

THE SALTOPTERAN FAUNA OF PORTUGAL:  
NEW RECORDS AND BIOGEOGRAPHICAL ASPECTS  
(Orthopteroidea)

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INTRODUCTION

For the Iberian Peninsula, most faunistic studies of Saltatoria refer to Spanish populations. The orthopteroid fauna of Portugal is still poorly known. In the first half of the 20th century, De Seabra (1942) presented the first survey of the Portuguese Saltatoria, as well as a list of the literature then available, including a study of the orthopteran species of Setúbal Peninsula (Cordeiro 1914) and a list of the species kept at the museum of the University of Coimbra, with an identification key (Aires & Menano 1916). Ebner (1941) reported on 40 species found at Monchique.

Fernandes (1959a, 1959b, 1960) found some species new for the Portuguese fauna; since then, no intensive survey was carried out in Portugal. However, Harz published two valuable books entitled “The Orthoptera of Europe” (1969, 1975), in which the Orthopteroidea (Ensifera and Caelifera) of Portugal were related to the European fauna. Schmidt & Lilje (1997) reported on the distribution of the subfamily Oedipodinae in Europe and adjacent regions, discussing the origin of some species. Ragge & Reynolds (1998) added the male songs to the morphology and distribution of the western European species, as a further species-specific character, but without checking the Portuguese populations, except for *Callicrania selligera* (Charpentier), syn. *Platystolus* (*Neocallicrania*) *selliger* (Charpentier) (compare Pfau 1996). Furthermore, two short notes were recently published on grasshoppers found in the province of Baixo Alentejo by Gonzáles Garcia (1985) and Hochkirch (1999). Lock (1999) conducted a

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study over nine months (October-June 1996/97), near the southern coast, mainly in Parque Natural da Ria Formosa, and in parts of Serra da Estrela (BB+BA in fig. 1); twelve localities were visited in which 62 species were collected, and Miranda-Arabolaza & Barranco (2005) reported on 64 species found in NE of Portugal, near Rio Sabor (Trás-os-Montes and Alto Douro, TM in fig.1) during the years 1991-2000.

To our knowledge, to date no work has been compiled considering specially the saltatorian fauna of Portugal, in relation to neighbour regions, like Spain and North Africa. For Morocco, papers have been produced by Werner (1932), Chopard (1943), Louveaux & Ben Halima (1987). Our studies present a further contribution to this neglected subject.

#### GEOGRAPHY, CLIMATE AND VEGETATION OF PORTUGAL IN RELATION TO THE SALTATORIA FAUNA

Portugal covers about one fifth of the Iberian Peninsula and is limited to the West and South by the Atlantic Ocean. The coastline is high and rugged, however indented by bays and beaches. The northern and eastern regions of Portugal border the Central Iberian Plateau of Castilla, where powerful natural barriers, like mountain ranges, punctuate the surface and some river basins drain the arid countryside. The country is divided in eleven provinces (fig. 1A), the southern ones being mostly flat and the northern ones more mountainous, with heights of up to 2000 m a.s.l.

The climate of Portugal is strongly influenced by the Atlantic Ocean currents and by the prevailing westerly winds, that carry eastwards their warm moist effects resulting in moderate temperatures and rainfalls. Warmer and dryer airstreams occasionally blow from the Sahara and a general absence of cloud cover and rich insulation characterize the summer, while scattered mountain ranges influence the temperature, rainfall and humidity. Tab. 1 shows some climatic differences for coastal areas in the North and South of Portugal.

Surrounded by the Atlantic coast on two sides, most parts of Portugal have a maritime climate. The ocean effectively tempers the summer heat and winter cold, rainfall being abundant in the winter but scarce in the summer. This Atlantic influence extends northwards into Galicia and eastwards into Spain and covers most of the country. The climate of Algarve and Alentejo is influenced by mediterranean and African mild winters. Interactions among those factors result into an extraordinary diversified climate (fig. 1B).

Tab. 1 – Meteorological data for two localities in Portugal, after Hernández-Pacheco (1955).

| Place (City) | Region                  | Altitude<br>(in m) | Av. Annual<br>Rainfall<br>(in mm) | Av. January<br>Temperature<br>(in °C) | Av. August<br>Temperature<br>(in °C) | Total Av.<br>Annual Hrs<br>of Sun |
|--------------|-------------------------|--------------------|-----------------------------------|---------------------------------------|--------------------------------------|-----------------------------------|
| Oporto       | North Atlantic<br>Coast | 90                 | 1271                              | 08.5                                  | 19.4                                 | 2000                              |
| Faro         | Southwestern<br>Coast   | 10                 | 444                               | 11.5                                  | 23.1                                 | 2500                              |

In our work soil types were not considered in detail, since their importance is not decisive for the distribution of Orthopteroidea species *sensu* Kukulova-Peck (1991). It is sufficient to note that more mature and humus enriched soils are present in the centre and northern parts of Portugal, while south of the valley of the Tagus river soils are generally thin, with high Al contents and P deficient, prone to salinization and mostly inappropriate for agriculture. Soils of river basins are alluvial and fertile, while a mosaic of forest and mountainous soils have a low humic content and are prone to erosion. The vegetation is extremely important for the bioecology of orthopteroid insects, since it provides food and shelter and determines microclimatic conditions. Climate, vegetation, soil and orography result into an unusual rich mosaic of ecotones and consequently, partly due to edge effects, into the presence of a high number of saltop-teran species.

Portugal has a diversified flora and fauna containing elements from Palearctic, Mediterranean, Maghrebian and Ethiopian origin, as a result of its location, having formerly been the bridge that linked Europe and Africa. Furthermore, its isolation in the Upper Miocene was responsible for the development of an extraordinary number of autochthonous forms.

The original cover has been strongly modified by anthropogenic pressures, resulting in an impoverishment of the woody associations and transformation into more open and arid types of ecosystems. Such changes reflected in alterations of the available humidity, heat, wind and light, which favoured the development of bare ground, scrub and grassland orthopteroids, and impaired the diversification of their arboreal counterparts.

Regarding the study of orthopteroids, a subdivision of Portugal can be considered into two arbitrary phytogeographic regions: southern and northern (fig. 1C).

Provinces MH, DL, BL, and EX of the western Atlantic coast are

mostly forested, extending between Oporto and Lisbon, with some coastal slopes. The climate is mild, with heavy rainfall and high humidity persisting throughout the year, and having a potential climax vegetation of deciduous broad-leaved species such as oaks, alders, chestnuts and poplars; however pines, and particularly *Pinus pinaster* are now dominant throughout the region. Extensive fertile meadows, dominated by grasses and evergreen shrubs, occupy mainly the valleys. The peninsular conditions, typifying the entire region, are well represented in Galicia and tend to disappear southwards, towards the Douro valley.

In the southern coastal region, the provinces AG, BT and EX have a mild winter climate and hot summers, but still exhibit significant climatic and phytogeographic differences at local level. Cultivated citrus fruits, olives, figs, almonds, grapes, and vegetables, as well as exotic palms, are abundant.

To the eastern side of both regions, extensive mountain ranges and arid plains are distributed in the provinces of TM, BE and BB, up to Central and Meridional Spain and ranging the Mediterranean regions in AT and RB. For the Iberian Peninsula, further details are reported by Gangwere & Morales Agacino (1970).

#### MATERIAL AND METHODS

The work described was developed between 1992 and 2000, resulting from a collaboration established between the Department of Zoology-Entomology, University of Hannover, Germany, and DCEA/FCT, New University of Lisbon, Portugal. Extensive travelling took place in Portugal to collect Orthoptera in southern and northern regions in various seasons. In 1993 a group 18 persons mostly students, stayed near Lisbon (Sobreda: Quinta de São Pedro) for 14 days studying the insect fauna of various biotopes, mainly grasshoppers. During field trips, orthopteran species were located visually, as well as auditively and additionally a net was used to catch specimens. In areas with high vegetation, a net was dragged through the herbaceous layer and stones were over-turned; all orthopteran specimens found were recorded (rec.), collected (leg.) and registered. Most of the specimens sampled are kept in the collection of the first author.

Species were determined using the keys of Harz (1969, 1975) and other reference works, namely Pfau (1996) and Ragge & Reynolds (1998), as well as the orthopteran collection of the first author which is

now in the Zoological State Collection, Munich (ZSM) and of the Museo de Ciencias Naturales, Madrid, Spain.

For several of the species captured the songs of the males were recorded. The male specimens of *Ensifera* were placed inside a net of nylon-gauze with a diameter of 30 cm, and all song recordings were made under laboratory, or indoor conditions, with background noise reduced to a minimum. For the *Caelifera* specimens, the songs were recorded under natural conditions. Air temperatures were always measured, since their influence may be considerable. All recordings were made using an UHER 4000 report monitor tape recorder and UHER M 53 microphone, setting the tape speed to 19 cm/s. The microphone was placed on the ground at about 10-20 cm from the subject. The songs were analysed on a Dual-beam oscillograph, type 502, together with a special photcamera (Recordine). The film speed was 20 cm/sec in all cases. A filter of 1000 Hz was used to attenuate background noise. Song descriptions were based on the oscillograms. In some cases a computer TL-programme (Turbolab combined with Neurolab) was used partly with reduced type speed of 9,5 cm/s and a filter of 2000 Hz.

The terminology of Elsner (1974), Schmidt & Schach (1978), Heller (1988), and Ragge & Reynolds (1998) was followed: a calling song is a stridulation produced by an isolated male. A courtship song is produced when a male is sitting close to a female. A rivalry song is produced by two, or more males, reacting to each other. A chirp or echeme is a part of a song sequence separated by an interval, and consists of a variable number of syllables. A syllable is a sound produced by one complete movement of the elytra, or of the hind legs.

Whenever possible, the nymphs collected were reared to the adult stage to confirm the species' s identification.

## THE SPECIES RECORDED

### **TETTIGONIOIDEA PHANEROPTERIDAE**

#### ***Phaneroptera nana nana* Fieber, 1853**

MATERIAL EXAMINED. Leiria, Mata Nacional de Leiria, 18.08.1998, 1 ♀; Abrantes, 03.09.1998, 1 ♂, 2 ♀♀, 03.05.1998, 1 ♂, 27.07.1999, 1 ♀; Sesimbra, 16.10.1998, 1 ♂, 2 ♀♀;

Vila Real: Serra do Alvão, 800 m a.s.l., 15.-23.08.2000, 2♂♂, as nymphs (all leg. A.P. Martinho); Serra do Alvão, 800 m a.s.l., 04.09.2000, 1♀ (leg. G.H. Schmidt).

The species was found throughout the Mediterranean region (Cebada & Novoa 1983; Pinedo & Llorente 1987; Schmidt 1989, 1996a; Pardo et al. 1993), known from Portugal by Lock (1999) at Ria Formosa and Miranda-Arabolaza & Barranco (2005) for NE of Portugal.

### **Tylopsis lilifolia** (Fabricius, 1793)

MATERIAL EXAMINED. Montemor-o-Novo, 25.04.1992, 1♀, as nymph (leg. G.H. Schmidt).

Widespread and common in the Mediterranean region and North Africa (Schmidt 1989, 1996a); known from Spain, but not mentioned for Portugal (Herrera 1982).

### **Odontura (Odontura) spinulicauda** Rambur, 1839

MATERIAL EXAMINED. Montemor-o-Novo, 25.04.1992, 1♂, 1♀ (leg. G.H. Schmidt).

Known from South Portugal and Morocco (Bolivar 1908, Harz 1969, Herrera 1982, Llorente & Pinedo 1990, Lock 1999).

### **Odontura (Odonturella) aspericauda** (Rambur, 1839)

MATERIAL EXAMINED. Vila Real: Serra do Alvão, 800 m a.s.l., 04.09.2000, 1♀ (leg. A.P. Martinho).

This small green species is known from Spain and Portugal (Serra da Estrela: Covilhã) (Harz 1969, Lock 1999).

## **MECONEMATIDAE**

### **Cyrtaspis scutata** (Charpentier, 1825)

MATERIAL EXAMINED. Grândola/Ribeiro Abeixo (BT), Aug. 1998, 1♂ (leg. P. Oliveira).

Known from the whole Iberian Peninsula (Herrera 1982) and Italy (Schmidt 1989, 1996a), also found in S-France, Algeria and Morocco (Chopard 1943, Harz 1969).

## CONOCEPHALIDAE

### **Ruspolia nitidula** (Scopoli, 1786)

MATERIAL EXAMINED. Herdade do Pinheiro, Alcácer do Sal, 23.08.1996, 1♀ (leg. A.P.Martinho); Leiria, Aug. 1998, 1♂ (leg. P. Oliveira).

South of latitude 50° N, near wet biotopes, down to Africa (Harz 1969, Cebada & Novoa 1983, Pinedo & Llorente 1987, Schmidt 1989, 1996a, Pardo et al. 1993); found in Portugal (Ria Formosa) by Lock (1999).

### **Conocephalus conocephalus** (Linnaeus, 1767)

MATERIAL EXAMINED. Grândola/Ribeiro Abeixo (BT), Aug. 1998, 1♂ (leg. P. Oliveira).

Locally found in parts of southern Europe, near the Mediterranean coast (Pinedo & Llorente 1987, Schmidt 1989, 1996a, Pardo et al. 1993)(African species); not mentioned for Portugal. The species is always found near lakes and rivers.

## TETTIGONIIDAE

### **Tettigonia viridissima** Linnaeus, 1758

MATERIAL EXAMINED. Vila Real: 30 km NE-Cevices, 16.06.1999, 3♂♂, 3♀♀, as nymphs; Serra do Alvão, 800 m a.s.l., 17.06.1999, 1♂, 1♀, as nymphs (all leg. G.H. Schmidt); Grândola/Ribeiro Abeixo (BT), Aug. 1998, 1♂ (leg. P. Oliveira); Vila Real: Serra do Alvão, 800 m a.s.l., 20.08.2000, 1♂ (leg. A.P. Martinho).

Distributed in the whole Mediterranean region (Cebada & Novoa 1983, Pinedo & Llorente 1987, Schmidt 1989, Pardo et al. 1993), also found in Morocco (Chopard 1943); mentioned from Portugal (Ria Formosa) by Lock (1999) and for TM province by Miranda-Arabolaza & Barranco (2005).

### **Decticus albifrons** (Fabricius, 1775)

MATERIAL EXAMINED. Montemor-o-Novo, 25.04.1992, 1♂, as nymph (leg. G.H. Schmidt); Grândola/Ribeiro Abeixo (BT), Aug. 1998, 1♂ (leg. P. Oliveira).

The song of the male found in Montemor-o-Novo (fig. 2) differs from that of the males collected in Italy (Schmidt 1996a, Abb. 12). The loud calling song consisted of a series of very short syllables, sometimes repeated fairly regularly, at a rate of about 16/s at relatively high temperatures. The interval between successive syllables was very short (about 30-110 ms). The song continued for indefinite periods, often for many minutes. The oscillographic analysis showed that diplosyllables were emitted. The opening stroke is always faint and clear, but the audible sound is produced by the closing stroke of the elytra. The loud part of the hemisyllable lasts for about 5 ms. Ragge & Reynolds (1998) also reported some differences in the songs of males collected in France.

Distributed in the whole mediterranean region and North Africa (Werner 1932, Chopard 1943, Pardo et al. 1993); reported from Portugal (Ria Formosa, Castelo Branco) by Lock (1999) and the TM province by Miranda-Arabolaza & Barranco (2005).

### **Platycleis (Platycleis) albopunctata albopunctata** (Goeze, 1778)

MATERIAL EXAMINED. Bragança: Montesinho Natural Park 1200 m a.s.l., 20.07.1998, 2♀; Vila Real: Cevives, 17.06.1999, 1♂, 16.06.1999, 1♀, as nymph; Serra do Alvão, 800 m a.s.l., 04.09.2000, 1♂; Leiria, Mata Nacional de Leiria, 20-21.06.1999, 2♂♂, 3♀♀, (all leg. G.H. Schmidt); Vila Real: Serra do Alvão, 800 m a.s.l., 20.08.2000, 4♀♀ (leg. A.P. Martinho).

This subspecies occurs in the westernmost part of Europe (Cebada & Novoa 1983, Heller 1988, Pardo et al. 1993, Ragge & Reynolds 1998), in North Europe up to Sweden (Ahlen 1998) and North Africa (Werner 1932, Chopard 1943); known from Portugal (Miranda-Arabolaza & Barranco 2005).

### **Platycleis (Platycleis) intermedia intermedia** (Serville, 1839)

MATERIAL EXAMINED. Vila Real: Serra do Alvão, 800 m a.s.l., 17.06.1999, 1♂, as nymph (leg. G.H. Schmidt); Grândola/Ribeiro Abeixo (BT), Aug. 1998, 1♂ (leg. P. Oliveira).

Distributed in various parts of the Mediterranean region (Pardo et al. 1983, Schmidt 1996a) and North Morocco (Werner 1932, Chopard 1943); known from Portugal (Castelo Branco) by Lock (1999) and the TM province by Miranda-Arabolaza & Barranco (2005).



### **Platycleis (Platycleis) affinis** Fieber, 1853

MATERIAL EXAMINED. Grândola/Ribeiro Abeixo (BT), Aug. 1998, 1♂ (leg. P. Oliveira).

Occurs in large parts of the Mediterranean region (Pardo et al. 1993), including North Africa (Werner 1932, Chopard 1943) and eastwards to Turkey and southern Russia, a little further north than *P. intermedia* (Schmidt & Schach 1978), mentioned for Portugal (Castelo Branco) by Lock (1999) and the TM province by Miranda-Arabolaza & Barranco (2005).

### **Platycleis falx laticauda** Brunner, 1882

MATERIAL EXAMINED. Montemor-o-Novo, 25.04.1992, 1♂, adult, 1♂, 2♀♀, as nymphs (leg. G.H. Schmidt).

The calling song of two males was recorded (one viewed in fig. 2). It consists of a long sequence of echemes (chirps) lasting several seconds (5-6 s), comprising about 32-43 macrosyllables and often ending with 5-6 microsyllables. Within one echeme the syllables are fairly uniform in duration and are repeated at the rate of about 30 ms. The analysis of the oscillogram shows that opening hemisyllables are absent, as reported by Ragge & Reynolds (1998) for males from southern France. The closing macrosyllables lasted for 105-110 ms and the microsyllables 5-10 ms at 19°C, at night (22°). The macrosyllables were repeated at an ascending rate from 45 to 60 ms. The microsyllable sequence, at the end of an echeme, lasted for 0.6 s at the most. The echemes began quietly, reaching a maximum, and remaining at this intensity, after four to eight syllables, until the call ended. Almost all macrosyllables ended with one, or two, strong strokes. The song shows some similarities with that of *P. affinis* (see Schmidt & Schach 1978).

The species is distributed in the western part of the Mediterranean region (Harz 1969): Italy (Herrera 1982), southern France (Heller 1988), Spain (Gangwere & Morales Agacino 1970, Pardo et al. 1993), North Africa (Chopard 1943); unknown from Portugal.

### **Platycleis (Platycleis) sabulosa** Azam, 1901

MATERIAL EXAMINED. Grândola/Ribeiro Abeixo (BT), Aug. 1998, 1♂ (leg. P. Oliveira); Vila Real: Cevives, 18.06.1999, 2♀♀; Abrantes, 27.07.1999, 1♀ (both leg. A.P. Mar-

tinho): Sesimbra, on meadow, 15.06.1995, 1♀ ; Leira, 20.06.1999, 1♂ (both leg. G.H. Schmidt).

Distributed in western Europe, near the coastal areas (Pinedo & Llorente 1987, Pardo et al. 1993, Schmidt 1996a) and Morocco (Chopard 1943); mentioned from Portugal (Ria Formosa) by Lock (1999) and the TM province by Miranda-Arabolaza & Barranco (2005).

### **Platycleis (Tessellana) tessellata** (Charpentier, 1825)

MATERIAL EXAMINED. Montemor-o-Novo, 25.04.1992, 2♂♂, as nymphs; Serra da Arábida, 07.06.1996, 1♀, as nymph; Castro Verde, 11.07.1997, 1♂; 30 km to Vila Real: Cevives, 16.07.1998, 2♂♂; Leiria, Mata Nacional de Leiria, 21.06.1999, 1♂ (all leg. G.H. Schmidt); Vila Real: Serra do Alvão, 1000 m a.s.l., 17.06.1999, 1♂ (leg. A.P. Martinho).

The male calling song was recorded at a relatively low temperature (17°C), after moulting to the adult stage at Hannover, and was somewhat irregular (fig. 2). The quiet diplosyllables, each lasting for about 165-175 ms, are composed of an opening hemisyllable lasting for about 40 ms and a little louder closing hemisyllable, lasting for 100-120 ms, separated by a short interval of about 10 ms. The rate of repetition of the syllables was irregular, occurring at about 1-2/s, for long periods. The male calling songs recorded in France and Spain reported by Ragge (1990) differ somewhat from those presented by Schmidt (1989) for Italian individuals.

The species is widespread in the western Mediterranean region (Llorente del Moral 1980, Cebada & Novoa 1983, Schmidt 1989, 1996a, Pardo et al. 1993) extending northwards to central France and southern Germany, and eastwards to southern Russia and Asia Minor (Herrera 1982, Ragge & Reynolds 1998), and North Africa (Werner 1932, Chopard 1943); known from Portugal (Ria Formosa) at least by Lock (1999) and the TM province by Miranda-Arabolaza & Barranco (2005).

### **Thyreonotus bidens** Bolivar, 1887

MATERIAL EXAMINED. Vila Flor, 120 km N Vila Real, 16.07.1998, 1♂, 1♀ (leg. P.M. Seixal); Sesimbra-Ferraria, 09.10.1998, 1♂, 20.10.1998, 1♀, 02.11.1998, 1♀, 07.08.2000, 1♂ 1♀ as nymphs, 28.08.2000, 1♀, as nymph; Apostiça-Lagoa de Albufeira, 25.-29.08.1998, 2♀♀, as nymphs; Leiria, 18.08.1998, 1♀; Abrantes, 06.09.1999, 2♀♀, as nymphs, 21.10.1999, 1♂, 1♀ (all leg. A.P. Martinho); Grândola/Ribeiro Abeixo (BT), Aug. 1998, 1♂ (leg. P. Oliveira). Most of the specimens were found in flight traps, used for collecting males of *Thaumetopoea pityocampa* (Denis & Schiffermüller, 1775), the pine processionary moth.

Distributed in central and southern Spain and Portugal (Harz 1969, Llorente del Moral 1980, Herrera 1982, Pardo et al. 1993, Barranco et al. 1996, Miranda-Arabolaza & Barranco 2005).

### **Rhacocleis grallata** (Pantel, 1886)

MATERIAL EXAMINED. Ferrara, near Sesimbra, 07.08.2000, 1♂, 28.08.2000, 1♀ (both leg. A.P. Martinho). Both specimens were found in flight traps set up to collect males of *T. pityocampa*.

This long-legged species is distributed in the Iberian Peninsula and known from Portugal (TM) (Miranda-Arabolaza & Barranco 2005).

### **Pterolepis spoliata** Rambur, 1839

MATERIAL EXAMINED. Leiria, 18.08.1998, 1♀ (leg. A.P. Martinho); Vila Real: Cevives, 18.06.1999, 1♀, as nymph (leg. G.H. Schmidt).

Distributed in South Spain (Granada, Cartagena, Algeiras, Malaga) (Harz 1969, Llorente del Moral 1980), known from Portugal.

### **Antaxius spinibrachius** (Fischer, 1853)

MATERIAL EXAMINED. 30 km to Vila Real: Cevives, 16.07.1998, 2♂♂, 2♀♀, 16-18.06.1999, 2♂♂, 2♀♀, as nymphs (leg. G.H. Schmidt); Abrantes, 03.05.1998, 1♂, 11.10.1999; 1♀; Bragança, 20.07.1998, 1♀; Vila Real: Serra do Alvão, 800 m a.s.l., 15.-23.08.2000, 5♂♂, 10♀♀ (all leg. A.P. Martinho).

Known from central Spain and Portugal (Harz 1969, Herrera 1982, Pardo et al. 1993), Galicia (Cebada & Novoa 1983) and the TM province by Miranda-Arabolaza & Barranco (2005).

Fig. 3 represents the calling song of a male found in Serra do Alvão.

### **Ctenodecticus** sp. a

MATERIAL EXAMINED. Abrantes, 03.05.1999, 1♀ nymph, (leg. A.P. Martinho).

Not known from Portugal.

## **Ctenodecticus sp. b**

MATERIAL EXAMINED. Vila Real: Serra do Alvão, 800 m a.s.l., 07.05.1999, 1♀ nymph (leg. A.P. Martinho).

Not known from Portugal.

## **BRADYPORIDAE**

### **Uromenus (Steropleurus) pseudolus (Bolivar, 1878) (fig. 4 A, B)**

MATERIAL EXAMINED. Troia/Rio Sado, pine stand, on bushes, 09.06.1996, 1♀, (leg. G.H. Schmidt).

The brightly coloured female collected was bigger and somewhat different from reported by Harz (1969). Measurements (mm): length of body 32, hind femur 25, hind tibia 24, pronotum 7.0, ovipositor 30. Colouration: body generally green, abdomen above light brown patterned, below almost white to ochreous; head with oblique white stripe below eyes; paranota laterally white-yellow bordered; abdominal tergites laterally white stripe pattern (viewed in fig. 4A); elytra yellow with a row of dark brown to black cells near distal border, disc with light brownish cells; sterna brilliant white-yellow (fig. 4B); ovipositor green, brown tipped.

Antennae surpassing tip of ovipositor weakly upraised; fastigium slightly projected, obtusely tipped, triangularly shaped, dorsally with dark triangular groove; pronotum about one third of the length of ovipositor, prozona little longer than metazona, slightly upraised, metazona with parallel lateral keels coarsely grooved, reaching hind margin concavely rounded, median carinula distinct but weak, metazona right-angled to smooth paranota, 1st transverse sulcus deep, half-circled dark-brown; 10th tergum posteriorly slight-concavely rounded; epiproct triangular with longitudinal groove, obtusely tipped; cerci conical, at base strong, constricted to slightly rounded tip, bit incurved, base about as large as length, hirsute; subgenital plate much larger than long, posteriorly notched, in midline proximally flat and little wriggled, laterally with transverse callosity before midline, behind weak depression rounded, on either side; 7th sternite callous, about three times larger than others (fig. 4B), directly behind small groove connected by a sclerotized bridge to SGP; ovipositor valves rasped to weakly serrated in distal third.

Known from S Spain (Andalusia) and S Portugal, up to Serra da Estrela (Harz 1969, Herrera 1982).

### **Uromenus (Steropleurus) asturiensis** (Bolivar, 1898)

MATERIAL EXAMINED. Vila Real: Serra do Alvão, 800 m a.s.l., 21.08.1999, 1♀, 15-23.08.2000, 2♂♂, 4♀♀, 20.08.2000, 1♀, as nymph, 04.09.2000, 1♂ (all leg. A.P. Martinho).

The type material of this species was collected in Asturias, Spain (Cangas de Tineo), but the species is also known from Portugal (Mata do Fundão) (Harz 1969) and the TM province by Miranda-Arabolaza & Barranco (2005).

Ragge & Reynolds (1998) recorded male calling songs, produced during sunny days, consisting of very brief echemes. The specimens were collected in Spain (León, Orense). In Portugal (Serra do Alvão), males were sampled which produced either short echemes (with 6-7 or 9-11 syllables) or echemes with 14-16 syllables (fig. 5). This calling behaviour was individual-specific and temperature dependant, occurring only around noon. The echemes were repeated at intervals of 6-8s. The oscillographic analysis showed that each echeme begins with increasingly loud and short syllables (opening hemisyllables). Only the last 2-3 were diplosyllables, with very brief closing hemisyllables followed immediately by a longer diplosyllable, in which the closing stroke is three times longer than the opening stroke. In all cases, only the long echemes were followed by one, or two, diplosyllables after short intervals of about 0.5-1 s.

### **Uromenus (Steropleurus) a n a p a u l a e** n. sp. G.H. Schmidt (figs 4C, 6)

DIAGNOSIS. Regarding the male and following the key of Harz (1969) the determination ended with *U. brunnerii* (Bolivar). The morphological description of *U. brunnerii* almost fits the male specimens found in Portugal, but the structures of the cerci and titillator are different. Strong differences were found in the stridulation. Heller (1988) recorded for *U. brunnerii*, collected in Spain (Cuenca), syllables (50-70 ms) singly produced at intervals of 1.5-3 s (at >25°C). Echemes of several syllables were not recorded, as shown in fig. 7.

For the female collected in Leiria, the key of Harz (1969) lead to *U.*

(*Bolivarius*) *ortegai* (Pantel), which was found in Spain (Cuenca, Ciudad) and has a somewhat longer (15.5-17 mm) ovipositor than the new species found in Portugal. The ovipositor of *U. brunnerii* (Bolivar) is much longer (20.5-24 mm). The main difference, in relation to all other *Uromenus* species, was a large whitish callousity found in the 7th abdominal sternit surrounding partly the subgenital plate. This morphological character differs most between *U. anapaulae* and *U. brunnerii*. In the latter the callousity of the 7th sternite is clasp-shaped.

In both sexes, the clear differences detected allowed for the separation of the new species, named after the second author, who collected the holo- and allotype in Leiria, as non-target catch in traps aimed a collecting *Thaumetopoea* males.

MATERIAL EXAMINED. Leiria (EX), 14.11.1998, 1♀ (holotype), 08.08.2000, 1♂ (allotype) (both leg. A.P. Martinho, coll. G.H. Schmidt in ZSM); Grândola/Ribeiro Abeixo (BT), Aug. 1998, 2♂♂ (leg. P. Oliveira, coll. G.H. Schmidt in ZSM).

Sampling sites are situated about 100 km apart, thus the two males caught in Grândola cannot be considered as paratypes.

DESCRIPTION. In both sexes, fastigium verticis narrow, short-conical, tip rounded, dorsally weakly grooved (fig. 6); pronotum saddle-shaped, strongly wrinkled, front border upraised and concavely rounded, prozona as long as metazona (in allotype metazona longer than prozona), 1st transverse sulcus deep, half-circled black, crossed by black longitudinal furrow in midth (cross-like) (well visible in light-brown specimens), metazonal disc vaulted, coarsely rasped above and raised up to behind; scored lateral carinae almost parallel to slightly diversing to behind reaching hind margin of pronotum, weakly carinated in midth, stuffed bordered on side, forming right angle to paranota, carinated from 1st sulcus to hind margin weak-concavely rounded to almost straight; lower margin of paranota sinuously arranged (fig. 6); elytra small, light brown, almost totally covered by metazona, cells of elytron disc small and dark 10th tergite deep-roundly incised, epiproct round-angularly arranged (fig. 6A).

IMale: 10th tergite (SAP) in midth half-circlic excised; epiproct triangularly rounded to half-circled; cerci cylindrical until black inner tooth curved inwards, situated in the apical third, apical tooth short and thickened, conically narrowed and abruptly terminated by black pointed apex (fig. 6A); subgenital plate large, at base triangularly excised, hind margin incised as long as stylus; titillator straight, strongly toothed on whole

length, at tip roundly thickened and excurved (fig. 6A), not visible under epiproct.

Female: cerci short, broad-conical; subgenital plate distally notched forming an obtuse angle, laterally transversally rounded, on base roundly depressed, hind margin concavely rounded; sterna narrow and callous, 1st sternum bearing two small spines, 7th sternum more oval, with a horse-shoe shaped callousity (fig. 6B), light coloured and slightly dark spotted, callousity rounding subgenital plate proximally and laterally; ovipositor in proximal half straight, apically slightly upcurved and weakly rasped.

Colouration of both sexes, olive-brown from above, green from below, head with green spots, if dried-up brown to dark brown.

Male and female show similar characters ( $\sigma/\text{♀}$ ): body length (mm) 22/23, pronotum 5.5-6/5.5, elytra 1.5/1, hind femur 18/20, hind tibia 20/19, ovipositor 14.

Males required sunshine and temperatures  $>25^{\circ}\text{C}$  to sing (fig. 7).

### **Platystolus (Neocallicrania) lusitanicus** (Aires & Menano, 1916)

MATERIAL EXAMINED. Bragança, 10 km E, 16.07.1998, 1 $\sigma$  (fig. 8A) (leg. G.H. Schmidt); Bragança, Montesinho Natural Park, 1200 m a.s.l., 20.07.1998, 1 $\text{♀}$  (fig. 8C) (leg. A.P. Martinho).

Distributed in southern Spain and northern Portugal (Pinedo & Llorente 1987, Pfau 1996). Lock (1999) identified specimens collected at Covilhã (Serra da Estrela) as *Callicrania miegi* (Bolivar, 1873), without considering the revision of Pfau (1996).

Fig. 9 represents the male calling song.

### **Platystolus (Neocallicrania) serratus** (Bolivar, 1885)

MATERIAL EXAMINED. Setúbal: Ferraria, 02.11.1998, 1 $\text{♀}$ ; Leiria, Mata Nacional de Leiria, 26.07.1999, 1 $\text{♀}$ , 08.08.2000, 1 $\sigma$  (all leg. A.P. Martinho).

Distributed in the southern part of Portugal (Harz 1969, Herrera 1982, Pfau 1996, Lock 1999). However, we found this species 150 km North of Lisbon.

### **Platystolus (Neocallicrania) selliger selliger** (Charpentier, 1825)

MATERIAL EXAMINED. 30 km to Vila Real: Cevives, near Vila Pouca de Aguiar,

16.07.1998, 1♂ fig. 8E) (leg. G.H. Schmidt); Vila Real: Serra do Alvão, 800 m a.s.l., 15.08.2000, 1♀ (leg. A.P. Martinho).

This species was studied in detail by Pfau (1996), who separated two subspecies locally distributed in the North of Portugal. *P. selliger selliger* was found in Serra do Gerês and *P. selliger meridionalis* South of the river Douro.

Fig. 10 shows the calling song of the male collected.

## **GRYLLOIDEA**

### **GRYLLIDAE**

#### **Gryllus campestris** Linnaeus, 1758

MATERIAL EXAMINED. Grândola/Ribeiro Abeixo (BT), Aug. 1998, 2♂♂ (leg. et coll. P. Oliveira); Vila Real: Serra do Alvão, 1000 m a.s.l., 17.06.1999, 1♂ (leg. A.P. Martinho); Vila Real, 30 km E-Cevives, 18.06.1999, 1♀ (leg. G.H. Schmidt).

Widespread in Europe and North Africa (Werner 1932), including the Mediterranean region (Schmidt 1989, Pardo et al. 1993), mentioned for Portugal by Lock (1999) and the TM province by Miranda-Arabolaza & Barranco (2005).

#### **Sciobia lusitanica** Rambur, 1839

MATERIAL EXAMINED. Grândola/Ribeiro Abeixo (BT), Aug. 1998, 2♂♂ (leg. et coll. P. Oliveira).

Distributed in Spain, Portugal, Morocco (Harz 1969, Herrera 1982, Pardo et al. 1993, Barranco et al. 1996, Lock 1999, Miranda-Arabolaza & Barranco 2005).

### **MOGOPLISTIDAE**

#### **Arachnocephalus vestitus** A. Costa, 1855

MATERIAL EXAMINED. Setúbal: Sesimbra, 29.07.1998, 1♀; Setúbal: Ferraria, 29.07.1998, 1♀, 11.08.1998, 1♂ (leg. A.P. Martinho).

Distributed in France, Spain (Llorente del Moral 1980, Pardo et al. 1993, Barranco et al. 1996), Portugal (Harz 1969), Italy (Schmidt 1989,



1996a), Sardinia (Schmidt & Herrmann 1999), Greece (Willemse 1984) and North Africa (Chopard 1943).

### **Mogoplistes brunneus** Serville, 1839

MATERIAL EXAMINED. Sesimbra, 11.08.1998, 1♀ (leg. A.P. Martinho).

Distributed near the Mediterranean coast in all departments (Harz 1969, Willemse 1984, Schmidt 1989, 1996a, Barranco et al. 1996); unknown from Portugal. Recently, Gorochov (1995) described a similar species, as *Pseudomogoplistes vicentae*, from Lisbon area and Morocco!

## **OECANTHIDAE**

### **Oecanthus pellucens** (Scopoli, 1763)

MATERIAL EXAMINED. Vila Real: Serra do Alvão, 800 m a.s.l., 21.08.2000, 1♂, 1♀ (leg. A.P. Martinho).

The species is well known, being distributed from southern Europe to Siberia, and in N Africa; mentioned for Portugal (Ria Formosa) by Lock (1999) and the TM province by Miranda-Arabolaza & Barranco (2005).

## **TETRIGOIDEA**

### **TETRIGIDAE**

### **Tetrix ceperoi** (Bolivar, 1887)

MATERIAL EXAMINED. Vila Real: Serra do Alvão, 1000 m a.s.l., 31.03.1999, 1♀ (leg. A.P. Martinho).

Widespread in South Europe (Schmidt 1989) and North Africa (Chopard 1943); known from Portugal and Spain (Llorente del Moral 1980, Llorente & Presa 1981, Cebada & Novoa 1983, Barranco et al. 1996, Miranda-Arabolaza & Barranco (2005).

### **Tetrix subulata** (Linnaeus, 1758)

MATERIAL EXAMINED. Setúbal: Lagoa de Albufeira, 17.-20.06.1995, 1♀, as nymph (leg. G.H. Schmidt).

Distributed throughout Europe (Schmidt 1989, 1996a), southwards to Spain (Llorente & Presa 1981); to our knowledge, first record from Portugal.

### **Paratettix meridionalis** (Rambur, 1838)

MATERIAL EXAMINED. Montemor-o-Novo, 25.04.1992, 1♂, 2♀♀; Landeira/Ribeira da Marateca, 26.04.1992, 1♂, 2♀♀; Setúbal: Pinheiro/Rio Sado, 25.04.1992, 1♂ (all leg. G.H. Schmidt); Ferragudo, April 1994, 1♂ (leg. A. Melber).

Widespread in wet areas of South Europe (Llorente & Presa 1981, Cebada & Novoa 1983, Pinedo & Llorente 1987, Schmidt 1989, 1996a, Hochkirch 1999) and North Africa (Werner 1932, Chopard 1943); known from Portugal at least by Lock (1999).

### **Tetratettix undulata** (Sowerby, 1866)

MATERIAL EXAMINED. Ferraria, 09.10.1998, 1♂ (leg. A.P. Martinho).

Distributed in Europe and North Africa (Chopard 1943, Harz 1975), known from Spain and North Portugal (Llorente & Presa 1981, Cebada & Novoa 1983, Gómez Ladron de Guevara et al. 1992, Lock 1999, Miranda-Arabolaza & Barranco 2005).

### **Mishtshenkotetrix brachyptera** (Lucas, 1849)

MATERIAL EXAMINED. Landeira/Ribeira da Marateca, 26.04.1992, 3♀♀ (leg. G.H. Schmidt).

Occurs mainly near rivers of the Atlantic coast of the Iberian Peninsula and North Africa (Harz 1975, Llorente & Presa 1981, Herrera 1982, Cebada & Novoa 1983, Gómez Ladron de Guevara et al. 1992, Barranco et al. 1996).

## **TRIDACTYTOIDEA**

### **TRIDACTYLIDAE**

### **Xya iberica** Günther, 1990

MATERIAL EXAMINED. Landeira/Ribeira da Marateca, 24.04.1992, 6♂♂, 8♀♀ (leg. G.H. Schmidt).

Known from SW Spain and Portugal (Günther 1990, Hochkirch 1999); found in wet and sandy areas.

## **ACRIDOIDEA**

### **PYRGOMORPHIDAE**

#### ***Pyrgomorpha conica* (Oliver, 1791)**

**MATERIAL EXAMINED.** Leiria, Mata Nacional de Leiria, 13.06.1998, 1♀ (leg. A.P. Martinho).

Widespread in South Europe (Presa & Monserrat 1978b, Llorente del Moral 1980, Gonzales Garcia 1981, Willemse 1984, Clemente Espinosa et al. 1985, Gómez Ladron de Guevara et al. 1992, Barranco et al. 1996), West Africa (Mestre & Chiffaud 1997) and North Africa (Chopard 1943); records from Portugal by Lock (1999) from Ria Formosa, Hochkirch (1999) from Baixo Alentejo (BT) and the TM province by Miranda-Arabolaza & Barranco (2005).

## **CATANTOPIDAE**

#### ***Pezotettix giornae* (P. Rossi, 1794)**

**MATERIAL EXAMINED.** Almada, Sobreda: Quinta de São Pedro, 10.10.1993, 3♂♂, 3♀♀; Castro Verde, 11.07.1997, 1♀; Setúbal/Rio Sado, 07.06.1995, 3♀♀ (all leg. G.H. Schmidt); Lisbon-S, 05.10.1993, 3♀♀ (leg. A. Klause-de-Pupka); Setúbal, Sesimbra-Ferraria, 08.10.1998, 2♂♂, 2♀♀; Leiria, Mata Nacional de Leiria, 24.10.1998, 1♂, 1♀ (all leg. A.P. Martinho).

Known from South Europe and North Africa (Werner 1932, Chopard 1943, Presa & Monserrat 1978b, Llorente del Moral 1980, Gonzáles Garcia 1981, Schmidt 1989, 1996a, Barranco et al. 1996); mentioned for Portugal by Hochkirch (1999). Lock (1999) found the species near southern coastal areas (Setúbal, Odemira, Monchique), Ria Formosa, and in Porto Covo, Baixo Alentejo province, and , Miranda-Arabolaza & Barranco (2005) at TM.

#### ***Calliptamus wattenwylanus* (Pantel, 1896)**

**MATERIAL EXAMINED.** Setúbal, Sesimbra, 29.07.1998, 1♀; Castro Verde, 11.07.1997, 2♂♂; Lisbon-S, 95.10.1993, 2♂♂, 1♀; Serra da Arrábida, 07.06.1996, 5♀♀, as nymphs; Almada, Sobreda: Quinta de São Pedro, 10.10.1993, 2♀♀; Setúbal/Rio Sado, 17.06.1995,

1♀; Almada, Caparica, 07.06.1996, 3♂♂, as nymphs; Leiria, Mata Nacional de Leiria, 20.06.1999, 3♂♂ (all. leg. G.H. Schmidt); Leiria, Mata Nacional de Leiria, 20.06.1999, ♂ + ♀ (rec. G.H. Schmidt); Lagos/Algarve, 30.08.1998, 2♀♀ (leg. A.P. Martinho).

Widespread in Spain (Louveaux & Ben Halima 1987), Portugal (Harz 1975, Herrera 1982, Lock 1999, Miranda-Arabolaza & Barranco 2005) and southern France (Foucart 1997), also known from Morocco and other countries of North Africa (Werner 1932, Chopard 1943).

### ***Calliptamus barbarus barbarus* (Costa, 1836)**

MATERIAL EXAMINED. Bragança: Montesinho Natural Park, 20.07.1998, 5♂♂, 1♀; Vila Real: Cevives, 16.06.1999, 1♂; Vila Real: Serra do Alvão, 1000 m a.s.l., 03.09.2000, 1♂ (leg. G.H. Schmidt); Vila Real: Serra do Alvão, 1000 m a.s.l., 20.08.2000, 4♂♂, 6♀♀ (leg. A.P. Martinho).

Most common *Calliptamus* species in Europe (Schmidt 1989, 1996a); known from Spain and Portugal (Harz 1975, Llorente del Moral 1980, Gónzales Garcia 1981, 1985, Cebada & Novoa 1983, Clemente Spinosa et al. 1985, Garcia & Presa 1985, Pinedo & Llorente 1987, Barranco et al. 1996, Lock 1999, Miranda-Arabolaza & Barranco 2005) and North Africa (Chopard 1943). Clemente et al. (1987) referred to the taxonomic value of morphometric and pigmentary characters in this species that presents a wide morphological variation.

### ***Anacridium aegyptium* (Linnaeus, 1764)**

MATERIAL EXAMINED. Setúbal: Pinheiro/Rio Sado, 20.04.1992, 1♀ (leg. G.H. Schmidt); Lisbon-S, 5.10.1993, 1♀ (leg. A. Klause-de-Pupka).

Widespread in South Europe (Presa & Monserrat 1978b, Llorente del Moral 1980, Pinedo & Llorente 1987, Schmidt 1989, 1996a, Barranco et al. 1996) and North Africa (Chopard 1943), hibernates as adult. The species was often seen in parks, in Lisbon, during the winter (M.R.Paiva, personal observations). Reported from Portugal by Hochkirch (1999), Lock (1999) and Miranda-Arabolaza & Barranco (2005).

## **ACRIDIDAE**

### ***Truxalis nasuta* (Linnaeus, 1758)**

MATERIAL EXAMINED. Setúbal: Pinheiro/Rio Sado, 26.04.1992, 1♂; Lisbon: Tejo

bank, 11.06.1996, 1♂ (both leg. G.H. Schmidt); Abrantes, 03.09.1998, 1♂ (leg. A.P. Martinho).

Distributed in the southern parts of the Iberian Peninsula (Dirsh 1950, Presa & Monserrat 1978b, Llorente del Moral 1980, Garcia & Presa 1985, Gómez Ladrón de Guevara et al. 1992, Barranco et al. 1996) and North Africa (Chopard 1943); recorded from Portugal (Ria Formosa, Castelo Branco) by Lock (1999).

### ***Locusta migratoria cinerascens* (Fabricius, 1781)**

**MATERIAL EXAMINED.** Almada: Caparica, 17.04.1995, 1♀; Setúbal/Rio Sado, 18.04.1995, 1♂ (both leg. A.P. Martinho), 17.04.1996, 1♂ (leg. M.R. Paiva). All specimens were used for breeding experiments.

Distributed in South Europe, mainly in damp biotopes (Schmidt 1989, 1996a), known from Spain (Presa & Monserrat 1978b, Llorente del Moral 1980, González Garcia 1981, Garcia & Presa 1985, Barranco et al. 1996), reported from Portugal by Schmidt & Lilge (1997), Lock (1999) and Miranda-Arabolaza & Barranco (2005). However, Lock did not identify the subspecies.

### ***Oedaleus decorus* (Germar, 1826)**

**MATERIAL EXAMINED.** Vila Real: Serra do Alvão, 1000 m a.s.l., 20.08.2000, 1♂, 1♀ (leg. A.P. Martinho); Serra do Alvão, 1000 m a.s.l., 03.09.2000, 2♂♂, 1♀ (leg. G.H. Schmidt).

The species is widespread in southern Europe, North Africa and Asia Minor, it prefers mountainous uncultivated areas with low vegetation (Schmidt & Lilge 1997). On the Iberian Peninsula, the species was recorded mainly in the eastern part, near the Mediterranean Sea. In Portugal, found by Miranda-Arabolaza & Barranco (2005) iat TM.

### ***Oedipoda caerulescens* (Linnaeus, 1758)**

**MATERIAL EXAMINED.** Setúbal: Sesimbra, 15.06.1995, 1♀; Setúbal/Rio Sado, 17.06.1995, 2♂♂, 2♀♀; Bragança: Montesinho Natural Park, 1200 m a.s.l., 20.07.1998, 1♂; Almada, Sobreda: Quinta de São Pedro, 10.10.1993, 1♂; Vila Real: Cevives - Vila Pouca de Aguiar, 16.06.1998, 1♀; Vila Real, Serra do Alvão, 1000 m a.s.l., 03.09.2000, 2♂♂; Setúbal: Serra da Arrábida, 07.06.1996, 1♂, 2♀♀, as nymphs; Setúbal: Comporta-Troia 17.07.1997, 1♂ (all leg. G.H. Schmidt); Leiria, Mata Nacional de Leiria, 18.06.1999, adults and many nymphs (rec. G.H. Schmidt); Lisbon-S, 05.10.1993, 2♂♂

(leg. A. Klause-de-Pupka); Vila Real: Serra do Alvão, 1000 m a.s.l., 20.08.2000, 4♂♂, 6♀♀ (leg. A.P. Martinho).

Common in Europe from sea level up to 3000 m a.s.l. (Schmidt 1989, 1996a, 1999, Schmidt & Lilge 1997), known from the Iberian Peninsula (Llorente del Moral 1980, Gonzáles Garcia 1981, 1985, Herrera 1982, Cebada & Novoa 1983, Clemente Espinosa et al. 1985, Garcia & Presa 1985, Pinedo & Llorente 1987, Barranco et al. 1996, Lock 1999), Miranda-Arabolaza & Barranco (2005), on places with scarce vegetation; widespread in North Africa (Werner 1932, Chopard 1943).

### ***Oedipoda fuscocincta caerulea* Saussure, 1884**

MATERIAL EXAMINED. Bragança: Montesinho Natural Park, 1200 m a.s.l., 20.07.1998, 1♂, 3♀♀; Setúbal: Sesimbra, 15.06.1995, 1♀ 23.08.1998, 1♂, 3♀♀ (all leg. G.H. Schmidt).

This subspecies is distributed in Spain and Portugal (Llorente del Moral 1980, Herrera 1982, Garcia & Presa 1985, Pinedo & Llorente 1987, Schmidt & Lilge 1997, Miranda-Arabolaza & Barranco 2005), and North Africa (Werner 1932, Chopard 1943).

### ***Sphingonotus azureus* (Rambur, 1838)**

MATERIAL EXAMINED. Lisbon-S, 05.10.1993, 1♀ (leg. A. Klause-de-Pupka); Setúbal/Rio Sado, 17.06.1997, 3♂♂, 4♀♀; Setúbal: Seixal, 16.06.1996, 1♂; Castro Verde, 11.07.1997, 2♂♂; Setúbal: Sesimbra, 23.07.1998, 5♂♂, 7♀♀ (all leg. G.H. Schmidt); Leiria, Mata Nacional de Leiria, 19.08.1999, 1♀ (leg. A.P. Martinho).

Known from Spain (Presa & Monserrat 1978b, Gonzáles Garcia 1981, Herrera 1982, Pinedo & Llorente 1987, Barranco et al. 1996), often found on sandy-damp biotopes, and North Africa (Werner 1932, Chopard 1943), extending to East Africa (Schmidt & Johnsen 1999); mentioned from Portugal by Schmidt & Lilge (1997), Lock (1999) and Miranda-Arabolaza & Barranco (2005).

### ***Sphingonotus rubescens* (Walker, 1870)**

MATERIAL EXAMINED. Setúbal: Serra da Arrábida, 300 m a.s.l., 06.10.1993, 1♂ (leg. G.H. Schmidt); Lagos, 30.08.1998, 1♀ (leg. A.P. Martinho).

Found in southern parts of Europe and North, West and East Afri-

ca (Werner 1932, Mestre & Chiffaud 1997, Schmidt & Johnsen 1999); known from Spain and Portugal (Herrera 1982, Garcia & Presa 1985, Pinedo & Llorente 1987, Gómez Ladrón de Guevara et al. 1992, Schmidt & Lilge 1997, Lock 1999).

### **Sphingonotus caeruleans corsicus** Chopard, 1923

MATERIAL EXAMINED. Setúbal: Serra da Arrábida, 06.10.1993, 1♀ (leg. G.H. Schmidt).

The species is mainly distributed in the southern regions of Europe and North Africa (Louveaux & Ben Halima 1987); this subspecies is known from Corsica, Sardinia (Schmidt & Herrmann 2001) and Spain (Presa & Monserrat 1978b, Herrera 1982, Garcia & Presa 1985, González Garcia 1985, Pinedo & Llorente 1987, Barranco et al. 1996); mentioned from Portugal (Schmidt & Lilge 1997).

### **Jacobsiella imitans** (Brunner, 1882)

MATERIAL EXAMINED. Setúbal/Rio Sado, 17.06.1995, 4♂♂, 5♀♀, two as nymphs; Setúbal: Comporta-Troia/Rio Sado, 12.07.1997, 11♂♂, 5♀♀, 10.09.2000, 1♀; Leiria, Mata Nacional de Leiria, 21.06.1999, 3♂♂, 3♀♀ (all leg. G.H. Schmidt); Leiria, Mata Nacional de Leiria, 19.08.1998, 2♀♀, 21.06.1999, 1♂, 1♀ (leg. A.P. Martinho).

Occurs on sandy areas near rivers and coastal areas of Spain (Llorente del Moral 1980, Herrera 1982) and Portugal (González Garcia 1985, Schmidt & Lilge 1997).

### **Acrotylus insubricus** (Scopoli, 1786)

MATERIAL EXAMINED. Lisbon-S, 05.10.1993, 1♂ (leg. A. Klause-de-Pupka): Almada, Sobreda: Quinta de São Pedro, 10.10.1993, 1♂, 1♀; Vila Real: Serra do Alvão, 800 m a.s.l., 04.09.2000, 1♂, 2♀♀ (leg. G.H. Schmidt); Ferragudo/Algarve, April 1994, 1♂ (leg. A. Melber);. Setúbal: Apostiça, 01.09.1998, 1♂, 1♀; Vila Real: Serra do Alvão, 31.03.1999, 1♂, 1♀ (leg. A.P. Martinho).

Widespread in southern Europe, West and North Africa (Werner 1932, Presa & Llorente 1979, Llorente del Moral 1980, González Garcia 1981, Cebada & Novoa 1983, Clemente Espinosa et al. 1985, Garcia & Presa 1985, Schmidt 1996b, Mestre & Chiffaud 1997); known from Portugal (González Garcia 1985, Lock 1999, Miranda-Arabolaza & Barranco 2005). The adults are mainly present in the spring and autumn.

### **Acrotylus patruelis** (Herrich-Schäffer, 1838)

MATERIAL EXAMINED. Setúbal, on meadows, 15.06.1995, 1♀; Setúbal, near Rio Sado, 17.06.1995, 1♂; Setúbal: Seixal, 11.06.1996, 1♂; Almada, Sobreda: Quinta de São Pedro, 16.10.1993, 1♂, 1♀; Setúbal, near Alfirim, 08.10.1993, 2♀♀ (all leg. G.H. Schmidt); Lisbon-S, 10.10.1993, 1♂ (leg. A. Klause-de-Pupka); Setúbal: Lagoa de Albufeira, 01.09.1998, 1♂, 1♀ (leg. A.P. Martinho).

Mainly distributed in lower parts of the Iberian Peninsula (Presa & Llorente 1979, Llorente del Moral 1980, Garcia & Presa 1985, Pinedo & Llorente 1987, Schmidt 1996b, Lock 1999); distributed in southern Europe (Schmidt 1989, 1996a) and the whole of Africa (Werner 1932, Mestre & Chiffaud 1997, Schmidt & Lilge 1997, Schmidt & Johnsen 1999). The biology and behaviour of the species were described by Schmidt (1980, 1988).

### **Acrotylus fischeri** Azam, 1901

MATERIAL EXAMINED. Almada, Sobreda: Quinta de São Pedro, 200m a.s.l., 10.10.1993, 1♂ (leg. G.H. Schmidt).

Mainly found in mountainous parts of the Iberian Peninsula, up to France (Presa & Llorente 1979, Cebada & Novoa 1983, Garcia & Presa 1985, Schmidt 1996b, Schmidt & Lilge 1997, Schmidt 2000) and Morocco (Atlas region) (Chopard 1943); known from Portugal (Herrera 1982, Lock 1999, Miranda-Arabolaza & Barranco 2005).

### **Morphacris fasciata sulcata** Thunberg, 1905

MATERIAL EXAMINED. Setúbal: Seixal, 18.09.1995, 1♀, as nymph (leg. A.P. Martinho); Setúbal: Comporta, near Rio Sado, 11.07.1997, 1♀ (leg. G.H. Schmidt).

This species occurs in Africa in different forms with red, orange and yellow hind wings (alae); the latter form is distributed in Morocco and was named 'sulcata' (Chopard 1943). In Europe, it was recorded from the province of Cadiz (Spain) by Presa & Monserrat (1978a,b) and in Portugal on the Atlantic coast, near rice fields (Schmidt & Lilge 1997, Lock 1999).

### **Aiolopus thalassinus** (Fabricius, 1781)

MATERIAL EXAMINED. Lisbon-S, 05.10.1993, 2♀♀ (leg. A.Klause-de-Pupka); Setú-



bal: Lagoa de Albufeira, 17.-20.06.1995, 1♂; Almada, Sobreda: Quinta de São Pedro, 10.10.1993, 1♀; Setúbal, meadows near the sea, 06.10.1993, 1♀; Estuário do Sado, 06.10.1993, 1♀; Rio Sado, near Setúbal, 17.06.1995, 1♂, 2♀♀ (leg. G.H. Schmidt); Setúbal: Lagoa de Albufeira - Apostiça, 01.09.1998, 1♂, 3♀♀ (leg. A.P. Martinho).

Distributed in the southernmost areas of Europe (Presa & Monserrat 1978b, Llorente del Moral 1980, Pinedo & Llorente 1987, Schmidt 1989, 1996a, Barranco et al. 1996, Schmidt & Lilge 1997, Lock 1999, Miranda-Arabolaza & Barranco 2005), and whole Africa (Werner 1932, Hollis 1968, Mestre & Chiffaud 1997, Schmidt & Johnsen 1999), mainly in wet biotopes.

### ***Aiolopus strepens* (Latreille, 1804)**

MATERIAL EXAMINED. Lisbon-S, 05.10.1993, 2♀♀ (leg. A. Klause-de-Pupka); Setúbal: Sesimbra - Ferraria, 08.10.1998, 1♀; Leiria, Mata Nacional de Leiria, 19.08.1998, 1♀; Vila Real: 30 km E-Cevives, 31.03.1999, 1♀, 18.06.1999, 1♀; Serra do Alvão, 31.03.1999, 1♀; Setúbal: Lagoa de Albufeira, 07.05.1999, 1♂, 1♀ (all leg. A.P. Martinho); Vila Real, Cevives, 16.06.1999, 1♀ (leg. G.H. Schmidt).

Widespread in South Europe (Presa & Monserrat 1978b, Llorente del Moral 1980, Clemente Espinosa et al. 1985, Garcia & Presa 1985, Pinedo & Llorente 1987, Schmidt 1989, 1996a, Barranco et al. 1996) and Africa (Chopard 1943), mainly in mountainous areas; known from Portugal (Schmidt & Lilge 1997, Hochkirch 1999, Lock 1999, Miranda-Arabolaza & Barranco 2005). Adults were found both in the winter and spring.

### ***Paracinema tricolor bisignata* (Charpentier, 1825)**

MATERIAL EXAMINED. Near Setúbal - Rio Sado, 17.06.1995, 1♂ (leg. G.H. Schmidt).

Widespread in southern Europe, distributed as far as the Balkans and the mediterranean region of North Africa (Harz 1975, Pinedo & Llorente 1987, Schmidt 1996a, Schmidt & Lilge 1997, Schmidt & Herrmann 2001); not previously mentioned for Portugal.

### ***Calephorus compressiformis* (Latreille, 1804)**

MATERIAL EXAMINED. Setúbal: Quinta do Conde, 30.08.1996, 2♂♂ (leg. A.P. Martinho); Setúbal: Lagoa de Albufeira, 20.06.1995, 1♂, 2♀♀, as nymph (leg. G.H. Schmidt).

Found in the whole Iberian Peninsula and on the Atlantic coast of France (Llorente del Moral 1980, González Garcia 1981, Cebada Nova 1983, Schmidt & Lilge 1997). Widespread in North, West and East Africa (Chopard 1943, Mestre & Chiffaud 1997, Schmidt & Johnsen 1999); known from Portugal (González Garcia 1985, Lock 1999, Miranda-Arabolaza & Barranco 2005).

### **Arcyptera (Arcyptera) tornosi** Bolivar, 1884

MATERIAL EXAMINED. Vila Real: 30 km E-Cevives, 18.06.1999, 3♂♂, 1♀, as nymph (leg. G.H. Schmidt).

Found in Portugal (Lock 1999, Miranda-Arabolaza & Barranco 2005) and in the central mountains of Spain (González Garcia 1981, Herrera 1982); the taxonomic characters were described and the male song recorded (Garcia et al. 1996, Ragge & Reynolds 1998).

### **Doclostaurus (Kazakia) jagoi occidentalis** Soltani, 1978

MATERIAL EXAMINED. Setúbal: Quinta do Conde, August.1996, 1♂ (leg. A.P. Martinho); Setúbal/Rio Sado, 17.06.1995, 3♂♂, 7♀♀; Castro Verde, 11.07.1997, 2♂♂, 1♀; Vila Real: Serra do Alvão, 800-1000 m a.s.l., 03-04.09.2000, 3♂♂, 5♀♀ (all leg. G.H.Schmidt); Lagos, 30.08.1998, 1♀; Vila Real: Serra do Alvão, 1000 m a.s.l., 20.08.2000, 4♂♂, 6♀♀ (all leg. A.P. Martinho).

Widely distributed in the Iberian Peninsula (Herrera 1982, Garcia & Presa 1985, Pinedo & Llorente 1987, Gómez Ladron de Guevara 1992, Garcia et al. 1994, Barranco et al. 1996, Ragge & Reynolds 1998, Miranda-Arabolaza & Barranco 2005), and Sardinia (Baccetti 1991, Schmidt & Herrmann 1999). Lock (1999) identified his specimens as *D. genei* (Ocskai, 1832) without considering the revision of Soltani (1978).

### **Omocestus (Dirshius) raymondi** (Yersin, 1863)

MATERIAL EXAMINED. Setúbal: Fonte da Telha, 11.10.1993, 3♂♂, 2♀♀; Nature Reserve of Sado Estuary, 06.10.1993, 3♀♀; Bragança: Montesinho Natural Park, 1200 m a.s.l., 20.07.1998, 4♀♀; Vila Real: Serra do Alvão, 800-1000 m a.s.l., 03-04.09.2000, 2♀♀ (all leg. G.H. Schmidt); Abrantes, 03.05.1998, 1♀; Setúbal: Lagoa de Albufeira, 01.09.1998, 1♂, 2♀♀; Leiria, Mata Nacional de Leiria, 24.06.1998, 1♂, 2♀♀, 19.08.1998, 1♂, 1♀, 24.10.1998, 2♀♀, 20.06.1999, 1♂; Setúbal: Sesimbra-Apostiça, 01.09.1998, 2♀♀; Setúbal: Sesimbra-Ferraria, 02.11.1998, 1♂; Vila Real: Cevives, 18.06.1999, 1♀; Vila Real: Serra do Alvão, 800 m a.s.l., 20.08.2000, 1♂, 1♀ (all leg. A.P. Martinho).

The male calling song was presented by Ragge (1986) and is shown in fig. 10 (two echemes). The calling song of a male is an echeme lasting for about 1.0-1.5/s and consisting of about 20-22 syllables repeated at a rate of about 18-20/s (fig. 11). Each echeme begins quietly, rapidly increasing in intensity. The oscillographic analysis shows that the downstroke hemisyllables have a characteristic pattern of gaps, which often become obscured towards the end of the echeme. The echemes are often produced singly and repeated at irregular intervals, as Ragge & Reynolds (1998) reported.

Widespread in the Iberian Peninsula (Presa & Monserrat 1978b, González Garcia 1981, Cebada & Novoa 1983, Garcia & Presa 1985, Pinedo & Llorente 1987, Nadig 1988, Clemente et al 1990, Barranco et al. 1996) southern France, West Italy (Schmidt 1996a), and North Africa (Chopard 1943); known from Portugal (Hochkirch 1999, Lock 1999, Miranda-Arabolaza & Barranco 2005).

### ***Omocestus rufipes* (Zetterstedt, 1821)**

MATERIAL EXAMINED. Abrantes, 03.05.1999, 1♀; Vila Real: Serra do Alvão, 800 m a.s.l., 07.05.1999, 1♀, 31.05.1998, 1♂, 30 km NE-Cevives, 18.06.1999, 1♂ (leg. A.P.Martinho); Vila Real: Serra Odo Alvão, 17.06.1999, 2♂♂; Leiria, Mata Nacional de Leiria, 21.06.1999, 1♂, 1♀ (leg. G.H. Schmidt)

Widespread in Europe (Schmidt 1989) and North Africa (Chopard 1943); known from Spain and Portugal (Harz 1975, Cebada & Novoa 1983, Clemente et al. 1990, Lock 1999, Miranda-Arabolaza & Barranco 2005).

The species occurs often in more shaded habitats (Ragge 1986).

### ***Omocestus panteli* (Bolivar, 1887)**

MATERIAL EXAMINED. Vila Real: Cevives-Vila Pouca de Aguiar, 16.07.1998, 1♂, 3♀♀, 16.06.1999, 1♂, 1♀; Vila Real: Serra do Alvão, 1000 m a.s.l., 17.06.1999, 1♂, 3♀♀, 03.-04.09.2000, 2♂♂, 4♀♀; Setúbal: Serra da Arrábida, 07.06.1996, 3♀♀; Setúbal: Pinheiro/Rio Sado, 26.04.1992, 3♂♂, 7♀♀; Nature Reserve of Sado Estuary, 06.10.1993, 5♂♂, 4♀♀; Montemor-o-Novo, 25.04.1992, 1♂, 5♀♀; Setúbal: Sesimbra, 15.06.1995, 1♂; Bragança: Montesinho Natural Park, 1200m a.s.l., 20.07.1998, 1♂, 1♀; Setúbal: Seixal, 11.06.1996, 1♂; Leiria, Mata Nacional de Leiria, 21.06.1998, 1♂ (all leg. G.H. Schmidt); Setúbal: Quinta do Conde, Aug. 1996, 3♂♂; Abrantes, 03.05.1999, 1♀; Vila Real: Serra do Alvão, 31.05.1999, 1♀, 20.08.2000, 5♂♂, 8♀♀; Setúbal: Lagoa de Albufeira - Apostiça, 04.09.1998, 2♂♂, 1♀ (leg. A.P. Martinho); Lisbon-S, 05.10.1993, 1♀ (leg. A. Klause-de-Pupka).

Ragge (1986) and Schmidt (1999) reported the male calling song of this species from different sites where it was collected, either in Spain or Portugal.

The different song types are shown in figs. 11 and 12. The male calling song is an echeme lasting for about 1.0-1.5/s and consisting of 28-35 syllables repeated at the rate of about 20 syllables/s, at 30°C. Each echeme begins quietly, some times starting with a loud syllable and soon reaching maximum intensity. At the beginning some incomplete hemisyllables were produced, after which syllable repetition was similar during the course of the echeme.

The courtship song is quite different. Sitting obliquely head-to-head the male stridulates intensively producing a quiet sound of a long monotone echeme, lasting for up to 6 s, and which is probably influenced by temperature. At 17°C, 11 syllables/s were produced. In total, up to 74 syllables per echeme could be counted. Its structure was similar to that of the calling song.

The species is confined to the Iberian Peninsula, where it is widespread and very common (Llorente del Moral 1980, González Garcia 1981, Cebada & Novoa 1983, Pinedo & Llorente 1987, Clemente et al. 1990, Barranco et al. 1996); known from Portugal by Lock (1999) and Miranda-Arabolaza & Barranco 2005).

### ***Stenobothrus festivus* Bolivar, 1897**

MATERIAL EXAMINED. Bragança: Montesinho Natural Park, 1200 m a.s.l., 20.07.1998, 1♀ (leg. G.H. Schmidt).

Widespread in the Iberian Peninsula and locally in France (González Garcia 1981, Herrera 1982, Pinedo & Llorente 1987, Clemente et al. 1989, Gómez Ladrón de Guevara et al. 1992), mainly found in mountain areas, known from Portugal (Harz 1975). Ragge (1987) recorded the male calling songs.

### ***Stenobothrus stigmaticus stigmaticus* (Rambur, 1838)**

MATERIAL EXAMINED. Abrantes, 03.05.1998, 2♂♂, 1♀; Vila Real: 30 km E-Cevives, 18.06.1999, 2♂♂, 2♀♀, Vila Real: Serra do Alvão, 1000 m a.s.l., 20.08.2000, 2♂♂, 4♀♀ (leg. A.P. Martinho); Leiria, Mata Nacional de Leiria, 21.06.1999, 1♂, 2♀♀; Vila Real: 30 km E-Cevives, 17.06.1999, 1♀, Vila Real: Serra do Alvão, 1000 m a.s.l., 03.09.2000, 1♂ (leg. G.H. Schmidt).

This small fully winged species is widespread on the Iberian Peninsula (González Garcia 1981, Cebada & Novoa 1983, in Galicia, Clemente et al. 1989), also in western and central Europe, but not reaching as far North as Scandinavia; its range of distribution extends to European Russia and Asia Minor (Ragge 1987) and it is known from Morocco (Chopard 1943). In southern Europe, it occurs in the mountainous parts of the Iberian Peninsula (Miranda-Arabolaza & Barranco 2005).

### **Myrmeleotettix maculatus hispanicus** Harz, 1975

MATERIAL EXAMINED. Vila Real: Cevives, 07.05.1999, 1♀, 16.06.1999, 2♂♂, 2♀♀ (leg. A.P. Martinho), 16.-18.06.1999, 3♀♀ ; Vila Real: Serra do Alvão, 1000 m a.s.l., 03.09.2000, 1♂, 3♀♀ (leg. G.H. Schmidt).

The species is widespread in Europe, and the subspecies extends down to central and northern Spain (Cebada & Novoa 1983, Clemente et al. 1989); known from Sierra Nevada as *M. m. australis* Harz, 1975; mentioned for Portugal (Miranda-Arabolaza & Barranco 2005), and Morocco (Chopard 1943).

### **Chorthippus jucundus** (Fischer, 1853)

MATERIAL EXAMINED. Vila Real: Cevives-Vila Pouca de Aguiar, 16.07.1998, 1♂, 2♀♀, Vila Real: Serra do Alvão, 800 m a.s.l., 04.09.2000, 1♂ (leg. G.H. Schmidt).

Known from the Iberian Peninsula (González Garcia 1981, Cebada & Novoa 1983, Garcia & Presa 1985, Pinedo & Llorente 1987, Miranda-Arabolaza & Barranco 2005), southern France and Morocco (Werner 1932, Chopard 1943).

### **Chorthippus parallelus erythropus** Faber, 1958

MATERIAL EXAMINED. Vila Real: 30 km E - Cevives, 18.06.1999 1♂,1♀; Vila Real: Serra do Alvão, 1000 m a.s.l., 20.08.2000, 1♂, 4♀♀ (leg. A.P. Martinho); Leiria, Mata Nacional de Leiria, 20.06.1999, 1♂; Vila Real: Serra do Alvão, 1000 m a.s.l., 04.09.2000, 2♂♂ (leg. G.H. Schmidt).

This subspecies is widespread in mountainous regions of the Iberian Peninsula (Gómez Ladrón de Guevara et al. 1992, Schmidt 1999, Miranda-Arabolaza & Barranco 2005).

## **Chorthippus (Glyptobothrus) apicalis** (Herrich-Schäffer, 1840)

MATERIAL EXAMINED. Montemor-o-Novo, 25.04.1992, 8♂♂, 9♀♀; Setúbal: Serra da Arrábida, 07.06.1996, 1♂, 4♀♀; Vila Real: Serra do Alvão, 17.06.1999, 1♂ (leg. G.H. Schmidt); Lagos, Ferragudo, April 1994, 1♂ (leg. A. Melber); Abrantes, 03.05.1998, 1♂, 2♀♀; Lagos, 30.08.1998, 3♂♂, 3♀♀ (leg. A.P. Martinho).

The song of the males of this species presented large variations, particularly when compared with those recorded for males caught near Madrid (Ragge & Reynolds 1998) and fig. 11. However, in both cases, the male calling song consists of a series of echemes, lasting for about 1.0-1.7 s each, at 30°C, made up of about 29-31 syllables repeated for undefined periods, at a rate of 15-17/s. In contrast to the males from Madrid, each echeme begins at a low pitch reaching maximum intensity after about 1/3 of its duration. The oscillographic analysis showed that the sound consists of both upstroke and downstroke syllables, the later being longer and louder and lasting for 35 ms. The upstroke lasted for 20 ms and could always be recognized.

This species shows large morphological variations and is distributed throughout the Iberian Peninsula (Presa & Monserrat 1978b, González Garcia 1981, Cebada Novoa 1983, Garcia & Presa 1985, Barranco et al. 1996), parts of France, the western Mediterranean islands (Sardinia) (Baccetti 1991) and Morocco (Werner 1932, Chopard 1943); mentioned for Portugal by Hochkirch (1999), Lock (1999) and Miranda-Arabolaza & Barranco (2005).

## **Chorthippus (Glyptobothrus) vagans** (Eversmann, 1848)

MATERIAL EXAMINED. Vila Real: 30 km E - Cevices, 18.06.1999, 1♀; Setúbal: Lagoa de Albufeira - Apostiça, 01.09.1998, 1♂; Setúbal: Sesimbra - Ferraria, 08.10.1998, 1♀; Leiria, Mata Nacional de Leiria, 19.08.1999, 3♀♀; Vila Real: Serra do Alvão, 800 m a.s.l., 20.08.2000, 7♂, 7♀♀ (all leg. A.P. Martinho).

Common in the Iberian Peninsula (González Garcia 1981, Cebada & Novoa 1983, Garcia & Presa 1985, Pinedo & Llorente 1987, Barranco et al. 1996, Lock 1999, Miranda-Arabolaza & Barranco 2005) and widespread in the whole Mediterranean region, with a characteristic male song (Schmidt 1996a, Ragge & Reynolds 1998).

## **Chorthippus (Glyptobothrus) binotatus binotatus** (Charpentier, 1825)

MATERIAL EXAMINED. Montemor-o-Novo, 25.04.1992, 1♂; Almada, Sobreda: Quinta

de São Pedro, 16.04.1996, 1♀ (leg. G.H. Schmidt); Vila Real: Serra do Alvão, 1000 m a.s.l., 20.08.2000, 2♂♂, 4♀♀ (leg. A.P. Martinho).

Known from Portugal and Spain (Llorente del Moral 1980, González García 1981, Herrera 1982, Cebada & Novoa 1983, as *Ch. b. dilutus* Ebner, 1941, Garcia & Presa 1985, Garcia et al. 1995, Lock 1999, Miranda-Arabolaza & Barranco 2005), France and Morocco (Grand Atlas) (Chopard 1943, Harz 1975). The species appears to be very variable (Ragge & Reynolds 1998, Schmidt 1999).

### ***Chorthippus (Glyptobothrus) jacobsi* Harz, 1975**

MATERIAL EXAMINED. Lisbon-S, 05.10.1993, 2♂♂, 2♀♀ (leg. A.Klause-de-Pupka); Almada, Sobreda: Quinta de São Pedro, 10.10.1993, 5♂♂, 3♀♀; Setúbal: Serra da Arábida, 07.06.1996, 1♂; Setúbal/Rio Sado, 26.04.1992, 1♂; Bragança: Montesinho Natural Park, 1200 m a.s.l., 20.07.1998, 1♀; Vila Real: Cevives - Vila Pouca de Aguiar, 16.07.1998, 1♂, 16.06.1999, 2♀♀; Leiria, Mata Nactonal de Leiria, 21.06.1999, 2♀♀ (all leg. G.H. Schmidt); Vila Real: 30 km E - Cevives, 18.06.1999, 1♀; Abrantes, 03.05.1999, 1♀ (leg. A.P. Martinho).

The male calling song and taxonomic measurements were presented by Ragge & Reynolds (1988), showing that the species is closely related to *C. (G.) brunneus* which is distributed in central Europe beyond the Pyrenees and in Italy, as a special form. Fig. 10 presents some echemes of the Portuguese males. The male calling song is a sequence of usually 5-8 short echemes, each lasting for about 0.5s. The echemes usually consist of 5 syllables without recognisable intervals, but a short gap appears before the ending of the downstroke. Up- and downstrokes are not clearly separated (fig. 10), as found in individuals from Sierra Nevada (Schmidt 1999).

Similarly to what happens between the related species, *C. (G.) brunneus*, and *C. (G.) jacobsi*, which are sympatric in the Pyrenees, rivalry singing between two males often takes place, as shown in fig. 11. In such songs the echemes are shorter than in the male calling songs. In the present case, the males alternated at intervals of 1 s.

Only known from the Iberian Peninsula where it is widespread (Gómez Ladrón de Guevara et al. 1992, Ragge & Reynolds 1998); mentioned for Portugal (southern coastal areas) by Lock (1999) and in TM province by Miranda-Arabolaza & Barranco (2005).

### ***Chorthippus (Glyptobothrus) yersini* Harz, 1975**

MATERIAL EXAMINED. Vila Real: 30 km E - Cevives, 18.06.1999, 1♀; Setúbal: Sesim-

bra-Ferraria, 08.10.1998, 1♀; Leiria, Mata Nacional de Leiria, 19.06.1998, 2♂♂, 2♀♀; 24.10.1998, 2♀♀ (leg. A.P. Martinho); Vila Real: Serra do Alvão, 17.06.1999, 2♂♂, 1♀ (leg. G.H. Schmidt).

The male song was presented by Ragge & Reynolds (1988), together with taxonomic measurements, thus allowing for separation from the former species. The species is closely related to *C. (G.) biguttulus*; both species occur in the Pyrenees.

The species was mainly sampled in mountainous regions of the Iberian Peninsula (Garcia & Presa 1985, Pinedo & Llorente 1987, Gómez Ladrón de Guevara et al. 1992); known from Portugal (TM) (Miranda-Arabolaza & Barranco 2005).

### ***Euchorthippus chopardi* Descamps, 1968**

MATERIAL EXAMINED. Vila Real: Cevives - Vila Pouca de Aguiar, 16.07.1998, 2♂♂, 4♀♀ (leg. G.H. Schmidt).

The species occurs widely in the Iberian Peninsula and its range extends north-eastwards into the French departments near the Mediterranean Sea, known from Portugal (Leiria: Serra d'Aires e Candeiros) (Ragge & Reynolds 1984) and TM province (Miranda-Arabolaza & Barranco 2005). For this species, a strong longitudinal striped colour pattern is typical which almost always lacks in *E. pulvinatus*.

### ***Euchorthippus pulvinatus gallicus* Marân, 1957**

MATERIAL EXAMINED. Castro Verde, 11.07.1997, 1♂, 1♀; Setúbal, on meadows, near the sea, 06.10.1993, 1♀; Setúbal/Rio Sado, 17.06.1995, 2♀♀; Setúbal: Lagoa de Albufeira, 17.-20.07.1998, 1♀; Bragança: Montesinho National Park, 1200 m a.s.l., 20.07.1998, 2♀♀ (all leg. G.H. Schmidt); Setúbal: Quinta do Conde, August 1996, 1♀; Vila Real: Serra do Alvão, 600 m a.s.l., 20.08.2000, 3♂♂, 4♀♀ (all leg. A.P. Martinho).

The subspecies is distributed in central and southern France reaching the Iberian Peninsula. It is known from Portugal (Leiria, Lisboa, Setúbal, TM) (Ragge & Reynolds 1984) and (Castelo Branco, Malcata) (Lock 1999) and Miranda-Arabolaza & Barranco (2005), as *E. elegantulus gallicus* Marân, 1957.

Descamps (1968) recorded *Euchorthippus albolineatus albolineatus* (Lucas, 1849) from Portugal, and Presa et al. (1983) mentioned Sierra de Guadarrama as a locality for the distribution of this species. Ragge & Reynolds (1998) were doubtful about records from the Iberian Penin-



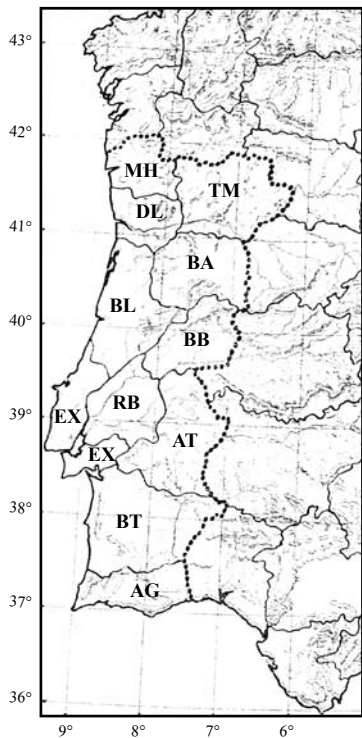
sula. To date it is only known from North Africa. The taxonomic measurements presented by Ragge & Reynolds (1984) for individuals of *E. albolineatus* are similar to those of our samples from Portugal: pronotum often longer than head, elytra extending sometimes beyond tips of hind femora, male subgenital plate short and blunt. It is very difficult to discriminate between the African specimens and some of those found in Portugal described as *E. pulvinatus* and *E. chopardi*.

Gomez-Ladrón de Guevara et al. (1992) mentioned *E. chopardi* and *E. pulvinatus gallicus* from Sierra del Taibilla (Alicante) but not *E. albolineatus*.

#### DISCUSSION AND CONCLUSIONS

The records presented concern faunistic studies of Orthopteroidea caught in Portugal at different altitudes, from sea level up to about 1400 m. In total, 76 species, - 31 Ensifera (E) and 45 Caelifera (C) - were recorded. For the region, a relatively high C/E quotient of 1.45 was ascertained. From the data of Lock (1999), a similar C/E of 1.47 was calculated for the Natural Park of Ria Formosa, and a higher quotient of 1,56 (25 E/39 C) for NE Portugal (Basin of Rio Sabor) by Miranda-Arabolaza & Barranco (2005). Taking into account all saltopteran species known for Portugal, in total 130 species (67 Ensifera and 63 Caelifera), a C/E of 0.94 results, a value lower than found by us. In our partial survey, we did not sample intensively the warmer regions of south-eastern Portugal. On the other hand, catching Caelifera is generally easier than Ensifera.

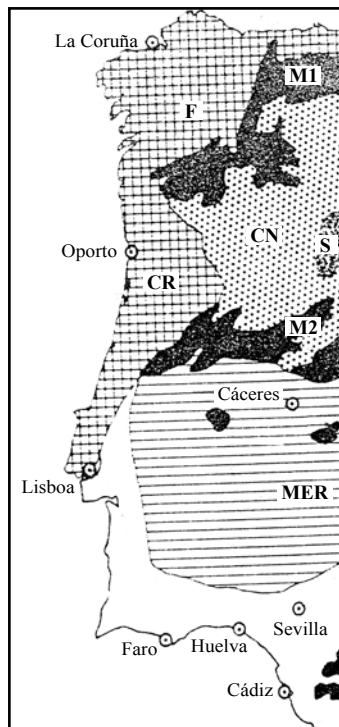
The climate of Portugal is influenced by Atlantic winds which, to a considerable extent, cool down the hot season. Compared with the saltopteran fauna of middle Italy, where 73 species (42 Ensifera and 31 Caelifera) were recorded (Schmidt 1989), these data indicate that long-horned species are not as numerous in Portugal as in Italy, showing that the climate of most parts of Portugal is not as warm as in the Toscana. In general, Ensifera prefer damp-warm and Caelifera dry-hot climatic conditions; the latter are diurnal species and prefer grasslands, steppes and savannas, and the former are mainly nocturnal, living on litter, bushes, trees and in humid deciduous forests, which are rare in Portugal. More Caelifera than Ensifera species were found in Portugal by us, the proportion being different from that for the whole Iberian Peninsula, where 282 species (153 Ensifera and 129 Caelifera) were recorded (Gangwere & Morales Agacino 1970). From these data a C/E quotient of 0.84 can be obtained, clear-



**A**



**B**



**C**

Fig. 1 – Map of Portugal, A Division in 11 provinces; AG: Algarve, AT: Alto Alentejo, BT: Baixo Alentejo, BA: Beira Alta, BB: Beira Baixa, BL: Beira Litoral, DL: Douro Litoral, EX: Estremadura, MH: Minho, RB: Ribatejo, TM: Trás-os-Montes Alto Douro, B Mountain ranges and rivers, C Biogeographic regions, as recognized in this study and main cities; F: Northwest forest region, CN: Central subregion, MER: Meridional subregion, CR: Coastal region, M1, M2: Montane region, S: Steppe region, partly after Gangwere & Morales Agacino (1970) and Gangwere et al. (1985).

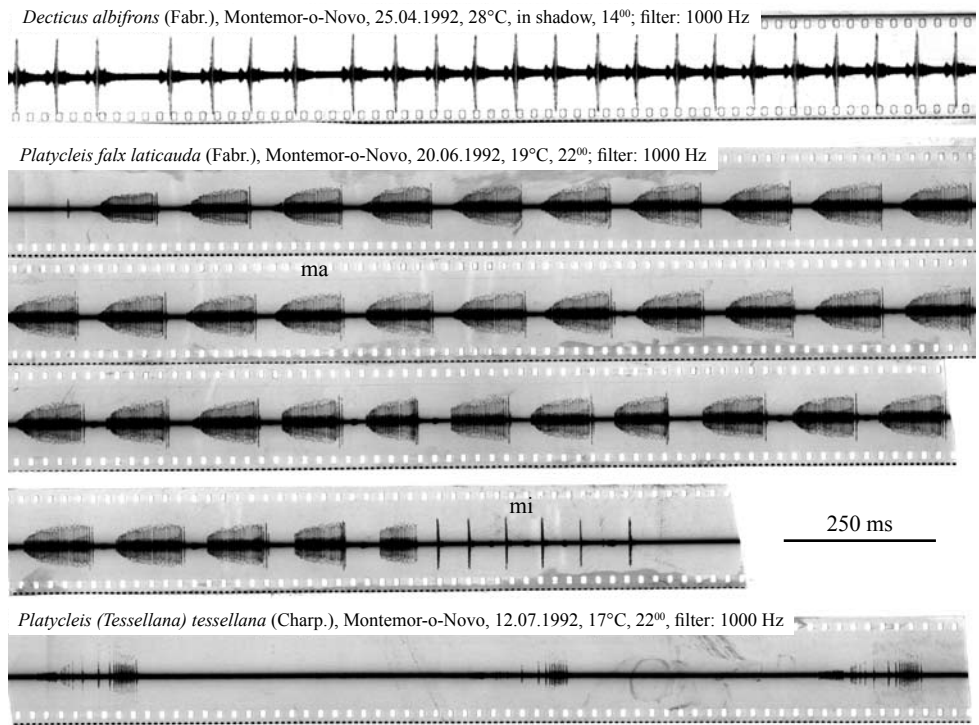


Fig. 2 – Male calling songs of three Decticinae: *Decticus albifrons* produced a loud and resonant stridulation consisting of a syllable rate of 15/s. The closing stroke is much louder than the opening stroke, as shown by the oscillographic analysis. The song can last for many seconds; a section of the song sequence is presented. The song of *Platycleis falx laticauda* consists of long fairly uniform sequences of echemes., each lasting for up to 5.5 s. The echeme presented shows 38 macrosyllables (ma) and ends with 6 microsyllables (mi). The oscillographic analysis reveals that opening hemisyllables are usually absent and that closing macrosyllables last about 85-110 ms, repeated at a rate of 7 ma/s. *Platycleis (Tessellana) tessellata* - song consists of a series of low intensity irregular diplosyllables produced at long intervals. Three syllables of the song sequence were presented at relatively low temperature. The calling songs of the *Platycleis* species were recorded at a colder temperature in Hannover, after moulting to the adult stage, the insects being kept in a nylon net.

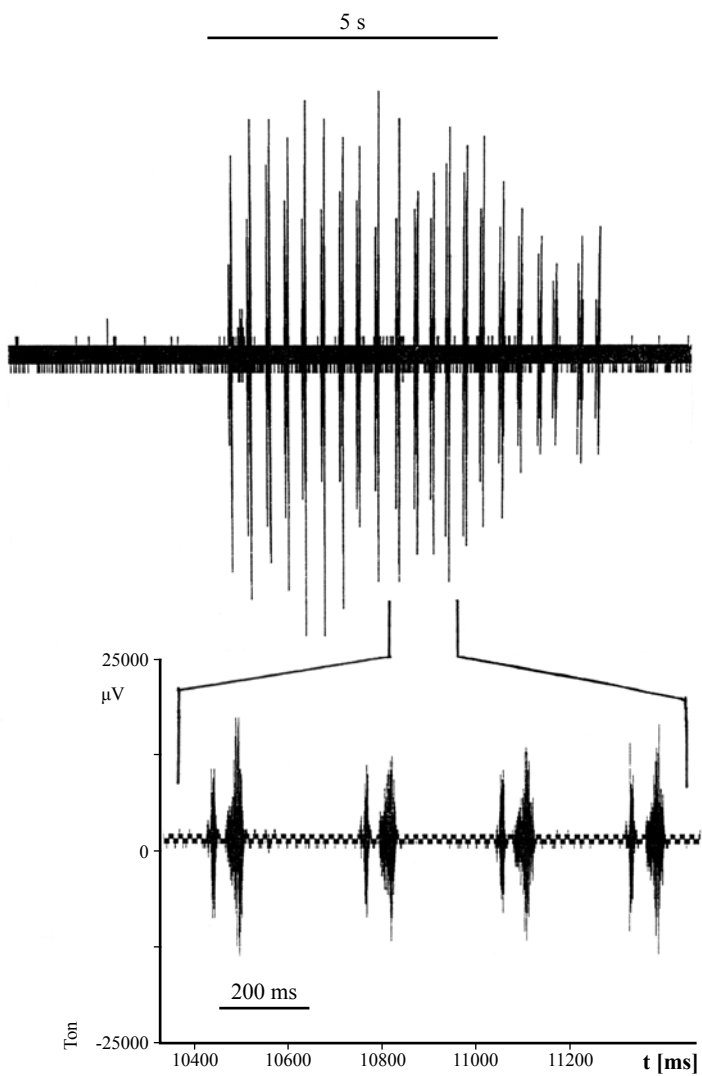


Fig. 3 – *Antaxius spinibrachius*: a long series of well separated diplosyllables of the quiet nocturnal calling song of a male, lasting for about 6 s. Oscillographic analysis shows that the opening hemisyllables last for less than half of the duration of the closing hemisyllables. The interval between two successive syllables lasts for about 190-250 ms. The rate of repetition of the song varied between 2-4 s at 24°C.

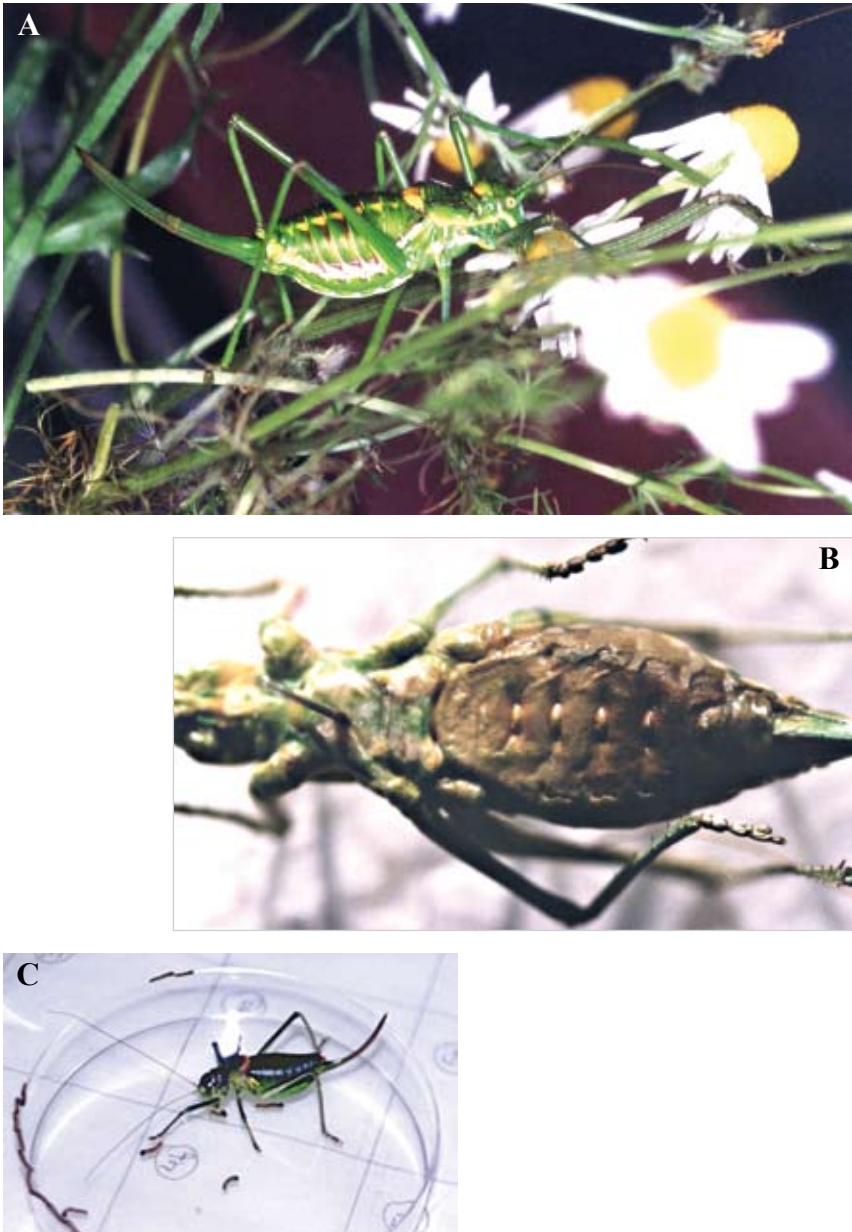


Fig. 4 – *Uromenus (Steropleurus) pseudolus*: A - the female collected, B - ventral side of the freeze-dried female showing the small callous sternal patches (light coloured) and the sclerotized bridge between 7th sternum and SGP, C - *Uromenus (Steropleurus) anapaulae* n. sp., female (holotype), collected at Leiria, feeding on L1 caterpillars of *Thaumetopoea pityocampa* forming a procession on the rim of the petri dish.

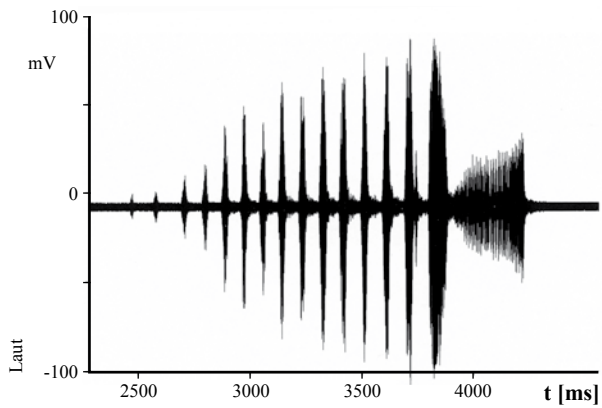


Fig. 5 – *Uromenus (Steropleurus) asturiensis*, male calling song, long echeme consisting of 16 (14-16) syllables, recorded on 21.09.2000, 20°C at 13<sup>30</sup> h, evaluated at a velocity of 9.5 cm/s, filter 2000 Hz, by PC programme. The echemes lasted for 800-900 ms. The same male produced on 21.09.2000, 24°C at 13<sup>00</sup> echemes consisting of 11-12 syllables (4 records).

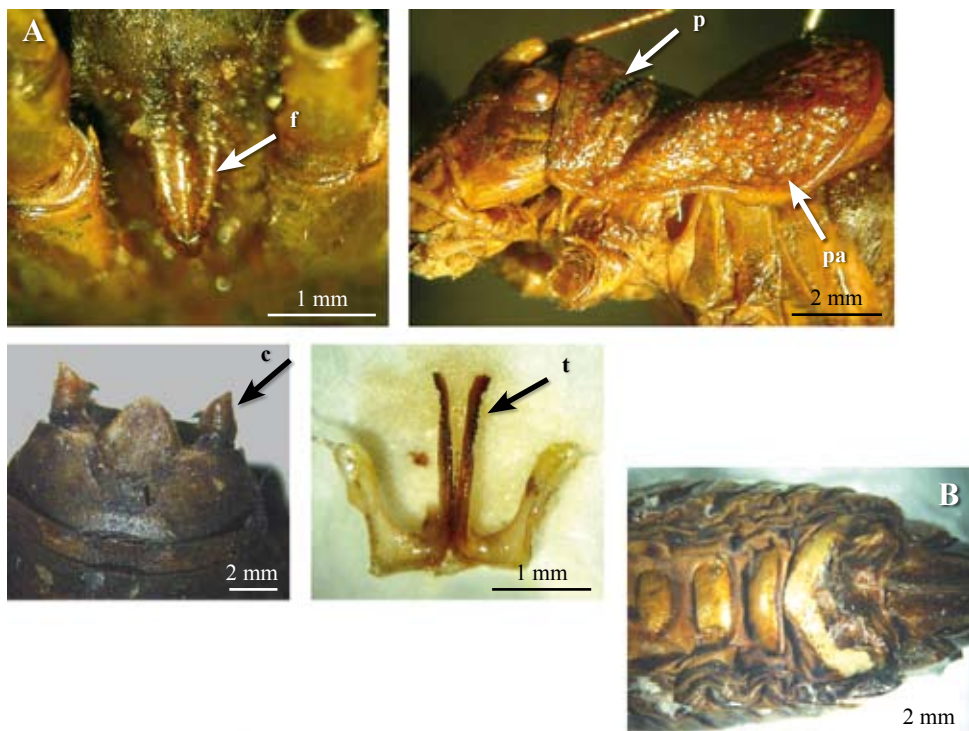


Fig. 6 – *Uromenus (Steropleurus) anapaulae* n. sp., A: male - fastigium verticis (f), pronotum (p), paranotum (pa), tip of abdomen with cercus (c), titillator (t), B: female - sternite pattern with horse-shoe-shaped callousity near SGP.

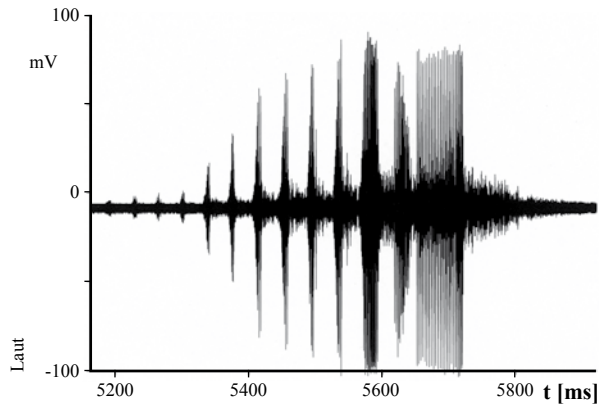


Fig. 7 – *Uromenus (Steropleurus) anapaulae* n. sp., male (allotype) collected in Leiria, calling song, recorded on 14.10.2000, 26°C at 14<sup>00</sup> h, with sunshine. The echemes lasted for 270-310 ms consisting of 11-13 syllables (7 records). The syllable sequence of an echeme lasted about 18 ms. After 3-4 very quiet syllables, the repetition became louder with a crescendo during the next 5-6 syllables to a maximum of 2-3 syllables after 2/3 of the echeme. The last syllable was about twice as long as the previous one; the repetition rate of the echemes varied between 8-12 s, evaluated by a PC programme at a speed of 9.5 cm/s, filter 2000 Hz.



Fig. 8 – *Platystolus (Neocallicrania) lusitanicus* male (A) (body length 37 mm) and the grass green female (C) (l = 30 mm), both collected near Bragança, and an olive green *P. (N.) selliger* male (E) (l = 22 mm) found near Vila Real; from both males, songs were recorded and are partly presented in figs 9 and 10.

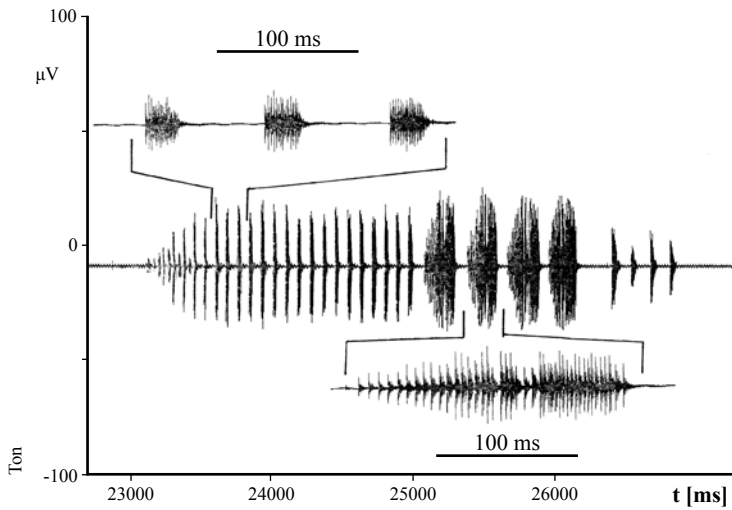


Fig. 9 – *Platystolus (N.) lusitanicus* initial male song consisting of 8-12 syllables lasting for about 1.8-2.2 s and showing a crescendo during the first 3-4 s. All the long closing hemisyllables, produced at night (22<sup>00</sup>), lasted slightly longer than 100 ms at 28°C, similarly to the intervals between them, which became a little shorter towards the end of the song. The echemes were repeated at variable intervals.

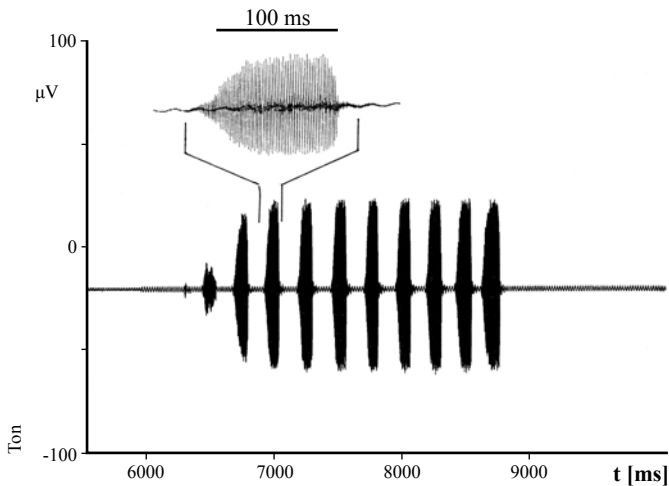


Fig. 10 – *Platystolus (N.) selliger sellige* male calling song consisting of echemes lasting between 2-3.8 s. Each echeme begun with a series of 10-24 very brief syllables (12 echemes of the same male were studied) of which the first 3-4 were diplosyllables produced at a rate of about 10/s and showing a crescendo during the first few. The brief syllables are followed immediately by (3)-4 much longer closing hemisyllables. These may in turn be followed by 3-4 shorter sounds, if a female is not present. Each of the short closing hemisyllables lasted for about 30 ms and the longer ones 200 ms. In the song of the male studied, the echemes were separated by variable intervals of 8-12 s.



*Omocestus (Dirshius) raymondi* (Yersin), Lisbon, Fonte da Telha, 12.10.1993, 30°C, 13<sup>00</sup>, filter: 1000 Hz



*Omocestus panteli* (Bolivar), Pinheira/Rio Sado, 26.04.1992, 30°C, 10<sup>30</sup>, filter: 1000 Hz



*Chorthippus (Glyptobothrus) apicalis* (H.-S.), Montemor-o-Novo, 25.04.1992, 30°C, 11<sup>00</sup>, filter: 1000 Hz



*Chorthippus (Glyptobothrus) jacobsi* Harz, SO Lisbon, 25.04.1992, 30°C, 12<sup>00</sup>, filter: 1000 Hz

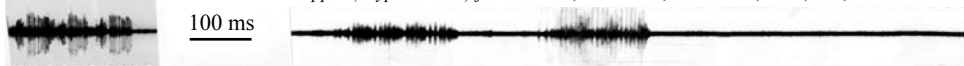


Fig. 11 – Oscillograms of male calling songs of four gomphocerine species; *Omocestus (Dirshius) raymondi*, two echemes of different individuals (1, 2) lasting for little longer than 1 s. Each echeme begins quietly, rapidly increasing in intensity. Both echemes show a characteristic pattern of gaps in the downstroke. *Omocestus panteli*: the echeme of the male calling song lasts for about 1-2 s and is more intensive than the courtship song shown in Fig. 11. The syllables (di: diplosyllable) were repeated at a rate of 20/s. The echeme begins quietly, sometimes with incomplete hemisyllables, but soon reaching maximum intensity. *Chorthippus (Glyptobothrus) apicalis* produces echemes of about 1.5 s. The syllables (di: diplosyllables) were repeated at a rate of 17-18/s. *Chorthippus (Glyptobothrus) jacobsi*, three individuals, a- Calling song showing 4-5 syllables (compare Ragge & Reynolds 1998), b<sub>1</sub>, b<sub>2</sub> and c<sub>1</sub>, c<sub>2</sub> two echemes of the rivalry song of two males b and c.

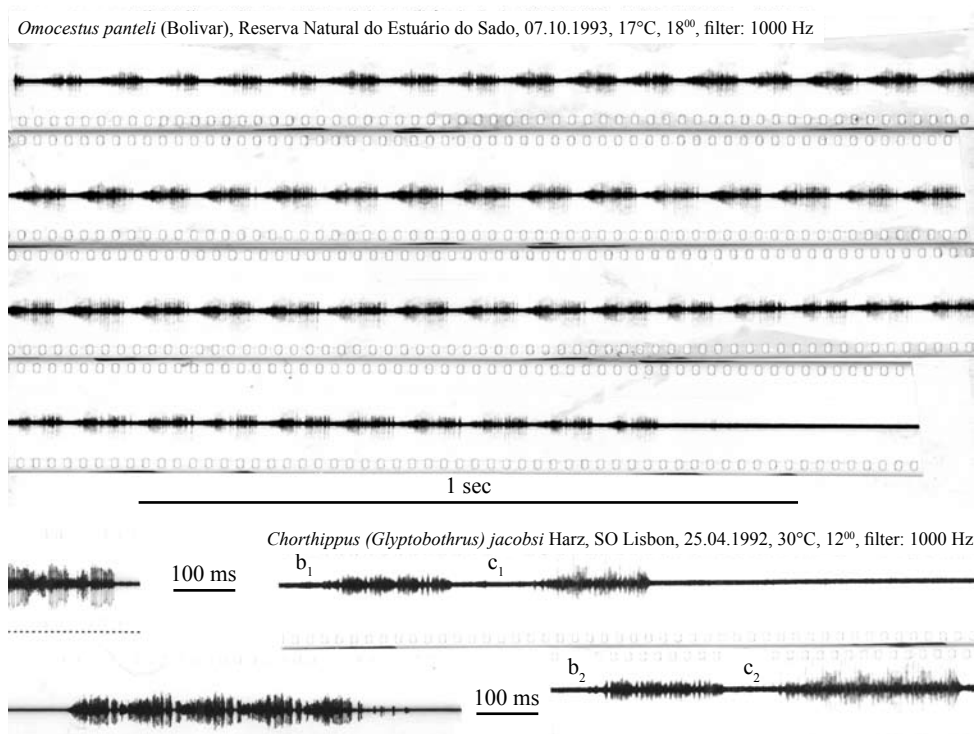


Fig. 12 – *Omocestus panteli*: oscillogram of the soft courtship song of a male sitting in front of a female, lasting for more than 5 s (compare Ragge & Reynolds 1998). The structure of an echeme is similar to that of the much shorter and louder calling song presented in fig. 11 and published by Schmidt (1999). Unlike the calling song, the successive diplosyllables (di) of the courtship song are very similar and both hemisyllables are not much different in intensity and length. No copulation took place.

ly showing a stronger Mediterranean influence in Spain than in Portugal. Thus, the composition of the salopteran fauna can be used as a climatic indicator (Schmidt 1970, 1989, 1996a, Schmidt & Schach 1978), when extensive and detailed faunistic data are available.

The salopteran fauna of Portugal includes different faunal elements namely Palearctic, Mediterranean, Maghrebian and Ethiopian genera. Furthermore, endemic, Atlantic and cosmopolitan genera are also present. The different groups are shown in tab. 2.

Considering the present distribution of the species recorded most of them are widespread in the Iberian Peninsula and in the Mediterranean zones of Europe and Africa. A relationship with the orthopteroid fauna

Tab. 2 – Biogeographical composition of the saltoperan species recorded in Portugal by us.

|                                      |                                     |   |
|--------------------------------------|-------------------------------------|---|
| HOLOPALEARCTIC (8 n)                 | <i>Chorthippus (G.) apicalis</i>    | <i>Sphingonotus rubescens</i>             |
| <i>Tettigonia viridissima</i>        | <i>Chorthippus (G.) binotatus</i>   | <i>Oedaleus decorus</i>                   |
| <i>Platycleis albopunctata</i>       | <i>Chorthippus (Ch.) jucundus</i>   | <i>Acrotylus patruelis</i>                |
| <i>Tetrix subulata</i>               | <i>Euchorthippus chopardi</i>       | <i>Acrotylus insubricus</i>               |
| <i>Tetrix undulata</i>               | <i>Euchorthippus pulv. gallicus</i> | <i>Aiolopus thalassinus</i>               |
| <i>Oedipoda caerulescens</i>         |                                     | <i>Aiolopus strepens</i>                  |
| <i>Omocestus rufipes</i>             | HOLOMEDITERRANEAN-                  | <i>Paracinema t. bisignata</i>            |
| <i>Myrmeleotettix maculatus</i>      | PONTIC (12 N)                       | <i>Calephorus compressiformis</i>         |
| <i>Omocestus stigmaticus</i>         | <i>Decticus a. albifrons</i>        | <i>Pyrgomorpha conica</i>                 |
|                                      | <i>Platycleis i. intermedia</i>     |   |
| WEST-MEDITERRANEAN-                  | <i>Platycleis (T.) tessellata</i>   | IBERIAN ENDEMIC (19 N)                    |
| MAGHREBIAN (22 n)                    | <i>Gryllus campestris</i>           | <i>Thyreonotus bidens</i>                 |
| <i>Odontura aspericauda</i>          | <i>Arachnocephalus vestitus</i>     | <i>Pterolepis spoliata</i>                |
| <i>Odontura spnlicauda</i>           | <i>Mogoplistes brunneus</i>         | <i>Ctenodecticus sp. a</i>                |
| <i>Cyrtaspis scutata</i>             | <i>Tetrix ceperoi</i>               | <i>Ctenodecticus sp. b</i>                |
| <i>Platycleis falx laticauda</i>     | <i>Paratettix meridionalis</i>      | <i>Uromenus (St.) pseudolus</i>           |
| <i>Platycleis sabulosa</i>           | <i>Pezotettix giornae</i>           | <i>Uromenus (St.) astericauda</i>         |
| <i>Rhacocleis grallata</i>           | <i>Locusta m. cinerascens</i>       | <i>Uromenus (St.) anapaulae</i>           |
| <i>Scobia lusitanica</i>             | <i>Chorthippus (G.) vagans</i>      | <i>Platystolus (N.) lusitanicus</i>       |
| <i>Mishtshentotettix brachyptera</i> |                                     | <i>Platystolus (N.) serratus</i>          |
| <i>Calliptamus wattenwylianus</i>    | MEDITERRANEAN-MAGHREBIAN-           | <i>Platystolus (N.) selliger selliger</i> |
| <i>Truxalis nasuta</i>               | ETHIOPIAN (16 N)                    | <i>Xya iberica</i>                        |
| <i>Oedipona fuscocincta</i>          | <i>Tylopsis lilifolia</i>           | <i>Jacobsiella imitans</i>                |
| <i>Sphingonotus c. corsicus</i>      | <i>Phaneroptera nana nana</i>       | <i>Arcyptera tornosi</i>                  |
| <i>Sphingonotus azurescens</i>       | <i>Conocephalus conocephalus</i>    | <i>Omocestus panteli</i>                  |
| <i>Acrotylus fischeri</i>            | <i>Ruspolia nitidula</i>            | <i>Stenobothrus festivus</i>              |
| <i>Morphacris f. sulcata</i>         | <i>Oecanthus pellucens</i>          | <i>Chorthippus p. erythronotus</i>        |
| <i>Omocestus (D.) raymondi</i>       | <i>Anacridium aegyptium</i>         | <i>Chorthippus (Gl.) jacobsi</i>          |
| <i>Dociolestes j. occidentalis</i>   | <i>Calliptamus barbarus</i>         | <i>Chorthippus (Gl.) yersini</i>          |

of Morocco is obvious. Compared with the data reported by Chopard (1943), only 14 species of Ensifera and 33 species of Caelifera were recorded in Portugal which were not found in North Africa. From the saltoperan species of the Iberian Peninsula, 45 % were recorded in Portugal.

Eight species can be considered as clearly palearctic faunal elements, which are essentially of Euro-Siberian origin. The holopalaearctic species are distributed throughout Europe up to Russia and North Africa, mainly

in mountainous regions. These species indicate the existence of a connection between the Iberian Peninsula and middle Europe, in spite of the mountainous barrier presented by the Pyrenees (Schmidt 2000).

Most of the saltopteran species found in Portugal have a Mediterranean distribution, from which 12 holomediterranean species were found around the Mediterranean Basin in Europe, Africa and Asia Minor, extending to southern Russia. Other 22 west mediterranean species are found mainly in the Iberian Peninsula, some reaching France and Italy and extending to Northwest Africa. Another group of these Mediterranean species inhabits the Iberian Peninsula only, however also extending to Morocco.

Some species occur only in the extreme West regions of Europe, like *Odontura spinulicauda*, *Leptoternis c. lusitanicus*, *Sphingonotus azureus*, *Morphacris f. sulcata*, where they probably arrived by crossing the landbridge that in the Miocen linked Europe with Africa. The Peninsula and Africa have been separated geographically since the Upper Miocene, when the Straits of Gibraltar were formed. Some of the species may have arrived by ship, later on.

About 16 species were found in the Mediterranean region which are distributed in North and East Africa, sometimes up to the far South, like *A. patruelis* and *A. thalassinus*. Most of them extend to Asia Minor and to southwestern Russia, like the holomediterranean-pontic species.

Most of the species considered to have originated in Africa actually consist of a mixture of representatives, including tropical, savanna, mountain, Mediterranean, and other forms. The comparatively few truly Ethiopian species found extending northwards to the Iberian Peninsula, can be considered as being of special interest, since they successfully transposed the Sahara desert, a natural barrier separating the Ethiopian region from palearctic North Africa. Such is the case of the phaneropterine genus *Tylopsis*, containing thamnophilous katyids, which are peculiar Ethiopian elements. *T. lilifolia*, however, is an exception since it occurs throughout the Mediterranean countries, extending into southwestern Russia and being widespread in the Iberian Peninsula, except in the North Meseta and drier plains. The subfamily Truxalinae is in strict sense, Ethiopian. The genus *Truxalis* is here of interest because certain species penetrate into Mediterranean Europe and southwestern Asia. Among them is *T. nasuta*, known outside Africa only from the southernmost part of Europe, like S Greece, S Italy, Sicilia, Sardinia, Spain and Portugal. All those saltopteran groups are made up of Ensifera and Caelifera.

From the 76 species recorded, 19 seem to be endemic for the Iberian Peninsula resulting from interactions between the various faunal elements in a highly diversified physical, climatic and biotic environment and from the isolation created by powerful barriers. These autoctonous species add up to approximately 25% of the Saltatoria species collected in Portugal. Considering the endemic species of the whole Peninsula (Gangwere & Morales Agacino 1970), 37% of 282 species (153 Ensifera, 129 Caelifera), present in Spain and Portugal are considered endemic. These species were not found in countries adjacent to the Peninsula. Some of these species are highly localized within a small area of a given province, others are found throughout a major region.

In Portugal, the species of the genera *Platystolus* and *Uromenus*, as well as some species of other genera of Bradyporidae, are mainly found in mountain ranges and can be faunistically considered among the most important ones. Some genera of Pamphagidae constitute another characteristic group, which is flightless and inhabit dry, chiefly desert and mountain areas, originating from North Africa and Spain. A similar distribution is shown by some Decticinae, Gryllinae, and by the also flightless genus *Odontura*, which is known from North Africa, Sicily and Iberian Peninsula (Messina 1981). Contrasting with these groups, the small oedipodine genus *Jacobsiella*, with one macropterous species, is only known from places near the Atlantic coast of Portugal, and the southwestern provinces of Spain. Its distribution is undoubtedly Atlantic, contrasting with that of the genus *Leptoternis*, from which *L. c. lusitanicus* only is restricted to the Atlantic coast of Portugal. Other species of this genus are found in Sardinia and in the Italian Peninsula (Schmidt 1996a, Schmidt & Herrmann 2001). *Omocestus*, a genus of gomphocerine grasshoppers from Europe, North Africa and Palearctic Asia, has among its species a subgroup that has evolved in association with the Iberian mountains. Each of these localized forms is practically brachypterous, especially the female, and is restricted to a particular mountain range, or even to one single mountain.

In our study, we could only record about 60 (58.5)% of the saltoteran species known for Portugal (76 of 130 species). However, nine species were reported for the first time for Portugal. Most of the species not found by us are endemisms belonging to the Pamphagidae and Bradyporidae, which are large, normally not abundant, and recorded mainly by chance. Table 3 presents 36 species of Ensifera and 18 species of Caelifera (totally 54 species) that we could not collect. The higher number of

Tab. 3 – Saltatoria species of Portugal not found by us, but reported by former authors

| ENSIFERA  | LOCALITY   | REFERENCES   |
|---|--|--|
| <i>Leptophyes punctatissima</i> (Bosc, 1792)                      | Trás-os-Montes, Alto Douro                                   | Miranda-Arabolaza & Barranco (2005)                                    |
| <i>Odontura (Odonturella) macphersoni</i> (Morales Agacino, 1943) | Serra da Estrela, N Portugal                                 | Gangwere & Morales Agacino (1970), Miranda-Arabolaza & Barranco (2005) |
| <i>Meconema thalassinum</i> (De Geer, 1773)                       | Coimbra  | Harz (1969)  |
| <i>Conocephalus (Xiphidium) discolor</i> (Thunberg, 1815)         | Ria Formosa, Trás-os-Montes, Alto Douro                      | Lock (1999), Miranda-Arabolaza & Barranco (2005)                       |
| <i>Metrioptera (Decorana) decorata</i> (Fieber, 1853)             | Monchique, 600-800 m, Serra do Suajo, Coimbra                | Harz (1969)  |
| <i>Rhacocleis lusitanica</i> (Bolivar, 1900)                      | Castelo Branco, Coruche, Aviz, Mora, Ponte de Sôr            | Harz (1969)  |
| <i>Antaxinus (Chopardia) flozei</i> Bolivar, 1899                 | Trás-os-Montes, Alto Douro                                   | Miranda-Arabolaza & Barranco (2005)                                    |
| <i>Thyreonotus corsicus</i> (Rambur, 1839)                        | in the North   | Harz (1969)  |
| <i>Saga pedo</i> (Pallas, 1771)                                   | Beja, Vila Nova de Milfontes                                 | Pinedo (1985)  |
| <i>Ephippigerida saurureiana</i> (Bolivar, 1878)                  | N Portugal   | Harz (1969)  |
| <i>Ephippigerida hispanica</i> (Bolivar, 1853)                    | S Portugal up to Coimbra                                     | Harz (1969)  |
| ° <i>Uromenus (St.) brunnerii</i> (Bolivar, 1877)                 | Ria Formosa  | Lock (1999)  |
| <i>Uromenus (St.) dilutus</i> (Bolivar, 1878)                     | Serra da Estrela, Serra do Marão, Trás-os-Montes, Alto Douro | Harz (1969), Lock (1999), Miranda-Arabolaza & Barranco (2005)          |
| <i>Uromenus (St.) flavovittatus</i> (Bolivar, 1878)               | S Portugal   | Harz (1969)  |
| <i>Uromenus (St.) stáli</i> (Bolivar, 1877)                       | Serra do Gerês   | Harz (1969)  |
| <i>Uromenus (Bol.) nobrei</i> (Bolivar, 1898)                     | Serra do Gerês, Serra da Estrela                             | Harz (1969)  |
| # <i>Platystolus (Neocallicr.) miegii</i> (Bolivar, 1873)         | Serra da Estrela: Covilhã                                    | Lock (1999)  |
| <i>Platystolus martinezi</i> (Bolivar, 1851)                      | ?  | Harz (1969)  |
| <i>Pycnogaster jugicola</i> Graells, 1851                         | Serra da Estrela: Guarda, Castelo Branco                     | Harz (1969), Lock (1999)   |
| <i>Pycnogaster cucullatus</i> (Charpentier, 1825)                 | Mora, Coruche (BA, AT)                                       | Harz (1969), Gangwere et al. 1985                                      |
| <i>Gryllus bimaculatus</i> (De Geer, 1773)                        | Southern coastal areas                                       | Lock (1999)  |
| <i>Acheta hispanicus</i> Rambur, 1839                             | Ria Formosa, Salir   | Lock (1999)  |

continued

|   |  |   |
|---|--|---|
| <i>Eumodicogryllus bordigalensis</i><br>(Latreille, 1802)     | Southern coastal area: wetland,<br>Trás-os-Montes, Alto Douro        | Lock (1999), Miranda-Arabolaza<br>& Barranco (2005) |
| <i>Svercus palmitorum</i> (Krauss, 1902)                      | Ria Formosa, coastal area  | Lock (1999)   |
| <i>Eugryllodes pipiens lusitanus</i><br>(Bolivar, 1894)       | Serra da Estrela   | Harz (1969)   |
| <i>Eugryllodes escalerae</i> (Bolivar, 1894)                  | Serra da Estrela   | Harz (1969)   |
| <i>Eugryllodes littoreus</i> (Bolivar, 1885)                  | near Tejo  | Harz (1969)   |
| <i>Gryllomorpha merobricensis</i><br>Fernandes, 1959          | Serra de Grândola, Monchique   | Harz (1969)   |
| <i>Nemobius sylvestris</i> (Bosc, 1792)                       | Serra da Estrela, W coast:<br>Odemira, Tras-os-Montes,<br>Alto Douro | Lock (1999), Miranda-Arabolaza<br>& Barranco (2005) |
| <i>Pteronemobius lineolatus</i> (Brulle, 1835)                | Trás-os-Montes, Alto Douro   | Miranda-Arabolaza &<br>Barranco (2005)              |
| <i>Pseudomogoplistes vicentae</i><br>Gorochov, 1995           | Praia do Castelejo, Cabo Raso<br>(Lisboa)                            | Gorochov (1995)                                     |
| <i>Pseudomogoplistes vicentae</i><br>Gorochov, 1996           | Algarve, Estremadura   | Gorochov & Llorente (2001)                          |
| <i>Gryllomorpha adspersa merobricensis</i><br>Fernandes, 1959 | Baixo Alentejo, Grândola   | Gorochov & Llorente (2001)                          |
| <i>Eugryllodes escalerae</i> (Bolivar, 1894)                  | Guarda, Serra Estrela  | Gorochov & Llorente (2001)                          |
| <i>Trigonidium cicindeloides</i><br>(Rambur, 1839)            | Ria Formosa, Odemira   | Lock (1999)   |
| ? <i>Gryllotalpa gryllotalpa</i><br>(Linnaeus, 1758)          | Ria Formosa, Serra da Estrela,<br>Trás-os-Montes, Alto Douro         | Lock (1999), Miranda-Arabolaza<br>& Barranco (2005) |

| CAELIFERA                                       | LOCALITY  | AUTOR  |
|---|---|--|
| <i>Tetrix ceperoi</i> Bolivar, 1887             | Aveiro, Esmoriz, Tras-os-<br>Montes, Alto Douro                         | Llorente & Presa (1981),<br>Miranda-Arabolaza &<br>Barranco (2005) |
| <i>Depressotetrix depressa</i> (Brisout, 1848)  | Trás-os-Montes, Alto Douro  | Miranda-Arabolaza &<br>Barranco (2005)                             |
| • <i>Uvarovitettix nodulosus</i> (Fieber, 1853) | Setúbal and coastal area  | Lock (1999)  |
| <i>Acinipe paulinoi</i> (Saussure, 1887)        | Ribeiro de Monchique,<br>Milfontes (BA), Picota,<br>Barranco dos Pisões | Llorente del Moral & Presa<br>Asensio (1997), Lock (1999)          |
| <i>Acinipe ignatii</i> (Presa & Llorente, 1982) | Santarém, Coruche, Ponte<br>de Sôr                                      | Llorente del Moral & Presa<br>Asensio (1997)                       |
| <i>Eumigus ayresi</i> (Bolivar, 1912)           | Serra da Estrela  | Harz (1975)  |
| <i>Euryparyphes stâlii</i> (Bormans, 1879)      | S Portugal  | Harz (1975)  |

continued

|   |   |   |
|---|---|---|
| <i>Ocnerodes fallaciosus</i> (Bolivar, 1912)                          | São Marcos da Serra (AG),<br>Monchique                  | Harz (1975), Lock (1999)                                  |
| <i>Ocnerodes prosternalis</i> Bolivar, 1912                           | Santarém: Cardigos, Malcata                             | Llorente del Moral & Presa<br>Asensio (1997); Lock (1999) |
| <i>Pyrgomorpha conica</i> (Olivier, 1791)                             | Trás-os-Montes, Alto Douro                              | Miranda-Arabolaza &<br>Barranco (2005)                    |
| <i>Calliptamus italicus</i> (Linné, 1758)                             | Trás-os-Montes, Alto Douro                              | Miranda-Arabolaza &<br>Barranco (2005)                    |
| * <i>Schistocerca gregaria</i> (Forskål, 1775)                        | Southern parts by invasion from<br>N Africa             | Gangwere & Morales Agacino<br>(1970)                      |
| <i>Eyprepocnemis plorans</i><br>(Charpentier, 1825)                   | Type Portugal (lost), Ria<br>Formosa                    | Harz (1975), Lock (1999)                                  |
| <i>Acridium</i> (= <i>Phophus</i> ) <i>stridulum</i><br>(Linné, 1758) | N Portugal, in mountains                                | Gangwere & Morales Agacino<br>(1970)                      |
| <i>Oedipoda charpentieri</i> Fieber, 1853                             | Alvor near Portimão                                     | Harz (1975)   |
| <i>Mioscirtus wagneri</i> Eversmann, 1859                             | Castro Marim (Algarve), Setúbal<br>(Lagoa de Albufeira) | Harz (1975), Presa (1979)                                 |
| <i>Leptoternis c. lusitanicus</i> Ebner, 1941                         | SE Portugal, Ria Formosa                                | Harz (1975), Lock (1999)                                  |
| <i>Dociostaurus maroccanus</i><br>(Thunberg, 1815)                    | Castelo Branco, Trás-os-Montes,<br>Alto Douro           | Lock (1999), Miranda-Arabolaza<br>& Barranco (2005)       |

# The revision of Pfau (1996) was not considered;

• After Harz (1969) nymph of *T. depressa*;

\* African species, not indigeous in Portugal;

? See Baccetti & Capra (1978);

° The specimen found at Ria Formosa has to be confirmed before *U. brunnerii* is considered as a Portuguese species.

long-horned species not recorded by us, like some shield-backed katylds, show the difficulties associated with their capture, since they live mainly on bushes and trees, or near the ground and often hide in scrubby vegetation. Gryllids are also particularly difficult to observe, because many species dwell beneath leaf litter and debris, or in galleries under stones. Pamphagidae prefer warm arid places, often uncultivated fields, which were not common in the regions surveyed by us.

Most of the literature data listed on tab. 3 were compiled by Harz (1969, 1975) and by Gangwere & Morales Agacino (1970), and in most cases a few individuals only were caught. However, the sampling methods used in our work do not allow for the capture of all species present in the Portuguese territory. On the other hand, our survey of the country was not exhaustive, and species such as flightless endemisms present in habitats restricted to specific areas, were not targeted by us.



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#### ABSTRACT

The saltopteran fauna of Portugal was studied between 1992-2000. Sampling took place during field trips, lasting yearly 5 to 14 days. Several southern, central and northern regions were visited at different times of the year. In total, 76 species (31 of Ensifera and 45 of Caelifera) were recorded, from which a C/E quotient of 1.45 was calculated. For some of the species caught, the song of the male was presented as additional taxonomic character. First records were made for nine species: *Tylopsis lilifolia*, *Conocephalus conocephalus*, *Platycleis falx laticauda*, two *Ctenodecticus* spp., *Mogoplistes brunneus*, *Tetrix subulata*, *Paracimena t. bisignata*. *Uromenus anapaulae* was found as new species and described.

Using literature data, the species of Saltatoria previously mentioned for Portugal were listed, and some notes added for insufficiently known species. The biogeography of the saltatoria fauna of Portugal is discussed in relation to its origin with the result that 19 (25%) species are endemic for the Iberian Peninsula.

#### ZUSAMMENFASSUNG

*Die Springschrecken-Fauna von Portugal: Neue Funde und biogeographische Aspekte (Orthopteroidea).*

Die Springschrecken wurden zwischen 1992-2000 jährlich während 5-14-tägiger Exkursionen zu verschiedenen Jahreszeiten in diversen Provinzen Portugals studiert. Zusätzlich wurden zahlreiche kurze Fahrten zu speziellen Lokalitäten in der Nähe von Lissabon und Vila Real unternommen, um Saltatoria zu sammeln. Insgesamt wurden 76 Arten (31 Ensifera- und 45 Caelifera-Arten) aufgefunden, woraus sich ein C/E-Quotient von 1,45 errechnet. Für einige Arten wurde der Männchengesang als zusätzliches taxonomisches Merkmal registriert. Neun der gefundenen Arten wurden bisher nicht für Portugal erwähnt, wie *Tylopsis lilifolia*, *Conocephalus conocephalus*, *Platycleis falx laticauda*, *Ctenodecticus 2* spp., *Mogoplistes brunneus*, *Tetrix subulata*, *Paracimena t. bisignata*. *Uromenus anapaulae* wurde als neue Art beschrieben.

Zur Beurteilung der gefundenen Anzahl von Arten wurden zusätzlich die Spezies aufgeführt und diskutiert, die von anderen Autoren in Portugal nachgewiesen, aber von uns nicht entdeckt wurden. Weniger bekannte Arten wurden näher spezifiziert. Basierend auf Literaturangaben wurde eine Herkunftsanalyse für die von uns in Portugal gefundenen Arten erstellt; 19 (25%) Spezies werden als endemisch für die Iberische Halbinsel angesehen.

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