Odonata from Iberá Wetlands (Corrientes, Argentina): preliminary inventory and biodiversity

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Odonata de los Esteros del Iberá (Corrientes, Argentina): inventario preliminar y biodiversidad

RESUMEN. Se presenta un inventario preliminar de los Odonata de los Esteros del Iberá, así como su área de influencia (Corrientes, Argentina). Distintos tipos de ambientes fueron muestreados en siete localidades. Se registraron setenta y cinco especies agrupadas en 33 géneros y siete familias, de las cuales tres géneros y 10 especies son nuevos registros para el país. Las localidades que pertenecen al sistema de Esteros del Iberá, muestran bajos niveles de endemismo y una similitud faunística elevada con la cuenca del Paraná.

PALABRAS CLAVE. Esteros del Iberá. Odonata. Libélulas. América del Sur. Argentina. Biodiversidad.

ABSTRACT. A preliminary inventory of the Odonata from Iberá Wetlands and their area of influence (Corrientes, Argentina) is presented. Different kinds of environments were surveyed in seven localities. Seventy five species grouped in 33 genera and seven families were registered, from which three genera and 10 species are new records for the country. The localities belonging to the Iberá Wetland system show low endemicity and a high faunistic relationship with the Paraná basin.

KEY WORDS. Iberá wetlands. Odonata. Dragonflies. South America. Argentina. Biodiversity.

INTRODUCTION

Different biogeographic components meet in the Iberá wetlands giving them an ecotonal character. They constitute one of the less explored areas from Argentina regarding their aquatic entomological fauna, being its knowledge fragmentary (Estévez *et al.*, 2003; López Ruf *et al.*, 2003; Bar *et al.*, 2005). State of knowledge of their odonates is likewise scarce, represented by preliminary communications of this research (Muzón *et al.*, 2006; von Ellenrieder & Muzón, 2007) or studies

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referred to some particular taxa (e.g., Pessacq & Muzón, 2004; Muzón & Garré, 2005; Lozano *et al.*, 2007; Muzón & Weigel Muñoz, 2007; Pessacq, 2007). Goals of this contribution are to provide a first inventory of the odonates from Iberá Wetlands and their influence area, provide a preliminary analysis of their assemblages, and contrast this information with the proposed biogeographic schemes, considering also assemblages from neighboring wetlands hydrologically unrelated to the Iberá wetland system.

MATERIAL AND METHODS

Iberá Wetlands. This is a complex system of wetlands located in Corrientes Province, Argentina, between 27° 30' to 29° S and 56° 25' to 58° W, occupying an extension of about 14,000 km^2. According to an hydrological criterion, superficial limits are given by the split of Paraná river in the north, affluents of Aguapey and Miriñay Rivers in the East, wetlands (mainly Batel Batelito) and affluents of Paraná River in the West, and affluents to the right of Miriñay River and Pay Ubre Stream in the South (Ferrati *et al.*, 2003). It constitutes a natural reservoir fed by pluvial precipitations which exits on the Corriente River, a tributary of the Paraná River. It is composed by a wide array of lentic (mainly marshes, ponds and swamps) and lotic environments connected by wide interface areas, with a changing physiognomy due to changes in water levels.

The Iberá system can be divided into five main hydrological basins: Gallo Sapucay marsh (98,326 ha), Carambola Stream (291,580 ha), Moreno Marsh (200,696 ha), Iberá Marshes (496,372 ha) and head of Corriente River (222,012 ha), the latter receiving water from the other four. From a biogeographic viewpoint this is a complex area, and there have been several proposals of regionalization based mainly on its terrestrial flora. According to the classic biogeographic schemes (Cabrera & Willink, 1973; Morrone, 1999), this system is included in three large divisions: Oriental District of Chaco Province and Ñandubay District of Espinal Province within the Chaco Domain, and de los Campos District of Paranense Province within the Amazon Domain. This confluence of regions and the large extent of wetlands create several ecotonal or transitional areas which make its limits hard to define. This complexity is also evidenced in the system of Eco-Regions (Burkart *et al.*, 1999), where the regions of Campos y Malezales, Espinal and Iberá wetlands are represented.

Sampling methods and study stations. Five collecting trips were carried out during 1999-2005, which allowed qualitative representative sampling of odonate assemblages from seven localities. Samples were taken with aerial nets for adults and drag nets and sieves for larvae. Material is deposited in the collections of the Departamento Científico de Entomología, Museo de La Plata (localities 1-6), and of the Instituto Miguel Lillo, Tucumán (locality 7).

Localities (Fig. 1):

1. Pay Ubre Grande Stream and Provincial Route 29, Mercedes, 29°01´41´´S-58°10´28´´W. Located within Ñandubay District of Espinal biogeographic Province and Espinal Eco-Region, Pay Ubre Stream constitutes the southern limit of the Iberá system, and flows into the Corriente River, the main effluent of the system. It is characterized by gallery forest and an array of ponds generated by overflowing events of the stream. Stream bed is heterogeneous, mainly sandy with basalt areas in some sectors.

2. El Dorado Ranch, Mercedes, 28°44´34´´S-58°07´36´´W. Located in the basin of Corriente River's head, within Espinal biogeographic Province near limit with Chaco Province and in Espinal Eco-Region. Sampling sites were selected in the interface lowland with the flooded plain of Corriente River, in an artificial channel connecting the ranch with the river, and in surrounding marshes and dams.

3. Colonia Pellegrini, Iberá Pond, 28°32´16´´S-57°11´12´´W. Colonia Pellegrini is situated in the NW margin of Iberá pond,

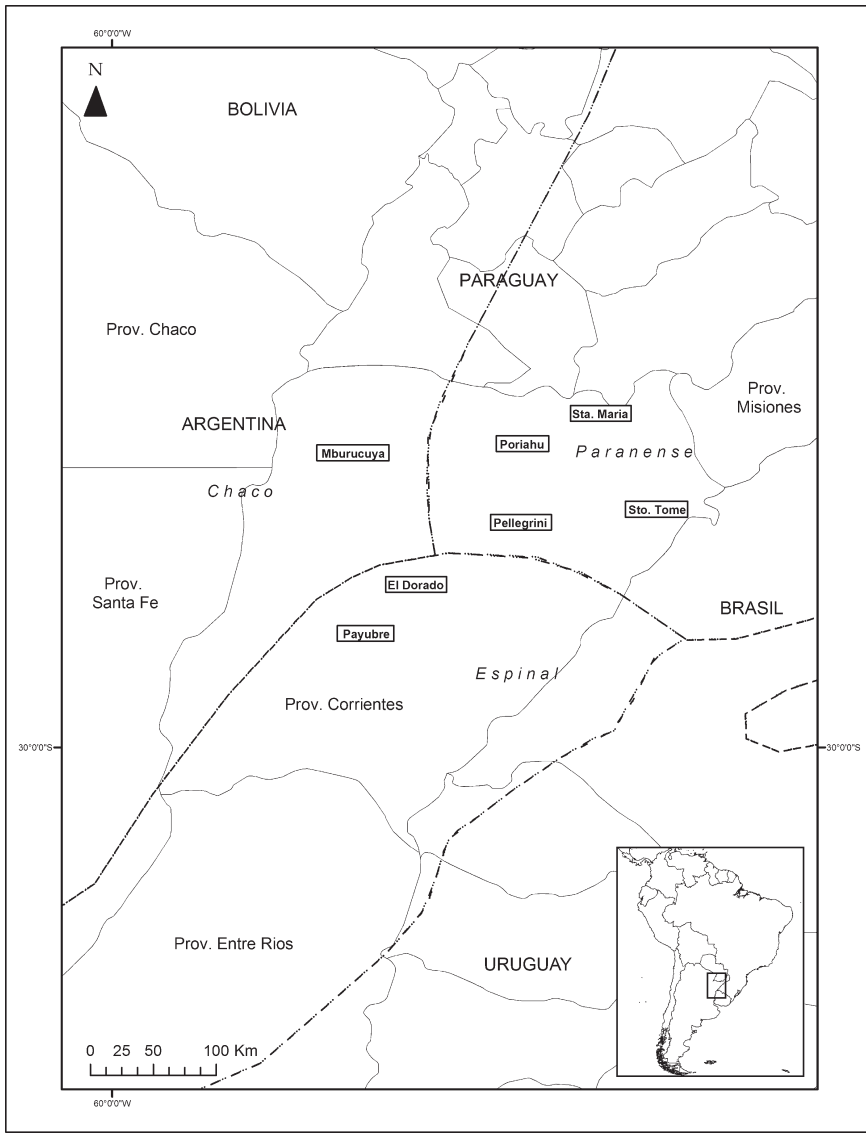

Fig. 1. Study area. Localities and biogeographic provinces.

within Paranense biogeographic Province and Iberá Wetlands Eco-Region. The pond, with an area of 53 km^2 and an average depth of 3.2 m, is one of the main ponds of the Iberá Wetland basin. It is polymyctic, with a high degree of interchange with neighboring marshes. Sampling was carried out in the pond, dams and associated pools.

4. Natural Reserve Rincón de Santa María, Ituzaingó, 27°27´09´´S / 27°32´07´´S - 56°33´23´´W / 56°37´39´´W. Located on the left side of the Yaciretá Dam within Paranense biogeographic Province and Iberá Wetlands Eco-Region, it is subjected to important anthropic influence. The Reserve area of about 3,000 ha will be reduced in about 18 % once the Yaciretá Dam reaches its full capacity (Fontana, 2002). It is dominated by straw lands, patches of remnant native forest along the shore of the dam, and planted trees. Sampling sites were selected in shore sectors associated to the dam and in temporary pools.

5. San Juan Poriahú Ranch, Ituzaingó, 27°42´51´´S-57°11´14´´W. Located in the

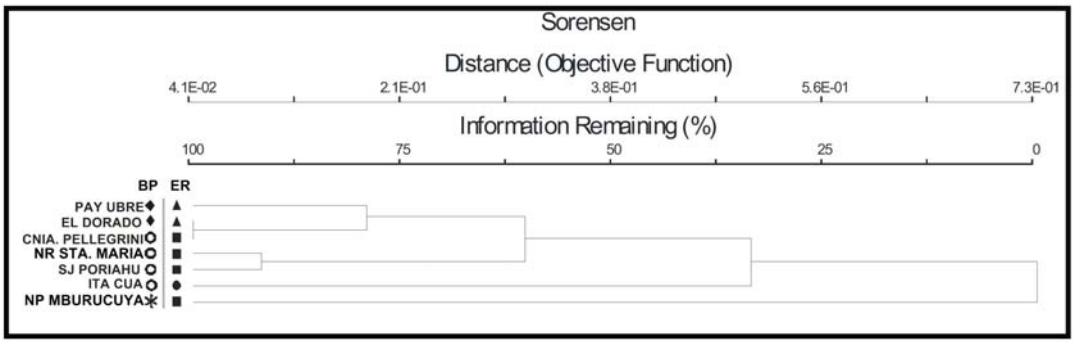

Fig. 2. Cluster analysis (Sorensen). Biogeographic Province (BP) and Eco-Region (ER) indicated for each locality: ♦, Espinal; ○, Paranense; ✳, Chaco; ▲, Espinal; ■, Iberá Wetlands; ●, Campos y Malezales.

Fig. 3. Ordination analysis (NMS). Biogeographic Province (BP) and Eco-Region (ER) indicated for each locality: ♦, Espinal; ○, Paranense; ✳, Chaco; ▲, Espinal; ■, Iberá Wetlands; ●, Campos y Malezales.

northern end of the Iberá system within Paranense biogeographic Province and Iberá Wetlands Eco-Region. Sampling sites were situated in marshes, low interface areas and pools in highland areas next to the Ranch´s house.

6. Itá Cuá Stream and Provincial Route 94, Santo Tomé, 28°26´53´´S-56 00´34´´W. Located in the Uruguay River basin within de los Campos District of Paranaense biogeographic Province and Campos y Malezales Eco-Region. Sampling was carried out in a stream, in a wide marsh bordered by pine tree plantations, and in a creek, affluent to the stream, crossing small remnants of native forest.

7. National Park Mburucuyá, 28°03´S-58°14´W. Protected area of 17,660 ha, previously used for cattle herding, within Chaco biogeographic Province and Iberá Eco-Region. Sampling was carried out in the main Ranch area.

Analysis of diversity. Three diversity indices were estimated: alpha diversity, calculated as the average specific richness per locality; beta diversity, a measurement of the heterogeneity of the data, calculated as the ratio between total number of species and average number of species; and gamma diversity, or diversity at landscape level, calculated as total number of species across all localities (McCune *et al*., 1997). Expected specific richness for the entire area was calculated with the first order Jackknife and Chao 2 estimates. Standard deviation was calculated by means of sub sampling with replacement. As a further measurement of beta diversity, similarity between localities was calculated by means of multivariate cluster and ordination methods. For the cluster analysis Sorensen (Bray-Curtis) was chosen as distance coefficient because it does not consider joined absences (shared zeros) as a positive relationship. Flexible Beta with a value of β = -0.25 was used as linkage method because it is compatible with the distance coefficient of Sorensen (McCune & Grace, 2002). For multivariate ordination an NMS analysis (non-metric multidimensional scaling; Mather, 1976) was performed using PC-ORD, with Sorensen as distance coefficient. A possible maximum of six axes was analyzed with 400 iterations; 40 repetitions with real data and 50 with random data were run (Monte Carlo test), starting from a random initial configuration.

RESULTS

Seventy five species belonging to 33 genera and seven families were found (Appendix 1). From these, three genera (one new to science) and 10 species (four new to science) were recorded for the first time for Argentina, and 23 species for the first time for Corrientes province. Species most widely distributed in the study area were *Acanthagrion cuyabae* Calvert, *Homeoura ambigua* (Ris), *H. chelifera* (Selys), *Ischnura capreolus* (Hagen), *I. fluviatilis* Selys and *Telebasis willinki* Fraser (Coenagrionidae), *Erythemis credula* (Hagen), *Erythrodiplax ochracea* (Burmeister), *E. paraguayensis* (Förster), *E. umbrata* (Linnaeus) and *Miathyria marcella* (Selys) (Libellulidae).

Species richness per locality varied from 14 to 45, with an average (alpha diversity) and standard deviation of 27.86 ± 11.68 respectively. The localities with the highest richness were Itá Cuá Stream with 45 species (24 genera) and Pay Ubre Stream with 41 species (25 genera). Beta diversity was of 2.69 and gamma of 75. First order Jackknife estimate of total number of species expected for the area was of 104.14 (SD 14.96) and Chao 2 of 118.71 (SD 21.7).

Cluster analysis (Fig. 2) showed two main similarity nuclei. The first one was integrated by El Dorado and Colonia Pellegrini (Laguna Iberá), secondarily associated with Pay Ubre, and the second one was composed by Natural Reserve Santa María and San Juan Poriahú. Itá Cuá Stream and N. P. Mburucuyá displayed the least similarity in their odonate fauna.

Ordination analysis resulted in one main gradient which captured most of the variability of the odonate assemblages (Fig. 3), accounting for 82.9 percent of the information from the analytical data

(cumulated variance) with a final stress of 12.96 after 52 repetitions. In the ordination space it can be noted that, as showed in the cluster analysis, N. P. Mburucuyá and Itá Cuá are the localities more dissimilar as regards their odonate composition, being located at opposite ends of the ordination axis.

DISCUSSION

Richness estimates indicate that knowledge of the odonate assemblages from this area is still incomplete, comprising from 63 % (Chao 2) to 72 % (first order jackknife) of the expected species according to species-area accumulation curves. Localities from Iberá system showed a low endemicity level and a stronger faunistic relationship with the Párana River basin than with the Uruguay River basin. Their specific richness values were up to 20% lower (*i.e.*, El Dorado and Colonia Pellegrini) than those of the localities with the highest richness (Itá Cuá and Pay Ubre Streams). High specific richness recorded for Itá Cuá and Pay Ubre Streams might be due to the higher environmental heterogeneity displayed by these localities, in particular to the presence of a higher diversity of wetlands (streams, marshes and pools). Localities within Iberá system, e.g. El Dorado, Colonia Pellegrini and San Juan Poriahú, together with N. R. Santa María and Pay Ubre Stream (the latter pair located close to the NE and SW limits of the system) showed an important level of association; their low similarity in specific composition with N. P. Mburucuyá and Itá Cuá Stream might be due to a different sampling strategy (N. P. Mburucuyá) or to location in a different hydrological basin (Itá Cuá).

The study area is mixed from a biogeographic point of view; El Dorado and Pay Ubre Stream correspond to Espinal Province, N. P. Mburucuyá to Chaco Province and Colonia Pellegrini, San Juan Poriahú, N. R. Santa María and Itá Cuá Stream to Paranense Province. Likewise regarding the Eco Regions system, El Dorado and Pay Ubre Stream belong to Espinal, Colonia Pellegrini, San Juan Poriahú, N. R. Santa María and N. P. Mburucuyá to Iberá Wetlands and Itá Cuá to Campos y Malezales Region. Cluster and ordination analyses (Figs. 2 and 3) did not agree with these schemes. For example, Itá Cuá, in spite of belonging to the same biogeographic Province (Paranense) as San Juan Porihaú and N. R. Santa María, significantly differs from them in its specific composition. According to the results of the cluster analysis (Fig. 2), Colonia Pellegrini (Paranense/ Esteros del Iberá) shares most of its odonates with El Dorado (Espinal). In the ordination graph (Fig. 3) the transitional character of this latter locality between Espinal and Parananse Provinces and between Espinal and Esteros del Iberá Eco Regions is evident. It is worth noting that from an odonatological viewpoint Iberá system is homogeneous and little sensitive to accepted biogeographic schemes, which were built based on terrestrial biota.

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Appendix 1. Species List. For each species following information is provided: (L) larva described; * new record for Corrientes province; + new record from Argentina; in brackets known distribution and in square brackets localities from this study (see locality codes in Material and Methods). BA: Buenos Aires; Ca: Catamarca; Cb: Córdoba; CH: Chaco; Co: Corrientes; Cu: Chubut; ER: Entre Rios; Fo: Formosa; Ju: Jujuy; LP: La Pampa; LR: La Rioja; Me: Mendoza; Mi: Misiones; Ne: Neuquén; RN: Río Negro; Sa: Salta; SJ: San Juan; SL: San Luis; SF: Santa Fe; SE: Santiago del Estero; Tu: Tucumán.

Zygoptera
Calopterygidae
Hetaerina Hagen in Selys
1. *H. rosea* Selys (L) (Sa, Ju, Tu, Mi, Co, Cb, SE, ER, BA) [1-3, 6]

Lestidae
Lestes Leach
2. *L. dichrostigma* Calvert * (L) (Sa, Ju , Mi) [6]
3. *L. paulistus* Calvert * (Mi) [1]
4. *L. pictus* Hagen *in* Selys * (L) (Sa, Ju , Mi) [6]
5. *L. spatula* Fraser (L) (Sa, Ca, Mi, Co, Ch, SE, ER, BA) [1, 3, 6]

Coenagrionidae
Acanthagrion Selys
6. *A. aepiolum* Tennessen * (L) (Sa, Mi, ER) [1, 6]

7. *A. cuyabae* Calvert * (Mi, Fo, ER) [1-6]
8. *A. gracile* (Rambur) (Mi, Co, ER) [6]
9. *A. lancea* Selys (Mi, Co, ER, Sa, Ju, Tu, Ch, SF, BA) [1-2, 6]
10. *A. minutum* Leonard + [4]. Previously known from Venezuela, Perú, Brazil and Bolivia (Lencioni, 2006).
11. *Acanthagrion* sp. nov. *viridescens* group [6]

Argia Rambur

12. *Argia* sp. nov. [1]

Helveciagrion Machado +. Neotropical, with 3 species.

13. *H. obsoletum* (Selys) [1]. Previously known from Ecuador, Perú, Brazil and Bolivia (Lencioni, 2006).
14. *H. simulacrum* (Calvert) [5]. Previously known from Brazil (Lencioni, 2006).

Homeoura Kennedy

15. *H. ambigua* (Ris) (L) (Sa, Tu, Fo, Ch, Mi, Co, SF, ER, BA) [1-7]
16. *H. chelifera* (Selys) (L) (Sa, Ju, Tu, Fo, Ch, Mi, Co, ER, SF, BA) [1-7]
17. *H. lindneri* (Ris) * (Fo, Ch, ER, SF, BA) [1, 3-4]

Ischnura Charpentier

18. *I. capreolus* (Hagen) (L) (Sa, Ju, Tu, Mi, Co, ER, SF, BA) [1-7]
19. *I. fluviatilis* Selys (L) (Sa, Ju, Tu, Ca, Fo, Ch, Mi, Co, ER, SE, Cb, SF, BA, LR, SJ, Me, Ne, RN) [1-7]

Oxyagrion Selys

20. *O. rubidum* (Rambur) * (L) (Sa, Ju, ER, SE, Cb, SF, BA, Me, Ne, RN, Cu) [6]
21. *O. terminale* Selys (L) (Mi, Co, ER, SF, BA) [6]

Telebasis Selys

22. *T. limoncocha* Bick & Bick * (Sa, Ju, Mi, ER) [3, 6]
23. *T. willinki* Fraser * (Sa, Ju, Tu, Fo, Ch, SF, BA) [1-6]

Gen. nov.

24. sp. nov. [6]

Protoneuridae

Neoneura Selys

25. *N. ethela* Williamsom * (Mi, ER) [1]

Peristicta Hagen *in* Selys

26. *P. aeneoviridis* Calvert (L) (Mi, ER) [1]
27. *P. forceps* Calvert (L) (Mi, Co, ER, BA) [1]

Gen. indet.

28. sp. indet. [6]

Anisoptera

Aeshnidae

Anax Leach

29. *A. amazili* (Burmeister) (L) (Sa, Tu, Mi, Co, Ch, SE, SF, ER, BA, LP) [2, 4]

Coryphaeshna Williamsom

30. *C. adnexa* (Hagen) (L) (Sa, Ju, Tu, Mi, Co, Ch, SF, ER) [1, 3]
31. *C. perrensi* (McLachlan) (L) (Ju, Mi, Co, Cb, SF, BA) [6]

Rhionaeschna Förster

32. *R. bonariensis* (Rambur) (L) (Sa, Ju, Tu, Ca, LR, SJ, Ch, Fo, Mi, Co, ER, SF, SE, Cb, BA, Me, RN) [1-4, 6]

Staurophlebia Brauer

33. *S. reticulata* (Burmeister) * (L) (Mi) [1]

Triacanthagyna Selys

34. *T. nympha* (Navás) (L) (Mi, Co, BA) [2]

Gomphidae

Aphylla Selys

35. *A. producta* Selys* (L) (Sa, Mi, SE) [1]
36. *A. theodorina* (Navás)* (L) (Mi) [6]

Libellulidae

Brachymesia Kirby

37. *B. furcata* (Hagen) (L) (Sa, Tu, Mi, Co, ER, SE) [1, 6-7]
38. *B. herbida* (Gundlach)* (L) (Mi) [1-3, 7]

Diastatops Rambur

39. *D. intensa* Montgomery* (Mi, Cb, ER) [2, 7]
40. *D. obscura* (Fabricius)* (L) (Mi, Cb) [2-3, 6]

Erythemis Hagen

41. *E. credula* (Hagen) (L) (Co) [1-7]
42. *E. peruviana* (Rambur) (L) (Mi, Co, Fo, Ch, ER) [1, 3-4, 7]
43. *E. plebeja* (Burmeister) (L) (Sa, Tu, Fo, Ch, Mi, Co, ER, SE, SF, BA) [1-3, 5]
44. *E. vesiculosa* (Fabricius) (L) (Sa, Ju, Tu, Mi, Co, Fo, Cb, SE, SF, BA) [1-4]

Erythrodiplax Brauer

45. *E. atroterminata* (Ris) (Sa, Mi, Co, Ca, SJ, SL, Cb, BA, RN) [2, 6]
46. *E. corallina* (Brauer)* (Sa, Ju, Tu, Ca, LR, SJ, Me, SE, Cb, LP, BA, Ne, RN, Cu) [6]
47. *E. fusca* (Rambur) (L) (Mi, Co, Ch, ER, SF, BA) [6]
48. *E. media* Borror* (L) (Sa, Ju, Tu, Mi, ER, RN) [1-2, 6]
49. *E. melanorubra* Borror [6]
50. *E. nigricans* (Rambur) (L) (Mi, Co, ER, Ch, SE, Ca, LR, Me, SF, BA, Ne, RN) [1-2, 6]
51. *E. ochracea* (Burmeister) (L) (Mi, Co, Fo, Ch, SF, BA, Ne) [1-6]
52. *E. paraguayensis* (Förster) (L) (Mi, Co, ER, Fo, Ch, Cb, BA) [1-7]
53. *E. umbrata* (Linnaeus) (L) (Sa, Ju, Tu, Fo, Ch, Mi, Co, ER, SF, Ca, LR, BA) [1-6]
54. *Erythrodiplax* sp. nov. [7] *Idiataphe* Cowley +. Neotropical, with 4 species, previously known from Florida (USA) and Antilles to S Brazil (Garrison *et al*., 2006).
55. *I. longipes* (Hagen) [6-7]

Macrothemis Hagen

56. *M. imitans* Karsch * (Sa, Ju, Tu, Ca, Mi, SE, ER, Cb) [1]

Miathyria Kirby

57. *M. marcella* (Selys) (L) (Sa, Tu, LR, Fo, Ch, Mi, Co, ER, SE, SF, BA) [1-7]

Micrathyria Kirby

58. *M. longifasciata* Calvert (L) (Sa, Ju, Tu, Fo, Ch, Co, ER, SF, SE, ME, BA) [1-4]
59. *M. pseudeximia* Westfall + [6]. Previously known from remaining countries of Neotropical region.
60. *M. spuria* (Selys) * (L) (ER) [4-6]
61. *M. tibialis* Kirby * (L) (Fo) [7]
62. *Micrathyria. sp nov*. [4]
63. *Micrathyria sp*. indet. [1]

Nephepeltia Kirby

64. *N. aequisetis* Calvert + [1]. Previously known from Brazil.
65. *N. flavifrons* (Karsch) (Co) [2-4]

Orthemis Hagen

66. *O. ambinigra* Calvert * (Mi, BA) [1]
67. *O. discolor* (Burmeister) (Sa, Ju, Tu, Ca, Ch, Mi, Co, SF, SL, Me, BA) [6]
68. *O. nodiplaga* Karsch (L) (Sa, Tu, Ca, Fo, Ch, Mi, Co, ER, SE, SF, SL, Me, BA) [3, 6]

Pantala Hagen

69. *P. flavescens* (Fabricius) (L) (Sa, Ju, Tu, Ca, Fo, Mi, Co, ER, SF, SL, Me, BA) [1, 6]

Perithemis Hagen

70. *P. lais* (Perty) * (Mi) [6]
71. *P. mooma* (Kirby) (L) (Sa, Ju, Tu, Mi, Co, ER, Cb, SE, SF, BA) [1, 4, 6]

Tauriphila Kirby

72. *T. argo* (Hagen) (L) (Mi, Co) [2, 7]
73. *T. risi* Martin (L) (Tu, Ch, Co, ER, SF, SE, Cb, BA) [2, 6-7]
74. *T. xiphea* Ris (Co) [2-3, 7]

Tramea Hagen

75. *T. cophysa* Hagen (L) (Sa, Tu, Ca, Fo, Mi, Co, ER, SE, BA) [1-2, 6]