

Two dragonfly species (Insecta: Odonata) migrating at Dakhla (region of Oued Ad-Dahab Lagouira, Morocco)

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Large numbers of migrating imagos of *Anax ephippiger* were observed from the end of January to March 2012 at Dakhla Bay, Southern Morocco, in an area where long-lasting fresh and brackish waters are lacking, and thus which is unfavourable for the reproduction of Odonata. This supports well the classical scheme of northward mass migration of the species along the Atlantic coast of Africa, induced by autumnal mass emergences in the Sahel as a result of the summer African monsoon. Small numbers of *Sympetrum fonscolombii* were previously temporarily recorded from the same area in July 2011. They were probably nomadic individuals of which the origin could not be verified, but which could have been involved in long distance vagrancy, typical of the species, due to the scarcity of fresh and brackish water in the area.

Keywords: migration; *Anax ephippiger*; *Sympetrum fonscolombii*; Southern Sahara; Dakhla; Morocco

Introduction

In North Africa, and particularly in the Sahara desert, biodiversity is poorly known and remains relatively unexplored, owing both to the remoteness of the region and its geopolitical instability (Archer & Popovic, 2007; Ward, 2009). The large extent of the Sahara in southern Atlantic Morocco (more than 326,000 km²) creates many logistical difficulties for comprehensive studies of the fauna and flora of this region. Nevertheless, recent exploration has resulted in substantial expansion of knowledge, including, for example, extremely isolated fish populations (Qinba et al., 2009) as well as aspects of the rich mammal and avifaunal life in the region (e.g. Amezian et al., 2011; Brito et al., 2009; Qinba et al., 2011).

The desert biome, with its scarcity of water resources, remains a severe ecological barrier for species requiring water during any part of their life cycle. This harsh environment is passable only by migratory species, such as some species of birds, butterflies and dragonflies. This explains

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why only two Odonata species are known from the Moroccan Atlantic Sahara, namely *Anax ephippiger* (Burmeister, 1839) and *Sympetrum fonscolombii* (Selys, 1840) (Boudot et al., 2009). In comparison, northern Morocco hosts a richer assemblage of dragonflies including to date 63 Odonata species (Boudot et al., 2009). Seven of the latter are North African endemics and 28 are listed in the 2010 IUCN North African Red List (Samraoui et al., 2010). The nearby Canary Islands host 14 species, including four migrants or sporadic vagrants (*A. ephippiger*, *S. fonscolombii*, *Platycnemis subdilatata* and *Ischnura senegalensis*) (Boudot et al., 2009; also see <http://www.flickr.com/photos/35142635@N05/4117856368/in/photostream/>). To the south, Mauritania is also a rather species-poor country, with only 20 known species of dragonflies (Ferreira et al., 2011). Of these, six occur in the Adrar mountains in the north, including the migrants, *A. ephippiger* and *S. fonscolombii*, which are also widespread throughout the country (Ferreira et al., 2011).

Since works referring to Odonata in southern Morocco are rather rare and old, it is worthwhile to report and discuss some new observations in this area. These observations were made on the Atlantic coast of the Moroccan Sahara, in the Dakhla area, in the framework of field studies with the members of the *Association "Nature Initiative"*. This region is the mouth of the dry fossil wadi Rio de Oro and has a mild climate, with temperatures not exceeding 30°C during the summer, due to the storms of the August–September period. The minimum winter temperature is 16°C to 24°C.

Observations

At Dakhla Bay, the first author observed large numbers of imagoes of *A. ephippiger* from the end of January to March 2012 (23°42'48"N, 15°56'36"W, decimal degrees WGS84), and some individuals of *S. fonscolombii* in July 2011 (23°38'15"N, 15°59'49"W) (Figure 1).

Anax ephippiger was observed during the entire period (January–March) over an area of 50,000 ha after light rains which created small ponds that dried out after four weeks on average. The daily numbers of individuals were in the hundreds during January and then decreased over time. They were very active and flying in several directions throughout the day, as if they were feeding, and an individual was clearly seen to capture a fly in flight and then perch to chew it. A few individuals were observed egg-laying in the temporary ponds dominated by a grass-like vegetation edge, although we did not observe any mating pairs. We do not know whether members of these groups ultimately migrate only along the coast or depart in different directions. Recently though, a friend from *Association Nature Initiative* told us that he observed an Odonata species in the Aousserd region (Oued Jenaâ: 22°40'52"N, 14°29'39"W), of which the description fitted *A. ephippiger* well, during the period of January 2012, but the number observed was very low. All specimens observed in Dakhla were mature and large; those observed during March were in general larger compared to those recorded in January and February.

The other species observed in the Dakhla Bay was *S. fonscolombii*, which was found on the littoral during a herpetological survey, during a comparatively dryer period (July 2011). Few specimens of this species (not exceeding five males in a very sunny day) were found at rest on the *Salicornia* vegetation in July 2011 in the close vicinity of the sea. They were present here for several weeks but were not seen after the end of July 2011.

Discussion

Anax ephippiger (Vagrant Emperor) has a very wide geographical distribution in Africa and South Asia and occasionally reaches Central and Northern Europe (Burbach & Winterholler, 1997; Edelaar et al., 1996) and Central Asia (Borisov & Haritonov, 2008). It is an obligate

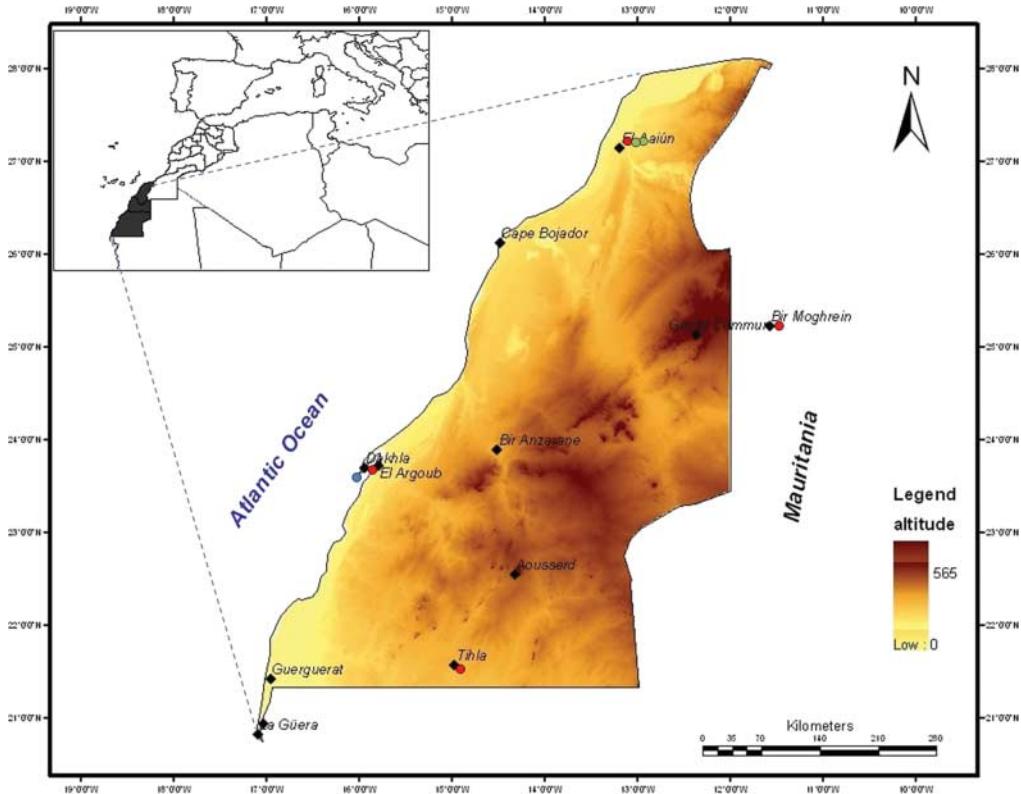


Figure 1. Records of *A. ephippiger* and *S. fonscolombii* in the Moroccan Atlantic Sahara. Red dots = previous localities known for *A. ephippiger*; green dots = previous localities known for *S. fonscolombii* (see text for references); blue dot = new records for the two species at Dakhla Bay).

migrant, leaving its native habitats promptly after emergence, in the early post-tenal stage (Corbet, 1999), and its long distance migrations are well known, as it has been collected in the Faroe Islands (Parr, 2011), Iceland (Norling, 1967; Olafsson, 1975; Tuxen, 1976), the Lesser Antilles (Meurgey & Picard, 2011) and French Guiana, where it has now begun to reproduce (Duquef, 2012; Machet & Duquef, 2004). It crosses parts of the Indian Ocean as well (Anderson, 2009). Its short larval period of 70–120 days or less, depending on the temperature (Corbet, 1999; Sternberg & Buchwald, 2000), enables it to use ephemeral fresh and brackish pools in the deserts to complete successfully its full larval development. The species breeds regularly in southern Europe and temporarily so in central and western Europe (Sternberg & Buchwald, 2000), but there is little evidence that its larvae can overwinter in these regions. Due to its obligate nomadism, the European summer generation leaves Europe to an unknown destination before ovipositing (Boudot et al., 2009; Peters & Günther, 2000). Only the single record of a teneral female in the Coto Doñana National Park in Andalusia (Spain) on 27 March 1979 (Belle, 1984) refers obviously to a local larval winter development of the species. Other winter and early spring European records (e.g. 25 February, Ferreras Romero, 1982) are better explained as African invaders (Weihrach & Weihrach, 2003).

Anax ephippiger has been known for a long time from the Maghreb and the whole Sahara, where parts of the populations spend the winter in the central Sahara and at the foothills of the Atlas mountains, waiting for increased spring temperatures to cross the mountains and to migrate northward (Dumont, 1977, 1988; Dumont & Desmet, 1990). In addition, autumnal and winter migratory activity is perceptible along the whole Atlantic coast from Senegal to northern

Morocco, where the species breeds in December to give rise to a new generation in early spring (Dumont, 1978; Jacquemin & Boudot, 1999). A similar winter larval development is locally known on the northern fringe of the Sahara at the foothills of the Atlas range (Juillerat & Monnerat, 2009). All these populations migrate northward (Dumont, 1988) and are believed to result from mass emergences in the Sahel as a consequence of the summer African monsoon (Corbet, 1999; Dumont, 1988; Dumont & Desmet, 1990). In contrast, summer emergences observed in the north-eastern lowlands of the Moroccan Oriental region (Boudot & De Knijf, 2012) are likely to represent a second generation issued from the early spring migration waves which crossed the Atlas. To the east, *A. ephippiger* is also a well-known pan-Arabian immigrant, which reproduces in brackish reedy pools in the inland desert and in coastal marshes (Schneider, 1988; Waterston, 1984; Waterston & Pittaway, 1991). First yearly incoming waves numbering from small groups to huge clouds of hundreds of thousands of individuals (Schneider, 1988) are usually observed in January–February (Feulner, 2008). In addition to coasts, such huge mass-migrations are known also in inland Arabia (Schneider, 1988).

In the Dakhla area, large numbers of *A. ephippiger* have only been reported in the past by Mathew (1882), 24–29 December (1881 or before). In other places in the Atlantic Sahara, large numbers of hunting individuals of this species were reported from Tichla, 257 km SSE of Dakhla near the Mauritanian border (21°35'43"N, 14°59'8"W), in November 1987 (Jacquemin & Boudot, 1999) and throughout Mauritania, including the Atlantic coast (Dumont, 1978; Ferreira et al., 2011; <http://observado.org>, consulted on June 2012). About 500 km north of Dakhla, *A. ephippiger* is known from the region of El Aaiùn (Dumont, 1976) (Figure 1).

All these reports and our own records from Dakhla support perfectly the general picture in which, besides the large numbers of the species confined within the Sahara during the winter due to the Atlas range, a permanent migratory activity persists throughout the winter along the Atlantic coast of Africa due to its mild winter climate, eventually reaching the Iberian Peninsula.

The genus *Sympetrum* is represented in Morocco by five species (Boudot et al., 2009), among which *S. fonscolombii* is very common in the northern part of the country. This species has a widespread Afro-tropical, Indo-Malayan and European distribution. It is a permanent resident over most of Africa and surrounding islands, the Azores, south-western Asia (from Arabia to India) and the whole Mediterranean basin. Northward, migration has resulted in repeated records of the species from most of continental Europe and more sporadic ones in the British Isles (Nelson et al., 2003), Central Asia (Borisov & Haritonov, 2008), Mongolia (Dumont, 2003) and even Japan (Ryo, 2004). This range emphasizes the nomadic behaviour of the species, which is able to disperse over long distances to colonize additional pools, either permanent or temporary, and it is often recorded far from its reproducing localities during vagrancy events (Corbet, 1999). On the Atlantic coast of the Sahara, *S. fonscolombii* has been recorded from only a few localities in the Guelmim and the El Aaiùn regions (Dumont, 1976) (Figure 1), the lower Drâa area (Juillerat & Monnerat, 2009) and the Nouamghar–Iwik area in Mauritania (Ferreira et al., 2011; <http://observado.org>, consulted on June 2012). Therefore our record from Dakhla Bay refers to a new coastal location. The rather short time span during which the individuals of interest were present at Dakhla Bay suggests that they were nomadic (vagrant or migrant), which is typical for this species. Given the general lack of potential reproductive places in the area, they most likely were part of a long-distance displacement whose precise origin cannot be identified.

References

- Amezian, M., Radi, M., Ibn Tattou, M., Khayya, M.L., Samlali, M.L., & Qninba, A. (2011). Cricket Longtail breeding in southern Morocco. *Dutch Birding*, 33, 229–233.
- Anderson, C.R. (2009). Do dragonflies migrate across the western Indian Ocean? *Journal of Tropical Ecology*, 25, 347–358.
- Archer, T., & Popovic, T. (2007). *The Trans-Saharan Counter-Terrorism Initiative. The US War on Terrorism in Northwest Africa* (Report no. 16). Espoo, Finland: The Finnish Institute for Foreign Affairs.

- Belle, J. (1984). *Orthetrum trinacria* (Selys) new to the fauna of Spain, with records of three other afro-tropical Odonata Anisoptera. *Entomologische Berichten, Amsterdam*, 44, 79–80.
- Borisov, S.N., & Haritonov, A.Y. (2008). The dragonflies (Odonata) of Middle Asia. Part 2. (Anisoptera). *Euroasian Entomological Journal*, 7(2), 97–123.
- Boudot, J.-P., & De Knijf, G. (2012). Nouvelles données sur les Odonates du Maroc oriental et méridional (Odonata). *Martinia*, 28(1/2), 1–28.
- Boudot, J.-P., Kalkman, V.J., Azpilicueta Amorín, M., Bogdanović, T., Cordero Rivera, T.A., Degabriele, G., Dommanget, J.-L., Ferreira, S., Garrigós, B., Jović, M., Kotarac, M., Lopau, W., Marinov, M., Mihoković, N., Riservato, E., Samraoui, B., & Schneider, W. (2009). Atlas of the Odonata of the Mediterranean and North Africa. *Libellula, Supplement 9*, 1–256.
- Brito, J.C., Acosta, A.L., Álvares, F., & Cuzin, F. (2009). Biogeography and conservation of taxa from remote regions: An application of ecological-niche based models and GIS to North-African Canids. *Biological Conservation*, 142, 3020–3029.
- Burbach, K., & Winterholler, M. (1997). Die Invasion von *Hemianax ephippiger* (Burmeister) in Mittel- und Nordeuropa 1995/1996 (Anisoptera: Aeshnidae). *Libellula*, 16, 33–59.
- Corbet, P.S. (1999). *Dragonflies. Behavior and ecology of Odonata*. Ithaca, NY: Cornell University Press, and Colchester, UK: Harley Books.
- Dumont, H.J. (1976). Odonata of South Morocco, Rio de Oro and Mauretania, with biogeographical notes. *Odonatologica*, 5, 107–117.
- Dumont, H.J. (1977). On migration of *Hemianax ephippiger* (Burmeister) and *Tramea basilaris* (P. de Beauvois) in West and North-West Africa in the winter 1975/76 (Anisoptera: Aeshnidae, Libellulidae). *Odonatologica*, 6, 13–17.
- Dumont, H.J. (1978). Additions à la faune des Odonates de Mauritanie. *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 114, 29–34.
- Dumont, H.J. (1988). *Hemianax ephippiger* (Burmeister) in the northern Algerian Sahara in winter (Anisoptera: Aeshnidae). *Notulae Odonatologicae*, 3(2): 20–22.
- Dumont, H.J. (2003). Odonata from the Republic of Mongolia and from the Autonomous Region of Inner Mongolia. *International Journal of Odonatology*, 6, 127–146.
- Dumont, H.J., & Desmet, K. (1990). Transsahara and transmediterranean migratory activity of *Hemianax ephippiger* (Burmeister) in 1988 and 1989 (Anisoptera: Aeshnidae). *Odonatologica*, 19, 181–185.
- Duquef, M. (in press). Reproduction probable d'*Hemianax ephippiger* (Burmeister, 1839) en Guyane (Odonata, Anisoptera: Aeshnidae). *Martinia*.
- Edelaar, P., Dijkstra, K.-D.B., & Dingemans, N.J. (1996). *Hemianax ephippiger*: A new dragonfly for The Netherlands (Odonata: Aeshnidae). *Entomologische Berichten*, 56, 192–195.
- Feulner, G. (2008). Emperor Dragonflies swarming. *Gazelle*, 23(2), 6.
- Ferreira, S., Boudot, J.-P., Tarroso, P., & Brito, J.C. (2011). Overview of Odonata known from Mauritania (West Africa). *Odonatologica*, 40, 277–285.
- Ferreras Romero, M. (1982). Odonatos de Sierra Morena Central (Córdoba): Aspectos Faunísticos. *Boletín de la Asociación Española de Entomología*, 5, 13–23.
- Jacquemin, G., & Boudot, J.-P. (1999). *Les Libellules (Odonates) du Maroc*. France: Société Française d'Odonatologie, Bois-D'Arcy.
- Juillerat, L., & Monnerat, C. (2009). Odonata in southern Morocco, with first records of *Orthetrum ransonnetii* and *Sympetrum sinaiticum* (Odonata: Libellulidae). *Libellula*, 28, 97–115.
- Machet, P., & Duquef, M. (2004). Un visiteur inattendu, et de taille !... *Hemianax ephippiger* (Burmeister, 1839) capturé à la Guyane française. *Martinia*, 20(3), 121–124.
- Mathew, G.F. (1882). Entomological note from Tenerife, St. Vincent & C. *The Entomologist's Monthly Magazine*, 18, 256–259.
- Meurgey, F., & Picard, L. (2011). *Les Libellules des Antilles françaises*. France: Biotope, Mèze, collection Parthénope.
- Nelson, B., Ronayne, C., & Thompson, R. (2003). Colonization and changing status of four odonata species, *Anax imperator*, *Anax parthenope*, *Aeshna mixta* and *Sympetrum fonscolombii*, in Ireland 2000–2002. *The Irish Naturalists' Journal*, 27(7), 266–272.
- Norling, U. (1967). *Hemianax ephippiger* (Burm.) found in Iceland (Odonata). *Opuscula Entomologica*, 32(1/2), 99–100.
- Olafsson, E. (1975). The dragonfly *Hemianax ephippiger* (Burm.) (Odonata), an unexpected guest in Iceland. *Náttúrufræðingurinn*, 45, 209–212.
- Parr, A.J. (2011). The Vagrant Emperor *Anax ephippiger* in Britain and Europe during early 2011. *Journal of the British Dragonfly Society*, 27(2), 80–87.
- Peters, G., & Günther, A. (2000). Frühjahrsbeobachtungen an *Anax ephippiger* auf Rhodos nebst Anmerkungen über den Invasionsraum der Art. *Libellula Supplement 3*, 49–61.
- Qninba, A., Ibn Tattou, M., Radi, M., El Idrissi Essougrati, A., Bensouiba, H., Ben Moussa, S., Ougga, T., Bouzrou, J., Azaguagh, I., Bensbai, J., & Khayya, M.L. (2009). Sebket Imlily, une zone humide originale dans le sud marocain. *Bulletin de l'Institut Scientifique, Rabat, Section Sciences de la Vie*, 31(1), 51–55.
- Qninba, M., Radi, M., Amezian, M., Ibn Tattou, M., Khayya, M.L., Samlali, M.L., Khalil, M.L., & Hammia, A. (2011). Nidifications automnales d'oiseaux sahariens dans la région d'Oued Ad-Dahab – Lagouira (Maroc méridional). *Go-South Bulletin*, 8, 21–34.
- Ryo, F. (2004). Record of the migrant species, *Sympetrum fonscolombii* in Koto-ku, Tokyo. *Tonbo*, 47(1–4), 46.
- Samraoui, B., Boudot, J.-P., Ferreira, S., Riservato, E., Jović, M., Kalkman, V.J., & Schneider, W. (2010). The status and distribution of Dragonflies (Odonata). In N. Garcia, A. Cuttelod & D. Abdul Malak (Eds.), *The status and distribution*

- of freshwater biodiversity in Northern Africa* (chapter 5, pp. 51–70). IUCN Red List of Threatened Species, Regional Assessments series. Gland, Switzerland & Malaga, Spain: IUCN.
- Schneider, W. (1988). Dragonflies (Odonata) on the Wahiba Sands and adjacent Areas, Eastern Oman. *Journal of Oman Studies Special Report*, 3, 377–388.
- Sternberg, K., & Buchwald, R. (2000). *Die Libellen Baden-Württembergs. Band 2 : Großlibellen (Anisoptera) Literatur*. Stuttgart: E. Ulmer.
- Tuxen, S.L. (1976). Odonata. In S.L. Tuxen (Ed.) *Zoology of iceland*, 39a, 1–7.
- Ward, D. (2009). *The biology of deserts*. New York, NY: Oxford University Press.
- Waterston, A.R. (1984). Insect of Southern Arabia. Odonata from the Yemens and Saudi Arabia. *Fauna of Saudi Arabia*, 6, 451–472.
- Waterston A.R., & Pittaway, A.R. (1991). The Odonata or dragonflies of Oman and neighbouring territories. *Journal of Oman Studies*, 10(1989), 131–168.
- Weihrauch, F., & Weihrauch, S. (2003). Spring odonata records from Alentejo (Portugal), Andalusia and Extremadura (spain). *Opuscula Zoological Fluminensia*, 207, 1–18.