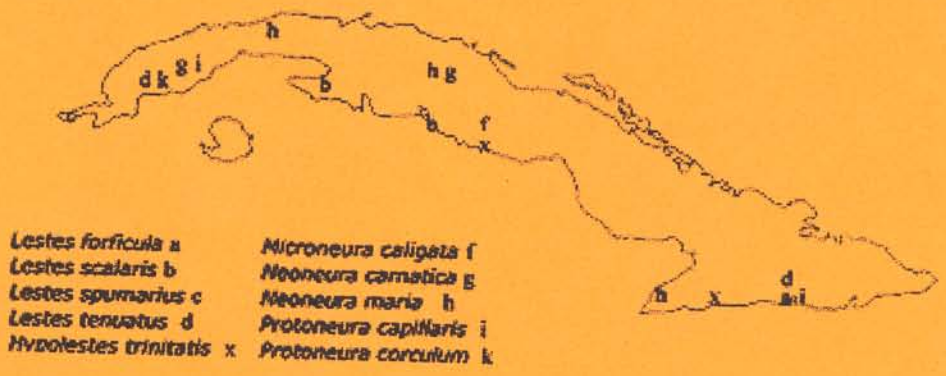
ISSN 1061-3781

BULLETIN OF AMERICAN

ODONA=¡=OLOGY



Volume 7 Number 2

1 August 2003

REVISION OF THE ORDER ODONATA IN CUBA

Adrián Trapero Quintana and **Carlos Naranjo López p. 23 – 40**

THE DRAGONFLY SOCIETY OF THE AMERICAS

Business address: c/o T. Donnelly, 2091 Partridge Lane, Binghamton NY 13903

JOURNALS PUBLISHED BY THE SOCIETY

ARGIA, the quarterly news journal of the **DSA**, is devoted to non-technical papers and news items relating to nearly every aspect of the study of Odonata and the people who are interested in them. The editor especially welcomes reports of studies in progress, news of forthcoming meetings, commentaries on species, habitat conservation, noteworthy occurrences, personal news items, accounts of meetings and collecting trips, and reviews of technical and non-technical publications. Articles for publication in **ARGIA** should preferably be submitted as hard copy and (if over 500 words) also on floppy disk (3.5" or 5.25"). The editor prefers MS DOS based files, preferably written in WORD, WORD for WINDOWS, WordPerfect, or WordStar. Macintosh WORD disks can be handled. All files should be submitted **unformatted and without paragraph indents.** Each submission should be accompanied by a text (=ASCII) file. Other languages should be submitted only as text (=ASCII) files. Line drawings are acceptable as illustrations.

T. Donnelly (address below) is the interim editor of **ARGIA.**

BULLETIN OF AMERICAN ODONATOLOGY is devoted to studies of Odonata of the New World. This journal considers a wide range of topics for publication, including faunal synopses, behavioral studies, ecological studies, etc. The **BAO** publishes taxonomic studies but will not consider the publication of new names at any taxonomic level. Enquiries and submission of manuscripts should be made to **BAO** editor T. Donnelly, 2091 Partridge Lane, Binghamton NY 13903. Final submissions (after review) should be made on floppy disk, as above, with illustrations in final form and preferably adjusted to final size.

MEMBERSHIP IN THE DRAGONFLY SOCIETY OF THE AMERICAS

Membership in the **DSA** is open to any person in any country. Dues for individuals in the US, Canada, or Latin America are $15 for regular membership and $20 for institutions or contributing membership, payable annually on or before 1 March of membership year. Dues for members in the Old World are $25.
Dues should be mailed to Jerrell Daigle, 2067 Little River Lane, TALLAHASSEE FL 32311

The **BULLETIN OF AMERICAN ODONATOLOGY** is available by a separate subscription at $15 for members and $18.75 for non-members and institutions.

REVISION OF THE ORDER ODONATA IN CUBA[1]

Adrián Trapero Quintana and **Carlos Naranjo López**
Departamento de Biología de la Universidad de Oriente

Translated by Natalia Biani and T. W. Donnelly

RESUMEN

Mediante una profunda revisión bibliográfica se sigue paso a paso y de manera cronológica todos los eventos relacionados con las investigaciones sobre uno de los órdenes de la clase Insecta mejor conocido de la Isla de Cuba desde el punto de vista sistemático. Como refleja el trabajo, históricamente las investigaciones en su gran mayoría fueron dirigidas al campo de la Sistemática de las siete familias que presenta el orden en Cuba. Se presenta una lista anotada de las 83 especies de Odonata reportadas para Cuba por diferentes investigadores, que incluye cuarenta colectadas (357 individuos) por los autores, durante un período de diez años, en los tres sectores del archipiélago cubano, los ejemplares se encuentran en la colección del Museo Charles Ramsden de la Universidad de Oriente. En la lista se adjuntan datos ecológicos de interés para cada especie y su distribución geográfica, así como los nuevos reportes de sector para 7 especies. A partir de los datos acumulados por ambos autores de observaciones y colectas, así como de los registros que aparecen en la bibliografía sobre las localidades de captura se hace un análisis de distribución altitudinal y se logran establecer cuatro grupos según los intervalos de altura. El 100 % de los odonatos que habitan la Isla han sido colectados entre los 0-500 msnm. En el análisis a nivel de familias y especies se hace más evidente la conclusión anterior, debido quizás a que en Cuba no existen grandes variaciones altitudinales y porque la condición de archipiélago facilita una enorme longitud en las líneas de costa marinas, que a su ves garantiza la existencia de suficientes hábitats cercanos a las zonas bajas. Mediante un estudio de 476 registros que incluye las fechas de colectas por los autores, así como los datos recogidos de la literatura y colecciones de referencias, a partir de los adultos, se determina la distribución estacional de 80 especies de Odonata en el territorio cubano. Los meses que resultaron los mejores para la colecta u observación de este grupo resultaron junio y noviembre. Dos especies pueden ser capturadas casi todo el año, mientras que nueve han sido registradas solo en un mes. Se analizan las relaciones de la odonatofauna cubana con la parte neotropical del continente americano, Las Antillas y dentro del propio territorio de Cuba.

ABSTRACT

An annotated list of 81 Odonata species from Cuba is herein presented, including 40 collected by us (357 specimens) during a period of more than 10 years. Specimens are deposited in the Charles Ramsden Museum Entomological collection of the Universidad de Oriente. Ecological data, geographical distribution and new localities are included .

INTRODUCTION

The objective of this paper is to review the present status of the knowledge of the Order Odonata in Cuba. The last revision was in 1968 (Alayo, 1968 a & b) and subsequently many papers have been published in national and international journals.

Here, we present data obtained in the island during 10 years of research on the invertebrate macrofauna of the fresh water ecosystems, where the order Odonata has a significant importance.

Despite the fact that it is one of the best know insect orders, from the systematic point of view, many questions still remain unanswered, especially as regards the ecology of the species.

HISTORY OF THE STUDY OF THE ORDER ODONATA IN CUBA

1857: Michel Edmond de Selys Longchamps published in "Historia, Física, Política y Natural de la Isla de Cuba" by D. Ramón de la Sagra. [new Cuban species: ***Erythemis attala, Macrothemis celeno, Micrathyria didyma, Telebasis dominicanum, Erythrodiplax justiniana, Miathyria marcella, Nehalennia minuta, Triacanthagyna septima***]

[1] Bulletin of American Odonatology 7(2): 23-40

1861: Hagen published "Synopsis of the Neuroptera of North America" (Smithsonian Institution of Washington). [new Cuban species: ***Coryphaeschna adnexa, Micrathyria aequalis, Macrodiplax balteata, Ischnura capreolus, Enallagma civile, Enallagma coecum, Micrathyria debilis, Brachymesia furcata, Tramea insularis, Tramea lacerata, Anax longipes, Tramea onusta, Dythemis sterilis***]

1866: Samuel H. Scudder published an article on the Odonata of the Isla de Pinos, which contains 16 species, five of them were new (two presently valid). [new Cuban species: ***Idiataphe cubensis, Neoneura maria***]

1867: Hagen revised Scudder's new species, and synonymized the remainder.

1868: Hagen published "Odonaten Cubas" and "The Odonate fauna of the Island of Cuba."

1875: Hagen published on the "Odonata of North America" and cited 11 species for Cuba.

1888: The great German naturalist Johannes Gundlach published his "Contribución a la Entomología Cubana, Parte Tercera: Neuropteros", where he presented a list of 76 species known up to that moment and described the color of the living specimens (which is altered post mortem). Because of the limited distribution of this work, many species were described later by other authors until Calvert (1919) in "Gundlach's Work on Odonata of Cuba; a Critical Study" confirmed the status of species and genera created by Gundlach. [new Cuban species: ***Gynacantha ereagris, Brachymesia herbida, Lestes scalaris, Hypolestes trinitatis, Enallagma truncatum***]

1929: J.G. Needham and H. Heywood published "A Handbook of the Dragonflies of North America", in which several Caribbean species are included.

1932: Klots published "Scientific Survey of Porto Rico and the Virgin Islands", in which he discussed Antillean species of Odonata, of which 55 are present in Cuba.

1939: Needham described the larva of ***Neoneura carnatica***.

1955: Needham and Westfall published "A Manual of the Dragonflies of North America" in which 55 species of Suborder Anisoptera present in Cuba are described in the larval and adult stages, along with some aspects of the ecology and geographic distribution.

1966: Donnelly and Alayo (1966) published the description of a new genus and a new species for Guatemala and Cuba: ***Enacantha caribbea***.

1968: Alayo published "Las Libélulas de Cuba parte I y II", in which he diagnosed males and females of 87 species, and figured the wings and genitalia of the adults. In our list, several species have been eliminated from the list of Alayo because they are not present in Cuba: ***Perithemis mooma, Erythrodiplax minuscula, Erythrodiplax connata; Diceratobasis macrogaster, Telebasis vulnerata*** and ***Amphiagrion saucium.***

Moreover, the following species have been synonymized or assigned to a different genus or species:
Telebasis sanguinalis Calvert has become ***Telebasis corallina*** Selys.
Ceratura capreola Hagen has become ***Ischnura capreolus*** Hagen.
Anomalagrion hastatum Say has become ***Ischnura hastata*** Say
Argiallagma minutum Selys has become ***Nehalennia minuta*** Selys.
Perithemis metella Selys has become ***Perithemis domitia*** Drury.
Cannacria herbida Gundlach has become ***Brachymesia herbida*** Gundlach.
Dythemis velox Hagen has become ***Dythemis sterilis*** Hagen.
Tramea binotata Rambur has become ***Tramea insularis*** Hagen.
Tramea cophysa Hagen has become ***Tramea calverti*** Muttkowski.
Anax longipes Hagen has become ***Anax concolor*** Brauer.

1982: Paulson published a list of 80 species for Cuba which provided corrections made to the Alayo (1968a)'s list.

1985: R. Alayo described the larva of ***Hypolestes trinitatis*** (Gundlach), an endemic Antillean species, whose larva were unknown until then.

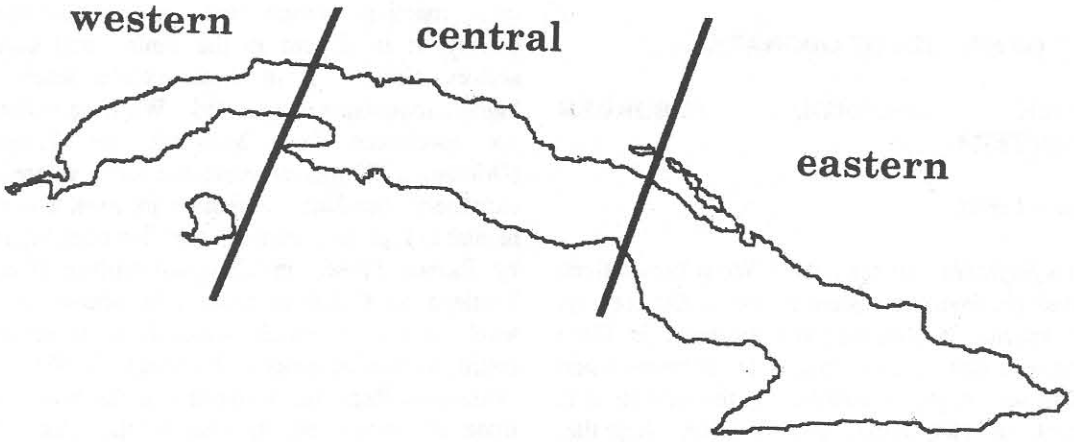


Fig. 1 Map of Cuba, showing sectors referred to in text

1986: Naranjo studied the fresh water fauna of the "Parque Nacional Sierra Maestra" and reported 23 species. Later, in 1988, he found in Sierra Maestra a live larva of ***Hypolestes trinitatis*** under some rocks beside a stream.

1996: Ramos, in his work "Estudio del Orden Odonata en la Cuenca del Río San Juan" in Santiago de Cuba, presented a list of 27 species of the seven families present in Cuba.

1996: Westfall and May published "Damselflies of North America" and cited 22 species of the 25 of this Suborder present in the island.

1996: Flint published a list of the Odonata of Cuba. He surveyed the western and central zones in the summer of 1994, and he raised the list for Cuba to 81 species. He included a report on *Crocothemis servilia* (Drury).

1998: Pérez and Rodríguez studied the basin of the rivers Cautillo and Jibacoa in the province of Granma and presented a general list of the aquatic fauna. Eleven species of Odonata were included, from which resulted two new records for the eastern zone of Cuba: ***Neoneura carnatica*** and ***Libellula needhami***.

METHODOLOGY

Preparation of this report included: numerous expeditions to different localities; examination of the collections in the "Instituto de Ecología y Sistemática de la Habana" and the "Museo Charles Ramsden de la Universidad de Oriente"; consulting with Drs. Dennis Paulson and Thomas Donnelly; and a review of the literature. A characterization of the status of the Order in Cuba was made, including an updated list of the species present in Cuba, with emphasis on collecting data, in the geographic distributions, earlier studies of the Order, altitudinal and seasonal distributions, and zoographical relationships of the odonate fauna of Cuba.

For the analysis of the altitudinal distribution 4 height ranges were chosen:

- Range I: 0-500 m above sea level
- Range II: 0-1000 m above sea level
- Range III: 0-1500 m above sea level
- Range IV: 0-2000 m above sea level

A total of 476 dates of capture were processed.

An analysis of zoographic relationships was made, taking into consideration affinity with the American continent, the Antilles and the distribution within

the three sectors of Cuba, according to the regional divisions of Samek (1973). The biological similarity index of Czechanovski (Margalef, 1977) was applied.

LIST OF SPECIES OF ODONATA

ORDER *ODONATA;* SUBORDER *ZYGOPTERA*

Family *Lestidae*

Lestes forficula Rambur (1842) We collected three individuals from the eastern sector, in flat country. This species is abundant and scattered in Cuba (Alayo, 1968a). It is reported only for western and eastern sectors of the country. In the Antilles it is present in Hispaniola, Puerto Rico, Anguilla, Grenada and Trinidad. In the continent it is found in USA, Mexico, Venezuela and Argentina.

Lestes scalaris Gundlach (1888). We did not collect this species. Since its description (Gundlach, 1888) it has only been observed again by Needham in Soledad, Cienfuegos. In Cuba it is present in the central sector. In the Antilles it is found in Bahamas, Jamaica, Hispaniola and Puerto Rico, while in the continent only in the south of Mexico. [The continental records are probably *tikalus*, which occurs south to Panama. (TWD)].

Lestes spumarius Hagen *in Selys* (1862). We collected no examples. It was taken by Alayo (1968a) in August 1962 in the Peninsula de Guanahacabibes, Pinar del Rio. Adults inhabit the shadows of the forests away from water. It is only present in the western part of the island. In the Antilles it is present in the Cayman Islands, Jamaica, Hispaniola, Puerto Rico and Grenada, and in the continent, in Florida (USA).

Lestes tenuatus Rambur (1842) We took no examples. It is present in Cuba in the western and eastern sectors. Alayo collected only one and observed it relatively abundant on another occasion. Within the Antilles it is found in Jamaica, Anguilla, Grenada and Trinidad, while in the continent in USA, Mexico, Guatemala, El Salvador, Panama and Venezuela.

Family *Megapodagrionidae*

Hypolestes trinitatis (Gundlach, 1888) We have collected six adults. It has been observed by Naranjo (1988) in the larval stage under some rocks of a dry stream of the south slope of Sierra Maestra. We have observed adults flying at about 5 cm of the water surface, always among branches. It is a quite inactive species, and can be approached closely. It is present in the central and eastern sectors, since it is in these regions where the highest mountains are located. We have collected six specimens from Malverde del Turquino (Oriente), 1250 meters above sea level, where it is extremely abundant. Although its most common habitat is high mountains, it has also been reported by Ramos (1996) in Campana village (Caney, Santiago de Cuba) at about 50m above the sea level, near to mountain areas. It is an endemic Antillean species, reported by Daigle (1993) in the Dominican Republic. It appears in the World Red Book of endangered species of the year 2000. However, from our point of view Sierra Maestra constitutes an important reservoir of populations. In Hispaniola and Jamaica there exist two very closely related species (***Hypolestes clara*** and ***H. abbotti***), which may be varieties of this same species (Alayo, 1968a).

Family *Protoneuridae*

Microneura caligata Hagen in Selys (1886) We collected three larvae. This species is reported for the center and eastern sectors, restricted to few localities. We found larvae in a clear-water river near Manicaragua village (Escambray) in the central sector. It is a Cuban endemic.

Neoneura carnatica Selys (1886) We have taken 7 larvae and 6 adults. This species is an inhabitant of primordial woodlands (Alayo, 1968a). It has been only reported for the western sector; however, specimens have been recently collected from the central region in woodlands and plains, which constitute a new report for this sector. This is one of the 5 endemic species of the Cuban odonate fauna.

Neoneura maria (Scudder, 1866). We have taken three larvae. Adults have the same behavior and habitat as ***Neoneura carnatica***. Both species are very similar, and the color is the only one noticeable difference between these species in the field (Alayo 1968a). It is a Cuban endemic and it is distributed in the three Cuban sectors.

Protoneura capillaris (Rambur 1842) It was not collected by us; nevertheless, Alayo (1968a) reports that it is abundant in some localities. It is present in

the three sectors, being very abundant in the western one. Adults can be found in wooded, shaded places. In Cuba it is reported from the three sectors, being especially abundant in the west. Westfall (1964) reported it from an intermittent stream in Soledad, ovipositing in tandem in a trickle between pools. It is an Antillean species, and it is also present in Jamaica.

Protoneura corculum Calvert (1907). This was not taken by us. The larva of this species is not yet described. It rests on plants near rivers and ponds which it inhabits. It is present in the western sector of Cuba, and also in Mexico and Guatemala, reflecting an evident process of colonization of the western area of Cuba.

Family *Coenagrionidae*

Enacantha caribbea Donnelly and Alayo (1966) We did not collect this species. It is present only in the western sector of Cuba and was not collected by us. Alayo (1968a) collected it is August, 1962, and found it locally abundant in Los Negros Lake, Veral, Guane, and Pinar del Río. It is also found in Mexico and Guatemala.

Enallagma civile (Hagen, 1861). We took 41 larvae and 5 adults, and is the most commonly taken odonate, both by us and others. The larva is easily found among plants of the genus *Elodea*. Adults are not found on rapid streams, but prefer small ponds and lakes (Alayo 1968a). It is present in the three sectors of Cuba and in the Antilles, in Jamaica, Hispaniola, Puerto Rico and Trinidad. In the continent is reported for USA, Mexico, Guatemala and Venezuela.

Enallagma coecum coecum (Hagen, 1861) We found no examples, and it is apparently very rare in Cuba (Alayo, 1968a), reported only as a single individual in Cupeyal (Orinte).. Within the Antilles, it is found in Jamaica, Hispaniola, Puerto Rico, Anguilla and Grenada. It is an Antillean endemic, and is in a process of expansion in Cuba.

Enallagma coecum cardenium Hagen *in* Selys (1876) is considered one of the most abundant damselflies in Cuba. It generally lives in shadowy places on leaves and small branches, preferably near fast flowing streams, avoiding stagnant streams. It is widely distributed in the three sectors of Cuba. We took 34 specimens, including 1 larva. We found it on the shore of Río Cuyaguateje, in the western sector; in Villa Clara (central sector); and in the eastern sector. It is also present in Florida, which may reflect a possible expansion process to the continent.

Enallagma doubledayi (Selys,1850) We did not find this species, which is apparently rare in Cuba. It had been found by Ing. Julian Acuña near Placetas Las Villas, in the central sector (Alayo, 1968a). Within the Antilles it is only otherwise present in Jamaic,a and it is abundant in the south of USA (Alayo,1968a).

Enallagma truncatum (Gundlach, 1888). We took five adult specimens. Adults usually found on the leaves of *Nymphaea*. In Cuba, Alayo (1968a) reported it as one of the 5 endemics in the western and central sectors. However, five specimens were recently collected in Santiago and Baracoa, Guantánamo, constituting a new report for the eastern sector.

Ischnura capreolus (Hagen, 1861). We took five adult individuals. In Cuba it is present in the three sectors. Within the Antilles, it occurs in Jamaica, Hispaniola, Puerto Rico, Santa Lucia and Martinique. In the continent it is reported from Mexico to Argentina.

Ischnura hastata (Say, 1839) We took four adult individuals in the central sector near a pond in the city of Santa Clara. It is present in all three sectors of Cuba. According to Wilson (1911, in Alayo, 1968a) the larvae can develop in the water accumulating in bromeliads, but prefers ponds and lakes. Within the Antilles it is present in Bahamas, Jamaica, Hispaniola, Puerto Rico, Anguilla, Trinidad and Cayman Islands. In the continent is present from the USA to Venezuela.

Ischnura ramburii (Selys, 1850) We took 18 adults, which were found flying in vegetation along the shore, or resting on small twigs on the water, as observed by Alayo (1968a). In Cuba it is present in all three sectors, in lowlands, where it is one of the most abundant species of the Suborder. Within the Antilles it is present in Cayman Islands, Jamaica, Hispaniola, Puerto Rico, Anguilla, Grenada and Trinidad. In the continent it goes from eastern Canada to the Andes in Venezuela and Colombia.

Leptobasis candelaria Alayo (1968a). We did not find this species. It was described by Alayo (1968a) from a specimen found dead in a house in

Caldelaria, Pinar del Río. The larva of this species is not known. In Cuba it is only present in the western sector. In the continent it is present in Mexico and Guatemala (Westfall and May, 1996). It is possible that this species has been established from the continent.

Leptobasis vacillans Hagen *in* Selys (1877) We did not locate this species; nevertheless Alayo (1968a) reported it as abundant. It lives in quiet water of lakes and ponds. It is reported in Cuba for all three sectors. Within the Antilles it is found in the Cayman Islands, Jamaica, Hispaniola and Puerto Rico, while in the continent, from Mexico to Venezuela.

Nehalennia minuta (Selys, 1857) We did not locate this species. Gundlach (1888) took it in several localities., and Alayo (1968a) found it once. Alayo observed examples resting on small dry branches in shaded woodlands around the Ciénaga de Zapata. In th island it is reported from the western and centyral sectors. Within the Antilles it is present in the Cayman Islands and Trinidad. In the continent, it is present from the Florida Keys to Venezuela.

Neoerythromma cultellatum (Selys, 1876) We did not take examples of this species. Alayo (1968a) found it relatively abundant in several occasions in May, 1968. It is present in the three sectors of Cuba. Within the Antilles it is present in Jamaica, Hispaniola and Trinidad. In the continent it is distributed from USA to Venezuela.

Telebasis corallina (Selys, 1876). We did not take any examples; Alayo (1968a) found it twice, in October, 1962, and June, 1965, at the same locality. Adults live in swampy areas (Alayo, 1968a). In Cuba it is only present in the western sector. Within the Antilles it is present in Anguilla, Grenada and Trinidad, and, in the continent, in Venezuela.

Telebasis dominicana (Selys,1857). We took 15 adult specimens, in the eastern lowlands. According to Alayo (1968a) it prefers stagnant lakes. It is present in the three sectors of the Cuban archipelago and it is considered very abundant (Alayo, 1968a). It is an Antillean endemic, found also in Jamaica, Hispaniola, Puerto Rico, and the Virgin Islands.

SUBORDER *ANISOPTERA*

Family *Aeshnidae*

Aeshna psilus Calvert (1947) We have not found this species. It has been observed (Alayo, 1968a) on the slopes of Gran Piedra mountain and is very rare in the island. Within the Antilles it is present in Hispaniola, Jamaica and Puerto Rico, and the Lesser Antilles, while in the continent, from the USA (rarely) and Mexico to Ecuador, Peru and Argentina.

Anax amazili (Burmeister, 1839) We have not seen this species. It has been observed in several localities of the western and eastern sectors. Alayo (1968a) observed it twice, in the western and central sectors. Within the Antilles it is present in the Cayman Islands, Hispaniola, Puerto Rico, Grenada, Anguilla and Trinidad, while in the continent, from USA (rarely) and Mexico to Argentina.

Anax concolor Brauer, 1865. We did not collect this species, nor did Alayo. It is known from a single example taken by Gundlach (1888) in the western sector. Within the Antilles it is present in Jamaica, Hispaniola, Grenada and Anguilla, while in the continent in from Mexico, Costa Rica, Panama and Argentina.

Anax junius (Drury, 1770) We did not collect this species. It is relatively frequent in rivers and lagoons, where it patrols rivers (Alayo, 1968a). In the island it is reported for the western sector, where it is very apparently abundant, and also in the eastern sector. Within the Antilles it is present in Hispaniola, Jamaica, Puerto Rico, Grenada and Anguilla, while in the continent, in Canada, USA, Mexico and Guatemala.

Coryphaeschna adnexa (Hagen, 1861) We collected a single adult, in the lowlands of the eastern sector. This species was observed by us flying acrobatically along a river without perching. It is present in Cuba in the three sectors and is considered by Alayo (1968a) the most abundant of the family *Aeshnidae*. Within the Antilles it is present in Jamaica, Hispaniola and Puerto Rico, while in the continent, from the USA (rarely) and Mexico to Argentina.

Coryphaeschna ingens (Rambur, 1842) We did not collect this species. Alayo (1968a) did not find it

and reported it as apparently scarce in Cuba. Its distribution is unknown in the country. Apparently it was collected by Needham. In the continent it is present in the southern USA.

Coryphaeschna viriditas Calvert (1952). We did not collect this species. It flies high, landing in inaccessible places. According to Whitehouse (1943) this species prefer brackish waters in mangrove forests for reproduction. Although it has been considered to have a wide distribution, it is only reported for the western and central sectors. Within the Antilles it is present in the Cayman Islands, Jamaica and Hispaniola, while in the continent, from USA (rarely) and Mexico to Brazil and Bolivia.

Gynacantha ereagris Gundlach (1888) We did not collect this species. It is not very abundant in Cuba. It has also been observed in Bahamas and is an Antillean endemic.

Gynacantha nervosa Rambur (1842) We did not collect any individuals. It flies at a great height at dusk and dawn, resting in hidden places during the day. It is abundant in the island. Within the Antilles it is present in the Cayman Islands, Jamaica, Hispaniola and Puerto Rico, while in the continent, from USA to Brazil.

Remartinia secreta (Calvert, 1952). We did not collect this species. Alayo (1968a) took three individuals, two males and a female. The adults are strong fliers. In Cuba it has been reported for the three sectors. In the continent it is present in Mexico and Guatemala.

Triacanthagyna septima (Selys, 1857) We did not collect this species. It is not very frequent in the island, and it is only present in the western sector. Within the Antilles it inhabits the Cayman Islands, Jamaica and Puerto Rico, while in the continent, from Mexico to Bolivia.

Triacanthagyna trifida (Rambur, 1842) We did not collect this species. It is not considered to be very abundant in Cuba. Within the Antilles it is reported for Bahamas, Hispaniola, Jamaica, Puerto Rico, Anguilla, Grenada and Trinidad, while in the continent from the southern USA to Argentina.

Family *Gomphidae*

Aphylla caraiba Selys (1854) We collected two adults. It is widely distributed in Cuba in the three sectors. The larvae live ponds where they burrow completely except for the tip of the abdomen. Adults rest on the shores, on low vegetation or on rocks (Alayo, 1968a). Within the Antilles it is reported for Hispaniola and, in the continent, in Mexico.

Progomphus integer (Hagen in Selys, 1878). We took 14 larvae and two adults. The larvae prefer lotic zones of rivers and are active predators. They burrow in a characteristic niche in the sand at the shallow bottom of clean streams. The adults are found on the shores, preferably sandy. The adults collected by us were in flight on the Río Cuyaguateje (Pinar del Río). In Cuba it is widely distributed in the three sectors, and it is an Antillean endemic, being also reported for Jamaica and Hispaniola.

Family *Libellulidae*

Brachymesia furcata (Hagen, 1861) We took a single specimen on the Río Gascón, Santiago de Cuba. Ithas been reported in Cuba in the western and eastern sectors, and it is apparently not abundant (Alayo 1968a). Adults are seen flying on lakes, ponds, and also flowing rivers. In the Antilles it is present in the Cayman Islands, Jamaica, Hispaniola, Puerto Rico, Anguilla, Grenada and Trinidad, and in the continent, from USA to Argentina.

Brachymesia herbida (Gundlach, 1888). We have collected seven adults at impounded water bodies, six in Camagüey (shores of the Máximo Reservoir). Adults are found mainly in large lakes, but also in backwater of rivers (Alayo, 1968a). They rest on leaves of bushes. In Cuba it has been reported for the western and eastern sectors; however it has recently been collected in the central sector. Within the Antilles it is present in the Cayman Islands, Jamaica, Hispaniola, Puerto Rico, Anguilla, Grenada and Trinidad, while in the continent, from USA to Argentina.

Cannaphila insularis funerea (Carpenter, 1897) We collected five adult specimens. This species has been reported In Cuba for the western and eastern sectors. The examples were collected in the eastern sector, near the Chalón Reservoir in

Santiago de Cuba. Within the Antilles it is present in Jamaica and Hispaniola, while in the continent, in USA (rarely), Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica and Panama.

Celithemis eponina (Drury, 1773). We did not collect specimens. Alayo (1968a) collected many individuals in November, 1961, and inferred that they probably came from the USA, and considered this species an occasional visitor. Larvae live in lentic habitats, climbing on floating aquatic vegetation in rovers, where they are active predators. In Cuba it has only been observed in the western sector, while, in the continent, in Canada and USA.

Crocothemis servilia (Drury, 1770) This was reported for the first time by Flint (1996) in the western sector. More recently Ramos (2000) reported it in the central sector, and, finally, Trapero and Naranjo (2001) reported it in various localities in the eastern sector. It is evidently a recently introduced species which has expanded rapidly. It is of tropical Asian origin and was been reported for the first time in the south of Florida in 1975.

Dythemis rufinervis. (Burmeister, 1839) We collected nine adult specimens, all in lowlands of the central and eastern sectors. It can be found in the three sectors of Cuba in any river. Within the Antilles it is present in Bahamas, Jamaica, Hispaniola and Puerto Rico, and is an Antillean endemic.

Dythemis sterilis Hagen (1861) We collected ten adult specimens, some in each of the sectors. It is present in Cuba in the three sectors, and in the continent, in Mexico, Guatemala, El Salvador, Honduras, Panama, Venezuela, Colombia, Argentina and Chile.

Erythemis attala Selys (1857) We have not collected this species. Alayo (1968a) took a few specimens in La Habana. It is apparently rare in Cuba. Within the Antilles it is found in Jamaica, Hispaniola and Trinidad, while in the continent from Mexico to Argentina.

Erythemis haematogastra (Burmeister, 1839) We did not collect it, nor did Alayo (1968a). It is considered an occasional visitor. Within the Antilles it is reported for Jamaica and Trinidad, while in the continent, in Mexico, Panama, Venezuela, Colombia, Brazil, Peru, Paraguay and Argentina.

Erythemis plebeja (Burmeister, 1839) We collected eight adult specimens. It is widely distributed in the three sectors. Within the Antilles it is reported for the Cayman Islands, Jamaica Hispaniola, Puerto Rico and Trinidad, while in the continent, from USA to Argentina.

Erythemis simplicicollis (Say, 1839). We did not collect this species. Alayo (19680 took it abundantly in various parts of the island. It is common in stagnant water and rare in rivers. In Cuba it is reported for the western and eastern sectors. Within the Antilles it is found in Bahamas, Cayman Islands, Jamaica and Hispaniola, while in the continent, in Canada, USA, Mexico, Belize and Costa Rica.

Erythemis vesiculosa (Fabricius, 1775) We took nine adult specimens. It frequents slow rivers, not flying above the water, but resting on plants around the water, on soil, or on rocks. It is not a very active species and it is considered to be an migratory (Alayo,1968a). In Cuba it is found scattered in the three sectors. It is widely distributed within the Antilles and in the continent it is found from southern USA to Argentina. It is a species of broad distribution.

Erythrodiplax berenice naeva (Hagen, 1861). We have not collected this species. In Cuba it has only been reported for the western sector by Alayo (1968a), being abundant in Viñales, Guanahacabibes, and Pinar del Río. Within the Antilles it is present in the Cayman Islands, Jamaica, Grenada, and Trinidad, while in the continent from USA to Colombia.

Erythrodiplax bromeliicola (Westfall, 2000) is an Antillean endemic, recently reported in Jamaica and Cuba, in the vicinity of San Diego de los Baños and Las Animas in Pinar del Río, and Nueva Gerona in the Isla de Pinos. Dennis Paulson informs us that he has a male and female collected in Santiago de Cuba in 1938. Evidently it is a rare species and its larva has a very unusual ecological niche, developing in water deposited in the base of leaves of the family *Bromeliaceae*.

Erythrodiplax fervida (Erichson, 1848) We have taken 9 individuals. It is frequent in the shaded parts of slow rivers. It our country itis abundant,

especially the western sector. Within the Antilles it has been reported in the Cayman Islands, Jamaica, Hispaniola and Puerto Rico, while in the continent it is found from Mexico to Colombia.

Erythrodiplax justiniana (Selys,1857) We have taken 13 adults and four larvae. Generally it is found in lakes and ponds, but also in shaded backwaters of rivers, and springs. It is widely distributed through Cuba. Our collections contains examples from all three sectors. Within the Antilles it is reported for Bahamas, Jamaica, Hispaniola and Puerto Rico. It is considered an Antillean endemic.

Erythrodiplax umbrata (Linnaeus, 1758) We have collected 11 adult specimens. Males of this species are observed flying tirelessly from one side to the other, while the females rest in shaded places in low plants. Its distinctive habitat is mud holes. In our island it is widely distributed in the three sectors of the Cuban archipelago. Within the Antilles it is present in Bahamas, Cayman Islands, Jamaica, Hispaniola, Puerto Rico, Anguilla, Grenada and Trinidad, while in the continent, from USA to Argentina. It is considered a migrant species.

Idiataphe cubensis (Scudder, 1866) We have collected only one adult specimen. is rare in Cuba, being previously reported only for the western sector. However, We recently collected it in the central secto, in Camagüey Province. Within the Antilles it is present in Bahamas, Cayman Islands, Jamaica and Puerto Rico, while in the continent, in USA, Mexico, Guatemala, Honduras and Peru.

Libellula needhami Westfall (1943) We have not collected this species. It was observed by Alayo (1968a), who reported it as abundant. It was reported only for the western sector, but Peréz and Rodríguez (1998) reported it from the Granma part of the eastern sector.. Within the Antilles it is present in Bahamas, and in the continent in USA and Mexico.

Macrodiplax balteata (Hagen,1861) We have not taken specimens of this species. Alayo (1968a) observed it flying it on a clean lake in 1962. It flies very rapidly, resting on plants near the water. It is a very wary species and difficult to collect (Alayo, 1968a). In Cuba it has been reported only for the the western sector, where it seems abundant. Within the Antilles it is present in Bahamas, Cayman Islands, Jamaica, Hispaniola and Trinidad, while in the continent, in USA, Mexico, Venezuela and Argentina.

Macrothemis celeno (Selys, 1857) We have taken 17 individuals, including one larva. It6 can be seen flying slowly and casually. It is very abundant at sea level in arroys and torrents arising in the high mountains; it is the only species observed by us at the summit of the Gran Piedra (1200 m elevation). It is widely distributed in Cuba, and is considered abundant. We have taken it in all three sectors.. It is an Antillean endemic, present in Jamaica, Hispaniola and Puerto Rico.

Macrothemis inequiunguis (Calvert, 1895) We have not found this species., but it has been recently reported by Westfall et al (2000) for Cuba, in USA for Texas, in Mexico and in the south to Venezuela and Colombia.

Miathyria marcella (Selys, 1857) We collected eight individuals, in the central and eastern sectors. It is especially found in the company of members of the genus ***Tramea***. It is widely distributed in the three sectors of Cuba. Within the Antilles it is found in Jamaica and Puerto Rico, while in the continent, from USA to Argentina.

Miathyria simplex (Rambur, 1842) We did not collect this species. It is relatively abundant in Cuba, being found in the three sectors. Within the Antilles it is present in Jamaica and in the continent from Mexico to Brazil.

Micrathyria aequalis (Hagen, 1861) We collected two adult specimen, from the eastern sector, in the Chalón reservoir. Adults prefer lakes; exceptionally they are found on running water. It is present in the three sectors and is one of the most abundant of this genus. Within the Antilles it is present in Hispaniola, Puerto Rico, Anguilla, Grenada and Trinidad, and in the continent, from the south of Texas and Florida to Ecuador.

Micrathyria debilis (Hagen, 1861) We have not taken examples. It was taken by Alayo (1968a) who considered it rare and found it only in the western sector. In the continent it is present in Mexico, Guatemala and Argentina.

Micrathyria didyma (Selys, 1857) We collected two adult samples. It is observed at lakes, clean ponds, and in backwaters of rivers. It is reported for the three sectors of Cuba; our examples are

from the central and eastern sectors. Within the Antilles it is present in Bahamas, Cayman Islands, Jamaica, Hispaniola, Puerto Rico, Anguilla, Grenada and Trinidad, while in the continent, from southern Texas, Florida, Mexico to Argentina.

Micrathyria dissocians. (Calvert, 1906) We have taken two adult specimens. It is widely distributed in the three sectors of Cuba. Our samples came from the central sectr, where they were resting on branches of marabú (*Dichrostachys cinerea*). Within the Antilles it is reported for Jamaica, Hispaniola and Puerto Rico, while in the continent in Mexico and Guatemala.

Micratyria hagenii Kirby (1890) We have taken four adults. It is found in the three sectors of Cuba, and we have found it in all three. Within the Antilles it is present in Jamaica, Hispaniola and Puerto Rico, while in the continent from USA to Panama.

Orthemis ferruginea (Fabricius, 1775) We have taken 19 individuals, including one larva, in all three sectors. It is widely distributed and is considered one of the most abundant species in Cuba. Within the Antilles it is present in the Cayman Islands, Jamaica, Hispaniola, Puerto Rico, Anguilla, Grenada and Trinidad, while in the continent, from USA to Argentina. [Most of the Cuban specimens belong to an undescribed species, but the true ***ferruginea*** is also present. ed.]

Pachydiplax longipennis (Burmeister, 1839) We have not taken this species. C. Roig (in Alayo, 1968a) took a male in La Habana in October, 1965. In our territory it is only reported for the western sector, and it is considered a rare visitor. Within the Antilles it is present in Bahamas, and in the continent in USA and Mexico.

Pantala flavescens (Fabricius, 1798). We collected ten adults. Adults can be found everywhere, flying incessantly at heights of 10 – 20 meters. It is distributed in the whole archipelago, being seen and collected by us in nearly all the localities we visited. It is reported on all the Antillean islands. Similarly, in the continent it is present from Canada to Argentina. It is a cosmopolitan species (Alayo,1968a).

Pantala hymenaea (Say, 1839). We have taken a specimen of this species, when it came to a light within a house in Santiago de Cuba early in the evening. Alayo (1968a) took it twice and considered that it bred in clean water... Although considered rare, it is present in the three sectors of Cuba. Within the Antilles it is present in Cayman Islands, Jamaica and Virgins Islands, while in the continent, from Canada to Chile.

Perithemis domitia (Drury,1773) Eleven adult specimen were taken. Males prefer to fly close to the water, resting time and again on emergent branches. It is abundant in Cuba and is present in the three sectors (also for our examples). Within the Antilles it is reported for Jamaica, Hispaniola and Puerto Rico, and in the continent in USA, Mexico, Guatemala, Honduras, Panama, Venezuela and Colombia.

Scapanea frontalis (Burmeister, 1839) We have teken four specimens of this species and observed it on several occasions. Males frequently fly on various beats along flowing rivers, preferring shaded zones. Females rest near the water. It has a wide distribution in Cuba, always in mountain areas. It is an Antillean endemic, found in Jamaica and Puerto Rico.

Sympetrum illotum (Hagen, 1861) We have not collected an example in this project. In Cuba it is only present in the eastern sector, at the highest elevations of the island: Pico Cuba and Cupeyal de Yateras in Guantanamo. Within the Antilles it is found in Jamaica and Hispaniola, and in the continent, from Canada to Argentina.

Tauriphila argo (Hagen, 1869) We have not taken individuals of this species. It was taken in Cuba by Westfall (1964) and by Alayo (1968a) in May and July. In Cuba it is only present in Cuba in the western sector and it is considered an occasional visitor from the continen, where it is reported for Mexico, Guatemala, Peru, Brazil, Paraguay, Colombia, Venezuela and Argentina.

Tauriphila australis (Hagen, 1867) We collected three adults. It visits quiet water of rivers. in Cuba it is present in the three sectors, our examples being from the eastern sector. Within the Antilles it is present in Hispaniola and Trinidad, while in the continent, in USA, Mexico, Guatemala, Panama, Venezuela, Colombia, Brazil and Paraguay.

Tholymis citrina (Hagen,1867) We collected only a single adult, while it rested on a branch deep in the forest in the zone of Caney, east of Santiago de

Cuba. Alayo (1968a) found it abundant in June, 1962, flying in shaded places. Adults are observed at dusk flying from resting place to another. It is present in the three sectors of the archipelago. Within the Antilles it is found in Jamaica and Hispaniola, while in the continent, from Mexico to Argentina.

Tramea abdominalis (Rambur, 1842) We captured five individuals, including one larva. Adults frequent lakes and fresh water ponds, although they have been observed along the shoreline. It is present in Cuba in the three sectors; our examples are from the central and western. Within the Antilles it is found in Bahamas, Cayman Islands, Jamaica, Hispaniola, Puerto Rico, Grenada and Trinidad, while in the continent, in USA (rarely), Mexico, Guatemala, Venezuela and Argentina.

Tramea calverti Muttkowski (1910) We have not collected this species. It is reported for the western and eastern sectors of the Cuban archipelago and it is apparently rare. Within the Antilles it is present in Cayman Islands, Jamaica and Hispaniola, while in the continent, from USA to Argentina.

Tramea insularis (Hagen, 1861) We collected two adult specimens. It prefers clean water for oviposition. In our country it is reported from the western and eastern sectors; our two examples are from the eastern sector. Within the Antilles it is found in Bahamas, Jamaica, Hispaniola, Puerto Rico, Anguilla and Grenada, while in the continent, in USA, Colombia, Brazil, Paraguay and Argentina.

Tramea lacerata Hagen (1861) This has not been collected by us. It was taken by Alayo (1968a) in November, 1962, and Fermín Cervera in November, 1923. Like Celithemis eponina it was foundin La Habana at the end of the year (Alayo, 1968a). It has only been reported in Cuba for the western sector, and has been considered occasional. Within the Antilles it is reported for Bahamas and in the continent for USA and Mexico.

Tramea onusta (Hagen, 1861) We have collected 8 larvae and 1 adult. It is abundant along the coast and flies at a great height (Alayo, 1968a). It has only been reported in Cuba for the eastern sector, where we found the eight larvae. The adult (new record) was found on the shores of the Máximo Reservoir, in Camagüey, central sector, about 4 km from the coast. Within the Antilles it is found in Bahamas, Cayman Islands, Hispaniola, Puerto Rico, Anguilla, Grenada and Trinidad, while in the continent, USA, Mexico, Guatemala, Panama and Venezuela.

ANALYSIS OF ALTITUDINAL DISTRIBUTION

Species of the suborder *Zygoptera* never go above 1500 m (above sea level) and are found mainly below 500 m. On the other hand, three species of *Anisoptera* can reach 1900 m (above sea level), which reflects the flight power of this suborder.

Among the 15 species in the family Coenagrionidae, 10 always fly below 200 m above sea level. The species ***Ischnura ramburii***, ***Neoerytromma cultellatum*** and ***Telebasis dominicana*** fly above 280 m and ***Enallagma doubledayi***, has been found in a very narrow range: 200-210 m.a.s.l. Only ***Enallagma coecum cardenium*** can be found as high as 800 m. Lestidae have 4 species, which do not fly above 120 m.a.s.l. The family Megapodagrionidae presents only one species in the archipelago, ***Hypolestes trinitatis***, which flies from sea level up to 1300 m. Actually it is very abundant around 700 m.a.s.l., despite the fact that it has been observed in Campana, El Caney, Santiago de Cuba at about 200 m (Ramos, 1996). The five species of family Protoneuridae are not found above 400 m.a.s.l. Twelve species of Aeshnidae are found in Cuba, two of them (***Aeshna psilus*** and ***Triacanthagyna trifida***) have been observed in the range of 0-1200 m.a.s.l.; three species reach 800 m and five do not pass 500 m.a.s.l. There are no altudinal data for ***Coryphaeschna ingens*** in the archipelago.

The two species of the family Gomphidae do not occur together; ***Progomphus integer*** flies up to 200 m while ***Aphylla caraiba*** flies up to 800 m.a.s.l.

Among the 41 species in the Libellulidae family 33 (41% of Cuban Odonata) have been captured or observed exclusively below 300 m. Two of them reach 400 m, three can fly up to 400 and 500 m, only one (***Dythemis rufinervis***) flies from 45 up to 800 m, and three can be collected up to 1500 m. In this family, 7 species present a very narrow range, such as ***Erythemis attala*** (50-125 m), ***Erythemis haematogastra*** (0-25 m), ***Miathyria simplex*** (50-75 m), ***Micrathyria debilis*** (0-50 m), ***Pachydiplax longipennis*** (50-110 m), ***Tauriphila argo*** (0-50 m) and ***Tramea lacerata*** (100-105m).

ALTITUDINAL ANALYSIS AT SPECIES LEVEL

Range I (0-500 m): 80 species are present in this range. We note that 68 species are confined to this range; thus, 85 % of the Cuban species fly at low elevation.

Range II (0-1000 m): in this range six species appear (7.5 %): ***Anax concolor, Anax junius*** and ***Remartinia secreta*** of family Aeshnidae; ***Aphylla caraiba*** of family Gomphidae; family ***Dythemis rufinervis*** of Libellulidae and ***Enallagma coecum cardenium*** of family *Coenagrionidae*. It is interesting to note that four of these six species have robust bodies and large wings which allow them to move in a wide range.

Range III (0-1500 m): in this group are included the species that fly between the sea level and 1500 m: ***Hypolestes trinitatis*** of family Megapodagrionidae, which is the largest zygopteran in Cuba; ***Aeshna psilus*** and ***Triacanthagyna trifida***, which are the species of Aeshnidae that reach the highest altitudes.

Range IV (0-2000 m): only three species belonging to family Libellulidae reach the maximum height: ***Orthemis "ferruginea"***, a species with broad distribution and great abundance in Cuba and in the Neotropics in general; ***Scapanea frontalis***, an Antillean endemic characteristic of the mountain creeks of the archipelago, and ***Sympetrum illotum***, collected in Pico Cuba, Macizo del Turquino, higher than 1800 m.

Based on these data, it can be pointed out that most of the Cuban dragonflies have been observed in the range of 0-500m. That is to say that there is a noticeable preference for the lower elevations. However, it is necessary to state that altitudinal variations in Cuba are not spectacular, and, because the country is an archipelago, diversity is greatest in the coastal areas.

SEASONAL DISTRIBUTION OF THE SPECIES OF THE ODONATA ORDER IN CUBA. From our results it can be inferred that the optimal months for collecting adults are June with 85 specimens (18 % of the total) and November with 59.

Since Cuba is a tropical country, there are two seasons intimately related to precipitation, and consequently the analysis should take into account the rainy and the dry seasons. In view of that, 236 records correspond to the rainy season (from May to November) and 110 to the dry season (from December to April), representing 68 % and 32 % of the total respectively.

Species captured and/or observed during 10 months of the year are: ***Perithemis domitia*** and ***Telebasis dominicana,*** from which can be inferred that they do not have a seasonal life cycle. Besides, these two species present a very wide geographical distribution.

On the contrary, nine species have been collected only during one month, among them, ***Enacantha caribbea, Enallagma doubledayi, Leptobasis candelaria*** and ***Protoneura corculum*** are considered very rare, with a localized distribution in Cuba. ***Anax concolor, Micrathyria debilis, Pachydiplax longipennis*** and ***Tramea lacerata*** are considered accidentals, since they have only been observed in the rainy season (May-November), when our archipelago is buffeted by strong winds from the north. The adults of the latter species certainly come from Florida, and apparently are dragged towards the western part of Cuba by the northern winds, which prevail at this time of the year. The ninth species in this group is ***Sympetrum illotum,*** which has been collected by Alayo (1968a) in Pico Cuba of Macizo del Turquino, above 1800 m. According to Donnelly this species is typical of great altitudes, principally in Central America and the Pacific coast states of USA. However, it has been observed in the northwest of Cuba at very low altitude.

ZOOGEOGRAPHIC RELATIONSHIPS OF THE CUBAN ODONATE FAUNA

RELATIONSHIPS WITH THE AMERICAN CONTINENT Endemic species are excluded from this analysis. The analysis of biological similarity between Cuba and the continent shows the highest indexes for Cuba-North America (28%) and Cuba-northern South America (37%) and, surprisingly enough, the lowest for Cuba-Central America (9%). This fact can be explained by the proximity of western Cuba with North America, and the eastern part with South America through the connections of the Antillean islands, constituting a possible route for expansion of dragonflies.

On the other hand, the inverse situation occurs with the relationships with Central America because of the considerable distance between Cuba and this part of the American continent.

Based on these results it can be stated that the Antilles, and mainly Cuba, constitute a link for the flux of species from south to north or vice versa, and in addition, it could be the center of dispersion of the species originated in the archipelago.

RELATIONSHIPS WITH THE GREATER ANTILLES The highest biological similarity index is found between Cuba and Hispaniola (78%), probably because of the their proximity. The second one is between Cuba and Jamaica (76,8%), and the lowest is between Cuba and Puerto Rico (65%), probably due to the greater distance separating these islands.

An interesting case occurs with the subspecies ***Enallagma coecum coecum***, which is only reported for Grenada, Anguilla, Puerto Rico, Virgin Islands, Hispaniola, Jamaica and the eastern sector of Cuba, and can be interpreted as an expansion process towards the Cuban territory. The species ***Dythemis rufinervis*** and ***Erythrodiplax justiniana*** are present in Bahamas, Cuba, Jamaica, Hispaniola and Puerto Rico, and are probably expanding towards North America and the Lesser Antilles.

RELATIONSHIPS WITHIN THE CUBAN TERRITORY Among the 83 species of Odonata in Cuba (Flint, 1996; Westfall, 2000), 72 (87% of the total) are reported for the western sector, 44 (53% of the total) for the central sector and 55 (66% of the total) for the eastern sector. There are 41 species in common between western and central sectors, while there are 39 species in common between central and eastern sectors. Similarly, there exist 49 common species between eastern and western sectors, and 37 common species between the three Cuban sectors.

The geographic distribution analysis of the Cuban species reflects that the biological similarity is higher among central and western sectors (79%), while among western and eastern sectors the value is 77%.

As noted, there are no marked differences in the biological similarity index among the sectors, since all species have a good flight capacity.

ENDEMISM Alayo (1968a) stated out that there are eight exclusively Cuban species, among them one from the suborder Anisoptera and six from the Zygoptera. From the latter, three have been found later in other countries, such as ***Remartinia secreta*** in Brasil and Mexico (Novelo,1998), ***Leptobasis candelaria*** in Guatemala (Paulson, 1982), and ***Hypolestes trinitatis*** in Hispaniola (Daigle, 1993). Nowadays only five endemic species remain, all of them from the suborder Zygoptera: ***Protoneura capillaris, Neoneura carnatica, Neoneura maria, Microneura caligata*** and ***Enallagma truncatum***. The endemism percentage is low (6 %), and all endemics are Zygoptera, which have a poorer flight capacity than Anisoptera. Note that the five endemic species have a slow and low flight and are localized in streams and ponds. These species are found in the central sector, while four of them are also present in the western and eastern sectors, resulting in a very homogeneous distribution.

CONCLUSIONS

1. A thorough bibliographic review has been accomplished in order to establish the history of the study of Odonata in Cuba. Most of the species (72) have been described or reported before the 20th century, and only nine have been later added to the list. The greatest thrust in the knowledge of the group was reached in the second half of the 20th century, thanks to the efforts of the German naturalist J.C. Gundlach.

2. An updated list of 83 species was obtained, grouped in seven families and 48 genera.

3. Based on the data it can be stated that most Cuban dragonflies have been observed in the 0-500m range, reflecting a preference for lower heights, although the altitudinal variation are not spectacular in Cuba, and the fact that the country is an archipelago results in the highest diversity in the coastal areas.

4. The optimal months of the year for collecting adults are June and November. Only two species were captured and/or observed during 10 months of the year, on the contrary, and nine were collected in only one month; of them, 4 are considered very rare with a very localized distribution in Cuba, and 4 are accidental.

5. The Cuban Odonate fauna is typically Neotropical. In its relation with the continent, the

fauna presents greatest affinity with the southern part of North America, nearly as much with the northern part of South America, and thirdly with Central American. At the regional level, according to the present data the greatest affinity was obtained between Cuba and Hispaniola, as was foreseeable. In the intra-insular analysis the higher value of biological similarity is between the central and eastern sectors, and less between the western and central sectors.

ACKNOWLEDGEMENTS

We want to thank Dr. Dennis Paulson of the Slater Museum of the University of Puget Sound; Dr. Thomas Donnelly, editor of **ARGIA**; and Dr. Oliver S. Flint, Jr., who sponsored a study grant for one of the authors at the National Museum of Natural History in 1998. Dr. Donnelly also arranged for the translation of the text.

REFERENCES

Alayo, P,. 1968a. Las Libélulas de Cuba. (Insecta – Odonata). Part 1 Texto. Torreia, Nueva Serie, 2:3-102

Alayo, P., 1968b. Las Libélulas de Cuba. (Insecta – Odonata). Part 2 Laminas. Torreia, Nueva Serie, 3:3-54

Alayo Soto, R., 1985. Descripción de la náyade de *Hypolestes trinitatis* Gundlach (Odonata-Hypolestidae). Ciéncias Biológicas, 14:111-113

Burmeister, H., 1839. Handbuch der Entomologie. Berlin. Reimer, 2(2):xii+ 757-1050

Calvert, P.P., 1919. Gundlach's work on the Odonata of Cuba; a critical study, Trans. Amer. Entomol. Soc, 45:353-396

Donnelly, T. and P. Alayo, 1966. A new genus and species of damselfly from Guatemala and Cuba. (Odonata-Coenagrionidae) . Florida Entomologist, 49(2): 107-117

Flint, O,. 1996, The Odonata of Cuba, with a report on a recent collection and checklist of the Cuban species. Cocuyo., No. 5.

Gundlach, J., 1888, Contribución a la Entomología cubana- Neuropteros. Anales Acad. Ciec. Med. Fis. y Nat., Habana, Alvarez & Co., 2: 189-291.

Hagen, H., 1861, Synopsis of the Neuroptera of North America. Smith. Misc. Colls., Wash., 4:1-34.

Hagen, H., 1867a, Revisionen der von Herrn Scudder beschreiben Odonaten. Stett. ent. Zeit., 28: 96-100

Hagen, H., 1867b, Odonata fauna of the Island of Cuba. Proc. Boston Soc. Nat. Hist., 11:289-194

Hagen, H., 1867c, Odonaten Cubas. Stett. ent. Zeit. 29: 274-287

Hagen, H., 1867d, Die Neuropteren der Inseln Cuba. Stett. Ent. Zeit. 28: 215-232

Hagen, H., 1875, Synopsis of the Odonata of North America. Proc. Boston Soc. Nat. Hist. 18: 20-96

Klots E., 1932, Scientific Survey of Porto Rico and the Virgin Islands:New York:Published by the Academy. Vol XIV-Part 1 pp.12-100.

Kluge, N., E. Novikova and A. Brodski, 1984, Movimientos de las larvas de efímeras (Ephemeroptera) durante la natación, respiración y limpieza. Zoologuicheskii Yournal, Tomo XIII, Vol. 9, pp.1345-1354.

Margalef, R. 1977, Ecología, Ediciones Omega, S.A., Barcelona, .405 pp.

Merritt, R., and K. Cummins, 1996, An Introduction to the Aquatic Insects of North America. Kendall - Hunt Publishing Company: 3ª Edition, pp. 164-211.

Naranjo, C., 1986, Análisis Ecologo-faunístico de Insectos Afibióticos (Ephemeroptera, Trichoptera y Odonata) del Parque Nacional Sierra Maestra (Cuba). Tesis de Dr. En Cienc. Biol. State University of Leningrad (Russian), pp. 164.

Naranjo, C., 1988,Tipos ecomofológicos de larvas de las efímeras cubanas (Ephemeroptera). Miscelánea Zoológica, Nº. 37, Inst. de Zool. Ac. de Cienc. Cuba, p. 4.

Needham, J.G., 1939, Nymph of the protoneurine genus *Neoneura* (Odonata). Entomological News. 50(9): 243-244.

Needham, J.G. and H. Heywood, 1929, A Handbook of the Dragonflies of North America. Charles Thomas., Springfield, Ill. 378 pp.

Needham, J. and M.J. Westfall, Jr., 1955, A Manual of the Dragonflies of North America (Anisoptera). Univ. California Press, 615 pp.

Needham, J.G., M.J. Westfall, Jr., and M. May, 1996, Dragonflies of North America. Scientific Publishers, Gainesville Florida. 939 pp.

Paulson D.R., 1982, Odonata. In: S.H. Hurlbert and A. Villalobos, eds., Aquatic Biota of Mexico, Central America and the West Indies, San Diego State University, 277 pp.

Perez, M. and O. Rodríguez, 1998, Estudio de la cuenca de los ríos Cautillo y Jibacoa. Tésis de Licenciatura. Univ. de Ote. Santiago de Cuba, Cuba, 20 pp.

Rambur. P., 184,. Histoire Naturelle des Neuropteres. Paris, p. 245.

Ramos, L., 1996, Estudio del orden Odonata en la cuenca del Río San Juan (Santiago de Cuba).Tesis de Lic. en Ciénc. Biol. Universidad de Oriente. Santiago de Cuba,. 37 pp.

Ramos, J. 2000, Geographic distrbution of Crocothemis servilia (Drury) (Odonata: Libellulidae) in Cuba. ARGIA 12 (3):28-29.

Samek, VM. 1973M Regiones fitogeográficas de Cuba. Serie Forestal N°. 15, Ac. de Ciénc. de Cuba, pp. 63.

Scudder, S., 1866, Notes upon some Odonata from the Isle of Pines. Proc. Boston Soc. Nat. Hist., 10:187-198

Selys, E., 1857, Neuroptères de l'isle de Cuba. In de la Sagra, Histoire physique, politique, et naturellede l'Ile de Cub. Paris, Animaux articulés. 7:433-473

Selys, E., 1877, Sinopsis der Agrionines. 5e legion: Agrion (suite et fin) Les Genres *Telebasis*, *Agriocnemis*, et *Hemiphlebia*. Bull. Acad. Roy. Belg. (2)43:97-159

Trapero, A., 1999, Revisión del orden Odonata en Cuba. Tesis de Lic. en Ciénc. Biol. Universidad de Oriente. Santiago de Cuba, 71 pp.

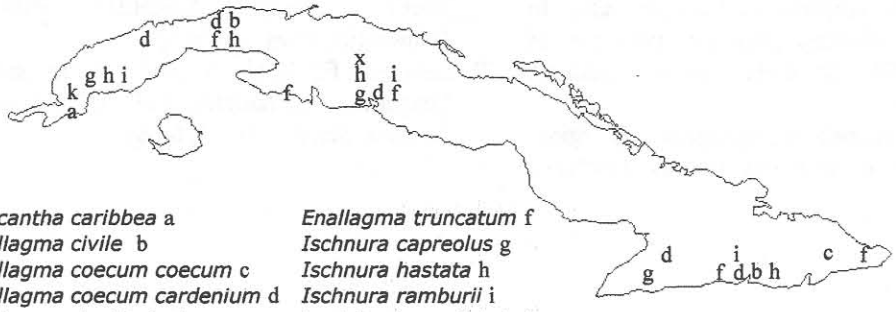
Trapero, A. and C. Naranjo, 2001, New locality reports for *Crocothemis servilia* (Drury, 1770) (Odonata: Libellulidae) in Cuba. ARGIA, Vol.13(2):3

Westfall, M.J. Jr.,1964, Notes of the Odonata of Cuba. Quarterly Journal of the Florida Academy of Sciences, Vol. 27(1):67-85.

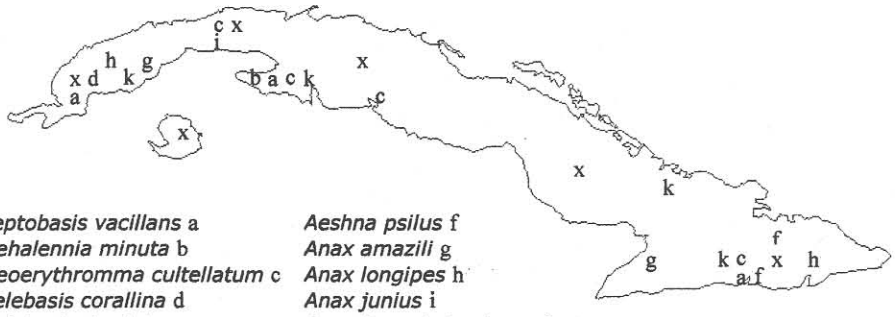
Westfall, J. and M. May, 1996, Damselflies of North America. Scientific Publishers, Gainesville, Florida, 570 pp.

Whitehouse, F., 1943, A guide of the study of Dragonflies of Jamaica. Bull. Of the Inst. Of Jamaica, Sci. Ser. No. 3, 69 pp.

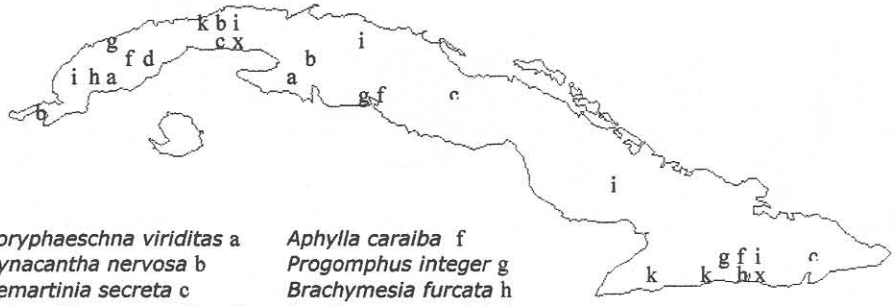
Lestes forficula a
Lestes scalaris b
Lestes spumarius c
Lestes tenuatus d
Hypolestes trinitatis x
Microneura caligata f
Neoneura carnatica g
Neoneura maria h
Protoneura capillaris i
Protoneura corculum k



Enacantha caribbea a
Enallagma civile b
Enallagma coecum coecum c
Enallagma coecum cardenium d
Enallagma doubledayi x
Enallagma truncatum f
Ischnura capreolus g
Ischnura hastata h
Ischnura ramburii i
Leptobasis candelaria k

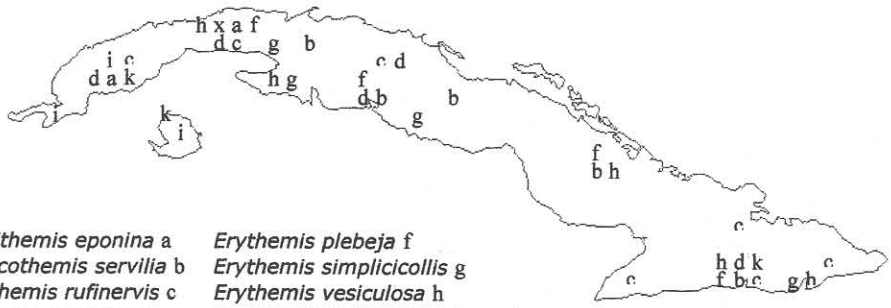


Leptobasis vacillans a
Nehalennia minuta b
Neoerythromma cultellatum c
Telebasis corallina d
Telebasis dominicana x
Aeshna psilus f
Anax amazili g
Anax longipes h
Anax junius i
Coryphaeschna adnexa k

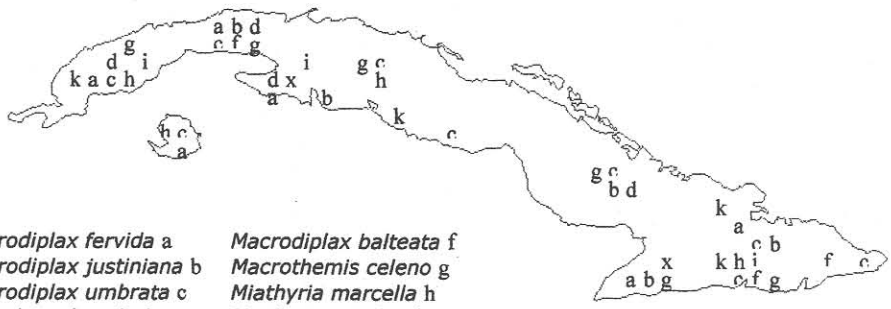


Coryphaeschna viriditas a
Gynacantha nervosa b
Remartinia secreta c
Triacanthagyna septima d
Triacanthagyna trifida x
Aphylla caraiba f
Progomphus integer g
Brachymesia furcata h
Brachymesia herbida i
Cannaphila insularis funerea k

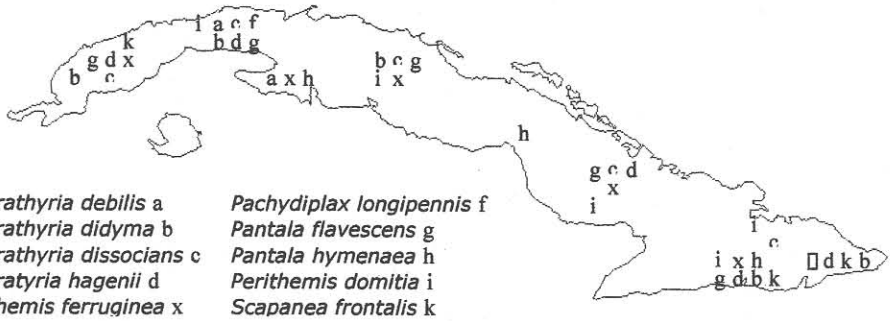
Appendix 1: Distributional maps of Cuban Odonata



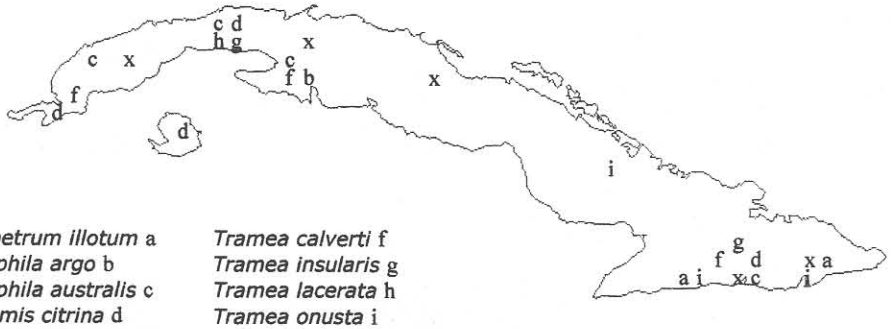
Celithemis eponina a
Crocothemis servilia b
Dythemis rufinervis c
Dythemis sterilis d
Erythemis attala x
Erythemis plebeja f
Erythemis simplicicollis g
Erythemis vesiculosa h
Erythrodiplax berenice naeva i
Erythrodiplax bromeliicola k



Erythrodiplax fervida a
Erythrodiplax justiniana b
Erythrodiplax umbrata c
Idiataphe cubensis d
Libellula needhami x
Macrodiplax balteata f
Macrothemis celeno g
Miathyria marcella h
Miathyria simplex i
Micrathyria aequalis k



Micrathyria debilis a
Micrathyria didyma b
Micrathyria dissocians c
Micratyria hagenii d
Orthemis ferruginea x
Pachydiplax longipennis f
Pantala flavescens g
Pantala hymenaea h
Perithemis domitia i
Scapanea frontalis k



Sympetrum illotum a
Tauriphila argo b
Tauriphila australis c
Tholymis citrina d
Tramea abdominalis x
Tramea calverti f
Tramea insularis g
Tramea lacerata h
Tramea onusta i

Appendix 2: Distributional Maps of Cuban Odonata

BULLETIN OF AMERICAN ODONATOLOGY

VOLUME 5

VOLUME 6

VOLUME 7

BULLETIN OF AMERICAN ODONATOLOGY

VOLUME 1

THE ODONATA OF NEW YORK, Thomas W. Donnelly 1(1): 1-27

DISTRIBUTION OF DRAGONFLIES AND DAMSELFLIES (ODONATA) IN FLORIDA, Sidney W. Dunkle 1(2): 29-50

MORPHOLOGICAL AND ECOLOGICAL DIFFERENCES AMONG SPECIES OF *LADONA* (ANISOPTERA: LIBELLULIDAE), Michael L. May 1(3): 51-56

COMPORTAMIENTO REPRODUCTIVO Y POLICROMATISMO EN *ISCHNURA DENTICOLLIS* Burmeister (Zygoptera: Coenagrionidae), [Reproductive behavior and polychromatism in ***Ischnura denticollis***], with English summary Alejandro Córdoba Aguilar. 1(3): 57-64

A CHECKLIST OF THE ODONATA OF THE DOMINICAN REPUBLIC BY PROVINCE, Jerrell James Daigle 1(4):65-69

ODONATA DE LA SIERRA DE HUAUCHINANGO, PUEBLA, MEXICO [Odonata of the Sierra de Huachinango, Puebla, Mexico], José A. Gómez Anaya y Rodolfo Novelo Gutiérrez 1(4):71-73

VOLUME 2

LA NAYADE DE *ARCHILESTES LATIALATUS* DONNELLY, 1981 (ZYGOPTERA: LESTIDAE) [The naiad of ***Archilestes latialatus*** Donnelly, 1981], R. Novelo-Gutiérrez 2(1): 1-7

DESCRIPCIÓN E HISTORIA NATURAL DE LAS LARVAS DE ODONATOS DE COSTA RICA. I II: *GYNACANTHA TIBIATA* (KARSCH 1891) (ANISOPTERA, AESHNIDAE) [Description and Natural History of of the Odonata Larvae of Costa Rica. III: ***Gynacantha tibiata*** (Karsch 1891)(Anisoptera: Aeshnidae)], Alonso Ramírez 2(1): 9-14

DESCRIPTION OF THE NYMPH OF *EPITHECA (TETRAGONEURIA) SPINOSA* (HAGEN) (ODONATA:CORDULIIDAE), K. J. Tennessen 2(2): 15-19

THE LARVA AND ADULT MALE OF *SOMATOCHLORA GEORGIANA* WALKER (ODONATA: CORDULIIDAE), Jerrell J. Daigle 2(2): 21-26

***MACROMIA ILLINOIENSIS* AND *GEORGINA*: A STUDY OF THEIR VARIATION AND APPARENT SUBSPECIFIC RELATIONSHIP (ODONATA: CORDULIIDAE),** Thomas W. Donnelly and Kenneth J. Tennessen 2(3): 27-61

THE SUBGENUS *TETRAGONEURIA* (ANISOPTERA: CORDULIIDAE: *EPITHECA*) IN NEW JERSEY, Michael L. May 2(4): 63-74

VOLUME 3

THE ODONATA OF OHIO - A PRELIMINARY REPORT, Robert C. Glotzhober 3(1): 1 - 30

FOUR DECADES OF STABILITY AND CHANGE IN THE ODONATA POPULATIONS AT TEN ACRE POND IN CENTRAL PENNSYLVANIA, Clark N. Shiffer and Harold B. White 3(2): 31 - 41

DESCRIPCION E HISTORIA NATURAL DE LAS LARVAS DE ODONATOS DE COSTA RICA. IV: *MECISTOGASTER ORNATA* (RAMBUR, 1842) (ZYGOPTERA, PSEUDOSTIGMATIDAE).[Description and Natural History of Odonata larva of Costa Rica. IV. *Mecistogaster ornata* (Rambur, 1842) (Zygoptera, Pseudostigmatidae], Alonso Ramírez 3(2): 43-47

THE DISTRIBUTION OF ODONATA IN ALABAMA, Kenneth J. Tennessen, James D. Harper, R. Stephen Krotzer, 3(3): 49-74

DISTRIBUTION RECORDS OF THE ODONATA OF MONTANA, Kelly B. Miller and Daniel L. Gustafson, 3(4): 75 - 88

continued on inside cover

VOLUME 4

AN ANNOTATED LIST OF THE ODONATA OF NEW JERSEY
With an Appendix on Nomenclature in the Genus ***Gomphus***, Michael L. May & Frank L. Carle 4(1): 1 - 35

THE ODONATA OF PATUXENT WILDLIFE RESEARCH CENTER AND VICINITY, Richard L. Orr 4(2): 37 - 67

THE STATUS OF *LESTES APOLLINARIS* NAVÁS AND *L. HENSHAWI* CALVERT, Thomas W. Donnelly 4(3): 69-74

THE DRAGONFLIES OF WASHINGTON, Dennis R. Paulson 4(4): 75-90