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Additions to the checklist of terrestrial biodiversity of Cabo Verde

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RESUMO

Em resultado de seis semanas passadas em trabalho de campo em seis ilhas caboverdianas em Setembro/ Outubro de 2016 e 2017, apresentamos 18 adições à lista da biodiversidade terrestre do arquipélago (dez artrópodes, uma ave, dois fungos e cinco plantas). Quatro deles são os primeiros registos para Cabo Verde, os outros para ilhas particulares. De entre as espécies mais interessantes refira-se a mosca da fruta da maçã-de-Sodoma *Dacus longistylus*, provavelmente introduzida para o biocontrolo da árvore tóxica da maçã-de-Sodoma e novas adições à distribuição de várias espécies de abelhas dos géneros *Amegilla*, *Megachile* e *Xylocopa*. As nossas observações indicam que o conhecimento da biodiversidade de Cabo Verde ainda está incompleto e que mais trabalho de campo é necessário.

Palavras-chave: fauna nativa, novos registos, *Dacus longistylus*, *Amegilla*, *Megachile*

ABSTRACT

Based on six weeks spent in the field on six Cabo Verdean Islands in September/ October 2016 and 2017, we present 18 additions to the checklist of terrestrial biodiversity of the archipelago (ten arthropods, one bird, two fungi, and five flowering plants). Four of them are first records for Cabo Verde, the others for particular islands. Most interesting are the apple of Sodom fruit fly *Dacus longistylus*, perhaps actively introduced for biocontrol of the toxic apple of Sodom tree and the additions to the distribution of several bee species of the genera *Amegilla*, *Megachile*, and *Xylocopa*. Our observations indicate that the biodiversity of Cabo Verde is still incompletely known and more fieldwork is needed.

Keywords: native fauna, new records, *Dacus longistylus*, *Amegilla*, *Megachile*

INTRODUCTION

In the Macaronesian region, the terrestrial and marine biodiversity of the Canary Islands and Madeira are well-studied but our knowledge of other archipelagos, including the Azores and Cabo Verde seems much less complete, when counting and comparing the species numbers in published checklists (Borges *et al.* 2010; Arechavaleta *et al.* 2005). This is especially the case for arthropods, where, for example, no species of the bee genus *Amegilla* is mentioned in the Cabo Verde Hymenoptera checklist (Baéz *et al.* 2005) even though Brooks (1988) already described and listed several Cabo Verde endemics of that genus. Bryophytes and even flowering plants probably also need more work in terms of basic taxonomy, ecology and biogeography.

This type of information is crucial for conservation management but also for macroecological studies which rely on robust distribution data. As an exception, the avifauna of Cabo Verde is rather well-known due to the efforts of Hazevoet (1995) and others. While the information of the bird checklist (López-Jurado *et al.* 2005) is a bit outdated, the field guide of Garcia-del-Rey (2011) is still a good reference.

During two botanical and zoological trips to Cabo Verde in 2016 and 2017, we observed several animal, plant and fungus species not mentioned in the checklist of animals, plants, and fungi of Cabo Verde (Arechavaleta *et al.* 2005) or new to a particular island. The aim of this contribution is to publish those new records and discuss their importance.

MATERIAL AND METHODS

The first sampling took place in September/ October 2016, when the islands of Boavista, Sal, Santiago, São Vicente, and Santo Antão were visited by the senior author for three weeks. The second trip took place in September/October 2017, when all authors visited the five islands of the previous trip plus Fogo. On each of the islands, we went for half- or full-day hikes and tried to identify as

many terrestrial species as possible, but we did not perform standardized monitoring or used any particular method for targeting a taxonomic group. All new records except birds are documented with photographs. We describe our observations and whenever possible provide details on numbers of individuals and ecology of the species in Cabo Verde.

RESULTS

Altogether, we add new observations for 18 species, ten of them arthropods, one bird, two fungi, and five flowering plants (Table 1).

ANIMALIA**Arthropoda**Arachnida

Araneae: The banded-legged golden orb-web spider *Nephila senegalensis*, so far reported from Brava, Fogo, Maio, Santiago, and Santo Antão (García *et al.* 2005), was found in high densities on Boavista in 2016 and 2017 (Fig. 1A). The huge females had their webs preferably in *Tamarix* and *Acacia* shrub, often across foot paths. The largest prey items seen in the webs included grasshoppers and female carpenter bees *Xylocopa modesta*.

Chilopoda

Scolopendromorpha: One *Scolopendra morsitans* centipede so far known from Fogo, Maio, Sal, Santiago, Santo Antão, and São Vicente (Zapparolia *et al.* 2005), was found under stones in semi-desert habitat near Sal Rei, Boavista together with juvenile geckos (Fig. 1B).

Insecta

Diptera: The fruit fly *Dacus longistylus* (Fig. 1C) was found in considerable numbers on Fogo while mating on flowers and young fruits of *Calotropis procera*.

Orthoptera: The house cricket *Acheta domesticus*, so far reported from Maio, Santiago, Santo Antão, and São Vicente (Baéz & Oromí 2005), was found dead at Boavista airport (Fig. 1D). The large conehead *Ruspolia nitidula*, so far reported from Santo Antão and São Nicolau (Baéz & Oromí 2005), was found on Fogo during our 2017 trip (Fig. 1E).

Hymenoptera: *Apis mellifera*, so far reported from Santiago only (Baéz *et al.* 2005), was observed on Boavista, Fogo, and Santo Antão in high numbers on ice plant flowers (Aizoaceae) but also on ornamentals in gardens (Fig. 1F).

No leafcutter bee was listed by Baéz *et al.* (2005), but a specimen of a small, widespread African species, *Megachile concinna*, collected on Sal, was included in a recent phylogenetic analysis (Soltani *et al.* 2017). The species was now observed in relatively small numbers also on Boavista, Fogo, and Santo Antão (Fig. 2 A and B), where it visited different *Lotus* species as well as Brassicaceae and *Cleome* species (Capparidaceae).

The carpenter bee *Xylocopa modesta*, a native of Sub-Saharan Africa, has been reported from Santiago, Santo Antão, São Nicolau, and São Vicente (Baéz *et al.* 2005), and was found to be common on Boavista, Fogo, and Sal as well (Fig. 2C and D). On Boavista, we found the species nesting in considerable numbers in stems of dead *Phoenix atlantica* east of Sal Rei, both 2016 and 2017, and visiting flowers of ornamental plants in the gardens of Sal Rei.

We observed at least two *Amegilla* species: the yellow-ochre *Amegilla capeverdensis* (Fig. 2E) on Boavista and Sal, where it was common in coastal dunes on the flowers of *Lotus brunneri*. The holotype of the species is from Boavista (Brooks 1988), but the species has not been mentioned from Sal so far. We observed the slightly larger, much darker *Amegilla godofredi* (Fig. 2F) with orange hind legs on Santo Antão and São Vicente, where the females visited *Aeonium gorgoneum* (Crassulaceae) and *Echium stenosphon* s.l. (Boraginaceae) flowers. The original type locality is São Vicente and additional material was collected on São Nicolau (Brooks 1988), but the species has not been mentioned from Santo Antão yet.

Table 1. New records (*) and previously known distribution (●) for the 18 discussed taxa in alphabetical order per island (SA, Santo Antão; SV, São Vicente; SL, Santa Luzia; Br, Branco; Ra, Raso; SN, São Nicolau; S, Sal; BV, Boavista; M, Maio; ST, Santiago; F, Fogo; B, Brava).

Taxon	S A	SV	SL	Br	Ra	SN	S	BV	M	ST	F	B
<i>Acheta domesticus</i> (L.)	●	●	-	-	-	-	-	*	●	●	-	-
<i>Amegilla capeverdensis</i> Brooks	-	-	-	-	-	-	*	●	-	-	-	-
<i>Amegilla godofredi</i> (Sichel)	*	●	-	-	-	●	-	-	-	-	-	-
<i>Apis mellifera</i> L.	*	-	-	-	-	-	-	*	-	●	*	-
<i>Ceratophyllum demersum</i> L.	*	-	-	-	-	-	-	-	-	-	-	-
<i>Cucumis dipsaceus</i> Ehrenb. ex Spach	*	*	-	-	-	-	-	-	-	*	*	-
<i>Cucumis melo</i> L. ssp. <i>meloides</i> Endl & H.Schaef.	-	-	-	-	-	-	*	*	●	●	●	-
<i>Dacus longistylus</i> Wiedemann	-	-	-	-	-	-	-	-	-	-	*	-
<i>Gallinago gallinago</i> (L.)	*	●	-	-	-	-	●	●	●	●	-	-
<i>Megachile concinna</i> Smith	*	-	-	-	-	-	●	*	-	-	*	-
<i>Nephila senegalensis</i> (Walckenaer)	●	-	-	-	-	-	-	*	●	●	●	●
<i>Oxalis corniculata</i> L.	●	●	-	-	-	●	●	*	-	●	●	●
<i>Oxalis latifolia</i> Kunth	*	-	-	-	-	-	-	-	-	-	-	-
<i>Pisolithus tinctorius</i> (Pers.) Coker & Couch	-	-	-	-	-	-	-	-	-	●	*	-
<i>Podaxis pistillaris</i> (L.) Fr.	●	●	-	-	●	-	●	*	-	●	-	-
<i>Ruspolia nitidula</i> (Scopoli)	●	-	-	-	-	●	-	-	-	-	*	-
<i>Scolopendra morsitans</i> L.	●	●	-	-	-	-	●	*	●	●	●	-
<i>Xylocopa modesta</i> F. Smith	●	●	-	-	-	●	*	*	-	●	*	-



Fig. 1. Arthropods of Cabo Verde. **A)** *Nephila senegalensis*, female, near Rabil (Boavista), October 2016 (photo by H. Schaefer); **B)** *Scolopendra morsitans* near shipwreck of Santa Maria in the Northeast of Boavista, October 2017 (photo by H. Schaefer); **C)** *Dacus longistylus*, female (top) and male (below) on flowers of *Calotropis procera* (Apocynaceae) near São Filipe (Fogo), October 2017 (photo by H. Schaefer); **D)** *Acheta domesticus*, female, found dead at Boavista airport, October 2017 (photo by J. Bretzel); **E)** *Ruspolia nitidula*, near Mosteiros (Fogo), October 2017 (photo by J. Bretzel); **F)** *Apis mellifera*, near Ponta do Sol (Santo Antão), October 2017 (photo by J. A. Weissmann); all scale bars correspond to 5 mm.



Fig. 2. Wild bees of Cabo Verde (photos in B, E and F by J. A. Weissmann and the others by H. Schaefer). **A)** *Megachile concinna* female visiting flowers of *Cleome viscosa*, Capparidaceae, near Sal Rei (Boavista), October 2016; **B)** *Megachile concinna* male on flowers of the endemic *Heliotropium ramosissimum*, Boraginaceae, Sal Rei (Boavista), October 2017; **C)** *Xylocopa modesta* female on flowers of *Grewia villosa*, Malvaceae, near Sal Rei (Boavista), October 2016; **D)** *Xylocopa modesta* male on flowers of the endemic *Lotus brunneri*, Fabaceae, Sal Rei (Boavista), October 2016; **E)** *Amegilla capeverdensis*, Sal Rei (Boavista), October 2017; **F)** *Amegilla godofredi* visiting flowers of the endemic *Echium stenosphon*, Boraginaceae, Paúl valley (Santo Antão), October 2017; all scale bars correspond to 5 mm.

Aves

Charadriiformes: One individual of the common snipe *Gallinago gallinago* flew off a small riverbed in Ribeira de Paúl, Santo Antão, October 2017. The species was mentioned by Garcia-del-Rey (2011) as visitor to Boavista, Sal, Maio, Santiago, and São Vicente.

Pelecaniformes: An immature individual of the purple heron *Ardea purpurea*, possibly ssp. *bournei* due to its pale plumage, was observed at the sewage pond of the desalination plant of the 'Riu Touareg' Hotel in the south of Boavista near Praia de Santa Mónica in 2017.

Accipitriformes: An individual of the black kite *Milvus migrans* was observed at João Galego, Boavista in 2016 and at Monte Barro, Fogo in 2017.

FUNGI

Basidiomycetes

Boletales: The dead man's foot fungus *Pisolithus tinctorius*, so far reported only from Santiago (Baudet 2005) was found in *Eucalyptus globulus* and *Pinus canariensis* plantations in the northeastern part of Fogo (Fig. 3A).

Agaricales: The puffball fungus *Podaxis pistillaris*, so far reported from Raso, Sal, Santiago, Santo Antão, and São Vicente (Baudet 2005), was found in considerable numbers on Boavista in October 2016 and less common in 2017, especially in the surroundings of Sal Rei, where it seems to grow preferably in areas with dog or donkey faeces (Fig. 3B).

PLANTS

Angiosperms

Ceratophyllales: *Ceratophyllum demersum* (Ceratophyllaceae), was found growing in small amounts in Ribeira do Paúl, Santo Antão (Fig. 3C).

Cucurbitales: A conspicuous representative of the gourd family *Cucumis dipsaceus* (Cucurbitaceae), which had not been included in the checklist (Sánchez-Pinto *et al.* 2005), was found in 2016 on Santiago, and in 2017 on Santo Antão, on disturbed ground at the southern margin of Ponta do Sol. It was also found on Fogo, at the western margin of the capital São Filipe (Fig. 3D). Another wild melon (Cucurbitaceae) was found on Boavista and Sal in 2016 and 2017, *Cucumis melo* ssp. *meloides* (Fig. 3E). This taxon was previously reported from Fogo, Maio, and Santiago (Sánchez-Pinto *et al.* 2005 [as *C. melo* L]).

Oxalidales: *Oxalis latifolia* (Oxalidaceae), a widespread field weed of South African origin was found growing along a path in fields on Santo Antão, Ribeira do Paúl, in 2017 (Fig. 3F). This is the first record of that species for Cabo Verde (Sánchez-Pinto *et al.* 2005). The related, also weedy *Oxalis corniculata*, already known from Brava, Fogo, Sal, Santiago, Santo Antão, São Nicolau, and São Vicente (Sánchez-Pinto *et al.* 2005), was found on Boavista in 2016 and 2017 (Fig. 3G).



Fig. 3. Fungi and flowering plants of Cabo Verde (all photos by H. Schaefer, except the penultimate by V. Rupprecht). **A)** *Pisolithus tinctorius*, Monte Velha (Fogo), October 2017; **B)** *Podaxis pistillaris*, Sal Rei (Boavista), October 2016; **C)** *Ceratophyllum demersum*, dry plant taken from small artificial reservoir in Paúl valley (Santo Antão), October 2017; **D)** *Cucumis dipsaceus*, Ponta do Sol (Santo Antão), October 2017; **E)** *Cucumis melo meloides*, near Sal Rei (Boavista), October 2016; **F)** *Oxalis latifolia*, field weed in Paúl valley (Santo Antão), October 2017; **G)** *Oxalis corniculata*, roadside weed in Sal Rei (Boavista), October 2016; scale bars in A, B, D correspond to 5 cm, and in C, E, F, G to 1 cm.

DISCUSSION

Most of our new records are for Boavista (nine species), but Fogo and Santo Antão come very close with seven new records each, whereas our short visits to Sal and São Vicente resulted in only three and zero additions, respectively. It is thus likely that

this just reflects the time spent on each of these islands.

None of the 18 records we report is really surprising, as they mostly represent range expansions of species within Cabo Verde and not new colonisations from the continent.

The large conehead *Ruspolia nitidula*, for example, is a widespread grasshopper species known from Southern Europe, Asia, and Northern Africa, including the Canary Islands (Hochkirch *et al.* 2016) that now seems to be expanding in Cabo Verde. Despite several recent studies (e.g. Pauly *et al.* 2002, Straka & Engel 2012, Weissmann *et al.* 2017), the bee fauna of Macaronesia and especially of Cabo Verde is still incompletely known. So far, 21 bee species have been reported from Cabo Verde (Weissmann *et al.* 2017), including the honeybee, *Apis mellifera*, which according to locals, is not kept in bee hives, so most likely represents wild or feral colonies. Compared to other Macaronesian archipelagos, this diversity is quite similar to Madeira and the Azores, but much lower than in the Canaries. It is therefore expected that bees make up such a big proportion of our new records.

Our bird observations suggest follow-up fieldwork: snipe might have a small breeding population on Santo Antão, black kite might breed on Boavista, and the pale purple heron on Boavista could have been from the endemic Santiago population.

The few new colonisations we observed are the fruit fly *Dacus longistylus* and the flowering plants *Ceratophyllum demersum*, *Cucumis dipsaceus*, and *Oxalis latifolia*, all four supposedly new records for Cabo Verde (see Arechavaleta *et al.* 2005). The latter two species were most likely introduced unintentionally as contamination of soil or seeds. Both are weedy in tropical and subtropical areas worldwide and will probably spread throughout the archipelago within a few years' time. *Cucumis dipsaceus* was also found on São Vicente (R. Vasconcelos, pers.

comm). *Dacus longistylus* is a different case: it is widely distributed throughout Northern Africa and Arabia and was recently discovered on *Calotropis* plants in Morocco (El Harym & Belqat 2017). No species of the genus *Dacus* was so far reported from Cabo Verde (Baéz & García 2005). It has been tested as a biocontrol agent to limit the spread of toxic *Calotropis procera* shrubs (Dhileepan 2014) and it seems possible that the flies we found on Fogo go back to such an intentional release, but we could not find any official confirmation of such biocontrol attempts. The rigid hornwort *Ceratophyllum demersum* (Ceratophyllaceae) is an almost cosmopolitan inhabitant of ponds and quiet streams. It grew in a place where the stream has been turned into a small artificial water reservoir. This is also the site where the first freshwater fish record of the archipelago *Poecilia reticulata* Peters has recently been found (Lucek & Lemoine 2012). We can confirm a healthy *Poecilia* population, which seemed to have grown since its first discovery in 2012. Whether the hornwort plants have been introduced on purpose together with the fish is unknown, a natural dispersal from the African mainland to Santo Antão attached to feet or plumage of water birds would be possible, but has not been documented so far for any of the few water plant species of Cabo Verde.

Cucumis melo ssp. *meloides* is the wild ancestor of African melon landraces cultivated in Sudan and possibly West Africa (Endl *et al.* 2018). Whether the Cabo Verde plants represent an indigenous population or more recent accidental introductions from the West African mainland remains to be studied with population genetics methods.

CONCLUDING REMARKS

We conclude that despite all the recent efforts, many taxonomic terrestrial groups of Cabo Verde still need a lot more fieldwork to achieve a reliable and comprehensive checklist, which is crucial not only for

conservation and management within the islands but also for macroecological and evolutionary studies which compare species numbers of islands worldwide.

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