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SHORT COMMUNICATION

New data on the Odonate fauna from Graciosa Island (Azores)

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INTRODUCTION

The Azorean archipelago includes nine inhabited volcanic islands, of which Graciosa (39º02' N / 31º54'15" W) is the second smallest (62 Km^2). The maximum altitude of this island is 402 m a.s.l. at Caldeira. Because of its outermost position within the central group of islands (e.g. Terceira), the Odonate fauna of Graciosa is less explored than that of the other Azorean islands.

According Cordero-Rivera et al. (2005), the first publications concerning Neuroptera or Pseudo-Neuroptera material from the Azores islands are probably those by Drouët (1861) and Guerne (1888).

Currently, four odonate species are known from the Azores archipelago (Valle 1940; Gardner 1959, 1960; Belle 1992; Cordero-Rivera et al. 2005; Lorenzo-Carballa et al. 2009), namely, *Anax imperator* Leach, 1815 (Aeshnidae), *Sympetrum fonscolombii* (Selys, 1840) (Libellulidae), *Ischnura pumilio* (Charpentier, 1825) and *Ischnura hastata* (Say, 1839) (Coenagrionidae). The first three species belong to the European fauna, whereas the last one is native to the Americas (Belle & van Tol 1990; Lorenzo-Carballa et al. 2009; Weihrauch 2011). In a previous paper we found that all four species were known from all islands except Santa Maria and Graciosa, but we proposed that this was due to a lack of sampling and suggested that it is likely that all four species are present in all of the nine islands (Cordero Rivera et al. 2005). Further sampling confirmed the presence of these four species in Santa Maria Island (Lorenzo-Carballa et al. 2009; Tavares et al. 2010). Very few records of odonates have been published for Graciosa. The first was a female *S. fonscolombii* observed on July 17, 1938 (Valle 1940). No indication of the relevant locality was given. To our knowledge, only *A. imperator* and *S. fonscolombii* species were further recorded for Graciosa (Cordero-Rivera et al. 2005; Lorenzo-Carballa et al. 2009), but again without localities. So, the present contribution deals with new odonate records for this island. Given that *I. hastata* is of great interest in every island of the archipelago due to its unique parthenogenetic reproduction in all its Azorean localities, the first author made two visits to Graciosa in 2004 and 2007, in order to survey the local odonate fauna.

MATERIAL AND METHODS

The odonate survey was conducted on Graciosa Island during June 2004 and August 2007. Collection of adults with hand nets was carried out when meteorological conditions were favorable.

When adults could not be found, larvae were collected. Families and species were listed and named according to Dijkstra & Lewington (2006). For each species, date, place and number of specimens (♀ and ♂) captured or observed will be given. Information on zoogeographical origin (Weihrauch 2011) and distribution of taxa recorded on the Azorean islands are provided according to previously published information (Drouet 1861; Guerne 1888; Navas 1933; Valle 1940; Gardner 1959, 1960; Belle & Van Tol 1990; Belle 1992; Cordero Rivera et al. 2005; Sherratt & Beatty 2005; Dijkstra & Lewington 2006; Lorenzo-Carballa et al. 2009; Borges et al. 2010; Lorenzo-Carballa et al. 2011).

RESULTS AND DISCUSSION

Only two species of odonates, namely *Anax imperator* and *Sympetrum fonscolombii*, were found in Graciosa during June 07-15, 2004, and August 31- September 01, 2007. Table 1 shows detailed information of the localities sampled, and Table 2 summarizes the number of individuals observed. These species were common in ponds rich in *Potamogeton* and other macrophytes.

No damselflies were found during the two surveys. Two *Ischnura* species are known from the Azores (Cordero Rivera et al. 2005; Weihrauch 2011). Lorenzo-Carballa et al. (2009) showed that in the Azores *I. hastata* is restricted to oligotrophic ponds, basing on studies in São Miguel and Pico. It was absent from all eutrophic ponds

Table 1. Characterization of localities prospected for Odonate species at Graciosa Island, in 2004 and 2007. Type of habitat, UTM coordinates (Easting - Northing, all in zone 26S, geodesic system WGS84) and altitude (Alt.) are given. PA – Protected Areas were classified according to http://parquesnaturais.azores.gov.pt/pt/graciosa/parque-natural.

Locality	Type of habitat	Easting	Northing	Alt. (m)	Observations
1- Airport	Temporary pool/forest of *Erica azorica and Myrica faya*	410430	4327465	20	
2- Brasileira	Tank/water reservoir	409611	4324523	84	Near populated place
3- Caldeira Furna do Enxofre	Natural and artificial ponds/small lagoon	415775	4320100	110	PA
4- Caldeirinha - Barreiro	Water container for cattle at intensive pasture	410750	4321700	340	Near to the wind farm
5- Farol do Carapacho	Watering hole	417372	4318754	174	
6- "Fontes"	Tank/water reservoir	411012	4321845	180	Named Tanque das Fontes
7- Funchais	Water container for cattle at intensive pasture	411850	4325920	48	
8- Furna da Maria Encantada	Pasture and forest of *Erica azorica*	415135	4320572	258	
9- Guadalupe	Water container for cattle at corn culture	412046	4324666	62	Near Poço Novo
10- Pico do Timão	Water container for cattle at intensive pasture	412836	4322327	215	
11- Ponta da Barca	Wet zone with vegetation	409169	4327769	40	PA. near Farol da Barca
12- Tanque	Pond and water reservoir	410971	4322105	255	
13- Terreiros	Water container for cattle at intensive pasture	412365	4327372	18	
14- Baía da Vitória	Wet coastal zone with *Tamarix africana*	408445	4326030	26	Near Sª da Vitória church

Table 2. Number of males (♂) and females (♀) of *A. imperator* and *S. fonscolombii* observed at different localities from Graciosa Island (see also Table 1).

Locality	Date	*A. imperator*			*S. fonscolombii*		
		♂	♀	Other	♂	♀	Other
1	1/9/2007	1	1		1	1	
2	31/8/2007	2					
3	8-9-14/6/2004	4	1		3		
	9/6/2004				1	1	
4	9-14/6/2004	Several ♀♂ flying		Several exuviae and larvae	Several ♀♂ flying		several exuviae and larvae
	31/8/2007				Several ♀♂ flying		Two ♂ fighting
5	8/6/2004	1					
6	8/6/2004				1		
	31/8/2007	1	1		3	1	Two pairs in tandem, laying eggs
7	31/8/2007				1	1	
8	1/9/2007	1				1	Pair in tandem flying
9	9/6/2004					1	
	31/8/2007	1			1	1	
10	11/6/2004	1					
	31/8/2007	2					
11	31/8/2007	2				1	
12	7-15/6/2004	Several ♀♂ flying		Several exuviae			
13	31/8/2007				2	2	Pair in tandem, laying eggs
14	31/8/2007	4	1			3	

impacted by cattle grazing and by ponds subjected to water extraction by humans. This suggests that parthenogenetic populations of *I. hastata* are highly sensitive to eutrophication, which is different from the habitat preferences showed by sexual populations in the Americas. Accordingly, in 2012, the second author observed dense sexual populations of *I. hastata* in eutrophic ponds in Cuba and the Dominican Republic. In the Azores, therefore, *I. hastata* can be considered an excellent bioindicator of high water quality, but not in other regions.

The second species, *I. pumilio*, is more tolerant to low water quality (Lorenzo-Carballa et al., 2011) and could possibly be present in Graciosa. Nevertheless, the density of cattle is very high and the demand for water is increasing, two factors that, together with the proliferation of cyanobacteria due to nutrient inputs to pastures, accelerate water eutrophication. Consequently, on this island, all the ponds are strongly eutrophic (Azevedo et al. 2005). Further, several ponds known through historical records (Azevedo et al. 2005) do not longer persist. All these factors are probably responsible for the present lack of any *Ischnura* spp. in Graciosa, and even if they have colonized the island in the past it is doubtful that they could survive given the present water chemistry.

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