Rapid Assessment Program

A Rapid Biological Assessment of Lokutu, Democratic Republic of Congo

Thomas M. Butynski and Jennifer McCullough (Editors)

RAP Bulletin of Biological Assessment 46

Center for Applied Biodiversity Science (CABS)

Conservation International

Conservation International—Central Africa Program

Institut Congolais pour la Conservation de la Nature (ICCN)

Cover photos

[Top]: Adult male De Brazza's monkey (*Cercopithecus neglectus*). This is one of the species of primate that continues to occur in the vicinity of Lokutu, Democratic Republic of Congo. Photo © Harald Schuetz.

[Center]: A male butterfly (*Cynandra opis*), at Lokutu, Democratic Republic of Congo. Photo © Brian Finch.

[Bottom]: An adult green bush viper (*Atheris squamiger*) captured by local hunters near the Lukumete camp site. Photo © Johannes Penner.

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Organizational Profiles

CONSERVATION INTERNATIONAL

Conservation International (CI) is an international, non-profit organization based in Arlington, VA. CI believes that the Earth's natural heritage must be maintained if future generations are to thrive spiritually, culturally and economically. Our mission is to conserve the Earth's living heritage, our global biodiversity, and to demonstrate that human societies are able to live harmoniously with nature.

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CI's Central Africa Program uses a focused, strategic approach to conservation based on the identification of areas of high biodiversity importance. Critical to this approach is using the best available scientific methods and expertise in developing a comprehensive strategic plan. By involving all stakeholders, CI's Central Africa Program aims to develop a comprehensive corridor approach in protecting several key areas of high biodiversity importance. Such an approach relies upon a network of intact core protected areas of biodiversity surrounded by a mixture of land uses compatible with the preservation of biodiversity.

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The Center for Applied Biodiversity Science (CABS), the scientific hub of Conservation International, works to link science and action to guide the conservation of nature worldwide. CABS scientists build on knowledge about the Earth's plant and animal life, identify the best opportunities to preserve it, and deliver new methods and strategies to apply in the field. CABS research identifies priority sites for conservation, provides early warning of impending biodiversity loss, and produces powerful strategies to curtail this loss.

The Center for Applied Biodiversity Science (CABS)
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INSTITUT CONGOLAIS POUR LA CONSERVATION DE LA NATURE (ICCN)

ICCN, created in 1975, is a public institution providing technical and scientific support to the Democratic Republic of Congo. The mandate of ICCN is to: 1) manage and conserve the biodiversity of protected areas, 2) promote scientific research and ecological development, 3) develop ecotourism with respect to the fundamental principles of the Conservation of Nature, and 4) integrate conservation into local development processes in human populations along rivers in protected areas. ICCN believes that the protection of nature and its conservation for future generations is not only an important task for the Congolese, but also an obligation for the international community to preserve the genetic resources of the unique flora and fauna for all of humanity.

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We thank the RAP scientists, Tom Butynski, K.-D. Dijkstra, Brian Finch, Quentin Luke, Johannes Penner and Jim Sanderson, for their inspiring hard work in the field and for maintaining a sense of humor under difficult conditions. Tom Butynski led the six person scientific team. Jim Sanderson and Karl Morrison assisted in transporting RAP equipment. Karl Morrison looked after the team on its departure from Kinshasa. Johannes Penner arranged the export permits at the last minute. Yvonne A. de Jong compiled the map of the Lokutu area. Ole Müller allowed the reproduction of his *Zygonoides* drawings (Figure 3.6).

Conservation International (CI) supported this RAP survey in many ways. Leeanne E. Alonso and Jennifer McCullough facilitated and supported planning for the RAP expedition. Jennifer McCullough led preparation of this report. CI's Central Africa Program, especially Juan Carlos Bonilla, Karl Morrison, Ian Dodds and Sarah Banks, helped to make this RAP possible. Leslie Kasmir of the RAP program assisted in logistical coordination. CI's Finance department provided essential assistance with financial logistics.

This RAP survey was generously funded as part of a grant from the United States Agency for International Development (USAID) to Conservation International to develop a strategy for conservation and development for the Lokutu Region in the Democratic Republic of Congo.

Report at a Glance

A RAPID BIOLOGICAL ASSESSMENT OF LOKUTU, DEMOCRATIC REPUBLIC OF CONGO

Expedition Dates
26 October – 8 November 2004

Area Description
Lokutu, within the Territory of Basoko in the Democratic Republic of Congo, lies on the southern boundary of the northern-most extent of the Congo River. At one time, the Lokutu area was completely covered with lowland moist forest. Today, the Lokutu area still contains forest, some within Unilever's Lokutu Oil Palm Plantation concession. The plantation has been cleared except for narrow strips of forest along streams and rivers, and two (ca. 50 km^2 each) forest blocks in the northwest of the concession. The Lokutu area is adjacent to the Maringa-Wamba-Lopori landscape, targeted for conservation and development activities under the Congo Basin Forest Partnership (CBFP). Despite the high conservation importance of this landscape, there are no formal protected areas in this region.

Expedition Objectives
The primary objective of this survey was to identify potential areas for long-term investment as part of Conservation International's biodiversity conservation program for the Congo Basin High Biodiversity Wilderness Area. A first short survey of the area around the village of Lokutu in September 2002 examined the opportunity of an involvement of CI into the logging and oil palm concession of Unilever. The purpose of this RAP survey was to investigate the conservation value of the Lokutu area. The RAP team examined selected taxonomic groups to determine the area's biological diversity, its degree of endemism, and the uniqueness of the ecosystem. We chose to survey plants, odonates (dragonflies), amphibians, reptiles, birds, and larger mammals (with an emphasis on primates).

Overall Results
Due to permit restrictions, the RAP team was unable to access good forest for comparison to the Unilever plantation. Low species richness of all taxonomic groups, except dragonflies, was recorded within the plantation and nearby forest in the Lokutu area. High levels of forest degradation and fragmentation as well as hunting were widely documented.

Number of Species Recorded

Plants	574
Odonata (dragonflies)	86
Amphibians	21
Reptiles	6
Birds	204
Large mammals	14
Primates	6
Total	915

New Species Discovered

Odonata (3)

Mesocnemis sp.
Platycypha sp.
Elattoneura sp.

New Records for the Democratic Republic of Congo

Odonata (4)

Ceriagrion ignitum
Pseudagrion simplicilaminatum
Phyllogomphus coloratus
Chlorocypha pyriformosa

Amphibians (3)

Cardioglossa gratiosa
Amnirana amnicola
Dimorphognathus africanus

CONSERVATION RECOMMENDATIONS

Given the great loss of biodiversity, increasing human population, the apparent lack of interest or will by central and local government to manage the use of the natural resources, and the high costs of working in the area, the RAP team concluded that the Lokutu area is not a priority site for conservation investment or action. The RAP team also does not recommend that Lokutu be considered part of CI's Congo Basin High Biodiversity Wilderness Area.

If conservation funds are specifically earmarked for mitigating the negative conservation situation at Lokutu, there are some actions that could be taken. These include:

- Establishing active, long-term family planning and conservation education programs,

- Putting into place large community-protected and community-managed conservation areas, together with bushmeat hunter cooperatives, that would allow for recovery of wildlife populations and their sustainable exploitation,

- Re-establishing the livestock industry with the aim of providing substitutes for a portion of the bushmeat that is presently consumed.

An additional conservation recommendation of this report is that all necessary permits be obtained from the central, regional and local government authorities and additional surveys be undertaken in the forests located > 40 km to the south of Lokutu, as well as on both sides of the Congo River near Lokutu.

Executive Summary

INTRODUCTION

Because of their high biological diversity and uniqueness, African rainforests are a top global conservation priority (Olson and Dinerstein 1998, Kamdem-Toham et al. 2003, Mittermeier et al. 2004). Forest destruction has been fueled by rapid population growth and also by extensive road building which have greatly increased access to forests (Wilkie and Laporte 2001). The total harvest of wildlife in the Afrotropical region is estimated to be about 5 million tons annually, making this the most intensively hunted tropical region in the world (Fa et al. 2002). Recurring wars, political instability, disease, and endemic corruption have also created serious impediments for African forest conservation. While well over half of all of Africa's rainforests have been cleared and fragmented, Central Africa retains almost 60% of the original forest cover (Naughton-Treves and Weber 2001).

The Congo Basin Forest comprises the second largest block of tropical rainforest remaining on Earth. The majority of the Congo Basin Forest lies within the Democratic Republic of Congo (DRC), the third largest country in Africa, covering some 2,344,000 km² at the center of the continent. DRC is the single most biologically rich country in Africa, and, in terms of species richness, is near the top of the list for Africa for virtually every group of organisms. DRC harbors important communities of megafauna and, resulting from its proximity to the second largest river system on Earth, the Congo, DRC also holds a diverse freshwater fish fauna. Conservation International (CI) has identified the Congo Basin Forest as one of the world's High Biodiversity Wilderness Areas and, as such, a global biodiversity conservation priority.

Lokutu

Lokutu, within the Territory of Basoko, DRC, lies on the southern boundary of the northern-most extent of the Congo River (see Map). The Lokutu area still has forests, some of them within Unilever's Lokutu Oil Palm Plantation concession. Lokutu Oil Palm Plantation concession (630 km^2) is an active plantation of which ca. 100 km^2 are covered with oil palm (and some cocoa and coffee). The remaining ca. 530 km^2 are lightly to heavily disturbed. At one time, the Lokutu area was completely covered with lowland moist forest (Grainger 1996). The Plantation has been cleared except for narrow strips of forest along streams and rivers, and two (ca. 50 km^2 each) forest blocks in the northwest of the concession. These two blocks, as well as the forests surrounding the plantation, have been selectively logged. Lokutu Plantation employs ca. 1,900 people. The total population of the Lokutu area is ca. 10,000 people.

Lokutu is located in the northeastern section of the region south of the Great Bend of the Congo River, sometimes referred to as the *Cuvette Centrale*. This is also adjacent to the Maringa-Wamba-Lopori landscape, targeted for conservation and development activities under the Congo Basin Forest Partnership (CBFP). Despite the high conservation importance of this landscape, there are no formal protected areas in this region.

RAP EXPEDITION OVERVIEW AND OBJECTIVES

The primary objective of this RAP survey was to identify potential areas for long-term investment as part of Conservation International's biodiversity conservation program for the Congo Basin High Biodiversity Wilderness Area.

A first short survey of the area around the village of Lokutu in September 2002 examined the opportunity of an involvement of CI into the logging and oil palm concession of Unilever. The purpose of this RAP survey was to investigate the conservation value of the Lokutu area. The specific aims of the expedition were to:

- Derive a brief but thorough overview of species diversity within the Lokutu area and evaluate the area's relative conservation importance;
- Undertake an evaluation of threats to this biodiversity;
- Provide management and research recommendations for this area together with conservation priorities; and
- Make RAP data publicly available for decision-makers as well as members of the general public in the DRC and elsewhere, with a view to increasing awareness of this ecosystem and promoting its conservation.

The RAP expedition's team of six scientists comprised international scientists specializing in Central Africa's terrestrial ecosystems and biodiversity. The RAP team examined selected taxonomic groups to determine the area's biological diversity, its degree of endemism, and the uniqueness of the ecosystem. RAP expeditions survey focal taxonomic groups as well as indicator species, with the aim of choosing taxa whose presence can help identify a habitat type and its condition. We chose to survey plants, odonates (dragonflies), amphibians, reptiles, birds, and larger mammals (with a focus on primates).

STUDY AREA

We conducted surveys during the dry season in forests within and near Unilever's Lokutu Oil Palm Plantation concession. The surveys were conducted over 14 days (26 October – 8 November, 2004). Surveys focused mainly on four forest sites (see Map, Table 1.1).

SUMMARY OF RESULTS

Criteria generally considered during RAP surveys in order to identify priority areas for conservation across taxonomic groups include species richness, species endemism, rare and/or threatened species, and critical habitats. Measurements of species richness can be used to compare the number of species per area among areas within a given region. Measurements of species endemism indicate the number of species endemic to some defined area and give an indication of both the uniqueness of the area and the species that will be threatened by degradation or loss of that area's habitats (or conversely, the species that will likely be conserved through protected areas). Assessment of rare and/or threatened species that are known or suspected to occur within a given area provides an indicator of the importance of the area for the conservation of biodiversity. The presence or absence of such species also aids assessment of their conservation status. Many species listed on the IUCN Red List (IUCN 2006) carry increased legal protection, thus giving greater importance and weight to conservation decisions. Describing the number of critical habitats or subhabitats within an area identifies sparse or poorly known habitats within a region that contribute to habitat variety and, therefore, to species diversity. The following is a summary, based on these criteria, of the key findings from our field study.

Plants

A total of 485 taxa of indigenous plants and 89 taxa of exotic plants were recorded. The low botanical diversity of the palm plantations is compared with almost primary forest. The most interesting of the timber species was *Pericopsis elata* or Afrormosia. Considering that the Kisangani area is considered to be the last stronghold of this species, the very low stocking rate noted during this survey suggests that the situation is more serious than previously thought.

Odonates (Dragonflies)

A total of 86 taxa of odonates, mostly Guineo-Congolian running-water species, were found. There were several remarkable range extensions, as well as new species of *Platycypha*, *Elattoneura* and *Mesocnemis*. The species richness for odonates in this area is high, especially since only 24 (28%) species are widespread Afrotropical species; the remaining 62 (72%) are Guineo-Congolian species. Of the Guineo-Congolian group, 47% of the species occur almost throughout the Guineo-Congolian realm (i.e., well into West Africa), but the other 53% are more localized, restricted to the forested center of the continent. Thirteen of the species (almost one in six) have yet to be found outside the Congo Basin. The RAP results indicate a healthy watershed in the Lokutu area, with limited degrees of pollution and streambed erosion. If forest cover and natural stream morphology are retained, the rich dragonfly fauna is expected to persist. The species list is especially long considering the paucity of stagnant water species and the absence of certain Congolian endemics. The observed richness is probably typical of the Congo Basin as a whole and other areas are expected to be even richer. Therefore, the Lokutu area does not require specific conservation action as concerns the conservation of the odonate fauna.

This RAP survey demonstrated that it is possible to rapidly obtain a clear picture of odonate diversity, even

allowing a partial description of their ecology. The rich and apparently largely natural odonate fauna found contrasts with the impoverished status of the other taxonomic groups studied. Therefore, it is recommended to use odonates more frequently to supplement biodiversity assessments of the more traditional taxonomic groups, especially in the Congo Basin, where sampling odonates may show whether existing conservation priorities also protect watersheds and freshwater biodiversity.

Amphibians and Reptiles

Twenty-one species of amphibians and 16 species of reptiles were identified. Most species were common savannah or forest species that can adapt to a high level of anthropogenic disturbance. The known distributional range for six amphibian species (*Afrixalus equatorialis*, *Amnirana amnicola*, *Cardioglossa gratiosa*, *Dimorphognathus africanus*, *Hyperolius* cf. *lateralis* and *Leptopelis ocellatus*) was extended. Given the circumstances of this RAP survey (i.e., inaccessibility of potentially pristine forest patches), the species list reported here does not allow for meaningful conservation recommendations.

Birds

A total of 204 species of birds were found in the Lokutu area, of which 20 species are Palearctic migrants. No bird species listed as threatened on the 2004 IUCN Red List were encountered. We obtained geographic range extensions for 14 species and one subspecies. Previous logging activity, past and ongoing wide-scale conversion of forests to oil palm plantations and gardens, and heavy hunting pressure were documented. The findings indicate that the Lokutu area is of relatively low value as a site for the conservation of birds. This is due, in part, to a decline in the bird species richness of the site as a result of forest degradation, fragmentation, and clearance, together with unsustainable levels of hunting of some species. A preliminary list of the birds of the Lola ya Bonobo Sanctuary (near Kinshasa) is presented at the end of this report.

Mammals

Six species of primates and eight species of large mammals were recorded. Previous logging activity, ongoing wide-scale conversion of forests to oil palm plantations and gardens, and heavy hunting pressure were documented. Hunters claimed that they never observed large mammals such as African elephants, African buffaloes, leopards, or gracile chimpanzees (bonobos). The largest mammal present is the red river hog. The Lokutu area is of little conservation value for the conservation of primates and large mammals due to a considerable decline in the biological richness of the site and the collapse of the primate and large mammal communities. This situation has come about as a result of forest degradation, fragmentation, and clearance, together with unsustainable levels of hunting.

CONSERVATION CONCLUSIONS AND RECOMMENDATIONS

Given (1) the great loss of biodiversity and other conservation values, (2) the ever increasing human population and concomitant need to exploit the area's natural resources, (3) the lack of interest/will/ability, both of central government and local government, to control and manage the use of the natural resources, and (4) the high costs (both in terms of money and time) of working in the area, we do not find the Lokutu area to be a priority site for conservation investment or action — nor do we recommend that Lokutu be considered part of CI's Congo Basin High Biodiversity Wilderness Area. In other words, there are numerous other forests in equatorial Africa with a far more valuable biodiversity, and with far fewer threats, where much more conservation impact can be achieved for the funds and time invested.

Although the necessary permits were obtained from the various ministries in Kinshasa, the local authorities in the Lokutu area had little respect for this authorization, and actively sought out discrepancies — no matter how seemingly insignificant. Central Government has little or no authority in the Lokutu area. This opens the question as to the safety of any financial investment in the area. Based on the above, any investment in this area would be highly risky, not only as far as funding conservation actions is concerned, but also in support of the oil palm industry.

If, however, Unilever, or some other source (e.g., USAID), has conservation funds that can only be used for mitigating the negative conservation situation at Lokutu, there are some actions that could be taken. These include:

- Establishing active, long-term, family planning and conservation education programs,
- Putting into place large community-protected and community-managed conservation areas, together with bushmeat hunter cooperatives, that would allow for recovery of wildlife populations and their sustainable exploitation for bushmeat,
- Re-establishing the livestock industry with the aim of replacing a large portion of the bushmeat that is now eaten with beef, goat, sheep and poultry.

One of the original objectives of this RAP was to assess the biodiversity over a much wider area, more specifically, of the forests 40 km or more south of Lokutu. We were unable to accomplish this objective due to permit restrictions. Thus, we are unable to say in this report (1) how far south from Lokutu are found the nearest sites of high biodiversity value, (2) what impact the departure of Unilever from Lokutu might have on the survival of that biodiversity, or (3) what kind of conservation strategy would need to be put into place for the Lokutu area in order to conserve any

high biodiversity sites that might exist to the south. Thus, an additional conservation recommendation of this report is that all necessary permits be obtained from the central, regional and local government authorities and another survey of about one month be undertaken in the forests located > 40 km to the south of Lokutu.

The Congo River is one of Africa's great biological barriers and, as such, the floras and faunas on either side of this River are known to be substantially different. We recommend that more extensive biodiversity surveys be conducted on both sides of the River in the Lokutu area.

REFERENCES

Fa, J.E., C.A. Peres and J. Meeuwig. 2002. Bushmeat exploitation in tropical forests: an intercontinental comparison. Conservation Biology 16: 232–237.

IUCN. 2006. IUCN Red List of Threatened Species. www.iucnredlist.org

Kamdem-Toham, A., A.W. Adeleke, N.D. Burgess, R. Carroll, J. D'Amico, E. Dinerstein, D.M. Olson and L. Some. 2003. Forest conservation in the Congo Basin. Science 299: 346.

Mittermeier, R.A., P.R. Gil, M. Hoffman, J. Pilgrim, T. Brooks, C.G. Mittermeier, J. Lamoreux, G.A.B. da Fonseca. 2004. Hotspots Revisited. Cemex, Mexico City.

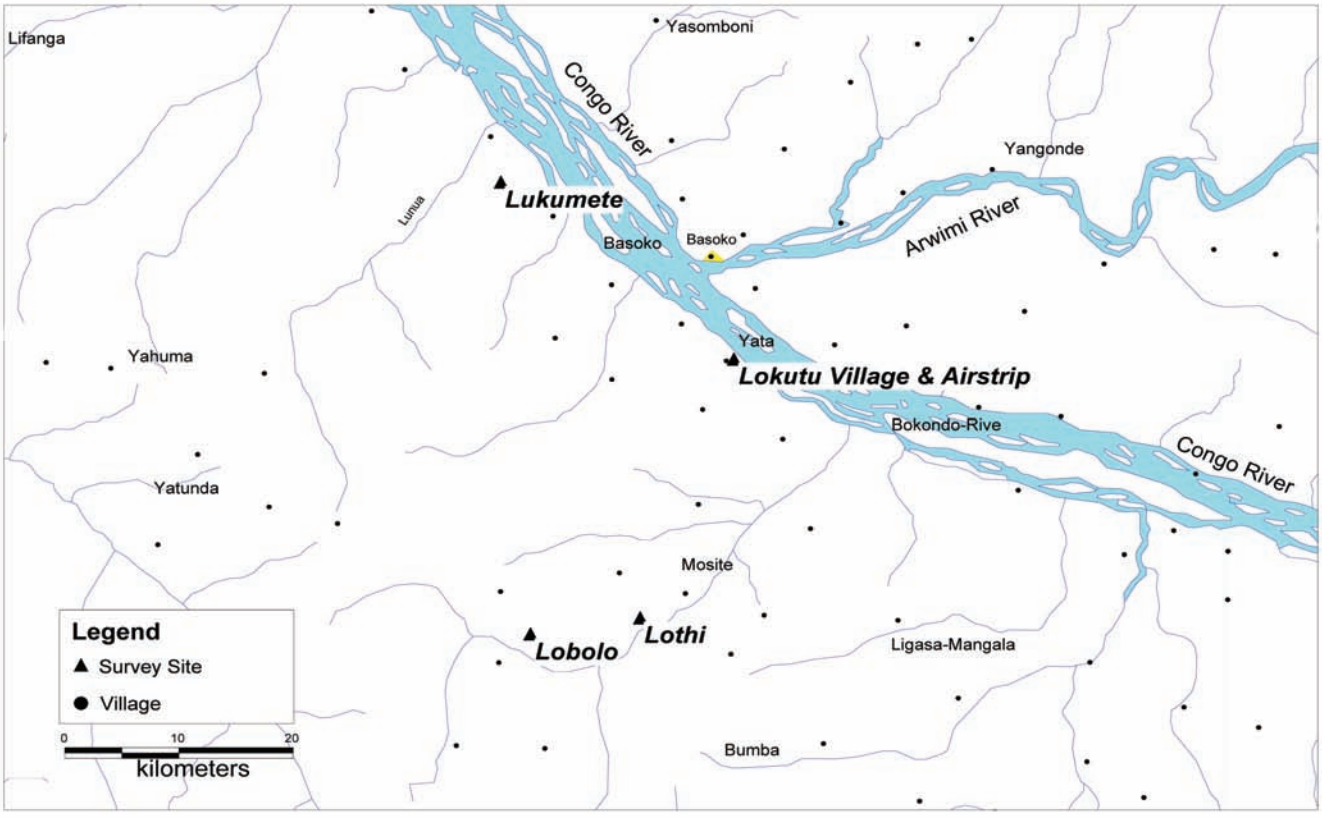
Naughton-Treves, L. and W. Weber. 2001. Human dimensions of the African rain forest. *In:* Weber, W., L.J.T. White, A. Vedder, N. Naughton-Treves (eds.). African Rain Forest Ecology and Conservation, pp. 20–46. Yale University Press, New Haven, CT.

Olson, D.M. and E. Dinerstein. 1998. The Global 200: a representation approach to conserving the earth's most biologically valuable ecoregions. Conservation Biology 12: 502–515.

Wilkie, D.S. and N. Laporte. 2001. Forest area and deforestation in Central Africa: current knowledge and future directions. *In:* Weber, W., L.J.T. White, A. Vedder, N. Naughton-Treves (eds.). African Rain Forest Ecology and Conservation, pp. 119–139. Yale University Press, New Haven, CT.

Maps

Map 1. The Democratic Republic of Congo, showing the location of Lokutu.
https://www.cia.gov/cia/publications/factbook/geos/cg.html



Map 2. Map of the Lokutu area, Democratic Republic of Congo, showing the locations of the four survey sites. See Table 1.1 for details. Map compiled by Yvonne A. de Jong.

Chapter 1

An Introduction to the RAP survey in the Lokutu Area, Democratic Republic of Congo

Jennifer McCullough

Tropical rainforests sustain a large portion of the world's biological diversity and are vanishing more rapidly than any other biome (Laurance 1999, Achard et al. 2002). In Africa, tropical rainforests are mainly confined to an equatorial belt of varying width as vegetation change is more strictly associated with latitude (Terborgh 1992). African vegetation zones roughly form a series of parallel bands across the continent that correspond to rainfall patterns. Evergreen forests occur in a narrow band along the coasts of West Africa and Central Africa, and across the Congo Basin into East Africa. Because of their high biological diversity and uniqueness, African rainforests are a top global conservation priority (Olson and Dinerstein 1998; Kamdem-Toham et al. 2003; Mittermeier et al. 2004).

Well over half of all African rainforests have been cleared and fragmented, mainly from slash-and-burn farming. Forest loss has been most severe in West Africa, which currently has <12% of its original rainforest (declining from 1.25 to 0.15 million km^2), and in eastern Africa, which has 8% of its original rainforest (declining from 0.36 to 0.03 million km^2). In contrast, Central Africa's forests still comprise almost 60% of their original distribution (Naughton-Treves and Weber 2001).

Forest destruction has been fueled by the rapid growth of human populations and also by extensive road building for logging, oil, mineral, and infrastructure projects, which have greatly increased access to forests (Wilkie and Laporte 2001). Additionally, the total harvest of wildlife in the Afrotropical region is estimated to be about 5 million tons annually, making it the most intensively hunted tropical region in the world (Fa et al. 2002). Recurring wars, political instability, disease epidemics, and endemic corruption are also serious impediments to forest conservation. In recent years, nearly one-third of the 42 sub-Saharan countries in Africa have been involved in international or civil wars. As one example, as a means of combatting rebels in the eastern half of the country, the Democratic Republic of Congo (DRC) (formerly Zaire) has bartered access to timber, gemstones, and minerals to Zimbabwe, Uganda, Rwanda, and Burundi in exchange for military support (Vedder et al. 2001).

The Congo Basin Forest, also referred to as the Lower Guineo-Congolian Forest, comprises the second largest block of tropical rainforest on Earth. The Congo Basin Forest extends from the coast of the Atlantic Ocean in the west to the Albertine Rift in the east, and spans the equator by nearly 7 degrees north and south. This forest block is one of two remaining regions on Earth that still boast large interconnected tracts of tropical rainforest.

Current biodiversity patterns in the Congo Basin date to the Pleistocene epoch (15,000–250,000 B.P.). The last great ice age, which peaked about 18,000 years ago, had a profound influence on biodiversity in this region. Cool, dry conditions existed at the equator during the peak of the ice age when much of North America and Europe were covered by a thick sheet of ice. The dry conditions in the tropics created isolated forested refugia. With repeated expansions and contractions of these forests during the Pleistocene, the flora and fauna experienced considerable isolation and speciation. These refugia included forested mountains to the west and east of the Congo Basin and vast swamps within the Congo Basin (Colyn et al. 1991; Maley 1996; White 2001). As the climate warmed and the ice cap receded, equatorial forests in

the Congo Basin and neighboring highlands greatly expanded to, once again, cover the Congo Basin.

The majority of the Congo Basin Forest lies within the Democratic Republic of Congo (DRC), the third largest country in Africa, covering some 2,344,000 km² at the center of the continent. Overall it is the single most biologically rich country in Africa, and, in terms of species richness, is near the top of the list for Africa for virtually every group of organisms. Evergreen forest canopy composition varies, from highly diverse mixed forests to forests dominated by one or a few tree species. Particularly noteworthy are the mono-dominant forests where a single species, *Gilbertiodendron dewevrei*, represents from 60% to over 80% of the canopy. DRC harbors important communities of megafauna, including gracile chimpanzee or bonobo (*Pan paniscus*), robust or common chimpanzee (*Pan troglodytes*), eastern gorilla (*Gorilla beringei*), forest elephant (*Loxodonta cyclotis*), and the okapi (*Okapia johnstoni*). DRC also has the second largest river system on Earth, the Congo, and one of the most diverse freshwater fish faunas. Conservation International (CI, Mittermeier et al. 2003) has identified the Congo Basin Forest as one of five High Biodiversity Wilderness Areas. As such, conservation of the Congo Basin Forest is a global biodiversity conservation priority.

Lokutu

Lokutu (formerly named 'Elizabetha'), within the Territory of Basoko, DRC, lies on the southern boundary of the northern-most extent of the Congo River and still has forested areas, some of them within Unilever's Lokutu Oil Palm Plantation concession (N 01° 08' 43.2" E 23° 36' 53.7"). The climate at Lokutu is probably very similar to that for Kisangani, 250 km up the Congo River to the east. At Kisangani, the mean annual temperature is approximately 25° C. Climate type is equatorial (Stock 2004) with no monthly mean temperature below18°C. Mean monthly rainfall is between 100 mm and 199 mm (Stock 2004). Total annual rainfall varies between 1400 mm and 2200 mm (Goudie 1996). Thus, there is little seasonality in the climate of the region, although rainfall tends to be highest during April and October (Anon. 2005). The soils of the area are pedalfers (ferrasols) (Areola 1996), acidic soils in which iron and aluminum oxides have accumulated.

Lokutu Plantation Concession (630 km²) was granted in 1911 and the first oil palms (*Elaeis guineensis*) were planted in 1922. Today, this is an active plantation of which ca. 100 km² are covered with oil palm (and some cocoa and coffee). The remaining ca. 530 km² are lightly to heavily degraded (i.e., covered with secondary forest, scrub, fallow fields, or garden crops grown by plantation workers and settlers — especially cassava and bananas). At one time, the Lokutu area was completely covered with lowland moist forest (Grainger 1996). The plantation has been cleared except for narrow strips of forest along streams and rivers, and two (ca. 50 km² each) forest blocks in the northwest of the concession. These two blocks, as well as the forests surrounding the Plantation, have been selectively logged.

Lokutu Plantation employs ca. 1,900 people. The total population of the Lokutu area is ca. 10,000 people. During this survey, the streams and rivers within the interior of these forests were flowing normally for this time of year.

Lokutu is located in the northeastern section of the region south of the Great Bend of the Congo River, sometimes referred to as the *Cuvette Centrale*. Lokutu is adjacent to the Maringa-Wamba-Lopori landscape, targeted for conservation and development activities under the Congo Basin Forest Partnership (CBFP). Despite the high conservation importance of this landscape, there are no protected areas in this region. Lokutu forms a significant demographic and economic center in this otherwise sparsely populated area.

A first short survey of the area around the village of Lokutu in September 2002 examined the opportunity of an involvement of CI in the logging and oil palm concession of Unilever. A CI team reported the area to be of little or negligible conservation value. We investigated this statement with a much stronger biological emphasis. On the basis of a two-week survey, we herein present a preliminary inventory of the flora and fauna of the Lokutu region.

RAP STUDY SITES

We conducted surveys during the dry season over 14 days (25 October – 8 November 2004) in forests within and near Unilever's Lokutu Plantation Concession. Surveys focused mainly on four forest sites (see Map, Table 1.1). Lobolo (Site 2) is located ca. 31 km to the northwest of Lokutu Village, and Lukumete (Site 4) is located about ca. 26 km to the northwest of Lokutu Village. A short flight over the area confirmed that a large part of the forest around Lokutu Village had been either destroyed or heavily altered for oil palm plantations and other agricultural uses.

The original RAP plan was to survey sites far to the south of Lokutu, beyond where significant levels of logging or hunting would have occurred. The data from such sites would have provided a useful baseline and insights into what species of plants and animals might have been present at Lokutu prior to the establishment of the oil palm plantation and the related large influx of people. However, due to permit restrictions and the inflexibility of the local authorities, we had access to only a few selected areas of slightly to highly degraded natural forests within and close to the Lokutu Plantation. This was a severe impediment to our evaluation of the Lokutu area as a site for conservation investment and action. Nevertheless, while we were unable to compare low impact sites with the high impact sites we surveyed, our conclusions regarding the current value of the Lokutu Oil Palm Plantation as a site for conservation are firmly grounded.

Table 1.1. Principal survey sites in the Lokutu area, Democratic Republic of Congo.

Site name	Coordinates	Description
Lokutu Village & Airstrip (Site 1)	N 01° 08' 43.2" E 23° 36' 53.7" 395 m a.s.l.	Located on the south (left) bank of the Congo River. An intensively cultivated area and village of ca. 10,000 people that was established in 1911. Headquarters of the Unilever Oil Palm Plantation. Oil palm processing factory, loading dock, and airstrip located here. Much oil palm grown here, and some bananas, cassava, sugar cane, mangoes, beans, yams and other crops. Highly altered vegetation with only small, degraded remnants of natural forest remaining. Dates present: October 26–31; November 6–9.
Lobolo (Site 2)	N 00° 54' 53.1" E 23° 27' 16.4" 410 m a.s.l.	2 km SW of Lothi. Degraded forest next to oil palm plantation. Main road passes here. High human population nearby. October 29–30.
Lothi (Site 3)	N 00° 55' 41.7" E 23° 32' 27.5" 390 m a.s.l.	Degraded forest next to oil palm plantation and the small (1 m wide) Lingomo stream. October 30.
Lukumete (Site 4)	N 01° 17' 38.7" E 23° 25' 53.3" 380 m a.s.l.	The largest and least degraded forest surveyed, and also the forest farthest from Lokutu Village. Several small to medium-sized streams (Dumba, Moha, Lukumete, Letissé, and Lingunguare) are located within this site, as is the 12-18 m wide Lunua River. The Lunua River was a 4.7 km walk to the west of camp and represented the most remote area surveyed (N 01° 17' 45.3"; E 23° 25' 53.3"; 360 m a.s.l.). Parts of this site are dominated by Mbau (also known as 'Limbali') *Gilbertiodendron dewevrei*. African celtis (*Celtis mildebraedii*) was also common here. This was the most intensively sampled of the four sites. November 1–6.

THREATS TO BIODIVERSITY

Africa's tropical rainforests and wildlife have been severely degraded in recent decades by many threats, including industrial logging, slash-and-burn agriculture, over-hunting, disease and increasing infrastructure development. In DRC, vast timber leases have been granted to Zimbabwean, German, Malaysian, and Chinese corporations. Logging has important impacts on tropical ecosystems and wildlife (Malcolm and Ray 2000; Laurance et al. 2006), but often its most pervasive effects are secondary: by creating extensive networks of roads and bulldozer tracks, logging greatly increases physical access to forests for hunters, miners, and farmers that can severely degrade or destroy forests (Wilkie et al. 1992; Laurance 2001).

As the human population has increased, traditional forms of forest exploitation, like the gathering of fuelwood and building poles, have grown sharply. Hunting pressure is growing rapidly throughout Central Africa, as road networks expand and the area of forest accessible to hunters increases (Wilkie et al. 1992; Barnes et al. 1997; Fa et al. 2005). Moreover, the efficiency of hunters has increased because shotguns and cable snares have replaced traditional crossbows, spears, nets, snares made from bush rope (Noss 1998; Lahm 2001). Few remaining areas of forest are inaccessible to hunters (Wilkie et al. 2000). Populations of hunted wildlife, especially larger-bodied species like duikers, buffalo, elephants, monkeys and apes, have declined sharply within 10–15 km of villages and roads (Barnes et al. 1991; Lahm et al. 1998, Fa et al. 2000; Lahm 2001). In addition, commercial hunters use hunting and logging camps to penetrate deep into remaining forest tracts (Wilkie et al. 1992; 2000; Lahm 2001).

Wild meat is a key protein source in rural areas and is favored in towns and cities. Improved road networks drive a burgeoning commercial bushmeat trade (Milner-Gulland et al. 2003). Hunting typically contributes between 30 to 80% of protein consumed by forest-dwelling families in the Congo Basin (Koppert et al. 1996), representing almost all animal-based protein consumed. It is estimated that more than 1 million tons of antelope, pigs, rodents and other wildlife are killed and eaten every year in Central Africa (Wilkie and Carpenter 1999). Of 57 mammal, bird, and reptile species hunted in the Congo Basin, 60% are exploited unsustainably (Fa et al. 2002).

In DRC, the human population is expected to double (from 50–60 million to 100–120 million) by 2020 (CBFP 2005). Human population pressure is the root cause of many of the threats mentioned above, driving demand for natural resource consumption in DRC. Immigration to DRC from West Africa is also likely to increase, exacerbating demands on the natural resource base.

Armed conflicts in countries neighboring DRC (Rwanda, Burundi, Uganda, Congo, Sudan, Central African Republic,

and Angola) have killed millions of people with associated impacts on forests, wildlife, and national-park staff and infrastructure. In eastern DRC, fighting has pushed refugees west and has also displaced rural populations away from major roads and into the forest and protected areas where they are less likely to encounter soldiers and armed bands. Such conflict-triggered displacement has significant ecological and social impacts (CBFP 2005). Moreover, corruption is a serious impediment to conservation. In a recent report commissioned by the European Community, a complete moratorium on logging in five African nations — including DRC — was recommended in response to issues of corruption (Laurance 2000; Sizer and Plouvier 2000).

OPPORTUNITIES FOR CONSERVATION

Recent developments in the Congo Basin Forest are working to address the situation and propel conservation forward. In March 1999, six heads of state from Central African nations signed the 'Yaoundé Declaration.' This Declaration contains commitments to forest conservation and sustainable forest management, including conserving, in protected areas, a minimum of 10% of each nations' forests (Kamdem-Toham et al. 2003). Since 1999, there has been a 36% increase (40,607 km^2) in the coverage of protected areas across the region's forests. In Gabon, 13 new national parks covering 30,000 km^2 (10% of the country) have been gazetted, and similar processes are underway in Cameroon, Congo, Equatorial Guinea and DRC.

The Congo Basin Forest Partnership (CBFP) conservation activities focus on 11 landscapes that were selected by more than 160 regional and international experts at a workshop in Libreville in April 2000. Landscapes were selected because of their outstanding biodiversity (including their concentration of endemic species), because they encompass intact populations of larger mammals (e.g., elephant, buffalo, robust chimpanzee and gorilla in forest wilderness), or because they represent important and distinctive habitats and communities of species. Priority landscapes represent zones within which conservation should play a prominent role, through various activities in protected areas and corridors, and through sustainable forestry management and community-based natural resource management. Within these landscapes, the CBFP is working with a range of government and nongovernmental organizations to conserve biodiversity and promote sustainable land use practices.

REFERENCES

Achard, F., H.D. Eva, H.J. Stibig, P. Mayaux, J. Gallego, T. Richards and J.P. Malingreau. 2002. Determination of deforestation rates of the world's humid tropical forests. Science 297: 999–1002.

Anonymous. 2005. Climate Controls. Climographs / Africa. Web site: http://people.cas.sc.edu/carbone/modules/mods4car/ccontrol/questions/africa.html

Areaola, O. 1996. Soils. *In*: Adams, W.M., A.S. Goudie and A.R. Orme (eds.). The Physical Geography of Africa, pp. 134–147. Oxford University Press, Oxford, UK.

Barnes, R.F., W.K. Barnes, M. Alers and A. Blom. 1991. Man determines the distribution of elephants in the rain forests of northeastern Gabon. African Journal of Ecology 29: 54–63.

Barnes, R.F.W., K. Beardsley, F. Michelmore, K.L. Barnes, M. Alers and A. Blom. 1997. Estimating forest elephant numbers with dung counts and a geographic information system. Journal of Wildlife Management 61: 1384–1393.

[CBFP] Congo Basin Forest Partnership. 2005. The Forests of the Congo Basin: a Preliminary Assessment. Available online, 15 Oct 2006. http://carpe.umd.edu/products/PDF_Files/FOCB_APrelimAssess.pdf

Colyn, M., A. Gautier-Hion and W. Verheyen. 1991. A re-appraisal of palaeoenvironmental history in Central Africa: evidence for a major fluvial refuge in the Zaire Basin. Journal of Biogeography 18: 403–407.

Fa, J.E., J.E.G. Yuste and R. Castelo. 2000. Bushmeat markets on Bioko Island as a measure of hunting pressure. Conservation Biology 14: 1602–1613.

Fa, J.E., C.A. Peres and J. Meeuwig. 2002. Bushmeat exploitation in tropical forests: an intercontinental comparison. Conservation Biology 16: 232–237.

Fa, J.E., S.F. Ryan and D.J. Bell. 2005. Hunting vulnerability, ecological characteristics and harvest rates of bushmeat species in afrotropical forests. Biological Conservation 121: 167–176.

Goudie, A.S. 1996. Climate: past and present. *In*: Adams, W.M., A.S. Goudie and A.R. Orme (eds.). The Physical Geography of Africa, pp. 34–59. Oxford University Press. Oxford, UK.

Kamdem-Toham, A., A.W. Adeleke, N.D. Burgess, R. Carroll, J. D'Amico, E. Dinerstein, D.M. Olson and L. Some. 2003. Forest conservation in the Congo Basin. Science 299: 346.

Koppert, G.J.A., E. Dounias, A. Froment and P. Pasquet. 1996. Consommation alimentaire dans trois populations forestières de la region côtière du Cameroun: Yassa, Mvae et Bakola. *In:* Hladik, C.M., A. Hladik and H. Pagezy (eds.). L'alimentation en forêt tropicale. Interactions bioculturelles et perspectives de développement, pp 477–496. Orstom, Paris.

Lahm, S.A. 2001. Hunting and wildlife in northeastern Gabon: why conservation should extend beyond park boundaries. *In:* Weber, W., L.J.T. White, A. Vedder, and N. Naughton-Treves (eds.). African Rain Forest Ecology and Conservation, pp. 344–354. Yale University Press, New Haven, CT.

Lahm, S.A., R.F.W. Barnes, K. Beardsley and P. Cervinka. 1998. A method for censusing the greater white-nosed

monkey in northeastern Gabon using the population density gradient in relation to roads. Journal of Tropical Ecology 14: 629–643.

Laurance, W.F. 1999. Reflections on the tropical deforestation crisis. Biological Conservation 91: 109–117.

Laurance, W.F. 2000. Cut and run: the dramatic rise of transnational logging in the tropics. Trends in Ecology and Evolution 15: 433–434.

Laurance, W.F. 2001. Tropical logging and human invasions. Conservation Biology 15: 4–5.

Laurance, W.F., A. Alonso, M. Lee and P. Campbell. 2006. Challenges for forest conservation in Gabon, Central Africa. Futures 38: 454–470.

Malcolm, J. and J.C. Ray. 2000. Influence of timber extraction routes on central African small-mammal communities, forest structure, and tree diversity. Conservation Biology 14: 1623–1638.

Maley, J. 1996. The African rain forest – Main characteristics of changes in vegetation and climate from the Upper Cretaceous to the Quaternary. The Royal Society of Edinburgh Proceedings Section B (Biological Sciences) 104: 31–74.

Milner-Gulland, E.J., E.L. Bennett and the SCB 2002. Annual Meeting Wild Meat Group. 2003. Wild meat: the bigger picture. Trends in Ecology and Evolution 18: 351–357.

Mittermeier, R.A., P.R. Gil, M. Hoffmann, J. Pilgrim, T. Brooks, C.G. Mittermeier, J. Lamoreux, G.A.B. da Fonseca. 2004. Hotspots Revisited. Cemex, Mexico City.

Mittermeier, R.A., C.G. Mittermeier, T.M. Brooks, J.D. Pilgrim, W.R. Konstant, G.A.B. da Fonseca and C. Kormos. 2003. Wilderness and biodiversity conservation. Proceedings of the National Academy of Sciences of the United States of America 100: 10309–10313.

Naughton-Treves, L. and W. Weber. 2001. Human dimensions of the African rain forest. *In:* Weber, W., L.J.T. White, A. Vedder, and N. Naughton-Treves (eds.). African Rain Forest Ecology and Conservation, pp. 20–46. Yale University Press, New Haven, CT.

Noss, A.J. 1998. The impacts of cable snare hunting on wildlife populations in the forests of the Central African Republic. Conservation Biology 12: 390–398.

Olson, D.M. and E. Dinerstein. 1998. The Global 200: a representation approach to conserving the earth's most biologically valuable ecoregions. Conservation Biology. 12: 502–515.

Sizer, N. and D. Plouvier. 2000. Increased Investment and Trade by Transnational Logging Companies in Africa, the Caribbean and the Pacific. Joint report of the World Wide Fund for Nature-Belgium, World Resources Institute, and WWF-International.

Stock, R. 2004. Africa South of the Sahara: a Geographical Interpretation. 2nd Edition. The Guilford Press. New York, USA.

Terborgh, J. 1992. Diversity and the Tropical Rain Forest. W.H. Freeman and Company, New York.

Vedder, A., L. Naughton-Treves, A. Plumptre, L. Mubalama, E. Rutagarama and W. Weber. 2001. Conflict and conservation in the African rain forest. *In:* Weber, W., L.J.T. White, A. Vedder, and N. Naughton-Treves (eds.). African Rain Forest Ecology and Conservation, pp. 557–562. Yale University Press, New Haven, CT.

White, L. 2001. The African rain forest: climate and vegetation. *In:* Weber, W., L.J.T. White, A. Vedder, and N. Naughton-Treves (eds.). African Rain Forest Ecology and Conservation, pp. 2–29. Yale University Press, New Haven, CT.

Wilkie, D.S. and J.F. Carpenter. 1999. Bushmeat hunting in the Congo Basin: an assessment of impacts and options for mitigation. Biodiversity and Conservation 8: 927–955.

Wilkie, D.S. and N. Laporte. 2001. Forest area and deforestation in central Africa: current knowledge and future directions. *In:* Weber, W., L.J.T. White, A. Vedder, and N. Naughton-Treves (eds.). African Rain Forest Ecology and Conservation, pp. 119–139. Yale University Press, New Haven, CT.

Wilkie, D.S., J.G. Sidle and G.C. Boundzanga. 1992. Mechanized logging, market hunting, and a bank loan in Congo. Conservation Biology 6: 570–580.

Wilkie, D.S., E. Shaw, F. Rothberg, G. Morelli and P. Auzel. 2000. Roads, development, and conservation in the Congo Basin. Conservation Biology 14: 1614–1622.

Chapter 3

Dragonflies and Damselflies (Odonata) of Lokutu

Klaas-Douwe B. Dijkstra

SUMMARY

Odonata were surveyed during a Rapid Assessment Program (RAP) survey of the Lokutu area in central Democratic Republic of Congo. Eighty-six mostly Guineo-Congolian running-water species were found, with remarkable range extensions, as well as new species of *Platycypha*, *Elattoneura* and *Mesocnemis*. The results indicate a healthy watershed in the Lokutu surroundings, with limited degrees of pollution and streambed erosion. If forest cover and natural stream morphology are retained, the rich dragonfly fauna will be as well. The obtained species list is especially long considering the paucity of stagnant water species and the absence of certain Congolian endemics. This is explained by the absence of their habitat and possibly by the barrier that the extensive forest surrounding Lokutu (still) poses to the dispersal of open land species. The observed richness is probably typical of the Congo Basin as a whole and other areas are expected to be even richer. Therefore the Lokutu area does not require specific conservation action.

Unlike other groups traditionally surveyed in RAPs, Odonata are invertebrates, strongly tied to freshwater, that are not actively exploited by humans. This RAP proved that it is possible to rapidly obtain a clear picture of Odonate diversity, even allowing a partial description of their ecology. The rich and apparently largely natural Odonate fauna found contrasts with the impoverished and imperiled status of the other groups studied. Therefore it is recommended to use Odonata more frequently to supplement biodiversity assessments of traditional groups, especially in the Congo Basin, where sampling Odonata may show whether existing conservation priorities also protect watersheds and freshwater biodiversity.

INTRODUCTION

Odonata (dragonflies and damselflies) are receiving increasing interest from scientists and the 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 for 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 clarity) and amphibious habits make Odonata well suited to be used in 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 critical indicators of the morphology and water quality of their aquatic habitats (e.g., bottom substrate, vegetation structure) while adult Odonata exhibit strong selection with regards to the structure of their terrestrial habitats (e.g., degree of shading). As a consequence, Odonata show strong responses to habitat changes such as 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 often localized 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 groups like plants, butterflies, birds and mammals. Therefore, their study will supplement 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 them easy to study. Extensive experience with monitoring Odonata has been obtained in Europe and elsewhere. The number of dragonfly species occurring in Africa is manageable, their taxonomy is fairly well resolved, and identification is relatively straightforward. Considering the ever-changing nature of the African landscape, be it under human, geological or climatic influence, the study of African Odonata constitutes an exciting challenge, as knowledge of their geography, ecology and phylogeny may help to understand the past and future of a rapidly changing continent.

Called an "evolutionary whirlpool" by Kingdon (1989), the Congo Basin is one of the most interesting parts of Africa for Odonata. From west to east it connects the continent's main rainforests with its main highlands, to the north and south it gently grades through a mosaic of forest, woodland and savannah towards the dry lands of the Sahara and Kalahari. With its forests, rivers and swamps, the Basin itself is an endless succession of prime Odonate habitat. Africa's wet heart is the center of diversity of several genera, especially in Libellulidae, including poorly known genera such as *Aethiothemis*, *Lokia*, *Porpax,* and the aptly named *Congothemis*. Probably the radiation and preservation of Odonate species during Africa's climatic vicissitudes were centered on the Basin.

We largely owe our knowledge of the Congolese fauna to the efforts of Belgian collectors who assembled their material in the 1930s to 1960s. Almost no research took place during the last three decades of the 20th century, while earlier efforts were concentrated in a handful of peripheral regions (Fig. 3.1). The knowledge of most of the lower Basin ('cuvette') is, therefore, marginal.

METHODS

(See Introduction and Map for information on study sites.)

Adult and larval Odonata were observed and caught with a hand net during daylight at freshwater habitats (Table 3.1), and details of their ecology and behavior were noted. Identifications were made using Clausnitzer and Dijkstra (in prep.); nomenclature follows Dijkstra and Clausnitzer (in prep.). Relevant name-changes from that unpublished checklist are provided in the footnotes of Table 3.2.

Collected specimens are deposited in the National Museum of Natural History (RMNH, Leiden, The Netherlands); comparisons with Congolese (type) material were made in the Royal Museum for Central Africa (MRAC, Tervuren, Belgium).

Table 3.1. Principal Odonata study sites in the Lokutu area, DRC. Accuracy of coordinates varies with size of site and precision with which a GPS reading could be taken. All sites lie at approximately 400 m a.s.l.

		Coordinates	Description
Co	Congo near Lokutu	1°10'N 23°37'E	Huge river (> 1 km broad) with mostly forested banks, others sandy or dominated by *Eichhornia*
Du	Dumba	1°17.65'N 23°24.10'E	Large shallow, sandy, clear blackwater stream (4–8 m) with much *Pandanus* and some grassy verges in forest
Lc	Lukumete camp	1°17.6'N 23°25.8'E	Two small streams in forest, partially sandy, muddy, and with much leaf litter
Le	Letissé	1°16.34'N 23°27.23'E	Large shallow, sandy, clear stream (3–5 m) with in disturbed forest
Lg	Lingungu	1°17.6'N 23°25.9'E	Large shallow, sandy, clear stream (2–4 m) within forest
Lk	Lukumete plantation	1°16'N 23°28'E	Swampy streams (1–2 m) in gallery forest opening up into edge of oil palm plantation
Lm	Lingomo	0°55.30'N 23°27.88'E	Small, gravel-bottomed stream (1 m) in gully in forest
Lo	Lokutu plantation	1°08.8'N 23°36.9'E	Oil palm plantation with stagnant waters, such as grassy pools, swampy fishponds, and a disused swimming pool
Lt	Loti	0°55.81'N 23°32.45'E	Larger turbid river (8–12 m) in gallery forest beside oil palm plantation
Lu	Lunua	1°17.73'N 23°23.35'E	Large turbid river (12–18 m) in forest with adjacent flooded areas

RESULTS

Table 3.2 summarizes the records of the species found, and characterizes their ranges and ecology.

DISCUSSION

Because no prior research of Odonata has been undertaken in the Lokutu region, any result from the area greatly supplements the knowledge of the Congolese fauna. However, interpretation of the results is difficult, as there are limited references for comparison. The nearest sites with reasonable inventories are Bambesa, 350 km to the northeast, and the Kungu and Mbandaka areas 550–600 km to the west (Fig. 3.1). Not only are these sites distant, they also differ biogeographically and ecologically, lying on the northwestern edge of the Ituri Forest and the swamp forest heart of the 'Cuvette Centrale' respectively.

The total of 86 species found is high, especially considering that only 24 (28%) of species found are widespread Afrotropical species: the remaining 62 (72%) are Guineo-

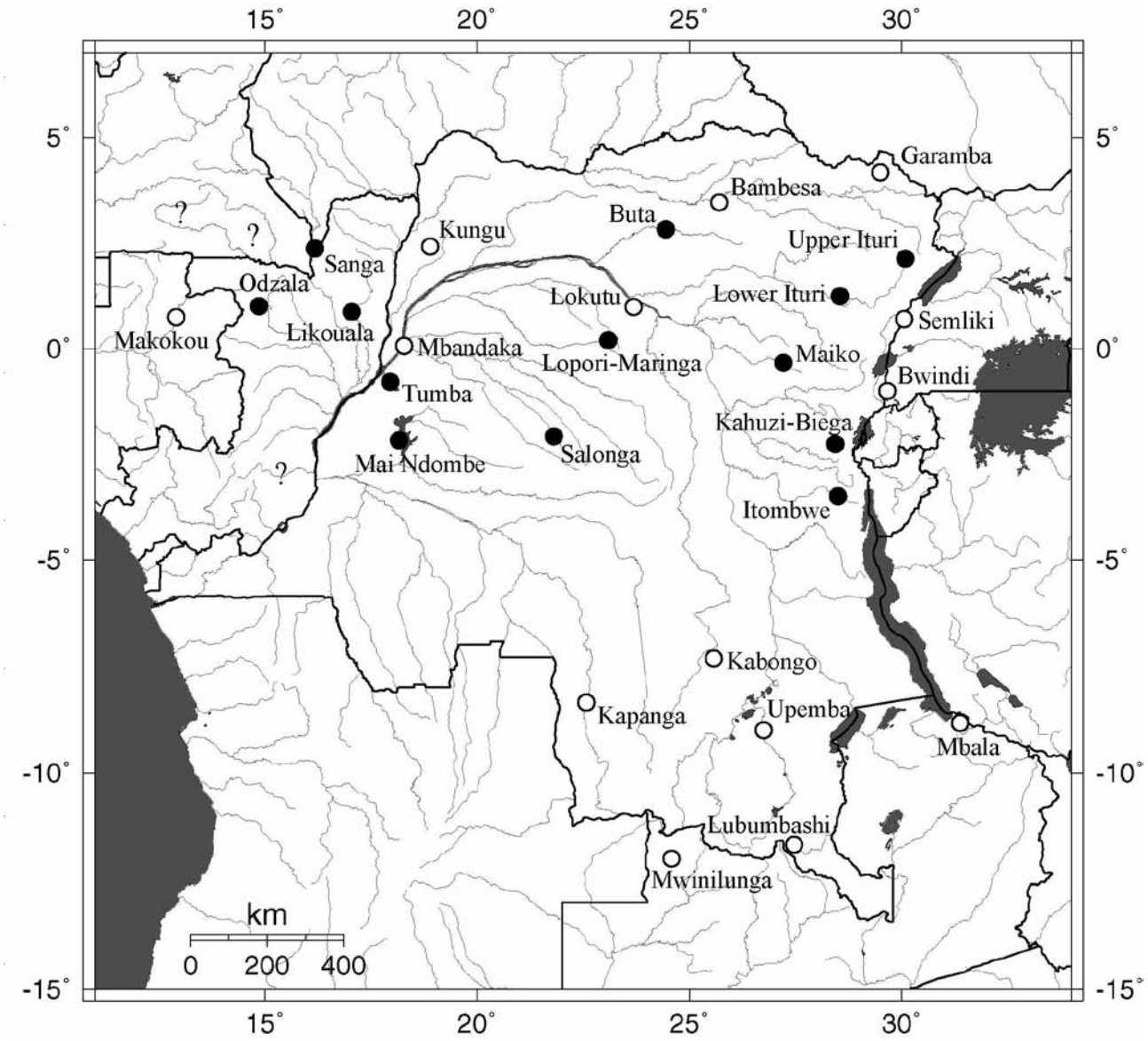


Figure 3.1. Position of Lokutu relative to sites with reasonable historic data (open circles) and selected sites within areas of highest and high conservation priority (filled circles), none of which have been surveyed for Odonata. Possible additional sites of conservation importance are indicated by question marks. Priorities follow the assessment of the Congo Basin Forest Partnership. Lokutu and other open circle sites do not lie within CBFP areas of conservation priority.

Table 3.2. Species of Odonata recorded from the Lokutu area, DRC. See Table 3.1 for site details and names. Preferences are inferred from observations during fieldwork, augmented with previous experience. Clear preferences are indicated with capital letters. Less clear preferences are bracketed, either because data were insufficient, a species is catholic in its choice, or the habitat is of secondary importance to the species.
S: status (1: single record, S: several observations, M: many observations)
B: biogeography of the species (A: all over tropical Africa including savannahs, B: confined to Congo Basin, C: confined to Central Africa (eastern Nigeria to western Kenya), E: ranging largely in forest of Eastern Africa (eastern DRC to western Kenya), W: West and Central Africa
R: breeds in running water (S: small streams, M: large streams and small rivers, L: large rivers)
St: breeds in standing water (pools, swamps)
F: favors forested habitats and avoids open areas
O: favors open habitats avoiding forest (farmland, bush, savannah).

							Sites									
	S	B	R	St	F	O	Lo	Lm	Lc	Lk	Lg	Le	Du	Lt	Lu	Co
ZYGOPTERA																
Calopterygidae																
***Phaon* Selys, 1853**																
Phaon camerunensis Sjöstedt, 1900	M	W	L		F										+	
***Umma* Kirby, 1890**																
Umma cincta (Hagen in Selys, 1853)	1	W	M		F											
Umma longistigma (Selys, 1869)	M	C	M		F						+	+	+			
Umma saphirina Förster, 1916	M	C	S		F			+	+			(+)				
Chlorocyphidae																
***Chlorocypha* Fraser, 1928**																
Chlorocypha aphrodite (Le Roi, 1915)	M	B	M		F					+	+	+	+			
Chlorocypha pyriformosa Fraser, 1947	M	W	L		F									+	+	+
Chlorocypha cf. *trifaria* (Karsch, 1899)	M	E	S		F			+			+	+				
***Platycypha* Fraser, 1949**																
Platycypha sp. nov.	M	B	M		(f)						+	+				
Protoneuridae s.s.																
***Elattoneura* Cowley, 1935**																
Elattoneura centrafricana Lindley, 1976	S	B	S		F				+	+						
Elattoneura sp. nov. cf. *lliba* Legrand, 1985	M	B	SM		F			+	+		+	+	+			
***Prodasineura* Cowley, 1934**																
Prodasineura vittata (Selys, 1886)	S	C	S		F			+								
Platycnemididae s.l.																
***Chlorocnemis* Selys, 1863**																
Chlorocnemis cyanura Förster, 1909 [1]	S	C	S		F				+							

continued

Table 3.2. *continued*

							Sites									
	S	**B**	**R**	**St**	**F**	**O**	**Lo**	**Lm**	**Lc**	**Lk**	**Lg**	**Le**	**Du**	**Lt**	**Lu**	**Co**
Chlorocnemis nigripes Selys, 1886	S	C	S		F			+								
Chlorocnemis pauli Longfield, 1936	S	E	S		F			+								
***Mesocnemis* Karsch, 1891**																
Mesocnemis singularis Karsch, 1891	1	A	L		(f)	(o)										+
Mesocnemis sp. nov.	S	B	L		(f)	(o)										+
***Platycnemis* Burmeister, 1839**																
Platycnemis nyansana Förster, 1916 [2]	M	E		St	F					+			(+)		(+)	(+)
Coenagrionidae																
***Agriocnemis* Selys, 1877**																
Agriocnemis forcipata Le Roi, 1915	M	C		S	(f)	(o)	+							(+)		
Agriocnemis maclachlani Selys, 1877	S	W		S	(f)					+				(+)		
Agriocnemis stygia Fraser, 1954	1	B		?	F											(+)
***Ceriagrion* Selys, 1876**																
Ceriagrion corallinum Campion, 1914	S	W		S	(f)	(o)	+									
Ceriagrion glabrum (Burmeister, 1839)	M	A		S		O	+									
Ceriagrion ignitum Campion, 1914	M	W		S	(f)	(o)	+									
***Pseudagrion* Selys, 1876 (A-group)**																
Pseudagrion kibalense Longfield, 1959	M	E	S		F			+	+		+	(+)		(+)		
Pseudagrion melanicterum Selys, 1876	M	W	M		(f)	(o)	+					+		+		
Pseudagrion simplicilaminatum Carletti & Terzani, 1997	S	B	M		F								+			
Pseudagrion superbum Fraser, 1956	M	B	M		F						+		+			
***Pseudagrion* Selys, 1876 (B-group)**																
Pseudagrion glaucum (Sjöstedt, 1900) [3]	M	W	L	S	(f)		+									+
Pseudagrion nubicum Selys, 1876	M	A	L			O										+
Pseudagrion sjoestedti Förster, 1906	1	A	L		(f)	(o)										+
ANISOPTERA																
Aeshnidae																
***Heliaeschna* Selys, 1882**																
Heliaeschna fuliginosa Selys, 1883	1	W	S		F				+							

continued

Table 3.2. *continued*

							Sites									
	S	B	R	St	F	O	Lo	Lm	Lc	Lk	Lg	Le	Du	Lt	Lu	Co
Gomphidae																
***Diastatomma* Burmeister, 1839**																
Diastatomma selysi Schouteden, 1934	S	E	SM		F				+		+					
***Gomphidia* Selys, 1854**																
Gomphidia bredoi (Schouteden, 1934)	S	W	L		(f)	(o)										+
***Ictinogomphus* Cowley, 1934**																
Ictinogomphus regisalberti (Schouteden, 1934)	M	B	L		F									+	+	+
***Lestinogomphus* Martin, 1911**																
Lestinogomphus sp.	1	?	L		F?											+
***Neurogomphus* Karsch, 1890**																
Neurogomphus cf. *chapini* (Klots, 1944)	S	B	L		F?											+
Neurogomphus cf. *uelensis* Schouteden, 1934	1	C	L		F?											+
***Paragomphus* Cowley, 1934**																
Paragomphus acuminatus Fraser, 1949	M	B	L		F											+
Paragomphus nigroviridis Cammaerts, 1969	S	W	M		F						+					
***Phyllogomphus* Selys, 1854**																
Phyllogomphus annulus Klots, 1944	1	B	M		F									+		
Phyllogomphus coloratus Kimmins, 1931	S	C	ML		F						+					+
Libellulidae																
***Acisoma* Rambur, 1842**																
Acisoma trifidum Kirby, 1889	M	W		S	(f)		+									
***Aethriamanta* Kirby, 1889**																
Aethriamanta rezia Kirby, 1889	1	A		S	(f)	(o)	+									
***Brachythemis* Brauer, 1868**																
Brachythemis lacustris (Kirby, 1889)	M	A	L		(f)	(o)										+
Brachythemis leucosticta (Burmeister, 1839)	M	A	L	S		O										+
***Chalcostephia* Kirby, 1889**																
Chalcostephia flavifrons Kirby, 1889	M	A		S?	(f)	(o)	+			+				(+)		
***Congothemis* Fraser, 1953**																
Congothemis apicalis (Fraser, 1954) [4]	1	C	?	?	F			(+)								
***Cyanothemis* Ris, 1915**																
Cyanothemis simpsoni Ris, 1915	M	W	ML		F								+		+	

continued

Table 3.2. *continued*

							Sites									
	S	B	R	St	F	O	Lo	Lm	Lc	Lk	Lg	Le	Du	Lt	Lu	Co
***Eleuthemis* Ris, 1910**																
Eleuthemis buettikoferi Ris, 1910	M	W	L		F										+	
***Hadrothemis* Karsch, 1891**																
Hadrothemis coacta (Karsch, 1891)	S	W		S	F			(+)								
Hadrothemis defecta (Karsch, 1891)	M	W	?	S	F		+		+	+		+				
Hadrothemis infesta (Karsch, 1891)	S	W		S	F											
Hadrothemis versuta (Karsch, 1891)	M	W	?	S	F		+	+		+						
Hadrothemis vrijdaghi Schouteden, 1934	1	B		S?	F										(+)	
***Micromacromia* Karsch, 1890**																
Micromacromia camerunica Karsch, 1890	M	C	SM		F				+		+					
***Neodythemis* Karsch, 1889**																
Neodythemis klingi (Karsch, 1890) [5]	S	W	SM		F				+		+					
***Nesciothemis* Longfield, 1955**																
Nesciothemis farinosa (Förster, 1898)	M	A	?	?		O	+			+		+				
***Notiothemis* Ris, 1919**																
Notiothemis robertsi Fraser, 1944	S	W	S?	S	F			+	+							
***Olpogastra* Karsch, 1895**																
Olpogastra lugubris Karsch, 1895	M	A	L			O	+							+		+
***Orthetrum* Newman, 1833**																
Orthetrum austeni (Kirby, 1900)	M	W	?	S	(f)	O	+			+						
Orthetrum brachiale (Palisot de Beauvois, 1817)	1	A		S		O										
Orthetrum chrysostigma (Burmeister, 1839)	1	A		S?		O	+									
Orthetrum hintzi Schmidt, 1951	M	A		S		O	+									
Orthetrum julia Kirby, 1900	1	A	S		(f)	(o)		+								
Orthetrum microstigma Ris, 1911	M	W	M		(f)	(o)				+	+	+				
Orthetrum saegeri Pinhey, 1966	1	W	?		F					+						
Orthetrum stemmale (Burmeister, 1839)	M	A		S	(f)	(o)	+		+							
***Oxythemis* Ris, 1910**																
Oxythemis phoenicosceles Ris, 1910	M	W	?	S	(f)		+			+					(+)	
***Palpopleura* Rambur, 1842**																
Palpopleura deceptor (Calvert, 1899)	1	A		S		O	+									
Palpopleura lucia (Drury, 1773)	M	A		S		O	+							(+)		
Palpopleura portia (Drury, 1773)	M	A		S		O	+							(+)		

continued

Table 3.2. *continued*

							Sites									
	S	B	R	St	F	O	Lo	Lm	Lc	Lk	Lg	Le	Du	Lt	Lu	Co
***Pantala* Hagen, 1861**																
Pantala flavescens (Fabricius, 1798)	M	A		S		O	+							(+)		+
***Porpax* Karsch, 1896**																
Porpax asperipes Karsch, 1896	S	C		S?	F				+							
***Rhyothemis* Hagen, 1867**																
Rhyothemis notata (Fabricius, 1787)	1	A		S	(f)	(o)					(+)			(+)		
***Tetrathemis* Brauer, 1868**																
Tetrathemis camerunensis (Sjöstedt, 1900) [6]	M	W	?	S	(f)					+				+		
***Thermochoria* Kirby, 1889**																
Thermochoria equivocata Kirby, 1889	S	W		S?	F									(+)		
***Tholymis* Hagen, 1867**																
Tholymis tillarga (Fabricius, 1798)	S	A	L	S	(f)	(o)	+									+
***Tramea* Hagen, 1861**																
Tramea basilaris (Palisot de Beauvois, 1817)	S	A		S		O										
***Trithemis* Brauer, 1868**																
Trithemis dichroa Karsch, 1893	1	W	M			O?										
Trithemis grouti Pinhey, 1961	1	W	L			O										+
Trithemis nuptialis Karsch, 1894	M	C	SM		(f)	(o)	+			+						
***Urothemis* Brauer, 1868**																
Urothemis assignata (Selys, 1872)	1	A		S		O	+									
Urothemis edwardsii (Selys, 1849)	1	A	L	S		O	+									+
***Zygonoides* Fraser, 1957**																
Zygonoides occidentis (Ris, 1912) [7]	S	C	L		(f)											+
***Zygonyx* Hagen, 1867**																
Zygonyx flavicosta (Sjöstedt, 1900)	1	W	ML		F									+		
Zygonyx regisalberti (Schouteden, 1934)	S	C	M		F						+					

[1] Formerly placed in *Isomecocnemis* Cowley, 1936.
[2] Formerly erroneously known as *P. congolensis* Martin, 1908.
[3] Formerly known by synonym *P. basicornu* Schmidt in Ris, 1936.
[4] Formerly placed in *Anectothemis* Fraser, 1954 and known by synonym *Porpacithemis trithemoides* Fraser, 1958.
[5] Formerly placed in *Allorrhizucha* Karsch, 1890.
[6] Includes probable synonym *T. bifida* Fraser, 1941.
[7] Formerly placed in *Olpogastra* Karsch, 1895 as a subspecies of *O. fuelleborni* Grünberg, 1902.

Congolian species. Of this group 47% of the species occur almost throughout the Guineo-Congolian realm (i.e., well into West Africa), but the other 53% are more localized, restricted to the forested center of the continent. Thirteen of the species (almost one in six) have yet to be found outside the Congo Basin.

The fairly well studied Bwindi Impenetrable National Park and Semliki National Park of Uganda, both on the DRC border (Fig. 3.1), have 65 and 91 species, respectively, of which 45 (69%) and 47 (52%) are non-widespread species (K.-D.B. Dijkstra, pers. obs.). In comparison, the Lokutu area has a richer fauna of localized (generally forest-associated) odonates. If all widespread species found at Semliki occur around Lokutu (a reasonable assumption), the list would already stand at 109 species. With the addition of poorly sampled groups (see below), the local fauna could number over 125 species. The relative poverty of the western Uganda forests may be a periphery effect: fewer Guineo-Congolian species reach that far east.

Many widespread, well-dispersing species of Odonata are absent from our collection. Ubiquitous savannah species, such as those in the genus *Crocothemis* and the red group of *Trithemis* species, were totally absent, even in disturbed habitats. Some forest groups were also poorly represented: the lack of gynacanthine aeshnids (only *Heliaeschna fuliginosa* was collected, ten more species are possible in the central Basin) and macromiids (up to ten species possible) was also notable, although, in the latter case, several species were observed but could not be caught for identification. MRAC has almost no Odonata from Elisabetha (the historic name of Lokutu), but remarkably among these are *Gynacantha africana* (Palisot de Beauvois, 1807), *G. bullata* Karsch, 1891, *G. manderica* Grünberg, 1902 (a dark Congo Basin form of this savannah species) and *G. sextans* McLachlan, 1896. The discrepancy with our collection could be the effect of season or method: these crepuscular insects may fly into lit buildings at night, although none were among the myriads of insects drawn to the Lokutu Guesthouse during our stay (Dijkstra 2005).

Also notable was the paucity of two categories of characteristic Congo Basin species. Firstly, several taxa that are common and widespread in open habitats in Africa (e.g., savannah) are replaced in the Basin by a larger and darker form (these have been variously treated as species, subspecies or mere varieties). Of collected adults, only the dark Congolian form of *Gomphidia bredoi* belonged to this category. However, exuviae were found that must pertain to the unknown larva of *Zygonoides occidentis* (Fig. 3.2) and a historic *G. manderica* record (housed at the MRAC, see above) also pertained to a Congolian variety. Secondly, the only sign of the endemic libellulid diversity mentioned in the introduction were single specimens of *Congothemis apicalis* and *Hadrothemis vrijdaghi*.

The observed poverty of libellulids, aeshnids and Congolian open land forms is probably explained by the selection of habitats encountered in the region. A flight over the basin revealed numerous other habitat types that are likely to hold these species, such as forested and open swamps, seasonally flooded forest, oxbows, and medium-sized rivers (intermediate between the streams and the Congo River sampled during the survey). These all have stagnant or slow-flowing water, as is typically inhabited by the missing taxa. The wealth of encountered species, especially of the more localized ones, lies in Zygoptera and Gomphidae, which principally inhabit flowing water. The most interesting records obtained belong to these two groups, and are discussed below.

Logically, many of the records constitute range extensions: for instance *Chlorocnemis pauli*, *Pseudagrion kibalense* and *P. superbum* had not been previously found so far west and on the southern side of the Congo River. *Ceriagrion ignitum* (Fig. 3.3f) was previously known only from the Ghanaian type series and its rediscovery in an anthropogenic habitat (fishponds and a disused swimming pool) 2700 km to the east comes as a surprise (Dijkstra 2006). *Pseudagrion simplicilaminatum* (Fig. 3.3e) and *Phyllogomphus coloratus* (Fig. 3.3h) were not known east of Congo-Brazzaville (Carletti and Terzani 1997, F. Terzani pers. comm., Dijkstra et al. 2006). *Chlorocypha pyriformosa* was not known east of Nigeria (Dijkstra 2003), but the discovered populations are somewhat aberrant.

Three species appear to be new to science. Finding distinctive species of the conspicuous but small genera *Platycypha* (Fig. 3.3c) and *Mesocnemis* (Figs 3.4–3.5) is remarkable. With the exception of the widespread *P. caligata* and *P. lacustris*, all *Platycypha* species have rather restricted ranges (Fig. 3.6). The new species fills a gap in the genus's distribution in the central Congo Basin. Although the abdominal coloration is highly distinctive (Fig. 3.7), the new species could not be distinguished genetically from the two widespread species, despite the use of a marker that normally suffices well to separate dragonflies at the species level (H. Hadrys pers. comm.).

All *Mesocnemis* species are superficially alike and inhabit rivers. They can be separated by structural details on the male appendages (Fig. 3.4) and anteriorly on the female thorax (Fig. 3.5), which interlock in courtship, as was the case of the illustrated type pair. While the two species shown in Fig. 3.4 are widespread in Africa, with *M. singularis* collected at the same site as the new species, two others species of *Mesocnemis* are only known from Senegambia and Liberia respectively. The new species may be endemic to the Congo River, where it was discovered.

A third probable new species belongs to the difficult genus *Elattoneura*, but this genus is also present in the MRAC collections. The observed specimens of *C. trifaria* do not conform with typical populations of that species (Fig. 3.3a). A female *Lestinogomphus,* found emerging from the Congo River, seems larger than any known species, but the genus's taxonomy is fragmentary and based on male characters.

As stated, the richness of the Lokutu fauna lies in running-water forest species: the relative diversity of species of this

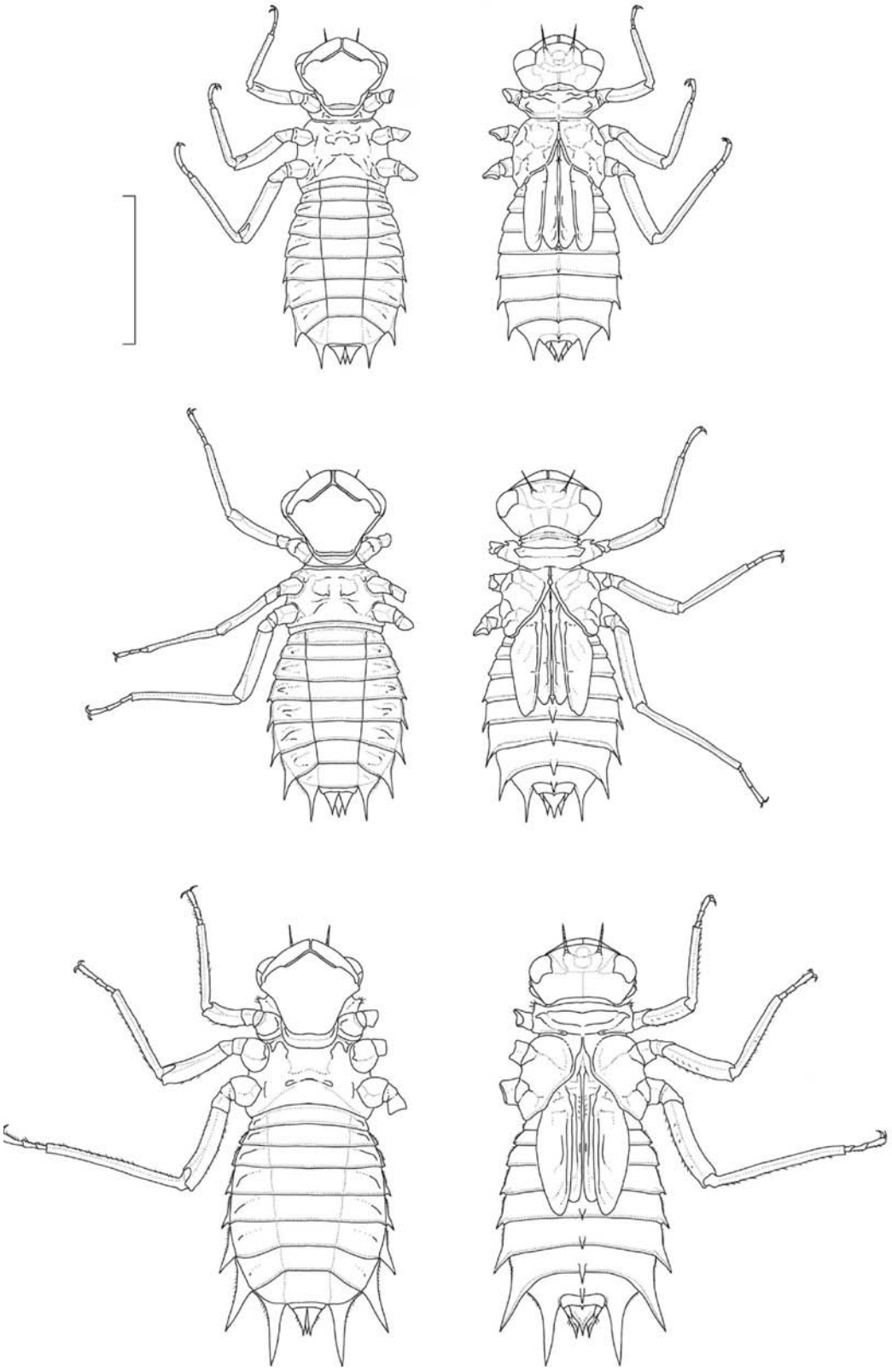


Figure 3.2. Ventral (left) and dorsal (right) view of larval exuviae of the three continental *Afrotropical Zygonoides* species, from top to bottom *Z. fuelleborni, Z. fraseri* and *Z. occidentis*. The latter was the last to be discovered, at Lokutu. *Zygonoides* is an example of an openland taxon (inhabits large rivers), which has a Congo Basin representative that is large and dark (in the adult). The scale represents 10mm. Drawings by Ole Müller.

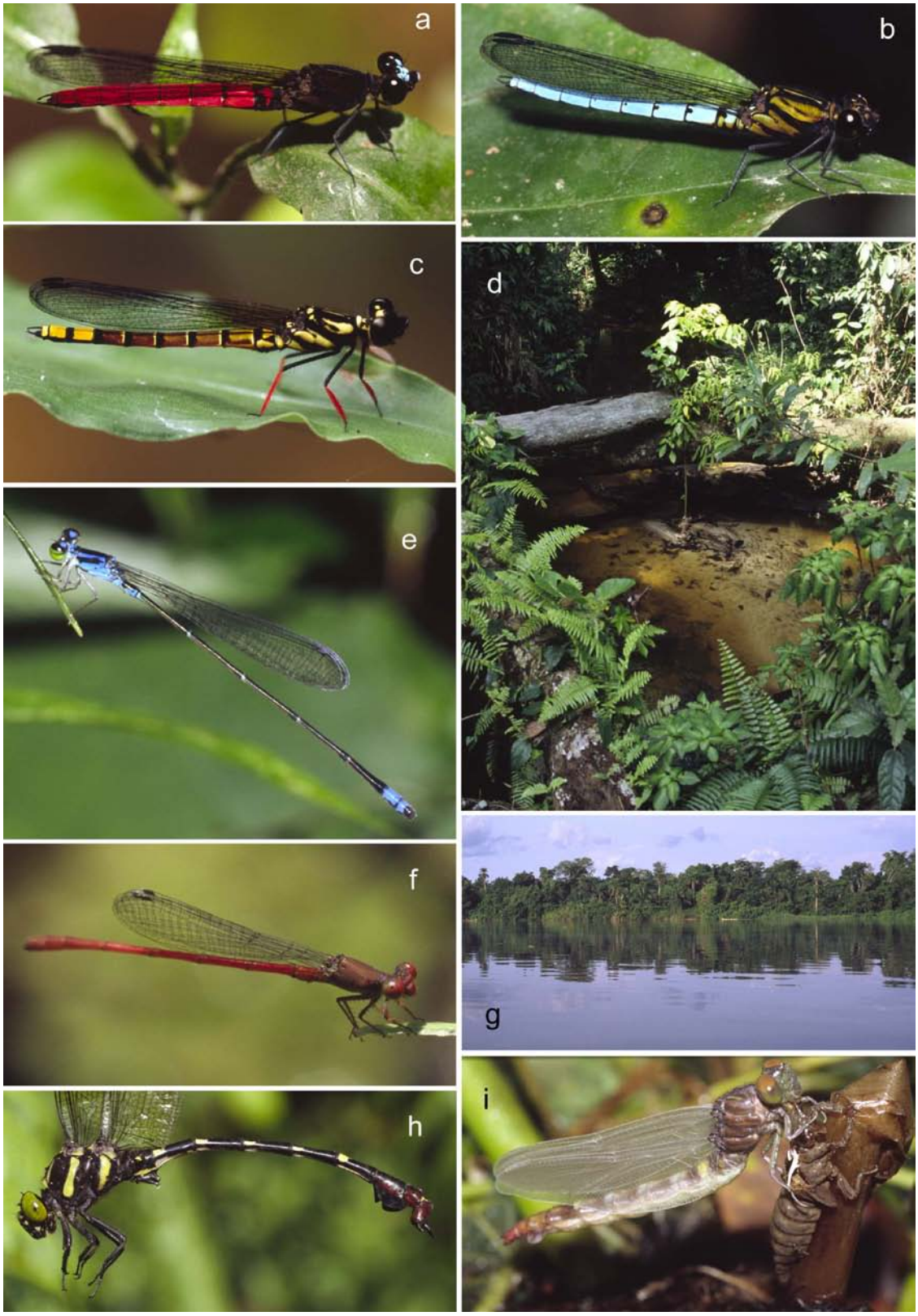


Figure 3.3. Some odonatological highlights at Lokutu: (a) male *Chlorocypha* cf. *trifaria*; (b) male *Chlorocypha aphrodite*; (c) male *Platycypha* spec. nov.; (d) Letissé River, the type locality of *Platycypha* spec. nov.; (e) male *Pseudagrion simplicilaminatum*; (f) male *Ceriagrion ignitum*; (g) forested bank of Congo River; (h) male *Phyllogomphus coloratus* in the hand; (i) emerging female *P. coloratus*. All photos by K.-D.B. Dijkstra.

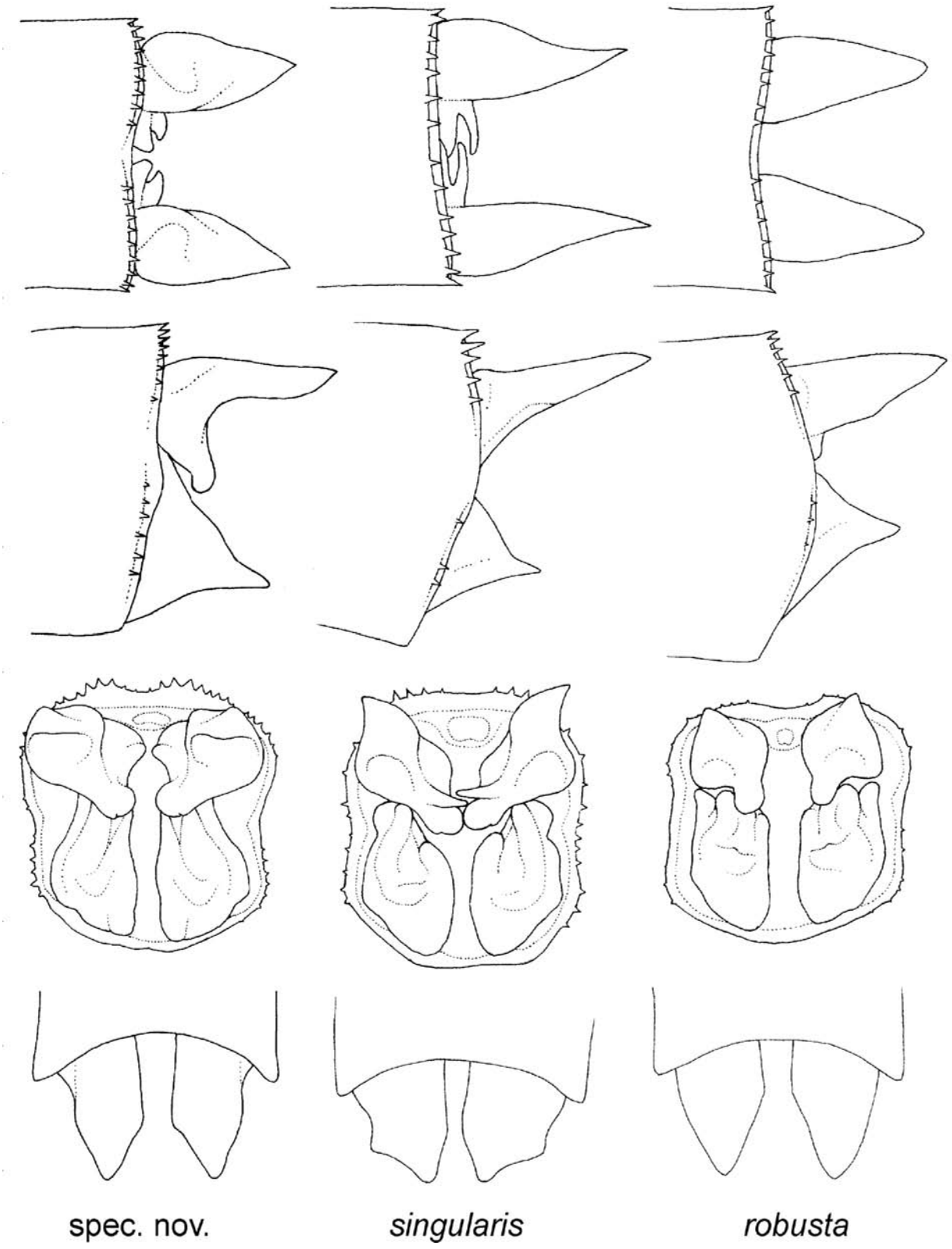


Figure 3.4. *Mesocnemis* male appendages (cerci and paraprocts), from top to bottom in dorsal (paraprocts omitted), lateral, caudal and ventral view (cerci omitted).

specialization (at least 32 species, which is 37% of recorded species) lies above that of Semliki (23, 25%) and Bwindi (23, 35%). Within this community, only the Zygoptera can be readily surveyed thoroughly and for this group data are available to describe the ecological segregation of the species (Table 3.3): openness is the main determinant of habitat selection, both at a large (water body size) and a fine scale (shading of banks). The obligate stream-dwelling families Calopterygidae and Chlorocyphidae showed marked segregation of species, with seldom more than one species of each at a site. Of the small 'coenagrionoid' families, Coenagrionidae *s.s.* are concentrated in the calmer, more open habitats, with a distinct separation between the A- and B-groups of Africa's dominant damselfly genus *Pseudagrion*, while the other two families are most speciose at the shaded small stream end of the habitat gradient. Dijkstra and Lempert (2003) found a similar pattern in West Africa, with a somewhat different mix of species (usually in the same genera) occupying niches.

For the running-water anisopterans the picture is still fragmentary. One of the survey's most interesting results is

Table 3.3. Ecological segregation of damselflies (Zygoptera) observed at Lokutu, DRC. Two families are combined because taxonomic limits are uncertain. The positions of two species that were not found at the waterside are assumed. Macrohabitat is indicated in columns. Microhabitat is indicated by shading: dark gray — found in predominantly shaded areas, light gray — found in half-open areas, or none — found in largely open areas.

	Small streams	Large streams and small rivers	Large rivers	Standing water
Calopterygidae	*Umma saphirina*	*Umma longistigma* *Umma cincta* ?	*Phaon camerunensis*	
Chlorocyphidae	*Chlorocypha* cf. *trifaria*	*Chlorocypha aphrodite* *Platycypha* sp. nov.	*Chlorocypha pyriformosa*	
Protoneuridae + Platycnemididae	*Prodasineura vittata* *Elattoneura centrafricana* *Chlorocnemis cyanura* *Chlorocnemis nigripes* *Chlorocnemis pauli*	*Elattoneura* sp. nov.	*Mesocnemis* sp. nov. *Mesocnemis singularis*	*Prodasineura nyansana*
Coenagrionidae	*Pseudagrion* (A) *kibalense*	*Pseudagrion* (A) *simplicilaminatum* *Pseudagrion* (A) *superbum* *Pseudagrion* (A) *melanicterum*	*Pseudagrion* (B) *glaucum* *Pseudagrion* (B) *sjoestedti* *Pseudagrion* (B) *nubicum*	*Agriocnemis stygia* ? *Agriocnemis forcipata* *Agriocnemis maclachlani* *Ceriagrion corallinum* *Ceriagrion glabrum* *Ceriagrion ignitum*

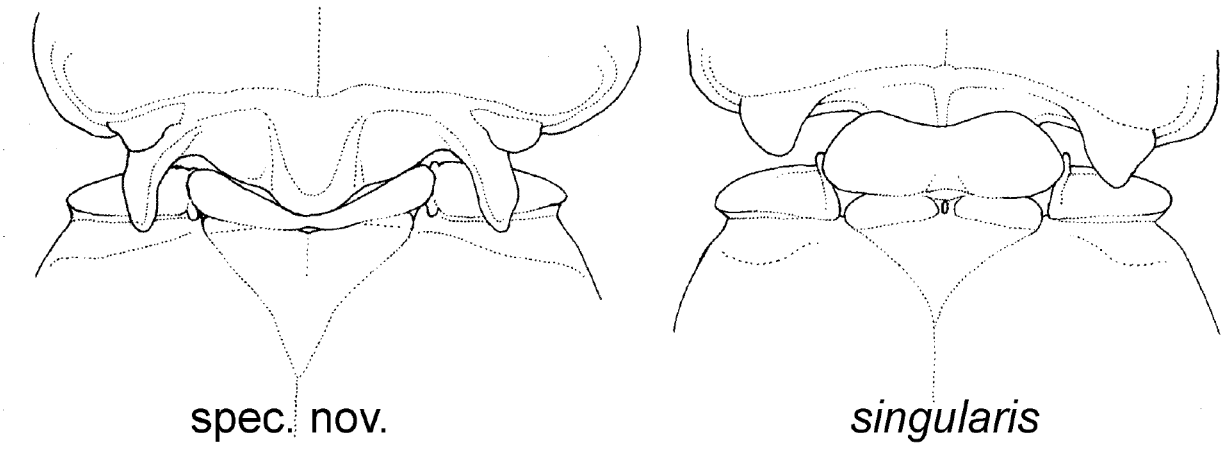


Figure 3.5. *Mesocnemis* female hind margin of pronotum and mesostigmal region of synthorax in dorsal view.

the diverse gomphid community found on the huge Congo River (3–3.5 km across at Lokutu, fragmented by numerous islands, Fig. 3.3g). Because adults emerge at night and rarely come to water, mature adults of river gomphids are seldom collected. Dusk is possibly the main time for reproductive activity, which may largely take place above the water far from the banks: in the case of the Congo River, 1 km or more from the water's edge. Nonetheless, a couple of hours spent coursing the river at dusk and scouring the banks around midnight and in the morning revealed (mostly through emerging adults and larval exuviae) that seven species in seven different (sub)genera (probably) reproduce in the river: *Gomphidia bredoi*, *Ictinogomphus regisalberti*, *Lestinogomphus* sp., *Neurogomphus* (*Mastigogomphus*) cf. *chapini*, *N.* (*Neurogomphus*) cf. *uelensis*, *Paragomphus acuminatus* and *Phyllogomphus coloratus* (Fig. 3.3i). The discovery of the aberrant and previously unknown larvae of the very distinctive subgenus *Mastigogomphus* of *Neurogomphus*, and the atypical *P. acuminatus* were among the taxonomically most significant findings of the survey.

Odonates were the only invertebrate group included in the RAP survey. Moreover, they differ from most other groups studied in that they are not actively exploited (i.e., not hunted or logged) and in their strong ties to water. They, therefore, serve to assess the more indirect anthropogenic disturbance by man: the gradual alteration of the landscape. The rich and 'intact' (i.e., no unexplained gaps in Table 3.3) forest stream community of Odonata found in the Lokutu area suggests a healthy watershed, with limited degrees of pollution and streambed erosion. Indeed, most streams, including those within the plantation, were forested. Those that were not had poor assemblages consisting mainly of widespread species. As long as forest cover and natural stream morphology are retained, the rich dragonfly fauna is expected to persist. The obtained species list, which represents about one-tenth of described Afrotropical Odonata,

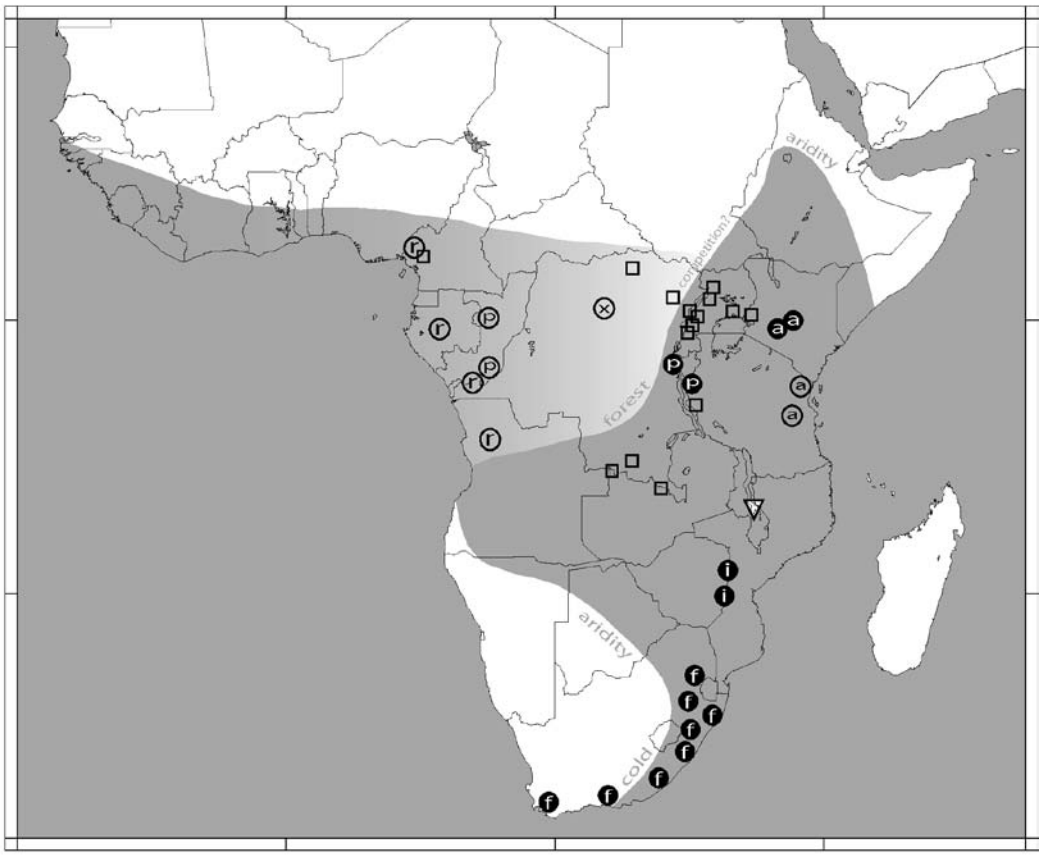


Figure 3.6. Distribution of *Platycypha*. Open circles: relictual species of lowland occurrence (a: *P. auripes*; p: *P. picta*; r: *P. rufitibia*; x: new species found at Lokutu). **Black circles:** relictual species of submontane occurrence (a: *P. amboniensis*; f: *P. f. fitzsimonsi*; i: *P. f. inyangae*; p: *P. pinheyi*). **Squares:** *P. lacustris*. **Dark shading:** *P. caligata*, the only truely non-forest species of the family Chlorocyphidae in Africa, with possible factors limiting its spread westwards indicated. **Triangle:** Aberrant lacustrine population of *P. caligata* (all other family members are strictly riverine). **Paler shading:** main range of other Chlorocyphidae (areas with two or more species), mostly Chlorocypha, outside that of *Platycypha*.

is especially long considering the paucity of standing water species of both forested and open habitats. The absence of numerous well-dispersing open land species suggests that the extensive forest that still surrounds Lokutu may form an insurmountable barrier.

None of the recorded species are included in the global Red List. In contrast to northern, eastern and southern Africa, the Odonata of central and western Africa have not yet been assessed, as data is either limited or fragmented (Dijkstra and Vick 2004). Nonetheless, none of the recorded species are likely threatened. Moreover, the area does not support certain Congolian endemics, probably because their habitat is absent (see above). I believe that the observed richness is typical of the Basin as a whole and therefore the Lokutu area does not require specific conservation action. Indeed, considering observed gaps in the Odonate assemblage, other areas are expected to be even richer.

The main message that follows from the survey of Lokutu's Odonata is not about the study area, but about the study group. This was the first RAP survey in Africa to include Odonata, and it proved possible to obtain a fair picture of the local diversity within a short period of time (Table 3.2), even allowing a partial description of their ecology (Table 3.3). This picture indicated a rich and apparently largely natural fauna, which probably represents high overall aquatic biodiversity, contrasting sharply with the impoverished and imperiled fauna and flora indicated by the other groups studied. Because of their 'information-rich' potential, I recommend that Odonata are placed more at the forefront of RAP and conservation policy. The group is very 'RAPable' and is complementary to traditional RAP taxa, such as large mammals. Particularly in the Congo Basin, the largest and probably most intact forest-water ecosystem in Africa, an emphasis on Odonate research seems beneficial as a baseline for biodiversity and watershed conservation. Sampling a network of sites (Fig. 3.1) for these charismatic insects (Fig. 3.3) can demonstrate whether existing conservation priorities in the Basin also protect its freshwater biodiversity.

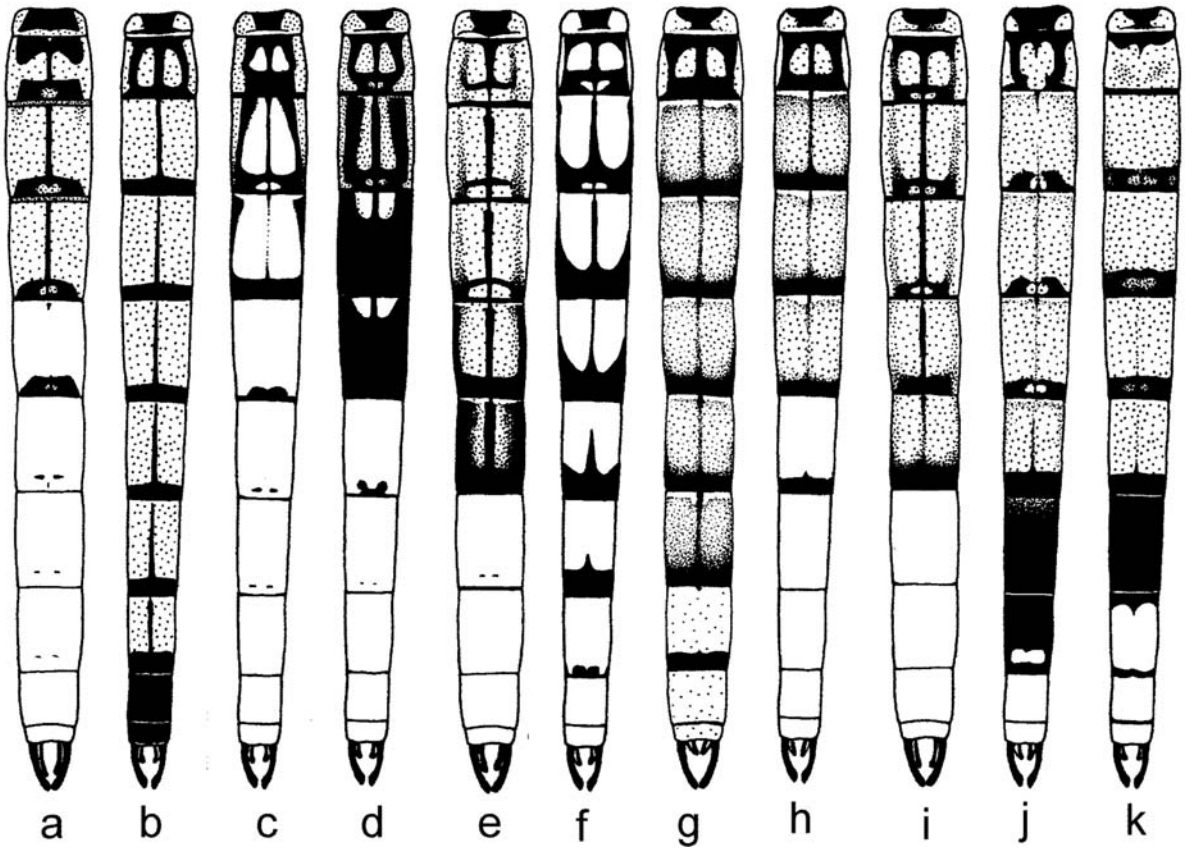


Figure 3.7. Platycypha male abdomens in dorsal view. Dotted areas are yellow to brown or red, undotted blue. (a) *P. amboniensis;* (b) *P. auripes;* (c) *P. caligata* typical; (d) *P. caligata* aberrant lacustrine form; (e) *P. fitzsimonsi;* (f) *P. lacustris;* (g) new species found at Lokutu; (h) *P. picta;* (i) *P. pinheyi;* (j) dark *P. rufitibia,* Cameroon; (k) pale *P. rufitibia,* Angola.

REFERENCES

Carletti, B. and F. Terzani. 1997. Descrizione di *Pseudagrion simplicilaminatum* spec. nov. della Repubblica del Congo (Odonata: Coenagrionidae). Opuscula zoologica fluminensia 152: 1–7.

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

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.

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

Dijkstra, K.-D.B. 2003. Problems in *Chlorocypha* classification: four cases from West Africa and a discussion of the taxonomic pitfalls (Odonata: Chlorocyphidae). International Journal of Odonatology 6: 109–126.

Dijkstra, K.-D.B. 2005. Taxonomy and identification of the continental African *Gynacantha* and *Heliaeschna* (Odonata: Aeshnidae). International Journal of Odonatology 8: 1–33.

Dijkstra, K.-D.B. 2006. A review of continental Afrotropical *Ceriagrion* (Odonata: Coenagrionidae). Journal of Afrotropical Zoology 2: 3–14.

Dijkstra, K.-D.B., V. Clausnitzer and G.S. Vick. 2006. Revision of the three-striped species of *Phyllogomphus* (Odonata, Gomphidae). Tijdschrift voor Entomologie 149: 1–14.

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 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 G.S. Vick. 2004. Critical species of Odonata in western Africa. *In*: Clausnitzer, V. and R. Jödicke (eds). Guardians of the Watershed. Global status of dragonflies: critical species, threat and conservation. International Journal of Odonatology 7: 229–238.

Kingdon, J. 1989. Island Africa. Princeton University Press, Princeton.

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* Paraguay: Río Paraguay Basin. Chernoff, B., P.W. Willink and J. R. Montambault (eds.). 2001. A biological assessment of the Río Paraguay Basin, Alto Paraguay, Paraguay. RAP Bulletin of Biological Assessment 19. Conservation International, Washington, DC.

* Perú: Tambopata-Candamo Reserved Zone. Foster, R.B., J.L. Carr and A.B. Forsyth (eds.). 1994. The Tambopata-Candamo Reserved Zone of southeastern Perú: A Biological Assessment. RAP Working Papers 6. Conservation International, Washington, DC.

* Perú: Cordillera de Vilcabamba. Alonso, L.E., A. Alonso, T. S. Schulenberg and F. Dallmeier (eds.). 2001. Biological and Social Assessments of the Cordillera de Vilcabamba, Peru. RAP Working Papers 12 and SI/MAB Series 6. Conservation International, Washington, DC.

* Suriname: Coppename River Basin. Alonso, L.E. and H.J. Berrenstein (eds.). 2006. A rapid biological assessment of the aquatic ecosystems of the Coppename River Basin, Suriname. RAP Bulletin of Biological Assessment 39. Conservation International, Washington, DC.

* Venezuela: Caura River Basin. Chernoff, B., A. Machado-Allison, K. Riseng and J.R. Montambault (eds.). 2003. A Biological Assessment of the Aquatic Ecosystems of the Caura River Basin, Bolívar State, Venezuela. RAP Bulletin of Biological Assessment 28. Conservation International, Washington, DC.

* Venezuela: Orinoco Delta and Gulf of Paria. Lasso, C.A., L.E. Alonso, A.L. Flores and G. Love (eds.). 2004. Rapid assessment of the biodiversity and social aspects of the aquatic ecosystems of the Orinoco Delta and the Gulf of Paria, Venezuela. RAP Bulletin of Biological Assessment 37. Conservation International, Washington, DC.

* Venezuela: Ventuari and Orinoco Rivers. C. Lasso, J.C. Señarìs, L.E. Alonso, and A.L. Flores (eds.). 2006. Evaluación Rápida de la Biodiversidad de los Ecosistemas Acuáticos en la Confluencia de los ríos Orinoco y Ventuari, Estado Amazonas (Venezuela). Boletín RAP de Evaluación Biológica 40. Conservation International. Washington DC, USA.

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* Indonesia: Raja Ampat Islands. McKenna, S.A., G.R. Allen and S. Suryadi (eds.). 2002. A Marine Rapid Assessment of the Raja Ampat Islands, Papua Province, Indonesia. RAP Bulletin of Biological Assessment 22. Conservation International, Washington, DC.

* Indonesia: Yongsu - Cyclops Mountains and the Southern Mamberamo Basin. Richards, S.J. and S. Suryadi (eds.). 2002. A Biodiversity Assessment of Yongsu — Cyclops Mountains and the Southern Mamberamo Basin, Papua, Indonesia. RAP Bulletin of Biological Assessment 25. Conservation International, Washington, DC.

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* Papua New Guinea: Milne Bay Province. Allen, G.R., J.P. Kinch, S.A. McKenna and P. Seeto (eds.). 2003. A Rapid Marine Biodiversity Assessment of Milne Bay Province, Papua New Guinea — Survey II (2000). RAP Bulletin of Biological Assessment 29. Conservation International, Washington, DC.

† Philippines: Palawan Province. Werner, T.B. and G. Allen (eds.). 2000. A Rapid Marine Biodiversity Assessment of the Calaminanes Islands, Palawan Province, Philippines. RAP Bulletin of Biological Assessment 17. Conservation International, Washington, DC.

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Madagascar: Northwest Madagascar. McKenna, S.A. and G.R. Allen (eds). 2003. A Rapid Marine Biodiversity Assessment of the Coral Reefs of Northwest Madagascar. RAP Bulletin of Biological Assessment 31. Conservation International, Washington, DC.

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