Boletín de la Sociedad Entomológica Aragonesa (S.E.A.), nº **48** (30/06/2011): 389–393.

PROVISIONAL CATALOGUE AND BIOGEOGRAPHICAL ANALYSIS OF THE ODONATA OF LA RIOJA (SPAIN)

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Abstract: The first conclusions are here presented of a research project about the Odonata of La Rioja (Spain) promoted by the Research Institute of La Rioja. 49 species are included (23 Zygoptera and 26 Anisoptera) in the provisional catalogue, of which 22 species are recorded from La Rioja for the first time. A biogeographical analysis of these taxa is also provided.
Key words: Odonata, catalogue, biogeography, Spain, La Rioja.

Catálogo provisional y análisis biogeográfico de los odonatos de La Rioja (España)
Resumen: Se presentan las primeras conclusiones del Plan de Investigación del Instituto de Estudios Riojanos "Insectos del Orden Odonata en la Comunidad Autónoma de la Rioja". Se ha elaborado el catálogo provisional de los odonatos de La Rioja compuesto por 49 especies (23 zigópteros y 26 anisópteros) de las que 22 se citan por primera vez de la región. Se aporta un análisis biogeográfico de las especies localizadas.
Palabras clave: Odonata, catálogo, biogeografía, España, La Rioja.

Introduction

The Odonata first known data in La Rioja were provided by Longinos Navás (Navás, 1902, 1906, 1907, 1914 and 1924) who published several notes related to nine species: *Calopteryx virgo, Pyrrhosoma nymphula, Onychogomphus forcipatus, Cordulegaster boltonii, Libellula quadrimaculata, Libellula depressa, Orthetrum brunneum, Sympetrum flaveolum* and *Sympetrum striolatum.* Many years later, Compte Sart (1975) added *Sympecma fusca* to La Rioja's list and Ocharan Larrondo (1987) collected *Anax imperator* and *Sympetrum fonscolombii*.

After their visit to the Iberian mountain system, Anselin & Hoste (1996) provided two new species for La Rioja: *Onychogomphus uncatus* and *Orthetrum coerulescens*. Furthermore, they cited the capture of a male *Coenagrion pulchellum* in La Rioja, an eurosiberian taxon that becomes rare in southern areas far from its distribution range (Boudot *et al*., 2009), being the reason why it has not been considered in the present study, although Torralba-Burrial & Alonso-Naveiro (2007) include it in their La Rioja Odonata catalogue.

To these 14 species, Galante & Verdú (2000) added *Coenagrion mercuriale*, Rodríguez (2008) added *Onychogomphus costae* and Torralba-Burrial & Alonso-Naveiro (2009) increased the La Rioja *Odonata* provisional catalogue with ten more species: *Lestes barbarus, Lestes dryas, Coenagrion caerulescens, Coenagrion puella, Ischnura graellsii, Ischnura pumilio, Ceriagrion tenellum, Aeshna mixta, Aeshna cyanea* and *Sympetrum sanguineum.* Recently, Torralba-Burrial & Ocharan (2010) have cited *Anax parthenope*.

All these already mentioned researches integrated a catalogue of 27 species (11 Zygoptera and 16 Anisoptera) with proved presence in La Rioja, 34.6% of those distributed in the Iberian Peninsula.

The lack of deep Odonata biogeographical studies in the whole La Rioja territory motivated the constitution of Zalandrana Odonatology Group and the beginning of its 2008-2010 Research Plan: "Order of Odonata insects in the autonomous region of La Rioja" (unpublished), granted by the Institute of La Rioja Studies (Instituto de Estudios Riojanos - IER-). The first results of this Research Plan are presented.

Study area

La Rioja is a small region (5,045 km²) located in the northern of the Iberian Peninsula (fig. 1) within the Mediterranean biogeographical region. It receives two main climatic influences: the Mediterranean one which is felt especially in the Ebro river great depression, in the northern part of the region, and the Atlantic one that is evident in the Iberian mountain system located in the south. Thus, the Ebro valley stretch located in La Rioja is the entry area of species that prefer hotter temperatures and dry environments, while Iberian mountain areas (La Demanda, Urbión, Cebollera and Cameros) are the species locations linked to Atlantic, Continental-European and even Boreo-alpine conditions of highest climbs.

Methodology

For the elaboration of the Odonata provisional catalogue in La Rioja a bibliographical review was firstly realized and whose results have been already mentioned. Secondly, the La Rioja territory was divided into a 10x10 km UTM geographical grid (referred to European Datum 1950_UTM 30N projected coordinates system) and systematic samplings were done in the best periods for imago detection, covering the whole grid during the 2008-2010 period.

The main sampling method was the active capture of adult individuals with entomological nets and the live specimens' identification was conducted using the keys proposed by Dijkstra & Levington (2006).

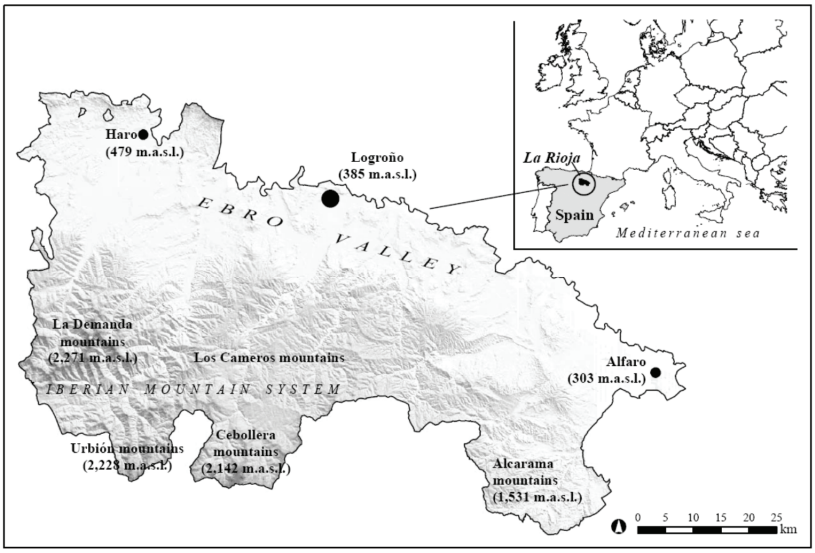

Fig. 1. La Rioja in the European context and its main relief units. / *La Rioja en el contexto europeo y sus principales unidades de relieve.*

Data obtained in the field work were added to a data base where each sampling site includes information about geographical location (referred to the UTM grid and with an 1 km accuracy range) and altitude, date and capture method used, researcher name, and a list of captured and observed species. The taxonomic classification used is referred to Boudot *et al*. (2009).

A total amount of 4,200 records were obtained and used in the elaboration of the provisional catalogue (unpublished). Explicit references included in this paper only correspond to the Odonata first citations in La Rioja, not yet mentioned in the literature.

For the Odonata biogeographical analysis, elements defined by Ocharan (1988) and its later reclassification applied to the Iberian Peninsula (Torralba-Burrial & Ocharan, 2007) have been followed. This systematic distinction includes seven biogeographical elements and the zoogeographic pattern assigned to polytypical species is referred to the subspecies present in the Iberian Peninsula. Obtained data have been compared with other region more influenced in order Mediterranean conditions (Andalucia) and with the Iberian Peninsula in order to characterize them biogeographically.

Results and Discussion

Provisional catalogue

The Odonata provisional catalogue in La Rioja is formed by 49 species (23 Zygoptera and 26 Anisoptera), representing 62.8% of the whole Odonata diversity in the Iberian Peninsula, currently composed by 78 species (Sánchez *et al*., 2009). 22 from these 49 species have been cited for the first time in La Rioja (Table I; see also the Annex for the most relevant citations in the context of this study).

Attending to global climatic trends and their influence on odonates (Ott & Samways, 2010) it is not rejectable the presence of species like *Trithemis annulata* Palisot de Beauvois, 1805, among others, in the most arid zones of the Ebro valley stretch that have been increasing their distribution range (very low by the moment but probably more widespread in the near future), in the same way that *Onychogomphus costae*, *Crocothemis erythraea*, and other species in Europe (Ott, 2001) have recently done.

Due to the same climatic scenario, it could be also those taxa like *Aeshna juncea* and *Sympetrum flaveolum* - absent in the most part of La Rioja except in the highest altitudinal areas of the Iberian system mountains- will reduce their distribution range and even disappear.

On the other hand, it is not also rejectable the presence in La Rioja of other rare taxa in the Iberian Peninsula as e.g. *Sympetrum vulgatum ibericum* Ocharan, 1985; *Oxygastra curtisii* Dale, 1834 or *Gomphus graslinii* Rambur, 1842. In that case, their presence must be low due to the negative results achieved during the sampling period of three years that has been carried out in the present study.

Biogeographical analysis

In La Rioja (Tables I and II) there are represented the seven biogeographical elements types defined by Ocharan (1988) and updated by Torralba-Burrial & Ocharan (2007).

Among them (Table II), Iberian-Maghrebian distribution taxa (24.5%) highlights; they and the West Mediterranean taxa account almost 41% of the Odonata diversity in La Rioja.

Attending to the comparison of La Rioja biogeographical elements with the Iberian Peninsula and other further south region (Andalucia) (Tables II and III), we conclude that Odonata diversity in La Rioja is more or less the expected. In comparison with Andalucia, the most remarkable fact is that Odonata in La Rioja have less Ethiopian taxa (6.1% vs. 15%) and some more Holarctic and Eurosiberian ones.

Combinated data (Table II and III) shows that Odonata in La Rioja is essentially Mediterranean (75.5%), with two complementary components: a Nordic one (18.4%) similar to the average percentage observed in the Iberian Peninsula (21%), although slightly lower due to the absence of taxa from the Pyrenees or the Cantabrian coast, whose southern distribution range limit don't reach La Rioja; and an Ethiopian component (6.1%) lower than the Iberian Peninsula average ratio percentage (13%) due to the less extreme Mediterranean climatic conditions in La Rioja than in the eastern and southern part of Spain.

Table I. Odonata provisional catalogue, first records and biogeographical characterization in La Rioja (biogeographical elements as Torralba-Burrial & Ocharan, 2007). */ Catálogo provisional de los odonatos de La Rioja, incluyendo las primeras citas y su caracterización biogeográfica (según Torralba-Burrial & Ocharan, 2007)*

Taxa	First record in La Rioja	Biogeographical element
Fam. CALOPTERYGIDAE		
Calopteryx xanthostoma (Charpentier, 1825)	this study	Iberian-Maghrebian
Calopteryx virgo meridionalis Sélys, 1873	Navás (1907)	West Mediterranean
Calopteryx haemorrhoidalis haemorrhoidalis Vander Linden, 1825	this study	West Mediterranean
Fam. LESTIDAE		
Lestes sponsa (Hansemann, 1823)	this study	Eurosiberian
Lestes dryas Kirby, 1890	Torralba-Burrial & Alonso-Naveiro (2009)	Holarctic
Lestes barbarus (Fabricius, 1798)	Torralba-Burrial & Alonso-Naveiro (2009)	Pontic-Eastern
Lestes virens virens (Charpentier, 1825)	this study	Iberian-Maghrebian
Lestes viridis (Vander Linden, 1825)	this study	West Mediterranean
Sympecma fusca (Vander Linden, 1820)	Compte-Sart (1975)	Holomediterranean
Fam. COENAGRIONIDAE		
Ischnura elegans (Vander Linden, 1820)	this study	Eurosiberian
Ischnura graellsii (Rambur, 1842)	Torralba-Burrial & Alonso-Naveiro (2009)	Iberian-Maghrebian
Ischnura pumilio (Charpentier, 1825)	Torralba-Burrial & Alonso-Naveiro (2009)	Pontic-Eastern
Enallagma cyathigerum (Charpentier, 1840)	this study	Holarctic
Coenagrion puella (Linnaeus, 1758)	Torralba-Burrial & Alonso-Naveiro (2009)	Pontic-Eastern
Coenagrion mercuriale mercuriale (Charpentier, 1840)	Galante & Verdú (2000)	Iberian-Maghrebian
Coenagrion scitulum (Rambur, 1842)	this study	Holomediterranean
Coenagrion caerulescens caerulescens (Fonscolombe, 1838)	Torralba-Burrial & Alonso-Naveiro (2009)	Iberian-Maghrebian
Erythromma viridulum (Charpentier, 1840)	this study	Holomediterranean
Erythromma lindenii (Selys, 1840)	this study	Holomediterranean
Pyrrhosoma nymphula (Sulzer, 1776)	Navás (1907)	West Mediterranean
Ceriagrion tenellum (Villers, 1789)	Torralba-Burrial & Alonso-Naveiro (2009)	West Mediterranean
Platycnemis acutipennis Selys, 1841	this study	Iberian-Maghrebian
Platycnemis latipes Rambur, 1842	this study	Iberian-Maghrebian
Fam. AESHNIDAE		
Aeshna mixta Latreille, 1805	Torralba-Burrial & Alonso-Naveiro (2009)	Eurosiberian
Aeshna affinis Vander Linden, 1820	this study	Pontic-Eastern
Aeshna cyanea (Müller, 1764)	Torralba-Burrial & Alonso-Naveiro (2009)	Holomediterranean
Aeshna juncea (Linnaeus, 1758)	this study	Holarctic
Anax imperator Leach, 1815	Ocharan Larrondo (1987)	Ethiopian
Anax parthenope Selys, 1839	Torralba-Burrial & Ocharan (2010)	Pontic-Eastern
Anax ephippiger (Burmeister, 1839)	this study	Ethiopian
Boyeria irene (Fonscolombe, 1838)	this study	West Mediterranean
Fam. GOMPHIDAE		
Gomphus simillimus Selys, 1840	this study	Iberian-Maghrebian
Gomphus pulchellus Selys, 1840	this study	Iberian-Maghrebian
Onychogomphus uncatus (Charpentier, 1840)	Anselin & Hoste (1996)	Iberian-Maghrebian
Onychogomphus forcipatus unguiculatus (Vander Linden, 1823)	Navás (1907)	West Mediterranean
Onychogomphus costae Selys, 1885	Rodríguez (2008)	Iberian-Maghrebian
Fam. CORDULEGASTRIDAE		
Cordulegaster boltonii (Donovan, 1807)	Navás (1907)	West Mediterranean
Fam. LIBELLULIDAE		
Libellula quadrimaculata Linnaeus, 1758	Navás (1906)	Holarctic
Libellula depressa Linnaeus, 1758	Navás (1906)	Pontic-Eastern
Orthetrum nitidinerve (Selys, 1841)	this study	Iberian-Maghrebian
Orthetrum cancellatum (Linnaeus, 1758)	this study	Holomediterranean
Orthetrum coerulescens (Fabricius, 1798)	Anselin & Hoste (1996)	Holomediterranean
Orthetrum brunneum (Fonscolombe, 1837)	Navás (1902)	Holomediterranean
Sympetrum sanguineum (Müller, 1764)	Torralba-Burrial & Alonso-Naveiro (2009)	Holomediterranean
Sympetrum flaveolum (Linnaeus, 1758)	Navás (1914)	Eurosiberian
Sympetrum fonscolombii (Selys, 1840)	Ocharan Larrondo (1987)	Holomediterranean
Sympetrum striolatum (Charpentier, 1840)	Navás (1914)	Eurosiberian
Sympetrum meridionale (Selys, 1841)	this study	Pontic-Eastern
Crocothemis erythraea (Brullé, 1832)	this study	Ethiopian

Table II. Odonata biogeographical composition in La Rioja. */ Composición biogeográfica de los odonatos de La Rioja.*

Biogeographical element	Species in La Rioja	% in La Rioja	% in Andalusia*	% in Iberian Peninsula*
Holarctic	4	8.2	5	5
Eurosiberian	5	10.2	8	16
Pontic-Eastern	7	14.3	15	18
Holomediterranean	10	20.4	20	16
West Mediterranean	8	16.3	13	10
Iberian-Maghrebian	12	24.5	24	22
Ethiopian	3	6.1	15	13

* Data from Andalusia and Iberian Peninsula are obtained from Torralba-Burrial & Ocharan (2007)

Table III. Odonata general types in La Rioja */ Caracterización biogeográfica general de los odonatos de La Rioja.*

General Biogeographical element	% in La Rioja	% in Andalusia*	% in Iberian Peninsula*
Nordic (Holarctic and Eurosiberian)	18.4	13	21
Mediterranean (Pontic-Eastern, Holomediterranean, West Mediterranean and Iberian-Maghrebian)	75.5	72	66
Ethiopian	6.1	15	13

* Data from Andalusia and Iberian Peninsula are obtained from Torralba-Burrial & Ocharan (2007)

Threatened species

According to the updated "Spanish Red List of Threatened Species" (Verdú & Galante, 2009) and the recent revision done by Torralba-Burrial *et al*. (2010), 13 of the taxa cited in La Rioja appear under some threat status; eight of them are cited as "Vulnerable" (VU): *Coenagrion caerulescens*, *Coenagrion mercuriale*, *Coenagrion scitulum*, *Aeshna juncea, Gomphus simillimus*, *Onychogomphus costae, Orthetrum nitidinerve* and *Sympetrum flaveolum*; three are cited as "Data Deficient" (DD): *Platycnemis acutipennis, Aeshna affinis* and *Sympetrum meridionale* and two are cited under "Least Concern" (LC) category: *Calopteryx haemorrhoidalis* and *Onychogomphus uncatus.*

On the other hand, 5 taxa founded in La Rioja are included in the "European Red List of Dragonflies" (Kalkman *et al*., 2010): one defined as "Endangered" (EN): *Onychogomphus costae*, another one classified as "Vulnerable" (VU): *Orthetrum nitidinerve* and three more under the "Near Threatened" status: *Coenagrion caerulescens*, *Coenagrion mercuriale* and *Gomphus simillimus simillimus.*

Coenagrion mercuriale is the only taxon of this provisional catalogue included in the Annex II of the Habitats Directive which gathers the species requiring the designation of Special Areas of Conservation (Council of the European Communities, 1992).

Acknowledgements

Thanks to the Institute of La Rioja Studies for granting and promoting the 2008-2010 "Order of *Odonata* insects in the autonomous region of La Rioja" Research Plan that has conducted the present work. Thanks to Adolfo Cordero and Rosa Ana Sánchez-Guillén for their support, to Antonio Correas for the computer applications design, to Antonio Padró for his review work, to José Ignacio Esquisabel for his contributions about threatened species and to Sara Zaldívar and F. Javier Gómez for their translation work. Also, thanks to all members of Zalandrana Odonatology Group that arrived till the end (by alphabetical order): Andrés Garzón, Antonio Correas, David Mazuelas, Eduardo Ruiz, Enrique Aguilar, Gerardo Hernando, Héctor M. García, Ismael Sarabia, José Antonio Bustillo, José Antonio Gainzarain, José Ignacio Esquisabel, José Pinillos, Juan José Almazán, Leandro Arroyo, Pablo Alba, Ricardo Zaldívar and Salvador Peñalva. And thanks to all who left at the middle of the way.

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Annex. Data about the 22 Odonata species cited for the first time in La Rioja in this study.
/ Datos de las primeras citas de las 22 especies de odonatos citadas por vez primera en este estudio para La Rioja.

Taxa	♂♂	♀♀	Date	Municipality	X,Y Coordinates*		Altitude (m.a.s.l.)
Calopteryx xanthostoma	1	1	19-VI-08	Fonzaleche	501833	4716328	546
Calopteryx haemorrhoidalis	2	1	07-VI-08	Cervera del Río Alhama	590849	4646355	590
Lestes sponsa	0	1	23-VI-08	Logroño	551995	4699538	475
Lestes virens	0	1	18-VI-08	Hervías	511029	4699866	630
Lestes viridis	0	1	13-VII-08	Arnedillo	566378	4673089	625
Ischnura elegans	0	1	11-V-08	Logroño	545019	4703615	390
Enallagma cyathigerum	1	1	25-V-08	Alfaro	593355	4666071	400
Coenagrion scitulum	1	0	09-VII-08	Sojuela	536612	4690096	740
Erythromma viridulum	1	0	14-VII-08	Calahorra	584070	4682349	360
Erythromma lindenii	1	0	20-VI-08	San Vicente de la Sonsierra	519683	4711293	429
Platycnemis acutipennis	1	1	31-VII-08	Cornago	573370	4655355	810
Platycnemis latipes	1	1	20-VI-08	San Vicente de la Sonsierra	519681	4711252	429
Aeshna affinis	0	1	29-VI-08	Sojuela	535379	4689663	850
Aeshna juncea	1	1	28-VIII-08	Lumbreras	528782	4649302	1,950
Anax ephippiger	1	0	20-VIII-09	Nestares	531230	4684927	1,470
Boyeria irene	1	0	12-VIII-08	San Román de Cameros	547196	4671297	1,000
Gomphus simillimus	1	0	04-VI-08	Logroño	544302	4701918	389
Gomphus pulchellus	0	1	11-VI-08	Sojuela	536607	4690101	740
Orthetrum nitidinerve	1	1	07-VII-08	Logroño	550281	4699461	400
Orthetrum cancellatum	0	1	14-VI-08	Sojuela	536621	4690092	740
Sympetrum meridionale	0	1	29-VII-08	Villalba de Rioja	509290	4717289	540
Crocothemis erythraea	0	1	18-VI-08	Hervías	511005	4699868	630

*X and Y values referred to ETRS89_UTM 30N projected coordinates system