala flavescens*, both of which are first records for Cape Verde. The next records of Odonata were by Leonardo Fea, an Italian explorer and zoologist, during a visit to Cape Verde in 1898. The eight species observed or collected by Fea were published by Martin (1908) without any additional data. With the exception of *C. erythraea* and *P. flavescens* they are all first records for Cape Verde: *Ischnura senegalensis*, *Anax imperator* (sub *A. formosus*), *Orthetrum trinacria*, *Trithemis annulata* (sub *T. rubrinervis*), *T. arteriosa* and *Zygonyx torridus* (sub *Pseudomacromia torrida*). Several specimens collected by Fea in Cape Verde were checked additionally in the collection of the Natural History Museum in Genoa, Italy (Aistleitner *et al.*, 2008): *I. senegalensis* (Boa Vista, February 1898), *C. erythraea* (ditto), *O. trinacria* (ditto), and *T. annulata* (São Nicolau, November 1898). However, *T. arteriosa* has not been substantiated by any further records and hence has to be regarded critically.

*Sympetrum fonscolombii* was first mentioned from Cape Verde by Lobin (1982), referring to an observation by E. Bauer and B. Traub on 1 January 1979. The three other species on the checklist of Cape Verde are credited as first records to Aistleitner *et al.* (2008): *Lestes pallidus* (São Vicente, 14 December 2000, leg. Eyjolf Aistleitner), *Anax ephippiger* (Maio, 24 January 2002, leg. E. Aistleitner) and *Tramea limbata* (Boa Vista, 2 January 2001, leg. E. Aistleitner and Uli Aistleitner). In conclusion, 11 species definitely occur today on the islands of Cape Verde but records of additional species are likely in the future.

### The *Ischnura* puzzle: synopsis

In the **Azores**, two *Ischnura* species have widely established populations: *I. hastata* (a worldwide unique parthenogenetic population) and *I. pumilio*.

In **Madeira** and **Porto Santo**, *I. pumilio* has established populations. During both 19<sup>th</sup> and 20<sup>th</sup> centuries, records of at least one other *Ischnura* species have been made in the Madeira archipelago but it is not known whether this species still exists there today and its true identity is unknown. However, potential candidates are, with decreasing probability, *I. saharensis*; *I. senegalensis*; *I. graellsii*; *I. fountaineae* and *I. hastata*.

In the **Canary Islands**, *I. saharensis* has established populations on most or even all of the islands. The occurrence of *I. senegalensis* in Tenerife has been confirmed by genetic analyses but its status in the Canaries is completely unclear.

The potential occurrence of the highly vagrant pioneer species *I. pumilio*, in the Canaries cannot be excluded *a priori*.

In the **Cape Verde Islands**, *I. senegalensis* is the only *Ischnura* species present but it does not occur frequently nor is it widely distributed.

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