NEW RECORDS OF TRICHOPTERA IN REFERENCE MEDITERRANEAN-CLIMATE RIVERS OF THE IBERIAN PENINSULA AND NORTH OF AFRICA: TAXONOMICAL, FAUNISTICAL AND ECOLOGICAL ASPECTS

N. Bonada*, C. Zamora-Muñoz**, M. El Alami***, C. Múrria* & N. Prat*

ABSTRACT

Trichoptera is a very rich order in the Western Mediterranean, but knowledge of caddisflies in the Iberian Peninsula and northern Africa is still not complete. We present records of caddisflies collected in 114 sites of the Mediterranean climate region of the Iberian Peninsula and the western Rif. We also provide notes on ecological aspects and taxonomical remarks on some species. A total of 86 species were identified and 8 species extended their distribution range. Considering the four differentiated geological regions in the western Mediterranean Basin during the Tertiary, 60 species were collected in the Iberian plate region, 29 in the Transition, 30 in the Betic and 18 in the Rif. Local richness was not significantly different between the four regions but significant differences were found among several river ecotypes within regions. Temporary sites had lower local richness than other ecotypes in all regions except in the Rif, whereas headwaters had similar richness in any region regardless of their geology. The Rif region had the lowest Trichoptera richness, which is not only the result of the scarcity of faunistic studies in the area but also of the high frequency of temporary rivers and the isolation of the area. Our results suggest that conservation measures addressed to preserve the biodiversity of the Western Mediterranean should be enforced, especially in the Rif region.

Key words: Trichoptera, Mediterranean rivers, Iberian Peninsula, Morocco, Faunistic, Taxonomy, Ecology.

RESUMEN

Nuevos datos de tricópteros en ríos de referencia de clima mediterráneo en la Península Ibérica y norte de África: aspectos taxonómicos, faunísticos y ecológicos

El orden Trichoptera es rico en especies en la zona del Mediterráneo Occidental, pero el conocimiento de este grupo en la Península Ibérica y el norte de África resta aún de ser completo. Presentamos datos de tricópteros recolectados en 114 localidades de la región Mediterránea de la Península Ibérica y del Rif occidental. Además, proporcionamos datos sobre la ecología de algunas especies así como notas taxonómicas. Se identificaron un total de 86 especies y el rango de distribución aumentó para 8 de ellas.

* Department of Ecology, University of Barcelona, Diagonal, 645. E-08028 Barcelona (Spain)
** Department of Animal Biology, University of Granada, Faculty of Science, Campus Universitario de Fuentenueva. E-18071 Granada (Spain)
*** Department of Biology, University Abdelmalek Essaâdi, Faculty of Science Tétouan B.P. 2121. Tétouan (Morocco)
Introduction

The Mediterranean Basin has been considered a hotspot of biodiversity, at least when looking at plants and vertebrates (Myers et al., 2000). Insects are also diverse in the area especially when considering the reduced dimensions of the emerged land (Balleto & Casale, 1989). In particular, the western Mediterranean, and specially the south of the Iberian Peninsula and the north of Morocco (i.e. Betic-Rif ranges), is one of the two main centres of biodiversity within the Mediterranean Basin (Médail & Quézel, 1997). Likewise, Trichoptera is a very rich order in the Western Mediterranean, with about 390 species in the Iberian Peninsula (González, 2007) and 72 in Morocco (Dakki, 1980). In spite of having a high caddisfly richness, the knowledge of caddisflies in the Iberian Peninsula and north of Africa is still incomplete, new species are still recorded and many larval stages are not yet described (e.g. González & Ruiz, 2001; Zamora-Muñoz et al., 2002, 2006). Consequently, general studies providing information about caddisflies are required in both areas to have a consistent taxonomy of the group which will help to carry out proper ecological studies or to promote specific conservation measures.

Thus, our main aim was to complement the existing information (e.g. Dakki, 1980; González et al., 1992; Vieira-Lanero, 2000; Ruiz et al., 2001; Bonada et al., 2004b) with new records. The study area broadly corresponds to that studied in Bonada et al. (2004b) but with new sites and basins, including those found in the western Rif. The caddisfly records presented follow the taxonomical classification described in Wiggins (1996) and are updated using Fauna Iberica (www.fauna-iberica.mncn.csic.es) and Fauna Europaea (www.fauanaeur.org) web services. In addition, we follow the traditional species terminology and escape from recent synonyms without a consistent study of the species implied (Botosaneanu, in letter to C. Zamora-Muñoz, 2005). In some cases, we also provide taxonomical notes. Notes on ecological aspects of the species not already included in Bonada et al. (2004b) are given by using information compiled by the Guadalmed project (see www.ecostrimed.net) or by using references provided in Table 1.

Several authors have suggested that a mixture of complex past historical processes occurring during the Tertiary and Quaternary with current heterogeneous environmental conditions are responsible for the high biodiversity found in the Mediterranean Basin (Balleto & Casale, 1989; Hewitt, 2004; Bonada et al., 2005). Among historical factors, those that occurred during the Tertiary in the western Mediterranean Basin resulted in four differentiated geological regions: Iberian Plate, Transition, Betic and Rif. Among ecological factors, basin geology, river zonation and seasonal variability are the most relevant to understand caddisfly distribution (Bonada et al., 2005). Both groups of factors have implications on regional richness which in turn influences local richness (Vinson & Hawkins, 2003). We will analyze Trichoptera from these geological regions in terms of regional (i.e. richness in each geological region) and local richness (i.e. richness in each site). Given that basin geology and river zonation are the main environmental factors constraining caddisflies

Palabras clave: Trichoptera, ríos Mediterráneos, Península Ibérica, Marruecos, Faunística, Taxonomía, Ecología.
(Bonada et al., 2005), we will analyze local caddisfly richness between five river ecotypes based on these factors and described by Sánchez-Montoya et al. (2007) within geological regions: (1) temporary streams, (2) evaporite calcareous streams at medium altitude, (3) siliceous headwaters at high altitude, (4) calcareous headwaters at medium and high altitude and (5) large watercourses. By examining this, we will explore how main historical and environmental factors constrain local richness at two nested spatial scales (i.e. geological region and ecotype).

Material and methods

We collected Trichoptera specimens from 114 sites belonging to 28 basins. All sites were considered as reference regarding their ecological quality (Bonada et al., 2004a) and located in different river sections (i.e. headwaters, midstreams and lowland reaches) with different basin geology (i.e. calcareous, siliceous or sedimentary) and at different altitudes (from 20 to 1940 m.a.s.l., Appendix). Our study was focused within the limits of the Mediterranean climate established by Köppen (1931) and covered a sampled area of 70854.12 km²; from the northeast of the Iberian Peninsula to the western Rif zone in Morocco (Fig. 1). The sampled area was divided into 4 different geological regions: the Iberian Plate (42 sites), the Transition zone (9 sites), the Betic (43 sites) and the Rif zones (20 sites). The Iberian Plate comprises the area of the Iberian Peninsula which includes the Hesperic Massif (west of the Iberian Peninsula which originated in the Hercynian orogeny during the Carboniferous), the Iberian Ranges (east of the Hesperic Massif with a Hercinian base and a sedimentary cover) and the Catalan Ranges (northeast of the Hesperic Massif with a Hercinian and alpine orogeny origin and a sedimentary cover). The Transition zone is equivalent to the Prebetic area, located in the external zone of the Betic Ranges and originated, before the collision of the Betic-Rif microplate, by marine deposits or terrestrial sediments from the Iberian Plate. The Betic zone encloses the Internal Zone of the Betic Ranges (also called Betic s.s.), which was part of the Betic-Rif microplate, and the flysch deposits, coming from eastern areas and reached the Strait of Gibraltar with the migration of the Betic-Rif microplate (Sanz de Galdeano & Vera, 1991). Likewise, the Rif zone comprises the Internal zone and the flysch deposits of the Rif Ranges (Fig. 1).

In each site, we sampled all available habitats with a kick net of 250-300 µm mesh size depending on the survey, until no new caddisfly families were observed in the field. Samples were preserved in formalin (4%) or alcohol (96%) and identified to the species level in the laboratory. In addition, last-instar larvae and pupae were collected in the field and reared in the laboratory to obtain adults for ensuring larval identifications (for the method used see Bonada et al., 2004b). When possible, adults were also obtained in the field by sweeping riparian vegetation with an entomological net or by using a UV-light trap.

Local richness referred to the number of species collected at each site. In order to check local richness of caddisflies between ecotypes within geological regions we performed a nested ANOVA. Residuals were checked for normality and homogeneity of variances using Shapiro-Wilk and Bartlett tests, respectively. The nested design included 2 fixed factors nested as follows: ecotype nested to geological region. Although nested ANOVA designs usually use random nested factors, fixed factors can also be used (Quinn & Keough, 2002). As mentioned, the geological region factor includes: Iberian Plate, Transition, Betic and Rif. Regarding ecotypes, we used those developed for Mediterranean Basin rivers in Sánchez-Montoya et al. (2007): (1) temporary streams, (2) evaporite calcareous streams at medium altitude, (3) siliceous headwaters at high altitude, (4) calcareous headwaters at medium and high altitude and (5) large watercourses (Appendix). These statistical analyses were performed using the R freeware (http://www.r-project.org/).

Results

A total of 4041 larvae, 25 pupae and 131 adults were collected in the sampled area. Most of them were identified at species level, resulting in 86 different species. For each species, information of number of larva (L), pupae (P) and adults (♂ and ♀) collected are provided. For mature pupae and adults, the months of capture are presented in brackets after the locality. When the identity of the identification was not clear, a question mark (?) is added before some sampling sites or number of specimens. Sites are arranged by latitude of the whole basin (Fig. 1) and information about geographical position and general environmental characteristics of each locality is found in the Appendix.
Faunistic list

Suborder SPICIPALPIA
Family RHYACOPHILIDAE Stephens, 1836
Subfamily Rhyacophilinae Stephens, 1836

*Rhyacophila* Pictet, 1834

*Rhyacophila dorsalis* (Curtis, 1834)
Material studied: 18L. Fluvià: H18; Ter: H27, H29; Llobregat: H22, H32; Tajo: H9, H12

*Rhyacophila evoluta* McLachlan, 1879
Material studied: 16L. Ter: H24, H25

*Rhyacophila fasciata* Hagen, 1859
Material studied: 3L. Fluvià: H18, H19

Larvae found corresponded to this species but there is controversy about the presence of this species in the Iberian Peninsula (see Bonada et al., 2004b).

Fig. 1.— Site location and sampling area grouped by geological regions: Iberian Plate, Transitional, Betic and Rif zones. The boundary of the Mediterranean climate according to Köppen (1931) is also shown. See Appendix for detailed information on site location.

Fig. 1.— Localización de las estaciones de muestreo y de la zona muestreada agrupadas por regiones geológicas: Placa Ibérica, Transición, Béticas y Rif. Se muestra también el limite del clima Mediterráneo según Köppen (1931). Ver el Apéndice para obtener información detallada sobre la localización de las estaciones.
Rhyacophila fonticola Giudicelli & Dakki, 1984
MATERIAL STUDIED: 10L. Martil: R14; Laou: R3, R4, R8
See comments for Rhyacophila munda.

Rhyacophila meridionalis E. Pictet, 1865
MATERIAL STUDIED: 30L. Tordera: H14; Tajo: H5; Júcar: H4; Guadiana: H11; Segura: T1; Guadiana Menor: H1; Adra: B1, B3

Rhyacophila munda McLachlan, 1862
MATERIAL STUDIED: 56L, 1P. Tajo: H8; Júcar: H4, H13, T3; Guadiana: H1; Segura: T4; Guadalquivir: H6; Guadiana Menor: H11; Segura: T4; Guadalquivir: H6; Guadiana Menor: T5; Adra: B1, B2, B3

Rhyacophila nevada Schmid, 1952
MATERIAL STUDIED: 19L, 22A. Guadiana Menor: T9; Genil: B9, B11 (1P: VIII-2007); Guadalfeo: B20, B23

Although Malicky (2002; 2005b) considered this species as a subspecies of R. dorsalis, we believe that it should be kept as a distinct species because of larval morphology and ecological requirements (see more details in Bonada et al., 2004b).

Rhyacophila occidentalis McLachlan, 1879
MATERIAL STUDIED: 12L, 1A. Genil: B9, B11 (1P: VIII-2007); Guadalfeo: B20, B23

With the adults collected in the Genil Basin, specimens from other sites in Sierra Nevada mountains (from Adra and Guadalfeo basins), identified as R. cf. occidentalis in Bonada et al. (2004b), correspond, probably, to this species.

Rhyacophila rupta McLachlan, 1879
MATERIAL STUDIED: 1L. Llobregat: H32

Rhyacophila cf. tristis Pictet, 1834
MATERIAL STUDIED: 9L. Ter: H24, H25, H26; Llobregat: H23

See Bonada et al. (2004b) for comments on the difficulty of identifying the tristis group.

Family GLOSSOSOMATIDAE Wallengren, 1891
Subfamily Agapetinae Martynov, 1913

Agapetus Curtis, 1834
As reported before (Bonada et al. 2004b) this genus contains one species with undescribed larvae present in our sampled area (Agapetus theischingeri Malicky, 1980). In addition, most of the morphological characters used to distinguish species use lateral and ventral abdominal setae patterns (e.g. see Pitsch, 1993). This may yield misidentifications because these setae may be broken or not clearly visible. For example, two specimens found in Tajo Basin (H5) had only one lateral seta in the first abdominal segment and very few dorsal setae in the ninth abdominal sclerite. Given this difficulty, here we only present specimens with larvae that fit in the known species and from sites where pupae or adults have been collected previously (Bonada et al., 2004b).

Agapetus fuscipes Curtis, 1834
MATERIAL STUDIED: 114L, 2P. Ter: H25; Guadiana: H1; Guadiana Menor: B28 (1P: IV-2003); Genil: B14 (1P: I-2004); Adra: B2, B4

Agapetus delicatulus McLachlan, 1884
MATERIAL STUDIED: 2L. Ter: H25

Agapetus beredensis Dakki & Malicky, 1980
MATERIAL STUDIED: 16L, 1P. Laou: R13; Adelmane: R15 (1P: VI-2003), R16

Agapetus incertulus McLachlan, 1884
MATERIAL STUDIED: 33L, 1P. Laou: R13 (1P: IV-2003; 1P: X-2005); Genil: B10, B12, B13, B15, B18, B19; Verde: B35; Martil: R14; Adelmane: R15, R16

Ruiz et al. (2004) reported that larva of A. incertulus does not have ventral setae in the sixth and seventh segments. Although most of our specimens followed this character (as well as the others characteristics of this species), some specimens in B13 and B15 had ventral setae in at least one of these segments.

Agapetus nimbulus McLachlan, 1879

This species was recently cited from the Iberian Peninsula (Zamora-Muñoz et al., 2006). The larvae are similar to those of Agapetus segovicus Schmid, 1952. Thus, the intention of building a key with the described species of the Iberian Peninsula was resulted unsuccessful, at least with the characters used until now for the step-keys.

Synagapetus McLachlan, 1879

Nineteen larvae of this genus have been found in Ter (H17 and H25), Tordera (H14) and Segura (T2 and T4)
basins. Given the difficulties in the larva taxonomy we did not reach to species level for this genus.

Subfamily Glossosomatinae Wallengren, 1891

Glossosoma Curtis, 1834

Glossosoma boltoni Curtis, 1834

By distribution (northern basins of the Iberian Peninsula), specimens from the Ter Basin could also belong to Glossosoma spoliatum McLachlan, 1897, whose larva has not been described yet (Bonada et al., 2004b).

Family HYDROPTILIDAE Stephens, 1836

Subfamily Hydroptilinae Stephens, 1836

Allotrichia McLachlan, 1880

Allotrichia pallicornis (Eaton, 1873)
Material studied: 6L. Fluvià: H20; Guadiana: H3

We collected 178 larva specimens belonging to this genus but because many immature forms of Iberian species remain undescribed, we only present here results from sites where pupa or adults of the species were found.

Hydrotiella gr. sparsa Curtis, 1834

Hydrotiella vectis Curtis, 1834

Oxycera Eaton, 1876

Three specimens from this genus have been found in Francoli (H35), Júcar (T3) and Guadalfeo (B25) basins. Given the difficulties of identifying larvae, we did not reach species level.

Tribe Orthotrichiini Nielsen, 1948

Ithytrichia Eaton, 1873

Three specimens of this genus (not identifiable at species level because of the scarcity of published information on larval morphology, Vieira-Lanero, 2000) were found in the Guadiana Basin (H11).

Orthotrichia Eaton, 1873

Orthotrichia angustella (McLachlan, 1865)
Material studied: 8L. Fluvià: H20; Calonge: H35; Tordera: H14

Suborder ANNULIPALPIA

Superfamily PHILOPOTAMOIDEA Stephens, 1829

Family PHILOPOTAMIDAE Stephens, 1836

Subfamily Philopotaminae Stephens, 1836

Philopotamus Stephens, 1829

Philopotamus montanus (Donovan. 1813)

Wormaldia McLachlan, 1865

We found 115 larvae of this genus in Muga (H33), Ter (H28), Tordera (H14, H15 and H16), Llobregat (H23), Júcar (T3), Guadiana (H1), Guadiana Menor (B30, B33, B35), Genil (B15), Guadalfeo (B25), Chillar (B7) and Laou (R13) basins. Only one female was found in Genil Basin (B19) in July-2003. Given that no males were found, it was not possible to reach the species level.

Subfamily Chimarrinae Rambur, 1842

Chimarra Stephens, 1829

Chimarra marginata (Linnaeus, 1767)
Material studied: 46L. Muga: H33; Fluvià: H20; Llobregat: H22, H23; Francoli: H35; Ebre: H37; Tajo: H5, H8, H9; Júcar: H7; Segura: T1; Guadalquivir: H38; Jara: B36; Guadalfeo: B37; Martil: R20.

Superfamily HYDROPSYCHOIDEA Curtis, 1835

Family HYDROPSYCHIDAE Curtis, 1835

Hydropsyche Pictet, 1834

Hydropsyche cl. angustipennis (Curtis, 1834)
Material studied: 1L. Ter: H26

Although some larva specimens from northern basins have been recently assigned to this species (Valladolid et al., 2007), adult records in the Iberian Peninsula are not known despite being recorded in the Balearic Islands (González et al., 1992). Our specimen clearly shows the distinctive features of this species (Neu & Tobias, 2003) but adult material should be collected to confirm its presence in the area.

Hydropsyche brevis Mosely, 1930
Material studied: 4L. Tajo: H5; Júcar: H7; Segura: T4

Hydropsyche bulbifera McLahlan, 1878
Material studied: 5L. Fluvià: H18, H20
Hydropsyche dinarica Marinkovic-Gospodnetic, 1979
Material studied: 56L. Ter: H17, H24, H25

Hydropsyche exocellata Dufour, 1841
Material studied: 11L. Fluvià: H20, Tajo: H10; Segura: T1

Hydropsyche fezana Navás, 1935
Material studied: 314L. Laou: R2, R3, R4, R5, R8, R12, R13; Adelmane: R15, R16; Sebou: R17, R18

Hydropsyche fontinalis Zamora-Muñoz & González, 2002
Material studied: 1L. Guadiana Menor: T8

Hydropsyche infernalis Schmid, 1952

Hydropsyche instabilis (Curtis, 1834)

Hydropsyche gr. instabilis
Material studied: 71L. Ter: H28; Llobregat: H23, H32; Foix: H31; Francoli: H35

This species corresponds to the same Hydropsyche gr. instabilis in Bonada et al. (2004b), potentially considered as a new species by larval and male pupa morphology. Recently, molecular analysis using portions of COI gene have revealed that individuals with this morphology constitute a single group that is different from other species within the instabilis group, supporting the idea that it should be considered as a new species (Múrria, unpubl. data). Adult material is however needed to formally describe this species using morphological characters.

Hydropsyche lobata McLachlan, 1884
Material studied: 81L. Guadiana: H3; Laou: R6, R7, R9, R10, R11, R12

Hydropsyche maroccana Navás, 1935
Material studied: 152L, 1A. Laou: R6, R9, R11 (1º: V-2005), R13

Hydropsyche gr. pellucidula
Material studied: 349L. Fluvià: H18, H19; Llobregat: H22, H32; Francoli: H35; Tajo: H8, H9, H10; Guadiana: H11; Segura: T1; Guadiana Menor: T9; Genil: B18; Guadalfeo: B21; Laou: R1, R6, R7, R9, R10, R11, R12

Given the difficulties of identifying larvae of Hydropsyche iberomaroccana González & Malicky, 1999, Hydropsyche incognita Pitsch, 1993 and Hydropsyche punica Malicky, 1981 (Zamora-Muñoz et al., 1995; González & Malicky, 1999), we have grouped all individuals under the pellucidula group. H. incognita has a widespread distribution in Central Europe and in the Iberian Peninsula (Bonada et al., 2004b). However, H. iberomaroccana has been recorded in southern Iberian basins and in Morocco (e.g. González & Malicky, 1999; Bonada et al., 2004b), whereas H. punica has been cited only from northern Africa (Malicky & Lounaci, 1987; Kumanski, 2006).

Hydropsyche siltalai Döhler, 1963
Material studied: 123L. Muga: H33; Fluvià: H18, H19; Ter: H26, H27, H29; Tordera: H14, H16; Tajo: H12; Júcar: T3; Guadiana: H1; Segura: T2, T4, Guadalquivir: H6

Hydropsyche teruela Malicky, 1980
Material studied: 2L. Segura: T1

Hydropsyche tibialis McLachlan, 1884
Material studied: 1L. Adra: B3

Cheumatopsyche Wallengren, 1891

Cheumatopsyche atlantis (Navás, 1930)
Material studied: 2L. Laou: R7

Malicky (2005b) has considered this species as a synonym of Cheumatopsyche lepida (Pictet, 1834). The study of the larvae collected showed some differences with this species: the hairy areas were less conspicuous than in C. lepida and mostly limited to the anterior margin of the pronotum. We consider, thus, that C. atlantis is different from C. lepida, but more individuals need to be collected to ensure that C. atlantis is a good species.

Cheumatopsyche lepida (Pictet, 1834)
Material studied: 79L. Fluvià: H20; Ter: H29; Francoli: H35; Júcar: H7

Family PSYCHOMYIIDAE Walker, 1852
Subfamily Psychomyiinae Walker, 1852

Psychomyia Latreille, 1829

Psychomyia pusilla (Fabricius, 1781)
Lype McLachlan, 1878
Lype phaeopa Stephens, 1836
Material studied: 1L. Muga: H33

Metalype Klapálek, 1898
Metalype fragilis (Pictet, 1834)
Material studied: 3L. Llobregat: H22; Tajo: H5
This species has been considered as Psychomyia fragilis by Malicky (2005b).

Tinodes Curtis, 1834
As pointed out in Bonada et al. (2004b) several species of this genus present in the area of study are not described and records presented here should be confirmed, except in cases where adults are found.

Tinodes cf. assimilis McLachlan, 1865
Material studied: 24L. Júcar: T3; Genil: B12, B13, B15, B18; Adra: B4; Verde: B35
The presence of this species in Guadalfeo and Guadiana Menor Basins has been confirmed by adult collection in previous studies (Zamora-Muñoz, unpubl. data).

Tinodes baenai González & Otero, 1984
The larva of this species is not described but adults confirmed that this species was collected in the site.

Tinodes cf. dives (Pictet, 1834)
Material studied: 38L. Llobregat: H23; Foix: H31; Tajo: H8

Tinodes cf. unicolor Pictet, 1834
Material studied: 1L. Tordera: H14

Tinodes cf. waeneri (Linnaeus, 1758)
Material studied: 14L. Ter: H29; Llobregat: H32

Family POLYCENTROPODIDAE Ulmer, 1903
Subfamily Polycentropodinae Ulmer, 1903

Polycentropus Curtis, 1835
Polycentropus cf. corniger McLachlan, 1884
Material studied: 3L. Fluvià: H18; Segura: T2
Records of pupae and adults are needed to confirm the presence of this species in the study sites.

Polycentropus flavocinatus (Pictet, 1834)
Material studied: 5L. Ter: H29; Foix: H31

Polycentropus kingi McLachlan, 1881
Material studied: 99L. Tordera: H14, H16; Tajo: H8; Júcar: H13; Segura: T2; Guadiana Menor: B33, T7, T8; Genil: B18, B13, B14; Adra: B4; Guadalfeo: B24, B25; Laou: R3, R4, R8; Adelmene: R15, R16
The presence of this species in T8 is confirmed by adult collection in previous studies (Zamora-Muñoz et al., 2002).

Cyrnus Stephens, 1836
Cyrnus cf. montserratii Gonzalez & Otero, 1963
Material studied: 2L. Guadiana Menor: H1
Records of pupae and adults are needed to confirm the presence of this species in the studied sites, but these larvae resembled those found in a previous study (Bonada et al., 2004b).

Suborder INTEGRIPALPIA
Superfamily LIMNEPHILOIDEA Kolenati, 1848
Family BRACHYCENTRIDAE Ulmer, 1903

Brachycentrus Curtis, 1834
Brachycentrus (B.) cf. montanus Klapálek, 1892
Material studied: 1L. Júcar: H13
This specimen has a squared section case without silk and the head has a uniform coloration, typical features of this species. However, until now it has only been recorded in northern Portugal and north-western Spain (Vieira-Lanero, 2000).

Brachycentrus (B.) subnubilus Curtis, 1834
Material studied: 3L. Tajo: H9

Micrasema LacLachlan, 1876
Micrasema longulum McLachlan, 1876
Material studied: 8L. Genil: B9, B11; Adra: B2, B3; Guadalfeo: B22

Micrasema cf. minimum McLachlan, 1876
Material studied: 5L. Ter: H25

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Although specimens fitted well under this species according to Vieira-Lanero (2000), *Micrasema saltatum* Schmid, 1952 or *Micrasema vestitum* Navás, 1918, whose larvae are not yet described, have been cited close to site H25 (Estación Valter 2000, in Botosaneanu & González, 2006).

*Micrasema moestum* (Hagen, 1868)

**Material studied:** 283L. Tajo: H9; Guadiana Menor: B27, T5, T8; Genil: B9, B14, B17, B19; Adra: B1, B2, B3, B4, B5; Guadalfeo: B22, B23, B26; Laou: R2

The presence of this species in T8 has been confirmed previously by adult collection (Zamora-Muñoz et al., 2002).

**Family LEPIDOSTOMATIDAE** Ulmer, 1903

Subfamily Lepidostomatinae Ulmer, 1903

*Lepidostoma* Rambur, 1842

*Lepidostoma hirtum* (Fabricius, 1775)

**Material studied:** 15L. Muga: H33; Tordera: H15; Júcar: T3; Guadiana: H1; Genil: B10

*Lasiocephala* Costa, 1857

*Lasiocephala basalis* (Kolenati, 1848)

**Material studied:** 89L, 1P. Júcar: H4; Segura: T2; Guadiana Menor: T5, T8 (1P < 100 mm); Genil: B9, B10, B11, B14; Adra: B4; Guadalfeo: B20, B22, B23, B26

This species has been considered as *Lepidostoma basale* by Malicky (2005b).

**Family LIMNEPHILIDAE** Kolenati, 1848

Subfamily Drusinae Banks, 1916

*Drusus* Stephens, 1837

*Drusus bolivari* (McLachlan, 1880)

**Material studied:** 8L. Guadiana Menor: B27

*Drusus rectus* (McLachlan, 1868)

**Material studied:** 2L. Ter: H25

Given the difficulties of separating *D. rectus* from *Drusus annulatus* (Stephens 1837) using larvae, we provisionally considered these specimens as *D. rectus* because adults have been found in ecologically similar sites of the Ter Basin (Bonada et al., 2004).

*Anomalopterygella* Fischer, 1966

*Anomalopterygella chauviniana* (Stein, 1874)

**Material studied:** 16L. Guadiana Menor: B27; Genil: B9; Adra: B2, B3; Guadalfeo: B20, B26

Subfamily Limnephilinae Kolenati, 1848

Tribe Limnephilini Kolenati, 1848

*Limnephilus* Leach, 1815

*Limnephilus guadarramicus* Schmid, 1955

**Material studied:** 27L. Ter: H28; Llobregat: H23; Tajo: H12; Júcar: H13; Segura: T2

*Limnephilus lunatus* Curtis, 1834

*Glyptotaelius* Stephens, 1833

*Glyptotaelius pellucidus* (Retzius, 1783)

**Material studied:** 5L. Ter: H28; Llobregat: H23

Tribe Chaetopterygini Hagen, 1858

*Annitella* Klapalek 1907

*Annitella esparraguera* Schmid, 1952

**Material studied:** 13L, 1P, 100A. Guadiana Menor: B27 (1P < 100 mm, 100A: X-2005)

Until now, *A. esparraguera*, one of the eight species of this genus present in the Iberian Peninsula, had been recorded only in Sierra Nevada (Schmid, 1952a,b) and Sierra de Cazorla (Sipahiler, 1998). With this record of Sierra de Baza, we extend its distribution to other areas of the Betic Ranges. All *Annitella* species are rare and only the larva of *A. obscurata* (McLachlan, 1876) has been described (e.g. Vieira-Lanero, 2000), thus the genus is seldom included in larval keys. The larvae collected in this site were small (III instar) and fitted with *Halesus* or *Chaetopteryx* following the keys of Vieira-Lanero (2000) and Camargo & García de Jalón (1988).

*Chaetopteryx* Stephens, 1829

We collected 1 larva of this genus in the Segura Basin (T2). The species level is not provided because of the difficulties at larval level (Vieira-Lanero, 2000).

Tribe Stenophylacini Schmid, 1955

*Potamophylax* Wallengren, 1891

*Potamophylax cingulatus* (Stephens, 1837)

**Material studied:** 9L. Tordera: H14, H15; Ter: H17, H25, H26

*Potamophylax latipennis* (Curtis, 1834)

**Material studied:** 20L. Ter: H25, H26; Genil: B9, B11; Adra: B1, B2, B3, B4; Guadalfeo: B23

*Halesus* Stehens, 1836

*Halesus radiatus* (Curtis, 1834)

**Material studied:** 25L. Ter: H24; Tordera: H16; Llobregat: H23
Halesus tesellatus (Curtis, 1834)
MATERIAL STUDIED: 33L. Adra: B1, B2, B3, B4, B5; Guadalfeo: B20, B22, B26

Stenophylax Kolenati, 1848
Larval description of all the species of this genus recorded in the study area (11 species) are not provided in the literature, and species level can only be reached with reliability using pupae or adults. Following the available keys for the described species (Wallace et al., 1990; Waringer & Graf, 1997; Vieira-Lanero, 2000), we have identified 22 larvae from Ter (H28), Llobregat (H23) and Sebou (R19) basins as Stenophylax sequax (McLachlan, 1875). However, this species has not been cited in North Africa (Dakki, 1980; Tobias & Tobias, 2007). Six larvae in the Guadiana Menor (T6) and Genil (B8) basins were identified as Stenophylax nycterobius (McLachlan, 1875), confirmed in the B8 site by larval rearing in the laboratory. On the other hand, 13 larvae in the Guadiana Menor (B30, B33 and B34) and Genil basins (B8, B10, B12 and B14) may fit with Stenophylax crossotus McLachlan, 1884 following the recent description by Ruiz-García & Ferreras-Romero (2007).

Mesophylax McLachlan, 1882
Mesophylax aspersus (Rambur, 1842)
MATERIAL STUDIED: 1L. Llobregat: H23

Allogamus Schmid, 1955
Allogamus auricollis (Pictet, 1834)
MATERIAL STUDIED: 120L. Guadiana Menor: B32, B33, B40 (2♀; X-1996; 1♂; XI-1996; 2♀; 10♂♂; X-2007); Genil: B12, B13 (2♂♂; X-1996; 1♂; XI-1996); B14 (1♂; X-2005), B16, B17 (12♂♂; X-2007), B19; Laou: R2, R4, R5, R13, R15; Sebou: R17; Adelmane: R16

Allogamus ligonifer (McLachlan, 1876)
MATERIAL STUDIED: 10L. Tajo: H12; Júcar: H4; Segura: T2, T4

Allogamus mortoni (Navás, 1907)
MATERIAL STUDIED: 220L., 31A. Guadiana Menor: B32, B33, B40 (2♀; X-1996; 1♂; XI-1996; 2♀; 10♂♂; X-2007); Genil: B12, B13 (2♂♂; X-1996; 1♂; XI-1996), B14 (1♂; X-2005), B16, B17 (12♂♂; X-2007), B19; Laou: R2, R4, R5, R13, R15; Sebou: R17; Adelmane: R16

Larvae of this species were identified using the key of Ruiz-García et al. (2004) which includes all known Allogamus species of the Iberian Peninsula. In addition, some specimens from North Africa and Genil basins were confirmed by the author of the key (Ruiz, pers. comm.) and in Guadiana Menor (B40) and Genil basins (B13, B14 and B17) we collected adults of this species. Therefore, our records would extend the distribution of this Iberian species to North Africa. The study of the male genitalia of individuals from B17 and B40 revealed certain variability in the number (from 2 to 4) and the length of the spines of the parameres. In each locality we could distinguish three morphotypes in relation to this character and in two of them the length of one of the spines was longer than in the original description of A. mortoni (see Malicky, 2004). Nevertheless, after comparing the individuals with specimens of Allogamus antennatus McLachlan, 1876 and Allogamus antennatus ausoniae (Moretti, 1991), our individuals never had the parameres as long as the aedeagus, like these have. The parameres of A. mortoni thus show a high morphological variability as noticed for A. auricollis Pictet, 1834 (see Malicky, 2004).

Family GOERIDAE Ulmer, 1903
Subfamily Goerinae Ulmer, 1903

Silo Curtis, 1830
Silo graellsii E. Pictet, 1865
MATERIAL STUDIED: 2L. Ter: H25

Silonella Fischer 1966
Silonella aurata (Hagen, 1864)
MATERIAL STUDIED: 61L. Genil: B19; Laou: R2; Adelmane: R16

Larcasia Navás, 1917
Larcasia partita Navás, 1917
MATERIAL STUDIED: 3L. Guadiana: H1

Superfamily LEPTOCEROIDEA Leach, 1815
Family LEPTOCERIDAE Leach, 1815
Subfamily Leptocerinae Leach, 1815
Tribe Athripsodini Morse & Wallace, 1976
Athripsodes Billberg, 1820
Some species of this genus (e.g. A. taounate Dakki & Malicky, 1980) have been recorded in the study area but are not yet described (González et al., 1992). We found 36 larvae of this genus in Fluvià (H18), Ter (H29), Tajo (H5), Júcar (H4), Guadiana Menor (B29, B33), Genil (B10, B11, B12, B16), Guadalfeo (B20, B22, B26), Martil (R14) and Laou (R1) basins. Larvae found in H18 were similar to Athripsodes albifrons (Linneaus, 1758).

Tribe Leptocerini Leach, 1815
Leptocerus Leach, 1815
Leptocerus lusitanicus McLachlan, 1884
MATERIAL STUDIED: 1L. Fluvià: H20
Tribe Mystacidini Burmeister, 1839

**Mystacides** Burmeister, 1827

**Mystacides azurea** (Linnaeus, 1761)

**Oecetis** McLachlan, 1877

We found 4 larvae of this genus in Muga (H33), Ter (H27, H29) and Tordera (H16) similar to **Oecetis testacea** Curtis, 1834.

Tribe Setodini Morse, 1981

**Setodes** Rambur, 1842

Eleven specimens of this genus were found in the Laou Basin (R4, R13) but given that some species remain undescribed (e.g. **Setodes zerroukii** Dakki, 1981), it was not possible to reach the species level.

**Setodes argentinipunctellus** McLachlan, 1877

**Adicella** McLachlan, 1877

The genus has some species with undescribed larvae (e.g. **Adicella melanella** (McLachlan, 1884)) but the presence of **A. reducta** in the study area has been confirmed by adults previously collected in the sites from Tordera, Guadiana Menor and Guadalfeo basins (Zamora-Muñoz et al., 2002; Bonada et al., 2004b) and now in the Genil Basin.

Tribe Triaenodini Morse, 1981

**Adicella reducta** (McLachlan, 1865)

The genus has some species with undescribed larvae (e.g. **Adicella melanella** (McLachlan, 1884)) but the presence of **A. reducta** in the study area has been confirmed by adults previously collected in the sites from Tordera, Guadiana Menor and Guadalfeo basins (Zamora-Muñoz et al., 2002; Bonada et al., 2004b) and now in the Genil Basin.

Tribe Triacnodini Morse, 1981

**Adicella** McLachlan, 1877

**Adicella reducta** (McLachlan, 1865)

**Calamoceras** Brauer, 1865

**Calamoceras marsupus** Brauer, 1865

**Calamoceras gr. marsupus** Brauer, 1865

In spite of larvae of **C. marsupus** building their cases with vegetable material (García de Jalón et al., 1987), some larval specimens in R8 presented a stony case. Adults collected did not fit clearly under the male genitalia description of **C. marsupus** or **Calamoceras illiesi** Malicky & Kumanski, 1974, another species present in the Mediterranean Basin (Malicky, 2005a), and in some features our specimens present intermediate characteristics (González, pers. comm.). In ventral view, the IXth segment is shorter in our specimens than in **C. marsupus**, with the lateral edges more developed, particularly in the distal end. In lateral view, the ventral lobes of Xth segment present a small blunted tooth, as in **C. illiesi**. Gonopods of our specimens resemble those of **C. marsupus**, but they have the basal segment more slender and the distal segment (harpa-go) longer (about as long as basal segment) than this species. Considering that **C. marsupus** and **C. illiesi** have small differences in the genitalia and there is some morphological variability in the Mediterranean Basin (Malicky, in letter to N. Bonada), we can not ensure the identification of these specimens until more adults are collected.

**Sericostoma** Latreville, 1825

**Schizopelex** McLachlan, 1876

**Schizopelex festiva** (Rambur, 1842)

**Odontocerum** Leach, 1815

**Odontocerum albicorne** (Scopoli, 1763)

**Sericostoma** Latreville, 1825

Larvae within this genus are very difficult to identify at species level. We provide specimens of this genus collected in the sampled area.

**Sericostoma vittatum** Rambur, 1842, a species collected in this site in previous studies (Zamora-Muñoz et al., 2002). Specimens from R2 and R13 were classified as **Sericostoma** according to Vieira-Lanero (2000), but this genus has not been recorded from North Africa (Dakki, 1980; Tobias & Tobias, 2007).
Table 1.— Global and local distribution, ecological characteristics and water quality preferences of the caddisfly species collected in the sampled area and not recorded in Bonada et al. (2004b).

<table>
<thead>
<tr>
<th>Species</th>
<th>World-Wide Distribution</th>
<th>Iberian Peninsula and North Africa</th>
<th>Mediterranean Basin</th>
<th>Longitudinal Zonation</th>
<th>Geographical Preferences</th>
<th>Water Quality Preferences</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Rhyacophila fonticola</em> Giudicelli &amp; Dakki, 1984</td>
<td>Iberian Peninsula and north of Africa</td>
<td>Southern basins of the IP and the Rif</td>
<td>Rif</td>
<td>Headwaters</td>
<td>Calcareous</td>
<td>Very good</td>
</tr>
<tr>
<td><em>Rhyacophila rupta</em> McLachlan, 1879</td>
<td>Iberian Peninsula and Pyrenees</td>
<td>Northern basins of the IP</td>
<td>Northern basins of the IP</td>
<td>Headwaters</td>
<td>Calcareous</td>
<td>Very good</td>
</tr>
<tr>
<td><em>Agapetus delicatulus</em> McLachlan, 1884</td>
<td>Central and southern Europe and Anatolia</td>
<td>Northern and central basins of the IP except northwest</td>
<td>Northern basins of the IP</td>
<td>Headwaters</td>
<td>Siliceous</td>
<td>Very good</td>
</tr>
<tr>
<td><em>Agapetus nimbulus</em> McLachlan, 1879</td>
<td>Central and southern Europe</td>
<td>Southern basins of the IP</td>
<td>Southern basins of the IP</td>
<td>Headwaters</td>
<td>Siliceous, Calcareous</td>
<td>Very good</td>
</tr>
<tr>
<td><em>Agapetus beredensis</em> Dakki &amp; Malek, 1980</td>
<td>Rif</td>
<td>Rif</td>
<td>Rif</td>
<td>Headwaters</td>
<td>Calcareous</td>
<td>Very good to moderate</td>
</tr>
<tr>
<td><em>Hydropsyche cf. angustipennis</em> (Curtis 1834)</td>
<td>Europe and Anatolia</td>
<td>Northern and central basins of the IP</td>
<td>Northern and central basins of the IP*</td>
<td>Headwaters</td>
<td>Calcareous</td>
<td>Very good to good</td>
</tr>
<tr>
<td><em>Hydropsyche fezana</em> Navás, 1935</td>
<td>North of Africa</td>
<td>North Africa</td>
<td>Rif</td>
<td>Headwaters</td>
<td>Calcareous</td>
<td>Very good to good</td>
</tr>
<tr>
<td><em>Hydropsyche lobata</em> McLachlan, 1884</td>
<td>Iberian Peninsula and north Africa</td>
<td>Widespread in the IP except northeast and North of Africa</td>
<td>Southern basins of the IP and the Rif</td>
<td>Headwaters to lowland reaches</td>
<td>Calcareous</td>
<td>Very good to moderate</td>
</tr>
<tr>
<td><em>Hydropsyche maroccana</em> Navás, 1935</td>
<td>North Africa and Canary Islands</td>
<td>North Africa</td>
<td>Rif</td>
<td>Headwaters to lowland reaches</td>
<td>Calcareous</td>
<td>Good to moderate</td>
</tr>
<tr>
<td><em>Cheumatopsyche atlantis</em> (Navás, 1930)</td>
<td>North of Africa</td>
<td>North Africa</td>
<td>Rif</td>
<td>Midstream to lowland reaches</td>
<td>Calcareous</td>
<td>Good to moderate</td>
</tr>
<tr>
<td><em>Lype phaeopa</em> Stephens, 1836</td>
<td>Europe and Iran</td>
<td>Widespread in the IP</td>
<td>Northern basins of the IP</td>
<td>Headwaters</td>
<td>Siliceous</td>
<td>Very good</td>
</tr>
<tr>
<td><em>Tinodes baenai</em> González &amp; Otero, 1984</td>
<td>Iberian Peninsula</td>
<td>Southern basins of the IP</td>
<td>Southern basins of the IP</td>
<td>Headwaters</td>
<td>Calcareous</td>
<td>Very good</td>
</tr>
<tr>
<td><em>Tinodes unicolor</em> Pictet, 1834</td>
<td>Europe</td>
<td>Northern basins of the IP</td>
<td>Northern basins of the IP</td>
<td>Headwaters</td>
<td>Siliceous</td>
<td>Very good</td>
</tr>
<tr>
<td><em>Polycentropus corniger</em> McLachlan, 1884</td>
<td>Iberian Peninsula and Pyrenees</td>
<td>Central and western basins of the IP</td>
<td>Northern and southern basins of the IP*</td>
<td>Headwaters</td>
<td>Calcareous</td>
<td>Very good</td>
</tr>
</tbody>
</table>
Table 1.— Cont.

<table>
<thead>
<tr>
<th>WORLD-WIDE DISTRIBUTION</th>
<th>DISTRIBUTION IBERIAN PENINSULA AND NORTH AFRICA</th>
<th>DISTRIBUTION IN SAMPLED MEDITERRANEAN BASIN</th>
<th>LONGITUDINAL ZONATION</th>
<th>GEOLOGICAL PREFERENCES</th>
<th>WATER QUALITY PREFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Brachycentrus (B.) montanus</em> Klapálek, 1892</td>
<td>Central and southern Europe</td>
<td>Northern basins of the IP</td>
<td>Central basins of the IP*</td>
<td>Headwaters</td>
<td>Calcareous</td>
</tr>
<tr>
<td><em>Brachycentrus (B.) subnubilus</em> Curtis, 1834</td>
<td>Palearctic</td>
<td>Northern and central basins of the IP</td>
<td>Central basins of the IP</td>
<td>Headwaters</td>
<td>Calcareous</td>
</tr>
<tr>
<td><em>Annitella esparraguera</em> Schmid, 1952</td>
<td>Iberian Peninsula</td>
<td>Southern basins of the IP</td>
<td>Southern basins of the IP</td>
<td>Headwaters</td>
<td>Calcareous</td>
</tr>
<tr>
<td><em>Allogamus ligonifer</em> (McLachlan, 1876)</td>
<td>Southwestern Europe</td>
<td>Widespread in the IP except in northeast</td>
<td>Central and southern basins of the IP</td>
<td>Headwaters</td>
<td>Calcareous Sedimentary</td>
</tr>
<tr>
<td><em>Silonella aurata</em> (Hagen, 1864)</td>
<td>Iberian Peninsula, Corse, Sardinia and North of Africa</td>
<td>Southern basins of the IP and North Africa</td>
<td>Southern basins of the IP and the Rif</td>
<td>Headwaters</td>
<td>Calcareous</td>
</tr>
<tr>
<td><em>Lucarsia partita</em> Navás, 1917</td>
<td>Iberian Peninsula</td>
<td>Widespread in the IP except in northeast</td>
<td>Southern basins of the IP</td>
<td>Headwaters</td>
<td>Siliceous</td>
</tr>
<tr>
<td><em>Leptocerus louisianicus</em> McLachlan, 1884</td>
<td>Western Europe</td>
<td>Widespread in the IP</td>
<td>Northern basins of the IP</td>
<td>Headwaters to midstream reaches</td>
<td>Calcareous</td>
</tr>
<tr>
<td><em>Schizopelex festiva</em> (Rambur, 1842)</td>
<td>Iberian Peninsula and north of Africa</td>
<td>Widespread in the IP except in southern basins and North Africa</td>
<td>Rif</td>
<td>Headwaters</td>
<td>Calcareous</td>
</tr>
</tbody>
</table>

* Adult material is needed to confirm the presence of this species in the sampled area.
1 Information was obtained from our records and the following references: Dakki (1980); Dakki & Malicky (1980); El Alami & Dakki (1998); González et al. (1992); Tayoub (1989); Vieira-Lanero (2000); Ruiz-Garcia et al. (2006); Zamora-Muñoz (2006); Valladolid (2007). “IP” refers to Iberian Peninsula and “North Africa” includes Magreb, Libya and Egypt.
3 Information in this column was obtained from our records. Northern basins go from Muga to Ebre basins; Central basins go from Mijares to Guadiana basins; Southern basins go from Segura to Guadalquivir basins.
3 Ecological information was obtained from our records using the same criteria of Bonada et al. (2004b) and Guadalmed typology (Sánchez-Monteoya et al. 2007).
Eight larvae of this genus were found in Tajo (H8), Guadiana (H1) and Guadalquivir (H6) basins, and resembled Beraea terrai Malicky, 1975. However, species level was not reached because the larva of Beraea dira McLachlan, 1875 is not described and could be present in the area (González et al., 1992).

Beraea maurus (Curtis, 1834)

Material studied: 1L. Llobregat: H23

Local richness

From the 86 species identified with certainty in this study, 60 species were present in the Iberian plate region, 29 in the Transition, 30 in the Betic and 18 in the Rif. Although Rif showed the lowest regional species richness, local richness was not significantly different between geological regions (F-value = 2.457, p = 0.068). Significant differences were however found between ecotypes within regions (F-value = 4.097, p = 0.004). Residuals did not significantly differ from normality (p = 0.70) and from homogeneity of variances (p > 0.160). Box-plots indicated that temporary sites (Fig. 2) had lower local richness than other ecotypes in all regions except in the Rif. Headwaters, regardless of their geology, had similar richness and, when present, richness in lowland sites was also similar to that present in headwaters.

Discussion

Our work complements records reported in previous studies in the Mediterranean climate region of the Iberian Peninsula and north Africa (e.g. Dakki, 1980; Ruiz et al., 2001; Bonada et al., 2004b) with information from several not previously studied sites. We have found 22 species not recorded in Bonada et al. (2004b), 4 of them only found in the Rif. Information about the distribution of these species and their ecological requirements is provided in Table 1. In addition, comparing with González et al. (1992) and Bonada et al. (2004b) we provide records that extend the distribution of several species in the Mediterranean area of the Iberian Peninsula. Glossosoma boltoni, Allogamus ligonifer, Lepidostoma hirtum and Lacarsia partita were recorded in the southern basins. Brachycen-
Coleoptera, Bennás et al., 1992; Ribera, 2000). However, the Rif has been considered an isolated area (Jolly et al., 1998; Cosson et al., 2005), which makes the maintenance of a diverse freshwater fauna more difficult. This is even more problematic for caddisflies, which are not equipped with biological strategies to cope with the frequent summer droughts of the region (Littmann, 2000; Williams, 2006). This observation is in accordance with the lowest local caddisfly richness recorded in the eco-type 1 that we found in all geological regions except in the Rif. All this suggest that conservation measures have to be enforced in this area to preserve its biodiversity.

Several authors have pointed out the importance of large-scale characteristics on macroinvertebrate distributions (e.g. Sandin & Johnson, 2004). In particular, basin geology and river zonation were considered, among several environmental variables, the most important to explain caddisfly distribution in the Mediterranean climate rivers of the Iberian Peninsula (Bonada et al., 2005). Basin geology determines mineralization of water and river zonation results in changes in the hydraulic forces, the terrestrial influence and the resources available among others (Hawkins & Sedell, 1981; Statzner et al., 1988; Leland & Porter, 2000). However, although these parameters constrain caddisfly distribution, our results show that taxa richness is maintained between ecotypes with permanent flow conditions. This observation contrasts with other studies in temperate Europe using caddisflies that recorded an increase of species with surrogates of river zonation, such as stream width and slope (Wiberg-Larsen et al., 2000). The higher biodiversity of caddisflies in the Western Mediterranean compared to temperate Europe (e.g. around 200 species in Denmark and England, but almost double in the Iberian Peninsula, Wallace et al., 1990; González et al., 1992; Edington & Hildrew, 1995; Wiberg-Larsen et al., 2000) is probably accountable to this observation.

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Los Alcornocales (sur de España). Boletín de la Asociación Española de Entomología, 25(3-4): 105-120.


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Appendix.— Location of the sampled sites in the Iberian Peninsula and the Rif. For each site the code used in the text, UTM coordinates, altitude, river name, geographical province and ecotype are shown. Ecotype refers to the categories provided by Sánchez-Montoya et al. (2007) and corresponds to: (1) temporary streams, (2) evaporite calcareous streams at medium altitude, (3) siliceous headwaters at high altitude, (4) calcareous headwaters at medium and high altitude and (5) large watercourses. Sites are arranged by alphabetical order of “Code”.

Apéndice.— Localización de las estaciones muestreadas en la Península Ibérica y en el Rif. Para cada estación se presenta el código utilizado en el texto, las coordenadas UTM, la altitud, el nombre del río, la provincia geográfica y el ecotipo. El ecotipo incluye las categorías consideradas en Sánchez-Montoya et al. (2007) y corresponden a: (1) ríos temporales, (2) ríos calcáreos y evaporíticos de mediana altitud, (3) cabeceras silíceas de elevada altitud, (4) cabeceras calcáreas de mediana y elevada altitud y (5) grandes cursos de agua. Los puntos de muestreo están ordenados por orden alfabético del “Code”.

<table>
<thead>
<tr>
<th>Code</th>
<th>Basin</th>
<th>Longitude X_UTM</th>
<th>Latitude Y_UTM</th>
<th>Altitude m.a.s.l.</th>
<th>River/Stream</th>
<th>Province</th>
<th>Ecotype</th>
</tr>
</thead>
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