Rapid survey of dragonflies and damselflies (Odonata) of North Lorma, Gola and Grebo National Forests, Liberia

Author: Dijkstra, Klaas-Douwe B.

Source: A Rapid Biological Assessment of North Lorma, Gola and Grebo National Forests, Liberia: 25

Published By: Conservation International

URL: https://doi.org/10.1896/978-1-934151-01-3.25

Chapter 2

Rapid survey of dragonflies and damselflies (Odonata) of North Lorma, Gola and Grebo National Forests, Liberia

Klaas-Douwe B. Dijkstra

SUMMARY

During a rapid survey of the North Lorma, Gola and Grebo National Forests, 93 species of dragonflies and damselflies were found. Seven species were recorded in Liberia for the first time. Numbers of species and individuals seemed low, probably because the survey was at the end of the wet season, rather than towards the start.The results nonetheless indicate a healthy watershed in each forest, with limited pollution and streambed erosion. If forest cover and natural stream morphology are retained, the present dragonfly faunas are expected to persist. The most interesting species assemblage was recorded in Gola National Forest, including two species of conservation concern. Gola National Forest is a major diamond mining area, and the possible beneficial and detrimental impacts of these activities are discussed. Harboring typical examples of a rich Upper Guinea fauna, each forest, and especially Gola National Forest, deserves to be conserved.

INTRODUCTION

Odonata (dragonflies and damselflies) are receiving increasing attention from scientists and the general public. These graceful, colorful creatures are the quintessence of freshwater health. Due to their attractive appearance, dragonflies and damselflies can function as guardians of the watershed. They can be flagships for conservation, not only of water-rich habitats such as wetlands and rainforests, but also of habitats where water is scarce and, therefore, especially vital to the survival of life. Their sensitivity to structural habitat quality (e.g. forest cover, water limpidity) and amphibious habits make Odonata well suited for evaluating environmental change in the long term (biogeography, climatology) and in the short term (conservation biology), both above and below the water surface (Corbet 1999).

Odonata larvae are excellent indicators of the structure and quality of aquatic habitats (e.g. water, vegetation, substrate), while adult Odonata are highly sensitive to the structure of their terrestrial habitats (e.g. degree of shading). As a consequence, Odonata respond strongly to habitat changes, such as those related to deforestation and erosion. Ubiquitous species prevail in disturbed or temporary waters, while habitats like pristine streams and swamp forests harbor a wealth of more vulnerable and local species. Different ecological requirements are linked to different dispersal capacities. Species with narrow niches disperse poorly, while pioneers of temporal habitats (often created by disturbance) are excellent colonizers. For this reason, Odonata have a potential use in the evaluation of habitat connectivity (Clausnitzer 2003, Dijkstra and Lempert 2003).

Odonata possess characteristics distinct from those of relatively well-studied taxonomic groups like plants, birds, mammals and butterflies. Therefore, their study supplements knowledge obtained from these better-known groups. There are also practical advantages to Odonata as environmental monitors. Aquatic habitats, the focal point of their life histories, are easy to locate, and their diurnal activity and high densities make Odonata easy to study. The number

of dragonfly species occurring in Africa is manageable, their taxonomy is fairly well resolved, and identification relatively straightforward. Considering the ever-changing nature of the African environment, be it under human, geological or climatic influence, the study of African Odonata constitutes an exciting challenge, as knowledge of their distribution, ecology and phylogeny helps us understand the past and future of a rapidly changing continent.

This was only the second African RAP survey that included Odonata. The first, at Lokutu in Democratic Republic of Congo (Butynski and McCullough *in press*), proved that it is possible to obtain a fair picture of the local diversity within a short period of time. This picture showed a rich and apparently largely natural Odonata fauna, which probably represents high overall aquatic biodiversity. This result contrasted sharply with the impoverished and imperiled fauna and flora found for the other taxonomic groups studied on that RAP survey. Because of their 'information-rich' potential, Odonata might be placed more at the forefront of RAP surveys and conservation policy. Particularly in forest and freshwater ecosystems, an emphasis on odonate research seems beneficial as a baseline for biodiversity and watershed conservation. Sampling these charismatic insects can demonstrate whether present and future conservation actions are protecting freshwater biodiversity. Moreover, the interpretation of survey results has recently been facilitated by the inclusion of Odonata in IUCN's assessment of freshwater biodiversity in western Africa, which summarizes the distribution, habitat, threats and taxonomy of all species (Dijkstra, unpubl.).

The Odonata of the Upper Guinea forest have been fairly well studied. Landmark papers appeared on Sierra Leone (Carfì and D'Andrea 1994), Ghana (O'Neill and Paulson 2001), the Guinean side of Mt Nimba (Legrand 2003) and Taï Forest in Côte d'Ivoire (Legrand and Couturier 1985). The fauna of Liberia is principally known due to Lempert (1988), who surveyed the country (mostly the eastern half) during a total of six months. His thesis is still the most in-depth study of any tropical dragonfly community and includes countless unique observations of reproductive behavior. Lempert recorded between 140 and 150 species, including numerous unnamed species, especially in the Gomphidae. A number of these have probably been described since by Legrand (1992, 2003) and require re-examination. Judging from data from neighboring countries, the true number of species occurring in Liberia should be approximately 200 (Dijkstra and Clausnitzer 2006); about one-fifth of these do not occur east of Nigeria. Lempert's data were analyzed in combination with this author's data from Ghana (Dijkstra and Lempert 2003). This analysis describes the composition of odonate assemblages in running waters in the Upper Guinea rainforest. As running forest waters harbor the larger part of the region's odonate diversity, particularly of range-restricted species, this baseline is an important tool in the interpretation of the data from the present survey.

Despite Lempert's (1988) efforts, large parts of Liberia remain unexplored, in particular the center (e.g. Grand Bassa and River Cess Counties), the southeast (River Gee, Grand Kru, Maryland) and the northwest (Gbarpolu, Lofa). Central Liberia is probably of lesser interest because it is enclosed in Lempert's survey area and relatively deforested. The southeast is interesting because rainfall is spread most evenly over the year and the region is probably nearest to the center of the Upper Guinea rainforest refugium. The northwest has the most diverse terrain, with marked relief and the strongest savannah influences in a country consisting largely of rainforest. It is also the region with the most marked seasons, with distinct wet (May–Oct) and dry (Nov–Apr) seasons. The three national forests (North Lorma, Gola and Grebo) covered by the present survey lie in three previously unstudied counties (Lofa, Gbarpolu and River Gee respectively).

METHODS

North Lorma National Forest was surveyed from 19 to 25 November, Gola National Forest from 27 November to 3 December, and Grebo National Forest from 5 to 11 December 2005. Adult and larval Odonata were observed and caught with a handnet during daylight at freshwater habitats, and details of their ecology and behavior were noted. Identifications were made using Clausnitzer and Dijkstra (in prep.) and additional literature; taxonomy follows Dijkstra and Clausnitzer (in prep.). Relevant name changes from that checklist and other unpublished revisions by the author are provided in the footnotes. Collected specimens will be deposited in the collection of the National Museum of Natural History (Leiden, The Netherlands).

RESULTS

A total of 93 species of Odonata were found, representing 59% of the estimated 158 species known from the country (Appendix 2). Of these, 60% are forest species found only within the Guineo-Congolian realm, with the remaining 40% being widespread non-forest species. Only 31% of the forest species are of more restricted occurrence (i.e. not occurring throughout the realm). Seven species were recorded for the first time in Liberia: *Paragomphus nigroviridis, Phyllogomphus moundi*, *Nesciothemis minor*, *Palpopleura deceptor*, *Tetrathemis polleni*, *Tramea limbata* and *Trithemis monardi*.

DISCUSSION

Because no research of Odonata had been undertaken prior to this study in the regions visited, any result from these areas greatly supplements the knowledge of the Upper Guinea fauna in general and the Liberian fauna in particular.

Although the total of 93 species seems high, it compares poorly with the result of the RAP in D.R. Congo, where 86 species were found at a single site during half the number of field days. Moreover, in D.R. Congo 72% were forest species found only within the Guineo-Congolian realm (versus 60% in Liberia), with 53% of these being of more restricted occurrence (versus 31% in Liberia) Of the seven species that were recorded for the first time in Liberia, *Paragomphus nigroviridis* is a widespread forest species, while the remaining additions are widespread non-forest species.

The absence of certain expected species, as well as the generally low individual numbers observed, may be explained by seasonality. High and fluctuating water levels are a possible reason why activity of adult dragonflies is low during the transition from wet to dry season. Conditions are then not only challenging for adult dragonflies (e.g. submerged or variably available oviposition substrates; dangerous conditions for emergence), but also for the researcher, whose access to research sites is limited by high water. Moreover, many species may still be in the larval stage at the close of the wet season, because heightened reproductive activity can be expected at the start of the rains when habitat availability increases. Insect numbers generally seemed low during the RAP survey, especially where concentrations would be expected. For instance, very few nocturnal insects were drawn to light, and fruit on the forest floor attracted low numbers of frugivorous butterflies. Insect captures with Malaise traps were also low. The period from February to May is probably the best for recording Odonata.

Of the species found, 17 are rainforest species that do not enter the Congo Basin (mostly ranging east to Nigeria, Cameroon or Gabon); six of these are Upper Guinea endemics (not occurring east of Togo). Of these, *Prodasineura villiersi*, *Phyllomacromia sophia*, *Eleuthemis* sp. n. and *Zygonyx chrysobaphes* are widespread in the Upper Guinea realm. The first was found at all three sites, the second and third in Gola National Forest only, and the fourth in Grebo National Forest. Unlike the Odonata of northern, eastern and southern Africa, those of central and western Africa were not assessed for the global Red List of 2006, as data were fragmented and relatively limited (Dijkstra and Vick 2004). However, the author has recently collated these data and made a regional and preliminary global assessment (Appendix 2). Six Liberian species have globally been assigned the category Near Threatened or higher: *Sapho fumosa* (Near Threatened = NT), *Mesocnemis tisi* (Endangered = EN), *Agriocnemis angustirami* (Vulnerable = VU), *Phyllomacromia funicularioides* (NT), *Neodythemis campioni* (NT) and *Trithemis africana* (NT). Three additional species occur in adjacent Sierra Leone: *Elattoneura dorsalis* (VU), *Pseudagrion mascagnii* (Critically Endangered = CR) and *Orthetrum sagitta* (NT). Of these nine, only two in the lowest category were found during the survey, both in Gola National Forest:

1. *T. africana* is only known from deeply shaded rainforest streams in Sierra Leone, Liberia and Côte d'Ivoire; Liberia must be the species' stronghold.

2. *S. fumosa* is known from a few sites in Senegal and Guinea-Bissau near the border with Guinea, through Sierra Leone to Mt Nimba, where the only previous Liberian record was obtained by Lempert (1988). The species is closely related to *S. ciliata*, *S. bicolor* and *Umma cincta*. All four species were found on the same stream system at Gola National Forest, although they are ecologically segregated. *S. ciliata*, *S. bicolor* and *U. cincta* favor sandy streams, occurring on the sunniest, shadiest and intermediate sections respectively. *S. fumosa* was found only where streams were rather shaded and dominated by rocks, a preference that explains why the species is confined to the more hilly parts of Upper Guinea.

Three additional species found at Gola National Forest are more widespread in western Africa, ranging east to Cameroon, but have been recorded only locally: *Phyllogomphus moundi*, *Tetrathemis godiardi* and *Trithemis basitincta*. These results indicate that from an odonatological perspective Gola National Forest was the most interesting site. Of the 17 western African species mentioned above, only seven were found at North Lorma National Forest, compared to 14 in Gola National Forest and 12 in Grebo National Forest.

Although deforestation and subsequent alteration of waterbodies (e.g. erosion, siltation) seem to be the only potential threats to Odonata in North Lorma and Grebo National Forests, diamond mining may be detrimental also in Gola National Forest. Small-scale activities that do not open up the canopy appear beneficial. Stagnant waterbodies are comparatively scarce in rainforest, and partly overgrown pits filled with leaf-litter create new habitat. *Tetrathemis godiardi* is the most obvious beneficiary; both territorial and emerging individuals were found at abandoned pits under closed canopy. Open pits are colonised by many species that would otherwise find no or almost no habitat in the area, but these are all well-dispersing species that dominate savannah faunas throughout Africa. The drainage of the mines leads to increased turbidity, and probably siltation of streams, the former reducing visibility for larvae, the latter changing the substrate. Reduced motion and increased insolation of water in open pits also affects the flow, oxygen and temperature regimes of drainage streams. One such stream in Gola National Forest, which was rocky and therefore suitable for *S. fumosa*, held very low numbers of that species in comparison to a pristine stream, but observations are too limited to draw conclusions.

CONSERVATION RECOMMENDATIONS

Odonates were the only invertebrate group included in the RAP. Unlike some other taxonomic groups studied, they are not actively exploited by man and are strongly tied to water. They therefore serve to assess the more indirect anthropogenic disturbance — the gradual alteration of the environment. As expected, all three studied forests harbor odonate assemblages that are representative of the Upper Guinea rainforest fauna. The forest stream assemblages found match those described by Dijkstra and Lempert (2003), suggesting healthy watersheds, with limited degrees of pollution and streambed erosion. As long as forest cover and natural stream morphology are retained, the existing dragonfly fauna is expected to persist. Considering the threats to the Upper Guinea rainforest, it is recommended that the three forests and the watersheds they protect be conserved. This recommendation especially concerns Gola National Forest, which had the most interesting dragonfly fauna, including two species of conservation concern (*Sapho fumosa*, *Trithemis africana*). The additional threat of diamond mining may jeopardize the aquatic biodiversity in Gola National Forest. Minimizing the outflow of mining water into the stream systems may reduce the possible negative effect of those activities.

REFERENCES

Aguesse, P. 1968. Quelques Odonates récoltés en Sierra Leone. Bull. Inst. fond. Afr. noire, sér. A, 30: 518–534.

Butynski, T. M. and J. M. McCullough (editors). *In press*. A rapid biological assessment of Lokutu, Democratic Republic of Congo. RAP Bulletin of Biological Assessment 46. Conservation International, Arlington, VA, USA.

Carfi, S. and M. D'Andrea. 1994. Contribution to the knowledge of odonatological fauna in Sierra Leone, West Africa. Problemi Attuali di Scienza e di Cultura 267: 111–191.

Clausnitzer, V. 2003. Dragonfly communities in coastal habitats of Kenya: indication of biotope quality and the need of conservation methods. Biodiversity and Conservation 12: 333–356.

Clausnitzer, V. and K.-D.B. Dijkstra. In prep. The dragonflies of Eastern Africa (Odonata), an identification key. Studies in Afrotropical Zoology.

Corbet, P.S. 1999. Dragonflies: Behaviour and Ecology of Odonata. Harley Books, Colchester.

Dijkstra, K.-D.B. and V. Clausnitzer. 2006. Thoughts from Africa: how can forest influence species composition, diversity and speciation in tropical Odonata? *In*: Cordero Rivera, A. (ed.). Forests and Dragonflies. Pensoft Publishers, Sofia.

Dijkstra, K.-D.B. and V. Clausnitzer. In prep. An annotated checklist of the dragonflies (Odonata) of Eastern Africa, with critical lists for Ethiopia, Kenya, Malawi, Tanzania and Uganda, new records and taxonomic notes.

Dijkstra, K.-D.B. and J. Lempert. 2003. Odonate assemblages of running waters in the Upper Guinean forest. Archiv für Hydrobiologie 157: 397–412.

Dijkstra, K.-D.B. and G.S. Vick. 2004. Critical species of Odonata in western Africa. *In*: Clausnitzer, V. & R. Jödicke (eds.). Guardians of the Watershed. Global status of dragonflies: critical species, threat and conservation. Int. J. Odonatol. 7: 229–238.

Legrand, J. 1992. Nouveaux Gomphidae afrotropicaux. Descriptions préliminaires. (Odonata, Anisoptera). Rev. fr. Entomol. (N.S.) 14 (4): 187–190.

Legrand, J. 2003. Les Odonates du Nimba et de sa région. *In*: M. Lamotte and R. Roy: Le peuplement animal du mont Nimba (Guinée, Côte d'Ivoire, Liberia). Mém. Mus. natl. Hist. nat. 190: 231–310.

Legrand, J. and G. Couturier. 1985. Les Odonates de la forêt de Taï (Côte d'Ivoire). Premières approches: faunistique, répartition écologique et association d'espèces. Rev. Hydrobiol. trop. 18 (2): 133–158.

Lempert, J. 1988. Untersuchungen zur Fauna, Ökologie und zum Fortpflanzungsverhalten von Libellen (Odonata) an Gewässern des tropischen Regenwaldes in Liberia, Westafrika. Diplomarbeit, Friedrich-Wilhelms Universität, Bonn.

Marconi, A. and F. Terzani. s.d. Odonati della Sierra Leone. Unpublished.

O'Neill, G. and D.R. Paulson. 2001. An annotated list of Odonata collected in Ghana in 1997, a checklist of Ghana Odonata, and comments on West African odonate biodiversity and biogeography. Odonatologica 30: 67–86.

Pinhey, E. 1984. A checklist of the Odonata of Zimbabwe and Zambia. Smithersia 3: 1–64.

Appendix 2

Checklist of Odonata recorded from Liberia and neighboring areas.

Klaas-Douwe B. Dijkstra

RL: Unpublished global or western African (between brackets) Red List assessment made by the author (assessed May, evaluated August 2006).

Biology (preferences are inferred from observations during the fieldwork, augmented with previous experience):
B: biogeography of the species. **A:** all over tropical Africa including savannahs, **G:** confined to Guineo-Congolian forest, **N:** associated with northern African savannah (Senegal to Ethiopia), **U:** confined to Upper Guinean forest (Sierra Leone to Togo), **W:** confined to western Africa forest (Senegal to Cameroon).
L: preferred landscape. **F:** forest, **O:** open habitats.
W: preferred water type. **R:** running; **S:** standing.

Liberian records (type locality lies in Liberia if species marked with asterisk):
NL, Go, Gr: North Lorma, Gola and Grebo National Forests.
A: adult voucher obtained; **L:** larval voucher obtained; **S:** adults caught for identification or seen only; records obtained nearby but outside the national forest are given between brackets.
Li: country records after Lempert (1988) and current survey. **1:** species found in current survey (! indicates new national record), **2:** found by Lempert, **3:** found by Lempert, but identification requires confirmation, **4:** literature record listed by Lempert; **5:** not listed by Lempert, but by Pinhey (1984). Species with old or dubious records (probable misidentifications) that are removed from the list until confirmed are: *Sapho orichalcea* McLachlan, 1869; *Umma puella* (Sjöstedt, 1917); *Ceriagrion ignitum* Campion, 1914; *Trithemis nuptialis* Karsch, 1894.

Neighboring areas (type locality lies in stated area if species marked with asterisk):
SL: Sierra Leone records after Carfi and D'Andrea (1994) and Marconi and Terzani (2006). **1:** authors' material; **2:** authors' material, identification requires confirmation; **3:** Aguesse (1968) records; **4:** other literature records. Omitted are: *Stenocnemis pachystigma* (Selys, 1886); *Elattoneura pruinosa* (Selys, 1886); *Agriocnemis forcipata* Le Roi, 1915; *Pseudagrion nubicum* Selys, 1876; *Anaciaeschna triangulifera* McLachlan, 1896; *Anax speratus* Hagen, 1867; *Diastatomma* sp. Gambles, 1987; *Phyllogomphus aethiops* Selys, 1854; *Phyllomacromia monoceros* (Förster, 1906); *Orthetrum caffrum* (Burmeister, 1839); *Orthetrum machadoi* Longfield, 1955; *Porpax asperipes* Karsch, 1896; *Trithemis dorsalis* (Rambur, 1842).
MN: Mt Nimba (Guinean side) records after Legrand (2003). **1:** author's material; **2:** author's material, identification requires confirmation; **3:** uncertain records, mostly personal communication P. Aguesse. Omitted are: *Lestes tridens* McLachlan, 1895; *Phyllomacromia aequatorialis* Martin, 1907; *Trithemis furva* Karsch, 1899.
Si: Simandou (Guinea) records after Legrand and Girard (1992). **1:** identification reliable; **2:** identification requires confirmation.
TF: Tai Forest (Côte d'Ivoire) records after Legrand and Couturier (1985): 1.

Taxa	Notes	RL	Biology			Liberian records				Neighboring areas			
			B	L	W	NL	Go	Gr	Li	SL	MN	Si	TF
Calopterygidae													
Phaon camerunensis Sjöstedt, 1900	1.		G	F	R	A		A	1	2	1	1	1
Phaon iridipennis (Burmeister, 1839)			A	O	R	A	A		1	1	1	1	1
Sapho bicolor Selys, 1853			G	F	R	A	A	S	1	1	1	1	1
Sapho ciliata (Fabricius, 1781)			W	F	R	A	A	A	1	1	1	1	1
Sapho fumosa Longfield, 1932	2.	NT	U	F	R		A		1	3*	1		
Umma cincta (Hagen in Selys, 1853)			G	F	R	A	A	S	1		1	1	1
Chlorocyphidae													
Chlorocypha curta (Hagen in Selys, 1853)			G	O	R				2	1	1	1	
Chlorocypha dispar (Palisot de Beauvois, 1807)			G	F	R	A	A	A	1	1	1	1	1
Chlorocypha luminosa (Karsch, 1893)	3.		U	F	R				2		1		
Chlorocypha pyriformosa Fraser, 1947	4.		G	F	R	A		S	1	1			1
Chlorocypha radix Longfield, 1959	5.		W	F	R	A	S	A	1	1	1	1	1
Chlorocypha rubida (Hagen in Selys, 1853)			W	F	R				2	1	3		1
Chlorocypha selysi (Karsch, 1899)			G	F	R	A	A	A	1	1	1	1	1
Lestidae													
Lestes dissimulans Fraser, 1955			A	O	S						1		1
Platycnemididae													
Mesocnemis singularis Karsch, 1891			A	O	R	S	S	A	1	1	1		1
Mesocnemis tisi Lempert, 1992	6.	EN	U	F	R				2*				
Platycnemis guttifera Fraser, 1950			W	F	R	A		A	1				1
Platycnemis sikassoensis (Martin, 1912)			G	O	R				2	1	1	1	1
Protoneuridae													
Chlorocnemis elongata Hagen in Selys, 1863			W	F	R	A	S	A	1	1	1	1	
Chlorocnemis flavipennis Selys, 1863	7.		W	F	R		A	A	1	1	1	1	
Chlorocnemis subnodalis (Selys, 1886)	8.		W	F	R	A	A	A	1	1	1		1
Elattoneura balli Kimmins, 1938			W	F	R	A	A	A	1	1*	1	1	1
Elattoneura dorsalis Kimmins, 1938		VU	U	F	R					1*			
Elattoneura girardi Legrand, 1980	9.		W	F	R				2	1	1		1
Elattoneura nigra Kimmins, 1938			G	O	R					1	1		
Prodasineura villiersi Fraser, 1948			U	F	R	A	A	A	1		1		1
Coenagrionidae													
Aciagrion africanum Martin, 1908			G	O	S				2		1		
Aciagrion gracile (Sjöstedt, 1909)			A	O	S						1		1
Africallagma subtile (Ris, 1921)	10.		A	O	S					1	1	1	
Agriocnemis angustirami Pinhey, 1974		VU	U	?	S				2*	1			
Agriocnemis exilis Selys, 1872			A	O	S				2	1			
Agriocnemis maclachlani Selys, 1877			G	F	S			A	1	3	1		1
Agriocnemis victoria Fraser, 1928	11.		G	O	S				2	1	3		
Agriocnemis zerafica Le Roi, 1915			A	O	S				2				
Argiagrion leoninum Selys, 1876	12.	DD	U	?	?					4*			
Ceriagrion bakeri Fraser, 1941			G	O	S			A	1	1	2		1

continued

Taxa	Notes	RL	Biology			Liberian records				Neighboring areas			
			B	L	W	NL	Go	Gr	Li	SL	MN	Si	TF
Ceriagrion corallinum Campion, 1914			G	O	S		A		1	1*			
Ceriagrion glabrum (Burmeister, 1839)			A	O	S	S	S		1	1	1	1	1
Ceriagrion rubellocerinum Fraser, 1947			G	F	S	A		A	1	1	1		1
Ceriagrion suave Ris, 1921	13.		A	O	S				3	1	2		
Ceriagrion tricrenaticeps Legrand, 1984		(DD)	G	?	S				2				
Ceriagrion whellani Longfield, 1952			A	O	S				2	3	1		
Ischnura senegalensis (Rambur, 1842)			A	O	S				2	1			
Pseudagrion aguessei Pinhey, 1964			N	O	R					3*			
Pseudagrion camerunense (Karsch, 1899)	14.		W	O	R				2	1			
Pseudagrion epiphonematicum Karsch, 1891			G	F	R	A	A	A	1	3	1	1	
Pseudagrion gigas Ris, 1936			N	?	R					3	1		
Pseudagrion glaucescens Selys, 1876			A	O	S				2	1	3		
Pseudagrion glaucoideum Schmidt in Ris, 1936			G	F	S	S			1				
Pseudagrion glaucum (Sjöstedt, 1900)	15.		G	O	S				2				
Pseudagrion hamoni Fraser, 1955			A	O	S					1		2	
Pseudagrion hemicolon Karsch, 1899	16.		G	F	R	A	A	A	1	1		1	1
Pseudagrion kersteni Gerstäcker, 1869			A	O	R					1			
Pseudagrion mascagnii Terzani & Marconi, 2004		CR	U	?	?					1*			
Pseudagrion melanicterum Selys, 1876			G	O	R	A	A	A	1	1	1	1	1
Pseudagrion sjoestedti Förster, 1906			A	O	R		A	S	1	1			1
Pseudagrion sublacteum (Karsch, 1893)			A	O	S				2	1		2	1
"*Pseudagrion*" *cyathiforme* Pinhey, 1973	17.		W	F	R				2	1			
"*Pseudagrion*" *malagasoides* Pinhey, 1973	18.		W	F	R				2				
Aeshnidae													
Anax chloromelas Ris, 1911			A	O	S					4			
Anax imperator Leach, 1815			A	O	S	S			1			1	
Anax tristis Hagen, 1867			A	O	S				2		3		
Gynacantha africana (Palisot de Beauvois, 1807)			G	F	S								1
Gynacantha bullata Karsch, 1891			G	F	S	S		A	1	1	1	1	1
Gynacantha cylindrata Karsch, 1891			G	F	S				2	1	3		1
Gynacantha manderica Grünberg, 1902			A	O	S					1	3		
Gynacantha nigeriensis (Gambles, 1956)	19.		G	F	S					1			
Gynacantha sextans McLachlan, 1896			G	F	S						1		1
Gynacantha sp. indet.	20.		?	?	?				3				
Gynacantha vesiculata Karsch, 1891			G	F	S				2	1	3		
Heliaeschna fuliginosa Karsch, 1893	21.		G	F	S		A	A	1	1			1
Heliaeschna cf. *cynthiae* Fraser, 1939	22.		?	?	?				3				
Gomphidae													
Diastatomma gamblesi Legrand, 1992	23.		U	F	R				2		1*		
Gomphidia bredoi (Schouteden, 1934)	24.		N	O	R								1
Gomphidia gamblesi Gauthier, 1987			W	F	R			S	1		1		
Ictinogomphus ferox (Rambur, 1842)			A	O	R					1	3		
Ictinogomphus fraseri Kimmins, 1958			W	F	R					1*			

continued

Taxa	Notes	RL	Biology			Liberian records				Neighboring areas			
			B	L	W	NL	Go	Gr	Li	SL	MN	Si	TF
Lestinogomphus africanus (Fraser, 1926)		DD	?	F	R					4*			
Lestinogomphus matilei Legrand & Lachaise, 2001	25.		U	F	R				2				
Lestinogomphus n. sp. 1	26.		U	F	R				3				
Lestinogomphus n. sp. 2	27.		U	F	R				3				
Lestinogomphus sp. indet.			?	F	R	S		L	1				
Microgomphus jannyae Legrand, 1992			U	F	R						1*		
Microgomphus sp. indet.	28.		?	F	R	A			1				
Onychogomphus xerophilus Fraser, 1956	29.	(DD)	U	F	R					2	2		
Paragomphus genei (Selys, 1841)			A	O	S				2	1			
Paragomphus kiautai Legrand, 1992		DD	U	F	R						1*		
Paragomphus mariannae Legrand, 1992	30.	DD	U	F	R				2		1*		
Paragomphus nigroviridis Cammaerts, 1968			G	F	R		A		1!				
Paragomphus serrulatus (Baumann, 1898)	31.		N	F	R				2	1			
Paragomphus tournieri Legrand, 1992	32.	DD	U	F	R				2		1*		
Paragomphus n. sp. cf. *elpidius* Ris, 1921	33.		U	F	R				2				
Paragomphus sp. indet.			?	F	R	L	L		1				
Phyllogomphus bartolozzii Marconi, Terzani & Carletti, 2001	34.	DD	U	F	R					1*			
Phyllogomphus helenae Lacroix, 1921		DD	U	F	R					4*			
Phyllogomphus moundi Fraser, 1960			W	F	R		A	S	1!		1		
Phyllogomphus n. sp.	35.		U	F	R				2				
Tragogomphus christinae Legrand, 1992	36.	DD	U	F	R				2		1*		
Tragogomphus sp. indet.			?	F	R		L		1				
Corduliidae													
Idomacromia lieftincki Legrand, 1984			G	F	R				2		1		
Idomacromia proavita Karsch, 1896			G	F	R						1		1
Neophya rutherfordi Selys, 1881			G	F	R				2	1	1		
Phyllomacromia aeneothorax (Nunney, 1895)		(DD)	G	F	R				2	4	1	1	
Phyllomacromia contumax Selys, 1879	37.		A	O	R				2				
Phyllomacromia funicularioides (Legrand, 1983)		NT	U	F	R				2		1*		
Phyllomacromia hervei (Legrand, 1980)			G	F	R	A		A	1				
Phyllomacromia kimminsi (Fraser, 1954)			A	F	R					1*			
Phyllomacromia lamottei (Legrand, 1993)	38.	DD	U	F	R				2		1*		
Phyllomacromia melania (Selys, 1871)	39.		G	F	R	A	A		1	4	1		
Phyllomacromia occidentalis (Fraser, 1954)		(DD)	U	F	R				2				
Phyllomacromia sophia (Selys, 1871)			U	F	R		A		1	4	1		1
Libellulidae													
Acisoma panorpoides Rambur, 1842			A	O	S	S	S	(S)	1	1	1		1
Acisoma trifidum Kirby, 1889			G	O	S	S	S	(S)	1	1	1		
Aethiothemis bella (Fisher, 1939)	40.	(DD)	G	F	?					3			
Aethiothemis solitaria Martin, 1908			A	O	S					2			
Aethriamanta rezia Kirby, 1889			A	O	S	S	S	S	1		1		
Atoconeura luxata Dijkstra, 2006	41.	(VU)	G	F	R					1	1		

continued

Taxa	Notes	RL	Biology			Liberian records				Neighboring areas			
			B	L	W	NL	Go	Gr	Li	SL	MN	Si	TF
Brachythemis lacustris (Kirby, 1889)			A	O	S				2				
Bradinopyga strachani (Kirby, 1900)			N	O	S		A		1	1	3		
Chalcostephia flavifrons Kirby, 1889			A	O	S	S	S	S	1	1	1		
Crocothemis divisa Baumann, 1898	42.		A	O	S				5	1	1		
Crocothemis erythraea (Brullé, 1832)			A	O	S	S	S	(S)	1	1	3		
Crocothemis sanguinolenta (Burmeister, 1839)			A	O	R		(S)		1	1	1	1	
Cyanothemis simpsoni Ris, 1915			G	F	R	A	S	S	1	4*	1		1
Diplacodes deminuta Lieftinck, 1969	43.	(DD)	A	O	S				2				
Diplacodes lefebvrii (Rambur, 1842)			A	O	S		A	(S)	1	1	1		
Diplacodes luminans (Karsch, 1893)	44.		A	O	S				2	1	3		
Eleuthemis buettikoferi Ris, 1910			G	F	R			S	1*	2	2		
Eleuthemis n. sp.			U	F	R		A		1				
Hadrothemis camarensis (Kirby, 1889)	45.		G	F	S	S	A	A	1	1	1		1
Hadrothemis coacta (Karsch, 1891)			G	F	S			A	1		3		1
Hadrothemis defecta (Karsch, 1891)			G	F	S	S	A	S	1	1	1		
Hadrothemis infesta (Karsch, 1891)			G	F	S	A	A	S	1	4	1		1
Hadrothemis versuta (Karsch, 1891)			G	F	S	S	A		1		1		
Hemistigma albipunctum (Rambur, 1842)			A	O	S		A		1	1	3		
Lokia incongruens (Karsch, 1893)	46.		W	F	R				2				
Malgassophlebia bispina Fraser, 1958			G	F	R				2		1		
Micromacromia camerunica Karsch, 1890	47.		G	F	R	A			1	4			
Micromacromia zygoptera (Ris, 1909)	48.		G	F	R			A	1	1	1		1
Neodythemis campioni Ris, 1915	49.	NT	U	F	R				2	4*	2		
Neodythemis klingi (Karsch, 1890)	50.		G	F	R		A	A	1	1	1		1
Nesciothemis minor Gambles, 1966			N	O	R			(A)	1!	1	1		
Nesciothemis nigeriensis Gambles, 1966			N	O	S					3			
Nesciothemis pujoli Pinhey, 1971	51.		N	O	S				4	1	2		
Notiothemis robertsi Fraser, 1944			G	F	S		S		1		1		
Olpogastra lugubris Karsch, 1895			A	O	R		A	S	1	3	1	1	
Orthetrum abbotti Calvert, 1892			A	O	S	A	A		1	1	1		
Orthetrum africanum (Selys, 1887)			G	F	R				2	4	1		
Orthetrum angustiventre (Rambur, 1842)			A	O	S				2	1			
Orthetrum austeni (Kirby, 1900)			G	O	S	S	S	S	1	1*	1		1
Orthetrum brachiale (Palisot de Beauvois, 1817)			A	O	S		A		1	1	3		1
Orthetrum chrysostigma (Burmeister, 1839)			A	O	S				2	1	3		
Orthetrum guineense Ris, 1910			A	O	R				4	1	1		
Orthetrum hintzi Schmidt, 1951			A	O	S		A	S	1	1	1		1
Orthetrum icteromelas Ris, 1910	52.		A	O	S				2	4			
Orthetrum julia Kirby, 1900			A	O	R	A	A	S	1	1*	1	1	1
Orthetrum latihami Pinhey, 1966	53.		N	O	?					1	1		
Orthetrum microstigma Ris, 1911			G	O	S	A	A	S	1	1	1	1	1
Orthetrum monardi Schmidt, 1951			A	O	S					1			
Orthetrum sagitta Ris, 1915		NT	U	?	?					2*			

continued

Taxa	Notes	RL	Biology			Liberian records				Neighboring areas			
			B	L	W	NL	Go	Gr	Li	SL	MN	Si	TF
Orthetrum stemmale (Burmeister, 1839)			A	O	S	A	A		1		3	1	1
Oxythemis phoenicosceles Ris, 1910			G	F	S				2				
Palpopleura deceptor (Calvert, 1899)			A	O	S		A		1!	4			
Palpopleura jucunda (Rambur, 1842)			A	O	S					1			
Palpopleura lucia (Drury, 1773)			A	O	S	S	S	S	1	1	1	1	1
Palpopleura portia (Drury, 1773)	54.		A	O	S	S	A	S	1	1	1	1	1
Pantala flavescens (Fabricius, 1798)			A	O	S	S	S	(S)	1	1	1		
Parazyxomma flavicans (Martin, 1908)			G	O	S	S			1				
Porpax bipunctus Pinhey, 1966		(VU)	G	F	?				2				1
Rhyothemis fenestrina (Rambur, 1842)			A	O	S	S	A	(S)	1	4			
Rhyothemis notata (Fabricius, 1781)			G	O	S			(A)	1	4	1		
Rhyothemis semihyalina (Desjardins, 1832)			A	O	S				2	1			
Sympetrum navasi Lacroix, 1921			A	O	S				2	3			
Tetrathemis camerunensis (Sjöstedt, 1900)	55.		G	F	S	A	A	S	1		3	1	1
Tetrathemis godiardi Lacroix, 1921			W	F	S		A	A	1		1		
Tetrathemis polleni (Selys, 1869)			A	O	S	S			1!				
Thermochoria equivocata Kirby, 1889			G	F	S				2	1	1		1
Tholymis tillarga (Fabricius, 1798)			A	O	S		A	A	1	1	1		1
Tramea basilaris (Palisot de Beauvois, 1817)			A	O	S	S	S	(S)	1	1			
Tramea limbata (Desjardins, 1832)			A	O	S	S	A	(S)	1!	1			
Trithemis aconita Lieftinck, 1969	56.		A	O	R	A	A	A	1	1	1	1	1
Trithemis africana (Brauer, 1867)		NT	U	F	R		A		1	1*			
Trithemis annulata (Palisot de Beauvois, 1807)			A	O	S				2	1	3		
Trithemis arteriosa (Burmeister, 1839)			A	O	S	A	A	S	1	1	1		1
Trithemis basitincta Ris, 1912			W	F	R		A		1				
Trithemis bredoi Fraser, 1953			N	O	S					1			
Trithemis dichroa Karsch, 1893			G	O	R				2	1	1		
Trithemis dejouxi Pinhey, 1978	57.		N	O	R				3				
Trithemis grouti Pinhey, 1961	58.		G	O	R	A	A	S	1	1	1	1	1
Trithemis hecate Ris, 1912	59.		A	O	?				3	1			
Trithemis kalula Kirby, 1900			N	O	?					1*	1		
Trithemis kirbyi Selys, 1891			A	O	S				2		3		
Trithemis monardi Ris, 1931	60.		A	O	S		A		1!	1			
Trithemis pruinata Karsch, 1899			G	F	R						1		
Trithemis stictica (Burmeister, 1839)			A	O	R				2	1			
Urothemis assignata (Selys, 1872)			A	O	S	S			1		1		
Urothemis edwardsii (Selys, 1849)			A	O	S				2	1			
Zygonyx chrysobaphes Ris, 1915			U	F	R			S	1	4*	1		
Zygonyx flavicosta (Sjöstedt, 1900)	61.		G	F	R	L	A		1	1	1		
Zygonyx geminunca Legrand, 1997	62.		U	F	R				3		1*		
Zygonyx torridus (Kirby, 1889)			A	O	R				2	1*	1		
Zyxomma atlanticum Selys, 1889			A	O	S		S	S	1				

Notes:
1. Includes Lempert's (1988) "*Phaon* cf. *fraseri* Pinhey, 1961";
2. The author's study of type specimens of *Sapho fumosa* and *Umma infumosa* Fraser, 1951 in the Natural History Museum in London suggest the two are synonymous;
3. Formerly known as *C. sharpae* Pinhey, 1972;
4. Formerly known as *C. mutans* Legrand & Couturier, 1986, misidentified as *C. neptunus* (Sjöstedt, 1899) by Carfi & D'Andrea (1994);
5. Formerly listed as *C. glauca radix* or just *C. glauca* (Selys, 1879);
6. "*Mesocnemis* sp.nov." in Lempert (1988);
7. *C. rossii* Pinhey, 1969, treated as a good species by Legrand (2003) is considered a synonym of *C. flavipennis* by the author;
8. Formerly placed in *Isomecocnemis*;
9. Misidentified as *E. acuta* Kimmins, 1938 by Carfi & D'Andrea (1994);
10. Formerly placed in *Enallagma*;
11. Misidentified as *A. forcipata* Le Roi, 1915 by Carfi & D'Andrea (1994);
12. Single female holotype from Sierra Leone is unlike any known African species and may pertain to a mislabelling.
13. Includes *C. moorei* Longfield, 1952;
14. Formerly known as *P. angelicum* Fraser, 1947;
15. Formerly known as *P. basicornu* Schmidt in Ris, 1936;
16. Formerly known as *P. flavipes* Sjöstedt, 1899 or *P. f. leonense* Pinhey, 1964;
17. Described as *Aciagrion walteri* by Carfi & D'Andrea (1994);
18. This and the previous species probably belong to an unnamed genus;
19. Formerly known as *G. sevastopuloi* (Pinhey, 1961), identification by Carfi & D'Andrea (1994) confirmed;
20. Lempert's (1988) "*Gynacantha* sp." female could not be assigned to a known species;
21. Misidentified as "*Gynacantha* cfr. *usambarica* Sjöstedt, 1909" by Carfi & D'Andrea (1994);
22. Female published by Lempert (1988) as *H. fuliginosa*;
23. "*Diastatomma* sp. nov." in Lempert (1988);
24. Formerly known as *G. madi* Pinhey, 1961:
25. "*Lestinogomphus* sp. 2" in Lempert (1988);
26. "*Lestinogomphus* sp. 1" in Lempert (1988);
27. "*Lestinogomphus* sp. 3" in Lempert (1988);
28. Includes Lempert's (1988) "*Microgomphus* sp." females;
29. Records of *O. quirkii* Pinhey, 1964 and *O. supinus* Hagen in Selys, 1854 listed under this name, the only one for this type of *Onychogomphus* from West Africa;
30. "*Paragomphus* sp. nov. 3" in Lempert (1988);
31. Formerly known as *P. bredoi* (Schouteden, 1934) includes records by that name and "*Paragomphus* sp. nov. 2" by Lempert (1988) and misidentified as *P. cognatus* (Rambur, 1842) by Carfi & D'Andrea (1994);
32. "*Paragomphus* sp. nov. 4" in Lempert (1988);
33. "*Paragomphus* sp. nov. 1" in Lempert (1988);
34. May be the same as *P. moundi* and *P. helenae*;
35. Lempert's (1988) "*Phyllogomphus* sp." male is unlike known species;
36. Identified as *T. tenaculatus* (Fraser, 1926) by Lempert (1988);
37. Formerly known as *P. bifasciata* Martin, 1912;
38. Lempert's (1988) "*Macromia* sp. nov." is this species;
39. Formerly known as *P. funicularia* (Martin, 1907);
40. Formerly known as *Sleuthemis diplacoides* Fraser, 1951 and *Monardithemis leonensis* Aguesse, 1968;
41. Formerly mistaken for *A. biordinata* Karsch, 1899;
42. Misidentified as *C. saxicolor* Ris, 1921 by Carfi & D'Andrea (1994), old Liberian record of that species also included here;
43. Three specimens published by Lempert (1988) as *D. lefebvrii*;
44. Formerly placed in *Philonomon*;
45. Misidentified (partly) as *Lokia incongruens* by Carfi & D'Andrea (1994);
46. Several records accidentally excluded by Lempert (1988);
47. Some records may requires reexamination following confusion with *M. zygoptera*;
48. Formerly placed in *Eothemis*;
49. Formerly placed in *Allorrhizucha*, probably misidentified as *Neodythemis scalarum* Pinhey, 1964 by Legrand (2003);
50. Formerly placed in *Allorrhizucha*;
51. All western African specimens of *N. farinosa* (Förster, 1898) examined by author pertained to *N. pujoli*;
52. Single Liberian female among material not noted previously by Lempert (1988);
53. Identification by Carfi & D'Andrea (1994) confirmed;
54. *P. lucia* and *P. portia* were not separated by Lempert (1988), but both present in material;
55. Includes *T. bifida* Fraser, 1941;
56. Misidentified as *T. bifida* Pinhey, 1970 and *T. basitincta* by Carfi & D'Andrea (1994);
57. "*T. donaldsoni* (Calvert, 1899)" in Lempert (1988);
58. Formerly known as *T. atra* Pinhey, 1961, misidentified as *T. nuptialis* Karsch, 1894 by Carfi & D'Andrea (1994);
59. Identification by Marconi & Terzani (2006) confirmed, Lempert's (1988) "*T.* cf. *hecate*" is probably also correct;
60. Includes *T. imitata* Pinhey, 1961;
61. Includes *Z. fallax* (Schouteden, 1934);
62. Lempert's (1988) "*Zygonyx* sp." may be this species, but the specimen is lost.