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A NEW CRICKET (ORTHOPTERA, GRYLLIDAE) FOR CASTILLA-LA MANCHA AND THE IBERIAN PENINSULA

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ABSTRACT

We report *Tartarogryllus tartarus* (Saussure, 1874), a species with disjunct distribution in the Mediterranean-Turanean area, for the first time in the Iberian Peninsula. We summarize morphological charateristics for the species identification adding some new relevant traits to distinguish it from *Acheta domesticus* and *Eumodicogryllus bordigalensis*, particularly the interior tympanic opening that is shaped like a narrow slot whereas it is almost rounded in *Acheta* and *Eumodicogryllus.* We have found the species in cereal crops and vegetation around hiper-saline lagoons of arid lands (Castilla-La Mancha, Spain). Adult emergence occurs in May with maximum sexual activity at the end of this month and in June. We suspect that this species may be more widely distributed in other regions of the Iberian Peninsula with appropriate habitat.

Key words: *Tartarogryllus tartarus*, disjunct distribution, taxonomic studies, tympanic opening; hipersaline lagoons, arid land.

RESUMEN

Nuevo grillo (Orthoptera, Gryllidae) para Castilla-La Mancha y la península Ibérica

Encontramos por primera vez en la península Ibérica *Tartarogryllus tartarus* (Saussure, 1874), especie de distribución disjunta en el área Turano-Mediterránea. Resumimos los distintos caracteres morfológicos utilizados para identificar esta especie y añadimos algunos nuevos para distinguirla de especies similares como *Acheta domesticus* y *Eumodicogryllus bordigalensis*. Destacamos la apertura timpánica interior en forma de ranura estrecha y poco perceptible en esta especie mientras que es redondeada en *Acheta* y en *Eumodicogryllus*. Habita cultivos de cereal y vegetación en zonas áridas alrededor de lagunas hipersalinas (Castilla-La Mancha, España). Los adultos emergen a partir de mediados de mayo con máxima actividad reproductiva a finales de este mes y en junio. Sugerimos que la especie puede tener una distribución más amplia en la península Ibérica en aquellas regiones que presentan el hábitat adecuado.

Palabras clave: *Tartarogryllus tartarus*, distribución disjunta, taxonomía, abertura timpánica, lagunas hipersalinas, zonas áridas.

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Introduction

Tartarogryllus tartarus (Saussure, 1874) (*T.t*) was originally described from Turkestan (Fedchenko, 1874). Saussure (in Fedchenko, 1874) described the nominal species attending to a female specimen. Male and female were described by Chopard (1940, 1943), Harz (1969) and Gorochov (1979). Male genitalia is compared with similar species and depicted by Chopard (1943, 1961), Randell (1964) and Gorochov (1979). The species was used by Tarbinsky (1940) to erect the new genus *Tartarogryllus* separating it from other former *Gryllulus* species (Uvarov, 1933). Chopard (1961) included some species in the genus *Tartarogryllus* based on male genitalia and created the genus *Modicogryllus* from several species of the genus *Acheta*. However, it was Gorochov (1979) who found enough differences in the structure of male genitalia among *Tartarogryllus bordigalensis* and *T.t* leaving the former as *Modicogryllus bordigalensis* (now *Eumodicogryllus bordigalensis*) (Latreille, 1804) (according to Gorochov, 1986) (*E.b*) and *T.t* as it is now.

Tartarogryllus tartarus (Saussure, 1874)
- *Gryllus tartarus*, Saussure (in Fedchenko, 1874. *Voyage Turkestan, Orthopt*.: 4).
- *Gryllulus intermedius* Chopard, 1940. *Ann. Soc. Ent. Fr*. 109: 164.
- *Gryllulus intercalatus* Chopard, 1943. *Orthopt. Afr. du Nord*: 184.

Under the name of *T.t sensu lato*, there are two recognised subspecies attending to a light or dark general colouration: *Tartarogryllus tartarus tartarus* (Sauss.) that occurs in North Africa (Algeria) (Chopard, 1940, 1943); Temperate and Middle Asia: Iran (Chopard, 1959); Afghanistan (Chopard, 1960); Pakistan (Saaed *et al*., 2000); Greece mainland -Macedonia (Willemse, 1984); European Turkey, including Imroz I. - Gökçeada; Greek isles of Andikíthira, Evvia, Ionian, Samothráki, Northern Sporades and Thásos; South Russia and Ukraine (The Fauna Europaea Web Service, 2004). *Tartarogryllus tartarus obscurus* (Uvarov, 1921). *Obscurior* (Uvarov, 1934, nom. nov.) has been recorded from North-Eastern Caucasus, North of Iran and Iraq (Jezirah steppe) according to Uvarov (1921, 1934) and from Crimea, Nanitsch; Transkaukasien and Asia according to Harz (1969).Thus, like other species of insects of the Iberian Peninsula (e.g. Ribera & Blasco-Zumeta, 1998, Cordero *et al*., 2007), *T.t* presents a Mediterranean-Turanian disjunct distribution. However, up to now it has not yet been recorded from the Iberian Peninsula, in spite of the many studies carried out on *Gryllidae* in this region during the last century (Gorochov & Llorente, 2001).

General description

According to Chopard (1940, 1943), *T.t* has the general aspect of a small *Acheta domesticus* (*A.d*). It presents three transverse brownish-grey stripes: occipital, medial, between the eyes and a third at the extreme of the vertex. The clypeus is convex with suture clypeo-frontalis in sharp angle, almost reaching the anterior ocellus. Pronotum a bit wider than long, with anterior border concave, disc almost flat ornate with brown spots similar to *A. d.* Extremities yellowish, with brown spots; outer side of post-femur stripped with brown; tibiae with 6 spines at each side. Males with tegmen a bit shorter than abdomen ending in a rounded apex; mirror wider than long, usually rounded backwards and a little angular forwards, divided by a small transversal vein, curved a bit posteriorly in the middle; 3 obliques; apical field short, divided by almost square cells; lateral field with tightened veins; Sc simple. Wings are long, double the length of the tegmina. Tegmina of female not surpassing half the length of the abdomen, greyish with yellowish lateral field; veins of dorsal field tightened a bit oblique with transverse smaller veins forming narrow and lengthened areolas. Female wings are rudimentary in our population although the species has both brachypterous and macropterous forms. Harz (1969, page 676) also mentions some morphological characters such as a clear dorsal flattening of the head; the character sub-brachypter of males; the presence of two curved veins in the harp; female usually micropter and tegmen rounded in the apex. Head yellowish bright (*T. tartarus tartarus*) with three grey-brownish transversal bands. Head almost black in the dark form (*T. tartarus obscurior*) (Uv. 1920). For Gorochov (1979) some relevant external characters relative to the differentiation between the genus *Tartarogryllus* and *Modicogryllus* (particularly *E.b*) are: flattened vs spherical head; distance between the highest and most forward points of the head considerably greater than the distance between the later and the lowest point of the head vs almost equal distance; clypeo-frontalis suture erased throughout its extent between the antennae in *T.t* and sharply marked at least in *E. b*. Genitalia of *T.t* is quite different from any other possible confounding genus as *Acheta* or *E.b* (Chopard, 1961; Gorochov, 1979). According to the latter author, *T.t* has a small median process

Table 1.— Measures of *T.t* (mm) from this study and those recorded from literature. All metrics of Spanish sample and those of the MNCN were taken on dried specimens by PJC using a calibrated flexible ruler to the nearest 0.5 mm. Figures recorded at the point of maximum value obtained. Male 1 and Females 1 and 2 were measured after living in the laboratory between May and October.

Tabla 1.— Medidas de *T.t* (mm) de este estudio y de la literatura. Todas las mediciones realizadas sobre la muestra española y de los ejemplares del MNCN fueron tomadas sobre especímenes en seco por PJC usando una regla calibrada flexible con precisión de 0,5 mm. Las cifras corresponden a los puntos de máximos valores obtenidos sobre el carácter. El macho 1 y las hembras 1 y 2 fueron medidos después de permanecer en el laboratorio entre mayo y octubre.

Indiv	Locality	Collector/ Ref.	Date	Body-size	Head Length	Head Width	Pronotum Length	Pronotum Width	Tegmen	Hind Femur	Ovipositor
Female	Turkestan	Saussure, 1874	?	15	-	-	3.3	-	8.0	-	9.5
Male	North of Africa	Chopard, 1940, 1943	?	17.5	-	-	-	-	9.0	8.5	-
Female				16.0	-	-	-	-	6.0	9.5	-
Male	?	Harz, 1969	?	14-15	-	-	2.0-2.5	-	6.0-8.0	7.0-9.0	-
Female	?		?	15-16	-	-	2.3-2.8	-	4.0-6.0	7.5-8.5	9.0-10.0
Male	Gotvend, Iran	M. Escalera MNCN	1899	15	2.5	3.5	3.0	4.5	8.0	8.5	-
Female 1	Gotvend, Iran	M. Escalera MNCN	1899	15	3.0	4.0	3.0	4.5	6.0	9.5	9.0
Female 2	Gotvend, Chimb Iran	M. Escalera MNCN	1899	15.5	3.0	4.5	3.0	4.5	5.0	9.5	9.0
Female 3 (dark)	Gotvend, Iran	M. Escalera MNCN	1899	17.0	3.0	4.0	3.0	4.0	6.0	8.5	9.0
Female 4 (dark)	Gotvend, Bazouft Iran	M. Escalera MNCN	1899	18.5	3.0	4.5	3.0	4.5	5.0	9.5	8.5
Male	Villasequilla, Toledo	Jordi Iñiguez MNCN	2005 June 12th	16.0	2.5	3.5	3.0	4.5	8.0	9.0	-
Male 1	Alcázar de San Juan, Ciudad Real	P.J.Cordero & J.M.Aparicio	2005 May 11th	17.0	2.5	4.0	3.5	4.5	8.5	9.0	-
Male 2	Villacañas, Toledo	P.J.Cordero & J.M.Aparicio	2005 May 24th	15.5	3.0	4.0	3.5	4.5	9.0	9.0	-
Male 3	Villacañas, Toledo	P.J.Cordero & J.M.Aparicio	2006 May 17th	17.0	3.0	4.0	3.5	4.5	7.6	9.0	-
Female 1	Villacañas, Toledo	P.J.Cordero & J.M.Aparicio	2006 May 29th	18.5	3.0	4.0	3.5	4.5	-	9.5	8.5
Female 2	Villacañas, Toledo	P.J.Cordero & J.M.Aparicio	2006 June 7th	16.5	3.0	4.5	3.5	4.5	6.0	9.0	9.0

directed backwards on hind margin (considering backward and hind in relation to normal position of genitalia in body of cricket). In both *T.t* and *E.b* fore inner lobe of ectoparameres is fused with mesal lobe, but in *T. t*, this lobe is much wider and shorter than in *E.b*.

In this paper we provide additional morphological traits that are useful as external characters for a rapid diagnostic identification of similar related species and we record *T.t* for the first time in the Iberian Peninsula (Castilla-La Mancha, Spain) including some notes on ecology and behaviour of this relatively little known species.

Material and methods

The study area of captures and field observations comprises the localities of Villacañas, Villasequilla and Villafranca de los Caballeros from Toledo province; Alcázar de San Juan and Campo de Criptana from Ciudad Real. The climate is meso-Mediterranean with mean temperatures ranging from 24-26ºC in July to 4-6ºC in January and 300-400 mm of rainfall mainly concentrated in spring and autumn. The area comprises several hypersaline lagoons and temporarily flooded land (500-650 m above sea level) surrounded by extensively cultivated fields immediately close to the lagoons, mainly of barley (*Hordeum vulgare*), wheat (*Triticum* spp.) and vineyards (*Vitis vinifera*). Other habitats include scattered olive groves (*Olea europaea*), some recent pine plantations (*Pinus* spp.) and non-cultivated areas covered with pastures.

We base our study on:

(1) Captures: TOLEDO, Villacañas: 1♂, 2005/05/11; 1♂, 2006/05/17; 1♀, 2006/05/29; 1♀, 2006/06/7. CIUDAD REAL: Alcázar de San Juan, 1♂, 2005/05/11 (P.J. Cordero & J.M. Aparicio) (Table 1).

(2) Field and laboratory observations including phenology, general behaviour and ecology of the species. We collected field data between May 2005 and end of April 2007 (see Appendix 1).

(3) Comparison with museum specimens of *T.t* (Museo Nacional de Ciencias Naturales of Madrid, Spain (MNCN)). In the MNCN there are five specimens apparently of both forms (light and dark colour), all them from IRAN: Gotvend, Chim., 1♂ (Escalera leg.) (*Tartarogryllus tartarus*, Sauss. A. Gorochov det.), 2♀♀ (light coloured), 1♀ (dark coloured) with the same localitiy label; Bazouft, 1♀ (dark coloured) (Escalera leg.). According to the historical records of the MNCN, Escalera carried out his expedition to Iran (Gotvend) from April to August 1899. Another recent specimen from SPAIN: Toledo, Villasequilla, valle Arroyo Cedrón, 1♂, 12/06/2005 (J. Iñiguez, leg) (*Eumodicogryllus bordigalensis*) (Table 1).

(4) We revised specimens of the species *E.b*, *A. d* and *Acheta hispanicus*, Rambur, 1839 (*A.h*) from MNCN and Universidad Complutense de Madrid (UCM). We studied 60 males and 103 females *E.b* from MNCN and additionally 18 males and 18 females from the collection of UCM covering a total of 25 provinces of Spain and two from Portugal. Also, we studied 14 females and 10 males of *A.d* from 3 Spanish provinces and 18 males and 32 females of *A. h* from 11 provinces of continental Spain (Gorochov & Llorente, 2001).

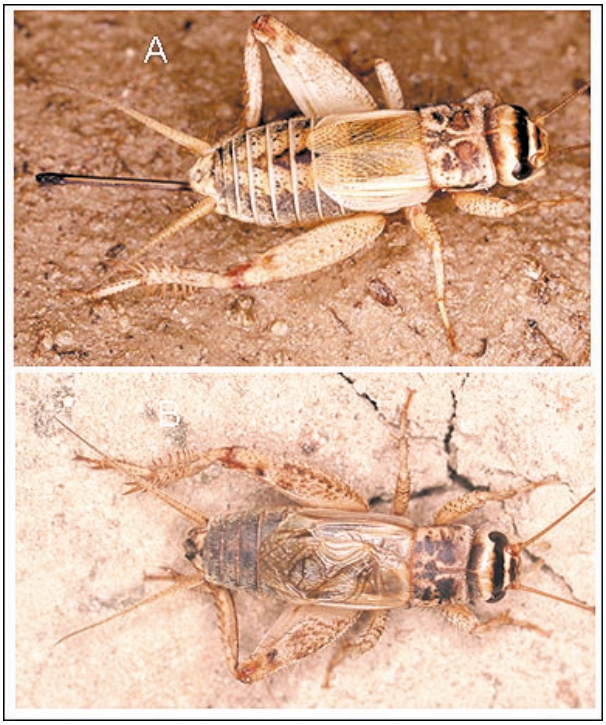

Fig. 1.— A) Female and B) Male *Tartarogryllus tartarus* from Villacañas, Toledo (Spain).

Fig. 1.— A) Hembra y B) Macho de *Tartarogryllus tartarus* de Villacañas, Toledo (España).

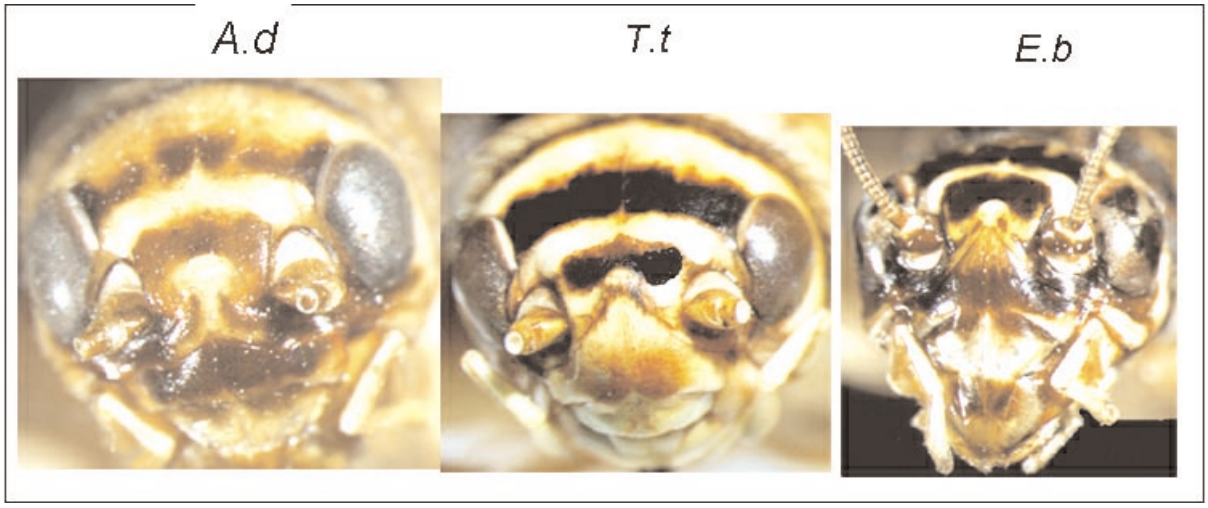

Fig. 2.— Frontal view of head of *A.d, Acheta domesticus*; *T.t, Tartarogryllus tartarus* and *E.b, Eumodicogryllus bordigalensis*.

Fig. 2.— Vista frontal de la cabeza de *A.d, Acheta domesticus*; *T.t, Tartarogryllus tartarus* y *E.b, Eumodicogryllus bordigalensis*.

Results

Measurements of all specimens of *T.t* collected, including those kept in the MNCN, and those given in the literature are summarized in Table 1. Field records are summarized in Appendix 1. In general, the description of the specimens collected or inspected by us in the field matched those identified by other authors. However, and contrary to Chopard (1943), we did not detect macropterous males among our material of study (Fig. 1).

Aside from the general coloration pattern, the short tegmina with apex rounded particularly in females and the two veins in the harp of males (Fig. 1), we sustain that *T.t* may be distinguished from *E.b* or *Acheta* species (e.g. *A.d; A.h*) easily and without dissection by the following traits.

(1) The suture clypeo-frontalis forms a long and elevated angle almost reaching the central ocellus. In *Acheta* species this angle is less elevated. In *E. b*, this angle is similar but the suture in *T.t* is fainter and loosely defined as already found by Gorochov (1979) (Fig. 2).
(2) The central ocellus is smaller in *T.t* than in *E. b*, the Iberian species most similar in relation to clypeum pattern (Fig. 2).
(3) The lateral field of tegmen shows veins that are mostly parallel following the upper border of the tegmen whereas they are not parallel in *E. b*. In *Acheta* veins follow a downwards oblique slope and ramifications from first upper vein are common (Fig. 3).
(4) The interior tympanic opening of the fore tibia is narrow, slot shaped, almost imperceptible and is hidden among the abundant bristles of this part of the tibiae. This is probably the most exclusive external characteristic of the species in our populations as this character is variable from St. Petersburg collection (A.V. Gorochov *in litt*.). In *E. b, A. d* and *A. h* this tympanic opening is almost rounded and conspicuous (Fig. 4).
(5) The relative length of cerci is greater in *T.t* than in *E. b* or *Acheta sp.* In females, it is almost the length of the ovipositor.
(6) Stridulation is more similar (to the human ear) to *Gryllus campestris*, Linnaeus, 1758, than to *E. b*, although it is more acute and of lesser intensity than that of *G. campestris* (Pollack, 2000; P.J. Cordero *et al*., in prep.).

Finally and consistently, male genitalia (two males, one from Alcázar de San Juan (Cr), and the other from Villacañas (To) are virtually identical to that given by Chopard (1961, Fig. 5 (*intercalatus*)) and Gorochov (1979, Fig. 13-14) quite different than those of *E. b* or *Acheta* species.

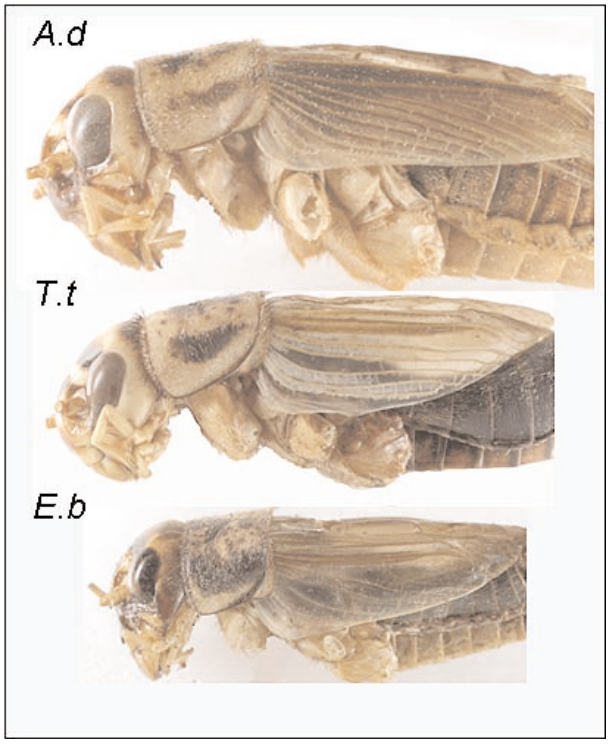

Fig. 3.— Lateral view of *A.d, Acheta domesticus*; *T.t, Tartarogryllus tartarus* and *E.b, Eumodicogryllus bordigalensis.*

Fig. 3.— Vista lateral de *A.d, Acheta domesticus*; *T.t, Tartarogryllus tartarus* y *E.b, Eumodicogryllus bordigalensis.*

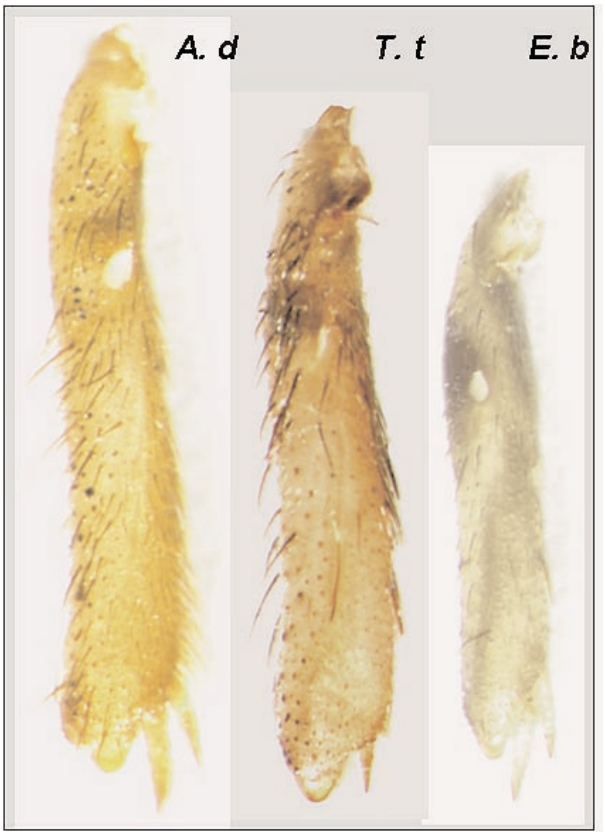

Fig. 4.— Fore tibia with interior tympanic opening of *A.d, Acheta domesticus*; *T.t, Tartarogryllus tartarus* and *E.b, Eumodicogryllus bordigalensis.*

Fig. 4.— Tibia anterior con la abertura timpánica interna de *A.d, Acheta domesticus*; *T.t, Tartarogryllus tartarus* y *E.b, Eumodicogryllus bordigalensis.*

Ecology and behaviour

Although new for the fauna of the Iberian Peninsula, *T.t* may be locally common inhabiting cereal crops (barley and wheat), mostly gypsophilous and particularly close to the margins of vegetation of hipersaline lagoons in arid land where they are also found hidden under stones or dry ground scratches. By stridulation, the species may be detected reaching densities of up to 0.1 male/m^2 in certain cereal crops near salty lagoons (Appendix 1). In fact, in the appropriate habitats it may be commonly heard between mid May and June declining its activity afterwards. The stridulation could be used as a relevant character for field differentiation from *E. b*, species with which it is often found in syntopy, both species stridulating at the same time and in the same microhabitat. *T.t* stridulates mostly during the day, but also frequently at dawn and the beginning of the night. *T.t* lives under stones and particularly between the cracks of the bare and dry ground amid cereal crops. It also forms round holes in dried muddy ploughed land although they do not seem to excavate cylindrical burrows like *G. campestris*. Once harvesting occurs, males can still be heard from their territories but their noisy activity declines to a certain extent although some males are heard up to the second half of September (see appendix 1).

Individuals captured in mid May, mated immediately and hatchlings emerged in the laboratory by the third week of August over-wintering as nymphs. This also occurs in the field as nymphs captured in February have the same size than those reared in the lab. However, some eggs do not hatch until late winter in the lab. This is revealed because asynchronous small nymphs (6 mm length) are

detected by late March coexisting with over-wintering nymphs (13-15 mm long). In captivity, they become adults in the second half of May and may live up to October.

Discussion

T.t is a locally common species in certain localities of Castilla-La Mancha and new for the catalogue of the Iberian fauna. The species inhabits cereal crops and vegetation around hipersaline lagoons in vast open dry lands. *T.t* may be considered another Iberian species with Mediterranean-Turanian disjunct distribution and thus it is expected to be found more widespread because the habitat where we record it in Castilla-La Mancha also occurs in other regions of the Iberian Peninsula (Ribera & Blasco-Zumeta, 1998; Cordero *et al*., 2007). However, the species has gone unnoticed altogether. One reason for this may be related to the progressive lack of interest or effort for taxonomic and faunistic studies, particularly on insects that are extraordinarily time consuming, receive poor funding and provide uncertain benefits of curricula for emerging field researchers (Hoagland, 1995; Wheeler *et al*., 2004). Furthermore, morphological keys and behavioural traits of the species are not very clear and description is associated with distant faunas (Chopard, 1940, 1943, 1961; Harz, 1969; Gorochov, 1979). Thus, it could have been undetected or confused with other similar species. To see this, we revised the MNCN and part of the UCM collections and among the 199 *E.b*, 24 *A.d* and 50 *A.h* there was no *T.t* misidentified. This suggests that it could probably be a matter of sampling bias of their preferred habitats rather than misidentification. Also, the species could be in recent expansion, which could be explained by the lack of old information in the areas prospected. In fact, *T.t* is found in villages where other species of *Gryllidae* have been reported in the past (Llorente & Gorochov, 2001).

Although male genitalia are important for identification, we believe that several external morphological traits are enough for unambiguous identification among other Iberian *Gryllidae*. Stridulation is vaguely similar to that of common species *G. campestris* but different to that of *E. b* species (e.g. Pollack, 2000) with whom it may coexist and stridulate simultaneously. *T.t* is similar in general aspect to *E.b*, though a bit larger and with a narrower ecological niche than *E.b*. Another similar species is *A.d* but this is slightly larger and it has never been found in the habitats prospected for *T.t.* Also, *T.t* has shorter tegmen with typical rounded apex.

Here, we also provide several new morphological traits to identify *T.t* like the small size of the central ocellus; the parallel disposition of the veins of the lateral field of tegmen and particularly the presence of a small interior tympanic slot, almost imperceptible in *T.t*, whereas it is well defined and rounded in *E. b,* and other Iberian species of the genus *Eumodicogryllus*, *Acheta*, *Gryllus* and *Melanogryllus*. However, and according to A.V. Gorchov (*in litt.*), a narrow tympanic opening is associated in *T.t* to brachypterous form. All these traits are helpful for an easy diagnostic of *T.t* in the field. The recognition of song is probably the easiest trait to record this species once it has been identified which would allow tracing its distribution map from ample geographic areas where it could be present. According to our data, we believe that *T.t*. could be more extended than hitherto found.

Our field and lab data suggest that *T.t* is a univoltine species, with a single breeding generation per year and with overwintering nymphs (field and lab) and spring asynchronic hatching (that is, overwintering eggs, at least in the lab). This is a phenomenon known from other *Gryllidae* species (Masaki & Walker, 1987) and it is probably related to differences between early (spring) and late (summer) ovipositions (e.g. Olvido *et al.,* 1998), perhaps favoured for longer life expectancy in the lab. *T.t* is also prolific in the lab: two pairs from June produced more than 500 hundred nymphs in a season.

In sum *T.t* is a new species for the Iberian fauna that probably has gone undetected by a combination of circumstances. Among these circumstances we should not forget the tendency of the species to select thermophilus habitats that could have been favoured by recent springs with higher temperatures that could result in a local proliferation and expansion of the species.

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Appendix 1.— Records for *Tartarogryllus tartarus*.

Apéndice 1.— Registros de *Tartarogryllus tartarus*.

CIUDAD REAL
Alcázar de San Juan:
2005/05/11: 1♂ (male 1 from Table 1);
2006/06/06:♂♂ frequent (stridulation in barley field);
2006/06/12: 0.1 ♂♂/m² (stridulation in just cut barley crop).
Campo de Criptana:
2006/06/06: ♂♂ frequent (stridulation in barley field);
2006/09/23: 1♂ (stridulation in abandoned barley field).

TOLEDO
Villacañas:
2005/05/24: 1♂; 1♀ nymph;
2005/06/14: 0.1 ♂♂/m² (stridulation field crops);
2005/06/15: ♂♂ frequent (stridulation) (including captured male 2 from Table 1);
2006/05/17: ♂♂ frequent (stridulation) (including captured male 3 from Table 1);
2006/05/29: 0.05 ♂♂/m² (stridulation in barley field), 1♀ (female 1 from Table 1);
2006/06/05: ♂♂, frequent (stridulation in the same wheat field than *E. b*);
2006/06/07: ♂♂ frequent (stridulation in wheat field) and 1♀ (female 2 from Table 1);
2007/02/27: 1♀ nymph;
2007/03/13: 1♀ and 1♂ nymphs.
Villafranca de los Caballeros:
2005/06/15: ♂♂ frequent (stridulation).