First records of *Philanthus triangulum* (Fabricius, 1775) for Fuerteventura (Spain) and further data on the distribution and phenology of *Colletes perezi* Morice, 1904 recently recorded on the island (Hymenoptera, Aculeata)

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Zusammenfassung

Bernhard Jacobi, Daniel Suárez: Erstnachweise von *Philanthus triangulum* (Fabricius, 1775) für Fuerteventura (Spanien) und weitere Daten zur Verbreitung und Phänologie von der vor kurzem nachgewiesenen Seidenbiene *Colletes perezi* Morica, 1904 (Hymenoptera, Aculeata). Bezug nehmend auf frühere Arbeiten beider Autoren über Hymenopterenfunde auf den östlichen Kanarischen Inseln, Lanzarote und Fuerteventura (Jacobi 2013; Suárez 2017), werden weitere Daten zu *Colletes perezi* und der Erstnachweis von *Philanthus triangulum* für Fuerteventura mitgeteilt.

Summary

Referring to earlier works of both authors on recent additions to the Hymenoptera of the eastern Canaries, Lanzarote and Fuerteventura (Jacobi, 2013; Suárez, 2017), additional data on *Colletes perezi* and the first records of *Philanthus triangulum* for Fuerteventura are communicated.

Resumen

Refiriéndose a trabajos previos de ambos autores sobre adiciones a los himenópteros de las Canarias orientales, Lanzarote y Fuerteventura (Jacobi, 2013; Suárez, 2017) se comunican datos adicionales sobre *Colletes perezi* y los primeros registros de *Philanthus triangulum* para Fuerteventura.

Introduction

Colonization of volcanic islands from a neighbouring continent is an intriguing phenomenon, as it is dependent on distance to the mainland, oceanic currents and prevailing winds as well as the surface and age of the island.

Fuerteventura as an island above sea level has a long history of nearly 21 million years.

During that time it has been subjected to geological (volcanism, sedimentation, erosion) and climatic forces as well as sea level changes. Accompanying changes of flora and fauna are partly documented by fossils.

Lastly the settlement of the island by man, who brought goats which became feral, had a great and lasting impact on the vegetation and fauna of the island. The most recent episode of changes has been brought about by the development of tourism.

As the conditions on islands never stay the same for very long, there is a continual change in the composition of flora and fauna, either from natural causes or from human activity or a combination of both. Discovering previously unrecorded species and trying to reconstruct their origins is especially interesting in this context.

Data were collected independently by both authors during their respective stays on the island.

Discussion 1

Phenology of *Philanthus triangulum* on Fuerteventura

As observed on Lanzarote previously by Jacobi (in: Jacobi et al. 2013), *P. triangulum* obviously is nesting in mid-winter in Fuerteventura, too, judging from the observed prey-searching behaviour and prey capture

Tab. 1: Results *Philanthus triangulum* (DS = Daniel Suárez, BJ = Bernhard Jacobi; * = photos taken)

rec. no.	locality/coordinates	date	rec. by	n/sex	*Apis* obs..	behaviour
1	Caleta de Fuste 28°23'56.43"N 13°52'35.87"W	06.08.2017	DS	1?*	+	resting on *Yucca* sp.
2	Betancuria 28°25'27.79"N 14°3'25.53"W	31.12.2017	BJ	1♀* Fig. 1	+	capturing *Apis* worker
3	Las Playitas 28°13'33.25"N 13°59'25.62"W	04.01.2017	BJ	1♀* Fig. 2	+	inspecting *Tecoma* sp. flowers

followed by aerial transport of an *Apis* worker (rec. 2). This agrees well with the average rainfall maximum on Fuerteventura as well as with the peak activity of *P. triangulum* on the islands of Gran Canaria and Tenerife (loc. cit.).

Fig. 1: *Philanthus triangulum* ♀ with captured and paralyzed *Apis mellifera* worker about to air-shuttle prey to her nest. Betancuria, 31.12.2017 (photo: B. Jacobi).

Fig. 2: *Philanthus triangulum* ♀ resting on *Tecoma* leaves at Las Playitas, 04.01.2018 (photo: B. Jacobi).

Habitat requirements of *Philanthus triangulum*

As observed on Lanzarote previously by Jacobi (in: Jacobi et al. 2013), *P. triangulum* obviously is nesting in mid-winter in Fuerteventura, too, judging from the observed prey-searching behaviour and prey capture followed by aerial transport of an *Apis* worker (rec. 2). This agrees well with the average rainfall maximum on Fuerteventura as well as with the peak activity of *P. triangulum* on the islands of Gran Canaria and Tenerife (loc.cit.).

Where did the Fuerteventuran *Philanthus triangulum* come from?

As the *P. triangulum* individuals recorded on Fuerteventura clearly belong to the north African subspecies *P. t. abdelcader* Lepeletier, 1845, two provenances seem possible, each supported by one of the temporarily prevailing atmospheric currents locally:

- riding the northeast trade winds (locally: alisio) from southern Lanzarote (Jacobi et al. 2013)
- riding the eastern dust-storms from the Sahara (locally: calima) from the west coast of Northern Africa (Southern Morocco or West-Sahara)

Discussion 2

Phenology of Colletes perezi on Fuerteventura compared to Cretan and North African populations

Apparently *C. perezi* is active in autumn only on Crete and seems to be strictly coastal (Frommer & Kuhlmann 2009, Devalez pers. comm.), while it is active nearly year-round in Northern Africa and distributed inland as well as on coasts (distributional map on discover life). From Fuerteventura (Suárez 2017, this work) activity has been recorded the following months: August, December and January so far.

Habitat requirements of *Colletes perezi* (Cp)

On Fuerteventura *C. perezi* so far has mostly been found at barranco mouths on the east coast, the typical vegetation of which is dominated (originally) by stands of *Tamarix canariensis* (tarajales). At least one inland site with *T. canariensis* and possibly other potential pollen sources has been colonised by *C. perezi* , too.
The very light soils at the barranco mouths were found to be silty-sandy and strongly salt influenced. The vegetation was dominated by halophytes like *Zygophyllum fontanesii, Salsola vermiculata* and *Suaeda sp*. Only

Tab. 2: Results *Colletes perezi* (DS = Daniel Suárez, BJ = Bernhard Jacobi; * = photos taken, # = specimen taken)

rec. no.	locality/coordinates	date	rec. by	n/sex	behaviour
1	Giniginamar 28°12'4.88"N 14° 4'33.61"W	27.12.2017	BJ	1♂* Fig. 3	mate-searching and nectaring on *Zygophyllum fontanesii*
2	Barranco de Esquinzo, 28°37'0.62"N 13°59'26.37"W	28.12.2017	DS	1♂# 2♀	visiting flowers of *Tamarix canariensis*
3	Gran Tarajal 28°12'51.36"N 14° 0'59.15"W	05.01.2018	BJ	2♀* Fig. 4	visiting flowers of *Zygophyllum fontanesii*

the former was in flower already and hence visited by both sexes of *C. perezi*. *Tamarix* was present, too, but found flowering further south only (rec. 2).
Frommer (in Frommer & Kuhlmann 1993) observed *C. perezi* collecting pollen from *Tamarix smyrnensis* and *Ceratonia siliqua* (Carob-Tree)
Devalez (in lit.) observed: „*Colletes perezi* collects pollen from *Tamarix* sp. and *Schinus terebinthifolius* [...]. I saw them in very large numbers on both plants flowering in October."

Fig. 3: *Colletes perezi* ♂ preening on *Zygophyllum fontanesii*. Giniginamar, 27.12.2017 (photo: B. Jacobi).

Fig. 4: *Colletes perezi* ♀ on *Zygophyllum fontanesii*. Gran Tarajal, 05.01.2018 (photo: B. Jacobi).

Has *C. perezi* been previously overlooked on Fuerteventura?

Suárez (2017) suggested a recent colonisation of Fuerteventura by *C. perezi* (Hypothesis 1 in this paper), given the rather large sampling effort invested by previous workers (Hohman et al. 1993).
Two arguments could be mounted to favour the opposite, though.
Firstly, the ecological niche of a coastal *Colletes* species should has been available at any time in the past million years.

As the increasing water use along with prolonged droughts and habitat destruction by development at barranco mouths has substantially decreased suitable habitat in the last decades, it would seem odd that *C. perezi* should not have colonized Fuerteventura in the past. However, past conditions rather should have been more favourable. The town of Gran Tarajal for example was named after the extensive stands of *Tamarix canariensis* of which only few are left today. The barranco mouths on the Fuerteventuran east coast are lined up from NE to SW parallel to the prevailing direction of the seasonally blowing northeast trade winds. So once one barranco mouth had been colonised successfully, the neighbouring one to the southwest (only a few km distant, separated by a rocky promontory only), is expected to have become settled, too, as a matter of years rather than decades through the supporting alisio winds.
Given the presumably continuous presence of *C. perezi* on the shores of southern Morocco (we could not trace records from West-Sahara) it would be very surprising indeed, had the species not reached the east coast of Fuerteventura long before and more or less frequently ever since! Has the species simply been overlooked, thus? (Hypothesis 2 in this paper)

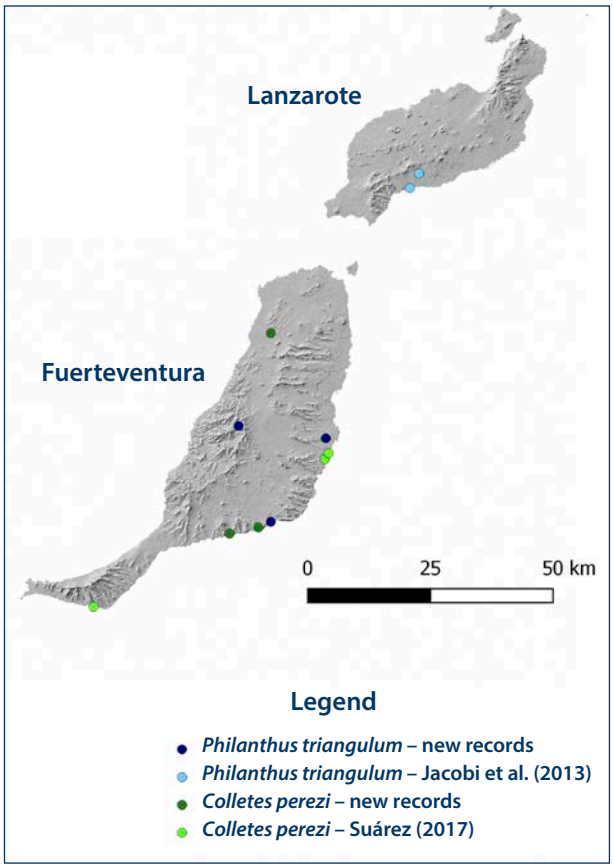

Fig. 5: Map of Lanzarote and Fuerteventura with record locations (GRAFCAN 2018 Infraestructuras de Datos Espaciales de Canarias).

As a third hypothesis, repeated colonisation (Hypothesis 3 in this paper) of Fuerteventura by *C. perezi* seems imaginable. Prolonged droughts could have wiped out small populations, but as soon as conditions improved, recolonisation from the mainland populations is expected to have been immediate (on geologic time scale).

Will adaptation change the Fuerteventura *Colletes perezi* populations in future?

Given the closeness of the African mainland, the yearly chances of African *C. perezi* individuals being blown over to Fuerteventura, it seems plausible not to expect much adaptation of the Fuerteventura populations of *C. perezi*. Rather the probable more ore less frequent influx of genes from the north African mainland population(s) would insure a unidirectional gene-flow, which would inhibit species formation.

Will *C. perezi* also be found on Lanzarote?

Lanzarote does not have sandy beaches of any extent on its east coast. There are very few barrancos carved into the extensive malpaís formations close to the coast. Additionally, given the recent volcanism on Lanzarote compared to Fuerteventura, there is a dearth of fine-grained nesting substrates suitable for *C. perezi*. As on Fuerteventura, spots more appealing to tourists have been built up with accommodation (like in Costa Teguise).

Still the possibility exists that *C. perezi* could be found in a very few locations.

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