Odonatologica 38(2): 151-158 *June 1, 2009*

SHORT COMMUNICATIONS

ODONATA FROM AGUASCALIENTES STATE, MEXICO

J.A. ESCOTO-MORENO[1], E. GONZÁLEZ-SORIANO[2] and J. ESCOTO-ROCHA[1]

[1] Departamento de Biología, Universidad Autónoma de Aguascalientes, Avenida Universidad 940, MX-20100 Aguascalientes, Mexico
jerjaem2002@yahoo.es

[2] Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México, Avenida Universidad 3000, MX-04510 Ciudad Universitaria, D.F., Mexico
esoriano@ibiologia.unam.mx

Received June 11, 2008 / Reviewed and Accepted November 25, 2008

A list is presented of 58 spp., including their distribution by municipalities; 50 of these are new records for the state. Information on general distribution of selected spp. is also provided. In accordance with the non-parametric estimation Chao2, the number of observed spp. represents ca 87.8% of the total number of spp. estimated for the state of Aguascalientes.

INTRODUCTION

The state of Aguascalientes is one of the smallest states in Mexico and one of the least studied regarding its biodiversity (e.g. LLORENTE et al., 1996; OCHOA--OCHOA & FLORES-VILLELA, 2006). It is ranked on the penultimate site in arthropod diversity of Mexico, surpassing in species numbers only the state of Tlaxcala (LLORENTE et al., 1996). Regarding its odonate fauna it has been classified as a poorly known state (GONZÁLEZ & NOVELO, 1996).

Here we present the results of a recent survey, recording a total of 58 species. The results are based mainly on material collected between January 2005 and January 2006 and on that deposited in the Colección Entomológica of the Universidad Autónoma de Aguascalientes (UAA). According to the non-parametric estimator Chao2, this number represents almost 87.8% of the true diversity of the state.

STUDY AREA

The state of Aguascalientes represents only 0.3% of the Mexican surface. It is located between the coordinates 21°38'- 22°27'N and 101°53'- 102°52'W (Fig 1). It is one of smallest states of México (5,589 km ^{2}), surpassing in size only the states of Tlaxcala, Morelos and Distrito Federal. It is located within three physiographic provinces: the Sierra Madre Occidental Province occupying the western portion of the state (46.5% of its area); the Mesa Central Province in the East (49.8%); and the Eje Neovolcanico Province in the South (3.6%).

The eastern part of the state is a flat area in which the Sierra de Asientos (2650 m asl) and Cerro Juan El Grande (2500 m asl) reach the highest elevations. In the West is located an extensive mountainous area, constituted by La Sierra Fría (3050 m asl), Sierra El Laurel (2760 m asl) Cerro La Calavera (2660 m asl) and Cerro El Mirador (2700 m asl).

Most of the state is underlain by igneous extrusive rocks, with only 28.2% of its surface being composed of sedimentary rocks, extrusions of Cretaceous marine sedimentary rocks, and of Triassic and Jurassic metamorphic rocks (INEGI, 2003).

The rivers Calvillo, San Gil and La Labor originate in the mountains of the western portion of the state. There are also intermittent water bodies and temporary ponds formed during the rainy season.

The dominant climate is of the BS1 kw(w) type, with annual average temperatures between 16 and 18°C; in the West the annual precipitation lies between 500 and 600 mm and in the East between 400 and 500 mm; the dry season occurs between January and May. The highest temperatures occur during April and May, reaching 36°C, while the lowest temperatures occur in the mountains between December and February, -4°C during the night.

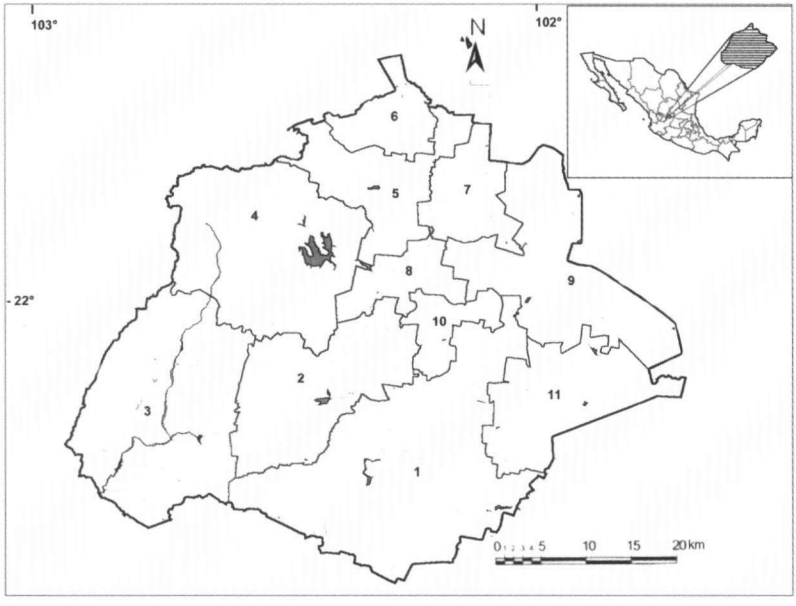

Fig 1. Municipalities of the state of Aguascalientes. 1 Aguascalientes, – 2 Jesús María, – 3 Calvillo, – 4 San José de Gracia, – 5 Rincón de Romos, – 6 Cosío, – 7 Tepezalá, – 8 Pabellón de Arteaga, – 9 Asientos, – 10 San Francisco de los Romo, – 11 El Llano.

METHODS

A list of the water bodies located in each municipality was made using some specialized maps (scale 1: 250,000) (INEGI, 2003). The minimum sample size effort was calculated using the program STATSTM v.2 (2003). Once the optimal sample size (166 localities) was established, we chose a random stratified sample by parcelling out the sample size (166) between the 11 municipalities in a proportional way, taking into account the size and the number of water bodies included in each municipality (Fig 1). The final localities were randomly chosen using the program STATSTM v.2 (2003).

Considering that the observed number of any sample of individuals from a community underestimates the true number of species present, one nonparametric estimator of species richness was performed using the data obtained during the period of study, with the purpose to determine how close is the recorded richness value to the true local richness for the state. The estimator used was Chao2, an incidence based estimator. The estimation was calculated using EstimateS 6.0b1 (COLWELL, 2006)

RESULTS

A total of 58 species were recorded for the state of Aguascalientes. They are included in 30 genera and seven families (see Tab. I).

At the family level, Coenagrionidae was the most diverse family with 26 species, followed by Libellulidae (21), Aeshnidae (6), and Lestidae (2). Calopterygidae, Gomphidae and Corduliidae are represented by a single species each.

Argia is the most diverse genus, with 16 species, followed by *Enallagma*, *Ischnura*, *Rhionaeschna* and *Sympetrum* with three species each and *Telebasis*, *Orthemis*, *Pantala*, *Perithemis* and *Tramea* with two species each. The remaining 19 genera have one species each.

The following species are the most widely distributed and were found in all municipalities (11) of the state: *Enallagma praevarum*, *Ischnura demorsa*, *Telebasis salva*, *Rhionaeschna multicolor*, *Libellula saturata* and *Pantala flavescens*. On the other hand, *Argia lugens*, *A. munda*, *A. oenea*, *A. pallens*, *A. sabino*, *A. sedula*, *Ischnura ramburii*, *Enallagma novaehispaniae*, *Telebasis griffinii*, *Macromia magnifica*, *Brachymesia furcata* and *Miathyria marcella* were collected in only one municipality. The remaining species were found in between two and 10 municipalities.

In this paper we added 50 new records for the Aguascalientes state (see Tab. I).

DISCUSSION

Similar to other little-known regions of Mexico, such as those of the neighbouring states of Zacatecas and Guanajuato and the northern regions of Jalisco and western regions of San Luis Potosí states, the state of Aguascalientes remained for many years a *terra incognita odonatologica*. The 50 species added in this paper represent an increase of a little more than 600% from the previous number recorded for the state (GONZÁLEZ & NOVELO, 1996, 2007). According to

Table I

List of Odonata of the state of Aguascalientes by municipalities. – [Municipalities: Ag = Aguascalientes, As = Asientos, Ca = Calvillo, Co = Cosío, JM = Jesús María, Ll = El Llano, PA = Pabellón de Arteaga, RR = Rincón de Romos, SF = San Francisco de los Romo, SJ = San José de Gracia, Te = Tepezalá]

Taxa	Ag	As	Ca	Co	JM	Ll	PA	RR	SF	SJ	Te
CALOPTERYGIDAE											
*Hetaerina americana** (Fabricius, 1798)	X		X		X						
LESTIDAE											
*Archilestes grandis** (Rambur, 1842)	X	X			X		X			X	X
*Lestes alacer** Hagen 1861	X		X		X			X	X	X	
COENAGRIONIDAE											
*Apanisagrion lais** (Brauer *in* Selys, 1876)	X		X		X		X				
*Argia anceps** Garrison, 1996	X		X		X					X	
*A. extranea** (Hagen, 1861)	X		X		X						
*A. fumipennis violacea** (Hagen, 1861)	X		X		X					X	
*A. inmunda** (Hagen, 1861)			X							X	
*A. lugens** (Hagen, 1861)										X	
*A. munda** Calvert 1902			X							X	
A. nahuana Calvert, 1902	X		X								
*A. oenea** Hagen *in* Selys, 1865			X								
*A. pallens** Calvert, 1902			X								
*A. plana** Calvert, 1902	X		X		X			X		X	X
*A. sabino** Garrison, 1994										X	
*A. sedula** (Hagen, 1861)										X	
*A. tarascana** Calvert, 1902	X									X	
*A. tezpi** Calvert, 1902			X		X						
*A. tonto** Calvert, 1902			X							X	
*A. translata** Hagen *in* Selys, 1865	X									X	
Enallagma civile (Hagen,1861)	X		X		X	X		X	X	X	
*E. novaehispaniae** Calvert, 1907										X	
E. praevarum (Hagen, 1861)	X	X	X	X	X	X	X	X	X	X	X
*Hesperagrion heterodoxum** (Selys, 1868)	X		X		X		X			X	X
Ischnura demorsa (Hagen, 1861)	X	X	X	X	X	X	X	X	X	X	X
*I. denticollis** (Burmeister,1839)	X	X			X				X	X	
*I. ramburii** (Selys, 1850)	X										
*Telebasis griffinii** (Martin, 1896)				X							
*T. salva** (Hagen, 1861)	X	X	X	X	X	X	X	X	X	X	X
AESHNIDAE											
*Aeshna persephone** Donnelly, 1961						X					X
*Anax junius** (Drury, 1773)		X		X		X		X	X	X	X
*Remartinia luteipennis** (Burmeister, 1839)	X		X		X					X	
*Rhionaeschna dugesi** (Calvert, 1905)					X					X	
R. multicolor (Hagen, 1861)	X	X	X	X	X	X	X	X	X	X	X
R. psilus (Calvert, 1947)	X		X								

Table I, continued

Taxa	Ag	As	Ca	Co	JM	LI	PA	RR	SF	SJ	Te
GOMPHIDAE											
*Erpetogomphus crotalinus** (Hagen *in* Selys, 1854)	X		X							X	
MACROMIIDAE											
*Macromia magnifica** McLachlan *in* Selys, 1874	X										
LIBELLULIDAE											
*Brachymesia furcata** (Hagen, 1861)			X								
*Dythemis maya** Calvert, 1906			X								
*Erythemis simplicicollis** (Say, 1839)					X		X				
*Erythrodiplax basifusca** (Calvert, 1895)			X		X				X	X	
*Libellula saturata** Uhler, 1857	X	X	X	X	X	X	X	X	X	X	X
*Miathyria marcella** (Selys *in* Sagra, 1857)			X								
*Micrathyria sp.nov**					X		X				
*Orthemis discolor** (Burmeister, 1839)			X		X						
O. ferruginea (Fabricius, 1775)	X		X							X	
*Pachydiplax longipennis** (Burmeister, 1839)					X						
*Paltothemis lineatipes** Karsch, 1890	X		X							X	
*Pantala flavescens** (Fabricius, 1798)	X	X	X	X	X	X	X	X	X	X	X
*P. hymenaea** (Say, 1839)	X								X		
*Perithemis intensa** Kirby, 1889	X		X		X		X	X	X	X	
*P. mooma** Kirby, 1889									X		
*Pseudoleon superbus** (Hagen, 1861)	X		X		X					X	
Sympetrum corruptum (Hagen, 1861)	X		X	X	X				X	X	
*S. illotum** (Hagen, 1861)	X		X	X	X		X	X	X	X	X
*S. signiferum** Cannings & Garrison, 1991										X	
*Tramea abdominalis** (Rambur, 1842)					X						
*T. onusta** Hagen, 1861	X				X		X	X		X	
Totals by municipality	**33**	**9**	**36**	**10**	**31**	**9**	**14**	**13**	**16**	**36**	**12**

* New records for the state of Aguascalientes

the estimator Chao2, the total number of species found in this study represents 87.8% of the true diversity of the state (Fig. 2).

The municipalities with the higher number of species were Calvillo and San José de Gracia (36 species each) and Aguascalientes and Jesus María (33 and 31 respectively). These are all located in the southern and western portions of the state, where the main rivers are present. On the other hand, El Llano and Asientos (9 species) and Cosio (10 species) were the less diverse municipalities. Asientos and El Llano are situated in the flat portion of the state while Cosio in the North (see Fig. 1 and Tab. I).

The Odonata known from Aguascalientes include at least three important biogeographic elements. The first and the most important element (28 species) is constituted by species widespread in the Mexican Altiplano: *Hetaerina americana*, *Lestes alacer*, *Apanisagrion lais*, *Argia anceps*, *A. extranea*, *A. lugens*, *A. munda*, *A. nahuana*, *A. pallens*, *A. sabino*, *A. tarascana*, *A. tonto*, *Enallagma civile*, *E. praevarum*, *Hesperagrion heterodoxum*, *Ischnura demorsa*, *I. denticollis*, *Aeshna persephone*, *Rhionaeschna dugesi*, *R. multicolor*, *Erpetogomphus crotalinus*, *Dythemis maya*, *Erythrodiplax basifusca*, *Libellula saturata*, *Paltothemis lineatipes*, *Perithemis intensa*, *Pseudoleon superbus* and *Sympetrum signiferum*. A second element is formed by species widely distributed elsewhere (11 species): *Archilestes grandis*, *Argia sedula*, *A. translata*, *Ischnura ramburii*, *Anax junius*, *Erythemis simplicicollis*, *Pachydiplax longipennis*, *Pantala flavescens*, *P. hymenaea*, *Sympetrum corruptum* and *S. illotum*. A third element comprise tropical species from the lowlands (10 species), viz.: *Enallagma novaehispaniae*, *Telebasis griffinii*, *T. salva*, *Rhionaeschna psilus*, *Brachymesia furcata*, *Miathyria marcella*, *Orthemis discolor*, *O. ferruginea*, *Perithemis mooma* and *Tramea abdominalis*. Some species of this group are present in both the eastern and western lowlands of Mexico. Finally, nine species could not be categorized clearly in any of the above groups: *Argia fumipennis*, *A. oenea*, *A. tezpi*, *A. immunda*, *A. plana*, *Remartinia luteipennis*, *Macromia magnifica* and *Micrathyria* sp.nov. *M. magnifica* is widely distributed in the west of Canada and USA, but it also has been found in Mexico in the state of Hidalgo, its southern limit. *A. fumipennis violacea* occurs from southeastern Canada South through Alabama and West through the Dakotas and central Arizona, South to Durango, Mexico (WESTFALL & MAY, 1996). *A. oenea* and *A. tezpi* are common both in the Mexican lowlands and the highlands.

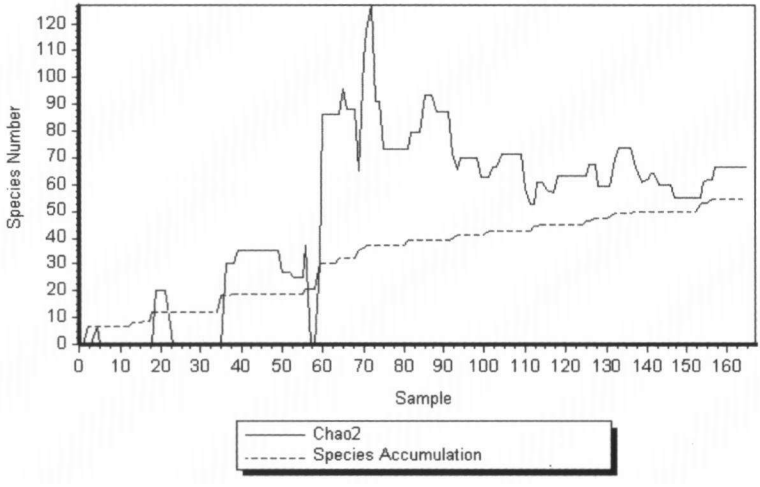

Fig 2. Species accumulation curve and Chao2 estimator

Among the most interesting records for the area are: *Argia sabino*, *Telebasis griffinii*, *Aeshna persephone*, *Macromia magnifica*, *Sympetrum signiferum*, and *Micrathyria* sp. nov. *A. sabino* was recently described from the USA and Mexico (GARRISON, 1994). It has been recorded from a few Mexican states, such as Jalisco, Sonora and now Aguascalientes (GARRISON, 1994; UPSON et al., 2007). *T. griffinii* is associated with more humid environments, such as those of the Gulf and Pacific lowlands (BICK & BICK, 1995; PAULSON, 2002; UPSON et al., 2007). Its recent discovery in central Mexico is somewhat surprising.

Aeshna persephone, *Macromia magnifica* and *Sympetrum signiferum* are species with scattered distributions in the uplands of Mexico. *A. persephone* has been recorded from the states of Chihuahua, Sonora and Nayarit. *M. magnifica* is a rare species in Mexico and has been previously recorded only for the states of Chihuahua and Hidalgo (GONZÁLEZ & NOVELO, 1996). *S. signiferum* is a recently described species found in the USA and the states of Durango and Nayarit in Mexico (CANNINGS & GARRISON, 1991). It has been recently found also in Sonora (UPSON et al., 2007). The record from Aguascalientes extends its range somewhat more to the Southeast on the Mexican Plateau.

Aguascalientes is one of the smallest states in Mexico, only larger than Distrito Federal, Tlaxcala, Morelos and Colima. A rough comparison of the odonate diversity with the other states indicates that Distrito Federal has a total of 40 species and Morelos 102 species. Consequently, Aguascalientes has 1.1 sp/km^2, Morelos 2.05 and Distrito Federal 2.62. However, several of the species recorded for the Distrito Federal came from historical records, so the "higher" diversity recorded for this area is now lower due to the urban expansion and the disappearence and/or degradation of all or almost all the original habitats. On the other side, the higher diversity of Morelos is based on more recent evaluations and reflects more accurately the true scheme of its diversity. For that state, the higher diversity is probably due to the tropical nature of most of it and to the larger number of freshwater habitats. Tlaxcala still remains a *terra incognita odonatologica*, with only six species reported (GONZÁLEZ & NOVELO, 1996, 2007; PAULSON & GONZALEZ, 2006). Finally, Colima is a poorly known state (GONZÁLEZ & NOVELO, 1996), but recent surveys have increased the number of species significantly from 53 to 90 taxa (E. González et al., unpublished data).

ACKNOWLEDGEMENTS

We thank MARIA DE LOURDES MORENO for her support during field collections and DENNIS PAULSON for reviewing the manuscript. We also thank the Departamento de Biología de la Universidad Autónoma de Aguascalientes for allowing us the use of their facilities.

REFERENCES

BICK, G.H. & J.C. BICK, 1995. A review of the genus Telebasis with descriptions of eight new species (Zygoptera: Coenagrionidae). *Odonatologica* 24: 11-44.

CANNINGS, R.A., & R.W. GARRISON, 1991. Sympetrum signiferum, a new species of dragonfly (Odonata: Libellulidae) from western Mexico and Arizona. *Ann. ent. Soc. Am.* 84: 474-479.

COLWELL, R.K. 2006. EstimateS:Statistical estimation of species richness and shared species from samples version 6.0b1. User's Guide and application. Available from http://viceroy.eeb.uconn.edu/estimates.

GARRISON, R.W., 1994. A synopsis of the genus Argia of the United States with keys and descriptions of new species, Argia sabino, A. leonorae and A. pima (Odonata: Coenagrionidae). *Trans. Am. ent. Soc.* 120: 287-368.

GONZÁLEZ S., E. & R. NOVELO G., 1996. Odonata. *In*: J. Llorente B; A.N. García-Aldrete & E. González-Soriano, [Eds], *Biodiversidad, taxonomía y biogeografía de artrópodos de México: hacia una síntesis de su conocimiento*, pp. 147-167, UNAM-CONABIO, Mexico.

GONZÁLEZ S., E. & R. NOVELO G., 2007. Odonata of Mexico revisited. *In*: B.K. Tyagi, [Ed.], *Odonata: biology of dragonflies*, pp. 105-136, Scient. Publ. (India), Jodhpur.

INEGI, 2003. *Anuario estadístico Aguascalientes*. Sistema para la consulta CD-ROM. [Edición 2003]. Instituto Nacional de Estadística y Geografía y Gobierno del Estado de Aguascalientes, México.

LLORENTE-BOUSQUETS, J., E.GONZÁLEZ S., A.N. GARCÍA A. & C. CORDERO, 1996. Breve panorama de la taxonomía de artrópodos en México. *In*: J. Llorente B; A.N. García-Aldrete & E. González-Soriano, [Eds], *Biodiversidad, taxonomía y biogeografía de artrópodos de México: hacia una síntesis de su conocimiento*, pp. 3-14, UNAM-CONABIO, México.

OCHOA-OCHOA, L. & O. FLORES-VILLELA, 2006. *Áreas de diversidad y endemismo de la herpetofauna Mexicana*. UNAM-CONABIO, México, D.F.

PAULSON, D.R., 2002. Odonata records from Nayarit and Sinaloa, Mexico, with comments on natural history and biogeography. *Odonatologica* 31: 359-370.

PAULSON, D. R. & E. GONZÁLEZ S, 2006. Odonata of México, by state. www.ups.edu/biology/museum/ODofMexico.html.

STATSTM v.2, (2003). CD-ROM. *Comunicometria*. S.C. & Decision Analyst, Arlington/TX.

UPSON, S., D. DANFORTH, E. GONZALEZ-SORIANO, R.A.BEHRSTOCK & R.A. BAILOWITZ, 2007. A preliminary checklist of the Odonata of Sonora, México. *Bull. Am. Odonatol.* 10: 23-51.

WESTFALL, M.J., Jr & M.L. MAY, 1996. *Damselflies of North America*. Scient. Publrs, Gainesville/FL.