

# The tribe Dyschiriini (Coleoptera Carabidae) in the Ibero-Balearic region: history, current state, and future of its study

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## Abstract

Dyschiriini (Coleoptera Carabidae) is a tribe of ground beetles that has never received specific attention in the Ibero-Balearic region, resulting in a general lack of taxonomic, ecological and distributional knowledge. In this work, we revise the available bibliography and published data, analyse the origins of the study on each taxon and its progression through time (with emphasis on chorology) and assess the precise known distribution of all the species in the territory. A total of 117 works treating Ibero-Balearic Dyschiriini was found, published from 1825 to 2021. Among them, the most common works appeared as local journal articles, and the most common scope was faunistic (including catalogues and/or collection material lists). The accumulation in time of published Dyschiriini records has been closely related to historical events that both obstructed and promoted the scientific activity in Spain and Portugal. A tendency of publishing repeated records was noticed in the catalogues edited in the last decades. Precise distribution maps were made combining bibliographic records with occurrences available in GBIF. Distribution patterns could be identified in the case of some species, whereas others remain poorly recorded in the study area. The current knowledge gaps and the future of studies on Iberian Dyschiriini are discussed.

**Key words:** *Dyschirius*, *Reicheiodes*, accumulation curves, data sources, distribution maps.

## Introduction

The taxonomic category of tribe is of a great interest in the study of the hyper-diverse family Carabidae (Coleoptera Adephaga), as it has historically defined with precision natural groups of species. The tribe Dyschiriini includes about 300 species and 11 genera present in all geographic regions except the Antarctic (Fedorenko, 1996; Bousquet, 2012). Dyschiriini is a well-supported monophyletic group placed in a relatively basal position within the subfamily Scaritinae (Hogan, 2012: page 215). In addition to morphological features that result from their predatory and digging habits, which are shared with the rest of Scaritinae taxa (Basilewsky, 1973; Jeannel, 1941; Hogan, 2012), the adults of Dyschiriini are characterized by the interrupted umbilicate series of elytra and a small-sized body (Fedorenko, 1996; Hogan, 2012: page 47). The tribe is especially diverse in the Holarctic region, where almost three quarters of the known Dyschiriini species are found (Bousquet, 2012). Regarding the Palearctic region, 215 species and subspecies have been recorded (Balkenohl, 2017).

The study of the tribe was formally assessed for first time by the Belgian entomologist Jules Putzeys, who published several revisions and supplements (Putzeys, 1846; 1863; 1867; 1868, 1873). After some contributions of different authors dealing the fauna of more or less large areas (Fleischer, 1899; Müller, 1922; Dostal, 1933; Puel, 1937; Kult, 1940), Fedorenko (1996) provided the most exhaustive and complete revision so far. The classification established by Fedorenko (1996) is still followed now, with the eventual exception of the taxon *Dyschiriodes* Jeannel 1941, which is treated as genus or subgenus depending on the author.

In the Iberian Peninsula and Balearic Islands, the family Carabidae is represented by 1482 known species and subspecies, from whom about 40% are endemic (Serrano

*et al.*, 2003; Serrano, 2020). The current state of knowledge about Carabidae in the Ibero-Balearic region is relatively good, as a result of the intense work done by entomologists for decades. However, this knowledge is unequal between taxa. For instance, monographies are available only for a limited number of taxonomic groups (Andújar and Serrano, 2001; Ortuño and Toribio, 2005; Gañán, 2008; Serrano *et al.*, 2021), and phylogenetic studies have been performed only for some genera, such as *Calathus* Bonelli 1810 (Ruiz and Serrano, 2006), *Zabrus* Clairville 1806 (Sánchez-Gea *et al.*, 2004) or *Paraphaenops* Jeannel 1916 (Ortuño *et al.*, 2017), among others. In the case of Dyschiriini, which is represented in the Ibero-Balearic region by the genera *Dyschirius* Bonelli 1810 and *Reicheiodes* Ganglbauer 1891, no studies have focused on it. Existing data remain unrevised, so the current knowledge about the tribe consists of information independently published that can be hardly interpreted and discussed. Distribution ranges of Dyschiriini species have been provided by the last Iberian catalogues of Carabidae (Serrano, 2003; 2013; 2020), but they follow a general approach and do not reflect, in most cases, available precise records. This situation represents an obstacle for assess both theoretical and applied questions regarding the taxon.

The aim of this work is to clarify the development and the current state of knowledge of the tribe Dyschiriini in the Ibero-Balearic region, discuss its implications and promote future studies. We hypothesized that: 1) published data are mainly chorological, and it has been published more frequently in local journals than in other platforms; 2) the publication of records through past years reflects the historic context, including relevant events that affected the scientific activity of the countries; 3) currently published data is enough to assess, with precision, the distribution patterns of at least some species of Dyschiriini.

## Materials and methods

### Study group

Taxa considered in this work are those listed in the last catalogue of Iberian Carabidae (Serrano, 2020). Regarding *Dyschirius fulvipes* Dejean 1825, two subspecies have been cited from the territory, but their distribution limits remain unclear. In order to avoid incorrect subspecific assignation of published data, in the case of *D. fulvipes* we focused only on the specific taxon.

### Bibliographic search

An extensive bibliographic revision was developed in order to document the evolution of the Dyschiriini knowledge in the Ibero-Balearic region. In addition to printed works harboured physically in libraries, several electronic data sources were also used for this purpose.

In Web of Science (WoS) we implemented the formula <*Dyschiri\** OR *Reicheiodes* AND (*Iberi\** OR *Balear* OR *Spain* OR *Spanish* OR *Portug\**)>, selecting the longest possible time-period (1900-2021) and without omitting any database. This search was done on April 28, 2021. In Google Scholar, we implemented the terms “*Dyschirius*”, “*Dyschiriodes*” and “*Reicheiodes*” together with “*Iberian*”, without omitting any date or language. This search was done on May 03, 2021. The same terms were implemented in the search query of relevant Iberian local journals, considering all volumes: *Graellsia*; *Real Sociedad Española de Historia Natural*; *Boletín de la Asociación Española de Entomología*; *Boletín de la Sociedad Entomológica Aragonesa*; *Revista Gaditana de Entomología*; *Archivos Entomológicos*. These searches were done on September 10, 2021.

### Treatment and characterization of bibliographic data

Species names and synonyms considered for the studied taxa are those listed in the last Catalogue of Palaearctic Coleoptera (Balkenohl, 2017). Thus, information here provided for a determinate species, such as its records, includes data published for its synonyms. *Dyschiriodes* is treated as a subgenus of *Dyschirius* in this work according to the proposal of Jeannel (1941), which was accepted by Balkenohl (2017).

In order to characterize the available data, for each work we recognized its type of publication: local journal article, SCI journal article, book, doctoral thesis, or congress communication. For those papers published in local journals which have become SCI journals, we considered the status at the moment of publication. In addition, we classified works in categories according to their main scope: 1) revision, taxonomy, systematic and/or identification key; 2) faunistic, catalogue and/or collection material list; 3) genetics; 4) ecology and/or conservation; 5) biogeography; 6) multi-scope.

### Chorological knowledge

Development in time of knowledge about the presence and distribution of Ibero-Balearic Dyschiriini was assessed by performing two accumulation curves of records published in the revised works. One curve represents accumulation of new records only, while the other one represents accumulation of all records, even if they were repeated.

We consider as new records all those that correspond to previously unknown localities. This was also applied when the record refers to a new small location in a large area from where the presence of the species had been already known. For instance, *Dyschirius aeneus* Dejean 1825 was recorded for first time from the province of Barcelona by Fuente (1919), and later Jeanne (1967) published several precise records inside this region. All these records were considered new, as they both increased the chorologic knowledge in their times. On the contrary, a record from a large area was not treated as new if a precise record within it had been previously published.

### Currently known distribution

We assessed the currently known distribution of the tribe Dyschiriini and its species in the study area by doing precise distribution maps. We combined the records obtained from the revised literature with occurrences published in open biodiversity data sources. For this purpose, we implemented the terms “*Dyschirius*”, “*Dyschiriodes*” and “*Reicheiodes*” in the search query of GBIF, iNaturalist and Biodiversidad Virtual. The search was restricted to the Iberian Peninsula and Balearic Islands, and it was done on January 17, 2022. All occurrence data were downloaded if possible.

Occurrence points included in the distribution maps correspond to the UTM 10 × 10 coordinates system. Records with insufficient precision were not represented. Maps were made using QGIS (Quantum Gis Development Team, 2018).

## Results

### Relation of Ibero-Balearic Dyschiriini

1. *Dyschirius (Dyschiriodes) aeneus aeneus* (Dejean 1825)
  - Clivina aerea* Ahrens 1830
  - Clivina ahena* Ahrens 1830
  - Clivina paludosa* Ahrens 1830
  - Dyschirius aeratus* Stephens 1828
  - Dyschirius remotepunctatus* Putzeys 1867
  - Dyschirius ruthenus* Motschulsky 1849
  - Dyschirius stethogamme* Kolontai 1845
  - Dyschirius tanaicensis* Motschulsky 1849
2. *Dyschirius (Dyschiriodes) agnatus* Motschulsky 1844
  - Dyschirius benedikti* Bulirsch 1995
  - Dyschirius laevipunctatus* A. Fleischer 1899
  - Dyschirius lucidens* Putzeys 1846
  - Dyschirius lucidus* Putzeys 1867
  - Dyschirius makolskii* J. Muller 1934
  - Dyschirius maroccanus* Antoine 1934
  - Dyschirius obenbergeri* Maran 1935
  - Dyschirius ovipennis* Putzeys 1867
3. *Dyschirius (Dyschiriodes) angusticollis* Putzeys 1867
4. *Dyschirius (Dyschiriodes) apicalis* Putzeys 1846
5. *Dyschirius (Dyschiriodes) auriculatus* Wollaston 1867
  - Dyschirius karamani* J. Muller 1922
  - Dyschirius longicollis* Fairmaire 1871
  - Dyschirius mitodes* Andrewes 1929
  - Dyschirius pseudoextensus* A. Fleicher 1899
  - Dyschirius tensicollis* Marseul 1880
6. *Dyschirius (Dyschiriodes) bacillus* Schaum 1857
7. *Dyschirius (Dyschiriodes) breviphthalmus* Balkenohl et Lompe 2003
8. *Dyschirius (Dyschiriodes) chalcuus* Erichson 1837
  - Dyschirius meridionalis* Puel 1937
  - Dyschirius oblongus* Putzeys 1846
  - Dyschirius provincialis* Puel 1925
9. *Dyschirius (Dyschiriodes) chalybeus chalybeus* Putzeys 1846
  - Dyschirius biskrensis* Bedel 1895

- Dyschirius dentipes* Putzeys 1867  
*Dyschirius hispanus* Putzeys 1866  
*Dyschirius subaeneus* Wollaston 1864
10. *Dyschirius (Dyschiriodes) clypeatus* Putzeys 1867  
*Dyschirius cameroni* Kult 1954  
*Dyschirius perlongus* J. Muller 1937  
*Dyschirius samharicus* Putzeys 1873
  11. *Dyschirius (Dyschiriodes) cylindricus* (Dejean 1825)
  12. *Dyschirius (Dyschiriodes) impressus* Putzeys 1846  
*Dyschirius subcylindricus* Motschulsky 1849  
*Dyschirius normandi* Puel 1937
  13. *Dyschirius (Dyschiriodes) longipennis* Putzeys 1867
  14. *Dyschirius (Dyschiriodes) luticola liguriensis* Putzeys 1873  
*Dyschirius halophilus* Fauvel 1890
  15. *Dyschirius (Dyschiriodes) macroderus breiti* J. Muller 1922
  16. *Dyschirius (Dyschiriodes) minutus minutus* (Dejean 1825)  
*Dyschirius dalila* Antoine 1943  
*Dyschirius misellus* Schaum 1857
  17. *Dyschirius (Dyschiriodes) paucillius* Wollaston 1864  
*Dyschirius frontalis* Putzeys 1867  
*Dyschirius uytenboogaarti* Klynstra 1937
  18. *Dyschirius (Dyschiriodes) punctatus* (Dejean 1825)  
*Dyschirius attenuatus* Putzeys 1867  
*Dyschirius bedeli* J. Muller 1922  
*Dyschirius micans* Gautier des Cottes 1863
  19. *Dyschirius (Dyschiriodes) salinus striatopunctatus* Putzeys 1846  
*Dyschirius simplicifrons* Apfelbeck 1904  
*Dyschirius tenuistriatus* J. Muller 1934
  20. *Dyschirius (Dyschirius) angustatus* (Ahrens 1830)  
*Dyschirius jejunos* Dawson 1854  
*Dyschirius sabulicola* Lacordaire 1835  
*Dyschirius ulginosus* Putzeys 1846
  21. *Dyschirius (Dyschirius) armatus* Wollaston 1864  
*Dyschirius peyerimhoffi* Puel 1929  
*Dyschirius suturalis* Puel 1929
  22. *Dyschirius (Dyschirius) numidicus numidicus* Putzeys 1846  
*Dyschirius libicus* Schatzmayr 1936  
*Dyschirius rugicollis* Fairmaire et Laboulbene 1854
  23. *Dyschirius (Dyschirius) thoracicus* (Rossi 1790)  
*Clivina nigra* Ahrens 1830  
*Dyschirius arenosus* Stephens 1827  
*Dyschirius riparius* Mannerheim 1844  
*Dyschirius septentrionalis* Motschulsky 1853
  24. *Dyschirius (Eudyschirius) antoinei* Puel 1925
  25. *Dyschirius (Eudyschirius) fulvipes fulvipes* (Dejean 1825)  
*Dyschirius (Eudyschirius) fulvipes rufoaeneus* Chaudoir 1843  
*Dyschirius aemulus* Putzeys 1846  
*Dyschirius africanus* Putzeys 1846  
*Dyschirius algiricus* Putzeys 1846  
*Dyschirius obsoletus* Putzeys 1846
  26. *Dyschirius (Eudyschirius) globosus* (Herbst 1783)  
*Carabus remotus* Marsham 1802  
*Clivina laevicollis* Ahrens 1830  
*Clivina minima* Ahrens 1830  
*Clivina rotundicollis* Faldermann 1835  
*Dyschirius glomeratus* Bousquet 1997  
*Dyschirius maritimus* Boheman 1849  
*Dyschirius muelleri* Wagner 1929  
*Dyschirius ragusae* J. Muller 1922  
*Dyschirius ruficollis* Kolentai 1845  
*Dyschirius tournieri* Putzeys 1867  
*Scarites gibbus* F. 1792
  27. *Dyschirius (Eudyschirius) gracilis ibericus* (Fedorenko 1996)
  28. *Dyschirius (Eudyschirius) importunus immarginatus* Putzeys 1866  
*Dyschirius fossulicola* Antoine 1943  
*Dyschirius inhumeralis* A. Fiori 1914
  29. *Dyschirius (Eudyschirius) semistriatus* (Dejean 1825)  
*Dyschirius iserlei* Kult 1940
  30. *Dyschirius (Paradyschirius) parallelus ruficornis* Putzeys 1846  
*Dyschirius susicus* Bruneau de Mire 1953  
*Dyschirius tunisius* J. Muller 1924
  31. *Dyschirius (Paradyschirius) substriatus substriatus* (Duftschmid 1812)  
*Dyschirius vitalei* J. Muller 1929
  32. *Reicheiodes (Iberiodes) assmanni* Balkenohl 1999
  33. *Reicheiodes (Iberiodes) meyhohmi* Balkenohl 2003
  34. *Reicheiodes (Iberiodes) microphthalmus* (Heyden 1870)

**Table 1.** Type of publication of works treating *Dyschiriini* in the Ibero-Balearic region from 1825 to 2021.

Type of publication	Works (n = 119)
Local journal article	81
SCI journal article	1
Book	31
PhD thesis	3
Congress communication	3

**Table 2.** Scope of published works treating *Dyschiriini* in the Ibero-Balearic region from 1825 to 2021.

Scope	Works (n = 119)
Review, taxonomy, systematic and/or identification key	16
Faunistic, catalogue and/or collection material list	85
Genetics	2
Ecology and/or conservation	5
Biogeography	2
Multi-scope (2 or more scopes)	9

#### Published works

A total of 119 publications containing information about *Dyschiriini* from the Ibero-Balearic region was gathered (supplemental material table S1). From them, 81 works were published in local journals, which represents about the 68% of the total; the rest was published as books and, in a very low number, as SCI journal articles, PhD theses and congress communications (table 1). From the 119 publications, 85 were faunistic works, catalogues and collection material lists, which represents about the 70% of the total; the remaining works have diverse scopes (table 2).

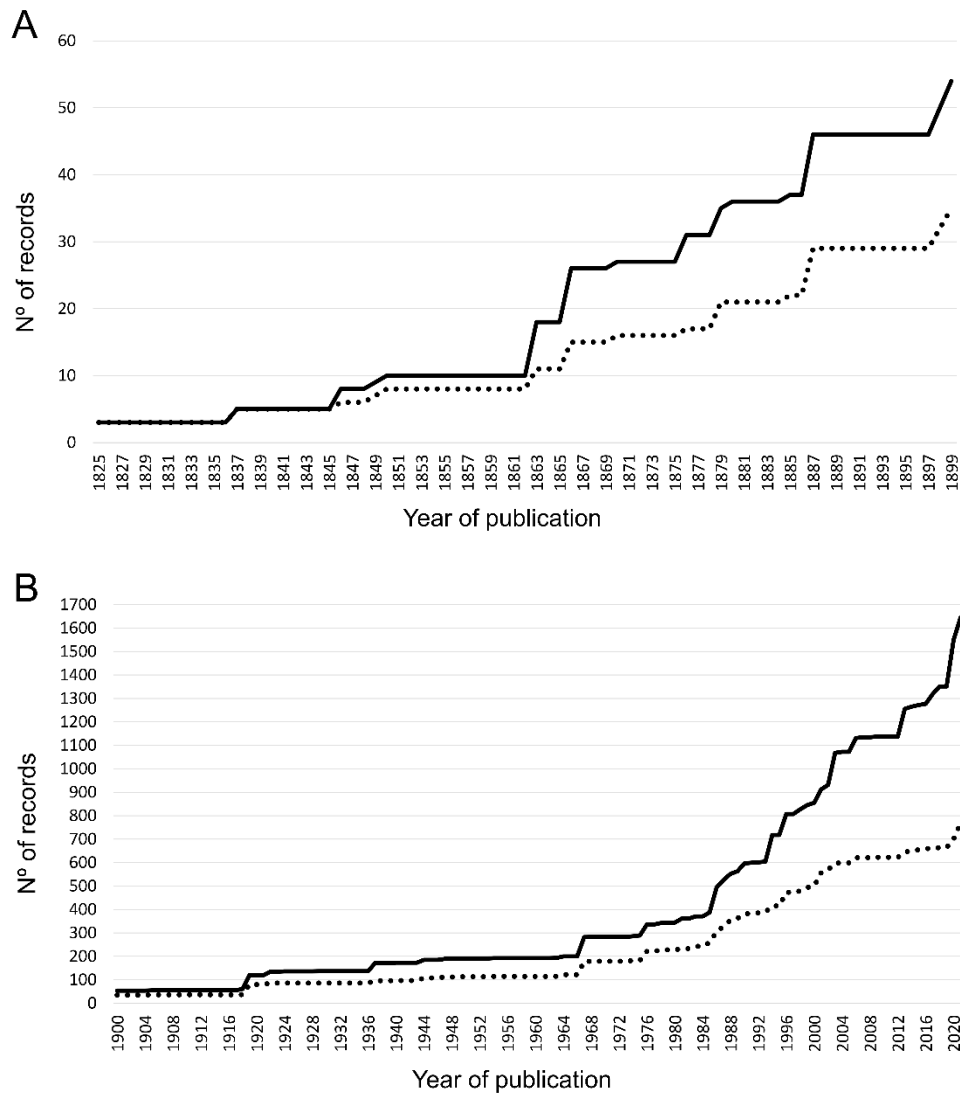
Records could be obtained from 116 publications.

#### Evolution of chorological knowledge

The accumulation curves of records are presented in figure 1.

The first publication containing information about *Dyschiriini* in the study area is a book published by Dejean (1825). The species *D. minutus*, *D. punctatus* and *D. fulvipes* were described using Iberian samples, which represents the first records of *Dyschiriini* representatives from Spain. *D. impressus* was also collected in the Iberian Peninsula and described by Putzeys (1846), but more chorologic data were hardly published in the first half of the XIX century (Putzeys, 1846; Chaudoir, 1850). The number of publications increased during the second half of the century, and 9 more species of *Dyschiriini* were found in the region (Marseul, 1863; 1880; Putzeys, 1866; 1867; Heyden, 1870; Martorell y Peña, 1879; Cuni Martorell, 1885; Champion, 1898; Fleischer, 1899). One of these works provided the description of the endemism *R. microphthalmus* (Heyden, 1870).

In the XX century, a catalogue published in various volumes by Fuente (1918; 1919) provided abundant new records and increased the number of known species in the territory from 13 to 21. A relatively slow accumulation of



**Figure 1.** Accumulation curves of published Dyschiriini records in the Ibero-Balearic territory, from 1825 to 1899 (A) and from 1900 to 2021 (B). The dotted line represents the accumulation of only new records, while the solid line represents the accumulation of all records, both new and repeated.

occurrences is observable during the following years, visible as an alternance of “plateaus” and “steps”. The most remarkable inputs of records were done by Puel (1937), Fernández Porter (1944) and Jeanne (1967; 1976), and the presence of *D. apicalis*, *D. agnatus* and *D. parallelus* was noticed for the first time.

The period of time between the catalogue of Marseul (1863) and that of Jeanne and Zaballos (1986) was characterized by an almost constant distance between the two accumulation curves obtained. This tendency changes from Jeanne and Zaballos (1986) forward, as the accumulation curve of all records (new and repeated) presents a quasi-exponential growth, separating more and more from that of new records. In addition, works containing chorological data of Dyschiriini were published with more frequency than in previous decades.

The rest of currently known Ibero-Balearic species were gradually found in the territory (Sauleda, 1985; Jeanne and Zaballos, 1986; Balkenohl, 2003a; 2003b; Balkenohl and Lompe, 2003; Zaballos and Jeanne, 1994;

Fedorenko, 1996; Serrano, 2016). The highest number of records in the last years has been provided by the catalogues of Carabidae from the Iberian Peninsula (Zaballos and Jeanne, 1994; Serrano, 2003; 2013; 2020) and the Palearctic region (Balkenohl, 2003b; 2017), and by some other works with different scope (Fedorenko, 1996; Ruiz-Tapiador and Zaballos, 2001; Campos and Novoa, 2006; Serrano *et al.*, 2021).

#### Known distribution of species

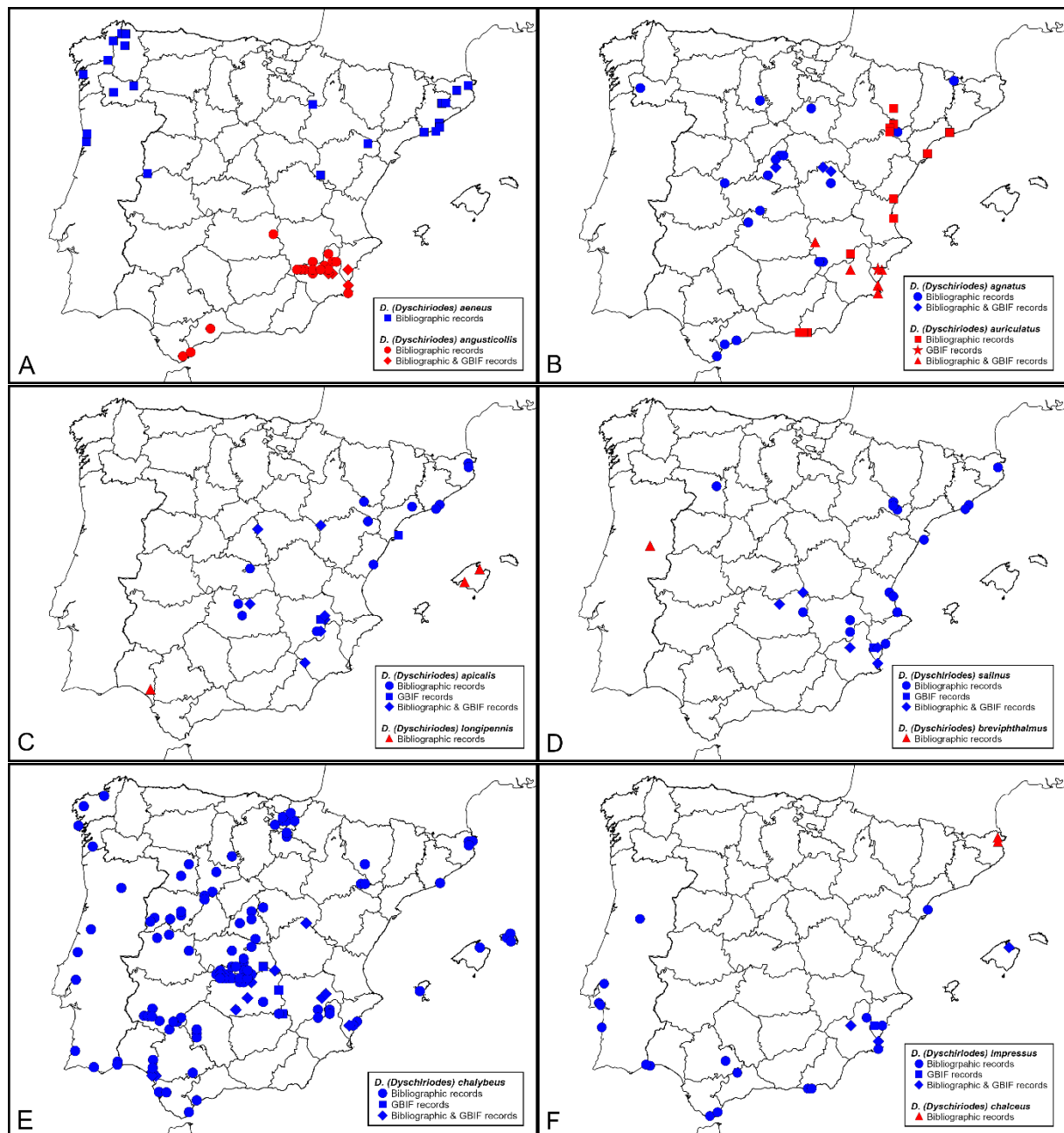
We obtained 1644 records of Dyschiriini species from the revised literature. This total includes both precise and imprecise records, in addition to repeated ones. In the case of GBIF, we obtained 156 results for *Dyschirius* (GBIF.org, 2022a), 2 for *Dyschiriodes* (GBIF.org, 2022b) and 2 for *Reicheiodes* (GBIF.org, 2022c). In the case of iNaturalist, no results were obtained for any taxa. In the case of Biodiversidad Virtual, 11 pictures of *Dyschirius* were found, but none of them could be used in the precise distribution maps.

The presence of Dyschiriini taxa could be noticed in 331 of 6338 UTM 10×10 coordinates included in the Iberian Peninsula and Balearic Islands, which represents about the 5% of the studied area. From this total, the occurrence in 291 coordinates was provided by the revised literature, 4 by GBIF and 36 by both sources. Detailed information of bibliographic records is provided in supplemental material table S2.

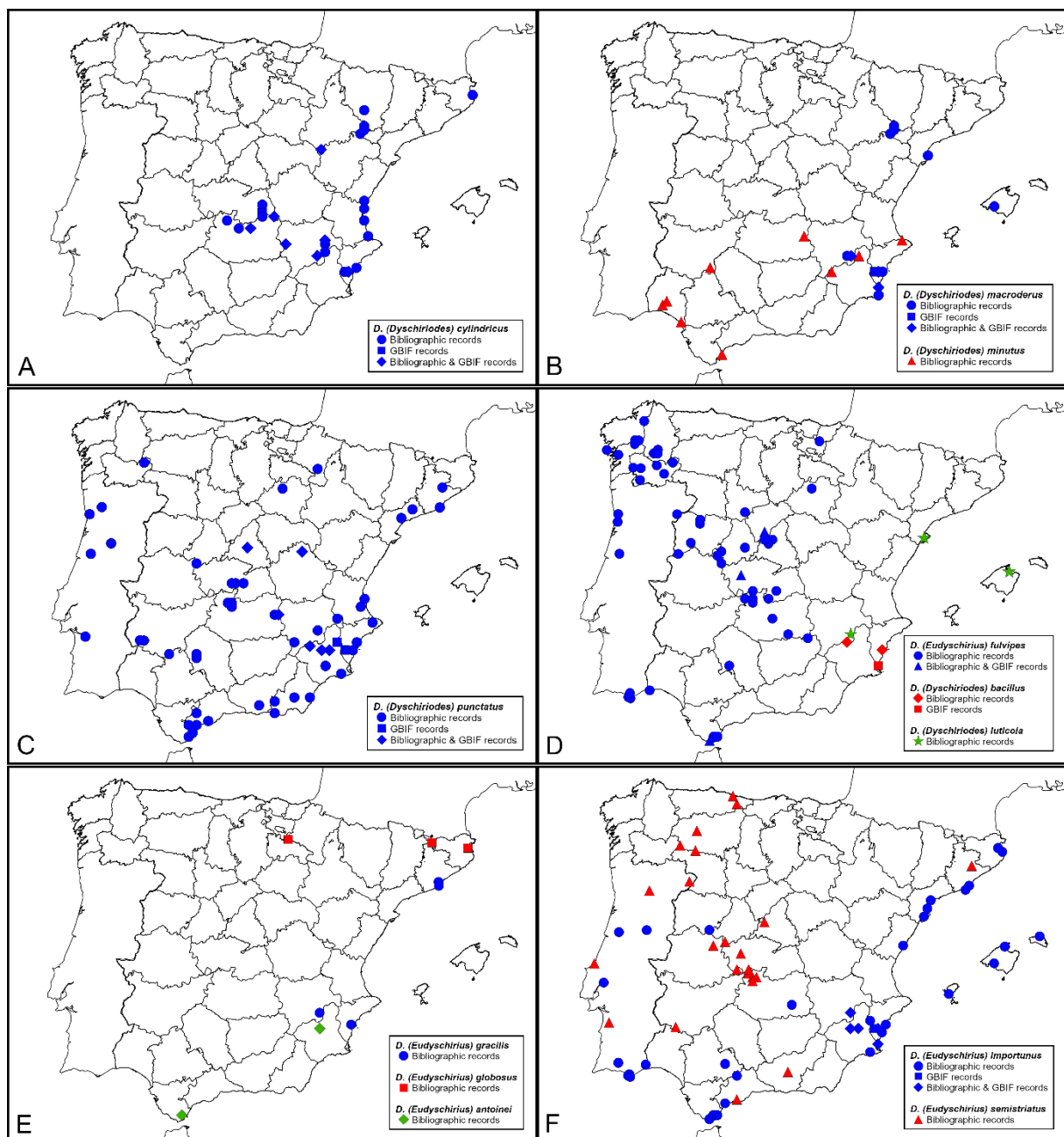
Distribution maps (figures 2-4) were made for all species except for *D. clypeatus*, *D. pauxillus* and *D. armatus*, as no precise records of them are currently available. *D. clypeatus* was recorded from Mallorca, in the Balearic Islands, by Jeanne and Zaballos (1986), and this

information has been repeated in the following catalogues (Zaballos and Jeanne, 1994; Balkenohl, 2003b; 2017; Serrano, 2003; 2013; 2020). *D. pauxillus* and *D. armatus* were considered for first time Ibero-Balearic elements by Balkenohl (2017), but no more data has been published so far.

Regarding the rest of species, the number of published occurrences ranged from only one locality, as in the case of *D. breviphthalmus* and *R. meyhohmi*, to more than 100, as in the case of *D. chalybeus chalybeus*. The genus *Reicheiodes* is restricted to the northwestern region of the Iberian Peninsula, whereas the genus *Dyschirius* is widespread in the study area.



**Figure 2.** Precise known distribution in the Ibero-Balearic region of *Dyschirius aeneus*, *D. angusticollis* (A), *D. agnatus*, *D. auriculatus* (B), *D. apicalis*, *D. longipennis* (C), *D. salinus*, *D. breviphthalmus* (D), *D. chalybeus* (E), *D. impressus* and *D. chalybeus* (F).



**Figure 3.** Precise known distribution in the Ibero-Balearic region of *Dyschirius cylindricus* (A), *D. macroderus*, *D. minutus* (B), *D. punctatus* (C), *D. fulvipes*, *D. bacillus*, *D. laticola* (D), *D. gracilis*, *D. globosus*, *D. antoinei* (E), *D. importunus* and *D. semistriatus* (F).

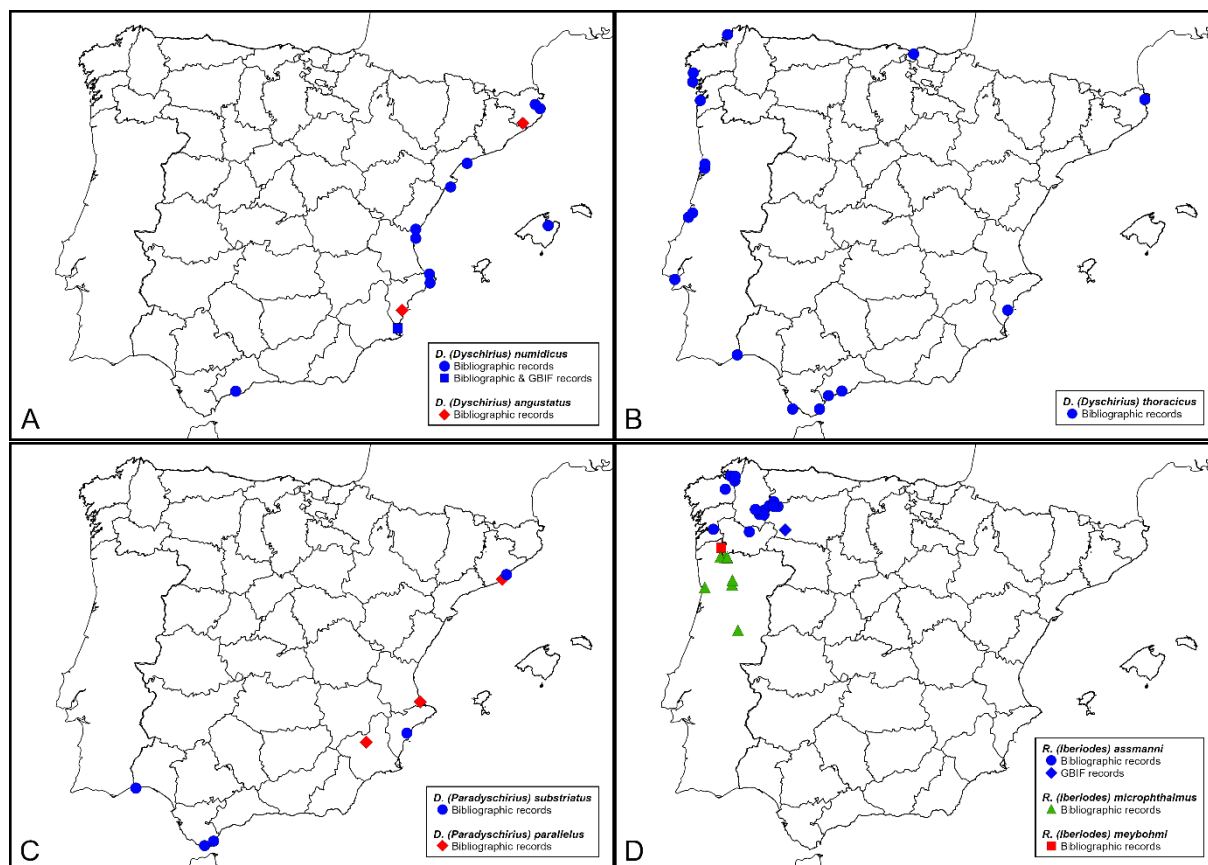
## Discussion

### Published works

We found support for our first hypothesis, as works treating Ibero-Balearic Dyschiriini were published mainly in local journals, and their most common scope was faunistic. Therefore, we found that the knowledge about Dyschiriini in the Ibero-Balearic region is mainly chorological, as most of it corresponds to occurrence data that have been published for almost 200 years.

Regarding this taxon, the creation of the SCI metric and its spread and international adoption seems to have not impacted in the publication dynamics in the study area. The only paper published in an SCI journal is the work

of Gutiérrez *et al.* (2004), which has an ecological and conservation scope. Since SCI journals started being highly considered in academic evaluations (Seglen, 1997; Solari and Magri, 2000), they have restricted their scope and established more or less strict requirements for publication. A high percentage of the examined literature is composed by papers providing Carabidae species lists from a concrete territory of the Iberian Peninsula and Balearic Islands, at most with some short comments on their biology and/or ecology. These faunistic works are published easier in local journals, such as bulletins of entomological societies, than in SCI journals. This fact could explain the found “preference” for publishing in local journals.



**Figure 4.** Precise known distribution in the Ibero-Balearic region of *Dyschirius numidicus*, *D. angustatus* (A), *D. thoracicus* (B), *D. substriatus*, *D. parallelus* (C), *Reicheiodes assmanni*, *R. microphthalmus* and *R. meybohmi* (D).

### Evolution of chorological knowledge

Studies on Dyschiriini species from the Iberian Peninsula and Balearic Islands were published initially by foreign entomologists (1825-1870). This corresponds to the general lack of Spanish and Portuguese specialists in those years, as Entomology in the Iberian countries was developed later than in other European regions (Bach and Compte, 1997; Moret, 2012; Serrano, 2000). During the XIX century, European naturalists regularly sampled the Iberian Peninsula and received material from collectors and merchants; in the case of Carabidae, this resulted in a high proportion of Ibero-Balearic species described by authors from France, Germany, England, and other countries (Moret, 2012). The examined literature supported this historic interpretation. Publications treating Dyschiriini in the study area mainly correspond to general revisions, catalogues (Putzeys, 1846; 1866; Chaudoir, 1850; Marseul, 1863; 1880; Fleischer, 1899) and works with lists of species found in expeditions (Dejean, 1825; Motschulsky, 1849; Putzeys, 1867; Heyden, 1870; Champion, 1898). The first native author that contributed to this input of publications was Oliveira (1876), who edited the first catalogue of Portuguese Carabidae and later updated it (Oliveira, 1887). He was followed by the Spanish naturalists Martorell y Peña (1879) and Cuní Martorell (1885), who provided several occurrences from Catalonia (Spain).

In the XX century, works published by native scientists

started being more frequent than those published by foreigners (supplemental material table S1). This is especially true during the last decades. The transition to the XX century was the beginning of the modern entomology in Spain (Bach and Compte, 1997). The most important promotion resulted from the foundation of several institutions: the Board for Extension of Studies and Scientific Research, the Royal Spanish Society of Natural History, and the Catalanian Institution of Natural History, among others. In addition, several journals started being edited, such the bulletin of the Spanish Royal Society of Natural History and *Eos, Revista Española de Entomología*. These and other events (Bach and Compte, 1997) highly helped and increased the activity of native entomologists. However, a relatively long plateau is observed between 1930 and 1960, with only 6 works published (figure 1). In this period occurred the Spanish Civil War (1936-1939) and the following dictatorship (1939-1975), two events that deeply harmed the scientific progress of the country due to their economic, political, and social implications. After it, the number of works containing chorological data of Dyschiriini highly increased (figure 1). The foundation in 1977 of the Spanish Association of Entomology and the Aragonese Entomological Society supported the emergence and consolidation of a new generation of Iberian carabidologists. The same happened in Portugal, where the Portuguese Society of Entomology was founded in the last years of the 1980s and started ed-

iting its own bulletin (Serrano, 2000). The second hypothesis was supported, as we found that the evolution of chorological knowledge is closely related to historical events that represented both improvements and obstacles for scientific works.

A change of tendency in the published records is observed in the last years of the XX century (figure 1). Between 1860 and 1980, a total of 34 works containing records were published. Some of them compiled records previously published, but also provided new ones. It resulted in an almost constant distance between the two accumulation curves: the chorological knowledge was subsequently revised and improved. This was also true for the Iberian catalogues edited during this period (Oliveira, 1876; 1887; Fuente, 1918; 1919; Jeanne, 1967; 1976). In 1980, a total of 344 records were available, of which 228 had been new when published. Between 1980 and 2021, up to 80 works containing occurrences were done. Many of them provided scarce but new records, which contributed to conform the currently known distribution of species. However, Iberian and Palearctic catalogues edited during this period (Jeanne and Zaballos, 1986; Zaballos and Jeanne, 1994; Balkenohl, 2003b; 2017; Aguiar and Serrano, 2013; Serrano, 2003; 2013; 2020) provided abundant but repeated records, which did not increase the chorological knowledge. Inputs of these numerous repeated records causes the separation of the two accumulation curves here obtained (figure 1). In 2021, 1644 records were available, from whom 769 had been new when published.

### Known distribution of species

Published data have been hardly used in recent times. Apart from the non-precise approach of the last published catalogues of Iberian Carabidae (Serrano, 2003; 2013; 2020), information available for one or more *Dyschiriini* species in the territory has been rarely reviewed. Available records in the Iberian Peninsula have been summarized and represented in map only for *D. semistriatus* (Dekoninck *et al.*, 2018). Therefore, the currently known distribution of all *Dyschiriini* in the Ibero-Balearic region is assessed with precision for first time in this study.

Regarding open biodiversity data sources, only GBIF was useful. Almost all records obtained from GBIF correspond to the labels information of collection material deposited in several scientific institutions (supplemental material table S3), which started being published in 2021. Data provided by Biodiversidad Virtual was not useful, as photographs do not illustrate the diagnostic characters that allow the determination of *Dyschiriini* species.

Known distribution ranges are highly diverse among *Dyschirius* species in the Iberian Peninsula and Balearic Islands, and some of them could be representative of real distributions. *D. breviphthalmus* (figure 2D) is likely to be the only known Iberian endemism in the genus, with a small distribution range, as Balkenohl and Lompe (2003) suggested. On the contrary, *D. chalybeus chalybeus* (figure 2E) is the most common *Dyschiriini* species in the territory, which suggests an euryoic condition. In the case of *D. auriculatus auriculatus* (figure 2B) and *D. macroderus breiti* (figure 3B), they seem to be restricted to the eastern region, as well as many other carabids which are typically

considered Mediterranean elements. Similarly, *D. angusticollis* (figure 2A) and *D. minutus minutus* (figure 3B) could be restricted to the southern part of the peninsula, as other Betic-Riffian elements. In those and other cases, new records and future works may confirm these distribution patterns. For instance, our results suggest that *D. thoracicus* is a coastal specialist, based on its published records in the study area (figure 4B). However, it has been recorded from continental environments in other territories (Fedorenko, 1996: page 76), which does not support this interpretation.

In the case of poor-recorded species in the studied area, small known distribution ranges may result from absence of data. This could be especially true for *D. chaldeus* (figure 2F), *D. longipennis* (figure 2C), *D. antoinei* (figure 3E) or *D. angustatus* (figure 4A). In addition, incorrect identification should be considered, especially for those species for whom only one record is available. The incidence of incorrect identifications in our results can be hardly confirmed without a revision of the studied material.

Several zones of the Iberian Peninsula with few or no records of *Dyschiriini* were noticed: in Portugal, many of the continental body waters; in Spain, the inner region of Extremadura, the Atlantic coast from Asturias to the Basque Country, the northeastern Andalusia, and the highest section of the hydrographic basins of the Duero and Júcar rivers. Although some of these gaps could represent real absences, sampling bias should be considered.

The third hypothesis was supported, and the real distribution of all *Dyschiriini* species will be assessed in the future.

### Current non-chorological knowledge

Taxonomy and systematic of Ibero-Balearic *Dyschirius* species were developed in revisions of the tribe from larger regions (Putzeys, 1846; 1867; Müller, 1922; Fedorenko, 1996). The endemism *D. breviphthalmus* is the only *Dyschirius* that has received specific taxonomic and systematic treatment in the study area (Balkenohl and Lompe, 2003). The unique existing identification key of Ibero-Balearic species was provided by Fuente (1927), but it strongly requires to be updated. Identification keys of *Dyschirius* found in concrete regions of the territory are available (Novoa, 1974; Ortuño and Marcos, 2003; Aguiar and Serrano, 2012), but they include few species. Thus, the currently most useful identification key for Ibero-Balearic samples is the one provided by Fedorenko (1996) for all Palearctic representatives.

On the contrary, studies on the *Reicheiodes* genus have been more integrative. In addition to faunistic works (Novoa, 1979; Novoa *et al.*, 1989; 2003; Novoa and Campos, 2000; Campos and Novoa, 2006; Ramos-Abuín, 2007), descriptions, taxonomic notes and identification keys for Ibero-Balearic species were provided by Balkenohl (1999; 2003a).

### Limitations and gaps of present studies

Although there are several experts in Palearctic Scaritinae, as M. W. Balkenohl, P. Bulirsch or D. Fedorenko, they have not focused their work on Ibero-Balearic species. Apparent lack of interest on *Dyschiriini* among



native entomologists in this region may result from technical difficulties in the study of such small and, in many cases, quite similar species.

Collection of study material of *Dyschirius* can be a challenging task. As most of species are related to dynamic humid habitats, such as rivers and seasonal lakes, optimal conditions for the development of populations could be difficult to predict. For instance, a locality that seems non-colonized during several months could suddenly present a demographic explosion (Muñoz-Santiago and Ortuño, personal observation). Passive samplings are rarely performed with focus on *Dyschiriini*. Pitfall trapping has succeeded in some studies (Bousquet, 1987; Kromp, 1990; Dekoninck, 2018; Hammond *et al.*, 2018), but it is hardly suitable in shores, where many *Dyschirius* species are commonly found. Flight Intercept Traps (FIT) and UV-light trapping have proved to be able to collect *Dyschirius* (Kádár and Szél, 1995; Fedorenko, 1996: page 5; Andújar *et al.*, 2009; Bulirsch, 2017), but their installation and use requires increasing the cost and complicating the logistic of projects. For now, hand-sorting sampling (*sensu* Fedorenko, 1996: pages 4-5) seems to be the most efficient collection method.

*Dyschirius* larva has been characterized (Bousquet, 1988; Makarov, 1994; Fedorenko, 1996), but pre-imaginal instars of concrete species have been hardly described. This means that a great part of what is published about *Dyschiriini* species could be true only for the last life stage, as differences in habits and requirements between larva and adult may exist. *Reicheiodes* larvae remain undescribed.

Phenology and life cycle of *Dyschiriini* species has never been approached in detail. Therefore, ecological and conservation studies can be hardly performed, which would be of interest because of the close relationship of *Dyschiriini* with humid habitats. *Dyschiriini* species may represent potential bioindicators of the quality of water bodies and/or target taxa for its management, as it has been suggested for other riparian ground beetles (Gerisch *et al.*, 2006; Kleinwächter and Rickfelder, 2007; Kang *et al.*, 2012).

#### Future perspectives

The main objective of the present work was to define and inform about the current state of knowledge of the tribe *Dyschiriini* in the Iberian Peninsula and Balearic Islands. It is expected to be the first step in a long-term study of the taxon in the region, which will clarify the taxonomy, chorology and autoecology of its species. New information obtained from samplings and revisions of institutional and private collections will allow not only to assess those questions, but also check the reliability of previously published data.

Records are still needed to be published, as distribution range and habitat requirements of several species remain unclear. However, novel researchers who want to maximize the impact of their work do not tend to perform faunistic studies, provided that SCI journals usually do not publish them. Thus, the number of articles containing presence data may decrease in the following years. On the other hand, current citizen science seems to not be suitable for *Dyschiriini*, as species recognition cannot be

approached through picture observation. These facts are likely to be impediments for the future development of chorological knowledge.

On the contrary, it must be noted that GBIF records here obtained represented a reliable source of data, as they consist in collection localities of study material. They started being published in 2021, which may correspond to a new way of providing chorological information. If this is true, open biodiversity data sources could represent an alternative or a complement to peer-reviewed works, as long as occurrences provided by them rely on identifications done by specialists with access to study material.

#### Conclusions

The current knowledge about *Dyschiriini* in the Iberian Peninsula and Balearic Islands is mainly chorological, and its evolution through the time is close related to the scientific development and historical events happened in Spain and Portugal since the XIX century. The most common works containing records of species are faunistic studies, catalogues, and collection material lists, which have been widely published in local journals. In the last decades, a general tendency of reviewing and repeating previously published data has established, and new occurrences have been less frequently provided.

The known distribution of some *Dyschiriini* species could be representative of their real chorology in the study area. However, distribution ranges of many others remain unclear. Future works, samplings and revisions on collection material are needed to assess this and other questions that could precede applied research.

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#### References

- AGUIAR C. A. S., SERRANO A. R. M., 2012.- *Coleópteros carabídeos (Coleoptera, Carabidae) de Portugal continental: claves para a sua identificação*.- Sociedade Portuguesa de Entomologia, Lisboa, Portugal.
- AGUIAR C. A. S., SERRANO A. R. M., 2013.- *Catálogo e atlas dos coleópteros carabídeos (Coleoptera: Carabidae) de Portugal continental*.- Sociedade Portuguesa de Entomologia, Lisboa, Portugal.
- ANDÚJAR A., SERRANO J., 2001.- *Revisión y filogenia de los Zabrus Clairville, 1806 de la Península Ibérica (Coleoptera, Carabidae)*.- Monografías S.E.A., vol. 5, Zaragoza, Spain.
- ANDÚJAR C., RUIZ C., IBÁÑEZ J., LENCINA J. L., SERRANO J., 2009.- Los insectos coleópteros carabídeos del yesar de Las Minas, Hellín, Albacete.- *Sabuco, Revista de Estudios Albalacetenses*, 7: 149-164.

- BACH C., COMPTE A., 1997.- La entomología moderna en España. Su desarrollo: de los orígenes a 1960.- *Boletín de la SEA*, 20: 367-392.
- BALKENOHL M. W., 1999.- *Reicheiodes microphthalmus* (Heyden, 1870) from the north-western Iberian Peninsula, with a description of the new subspecies *Reicheiodes microphthalmus assmanni* ssp. n.- *Beiträge zur Entomologie*, 49 (2): 389-397.
- BALKENOHL M. W., 2003a.- On *Reicheiodes* species of the Iberian Peninsula, with a description of the new species *Reicheiodes meybohmi* n. sp. (Coleoptera: Carabidae: Scaritinae).- *Coleoptera, Schwanfelder Coleopterologische Mitteilungen*, 7: 89-95.
- BALKENOHL M. W., 2003b.- Tribe Dyschiriini W. Kolbe, 1880, pp. 223-231. In: *Catalogue of Palaearctic Coleoptera: Archostemata Myxophaga Adephaga, vol. 1* (LÖBL I., SMETANA A., Eds).- Apollo Books, Stenstrup, Denmark.
- BALKENOHL M. W., 2017.- Tribe Dyschiriini H.J. Kolbe, 1880, pp. 263-274. In: *Catalogue of Palaearctic Coleoptera: Archostemata Myxophaga Adephaga, vol. 1, Revised and updated edition* (LÖBL I., LÖBL D., Eds).- Brill, Leiden, The Netherlands, Boston, USA.
- BALKENOHL M. W., LOMPE A., 2003.- *Dyschirius breviphthalmus* n. sp., a mountainous species of this group from Portugal (Coleoptera, Carabidae, Scaritinae).- *Coleoptera*, 7: 97-101.
- BASELEWSKY P., 1973.- *Insectes Coléoptères. Carabidae, Scaritinae, vol. I, Faune de Madagascar 37*.- Muséum National d'Histoire Naturelle, Paris, France.
- BOUSQUET Y., 1987.- The carabid fauna of Canada and Alaska: range extensions, additions and descriptions of two new species of *Dyschirius* (Coleoptera: Carabidae).- *The Coleopterists Bulletin*, 41 (2): 111-135.
- BOUSQUET Y., 1988.- *Dyschirius* of America North of Mexico: descriptions of new species with keys to species groups and species (Coleoptera: Carabidae).- *The Canadian Entomologist*, 120: 361-387.
- BOUSQUET Y., 2012.- Catalogue of Geadephaga (Coleoptera, Adephaga) of America, North of Mexico.- *ZooKeys*, 245: 1-1722.
- BULIRSCH P., 2017.- Three new species of the genus *Dyschiriodes* (Coleoptera: Carabidae: Scaritinae: Dyschiriini) from the Eastern Asia.- *Studies and Reports. Taxonomical Series*, 13 (2): 277-286.
- CAMPOS A. M., NOVOA F., 2006.- *Los Carabidae (Orden Coleoptera) de Galicia (N.O. de España). Catálogo, Distribución y Ecología*.- Monografías de Nova Acta Científica Compostelana, Serie Biología 2, Universidade de Santiago de Compostela, Galicia, Spain.
- CHAMPION G. C., 1898.- A list of the Cicindelidae, Carabidae and Staphylinidae collected by Mr. J.J. Walker, R.N., F.L.S., in the region of the Straits of Gibraltar.- *Transactions of the Entomological Society of London*, 5: 65-103.
- CHAUDOIR M., 1850.- Supplément à la faune des carabiques de la Russie.- *Bulletin de la Société Impériale des Naturalistes de Moscou*, 23 (3): 62-206.
- CUNÍ MARTORELL M., 1885.- Excursion entomológica á varias localidades de la provincia de Gerona (Cataluña).- *Anales de Historia Natural*, 14 (1): 51-73.
- DEJEAN P. F. M. A., 1825.- *Species général des coléoptères de la collection de M. le Comte Dejean. Tome premier*.- Crevot, Paris, France.
- DEKONINCK W., KERCKVOORDE M. VAN, NIEUWENHUYSE L. VAN, ZORGATI P., 2018.- Recent records of the very rare European carabid beetle *Dyschirius (Eudyschirius) semistriatus* (Dejean, 1825) (Coleoptera: Carabidae).- *Bulletin de la Société Royale Belge d'Entomologie/Bulletin van de Koninklijke Belgische Vereniging voor Entomologie*, 154 (2): 176-182.
- DOSTAL A., 1993.- Neue Taxa aus der Gattung *Reicheiodes* (stat. nov.) (Coleoptera, Carabidae: Scaritini).- *Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen*, 45 (3-4): 99-106.
- FEDORENKO D. N., 1996.- *Reclassification of word Dyschiriini, with a revision of the Palearctic fauna (Coleoptera, Carabidae)*.- Pensoft Publishers, Sofia - Moscow - St. Petersburg, Russia.
- FERNÁNDEZ PORTER C., 1944.- Introducción al catálogo de los carábidos valencianos.- *Graellsia*, 2 (4): 119-132.
- FLEISCHER A., 1899.- *Bestimmungs-Tabellen der europäischen Coleopteren. XXXIX. Heft. Carabidae: Abtheilung: Scaritini*.- Edm Reitter, Paskov, Czechia.
- FUENTE J. M. DE LA, 1918.- Catálogo sistemático-geográfico de los Coleópteros observados en la Península Ibérica, Pirineos propiamente dichos y Baleares.- *Boletín de la SEA*, 1 (9): 178-193.
- FUENTE J. M. DE LA, 1919.- Catálogo sistemático-geográfico de los Coleópteros observados en la Península Ibérica, Pirineos propiamente dichos y Baleares.- *Boletín de la SEA*, 2 (1): 11-18.
- FUENTE J. M. DE LA, 1927.- *Tablas analíticas para la clasificación de los coleópteros de la Península Ibérica. I. Cicindelidae, II. Carabidae*.- Altés, Barcelona, Spain.
- GAÑÁN I., 2008.- Revisión del género *Calathus* Bonelli, 1810 (Coleoptera, Carabidae, Harpalinae) en la Península Ibérica y Baleares. *PhD thesis*, University of Santiago de Compostela, Spain.
- GBIF.ORG, 2022a.- Occurrences of *Dyschirius*. GBIF Occurrence Download. doi:10.15468/dl.ex9z8f (accessed January 17, 2022).
- GBIF.ORG, 2022b.- Occurrences of *Dyschiriodes* GBIF Occurrence Download. doi:10.15468/dl.djff8b (accessed January 17, 2022)
- GBIF.ORG, 2022c.- Occurrences of *Reicheiodes*. GBIF Occurrence Download. doi:10.15468/dl.4sj8ek (accessed January 17, 2022)
- GERISCH M., SCHANOWSKI A., FIGURA W., GERKEN B., DZIOCK F., HENLE K., 2006.- Carabid beetles (Coleoptera, Carabidae) as indicators of hydrological site conditions in floodplain grasslands.- *International Review of Hydrobiology*, 91 (4): 326-340.
- GUTIÉRREZ D., MENÉNDEZ R., MÉNDEZ M., 2004.- Habitat-based conservation priorities for carabid beetles within the Picos de Europa National Park, northern Spain.- *Biological Conservation*, 115: 379-393.
- HAMMOND H. E. J., LANGOR D. W., HARTKEY D. J., 2018.- Effect of pitfall trap depth on epigeic beetle sampling (Coleoptera: Carabidae and Staphylinidae) in wet forested ecosites in Alberta, Canada.- *The Canadian Entomologist*, 150 (6): 813-820.
- HEYDEN L. VON, 1870.- *Entomologische Reise nach dem südlichen Spanien, der Sierra Guadarrama und Sierra Morena, Portugal und den Cantabrischen Gebirgen*.- Berlin, Germany.
- HOGAN J. E., 2012.- Taxonomy, systematics and biogeography of the Scaritinae (Insecta, Coleoptera, Carabidae). *PhD thesis*, Oxford Brookes University, UK.
- JEANNE C., 1967.- Carabiques de la Peninsule Iberique (4<sup>e</sup> note).- *Actes de la Société Linnéenne de Bordeaux*, 104 (3): 1-24.
- JEANNE C., 1976.- Carabiques de la Péninsule Ibérique (2<sup>e</sup> supplément).- *Bulletin de la Société Linnéenne de Bordeaux*, 6 (7-19): 27-43.
- JEANNE C., ZABALLOS J. M., 1986.- *Catalogue des Coléoptères Carabiques de la Peninsule Iberique*.- Supplément au Bulletin de la Société Linnéenne de Bourdeaux, Bourdeaux, France.
- JEANNEL R., 1941.- *Faune de France, 39. Coléoptères Carabiques, première partie*.- Lechevalier, Paris, France.
- KÁDÁR F., SZÉL G., 1995.- Data on ground beetles captured by light traps in Hungary (Coleoptera, Carabidae).- *Folia Entomologica Hungarica*, 56: 37-43.
- KANG B., LEE J.-H., PARK J.-K., 2012.- Carabid beetle species as a biological bioindicator for different habitat types of agricultural landscapes in Korea.- *Journal of Entomology and Field Biology*, 35 (1): 35-39.

- KLEINWÄCHTER M., RICKFELDER T., 2007.- Habitat models for a riparian carabid beetle: their validity and applicability in the evaluation of river bank management.- *Biodiversity and Conservation*, 16: 3067-3081.
- KROMP B., 1990.- Carabid beetles (Coleoptera, Carabidae) as bioindicators in biological and conventional farming in Austrian potato fields.- *Biology and Fertility of Soils*, 9: 182-187.
- MAKAROV K. V., 1994.- A key to the genera of ground-beetle larvae (Coleoptera, Carabidae) of the Palearctic region.- *Bollettino del Museo Regionale di Scienze Naturali*, 12 (1): 221-254.
- MARSEUL S., 1863.- *Catalogue des coléoptères d'Europe et du bassin de la Méditerranée en Afrique et en Asie. Deuxième édition.*- Ach. Deyllore, Paris, France. <https://gallica.bnf.fr/ark:/12148/bpt6k9232273/f1.item.zoom> (accessed February 23, 2022)
- MARSEUL S., 1880.- Nouveau répertoire contenant les descriptions des espèces de coléoptères de l'ancien-monde publiées isolément ou en langues étrangères, en dehors des monographies ou traités spéciaux et de l'Abeille.- *L'Abeille, Journal d'Entomologie*, 19: 1-526.
- MARORELL Y PEÑA M., 1879.- *Catálogos sinonímicos de los insectos encontrados en Cataluña, aumentados con los recientemente hallados por el autor, en los diversos órdenes de los Coleópteros, Hemipteros, Hymenópteros, Ortópteros, Lepidópteros, Dípteros y Neurópteros.*- Establecimiento tipográfico de los sucesores de N. Ramírez y C<sup>a</sup>, Barcelona, Spain.
- MORET P., 2012.- La Péninsule Ibérique et l'entomologie européenne au XIX<sup>e</sup> siècle, pp. 479-502. In: *Sortir du labyrinthe* (HUEZ DE LEMPS X., LUIS J. P., Eds).- Collection de la Casa Velázquez (131), Madrid, Spain.
- MOTSCHULSKY V., 1849.- Coléoptères reçus d'un voyage de M. Handschuch dans le midi de l'Espagne énumérés et suivis de notes.- *Bulletin de la Société Impériale des Naturalistes de Moscou*, 22: 52-163.
- MÜLLER J., 1922.- Bestimmungstabelle der *Dyschirius*-Arten Europas und der mir bekannten Arten aus dem übrigen palaarktischen Faunengebiet.- *Koleopterologische Rundschau*, 10: 33-120.
- NOVOA F., 1974.- Carabidae de la Sierra de Guadarrama. *PhD Thesis*, Universidad Complutense de Madrid, Spain.
- NOVOA F., 1979.- Los Carabidae (O. Coleoptera) de la sierra de Caurel (Lugo).- *Boletín de la Real Sociedad Española de Historia Natural (Biología)*, 77: 429-449.
- NOVOA F., CAMPOS A., 2000.- Citas nuevas o interesantes de Carabidae (Coleoptera) de Galicia (Noroeste de la Península Ibérica).- *Boletín de la Sociedad Española de Entomología*, 24: 205-207.
- NOVOA F., SÁEZ M., EIROA E., GONZÁLEZ J., 1989.- Los Carabidae (Coleoptera) de la Sierra de Ancares (Noroeste de la Península Ibérica).- *Boletín de la Real Sociedad Española de Historia Natural (Sección de Biología)*, 84 (3-4): 287-305.
- NOVOA F., BASELGA A., GONZÁLEZ J., CAMPOS A., 2003.- Coleópteros del Parque Natural de las Fragas del Eume (Galicia, noroeste de la Península Ibérica), I: Adephaga, Hydrophiloidea y Staphylinoidea.- *Boletín de la Sociedad Española de Entomología*, 27 (1-4): 71-91.
- OLIVEIRA P., 1876.- *Mélanges entomologiques sur les insectes du Portugal.*- Imprimerie de l'Université, Coimbra, Portugal.
- OLIVEIRA P., 1887.- *Catalogue des Insectes du Portugal. Coleopteres.*- Imprensa da Universidade, Coimbra, Portugal.
- ORTUÑO V. M., MARCOS J. M., 2003.- *Los Caraboidea (Insecta: Coleoptera) de la Comunidad Autónoma del País Vasco (Tomo I).*- Eusko Jaurlaritzaren Argitalpen Zerbitzu Nagusia (Servicio Central de Publicaciones del Gobierno Vasco), Vitoria-Gasteiz, Spain.
- ORTUÑO V. M., TORIBIO M., 2005.- *Carabidae de la Península Ibérica y Baleares. Vol. 1. Trechinae, Bembidiini.*- Argania Editio, Barcelona, Spain.
- ORTUÑO V. M., SENDRA A., REBOLEIRA A. S. P. S, FADRIQUE F., FAILLE A., 2017.- The Iberian genus *Paraphaenops* Jeannel, 1916 (Coleoptera: Carabidae: Trechini): morphology, phylogeny and geographical distribution.- *Zoologischer Anzeiger*, 266: 71-88.
- PUEL L., 1937.- Notes sur les Carabiques (suite): Les *Dyschirius*.- *Miscellanea Entomologica*, 38 (6): 93-136.
- PUTZEYS J. A. A. H., 1846.- Monographie des *Clivina* et genres voisins, précédée d'un tableau synoptique des genres de la tribu des Scaritides.- *Mémoires de la Société Royale des Sciences de Liège*, 2: 521-663.
- PUTZEYS J., 1863.- Postscriptum ad *Clivinidarum* monographiam atque de quibusdam aliis.- *Mémoires de la Société Royale des Sciences de Liège*, 18: 1-78.
- PUTZEYS J., 1866.- Coléoptères trouvés en Espagne pendant l'excursion de la Société en 1865. Amarides et *Clivinides*.- *Annales de la Société Entomologique de France*, 6 (4): 349-354.
- PUTZEYS J., 1867.- Révision générale des *Clivinides*.- *Annales de la Société Entomologique de Belgique*, 10: 1-242.
- PUTZEYS J., 1868.- Supplément a la révision générale des *Clivinides*.- *Annales de la Société Entomologique de Belgique*, 11: 7-22.
- PUTZEYS J., 1873.- Deuxième supplément à la révision générale des *Clivinides*.- *Annales de la Société Entomologique de Belgique*, 16: 10-18.
- QUANTUM GIS DEVELOPMENT TEAM, 2018.- Quantum GIS Geographic Information System. Open Source Geospatial Foundation Project.- [online] URL: <https://qgis.org/es/site/> (accessed July 2018).
- RAMOS-ABUÍN J. A., 2007.- Notas sobre Caraboidea en Galicia e conclusións sobre a súa ecoloxía.- *A Mobella, Boletín do Grupo Naturalista Hábitat*, 15: 11-25.
- RUIZ C., SERRANO J., 2006.- Molecular phylogeny and systematics of *Calathus* Bonelli (Coleoptera: Carabidae: Sphodrini) based on mitochondrial *cox1-cox2* sequences.- *Entomologica Fennica*, 17: 214-220.
- RUIZ-TAPIADOR I., ZABALLOS J. P., 2001.- Los Caraboidea (Coleoptera) de los Montes de Toledo (España Central).- *Boletín de la SEA*, 29: 11-31.
- SÁNCHEZ-GEA J.-F., GALIÁN J., SERRANO J., 2004.- Phylogeny of Iberian *Zabrus* (Coleoptera: Carabidae: Zabrini) based on mitochondrial DNA sequence.- *European Journal of Entomology*, 101: 503-511.
- SAULEDA N., 1985.- Caraboidea amofilos y halófilos de la provincia de Alicante.- *Anales de la Universidad de Alicante*, 2: 241-264.
- SEGLÉN P. O., 1997.- Why the impact factor of journals should not be used for evaluating research.- *British Medical Journal*, 314: 498-502.
- SERRANO A., 2000.- Estado do conhecimento dos Coleópteros (Insecta) em Portugal, pp. 155-170. In: *Hacia un proyecto CYTED para el inventario y estimación de la diversidad entomológica en Iberoamérica: PrIBES-2000* (MARTÍN-PIERA F., MORRONE J. J., MELIC A., Eds).- m3m: Monografías Tercer Milenio, vol 1. SEA, Zaragoza, Spain.
- SERRANO J., 2003.- *Catalogue of the Carabidae (Coleoptera) of the Iberian Peninsula.*- Monografías SEA, vol 9, Zaragoza, Spain.
- SERRANO J., 2013.- *New catalogue of the family Carabidae of the Iberian Peninsula (Coleoptera).*- Universidad de Murcia, Servicio de Publicaciones, Murcia, Spain.
- SERRANO J., 2016.- Additions and corrections to the catalogue of the family Carabidae (Insecta, Coleoptera) of the Iberian Peninsula.- *Boletín de la Asociación Española de Entomología*, 40 (3-4): 439-453.
- SERRANO J., 2020.- Catálogo electrónico de los Cicindelidae y Carabidae de la Península Ibérica (Coleoptera, Caraboidea). 2ª parte. [Version 12.2020].- *Monografías Electrónicas SEA 9*, Zaragoza, Spain. <http://sea-entomologia.org/monoelec.html> (accessed December 26, 2020).

- SERRANO J., LENCINA J. L., ANDÚJAR A., 2003.- Distribution patterns of Iberian Carabidae (Insecta, Coleoptera).- *Graellsia*, 59 (2-3): 129-153.
- SERRANO J., LENCINA J. L., MIÑANO J., 2021.- *Catálogo de los Caraboidea (Coleoptera: Cicindelidae y Carabidae) de la Región de Murcia*.- Editum, Ediciones de la Universidad de Murcia, Spain.
- SOLARI A., MAGRI M.-H., 2000.- A new approach to the SCI Journal Citation Reports, a system for evaluating scientific journals.- *Scientometrics*, 47 (3): 605-625.
- ZABALLOS J. P., JEANNE C., 1994.- *Nuevo catálogo de los carábidos (Coleoptera) de la Península Ibérica*.- Monografías SEA, 1, Zaragoza, Spain.

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