

An updated checklist of Lesser Antillean Odonata

François Meurgey* and C. Poiron

Société d'Histoire Naturelle L'HERMINIER – Muséum d'Histoire Naturelle 12, rue Voltaire,
44000 Nantes, France

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An updated checklist of known Odonata occurring in the Lesser Antilles is presented along with distributional information island by island. Twelve species are removed from previous listings and 16 new records are added, bringing the total number of species to 46. Of the new records, three correspond to the descriptions of new species and one is currently under taxonomic revision (*Brechmorhoga praecox grenadensis* Kirby).

Keywords: Odonata; West Indies; Lesser Antilles; checklist; biogeography

Introduction

Previous listings from the Lesser Antilles included 20–41 species (Dommangé et al., 2000; Goyaud, 1994; Klots, 1932; Meurgey, 2006). New records have been found during the last 10 years and many names have been recently revised, making it necessary to update the list in order to reflect the current name changes and synonymies. Although 16 species are new island records or new records for the Lesser Antilles, numerous names mentioned earlier refer to old records based on misidentified specimens. All species mentioned in our list are either represented by voucher material in a collection and/or were examined by us.

During the last 12 years (2000–2012), three new species (Daigle, 2007; Meurgey, 2006, 2009b) and the larval stage of five species (Meurgey, 2007a, 2008, 2009a, 2010; Meurgey & Daigle, 2007) have been described from this region as a result of our ongoing studies.

The Lesser Antilles

The Lesser Antilles extend from the island of Anguilla to Grenada (Figure 1). Biogeographically, Trinidad is not a part of the Antilles (Morrone, 2001). Lesser Antillean islands are different political entities and reflect different states of knowledge based on past history of collecting.

Guadeloupe, Martinique, St Martin and St Barthélémy are part of the French Overseas Territories. Guadeloupe comprises Les Saintes, Marie-Galante and La Désirade. The total surface

*Corresponding author. Email: francois.meurgey@shnlh.org

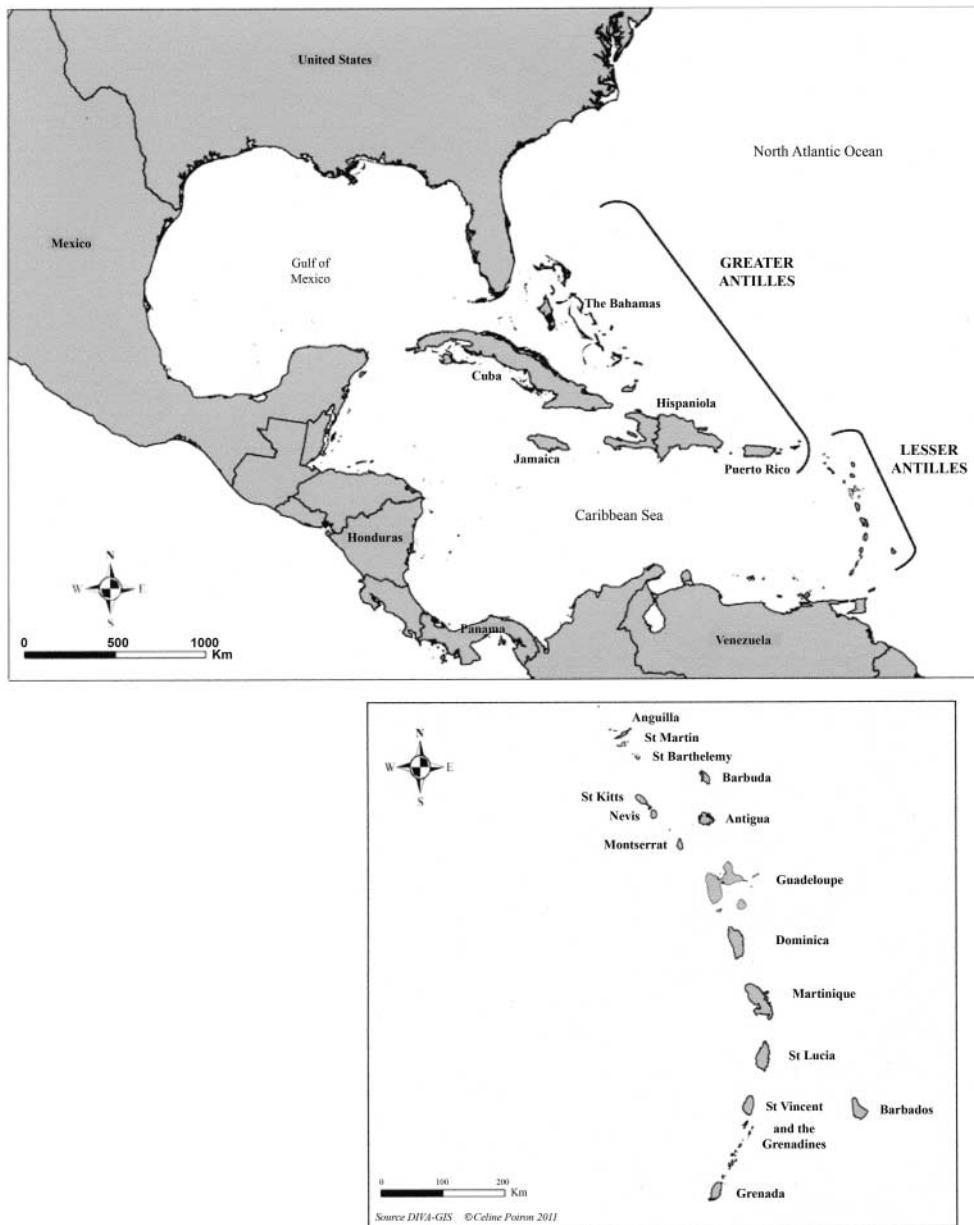


Figure 1. Location of the Lesser Antilles archipelago (at a regional and local scale).

area of these islands is approx. 3000 km². Guadeloupe and Martinique are the largest islands in the Lesser Antilles, with, respectively, 1434 km² and 1100 km². The islands south of the French West Indies (Dominica, St Lucia, St Vincent and Grenadines, Grenada and Barbados) and north of Guadeloupe (Montserrat, Antigua, Anguilla, Barbuda, St Kitts and Nevis) are independent republics.

The Lesser Antilles are among the best known areas of the Neotropical region in terms of odonatological research, housing 46 species, including eight endemic taxa. However, the dragonfly fauna of the Lesser Antilles has been studied only from a faunistic point of view, especially by

North American and French naturalists (Clarke, 1904; Dommange et al., 2000; Dupont, 2000; Geijskes, 1980; Goyaud, 1994; Grand, 1996, 2000, 2002; Ilbert & Menegaux, 2004; Klots, 1932; Mashaal, 2000; Meurgey, 2004, 2005, 2006, 2007a, 2007b; Poiron, 2011; Pont, 2003, 2004; Sibley, 1999; Woodruff et al., 1998). We know of no works on the ecology, biology and conservation of Odonata of this region. The main causes for this are (1) a regional shortage of trained resident or visiting naturalists until recently; and (2) the lack of a comprehensive literature base covering the entire region. This has severely hampered studies in many islands as the literature necessary to identify all known species is scattered and not easily accessible. This is changing, as identification guides have recently been published for the Neotropical region that describe species also occurring in the Lesser Antilles: keys to species for Central America (Förster, 2001), generic keys for adults of Brazilian Zygoptera (Lencioni, 2005, 2006), generic keys for larvae of Brazilian Odonata (Costa et al., 2004), generic keys for the New World Anisoptera and Zygoptera (Garrison et al., 2006, 2010), and generic keys for South American Odonata (von Ellenrieder & Garrison, 2009) as well as the recent publication of a book on the French West Indian Dragonflies (Meurgey & Picard, 2011).

Methods

Between 2000 and 2012, Odonata surveys were conducted throughout Guadeloupe (and other French islands), Dominica, Martinique, St Lucia, St Vincent and Grenada. Staff from the L'Herminier Society of Natural History organized these surveys, while volunteer naturalists, guests from USA and students participated in a number of teams each year. Sites investigated were chosen on the basis of the literature, recommendations from local people, examination of topographic maps and scouting the region by vehicle and on foot. Coordinates were taken with the help of a GPS Garmin 60CSx.

Data culled from the published literature and museum records and field collections total 5065 records for the period 1832–2012 (180 years). Most records have been gathered since 2000. Of the records 14% represent exuviae and 6% larval stages, with the remaining 80% concerning adults. We maintain an electronic database that includes georeferenced (WGS84 UTM20N) locality data in an Excel format.

Several species are known from very few localities, and only a few are widely distributed, with the three most often recorded species being *Ischnura ramburii* (467 records, 9% total), *Erythrodiplax umbrata* (428 records, 8.5% total), and *Orthemis macrostigma* (418 records, 8% total). Coenagrionidae provide 27% of records, followed by Libellulidae with 19%, in proportion to the total numbers known for the region for each family.

Species to be deleted from the Lesser Antillean checklist

Previous records of the following 11 species were either based on misidentifications or mislabelled material, have been shown to represent synonyms of other species, or have been recorded by previous authors without critical study.

Hetaerina cruentata (Rambur, 1842)

Recorded from Martinique (Klots, 1932; Selys-Logchamps, 1853). That record was most likely based on mislabelled specimens, since its known distribution ranges from Mexico to South America (Garrison, 1990).

Protoneura capillaris (Rambur, 1842)

Records from Martinique (Klots, 1932) presumably pertain to misidentified specimens (probably confusion with teneral specimens of *P. ailsa* described by Donnelly in 1961), as this species is endemic to Cuba (Greater Antilles) (Westfall, 1964).

Dythemis multipunctata (Kirby, 1894)

Records from St Lucia (Donnelly, 1961; Sibley, personal correspondence) and from Grenada (Woodruff et al., 1998) pertain to *Dythemis sterilis sterilis*. According to Meurgey & Poiron (2011), records from St Vincent correspond to *Dythemis sterilis multipunctata* (Kirby, 1984).

Erythemis attala (Selys in Sagra, 1857)

Recorded from Martinique (Klots, 1932) without specific locality. Also mentioned from Guadeloupe (Dommange et al., 2000). The later record is based on a misidentified female specimen of *Erythrodiplax berenice* (Drury) in the French Odonatological Society (SFO) collection.

Erythemis credula (Hagen, 1861)

Recorded from Martinique (Klots, 1932) without specific locality. We could not verify its occurrence there, and, based on the known distribution of this species, we consider this record in error.

Erythrodiplax connata (Burmeister, 1839)

Recorded from Martinique and St Vincent (Klots, 1932). Records most likely pertain to *Erythrodiplax fusca* and are here considered incorrect.

Erythrodiplax unimaculata (De Geer, 1773)

Recorded from Martinique and St Vincent (Klots, 1932). Records most likely pertain to *Erythrodiplax fusca* and are here considered incorrect.

Macrothemis hemichlora (Burmeister, 1839)

Records from Guadeloupe (Donnelly, 1995) presumably pertain to *Macrothemis meurgeyi* (Daigle, 2007).

Macrothemis celeno (Selys in Sagra, 1867)

Guadeloupean records presumably pertain to *Macrothemis meurgeyi* (Daigle, 2007).

Tramea onusta (Hagen, 1861)

Recorded from Guadeloupe without specific locality (Klots, 1932), but the record could not be verified and most likely pertains to another species and is (for the moment) considered incorrect,

but this widespread species in the Greater Antilles should be a possible resident or visitor in the Lesser Antilles.

Updated checklist

Our checklist includes 46 species as of June 2012. Although the discovery of new species in the Lesser Antilles has been low during the last century (over half of the species had been described at the beginning of the 1900s), at least three recently described ones are recorded here.

Discussion

Diversity

The list for the Lesser Antilles contains 25 genera, and 46 species in five families (Table 1). The odonate fauna of the Lesser Antilles is poor compared with that of the Greater Antilles (98 species), probably because the Lesser Antilles are relatively younger geologically (less than 10 million years) and also are smaller in size. A total of 111 species is recorded for the combined Greater and Lesser Antilles (Meurgey & Picard, 2011).

Distribution patterns

The varying distributions could reflect random opportunities and different abilities for active or passive dispersal in crossing oceanic water gaps and subsequent colonization ability on a new land mass. Table 2 shows the relation between island size, number of species and distance from South America. Guadeloupe is one of the richest islands in the Lesser Antilles, due to its large land mass. Dominica and Martinique are separated by less than 50 km and are about equally far from the mainland. However, Martinique is considerably larger than Dominica and supports the richer fauna.

This suggests that island diversity is more dependent on island area than on the distance from the mainland. A large island provides greater diversity of habitats and therefore more opportunities for a colonizing species to find its ecological niche. Nevertheless, the more the distance from the mainland is reduced, the more likely the arrival of a new species. However, these interpretations must be somewhat tentative since the data are still incomplete for the southern islands (St Vincent, Grenada), which deserve further investigation.

Have human factors influenced the odonate diversity in the Lesser Antilles?

Of the Lesser Antillean odonate species, 95% depend on standing water (Meurgey & Picard, 2011). Although the theory of insular biogeography (MacArthur & Wilson, 1967) explains that an island fauna relates to island size and distance from the nearest land mass (Figure 2), this theory does not consider obligate lentic requirements for the majority of odonate species in the Lesser Antilles. Soon after the first European settlements during the seventeenth century, numerous cattle ponds, lakes and dams were created to fulfil the needs of water both for humans and agriculture. We know that before the first European settlements, Guadeloupe was covered by dense forest, even in the driest Grande Terre (Hatzenberger, 2001; Pagney Bénito-Espinal, 1986). Even if some lentic habitats were present in the past, the fact that water requirements have increased, impelling settlers to create ponds and lakes, is a proof that these types of habitats were few in the past.

Table 1. Checklist of the Odonata of the Lesser Antilles.

Families/species	AN	SM	SB	BA	SK	MT	GU	DO	MA	SL	SV	GR	BR
ZYGOPTERA [3 fam, 6 gen, 12 spp]													
LESTIDAE [1 gen, 3 sp]													
<i>Lestes forficula</i> Rambur, 1842	L			L		X	X	X	X	X			X
<i>Lestes spumarius</i> Hagen in Selys, 1862								X	X	X			
<i>Lestes tenuatus</i> Rambur, 1842								X	X	X			X
PROTONEURIDAE [1 gen, 2 sp]													
<i>Protoneura ailsa</i> Donnelly, 1961									X	X			
<i>Protoneura romanae</i> Meurgey, 2006								XE					
COENAGRIONIDAE [4 gen, 7 sp]													
<i>Argia concinna</i> (Rambur, 1842)								XE	XE				
<i>Argia telesfordi</i> Meurgey, 2009												XE	XE
<i>Enallagma coecum</i> (Hagen, 1861)							L	X	X	X	X		
<i>Ischnura capreolus</i> (Hagen, 1861)							L	X	X	X	X		
<i>Ischnura hastata</i> (Say, 1840)								X	X	X	X		
<i>Ischnura ramburii</i> (Selys, 1850)	L	L	L	L		L	X	X	X	X	X	X	X
<i>Telebasis corallina</i> (Selys, 1876)							X	X	X	X	X		
ANISOPTERA [2 fam, 19 gen, 36 spp]													
AESHNIDAE [6 gen, 9 spp]													
<i>Anax amazili</i> (Burmeister, 1839)												X	L
<i>Anax concolor</i> (Brauer, 1865)													
<i>Anax junius</i> (Drury, 1773)					L								
<i>Coryphaeschna adnexa</i> (Hagen, 1861)							X	X					
<i>Gynacantha nervosa</i> Rambur, 1842							X	X					
<i>Hemianax ephippiger</i> (Burmeister, 1839)	L						X	X					
<i>Rhionaeschna psilus</i> (Calvert, 1947)							X	X					
<i>Triacanthagyna caribbea</i> Williamson, 1923							X	X					
<i>Triacanthagyna septima</i> (Selys in Sagra, 1857)							X	X					

(Continued)

Table 1. Continued

LIBELLULIDAE [13 gen, 25 spp]												
<i>Brachymesia furcata</i> (Hagen, 1861)					X	X	X	X	X	X	X	X
<i>Brachymesia herbida</i> (Gundlach, 1889)				X	X	X	X	X	X	X	X	X
<i>Brechmorhoga archboldi</i> (Donnelly, 1970)			X	XE	XE	XE	XE	XE				
<i>Brechmorhoga praecox grenadensis</i> (Kirby, 1894)											XE	
<i>Dythemis sterilis multipunctata</i> (Kirby, 1894)												XE
<i>Dythemis sterilis sterilis</i> Hagen, 1861				L	X	X	X	X	X			
<i>Erythemis vesiculosa</i> (Fabricius, 1775)				L	X	X	X	X	X			
<i>Erythrodiplax berenice</i> (Drury, 1773)					X	X	X	X	X			
<i>Erythrodiplax fervida</i> (Erichson, 1848)					XE							
<i>Erythrodiplax fusca</i> (Rambur, 1842)				L		X	X	X	X			
<i>Erythrodiplax umbrata</i> (Linnaeus, 1758)	L	L	L	L								
<i>Macrothemis meurgeyi</i> Daigle, 2007												
<i>Miathyria marcella</i> (Selys, 1857)					L	X	X	X	X			
<i>Micrathyria aequalis</i> (Hagen, 1861)						X	X	X	X			
<i>Micrathyria didyma</i> (Selys in Sagra, 1857)						X	X	X	X			
<i>Orthemis macrostigma</i> (Rambur, 1842)	L	L		L	L	X	X	X	X			
<i>Orthemis</i> sp. nr. <i>ferruginea</i>												
<i>Pantala flavescens</i> (Fabricius, 1798)	L			L		X	X	X	X			
<i>Pantala hymenaea</i> (Say, 1840)			L			X	X	X	X			
<i>Tauriphila australis</i> (Hagen, 1867)						X	X	X	X			
<i>Tholymis citrina</i> Hagen, 1867						X	X	X	X			
<i>Tramea abdominalis</i> (Rambur, 1842)	L		L		L	X	X	X	X			
<i>Tramea basilaris</i> (Palisot de Beauvois, 1805)						X	X	X	X			
<i>Tramea binotata</i> (Rambur, 1842)						X	X	X	X			
<i>Tramea calverti</i> Muttkowski, 1910		L				X	X	X	X			
<i>Tramea insularis</i> Hagen, 1861						X	X	X	X			

Notes: AN: Anguilla; SM: St Martin; SB: St Barthelemy; BA: Barbuda; SK: St Kitts; MT:Montserrat; GU: Guadeloupe; DO: Dominica; MA: Martinique; SL: St Lucia; SV: St Vincent; GR: Grenada; BR: Barbados
 (!) New record for the Lesser Antilles; (L) literature-based record, species not observed during our surveys; (E) species or subspecies endemic to the Lesser Antilles.

Table 2. Relationship between island size, distance from the continent and number of species.

Major Lesser Antillean Islands	Distance from the continent (km)	Area (km ²)	Number of species	Single island endemics	Regional endemics
Guadeloupe	686	1434	38	2	2
Dominica	575	754	24	0	2
Martinique	550	1100	30	0	1
St Lucia	492	620	25	0	2
St Vincent	432	389	11	1	2
Grenada	280	340	19	0	2
Barbados	536	430	9	0	0

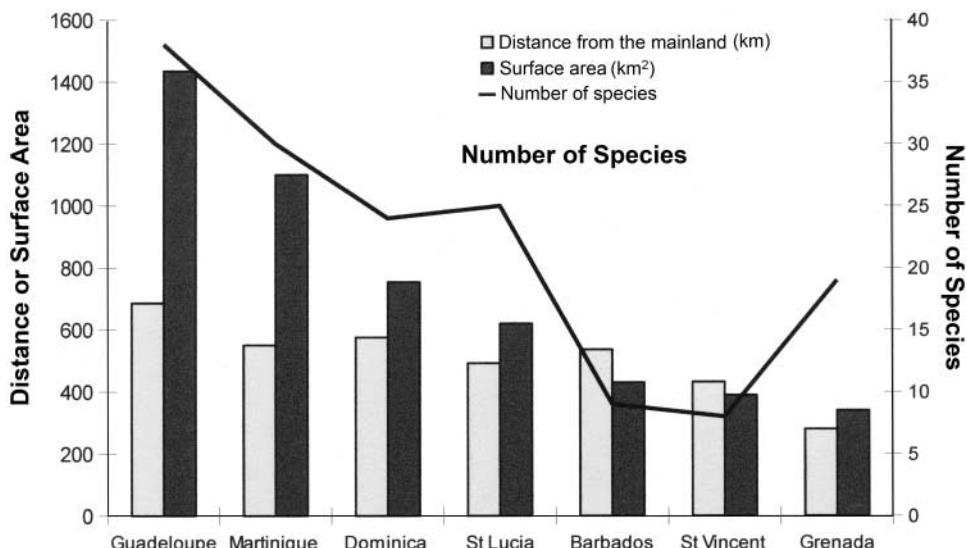


Figure 2. Relationship between island size, distance from South America and number of species.

This is particularly the case in Guadeloupe and Martinique, while Dominica, which lies between them, remained unexploited for a longer period. While this statement does not negate the insight of MacArthur and Wilson (1967), distributional patterns on the Lesser Antillean islands should also be studied in relation to human modification of habitats since European settlement.

St Vincent is larger than Grenada but hosts only 11 species (19 in Grenada). This might be explained by the fact that the former island has remained highly forested, with only fast-flowing montane rivers, whereas Grenada possesses more still-water habitats, supporting more widespread and vagrant species.

Newly created lentic habitats have favoured the presence and reproduction of species in these islands, especially many libellulids (*Pantala*, *Tramea*) and coenagrionids (*Telebasis*) usually absent from such mountainous, forested islands. Thus, the odonate diversity in the Lesser Antilles should be considered in part anthropogenic, with the original fauna of many islands based on a small group of highly specialized or endemic species of forested rivers.

Despite this certainty, understanding the occurrence of Odonata in the Lesser Antillean islands is complicated. Effective and sustainable colonization of an island by a propagule depends on many factors such as area of the island and its distance from the continent, climatic factors, and also morphological and ecological characteristics of the species itself. Flying species have a much greater chance of colonizing islands than terrestrial species, unless assisted by human actions.

The hypothesis of anthropogenic influence is proposed largely to begin debate. Further research is needed to confirm or refute this. It is also essential to check whether it is applicable to other island regions of the globe. It seems difficult to predict the organization of communities and identify the selection pressures on island populations, because each island has its own evolutionary and human history.

Surveys, collecting trips and taxonomic updates are not entirely sufficient to understand the origin of the Caribbean odonate fauna, and genetic studies seem necessary to understand the phylogenetic relationships among species inhabiting the islands.

Endemics

Genus-level endemism occurs only in the much larger and older islands of the Greater Antilles, with five endemic genera (*Hypolestes*, *Phyolestes*, *Diceratobasis*, *Microneura* and *Scapanea*), the remaining genera being widely distributed throughout the Americas and the Old World (Meurgey & Picard, 2011).

Species-level endemism is more prevalent in the Greater Antilles than in the Lesser Antilles. A total of 26 species are listed as being endemic to the Greater Antilles, representing 27% of the species ($n = 98$) and 23% of the total Antillean species (both Greater and Lesser Antilles, $n = 111$). Only eight species are endemic to the Lesser Antilles (Figure 3), representing 17% of the species ($n = 47$) and 7% of the total species (both Greater and Lesser Antilles, $n = 111$).

In the Lesser Antilles, four species or subspecies (8.5%) are endemic to a single island. Another four (8.5%) are endemic to at least two islands (regional endemics). This shows that the Lesser Antilles as a group have probably been a significant center of species-level evolution, followed by outward dispersal from their island of origin.

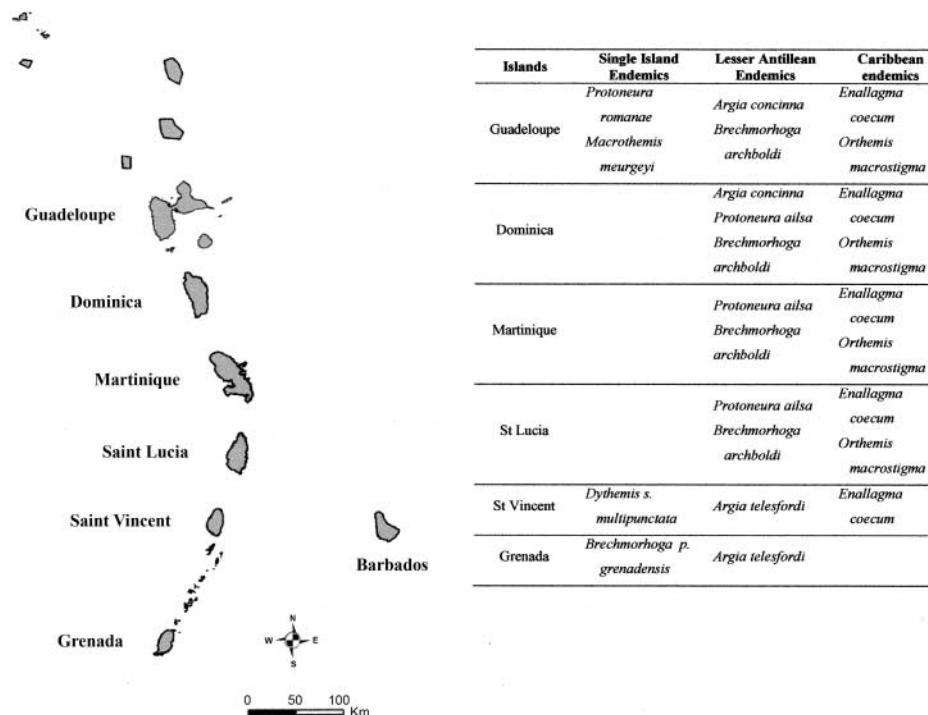


Figure 3. Distribution of endemic species and subspecies within the Lesser Antilles.

Table 3. Distribution of the Lesser Antillean Odonata by types of habitat and categories of species.

Type of species/ type of habitat	Montane rainforest	Seasonal forest	Flooded forest	Semi- deciduous forest	Open, low elevation habitats	Number of species per category
LA endemics**	4	3	1	0	0	8 (18%)
LA + GA Endemics**	0	1	0	0	2	2 (4%)
Widespread species**	1	1	3	4	25	35 (78%)
Number of species per habitat	5 (13%)	5 (13%)	4 (9%)	4 (9%)	27 (60%)	45*

* We have not included vagrant species from Africa and non-reproductive species in the area.

**For each row, the total number in the last column is not the sum of each number in the previous column; several habitats may share the same species. For example, there are only two Caribbean (LA + GA) endemics, but *Enallagma coecum* is present in both seasonal forest and open low elevation habitats.

Two species (2.0%, $n = 111$) are endemic to the combined Greater and Lesser Antilles and evolved somewhere within this extensive island grouping. This was probably on one of the Greater Antilles and the dispersal has been to the Lesser Antilles, because species movements tend (although not in all cases) to be from larger land masses to smaller land masses (Darlington, 1957).

Endemism and habitats

In the Lesser Antilles, endemic species are mainly distributed in pristine habitats (mountains and seasonal rainforests, four species), with only one species (*Protoneura romanae*) present in flooded forest, while wide-ranging species occur primarily in open, man-made standing water habitats (25 species, Table 3). The number of endemic species decreases from high elevation forested areas to the lowlands. The reverse occurs among widespread species, which show a reduction in numbers from lowland, open habitats to high elevation forested areas.

Widespread species

The remaining 40 species (83%) probably originated outside of the combined Greater and Lesser Antilles and have since dispersed to the Lesser Antilles. Current distribution patterns suggest that 34 (85.0%, $n = 40$) have dispersed into the Lesser Antilles predominantly from Central American and South American sources.

Thirty-four species are of such wide distribution throughout Latin America or the New World that the direction of their dispersal is not evident. The dispersal of this group may have been partly aided by accidental human activity for achieving their wide distributions. These are often species which are eurytopic ecological generalists. Such predictable and probabilistic “stepping-stone dispersal” between other Lesser and Greater Antillean islands and tropical America would be expected to decline with distance (depending on the organisms involved, prevailing wind patterns, and vagility of the species) from the mainland. The data do not show this.

From north to south the numbers of Lesser Antillean species are: Montserrat, 17; Guadeloupe, 38; Dominica, 25; Martinique, 30; St. Lucia, 25; St. Vincent, 11, and Grenada, 19. These numbers may be an artifact of different collecting activities and research effort mainly from isolated (but rather long) collecting trips per island rather than reflecting the actual distributional patterns. For example, only 11 species are recorded from St Vincent, which is a highly forested island with only rivers and streams, while Grenada houses 19 species and possess several standing water habitats such as cattle ponds or dams. This is consistent with the suggestion that the creation of man-made aquatic habitats has increased the species richness in the most developed islands, even in smaller ones. Further research (especially on historical biogeography) is needed to support this.

Perspectives

The information from our database, presently maintained by François Meurgey and Céline Poiron, can serve as a funding nucleus to build a comprehensive database for the Caribbean region. In order to achieve this, the following tasks should be undertaken.

Records from the literature need to be added, including information from numerous regional lists published during the last 30 years. Large numbers of dragonfly records are stored in collections and have never been published. If all odonatologists interested in the region were to make their unpublished records available, the database could begin to provide us with a fairly good picture of past and present odonate distribution patterns in the Caribbean.

Some collections do have paper databases, which could be digitized. In most collections there are also unidentified specimens awaiting examination, which could be identified by the specialists in charge of them or by visiting researchers.

Field work is still needed in some areas; the highest priority lies in the southernmost islands (St Vincent and Grenada) and especially in undisturbed mountain forest areas which remain mostly under-surveyed. Of intermediate priority are islands with probably moderately rich faunas for which odonate records are not available, such as the Grenadines and islands north of Guadeloupe.

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