

ZOOLOGIA CABOVERDIANA

REVISTA DA SOCIEDADE CABOVERDIANA DE ZOOLOGIA



VOLUME 7 | NÚMERO 1

Julho de 2018

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REVISTA DA SOCIEDADE CABOVERDIANA DE ZOOLOGIA

Zoologia Caboverdiana é uma revista científica com arbitragem científica (*peer-review*) e de acesso livre. Nela são publicados artigos de investigação original, artigos de síntese e notas breves sobre Zoologia, Paleontologia, Biogeografia, Etnozoologia e Conservação nas Ilhas de Cabo Verde. Também publicamos artigos originais ou de revisão de uma área geográfica mais ampla desde que debruçados sobre espécies que ocorrem no arquipélago de Cabo Verde.

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Nota editorial

Muito potencial

No primeiro número do sétimo volume desta revista dedicamos a nossa atenção a dois grupos de organismos pouco estudados em Cabo Verde. Referimo-nos nomeadamente aos mamíferos, tanto terrestres como marinhos, e aos invertebrados terrestres. Este número consolida ainda a vitalidade desta revista com revisão por pares, com dois artigos originais e uma nota breve de autores de cinco nacionalidades diferentes, incluindo a cabo-verdiana.

O primeiro artigo, designado “*Revisão bibliográfica e novos registos de morcegos (Chiroptera) no arquipélago de Cabo Verde*”, é um dos poucos artigos publicados neste século sobre os morcegos deste país. Sabemos muito pouco acerca da distribuição, endemidade ou origem das sete espécies de morcegos já registadas nestas ilhas. Assim, este estudo revê o estado da arte e descreve novas ocorrências de algumas dessas espécies em algumas das ilhas deste arquipélago.

O segundo artigo, intitulado “*Registo fotográfico do ciclo de vida de Chilades evorae Libert, Baliteau & Baliteau, 2011 (Lepidoptera: Lycaenidae), endémica das ilhas de Cabo Verde, com notas da ecologia e distribuição*”, fornece-nos as primeiras fotografias detalhadas das diferentes fases da única espécie de borboleta exclusivamente cabo-verdiana. Este estudo fornece-nos ainda novos dados sobre a distribuição e pistas sobre a ecologia deste invertebrado que, tal como muitos outros, salvo raras exceções, são quase desconhecidos nesta área geográfica.

Por último, a nota breve designada “*Registos de arrojamentos e avistamentos da baleia de bico de Gervais em Cabo Verde*”

incide sobre um mamífero marinho raramente observado no país. Esta baleia, tal como muitos outros cetáceos migradores que passam nas águas deste arquipélago, merece ser estudada com maior detalhe para que se possa compreender melhor a distribuição e abundância da mesma.

Espera-se que este número, para além de contribuir para aumentar o nosso conhecimento sobre os mamíferos e invertebrados de Cabo Verde, possa também motivar outros cientistas, naturalistas e estudantes a debruçarem-se cada vez mais na Zoologia deste arquipélago da Macaronésia, principalmente nas espécies menos estudadas. Vamos fazer mais ciência em Cabo Verde e para Cabo Verde, onde, no que diz respeito à biodiversidade, há ainda potencial para novas descobertas!

Doutora Raquel Vasconcelos
Editora-chefe da *Zoologia Caboverdiana*

Editorial note

Untapped potential

This first number of the seventh volume of *Zoologia Caboverdiana* is focussed on two groups of organisms that remain largely understudied in Cabo Verde. We are namely referring to mammals, both terrestrial and aquatic, and to terrestrial invertebrates. Two original articles and a short note, by authors from five different nationalities, including Cabo-Verdean, consolidate the vitality of this peer-reviewed journal.

The first article, called “*Bibliographic revision and new records of bats (Chiroptera) for Cabo Verde Archipelago*”, is one of the few articles studying bats in the country so far published in this century. The distribution, endemism or origin of the seven species of bats occurring in Cabo Verde is yet poorly characterized. In addition to reviewing the current state of the art, this article also describes new occurrences of bats in some of the islands of this archipelago.

The second article, entitled “*A photographic record of the life history of Chilades evorae Libert, Baliteau & Baliteau, 2011 (Lepidoptera: Lycaenidae), endemic to the Cabo Verde Islands, with notes on ecology and distribution*”, provides us the first detailed photographs covering the entire developmental stages of the unique exclusively Cabo-Verdean butterfly species. Additionally, this study provides us with new data on the distribution and clues on the ecology of this invertebrate which, like many others, with rare exceptions, are almost unnoticed in this geographical area.

Lastly, the brief note called “*Stranding and sighting records of Gervais’ beaked whale in Cabo Verde*” focuses on a marine mammal rarely observed in the country. This whale, like many other migratory cetaceans that cross

the waters of this archipelago, deserves to be studied further to allow a better understanding of its distribution and abundance.

It is hoped that this number, in addition to contributing to increasing our knowledge of Cabo Verde's mammals and invertebrates, may also motivate other scientists, naturalists and students to increasingly explore the Zoology of this Macaronesian archipelago, especially the lesser-studied species. In regards to the biodiversity, more science in Cabo Verde and to Cabo Verde is required, where there is untapped potential to discover!

Raquel Vasconcelos, PhD
Editor-in-chief of *Zoologia Caboverdiana*



Artigo original | Original article

Bibliographic revision and new records of bats (Chiroptera) for Cabo Verde Archipelago

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RESUMO

A região Oeste africana apresenta uma das maiores falhas de conhecimento na distribuição e taxonomia das espécies, especialmente das menos conspícuas. Este trabalho apresenta um dos poucos estudos alguma vez realizado nas ilhas de Cabo Verde sobre morcegos. O conhecimento da distribuição das sete espécies registadas neste arquipélago é ainda muito escasso e com baixa resolução (geralmente ao nível da ilha), assim novos registos são esperados, o que terá muito valor para o estabelecimento de políticas conservacionistas. A revisão da informação dispersa e inacessível por via digital (devido à antiga data de publicação) da fauna de morcegos de Cabo Verde, incluindo os primeiros registos de morcegos para duas ilhas e novos dados de ocorrência para duas espécies em três ilhas, é apresentada. Acredita-se que este trabalho pode constituir uma referência para futuros trabalhos sobre morcegos na região pois também providenciamos registos acústicos que poderão ser revistos em futuras revisões taxonómicas.

Palavras-chave: mamíferos, distribuição, sonogramas

ABSTRACT

The West African region possesses one of the largest knowledge gaps in the distribution and taxonomy of all species, especially inconspicuous ones. This work presents one of the few bat studies ever carried out in the Cabo Verde Islands. Knowledge on the distribution of the seven species recorded in this remote archipelago is still very scarce and with very low resolution (many at island level), so new records are expectable and invaluable for the establishment of conservation policies. A review on the scattered and digitally unavailable (due to the old date of publication) knowledge of the Cabo Verde bat fauna with the first bat records for two islands and new occurrence data for two species on three islands is presented. It is expected that this work can constitute a reference for future bat works in the region, while providing acoustic data that can easily be updated upon future taxonomic revisions.

Keywords: mammals, distribution, sonograms

INTRODUCTION

Very few studies and field expeditions have focused on the bats from Cabo Verde Islands. Some preliminary data published in the 1960's and 1980's indicate that there are up to five species of bats (four vespertilionids and one emballonurid) that might have colonised the islands by passive transport by boat, but the possibility that they have reached it by their own means is not excluded (Dorst & Naurois 1966, Pucetti & Zava 1988). Resident bats were identified as *Taphozous nudiventris* (Cretzschmar, 1830), *Hypsugo savii* (Bonaparte, 1837), *Pipistrellus kuhlii* (Kuhl, 1817), *Plecotus austriacus* (Fischer, 1829) and *Miniopterus schreibersii* (Kuhl, 1817) (Dorst & Naurois 1966, Hazevoet 2015, Ibañez & Fernández 1989, Masseti 2010, Pucetti & Zava 1988). All bat species were considered recent and rare on the archipelago (Tranier & Naurois 1985). Since then, no more information was published regarding those species, although a reference to another two, probably vagrant species, *Eidolon helvum* (Kerr, 1792) and an indeterminate species of Molossididae, occurred in 2010 and 2014, respectively (Hazevoet 2014, Jiménez & Hazevoet 2010). Knowledge on the distribution of bats in Cabo Verde is still very limited and lacking precise spatial localization (usually only the name of the island is given),

so new records are expectable and invaluable for the establishment of conservation policies, as some of these species (*M. schreibersii* and *E. helvum*) are classified as Near Threatened (Hutson *et al.* 2008, Mickleburgh *et al.* 2008).

The Cabo Verde Islands are located in the Atlantic Ocean (Fig. 1) and belong to the biogeographical region of Macaronesia. These islands are included in the Mediterranean biodiversity hotspot (Myers *et al.* 2000) and form a volcanic archipelago comprising 10 main islands plus several islets, with a total area of circa 4000 km². In past studies, the presence of bats was detected in seven of those islands, namely Santo Antão, São Vicente, Sal, Boavista, Maio, Santiago, and Fogo (Fig.1).

The goal of this work is to provide new distributional information regarding the presence of bats in Cabo Verde based on a review of the scattered and digitally unavailable literature and our own fieldwork, in order to facilitate future research on the seven resident and vagrant species occurring in this remote archipelago. In addition, this work intends to provide reference material for future taxonomic revisions that should follow, and to act as a statement that bats do exist in the country and should be included in conservation plans.

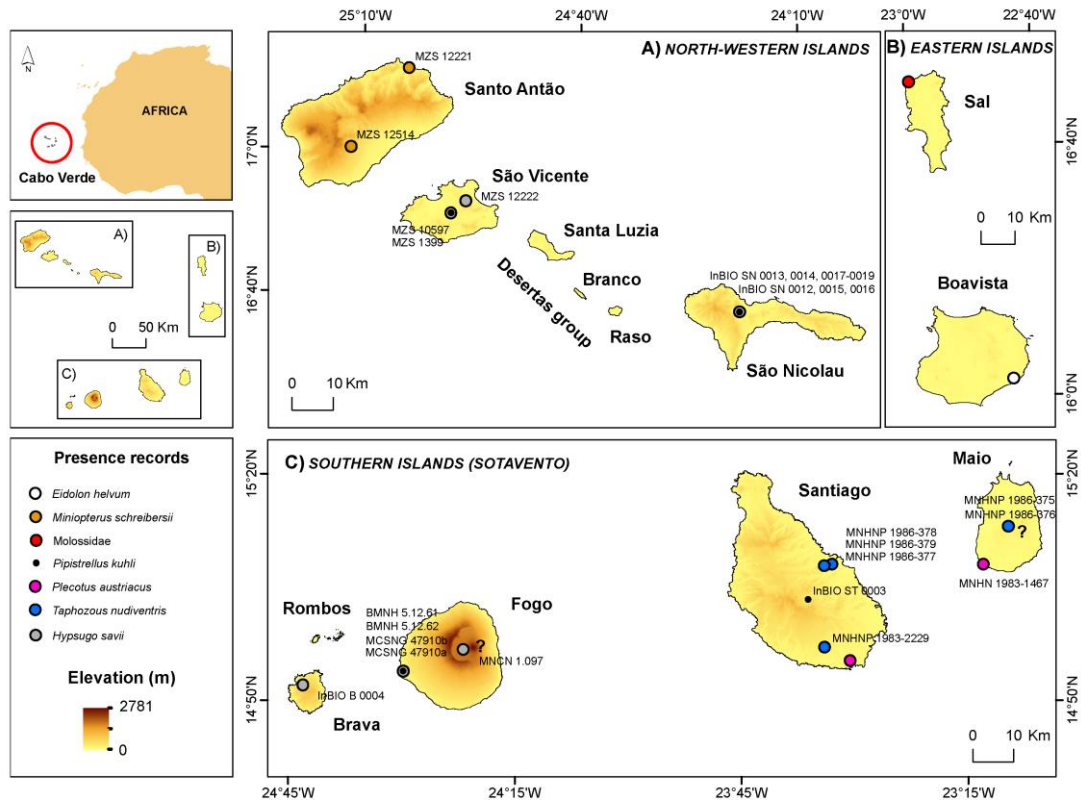


Fig. 1. Summary of bibliographic and new records of all species of bats registered in the Cabo Verde Islands. See Table 1 for details of museum vouchers or sonograms depicted with their codes (when no code is presented, no voucher or sonogram was collected; when it starts with InBIO, it refer to new records). Question marks stand for unknown localities (records represented on the island's centroids).

MATERIAL AND METHODS

Acoustic surveys were carried out on 10 Cabo Verde Islands from 2006 to 2008 during the dry season, from mid-May to mid-July. Ultrasound surveys were made with a D-240x (Pettersson Elektronik AB, Uppsala, Sweden) and recorded on an Edirol R-09 (Roland). Records were all made between 17:30 and 20:00 pm (circa one hour before sunset until one hour after sunset) in urbanised areas with low buildings and no trees. Sound analyses were made using BatSound Pro 4.2 (Pettersson Elektronik AB, Uppsala, Sweden) with a 1024 pt FFT and Hamming window for spectrogram analysis (Russo & Jones 2002; Amorim *et al.* 2014). Acoustic identification of bat calls, where frequency, duration and pattern were used as descriptors, were based on Russo & Jones (2002) and ACR (2017). It is likely that the current taxonomic status of

Cabo Verde bats will be revised in the near future (see Discussion). Therefore, we decided to compare call characteristics with both Africa and European call libraries, especially to help in the discrimination of *Pipistrellus* and *Hypsugo* calls. Records were deposited in figshare repository (<https://figshare.com/>).

The geographical coordinates of fieldwork observations were recorded with a global positioning system (GPS) device. Previous records from the literature were gathered in a database. Coordinates from literature records were determined from topographical maps (1:25,000). All coordinates from new and previous observations were recorded or determined on the WGS84 datum and mapped using ArcGIS v. 9.3 (ESRI, Redlands, USA).

RESULTS

For this study, 15 new records with sonograms and 22 bibliographic records were gathered. All bibliographic and new records are depicted in Fig. 1 and detailed in Table 1 and some relevant sonograms in Fig. 2. A list of all material available at the Museum National d'Histoire Naturelle de Paris

(MNHN), Museo Civico di Storia Naturale, Genova (MCSNG), British Museum Natural History, London (BMNH), Museo Zoologico de La Specola, Firenze (MZS), Museo Nacional de Ciencias Naturales, Madrid (MNCN) and the figshare repository is following:

Table 1. Details of all records of bats registered in the Cabo Verde Islands by island, with museum voucher codes and sonogram codes, identified sex (F, female; M, male; -, unknown), record type, year of collection (year), and location (islands and locality).

Island	Locality	Taxa	Code	Sex	Record type	Year
Boavista	Ervatão	<i>E. helvum</i>	(just seen)	F	bibliographic	2010
Brava	Nova Sintra	<i>H. c.f. savii</i>	InBIO B0004	-	this study	2006
Fogo	São Filipe	<i>H. savii</i>	MCSNG 47910a	M	bibliographic	1898
Fogo	São Filipe	<i>H. savii</i>	MCSNG 47910b	F	bibliographic	1898
Fogo	São Filipe	<i>H. savii</i>	BMNH 5.12.61	M	bibliographic	1898
Fogo	São Filipe	<i>H. savii</i>	BMNH 5.12.62	-	bibliographic	1898
Fogo	unknown	<i>H. savii</i>	MNCN 1.097	F	bibliographic	-
Fogo	São Filipe	<i>P. c.f. kuhlii</i>	InBIO F0005-0007, 0009	-	this study	2007
Maio	Vila do Maio	<i>P. austriacus</i>	MNHN 1983-1467	-	bibliographic	1965
Maio	unknown	<i>T. nudiventris</i>	MNHNP 1986-375	-	bibliographic	1965
Maio	unknown	<i>T. nudiventris</i>	MNHNP 1986-376	F	bibliographic	1965
Sal	Ponta Preta	Molossidae	(just seen)	-	bibliographic	2014
Santiago	São Jorge	<i>P. c.f. kuhlii</i>	InBIO ST0003	-	this study	2007
Santiago	Praia	<i>P. austriacus</i>	(just seen)	-	bibliographic	1965
Santiago	Pedra Badejo	<i>T. nudiventris</i>	MNHNP 1986-377	F	bibliographic	1968
Santiago	Pedra Badejo	<i>T. nudiventris</i>	MNHNP 1986-378	M	bibliographic	1969
Santiago	Pedra Badejo	<i>T. nudiventris</i>	MNHNP 1986-379	F	bibliographic	1969
Santiago	Trindade	<i>T. nudiventris</i>	MNHNP 1983-2229	M	bibliographic	1969
Santiago	Santa Cruz	<i>T. nudiventris</i>	(just seen)	M	bibliographic	2015
Santo Antão	unknown	<i>H. savii</i>	(not confirmed)	-	bibliographic	-
Santo Antão	Ribeira Grande	<i>M. schreibersii</i>	MZS 12221	F	bibliographic	1984
Santo Antão	Paúl	<i>M. schreibersii</i>	MZS 12514	M	bibliographic	1986
São Nicolau	Ribeira Brava	<i>H. c.f. savii</i>	InBIO SN0013, 0014, 0017-0019	-	this study	2006
São Nicolau	Ribeira Brava	<i>P. c.f. kuhlii</i>	InBIO SN0012, 0015, 0016	-	this study	2007
São Vicente	unknown	<i>H. savii</i>	MZS 1399	M	bibliographic	1909
São Vicente	Monte Verde	<i>H. savii</i>	MZS 12222	-	bibliographic	1984
São Vicente	unknown	<i>P. kuhlii</i>	MZS 10597	F	bibliographic	1909

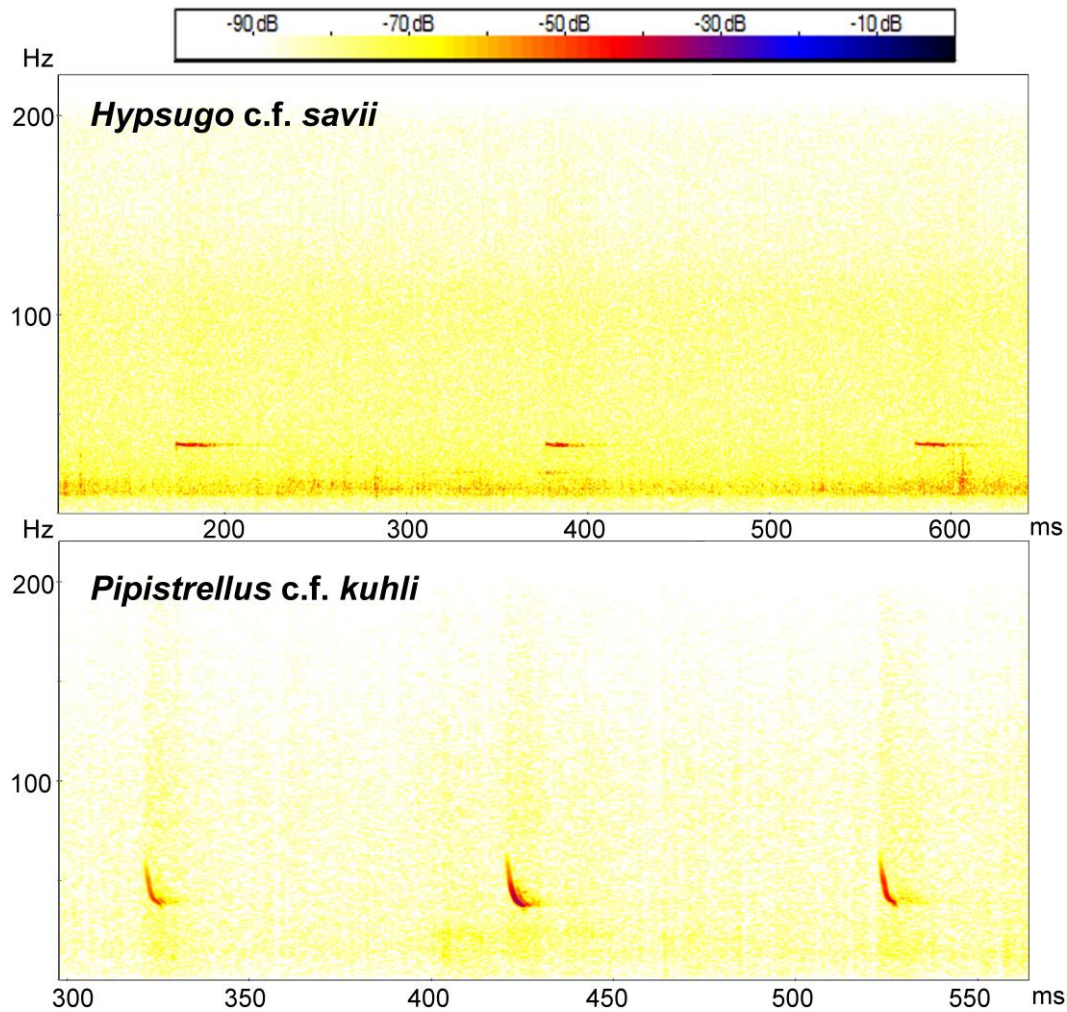


Fig 2. Examples of the recorded sonograms for each species (*Pipistrellus c.f. kuhli* on top and *Hypsugo c.f. savii* below). Six records were made for the first species and eight for the second and are available in Figshare ([10.6084/m9.figshare.6269582](https://doi.org/10.6084/m9.figshare.6269582)).

EMBALLONURIDAE

Taphozous nudiventris Cretzschmar, 1826.

Distribution: Santiago and Maio Islands; 6 specimens on MNHNP and no sonograms available (Table 1):

MNHNP 1983-2229, male collected in 1969 on Santiago, farm near Trindade

MNHNP 1986-375, unknown sex, collected in 1965 on Maio, unknown locality

MNHNP 1986-376, female collected in 1965 on Maio, unknown locality

MNHNP 1986-377, female collected in 1968 on Santiago, Pedra Badejo

MNHNP 1986-378, male collected in 1969 on Santiago, Pedra Badejo

MNHNP 1986-379, female collected in 1969 on Santiago, Pedra Badejo

Male collected in 2015 on Santiago, Santa Cruz beach and release at the site

VESPERTILIONIDAE

Hypsugo savii (Bonaparte, 1837)

Distribution: Santo Antão (cited in Masseti 2010 but not confirmed in the literature, possibly new record), São Vicente, São Nicolau (new record), Brava (new record) and Fogo Islands; 6 specimens on MCSNG, BMNH and MZS and 6 sonograms (Table 1):

MCSNG 47910a, male collected in 1898 on Fogo, São Filipe
 MCSNG 47910b, female collected in 1898 on Fogo, São Filipe
 BMNH 5.12.61, male collected in 1898 on Fogo, São Filipe
 BMNH 5.12.62, unknown sex, collected in 1898 on Fogo, São Filipe
 MZS 1399 male collected in 1909 on São Vicente, unknown locality
 MZS 12222, unknown sex, collected in 1984 on São Vicente, Monte Verde
 MNCN 1.097 female collected in unknown date on Fogo, unknown locality
 INBIO SN0013, 0014, 0017-0019, unknown sex, recorded in 2006 on São Nicolau, Ribeira Brava
 INBIO B0004, unknown sex, recorded in 2006 on Brava, Nova Sintra

Pipistrellus kuhlii Kuhl, 1819

Distribution: São Vicente, São Nicolau (new record), Santiago (new record) and Fogo (new record); 1 specimen at MZS and 8 sonograms (Table 1):
 MZS 10597, female collected in 1909 on São Vicente, unknown locality
 INBIO ST0003, unknown sex, recorded in 2007 on Santiago, São Jorge
 INBIO F0005 to 0009, unknown sex, recorded in 2007 on Fogo, São Filipe
 INBIO SN0012, 0015, 0016, unknown sex, recorded in 2006 on São Nicolau, Ribeira Brava

Plecotus austriacus (Fischer, 1829)

Distribution: Maio and Santiago; 1 specimen at MNHN and one observation record (Table 1):
 MNHN 1983-1467, unknown sex, collected in 1965 on Maio, Vila do Maio
 1 individual of unknown sex seen in 1965 at Santiago, Praia

Miniopterus schreibersii Kuhl, 1819

Distribution: Santo Antão; 2 specimens at MZS (Table 1):
 MZS 12221, female collected in 1984 on Santo Antão, Ribeira Grande
 MZS 12514, male collected in 1986 on Santo Antão, Paúl

MOLOSSIDAE

Distribution: Sal; no specimens, one observation record (Table 1), probably vagrant:

Indeterminate free-tailed bat, unknown sex, collected in 2014 on Sal, Ponta Preta and released at the site.

Eidolon helvum (Kerr, 1792)

Distribution: Boavista; no specimens, one observation record (Table 1), probably vagrant:
 Female collected in 2010 on Boavista, Ervatão beach and release at the site.

DISCUSSION

This study presents the first records of chiroptera for two of the islands of this archipelago (São Nicolau and Brava). Two bat species, identified as *Hypsugo* c.f. *savii* and *Pipistrellus* c.f. *kuhlii*, were also detected for the first time on three islands (on São Nicolau, Fogo, Brava, and possibly Santo Antão, and on São Nicolau, Fogo and Santiago, respectively). Based on the data gathered until now, the most widespread species in the

Cabo Verde Islands seem to be *Hypsugo* c.f. *savii*, with confirmed records in four out of 10 islands, comprising also the oldest records for the archipelago, dating from 1898 (Table 1). This species and *Pipistrellus* c.f. *kuhlii* are the only ones distributed both on the northern and southern islands of the archipelago; all the remaining taxa have records only on one or at most two islands of Cabo Verde (Fig. 1).

The known distributions of bats in Cabo

Verde show a highly scattered pattern. A recent colonisation, passive transport of individuals brought by boats or storms and/or poor sampling effort have been proposed as plausible explanations. Some authors state that the origin of chiroptera in Cabo Verde is recent, and so most species did not had enough time to colonise other islands, and that occasionally individuals might involuntarily reach different islands of the archipelago due to boat traffic (Chevalier 1935, Pucetti & Zava 1988). In fact, the migratory *E. helvum* is a common and widespread in countries adjacent to Cabo Verde, such as Guinea-Bissau and Senegal, with single individuals being recently found in the Canary Islands (Jiménez & Hazevoet 2010) and Cabo Verde, Boavista (Hazevoet 2014).

Poor sampling effort may be also undermining current knowledge on bat distributions. In fact, each new observation indicates a new chiroptera taxon or a new island of occurrence, what clearly indicates that bats have been continuously neglected in biodiversity surveys, maybe a consequence of their low detectability and difficulty in species identification. Therefore, it is essential to perform further extensive sampling in Cabo Verde to thwart this knowledge gap.

It is import to highlight that most of the known bat species for Cabo Verde are

identified as species related to the western Palearctic. At the time exploration missions in Cabo Verde were carried out, identifications of bat species were only based on morphological characters associated to European bats (ACR 2017). Bat colonization of Cabo Verde Islands can in fact be old, previous to the human occupation of the islands (from the 15th to the 17th century). Thus, it is possible that adaptation to the arid Cabo Verdean habitats could have led to speciation of native cryptic species or subspecies similarly to the Canary Islands due to the large distance from the African continent (Juste *et al.* 2004). In addition, some sub-Saharan species are recorded at the northern limit of their distribution, e.g. *Taphozous nudiventris* (Tranier & Naurois 1985). Only future studies including genetic analyses and detailed morphologic analyses of the voucher specimens (e.g. skulls and forearms) may confirm the previous morphological identification of these species. Hence, it would be very important to perform bat trapping to get tissue samples and to perform DNA analyses on the museum vouchers kept in alcohol (ongoing). Current taxonomy of some of these species is possibly outdated and uncertain classification of specimens was already recognised in Cabo Verde (Benda *et al.* 2004, Juste *et al.* 2004).

CONCLUDING REMARKS

Considering the undersampling of bats in Cabo Verde, it is highly likely that sound identifications will be useful in future taxonomic reassessments for some species. Knowledge presented in this study can be a valuable tool since new bat occurrence were identified in two islands using ultrasound recordings that will be made available on-line. These records can also provide a baseline to build from. So, even after taxonomic reviews

it will be easy to associate our records to possible new taxa, especially considering the low species richness of Cabo Verde. This study highlights the strong need for further studies on bats in Cabo Verde, both to increase knowledge on distributions, as well as to reassess their taxonomic status. It also highlights that most bats species are resident and hence should be included in conservation plans.

ACKNOWLEDGMENTS

I wish to thank to J. Harris, S. Rocha, M. Fonseca and A. Perera for help during fieldwork. RV was supported by a postdoctoral grant from the Fundação para a Ciência e Tecnologia (FCT) (SFRH/BPD/79913/2011) financed by POPH/FSE programme. I also would like to thank to R. Cooper-Bohannon for her review and constructive comments and to H. Rebelo for helping with the sound analyses and writing.

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Received 22 November 2017

Accepted 06 April 2018



Artigo original | Original article

A photographic record of the life history of *Chilades evorae* Libert, Baliteau & Baliteau, 2011 (Lepidoptera: Lycaenidae), endemic to the Cabo Verde Islands, with notes on ecology and distribution

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RESUMO

Das cerca de 25 espécies de borboletas que ocorrem no arquipélago de Cabo Verde, apenas uma é endêmica: *Chilades evorae* (Lycaenidae). A espécie foi incubada pelos autores e fotografias a cores dos estágios iniciais de desenvolvimento desta espécie são apresentadas pela primeira vez. As plantas-hospedeiras das ilhas de Santo Antão, São Vicente, Santa Luzia são também ilustradas em fotografias. A borboleta é reportada no ilhéu Raso pela primeira vez, conjuntamente com a presumível planta-hospedeira da mesma. Uma mosca taquinídea *Cadurciella* sp. é também reportada como parasita de *C. evorae*.

Palavras-chave: Macaronésia, borboleta, plantas-hospedeiras *Lotus*, mosca parasitóide, desenvolvimento larvar

ABSTRACT

Of the *circa* 25 species of butterfly species occurring in the Cabo Verde Archipelago, only one species is endemic: *Chilades evorae* (Lycaenidae). The species was reared by the authors and colour photographs of the early stages of this species are presented for the first time. The host-plants on the islands of Santo Antão, São Vicente, and Santa Luzia are illustrated with photographs. The butterfly is reported from Raso for the first time, together with a potential host-plant. A tachinid fly species *Cadurciella* sp. parasitising *C. evorae* is also reported.

Keywords: Macaronesia, butterfly, *Lotus* host-plants, parasitoid fly, larvae development

INTRODUCTION

Our previous investigations confirmed 26 butterfly species occurring on the Cape Verde Islands; although the status of two species: *Vanessa vulcania* and *Danaus plexippus*, is not clear (Tennent & Russell 2015). The only endemic butterfly species known from Cabo Verde, *Chilades evorae* Libert, Baliteau & Baliteau, 2011, was recorded and described from five male specimens and one female collected on Santo Antão in January 2009 (Libert *et al.* 2011).

It is interesting that only three species of butterfly have been recorded from Raso (*Danaus chrysippus*, *Vanessa cardui*, *Colias croceus*); the status of *Chilades evorae* is not known. As Tennent & Russell (2015) suggested, the dry conditions and associated differences in abundance of vegetation on Raso suggest that none are permanent residents there, but may expand their ranges temporarily when conditions are particularly favourable. The authors stayed on Raso for several days in 2013, but recorded no butterflies, due probably to the dryness of the season. However, in that same year, the authors discovered *C. evorae* on the neighbouring island of São Vicente (one adult specimen at *ca* 350m. on Monte Verde), and found it to be abundant on Santa Luzia between sea level and 200m (Tennent & Russell 2015).

Baliteau & Baliteau (2016) described and illustrated with fine line drawings the life history of *C. evorae*, demonstrated its myrmecophilous association and extended its distribution to Fogo based on their observation of a single larva at Fernão Gomes, at *circa* 1500-1600 m in the crater, among large numbers of *Leptotes pirithous* (Linnaeus, 1767) larvae feeding on a plant species, resembling *Lotus jacobaeus*. The fact that it was recorded for the first time from Fogo – a first record from the southern group of islands – suggests the butterfly is more widely distributed in Cabo Verde than was at first thought.

The conservation status of the species is unknown, both at national and international level, but authors refer it has common, indeed widespread and abundant on both Santo Antão and Santa Luzia (Tennent & Russell 2015, Baliteau & Baliteau 2016). It is unlikely to be under any immediate threat.

Further fieldwork was carried out in 2017, with the aim of photographing the species' life history. This would enable future researchers to more easily identify larvae of *C. evorae* in the field among those of other Lycaenids which utilise *Lotus* sp. as their hostplants. We also aimed to improve the knowledge of its ecology and distribution.

MATERIAL AND METHODS

On Santo Antão, on 8 July 2017, at *circa* 1100 m, the second author observed a female *C. evorae* ovipositing on the undersides of leaflets or on the stem close to leaflets of *Lotus* plants (Fabaceae). On close examination, two lycaenid larvae were found on the plant. These were placed in 59 x 38 x 27 mm plastic boxes and reared on return to the U.K. An angle poise lamp was placed above the pot containing the larvae to increase the temperature and thus their chances of pupating.

In a subsequent expedition to the Cabo Verde archipelago, eight larvae of *C. evorae* and a number of larvae of other polyommata lycaenids (*Lampides boeticus*, *Leptotes*

pirithous) were collected in various stages of development on the south side of the road between Lagoinha and Lagoa, Santo Antão at *circa* 1200 m, in mid-November 2017, and reared to adults.

A single Lycaenid butterfly was found and photographed on Raso in November 2017 by a member of the Cambridge University ornithological team (Brooke & Moss pers. comm.).

Lotus species were identified from descriptions and illustrations in Sandral *et al.* (2006); botanical nomenclature and island distributions of these species on Cabo Verde also follow those authors.

RESULTS

The life history of *C. evorae* and details on its ecology, including preferred host-plants, are illustrated in Fig. 1 (A–N).

Observations on oviposition and early stages, July/August 2017: The female observed laying eggs (Fig. 1A) in July used *Lotus latifolius* as host-plant (Fig. 1B), a species endemic to the higher reaches of Santo Antão (Sandral *et al.* 2006; Fig. 1 I). Young larvae were blue-green in colour, with a slightly darker dorsal median stripe and *circa* 1.5–2.0 mm in length (Fig. 1B & C). They fed on the upper leaflet surface, leaving small but obvious ‘windows’ in the leaves (Fig. 1B). By 10 July, the larger larvae had skin-changed and begun feeding again (Fig. 1C). The final instar larvae had a dark dorsal stripe (Fig. 1D) and yellowish lateral lines (Fig. 1E); it had finished feeding by 19 July; whilst the smaller one still appeared to be feeding. The first larva failed to pupate successfully. Following an induced change in temperature conditions of the rearing boxes, a larva (Fig. 1K and L) pupated and a male butterfly successfully emerged in August. The first author observed that although fresh *Lotus*

flowers were provided, none was eaten by either larva, whereas larvae of *Lampides boeticus* (Linnaeus, 1767) and *Leptotes pirithous* (Linnaeus, 1767), taken during the expedition from similar *Lotus* plants, devoured the flowers and not the leaves.

Observations on early stages, November 2017: as noted previously, females oviposited on the leaflets or stems but not on the flowers or calyx and larvae only consumed the leaves of their host-plant, leaving the flowers untouched. All eight larvae pupated successfully, the slightly hairy pupa was mottled brown with paler wing cases and a series of white spots representing the spiracles (Fig. 1F) becoming progressively darker, and almost black just prior to the emergence of the adult. Six adults emerged, the other two larvae had been parasitised by a parasitoid fly (Fig. 2), identified as *Cadurciella* sp. (Tachinidae).

The butterfly photographed on Raso (Fig. 3) was identified by the authors as *C. evorae*. The only known potential host-plant for this species seen on Raso was *Lotus purpureus* (Fig. 1M and N).

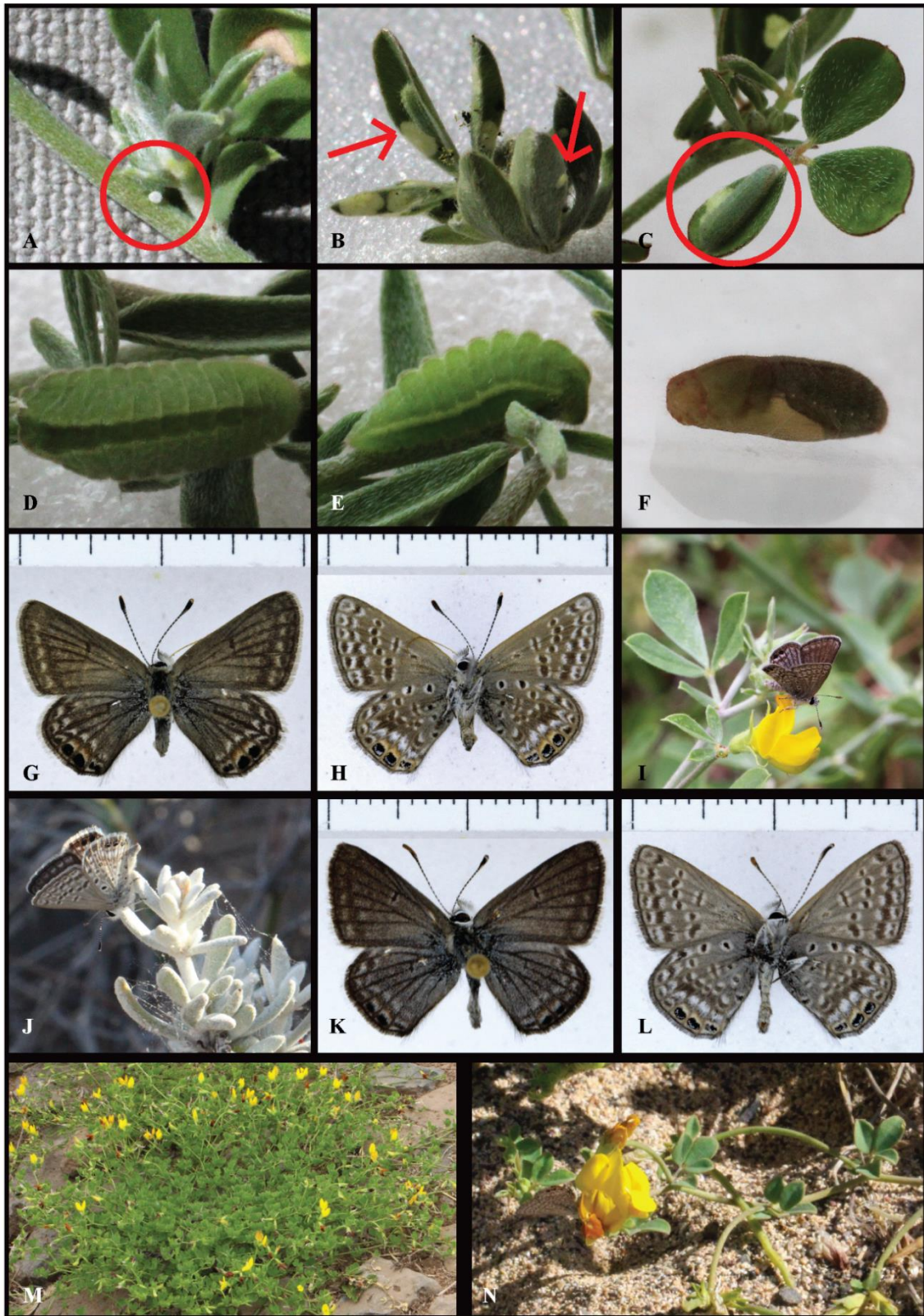


Fig. 1. Details of the life history of *Chilades evorae* (photographs by John Tennent). **A)** ovum on a leaf and stem of the host-plant *Lotus latifolius*, 8 July 2017, about 500 m, north of Selada do Alto Mira, Santo Antão, Cabo Verde; **B)** ‘windows’ in the leaflets of *L. latifolius* created by the larva, 8 July 2017 (an ovum can be seen on the edge of the underside of a leaflet to the right hand side of the larva); **C)** larva feeding on a leaflet of the host-plant, 11 July 2017; **D)** final instar larva dorsal and **E)** lateral views, 13 July 2017; **F)** pupa, lateral view, 20 November 2017; **G)** upper and **H)** underside of a female (ex larva 13 November 2017, emerged 23 November 2017), about 1050 m in Selada de Alto Mira, Santo Antão;

I) live females resting on the host-plant *L. latifolius*, Lagoa, 1200m, Santo Antão, 13 November 2017, and **J)** nectaring on *Polycarpaea nivea*, Santa Luzia, 18 November 2013; **K)** upper and **L)** underside of a male (ex larva 13 November 2017, emerged 24 November 2017), about 1200 m, Lagoinha, Santo Antão; **M)** the host-plant *Lotus purpureus* on Monte Verde, 350m, São Vicente, 7 July 2017 and **N)** in beachside scrub, Santa Luzia, 18 November 2013, illustrating the typical three rounded leaflets at the end of the rachis and the yellow flowers shading to orange with age.



Fig. 2. Tachinid fly parasitoid of *Chilades evorae* butterfly. A) Its pupa case next to an empty *C. evorae* pupa, 23 November 2017; B) emerged fly, 30 November 2017.



Fig. 3. First record of *Chilades evorae* on Raso, 18 November 2017 (photo by Jason Moss).

DISCUSSION

Our observations suggest that *C. evorae* appears to have successfully evolved to avoid competition with the abundant and widely distributed *Lampides boeticus* (Linnaeus, 1767) and *Leptotes pirithous* (Linnaeus, 1767) by utilising the leaves of their host-plant, as opposed to the flowers and young seed pods, which are favoured by *L. boeticus* and *L. pirithous* (Lafranchis *et al.* 2015), both of which often occur in the same habitats as *C. evorae*. This observation is in direct contrast to those of Baliteau & Baliteau (2016), who suggested that both leaves and flowers were consumed by the larvae and that they would even agonistically expel *L. pirithous* in the latest stages of development. This may be the case if older larvae are under stress, for instance in the absence of sufficient leaflets; however, our reared larvae were supplied frequently with fresh leaflets and continued to ignore flowers. *Chilades evorae* larvae were never observed eating flowers in their natural habitat, a fact that enables a clear distinction to be made in the field between larvae of this species and those of the other Lycaenids. Although young larvae were well camouflaged whilst resting on the upper leaf surface, the windows in adjacent leaves often

indicated the presence of a nearby larva.

The fact that *C. evorae* occurs on São Vicente, Santa Luzia (Tennent & Russell 2015), and (possibly only sporadically, under favourable conditions) on Raso, indicates that the butterfly uses *Lotus purpureus* as a host-plant, which it may well also utilise at lower levels on Santo Antão, where *L. latifolius* (endemic at moderate to high altitudes) is absent. As we have said previously (Tennent & Russell, 2015), there is sufficient *Lotus* host-plant on Raso to support *C. evorae* when conditions are favourable, although it seems probable that long term persistence of the species is unlikely, for reasons not yet understood. The presence of this butterfly on Raso suggests it is likely to be also present on São Nicolau, only some 16 km to the east of Raso, which is approximately the same distance southeast of Santa Luzia. Further sampling effort is needed to fully understand the distribution and abundance of this species.

Discovery of Tachinidae (Diptera) parasitising *C. evorae* is unsurprising. Shaw *et al.* (2009) recorded tachinids as common parasitoids of Lepidoptera larvae and Baliteau & Baliteau (2016) recorded those as parasites of *C. evorae*.

CONCLUDING REMARKS

Our successful efforts to discover new distribution data and aspects of the life history of the only endemic butterfly known from Cabo Verde highlighted the interesting fact that *C. evorae* is able to avoid direct competition with a number of common, widespread and successful Lycaenid species by utilizing a different part of the host-plant. At the times and in the seasons we visited Cabo Verde, we noted that *Lotus* species were common and widespread on almost all

islands, providing ideal circumstances for the long-term success of *C. evorae*. However, the conservation status of this endemic butterfly has not as yet been evaluated fully and thus we recommend that further studies are made. Although it may be sporadic on Raso and liable to extinction by volcanic activity on Fogo, due to its abundance on both Santo Antão and Santa Luzia, we consider that *C. evorae* is not threatened.

ACKNOWLEDGEMENTS

The authors are grateful to Jason Moss for showing us his photographs of *C. evorae* taken on Raso, and to Mike Brooke for information from unpublished reports. We are also grateful to Mark Shaw, David Horsfield and Peter Tschorsnig for examining the tachinid fly and providing us with a genus name. We also thank Raquel Vasconcelos for drawing our attention to the publication of Baliteau & Baliteau (2016).

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Received 07 June 2018

Accepted 14 July 2018



Nota breve | Short note

Stranding and sighting records of Gervais' beaked whale in Cabo Verde

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Keywords: Atlantic Ocean, cetacean, Macaronesia, *Mesoplodon europaeus*, Ziphiidae

Gervais' beaked whale *Mesoplodon europaeus* (Gervais, 1855) is restricted to the Atlantic Ocean. Although most records are from the North Atlantic, it is probably continuously distributed in deep warm waters around the equator (Mead 1989, Norman & Mead 2001). Its occurrence in West Africa is poorly known, as records are rare. It is classified as Data Deficient (Taylor *et al.* 2008). There were 303 strandings worldwide, involving 326 whales (Koenen *et al.* 2013, Bachara & Norman 2014). Like most other members of the genus, most of our knowledge comes from stranded animals. Stranding hotspots are in the USA and the Canary Islands (MacLeod 2000, Bachara & Norman 2014, V. Martin pers. comm.). There were several recent strandings in the Caribbean and Central America, including first records for Costa

Rica, Montserrat, and Saint Lucia (W. Bachara unpub. data). Regarding sightings in West Africa, on 10 September 2012 a group of three Gervais' beaked whales were reported 300 miles west of Casablanca (Smithsonian 2007).

In Cabo Verde four beaked whales were seen off southern Sal Island on 11 February 2010, another four (including one calf) near Praia, Santiago Island, on 8 September 2014, and a single individual north of Santa Maria Islet on 12 October 2017 (Hazevoet *et al.* 2010, Berrow *et al.* 2015, Ryan & Greenfelder 2017). All were tentatively identified as *Mesoplodon cf. europaeus*. Here we present some unpublished records to improve our knowledge on the distribution of this elusive species in Cabo Verde.

On 15 May 2013 and 26 August 2016 decomposed *Mesoplodon europaeus* were found stranded on Maio Island (Koenen *et al.* 2013), and on 1 October 2017, 19 February 2018, and 5 May 2019, a male, a female, and a male together with a female were found dead on Santiago, Boavista and Maio islands,

respectively (Table 1). On 26 September 2017, an individual of unknown sex stranded alive on Boavista Island, was refloated and pushed out to sea by locals, but its fate is unknown. On 21 January 2017, a group of three individuals were seen 240 miles southwest of Brava Island (Fig. 1).

Table 1. Details of the strandings of *Mesoplodon europaeus* in Cabo Verde. Asterisk (*) stands for estimated total length.

Date	Island	Locality	Sex	Total length (m)
15/05/2013	Maio	Calheta de Baixo	Male	3.80 *
26/08/2016	Maio	Praia de Ribeira Funda, Ribeira D. João	Unknown	2.84
26/09/2017	Boavista	Praia de Varandinha	Unknown	-
01/10/2017	Santiago	Farol de leste, Praia de São Francisco	Male	-
19/02/2018	Boavista	Santa Mónica	Female	4.65
05/05/2018	Maio	Praia de Santana	Male	3.90
05/05/2018	Maio	Praia de Santana	Female	4.60



Fig. 1. Three Gervais' beaked whales seen off Brava Island on 21 January 2017 (photo by G. Mucientes Sandoval).

This is the first confirmed sighting of the species in offshore waters of Cabo Verde. All individuals were identified as Gervais' beaked whales, based on the small-sized forehead, which is defined posteriorly by the indentation at the blowhole and a melon which merges seamlessly to the narrow, moderate length

rostrum (Smithsonian 2007). This short note reports on sightings and strandings of the very poorly known Gervais' beaked whale, and suggests that Cabo Verde may provide important habitats for the species in the North Atlantic.

ACKNOWLEDGEMENTS

Many thanks to G. M. Sandoval and K. Yeoman for the photos of the species and to V. Martin who kindly confirmed identification of all strandings. We would also like to thank C. Ryan and S. Norman for helpful comments, to the FMB local team (particularly L. Passos, A. Ramos, G. Monteiro, E. Reis), M. Gomes from 'Agência Marítima e Portuária' and J. Maria from 'Direcção Nacional da Economia Marítima'.

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Received 28 May 2018

Accepted 27 June 2018

**SOCIEDADE
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- c) publicação em papel e divulgação de material técnico-científicos relacionado com a História Natural de Cabo Verde em forma de panfletos, livros, actas, listas bibliográficas, entre outros;
- d) promoção da investigação científica em Cabo Verde através da atribuição de bolsas de estudo e apoio logístico;
- e) organização de encontros científicos (ex: palestras, fóruns, ateliers, congressos) em Cabo Verde dentro das temáticas da Sociedade;
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The **Zoological Society of Cabo Verde**, a scientific, non-governmental, non-partisan and non-profit organization, sets itself as a goal to promote zoological research and science communication in the broadest sense in the Cabo Verde Islands. This mission is accomplished by:

- a) publishing a bi-annual peer-review scientific journal, available online and freely accessible, *Zoologia Caboverdiana*, with periodical articles and special publications;
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- c) publishing in print and disseminating technical-scientific materials related to the Natural History of Cabo Verde in the form of leaflets, books, minutes, bibliographical lists, and others;
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- e) organizing scientific meetings (e.g. lectures, forums, workshops, congresses) in Cabo Verde within the purposes of the Society;
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ZOOLOGIA CABOVERDIANA

Volume 7 | Número 1 | Julho de 2018

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Espécimen de *Hypsugo* (Chiroptera) detectado em São Nicolau, Cabo Verde, pela primeira vez
Hypsugo specimen (Chiroptera) detected on São Nicolau, Cabo Verde, for the first time
(fotografia de | photo by: Raquel Vasconcelos)

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