



NEW FIELD DATA FOR OLD MUSEUM SPECIMENS: A PECULIAR CRICKET (GRYLLOIDEA, ORTHOPTERA) FROM SW SPAIN

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ABSTRACT

We obtained the first records of *Sciobia (Thilptoblemus) natalia* in Europe after a single record from Algeciras (Spain), about one century ago. We found the species in Tarifa, Benelup-Casas Viejas and Alcalá de los Gazules (Cádiz province) in plots with open land and herbaceous vegetation of wasteland, cattle states, edges of agricultural land, and hedgerows of pathways and local roads. The species may be common locally, in late spring. It may coexist with *Sciobia (Thilptoblemus) caliendrum* although the later presents a wider ecological spectrum whereas *S. (T.) natalia* prefers dense vegetation in more humid soils. Acoustic analyses indicate that the song of both species are very different, making field identification feasible. *S. (T.) natalia* may however easily go unnoticed among populations of the more conspicuous *S. (T.) caliendrum*. We discuss possible reasons why this species has gone unnoticed so far and factors that may pose at risk the maintenance of its populations.

Key words: *Sciobia natalia*; *S. caliendrum*; Coexistence; European distribution; Oscilogram; Sonogram.

RESUMEN

Nuevos datos de campo para viejos especímenes de museo: Un grillo (Grylloidea, Orthoptera) peculiar del SO-España

Obtenemos las primeras observaciones de *Sciobia (Thilptoblemus) natalia* en Europa después de un único registro de Algeciras hace casi un siglo. Hemos encontrado la especie en Tarifa, Benalup-Casas Viejas y Alcalá de los Gazules (provincia de Cádiz) en terrenos abiertos con vegetación herbácea de baldíos, fincas ganaderas y bordes de parcelas agrícolas, caminos y carreteras. Puede ser localmente común a finales de primavera y coexistir con *Sciobia (Thilptoblemus) caliendrum*, especie de más amplio espectro ecológico mientras que *S. (T.) natalia* muestra preferencia por vegetación más densa en suelos más húmedos. El análisis del canto de ambas especies muestra notables diferencias y su identificación en el campo es posible, aunque *S. (T.) natalia* puede pasar desapercibida entre poblaciones de la especie más conspicua, *S. (T.) caliendrum*. Discutimos las razones por las que la especie ha pasado desapercibida hasta ahora y los factores que pueden poner en riesgo el mantenimiento de sus poblaciones.

Palabras clave: *Sciobia natalia*; *S. caliendrum*; Coexistencia; Distribución europea; Oscilograma; Sonograma.

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Introduction

The South Western Mediterranean is an extraordinary area of diversification of plants and animals with confluence of species or populations with similar habitats on both sides of the Ibero-Maghrebian region. The connexion of both continents in Late Miocene (Messinian stage: 7,2-5,3 MYa) increased dispersion and the diversification and vicariance phenomena of the biota in a complex scenario while climate changes also multiplied ecological successions (Blondel & Aronson, 1999) and biodiversity (Sanmartín, 2003; Hidalgo-Galiana & Ribera, 2011). This area forms part of one of the main hot spots of biodiversity of the planet (Myers *et al.*, 2000). The Mediterranean biomes are among the most threatened regions in the world and predictions point to consider the Western Mediterranean as especially vulnerable to biodiversity loss due to drastic changes in human land use and global climate change (Giorgi & Lionello, 2008; Klausmeyer & Shaw, 2009).

Among the extraordinary biodiversity of this region, a good example of North African influence in SW Europe is the presence of singular cricket species of the genus *Sciobia* Burmeister, 1838. This genus constitutes a peculiar group of cricket taxa that originated and radiated from North of Africa, some of which colonised SW Europe. There are 37 *Sciobia* species described to date (Eades *et al.*, 2016) four of which occur in the Iberian Peninsula (see reviews in Gorochoy & Llorente, 2001; Barranco & Aguirre-Segura, 2013). Two species of *Sciobia*, subgenus *Thliptoblemus*, inhabit a relatively small piece of land in Europe, in the SW of the Iberian Peninsula. These two species are easily recognized by sight and morphology (i.e. Barranco & Aguirre-Segura, 2013). The least known European species is *Sciobia* (*Thliptoblemus*) *barbara* Saussure, 1877, now *Sciobia* (*Thliptoblemus*) *natalia* Gorochoy, 1985. It is common in Morocco (see review in Chopard, 1943), however, we know virtually nothing about its biology and current European distribution. In fact, the only report to date for Europe (SW Spain) comes from the naturalist M.M. Escalera (1867-1949). He collected one male and one female from Algeciras (Cádiz, province) and donated the specimens to the Museum of Entomology of Madrid (now Museo Nacional de Ciencias Naturales, MNCN). Up to now, all bibliographic literature mentioning the species in Europe (Spain) have Escalera's specimens from Algeciras as the only reference, either as *S. (T.) barbara* (Bolívar, 1925; Bolívar, 1927; Harz, 1969) or as *S. (T.) natalia* (Gorochoy & Llorente, 2001; Barranco & Aguirre-Segura, 2013). Although, specimen labels have no date of capture, we can estimate roughly the date of Escalera donation occurring between 1914 and 1925. Bolívar (1914)

(216p.) did not mention *S. (T.) barbara* for Spain in his "*Dermaptera and Orthopterans of Morocco*" which he did for other Moroccan species also present in Spain. However, he mentioned it in his paper on "*Contribution to the knowledge of Sciobidae*" (Bolívar, 1925) (431p.).

In this paper, we report the presence of *S. (T.) natalia* for Cádiz province and bring information useful for a better understanding of the distribution and biology of the European meta-population of this intriguing species. These data are crucial for its better conservation. To attain this, we performed several field campaigns in Cádiz and surrounding provinces in search of the species and collected information on its distribution, adding notes on its habitats, phenology and behaviour. We also include comparative analyses of the songs of *S. (T.) natalia* and its co-distributed species, *S. (T.) caliendrum*

Material and methods

During the course of our research projects on fragmentation of small populations of orthopterans, we followed methods used in previous works emphasizing on field collecting data to track rare species of crickets (Cordero *et al.*, 2007; Cordero & Llorente, 2008). We prospected potential areas in Cádiz and surrounding provinces during different seasons and years, searching for crickets on the ground, under stones, or by detecting their specific song in the field. Field campaigns took place several days in July 2006, August and October 2012; May and June 2014, and May 2015. We only found the species on May and June. When hearing *Sciobidae* species, we used car transects in rural pathways and secondary roads to detect singing plots along hedgerows and edges of open fields on May (2014, 2015) and June (2014). Once detected a *Sciobia* (*T.*) singing plot, we examined the area in search of the species, whenever conditions were feasible, to increase the prospected territory. We did not attempt to obtain the full current distribution of *Sciobia* (*T.*) *natalia*, but to reveal its current presence in the study area at as many plots as possible. We analysed male songs of *Sciobia* (*T.*) *natalia* and *Sciobia* (*T.*) *caliendrum* in the lab. Recording was under identical conditions for both species, at 21 °C temperature and in the same hour and day in order to compare oscilograms and sonograms. We used a digital audio recorder Tascam HD-P2, with a K6-M66 Sennheiser microphone and followed the methods described elsewhere (Cordero *et al.*, 2009). We also captured some females to obtain data on breeding under lab conditions. We maintained one female alive in 2014 and 2 in 2015, at room temperature and natural light regime with limited sun exposure to prevent excess of temperature. We kept individuals in plastic boxes for domestic pets with a 2-3 cm depth of soil mix containing 75%

of commercial peat for flowering plants and 25% of sand, or just with soil directly from the area of capture (Almodovar reservoir). We maintained individuals alive in the lab, recording dates of hatching of nymphs and adult deaths.

Results

CAPTURE POINTS, GPS DATA, DATES AND SPECIMENS

Specimens collected are similar to those of Escalera (Algeciras) (Fig. 1a, b) although the largest out of four males presents the facial protuberance that Gorochoy & Llorente (2001) mentioned for *S. (T.) natalia* from Morocco. The study of the taxonomic status of this population will be published somewhere else. We list below plots with detected presence of *S. (T.) natalia*. Data points are represented in Fig. 2

- (1) 36°9'32.07"N, 5°38'20.87"W (UTM: 30S 262594, 4004801). May-31st-2014; May-25th-2015. Almodovar's Reservoir, Facinas, Tarifa (Cádiz province, Spain). 2♂♂, 2♀♀ and 1♀ respectively.

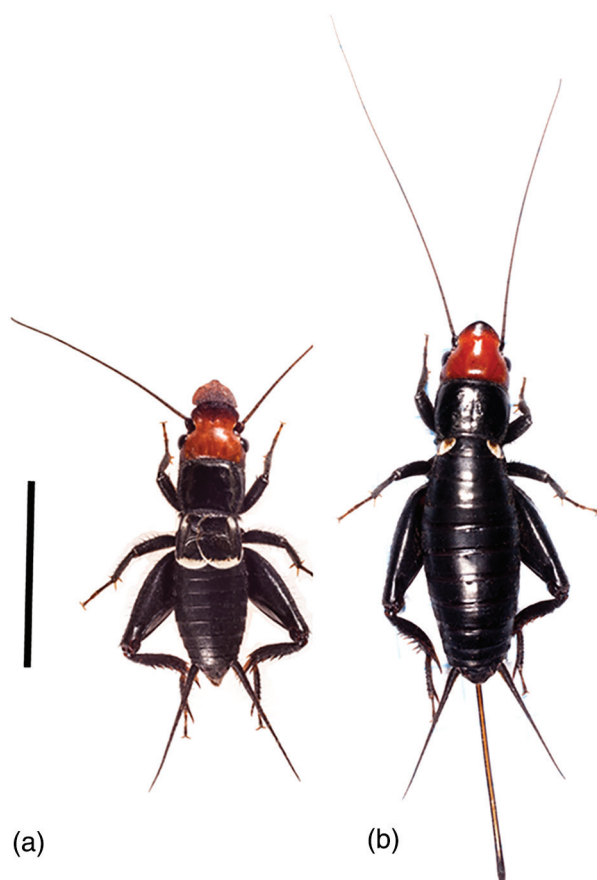


Fig. 1.— Adult male (a) and female (b) *Sciobia (T.) natalia* from Cádiz province. Scale, 1 cm. Photograph PJC.

Fig. 1.— Adultos macho (a) y hembra (b) de *Sciobia (T.) natalia* de la provincia de Cádiz. Escala, 1 cm. Fotografía PJC.

- (2) 36°21'56.99"N, 5°44'14.32"W (UTM: 30S 254409, 4028006). May-26th-2015. Barbate's Reservoir, Benalup-Casas Viejas (Cádiz province, Spain): 2♂♂.
- (3) 36°10'51.86"N, 5°48'20.38"W (UTM: 30S 247681, 4007681). May-31st-2014. Sides of the A-2227 road (Zahara de los Atunes- E5 road), Tarifa (Cádiz province, Spain): 2♂♂ and 1♀.
- (4) 36°32'41.9"N, 05°46'27.5"W (UTM: 30S 251661 4047978). June-14th-2014. Road hedgerows of the CA-5200, close to Ballesteros stream, Alcalá de los Gazules (Cádiz province, Spain): Sight without capture.

HABITAT, ECOLOGY AND BEHAVIOUR OBSERVATIONS

The species is local and occasionally abundant in open pasture meadows and road or pathways hedgerows during the maximum vegetative growth of herbaceous plants in May and June (Fig. 3). Adults are very active during the day, singing in choruses and moving around in a similar way that the codistributed *S. (T.) caliendrum* (Fischer, 1853) does, probably coinciding with courtship period. *Sciobia (T.) natalia* inhabits clay and loamy soils that crack when dried, allowing abundant underground refuges, although they also occupy temporary refuges under stones. They occur in non-cultivated fields and meadows, particularly in the proximities of water reservoirs, in open land of cattle states with several grasses and other herbaceous plants like *Daucus*, *Cynara*, *Malva* or the predominant *Scolymus hispanicus* scattered with small patches of bare ground i.e., typical cattle grazing land. We found it at the edges of the fields, and open hedgerows probably because of minor influence of cattle and more dense herbaceous vegetation. In three of the four localities mentioned (points 1, 2, and 4), *S. (T.) natalia* coexisted with the more abundant, widespread and conspicuous *S. (T.) caliendrum*, a species that presents a relatively wider distribution and ecological spectrum, occupying more diverse and drier plots, including those with scarce vegetation in mountainous areas of Sierra de Grazalema (data for this species not shown). The highest concentration of *S. (T.) natalia* occurred in point 3, on May 31st, 2014. Density was around 0.25 individuals per square meter in a humid hedgerow plot (225×15 m) of bare ground and dense tall grasses (*Avena*, *Brachypodium*, *Polypogon*) influenced by the "Pozo del Gallego" stream that crosses it in the lower side of the plot. This is the only plot in which *S. (T.) caliendrum* did not co-occur with *S. (T.) natalia*. On June 14th 2014, vegetation at this point was drier and we did not detect any individual by direct recording. On May 26th 2015, horses grazed out, trampled the grass and eutrophicated the ground in this point; humidity was also lower than in previous year. We could not record any individual neither.

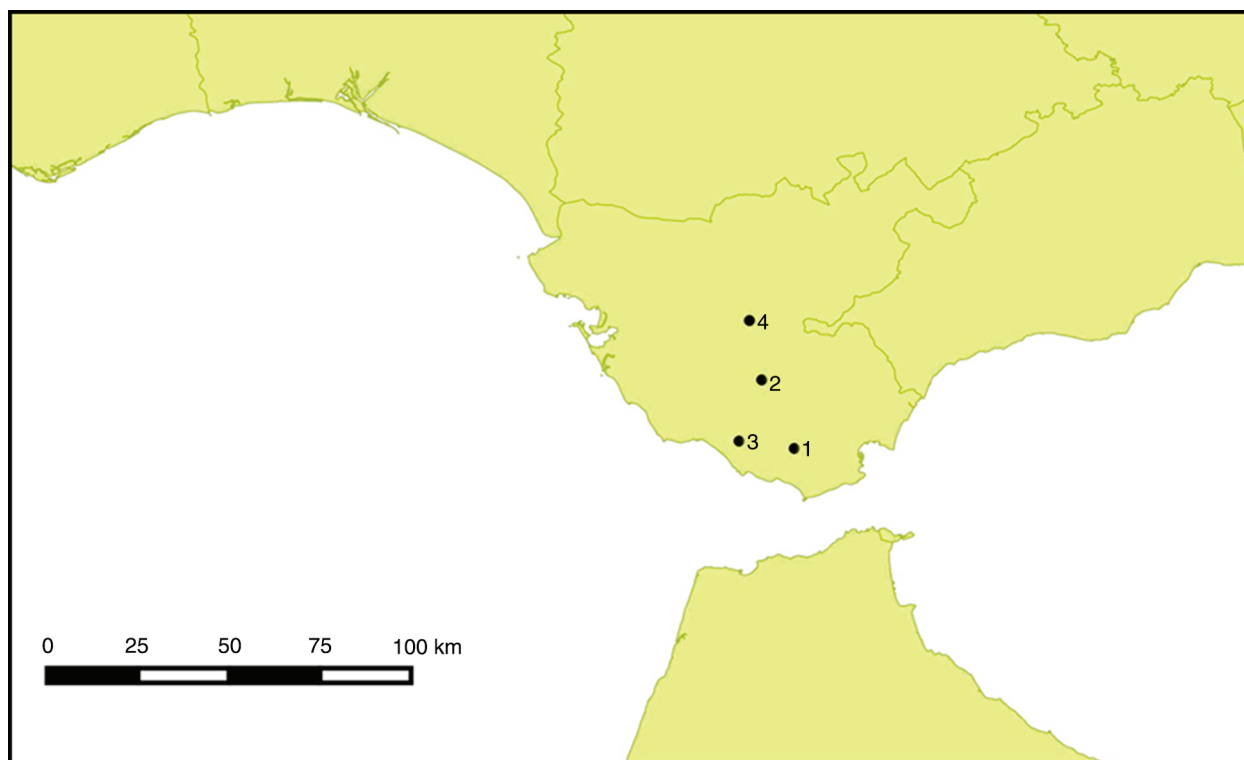


Fig. 2.— Map of *Sciobia (T.) natalia* recordings made with QGIS 2.10.1 Pisa. Numbers correspond to the four points described on the text.

Fig. 2.— Mapa de los registros de *Sciobia (T.) natalia* hecho con QGIS 2.10.1 Pisa. Los números corresponden a los cuatro puntos descritos en el texto.

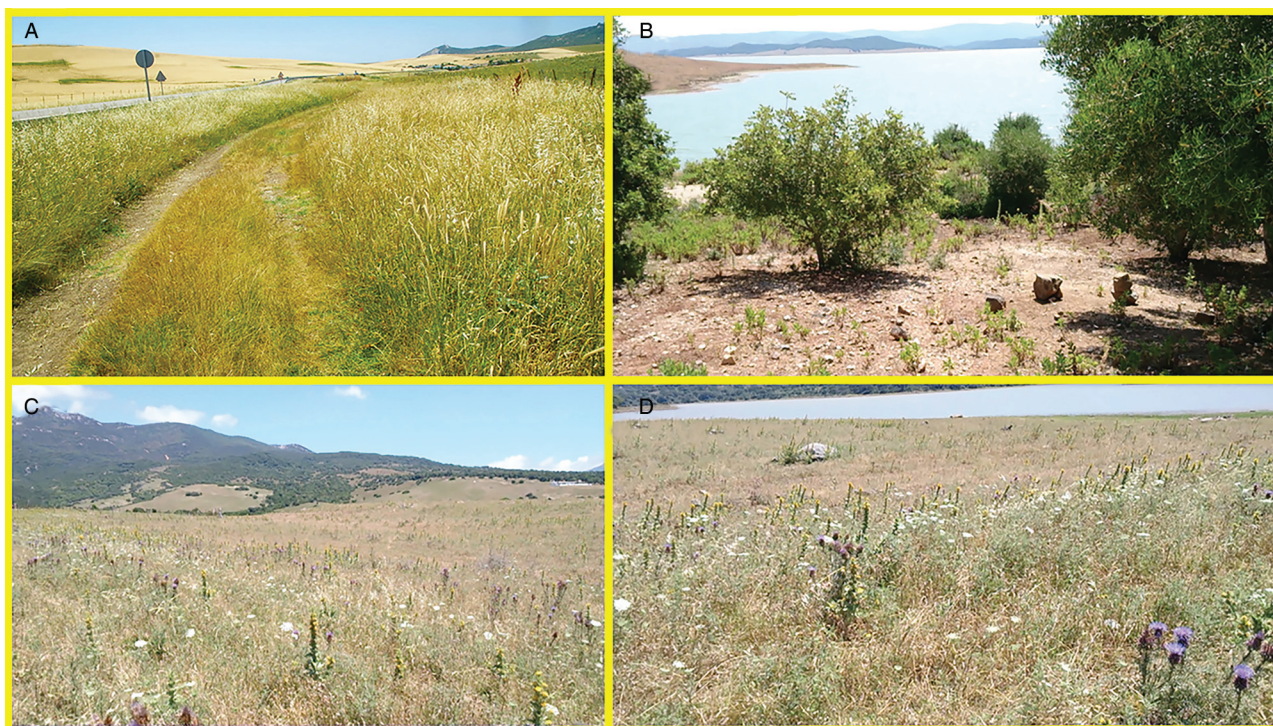


Fig. 3.— Habitats with presence of *Sciobia (T.) natalia* (A: point 3); *Sciobia (T.) caliendrum* (B: surroundings of point 2) and both species (C, D: point 1). Points as in Fig. 2. Photograph PJC.

Fig. 3.— Hábitats con presencia de *Sciobia (T.) natalia* (A: punto 3); *Sciobia (T.) caliendrum* (B: lugar próximo al punto 2) y de ambas especies (C, D: punto 1). Puntos como en la Fig. 2. Fotografía PJC.

In Almodovar and Barbate reservoirs (points 1 and 2), both species coexisted although *S. (T.) natalia* seemed to be more frequent than *S. (T.) caliendrum* in Almodovar (a plot of dense herbaceous vegetation, on May 2014). In Barbate's shores, we only found *S. (T.) natalia* in small plots of dense open herbaceous vegetation whereas *S. (T.) caliendrum* was extraordinary abundant (song choruses and direct observations) in neighbour large plots with sparse scrubs, trees and stony ground with more proportion of bare ground. For both reservoirs, May 2014 was better than May 2015 and June 2014 was negative for direct observations of *S. (T.) natalia*, but nor for *S. (T.) caliendrum*.

In point 4, *S. (T.) caliendrum* was predominant all around both in May 2014 and 2015, but we identified only one specimen of *S. (T.) natalia* on June 14th 2014. We recorded one male close to the edge of a state with abandoned and sparse olive trees with some scrubs and high herbaceous vegetation, mainly *Scolymus hispanicus*. The presence of sparse trees, high scrubs and herbaceous vegetation together with certain humidity due to the proximity of Ballesteros stream probably facilitated the presence of *S. (T.) natalia*.

Hatching in the lab occurred on some date of first half of July 2014 and on July 2nd and July 9th for the 2015 females. Adults died between mid-June and the end of July whereas nymphs overwintered, those of 2014 becoming adults on May 2015. Nymphs of *S. (T.) natalia* present the darkest colouration compared with the rest of other Iberian *Sciobia* nymphs species, changing to black jet, particularly on head and pronotum from November-December onwards (Fig 4). The species presents a univoltine reproductive cycle. Nymphs could spend between 8-9 months in subterranean galleries and crevices, so that the type

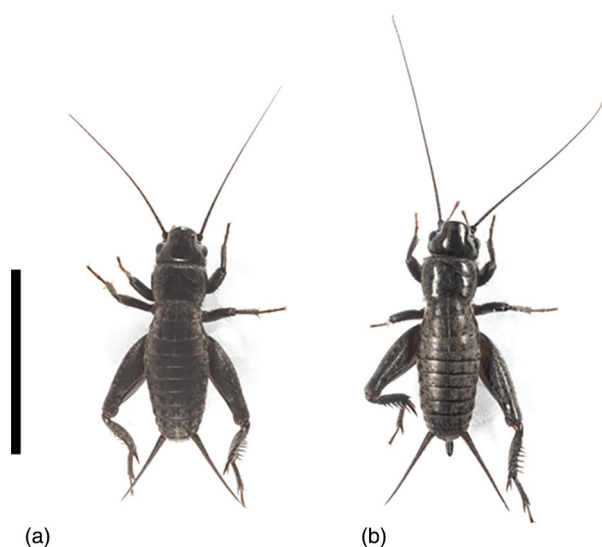


Fig. 4.— Male (a) and female (b) nymphs of *Sciobia (T.) natalia* during winter. Scale, 1 cm. Photograph PJC.

Fig. 4.— Ninfas macho (a) y hembra (b) de *Sciobia (T.) natalia* en invierno. Escala, 1 cm. Fotografía PJC.

and structure of the soil may be of great importance for the species. We could not find any nymph under stones in any other prospecting campaigns of July 2006, August 2012 or October 2012. Nymphs eventually could come up to surface by night or in periods of heavy rain as it may occur in other cricket species.

To the human ear, the song uttered by *S. (T.) natalia* can be distinguished from that of *S. (T.) caliendrum*. It is shorter, raspy, less intense and less musical than in *S. (T.) caliendrum*. In Fig. 5, we depict waveforms and spectrograms. *Sciobia (T.) caliendrum* shows a more continuous singing activity than *S. (T.) natalia*. Chirps are quite different between species. Chirps are 100ms in length with an uniform, low amplitude decay of 100-200 ms long (Fig. 5C) and are composed of 6-9 syllables of regular amplitude with the first to third increasing progressively and maintaining this maximum to the end (Fig. 3E). The syllable presents amplitude modulation (Fig. 5G) at 6 and 5 KHz respectively (Fig. 5I) related with a trill-type sound effect. On the contrary, *S. (T.) natalia* chirp is longer (250-350 ms) (Fig. 5D) with an average of 25 syllables per chirp

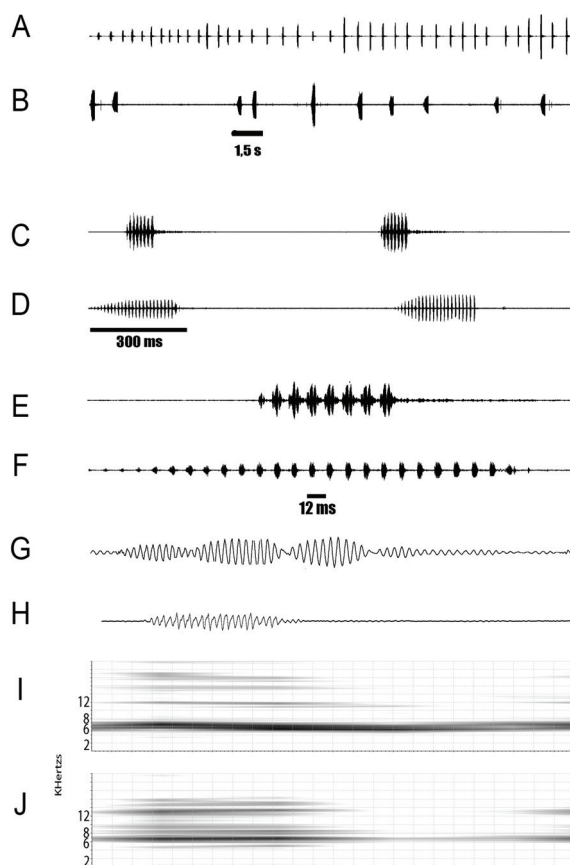


Fig. 5.— Oscilogramas (A-H) and espectrogramas (I-J) of *Sciobia (T.) caliendrum* (A, C, E, G, I) and *Sciobia (T.) natalia* (B, D, F, H, J). A, B, Cantos de 30s de duración; C, D, equemas; E, F, sílabas por equema; G, H, forma de onda de sílaba única.

Fig. 5.— Oscilogramas (A-H) y espectrogramas (I-J) de *Sciobia (T.) caliendrum* (A, C, E, G, I) y *Sciobia (T.) natalia* (B, D, F, H, J). A, B, Cantos de 30s de duración; C, D, equemas; E, F, sílabas por equema; G, H, forma de onda de sílaba única.

(range 23-28) and a progressive amplitude with sharp end (Fig. 5F). The syllable presents an only component at 7 KHz (Fig. 5H).

Discussion

Our observations suggest that *S. (T.) natalia* is not as rare as expected within the open landscape of part of Cádiz province. According to our observations, it prefers more dense vegetation as we did not find it in either drier or bare grounds where *S. (T.) caliendrum* may still be present. However, more intense study is necessary to attain a full picture of habitat variation for *S. (T.) natalia* and its full distribution in SW Spain.

WHY WE HAVE NO RECORDS OF *S. (T.) NATALIA* SINCE ESCALERA FOUND IT FROM ALGECIRAS?

Several factors may have contributed to this situation: (1) Factors related with the species specific behaviour and distribution. The distribution range of the species in the Iberian Peninsula, although still probably incomplete, is most likely very small. Further, its behaviour is cryptic, preferring dense herbaceous vegetation where individuals are more difficult to find. The species is probably active and visible only a few weeks in a year, spending most of the time in underground galleries and deep soil crevices, particularly in nymphal stages. According to our observations, it is probable that yearly climate fluctuations change population sizes or modify conspicuous behaviour, and thus the numbers of individuals detected in the field may change enormously year-to-year. (2) According to our field observations, we believe that an important reason for *S. (T.) natalia* going unnoticed is the coexistence in mosaic areas of appropriate microhabitats with *S. (T.) caliendrum*, a more conspicuous relative species. In the appropriate dates, *S. (T.) caliendrum* is extraordinary noisy and visible in areas where *S. (T.) natalia* can also be present. *Sciobia (T.) caliendrum* may be present at high densities in certain plots where choruses are heard everywhere with a louder and ubiquitous song, masking the presence of *S. (T.) natalia*, even if recognized by ear. Under the same situation, most of the visual contacts are for *S. (T.) caliendrum* that is easier to find in plots with bare ground or with short or sparse vegetation. A shallow evaluation probably result in *S. natalia* going unnoticed, which may be the case in some of the many areas in which we found *S. (T.) caliendrum*. (3) The lack of researchers devoted to studies of classical taxonomy, species discovery, descriptive work on faunistics of arthropods and prone to combine museum with field research. This is a serious problem for biodiversity assessment and respond to the low promotion value and poor funding of these kind of studies, particularly neglected for many decades (e.g. Wheeler *et al.*, 2004).

CONSERVATION CONCERNS

The crowd courtship of *Sciobia (T)* crickets, singing and moving in large numbers in certain plots of the Cádiz province, is an entomological phenomenon worth preserving for Europe. The limited extension of the distribution area of *S. (T.) natalia* and its dependence on anthropic habitats submitted to changes in land use may enhance hazardous threats for populations in small geographic areas. Unexpected changes in agricultural policy like over-increasing cattle density (as in other Spanish Regions); changes of land use for agriculture, a widespread misuse of pesticides or the introduction of harmful alien species for *Sciobiae*, are human-dependent factors that should be avoided. Stochastic factors like long and severe droughts or important flooding events may also influence populations negatively in a region particularly vulnerable to climate oscillations (e.g. Giorgi & Lionello, 2008). Conservation measures should include the knowledge of the existence of the species, the recognition of its habitats and the maintenance of traditional land uses.

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