The status of *Ischnura senegalensis* (Odonata: Coenagrionidae) in Cape Verde

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The first record of a zygopteran breeding population in the Cape Verde archipelago is presented. A small population of *Ischnura senegalensis* (Rambur, 1842) was found living in the lagoon 'Lagoinha', Santiago island, where the species was observed in all seven surveys conducted between May 2014 and June 2015. Reproductive behaviour was repeatedly observed and exuviae were found and collected.

Key words: Cape Verde, Coenagrionidae, *Ischnura senegalensis*, Odonata, Santiago island, resident species, Zygoptera.

INTRODUCTION

The number of odonate species recorded in the Cape Verde archipelago is not large: four zygopterans and 13 anisopterans (Loureiro 2013) and, while seven of the anisopterans are residents, all zygopterans have hitherto been considered incidental visitors (Martens 2010; Loureiro *et al*. 2013; Martens *et al*. 2013). The list of resident species gradually was considered to be a completed task (*e.g.* Aistleitner *et al*. 2008; Martens *et al*. 2013), and the biggest remaining issues were the understanding of the environmental conditions that favour the arrival of accidental migrants and vagrants (Loureiro 2013) and the sources of the individuals.

Despite that, the lack of systematic field surveys was obvious and the search of Zygoptera was always a challenge for odonatologists visiting the country. Martens (2010), who conducted a survey on Santo Antão island, mentioned his surprise because he could not find any zygopterans, and Bußmann (2012) on Boa Vista island also did not find any zygopterans. In their checklist of the archipelago, Aistleitner *et al*. (2008) listed a small number of individuals, all belonging to *Ischnura senegalensis* (Rambur, 1842) or *Lestes pallidus* Rambur, 1842.

Here, we present new records of *I. senegalensis*, which are the first records of Zygoptera on Santiago island and on the leeward islands of the archipelago (Ilhas de Sotavento), and the first record of life cycle completion of this suborder in the country.

Additionally, new records of *Anax ephippiger* (Burmeister, 1839), *A. tristis* Hagen, 1867 and *Zygonyx torridus* (Kirby, 1889) are presented in Appendix 1.

LOCALITY AND METHODS

The study site was a lagoon named 'Lagoinha' (15°07′44.1″N 23°31′14.5″W), at the mouth of 'Ribeira Seca' stream and east of the 'Achada da Igreja' village. The water body is permanent and fed by freshwater in a stream, an outlet of the 'Barragem de Poilão' reservoir situated upstream. Occasionally, the lagoon is also fed by seawater during very high tides and storms, thus becoming brackish. Since 2005 the site has been recognised as a wetland of international importance by designation under the Ramsar Convention (Ramsar site no. 1577), but the statute does not provide any protection or environmental management. With a maximum depth of 0.75 m and very fine sediments at the bottom, the lagoon has aquatic vegetation, predominantly *Ruppia maritima* L. At the pond margins there are succulent plants, like *Sesuvium sesuvioides* (Fenzl) Verdcourt, *Zygophyllum fontanesii* Webb & Berth. and *Z. waterlotii* Maire, as well as shrubs and small trees, such as *Prosopis juliflora* (Sw.) DC. and *Tamarix senegalensis* DC. (Figs 1, 2).

The water body was visited seven times (29 May 2014 – S.M.; 2 August 2014 – S.M.; 11 September 2014 – S.M.; 18 November 2014 – S.M.; 7 February 2015 – N.S.L. & S.M.; 29 March 2015 – S.M.; 10 June 2015 – S.M.), initially for an overall survey of the island's wetlands and later to reconfirm the presence of the target species. Earlier, the same water body was twice (August 2012 – N.S.L.) surveyed

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for odonates, as one of the visited localities during another odonatological survey conducted on Santiago island.

The definitive specific assignment to the captured individuals was based on the key by Samways (2008), namely the lateral S2 blue side patch, S8 entirely blue, and S9 black above, blue below. In addition, the detailed description of male and female morphological features useful for the identification of *I. senegalensis* by Peels (2014) was used. For males three distinguishing characters were listed: i) S2 colours, ii) S10 tubercle size, and iii) interpleural suture. For females: i) two colour forms (androchrome and gynochrome) were mentioned, and ii) S8 dorsally coloured black was reported as a decisive morphological characteristic for the determination of *I. senegalensis* females. Sánchez-Guillén & Cordero-Rivera (2015) added another morphological distinguishing character to the males: iv) the orientation of the lower appendages.

Adult specimens and exuviae that were collected in Cape Verde were deposited in the National Museum of Natural History and Sciences (MNHNC), Lisbon, collection code numbers pending.

RESULTS

Both adults and exuviae of *I. senegalensis* were observed and collected at the study site. Male and female adults have been observed at all the visits to the lagoon conducted between May 2014 and June 2015, and the number of specimens ranged between 10 and 25. During the first visit some photographs were taken that allowed preliminary identification of the species. Reproductive behaviour (copulation and oviposition) was observed since the second visit to the site. One exuvia was found on 2 August 2014 but it was caught by the wind and lost. On the same day eight adults were captured using a butterfly net. All were randomly chosen, and after identification three were males, three were females with an orange coloured thorax, and two were androchrome females. Later, on 7 February 2015, seven exuviae were collected and four adults were captured, two males and two orange thorax females, *i.e*. gynochrome immature females (Figs 3, 4).

DISCUSSION

The records of *I. senegalensis* presented here are of major importance for the Cape Verde odonatology. For the first time life cycle completion of a zygopteran species in the archipelago is documented in detail, and the records also are the first ones of damselflies on Santiago island. The presence of the species in 'Lagoinha' was observed over a full year, and evidence of successful reproduction was recorded two times. Unfortunately, during the other visits exuviae were not searched for.

Prior to the present records, only four adults of *I. senegalensis* had been reported from Cape Verde: from Boa Vista island one individual on February 1898 (Aistleitner *et al*. 2008) and two individuals on 31 January 1954 (Loureiro 2013); and from São Vicente island one individual on 13 December 2000 (Aistleitner *et al*. 2008).

The new data also suggest an update to the Cape Verde status in the *Ischnura* puzzle within the Macaronesian Islands as outlined by Weihrauch (2011). The species does neither occur on the Azores Archipelago nor in the Madeira and the Selvagens Islands (Ferreira *et al*. 2006), but it occurs in the Canary Islands, where a breeding population was reported from Tenerife (Peels 2014). In Cape Verde, it was hitherto only known that the species could sporadically reach the archipelago. It is now certain that *I. senegalensis* also can establish there.

On the other African Atlantic islands and archipelagos, such as São Tomé e Príncipe, Bioko (formerly Fernando Pó), Annobón, Saint Helena, Ascension Island and Tristan da Cunha, *I. senegalensis* was only reported at Annobón, 350 km off the African continent (Martin 1907; Compte-Sart 1962; Pinhey 1974; Brooks & Jackson 2001; Loureiro & Pontes 2012). Santiago island, Cape Verde, is 700 km off the African continent, twice the distance of Annobón or Tenerife. Thus, the newly found *I. senegalensis* breeding population is, in the Atlantic Ocean, the one that is most distant from continental Africa.

On the African Indian Ocean islands and archipelagos, such as Socotra, Seychelles, the Zanzibar archipelago, the Comoros and Mascarenes islands, *I. senegalensis* has been reported from all of the above-listed island groups (Wain & Wain 1998; Nahonyo *et al*. 2002; Fliedner & Martens 2008; Riservato *et al*. 2010; Couteyen & Papazian 2012; Schneider & Nasher 2013).

It is possible to conclude that *I. senegalensis* is not an uncommon damselfly on the African islands. On the Atlantic Ocean islands it is found between

Fig. 1. The 'Lagoinha'. View from the mouth of 'Ribeira Seca' stream.

Fig. 2. The 'Lagoinha'. View to the mouth of 'Ribeira Seca' stream.

Fig. 3. *Ischnura senegalensis* exuvia on a small piece of drip-irrigation hose.

Fig. 4. *Ischnura senegalensis* exuvia on *Sesuvium sesuvioides*.

latitudes of 30°N and 2°S, up to 700 km off the African continent. On the Indian Ocean islands it is found between latitudes of 12°N and 21°S, more than 1200 km off the African continent. Thus it is clearly a widespread species with also an insular Atlantic–Indian distribution, in addition to its mainland distribution.

Recording the occurrence of *I. senegalensis* in Cape Verde as a resident breeding population is, for sure, the highly unlikely conjugation of four main circumstances: i) the simultaneous accidental migration of males and females; ii) the landing near a water body adequate for breeding; iii) the successful reproduction of the just-arrived specimens; iv) the presence of someone that visited the site and whose attention was aroused by the presence of the unexpected damselflies. Note that the same locality was surveyed in 2012 and no signs of the zygopteran were found.

The capability of the insects for movements of hundreds of kilometres over the Atlantic Ocean and landing in Cape Verde was previously demonstrated, and there is a very high probability that many other arrivals occurred but these were not reported. Metadata from the isolated specimen records, such as the survey effort or the number of specimens observed but not collected, are unavailable and we cannot discuss the singularity of the recent simultaneous arrival. *Ischnura senegalensis* is considered highly ubiquitous, with the capability of occupying a variety of stagnant and slow-flowing water bodies, and being salt and pollution tolerant (Sharma 2013). It also is a species with a rather short adult pre-reproductive phase, having for that reason a high survival chance when occurring in less favourable environments (Kadoya *et al*. 2008). In short, for several reasons *I. senegalensis* is a strong candidate to the Cape Verde Odonata assemblage, and the main limitation resides in the habitat, with the almost total absence of water bodies adequate for the larval stage.

In the entire Cape Verde archipelago it is very well known that this kind of water body is very rare, and the newly found breeding population had the good fortune to land nearby 'Lagoinha', an almost unique and small water body, but apparently sufficient to ensure the survival of this small population.

Lastly, it was once again shown that when the survey effort is intensified, unexpected new findings may occur. This conclusion applies to the discovery of the *I. senegalensis* breeding population as well as the *A. tristis* record (Appendix 1).

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REFERENCES

AISTLEITNER, E., BARKEMEYER, W., LEHMANN, G. & MARTENS, A. 2008. A checklist of the Odonata of the Cape Verde Islands. *Mitteilungen des Internationalen Entomologischen Vereins* **33**: 45–57.

BROOKS, S.J. & JACKSON, K.A. 2001. The Odonata of Bioko, Republic of Equatorial Guinea, with the description of fan-shaped setae on early instar Libellulidae larvae. *Odonatologica* **30**(1): 29–38.

BUßMANN, M. 2012. Libellen auf Boa Vista, Kapverdische Inseln (Odonata). *Libellula* **31**(1/2): 61–75.

CLAUSNITZER, V., DIJKSTRA, K-D.B., KOCH, R., BOUDOT, J.P., DARWALL, W.R.T., KIPPING, J., SAMRAOUI, B., SAMWAYS, M.J., SIMAIKA, J.P. & SUHLING, F. 2012. Focus on African freshwaters: hotspots of dragonfly diversity and conservation concern. *Frontiers in Ecology and the Environment* **10**(3): 129–134.

COMPTE-SART, A. 1962. Resultados de la expedición Peris-Alvarez a la isla de Annobón. 11. Odonata. *Boletín de la Real Sociedad Española de Historia Natural (Sección Biológica)* **60**: 35–54.

COUTEYEN, S. & PAPAZIAN, M. 2012. Catalogue et affinités géographiques des Odonata des îles voisines de Madagascar (Insecta: Pterygota). *Annales de la Société Entomologique de France* (N.S.): *International Journal of Entomology* **48**(1-2): 199–215.

FERREIRA, S., GROSSO-SILVA, J.M., LOHR, M., WEIHRAUCH, F. & JÖDICKE, R. 2006. A critical checklist of the Odonata of Portugal. *International Journal of Odonatology* **9**(2): 133–150.

FLIEDNER, H. & MARTENS, A. 2008. The meaning of the scientific names of Seychelles dragonflies (Odonata). *Phelsuma* **16**: 49–57.

KADOYA, T., SUDA, S-I., TSUBAKI, Y. & WASHITANI, I. 2008. The sensitivity of dragonflies to landscape structure differs between life-history groups. *Landscape Ecology* **23**:149–158.

LOUREIRO, N.S. 2013. Dragonflies and damselflies (Insecta: Odonata) collected during the Lindberg expedition to the Cape Verde Islands, 1953–54. *Zoologia Caboverdiana* **4**(2): 43–48.

LOUREIRO, N.S., BROCHARD, C., CORREIA, A. & VAN DER PLOEG, E. 2013. *Orthetrum trinacria* exuviae (Odonata: Libellulidae) from Santiago Island, Cape

Verde: morphology, sexual size dimorphism and diagnostic features. *Boletín de la Sociedad Entomológica Aragonesa* **52**: 281–284.
LOUREIRO, N.S & PONTES, L. 2012. The *Trithemis nigra* (Odonata: Libellulidae) of Príncipe Island, Gulf of Guinea. *African Journal of Ecology* **51**: 180–183.
MARTENS, A. 2010. Ecology of the dragonflies at the westernmost spot of Africa, the island of Santo Antão, Cape Verde (Odonata). *International Journal of Odonatology* **13**(2): 241–254 + pl. IVa.
MARTENS, A., LOUREIRO, N.S. & HAZEVOET, C.J. 2013. Dragonflies (Insecta, Odonata) collected in the Cape Verde Islands, 1960–1989, including records of two taxa new to the archipelago. *Zoologia Caboverdiana* **4**(1): 1–7.
MARTIN, R. 1907. Voyage de Feu Leonardo Fea dans l'Afrique Occidentale. Odonates. *Annali del Museo Civico di Storia Naturale di Genova* **S.3 V.3** (43): 649–667.
NAHONYO, C.L., MWASUMBI, L.B., ELIAPENDA, S., MSUYA, C., MWANSASU, C., SUYA, T.M., MPONDA, B.O. & KIHAULE, P. 2002. Jozani Chwaka Bay proposed National Park biodiversity. Inventory Report. Department of Zoology and Marine Biology, University of Dar es Salaam, Tanzania. Online at http://coastalforests.tfcg.org/pubs/Jozani%20biodiversity%20inventory%20report%202002.pdf
PEELS, F. 2014. The occurrence of *Ischnura senegalensis* in the Canary Islands, Spain (Odonata: Coenagrionidae). *Notulae odonatologicae* **8**(4): 105–111.
PINHEY, E. 1974. Odonata of the Northwest Cameroons and particularly of the islands stretching southwards from the Guinea Gulf. *Bonner Zoologische Beitrage* **25**(1-3): 179–212.
RISERVATO, E., GRIECO, C., PELLA, F., SINDACO, R., PUPIN, F., SULEIMAN, A.S. & FASOLA, M. 2010. A contribution to the knowledge of the odonatofauna of the Socotra Archipelago (Yemen). *Zoology in the Middle East* **50**(1): 101–106.
SAMWAYS, M. J. 2008. *Dragonflies and Damselflies of South Africa*. Pensoft, Sofia, Bulgaria.
SÁNCHEZ-GUILLÉN, R.A. & CORDERO-RIVERA, A. 2015. Confirmation of the presence of *Ischnura senegalensis* (Rambur, 1842) on the Canary Islands. *Animal Biodiversity and Conservation* **38**(1): 71–76.
SCHNEIDER, W. & NASHER, A.K. 2013. Dragonflies from mainland Yemen and the Socotra Archipelago – additional records and novelties. *International Dragonfly Fund Report* **57**: 1–13.
SHARMA, G. 2013. *Ischnura senegalensis*. The IUCN Red List of Threatened Species. Version 2015.1. Online at http://www.iucnredlist.org/details/full/59897/0
WAIN, W.H. & WAIN, C.B. 1998. Observations on the Odonata of Silhouette, Seychelles Archipelago. *Phelsuma* **6**: 27–31.
WEIHRAUCH, F. 2011. A review of the distribution of Odonata in the Macaronesian Islands, with particular reference to the *Ischnura* puzzle. *Journal of the British Dragonfly Society* **27**(1): 28–46.

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APPENDIX 1

Anax ephippiger (Burmeister, 1839) – One adult male found dead in Boa Vista island, near Sal Rei (16°10′33.7″N 22°55′03.6″W), on 15 March 2015. At the same locality and on the same date other specimens were observed on the wing. The species was previously recorded at Boa Vista by Bußmann (2012), who observed adults, exuviae and reproductive behaviour, and by Aistleitner *et al*. (2008), who observed adults.

Anax tristis Hagen, 1867 – One adult male collected in Santiago island, flying over a temporary pond in 'Ribeira Zimbrão' (temporary stream – 14°56′16.9″N 23°39′17.9″W), on 26 August 2012. The specimen was deposited in the National Museum of Natural History and Sciences (MNHNC), Lisbon, collection code number MB730700. Two adults were observed foraging during a sunny and moderately windy morning; one was captured using a butterfly net and the other remained alive at the locality. From the Cape Verde archipelago, the species only was previously recorded in Santo Antão island, on 27 October 1972 (Martens *et al*. 2013).

Zygonyx torridus (Kirby, 1889) – One to five adults were found flying and with reproductive behaviour in 'Ribeira de Belém' (temporary stream and irrigation channel – 15°02′13.2″N 23°38′47.2″W; 15°02′02.5″N 23°38′46.6″W), on 26 and 27 August 2012, and one exuvia was found in an irrigation tank near 'Ribeira de Belém' (15°02′16.7″N 23°38′39.3″W), on 26 August 2012; one to five adults were found flying and with reproductive behaviour in 'Ribeira de Mato Gégé' (permanent stream – 15°04′18.0″N 23°40′28.9″W), on 30 August 2012; one to five adults were found flying and with reproductive behaviour in 'Pico da Antónia' (irrigation tank and channel – 15°03′24.6″N 23°37′29.7″W; 15°03′50.17″N 23°37′13.3″W), on 2 September 2012; one to five adults were found flying and with reproductive behaviour in 'Ribeira Principal' (permanent stream – 15°11′47.2″N 23°40′45.2″W; 15°11′43.5″N 23°40′49.2″W; 15°11′36.9″N 23°40′48.9″W), on 2 September 2012; one to five adults were found flying and with reproductive behaviour in 'Ribeira de Lagoa' (temporary stream – 15°12′13.2″N 23°41′19.2″W; 15°12′18.6″N 23°41′24.9″W). A specimen was deposited in the National Museum of Natural History and Sciences (MNHNC), Lisbon, collection code number MB730701. From the Cape Verde archipelago, the species was previously recorded on Santo Antão island (Lobin 1982; Aistleitner *et al*. 2008; Martens 2010), São Nicolau island (Aistleitner *et al*. 2008; Loureiro 2013), Santiago island (Loureiro *et al*. 2013; Martens *et al*. 2013), Fogo island (Martens *et al*. 2013) and Brava island (Lobin 1982). This is the first record of exuviae from Santiago island.