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Pyrrhocoridae from the Iberian Peninsula (Hemiptera: Heteroptera)

L. MATA[1, 4], J. M. GROSSO-SILVA[2], M. GOULA[1, 3]

[1]Departament de Biologia Animal; Facultat de Biologia; Universitat de Barcelona (UB); Avda. Diagonal 643; 08028 Barcelona; Spain

[2]Centro de Investigação em Biodiversidade e Recursos Genéticos; Universidade do Porto (CIBIO-InBIO); 4485-661 Vairão; Portugal

[3]Institut de Recerca de la Biodiversitat (IRBio); Universitat de Barcelona (UB); Avda. Diagonal 643; 08028 Barcelona; Spain

[4]Corresponding author: E-mail: luismata3@gmail.com

Abstract

We summarize data from published entomological literature, collected specimens, field observations, and biodiversity web resources to review the state of knowledge regarding Pyrrhocoridae from the Iberian Peninsula, including their taxonomical diagnosis, contemporary systematics, general biology and geographic distribution. An identification key to species is provided, which includes characters that should assist in photographic identification.

Key words: Faunistics, firebugs, Heteroptera, Iberian Peninsula, *Pyrrhocoris apterus*, *Scantius aegyptius*, true bugs.

Resumen

Pyrrhocoridae de la Península Ibérica (*Hemiptera: Heteroptera*)

Presentamos una revisión del estado de conocimiento de la familia Pyrrhocoridae en la Península Ibérica, incluyendo aspectos concernientes a su taxonomía, sistemática, biología y distribución geográfica. Para ello, resumimos información tomada de la literatura entomológica, especímenes recolectados, observaciones de campo y recursos para la biodiversidad en la red. Además, proponemos una clave de identificación de especies, que incluye caracteres que ayudarán en la identificación fotográfica de las mismas.

Palabras clave: Faunística, pirrocóridos, Heteroptera, Península Ibérica, *Pyrrhocoris apterus*, *Scantius aegyptius*, chinches.

Laburpena

Iberiar Penintsulako Pyrrhocoridae (*Hemiptera: Heteroptera*)

Iberiar Penintsulako Pyrrhocoridae familiari buruzko ezagueraren azterketa aurkezten dugu, taxonomia, sistematika, biologia eta banaketa geografikoa aintzat hartuz. Horretarako, literatura entomologikotik, harrapatutako aleetatik, landa-behaketetatik eta sarearen biodibertsitaterako baliabideetatik hartutako informazioa laburbildu dugu. Espezieak identifikatzeko klabe bat ere proposatzen dugu, bertan argazki bidezko identifikazioan lagunduko duten karaktereak sartu direlarik.

Gako-hitzak: Faunistika, pirrokoridoak, Heteroptera, Iberiar Penintsula, *Pyrrhocoris apterus*, *Scantius aegyptius*, zimitzak.

Introduction

The Pyrrhocoridae Amyot & Serville 1843, commonly called cotton stainers or firebugs, are a family of primarily granivorous or frugivorous terrestrial heteropteran bugs presenting a worldwide distribution. They are represented by 33 genera and 340 species (Henry, 2009), of which 13 and 43, genera and species respectively, live in the Palaearctic Region (Kerzhner, 2001). In the Iberian Peninsula, only two species of pyrrhocorids have been recorded: *Pyrrhocoris apterus* (Linnaeus, 1758) and *Scantius aegyptius* (Linnaeus, 1758). Of the latter two subspecies are recognized: *S. aegyptius aegyptius* (Linnaeus, 1758) and *S. aegyptius rossii* Carapezza, Kerzhner & Rieger, 1999.

Pyrrhocorids, notwithstanding their vivid aposematic coloration and ubiquity in most terrestrial habitats, tend to be overlooked in faunistic and ecological studies. In fact, their precise distribution in the Iberian Peninsula has to date never been reported. Here we address this issue by providing a general review of the Pyrrhocoridae from the Iberian Peninsula, including their taxonomical diagnosis, contemporary systematics, general biology and geographic distribution. We summarize data from published entomological literature (55 papers), field material (over a 110 new records and observations), and three web resources (284 curated photographs). We also provide an identification key to species, which includes characters that should assist in photographic identification.

Methods

As indicated above, we limit the scope of this review to the Iberian Peninsula. With an area of approximately 6×10^6 km^2, the Iberian Peninsula is bordered by the Atlantic Ocean (N, NW, W, SW) and Mediterranean Sea (S, SE, E), and separated from the rest of the Eurasian continent by the natural border constituted by the mountain range known as the Pyrenees. For the purpose of this work we considered the Iberian Peninsula to be divided into 67 spatial units: Andorra, the 18 continental districts of Portugal, and the 47 continental provinces of Spain plus the Balearic Islands (Fig. 1). The British overseas territory of Gibraltar and the French area known as French Cerdagne, which account for approx. 0.1% of the Iberian Peninsula territory, were not considered part of the study area. In the few cases when a species had been recorded in Gibraltar it was assigned to the Spanish province of Cádiz. To find records of *P. apterus* and *S. aegyptius* from the Iberian Peninsula, we searched the entomological literature spanning the timeframe between the years 1856 and 2012. New material and observations presented here, with a couple of exceptions, comes from fieldwork conducted by the authors between April 1996 and October 2013. Specimens are currently in the collections of José Manuel Grosso-Silva (JMGS), Luis Mata (LM) and the Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto (CIBIO-UP). To complement records coming from the literature and fieldwork, we curated 284 photographs from three different web resources: (1) The Encyclopedia of Life, an open-access, collaborative project that aims at documenting all living species known to science (Wilson, 2003; Encyclopedia of Life, 2012); (2) Heteroptera from the Iberian Peninsula, a photographic biodiversity resource started and curated by the authors (Heteroptera from the Iberian Peninsula, 2013); and (3) Biodiversidad Virtual, a citizens' platform compiling biodiversity data through georeferenced photography (Biodiversidad Virtual, 2012).

In the Results section below, the distribution of *P. apterus* and *S. aegyptius* in Andorra, Portugal and/or Spain is indicated by the three letter abbreviations AND, POR and/or SPA, respectively. These abbreviations are followed by the full names in alphabetical order of the districts (POR) or provinces (SPA) where the species is documented to occur. The names of the spatial units may be accompanied by the following symbols:

! indicates a new record for the district/province as documented in the present work.

* indicates the species is documented in the given district/province exclusively by one (or more) photographic record(s).

To develop the distribution maps, we first generated a base map of the Iberian Peninsula by downloading open-access shapefiles for Andorra, Portugal, and Spain from the Global Administrative Areas spatial database (Global Administrative Areas, 2012), for the country, district and province levels, respectively, and merged them using a GIS (ArcGIS version 10.1). This base map was loaded into R (R Development Core Team, 2012) using package maptools (Lewin-Koh and Bivand, 2012). We then generated the maps, by calling the method «spplot» in package sp (Pebesma and Bivand, 2005), which plotted the maps filling

Figure 1. The Iberian Peninsula. For the purpose of this work we considered the Iberian Peninsula to be divided into 67 spatial units: Andorra (1), the 18 continental districts of Portugal (2-19), and the 47 continental provinces of Spain (20-66) plus the Balearic Islands (67).

the polygons (*i.e.*, country, districts or provinces) according to the species occurrence data contained in our pyrrhocorid species dataset.

Results

Pyrrhocoridae Amyot & Serville, 1843

Diagnosis

General: body length between 8 and 10 mm, aposematically colored in red and black (Figs. 2-3), ocelli absent, metathoracic scent-gland openings small, macropterous (Fig. 2), brachypterous (Fig. 3) or micropterous. Head: black, prognathe, clypeus longer than head, bucculae narrow. Antennae: black, 4-segmented, 2nd antennomere longer than 3rd. Rostrum: 4-segmented, reaching metacoxae. Pronotum: red (margins) and black (disc) bicolored, trapezoidal. Scutellum: black, triangular. Coria: red (background) and black (roundish spots) bicolored, sclerified, softly punctuated. Membranes: black, eleven or more anastomosing veins present, reaching or surpassing the apex of abdomen (macropterous, Fig. 2); or largely reduced, leaving the last abdominal segments exposed (brachypterous, Fig. 3). Femora: black, profemora thickened and presenting 3-4 spines. Tibiae: black, cylindrical. Tarsi: black, 3-segmented, pretarsi presenting claws and parempodia.

Abdomen: sternites almost entirely black (*Pyrrhocoris*, Fig. 4, left) or red (*Scantius*, Fig. 4, right); tergites black (background) and red (last two segments) (*Pyrrhocoris*), or red (*Scantius*); connexiva red, laterally over-reaching coria and membranes. Male genitalia: parameres paired and symmetrical. Female genitalia: ovipositor platelike.

Some recent phylogenetical studies on Pentatomomorpha (Henry, 1997) point to a close relationship between Pyrrhocoridae and Largidae (not present in the Iberian Peninsula), Coreoidea, Idiostoloidea (not present in the Iberian Peninsula or Palaearctic Region) and Lygaeoidea, thus we anticipate that pyrrhocorids might be confused with some bugs within these taxa. In the context of the Iberian heteropterofauna, the latter becomes especially true with the presence of other red and black aposematically-colored species such as the rhopalid *Corizus hyoscyami* (Linnaeus, 1758), the oxycarenid *Oxycarenus lavaterae* (Fabricius, 1787), and lygaeids of the genera *Cosmopleurus*, *Graptostethus*, *Horvathiolus*, *Lygaeus*, *Melanocoryphus*, *Spilostethus* and *Tropidothorax*. All of these taxa present conspicuous ocelli whereas ocelli are absent in pyrrhocorids. Thus, lack of ocelli in *P. apterus* and *S. aegyptius* can be used as a diagnostic morphological character to distinguish them from the other similarly red and black aposematically-colored sympatric species.

Morphological characters used to prepare this diagnostic synthesis are extensively documented by Henry (1988, 1997), Moulet (1995) and Schuh and Slater (1995).

Systematics

As a taxon, pyrrhocorids were first recognized by Amyot and Serville (1843) under the name Pyrrhocorides. Most recent phylogenetical research places the Pyrrhocoridae and Largidae under the Pyrrhocoroidea superfamily, which in turn is placed under the Pentatomomorpha infraorder (Henry, 1997). To date, there is no agreement regarding subfamilial or tribal classifications for the Pyrrhocoridae, therefore we will not follow any in this work. Present day genera *Pyrrhocoris* and *Scantius* were established by Fallén (1814) and Stål (1865), respectively. In the Palaearctic Region, six species of *Pyrrhocoris* and two of *Scantius* are known to science (Kerzhner, 2001). Both species present nowadays in the Iberian Peninsula, *P. apterus* and *S. aegyptius*, were described by Linnaeus (1758) as *Cimex apterus* and *Cimex aegyptius*, respectively. Two subspecies of *S. aegyptius* are recognized: *S. aegyptius aegyptius* (Linnaeus, 1758) and *S. aegyptius rossii* Carapezza, Kerzhner & Rieger, 1999 (Carapezza, 1995; Carapezza *et al.*, 1999). Both subspecies are recorded from the Iberian Peninsula; however, to date, the latter has only been cited in the provinces of Barcelona and Gerona (E. Ribes and J. Ribes, 2001; Goula and Mata, 2011).

Biology

Most knowledge about the life history and behavior of pyrrhocorids from the Iberian Peninsula comes from research on *P. apterus*, as reviewed by Socha (1993), Moulet (1995) and Schaefer and Ahmad (2000). Characterized by their adaptation to feed on seeds and fruits of Malvales (*e.g.*, Malvaceae and Tiliaceae), pyrrhocorids remain, nonetheless, omnivorous. Thus, besides their plant polyphagy, cases of zoophagy, necrophagy, and cannibalism have also been reported. Living mostly on the ground (*e.g.*, on the upper layer of the soil, under fallen leaves, on rock crevices, on tree bark crevices close to the ground), they are also found feeding and reproducing upon the vegetation. Life cycle takes between 2 and 3 months. Adult expected life span varies from two months to one year. Normally, they develop only one generation per year; however, polyvoltinism might be induced by seasonal changes of temperature and photoperiod. Immature stages can aggregate following visual and chemical stimuli. Known parasites include kinetoplastid flagellates, microsporidians, mermithid worms and mites. Pyrrhocorids are predated by ants, amphibians, birds and even mammals. The ease with which *P. apterus* is reared under experimental conditions, has gained the species a significant importance as a model organism in biological research.

Identification key

Following we propose an identification key to the adult species of Pyrrhocoridae from the Iberian Peninsula bioregion. Our aim is to provide a key that may be equally useful to identify collected and photographed specimens, thus we complement the key by Moulet (1995) with characters observable in the dorsum of the body, namely the size and location of the corial spots. Identification of *Scantius aegyptius* subspecies requires the observation of parameres (♂) and gonocoxites (♀), as has been previously documented and illustrated by Carapezza *et al.* (1999).

Key to species of Pyrrhocoridae from the Iberian Peninsula

(1) Abdominal sternites almost entirely black (Fig. 4, left). Coria presenting both a small (anterior) and a large (posterior) roundish dark spot (Fig. 3). Macropterous, brachypterous (Fig. 3) or micropterous. Body length between 9.0 and 9.5 mm . . . . . *Pyrrhocoris: P. apterus*

– Abdominal sternites almost entirely red (Fig. 4, right). Coria presenting towards its post-median region a medium-sized dark roundish spot. Always macropterous (Fig. 2). Body length between 8.0 and 10.0 mm . . . . . *Scantius: S. aegyptius*

Figure 2. *Scantius aegyptius* (Linnaeus, 1758). In-situ digital macro-photograph. Barcelona province, Spain. Photo courtesy of J.M. Sesma.

Figure 3. *Pyrrhocoris apterus* (Linnaeus, 1758). Dorsal view (brachypterous). Illustration by Aleksandar Stojanović, with permission by Ljiljana Protić.

Figure 4. Ventral abdominal segments in pyrrhocorids from the Iberian Peninsula. In *Pyrrhocoris apterus* (left) the sternites are almost entirely black, whereas in *Scantius aegyptius* (right) they are predominantly reddish but might present black spots. Both specimens represented are males.

Pyrrhocoris apterus (Linnaeus, 1758)

Pyrrhocoris apterus is a Holarctic species (Kerzhner, 2001). In the Iberian Peninsula it has been recorded in (Fig. 5):

AND POR: Aveiro! Beja Braga Bragança Coimbra Évora Faro Guarda Leiria Lisboa Portalegre Porto Santarém! Setúbal! Viana do Castelo! Viseu. SPA: Álava! Albacete* Alicante Almería Asturias Badajoz* Baleares Barcelona Burgos Cáceres* Cádiz Cantabria* Castellón* Ciudad Real* Cuenca Gerona Granada* Guadalajara* Guipúzcoa* Huelva! Huesca* La Coruña La Rioja León* Lérida Lugo Madrid Málaga Murcia* Navarra* Orense* Palencia* Pontevedra Salamanca* Segovia* Sevilla Soria* Tarragona Teruel* Toledo* Valencia Valladolid* Vizcaya Zamora* Zaragoza.

Bibliographic records

Alicante: Español (1965), J. Ribes and Sauleda (1979). **Andorra:** Kerzhner (2001). **Baleares:** Moragues (1894), Saunders (1901), Sánchez (1920), J. Ribes (1965, 1984). **Barcelona:** Bolívar and Chicote (1879), Cuní (1888, 1897), Sánchez (1920), Codina (1926), Wagner (1960a), J. Ribes and Goula (1995), E. Ribes and J. Ribes (2001), J. Ribes and E. Ribes (2001), J. Ribes *et al.* (2004), Gessé and Goula (2006), Gessé (2011), Pérez Valcárcel and Prieto Piloña (2012a). **Beja:** Oliveira (1896), Seabra (1929, 1939b). **Bragança:** Seabra (1926, 1939b). **Burgos:** Codina (1925). **Cádiz:** J. Ribes (1967). **Coimbra:** Oliveira (1896), Seabra (1929, 1939a, 1939b). **Cuenca:** Champion (1902). **Évora:** Lethierry (1877), Seabra (1939b). **Faro:** Lethierry (1877), Oliveira (1896), Seabra (1929, 1939b), Pissarro (1951). **Gerona:** Cuní (1885), Español (1964), J. Ribes and Goula (1995), J. Ribes *et al.* (2004). **Granada**: Wagner (1960b). **Guarda:** Seabra (1939a, 1939b). **La Coruña:** Pérez Valcárcel and Prieto Piloña (2012b). **Leiria:** Lethierry (1877), Oliveira (1896), Seabra (1929, 1930, 1939a, 1939b). **Lérida:** Sánchez (1920), J. Ribes (1972), J. Ribes *et al.* (2004). **Lisboa:** Lethierry (1877), Oliveira (1896), Seabra (1929, 1939b). **Lugo:** Pérez Valcárcel and Prieto Piloña (2012b). **Madrid:** Bolívar and Chicote (1879), Fernández (1893). **Málaga:** Rosenhauer (1856), Vela and Bastazo (1986). **Pontevedra:** Pérez Valcárcel and Prieto Piloña (2012b). **Portalegre:** Seabra (1939b). **Porto:** Oliveira (1896), Grosso-Silva and Soares-Vieira (2009). **Sevilla:** Bolívar (1895). **Tarragona:** Jiménez *et al.* (2003), J. Ribes *et al.* (2004), Piñol *et al.* (2008). **Valencia:** Bolívar and Chicote (1879), Wagner (1960a), Docavo (1987). **Viseu:** Oliveira (1896), Seabra (1929). **Zaragoza:** Bolívar and Chicote (1879), Dusmet (1897), Laguna (1902), J. Ribes *et al.* (1997), Murria (2001).

Cuní (1881) cited the species in «La Cerdanya española», which makes reference to the present day shire of «Baixa Cerdanya» (belonging to both Gerona and Lérida provinces). Likewise, Martorell (1879) cites it from «Cataluña media», which may refer to more than one province.

Photographic records

BV: Biodiversidad Virtual, 2012.
EOL: Encyclopedia of Life, 2012.
HIP: Heteroptera from the Iberian Peninsula, 2013.

Albacete: BV. **Alicante:** BV. **Almería:** HIP. **Asturias:** BV. **Badajoz:** BV. **Baleares:** BV. **Barcelona:** BV. **Braga:** HIP. **Burgos:** BV. **Cáceres:** BV. **Cádiz:** BV. **Cantabria:** BV. **Castellón:** BV. **Ciudad Real:** BV. **Cuenca:** BV. **Faro:** EOL, HIP. **Gerona:** EOL, HIP. **Granada:** BV. **Guadalajara:** BV. **Guipúzcoa:** BV. **Huesca:** BV. **La Coruña:** BV. **La Rioja:** BV. **Leiria:** HIP. **León:** BV. **Lérida:** BV. **Lisboa:** HIP. **Lugo:** HIP. **Madrid:** BV. **Málaga:** BV. **Murcia:** BV. **Navarra:** BV. **Orense:** BV. **Palencia:** BV. **Pontevedra:** BV. **Salamanca:** BV. **Segovia:** BV. **Sevilla:** BV. **Soria:** BV. **Tarragona:** BV. **Teruel:** BV. **Toledo:** BV. **Valencia:** BV. **Valladolid:** BV. **Vizcaya:** BV. **Zamora:** BV. **Zaragoza:** BV.

Field records

M and S superscript indicate municipality and shire, respectively.

Álava: Valderejo Natural Park, Valdegovía^{M}, 31/05/2012, E. Palma & LM leg., LM det., 1 brachypterous male on herbaceous vegetation. **Almería:** La Cañada, Almería^{M}, 12/11/2006, M.D. Rodríguez leg., LM det., 2 brachypterous males inside greenhouse. **Asturias:** Valle del Lago, Somiedo Natural Park, Somiedo^{M}, 07/09/2012, LM leg. & det., 1 brachypterous male on herbaceous vegetation. **Aveiro:** Esteiro de Salreu, Estarreja^{M}, UTM 29TNF3508, 26/05/2005, JMGS leg. & det., CIBIO-UP col., 1 adult. Argoncilhe, Santa Maria da Feira^{M}, UTM 29TNF3742, 26/04/2012, JMGS det., 4 adult specimens observed. Mosteirô, Santa Maria da Feira^{M}, UTM 29TNF3927, 24/07/2011, JMGS det., 1 adult specimen observed. Santa Maria da Feira (city), Santa Maria da Feira^{M}, UTM 29TNF3830, 09/08/2009, JMGS det., 1 adult specimen observed. **Barcelona:** Avinguda del Castell, Montjuïc, Barcelona^{M}, Barcelonès^{S}, UTM 430137 E / 4579786 N, 02/05/2010, LM leg. & det., 1 brachypterous male on ruderal herbaceous vegetation. Collserola Natural Park, Barcelona^{M}, Barcelonès^{S}, 20/01/2008,

LM leg. & det., 1 brachypterous female. Experimental fields of the University of Barcelona, Les Corts, Barcelona[M], Barcelonès[S], 02/04/2008, LM leg. & det., 1 brachypterous male on ruderal herbaceous vegetation; 13/12/2010, Hasna E. leg., LM det., 1 brachypterous female & 1 brachypterous male inside greenhouse. Figueró, Figaró-Montmany[M], Vallès Oriental[S], 13/08/2011, LM leg. & det., 1 brachypterous female. Jardinet de l'Om, Les Corts, Barcelona[M], Barcelonès[S], UTM 426553 E / 4582037 N, 08/02/2008, LM leg. & det., 3 brachypterous females; 21/04/2008, LM leg. & det., 1 macropterous male; 09/12/2010, LM leg. & det, 1 brachypterous female. La Coromina, Sant Quirze de Besora[M], Osona[S], 07/03/2013, LM leg. & det., 1 brachypterous female and 1 brachypterous male on ruderal herbaceous vegetation. La Pedra, Santa Sussana[M], Maresme[S], UTM 475987 E / 4609379 N, 29/04/2010, LM leg. & det., 1 brachypterous female on ruderal herbaceous vegetation. Mas Nualard, Moianès, Collsuspina[M], Osona[S], UTM 431305 E / 4632710 N, 07/06/2012, LM & M. Goula leg., LM det., 1 brachypterous female & 1 immature on ruderal herbaceous vegetation. **Braga:** Merelim (S. Paio), Braga[M], UTM 29TNG4403, 06/11/2004, JMGS det., 1 adult specimen observed. Beach 1 km south of Apúlia, Esposende[M], UTM 29TNF1891, 17/05/2006, JMGS det., 2 adult specimens observed. Vila do Gerês, Terras de Bouro[M], UTM 29TNG6920, 19/09/2003, JMGS & P. Soares-Vieira det., 1 adult specimen observed. **Bragança:** Bragança (city), on and near the castle's walls, Bragança[M], UTM 29TPG8630, 24/08/2008, JMGS det., approx. 200 adult and immature specimens observed. Fundo do Campo Redondo, Bragança[M], UTM 29TPG8329, 15/10/2011, JMGS det., approx. 20 adult specimens observed. Barrocal do Douro, Miranda do Douro[M], UTM 29TQF2185, 26/03/2007, S. Ferreira leg., JMGS det., CIBIO-UP col., 1 adult specimen. Near Constantim, Miranda do Douro[M], UTM 29TQG2612, 09/05/2007, S. Ferreira & P. Sousa leg., JMGS det., CIBIO-UP col., 1 adult specimen. Near Felgueiras, Torre de Moncorvo[M], UTM 29TPF6657, 10/05/2005, S. Ferreira leg., JMGS det., CIBIO-UP col., 2 adult specimens. Near Ribeirinha, on river Tua's banks, Vila Flor[M], UTM 29TPF4781, 24/07/2006, JMGS det., 6 adult specimens observed. Moimenta, Vinhais[M], UTM 29TPG6746, 02/06/2005, JMGS leg. & det., CIBIO-UP col., 1 adult specimen. **Burgos:** Cillaperlata[M], 31/03/2013, LM leg. & det., 1 brachypterous female and 1 macropterous male on ruderal herbaceous vegetation; 29/09/2013, LM det., 1 adult specimen observed. Oña[M], 30/03/2013, LM leg. & det., 1 brachypterous female on ruderal herbaceous vegetation. Salas de Bureba[M], 21/09/2012, LM leg. & det., 1 macropterous male on ruderal herbaceous vegetation. **Cádiz:** Playa de la Barrosa, Chiclana de la Frontera[M], UTM 29SQA52, 28/04/2005, JMGS leg. & det., CIBIO-UP col., 2 adult specimens observed. **Faro:** Amado Beach, Aljezur[M], UTM 29SNB0813, 06/09/2005, JMGS det., 1 adult specimen observed. **Gerona:** Aiguamolls de l'Empordà Natural Park, Alt Empordà[S], 29/03/2008, LM leg. & det., 1 brachypterous male. Port Lligat, Cadaqués[M], Alt Empordà[S], 09/06/2010, LM leg. & det., 1 brachypterous female on ruderal herbaceous vegetation. **Guarda:** Vilar de Amargo, Figueira de Castelo Rodrigo[M], UTM 29TPF6734, 10/04/2004, JMGS & P. Soares-Vieira det., 1 adult specimen observed. Fonte Santa, Manteigas[M], UTM 29TPE2371, 03/09/2003, JMGS det., 1 adult specimen observed. Almendra, Vila Nova de Foz Côa[M], UTM 29TPF64, 08/04/1996, JMGS det., 3 adult specimens observed, 02/11/1996, JMGS leg. & det., 1 adult specimen. Quinta da Ervamoira, Vila Nova de Foz Côa[M], UTM 29TPF54, 25/03/2002, JMGS det., 10 adult specimens observed. Senhora do Campo, Almendra[S], Vila Nova de Foz Côa[M], UTM 29TPF6642, 22/08/1997, JMGS leg. & det., 1 adult specimen. **Huelva:** Camping El Madroñal, Fuenteheridos[M], 02/10/2013, LM leg. & det., 1 brachypterous female and 5 brachypterous males on ruderal herbaceous vegetation. **La Rioja:** Enciso[M], 16/10/2008, LM leg. & det., 2 brachypterous males on ruderal herbaceous vegetation. **Leiria:** Foz do Arelho, Caldas da Rainha[M], UTM 29SMD8164, 22/06/2006, JMGS leg. & det., 1 adult specimen. **Lisboa:** Casal do Bufo, Peral[S], Cadaval[M], UTM 29SMD9544, 25/08/2007, JMGS det., 1 adult specimen observed. **Lugo:** Baralla[M], Los Ancares[S], 09/09/2012, LM leg. & det., 1 brachypterous male. Carretera LU-40, 09/09/2012, LM leg. & det., 1 brachypterous male on oldfield herbaceous vegetation. Lugar de Importancia Comunitaria Carballido, Fonsagrada[S], 09/09/2012, LM leg. & det., 1 brachypterous females on ruderal herbaceous vegetation. Milleiros, Carballedo[M], Chantada[S], 09/09/2012, E. Palma & LM leg., LM det., 1 brachypterous male on oldfield herbaceous vegetation. **Portalegre:** Herdade da Comenda, Elvas[M], UTM 29SPD6907, 05/06/2008, JMGS leg. & det., CIBIO-UP col., 1 adult specimen + approx. 20 adult specimens observed. **Porto:** Matosinhos, near the city hall, Matosinhos[M], UTM 29TNF2659, 02/03/2009, JMGS det., 1 adult specimen observed, 06/06/2009, JMGS det., 10 adult specimens observed. Paços de Ferreira Urban Park, Paços de Ferreira[M], UTM 29TNF5269, 02/02/2006, JMGS det., approx. 35 adult specimens observed. Palácio de Cristal gardens, Porto[M], UTM 29TNF3155, 12/02/2009, JMGS det., 2 adult specimens observed. Porto Botanical Garden, Porto[M], UTM 29TNF3056, 26/10/2005, JMGS det., 10 adult specimens observed. Porto (city), Porto[M], UTM 29TNF2657, 22/09/1996, JMGS det., 2 adult specimens observed. Porto (city), Porto[M], UTM 29TNF2956, 30/04/1994, JMGS leg. & det., 1 adult specimen. Porto (city), Porto[M], UTM 29TNF3056, 09/03/2011, JMGS det., 1 adult specimen observed. Porto (city), Porto[M], UTM 29TNF3355, 23/04/2006, JMGS det., 1 adult specimen observed. Porto (city), Porto[M], UTM 29TNF3358, 23/05/2005, JMGS det., 2 adult specimens observed. Seixal, S. Romão do Coronado[S], Trofa[M], UTM 29TNF3770, 02/06/2008, JMGS det., approx. 20 adult specimens observed, 08/04/2010, JMGS det., 1 adult specimen observed. Vila Beatriz, Ermesinde (city), Valongo[M], UTM 29TNF3762, 16/10/2010, JMGS det., 3 adult specimens observed. Mindelo[S], coastal dune area, Vila do Conde[M], UTM 29TNF2173, 27/04/2012, JMGS det., 1 adult specimen observed. Mindelo[S], coastal dune area, Vila do Conde[M], UTM 29TNF2274, 21/10/2009, JMGS & W. Rabitsch det., 1 adult specimen observed. Vairão (Agricultural Campus), Vila do Conde[M], UTM 29TNF2775,

28/04/2006, JMGS det., 1 adult specimen observed. Gaia Biological Park, Avintes[S], Vila Nova de Gaia[M], UTM 29TNF3749, 28/08/2009, JMGS det., 2 adult specimens observed, 06/05/2010, JMGS det., 1 adult specimen observed, 05/07/2011, JMGS det., 1 adult specimen observed. Parque das Tílias, Seixezelo[S], Vila Nova de Gaia[M], UTM 29TNF3742, 25/05/2011, JMGS det., 1 adult specimen observed, 11/06/2011, JMGS det., 2 adult specimens observed, 05/08/2011, JMGS det., 1 adult specimen observed, 22/03/2012, JMGS det., 3 adult specimens observed, 04/04/2012, JMGS det., 1 adult specimen observed, 31/01/2013, JMGS det., 1 adult specimen observed. Vendas school, Seixezelo[S], Vila Nova de Gaia[M], UTM 29TNF3742, 21/03/2011, JMGS det., 3 adult specimens observed. **Santarém:** Alvega[S], Abrantes[M], UTM 29SND8269, 24/06/2006, JMGS det., 1 adult specimen observed. Reguengo, Almeirim[M], UTM 29SND3043, 23/06/2006, JMGS det., 1 adult specimen observed. Near Praia das Cismeiras, Alpiarça[M], UTM 29SND3244, 23/06/2006, JMGS det., 10 adult specimens observed. Golegã[S], Golegã[M], UTM 29SND4561, 23/06/2006, JMGS det., 1 adult specimen observed. Anteporta, near Vale da Mata, Rio Maior[M], UTM 29SND0648, 15/04/2006, JMGS det., 1 adult specimen observed. Casais da Cartaxa, Abuxanas, Rio Maior[M], UTM 29SND0250, 01/11/2011, JMGS det., approx. 20 adult specimens observed. Casais dos Silvas, Rio Maior[M], UTM 29SND0351, 14/05/2004, JMGS det., 1 adult specimen observed, 01/01/2006, JMGS det., 1 adult specimen observed, 22/06/2006, JMGS det., 1 adult specimen observed, 17/08/2008, JMGS det., 1 adult specimen observed, 28/06/2009, JMGS det., approx. 10 adult specimens observed, 11/10/2009, JMGS det., approx. 10 adult specimens observed, 31/10/2009, JMGS det., approx. 10 adult specimens observed, 22/05/2010, JMGS det., 1 adult specimen observed, 29/05/2010, JMGS det., 1 adult specimen observed, 22/07/2010, JMGS det., approx. 20 adult specimens observed, 02/11/2010, JMGS det., 1 adult specimen observed, 04/11/2010, JMGS det., 2 adult specimens observed, 04/06/2011, JMGS det., 1 adult specimen observed, 30/10/2011, JMGS det., approx. 50 adult specimens observed. Olho d'Água, Rio Maior[M], UTM 29SND0864, 25/06/2006, JMGS det., 1 adult specimen observed. Paúl da Marmeleira, Rio Maior[M], UTM 29SND1346, 16/11/2008, JMGS det., 10 adult specimens observed. Rio Maior (city), Rio Maior[M], UTM 29SND0554, 14/01/2008, JMGS det., 1 adult specimen observed. South of Sismarias, Rio Maior[M], 29SND0352, 06/09/2008, JMGS det., 2 adult specimens observed. **Setúbal:** Praia de Ilha do Pessegueiro, Sines[M], 08/10/2013, LM leg. & det., 1 brachypterous female. **Viana do Castelo:** Santa Isabel, Paradamonte, Ponte da Barca[M], UTM 29TNG5934, 17/04/2003, P. Soares-Vieira & S. Ferreira leg., JMGS det., 1 adult specimen. Xisto, Viana do Castelo[M], UTM 29TNG2517, 15/08/2006, S. Ferreira leg., JMGS det., CIBIO-UP col., 1 adult specimen. **Vizcaya:** Barrio de Artekona, Gordexola[M], 21/07/2012, LM leg. & det., 2 macropterous females & 1 brachypterous male on ruderal herbaceous vegetation.

Scantius aegyptius (Linnaeus, 1758)

Scantius aegyptius is a Ponto-Mediterranean species (Kerzhner, 2001). In the Iberian Peninsula it has been recorded in (Fig. 6):

POR: Beja Bragança Coimbra Évora Faro Guarda Santarém Setúbal SPA: Alicante Almería* Badajoz* Baleares Barcelona Burgos Cádiz Castellón Ciudad Real* Cuenca* Gerona Granada Huelva Lérida* Madrid Málaga Murcia Segovia* Sevilla Teruel Toledo Valencia Valladolid* Zaragoza.

Bibliographic records

Alicante: J. Ribes and Sauleda (1979), Moulet (1995). **Baleares:** Moragues (1894), Saunders (1901), Gómez-Menor (1956), J. Ribes (1965, 1984, 1993), Moulet (1995). **Barcelona:** Moulet (1995), E. Ribes and J. Ribes (2001) as *S. a. rossii*, Goula and Mata (2011) as *S. a. rossii*. **Beja:** Lethierry (1877), Oliveira (1896), Seabra (1929, 1939b). **Bragança:** Oliveira (1896), Seabra (1926, 1929). **Burgos:** Codina (1925). **Cádiz:** Rosenhauer (1856), Lethierry (1877), J. Ribes (1967), Moulet (1995). **Castellón:** Español (1958). **Coimbra:** Oliveira (1896), Seabra (1929). **Évora:** Seabra (1927, 1939b). **Faro:** Lethierry (1877), Oliveira (1896), Seabra (1929, 1939b), Pissarro (1951). **Gerona:** Goula and Mata (2011) as *S. a. rossii*. **Granada:** Wagner (1960b), Moulet (1995). **Guarda:** Oliveira (1896), Seabra (1929). **Huelva:** Moulet (1995). **Madrid:** Bolívar and Chicote (1879), Sánchez (1920), Moulet (1995). **Málaga:** Rosenhauer (1856), Moulet (1995). **Murcia:** Moulet (1995). **Santarém:** Seabra (1939b). **Setúbal:** Oliveira (1896), Seabra (1929). **Sevilla:** Medina (1890), Bolívar (1895). **Teruel:** Champion (1902), Moulet (1995). **Toledo:** Moulet (1995). **Valencia:** Bolívar and Chicote (1879). **Zaragoza:** J. Ribes *et al.* (1997), Murria (2001).

Photographic records

BV: Biodiversidad Virtual, 2012.
EOL: Encyclopedia of Life, 2012.
HIP: Heteroptera from the Iberian Peninsula, 2013.

Alicante: BV. **Almería:** BV. **Badajoz:** BV. **Baleares:** BV. **Barcelona:** BV. **Cádiz:** BV. **Ciudad Real:** BV. **Cuenca:** BV. **Faro:** BV, EOL. **Huelva:** BV. **Lérida:** BV. **Madrid:** BV. **Murcia:** BV, HIP. **Segovia:** BV. **Sevilla:** BV, HIP. **Valencia:** BV. **Valladolid:** BV. **Zaragoza:** BV.

Field records

M and S superscript indicate municipality and shire, respectively.

Cádiz: Playa de la Barrosa, Chiclana de la Frontera[M], UTM 29SQA52, 28/04/2005, JMGS leg. & det., CIBIO-UP col., 1 adult specimen. **Évora:** Serra de Ossa, near the «S. Gens» geodetic pillar, Estremoz[M], UTM 29SPC2389, 03/11/2007, P. Sousa leg., JMGS det., 1 adult specimen. **Faro:** Monchique[S], Monchique[M], UTM 29SNB3529, 05/09/2005, JMGS det., 1 adult specimen observed. **Guarda:** Almendra[S], Vila Nova de Foz Côa[M], UTM 29TPF64, 19/08/1997, JMGS leg. & det., 1 adult specimen, 23/11/1997, JMGS leg. & det., 3 adult specimens. Quinta da Ervamoira, Vila Nova de Foz Côa[M], UTM 29TPF54, 22/03/1997, JMGS leg. & det., 2 adult specimens, 25/03/2002, JMGS det., 10 adult specimens observed.

Discussion

We present a review of the diagnostic morphological characters, modern systematics, general biology, and geographic distribution of the Pyrrhocoridae from the Iberian Peninsula. The two pyrrhocorid species occurring in the Iberian Peninsula, *Pyrrhocoris apterus* and *Scantius aegyptius*, are confidently identified with the proposed key. The absence of ocelli in both species proves to be a robust diagnostic character to separate them from other phylogenetically related red and black aposematically-colored taxa such as the rhopalid *Corizus hyoscyami*, the oxycarenid *Oxycarenus lavaterae*, and lygaeids of the genera *Cosmopleurus*, *Graptostethus*, *Horvathiolus*, *Lygaeus*, *Melanocoryphus*, *Spilostethus* and *Tropidothorax*.

Published data stemming from the entomological literature indicates that *P. apterus* occurs in 45% of the spatial units we have used to define the Iberian Peninsula bioregion. The same data places *S. aegyptius* in 37% of these units. These observations seem intuitively misleading to the field entomologists, who would remember pyrrhocorids as being ubiquitous species all throughout the bioregion. To shed light on this issue, we complemented this literature data with occurrence data stemming from 284 curated in-situ photographs. Results from these combined bibliographical and photographic data indicate that *P. apterus* is present in 84% of the spatial units. We believe this represents a considerable increase in the state of knowledge regarding the occurrence of *P. apterus* in the Iberian Peninsula. These same combined data, however, places *S. aegyptius* in 48% of the spatial units, which represents at most a moderate increase.

The above-mentioned results seem to highlight the important role that photographs uploaded into biodiversity web resources may play in sharpening our understanding of biodiversity and ecological patterns (Wilson, 2003; Goula *et al.*, 2013). However, in order to effectively contribute to scientific research some critical issues regarding in-situ photographs and web resources must be addressed. First, as noted by Goula *et al.* (2013), an insect «photographic record» must hold enough metadata (*i.e.*, date, location, habitat) to make it comparable to a classic «field record». In this respect, it is worth highlighting the working methodology of the citizens science web biodiversity platform Biodiversidad Virtual (2012), which requires their members to fill in a series of metadata fields before their images can be uploaded. Other web-based projects should implement similar procedures to guarantee that their photographic material may be effectively used as a photographic record. For example, Flickr photos to be picked-up by the automated algorithm used by the Encyclopedia of Life (2012) could be required to also hold a machine-tag for «date» and «location». Secondly, given that certain characters or character states are very difficult (perhaps impossible) to observe in an in-situ photograph, identification to species or subspecies is frequently neither possible nor desirable. Taxonomists accustomed to work with physical specimens «under the microscope» are often faced with this same dilemma when essential characters for species identification are not possible to observe (*e.g.*, because of missing appendages, body parts or genital segments). An appropriate example of this issue emerged precisely in this work when we attempted to identify the two described subspecies of *S. aegyptius* using in-situ photographs. Because *S. a. aegyptius* and *S. a. rossii* are only accurately distinguished by the structure of the female (depth and width of the incision on the inner margin of the first gonocoxite) and male (size of the parameres) genitalia (Carapezza *et al.*, 1999: figs. 1-23), photographic identification to subspecies level was not possible. We therefore suggest that special attention should be paid to the taxa identification limitations inherent to in-situ photographs. As the editors have pointed out, this is no trivial issue, considering that this limitation in turn may influence the scope and accuracy of the scientific investigations to which they

FIGURE 5. Known distribution of *Pyrrhocoris apterus* in the Iberian Peninsula. (Dark grey: Species present as documented by bibliographic, photographic and new field records; Light grey: Species absent or not yet recorded.) (Names of spatial units are given in Fig. 1.)

are providing data for. Finally, in order for in-situ photography to fully contribute to an accessible and transparent modernization of taxonomy, ownership of photographic material used to generate photographic records should be released to the commons. A fitting example is the «Encyclopedia of Life», which only stores and shares media from creators that have previously given their work a «Creative Commons» license.

In the present study, we further complemented the bibliographical and photographic occurrence data with approximately 120 new field records, which include both collected and observed specimens. Among this field material are the first records of *P. apterus* for the Portuguese districts of Aveiro, Santarém, Setúbal and Viana do Castelo, and for the Spanish provinces of Álava and Huelva. These new combined data indicate that *P. apterus* and *S. aegyptius* occur in 62 and 32, respectively, of the spatial units defined in this study. Considering that the surface area of each one of the spatial units is well known (Instituto Geográfico Nacional, 2013; Instituto Nacional de Estatística, 2013), we may estimate that *P. apterus* and *S. aegyptius* are distributed through 92 and 54%, respectively, of the territory of the Iberian Peninsula bioregion. This, of course, is a rough estimate. Future macroecological studies into the distribution of heteropteran bug species in the Iberian Peninsula, or other taxa and/or bioregions for that matter, could be fine-tuned by increasing the resolution of the spatial units to, for example, the shire or municipality level. We also believe that the study of species distributions may considerably benefit from coupling faunistic investigations, such as the one presented here, with quanti-

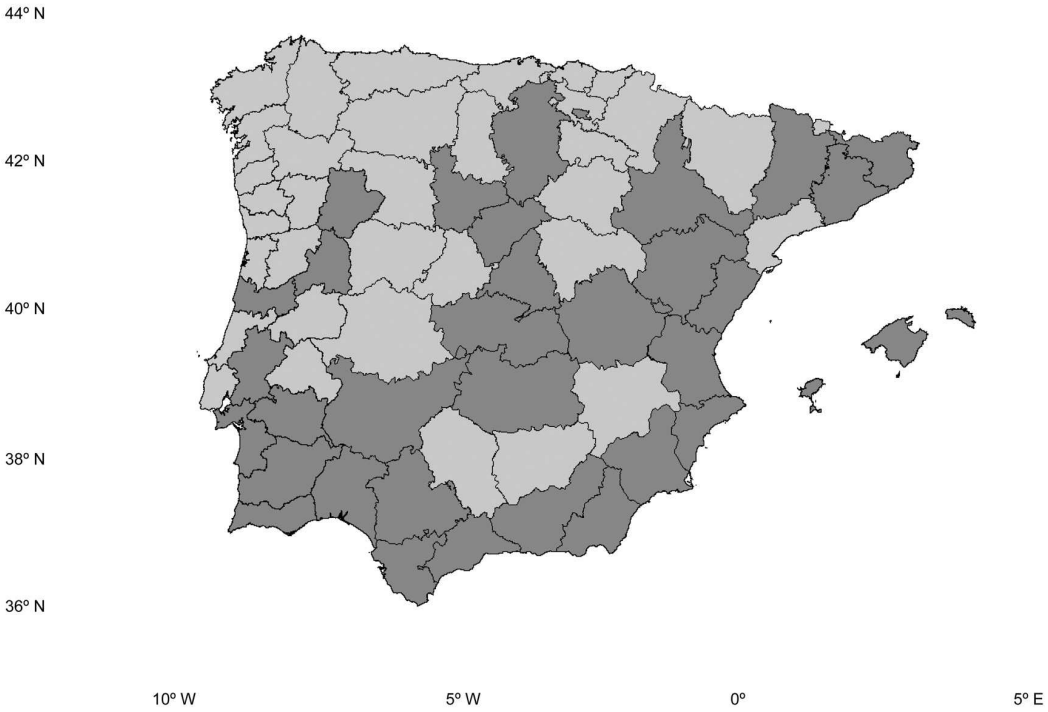

Figure 6. Known distribution of *Scantius aegyptius* in the Iberian Peninsula. (Dark grey: Species present as documented by bibliographic, photographic and new field records; Light grey: Species absent or not yet recorded.) (Names of spatial units are given in Fig. 1.)

tative approaches. The latter may provide methods to account for the uncertainty associated with the biological processes that distribute species along their geographical ranges, while simultaneously accounting for issues relating to the various ways in which species are imperfectly observed in their natural habitats (Elith and Leathwick, 2009; Kéry, 2011).

One definite result stemming from our combined bibliographical, photographic and field record occurrence data is that we now have a sharper understanding and more accurate picture of the spatial distribution of pyrrhocorids in the Iberian Peninsula bioregion. We note that there seems to be a correct agreement between the pyrrhocorid species distributions presented here and broader biogeographical distributions known for both *P. apterus* and *S. aegyptius*. In fact, the wide distribution of *P. apterus* in the Iberian Peninsula agrees with the well documented Holarctic distribution of this species (Moulet, 1995; Kerzhner, 2001). Likewise, *S. aegyptius* appears to be restricted to regions in the Iberian Peninsula under Mediterranean influence, which agrees with its Ponto-Mediterranean distribution (Moulet, 1995; Kerzhner, 2001). Interestingly, however, both species present gaps in their expected Iberian distributions. For example: (1) *P. apterus* appears to be absent from the Spanish province of Ávila and the Portuguese districts of Vila Real and Castelo Branco, which are regions that are well within the dispersion range of the species; and (2) *S. aegyptius* is yet to be recorded from the Spanish province of Tarragona, a region under strong Mediterranean influence. We believe further field work and/or photographic campaigns will contribute to fill these and other distribution gaps.

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