

Contribution to the knowledge of *Anax ephippiger* (Burmeister, 1839) (Insecta: Odonata) in the south of the Iberian Peninsula, Spain

Contribución al conocimiento de *Anax ephippiger* (Burmeister, 1839) (Insecta: Odonata) en el sur de la península ibérica, España

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Abstract. A phenomenon of *Anax ephippiger* (Burmeister, 1839) aggregation on the coast for the Strait of Gibraltar area, southern Iberian Peninsula, was recorded. Likewise, an annotated list of species recorded in Microreserve Arroyo Negro nearby to the Strait of Gibraltar is presented. Most of the species observed are thermophilic. The environmental and climatic conditions of this microreserve favor the settlement of African migratory species in a global warming scenario.

Key words: Gibraltar; migration; odonate.

Resumen. Se constata un fenómeno de agregación de *Anax ephippiger* (Burmeister, 1839) en la costa para la zona del estrecho de Gibraltar. Asimismo, se presenta una lista de especies registradas en la Microrreserva Arroyo Negro cercana al estrecho de Gibraltar, al sur de la península ibérica. Las condiciones ambientales y climáticas de esta microrreserva favorecen el asentamiento de especies migratorias africanas en un escenario de calentamiento global.

Palabras clave: Gibraltar; migración; odonato.

In Europe there are 146 species of Odonata, more than eighty in Spain, and 57 are cataloged in Cádiz southernmost province of Spain (Bernal Sánchez 2021; Díaz Martínez 2023). The coast of Tarifa in Cádiz is an extreme point of mainland Europe and is less than 15 km from the African continent. Southern Iberia constitutes an important contact zone between Palearctic and Paleotropical faunas (Annani *et al.* 2012). Migration is a typical behaviour within the life cycle of some odonate species (Boness 2000; Holuša 2011). At least 25 to 50 of the approximately 5,200 dragonfly species worldwide are thought to be migratory (Russell *et al.* 1998). Whereas migration predominantly takes place very inconspicuously, in some species and under certain conditions it can become a very striking phenomenon by 'aggregation', *i.e.*, grouping in swarms numbering sometimes up to millions of individuals (Corbet 2004). Trans-oceanic migration sustained by trade winds and additional storm events explain the ability of individuals to reach distant islands and to travel between continents (Ware *et al.* 2022). Despite extensive research on

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Odonata, many puzzling aspects about this phenomenon remain due to one of the main problems is how to determine the region of origin of migratory dragonflies (Borisov *et al.* 2020). For example, little is still known about the expansion of *Anax ephippiger* (Burmeister, 1839) from the Iberian Peninsula. The local reproduction of *A. ephippiger* in Andalusia is confined solely to the exceptionally warm years (Muñoz-Pozo & Tamajón-Gómez 1993). According to Mediani *et al.* (2012), scarce winter and early spring European records (*e.g.*, Ferreras-Romero 1982; Santos Quirós 1993) of this species are better explained as African invaders (Weihrauch and Weihrauch 2003). The phenology and migratory movements of this species in the Iberian Peninsula during the summer are even less known.

Odonates were investigated in the southernmost coast of Spain during the hot days of late summer 2023. As in other sampling in coastal sites such as the Balearic Islands (Márquez-Rodríguez 2014, 2019) and the south of the Iberian Peninsula (Márquez-Rodríguez 2017; Weihrauch and Weihrauch 2003; Lohr 2005), occasional observations were carried out at Atlanterra beach, Gibraltar Nature Reserve, and Arroyo Negro Microreserve. Most species were identified through binoculars (Dijkstra and Lewington 2006).

The average temperature recorded by the Tarifa station (State Meteorological Agency) in August 2023 was 24.11 °C, ranging between 17 and 30.6 °C. The average relative humidity for that month was 79.46% and varied between 30 and 99%. The wind blew at an average speed of 6.65 m/s, with a predominant direction from the west. The maximum speed was of 81 km/h (22/VIII/2023).

In the Gibraltar Nature Reserve (36°08'17"N, 5°20'50"W), 2.33 km² of Mediterranean sclerophyllous forest of *Olea europaea* L., 1753 (Oleaceae), on a sunny day (04/IX/202), were observed at 4 pm during an hour hundreds of *A. ephippiger* with gregarious behaviour flying at a height of 2 to 5 m above the ground. Throughout the flight, the dragonflies showed no tendency to alight on the vegetation. A few days earlier, from August 22 to 24, hundreds of them appeared in the vicinity of Atlanterra beach at Zahara de los Atunes (Tarifa, Cadiz), 36°06'21"N, 05°49'34"W. The largest group was detected the first of those days with a very intense wind.

Other studies have shown a permanent migratory activity of *A. ephippiger* persists throughout the winter along the Moroccan Atlantic coast eventually reaching the Iberian Peninsula (Mediani *et al.* 2012). However, the aggregation phenomenon of *A. ephippiger* observed here during late summer coincided with high temperatures and strong gusts of Mediterranean winds. According to Lambret and Boudott (2013), *A. ephippiger* from Arabian belt may lead to mass migrations in summer and autumn in southern Europe. Therefore, this fact reinforces the idea of a massive migration of this species pursuing success in its colonization process in the Iberian Peninsula: the most southwestern part of Europe.

I visited a small estuary called Arroyo Negro Microreserve at La Línea de la Concepción, Cadiz province (Spain), 36°11'53"N, 05°19'50"W. The basin of Arroyo Negro is composed of marshes, dunes, and desert scrub. The estuary vegetation can be described as halophilic: *Tamarix africana* Poir., 1789 (Tamariceae), *Bolboschoenus maritimus* (L., 1753) (Cyperaceae), *Paspalum distichum* L., 1759 (Poaceae), *Carpobrotus edulis* (L.) L. Bolus, 1927 (Aizoaceae), and *Phragmites* sp. (Poaceae). Nine species of Odonata were observed (Tab. 1), of which *Brachythemis impartita* (Karsch, 1890), and *Orthetrum chrysostigma* (Burmeister, 1839), are new to the study area (Fig. 1). Additionally, three more species of Odonata (Grupo Naturalista Arroyo Negro 2022) were observed in this estuary, of which *A. ephippiger* and *Anax imperator* Leach, 1815 are obligate migrants in Africa.

Table 1. List of odonates observed in Arroyo Negro Microreserve. / **Tabla 1.** Lista de odonatos observados en la Microrreserva Arroyo Negro.

	02/IX/2023	05/IX/2023	07/IX/2023	08/IX/2023
<i>Ischnura graellsii</i> (Rambur, 1842)			2 males	1 male
<i>Anax parthenope</i> (Selys, 1839)	2 males	2 males	2 males	1 male
<i>Brachythemis impartita</i> (Karsch, 1890)			1 male	3 females
<i>Crocothemis erythraea</i> (Brullé, 1832)			3 females	3 females (1, teneral)
<i>Orthetrum cancellatum</i> (L., 1758)			5 males	
<i>Orthetrum chrysostigma</i> (Burmeister, 1839)			2 males	2 males
<i>Orthetrum trinacria</i> (Selys, 1841)			1 male	3 males
<i>Sympetrum fonscolombii</i> (Selys, 1840)		1 male	1 male	
<i>Trithemis annulata</i> (Pal. de Beauvois, 1805)			2 males	



Figure 1. Dragonflies perched on the halophilic vegetation of Arroyo Negro: **a)** *Trithemis annulata*. **b)** *Orthetrum chrysostigma*. **c)** *Brachythemis impartita*. The last two are new contributions to the odonatofauna of the estuary. / **Figura 1.** Libélulas posadas sobre la vegetación halófila de Arroyo Negro: **a)** *Trithemis annulata*. **b)** *Orthetrum chrysostigma*. **c)** *Brachythemis impartita*. Las dos últimas son nuevos aportes a la odonatofauna del estuario Arroyo Negro.

The odonatofauna of Arroyo Negro Microreserve is very similar to that recently has been cataloged at Mediterranean wetlands on the north coast of Morocco (Benazzouz *et al.* 2009). Consequently, observed Anisoptera are the ones that best characterize arid and warm habitat appropriated to thermophilic species on both sides of the Strait of Gibraltar.

Recent research for the Cádiz coast detected the presence of two non-native vagrant specimens unknown to the Iberian fauna: *Pantala flavescens* (Fabricius, 1798) and *Trithemis arteriosa* (Burmeister, 1839) (Bernal Sánchez 2021). Specifically, *P. flavescens* is a well-known long-distance migrant with a circum-global distribution and is the most widely distributed of all dragonfly species (Borisov and Malikova 2019; May 2013; Russell *et al.* 1998). On the other hand, *T. arteriosa* is known for its migratory abilities and one of the most widespread and abundant dragonfly species in Africa (Hupało and Tończyk 2014). The observations made of the current odonatofauna in the southernmost province of Spain could be indicating an increase in species of migratory dragonflies in the face of an evident scenario of global warming.

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Author Contributions

JMR: Investigation, project administration, conceptualization, validation resources, data curation, writing - original draft, writing - review & editing, visualization.

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