

**A SYSTEMATIC REVISION OF SELECTED GENERA OF AFROTROPICAL
CURTONOTIDAE (DIPTERA: SCHIZOPHORA: EPHYDROIDEA) – A
PHYLOGENETIC APPROACH**

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ABSTRACT

The first comprehensive phylogeny of the family Curtonotidae is presented based on molecular markers and morphology. This enabled assessment of evolutionary relatedness, species radiation and zoogeography. A revised classification of the world fauna of the family, based on the results of this study is outlined. Nomenclatural acts flowing from these analyses include: the recognition three new Afrotropical species of *Axinota* van der Wulp; four new species of a new genus, *Tigrisomyia* Kirk-Spriggs; and nineteen new species of *Curtonotum* (six Madagascan and thirteen African). Ten informal species-groups of *Curtonotum* are recognised. Identification keys are provided for the Afrotropical species of these genera and errors in previous interpretations and designation of type specimens are resolved. Species distributions are mapped and interpreted and discussion is made of the historical biogeographical significance of these distributions.

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LISTS OF FIGURES, TABLES AND APPENDICES

CHAPTER 2

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2.0: Table 1. List of sequenced samples. The Genbank voucher numbers have format “UPOL” and the six digit designation listed below. Voucher specimens are deposited in BMSA.

2.0: Table 2. Exemplar species of Curtonotidae and out-group taxa used in the morphological analysis. The females of closely-related species cannot be reliably identified until such time as pairs have been taken *in copula* or collected in a single species collection event, sexes known or distinguishable are indicated in column 6. Abbreviations: CAR = Central African Republic; DRC = Democratic Republic of Congo; TSG = type species of genus; UAE = United Arab Emirates.

2.0: Appendix I. Specimens examined for comparative purposes and for the preparation of figures.

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CHAPTER 3

Figs 3.1: 1–4. Head (frontolateral views). **1**, *Axinota fuscipennis* (♀ N-T, Gambia, Abuko, NMWC); **2**, *A. quasimodoi* (♂ HT, Tanzania, nr. Soni, TAU); **3**, *A. ahdabi* (♂ HT, Yemen, Ar Rujum, NMWC); **4**, *A. kyphosis* (♀ PT, Madagascar, Maromandia, MNHN) (specimen missing right *ivs*, *ovs* and left *ivs*). Scale bar = 1 mm.

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3.1: Appendix I. Annotated checklist of *Axinota* van der Wulp (Diptera: Curtonotidae) of the world, based on published regional catalogues of Delfinado and Hardy (1977) for the Oriental Region and Wirth and Tsacas (1980) for the Afrotropical Region. Reference was also made to all original publications listed. Type localities are cited as they appear in the original publications, but modern state names are used in the country distribution lists for each species. A list of institutional codens is provided in the “Material and Methods”. Information is provided on lectotype designations where known, deposition of holotypes and synonymy.

3.1: Appendix II. Geographic coordinates (in decimal format) used to map distributions points plotted on Figs 3.1: 29, 30, 32; based on material examined in this study and listed in the material examined sections. Major Habitat Types and Vegetation Types listed below are based on the points plotted on Fig. 3.1: 29 (Major Habitat types) and follow WWF (1995), cited in Hearn *et al.* (2000). The locality of the lectotype and paralectotype of *Axinota fuscipennis* (Macquart), for which the specific locality remains unknown, is not listed.

Figs 3.2: 1–4. Head (frontolateral view). **1**, *Tigrisomyia rhayaderi* sp. n. (♀ HT, Kenya, near Takaugu, TAU); **2**, *T. scoliosis* sp. n. (♀ PT, [Tanzania], Mpwapwa, BMNH); **3**, *T. kinskii* sp. n. (♂ PT, Malawi, Centre Ntchisi Forest, TAU); **4**, *T. amnoni* sp. n. (♂ PT, Tanzania, Gologolo Forest, TAU). Scale bar = 1 mm.

Figs 3.2: 5–8. Wing. **5**, *Tigrisomyia rhayaderi* sp. n. (♀ HT, Kenya, near Takaugu, TAU); **6**, *T. scoliosis* sp. n. (♀ PT, [Tanzania], Mpwapwa, BMNH); **7**, *T. kinskii* sp. n. (♂ HT, Malawi, Centre Ntchisi Forest, TAU); **8**, *T. amnoni* sp. n. (♀ PT, Tanzania, Gologolo Forest, TAU). Scale bars = 1 mm.

Figs 3.2: 9–14. **9–11:** Hypandrium and epandrium (lateral view). **9**, *Tigrisomyia scoliosis* sp. n. (♂ HT, [Tanzania], Mpwapwa, BMNH); **10**, *T. kinskii* sp. n. (♂ PT, Malawi, Centre Ntchisi Forest, TAU); **11**, *T. amnoni* sp. n. (♂ HT, Tanzania, Gologolo Forest, TAU). **12–14:** Phallus (lateral view). **12**, *T. scoliosis* sp. n. (same); **13**, *T. kinskii* sp. n. (same); **14**, *T. amnoni* sp. n. (same). [The male of *T. rhayaderi* sp. n. is unknown.]. Scale bar = 0.3 mm.

Figs 3.2: 15–24. 15–18: Light micrographs of mesonotum and scutellum (dorsal view). **15**, *Tigrisomyia rhayaderi* sp. n. (♀ HT, Kenya, near Takaugu, TAU); **16**, *T. scoliosis* sp. n. (♂ HT, [Tanzania], Mpwapwa, BMNH); **17**, *T. kinskii* sp. n. (♂ HT, Malawi, Centre Ntchisi Forest, TAU); **18**, *T. amnoni* sp. n. (♂ HT, Tanzania, Gologolo Forest, TAU). **19–22**: Same (lateral view); **19**, *T. rhayaderi* sp. n. (same); **20**, *T. scoliosis* sp. n. (♂ PT, same); **21**, *T. kinskii* sp. n. (same); **22**, *T. amnoni* sp. n. (same). Not to scale. **23**, Habitus (lateral) of *T. amnoni* sp. n. (♀ PT, Tanzania, Gologolo Forest, TAU; length: 3.9 mm). **24**, Distribution of the species of *Tigrisomyia* gen. n. in the Eastern Arc Mountains and Malawi Rift of East Africa.

Figs 3.2: 25–27. Habitus photographs of *Tigrisomyia amnoni* sp. n. in life. Photographed at Mufindi in the Eastern Arc Mountains of Tanzania (photographs © Steve Marshall; reproduced with permission).

Figs 3.3: 1–8. Head and thorax (lateral view) of *Curtonotum* spp. (males). **1**, *C. keiseri* (PT, Mtge. D’Ambre, NHMB); **2**, *C. stuckenbergi* (HT, Ambohitantely, NMHN); **3**, *C. sternithrix* (HT, Antanambe, MNHN); **4**, *C. irwini* sp. n. (PT, Zombitse National Park, CAS); **5**, *C. parkeri* sp. n. (PT, same, CAS); **6**, *C. coroneiformis* sp. n. (PT, near Isalo National Park, CAS); **7**, *C. balachowskyi* (HT, Fia Mananjary, MNHN); **8**, *C. gladiiformis* sp. n. (HT, Fianarantsoa, CAS). Not to scale.

Figs 3.3: 9–13. Head and thorax (lateral view) of *Curtonotum* spp. (males). **9**, *C. rinhatinana* sp. n. (HT, Ankarafantsika, CAS); **10**, *C. boeny* (HT, Ambato-Boeni, MNHN); **11**, *C. griveaudi* sp. n. (HT, Asondrodava dry forest, CAS); **12**, *C. pauliani* (N-T, Tsingy National Park, CAS); **13**, *C. sakalava* (N-T, Berenty Special Reserve, CAS). Not to scale.

Figs 3.3: 14–26. Frons (dorsal view) of *Curtonotum* spp. (males). **14**, *C. keiseri* (PT, Mtge. D’Ambre, NHMB); **15**, *C. stuckenbergi* (HT, Ambohitantely, NMHN); **16**, *C. sternithrix* (HT, Antanambe, MNHN); **17**, *C. irwini* sp. n. (HT, Zombitse National Park, CAS); **18**, *C. parkeri* sp. n. (HT, same, CAS); **19**, *C. coroneiformis* sp. n. (HT, Fianarantsoa, CAS); **20**, *C. balachowskyi* (HT, Fia Mananjary, MNHN); **21**, *C.*

gladiiformis sp. n. (HT, Fianarantsoa, CAS); **22**, *C. rinhatinana* sp. n. (HT, Ankarafantsika, CAS); **23**, *C. boeny* (HT, Ambato-Boeni, MNHN); **24**, *C. griveaudi* sp. n. (HT, Asondrodava dry forest, CAS); **25**, *C. pauliani* (N-T, Ankarafantsika, CAS); **26**, *C. sakalava* (N-T, Andohahela National Park, CAS). Not to scale.

Figs 3.3: 27–39. Wing of *Curtonotum* spp. (males, unless otherwise stated). **27**, *C. keiseri* (N-T, Joffreville, TAU); **28**, *C. stuckenbergi* (♀ AT, Ambohitantely, NMSA); **29**, *C. sternithrix* (PT, Manambato, NMSA); **30**, *C. irwini* sp. n. (PT, Zombitse National Park, CAS); **31**, *C. parkeri* sp. n. (HT, same, CAS); **32**, *C. coronaeformis* sp. n. (PT, near Isalo National Park, CAS); **33**, *C. balachowskyi* (N-T, Asondrodava dry forest, CAS); **34**, *C. gladiiformis* sp. n. (PT, near Isalo National Park, CAS); **35**, *C. rinhatinana* sp. n. (HT, Ankarafantsika, CAS); **36**, *C. boeny* (♀ PT, Ambata-Boeni, MNHN); **37**, *C. griveaudi* sp. n. (N-T, Sambava Beach, TAU); **38**, *C. pauliani* (N-T, Tsingy National Park, CAS); **39**, *C. sakalava* (N-T, Berenty Special Reserve, CAS). Not to scale.

Figs 3.3: 40–48. Male terminalia of *Curtonotum* spp. **40–42:** Hypandrium and epandrium, lateral view: **40**, *C. keiseri* (N-T, Ambohitra, TAU); **41**, *C. stuckenbergi* (HT, Ambohitantely, NMHN); **42**, *C. sternithrix* (PT, Manambato, MNHN). **43–45:** Phallus, right lateral view: **43**, *C. keiseri*, ejaculatory apodeme missing; **44**, *C. stuckenbergi*; **45**, *C. sternithrix*. **46–48:** Basiphallus and distiphallus junction, dorsal view: **46**, *C. keiseri*, ventrally-directed lateral spine indicated with arrow; **47**, *C. stuckenbergi*, ventrally-directed lateral spine indicated with arrow; **48**, *C. sternithrix*. Scale bars = 0.5 mm.

Figs 3.3: 49–57. Male terminalia of *Curtonotum* spp. **49–51:** Hypandrium and epandrium, lateral view: **49**, *C. irwini* sp. n. (HT, Zombitse National Park, CAS); **50**, *C. parkeri* sp. n. (PT, same, CAS); **51**, *C. coronaeformis* sp. n. (HT, Fianarantsoa, CAS). **52–54:** Phallus, right lateral view: **52**, *C. irwini*; **53**, *C. parkeri*; **54**, *C. coronaeformis*. **55–57:** Basiphallus and distiphallus junction, dorsal view: **55**, *C. irwini*; **56**, *C. parkeri*; **57**, *C. coronaeformis*. Scale bars = 0.5 mm.

Figs 3.3: 58–66. Male terminalia of *Curtonotum* spp. **58–60:** Hypandrium and epandrium, lateral view: **58**, *C. balachowskyi* (N-T, Fianarantsoa, CAS); **59**, *C.*

gladiiformis sp. n. (PT, same, CAS); **60**, *C. rinhatinana* sp. n. (HT, Ankarafantsika, CAS). **61–63**: Phallus, right lateral view: **61**, *C. balachowskyi* (HT, Mananjary, MNHN); **62**, *C. gladiiformis* (HT, Fianarantsoa, CAS); **63**, *C. rinhatinana*, ejaculatory apodeme detached during dissection, but probably normally inserted at junction of phallapodeme and basiphallus; **63a**, *C. rinhatinana*, sperm pump, lateral view; **63b**, *C. rinhatinana*, sperm pump, ? ventral view. **64–66**: Basiphallus and distiphallus junction, dorsal view: **64**, *C. balachowskyi*; **65**, *C. gladiiformis*; **66**, *C. rinhatinana*. Scale bars = 0.5 mm.

Figs 3.3: 67–75. Male terminalia of *Curtonotum* spp. **67–69**: Hypandrium and epandrium, lateral view: **67**, *C. boeny* (N-T, E. Bekopaka, CAS); **68**, *C. griveaudi* sp. n. (PT, Asondrodava, CAS); **69**, *C. pauliani* (N-T, E. Bekopaka, CAS). **70–72**: Phallus, right lateral view: **70**, *C. boeny*; **71**, *C. griveaudi*; **72**, *C. pauliani*. **73–75**: Basiphallus and distiphallus junction, dorsal view: **73**, *C. boeny*; **74**, *C. griveaudi* (PT, Mahafaly Reserve, CAS); **75**, *C. pauliani*. Scale bars = 0.5 mm.

Figs 3.3: 76–78. *Curtonotum sakalava*, male terminalia. **76**, Hypandrium and epandrium, lateral view (N-T, Berenty Special Reserve, CAS); **77**, Phallus, right lateral view (HT, Morondava, MNHN); **78**, Basiphallus and distiphallus junction, dorsal view. **79–91**: Sternites 6 (79–85, 87–91) and 4–6 (86) of *Curtonotum* spp. (males): **79**, *C. keiseri* (N-T, Ambohitra, TAU); **80**, *C. stuckenbergi* (HT, Ambohitantely, NMHN); **81**, *C. irwini* sp. n. (PT, Zombitse National Park, CAS); **82**, *C. parkeri* sp. n. (PT, same, CAS); **83**, *C. coronaeformis* sp. n. (PT, Fianarantsoa, CAS); **84**, *C. balachowskyi* (N-T, same, CAS); **85**, *C. gladiiformis* sp. n. (N-T, same, CAS); **86**, *C. sternithrix* (PT, Manambato, MNHN); **87**, *C. rinhatinana* sp. n. (HT, Ankarafantsika, CAS); **88**, *C. boeny* (N-T, E. Bekopaka, CAS); **89**, *C. griveaudi* sp. n. (PT, Mahafaly Reserve, CAS); **90**, *C. pauliani* (N-T, E. Bekopaka, CAS); **91**, *C. sakalava* (N-T, Berenty Special Reserve, CAS). Scale bars = 0.5 mm.

Figs 3.3: 92–96. Distribution of Malagasy *Curtonotum* spp. **92**, *C. keiseri*; **93**, *C. stuckenbergi*; **94**, *C. sternithrix*; **95**, *C. irwini* sp. n.; **96**, *C. parkeri* sp. n.

Figs 3.3: 97–101. Distribution of Malagasy *Curtonotum* spp. **97**, *C. coronaeformis* sp. n.; **98**, *C. balachowskyi*; **99**, *C. gladiiformis* sp. n.; **100**, *C. rinhatinana* sp. n.; **101**, *C. boeny*.

Figs 3.3: 102–104. Distribution of Malagasy *Curtonotum* spp. **102**, *C. griveaudi* sp. n.; **103**, *C. pauliani*; **104**, *C. sakalava*. See Figs 92–101 for vegetation key. **105–107.** **105:** The biomes of Madagascar (after Yoder and Nowak 2006); **106**, Biogeographic zonation of Madagascar, following Boumans *et al.* (2007) and partly Wilmé *et al.* (2006) (after Glaw and Vences 2007); **107**, Bioclimatic zonation of Madagascar, following Cornet (1974) and Schatz (2000) (after Glaw and Vences 2007).

3.3: Table 1. Distribution of the Malagasy species of *Curtonotum* according to biome types. Biome classification follows Yoder and Nowak (2006) (Fig. 105). Coding: (+) presence, (–) absence, (*) remnant fragment of main biome type.

3.3: Table 2. Distribution of the Malagasy species of *Curtonotum* by biogeographic zone. Biogeographic zones follow Boumans *et al.* (2007) and partly Wilmé *et al.* (2006) (after Glaw and Vences 2007: 13) (Fig. 106). Coding: (+) presence, (–) absence, (*) borderline between two zones.

3.3: Table 3. Distribution of the Malagasy species of *Curtonotum* by bioclimatic zone. Bioclimatic zones follow Cornet (1974) and Schatz (2000) (after Glaw and Vences 2007: 13) (Fig. 107). Coding: (+) presence, (–) absence, (*) remnant fragment of main bioclimatic zone.

3.3: Appendix I. Annotated checklist of Curtonotidae of Madagascar. Type localities are cited as they appear on the original type specimen labels. Information is provided on deposition of holotypes and synonymy.

3.3: Appendix II. Geographical co-ordinates used to map distributions plotted on 3.3 Figs 92–104, based on material examined in this study and listed in the material examined sections. Vegetation types listed follow Moat and Smith (2007).

Figs 3.4: 1–6. Head and thorax (lateral view) of Afrotropical *Curtonotum* spp. (male unless stated). **1**, *C. herrero* (N-T, Namibia, Amkarub 269, NMNW); **2**, *C. maculiventris* (N-T, [Zimbabwe], Chipinda Pools, BMNH); **3**, *C. striatifrons* (LT, Chad, Bahr el Ghazal, BMNH); **4**, *C. marriott* sp. n. (PT, Cameroon, Kriba (beach), TAU); **5**, *C. moffatt* sp. n. (PT, Uganda, Mujenje, HNHM); **6**, *C. platyphallum* (♀ N-T, Liberia, 8 mi. NW Zorzor, CAS). Not to scale.

Figs 3.4: 7–12. Head and thorax (lateral view) of Afrotropical *Curtonotum* spp. (all males). **7**, *C. angolense* (PT, Angola, 10 mi. NE Sá da Bandeira, CAS); **8**, *C. campsiphallum* (N-T, Cameroon, Limbe (shore), TAU); **9**, *C. freidberg* sp. n. (PT, Malawi, Viphyia Mnts., TAU); **10**, *C. hay* sp. n. (PT, Uganda, Mujenje, HNHM); **11**, *C. quinquevittatum* (N-T, Malawi, Viphyia Mnts., TAU); **12**, *C. sao* (N-T, Nigeria, Gadau, BMNH). Not to scale.

Figs 3.4: 13–18. Head and thorax (lateral view) of Afrotropical *Curtonotum* spp. (male unless stated). **13**, *C. tsacas* sp. n. (♀ PT, South Africa, Kosi Bay Nature Reserve, BMSA); **14**, *C. gonzo* sp. n. (PT, Nigeria, River Bagel, NMWC); **15**, *C. saheliense* (N-T, Nigeria, Katsina, ZSM); **16**, *C. simile* (N-T, Israel, Ne’ot Semadar, TAU); **17**, *C. bicuspis* sp. n. (HT, Namibia, Salambala campsite, NMNW); **18**, *C. cimbebas* sp. n. (HT, Namibia, Tsaobismund 85, NMNW). Not to scale.

Figs 3.4: 19–24. Head and thorax (lateral view) of Afrotropical *Curtonotum* spp. (all males). **19**, *C. constance* sp. n. (HT, Angola, 7 mi. N Vila Perreira d’Eça, MNHN); **20**, *C. cuthbertsoni* (N-T, South Africa, Hartbeespoort, TAU); **21**, *C. litoralis* sp. n. (PT, [Tanzania], Zanzibar, BMNH); **22**, *C. pauliani* (N-T, Namibia, Ekuju, NMNW); **23**, *C. uncinatum* sp. n. (PT, Namibia, Kubunyana camp, NMNW); **24**, *C. unicuspis* sp. n. (PT, Namibia, Mile 46, NMNW) [head of *C. mcgregor* sp. n. missing from HT and PT cannot be illustrated]. Not to scale.

Figs 3.4: 25–36. Frons of Afrotropical *Curtonotum* spp. (male unless stated). **25**, *C. herrero* (N-T, Namibia, Amkarub 269, NMNW); **26**, *C. maculiventris* (N-T, [Zimbabwe], Chipinda Pools, BMNH); **27**, *C. striatifrons* (N-T, Nigeria, Gadau, BMNH); **28**, *C. marriott* sp. n. (♀ PT, Cameroon, Kriba (beach), TAU); **29**, *C. moffatt* sp. n. (PT, Uganda, Mujenje, HNHM); **30**, *C. platyphallum* (♀ N-T, Liberia, 8 mi.

NW Zorzor, CAS); **31**, *C. angolense* (PT, Angola, 10 mi. NE Sá da Bandeira, CAS); **32**, *C. campsiphallum* (N-T, Cameroon, Limbe (shore), TAU); **33**, *C. freidberg* sp. n. (PT, Malawi, Viphya Mnts., TAU); **34**, *C. hay* sp. n. (PT, Uganda, Mujenje, HNHN); **35**, *C. quinquevittatum* (N-T, Malawi, Viphya Mnts., TAU); **36**, *C. sao* (N-T, Nigeria, Gadau, BMNH). Not to scale.

Figs 3.4: 37–48. Frons of Afrotropical *Curtonotum* spp. (all males). **37**, *C. tsacas* sp. n. (PT, South Africa, Kosi Bay Nature Reserve, BMSA); **38**, *C. gonzo* sp. n. (PT, Nigeria, River Bagel, NMWC); **39**, *C. sahelense* (N-T, Nigeria, Katsina, ZSM); **40**, *C. simile* (PT, Arabia [= Yemen], S. Othman, MNHN); **41**, *C. bicuspis* sp. n. (HT, Namibia, Salambala campsite, NMNW); **42**, *C. cimbebas* sp. n. (HT, Namibia, Tsaobismund 85, NMNW); **43**, *C. constance* sp. n. (HT, Angola, 7 mi. N Vila Perreira d'Eça, MNHN); **44**, *C. cuthbertsoni* (N-T, Uganda, Ankole, USNM); **45**, *C. litoralis* sp. n. (HT, Kenya, Muhaka Field Station, NMNW); **46**, *C. pauliani* (N-T, Namibia, Ejuju village, NMNW); **47**, *C. uncinatum* sp. n. (PT, Namibia, Salambala campsite, NMNW); **48**, *C. unicuspis* sp. n. (PT, Namibia, Mile 46, NMNW) [head of *C. mcgregor* sp. n. missing from both HT and PT cannot be illustrated]. Not to scale.

Figs 3.4: 49–54. Head of Afrotropical *Curtonotum* spp. (all males). **49**, *C. herrero*, frontolateral view (N-T, Namibia, Amkarub 269, NMNW); **50**, Same, lateral view; **51**, *C. maculiventris*, frontolateral view (N-T, S. Rhodesia [= Zimbabwe], Chipinda Pools, BMNH); **52**, Same, lateral view; **53**, *C. striatifrons*, frontolateral view (N-T, Nigeria, Gadau, BMNH); **54**, Same, lateral view. Scale bar = 1 mm.

Figs 3.4: 55–60. Wing of Afrotropical *Curtonotum* spp. (male unless stated). **55**, *C. herrero* (N-T, Namibia, Amkarub 269, NMNW); **56**, *C. maculiventris* (N-T, S. Rhodesia [= Zimbabwe], Chipinda Pools, BMNH); **57**, *C. striatifrons* (♀ LT, Sudan, Bal el Ghanal, BMNH); **58**, *C. marriott* sp. n. (♀ PT, Cameroon, Kriba beach, TAU); **59**, *C. moffatt* sp. n. (HT, Uganda, Mujenje, HNHN); **60**, *C. platyphallum* (HT, Liberia, Robertsport, AMNH). **61–66:** Scutellum of Afrotropical *Curtonotum* spp. **61**, *C. herrero* (same); **62**, *C. maculiventris* (same); **63**, *C. striatifrons* (N-T, Nigeria, Gadau, BMNH); **64**, *C. marriott* (same); **65**, *C. moffatt* (♀ PT, Uganda, Mujenje, HNHN); **66**, *C. platyphallum* (same). Scale bar = 1 mm.

Figs 3.4: 67–76. Wing of Afrotropical *Curtonotum* spp. (all males). **67**, *C. angolense* (PT, Angola, 10 mi. NE of Sá da Bandeira, CAS); **68**, *C. campsiphallum* (N-T, Cameroon, Limbe (shore), TAU); **69**, *C. freidberg* sp. n. (PT, Malawi, Viphya Mts., TAU); **70**, *C. hay* sp. n. (HT, Uganda, Mujenje, HNHM); **71**, *C. quinquevittatum* (N-T, Malawi, Viphya Mts., TAU); **72**, *C. sao* (N-T, Nigeria, Gadau, BMNH); **73**, *C. tsacas* sp. n. (PT, South Africa, Kosi Bay Nature Reserve, BMSA); **74**, *C. gonzo* sp. n. (HT, [Ghana], Kwadaso, HNHM); **75**, *C. saheliense* (N-T, Nigeria, Samaru, MNHN); **76**, *C. simile* (N-T, Oman, Ourm, MZLU). Not to scale.

Figs 3.4: 77–85. Wing of Afrotropical *Curtonotum* spp. (all males). **77**, *C. bicuspis* sp. n. (PT, Namibia, Salambala forest, NMNW); **78**, *C. cimbebas* sp. n. (PT, Namibia, Tsams Ost spring, NMNW); **79**, *C. constance* sp. n. (HT, Angola, 7 mi. N Vila Perreira d'Eça, MNHN); **80**, *C. cuthbertsoni* (N-T, Zimbabwe, Chimana Causeway, ZSM); **81**, *C. litoralis* sp. n. (HT, Kenya, Muhaka Field Station, NMNW); **82**, *C. mcgregor* sp. n. (Nyasaland [= Malawi], Port Herald, BMNH); **83**, *C. pauliani* (N-T, Namibia, Ekuju village, NMNW); **84**, *C. uncinatum* sp. n. (PT, Namibia, Salambala campsite, NMNW); **85**, *C. unicuspis* sp. n. (HT, Salambala campsite, NMNW). Not to scale.

Figs 3.4: 86–97. Male terminalia of Afrotropical *Curtonotum* spp. **86–88**: Sternite 6 (ventral view): **86**, *C. herrero* (N-T, Namibia, Amkarab 269, NMNW); **87**, *C. maculiventris* (N-T, Nigeria, River Bagel, NMWC); **88**, *C. striatifrons* (PT, Nigeria, Gadau, BMNH). **89–91**: Hypandrium and epandrium (lateral view): **89**, *C. herrero* (same); **90**, *C. maculiventris* (same); **91**, *C. striatifrons* (same). **92–94**: Phallus (right lateral view): **92**, *C. herrero* (same) [ejaculatory apodeme removed and illustrated dorsally]; **93**, *C. maculiventris* (same); **94**, *C. striatifrons* (same). **95–97**: Detail of distiphallus (ventral view): **95**, *C. herrero* (same); **96**, *C. maculiventris* (same); **97**, *C. striatifrons* (same). Scale bars = 0.5 mm.

Figs 3.4: 98–107. Females of Afrotropical *Curtonotum* spp. **98–101**: Postabdomen: **98**, *C. maculiventris* (lateral) (N-T, Nigeria, River Bagel, NMWC) [not fully distended]; **99**, Same (ventral); **100**, *C. striatifrons* (lateral) (N-T, Sudan, Roseires, MNHN) [t7 distorted]; **101**, Same (ventral). **102–104**: Auxiliary sclerites in region of sternite 7: **102**, *C. herrero*; **103**, *C. maculiventris*; **104**, *C. striatifrons*. **105–107**:

Spermatheca/e: **105**, *C. herrero*; **106**, *C. maculiventris*; **107**, *C. striatifrons* (Figs 3.4: 102–107 from Tsacas (1977); fig. 6 and 9, as *C. tigrinum*). **108–112**: Spermathecae of *Curtonotum* spp. **108**, *C. marriott* sp. n. (PT, Cameroon, Kribi (beach), TAU); **109**, *C. moffatt* sp. n. (PT, Uganda, Katona, HNHM); **110**, *C. platyphallum* (N-T, Liberia, 8 mi. N.W. Zorzor, CAS); **111**, *C. helvum* (N-T, [Canada], Sandbanks P.P., Picton, DEBU); **112**, *C. anus* (lateral) (Israel, Park HaYarden, TAU). Scale bars: 98–101 = 1 mm; 102–107 = 0.2 mm; 108–112 = 50 μ m.

Figs 3.4: 113–122. Male terminalia of Afrotropical *Curtonotum* spp. **113–115**: Sternite 6 (ventral view): **113**, *C. marriott* sp. n. (PT, Cameroon, Kriba beach, TAU); **114**, *C. moffatt* sp. n. (PT, Uganda, Katona, HNHM); **115**, *C. platyphallum* (HT, Liberia, Robertsport, AMNH). **116–118**: Hypandrium and epandrium (lateral view): **116**, *C. marriott* (same); **117**, *C. moffatt* (same); **118**, *C. platyphallum* (same). **119–122**: Phallus (right lateral view): **119**, *C. marriott* (same) [ejaculatory apodeme missing]; **120**, *C. moffatt* (same); **121**, Same, detail of serrated edge; **122**, *C. platyphallum* (same). Scale bars = 0.5 mm.

Figs 3.4: 123–128. Female postabdomen of Afrotropical *Curtonotum* spp. **123**, *C. marriott* sp. n. (lateral) (PT, Cameroon, Kriba beach, TAU); **124**, Same (ventral); **125**, *C. moffatt* sp. n. (lateral) (PT, Uganda, Katona, HNHM); **126**, Same (ventral); **127**, *C. platyphallum* (lateral) (N-T, Liberia, 8 mi. NW Zorzor, CAS); **128**, Same (ventral). **129–132**: Comparative material of non-Afrotropical *Curtonotum* spp.: **129**, *C. helvum* (lateral) (N-T, [Canada], Sandbanks P.P., Picton, DEBU); **130**, Same (ventral); **131**, *C. anus* (lateral) (Israel, Park HaYarden, TAU); **132**, Same (ventral) (Figs 3.4: 131, 132 after Kirk-Spriggs and Freidberg 2007, figs 17, 18). Scale bars = 1 mm.

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Fig. 3.4: 217. Overall coverage of records for the genus *Curtonotum* in the Afrotropical Region (including species recorded from Madagascar by Kirk-Spriggs (2011), Chapter 3.3).

Fig. 3.4: 218. Distribution of continental Afrotropical species of *Curtonotum*. Topographical, *C. herrero*, *C. maculivenre*, *C. striatifrons*.

Fig. 3.4: 219. Distribution of continental Afrotropical species of *Curtonotum*. Major Habitat Types, *C. marriott* sp. n., *C. moffatt* sp. n., *C. platyphallum*.

Fig. 3.4: 220. Distribution of continental Afrotropical species of *Curtonotum*. Topographical, *C. angolense*, *C. campsiphallum*, *C. freidberg* sp. n., *C. hay* sp. n.

Fig. 3.4: 221. Distribution of continental Afrotropical species of *Curtonotum*. Major Habitat Types, *C. angolense*, *C. campsiphallum*, *C. freidberg* sp. n., *C. hay* sp. n.

Fig. 3.4: 222. Distribution of continental Afrotropical species of *Curtonotum*. Major humidity zones of Africa, *C. saheliense*, *C. simile*.

Fig. 3.4: 223. Distribution of continental Afrotropical species of *Curtonotum*. Topographical, *C. sao*, *C. gonzo* sp. n., *C. quinquevittatum*, *C. tsacas* sp. n.

Fig. 3.4: 224. Distribution of continental Afrotropical species of *Curtonotum*. Major Habitat Types, *C. sao*, *C. gonzo* sp. n., *C. quinquevittatum*, *C. tsacas* sp. n.

Fig. 3.4: 225. Distribution of continental Afrotropical species of *Curtonotum*. Major humidity zones of Africa, *C. bicuspis* sp. n., *C. cuthbertsoni*, *C. uncinatum* sp. n., *C. unicuspis* sp. n.

Fig. 3.4: 226. Distribution of continental Afrotropical species of *Curtonotum*. Topographical, *C. cimbebas* sp. n., *C. constance* sp. n., *C. litoralis* sp. n., *C. mcgregor* sp. n., *C. pauliani*.

Figs 3.4: 227–230. Distribution of continental Afrotropical species of *Curtonotum*. **227**, Major Habitat Types: *C. bicuspis* sp. n.; **228**, Same, *C. cuthbertsoni*; **229**, Same, *C. uncinatum* sp. n.; **230**, Same, *C. unicuspis* sp. n. The implied range of each species indicated with dashed line.

3.4: Appendix. Geographical co-ordinates for continental Afrotropical *Curtonotum* spp. used to map distributions plotted on Figs 217–230, based on material examined in this study and listed in the material examined sections (refer to Fig. 217 for coverage of records). Major Habitat Types and Vegetation Types listed below are based on points plotted on figures and follow WWF (1995), cited in Hearn *et al.* (2000). Abbreviations: CAR = Central African Republic; DRC = Democratic Republic of Congo; UAE = United Arab Emirates.

INSTITUTIONAL CODENS AND ABBREVIATIONS IN TEXT AND ON FIGURES

INSTITUTIONAL CODENS

A list of institutional codens used in the text is provided below. These codens exactly follow those listed in the *Insect and Spider Collections of the World*, as updated on the Bishop Museum website, available at: <http://hbs.bishopmuseum.org/codens/codensearch.html>. The names of respective curators and technicians, who loaned material (where applicable), are noted in parenthesis:

AMGS	Albany Museum, Grahamstown, South Africa.
AMNH	American Museum of Natural History, New York, United States (D. Grimaldi and T. Nguyen).
BHU	Banaras Hindu University, Varanasi, India.
BMNH	Natural History Museum, London, United Kingdom (N. Wyatt).
BMSA	National Museum Bloemfontein, Bloemfontein, South Africa.
BPBM	Bernice P. Bishop Museum, Honolulu, Hawai‘i, United States (N. Evenhuis and K. Arakaki).
CAS	California Academy of Sciences, San Francisco, United States (N. Penny and C. Griswold).
CBFC	Museo Nacional de Historia Natural, La Paz, Bolivia.
CUMZ	University, Museum of Zoology, Cambridge, United Kingdom (W. Foster).
DEBU	University of Guelph, Ontario, Canada (J. Klymko and S. Marshall).
DEI	Deutsches Entomologisches Institut im ZALF, Müncheberg, Germany.
FBUB	Biological Collection, Universität Bielefeld, Bielefeld, Germany (M. von Tschirnhaus).
HNHM	Hungarian Natural History Museum, Budapest, Hungary (M. Földvári and L. Papp).

INRA	Institut National de la Recherche Agronomique, UMR CBGP 2, place Pierre Viala 34060, Montpellier Cedex, France.
IRSNB	Institut royal des Sciences naturelles de Belgique, Brussels, Belgium (P. Grootaert).
J-HS	Jens-Herman Stuke Private Collection, Leer, Germany.
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, United States.
MNHN	Muséum national d'Histoire naturelle, Paris, France (C. Daugeron).
MSNG	Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy (F. Penati).
MSNM	Museo Civico di Storia Naturale, Milano, Italy.
MTD	Staatliches Museum für Tierkunde, Dresden, Germany.
MZLU	Museum of Zoology, Lund University, Lund, Sweden (R. Danielsson).
MZPW	Museum of the Institute of Zoology, Polish Academy of Science, Poland, Warszawa, Poland (W. Tomaszewska, D. Iwan and M. Banskiewicz).
MZSP	Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil.
NCSU	North Carolina State University, Raleigh, USA.
NHMB	Naturhistorisches Museum, Basel, Switzerland (D. Burckhardt and I. Zücher).
NHRS	Naturhistoriska riksmuseet, Stockholm, Sweden (B. Viklund).
NMNW	National Museum of Namibia, Windhoek, Namibia (E. Marais, G. Shihepo and W. Hauwanga).
NMSA	Natal Museum, Pietermaritzburg, KwaZulu-Natal, South Africa (M. Mostovski, B. Muller, R. Miller and P. Birkett).
NMW	Naturhistorisches Museum Wien, Wien, Austria (P. Sehnal).
NMWC	National Museum and Gallery of Wales, Cardiff, United Kingdom (J.C. Deeming, M. Pavett and A. Plant).
OUMNH	Hope Entomological Collections, Oxford University Museum of Natural History, Oxford, United Kingdom (D. Mann).
PPRI	National Collection of Insects, Plant Protection Research Institute South Africa, Pretoria, South Africa (R. Urban).
PPRZ	Plant Protection Research Institute, Harare, Zimbabwe (C. Mguni and G. Munetsi).

QCAZ	Catholic Zoology Museum, Pontífica Universidad Católica del Ecuador, Quito, Ecuador.
RMCA	Musée Royal de l’Afrique Centrale, Tervuren, Belgium (M. De Meyer and E. De Coninck).
SAMC	Iziko Museum of Cape Town (formerly South African Museum), Cape Town, South Africa (S. van Noort and M. Cochrane).
SMNS	Staatliches Museum für Naturkunde, Stuttgart, Germany.
TAU	Tel Aviv University, Tel Aviv, Israel (A. Freidberg).
USNM	National Museum of Natural History, Washington D.C., United States (W. Mathis).
ZMAN	Zoologisch Museum, Instituut voor Taxonomische Zoologie, Universiteit van Amsterdam, Netherlands (B. Brugge).
ZMHB	Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (J. Ziegler and F. Koch).
ZMUC	Zoological Museum, University of Copenhagen, København [= Copenhagen], Denmark (J. Pedersen and T. Pape).
ZMUM	Moscow State University, Moscow, Russian Federation.
ZSM	Zoologische Staatssammlung, München [= Munich], Germany (M. Kotrba and B. Stock, some <i>via</i> M. von Tschirnhaus (FBUB)).

ABBREVIATIONS AND TERMINOLGY USED IN THE TEXT AND ON FIGURES

General abbreviations

		<i>iss</i>	inner scutellar seta
		<i>oss</i>	outer scutellar seta
AT	allotype		
CAR	Central African Republic	<i>Wing</i>	
DRC	Democratic Republic of Congo	<i>C</i>	costa
HT	holotype	<i>cua₁</i>	cubital cell
LT	lectotype	<i>CuA₁</i>	cubital vein
m	metres above sea level	<i>dm</i>	discal medial cell
MY	million years	<i>dm–cu</i>	discal medial-cubital
MYBP	million years before present	crossvein	
NT	neotype	<i>h</i>	humeral crossvein
N-T	non-type/s	<i>m</i>	medial cell
PLT	paralectotype	<i>M</i>	medial vein
PT	paratype/s	<i>r₁</i>	first radial cell
ST	syntype	<i>r₂₊₃</i>	second radial cell
TSG	type species of genus	<i>R₂₊₃</i>	second radial vein
UAE	United Arab Emirates	<i>R₄₊₅</i>	third radial vein
		<i>r₄₊₅</i>	third radial cell
		<i>r–m</i>	radial-medial crossvein
		<i>Sc</i>	subcosta

Anatomical abbreviations

Head

<i>ivs</i>	inner vertical seta
<i>ocs</i>	ocellar setae
<i>or1</i>	anterior proclinate orbital seta
<i>or2</i>	medial reclinate orbital seta
<i>or3</i>	posterior reclinate orbital seta
<i>ovs</i>	lateral vertical seta
<i>pos</i>	postocellar seta
<i>vb</i>	vibrissae

Thorax

Scutellum

<i>bss</i>	basal scutellar setula
<i>ints</i>	intermediate scutellar setula

Abdomen

<i>T1–T8</i>	abdominal tergites 1–8
<i>S1–S8</i>	abdominal sternites 1–8

Postadomen

<i>bp</i>	basiphallus
<i>bvp</i>	basoventral process
<i>ce</i>	cercus
<i>dms</i>	divergent medial setae
<i>dopl</i>	dorsal plate
<i>dp</i>	distiphallus
<i>dp1</i>	first division of distiphallus
<i>dp2</i>	second division of distiphallus
<i>ea</i>	ejaculatory apodeme
<i>ep</i>	epandrium

<i>hy</i>	hypandrium
<i>lw</i>	lateral wing of distiphallus
<i>pg</i>	postgonite
<i>ph</i>	phallapodeme
<i>pp</i>	phallic plate
<i>S10</i>	abdominal sternite 10
<i>s10</i>	abdominal sternite 10
<i>sp</i>	spermatheca
<i>ss</i>	surstylus
<i>t10+ce</i>	abdominal tergite 10 + cercus
<i>vs</i>	ventral receptacle

INTRODUCTION

The Curtonotidae Enderlein, 1914, is a relatively species-rich family of flies that occurs predominantly in Africa, and which is sufficiently diverse and widely distributed that it holds excellent promise as a case study of dipteran evolution, biological diversity and zoogeography. It also holds interesting challenges in that the adults are morphologically conservative, suggesting both hidden diversity in the group and an opportunity to examine the value of other indicators of diversity, particularly internal anatomy and molecular markers. Extant species could also be of relatively recent origin, if the crown-group is young and extinction has eliminated the “older” species. This can be settled by investigating pairwise distances for fast-evolving genes. Such information would also feed into the subsequent stages of understanding the processes leading to biological diversity. These opportunities of intellectual challenge and broader application enhance the particular appeal of the Curtonotidae as an already attractive vehicle for postgraduate study.

Few families of acalyptate flies occurring in the Afrotropical Region have received as little systematic treatment as the Curtonotidae and only the genus *Curtonotum* Macquart, 1844 has been the subject of revisionary study (Tsacas 1974, 1977). In the second part of this revision, Tsacas (1977: 145) wrote: “The phenotypic uniformity of the species of this family, leads us to suppose that it comprises a very small number of species. The discovery among a relatively limited amount of material from Madagascar of seven new species of the genus *Curtonotum* has indicated that this impression is incorrect, and a more profound examination of material from the African continent will reveal unexpected riches” (translation M. De Meyer).

Since Tsacas’ revision the Afrotropical Curtonotidae has not been the subject of any dedicated systematic studies and a phylogeny has not been developed for the group. There is, therefore, a substantial gap in our knowledge of almost all aspects of the family,

including its systematics, phylogeny, biology, immature stages and zoogeography. The need for such knowledge has broader implications in our understanding of higher taxa. Although not the first published study of its kind to combine traditional morphological taxonomy, with a morphological and molecular phylogeny, such studies have been few in other dipterous families. Molecular studies at the familial and generic level would do much to improve our understanding of the evolution of the group and its relationship to other families within the Ephydroidea. Such a study of this family has not been embarked upon before.

Initial investigations have revealed that the family is highly diverse in terms of the number of undescribed species, but is not too large to embark upon within the timescale of a PhD. It is for these reasons that the writer has embarked on this revisionary study of the Afrotropical curtonotid fauna.

Generally speaking, it is not recommended that a revision be largely restricted to a particular biogeographical area, due to faunal overlaps that may occur between different regions. It is not uncommon, for example, for the same species with a wide distribution to be described more than once if taxonomists restrict their revisions to a single zoogeographic region. In the case of the Curtonotidae, however, good revisionary studies have been published for other regions and very little faunal overlap is evident. Only two examples of species occurring in more than one zoogeographical region are known: *Curtonotum anus* (Meigen, 1830), which occurs predominantly in the Palaearctic Region, extending as far east as Pakistan in Oriental, and the predominantly Afrotropical *C. simile* Tsacas, 1977, extends northwards into Israel in the Palaearctic (Kirk-Spriggs and Freidberg 2007). Continental borders between these zoogeographical regions are, however, somewhat arbitrary and these two species represent borderline cases.

In order to identify and describe new species, it is first necessary to specify the species concept adopted, as different concepts can yield different species delimitations. In general, taxonomists apply a modified Biological Species Concept (Coyne and Orr 2004; Mayr 1942, 1995), which is diagnosed definitively using a classical morpho-geographical species concept. This implies that if morphological or genetic differences are maintained in regions of geographical overlap, then lineages are presumed to be distinct. One method of diagnosing reproductively cohesive groups is to distinguish differences in the

terminalia (these being well-defined in males of the family Curtonotidae). Such differences are presumed to represent distinct lineages by way of a “lock and key” mechanism of exclusion. This thesis, therefore, applies the Evolutionary Species Concept in its broad sense, *i.e.*, “A species is a single lineage of ancestor-descendant populations which maintain its identity from other such lineages and which has its own evolutionary tendencies and historical fate” (Wiley 1981: 25). A genus is here defined as a clade of terminal taxa (species), exhibiting similar characteristics that are defined through shared synapomorphies, *i.e.*, a monophyletic group that is diagnosable, meaningful and does not render a named taxa paraphyletic. A species-group is here defined as an informal taxonomic rank into which an assemblage of closely related species within a genus are grouped, due to their monophyletic similarities (Allaby 1999) and their identity as a biological unit with a single monophyletic origin (Tiemann-Boege *et al.* 2000).

The central theme of this dissertation is a revision and revised classification of Afrotropical genera and species of Curtonotidae, drawing heavily on a cladistic phylogeny. The following hypothesis is proposed: the interrelatedness of species as terminals within the family Curtonotidae and the higher systematic grouping of clades within the family can be assessed through the construction of a cladistic phylogeny. Such a phylogeny should enable the assessment of evolutionary relatedness, species radiation and zoogeography as a final objective.

The scope of the study is as follows. 1) Primarily a taxonomic revision of selected genera of Curtonotidae, limited to the Afrotropical Region, as defined by Crosskey (1980: map p. 32), encompassing continental Africa south of the Sahara, Madagascar and its islands to the east, and the western Atlantic islands that are bedded in the African lithospheric plate. Crosskey (1980) considered only Yemen in the Arabian Peninsula to be part of the Afrotropical Region, here, however, the broader concept of Oman and the United Arab Emirates as included is preferred. Material is also examined from Oman, the United Arab Emirates and Israel, as this has direct bearing on the biogeography of the region. 2) while biological observations will be made on an opportunistic basis during periods of fieldwork, applied ecology is beyond the scope of the project and will not be attempted; 3) DNA analysis will only include those species for which suitably-preserved specimens are available, but will include species of all genera included in the study,

together with species from other zoogeographical regions, for comparative purposes. 4) the morphological phylogenetic analysis will, however, include all described Afrotropical species and this will be combined with the molecular analysis.

The aims of the study are to: 1) assess current taxonomic knowledge of the family Curtonotidae occurring in the Afrotropical Region; 2) undertake studies of the primary types of described species and the resolution of issues of type designation and amendment of the nomenclature of the group, in accordance with the *International Code of Zoological Nomenclature (ICZN)*; 3) undertake a limited molecular analysis of the available species from the Afrotropics and elsewhere; 4) develop a cladistic phylogeny for the family and reclassification where appropriate; 5) undertake a taxonomic revision of selected genera of Afrotropical Curtonotidae; 6) construct illustrated identification keys; and 7) examine the zoogeography and species radiation of the group in Africa and the Middle East.

The following is a review of the literature pertaining to the family prior to the onset of this study. Curtonotids were assigned to various families in the past, including the Heleomyzidae (Perris 1839), Opomyzidae (as Geomyzidae) (Osten Sacken 1882; Czerny 1903), Drosophilidae (*e.g.*, Malloch 1930; Hendel 1932, 1933), Diastatidae (Duda 1924, Meigen 1830; Okada 1960, 1966; Dwivedi and Gupta 1979), and Ephydriidae (see below).

Enderlein (1914, 1917) placed them as a subfamily (Cyrtonotinae) of the Ephydriidae. Hendel (1917, 1928), regarded them as a subfamily (Cyrtonotinae) of the Drosophilidae, followed by Sturtevant (1921), Malloch (1930), Hendel (1932), Curran (1933, 1934a), Greathead (1958) and several other authors. Duda (1934) gave them full familial rank, which has been followed by the majority of subsequent workers, including Hennig (1958, 1971, 1973), Hackman (1960), Wirth (1965, 1975, 1977), Delfinado (1969), Griffiths (1972), Tsacas (1974, 1977), Wirth and Tsacas (1980), Papp (1984, 1998), McAlpine (1987, 1989), Pollock (1996, 2002), Meier *et al.* (1997) and Kirk-Spriggs (2008a, b).

In a ground-plan phylogenetic approach, Hennig (1958, 1971, 1973), McAlpine (1989) and Griffiths (1972), established the monophyletic status of the Curtonotidae, and assigned the family to the Ephydroidea (as Drosophiloidea in some cases), together with

the families Camillidae, Diastatidae, Drosophilidae and Ephydriidae (as then defined). The Ephydroidea is a reasonably well-supported monophyletic group, and is the least controversial taxon ranked as a “superfamily” in the acalyptrate flies (Hennig 1958, 1971, 1973; McAlpine 1989; Griffiths 1972; Meier *et al.* 1997). Only two ephydroid families, the Drosophilidae and Ephydriidae, have been the subject of recent phylogenetic studies (Grimaldi 1990 and Zatwarnicki 1992, respectively).

The world Curtonotidae, as currently recognised, comprises three genera, namely: *Axinota* van der Wulp, 1886, *Curtonotum* and *Cyrtona* Séguy, 1938.

Axinota is known from eight described Oriental species (Delfinado 1969, as *Apsinota*; Wirth 1977), one of which also occurs in the Australasian and Oceanian Regions (Delfinado 1971; Evenhuis 1989), and one undescribed species recorded from Madagascar in the Afrotropical Region (Tsacas 1974).

Curtonotum (as currently defined) is the most species-rich and widely distributed genus of the family and the only genus known in the New World. It occurs in all zoogeographical regions except the Australasian / Oceanian Regions and Antarctica: 20 species are Afrotropical (Wirth and Tsacas 1980); one Nearctic (McAlpine 1987; Wirth 1965); 19 Neotropical (Marshall *et al.* 2010; Wirth 1975); five Oriental (Delfinado 1969; Wirth 1977); and one Palearctic (Papp 1998). Klymko and Marshall (2011) point out that *Curtonotum* in its current broad sense is paraphyletic with respect to *Axinota*, and suggest restricting the name *Curtonotum* to a monophyletic New World group.

Cyrtona is the least studied genus and comprises only four described species (Wirth and Tsacas 1980), all of which occur in the Afrotropical Region. The genus is poorly-defined, however (*e.g.*, Hackman 1960) and no detailed diagnosis has been published. Léonidas Tsacas’ projected revision of this group never came to fruition. In a paper apparently missed by previous workers on the group, Duda (1939) described two African species as “*Parapsinota angustipennis* de Meijere, var. *sublineata* n. var. ♂” from “Uganda: Mujenje” and “New Hannover” in South Africa and “*Parapsinota brevicornis* n. sp.” from “Oudebesch Caledon Div.” in South Africa. The recent discovery of a single ♀ specimen from W. Malaysia (Genting Tea Estate) in the BMNH, confirms the occurrence of this genus (as currently defined) in the Oriental Region, while published figures of the Oriental species, *Curtonotum angustipennis* Delfinado, 1969 (Delfinado

1969, figs 9, 24), and *Curtonotum neoangustipennis* Dwivedi & Gupta, 1979 (Dwivedi and Gupta 1979, figs A–C, as Drosophilidae), further indicate that these species should also be assigned to *Cyrtona sensu lato* in subsequent revisions of the group.

Curran (1933) made a first attempt to key the then known African species of “*Curtonotum*”. In this key he included six species, only five of which are today regarded as Curtonotidae; the fifth species, “*Curtonotum quadrimacula* Walter”, having subsequently been transferred to the genus *Homoneura* van der Wulp, 1891, of the Lauxaniidae (Miller 1980).

More recently, the Oriental, Australasian and Oceanian species of *Axinota* (as *Apsinota*) were treated and keyed by Delfinado (1969), the Madagascan species of *Curtonotum* were treated, but not keyed by Tsacas (1974) and the continental Afrotropical species of *Curtonotum* were treated and keyed by Tsacas (1977). The Nearctic and Neotropical species of *Curtonotum* have been revised (in part) by Klymko and Marshall (2011). The Afrotropical species of *Cyrtona* have not been the subject of a dedicated revision and a key has not been published.

Only a single compression fossil has been ascribed to the family in the past and no amber inclusions were known. *Curtonotum gigas* Théobald, 1937, was described from Early Oligocene deposits in Les Camoins, Provence, France (Théobald 1937; Evenhuis 1994). Type material was examined by Kirk-Spriggs (2007), who found the species not to represent the genus *Curtonotum* or the Curtonotidae. Due to the very poor state of preservation it could not be ascribed to a family, although it certainly represents an acalyprate fly. One new species of *Curtonotum* and a new extinct genus were recently described from Dominican amber by Grimaldi and Kirk-Spriggs (in press).

Little is known regarding the biology and behaviour of the Curtonotidae worldwide. The only behavioural information known for the genus *Axinota* is the account by Malloch (1930: 330), who noted “... the peculiar habit of the species [*A. uniformis* Malloch (as *Anaseiomyia*)] in rising, when disturbed, into the air almost straight up and then coming back to rest upon the same leaf.”

What is known regarding the biology and behaviour of the genus *Curtonotum* has been summarised by Tsacas (1977) and more recently by Meier *et al.* (1997). Cuthbertson (1936) was the first to record the habit of roosting in aardvark and warthog

burrows in Africa, noting this behaviour in *C. quinquevittatum* Curran, 1933 (as *quinquevittata*) and *C. cuthbertsoni* Duda, 1935, in Southern Rhodesia (Zimbabwe). He suggested (p. 54) that the latter species: “Probably breeds in the faeces of these burrowing animals.” Roosting behaviour was further noted by Tsacas (1977) for *C. sao* Tsacas, 1977, in the burrow of a porcupine in Nigeria, and for *C. tigrinum* Séguy, 1933, in warthog burrows in South Africa. Greathead (1958) recorded *Curtonotum cuthbertsoni* (as *Cyrtonotum*, Drosophilidae), from the locust egg fields of Eritrea, and reared larvae from the damaged egg pods of the Desert locust *Schistocerca gregaria* Forstål (Orthoptera: Acrididae). He noted that adults were found on dung, dead locusts and on sand wetted by camel urine. He concluded that they were probably saprophagous on damaged, putrefying egg pods rather than being truly parasitic and further noted that the damage they caused to locust eggs was minimal, as compared to insects causing primary attack (see also Stower *et al.* 1958). Tsacas (1977), followed by Meier *et al.* (1997), regarded *C. cuthbertsoni* (*sensu* Greathead 1958), as representing *C. saheliense* Tsacas, 1977, based on the known geographical range of that species.

Aside from the roosting behaviour noted above, Meier *et al.* (1997) also noted that some species roost in other shaded situations, including hollow trees, overhangs of dry river beds, *etc.*

Several authors, including: Wirth (1975, 1977), Wirth and Tsacas (1980), Papp (1984) and McAlpine (1987) have erroneously cited Cuthbertson’s (1936) record of *Cyrtona albomaculata* (as *Cy. albomacula* in some cases), from Southern Rhodesia (Zimbabwe), as having been “reared” from human faeces. In reality, Cuthbertson stated (p. 54): “The type specimens were collected at human faeces in shade during July, 1933...” thus these specimens were not “reared” and no larval association with human faeces can be inferred. In an examination of some undescribed species near *Cy. albomaculata* from Zimbabwe, Pollock (1996) concluded that these were multilarviparous, larvae developing in a brood pouch, and active larvae being deposited one, or a few at a time. He described the female reproductive system, maturation of the eggs and seasonal changes. The presence of mature eggs in the abdomens of some species of *Axinota*, *Curtonotum* and some species in *Cyrtona* indicate that these genera are, however, oviparous.

Pollock (2002) provided some additional information on the habits of adult flies in Zimbabwe. He noted (p. 1727), that during the height of the dry season "... specimens of *Cyrtona* are to be found in riverine habitats. Typical daytime resting sites are dark humid recesses in river banks overhung with tree roots, and sheltered by shrubs and taller trees producing dense shade." No other biological or behavioural information has been published for species of *Cyrtona*; although Pollock (1996) has suggested that they may be parasitic. Larvipary may, however, equally be an adaptation to the need for larvae to develop speedily in a highly competitive or rapidly depleting food source.

Kirk-Spriggs (2008c) studied variability in the spermathecal form of the three closely-related species ascribed to the *Curtonotum cuthbertsoni* species-group, *Cuthbertsoni* complex (*sensu* Tsacas 1977) and concluded that spermathecal form is not a useful character to distinguish females of the three species.

Some headway has been made in the study of the immature stages of the genus *Curtonotum*, but nothing is currently known in respect to *Axinota* and *Cyrtona*. Greathead (1958) was the first to describe the immature stages of a species of *Curtonotum*. He described the third-instar larva of *Curtonotum cuthbertsoni* (as *Drosophilidae*), using light microscopy, and provided line drawings illustrating diagnostic characters. He also provided supplementary descriptions of the second-instar larva and puparium, but these were not illustrated.

Meier *et al.* (1997) attempted the laboratory rearing of the Nearctic species *C. helvum* (Loew, 1862), using grasshopper egg pods and other rearing media, but were only partially successful, managing to describe only the egg and selected characters of the first-instar larva and puparium. They provided stereoscan micrographs of the cephalic region, creeping welt and posterior spiracles of the first-instar larva, comparing these to the illustration of the larva of *Cy. sahelense* (?) of Greathead. Third-instar larvae were not obtained. Meier *et al.* (1997) also provided notes on the biology of *Curtonotum helvum* and described and discussed the female reproductive system and the spermathecae of the three known genera. Kirk-Spriggs (2008b) described additional larval and pupal material of *C. simile* Tsacas and *C. sahelense* Tsacas from Africa and the Middle East and reviewed the known biology. He concluded that the larval morphology of the Curtonotidae is generally close to the putative ground-plan of the

Ephydroidea and are probably most closely allied to the Drosophilidae and Camillidae and that the relative length of abdominal compartments six and seven is probably an autapomorphy of the family.

Pollock (2002) studied the anatomy of Curtonotidae, principally the postabdominal sclerites and internal anatomy of the male abdomen, drawing on examples from the three known genera. He also proposed a revised ground-plan for the Ephydroidea.

No records of hymenopteran parasites of Curtonotidae could be located, but adults of some species are prone to infestations of entomophagous fungi (Laboulbeniales: Ascomycetes). Balazuc (1980) recorded three species of the genus *Laboulbenia* from Afrotropical species of *Cyrtona*: *L. cyrtomatis* Balazuc (Senegal), *L. matilei* Balazuc (Central African Republic) and *L. tsacasii* Balazuc (South Africa). Two records of infestations are known for the genus *Curtonotum*. Rossi (1993) recorded *Stigmatomyces venetus* Rossi from the upper portion of the abdomen of two specimens of the Palaearctic species *Curtonotum anus* from Italy, and in the most recent study, Rossi and Kirk-Spriggs (2011), recorded *L. curtonoti* Rossi & Kirk-Spriggs infesting the abdomen of the Madagascan endemic species *Curtonotum balachowskyi* Tsacas, 1974, and provided a review of known associations for that fungal genus. Additional new species of *Laboulbenia* from a new species of *Curtonotum* (South Africa) and two new species of *Cyrtona* (Kenya) await description (Rossi and Kirk-Spriggs in prep.).

PHYLOGENY OF THE CURTONOTIDAE

(with Brian Wiegmann, North Carolina State University, USA)

Preface: Previous interpretations of the phylogenetic position of the Curtonotidae in relation to other families in the superfamily Ephydroidea are reviewed. Regional faunas of the four described genera of Curtonotidae are also briefly reviewed. Published information on the external and internal anatomy and physiology of the family is summarised and their relevance as phylogenetic characters are discussed. Examples of key features of adults are illustrated to aid in the interpretation of morphological characters, namely the head and thorax, frons, flagellomere 1, wing, male terminalia, spermatheca and female terminalia. The first comprehensive phylogeny of the family Curtonotidae is presented. This comprises a phylogenomic estimation of Curtonotidae relationships based on molecular markers and morphology. The molecular data set comprises 33 taxa (30 in-group Curtonotidae; three out-groups: *Camilla*, *Diastata*, *Drosophila*) and 4 gene regions from 3 genes: 2 non-contiguous fragments from the CPSase (carbamoylphosphate synthetase) domain of the nuclear protein coding gene CAD (= CAD1 and CAD3); a fragment from the coding region of TPI (triosephosphosphate isomerase); and a fragment of the mitochondrial gene CO1 (cytochrome oxidase 1). We performed Bayesian likelihood analyses in the program MrBayes 3.2; maximum likelihood analyses in the program Garli 2.0; and parsimony analysis in PAUP*v4b10 on the concatenated genetic dataset. A data matrix of 62 discrete, morphological features of imagines was compiled from 75 taxa (70 in-group Curtonotidae taxa and five out-group exemplars: *Amiota*, *Camilla*, *Diastata*, *Drosophila*, *Stegana*), and these data are presented as Appendix II. For the combined morphological and molecular data a Bayesian likelihood analysis in the program MrBayes 3.2 and a parsimony analysis in PAUP*v4b10 were performed, and for the morphological dataset a parsimony analysis was carried out in PAUP*v4b10. Results of the molecular and morphological analyses attest to the monophyly of the Curtonotidae and clearly indicate two primary clades, with *Axinota* + *Curtonotum* being sister to the remainder of the Curtonotidae. A revised classification of the world fauna of the family Curtonotidae, based on the results of this study is outlined in 2.0: Appendix III. *Curtonotum sensu stricto* (*sensu* Klymko and Marshall 2011) is here adopted and ten newly-defined species-groups of the genus *Curtonotum* are recognised the: *Anus*; *Boeny*; *Campsiphallum*; *Gonzo*; *Platyphallum*; *Rinhatinana*; *Saheliense*; *Striatifrons*; *Stuckenbergi*; and *Uncinatum* species-groups. The three Oriental species *C. arenatum* (Osten Sacken, 1882), *C. ceylonense* Delfinado, 1969 and *C. maii* Delfinado, 1969, are unplaced in species-groups, pending a revision of the Oriental fauna. The following nomenclatorial changes are proposed: *Cyrtona appendiculata* Séguy, 1938 is formally re-instated as a valid species and is removed as a

junior synonym of *Cyrtona pictipennis* (Thomson, 1869). The former variety name *sublineata* (Duda, 1939) is upgraded to a specific name, as *Parapsinota sublineata* (Duda, 1939).

Combined molecular and morphological phylogenies (*e.g.*, Nylander *et al.* 2004), are now being increasingly applied in systematics to help resolve relationships within various plant and animal taxa. Key combined studies in the Diptera are those of Su *et al.* (2008) for Sepsidae, Germann *et al.* (2010) for Dolichopodidae, Skevington and Yeates (2000) for Syrphoidea, Petersen *et al.* (2010) for Tipuloidea, and perhaps most significantly, Wiegmann *et al.* (2011), for the Diptera as a whole.

The family Curtonotidae have not been the subject of a detailed morphological phylogenetic analysis and no study using molecular markers has been previously attempted. This Chapter therefore provides a first combined molecular and morphological phylogeny for the family Curtonotidae.

As outlined by Klymko and Marshall (2011), evidence for monophyly of *Curtonotum* (relative to *Axinota*) remains weak at best. This study is, therefore, primarily aimed at investigating phylogenetic relationships within the genus *Curtonotum* as it occurs in the Afrotropical Region. Examples of *Curtonotum* species from the Neotropical, Nearctic and Palaearctic Regions are also included, as are taxa from the other three described genera. Additional examples of species currently ascribable to the genus *Cyrtona* are also included to assist in analysis and interpretation, although full resolution of the status of *Cyrtona sensu lato* will only result from additional studies that include more taxa as terminals. Out-group exemplar taxa are selected from three other families in the Ephydroidea, namely: Camillidae, Diastatidae and Drosophilidae. Three out-group taxa (*Camilla*, *Diastata* and *Drosophila*) are used in the molecular analysis and five (*Amiota*, *Camilla*, *Diastata*, *Drosophila* and *Stegana*) in the morphological.

This study applies the exemplar approach, in which species are used as terminals, as opposed to supra-specific taxa as terminal entities. It has been argued, that using species as terminals gives consistently more accurate estimates than do the other coding methods, even when only a few taxa are sampled from each higher taxon (Wiens 1998). This approach has a strong potential for repeatability and is superior for simultaneous

analysis of morphological and molecular data (Kron and Judd 1989; Prendini 2001). One argument against the exemplar approach looks at how a failure to examine a full range of taxa within some families led Griffiths (1972) astray and it could be argued that the ground-plan approach is preferential, providing the ground-plan character states are strongly supported. This study, however, follows the recommendations for the selection of exemplars outlined by Prendini (2001), namely that a minimum of two exemplars per higher taxon (unless monotypic) should be included in all analyses, type taxa should be included whenever possible and exemplars should be selected to maximise morphological diversity for the supra-specific taxa they represent.

Afrotropical species of *Axinota* were revised by Kirk-Spriggs (2010a, Chapter 3.1), two species-groups of which are now recognised: a continental Afrotropical *Fuscipennis* species-group, with two species, *A. fuscipennis* (Macquart) and *A. quasimodoi* Kirk-Spriggs, and a predominantly Oriental *Pictiventris* species-group, with nine species in the Oriental Region and two Afrotropical species: *A. ahdabi* Kirk-Spriggs (from Yemen) and *A. kyphosis* Kirk-Spriggs (from Madagascar). Species of the Oriental *Pictiventris* species-group occur as far east as Queensland in Australia. The immature stages and biology of species of the genus are unknown.

Curtonotum is the most species-rich and widely distributed genus of the family and the only genus known in the New World, although Klymko and Marshall (2011) suggest restricting the name *Curtonotum* to a monophyletic New World group. It occurs in all zoogeographical regions, except the Australasian / Oceanian Regions and Antarctica. Seventy-six species are now recognised worldwide (including those described in this thesis): 37 Afrotropical (Wirth and Tsacas 1980; Kirk-Spriggs 2011, Chapter 3.3, Chapter 3.4); two Nearctic (McAlpine 1987; Wirth 1965; Klymko and Marshall 2011); 30 Neotropical (Wirth 1975; Marshall *et al.* 2010; Klymko and Marshall 2011); three Oriental (Delfinado 1969; Wirth 1977); and four Palaearctic (Papp 1998; Kirk-Spriggs and Freidberg 2007; 2.0: Appendix III; Ozerov 2007). Only three species are recorded from more than one Region. Known information of the biology and immature stages was summarised by Meier *et al.* (1997) and Kirk-Spriggs (2008b).

Kirk-Spriggs (2010b, Chapter 3.2) described the new genus *Tigrisomyia* and four new species confined to medium to high elevation Afromontane forests in the Eastern

Arc Mountains of Tanzania and the Malawi section of the Great Rift Valley. *Tigrisomyia* is the only described genus confined to the Afrotropical Region. The biology and immature stages of species of the genus remain unknown.

Cyrtona Séguy, 1938, was formerly regarded as a very small genus of only four described species, apparently restricted to the Afrotropics (Wirth and Tsacas 1980), but this study has revealed a highly diverse fauna of “*Cyrtona*” that occurs throughout sub-Saharan Africa (but absent from Madagascar), the Arabian Peninsula and into the Oriental Region, at least as far east as the Malay Peninsula (see below). “*Cyrtona*” is poorly defined, however, and no generic description or diagnosis has been published. It has largely been separated from the genera *Curtonotum* and *Axinota* on the basis of the disk of the scutellum, which is glabrous in “*Cyrtona*” and hirsute in *Curtonotum* and *Axinota* and the costal margin, which has short even spines in “*Cyrtona*” and a series of conspicuous longer spines in *Curtonotum* (e.g., Hackman 1960). It is apparent, even with the small number of species currently ascribed to the “genus”, that at least two genera may be represented, while other species-groups have also been discovered in unidentified material that would be ascribed to “*Cyrtona*”, on the basis of the two characters noted above. For this reason “*Cyrtona*”, as currently defined, is here treated as *Cyrtona sensu lato* and a diagnosis of the group must await a complete revision and phylogenetic analysis of the *Cyrtona sensu lato* clade (as outlined below), which may lead to new names in refereed publications. The biology and larval habits of species of “*Cyrtona*” remain entirely unknown, although Cuthbertson (1936: 54) collected (but did not rear) *Cyrtona albomacula* (Curran) (as *Curtonotum*, Drosophilidae) from human faeces in Zimbabwe (as S. Rhodesia), and Pollock (1996: 183) recorded three species occurring in Zimbabwe to be multilarviparous, retaining larvae in a brood pouch and to deposit a number of first-instar larvae, in a similar fashion to Sarcophagidae. In another paper Pollock (2002) recorded some biological notes on the occurrence of the “genus” based on observations in Zimbabwe.

Thomson (1869: 598) described *Geomyza pictipennis* from “Patria: Caput bonae spei [= Cape of Good Hope, South Africa]” and provided an extensive Latin description of the species. Czerny (1903) apparently examined the type specimen of *Geomyza pictipennis*, and described the patterning of the wing in detail, noting (p. 126): “The

bristle [arista] of the antenna of the type is missing, and furthermore it is not described. It is probably feathered. This species seems to be a species of *Cyrtanotum* Mcq. (syn. *Diplocentra* Lw.)” (translation F. Koch). These details concur with the condition of the type specimen (here examined), although this does not bear Czerny’s determination label, and transfer of *pictipennis* to the genus *Curtonotum* is therefore ascribable to Czerny.

Curran (1933: 2) included “*Curtonotum pictipennis*” in a first key to African “*Curtonotum*”. He compared this species to “*Curtonotum quadrimacula* Walker” and stated (p. 2): “Apparently this species is very close to *quadrimacula*, and possibly identical with it. There is very little in the descriptions to indicate that there are two species concerned.” Curran’s treatment of the then known African species of “*Curtonotum*” was, however, rather superficial and his study was not based on the examination of types. The “*Curtonotum quadrimacula* Walker” referred to by Curran is, in fact, a species of the genus *Homoneura* van der Wulp, 1891, in the family Lauxaniidae (Miller 1980). Curran described *Curtonotum albomaculata* in the same work from “Dande River, S. Rhodesia”, “Gurunge [S. Rhodesia]” and “Lenge Town, Liberia.”

The genus *Cyrtona* was erected by Séguy (1938: 342) for the new species *C. appendiculata* from “Kenya, Mau Escarpment, 3.000 m.”

Hackman (1960) described two new species into the genus *Cyrtona*, namely: *Cyrtona capensis* (p. 384) from “Cape Town, Table Mnt.” and “Hout Bay, Skoorsteenkop”, and *Cyrtona consobrina* (p. 385) from “Hout Bay, Skoorsteenkop.” Hackman also listed a single unnamed ♂ from “Albert Falls, Umgeni River E of Pietermaritzburg.”

Wirth and Tsacas (1980) listed four species in the genus *Cyrtona*, and placed *Cyrtona appendiculata* Séguy as a junior synonym of *Cyrtona pictipennis*. Examination of the types of both these species has revealed that they differ significantly in wing pattern and male terminalia and *C. appendiculata* Séguy is here re-instated as a valid species as *Cyrtona appendiculata* Séguy, 1938.

In 1911 de Meijere (p. 413) described the Oriental species *Drosophila angustipennis*, illustrating the wing (fig. 51) and listing the type material as: “[Java] Gunung Ungaran, October, 1 ♀, Jacobson leg.” Duda (1924: 174) transferred *D. angustipennis* to his newly-erected genus *Parapsinota*.

The type specimen of *Drosophila angustipennis* was examined by Delfinado (1969) for her revision of Oriental species of Curtonotidae, in which she synonymised *Parapsinota* as a synonym of *Curtonotum*. She re-described both sexes and provided illustrations of the male terminalia (fig. 9) and spermathecae (fig. 24). The three specimens (2♂, 1♀) cited by Delfinado (1969: 202) from Thailand (in BPBM) were examined as part of this study. It is clear from external and internal features that *Curtonotum angustipennis* is wrongly placed in the genus *Curtonotum*, but its formal transfer must await a complete revision of *Cyrtona sensu lato*. In addition, an intact female specimen from “W. Malaysia, Selangor, Genting Tea Estate, Genting Sembah, forest, 2000 feet, 24–27.xii.1972, A.E. Stubbs, BMNH 1974–87” (in BMNH), clearly belongs to the same group, and this proves the occurrence of *Cyrtona sensu lato* both in the Afrotropical and Oriental Regions.

In a more recent publication Dwivedi and Gupta (1979: 183) described the Oriental species *Curtonotum neoangustipennis* (as Drosophilidae) from: “India: West Bengal, Darjeeling District, Ramam”, illustrating the male terminalia (figs A, B) and the wing (fig. C). Although the scutellum is not described (*i.e.*, whether the disk is glabrous or hirsute), referral to the figures provided in that paper, especially the form and structure of the male terminalia leaves no doubt as to its identity with *Cyrtona sensu lato* (as currently defined). Again, the formal transfer must await a complete revision of *Cyrtona sensu lato*.

In a paper apparently missed by previous workers on the group, Duda (1939) described two African species, “*Parapsinota angustipennis* de Meijere, var. *sublineata* n. var. ♂” from “Uganda: Mujenje” and “New Hannover” in South Africa and “*Parapsinota brevicornis* n. sp.” from “Oudebesch Caledon Div.” in South Africa. The type material of these two species (examined here) reveals these to represent species of *Cyrtona sensu lato*, but their formal transfer must await a revision of *Cyrtona sensu lato*. The former variety name *sublineata* is formerly upgraded to a specific name. *Parapsinota brevicornis* Duda, 1939 is only represented by a unique female holotype and as females of this group cannot be reliably identified it is here left as unplaced.

PHYSIOLOGY AND INTERNAL ANATOMY

Only three studies dealing with the physiology and internal anatomy of the Curtonotidae have been published.

Pollock (1996) found undescribed species of *Cyrtona* near *albomacula* from Zimbabwe to be multilarviparous and to deposit a number of small first-instar larvae. He described and illustrated the seasonal development of ovaries and ova and noted that following mating mature eggs pass into a brood pouch. The eggs then develop *in situ* into first-instar larvae. He suggested that these are deposited by females one or a few at a time. He illustrated the female reproductive tract (p. 187, fig. 3), with a number of first-instar larvae in the brood pouch and noted that the two spermathecae are tubular in shape.

Meier *et al* (1997: 6, figs 2A, 2B) studied the female reproductive system of the Nearctic *C. helvum* (Loew). They described the internal female reproductive tract, noting that this comprises paired ovaries and lateral oviducts, a tubular vagina, a small ventral receptacle, a large antero-ventral pouch attached to the vagina, two dorsal spermathecae and a pair of accessory glands. The ovaries contained between 1 and 29 mature eggs. They further noted that a similar antero-ventral pouch was present in the reproductive track of an unidentified *Cyrtona* species from Kenya and a similar, but much smaller pouch was present in the Oriental *Axinota dissimilis* (Malloch), *A. uniformis* (Malloch) and in *C. helvum*. While this pouch is used to accommodate first-instar larvae in some species of the multilarviparous *Cyrtona sensu lato* its function in oviparous species remains unclear. Meier *et al* (1997) concluded, however, that whatever its function, the anterior pouch apparently belongs to the ground-plan of the Curtonotidae and very likely represents a synapomorphy of the family. They established that the so-called third “spermathecae” reported by Delfinado (1969: 219, figs 17–23) and McAlpine (1987) for Oriental species of the genus *Axinota* (as *Apsinota*) represented a misinterpretation of a modified, fairly large and slightly sclerotised ventral receptacle. They established, therefore, that two spermathecae represent the ground-plan condition in the Curtonotidae.

Pollock (2002) studied the external and internal anatomy of at least two undescribed Afrotropical *Cyrtona* spp. near *albomacula*, *Curtonotum quinquevittatum* Curran and the Oriental *Axinota dissimilis*. He illustrated and described external features

of the male abdomen and postabdomen of *Cyrtona*. He noted that the postsurstyli [= postgonites] are absent in *Cyrtona*, suggesting that this may be due to the absence of the narrowing of the ovipositor segments of the female abdomen, which the appendages are normally adapted to grip externally. He noted the presence of small presurstyli [= surstylus] on the hypandrium and that in general the aedeagus [= phallus] can be described as symmetrical, bird's head shaped. He described the presence of a membranous sheath, which he termed "cordiform plate", situated at the posterior base of the aedeagus. In the case of *C. quinquevittatum* he interpreted the paired appendages adjacent to the anal cerci [= cercus] as presurstyli and postsurstyli respectively, rather than surstyli and postgonites as in the more recent interpretations (*e.g.*, Marshall *et al.* 2010; Kirk-Spriggs 2011; Klymko and Marshall 2011). Pollock further described the ejaculatory sclerite [= ejaculatory apodeme] (p. 1736) "... from which the ejaculatory duct leads to the aedeagus and hence to the exterior, through the main shaft of the aedeagal apodeme which is proved therefore to be tubular." He inferred that the tubular condition of the aedeagal apodeme may have led to misunderstandings of the nature of this structure in some accounts, citing McAlpine (1987), as an example in which it was assumed that the main shaft of the aedeagal apodeme is a basiphallus, being the basal part of the aedeagus proper. Other features discussed by Pollock that have potential phylogenetic implications are discussed in the below phylogenetic analysis.

PREVIOUS PHYLOGENTIC INTERPRETATIONS OF SISTER GROUPS

Hennig (1958: 662) regarded the Ephydroidea (as Drosophiloidea) to include the families Ephydriidae, Camillidae, Diastatidae, Curtonotidae and Drosophilidae, considering the superfamily to be "... the best substantiated monophyletic part-groups of the Schizophora" (translation G.H. Harder). In a ground-plan approach, Hennig noted the following apomorphic characteristics of the Curtonotidae in relation to the basic ground-plan of the Schizophora: 1.) The costa is disrupted at two points (figs 346–347); 2.) Proclinate orbital seta are in evidence (fig. 336); 3.) The anal cell is short, cu_{1b} is recurved (figs 346–347); 4.) The anal vein is shortened, does not reach the wing margin (figs 346–347)" (translation G.H. Harder). Although he noted that the adduced

apomorphic characteristics did not provide a definitive association to any family in the Drosophiloidea, he nevertheless considered the Curtonotidae to be a sister-group of the Drosophilidae.

Hennig (1971) further discussed the phylogenetic significance of antennal development at some length. He noted that in *Curtonotum*, *Drosophila* (Drosophilidae), and *Camilla* (Camillidae) the lobe of flagellomere 1 is completely enclosed in the interior of the pedicel, presumably due to the fact that the outer wall became enlarged and its distal margin assumed a closed elliptic form. The margins of the dorsolateral notch on the pedicel presumably moved proximally, but are not fused, so that a long slit was formed. He noted that such peculiarities in antennal development can be regarded as an additional character supporting the assumption that the Ephydroidea (as Drosophiloidea) are a monophyletic group. He further noted that antennal structure also indicates that the Camillidae are more closely related to the Curtonotidae and Drosophilidae than to the Ephydridae and that this assumption is supported, perhaps, by the fact that the proclinate orbital seta in the Curtonotidae, Drosophilidae and Camillidae are inserted immediately ventral to the two reclinate ones, rather than being inserted between these and the eye margin, as in the Diastatidae and Ephydridae. He thus divided the Ephydroidea into two suprafamilies, the Drosophilidea, consisting of the Curtonotidae, Camillidae and Drosophilidae, and the Ephydridea, consisting of the Diastatidae and Ephydridae.

Hennig (1973) defined the family Curtonotidae by the following: “Apical plates [= orbital plates] with fronto-orbital bristles distinct from the anterior margin of the eye. Thorax strongly arched. Mesopleural bristles [= anepisternal setae] present. Postabdomen distinctly delimited from preabdomen, prehypopygial segments of the postabdomen reduced (smaller)” (translation G.H. Harder).

Griffiths (1972) followed Hennig (1958, 1971, 1973) in the delimitation of the superfamily Ephydroidea (as Drosophiloidea), his concept including the families Drosophilidae, Camillidae, Curtonotidae, Campichoetidae and Ephydridae. He also regarded the Ephydroidea (*sensu* Hennig 1958) to be (p. 100) “... one of the most surely grounded monophyletic groups in the Schizophora.” He noted the following apomorphic conditions in respect to the ground-plan of the Schizophora: 1.) 3rd antennal article [= flagellomere 1] bearing long dorsolateral process which projects within the 2nd article

[pedicel]; 2.) Aedeagus [phallus] (♂) grossly enlarged, curved downwards anteriorly where it is fused with the aedeagal apodeme [= phallapodeme] (fig. 40); 3.) 6th and 7th terga (♂) reduced, much shorter than preceding terga; 4.) 8th sternum (♂) completely lost; 5.) Second costal break present (shortly beyond humeral crossvein) [following Hennig 1958]; 6.) Base of m_4 (= “tb”, basal crossvein [= *bm-cu* crossvein]) lost [following Hennig 1958]; 7.) Spermathecae (♀) long and slender [following Hennig 1958]. Griffiths made no attempt to divide the Drosophiloidea into “prefamilies”, as Hennig (1958) did not discuss the Campichoetidae when proposing his subdivisions of the superfamily.

McAlpine (1989) followed the previous interpretations of Hennig (1958, 1971, 1973) and Griffiths (1972) in including the five families Curtonotidae, Camillidae, Drosophilidae, Diastatidae and Ephydridae in his concept of the Ephydroidea and corrected the usage of the superfamilial name Ephydroidea over Drosophiloidea. McAlpine disagreed with Hennig’s concept of suprafamilies, however, being of the view that the primary evolutionary dichotomy in the Ephydroidea lay between the Curtonotidae and the remaining four families. This view was based on the fact that *Sc* is complete and free from R_1 in the Curtonotidae (plesiomorphic condition), as opposed to being apically reduced and fused with R_1 in the remaining four families (synapomorphic condition). He noted that the Curtonotidae possess a peculiar set of plesiomorphic and autapomorphic character states, which sets the Curtonotidae apart from the remainder of the Ephydroidea. He stated that almost all ground-plan characters of the Ephydroidea are expressed in the ground-plan of the Curtonotidae and listed seven characters for the family that he regarded as unequivocally autapomorphic: 1). Postpronotum with supplementary bristles; 2). Scutum [= mesonotum] usually strongly humped; 3). Cells *bm* and *dm* confluent, *i.e.*, crossvein *bm-cu* absent; 4). A_1 secondarily lengthened; 5). Sternite 8 of the male absent; 6). Aedeagus enlarged, C-shaped, distiphallus antero-ventrally directed and; 7). Aedeagal apodeme [= phallapodeme] closely and broadly joined to basiphallus. He concluded that these seven autapomorphic characters, together with six other listed apomorphic conditions attest to the monophyly of the family and suggested that the Curtonotidae is probably sister group of the remainder of the Ephydroidea.

All of the above published studies took a ground-plan approach and presented matrices of characters. Grimaldi (1990) was the first to attempt a morphological cladistic

analysis of the Ephydroidea. He reassessed the characters noted by Hennig (1958, 1971, 1973), Griffiths (1972), and McAlpine (1989); included selected characters noted in a matrix format by Chandler (1987), for the Diastatidae and Campichoetidae, and included additional characters of his own. This study resulted in three equally parsimonious hypotheses of families in the Ephydroidea. Both trees 1 and 2 (p. 23, figs 8, 9) infer that the Curtonotidae are sister to the remainder of the Ephydroidea, while Grimaldi's preferred tree 3 (p. 23, fig. 10), infers that the Drosophilidae + Curtonotidae are the sister group to the remainder of the Ephydroidea.

Pollock (2002) assembled an alternative ground-plan character matrix for what he termed "Ephydroidea *sensu lato*", being in his view the six families then ascribed to "Ephydroidea *sensu stricto*", plus the calyptrate families Gastrophilidae, Hippoboscidae, Glossinidae and Oestridae. Pollock considered the Oestridae and Hippoboscidae to be "derived from early ephydroids". Evidence supporting such a theory was unconvincing, however, and recently published molecular phylogenies of the Calyptratae specifically (Kutty *et al.* 2010) and the Diptera in general (Wiegmann *et al.* 2011), lend no support to such a theory and this must, therefore, be regarded as ungrounded.

In a recent study, Wiegmann *et al.* (2011) provided a phylogenetic estimate of fly relationships based on combined molecular and morphological data from 149 of the 157 families worldwide. In a surprising result that differs dramatically from previous interpretations of relationships within the superfamily, this study revealed that (Drosophilidae + Braulidae + Cryptochetidae) are sister to the remainder of the Ephydroidea (Camillidae + (Curtonotidae + Diastatidae)), except for the Ephydridae.

In the most recent molecular resolution of the phylogeny of the Ephydroidea that includes the enigmatic family Mormotomyiidae (Winkler *et al.* in prep.) (Camillidae + Curtonotidae + Diastatidae) are sister to the remainder of the Ephydroidea (Braulidae + Drosophilidae + Cryptochetidae), except for the Ephydridae and Mormotomyiidae.

PREVIOUS PHYLOGENETIC INTERPRETATIONS WITHIN CURTONOTIDAE

In a morphological study, Tsacas (1977: 147–148) divided the Afrotropical species of *Curtonotum* into two species-groups, a *Cuthbertsoni* Group (“Groupe *cuthbertsoni*”) and a *Striatifrons* Group (“Groupe *striatifrons*”).

Tsacas defined the *Cuthbertsoni* Group as follows (p. 147): “Small species 4–6 mm (*platyphallum* 8 mm), orbital plate long, extending to just before anterior margin of frons, orbital setae widely spaced one from the other, ratio of distance between *or1* [= anterior orbital seta] and the anterior margin of the frons compared to the distance between *or1* [= anterior orbital seta] and *or3* [= posterior orbital seta] varies between 1.7 and 3.5; genitalia forceps long; distiphallus simple with prolonged basiphallus” (translation M. De Meyer). To this group he ascribed: *C. cuthbertsoni*, *C. angolense* (as *angolensis*), *C. campsiphallum*, *C. platyphallum*, *C. quinquevittatum*, *C. saheliense* (as *saheliensis*), *C. sao*, *C. simile* (as *similis*), the seven endemic Madagascan species named by Tsacas in 1974, plus the Oriental species *C. arenatum* (Osten Sacken, 1882), *C. ceylonense* Delfinado, 1969 and *C. maai* Delfinado, 1969.

Tsacas (p. 148) further subdivided the *Cuthbertsoni* Group into a *Cuthbertsoni* Complex (“Complexe *cuthbertsoni*”) and a *Quinquevittatum* Complex (“Complexe *quinquevittatum*”), characterised by the setae on the epandrium and the shape of the distiphallus. He defined the *Cuthbertsoni* Complex as having the “postero-inferior view of epandrium with tuft of long setae” and the “base of distiphallus carrying a double or single tooth or a long spine” (translations M. De Meyer). To this Complex he ascribed *C. cuthbertsoni* (*sensu* Tsacas 1977), *C. saheliense* (as *saheliensis*) and *C. simile* (as *similis*).

He defined the *Quinquevittatum* Complex as having the “postero-inferior view of epandrium with a very long seta, accompanied by some short setae” and the “base of distiphallus with processes which may be homologous with the paraphallus” (translations M. De Meyer). To this Complex he ascribed: *C. angolense* (as *angolensis*), *C. campsiphallum*, *C. platyphallum*, *C. quinquevittatum* and *C. sao*.

Tsacas defined the *Striatifrons* Group as follows (p. 148): “Large species 8–9 mm, rarely 6 mm, orbital plate short, oblique, ending about half length of frons, orbital setae close together, ratio of distance between *or1* [= anterior orbital seta] and the

anterior margin of the frons compared to the distance between *or1* [= anterior orbital seta] and *or3* [= posterior orbital seta] at least equal to 6 (6–7.6); genitalia forceps short; distiphallus folded back on the basiphallus and composed of three elements” (translation M. De Meyer). To this Group he ascribed: *C. herrero*, *C. striatifrons* and *C. tigrinum* (omitting to mention *C. maculiventris*, which also belongs to this group).

Meier *et al.* (1997) made some assumptions regarding phylogenetic relationships of the three genera of Curtonotidae described to that date. These assumptions were based on the form and surface texture of the spermathecae. They noted that three types of spermathecae occur in the genus *Curtonotum*: 1). Slender, elongate, sclerotised spermathecae that are studded with small protuberances. To this group they ascribed the Nearctic species *C. helvum*, the Neotropical type species of the genus, *C. taeniatum* Hendel, and the three Afrotropical species in the *Striatifrons* species-group (*sensu* Tsacas 1977). 2). Obclavate spermathecae (*i.e.*, having a wide base tapering to a point) with a wrinkled (rugose) surface (see Kirk-Spriggs 2008c: 246). To this group they ascribed the *Cuthbertsoni* species-group (*sensu* Tsacas 1977) and the “... 10 Madagascan species of the genus” [only seven of which are named species (Kirk-Spriggs 2011, Chapter 3.3)]. They further discussed the illustrations of the spermathecae of the Oriental species *C. ceylonese* by Delfinado (1969: 219, fig. 25) and concluded that these have the same general shape, but were illustrated from a different orientation. The spermathecal duct is not illustrated, but it is apparent that these are of the same type. Indeed, Tsacas (1977) ascribed the three species of *Curtonotum* occurring in the Oriental Region to the *Cuthbertsoni* species-group. 3). Small, subspherical spermathecae that are studded with small protuberances. They noted that this condition is only known in the Oriental species *Curtonotum angustipennis*.

On the basis of these assumptions, Meier *et al.* (1997) stated that *Axinota* is the sister group to *Curtonotum* + *Cyrtona*, due to the assumed plesiomorphic condition of the spermatheca of (the as then undescribed), *Axinota kyphosis* from Madagascar. The spermathecae of this species are small, doliform (*i.e.*, short cylindrical to round), with a deep basal and shallow, apical invagination, this being the most common spermathecal state in the Drosophilidae; the putative sister family of Curtonotidae, as proposed by Grimaldi (1990), and thus thought to represent the ground-plan condition for

Curtonotidae. They noted, however, that in the Oriental species of *Axinota* the spermathecae are rounded or mushroom-shaped and sclerotised with a smooth surface and further suggested that the presence of spinules on the spermatheca of *Cyrtona* and *Curtonotum* (absent in examined *Axinota* and the ground-plan of Drosophilidae) represents another synapomorphy for these two genera.

Pollock (2002) tentatively proposed *Cyrtona* as the sister group to a clade made up of *Curtonotum* + *Axinota* as the last two mentioned genera both exhibit aedeagal asymmetry and a reduction of the pregenital sclerites.

In the first and most recent morphological phylogenetic analysis of Curtonotidae, the New World species of *Curtonotum* were treated by Klymko and Marshall (2011), who recognised *Curtonotum* + *Axinota* as forming a monophyletic group. They noted that unlike *Cyrtona*, with its expanded tergite 7, *Axinota*, with its sexually dimorphic frons, and *Tigrisomyia* with its strikingly marked thorax and highly derived male terminalia, *Curtonotum* has no obvious apomorphies, with the possible exception of the spinose costa. They noted that this condition is absent in *Cyrtona* and is only expressed in the two Afrotropical species of the *Axinota fuscipennis* species-group (*sensu* Kirk-Spriggs 2010a), and is generally absent in the other families within Ephydroidea, the Diastatidae (including Campichoetidae) being an exception. This condition was considered plesiomorphic for the Ephydroidea by McAlpine (1989), given its scattered occurrence and its general absence in Drosophilidae. They considered this condition to more likely be independently derived several times in the Acalyptratae, and once or twice in Curtonotidae (either once in a *Curtonotum* + *Axinota* ancestor, followed by the secondary loss in most *Axinota*; or twice, once each in *Curtonotum* and *Axinota*). They concluded that *Curtonotum* in its current broad sense is paraphyletic with respect to *Axinota*, and suggest restricting the name *Curtonotum* to a monophyletic New World group. They suggested that the two Nearctic species of *Curtonotum* belong to the *Anus* species-group (as first proposed by Kirk-Spriggs and Freidberg 2007), together with the Palaearctic species of the genus and provided additional characters to define the group.

HOMOLOGIES OF MALE TERMINALIA AND TERMINOLOGY APPLIED

Unlike the Neotropical species of *Curtonotum sensu stricto*, which are strikingly marked, often with conspicuous picture wings and abdominal patterning, the Afrotropical species are by contrast more conservative and phenotypically very similar, frequently only distinguishable on slight, but consistent, differences in the male terminalia. For this reason the character analysis presented below relies heavily on features of the male terminalia and an explanation of the homologies and terminology applied here requires some discussion.

Griffiths (1972) illustrated the male terminalia of the Nearctic species *Curtonotum helvum* (fig. 40). He regarded the phallus as consisting of a lengthened aedeagal apodeme and aedeagus. He illustrated the ejaculatory apodeme as connected to the aedeagal apodeme by a short duct.

Tsacas (1977: 167, fig. 11a) interpreted the homologies of the male phallus of *Curtonotum striatifrons*. In his view this consisted of a short phallapodeme, a long, curved basiphallus and a distiphallus that is subdivided into two components, a more basal “paraphallus” and an apical spine (“épine apicale”), plus the fin (“ailette”) or lateral wing. The ejaculatory apodeme was not illustrated or described. Tsacas’ interpretation differs little from the interpretation provided here for the genus *Curtonotum*.

McAlpine (1987) also illustrated the male terminalia of *Curtonotum helvum* (fig. 94.2). His interpretation of the respective parts differed little from that of Tsacas (1977), although some of the terminology applied differed, principally the use of aedeagal apodeme for the phallapodeme. His illustration indicated that the ejaculatory apodeme was retracted into the aedeagal apodeme.

Papp (1998) illustrated the male terminalia of the Palaearctic and Oriental species *Curtonotum anus*. He regarded the phallus as consisting of a lengthened aedeagal apodeme and distiphallus only. His illustration further indicated that the ejaculatory apodeme was retracted into the aedeagal apodeme.

In a similar interpretation, Pollock (2002) pointed out that in McAlpine’s (1987, fig. 94.2) both the hypandrium and aedeagal apodeme appear to be extended too far, thus making the aedeagal apodeme resemble an aedeagus. He regarded the phallus to consist

of a lengthened aedeagal apodeme [= phallapodeme] and shorter aedeagus [= distiphallus]. He also applied the term ejaculatory sclerite to the structure here termed the ejaculatory apodeme. An explanation of why Pollock's interpretations are regarded as incorrect are outlined below.

Terminology applied here for male terminalia largely follows the original concept of Tsacas (1977) for *Curtonotum*, although some structures were unnamed. The terminology here applied is outlined on Figs 2.0: 49–72 and largely follows Sinclair (2000).

MATERIAL AND METHODS

PHYLOGENETIC ANALYSIS

Taxa Sampled

A total of 33 taxa representing all described Curtonotidae genera and 3 out-group families were sampled for nucleotide sequencing (2.0: Table 1). The included curtonotid species were sampled from multiple zoogeographic regions and represent a broad sample of the diversity of the family. Out-groups were selected from families considered to be closely related to curtonotids in the Ephydroidea, *Drosophila melanogaster* (Drosophilidae), *Camilla* sp. (Camillidae) and *Diastata fuscata* (Diastatidae).

DNA Extraction, Amplification and Sequencing

Genomic DNA was extracted using the DNeasy DNA extraction kit (Qiagen Inc., Valencia, CA). The standard protocol was altered by extending the length of time the specimen was in proteinase K solution to two days, in order to effectively break down chitin, but to avoid grinding the specimen. Final elution was reduced to 30 µl to avoid diluting the DNA solution.

Sequence data were collected from all 33 taxa 4 gene regions from 3 genes: 2 non-contiguous fragments from the CPSase (carbamoylphosphate synthetase) domain of the nuclear protein coding gene CAD (= CAD1 and CAD3); a fragment from the coding region of TPI (triosephosphate isomerase); and a fragment of the mitochondrial gene CO1 (cytochrome oxidase 1). For CAD, approximately 1491 base pairs (bp) from the

carbomoylphosphate synthase (CPS) domain of the gene were amplified in two non-overlapping amplification fragments and sequenced using degenerate primers designed by Moulton and Wiegmann (2004) (CAD1: CAD60F–CAD364R: CAD3: CAD581F–CAD843R). A 500 bp fragment of the nuclear protein coding gene triose phosphate isomerase (TPI) was amplified using primers published in Bertone *et al.* (2008) (TPI: Tpi111Fb TpiR275). Mitochondrial CO1 was amplified using the primers LC01490f and HC02198r (Folmer *et al.* 1994). Primer sequences and map locations for these genes are compiled in Gibson *et al* (2011). PCR parameters for CAD and TPI followed the baseline conditions for CAD1 published in Moulton and Wiegmann (2004) and CO1 amplification followed conditions published in Folmer *et al.* (1994). PCR products were extracted from agarose gels and purified with the Qiaquick Gel Extraction kit (Qiagen, Santa Clara, CA). BigDye Sequencing kits (Applied Biosystems, Foster City, CA) were used for sequencing reactions and sequencing was completed at the North Carolina State University Genome Sequencing Laboratory (GSL). Sequences were contiged and edited using Sequencher 4.1 (Gene Codes Corp., Ann Arbor, MI).

Alignment was carried out manually using Se-Al 2.0 (Rambaut 2002). CAD, TPI and CO1 were aligned according to the amino acid translation. The final nucleotide alignments and phylogenetic data sets are available as deposited in Treebase.org and all sequences are deposited in GENBANK (2.0: Table 1).

Phylogeny Estimation

Maximum parsimony (MP) analyses were carried out using PAUP*4.0b10 (Swofford 2002). Heuristic search with TBR branch swapping and 100 random addition replicates were completed to find the shortest trees. Node support was obtained by acquiring bootstrap values from heuristic searches of 500 re-sampled data sets with 50 random addition replicates. Analyses including all taxa were conducted for the molecular concatenated gene and morphological datasets as independent partitions, as well as with combined data sets that included all nucleotides equally weighted.

For Bayesian Likelihood and maximum likelihood analyses, the program Mr. Modeltest (Nylander 2005) was implemented to assess the adequacy of substitution models based on the Akaike Information Coefficient (AIC) and nested likelihood ratio

tests. GTR + I + G, was identified as the appropriate model for both concatenated gene data and when genes were analysed independently. Bayesian likelihood analyses were carried in MrBayes 3.2 (Huelsenbeck and Ronquist 2001), Bayesian tree searches were conducted for 10,000,000 generations, trees were sampled every 1000, and the first 25% (2500 trees) were discarded as burn-in. Maximum likelihood (ML) analyses were performed on the combined molecular data set using Garli 2.0 (Zwickl 2006). A GTR+I+G model was implemented.

CHARACTER ANALYSIS

Some characters employed in this study have been applied implicitly or explicitly in other morphological and classificatory studies on the Curtonotidae by previous authors, notably: Tsacas (1974, 1977), Hackman (1960), Delfinado (1969), Pollock (2002) and Kirk-Spriggs (2010a, b). In some cases the interpretation of such characters has been modified slightly from the original studies. Many of the characters applied in the explicit phylogenetic study of New World *Curtonotum* (Klymko and Marshall 2011) are especially useful and are further applied here. Some characters used by previous workers in morphological ground-plan studies of the Ephydroidea specifically have also been applied, notably those of Hennig (1958, 1971, 1973), McAlpine (1989), Griffiths (1972) and Grimaldi (1990).

The data matrix of 62 discrete, morphological features of imagines compiled from 75 taxa (70 in-group Curtonotidae; five out-group exemplars, as tabulated in 2.0: Table 2), is presented in Appendix II. Characters 1–6 pertain to structures of the head, characters 7–12 to thoracic structures, characters 13–19 deal with structures of the wing specifically and 20 to the leg. Characters 21–62 code for features of the abdomen and are divided into male (characters 21–56) and female (characters 57–62) structures. Characters 1–20 relate to both sexes. The majority of characters included in the matrix are binary (48 characters; 77.4%) and these are treated as additive. Fourteen characters (22.5%) are multi-state. Eight of these (12.9%; characters 2, 7, 10, 16, 17, 31, 50, 60) are treated as linear additive multistate characters and 6 (9.6%; characters 11, 14, 35, 39, 43, 62) as non-additive multistate characters (*sensu* Meier 1994).

There are some constraints on the data included in the matrix and some states could not be fully assessed as a result. These constraints comprise taxa for which only a single sex is known or can be reliably identified or unique specimens that are damaged in some way. As noted below (and in Chapter 3.4), females of most taxa of Afrotropical Curtonotidae can only be reliably associated if pairs are taken *in copula* or through genetic bar coding methods. In a few cases females can be associated with males where a single species of a genus occurs in one locality in a single collection event, but such conditions are uncommon. Significantly, although both the oviparous and multilarviparous reproductive states are now known to occur in some species of *Cyrtona sensu lato*, this and other female characters of the genus cannot be assessed as few females can be reliably associated with males at this stage.

PHYLOGENETIC ANALYSIS

HEAD

1. FRONS DEVELOPMENT: (0) not projecting forwards (Figs 2.0: 2–12; 3.3: 1–2, 4–13; 3.4: 7–24); (1) conspicuously projecting forwards (Figs 2.0: 1; 3.4: 1–6, 49–54; Kirk-Spriggs 2011, fig. 3, 3.3: 3; Kirk-Spriggs and Freidberg 2007, fig. 2; figures in Klymko and Marshall 2011). State (0) is expressed in the five out-group exemplars and most genera of Curtonotidae. Forward projection of the frons in the region of the antenna (viewed laterally), is regarded as a synapomorphic condition and is only expressed in the genus *Curtonotum*. It is apparent in all species of Neotropical *Curtonotum* (s.s.), the three species of the Afrotropical *Striatifrons* species-group, the Madagascan endemic species *C. sternithrix* Tsacas, the two Nearctic and three Palaearctic species of the *Anus* species-group and the three species of the Afrotropical *Platyphallum* species-group.

2. FRONS WIDTH: (0) wide in both sexes (*e.g.*, Figs 2.0: 17–25); (1) slightly narrower in males (compare Figs 2.0: 13 and 14); (2) markedly narrower in males (compare Figs 2.0: 15 and 16). This character was applied by Klymko and Marshall (2011), in their morphological phylogeny of New World *Curtonotum*. The frons is wide in both sexes in the five out-group exemplars and most genera of Curtonotidae and state (0) is, therefore, plesiomorphic. A narrower frons in males is a synapomorphy of the

genus *Axinota*, but takes two forms: slightly narrower in the Afrotropical *Fusciennis* species-group and markedly narrower in the predominantly Oriental *Pictiventris* species-group.

3. INSERTION OF ORBITAL SETA: (0) proclinate orbital seta inserted ventral to the two reclinate ones (Figs 2.0: 13–25; 3.3: 14–26; 3.4: 25–48); (1) reclinate orbital seta inserted between reclinate setae and eye margin (*e.g.*, Barraclough 1995, fig. 36). This character was first noted by Hennig (1971) in a ground-plan study of the Ephydroidea (see above). State (0) is expressed in the out-group exemplars *Camilla*, *Amiota*, *Stegana* and *Drosophila* and in all genera of Curtonotidae. State (1) is expressed in the out-group exemplar *Diastata* only.

4. ORBITAL PLATES: (0) long, orbital setae widely separated inserted medially on frons (Figs 2.0: 17–25); (1) short, orbital setae closely approximated, inserted proximal to vertex (Figs 3.3: 16; 3.4: 25–27; figures in Klymko and Marshall 2011). The length of the orbital plates was applied as a character by Klymko and Marshall (2011), in their phylogeny of New World *Curtonotum*. State (0) is here regarded as the plesiomorphic condition and is expressed in the five out-group exemplars and in most genera of Curtonotidae. State (1) is a synapomorphy of *Axinota*, the *Curtonotum striatifrons* species-group, Neotropical *Curtonotum* (s.s.) and the Madagascan endemic species *C. sternithrix*.

5. PROCLINATE ANTERIOR ORBITAL SETA: (0) strongly developed (Figs 2.0: 17–25; 3.3: 14–26; 3.4: 25–48); (1) minute or absent (Figs 2.0: 13–16). This character was applied by Klymko and Marshall (2011) in their morphological phylogeny of New World *Curtonotum* and prior to that was used as a character to separate *Axinota* from *Curtonotum*. State (0) occurs in the five out-group exemplars and in all Curtonotidae genera, except *Axinota* and is regarded as the plesiomorphic condition. State (1) is a synapomorphy of the genus *Axinota*.

6. VENTRAL BRANCHES OF ARISTA: (0) absent or markedly shorter than dorsal branches (Figs 2.0: 29–31, 33, 34); (1) equivalent length to dorsal branches (Figs 2.0: 26–28, 32, 35, 36). Characters of the arista have not been used in previous phylogenetic interpretation of Curtonotidae, but were applied by Grimaldi (1990) for the Drosophilidae. Grimaldi postulated that long dorsal and ventral arisal branches

constituted a synapomorphy of Curtonotidae + Drosophilidae, since the crowded, long branches in *Leucophenga* Mik and other genera of the more plesiomorphic subfamily Steganinae are very similar to those of Curtonotidae. Otherwise, morphological differences of a plumose arista suggest convergence among families of ephydroids. Such an arista in some Ephydridae, for example, possesses only dorsal branches. In a lineage of Camillidae comprised of the genera *Afrocamilla* Barraclough, *Camilla* and *Teratocamilla* Barraclough, the long branches of the plumose arista are much fewer in number. Diastatidae always have an arista with short to long pubescence or with very short branches (Grimaldi and Kirk-Spriggs, in press). State (0) is regarded as the plesiomorphic condition as expressed in the out-group exemplars *Camilla* and *Diastata*, and is evident in *Cyrtona* (s.s.), and in some species of *Cyrtona* (s.l.) used in this analysis. State (1) is expressed in the out-group exemplars *Amiota*, *Stegana* and *Drosophila*; in all *Curtonotum*, *Axinota* and *Tigrisomyia*, and in some species of *Cyrtona* (s.l.). The condition in *Cyrtona* (s.s.) is somewhat variable. In *Cyrtona* (s.s.) *pictipennis* the ventral branches are extremely short, whereas in *Cy.* (s.s.) *appendiculata* and two undescribed species (not included in this analysis) they are long dorsally, but only marginally shorter ventrally.

THORAX

7. CURVATURE OF MESONOTUM: (0) not hunchbacked; (1) moderately hunchbacked (as in Figs 2.0: 1, 4–12); (2) extremely hunchbacked (as in Figs 2.0: 2, 3). McAlpine (1989) regarded the unusually strongly humped mesonotum as an autapomorphy of the Curtonotidae, although he neglected to mention that the hunchbacked condition occurs exceptionally in some Drosophilidae genera, *e.g.*, *Leucophenga* Mik (Steganinae) and *Mycodrosophila* Oldenberg (Drosophilinae) (S. McEvey, pers. comm. 2011). State (0) is expressed in the five out-group exemplars. State (1) is expressed in the genera *Curtonotum*, *Tigrisomyia* and *Cyrtona* (s.l.). State (2) is a synapomorphy of the genus *Axinota* (both species-groups). The degree of curvature of the mesonotum is a significant character state in the separation of *Axinota* from other curtonotid genera.

8. MESONOTUM MARKEDLY INDENTED BEHIND HEAD (VIEWED IN PROFILE): (0) no (Figs 2.0: 1–7, 9–12); (1) yes (*e.g.*, Fig. 2.0: 8). This character has not been used previously in curtonotid phylogenetics. State (0) is expressed in the five out-group exemplars and most Curtonotidae. State (1) is a synapomorphy of *Cyrtona* (*s.l.*) sp. n. 4 and 5.

9. LATERAL SIDES OF MESONOTUM WITH STRIKING GREY OR SILVER V-SHAPED PRESUTURAL MACULA: (0) no (*e.g.*, Figs 2.0: 1–3, 5–12); (1) yes (*e.g.*, Figs 2.0: 4; 3.2: 15–22). State (0) is expressed in the five out-group exemplars and in most genera of Curtonotidae and is here regarded as the plesiomorphic condition. State (1) is a synapomorphy of the genus *Tigrisomyia*.

10. POSTPRONOTAL SETAE: (0) one strong; (1) two strong; (2) three strong. McAlpine (1989) noted the presence of “supplementary” postpronotal setae as an autapomorphy of the Curtonotidae. State (0) is expressed in the out-group exemplars *Camilla*, *Diastata*, *Amiota* and *Stegana*, state (1) in the more derived out-group exemplar *Drosophila*, plus *Axinota*, the *Curtonotum anus* and *Platyphallum* species-groups. State (2) is expressed in *Tigrisomyia*, *Cyrtona* (*s.l.*), Neotropical *Curtonotum* (*s.s.*), the *Curtonotum striatifrons* species-group and the Madagascan species *C. sternithrix*.

11. ANEPISTERNAL SETAE: (0) anepisternum glabrous; (1) 3 small setae on posterior margin; (2) 1 strong seta on posterior margin; (3) 2 strong reclinate (widely separated); (4) 3 strong setae (closely approximated); (5) 3, 2 strong reclinate, 1 slightly smaller dorsal ventrally-directed; (6) 4, 2 strong reclinate, 1 smaller medial reclinate and small dorsal ventrally-directed; (7) 3 strong, 1–2 moderately strong intermediate; (8) 5 strong setae. This character has not previously been applied in phylogenetic studies of the Curtonotidae. Anepisternal setae are absent (state 0) in the out-group exemplars *Amiota*, *Stegana* and *Drosophila* and in all Drosophilidae, with the notable exception of the four Oriental and Australasian species: *Mycodrosophila heterothrix* McEvey & Bock, *Scaptodrosophila merdae* (Bock), *S. paraguma* (Okada & Carson) and *Zaprionus obscuricornis* (de Meijere) (S. McEvey, pers. comm. 2011). State (1) is expressed in *Diastata* and state (2) in *Camilla*.

12. DISCAL SCUTELLAR SETULAE: (0) absent; (1) present. The disk of the scutellum is hirsute in the genera *Curtonotum* (all species-groups) (*e.g.*, 3.4: 61–66) and *Axinota*

(e.g., Kirk-Spriggs 2010a: 107, figs 9–12), but is glabrous in other genera; *Katacamilla* Papp (but not in other Camillidae, even the Eocene genus *Protocamilla* Hennig); and assorted, unrelated Ephydriidae. Scutellar setulae do not occur in Diastatidae or Drosophilidae and so may represent a synapomorphic feature for Curtonotidae (Grimaldi and Kirk-Spriggs, in press). This character state is one of the few used by previous authors to separate *Curtonotum* from *Cyrtona* (s.l.) (e.g., Curran 1933; Hackman 1960). State (0) is expressed in all out-group exemplars used in this analysis.

WING

13. WING MEMBRANE COLOUR. (0) pale yellow to brown/black infusate (Figs 2.0: 37, 38, 40–48; Kirk-Spriggs 2011, 3.3: 27–39; 3.4: 55–60, 67–85); (1) entirely hyaline (e.g., Figs 2.0: 39; Kirk-Spriggs 2010a, 3.1: 7–8). State (0) is expressed in the five out-group exemplars and in most Curtonotidae. State (1) is a synapomorphy of the *Axinota pictiventris* species-group.

14. WING PATTERN: (0) devoid of maculae or other distinct patterning (e.g., Figs 2.0: 38–40); (1) darker at *r-m* and *dm-cu* crossveins only (Figs 2.0: 45–48; Kirk-Spriggs 2011, 3.3: 27–39; 3.4: 55–60, 67–85); (2) darker at cell *c*, base of cell *r*₁ and *dm-cu* crossvein; (3) darker at *dm-cu* crossvein and in apical region of veins *R*₂₊₃, *R*₄₊₅, *M* (e.g., Fig. 2.0: 37); (4) distinct maculae over *r-m* crossvein, stump vein in cell *dm*, *dm-cu* crossvein and pre-apical region of vein *M* (Figs 2.0: 41, 42, 43); (5) extensive diffuse markings in apical region of wing (broadly corresponding to positions described in state 4) (e.g., Fig. 2.0: 44). Patterning of the wing has not previously been used as a character in the phylogeny of the Curtonotidae. State (0) is expressed in the four out-group exemplars *Camilla*, *Amiota*, *Stegana* and *Drosophila* and in *Tigrisomyia* and *Axinota*. State (2) is expressed only in *Diastata*.

15. COSTA (*C*): (0) reaching vein *M*; (1) reaching vein *R*₄₊₅. This character has not been previously applied in phylogenies of the Curtonotidae. State (0) occurs in the out-group exemplars, *Camilla* and *Drosophila*, *Amiota*, *Stegana* and is here regarded as the plesiomorphic condition. State (1) is expressed in *Diastata* and all Curtonotidae.

16. COSTAL MARGIN: (0) with spines short, uniform in size; (1) with moderately long, widely-spaced spines; (2) with very long, conspicuous, closely-packed spines (Figs

2.0: 37, 38; Kirk-Spriggs 2010a, 3.1: 5, 6; Kirk-Spriggs 2011, 3.3: 27–39; 3.4: 55–60, 67–85). State (0) is expressed in the out-group exemplars *Camilla*, *Amiota*, *Stegana* and *Drosophila*, state (1) in *Diastata*. Conspicuously longer spines on the costal margin (state 2) occur in *Curtonotum* (all species-groups) and the two Afrotropical species of the *Axinota fuscipennis* species-groups, *A. fuscipennis* and *A. quasimodoi*. The spines are short and uniform in the “Oriental” *Axinota pictiventris* species-group (Figs 2.0: 39; Kirk-Spriggs 2010a, 3.1: 7, 8), and in all other genera of Curtonotidae (e.g., Figs 2.0: 41–48). This character state is one of the few used by previous authors to separate *Curtonotum* from *Cyrtona* (s.l.) (e.g., Curran 1933; Hackman 1960). McAlpine (1989), on the one hand, regarded the presence of costal spines as a ground-plan condition in the Ephydroidea, noting that their reduced size and broader spacing in Camillidae and Diastatidae is probably derived. Klymko and Marshall (2011), on the other hand, discussed this character and considered it to be more likely derived once or twice in Curtonotidae (either once in a *Curtonotum* + *Axinota* ancestor, followed by the secondary loss in most *Axinota*; or twice, once each in *Curtonotum* and *Axinota*). It is equally parsimonious, however, to postulate a loss or two gains.

17. STUMP VEIN (SUPERNUMERARY CROSSVEIN) ON *M* VEIN: (0) absent; (1) present (Figs 2.0: 41, 42); (2) reduced or expressed as fold only (Fig. 2.0: 43). Wing venation in Curtonotidae is straightforward and varies little in configuration (e.g., Figs 2.0: 37–48). The presence of a short stump vein on the *M* vein post-medially in the *dm* cell is an interesting exception. The length and angle of this stump vein varies intra-specifically, but when present is invariably partly obscured by a dark macula on the wing membrane. State (0) is expressed in the five out-group exemplars and in most Curtonotidae. State (1) is expressed in *Cyrtona* (s.s.), namely *Cy. appendiculata* (type species of the genus), *Cy. pictipennis* and two closely-related undescribed species from South Africa. State (2) is expressed in *Cyrtona* (s.l.) sp. n. 3 only.

18. CROSSVEIN *BM–CU*: (0) present; (1) absent (e.g., Figs 2.0: 37–48). Absence of the *bm–cu* crossvein in the Curtonotidae was noted by Hennig (1958), Griffiths (1972) and McAlpine (1989) and was applied by Grimaldi (1990) in his morphological phylogeny of the Drosophilidae (figs 339–342) to establish the sister group relationships.

The crossvein is present in the out-groups *Drosophila*, *Amiota*, *Stegana* and *Diastata*, but is absent in *Camilla* and all genera of Curtonotidae.

19. ANAL FOLD: (0) absent; (1) developed (extending at least $\frac{1}{2}$ length of cua_1) (e.g., Figs 2.0: 37–48). This character was discussed at some length by Hennig (1958: 528, 674), who noted that a short anal vein is part of the ground-plan of the Ephydroidea (as Drosophiloidea) and its reduction represents a synapomorphic state. He noted that the apparent anal vein in *Curtonotum anus* is, in reality, a simple fold and that the true vein is very short and occurs close to the anal margin on the wing. He cited the case of the Neotropical species, *C. bathmedum* Hendel (e.g., Klymko and Marshall 2011, fig. 208), in which the wing fold is filled with chitin and is developed for a distance as an apparent “vein”. In this case, he suggested that the “anal vein”, that is so short in *C. anus*, apparently developed into this fold and continued secondarily for some distance in a parallel manner, alongside the vein-like fold; between the two, the vein area being darkened. He noted (p. 673), that it was “... altogether possible that the wing fold into which the “anal vein” was drawn, is the old bed or channel of this “anal vein” from which it perhaps was drawn off earlier” (translation G.H. Harder). Hennig concluded that the length of the “anal vein” in many *Curtonotum* species must not be evaluated as a plesiomorphic characteristic and apparently has a secondary origin. Hennig’s assumption that secondary fold development may have followed the original path of a withdrawn anal vein is negated, however, according to Dollo’s (1893) principle “That an organism cannot return, even partially, to a previous state already realized in its ancestral series”. The anal fold was, therefore, misinterpreted as comprising two weakly developed veins, a second anal (A_2) and a first anal vein + second branch of cubitus anterior ($A_1 + CuA_2$) (following Stark *et al.* 1999: 104, fig. 1a), by Kirk-Spriggs (2010a, b), and according to the labelled wing figure of *Curtonotum helvum* (Loew), provided by Klymko and Marshall (2011: 105, fig. 203), this fold was misinterpreted as the first anal vein (“ A_1 ”). The anal fold is absent (0) in the five out-group exemplars, but is developed as a fold in all genera of Curtonotidae and represents a synapomorphy of the family Curtonotidae.

LEG

20. CTENIDIUM ON FORE TIBIA: (0) absent; (1) present. A row of minute spines on the mesal surface of the fore femur (the ctenidium) is synapomorphic at the superfamily

Ephydroidea level, as this state is expressed in the Diastatidae and Camillidae, but is lost in Drosophilidae (Grimaldi 1990). A clearly defined ctenidium is absent (state 0) in the out-group exemplars *Amiota*, *Stegana* and *Drosophila*, but is present in *Camilla* and *Diastata* and in all Curtonotidae, including the extinct fossil genus *Depressonotum* Grimaldi & Kirk-Spriggs from Dominican Amber (Grimaldi and Kirk-Spriggs, in press).

MALE ABDOMEN

21. TERGITE 6: (0) present; (1) completely reduced. This character was applied by Klymko and Marshall (2011) in their phylogeny of New World *Curtonotum* and is here modified. Pollock (2002) proposed reduction of the male pregenital sclerites as a synapomorphy for *Curtonotum* + *Axinota*. Klymko and Marshall (2011: 4) note, however, that this conclusion was based on a misinterpretation of characters and that “At least some species of both *Axinota* and *Curtonotum* possess all the pregenital sclerites present in *Cyrtona*, and indeed in many of these they are well-defined.” We agree with Klymko and Marshall in respect to the presence of tergite 6, at least in some species of Neotropical *Curtonotum*, and in the case of the *Curtonotum striatifrons* species-group, but we found no evidence for its presence in other Afrotropical species of the genus. Although tergite 7 is well developed in the *Axinota* exemplars included in this analysis, we were unable to find any trace of tergite 6 as they suggested.

22. TERGITE 7 SYMMETRICAL GREATLY EXPANDED, LARGER THAN ASYMMETRICAL TERGITE 6 (IF PRESENT STRAP-LIKE): (0) no; (1) yes. Pollock (2002) noted the greatly expanded tergite 7 in *Cyrtona* (s.l.), regarding this as the plesiomorphic condition in the Curtonotidae. Klymko and Marshall (2011) refuted this, however, regarding this as more likely a synapomorphy for that genus. State (1) is clearly a synapomorphy of the “*Tigrisomyia* + *Cyrtona* (s.l.) clade”.

23. STERNITE 5 EXPANDED, 4–5 WITH MODIFIED SETAE: (0) no; (1) yes (Figs 3.4: 197; Kirk-Spriggs 2011, 3.3: 86). The laterally expanded sternite 4 and modified setae on sternites 4–5 is expressed in *Curtonotum gonzo* sp. n. and the Madagascan species *C. sternithrix* and may represent a synapomorphy. There are some other similarities between these two species, such as a very similarly shaped phallapodeme, the cordiform structure

on the distiphallus and the shape of the anal lobe of the wing (see character 46 below). Due to presumed long geographical isolation (one in Ghana and Nigeria and one in Madagascar) their relationship to one another (if any) must await a molecular study when recent material becomes available.

24. STERNITE 6 WITH PAIR OF DIVERGENT MEDIAL SETAE: (0) no; (1) yes (Figs 3.4: 86–88). A pair of divergent medial setae on male sternite 6 is a feature distinctive to some recent Diastatidae (*Euthychaeta spectabilis* (Loew), some *Campichoeta* Macquart and *Diastata* Meigen), as well as *Pareuthychaeta* Hennig in Baltic amber (Grimaldi and Kirk-Spriggs, in press). The state is expressed in the extinct fossil curtonotid genus *Depressonotum* Grimaldi & Kirk-Spriggs from Dominican Amber and in the three species of the *Curtonotum striatifrons* species-group.

25. PHALLUS SHAPE AND CONNECTION: (0) not grossly enlarged and C-shaped, not connected to hypandrium basally; (1) grossly enlarged, C-shaped, connected to hypandrium basally (*e.g.*, Figs 2.0: 49–72). State (0) is expressed in the five out-group exemplars and is regarded as plesiomorphic; state (1) was noted as an autapomorphy of the family Curtonotidae by McAlpine (1989). The condition is apparent in all genera of Curtonotidae, although the phallus and hypandrium are illustrated separately in the figures provided.

26. SYMMETRY OF THE “PHALLIC COMPLEX” (PHALLUS OR AEDEAGUS): (0) symmetrical (*e.g.*, Figs 2.0: 58–60, 64–66, 70–72; Kirk-Spriggs 2010b, 3.2: 12–14); (1) asymmetrical (Figs 2.0: 52–54; Kirk-Spriggs 2010a, 3.1: 21–24; Kirk-Spriggs 2011, figs 42–45, 49–54, 58–63, 67–72, 74, 75, 77, 78, 3.3: 43–48, 52–57, 61–66, 70–75, 77, 78; 3.4: 92–97, 119–122, 136–141, 146–153, 157–162, 166–171, 175–180, 184–189). The phallus in the Curtonotidae is comprised of four or five elements (phallapodeme, basiphallus, distiphallus, ejaculatory apodeme and (in one species only) a sperm pump). Collectively, the first three mentioned form a single C-shaped structure, here termed the “phallic complex”. Symmetry of the phallic complex was first noted as a character state for the Curtonotidae by Pollock (2002) and was later applied by Klymko and Marshall (2011) in their phylogeny of New World *Curtonotum*. Pollock (2002: 1742) noted that the phallus (as aedeagus) is “... symmetrical and relatively simply constructed in *Cyrtona*, but more derived and usually (possibly always) asymmetrical in the other

genera ...” He went on to note that “... more species have to be studied and in greater detail before enough data is available in order to make more definitive generalisations.” Pollock noted that the structure of the phallus of *Curtonotum platyphallum* Tsacas (based on Tsacas’ 1977: 158, fig. 6a), appeared somewhat intermediate between that of *Cyrtona* and those of other curtonotid genera. As this illustration was based on a damaged specimen it was unclear whether this structure was symmetrical or asymmetrical. Re-examination of the male holotype, as outlined in Chapter 3.4, reveals its asymmetry. It is further apparent from the current study that the majority of genera in the Curtonotidae possess a symmetrical phallic complex; asymmetry being confined to the genera *Curtonotum* (all species and regions of the world) and *Axinota* (both Afrotropical and Oriental species groups).

27. PHALLIC PLATE: (0) present (Figs 2.0: 58–60, 64–66, 70–72, *pp*); (1) absent (Figs 2.0: 52–54). Sinclair (2000) noted that the presence of the phallic plate represents an important reference point for determining homologies. Pollock (2002) was the first to report this state in *Cyrtona* spp. near *albomacula*. He regarded the condition as “primitive” and noted this for the first time in any Ephydroidea. The state is apparent in the “*Tigrisomyia* + *Cyrtona sensu lato* clade” and is a significant synapomorphy supporting their recognition as a clade.

28. PHALLIC PLATE LENGTH: (0) extending at least $\frac{1}{2}$ length of phallapodeme (Figs 2.0: 58–60, 64–66, 70); (1) extending less than $\frac{1}{3}$ length of phallapodeme (Figs 2.0: 71, 72). State (1) is a synapomorphy of some *Cyrtona* (*s.l.*) species included in the analysis.

29. LENGTH OF LONGEST TERMINAL SETAE ON CERCUS: (0) as short as or marginally longer than setae on epandrium (Figs 2.0: 49–51, 56–57, 61–63, 67–69); (1) grossly longer than setae on epandrium (Figs 2.0: 55; 3.2: 9–11). Short setae on the cercus (0), is the normal plesiomorphic condition in all genera of Curtonotidae, except for *Tigrisomyia*, which have grossly long, wavy setae apically. State (1) is therefore a synapomorphy of *Tigrisomyia*.

30. CERCUS WITH ELONGATE, FUSED VENTRAL PROCESS: (0) absent (*e.g.*, Figs 2.0: 49–51, 55–57, 61–63, 67–69; 3.4: 89–91; figures in Klymko and Marshall 2011); (1) present (Kirk-Spriggs 2011, figs 40–41, 46–48, 55–57, 64–66, 73, 76; 3.4: 116–118, 133–135, 142–145, 154–156, 163–165, 172–174, 181–183; Kirk-Spriggs and Freidberg 2007,

fig. 8). This character was applied by Klymko and Marshall (2011) in their phylogeny of New World *Curtonotum*. This long, finger-like projection is physically rooted in the cuticle immediately ventral to the cercus of the male and may be either apically or ventrally-directed, sometimes dependant on whether the cercus is distended or not. The anterior face and/or apex are clothed in a pad of very fine setulae, usually with some longer and stronger setulae interspersed. State (1) is only expressed in the genus *Curtonotum*, but (significantly) is not expressed in any species of the Neotropical *Curtonotum* (s.s.), or in the three described species of the Afrotropical *Striatifrons* species-group.

31. BASIPHALLUS: (0) distinctly separate from phallapodeme (*e.g.*, Figs 2.0: 58–60, 64–66, 70–72, *ph*, *bp*); (1) only partially fused to phallapodeme (Figs 3.4: 92–94); (2) fully fused to phallapodeme (Figs 2.0: 52–54; Kirk-Spriggs 2010a, 3.1: 21–24; 3.3: 43–45, 52–54, 61–63, 70–72, 77; 3.4: 119–122, 136–138, 146–149, 157–159, 166–168, 175–177, 184–186; figures in Klymko and Marshall 2011). The phallapodeme and basiphallus are distinctly separate in *Tigrisomyia* and *Cyrtona*. These are only partly fused to one another in the three species of the *Curtonotum striatifrons* species-group, but are fully fused in all other species-groups of *Curtonotum* and in the genus *Axinota*.

32. PHALLAPODEME/BASIPHALLUS RELATIVE LENGTHS: (0) phallapodeme longer than basiphallus (Figs 2.0: 58–60, 64–66, 70–72, *ph*); (1) phallapodeme shorter than basiphallus (*e.g.*, Figs 2.0: 52–54). The junction of the phallapodeme and basiphallus is here determined by the point of insertion of the ejaculatory duct of the ejaculatory apodeme. In the majority of genera in the Curtonotidae which possess a phallic plate, the duct is enclosed by this plate and is obscured for most of its length (in specimens illustrated in Figs 2.0: 58 and 2.0: 64 the plate was damaged, split and the duct free). State (0) is, therefore, expressed in the majority of genera of the Curtonotidae. State (1) is expressed only in the genera *Curtonotum* and *Axinota*. In *Curtonotum* the point of insertion of the ejaculatory duct indicates that the phallapodeme is shorter than the basiphallus. In *Axinota* the ejaculatory apodeme is apparently enclosed within the basiphallus (although further study of additional species is required to confirm this). These interpretations of the phallapodeme and basiphallus in *Curtonotum* and *Axinota* are contrary to the views expressed by Pollock (2002), who regarded the main arm of the

phallus to be the phallapodeme (as “aedeagal apodeme”), this being tubular, enclosing the ejaculatory duct. The virtually free phallapodeme and basiphallus expressed in the three species of the *Striatifrons* species-group coupled with the single sclerite forming the apical segment of the phallus (distiphallus) in these genera is strongly indicative that this view is incorrect. The large “lateral lobes” or muscle apodemes delimit the phallapodeme, *i.e.*, where the muscles attach to move the apodeme and thus articulate the phallus and so Tsacas’ original (1977) interpretation appears sound (B.J. Sinclair, pers. comm. 2011). The basiphallus is grossly extended in some species of the Neotropical *Curtonotum* (s.s.), especially in *C. (s.s.) gracile* Klymko & Marshall in which species it resembles a watch spring (Klymko and Marshall 2011: 89, fig. 163).

33. PHALLAPODEME WITH BROAD LATERALLY FLATTENED “FAN”: (0) no; (1) yes (*e.g.*, Fig. 2.0: 52; figures in Klymko and Marshall 2011). Klymko and Marshall (2011) noted state (1) as a synapomorphy of Neotropical species of *Curtonotum* (s.s.).

34. PHALLAPODEME WITH DISTINCT LATERAL LOBES: (0) no (*e.g.*, Figs 2.0: 52, 58–60, 64–66, 70–72; figures in Klymko and Marshall 2011); (1) yes (*e.g.*, Figs 2.0: 53, 54; Kirk-Spriggs 2010a, 3.1: 21–24; Kirk-Spriggs 2011, figs 42, 43, 49–51, 58–60, 67–69, 74, 77; 3.4: 92–94, 119–122, 136–138, 146–149, 157–159, 166–168, 175–177, 184–186; Kirk-Spriggs and Freidberg 2007, fig. 10). The character was applied by Klymko and Marshall (2011) in their phylogeny of New World *Curtonotum*. The large lateral lobes or muscle apodemes represent points of attachment for the muscles that move the apodeme and thus articulate the phallus (B.J. Sinclair, pers. comm. 2011). State (0) is expressed in most genera of Curtonotidae and Neotropical *Curtonotum* (s.s.). State (1) is a synapomorphy of *Axinota* + *Curtonotum*, other than the Neotropical clade, supporting the suggestion of Klymko and Marshall (2011) that *Curtonotum* is paraphyletic with *Axinota*.

35. EPANDRIAL SETAE: (0) all more-or-less equal in length and size (*e.g.*, Figs 2.0: 49–51, 56, 57, 61–63, 67–69; Kirk-Spriggs 2010a, 3.1: 17–20; 3.4: 89–91, 116–118); (1) lateral lobe with numerous stronger setae of variable length (Kirk-Spriggs 2011, figs 40–41, 48, 55–57, 64–66, 73, 76, 3.3: 40–42, 49–51, 58–60, 69, 76; 3.4: 154–156, 163–165, 172–174, 181–183); (2) lateral lobe with group of enormously long setae (Figs 2.0: 55; Kirk-Spriggs 2010b, 3.2: 9–11); (3) lateral lobe with 1 very strong seta and group of shorter setae (Figs 3.4: 133–135, 142–145); (4) lateral lobe with 2 very strong setae only

(Kirk-Spriggs 2011, figs 46, 47, 3.3: 67, 68). The size, number and arrangement of setae on the epandrium (especially the lateral lobes), has not been previously applied in Curtonotidae phylogenetics, although Grimaldi (1990) used the character in his phylogeny of the Drosophilidae. States (0) to (4) are regarded as an evolutionary transformation series. As the majority of genera have unmodified more-or-less equally-sized epandrial setae throughout (state 0), this condition is here regarded as plesiomorphic. State (1) is expressed in three species-groups of *Curtonotum*; state (2) is a synapomorphy of the genus *Tigrisomyia*, state (3) is an important synapomorphy of the *Curtonotum campsiphallum* species-group, and state (4) is a synapomorphy of *C. boeny* species-group.

36. FUSION OF HYPANDRIAL ARMS AND EPANDRIUM: (0) not fused laterally (*e.g.*, Figs 2.0: 49, 55–57, 61–63, 67–69); (1) distinctly fused laterally (*e.g.*, Fig. 2.0: 50). Full fusion of the epandrium with the hypandrial arms laterally is a synapomorphy of the genus *Axinota*. In the key to Afrotropical species of the genus, Kirk-Spriggs (2010a) mistakenly indicated that the epandrium and hypandrium of the *Axinota pictiventris* species-group are free. Examination of additional material now indicates that fusion is indeed a synapomorphy of *Axinota*.

37. SPERM PUMP: (0) absent; (1) present (Kirk-Spriggs 2011, figs 74a, 74b, 3.3: 63a, 63b). A large sclerotised sperm pump is only known in the Madagascan species *Curtonotum rinhatinana*, a species which also has a uniquely-shaped phallus. Sinclair (2000) noted that the sperm pump occurs at the junction of endophallus and the ejaculatory duct, represented by the ejaculatory apodeme and is a component of the Diptera ground-plan. In the Cyclorrhapha the sperm pump is separated from the base of the phallus by a long ejaculatory duct, being an apomorphic feature of the Cyclorrhapha. Its exact point of connection in *C. rinhatinana* remains uncertain, but it may rest within the lateral extension of the phallus. The presence of so distinct an organ, absent in all other species of the family, is difficult to explain, but this apparently plesiomorphic character of the Diptera may have been retained in the single species on Madagascar through long geographical isolation, but was lost in all others.

38. APICAL CURVATURE OF DISTIPHALLUS: (0) not recurved; (1) distinctly recurved (Figs 3.4: 92–94). This character has not been previously applied in phylogenies of the

Curtonotidae. The strongly recurved distiphallus, state (1), is a synapomorphy of the three species in the *Curtonotum striatifrons* species-group.

39. DIVISION OF DISTIPHALLUS: (0) formed of single straight process, not subdivided; (1) distinctly subdivided into two elements, a baso-ventral process and apico-dorsal process (Figs 2.0: 53, 54; Kirk-Spriggs 2011, figs 74, 75, 3.3: 63, 66; 3.4: 92–97, 119–122); (2) baso-ventral process developed into a short, blade-like, partially serrated process (Figs 3.4: 136–141, 146–153). Division of the distiphallus was applied by Tsacas (1977) to separate the *Cuthbertsoni* and *Striatifrons* species-groups in the genus *Curtonotum*, and by Klymko and Marshall (2011) in their phylogeny of New World *Curtonotum*. The distiphallus is distinctly subdivided into two elements (termed “paraphallus” and “apical spine” by Tsacas 1977), in the three species of the *Striatifrons* species-group, in the *Platyphallum* species-group, in the Madagascan endemic species *Curtonotum rinhatinana* Kirk-Spriggs, in some Neotropical species of *Curtonotum* and in *Axinota*. State (2) is a synapomorphy of the seven species in the *Campsiphallum* species-group.

40. DISTIPHALLUS APICALLY WITH DISTENDED AND INFLATED MEMBRANOUS PORTION: (0) absent; (1) present (*e.g.*, Figs 2.0: 71, 72). This character has not previously been applied in phylogenies of the Curtonotidae. The short balloon-like membranous structures of the distiphallus are a synapomorphy of the some species of *Cyrtona* (*s.l.*) included in the analysis.

41. DISTIPHALLUS WITH DEFINED HEAVILY SCLEROTISED PORTION DORSALLY: (0) no; (1) yes (*e.g.*, Klymko and Marshall 2011, figs 14, 15, 29, 31; Kirk-Spriggs and Freidberg 2007, figs 10, 11). A heavily sclerotised dorsal portion to the distiphallus (1), represents a synapomorphy of the Nearctic and Palaearctic/Oriental *Curtonotum anus* species-group.

42. BASIPHALLUS WITH EXTENSIVE ANGULATE VENTRALLY EXPANDED AND CONCAVE PROCESS: (0) no; (1) yes (Figs 3.4: 119–122). State (1) is a synapomorphy of the *Curtonotum platyphallum* species-group.

43. DEVELOPMENT OF LATERAL WING OF BASIPHALLUS: (0) lateral blade absent or weakly defined; (1) forming a distinct basally expanded, but narrow blade (Figs 3.4: 92–97, *lw*); (2) forming a broad lateral extension of the basiphallus (Figs 3.4: 119–122; Kirk-

Spriggs 2011, fig. 74, 3.3: 63). This character has not been previously applied in phylogenies of the Curtonotidae. In the genus *Curtonotum* development of the lateral wing of the basiphallus is apparent only in the *Striatifrons* species-group, in the three Afrotropical species of the *Platyphallum* species-group and in *C. rinhatinana*.

44. DISTIPHALLUS WITH LONG, OBLIQUELY ANGLED, POSTERIORLY-DIRECTED SPINE BASALLY: (0) absent; (1) present (Figs 3.4: 161, 162). The presence of the long basal spine is a synapomorphy of the two species here ascribed to the *Curtonotum sahelense* species-group. Tsacas (1977) grouped these two species together in the *Cuthbertsoni* species-group.

45. DISTIPHALLUS WITH TWO DORSALLY-DIRECTED BASAL SPINES OR DORSAL RIDGE: (0) no; (1) yes (Figs 3.4: 166–171, 175–180, 184–189). This character was first applied by Tsacas (1977) in his key to African *Curtonotum*. The relatively simple distiphallus with two spines developed to a greater or lesser degree is a synapomorphy of the *Uncinatum* species-group. The short ridge in the same position present in the Madagascan endemic species *C. sakalava* is here tentatively interpreted as homologous with the more ventrally positioned spine (Figs 3.3: 77, 78).

46. BASIPHALLUS WITH EXPANDED SUBDIVIDED MID SECTION AND CORDIFORM EXTENSION OF DISTIPHALLUS: (0) no; (1) yes (Kirk-Spriggs 2011, fig. 60, 63; 3.3: 45, 48; 3.4: 157, 160). State (1) is expressed in *Curtonotum gonzo* sp. n. and *C. sternithrix* from Madagascar. Although they differ significantly in other respects, they also both share modified setae on male sternites 4 and 5. The species-group placement of *C. sternithrix* remains an open question.

47. BASIPHALLUS HEAVILY SCLEROTISED, MARKEDLY EXPANDED APICALLY AND NARROWED PRE-APICALLY: (0) absent; (1) present (Kirk-Spriggs 2011, figs 44, 45, 61, 62, 70–72; 3.3: 46, 47, 55–57, 64–65). State (1) is a synapomorphy of seven species in the *Curtonotum stuckenbergi* species-group. Some additional molecular resolution is required in the Malagasy *Curtonotum* to determine whether this species-group should be further divided.

48. LATERAL LOBE OF EPANDRIUM: (0) not strongly excavated; (1) strongly excavated (Kirk-Spriggs 2011, figs 46, 47, 3.3: 67, 68). The reduction and subsequent excavation of the lateral lobe of the epandrium is linked to the drastic reduction of lateral

epandrial setae and is a synapomorphy of the two Madagascan species of *Curtonotum boeny* species-group. Similar reductions in setation and resulting excavations of the lateral lobe are noted as analogous in some genera of Drosophilidae by Grimaldi (1990).

49. EPANDRIAL LOBES SUBDIVIDED INTO LARGE APICAL EXTENSIONS: (0) no; (1) yes (*e.g.*, Fig. 2.0: 62). This character has not previously been applied in phylogenies of the Curtonotidae. State (1) in which the epandrial lobes are distinctly sub-divided into large blades is a synapomorphy of *Cyrtona* (*s.l.*) sp. n. 4 and 5.

50. EJACULATORY APODEME: (0) inserted proximal to phallapodeme (*e.g.*, Figs 2.0: 52; 3.4: 92–94, *ea*); (1) free, on membranous duct (*e.g.*, Figs 2.0: 70–72, 58–60, 64–66, *ea*); (2) entirely enclosed within phallus (Figs 2.0: 53, 54, *ea*). Pollock (2000) discussed development of the ejaculatory apodeme (as ejaculatory pump). He noted (p. 1743) that a small pump attached to the aedeagal apodeme near the attachment of the aedeagus “... is probably present in *Axinota dissimilis* (more species need to be studied, especially in the fresh state).” He further noted that “... the *Curtonotum quinquevittatum* condition can be envisaged as arising from the original one, by the pump migrating more deeply within the body, with the apodeme ensleeving the duct as the pump migrates.” No evidence of an external apodeme or duct could be located on the phallus of *Axinota* species examined as part of this study and this appears to be withdrawn into the phallus. If this state is consistent, then it represents synapomorphy of the genus. The ejaculatory apodeme was not illustrated for the three species of *Tigrisomyia*, for which males are known, by Kirk-Spriggs (2010b: 13, figs 12–14). Re-examination of the material concerned, however, indicates that a large ejaculatory apodeme is present on an extremely long duct, inserted as indicated on Fig. 2.0: 58. It appears that this structure is easily detached during dissection and very few specimens retain this structure intact. This was therefore missed during the initial study. Its point of insertion further indicates that the previous interpretation of Kirk-Spriggs (2010b) that the distiphallus is subdivided into two distinct segments in *Tigrisomyia* is incorrect. It now appears, at least in genera other than *Curtonotum* and *Axinota*, dealt with here, that the phallapodeme is greatly elongated and forms the greater part of the phallic complex. The structure labelled *dp1* by Kirk-Spriggs (2010b, figs 12–14) is, in fact, a greatly reduced basiphallus, while *dp2* on the same figures represents the true distiphallus. This conclusion concurs with the views of

Pollock (2002) to some extent, but in the case of *Curtonotum* the position of insertion of the ejaculatory apodeme, coupled with the only partial fusion of the phallapodeme with the basiphallus in the *Striatifrons* species-group (Figs 3.4: 92–94) indicates a short phallapodeme and elongate basiphallus, with the duct of the ejaculatory apodeme inserted between the phallapodeme and basiphallus.

51. POSTGONITES: (0) present (elongate articulated with hypandrium) (*e.g.*, Figs 2.0: 56, 57); (1) absent (or short setose extension of hypandrial arm only) (*e.g.*, Figs 2.0: 50, 51, 68, 69, 55). The character has not previously been applied in phylogenies of the Curtonotidae. Interpretation of this pair of lobes is extraordinarily complex and contradictory and has spawned a number of conflicting theories as to their origin and homology (see Introduction). In *Curtonotum* they are conspicuous and run parallel to the surstylus, but in some genera they are apparently absent.

52. PHALLAPODEME DEEPLY EXCAVATED BASALLY (SUB-TRIANGULAR): (0) no; (1) yes (*e.g.*, Fig. 2.0: 65). The character has not previously been applied in phylogenies of the Curtonotidae. State (1) is a synapomorphy of *Cyrtona* (*s.l.*) sp. n. 4 and 5.

53. SURSTYLI AND POSTGONITES COLLECTIVELY SHAPED LIKE A DODO’S BILL: (0) no; (1) yes (*e.g.*, Fig. 2.0: 49; figures in Klymko and Marshall 2011). This character has not been previously applied in phylogenies of the Curtonotidae. State (1) is expressed in the three species of Neotropical *Curtonotum* included in this analysis.

54. SURSTYLI DISTINCTLY FORKED: (0) no; (1) yes (*e.g.*, Figs 2.0: 50, 51; Delfinado 1969, figs 12–16, as *Apsinota*). This character has not been previously applied in phylogenies of the Curtonotidae. State (1) is a synapomorphy of the two Afrotropical species of the *Axinota fuscipennis* species-group and all species of the “Oriental” *Axinota pictiventris* species-group.

55. SURSTYLI DISTINCTLY SPATULATE WITH “ELBOW”: (0) no; (1) yes (*e.g.*, Figs 2.0: 55; Kirk-Spriggs 2010b; 3.2: 9–11). This character has not been previously applied in phylogenies of the Curtonotidae. State (1) is a synapomorphy of the three species in the genus *Tigrisomyia*, for which males are known.

56. PHALLAPODEME: DEEPLY AND NARROWLY EXCAVATED BASALLY (FORKED): (0) no; (1) yes (*e.g.*, Figs 2.0: 58; Kirk-Spriggs 2010b, 3.2: 12–14). This character has not

been previously applied in phylogenies of the Curtonotidae. State (1) is a synapomorphy of the genus *Tigrisomyia*.

FEMALE ABDOMEN

57. LENGTH OF POSTABDOMEN: (0) relatively short and broad (distance between sternites less than or equivalent to their length) (*e.g.*, Figs 2.0: 87, 88, 90–99); (1) very long, narrow and elongate (distance between sternites much greater than their length) (Fig. 2.0: 89). This character has not been previously applied in phylogenies of the Curtonotidae. State (1) is a synapomorphy of the genus *Tigrisomyia*.

58. DEVELOPMENT OF STERNITE 8: (0) forming distinct sclerotised sternite (*e.g.*, Figs 2.0: 90–99); (1) greatly reduced, weakly sclerotised (*e.g.*, Figs 2.0: 87, 88; 3.4: 98–101, 123–132, 201–216). This character has not been previously applied in phylogenies of the Curtonotidae. State (1) is a synapomorphy of *Axinota* + *Curtonotum*.

59. DEVELOPMENT OF STERNITE 10: (0) dorsoventrally flattened throughout, undivided (*e.g.*, Figs 2.0: 89, 90–97); (1) laterally flattened proximally, with medial division or invagination (*e.g.*, Figs 3.4: 201–216). This character was applied by Klymko and Marshall (2011) in their phylogeny of New World *Curtonotum*.

60. TERGITE 10: (0) free from cerci; (1) fused to fused cerci; (2) fused to free cerci. This character was applied by Klymko and Marshall (2011) in their phylogeny of New World *Curtonotum*.

61. CERCUS SCLEROTISATION AND SETATION: (0) with long terminal setulae (*e.g.*, Figs 2.0: 87–99; 3.4: 201–216); (1) spinose (Figs 3.4: 123–132). This character was applied by Klymko and Marshall (2011) in their phylogeny of New World *Curtonotum*. State (0) is apparent in all five out-group exemplars and the majority of Curtonotidae. State (1) is a synapomorphy of the Nearctic and Palaearctic/Oriental *Curtonotum anus* and Afrotropical *C. platyphallum* species-groups. Interestingly, state (1) is also expressed to some extent in the *C. gonzo* species-group, but the spines are much shorter and the cerci are not fused. Unfortunately, the female postabdomen is damaged in the single known female of *C. sternithrix* from Madagascar, so the condition cannot be assessed for that species.

62. SPERMATHECAL SHAPE AND TEXTURE: (0) doliform (subspherical), smooth (Figs 2.0: 75, 78, 81, 82); (1) barrel-shaped, smooth (Figs 2.0: 73, 74, 77); (2) doliform, studded with protuberances (Fig. 2.0: 80); (3) globular or mushroom-shaped, smooth (Fig. 2.0: 76); (4) tubular, short, studded with tuft-like protuberances (Figs 2.0: 83, 84); (5) tubular, elongated, studded with fine protuberances (Fig. 2.0: 79); (6) tubular, short, studded with fine protuberances (Fig. 2.0: 86); (7) tubular, broad, studded with fine protuberances (Fig. 2.0: 86); (8) short, obclavate (wide base tapering to a point), rugose and folded (*e.g.*, figures in Kirk-Spriggs 2008c); (9) long, obclavate, rugose and folded (Figs 3.4: 108–110). Spermathecal shape was used as a character by Meier *et al.* (1997), as discussed above. Klymko and Marshall (2011) regarding spermathecal shape as too variable for inclusion in their morphological phylogeny of New World *Curtonotum*. It is certainly complex and more taxa need to be described to truly access affinities. Spermathecal form is however broadly useful as part of a phylogeny, especially in respect to *Curtonotum*. Meier *et al.* (1997) regarded doliform spermathecae with an invaginated base as the plesiomorphic condition in the Curtonotidae, this being the most common spermathecal state in the Drosophilidae; then the putative sister family of Curtonotidae. The spermathecae of some genera, especially *Axinota*, *Tigrisomyia* and some species of *Cyrtona* (*s.l.*) used in the analysis are perfectly spherical, elliptical or tubular immediately following maceration of the female abdomen, but due to the extremely thin cuticular wall are highly prone to collapse, following transferral to other liquids, such as heated glycerine jelly, glycerol or even ethanol. For this reason Figs 2.0: 80, 81, 85 are distorted and appear flattened or mushroom-shaped. Some of the illustrations of spermathecae illustrated by Delfinado (1969: 219, figs 17–23) for Oriental species may also be distorted in this way and be spherical or elliptical in life. Many are also illustrated without spermathecal ducts which must be present in living examples. Special mention should be made here of the form of the spermathecae in the *Curtonotum anus* and *Platyphallum* species-groups as this is a special case of interest, as these two species-groups share a number of synapomorphies. State (5) is apparent in the Nearctic *C. helvum* and Palaearctic/Oriental *C. anus* (Figs 3.4: 111, 112), while state (9) is apparent in the Afrotropical *Platyphallum* species-group (Figs 3.4: 108–110). It must be borne in mind however, that state (9) is also expressed in the newly described Nearctic species *C.*

floridense (Klymko and Marshall 2011, fig. 23), which is undoubtedly closely related to *C. helvum*. This indicates that two spermathecal states occur in species of the two species-groups.

RESULTS

The fully concatenated nucleotide alignment includes 2681 aligned nucleotides CAD1 = 744 nt; CAD3 = 747 nt; CO1 = 683 nt; TPI = 507 nt. Uncorrected pairwise distances for the full dataset compared across all sampled taxa range from 0.433–0.192 between *Drosophila* (out-group) and curtonotid (in-group) species. Pairwise distances range from 0.037–0.140 between sampled species of *Cyrtona* (*s.l.*) and 0.005–0.192 between sampled species of *Curtonotum*.

Individual analyses of separate gene partitions were carried out for the CAD gene and the CO1 genes (not shown). Results of these tests were generally congruent with the results of concatenated gene and combined analyses with respect to close relationships within in-group congeneric species. No individual gene analysis was, however, able to recover Curtonotidae family monophyly – out-group families are placed within the in-group due to highly divergent sequence differences. These spurious family-level results are likely due to limited and conflicting data in individual genes and high 3rd position variability (3rd position homoplasy). There is too little data in any individually analysed partition to correct for the in-group / out-group placement (long-branch effect). Additionally, in individual gene analyses, support was low or highly conflicting for relationships among curtonotid genera. All further analyses were carried out with the full combined data sets (molecular only and molecular plus morphological data) to maximise phylogenetic information content and to include as many sampled taxa as possible.

Phylogenetic analysis of the concatenated nucleotide data set and combined molecular and morphological data set consistently yielded highly congruent results (Figs 2.0: 100–104). Bayesian likelihood, maximum likelihood and maximum parsimony results are topologically congruent with strong clade posterior probabilities and bootstrap values supporting monophyly of the Curtonotidae, monophyly for sampled genera, and monophyly and placement of genera in two clades: a “*Curtonotum* + *Axinota* clade” and a

“*Tigrisomyia* + *Cyrtona sensu lato* clade”. The single species sampled for *Axinota* was consistently placed as sister to all sampled *Curtonotum*. This placement is only weakly supported in molecular-only results and only poorly supported at best morphologically (Figs 2.0: 101, 104).

The Curtonotidae is corroborated as monophyletic with the following synapomorphies: anal fold developed (extending at least $\frac{1}{2}$ length of *cua*₁) (19), phallus grossly enlarged, C-shaped, connected to hypandrium basally (25).

McAlpine (1989) regarded the unusually strongly humped mesonotum as an autapomorphy of the Curtonotidae (7). This state is clearly expressed in all genera of Curtonotidae, but is also expressed to some extent in Diastatidae and some Drosophilidae and is not an autapomorphy. Absence of the crossvein *bm-cu* (18) was noted as an autapomorphy of the Curtonotidae by Hennig (1958), Griffiths (1972) and McAlpine (1989). The crossvein is absent in all Curtonotidae, but is also absent in *Camilla* and is, therefore not an autapomorphy of the Curtonotidae. In his definition of the Curtonotidae, Hennig (1973) included mesopleural bristles [= anepisternal setae] present. They are present in all Curtonotidae, but are also rarely present in some Drosophilidae (see above).

Results from the molecular and morphological analyses (Figs 2.0: 100–105) clearly indicate the division of the family Curtonotidae into two distinct well supported clades, a clade comprising the genera *Tigrisomyia* + *Cyrtona sensu lato* and a “*Curtonotum* + *Axinota* clade”, being sister to the remainder of the Curtonotidae.

The “*Tigrisomyia* + *Cyrtona sensu lato* clade” is subdivided into two well supported clades, with *Tigrisomyia* being sister to the remainder of the clade. The “*Curtonotum* + *Axinota* clade” is divided into two clades, with *Axinota* being sister to a clade comprising all terminal taxa of *Curtonotum*. As pointed out above, however, the molecular data only weakly supports a sister group relationship between *Axinota* and *Curtonotum* and the morphological data do not support a relationship at all and at best indicate an unresolved trichotomy between the Neotropical clade, *Axinota* and other *Curtonotum*. The *Curtonotum* clade is further subdivided into species-group categories as outlined in the revised classification of the Curtonotidae presented below.

Suitably preserved specimens of the *Curtonotum striatifrons* and *Platyphallum* species-groups were not available for inclusion in the molecular analysis, but results of

the morphological analysis (Fig. 2.0: 105 a) provide some support for cross-regional associations between these two species-groups and other regional faunas of *Curtonotum* (see Chapter 4: Discussion). An important character in defining associations between the Old and New World *Curtonotum* lineages is the presence or absence of the elongate, fused ventral process on the cercus of males (30). This is present in all Old World *Curtonotum* (Figs 2.0: 40–42, 49–51, 58–60, 67–69, 76; 3.4: 116–118, 133–135, 142–145, 154–156, 163–165, 172–174, 181–183; Delfinado 1969, figs 6–8), except in the Afrotropical *Striatifrons* species-group (Figs 3.4: 89–91) and all Neotropical *Curtonotum* (s.s.) (e.g., 2.0: Fig. 49; figures in Klymko and Marshall 2011). Results from the morphological analysis (Fig. 2.0: 105 a) indicate two possible cross-regional associations between faunas within *Curtonotum*. The Afrotropical *Striatifrons* species-group clade and the Neotropical *Curtonotum* (s.s.) clade originate from a single node, indicating that these may be derived from the same common ancestor. Likewise, the Afrotropical *Platyphallum* species-group + *C. rinhatinana* clade and Nearctic and Palaearctic *Anus* species-group clade also originate from a single node.

The high degree of species radiation within the Afrotropical Region is in sharp contrast to the three described species from the Oriental Region, namely: *Curtonotum arenatum* Osten Sacken, *C. ceylonense* Delfinado and *C. maii* Delfinado (that are not included in this analysis). These three species share the elongate, fused ventral process on the cercus (30) of other Old World *Curtonotum* (except the *Striatifrons* species-group), but their species-group associations must await a more detailed study of the Oriental fauna.

A REVISED CLASSIFICATION OF CURTONOTIDAE

1. “*TIGRISOMYIA* + *CYRTONA SENSU LATO* CLADE”

Genera included: *Tigrisomyia* Kirk-Spriggs 2010, *Cyrtona* Séguy, 1938.

Synapomorphies: Tergite 7 symmetrical, greatly expanded, larger than asymmetrical tergite 6 (22), phallic plate present (27), basiphallus distinctly separate from phallapodeme (31), and phallapodeme longer than basiphallus (32).

1.1. CYRTONA SÉGUY, 1938

Type species *Cyrtona appendiculata* Séguy, 1938, by original designation and monotypy.
Species included: 9 (Afrotropical/Oriental).

Insufficient terminal taxa ascribable to the genus *Cyrtona* as currently defined are included in the molecular and morphological analysis presented here to resolve relationships and this must await a more detailed analysis of the *Tigrisomyia* + *Cyrtona sensu lato* clade. Some broad conclusions can be drawn, however, based on these preliminary results. Results of the morphological analysis indicate that the two species of *Cyrtona sensu stricto* included in the analysis, *Cy. (s.s.) appendiculata*, *Cy. (s.s.) pictipennis*, form a distinct clade (Fig. 2.0: 105), based on the following synapomorphies: wing pattern with distinct maculae over *r-m* crossvein, stump vein in cell *dm*, *dm-cu* crossvein and pre-apical region of vein *M* (14), stump vein (supernumerary crossvein) on *M* vein present (17), spermathecae tubular, short, studded with tuft-like protuberances (62). *Cyrtona (s.l.)* sp. n. 3 may further belong to this group, but is unresolved in the molecular analysis (Figs 2.0: 100–104). *Cyrtona (s.l.)* sp. n. 4 and sp. n. 5 form a distinct clade in the morphological analysis (Fig. 2.0: 105), based on the following synapomorphies: mesonotum markedly indented behind head (viewed in profile) (8), wing pattern with extensive diffuse markings in apical region of wing (14), epandrial lobes subdivided into large apical extensions (49), and phallapodeme deeply excavated basally (sub-triangular) (52). This clade may represent a new genus. *Parapsinota angustipennis*, *Cyrtona (s.l.) albomacula* and *Cyrtona (s.l.)* sp. n. 6–12 also form a distinct clade in the molecular and morphological analyses (Figs 2.0: 100–105), and share the following synapomorphies: phallic plate extending less than $\frac{1}{3}$ length of phallapodeme (28), and distiphallus apically with distended and inflated membranous portion (40). This clade may represent a new genus or species-group. Other terminal taxa in the analysis remain unresolved.

1.2. *TIGRISOMYIA* KIRK-SPRIGGS, 2010B

Type species: *Tigrisomyia amnoni* Kirk-Spriggs, 2010b, by original designation. Species included: 4 (Afrotropical).

Synapomorphies: Lateral sides of mesonotum with striking grey or silver V-shaped presutural macula (9), 3 strong (closely approximated) anepisternal setae (11), longest terminal setae on male cercus grossly longer than setae on epandrium (29), lateral lobe of epandrium with group of enormously long setae (35), surstyli distinctly spatulate with “elbow” (55), phallapodeme deeply and narrowly excavated basally (forked) (56), female postabdomen very long, narrow and elongate (distance between sternites much greater than their length) (57), and spermathecae doliform studded with protuberances (62).

2. “*CURTONOTUM* + *AXINOTA* CLADE”

Genera included: *Axinota* van der Wulp, 1886 and *Curtonotum* Macquart 1844.

Synapomorphies: Discal scutellar setulae present (12), costal margin with very long, conspicuous, closely-packed spines (except in the case of the *Axinota pictiventris* species-group) (16), “phallic complex” (phallus or aedeagus) asymmetrical (26), basiphallus either partially or fully fused to phallapodeme (31), phallapodeme shorter than basiphallus (32), and female sternite 8 greatly reduced, weakly sclerotised (58).

2.1. *AXINOTA* VAN DER WULP, 1886

Type species: *Axinota pictiventris* van der Wulp, 1886. Species included: 13 (Afrotropical/Oriental/Australasia).

Synapomorphies: Frons either slightly or markedly narrower in males (2), mesonotum extremely hunchbacked (7), anepisternal with 2 strong, widely separated reclinate setae (11), hypandrial arms and epandrium distinctly fused laterally (36), ejaculatory apodeme entirely enclosed within phallus (50), and surstyli distinctly forked (54). Kirk-Spriggs (2010a; Chapter 3.1) divided the genus into two species-groups: a principally Oriental *Pictiventris* species-group (with two species in the Afrotropical Region) and an Afrotropical *Fuscipennis* species-group (two species). Only exemplars from the

Fuscipennis species-group are included in the molecular analysis, but examples of both are included as terminal taxa in the morphological analysis, including the type species of the genus. The tree presented as Fig. 2.0: 105 (a) support such a subdivision of the genus, and the informal species-group names are here retained.

2.1.1. *PICTIVENTRIS* SPECIES-GROUP

Species included: 11 (Afrotropical/Oriental/Australasia).

Synapomorphies: Frons markedly narrower in males (2), the wing membrane entirely clear hyaline throughout (13) and the costal margin with spines short and uniform in size (16).

2.1.2. *FUSCIPENNIS* SPECIES-GROUP

Species included: 2 (Afrotropical).

Synapomorphies: Frons only slightly narrower in males (2), the wing membrane entirely infusate throughout (13) and the costal margin with very long, conspicuous, closely-packed spines (although this is analogous with *Curtonotum*) (16).

2.2. *CURTONOTUM* MACQUART

Type species: *Musca gibba* Fabricius, 1805 [preoccupied], by original designation. [The name of the Type species is a junior primary homonym preoccupied by *Musca gibba* Müller, 1776: 175 and *M. gibba* Rossi, 1794: 73. *Curtonotum taeniatum* Hendel, 1913: 629 was accepted as the replacement name by Thompson and Pont (1993)]. Species included: 73.

Klymko and Marshall (2011) noted that there were no obvious synapomorphies for the genus *Curtonotum*, with the possible exception of the spinose costa. A costal margin with very long, conspicuous, closely-packed spines (16) would be regarded as a synapomorphy of *Curtonotum*, were it not expressed as an analogous feature in the two African species of the *Axinota fuscipennis* species-group.

2.2.1. *CURTONOTUM SENSU STRICTO* (*SENSU* KLYMKO AND MARSHALL 2011)

Species included: 27 (Neotropical).

Synapomorphies: 5 strong anepisternal setae (11), wing membrane pale brown, darker at *dm-cu* crossvein and in apical region of veins R_{2+3} , R_{4+5} , M (14), phallapodeme with broad laterally flattened “fan” (33), phallapodeme without distinct lateral lobes (34), surstyli and postgonites collectively shaped like a Dodo’s bill (53). Only three Neotropical species were included in the morphological analyses so synapomorphic characters cannot be fully assessed. Klymko and Marshall (2011) proposed that the Neotropical species of *Curtonotum* be regarded as *Curtonotum sensu stricto*, which is adopted here, with good support for the monophyly the group indicated in all trees presented.

2.2.2. *STRIATIFRONS* SPECIES-GROUP

Species included: 3 (Afrotropical).

Synapomorphies: Sternite 6 with pair of divergent medial setae (24), basiphallus only partially fused to phallapodeme (31), distiphallus distinctly recurved (38), lateral wing of basiphallus forming a distinct basally expanded, but narrow blade (43), tergite 10 fused to fused cerci (60). Tsacas (1977) recognised a *Striatifrons* species-group, comprising *C. herrero* Tsacas, *C. maculiventris* (Enderlein) (as *C. tigrinum* Séguéy) and *C. striatifrons* Malloch. As attested by the above-mentioned synapomorphies, they are here regarded as being sufficiently distinct to warrant inclusion in a species-group of their own.

2.2.3. *ANUS* SPECIES-GROUP

Species included: 6 (Nearctic/Palaearctic/Oriental).

Synapomorphy: Distiphallus with defined heavily sclerotised portion dorsally (41). Kirk-Spriggs and Freidberg (2007) tentatively proposed an *Anus* species-group, based on i) a short robust phallus; ii) a distiphallus with a defined apical sclerotized portion; and iii) a spinose female cercus (pseudacanthophorite). To this group they ascribed the Palaearctic

C. anus, Nearctic *C. helvum* and (tentatively) all 19 then known Neotropical species of *Curtonotum*. Characters defining an *Anus* species-group were reassessed by Klymko and Marshall (2011) who redefined the species-group as follows: i) female cerci free from one another, but fused to tergite 10; ii) female cerci with specialized stout setae; and iii) female sternite 10 invaginate posteriorly, anteriorly with laterally compressed apodeme. The noted character states of the cercus are, however, synapomorphies of both the *Anus* and *Platyphallum* species-groups (as here defined).

2.2.4. *PLATYPHALLUM* SPECIES-GROUP

Species included: 3 (Afrotropical).

Synapomorphies: Basiphallus with extensive angulate ventrally expanded and concave process (42) and lateral wing of basiphallus forming a broad lateral extension of the basiphallus (43). Tsacas (1977) included *C. platyphallum* Tsacas (based on the unique damaged holotype) in his *Cuthbertsoni* species-group. *Curtonotum platyphallum* and the two newly-described species, *C. moffatt* sp. n. and *C. marriott* sp. n., form a distinct clade, and as attested by the above-mentioned synapomorphy, are here regarded as being sufficiently distinct to warrant inclusion in a species-group of their own.

2.2.5. *CAMPSIPHALLUM* SPECIES-GROUP

Species included: 7 (Afrotropical).

Synapomorphies: Lateral lobe with 1 very strong seta and group of shorter setae (35), baso-ventral process of distiphallus developed into a short, blade-like, partially serrated process (39). Tsacas (1977) regarded the species *C. angolense* Tsacas, *C. campsiphallum* Tsacas, *C. sao* Tsacas and *C. quinquevittatum* Curran in his *Cuthbertsoni* species-group, *Quinquevittatum* complex. These four species, plus *C. friedberg* sp. n., *C. hay* sp. n. and *C. tsacas* sp. n. (described in Chapter 3.4), are here regarded as being sufficiently distinct to warrant inclusion in a species-group of their own, as attested by the above-mentioned synapomorphies.

2.2.6. *GONZO* SPECIES-GROUP

Species included: 2 (Afrotropical).

Synapomorphies: Sternite 5 expanded, 4–5 with modified setae (23), basiphallus with expanded subdivided mid section and cordiform extension of distiphallus (46). The systematic position of *C. gonzo* and *C. sternithrix* can only be fully assessed as part of a more extensive molecular study. They are here tentatively ascribed to the species-group based on the aforementioned synapomorphies, but different externally.

2.2.7. *SAHELIENSE* SPECIES-GROUP

Species included: 2 (Afrotropical/Palaearctic).

Synapomorphy: Distiphallus with long, obliquely angled, posteriorly-directed spine basally (44). Tsacas (1977) included the two sister species, *C. sahelense* Tsacas and *C. simile* Tsacas, both of which are confined to xeric habitats bordering the Sahara and the Arabian Peninsula, in his *Cuthbertsoni* species-group. As attested by the above-mentioned synapomorphy, they are here regarded as being sufficiently distinct to warrant inclusion in a species-group of their own.

2.2.8. *UNCINATUM* SPECIES-GROUP

Species included: 10 (Afrotropical).

Synapomorphy: Distiphallus with two dorsally-directed basal spines or dorsal ridge (45). Tsacas (1977) regarded 9 of the 10 species here ascribed to the species-group as a single species, *C. cuthbertsoni*. The 10 species are virtually identical externally and are only separable on the basis of slight, but consistent differences in the shape of the basiphallus of the male terminalia. As attested by the above-mentioned synapomorphy, they are here regarded as being sufficiently distinct to warrant inclusion in a species-group of their own.

2.2.9. *STUCKENBERGI* SPECIES-GROUP

Species included: 7 (Afrotropical, confined to Madagascar).

Synapomorphy: Basiphallus heavily sclerotised, markedly expanded apically and narrowed pre-apically (47). Tsacas (1977) included all species then known from Madagascar in his *Cuthbertsoni* species-group. Seven of the species recorded from the island are regarded as being sufficiently distinct to warrant inclusion in a species-group of their own, as attested by the above-mentioned synapomorphy. A more complete molecular study of the Malagasy *Curtonotum* fauna is required to ascertain whether this species-group is truly monophyletic.

2.2.10. *BOENY* SPECIES-GROUP

Species included: 2 (Afrotropical, confined to Madagascar).

Synapomorphies: Lateral lobe of epandrium with 2 very strong setae only (35), lateral lobe of epandrium strongly excavated (48). Tsacas (1977) assigned the Malagasy endemic species *C. boeny* Tsacas to his *Cuthbertsoni* species-group. Both *C. boeny* and its recently described sister species, *C. griveaudi* Kirk-Spriggs (also endemic to Madagascar), are here regarded as being sufficiently distinct to warrant inclusion in a species-group of their own, as attested by the above-mentioned synapomorphies.

2.2.11. *RINHATINANA* SPECIES-GROUP

Species included: 1 (Afrotropical, confined to Madagascar).

Autapomorphy: Sperm pump present (37). *Curtonotum rinhatinana* has a number of unique characters. Although similar in external characters to other species of the genus the bizarre structure of the basiphallus and the presence of a sclerotised sperm pump, precludes it from any direct association and it is here tentatively ascribed to a species-group of its own. Its systematic position can only be fully assessed as part of a more extensive molecular study.

2.0: Table 1. List of sequenced samples. The Genbank voucher numbers have format “UPOL” and the six digit designation listed below. Voucher specimens are deposited in BMSA.

Genus/species	Family	Zoogeographical Region	Country of origin	Locality	Unique specimen code	Genes & Genbank numbers			
						COI	CAD3	CAD1	TPI
<i>Camilla</i> sp.	Camillidae	Palaearctic	United Kingdom	Silwood Park	NCSU#11-06-14-42	–	JQ765807	–	JQ765814
<i>Diatata fuscula</i>	Diatridae	Palaearctic	Hungary	Nagyhuta, Rostallo	NCSU#08-01-04-31	–	JQ765808	–	JQ765815
<i>Drosophila melanogaster</i>	Drosophilidae	Nearctic	USA	NCSU lab. colony	NCSU#11-06-14-43	U37541	AAF48639	AAF48639	U60859
<i>Tigrisomyia ammoni</i>	Curtonotidae	Afrotropical	Tanzania	Udzungwa Mts. Nat. Park	BMSA(DNA)#0045	JQ765843	JQ765805	–	–
<i>Cyrtona</i> (s.s.) <i>pictipennis</i>	Curtonotidae	Afrotropical	South Africa	Garden Castle	BMSA(DNA)#0025	JQ765821	JQ765783	JQ765754	JQ765812
<i>Cyrtona</i> (s.l.) sp. n. 1	Curtonotidae	Afrotropical	South Africa	Hogsback, Redwood trail	BMSA(DNA)#0066	JQ765841	JQ765803	JQ765775	–
<i>Cyrtona</i> (s.l.) sp. n. 2	Curtonotidae	Afrotropical	South Africa	Moolhoekkop	BMSA(DNA)#0037	JQ765822	JQ765784	JQ765755	–
<i>Cyrtona</i> (s.l.) sp. n. 3	Curtonotidae	Afrotropical	South Africa	Keurbos forest	BMSA(DNA)#0001	JQ765816	JQ765778	JQ765749	JQ765809
<i>Cyrtona</i> (s.l.) sp. n. 4	Curtonotidae	Afrotropical	Burundi	Parc National de la Kibira	BMSA(DNA)#0067	JQ765842	JQ765804	JQ765776	–
<i>Cy. (s.l.) albomacula</i>	Curtonotidae	Afrotropical	Togo	Kpessi, 3 km SW	BMSA(DNA)#0011	JQ765831	JQ765794	JQ765764	–
<i>Cyrtona</i> (s.l.) sp. n. 6	Curtonotidae	Afrotropical	Togo	Ayikpara near Kokoté	BMSA(DNA)#0012	JQ765832	JQ765795	JQ765765	–
<i>Cyrtona</i> (s.l.) sp. n. 7	Curtonotidae	Afrotropical	South Africa	Ndumo Game Reserve	BMSA(DNA)#0032	JQ765833	JQ765796	JQ765766	–
<i>Cyrtona</i> (s.l.) sp. n. 8	Curtonotidae	Afrotropical	South Africa	Ndumo Game Reserve	BMSA(DNA)#0031	JQ765834	JQ765797	JQ765767	–
<i>Cyrtona</i> (s.l.) sp. n. 9	Curtonotidae	Afrotropical	South Africa	Ndumo Game Reserve	BMSA(DNA)#0022	JQ765835	JQ765798	JQ765768	–
<i>Cyrtona</i> (s.l.) sp. n. 10	Curtonotidae	Afrotropical	Tanzania	Udzungwa Mts. Nat. Park	BMSA(DNA)#0046	JQ765844	JQ765806	JQ765777	–
<i>Cyrtona</i> (s.l.) sp. n. 11	Curtonotidae	Afrotropical	South Africa	Ndumo Game Reserve	BMSA(DNA)#0033	JQ765820	JQ765782	JQ765753	JQ765811
<i>Axinota quasimodoi</i>	Curtonotidae	Afrotropical	Togo	Kpessi, 3 km SW	BMSA(DNA)#0013	JQ765825	JQ765787	JQ765758	–
<i>Curtonotum pantherinum</i>	Curtonotidae	Neotropical	Peru	Biological Station Tambopata,	BMSA(DNA)#0040	JQ765827	JQ765790	JQ765760	–
<i>Curtonotum</i> sp. indet. 1	Curtonotidae	Neotropical	Peru	Explorers Inn, Rio Tower	NCSU#11-06-14-40	JQ765823	JQ765785	JQ765756	–
<i>Curtonotum taeniatum</i>	Curtonotidae	Neotropical	Peru	Los Amigos Biological Station	BMSA(DNA)#0016	JQ765819	JQ765781	JQ765752	–

2.0: Table 1. (Extended).

Genus/species	Family	Zoogeographical Region	Country of origin	Locality	Unique specimen code	Genes & Genbank numbers			
						COI	CAD3	CAD1	TP1
<i>Curtonotum</i> sp. indet. 3	Curtonotidae	Neotropical	Bolivia	Cochambamba	NCSU#11-06-14-41	JQ765824	JQ765786	JQ765757	JQ765813
<i>Curtonotum anus</i>	Curtonotidae	Afrotropical	Israel	Park HaYarden	BMSA(DNA)#0028	JQ765817	JQ765779	JQ765750	–
<i>Curtonotum helvum</i>	Curtonotidae	Nearctic	Canada, Ontario	Pinery Provential Park	NCSU#11-06-14-39	JQ765836	JQ765799	JQ765769	–
<i>Curtonotum griveaudi</i>	Curtonotidae	Afrotropical	Madagascar	Asondrodava dry forest	BMSA(DNA)#0054	JQ765838	JQ765800	JQ765771	–
<i>Curtonotum balachowskyi</i>	Curtonotidae	Afrotropical	Madagascar	Asondrodava dry forest	BMSA(DNA)#0055	JQ765837	JQ765788	JQ765770	–
<i>Curtonotum irwini</i>	Curtonotidae	Afrotropical	Madagascar	Beza Mahafaly Reserve	BMSA(DNA)#0059	–	–	JQ765773	–
<i>Curtonotum quinquevittatum</i>	Curtonotidae	Afrotropical	Togo	Montagne Gabongala	BMSA(DNA)#0010	JQ765828	JQ765791	JQ765761	–
<i>Curtonotum isacas</i>	Curtonotidae	Afrotropical	South Africa	Kosi Bay Nat. Res.	BMSA(DNA)#0064	JQ765840	JQ765802	JQ765774	–
<i>Curtonotum sp. n.</i>	Curtonotidae	Afrotropical	Togo	SE of Anié, at river Anié near railway bridge	BMSA(DNA)#0009	JQ765818	JQ765780	JQ765751	JQ765810
<i>Curtonotum sahelense</i>	Curtonotidae	Afrotropical	Togo	SE of Anié, at river Anié near railway bridge	BMSA(DNA)#0009	JQ765818	JQ765780	JQ765751	JQ765810
<i>Curtonotum bicuspis</i> sp. n.	Curtonotidae	Afrotropical	Namibia	Ndopu village, 1 km SE Bukalo	BMSA(DNA)#0003	JQ765826	JQ765789	JQ765759	–
<i>Curtonotum unicuspis</i> sp. n.	Curtonotidae	Afrotropical	Namibia	Ndopu village, 1 km SE Bukalo	BMSA(DNA)#0004	JQ765830	JQ765793	JQ765763	–
<i>Curtonotum uncinatum</i> sp. n.	Curtonotidae	Afrotropical	South Africa	Soetdoring Nature Reserve	BMSA(DNA)#0006	JQ765829	JQ765792	JQ765762	–
<i>Curtonotum pauliani</i>	Curtonotidae	Afrotropical	Madagascar	Marofototra palm forest	BMSA(DNA)#0063	JQ765839	JQ765801	JQ765772	–

2.0: Table 2. Exemplar species of Curtonotidae and out-group taxa used in the morphological analysis. The females of closely-related species cannot be reliably identified until such time as pairs have been taken *in copula* or collected in a single species collection event, sexes known or distinguishable are indicated in column 6. Abbreviations: CAR = Central African Republic; DRC = Democratic Republic of Congo; TSG = type species of genus; UAE = United Arab Emirates.

Genus & species	Family	Repository	Country of Origin	Zoogeographical Region	Sexes known/distinguished	Notes
<i>Diastata montana</i> Cogan	Diastatidae	RMCA	DRC	Afrotropical	♂/♀	
<i>Drosophila melanogaster</i> Meigen	Drosophilidae	NMSA	South Africa	Afrotropical	♂/♀	
<i>Stegana varipes</i> Tsacas	Drosophilidae	NMSA	Zambia	Afrotropical	♂/♀	
<i>Amiota fenestrata</i> (Duda)	Drosophilidae	NMSA	Malawi	Afrotropical	♂/♀	
<i>Camilla manningi</i> Barraclough	Camillidae	NMSA	South Africa	Afrotropical	♂/♀	
<i>Tigrisomyia ammoni</i> Kirk-Spriggs	Curtonotidae	TAU	Tanzania	Afrotropical	♂/♀	TSG
<i>Tigrisomyia kinskii</i> Kirk-Spriggs	Curtonotidae	TAU	Malawi	Afrotropical	♂	
<i>Tigrisomyia rhayaderi</i> Kirk-Spriggs	Curtonotidae	TAU	Kenya	Afrotropical	♀	
<i>Tigrisomyia scoliosis</i> Kirk-Spriggs	Curtonotidae	BMNH	Tanzania	Afrotropical	♂/♀	
<i>Curtonotum angustipennis</i> (de Meijere)	Curtonotidae	BPBM	Thailand	Oriental	♂/♀	TSG
<i>Cyrtona</i> (s.l.) <i>albomacula</i> (Curran)	Curtonotidae	TAU	Nigeria	Afrotropical	♂	
<i>Parapsinota sublineata</i> Duda	Curtonotidae	NMSA/HNHM	South Africa	Afrotropical	♂	
<i>Cyrtona</i> (s.l.) sp. n. 6	Curtonotidae	BMNH/NMSA	Uganda/South Africa	Afrotropical	♂	
<i>Cyrtona</i> (s.l.) sp. n. 7	Curtonotidae	NMSA/TAU	Kenya/Malawi	Afrotropical	♂	
<i>Cyrtona</i> (s.l.) sp. n. 8	Curtonotidae	NMSA	Kenya/South Africa	Afrotropical	♂	
<i>Cyrtona</i> (s.l.) sp. n. 9	Curtonotidae	NMSA	South Africa	Afrotropical	♂	
<i>Cyrtona</i> (s.l.) sp. n. 10	Curtonotidae	ZMUC	Tanzania	Afrotropical	♂	
<i>Cyrtona</i> (s.l.) sp. n. 11	Curtonotidae	NMSA/CAS	South Africa/Tanzania	Afrotropical	♂	
<i>Cyrtona</i> (s.l.) sp. n. 12	Curtonotidae	TAU/BMNH	Kenya	Afrotropical	♂	
<i>Cyrtona</i> (s.s.) <i>appendiculata</i> Séguy	Curtonotidae	TAU	Malawi	Afrotropical	♂/♀	TSG

2.0: Table 2. (Extended).

Genus & species	Family	Repository	Country of Origin	Zoogeographical Region	Sexes known/distinguished	Notes
<i>Cyrtona</i> (s.s.) <i>pictipennis</i> (Thomson)	Curtonotidae	NMSA	South Africa	Afrotropical	♂/♀	
<i>Cyrtona</i> (s.l.) <i>capensis</i> Hackman	Curtonotidae	AMGS	South Africa	Afrotropical	♂/♀	
<i>Cyrtona</i> (s.l.) <i>consobrina</i> Hackman	Curtonotidae	NMSA	South Africa	Afrotropical	♂	
<i>Cyrtona</i> (s.l.) sp. n. 1	Curtonotidae	HNHM	South Africa	Afrotropical	♂/♀	
<i>Cyrtona</i> (s.l.) sp. n. 2	Curtonotidae	BMSA	South Africa	Afrotropical	♂/♀	
<i>Cyrtona</i> (s.l.) sp. n. 3	Curtonotidae	BMSA	South Africa	Afrotropical	♂/♀	
<i>Cyrtona</i> (s.l.) sp. n. 4	Curtonotidae	BMSA	Burundi	Afrotropical	♂/♀	
<i>Cyrtona</i> (s.l.) sp. n. 5	Curtonotidae	TAU	Tanzania	Afrotropical	♂	
<i>Axinota pictiventris</i> van der Wulp	Curtonotidae	BPBM	Indonesia/Malaysia/Philippines	Oriental	♂/♀	TSG
<i>Axinota fuscipennis</i> (Macquart)	Curtonotidae	NMWC/NMSA	Gambia/South Africa	Afrotropical	♂/♀	
<i>Axinota quasimodoi</i> Kirk-Spriggs	Curtonotidae	BMSA	DRC	Afrotropical	♂/♀	
<i>Axinota ahdabi</i> Kirk-Spriggs	Curtonotidae	NMWC	Yemen	Afrotropical	♂/♀	
<i>Axinota kyphosis</i> Kirk-Spriggs	Curtonotidae	ZSM	Madagascar	Afrotropical	♂/♀	
<i>Curtonotum taeniatum</i> Hendel	Curtonotidae	SMTD	Peru	Neotropical	♂/♀	TSG
<i>Curtonotum flavisetum</i> Klymko & Marshall	Curtonotidae	ZSM	Bolivia	Neotropical	♂/♀	
<i>Curtonotum pantherinum</i> (Walker)	Curtonotidae	ZSM	Bolivia	Neotropical	♂/♀	
<i>Curtonotum helvum</i> (Loew)	Curtonotidae	DEBU	Canada	Nearctic	♂/♀	
<i>Curtonotum anus</i> (Meigen)	Curtonotidae	TAU	Israel	Palearctic	♂/♀	
<i>Curtonotum herrero</i> Tsacas	Curtonotidae	NMNW	Namibia	Afrotropical	♂/♀	

2.0: Table 2. (Extended).

Genus & species	Family	Repository	Country of Origin	Zoogeographical Region	Sexes known/distinguished	Notes
<i>Curtonotum maculiventris</i> (Enderlein)	Curtonotidae	BMNH	Zimbabwe	Afrotropical	♂/♀	
<i>Curtonotum striatifrons</i> Malloch	Curtonotidae	BMNH/MNH	Chad/Nigeria/Sudan	Afrotropical	♂/♀	
<i>Curtonotum marriott</i> sp. n.	Curtonotidae	USNM/TAU	Cameroon/Nigeria	Afrotropical	♂/♀	
<i>Curtonotum moffatt</i> sp. n.	Curtonotidae	HNHM/ZMHB/MSNG	CAR/Cameroon/Uganda	Afrotropical	♂/♀	
<i>Curtonotum platyphallum</i> Tsacas	Curtonotidae	AMNH/CAS	Liberia	Afrotropical	♂/♀	
<i>Curtonotum sternithrix</i> Tsacas	Curtonotidae	MNH/NMMSA	Madagascar	Afrotropical	♂/♀	
<i>Curtonotum angolense</i> Tsacas	Curtonotidae	CAS/MNH/N/BMNH	Angola	Afrotropical	♂	
<i>Curtonotum campisphallum</i> Tsacas	Curtonotidae	TAU	Cameroon	Afrotropical	♂/♀	
<i>Curtonotum freidberg</i> sp. n.	Curtonotidae	TAU	Malawi	Afrotropical	♂	
<i>Curtonotum hay</i> sp. n.	Curtonotidae	HNHM/OU/MNH	Uganda	Afrotropical	♂	
<i>Curtonotum quinquevittatum</i> Curran	Curtonotidae	TAU	Malawi	Afrotropical	♂/♀	
<i>Curtonotum sao</i> Tsacas	Curtonotidae	NMWC/BMNH	Nigeria	Afrotropical	♂/♀	
<i>Curtonotum tsacas</i> sp. n.	Curtonotidae	BMSA	South Africa	Afrotropical	♂/♀	
<i>Curtonotum gonzo</i> sp. n.	Curtonotidae	HNHM/DEI/NMWC	Ghana/Cameroon/Nigeria	Afrotropical	♂/♀	
<i>Curtonotum saheliense</i> Tsacas	Curtonotidae	MNH/N/NMWC	Nigeria/Mali	Afrotropical	♂/♀	
<i>Curtonotum simile</i> Tsacas	Curtonotidae	TAU/NMWC	Israel/UAE	Afrotropical	♂/♀	
<i>Curtonotum bicuspidis</i> sp. n.	Curtonotidae	NMNW	Namibia	Afrotropical	♂	
<i>Curtonotum cimbebas</i> sp. n.	Curtonotidae	NMNW	Namibia	Afrotropical	♂	
<i>Curtonotum constance</i> sp. n.	Curtonotidae	MNH	Angola	Afrotropical	♂	
<i>Curtonotum cuthbertsoni</i> Duda	Curtonotidae	NMSA	South Africa	Afrotropical	♂	
<i>Curtonotum litoralis</i> sp. n.	Curtonotidae	NMNW/ZMUC/BMNH	Kenya/Tanzania	Afrotropical	♂/♀	

2.0: Table 2. (Extended).

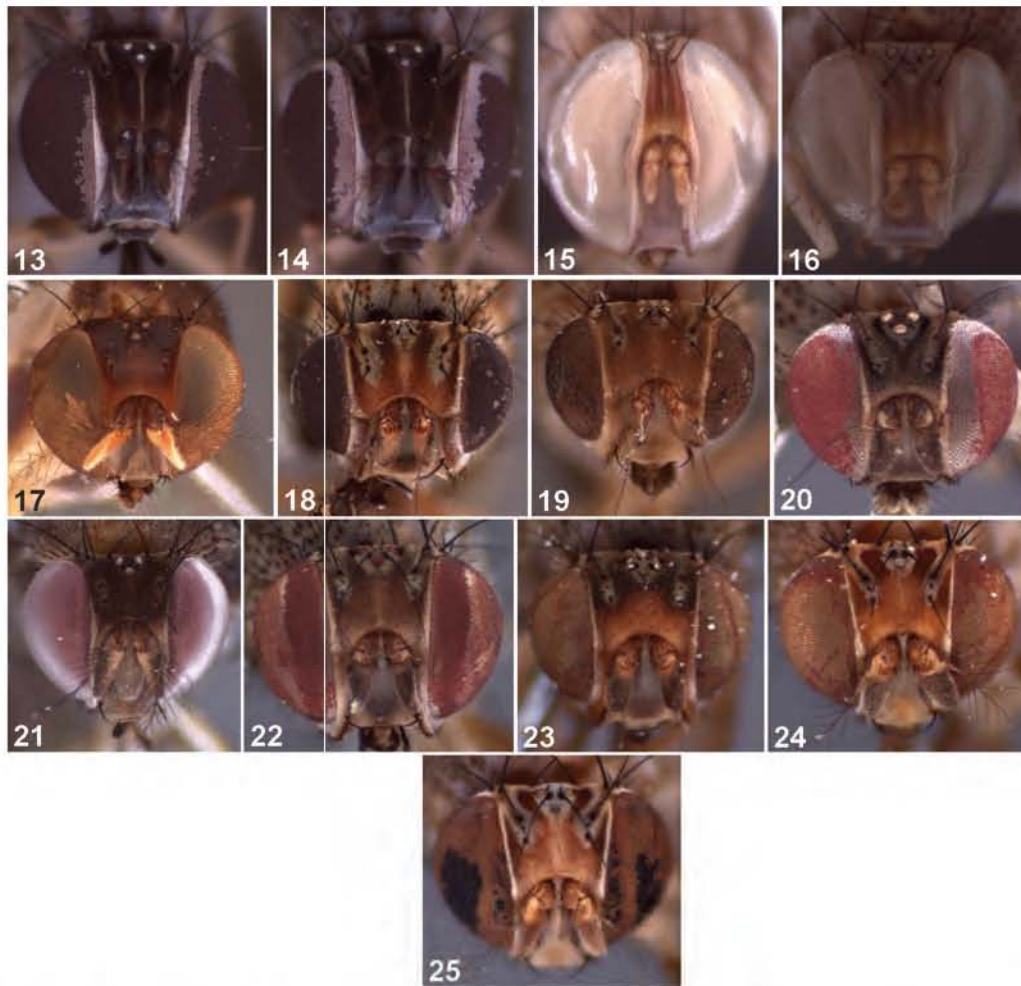
Genus & species	Family	Repository	Country of Origin	Zoogeographical Region	Sexes known/distinguished	Notes
<i>Curtonotum mcgregor</i> sp. n.	Curtonotidae	BMNH/NMMSA	Malawi/Mozambique	Afrotropical	♂	
<i>Curtonotum pauliani</i> Tsacas	Curtonotidae	MNHN/CAS	Madagascar	Afrotropical	♂/♀	
<i>Curtonotum uncinatum</i> sp. n.	Curtonotidae	NMNW	Namibia	Afrotropical	♂/♀	
<i>Curtonotum unicuspis</i> sp. n.	Curtonotidae	NMNW	Namibia	Afrotropical	♂	
<i>Curtonotum coroneiformis</i>	Curtonotidae	CAS	Madagascar	Afrotropical	♂	
Kirk-Spriggs						
<i>Curtonotum gladiiformis</i>	Curtonotidae	CAS	Madagascar	Afrotropical	♂	
Kirk-Spriggs						
<i>Curtonotum irwini</i> Kirk-Spriggs	Curtonotidae	CAS	Madagascar	Afrotropical	♂	
<i>Curtonotum parkeri</i> Kirk-Spriggs	Curtonotidae	CAS	Madagascar	Afrotropical	♂	
<i>Curtonotum balachowskyi</i> Tsacas	Curtonotidae	NHMB/CAS	Madagascar	Afrotropical	♂/♀	
<i>Curtonotum keiseri</i> Tsacas	Curtonotidae	MNHN/NHMB/TAU	Madagascar	Afrotropical	♂	
<i>Curtonotum stuckenbergi</i> Tsacas	Curtonotidae	MNHN/NHMB	Madagascar	Afrotropical	♂/♀	
<i>Curtonotum boeny</i> Tsacas	Curtonotidae	MNHN/NHMB/CAS	Madagascar	Afrotropical	♂/♀	
<i>Curtonotum griveaudi</i> Kirk-Spriggs	Curtonotidae	CAS/TAU	Madagascar	Afrotropical	♂/♀	
<i>Curtonotum sakalava</i> Tsacas	Curtonotidae	CAS	Madagascar	Afrotropical	♂/♀	
<i>Curtonotum rinhatinana</i>	Curtonotidae	CAS	Madagascar	Afrotropical	♂/♀	
Kirk-Spriggs					♂	



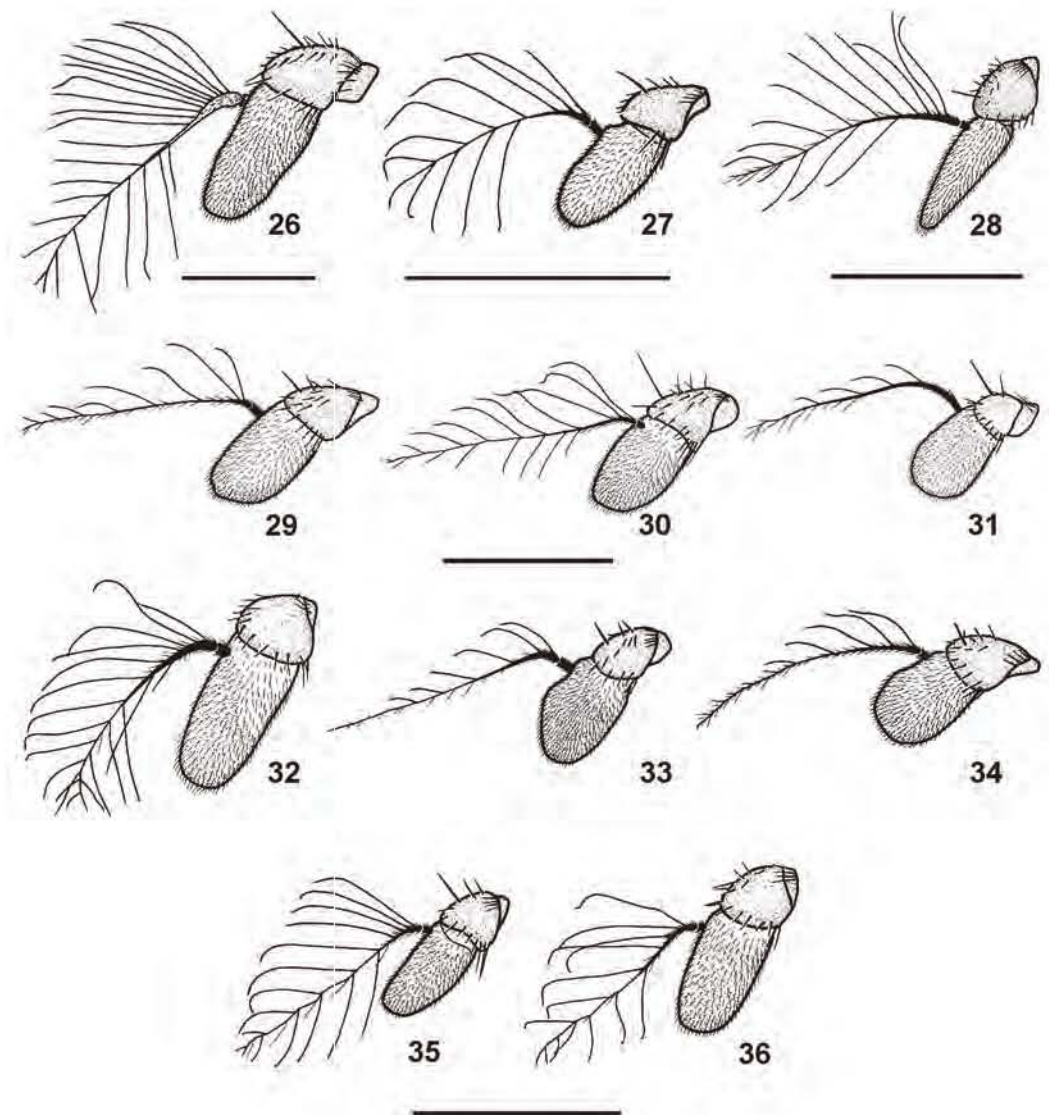
Figs 2.0: 1–6. Head and thorax (lateral) of Curtonotidae (male unless stated). **1.** *Curtonotum* (*s.s.*) *taeniatum* (LT, Peru: Umahuankiali, MTD); **2.** *Axinota quasimodoi* (N-T, DRC, Lieki village, BMSA); **3.** *A. pictiventris* (♀ HT, [Indonesia], Java, Batavia [= Jakarta], ZMAN); **4.** *Tigrisomyia amnoni* (♀ PT, Tanzania, Gologolo Forest, TAU); **5.** *Cyrtona* (*s.s.*) *pictipennis* (♀ N-T, South Africa, Highmoor Forestry Station, PPRI); **6.** *Cy.* (*s.s.*) *appendiculata* (♀ N-T, Kenya, Timboroa, TAU). Not to scale.



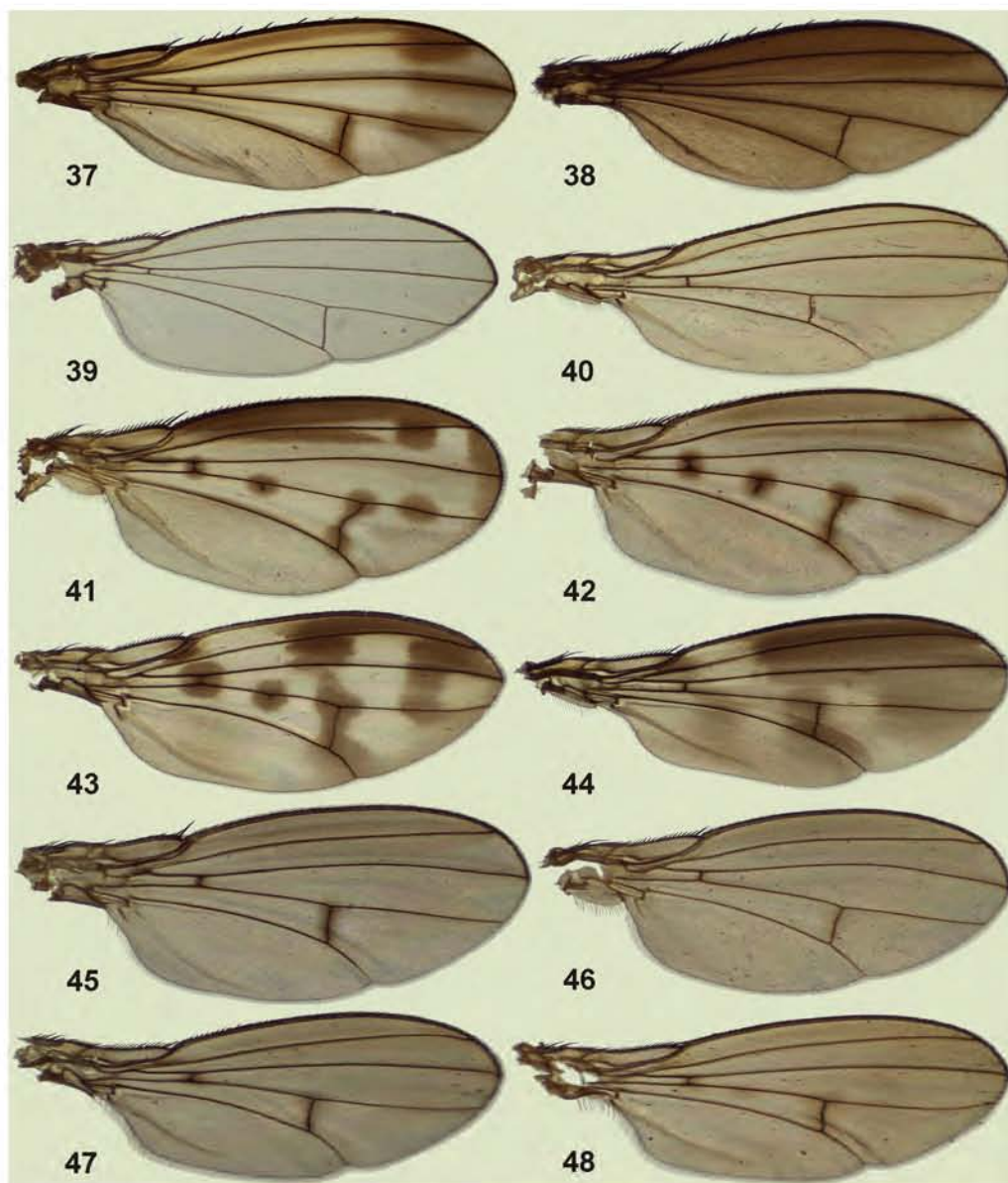
Figs 2.0: 7–12. Head and thorax (lateral) of Curtonotidae (male unless stated). 7, *Cyrtona* (*s.l.*) sp. n. 3 (N-T, South Africa, Benezos Forest, BMSA); 8, *Cy.* (*s.l.*) sp. n. 4 (♀ N-T, Burundi, Parc National de la Kibira, BMSA); 9, *Cy.* (*s.l.*) *capensis* (♀ N-T, South Africa, Grahamstown, AMGS); 10, *Cy.* (*s.l.*) *consobrina* (N-T, South Africa, Clanwilliam road, NMSA); 11, *Cy.* (*s.l.*) *albomacula* (N-T, South Africa, Vernon Crookes Nature Reserve, NMSA); 12, *Parapsinota sublineata* (N-T, South Africa, Pietermaritzburg, NMSA). Not to scale.



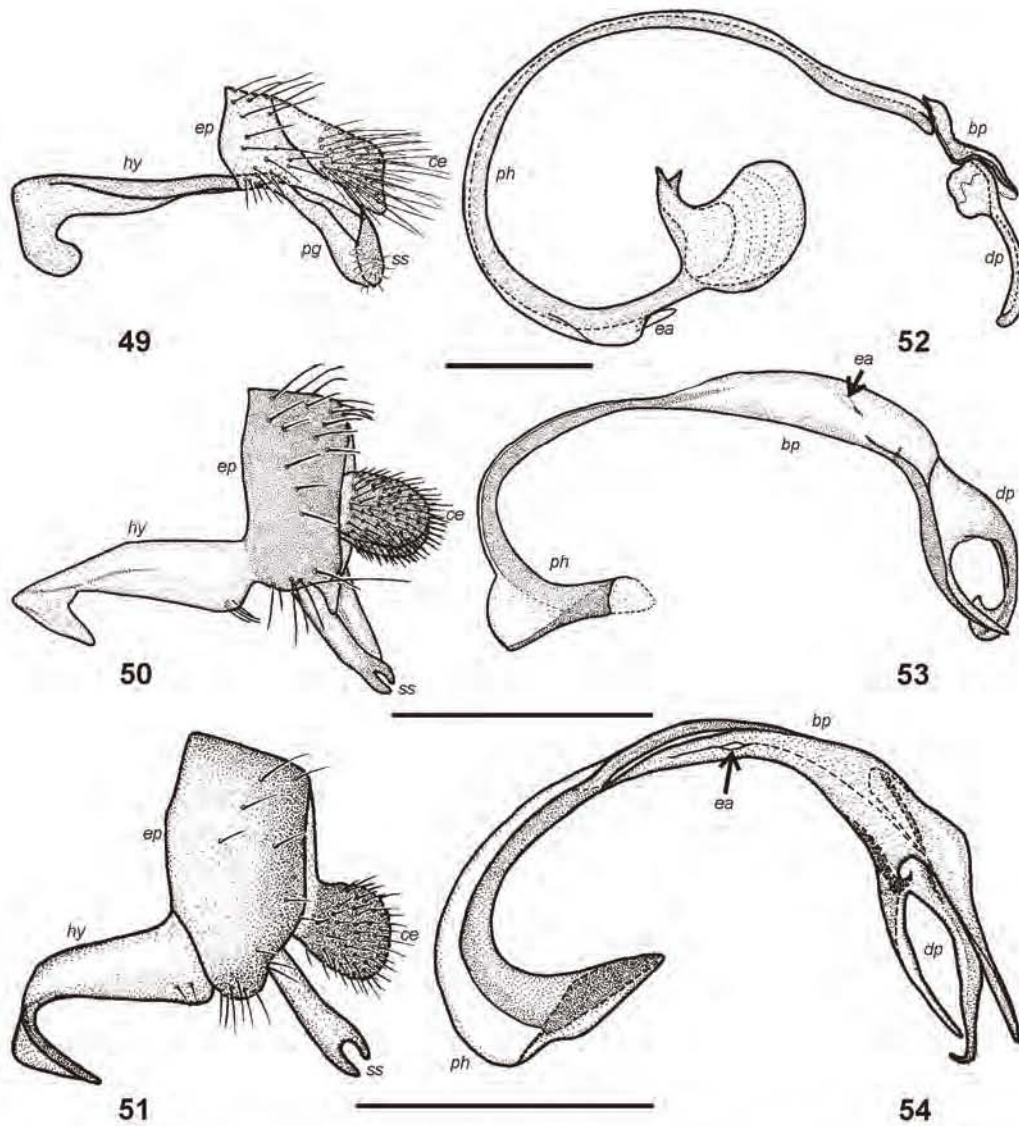
Figs 2.0: 13–25. Frons of Curtonotidae (dorsal) (male unless stated). **13**, *Axinota quasimodoi* (N-T, DRC, Bomane village, BMSA); **14**, Same (♀); **15**, *A. kyphosis* (HT, Madagascar, 10 km W von Sakaraha, ZSM); **16**, Same (♀ PT, same); **17**, *Tigrisomyia amnoni* (PT, Tanzania, Gologolo Forest, TAU); **18**, *Cyrtona* (*s.s.*) *pictipennis* (♀ N-T, South Africa, Giant's Castle Game Reserve, NMSA); **19**, *Cy. (s.s.) appendiculata* (♀ N-T, Kenya, Timboroa, TAU); **20**, *Cy. (s.l.)* sp. n. 3 (♀ N-T, South Africa, Benebos Forest, BMSA); **21**, *Cy. (s.l.)* sp. n. 4 (N-T, Burundi, Parc National de la Kibira, BMSA); **22**, *Cy. (s.l.) capensis* (N-T, South Africa, Grahamstown, AMGS); **23**, *Cy. (s.l.) consobrina* (N-T, South Africa, Du Toit's Kloof, NMSA); **24**, *Cy. (s.l.) albomacula* (N-T, South Africa, Durban, BMNH); **25**, *Parapsinota sublineata* (N-T, South Africa, Pietermaritzburg, NMSA). Not to scale.



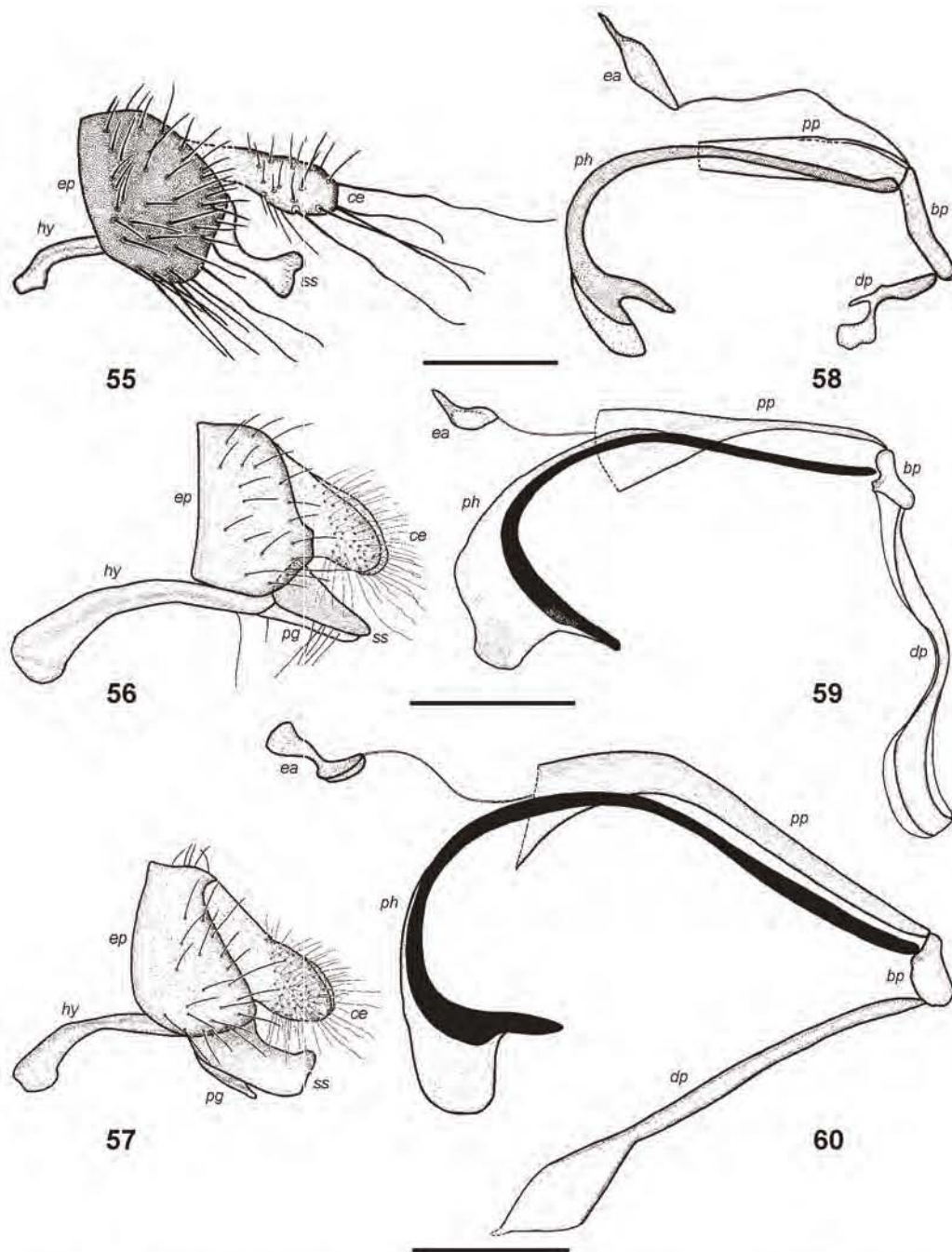
Figs 2.0: 26–36. Right antenna of Curtonotidae (female unless stated). **26**, *Curtonotum* (*s.s.*) *taeniatum* (PLT, Peru: Umahuankiali, MTD); **27**, *Axinota quasimodoi* (♂ N-T, DRC, Bomane village, BMSA); **28**, *Tigrisomyia annoni* (PT, Tanzania, Gologolo Forest, TAU); **29**, *Cyrtona* (*s.s.*) *pictipennis* (N-T, South Africa, Giant's Castle Game Reserve, NMSA); **30**, *Cy.* (*s.s.*) *appendiculata* (N-T, Kenya, Timboroa, TAU); **31**, *Cy.* (*s.l.*) sp. n. 3 (N-T, South Africa, Benebos Forest, BMSA); **32**, *Cy.* (*s.l.*) sp. n. 4 (♂ N-T, Burundi, Parc National de la Kibira, BMSA); **33**, *Cy.* (*s.l.*) *capensis* (N-T, South Africa, Grahamstown, AMGS); **34**, *Cy.* (*s.l.*) *consobrina* (♂ N-T, South Africa, Du Toits Kloof, NMSA); **35**, *Cy.* (*s.l.*) *albomacula* (♂ N-T, South Africa, Vernon Crookes Nature Res., NMSA); **36**, *Parapsinota sublineata* (N-T, South Africa, N. Drakensberg, HNHM). Scale bars = 0.5 mm.



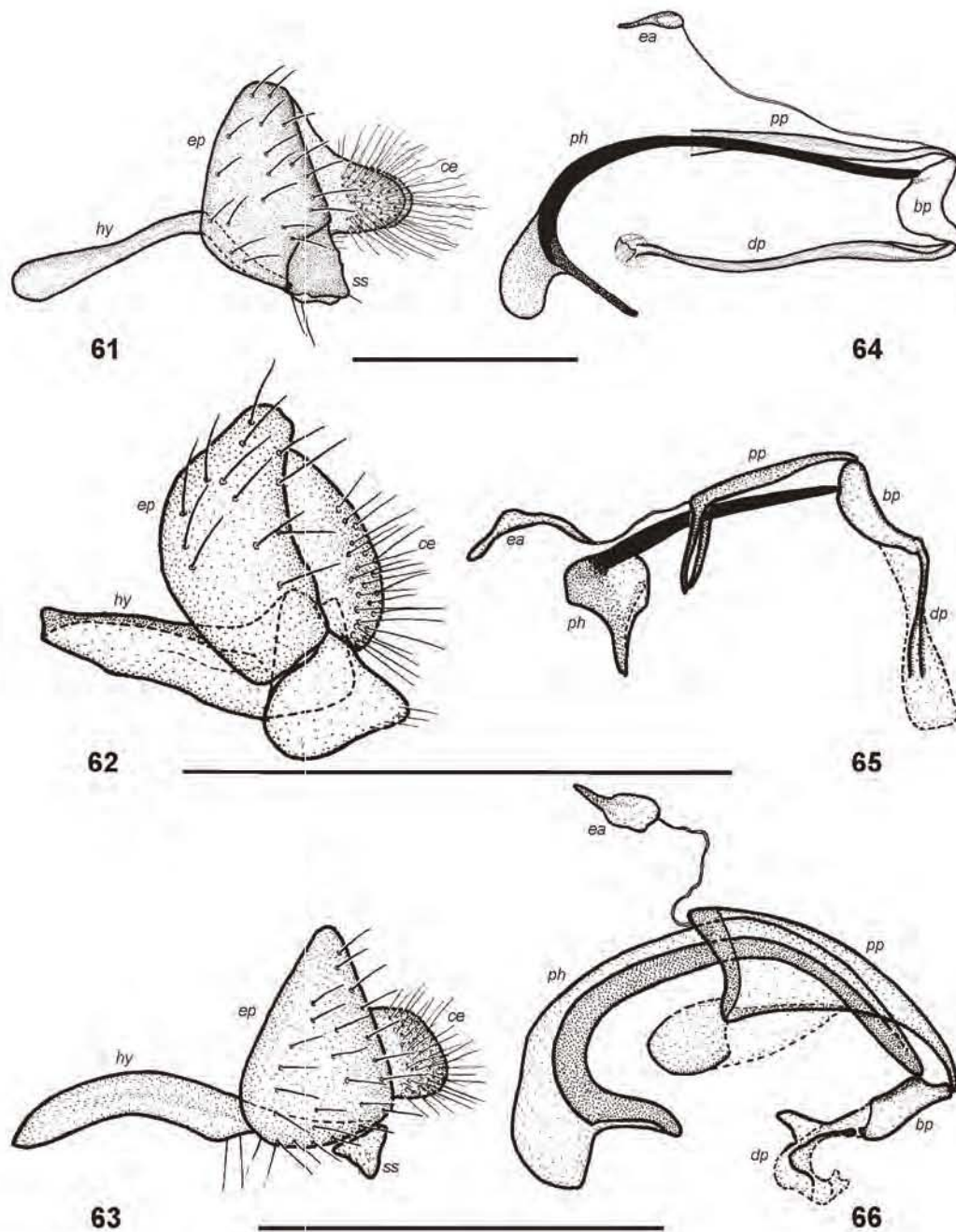
Figs 2.0: 37–48. Wing of Curtonotidae (male unless stated). **37**, *Curtonotum* (*s.s.*) *taeniatum* (PLT, Peru: Umahuankiali, MTD); **38**, *Axinota quasimodoi* (PT, Cameroon, Fako: Liongo, DEI); **39**, *Axinota* sp. n. nr. *Apsinota* sp. A of Delfinado (N-T, Borneo, Sabah, Danum Valley, NMWC); **40**, *Tigrisomyia amnoni* (PT, Tanzania, Ngozi Crater, TAU); **41**, *Cyrtona* (*s.s.*) *pictipennis* (N-T, South Africa, Giant's Castle, NMSA); **42**, *Cy. (s.s.) appendiculata* (N-T, Malawi, North Nyika National Park, TAU); **43**, *Cy. (s.l.)* sp. n. 3 (South Africa, below Sleepkloof hut, BMSA); **44**, *Cy. (s.l.)* sp. n. 4 (♀ N-T, Burundi, Parc National de la Kibira, BMSA); **45**, *Cy. (s.l.) capensis* (N-T, South Africa, Grahamstown, AMGS); **46**, *Cy. (s.l.) consobrina* (N-T, South Africa, Plattenbergbaai [*sic*], MZLU); **47**, *Cy. (s.l.) albomacula* (N-T, South Africa, near Pietermaritzburg, NMSA); **48**, *Parapsinota sublineata* (N-T, South Africa, Weenen, BMNH). Not to scale.



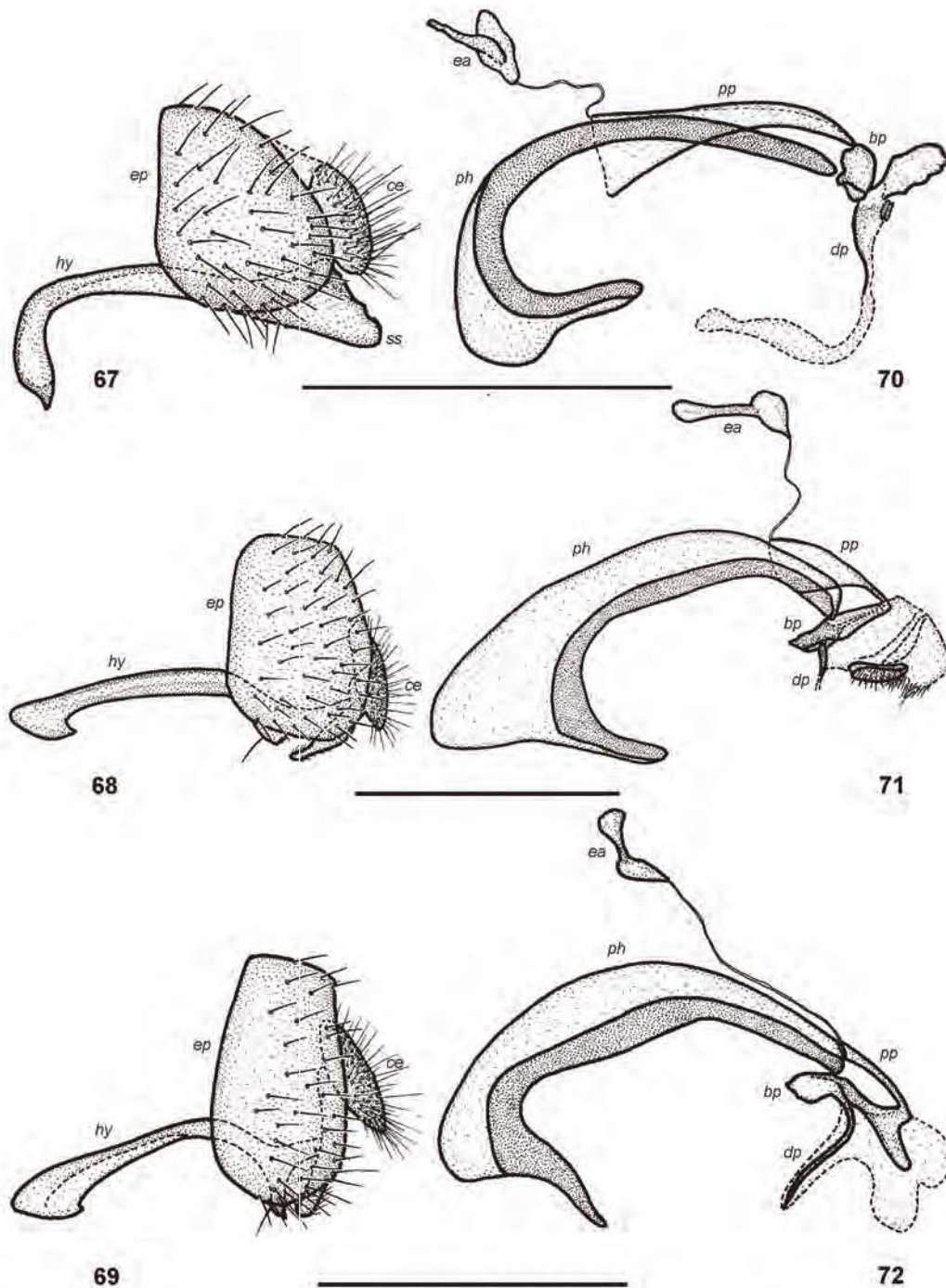
Figs 2.0: 49–54. Male terminalia of Curtonotidae. 49–51. Hypandrium and epandrium (lateral view): 49, *Curtonotum* (s.s.) *taeniatum* (LT, Peru: Umahuankiali, MTD); 50, *Axinota quasimodoi* (HT, Tanzania, nr. Soni, TAU); 51, *A. kyphosis* (HT, Madagascar, 10 km W von Sakaraha, ZSM). 52–54: Phallus (right lateral view): 52, *C.* (s.s.) *taeniatum* (same); 53, *A. quasimodoi* (same); 54, *A. kyphosis* (same) (Figs 50, 51, 53, 54 after Kirk-Spriggs 2010a: 109, figs 18, 22, 20, 24). Scale bars: 49, 52 = 0.5 mm; 50–54 = 0.3 mm.



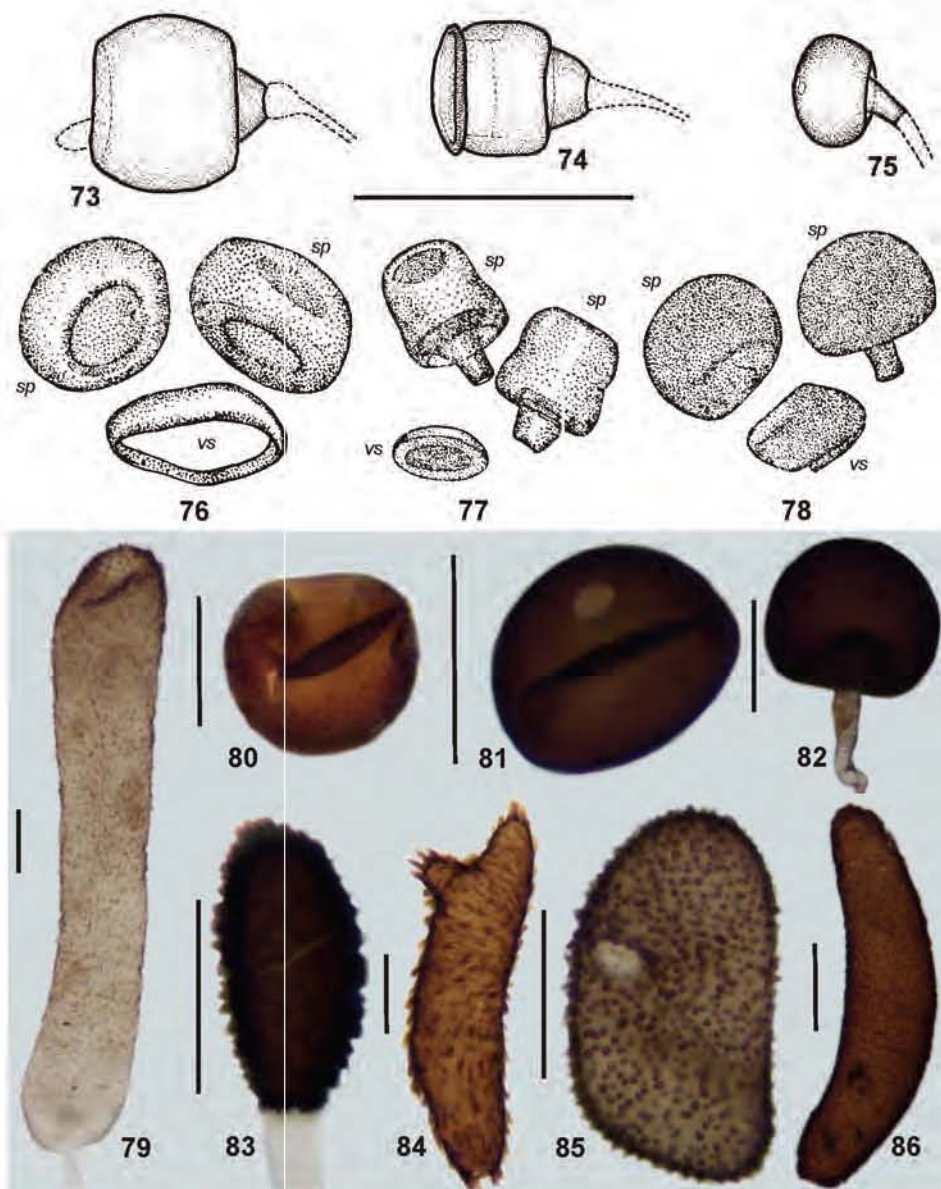
Figs 2.0: 55–60. Male terminalia of Curtonotidae. 55–57. Hypandrium and epandrium (lateral view): 55, *Tigrisomyia ammoni* (HT, Tanzania, Gologolo Forest, TAU); 56, *Cyrtona* (s.s.) *appendiculata* (N-T, Malawi, North Nyika National Park, TAU); 57, *Cy.* (s.s.) *pictipennis* (N-T, South Africa, Giants Castle Reserve, NMSA). 58–60: Phallus (right lateral view): 58, *T. ammoni* (same); 59, *Cy.* (s.s.) *appendiculata* (same); 60, *Cy.* (s.s.) *pictipennis* (same) (Figs 55, 58 after Kirk-Spriggs 2010b: 133, figs 11, 14). Scale bars = 0.3 mm.



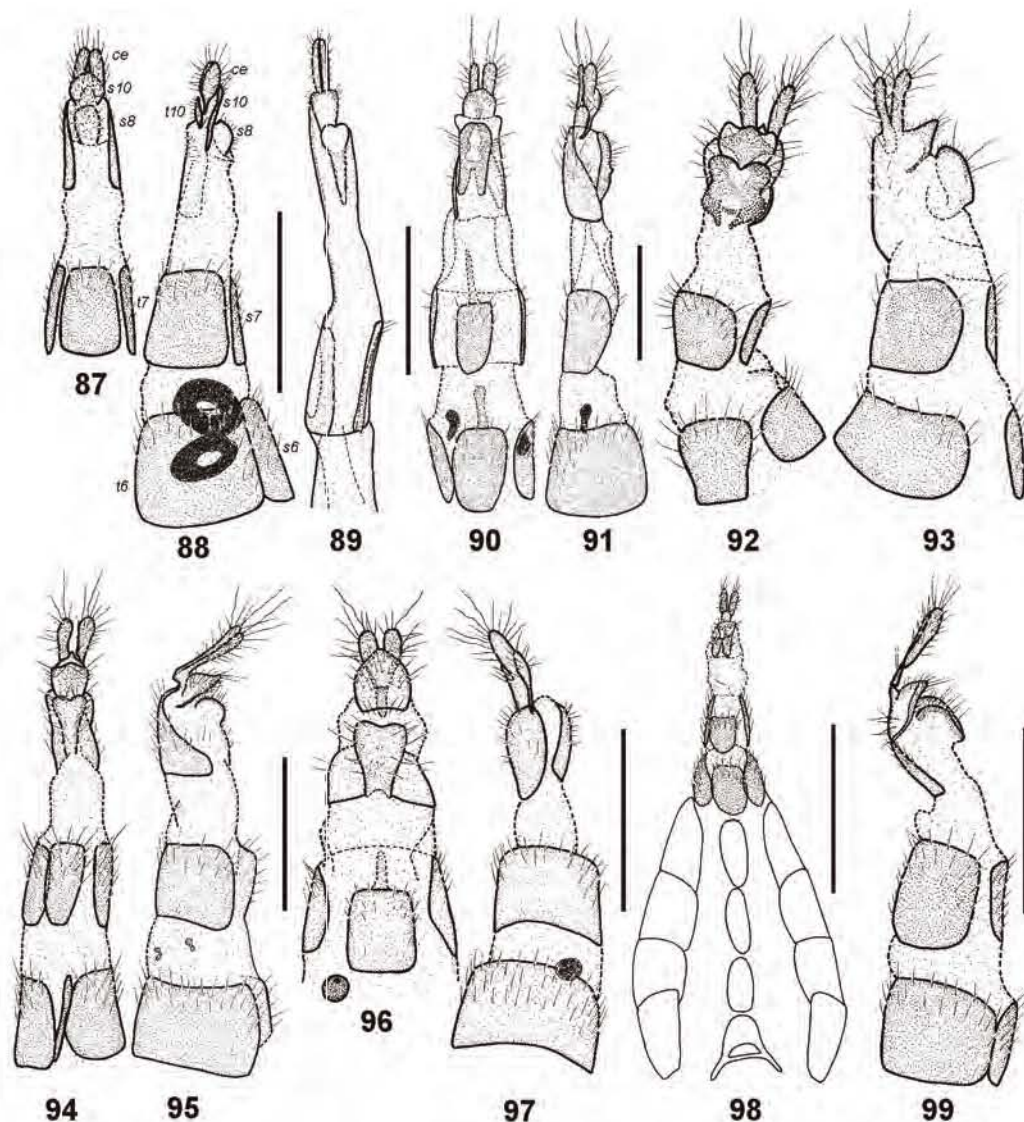
Figs 2.0: 61–66. Male terminalia of Curtonotidae. **61–63.** Hypandrium and epandrium (lateral view): **61**, *Cyrtona* (*s.l.*) sp. n. 3 (N-T, South Africa, French Hoek, BMNH); **62**, *Cy.* (*s.l.*) sp. n. 4 (N-T, Burundi, Parc National de la Kibira, BMSA); **63**, *Cy.* (*s.l.*) *capensis* (N-T, South Africa, Grahamstown, AMGS). **64–66:** Phallus (right lateral view): **64**, *Cy.* (*s.l.*) sp. n. 3 (same); **65**, *Cy.* (*s.l.*) sp. n. 4 (same); **66**, *Cy.* (*s.l.*) *capensis* (same). Scale bars: 61, 64 = 0.3 mm; 62–66 = 0.5 mm.



Figs 2.0: 67–72. Male terminalia of Curtonotidae. 67–69. Hypandrium and epandrium (lateral view): 67, *Cyrtona (s.l.) consobrina* (N-T, [South Africa], Wit River Valley, SANC); 68, *Cy. (s.l.) albomacula* (N-T, Kenya, 30 km N Kakamega (forest), TAU); 69, *Parapsinota sublineata* (N-T, DRC: P.N.U., Ganza, RMCA). 70–72: Phallus (right lateral view): 70, *Cy. (s.l.) consobrina* (same), 71, *Cy. (s.l.) albomacula* (same); 72, *Parapsinota sublineata* (same). Scale bars = 0.5 mm.



Figs 2.0: 73–86. Spermathecae of Curtonotidae. **73**, *Axinota fuscipennis* (N-T, Gambia, Abuko, NMWC); **74**, *A. quasimodoi* (PT, Tanzania, nr. Soni, TAU); **75**, *A. ahdabi* (PT, Yemen, Ta'izz, NMWC); **76**, *A. obscuripes*; **77**, *A. sarawakensis*; **78**, *A. hyalipennis*; **79**, *Curtonotum* (s.s.) *taeniatum* (N-T, Peru, Madre de Dios, DEBU); **80**, *Tigrisomyia amnoni* (PT, Tanzania, Gologolo Forest, TAU); **81**, *Cyrtona* (s.l.) sp. n. 3 (N-T, South Africa, Benebos Forest, BMSA); **82**, *Cy.* (s.l.) *capensis* (N-T, South Africa, Grahamstown, AMGS); **83**, *Cy.* (s.s.) *pictipennis* (N-T, South Africa, Cathedral Peak, NMSA); **84**, *Cy.* (s.s.) *appendiculata* (N-T, Kenya, Timboroa, TAU); **85**, *Cy.* (s.l.) sp. n. 4 (N-T, Burundi, Parc National de la Kibira, BMSA); **86**, *Cy.* (s.l.) ? *albomacula* (N-T, Kenya, 30 km N Kakamega, TAU). Figs 73–75 after Kirk-Spriggs (2010a: 109, figs 25–27); Figs 76–78 after Delfinado (1969: 219, figs 19, 18, 21, respectively). Scale bars: 73–74 = 0.3 mm; 79–86 = 50 μ m; 76–78 not to scale.



Figs 2.0: 87–99. Female postabdomen of Curtonotidae. 87, *Axinota dissimilis* (N-T, Bhutan, Gaylegphu, NMWC), ventral; 88, Same, lateral; 89, *Tigrisomyia ammoni* (PT, [Malawi], Zomba, NMSA), ventral; 90, *Cyrtona* (s.s.) *appendiculata* (N-T, Malawi, North Nyika National Park, TAU), ventral; 91, Same, lateral; 92, *Cy.* (s.l.) sp. n. 3 (N-T, South Africa, below Sleepkloof hut, BMSA), ventral; 93, Same, lateral; 94, *Cy.* (s.l.) sp. n. 4 (N-T, Burundi, Parc National de la Kibira, BMSA), ventral; 95, Same, lateral; 96, *Cy.* (s.l.) *capensis* (N-T, South Africa, Grahamstown, AMGS), ventral; 97, Same, lateral; 98, *Cyrtona* (s.l.) sp. (oviparous) (N-T, Kenya, 30 km N Kakamega forest, TAU), whole abdomen, ventral, setation omitted on segments 1–5; 99, Same, lateral. Scale bars = 87–97, 99: 0.5 mm; 98: 1 mm.

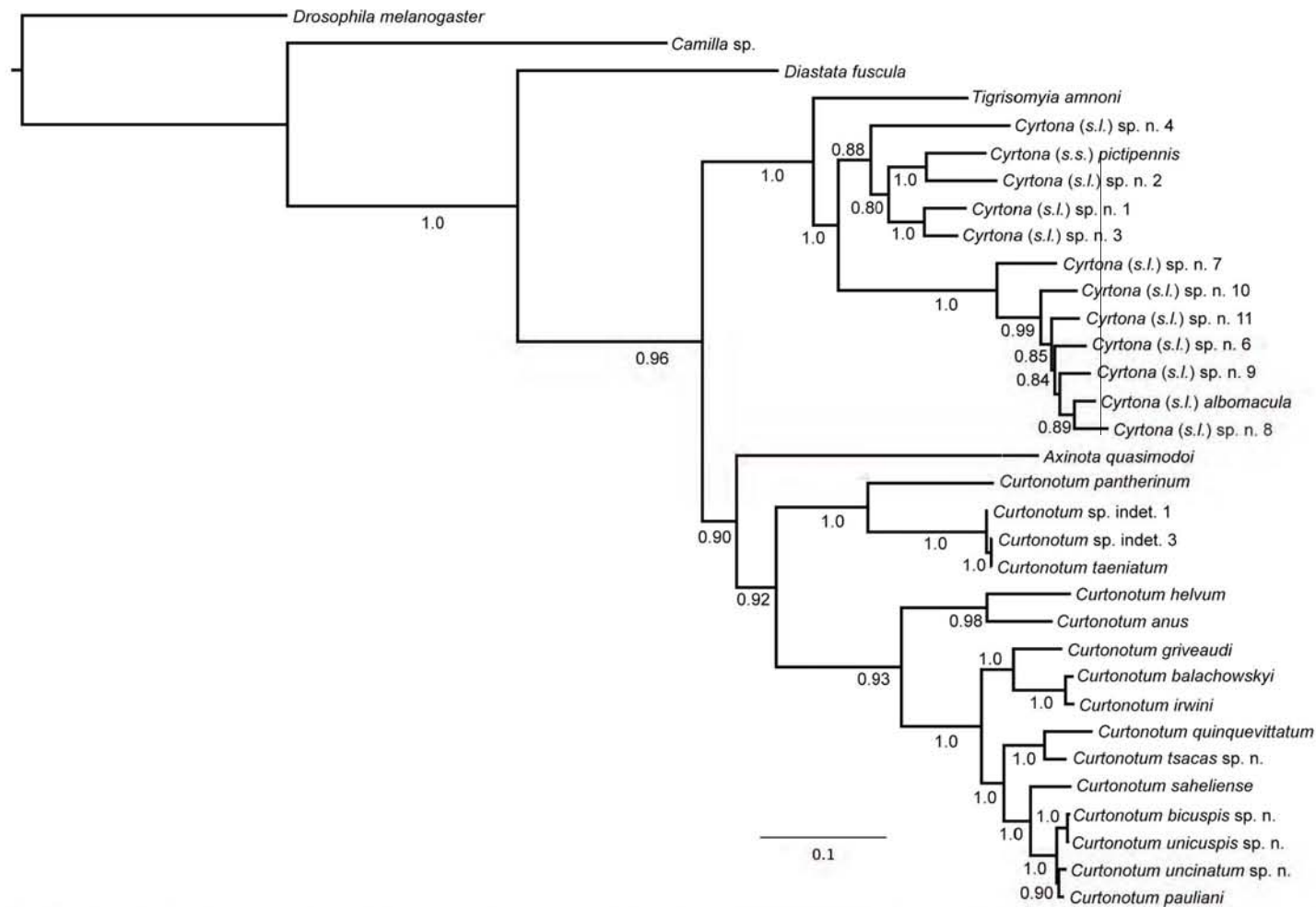


Fig. 2.0: 100. Bayesian likelihood topology based on concatenated molecular data from all gene regions (all sites included). Values below each branch are Bayesian posterior probabilities. Details of the Bayesian search are in the Phylogenetic Analysis section of Materials and methods.

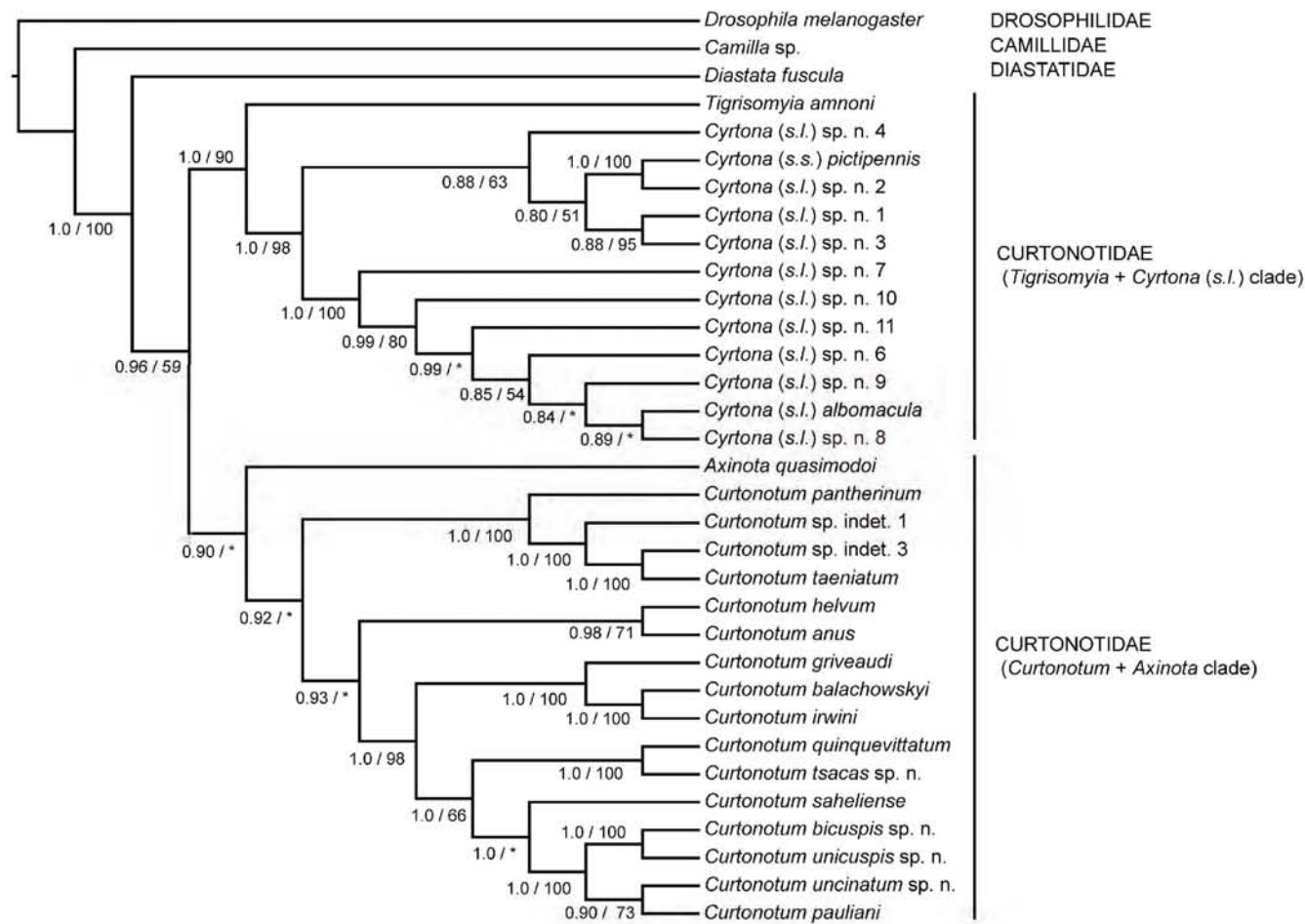


Fig. 2.0: 101. Bayesian likelihood topology for concatenated molecular dataset, all nucleotide positions included. Numbers on each branch are Bayesian posterior probabilities / maximum likelihood bootstrap values from 500 bootstrap replicate analyses calculated in Garli 3.2. Asterisks indicate bootstrap values < 50.

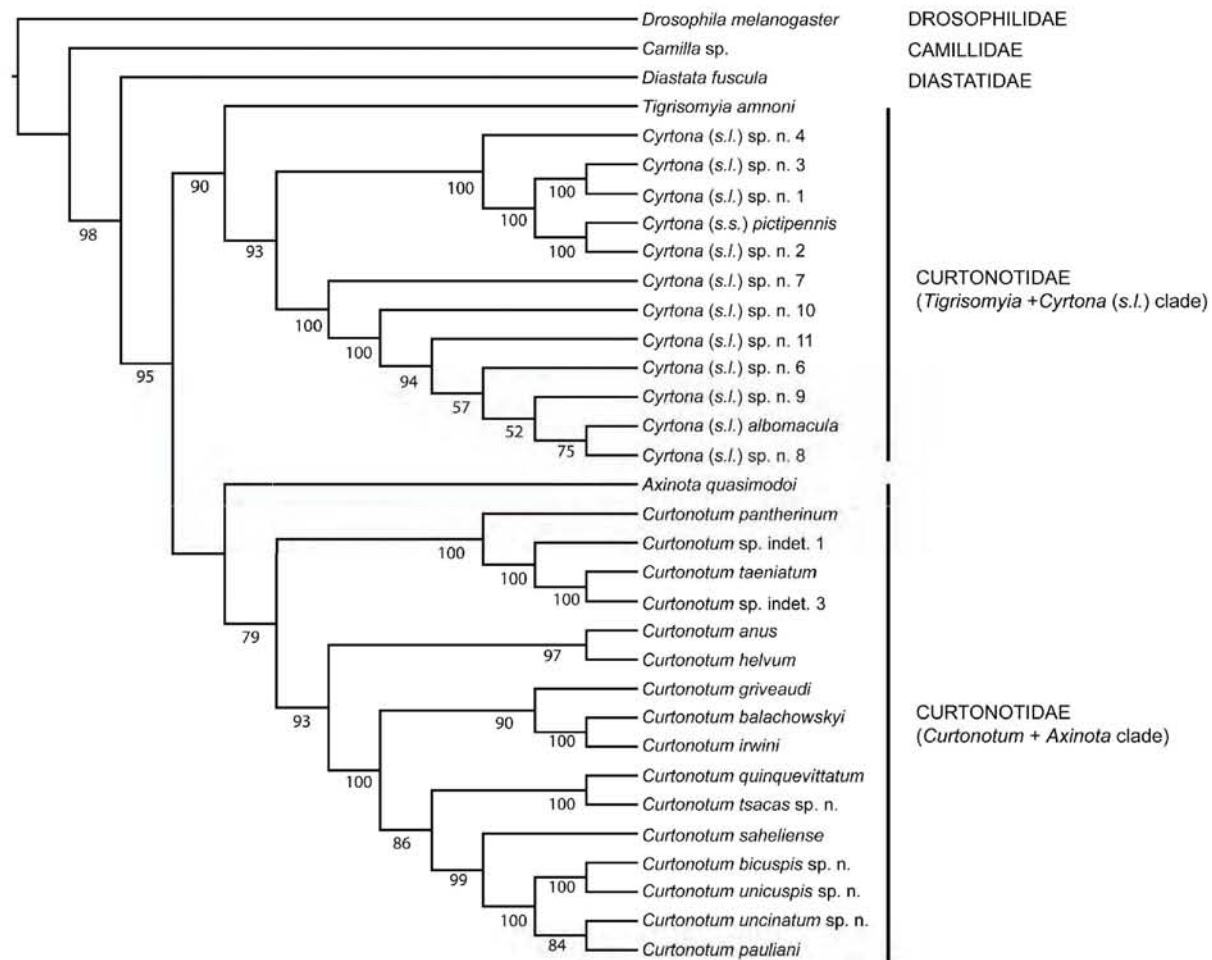


Fig. 2.0: 102. Single most parsimonious tree for the concatenated molecular dataset all nucleotide positions included, Heuristic search, TBR, addseq reps = 20; Numbers on the nodes are 500 parsimony bootstrap replicates calculated in PAUP*4b10.

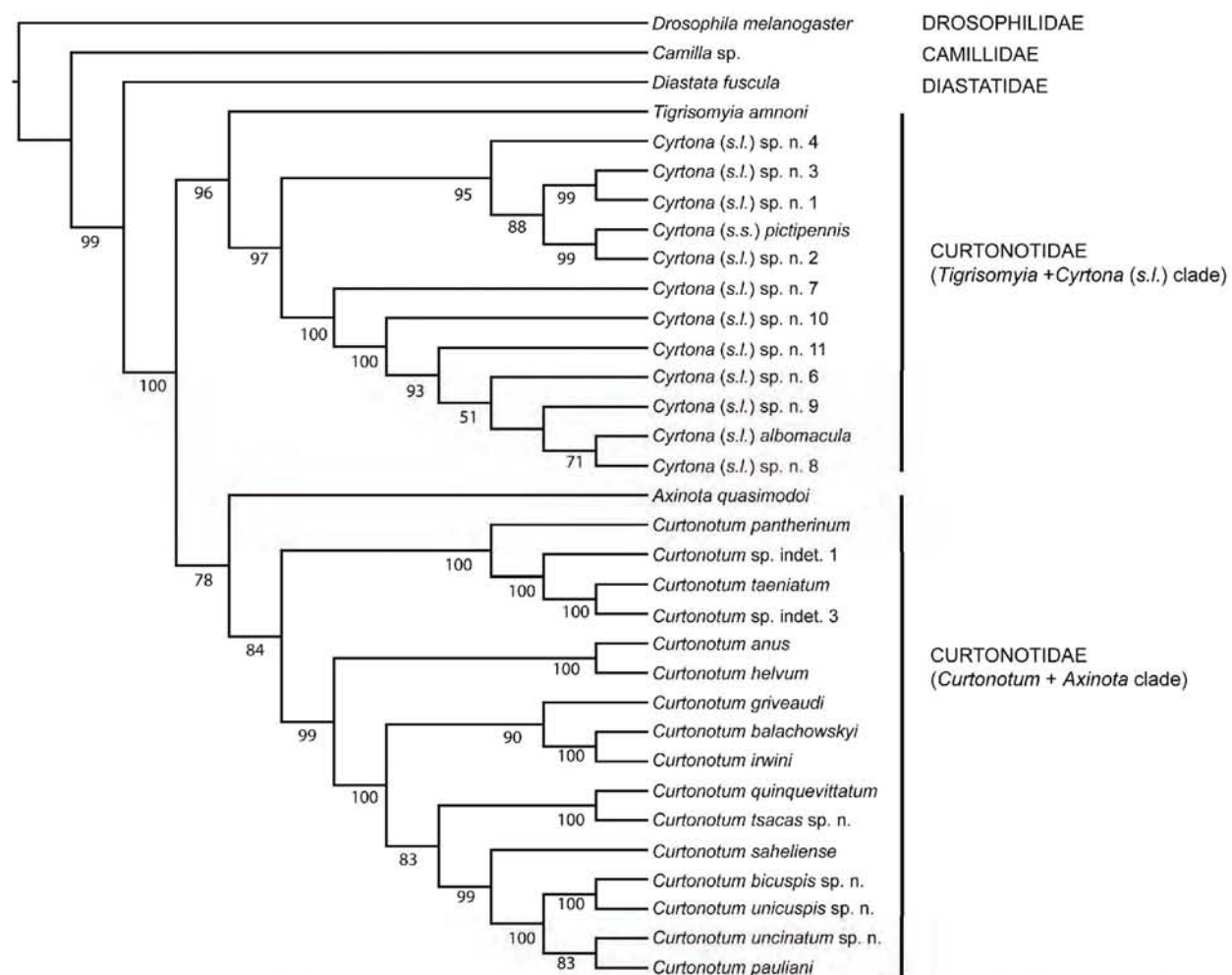


Fig. 2.0: 103. Single most parsimonious tree for the concatenated morphological and molecular datasets, Heuristic search, TBR, addseq reps = 20; Numbers on the nodes are 500 parsimony bootstrap replicates calculated in PAUP*4b10.

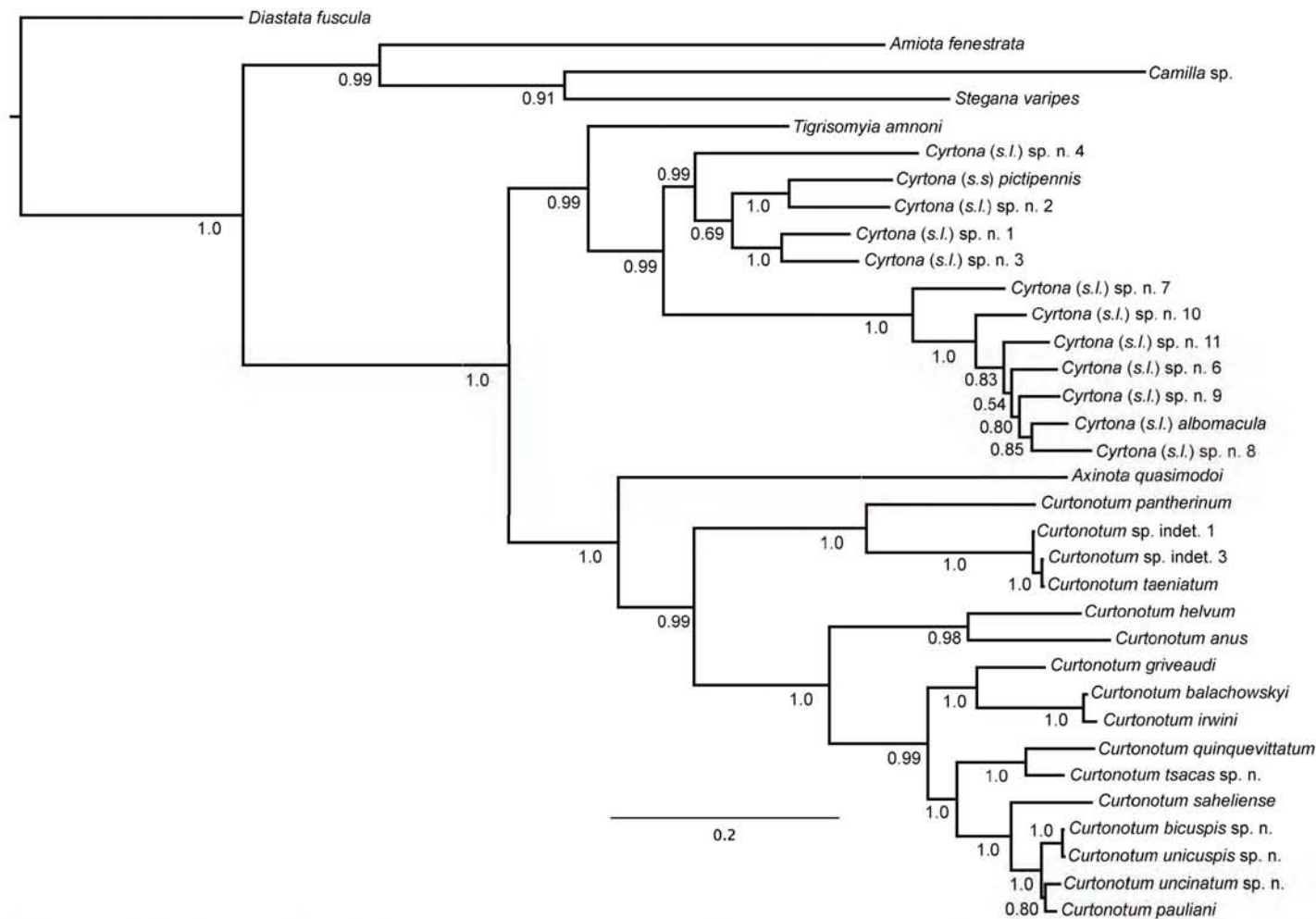


Fig. 2.0: 104. Bayesian likelihood topology, based on concatenated molecular and morphological datasets calculated in MrBayes 2.0. Details of the Bayesian search are in the Phylogenetic Analysis section of Materials and Methods.

2.0: Appendix I. Specimens examined for comparative purposes and for the preparation of figures. Type label data are quoted exactly as they appear. A division slash (/) denotes the commencement of a new line, two division slashes (//) data on a further label. Significant supplementary or qualifying information is presented in square brackets when considered necessary. Information on label colour, *etc.*, is only provided for type material. All labels are printed on white card, unless otherwise stated.

Out-group exemplars:

Diastata montana Cogan, 1975 (Diastatidae)

1♂, [Democratic Republic of Congo]: Congo belge, Kivu, Rutshuru, 1250 m, 4.vii.1935, G.F. de Witte: 1686; 1♂, Congo belge, Kivu, Sake (Lac Kivu), 1460 m, 19–22.ii.1934, G.F. de Witte: 253; 1♂, Congo belge, P.N.U., r. Kilamatambo (affl. Lusinga), 17.vii.1934, G.F. de Witte: 222–230; 1♀, Congo belge, P.N.A., Tshamugussa (Bweza), 2250 m, (Bambous), 10.viii.1934, G.F. de Witte: 526 (all RMCA).

Drosophila melanogaster Meigen, 1830 (Drosophilidae)

1♂, [South Africa]: Pretoria, 11.ii.[19]13, H.K. Munro, 6397, NMSA-DIP 21324; 1♀, same except: 6396, NMSA-DIP 21312; 1♂, [Zimbabwe]: Rhodes-Inyanga National Park, S. Rhodesia, 13.i.1955, B.R.S., P.G., *Drosophila melanogaster* Mg., L. Tsacas dét. 1980, NMSA-DIP 21322; 1♀, [South Africa]: Pretoria, 10.iii.[19]11, D. ampeloph. ♀ det. Dr. O. Duda, NMSA-DIP 21320 (all NMSA).

Camilla manningi Barraclough, 1993 (Camillidae)

Paratype ♂, “SOUTH AFRICA:Cape Prov / Klipkoppie 6.ix.1992 / 31°21’S:19°08’E 790m / Niewoudville Wild Flower / Reserve J. Manning [printed white card] // PARATYPE ♂ / *Camilla manningi* / BARRACLOUGH [printed & handwritten, yellow border] // NMSA-DIP / 18499 [printed, white card]” (NMSA); 1♀, South Africa: Western Cape, #104, 5 km W of Clanwilliam, 32°12’S:18°52’E, 270 m, 30.viii.1995, J. & A. Londt, rocky area flowers, NMSA-DIP, 18501 (NMSA).

Stegana (Steganina) varipes Tsacas, 1990 (Drosophilidae)

Paratype ♂, [ZAMBIA] “Vumba Mount / near Umtali / S. Rhodesia / 18 Jan. 1955 / B.R.S. P.G. // PARATYPE [red card] // *Stegana* / (*Steganina*) / *varipes* n.sp. / L. Tsacas det. 1986 [printed and handwritten] / NMSA-DIP / 66396”. Paratype ♀, same labels, except “NMSA-DIP / 66395” (both NMSA).

Amiota (Phortica) fenestrata (Duda, 1939) (Drosophilidae)

1♂, 1♀, Malawi, Ntchisi forest reserve, SE1334Ac, 1500 m, 3–4.xii.1980, Londt & Stuckenberg, montane forest and woodland, *Amiota (Phortica) fenestrata* (Duda) L. Tsacas det. 1997, NMSA-DIP 66397/98 (both NMSA)

Curtonotidae exemplars:

Tigrisomyia amnoni Kirk-Spriggs, 2010b

Holotype ♂, “TANZANIA: / Usambara Mts. / Gologolo Forest / 1900m / 23.viii.1996 / A. FREIDBERG // HOLOTYPE ♂ / *Tigrisomyia / amnoni* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (TAU). Paratypes (all labelled: “PARATYPE [♂, or ♀] / *Tigrisomyia / amnoni* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]”): 1♂, 1♀, same data as holotype; 1♂, “TANZANIA: / Ngozi Crater / nrRt.A345 2000- / 2200m, 1.ix.1996 / A. FREIDBERG” (both TAU); 1♀, “[Malawi]: Zomba / Nyasaland / IV.1958 [handwritten] // COLL / B & P STUCKENBERG” (NMSA).

Cyrtona (s.s.) appendiculata Séguy, 1938.

Lectotype (here designated) ♀, “Kenya / Timboroa / MAU ESCARPMENT / 3.000 m // MUSÉUM DE PARIS / Mission de l’Omo / C. ARAMBOURG / P.A. CHAPPUIS & R. JEANNEL / 1832-33 [printed; pale blue card] // Type [printed; red ink] // HOLOTYPE [printed; black ink, red card] // *Cyrtonotum / appendiculatum* / TYPE / E. SEGUY det. 1934 [handwritten & printed] // *Cyrtona / pictipennis* / Thomson / L. Tsacas det. 1976 [handwritten & printed] // LECTOTYPE / *Cyrtona* ♀ / *appendiculata* Séguy, 1938 / designated by / A.H. Kirk-Spriggs 2007 [printed; blue card]” (MNHN); 1♀, Kenya (West), Timboroa, 26.xi.1989, A. Friedberg & Fini Kaplan; 1♂, Malawi, North Nyika National Park, 2500 m, Kasaramba, 27.ix.1988, F. Kaplan & A. Friedberg (both TAU).

Cyrtona (s.s.) pictipennis (Thomson, 1869)

Lectotype ♀ (here designated), “*Cap. / B. Sp* [printed; white paper] // *Kinb.* [printed; white paper] // *Typus* [printed; white paper] // 106 / 76 [or 16] [printed & handwritten; pale red paper] // Riksmuseum / Stockholm [printed; discoloured paper] // LECTOTYPE / *Geomyza / pictipennis* Thomson, 1869 / designated by / A.H. Kirk-Spriggs 2006 [printed; blue card]” (NHRS); 1♀, South Africa: KZN, Highmoor Forestry Station #3, Central Drakensberg, 29°19’13”S 29°37’4”E, 2200 m, 19.iv.2002, M. Stiller & E. Breytenbach, DVac *Merxmüllera* sp. Poaceae outside gate entrance to office area (PPRI); 1♀, South Africa, KwaZulu Natal, Cathedral Peak, Drakensberg, 13.iv.1986, R.M. Miller; 1♂, 1♀, South Africa: KZ-Natal, Giant’s Castle Game Reserve, Bannerman’s Hut area, 2300 m a.s.l., 29°15’S, 29°25’E, 9.v.1981, R. Miller (all NMSA).

Cyrtona (s.l.) capensis Hackman, 1960

1♂, 1♀, South Africa: Eastern Cape Province, Grahamstown botanical gardens, 33°19.007’S, 26°31.377’E, 12.x.2006, A.H. Kirk-Spriggs, sweeping (AMGS).

Cyrtona (s.l.) consobrina Hackman, 1960

1♂, [South Africa]: Clanwilliam road, north of Gydo Pass, Ceres Dist., W. Cape, 1.x.1959, B. & P. Stuckenberg; 1♂, Du Toits Kloof, Paarl Dist., W, Cape, 2003–2500 ft., 27–28.ix.1959, B. & P. Stuckenberg (both NMSA); 1♂, RSA: Cape Prov., Plattenbergbaai [sic! = Plettenberg Bay], 34°03'S 23°22'E, 17.x.1994, loc. 24, leg. R. Danielsson (MZLU); 1♂, Wit River Valley, Bains Kloof, C.P., Mus. Exp. Dec. 1949 (SANC).

Parapsinota brevicornis Duda, 1939: 12

Holotype ♀, “Oudebosch / Caledon Div. / [on reverse] K. H. Barnard / Dec. 1920 // Type [printed; red card] // *Parapsinota / brevicornis* n. sp. ? / DET. DR. O. DUDA / type, ♀ [printed & handwritten] // SAM-DIP- / A0/0507 [printed & handwritten] // *Parapsinota* ♀ / *brevicornis* Duda, 1939 / *vidit*. A.H. Kirk-Spriggs 2008” (SAMC).

Cyrtona (s.l.) sp. n. 3

1♂, 1♀, South Africa: Eastern Cape, Benebos forest, 800 m, 33°54.426'S, 23°42.439'E / 29–30.iii.2009, A.H. Kirk-Spriggs, Sweeping indigenous montane forest; 1♂, RSA: Eastern Cape, below Sleepkloof hut, 33°56.974'S, 23°54.926'E, 31.iii–1.iv.2009, 300 m, A.H. Kirk-Spriggs, Malaise traps (2), Indigenous forest (stream), BMSA(D) 05409; 1♂, S. Africa, French Hoek, 40 mls. from Cape Town, xi–xii.1930, H.W. Simmonds, Pres. by Imp. Inst. Ent. Brit. Mus. 1931—83 (all BMNH).

Cyrtona (s.l.) sp. n. 4

1♂, 1♀, Burundi: Kayanza Province, Parc National de la Kibira, Rwegura Sector, 02°55.320'S, 29°30.067'E, 21–26.xi.2010, 2237 m, A.H. Kirk-Spriggs, Malaise traps, indigenous Afromontane forest (BMSA).

Curtonotum angustipennis (de Meijere, 1911)

1♂, Thailand, Chiangmai Prov., Doi Suthep, 14.xi.1957, J.L. Gressitt Collector, see slide # 13 ♂; 1♀, Thailand (NW), Doi Suthep, 1278 m, 29.iii–4.v.1958, water margin, T.C. Maa collector No. 291; 1♂, Thailand, Chiangmai Prov., Doi Suthep (water margin), 4.iv.1958, T.C. Maa Collection BISHOP (all BPBM).

Cyrtona (s.l.) albomacula (Curran, 1933)

1♂, 1♀, Kenya: 30 Km N Kakamega (Forest), 23.xi.1986, A. Freidberg (TAU); 1♂, South Africa KZ-Natal, Vernon Crookes Nature Res., near Umzinto, 30°17'S, 30°38'E, thick grass at forest edge, Hlatikulu West Valley, 01.vii.2007, G.P.D. Davies; 1♂, South Africa, KZ-Natal, Cumberland Nature Reserve Near Pietermaritzburg, 29°30'47.6"S: 30°30'47.1"E, ca. 830 m a.s.l., 22.xii.2007, G.B.P. Davies (both NMSA); 1♂, S. Africa, Durban, Natal, vii.1948, J.C. Faure, ARI. Pretoria (BMNH).

Parapsinota sublineata Duda, 1939

Lectotype ♂ (here designated), “Natal / New Hannover // *Parapsinota / sublineata* / DET. O. DUDA [printed & handwritten] // Zool, Mus. / Berlin // LECTOTYPE / *Parapsinota* ♂ / *angustipennis* de Meijere, / var. *sublineata* n. var. Duda, 1939 / designated by / A.H. Kirk-Spriggs 2008 [printed; blue card]” (ZMHB). Paralectotype ♀ (here designated): “Uganda / Katona // Mujenje / 1913.IX // ? *sublineata* / ♂ / DET. DR O. DUDA [printed & handwritten] // Zool, Mus. / Berlin // PARALECTOTYPE / *Parapsinota* ♀ / *angustipennis* de Meijere, / var. *sublineata* n. var. Duda, 1939 / designated by / A.H. Kirk-Spriggs 2008 [printed; blue card]” (ZMHB). 1♂, South Africa, Natal, Pietermaritzburg, SE2930Cb, 12.x.1971, M.E. Irwin (NMSA); 1♂, Natal, Weenen, xii.1923–1.1924, H.P. Thomasset, Pres. by Imp. Inst. Ent. Brit. Mus. 1932–338, *Curtonotum albomaculatum* Curt. (? should be transferred to *Cyrtona* Seguy, *Cyrtona* sp. L. Tsacas det. 1973 (BMNH); 1♂, Congo belge: P.N.U., Ganza (860 m.), 27-VI-2-VII-1949, Mis. G.F. de Witte. 2738a (RMCA); 1♂, RSA: KwaZulu Natal, S. Drakensberg, over along iMpofane River, Jan 29, 2007, No. 42, GPS32, S29°03'12.7" E29°23'06.2", 1531 m, L. Papp & M. Földvári (HNHM)

Curtonotum (s.s.) *taeniatum* Hendel, 1913

Lectotype ♂ “Peru-Urubamafl. [Urubamba River] / 19.ix.[19]03 / Umahuankilia, [pale green card] // Typus / *Curtonotum / taeniatum* / Hendel [printed & handwritten, red card] // *Curtonotum / taeniatum* H. / det. Hendel [printed & handwritten] // 179 [handwritten] // Dresden [handwritten] // LECTOTYPE / *Curtonotum / taeniatum* Hendel, 1913 / designated Klymko & Marshall / 2011” (SMTD). Paralectotype ♀, same data as lectotype, except: “19.9.[19]03” // “PARALECTOTYPE / *Curtonotum / taeniatum* Hendel, 1913 / designated Klymko & Marshall / 2011” (SMTD). 1♀, Peru: Madre de Dios, Los Amigos Biological Station, 2-14.vi.2006, Paiero & Klymko, debu00281347 (DEBU).

Curtonotum (s.s.) *flavisetum* Klymko & Marshall, 2011

Paratypes 3♂, “BOLIVIA / Beni-Gebiet / Guayaramerin 150 m / 17.v.1954 / leg. W. Forster / Staatssamml. / München // PARATYPE / *Curtonotum / flavisetum* / Klymko & Marshall”; 1♂, 1♀, same, except: “15.v.1954”; 1♀, same, except: “10.v.1954” (all ZSM).

Curtonotum (s.s.) *pantherinum* Walker, 1849

2♂, Bolivia: Beni-Gebiet, Guayaramerin, 150 m, 12.v.1954, leg. W. Forster, Staatssamml. München, *Curtonotum pantherinum* (Walker), Det. J. Klymko 2009; 1♂, same, except: 10.v.1954 (all ZSM).

Axinota pictiventris van der Wulp, 1886

Holotype ♀, [Indonesia]: “Java / Batavia [handwritten; label discoloured, “Batavia” virtually illegible due to fading] // *Axinota / pictiventris* ns. [handwritten] // Holotype ♀ [printed & handwritten; dark red card] // *Apsinota / pictiventris* / van der Wulp, 1886 / ZMAN type DIPT.1958.1 [pale red card]

// *Axinota* ♀ / *pictiventris* van der Wulp, 1886 / det. A.H. Kirk-Spriggs 2009” (ZMAN). 1♂, Java, Pekalongan, F. Muir, ♂ slide # 4; 1♀, Phillipines, Palawan, Mantalingajan, Pinigisan, 600 m, 23.ix.1961, Noona Dan, xp. 61–62; 1♂, 1♀, Borneo, Sarawak, Kapit District, Merirai Valley, 28–31.vii.1958, T.C. Maa Collection BISHOP; 1♀, Borneo, Sarawak, Gunong Matang, 120 m, 14.ix.1958, J.L. Gressitt Collector, T.C. Maa Collector BISHOP (all BPBM).

Axinota sp. n. nr. “*Apsinota* sp. A” *sensu* Delfinado (1969)

1♂, [Malaysia]: Borneo: Sabah, Danum Valley, 5°01'N 117°47'E, 8.ix.1987, 100 m, A.H. Kirk-Spriggs, roadside, secondary forest, *Axinota* sp. n. nr. *Apsinota* sp. A. of Delfinado (1969) ♂ det. A.H. Kirk-Spriggs 2009 (NMWC).

Axinota fuscipennis (Macquart, 1844)

1♀, Gambia: W. Div., Abuko, on mature rice, 27.xi.1993, J.C. Deeming & K.E. Shaw, NMW.Z.1993–093 (NMWC).

Axinota quasimodoi Kirk-Spriggs, 2010a

Holotype ♂, “TANZANIA: / Usambara Mts. / near Soni, 800m / river, 8.ix.1996 / A. FREIDBERG // HOLOTYPE ♂ / *Axinota* / *quasimodoi* sp. n. / A.H. Kirk-Spriggs 2010 [red card] (TAU); Paratype ♀, same data as holotype (TAU); Paratype ♂, “Cameroun: Sector E: / Province Sud-Ouest, Dépt. / Fako: Liongo (Community of Muea) NE of / Buéa 04°11'35"N 09°19'27"E / 14.v.2006, 470 m / F. Menzel, Cam23 // River bank along a banana / plantation, wet ruderal / vegetation on lava, swept” (DEI); 1♂, D.R. Congo, Oriental Prov., Lieki village area at: 00°41.117'N, 24°14.362'E, 25.v–4.vi.2010, sweeping bush paths & village environs; 1♂, 1♀, D.R. Congo, Oriental Prov., Bomane village area at: 01°16.283'N, 23°43.994'E, 20–24.v.2010, sweeping bush paths & village environs (all BMSA);

Axinota ahdabi Kirk-Spriggs, 2010a

Paratype: ♀, “YEMEN: / Ta'izz / 5.i–2.ii.1998 / light trap / A. van Harten / & M. Mahyoub // PARATYPE ♀ / *Axinota* / *ahdabi* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]” (NMWC).

Axinota kyphosis Kirk-Spriggs, 2010a

Holotype ♂, “Madagascar, Flußbett / 10 km W von Sakaraha / 22°53'57"S 44°28'12"E, 395 m / Leg. M.Kourba 8.xi.2003 // HOLOTYPE ♂ / *Axinota* / *kyphosis* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (ZSM). Paratype ♀, same data as holotype (ZSM).

Axinota dissimilis (Malloch, 1930)

1♀, Bhutan: Gaylegphu, rice field, 26.x–5.xii.1988, C. Dorji, NMW.Z.1989-071 (NMWC).

2.0: Appendix II. Morphological matrix of 62 characters for 70 Curtonotidae, plus 5 out-group exemplars. Names in bold represent type species of genera. ? = missing data.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
<i>Diastata montana</i> Cogan	0	0	1	0	0	0	0	0	0	0	1	0	0	2	1	1	0	0	0	1	0	0	0	0	0
<i>Drosophila melanogaster</i> Meigen	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Camilla manningi</i> Barraclough	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0
<i>Stegana varipes</i> Tsacas	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Amiota fenestrata</i> (Duda)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Tigrisomyia amnoni</i> Kirk-Spriggs	0	0	0	0	0	1	1	0	1	2	4	0	0	0	1	0	0	1	1	1	0	1	0	0	1
<i>Tigrisomyia kinskii</i> Kirk-Spriggs	0	0	0	0	0	1	1	0	1	2	4	0	0	0	1	0	0	1	1	1	0	1	0	0	1
<i>Tigrisomyia rhayaderi</i> Kirk-Spriggs	0	0	0	0	0	1	1	0	1	2	4	0	0	0	1	0	0	1	1	1	?	?	?	?	?
<i>Tigrisomyia scoliosis</i> Kirk-Spriggs	0	0	0	0	0	1	1	0	1	2	4	0	0	0	1	0	0	1	1	1	0	1	0	0	1
<i>Curtonotum angustipennis</i> (de Meijere)	0	0	0	0	0	1	1	0	0	2	6	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) <i>albomacula</i> (Curran)	0	0	0	0	0	1	1	0	0	2	6	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Parapsinota sublineata</i> Duda	0	0	0	0	0	1	1	0	0	2	6	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 6	0	0	0	0	0	1	1	0	0	2	6	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 7	0	0	0	0	0	1	1	0	0	2	6	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 8	0	0	0	0	0	1	1	0	0	2	6	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 9	0	0	0	0	0	1	1	0	0	2	6	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 10	0	0	0	0	0	1	1	0	0	2	6	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 11	0	0	0	0	0	1	1	0	0	2	6	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 12	0	0	0	0	0	1	1	0	0	2	6	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.s.) <i>appendiculata</i> Ségué	0	0	0	0	0	0	1	0	0	2	5	0	0	4	1	0	1	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.s.) <i>pictipennis</i> (Thomson)	0	0	0	0	0	0	1	0	0	2	5	0	0	4	1	0	1	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) <i>capensis</i> Hackman	0	0	0	0	0	0	1	0	0	2	5	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) <i>consobrina</i> Hackman	0	0	0	0	0	0	1	0	0	2	5	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 1	0	0	0	0	0	0	1	0	0	2	5	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 2	0	0	0	0	0	0	1	0	0	2	5	0	0	1	1	0	0	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 3	0	0	0	0	0	0	1	0	0	2	5	0	0	4	1	0	2	1	1	1	0	1	0	0	1
<i>Cyrtona</i> (s.l.) sp. n. 4	0	0	0	0	0	1	1	1	0	2	6	0	0	5	1	0	0	1	1	1	0	1	0	0	1

2.0: Appendix II (Extended)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
<i>Cyrtona (s.l.)</i> sp. n. 5	0	0	0	0	0	1	1	1	0	2	6	0	0	5	1	0	0	1	1	1	0	1	0	0	1
<i>Axinota pictiventris</i> van der Wulp	0	2	0	1	1	1	2	0	0	1	3	1	1	0	1	0	0	1	1	1	1	0	0	0	1
<i>Axinota fuscipennis</i> (Macquart)	0	1	0	1	1	1	2	0	0	1	3	1	0	0	1	2	0	1	1	1	1	0	0	0	1
<i>Axinota quasimodoi</i> Kirk-Spriggs	0	1	0	1	1	1	2	0	0	1	3	1	0	0	1	2	0	1	1	1	1	0	0	0	1
<i>Axinota ahdabi</i> Kirk-Spriggs	0	2	0	1	1	1	2	0	0	1	3	1	1	0	1	0	0	1	1	1	1	0	0	0	1
<i>Axinota kyphosis</i> Kirk-Spriggs	0	2	0	1	1	1	2	0	0	1	3	1	1	0	1	0	0	1	1	1	1	0	0	0	1
<i>Curtonotum taeniatum</i> Hendel	1	0	0	1	0	1	1	0	0	2	8	1	0	3	1	2	0	1	1	1	0	0	0	0	1
<i>Curtonotum flavisetum</i> Klymko & Marshall	1	0	0	1	0	1	1	0	0	2	8	1	0	3	1	2	0	1	1	1	0	0	0	0	1
<i>Curtonotum pantherinum</i> (Walker)	1	0	0	1	0	1	1	0	0	2	8	1	0	3	1	2	0	1	1	1	0	0	0	0	1
<i>Curtonotum helvum</i> (Loew)	1	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum anus</i> (Meigen)	1	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum herrero</i> Tsacas	1	0	0	1	0	1	1	0	0	2	7	1	0	1	1	2	0	1	1	1	0	0	0	1	1
<i>Curtonotum maculiventris</i> (Enderlein)	1	0	0	1	0	1	1	0	0	2	7	1	0	1	1	2	0	1	1	1	0	0	0	1	1
<i>Curtonotum striatifrons</i> Malloch	1	0	0	1	0	1	1	0	0	2	7	1	0	1	1	2	0	1	1	1	0	0	0	1	1
<i>Curtonotum marriott</i> sp. n.	1	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum moffatt</i> sp. n.	1	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum platyphallum</i> Tsacas	1	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum sternithrix</i> Tsacas	1	0	0	1	0	1	1	0	0	2	7	1	0	1	1	2	0	1	1	1	1	0	1	0	1
<i>Curtonotum angolense</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum campsiphallum</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum freidberg</i> sp. n.	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum hay</i> sp. n.	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum quinquevittatum</i> Curran	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum sao</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum tsacas</i> sp. n.	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum gonzo</i> sp. n.	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	1	0	1

2.0: Appendix II (Extended)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
<i>Curtonotum saheliense</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum simile</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum bicuspis</i> sp. n.	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum cimbebas</i> sp. n.	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum constance</i> sp. n.	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum cuthbertsoni</i> Duda	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum litoralis</i> sp. n.	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum mcgregor</i> sp. n.	?	?	?	?	?	?	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum pauliani</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum uncinatum</i> sp. n.	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum unicuspis</i> sp. n.	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum coroneaeformis</i> Kirk-Spriggs	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum gladiiformis</i> Kirk-Spriggs	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum irwini</i> Kirk-Spriggs	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum parkeri</i> Kirk-Spriggs	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum balachowskyi</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum keiseri</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum stuckenbergi</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum boeny</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum griveaudi</i> Kirk-Spriggs	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum sakalava</i> Tsacas	0	0	0	0	0	1	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1
<i>Curtonotum rinhatinana</i> Kirk-Spriggs	0	0	0	0	0	?	1	0	0	1	7	1	0	1	1	2	0	1	1	1	1	0	0	0	1

2.0: Appendix II (Extended)

[illegible]

2.0: Appendix II (Extended)

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
<i>Cyrtona (s.l.)</i> sp. n. 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
<i>Axinota pictiventris</i> van der Wulp	1	1	?	0	0	2	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
<i>Axinota fuscipennis</i> (Macquart)	1	1	?	0	0	2	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
<i>Axinota quasimodoi</i> Kirk-Spriggs	1	1	?	0	0	2	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
<i>Axinota ahdabi</i> Kirk-Spriggs	1	1	?	0	0	2	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
<i>Axinota kyphosis</i> Kirk-Spriggs	1	1	?	0	0	2	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
<i>Curtonotum taeniatum</i> Hendel	1	1	?	0	0	2	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Curtonotum flavisetum</i> Klymko & Marshall	1	1	?	0	0	2	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Curtonotum pantherinum</i> (Walker)	1	1	?	0	0	2	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>Curtonotum helvum</i> (Loew)	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
<i>Curtonotum anus</i> (Meigen)	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
<i>Curtonotum herrero</i> Tsacas	1	1	?	0	0	1	1	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0
<i>Curtonotum maculiventris</i> (Enderlein)	1	1	?	0	0	1	1	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0
<i>Curtonotum striatifrons</i> Malloch	1	1	?	0	0	1	1	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0
<i>Curtonotum marriott</i> sp. n.	1	1	?	0	1	2	1	0	1	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	1
<i>Curtonotum moffatt</i> sp. n.	1	1	?	0	1	2	1	0	1	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	1
<i>Curtonotum platyphallum</i> Tsacas	1	1	?	0	1	2	1	0	1	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	1
<i>Curtonotum sternithrix</i> Tsacas	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
<i>Curtonotum angolense</i> Tsacas	1	1	?	0	1	2	1	0	1	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1
<i>Curtonotum campsiphallum</i> Tsacas	1	1	?	0	1	2	1	0	1	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1
<i>Curtonotum freidberg</i> sp. n.	1	1	?	0	1	2	1	0	1	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1
<i>Curtonotum hay</i> sp. n.	1	1	?	0	1	2	1	0	1	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1
<i>Curtonotum quinquevittatum</i> Curran	1	1	?	0	1	2	1	0	1	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1
<i>Curtonotum sao</i> Tsacas	1	1	?	0	1	2	1	0	1	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1
<i>Curtonotum tsacas</i> sp. n.	1	1	?	0	1	2	1	0	1	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1
<i>Curtonotum gonzo</i> sp. n.	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1

2.0: Appendix II (Extended)

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
<i>Curtonotum saheliense</i> Tsacas	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
<i>Curtonotum simile</i> Tsacas	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
<i>Curtonotum bicuspis</i> sp. n.	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Curtonotum cimbebas</i> sp. n.	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Curtonotum constance</i> sp. n.	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Curtonotum cuthbertsoni</i> Duda	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Curtonotum litoralis</i> sp. n.	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Curtonotum mcgregor</i> sp. n.	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Curtonotum pauliani</i> Tsacas	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Curtonotum uncinatum</i> sp. n.	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Curtonotum unicuspis</i> sp. n.	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Curtonotum coronaeformis</i> Kirk-Spriggs	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
<i>Curtonotum gladiiformis</i> Kirk-Spriggs	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
<i>Curtonotum irwini</i> Kirk-Spriggs	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
<i>Curtonotum parkeri</i> Kirk-Spriggs	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
<i>Curtonotum balachowskyi</i> Tsacas	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
<i>Curtonotum keiseri</i> Tsacas	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
<i>Curtonotum stuckenbergi</i> Tsacas	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
<i>Curtonotum boeny</i> Tsacas	1	1	?	0	1	2	1	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>Curtonotum griveaudi</i> Kirk-Spriggs	1	1	?	0	1	2	1	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>Curtonotum sakalava</i> Tsacas	1	1	?	0	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Curtonotum rinhatinana</i> Kirk-Spriggs	1	1	?	0	1	2	1	0	1	1	0	1	0	1	0	0	0	2	0	0	0	0	0	0	1

2.0: Appendix II (Extended)

51	52	53	54	55	56	57	58	59	60	61	62
<i>Diastata montana</i> Cogan											
0	0	0	0	0	0	0	0	0	2	0	8
<i>Drosophila melanogaster</i> Meigen											
0	0	0	0	0	0	0	0	0	1	0	0
<i>Camilla manningi</i> Barraclough											
0	0	0	0	0	0	0	0	0	1	0	8
<i>Stegana varipes</i> Tsacas											
0	0	0	0	0	0	0	0	0	1	0	0
<i>Amiota fenestrata</i> (Duda)											
0	0	0	0	0	0	0	0	0	0	0	0
<i>Tigrisomyia amnoni</i> Kirk-Spriggs											
1	0	0	0	1	1	1	0	0	0	0	2
<i>Tigrisomyia kinskii</i> Kirk-Spriggs											
1	0	0	0	1	1	?	?	?	?	?	?
<i>Tigrisomyia rhayaderi</i> Kirk-Spriggs											
?	?	?	?	?	?	1	0	0	0	0	2
<i>Tigrisomyia scoliosis</i> Kirk-Spriggs											
1	0	0	0	1	1	1	0	0	0	0	2
<i>Curtonotum angustipennis</i> (de Meijere)											
1	0	0	0	0	0	0	?	?	?	?	?
<i>Cyrtona</i> (s.l.) <i>albomacula</i> (Curran)											
1	0	0	0	0	0	?	?	?	?	?	?
<i>Parapsinota sublineata</i> Duda											
1	0	0	0	0	0	?	?	?	?	?	?
<i>Cyrtona</i> (s.l.) sp. n. 6											
1	0	0	0	0	0	?	?	?	?	?	?
<i>Cyrtona</i> (s.l.) sp. n. 7											
1	0	0	0	0	0	?	?	?	?	?	?
<i>Cyrtona</i> (s.l.) sp. n. 8											
1	0	0	0	0	0	?	?	?	?	?	?
<i>Cyrtona</i> (s.l.) sp. n. 9											
1	0	0	0	0	0	?	?	?	?	?	?
<i>Cyrtona</i> (s.l.) sp. n. 10											
1	0	0	0	0	0	?	?	?	?	?	?
<i>Cyrtona</i> (s.l.) sp. n. 11											
1	0	0	0	0	0	?	?	?	?	?	?
<i>Cyrtona</i> (s.l.) sp. n. 12											
1	0	0	0	0	0	?	?	?	?	?	?
<i>Cyrtona</i> (s.s.) <i>appendiculata</i> Séguy											
0	0	0	0	0	0	0	0	0	0	0	4
<i>Cyrtona</i> (s.s.) <i>pictipennis</i> (Thomson)											
0	0	0	0	0	0	0	0	0	0	0	4
<i>Cyrtona</i> (s.l.) <i>capensis</i> Hackman											
1	0	0	0	0	0	0	0	0	2	0	0
<i>Cyrtona</i> (s.l.) <i>consobrina</i> Hackman											
1	0	0	0	0	0	?	?	?	?	?	?
<i>Cyrtona</i> (s.l.) sp. n. 1											
0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyrtona</i> (s.l.) sp. n. 2											
0	0	0	0	0	0	0	0	0	0	0	0
<i>Cyrtona</i> (s.l.) sp. n. 3											
0	0	0	0	0	0	0	0	0	2	0	0
<i>Cyrtona</i> (s.l.) sp. n. 4											
1	1	0	0	0	0	0	0	0	0	0	7

2.0: Appendix II (Extended)

51	52	53	54	55	56	57	58	59	60	61	62
<i>Cyrtona (s.l.)</i> sp. n. 5											
1	1	0	0	0	0	?	?	?	?	?	?
<i>Axinota pictiventris</i> van der Wulp											
1	0	0	1	0	0	0	1	0	0	0	3
<i>Axinota fuscipennis</i> (Macquart)											
1	0	0	1	0	0	0	1	0	0	0	1
<i>Axinota quasimodoi</i> Kirk-Spriggs											
1	0	0	1	0	0	0	1	0	0	0	1
<i>Axinota ahdabi</i> Kirk-Spriggs											
1	0	0	1	0	0	0	1	0	0	0	0
<i>Axinota kyphosis</i> Kirk-Spriggs											
1	0	0	1	0	0	0	1	0	0	0	0
<i>Curtonotum taeniatum</i> Hendel											
0	0	1	0	0	0	0	1	0	0	0	5
<i>Curtonotum flavisetum</i> Klymko & Marshall											
0	0	1	0	0	0	0	1	0	0	0	5
<i>Curtonotum pantherinum</i> (Walker)											
0	0	1	0	0	0	0	1	0	0	0	5
<i>Curtonotum helvum</i> (Loew)											
0	0	0	0	0	0	0	1	1	2	1	5
<i>Curtonotum anus</i> (Meigen)											
0	0	0	0	0	0	0	1	1	2	1	5
<i>Curtonotum herrero</i> Tsacas											
0	0	0	0	0	0	0	1	0	1	0	5
<i>Curtonotum maculiventris</i> (Enderlein)											
0	0	0	0	0	0	0	1	0	1	0	5
<i>Curtonotum striatifrons</i> Malloch											
0	0	0	0	0	0	0	1	0	1	0	5
<i>Curtonotum marriott</i> sp. n.											
0	0	0	0	0	0	0	1	1	2	1	9
<i>Curtonotum moffatt</i> sp. n.											
0	0	0	0	0	0	0	1	1	2	1	9
<i>Curtonotum platyphallum</i> Tsacas											
0	0	0	0	0	0	0	1	1	2	1	9
<i>Curtonotum sternithrix</i> Tsacas											
0	0	0	0	0	0	0	?	?	?	?	?
<i>Curtonotum angolense</i> Tsacas											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum campsiphallum</i> Tsacas											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum freidberg</i> sp. n.											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum hay</i> sp. n.											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum quinquevittatum</i> Curran											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum sao</i> Tsacas											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum tsacas</i> sp. n.											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum gonzo</i> sp. n.											
0	0	0	0	0	0	0	1	1	2	0	8

2.0: Appendix II (Extended)

51	52	53	54	55	56	57	58	59	60	61	62
<i>Curtonotum saheliense</i> Tsacas											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum simile</i> Tsacas											
0	0	0	0	0	0	0	1	1	0	0	8
<i>Curtonotum bicuspis</i> sp. n.											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum cimbebas</i> sp. n.											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum constance</i> sp. n.											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum cuthbertsoni</i> Duda											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum litoralis</i> sp. n.											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum mcgregor</i> sp. n.											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum pauliani</i> Tsacas											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum uncinatum</i> sp. n.											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum unicuspis</i> sp. n.											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum coroneiformis</i> Kirk-Spriggs											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum gladiiformis</i> Kirk-Spriggs											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum irwini</i> Kirk-Spriggs											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum parkeri</i> Kirk-Spriggs											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum balachowskyi</i> Tsacas											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum keiseri</i> Tsacas											
0	0	0	0	0	0	?	?	?	?	?	?
<i>Curtonotum stuckenbergi</i> Tsacas											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum boeny</i> Tsacas											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum griveaudi</i> Kirk-Spriggs											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum sakalava</i> Tsacas											
0	0	0	0	0	0	0	1	1	2	0	8
<i>Curtonotum rinhatinana</i> Kirk-Spriggs											
0	0	0	0	0	0	?	?	?	?	?	?

2.0: Appendix III. Annotated checklist and revised classification of the Curtonotidae (Diptera) of the world.

The below checklist is based on the published regional catalogues of Wirth (1965) for the Nearctic Region, Wirth (1975) for the Neotropical Region, Delfinado and Hardy (1977) for the Oriental Region, Wirth and Tsacas (1980) for the Afrotropical Region, Papp (1984) for the Palaearctic Region and Evenhuis (1989) for the Australasian and Oceanian Regions. Additional taxa have been added and taxon names updated, based on subsequently published papers that have appeared in the literature. Referral was made to all original publications listed to clarify the accuracy of published information. Type localities are listed as they appear in the original publications, but modern state names are used in the country distribution lists for each species. A list of institutional codens and abbreviations used in the text is provided on pp. xxvi–xxx of this thesis. Information is also provided on lectotype designations, where known, deposition of primary type specimens and synonymy. Only names that have not been formally published in the scientific literature are listed as “subfam. n.” or “sp. n.” The order of genera in the below checklist reflects phylogenetic relationships as analysed by Klymko and Marshall (2011) and Chapter 2 of this thesis and therefore serves as a re-classification of the world fauna.

Family **CURTONOTIDAE** Enderlein, 1914

CURTONOTINAE: Enderlein, 1914: 326, 327. Type genus: *Curtonotum* Macquart 1844: 350 (193), by original designation.

CYRTONOTINAE Enderlein, 1914. *auctt.* misspelling of Curtonotinae.

Genus **TIGRISOMYIA** Kirk-Spriggs

TIGRISOMYIA Kirk-Spriggs 2010b: 128. Type species: *Tigrisomyia amnoni* Kirk-Spriggs, 2010b, by original designation.

amnoni Kirk-Spriggs, 2010b: 129. Type locality: “Tanzania, Usambara Mts., Gologolo Forest” (HT, TAU). Afrotropical: Malawi, Tanzania and Zambia.

kinskii Kirk-Spriggs, 2010b: 135. Type locality: “Malawi, Centre, Ntchisi Forest” (HT, TAU). Afrotropical: Malawi.

rhayaderi Kirk-Spriggs, 2010b: 137. Type locality: “Kenya: Rt. B8, near Takaungu, 50 km N Mombassa” (HT, TAU). Afrotropical: Kenya and Malawi.

scoliosis Kirk-Spriggs, 2010b: 139. Type locality: “[Tanzania], Mpwapwa” (HT, BMNH). Afrotropical: Tanzania.

Genus **CYRTONA** Séguy *sensu stricto*

CYRTONA Séguy, 1938: 342. Type species *Cyrtona appendiculata* Séguy, 1938, by original designation and monotypy.

- albomacula** Curran, 1933: 3 (*Curtonotum*). Type locality: Zimbabwe “Dande River, S. Rhodesia” (HT, AMNH). Afrotropical: Cameroon, Côte d’Ivoire, Democratic Republic of Congo, Gambia, Guinea, Kenya, Liberia, Nigeria, South Africa, Togo, Uganda and Zimbabwe.
- appendiculata** Séguy, 1938: 342. Type locality: “Kenya: Timboroa, Mau Escarpment, 3.000 m” (MNHN). Afrotropical: Democratic Republic of Congo, Kenya, Malawi and Tanzania.
- capensis** Hackman, 1960: 382. Type locality: “South Africa: Cape Town, Table Mountain” (MZLU). Afrotropical: South Africa.
- consobrina** Hackman, 1960: 385. Type locality: “South Africa: Cape Peninsula, Hout Bay, Skoorsteenkop” (MZLU). Afrotropical: South Africa.
- pictipennis** Thomson, 1869: 598 (*Geomyza*). Type locality: “[South Africa], Caput bonæ spei [= Cape of Good Hope]” (NHRS), Afrotropical: Lesotho, South Africa and Zimbabwe.

Unplaced species and names of *Cyrtona sensu lato*

- angustipennis** de Meijere, 1911: 413 (*Drosophila*). Type locality: “Java: Gunung Ungaran” (ZMAN). Oriental: Indonesia (Java) and Thailand.
- Parapsinota angustipennis* de Meijere, var. *sublineata* (Duda, 1939: 9) *auctt.* misidentification.
- brevicornis** Duda, 1939: 12 (*Parapsinota*). Type locality: “[South Africa], Oudebosch, Caledon Div.” (HT, SAMC). Afrotropical: South Africa.
- neoangustipennis** Dwivedi & Gupta, 1979: 183 (*Curtonotum*). Type locality: “India: West Bengal, Darjeeling District, Ramam” (BHU). Oriental: India.
- sublineata** Duda, 1939: 9 (*Parapsinota angustipennis* de Meijere, var. *sublineata*). Type locality: “[South Africa], Natal: New Hannover” (LT, here designated, ZMHB). Afrotropical: Democratic Republic of Congo and South Africa.

Genus **AXINOTA** van der Wulp

- AXINOTA** van der Wulp, 1886: cviii. Type species: *Axinota pictiventris* van der Wulp, 1886, by original designation and monotypy (“gen. n, sp. n.”).
- APSINOTA* van der Wulp, 1887: 178 [footnote]. Unjustified emendation of *Axinota*.
- THAUMASTOPHILA** Hendel, 1914: 112. Type species: *Thaumastophila hyalipennis* Hendel, 1914: 113, by original designation.
- ANASEIOMYIA** Malloch, 1930: 328. Type species: *Anaseiomyia uniformis* Malloch, 1930: 329, by original designation.

Fuscipennis species-group

- fuscipennis** Macquart, 1844: 417 (260) (*Diastata*). Type locality: “Sénégal” (LT, designated by Kirk-Spriggs 2010a: 105, MNHN) (redescribed: Kirk-Spriggs, 2010a: 103). Afrotropical: Burundi, Cameroon, Democratic Republic of Congo, Gabon, Gambia, Malawi, Namibia, Nigeria, Senegal, South Africa, Tanzania and Togo.

quasimodoi Kirk-Spriggs, 2010a: 108. Type locality: “Tanzania, Usambara Mts., near Soni” (HT, TAU). Afrotropical: Angola, Burundi, Côte d’Ivoire, Cameroon, Democratic Republic of Congo, Ethiopia, Ghana, Liberia, Nigeria, Mozambique, Tanzania, Togo and Uganda.

Pictiventris species-group

ahdabi Kirk-Spriggs, 2010a: 113. Type locality: “Yemen, Ar Rujum” (HT, NMWC). Afrotropical: Yemen.

dissimilis Malloch, 1930: 330 (*Anaseiomyia*). Type locality: “[Malaysia], Selangor, Kuala Lumpur” (HT, BMNH). Oriental: Bhutan, Peninsula Malaysia and Vietnam.

demeijerei Delfinado, 1969: 206 (*Apsinota*). Type locality: “Vietnam, M’Drak E. of BanMeThuot” (HT, BPBM) (synonymy: Wirth 1977: 340).

hyalipennis Hendel, 1914: 113 (*Thaumastophila*). Type locality: “Pilam, Formosa” (LT, designated by Delfinado 1969: 208, DEI). Oriental: Cambodia and Taiwan.

kyphosis Kirk-Spriggs, 2010a: 115. Type locality: “Madagascar, 10 km W von Sakaraha” (HT, ZSM). Afrotropical: Madagascar.

Apsinota sp. *sensu* Tsacas (1974: 717). “Madagascar, Prov. d’Analalava, Maromandia” (PT, MNHN).

obscuripes de Meijere, 1911: 416 (*Apsinota*). Type locality: “Java, Gunung Ungaran” (HT, ZMAN). Oriental: Indonesia (Java).

pictiventris van der Wulp, 1886: cviii. Type locality: “[Indonesia], Java, Batavia [= Jakarta]” (HT, ZMAN). Australasian: Australia (Queensland), Papua New Guinea; Oceanian: Solomon Is. (Guadalcanal); Oriental: Indonesia (Ambon Is, Java, Sumatra), Peninsula Malaysia, East Malaysia (Borneo), Nepal, Thailand and Vietnam.

rufipes Okada, 1966: 11 (*Apsinota*). Type locality: “East Nepal, Arun Valley, below Tumlingtar” (HT, BMNH). Oriental: Nepal and Thailand.

sarawakensis Delfinado, 1969: 213 (*Apsinota*). Type locality: “Borneo, Sarawak, Kuching, Santubong” (HT, BPBM). Oriental: East Malaysia (Borneo).

simulans Delfinado, 1969: 213 (*Apsinota*). Type locality: “Ceylon [= Sri Lanka], Peradeniya” (HT, BMNH). Oriental: Sri Lanka.

uniformis Malloch, 1930: 329 (*Anaseiomyia*). Type locality: “[West Malaysia], Selangor, Kuala Lumpur” (HT, BMNH). Oriental: West Malaysia and Philippines.

hardyi Delfinado, 1969: 207 (*Apsinota*). Type locality: “Philippines, Luzon, Dalton Pass” (HT, BPBM) (synonymy: Wirth 1977: 341).

sp. indet. (*Apsinota*) (Delfinado, 1969: 214). “Malaya [= West Malaysia], Pahang, King George V National Park” (N-T, BPBM).

Genus **CURTONOTUM** Macquart

CURTONOTUM: Macquart 1844: 350 (193). Type species: *Musca gibba* Fabricius, 1805 [preoccupied], by original designation. [The name of the Type species is a junior primary homonym preoccupied by *Musca gibba* Müller, 1776: 175 and *M. gibba* Rossi, 1794: 73.

Curtonotum taeniatum Hendel, 1913: 629 was accepted as the replacement name by Thompson and Pont (1993)].

CYRTONOTUM Agassiz, 1846: 108. Unjustified emendation of *Curtonotum* Macquart, 1844.

DIPLOCENTRA Loew, 1862: 13. [Unnecessary] new replacement name for *Curtonotum* Macquart, 1844.

SELIACANTHA Bezzi, 1895: 66. *Nomen nudum*, attributed to Rondani and proposed in synonymy (with *Diplocentra* Loew, 1862). Name from a collection label. Also Bezzi (1902: 192).

SELIDACANTHA Bezzi, 1895: 66. *Nomen nudum*, proposed as an emendation of the likewise unavailable *Seliacantha* Bezzi, 1895: 66. Also Bezzi (1902: 192).

CURTONOTUM *sensu stricto* (*sensu* Klymko & Marshall 2011: 4)

adusticrus Klymko & Marshall, 2011: 48. Type locality: “Brazil, Itatiaia” (HT, USNM). Neotropical: Brazil.

apicale Hendel, 1913: 621. Type locality: “Peru, Junín, Chanchamayo” (LT designated by Klymko & Marshall, 2011: 54, MTD) (redescribed: Klymko & Marshall, 2011: 52). Neotropical: Ecuador and Peru.

atlanticum Klymko & Marshall, 2011: 93. Type locality: “Brazil, Campos do Jordão” (HT, MZSP). Neotropical: Brazil.

bathmedum Hendel, 1913: 628. Type locality: “Peru, Pachitea Münd” (LT, designated by Klymko & Marshall, 2011: 44, MTD) (redescribed: Klymko & Marshall, 2011: 43). Neotropical: Bolivia and Peru.

bathymedum Malloch, 1930: 325, *auctt.* misspelling of *bathmedum* Hendel.

bivittatum Klymko & Marshall, 2011: 39. Type locality: “Ecuador, Jatun Sacha Res., 6 km E Misahualli” (HT, QCAZ) (redescribed: Klymko & Marshall, 2011: 39). Neotropical: Columbia, Costa Rica and Ecuador.

brunneum Klymko & Marshall, 2011: 64. Type locality: “Bolivia, 8 km S Chulumani, Apa Apa” (HT, CBFC). Neotropical: Bolivia and Peru.

coriaceum Hendel, 1932: 133 (*Cyrtonotum*). Type locality: “Bolivia, Pilcomayo” (HT, SMNS). Neotropical: Bolivia.

curtispinum Klymko & Marshall, 2011: 61. Type locality: “Brazil, District Federal, Serviço Febre Amarela” (HT, USNM). Neotropical: Brazil.

decumanum Bezzi, 1914a: 199 (*Cyrtonotum*). Type locality: “Paraguay, Puerto Bertoni, Alto Paraná” (HT, MSNM). Neotropical: Paraguay.

desperatum Klymko & Marshall, 2011: 91. Type locality: “Brazil” (HT, BMNH). Neotropical: Brazil.

flavisetum Klymko & Marshall, 2011: 72. Type locality: “Brazil, Villa Murtinho” (HT, USNM). Neotropical: Brazil and Bolivia.

fumipenne Hendel, 1913: 626. Type locality: “Bolivia, Mapiri, Sarampioni” (HT, MTD). Neotropical: Bolivia.

gracile Klymko & Marshall, 2011: 88. Type locality: “Brazil, Cachimbo” (HT, MZSP). Neotropical: Brazil.

- hendelianum** Enderlein, 1917: 71 (*Diplocentra*). Type locality: “Surinam” (HT, HNHM) (redescribed: Klymko & Marshall, 2011: 83). Neotropical: Brazil, Guyana and Surinam.
- nigripalpe* Hendel, 1936: 90 (synonymy Klymko & Marshall 2011: 86). Type locality: “Brazil, Belém” (HT, NMW).
- hendeli sensu* Curran, 1934b: 441, *auctt.* misidentification.
- hunkingi** Klymko & Marshall, 2011: 97. Type locality: “Brazil, Bocaiúva do Sul” (HT, USNM). Neotropical: Brazil.
- impunctatum** Hendel, 1913: 625, *non impunctatum* Hendel, 1932: 134 (*Cyrtonotum*) (preoccupied). Type locality: “Peru, Pachitea-Mündung” (LT, designated by Klymko & Marshall, 2011: 61, MTD) (redescribed: Klymko & Marshall, 2011: 58). Neotropical: Ecuador and Peru.
- magnum** Malloch, 1930: 326 (*Cyrtonotum*). Type locality: “Brazil: Alto Itatiaya, Serra do Itatiaya” (HT, USNM) (redescribed: Klymko & Marshall, 2011: 45). Neotropical: Brazil.
- murinum** Hendel, 1913: 622. Type locality: “Peru, Chanchamayo, Meshagua, Urubamba R.” (HT, MTD). Neotropical: Peru.
- pantherinum** Walker, 1849: 1090 (*Helomyza pantherina*). Type locality: “Brazil, Pará” (HT, BMNH; specimen missing) (redescribed Hendel 1913: 623; Klymko & Marshall, 2011: 67). Neotropical: Bolivia, Brazil, Guyana, Peru, Suriname and Venezuela.
- salinum* Curran, 1934b: 440. Type locality: “Guyana, Kartabo” (HT, AMNH) (synonymy: Malloch 1930: 325).
- papillatum** Klymko & Marshall, 2011: 99. Type locality: “Brazil, Alto da Boa Vista” (HT, USNM). Neotropical: Brazil.
- perplexum** Klymko & Marshall, 2011: 50. Replacement name for *impunctatum* Hendel, 1932: 134 (*Cyrtonotum*) (preoccupied), *non impunctatum* Hendel, 1913: 625. Type locality: “[Bolivia], Ob. Pilcomayotal” (HT, SMNS). Neotropical: Bolivia.
- punctithorax** Fischer, 1933: 88 (*Cyrtonotum*). Type locality: “Brazil, Capital, Bairro da Avenida Paulista” (HT, DEI) (redescribed: Klymko & Marshall, 2011: 102). Neotropical: Brazil, Paraguay and Uruguay.
- scambum** Klymko & Marshall, 2011: 86. Type locality: “Peru, Iquitos” (HT, USNM). Neotropical: Peru.
- taeniatum** Hendel, 1913: 629. Type locality: “Peru, Urubamba R., Umahuankiali” (LT, designated by Klymko & Marshall, 2011: 80, MTD) (redescribed: Klymko & Marshall, 2011: 75). Neotropical: Brazil, Bolivia and Peru.
- gibbum* Fabricius, 1805: 297 (*Musca gibba*) *auctt. partim*; *non* Perris, 1839: 50 (*Helomyza gibba*) (synonymy Thompson & Pont, 1993: 80). Type locality: “America Meridionali” (LT, designated by Klymko & Marshall, 2011: 79, ZMUC). Refs. Hendel (1913: 624) descriptive notes; Enderlein (1917: 69) notes; Malloch (1930: 326) notes; synonym – *taeniatum* Hendel; Hendel (1933: 77) notes on synonymy.
- trypetipenne** Hendel, 1913: 620. Type locality: “Peru, Ucayalifl [Ucayali River], Unini” (LT, designated by Klymko & Marshall, 2011: 57, MTD) (redescribed: Klymko & Marshall, 2011: 55). Neotropical: Bolivia, Brazil, Colombia, Ecuador and Peru.

tumidum Enderlein, 1917: 68 (*Cyrtonotum*). Type locality: “Surinam Michaelis” (LT, designated by Klymko & Marshall, 2011: 83, HNHM) (redescribed: Klymko & Marshall, 2011: 80). Neotropical: Brazil, Colombia, Ecuador, Guyana, Peru and Suriname.

vulpinum Hendel, 1913: 627. Type locality: “Peru, Pichis, Pto. [= Puerto] Bermúdez” (HT, MTD). Neotropical: Bolivia and Peru.

Striatifrons species-group

herrero Tsacas, 1977: 156. Type locality: “[Namibia], S.-O. Africa (29): Kahn River, 8 km W. Usakos” (BMNH). Afrotropical: Angola and Namibia.

maculiventris Enderlein, 1917: 69 (*Diplocentra*). Type locality: “Eritrea: Asmara” (MZPW) (holotype lost, NT, here designated, ZMHB: “Tanzania, Nyassa-See, Langenburg”). Afrotropical: Botswana, Burundi, Chad, Côte d’Ivoire, Democratic Republic of Congo, Malawi, Mozambique, Nigeria, South Africa (Natal, Transvaal), Sudan, Tanzania and Zimbabwe.

tigrinum Séguy, 1933: 35 (*Cyrtonotum*) **syn. n.** Type locality: “Mozambique: Haut-Nhamapaza” (MNHN).

striatifrons Malloch, 1930: 325 (*Cyrtonotum*). Type locality: “[Chad], Bahr el Ghazal” (LT, here designated, BMNH). Afrotropical: Chad, Nigeria and Sudan.

Saheliense species-group

saheliense Tsacas, 1977: 161 (*saheliensis*). Type locality: “Niger: Guerimari” (HT, MNHN). Afrotropical: Chad, Gambia, Ghana, Niger, Nigeria, Mali, Senegal, Sudan and Togo.

simile Tsacas, 1977: 165 (*similis*). Type locality: “Arabia [= South Yemen]: S. Othman, N. Aden” (HT, BMNH) (redescribed Kirk-Spriggs & Freidberg 2007: 139; Kirk-Spriggs 2008a: 706). Afrotropical: Eritrea, Yemen. Palearctic: Israel, Oman, United Arab Emirates.

Stuckenbergi species-group

stuckenbergi Tsacas, 1974: 705. Type locality: “Madagascar, Ambohitantely” (HT, MNHN) (redescribed: Kirk-Spriggs, 2011: 438). Afrotropical: Madagascar.

keiseri Tsacas, 1974: 706. Type locality: “Madagascar, Joffreville” (HT, MNHN) (redescribed: Kirk-Spriggs, 2011: 419). Afrotropical: Madagascar.

parkeri Kirk-Spriggs, 2011: 422. Type locality: “Madagascar: Zombitse National Park” (HT, CAS). Afrotropical: Madagascar.

coronaeformis Kirk-Spriggs, 2011: 406. Type locality: “Madagascar: Province, near Isalo National Park, in dry wash east of Interpretive Center” (HT, CAS). Afrotropical: Madagascar.

balachowskyi Tsacas, 1974: 710. Type locality: “Madagascar, Mananjary” (HT, MNHN) (redescribed: Kirk-Spriggs, 2011: 398). Afrotropical: Madagascar.

irwini Kirk-Spriggs, 2011: 416. Type locality: “Madagascar: Zombitse National Park” (CAS). Afrotropical: Madagascar.

gladiiformis Kirk-Spriggs, 2011: 409. Type locality: “Madagascar: Province, near Isalo National Park, in dry wash east of Interpretive Center” (HT, CAS). Afrotropical: Madagascar.

Gonzo species-group

gonzo Kirk-Spriggs, **sp. n.** Type locality: “[Ghana], Kwadaso” (HT, HNHM). Afrotropical: Cameroon, Ghana and Nigeria.

sternithrix Tsacas, 1974: 708. Type locality: “Madagascar Est, Antanambe” (HT, MNHN) (redescribed: Kirk-Spriggs, 2011: 435). Afrotropical: Madagascar.

Rinhatinana species-group

rinhatinana Kirk-Spriggs, 2011: 428. Type locality: “Madagascar: Ankarafantsika Forest Reserve” (HT, CAS). Afrotropical: Madagascar.

Anus species-group

amurensis Ozerov, 2007: 2. Type locality: “Russia, Amurskaya oblast town Zeya” (HT, ZMUM). Palaearctic: Russian Federation.

anus Meigen, 1830: 95 (*Diastata*), *non anus sensu* Malloch, 1930: 327 (*Cyrtonotum*) *auctt.* misidentification. Type locality: “Italy” (HT, ZMUC) (redescribed Kirk-Spriggs and Freidberg 2007: 138). Oriental: Pakistan; Palaearctic: Albania, Austria, France, Greece, Hungary, Israel, Italy, Moravia, Romania, Russia, Serbia, Slovakia and Turkey.

gibbum Perris, 1839: 50 (*Helomyza gibba*) *non* Fabricius, 1805: 297 (*Musca gibba*) *nec* Hendel (1913: 624). Type locality: “[France], circà Mont-de-Marsan (Landes)” (ST, OUMNH, 7 from which lectotype should be selected, ST, INRA (5 specimens).

perisii Schiner, 1864: 23 (*Curtonotum*, as *perrisii*, new name for *gibba* (Perris 1839), *non* Fabricius (1805: 297), *nec* Hendel (1913: 624). Type locality: [not listed] (HT, NMW).

perrisii Nowicki, 1873: 33, *auctt.* misspelling of *perisii* Schiner.

grandis Bezzi, 1895: 66 (*Seliacantha*), *nomen nudum* (Italy).

perrisii Duda, 1934: 3, *auctt.* misspelling of *perisii* Schiner.

perrisi Papp, 1984: 222, *auctt.* misspelling of *perisii* Schiner.

floridense Klymko & Marshall, 2011: 27. Type locality: “United States of America, Florida, Polk Co., TNC Tiger Creek Preserve” (HT, DEBU). Nearctic: United States of America.

helvum Loew, 1862: 228 (*Diplocentra*). Type locality: “United States of America, Minnesota, North Red River” (LT, MCZ). Nearctic: Canada and United States of America.

maritimum Ozerov, 2007: 2. Type locality: “Russia: Primorskii krai, Gorno-Taezhnaya stantsia” (ZMUM). Palaearctic: Russian Federation.

shatalkini Ozerov, 2007: 4. Type locality: “Russia: Primorskii krai, Kamenushka” (ZMUM). Palaearctic: Russian Federation.

Platyphallum species-group

marriott Kirk-Spriggs **sp. n.** Type locality: “Nigeria: Ibadan” (USNM). Afrotropical: Cameroon and Nigeria.

moffatt Kirk-Spriggs **sp. n.** Type locality: “Uganda: Mujenje [= Muyenje]” (HNHM). Afrotropical: Central African Republic, Cameroon and Uganda.

platyphallum Tsacas, 1977: 157. Type locality: “Liberia: Robertsport, Talla” (AMNH). Afrotropical: Liberia.

Boeny species-group

boeny Tsacas, 1974: 712. Type locality: “Madagascar, Ambato-Boeny” (HT, MNHN) (redescribed: Kirk-Spriggs, 2011: 403). Afrotropical: Madagascar.

griveaudi Kirk-Spriggs, 2011: 413. Type locality: “Madagascar, Maintirano District, Asondrodava dry forest 15 km N of Maintirano” (HT, CAS). Afrotropical: Madagascar.

Campsiphallum species-group

angolense Tsacas, 1977: 149 (*angolensis*). Type locality: “Angola: 5 mls. NE. Negola” (HT, BMNH). Afrotropical: Angola.

campsiphallum Tsacas, 1977: 151. Type locality: “Zaire [= Democratic Republic of Congo], Bumba” (HT, IRSNB). Afrotropical: Cameroon, Central African Republic, Côte d’Ivoire, Democratic Republic of Congo and Ghana.

freidberg Kirk-Spriggs, **sp. n.** Type locality: “Malawi: Vipha Mts.” (TAU). Afrotropical: Malawi.

hay Kirk-Spriggs, **sp. n.** Type locality: “Uganda: Mujenje [= Muyenje]” (HNHM). Afrotropical: Uganda.

quinquevittatum Curran, 1933: 3. Type locality: “S. Rhodesia [= Zimbabwe], Lomagundi” (AMNH). Afrotropical: Angola, Democratic Republic of Congo, Malawi, ?Mozambique, Tanzania, Togo and Zimbabwe.

anus *sensu* Malloch, 1930: 327 (*Cyrtonotum*) *non* Meigen, 1830: 95 (*Diastata*) *auctt.* misidentification (synonymy by Curran 1933: 3).

sao Tsacas, 1977: 163. Type locality: “Nigeria: Gadau” (BMNH), Afrotropical: Chad and Nigeria.

tsacas Kirk-Spriggs, **sp. n.** Type locality: “South Africa: Enseleni Nature Reserve” (NMSA). Afrotropical: Ethiopia, Kenya, Mozambique and South Africa.

Uncinatum species-group

bicuspis Kirk-Spriggs, **sp. n.** Type locality: “Namibia: Salambala campsite” (HT, NMNW). Afrotropical: Angola, Botswana, Democratic Republic of Congo, Kenya, Mozambique, Namibia, South Africa and Zimbabwe.

cuthbertsoni Duda, 1935: 31, Type II of Tsacas (1977: 153), *auctt.* misidentification.

cimbebas Kirk-Spriggs **sp. n.** Type locality: “Namibia: Tsaobismund 85” (HT, NMNW). Afrotropical: Namibia.

cuthbertsoni Duda, 1935: 31, Type VII of Tsacas (1977: 153), *auctt.* misidentification.

constance Kirk-Spriggs, **sp. n.** Type locality: “Angola: 7 mi. N. Vila” (HT, MNHN). Afrotropical: Angola.

cuthbertsoni Duda, 1935: 31, Type VIII of Tsacas (1977: 153), *auctt.* misidentification.

cuthbertsoni Duda, 1935: 31 *auctt. partim*. Type locality: “S. Rhodesia [= Zimbabwe], Balla Balla” (LT, here designated, PPRZ). Afrotropical: Botswana, Kenya, Mozambique, Namibia, South Africa, Tanzania, Uganda and Zimbabwe.

litoralis Kirk-Spriggs, **sp. n.** Type locality: “Kenya: Muhaka Field Station” (HT, NMNW). Afrotropical: Kenya and Tanzania (Zanzibar).

cuthbertsoni Duda, 1935: 31, Type VI of Tsacas (1977: 153), *auctt.* misidentification.

mcgregor Kirk-Spriggs, **sp. n.** Type locality: “Nyasaland [= Malawi], Port Herald” (HT, BMNH). Afrotropical: Malawi and Mozambique.

cuthbertsoni Duda, 1935: 31, Type IV of Tsacas (1977: 153), *auctt.* misidentification.

pauliani Tsacas, 1974: 715. Type locality: “[Madagascar], Nosy Mitsio” (HT, MNHN) (redescribed Kirk-Spriggs 2011: 425). Afrotropical: Madagascar, Namibia and South Africa.

sakalava Tsacas, 1974: 713. Type locality: “Madagascar Quest, Morondava” (HT, MNHN) (redescribed: Kirk-Spriggs, 2011: 431). Afrotropical: Madagascar.

uncinatum Kirk-Spriggs, **sp. n.** Type locality: “Namibia, Kubunyana camp: Kwando River” (HT, NMNW). Afrotropical: Botswana, Namibia, South Africa and Zimbabwe.

cuthbertsoni Duda, 1935: 31, Type III of Tsacas (1977: 153), *auctt.* misidentification.

unicuspis Kirk-Spriggs, **sp. n.** Type locality: “Namibia, Salambala campsite” (HT, NMNW). Afrotropical: Burundi, Mozambique, Namibia, South Africa, Tanzania and Zimbabwe.

cuthbertsoni Duda, 1935: 31, Type V of Tsacas (1977: 153), *auctt.* misidentification.

Unplaced species of *Curtonotum*

arenatum Osten Sacken, 1882: 244 (*Diplocentra arenata*). Type locality: “Philippines, Mindanao, Misamis Or.” (DEI). Oriental: Philippines (Mindanao).

arcuatum Bezzi, 1914b: 311, *auctt.* misspelling of *arenata* Osten Sacken

ceylonense Delfinado, 1969: 204. Type locality: “Ceylon” (HT, BMNH). Oriental: Sri Lanka.

maii Delfinado, 1969: 204. Type locality: “S. China: Fukien, Shaowu, Chipei-kai” (BPBM). Oriental: China.

Nomen dubium (as *incertae sedis* Klymko & Marshall 2011: 106–107).

hendeli Malloch, 1930: 325 (*Cyrtonotum*). Type locality: “Brazil” (type specimen not designated, location uncertain). Proposed by Malloch as a new name; this is a new species proposed by Malloch for *Curtonotum gibbum sensu* Hendel (1913: 624), *non* Fabricius (1805: 297), *nec* Perris (1839: 50); Type locality is that of Wiedemann (1830: 586) specimens discussed by Hendel (1913: 525, as *gibbum*).

simplex Schiner, 1868: 237. Type locality: “Brazil” (NMW). Neotropical: Brazil.

Fossil removed from *Curtonotidae* (Kirk-Spriggs 2007)

gigas Théobald, 1937 [Oligocene]. Type locality: “France, Les Camoins” (Museum de Paléontologie de Provence, Université de Provence, France). Palaeartic: France.

[Although the familial placement of the specimen cannot be determined, due to poor preservation, it is, certainly an acalyprate fly.]

SYSTEMATIC REVISION OF SELECTED GENERA OF AFROTROPICAL CURTONOTIDAE

3.1.

The genus *Axinota* van der Wulp, with the description of three new species¹

Preface: Afrotropical species of *Axinota* van der Wulp, a genus exhibiting extreme curvature of the upper thorax (hunchbacked), are reviewed. This genus currently comprises eight described species, two new species in the Oriental Region and one published record from Madagascar. One new and one previously described species are shown to be widespread in continental sub-Saharan Africa. The two syntypes of *Diastata fuscipennis* Macquart, 1844, were examined and a lectotype and paralectotype are designated. The species is formally transferred to the genus *Axinota* (*Axinota fuscipennis* (Macquart, 1844), comb. n.), and a second, closely-related new species, *A. quasimodoi* Kirk-Spriggs, sp. n., is described and figured. Together these two species comprise a *Fuscipennis* species-group, being distinct from species of presumed Oriental origin (*Pictiventris* species-group). Two further new species are described and illustrated: *A. ahdabi* Kirk-Spriggs, sp. n., from the highlands of Yemen, and *A. kyphosis* Kirk-Spriggs, sp. n. from Madagascar. An identification key is provided for the two species-groups and for species occurring in the Afrotropical Region and an annotated checklist of world species of *Axinota* is provided as 3.1: Appendix. Distribution maps are included for the four species, with a list of decimal co-ordinates used to plot these as 3.1: Appendix II.

Axinota van der Wulp, 1886, is a remarkable genus of apparently rare hunchbacked flies, the biology and larval habits of which remain entirely unknown. The genus was previously known from only eight described species, all occurring in the Oriental Region (Wirth 1977). These were dealt with by Delfinado (1969, as *Apsinota*), who provided a key to species and descriptions of new species (see 3.1: Appendix I). However, Delfinado was evidently unaware of Malloch's (1930) paper, and two species she described in that work were subsequently synonymised by Wirth (1977), namely: *A. demeijerei* Delfinado, 1969 = *A. dissimilis* (Malloch, 1930), and *A.*

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hardyi Delfinado, 1969 = *A. uniformis* (Malloch, 1930). Considerable additional material of this genus has subsequently been amassed in various European museums and a revision of the Oriental species is now desirable.

As part of this study, 99 specimens of *Axinota*, originating from the Afrotropics, have been amassed from European, North American and African museums. Close examination and dissection of this material, in direct comparison to the syntypes of *Diastata fuscipennis* Macquart, 1844, in Muséum national d'Histoire naturelle, Paris, France, has revealed two new species in an Oriental *Pictiventris* species-group (one from Madagascar and one from Yemen), and two species widespread in continental sub-Saharan Africa, comprising *Diastata fuscipennis* of Macquart and a new species described herein (*A. quasimodoi* Kirk-Spriggs, sp. n.). These last two named species are sufficiently distinct to warrant their placement in a species-group of their own (the *Fuscipennis* species-group), and character states defining the two species-groups are provided in the key below. In previous interpretations of the orbital setae (*e.g.*, Delfinado 1969; Tsacas 1977), species of *Axinota* were regarded as having only a single, strong posterior orbital seta. Close examination of comparative material of *Axinota* from the Oriental Region (including the Type species of the genus: *A. pictiventris* van der Wulp, 1886) has revealed, however, that a minute setula does occur close to the socket of the posterior orbital seta, and in the case of the *Fuscipennis* species-group, an additional proclinate setula (anterior orbital seta) ventral to this. Given their position on the orbital plates, these setulae are here regarded as being homologous with the medial orbital setula (*or2*) and the anterior orbital seta (*or1*) of *Curtonotum* (*e.g.*, Kirk-Spriggs and Freidberg 2007, figs 3, 4).

MATERIAL AND METHODS

Figures of the head, wing, scutellum and abdomen were initially prepared from images captured with a Leica E24U binocular microscope with a built in digital camera. These were printed, traced and the details added by hand in pen and ink. All figures were prepared from dry-pinned specimens. Every effort was made to ensure that the same specimen orientation was applied in each case, to allow direct comparison.

Male terminalia were mounted laterally, in a blob of heated and set glycerine jelly; spermatheca as temporary slides in glycerine beneath a cover slip. Figures of these structures were prepared using a Wild M5-94286 binocular microscope with a *camera lucida* attachment. Images were enlarged and traced, and details added by hand in pen and ink. Scale bars were added using a Zeiss 0.01 mm graticule slide.

In the case of pre-independence names, modern place names are also provided in square brackets under each species heading. Each set of specimen locality co-ordinates was obtained in one of three ways: a) original co-ordinates provided on data labels, later converted to decimal co-ordinates; b) obtained from Internet geo-referencing websites or c) original co-ordinates were obtained from personal communications with the collectors themselves (as indicated in the text).

Distribution maps were prepared by converting a list of geographic co-ordinates indicating the point location of specimen records into a spatial data layer in ArcMap 9.3. The specimen location layer was overlaid on topography, vegetation and state boundaries in order to assist with the interpretation and location of records. The layers Major Habitat Types and country political boundaries used for Fig. 3.1: 29 and the shaded relief used on Fig. 3.1: 30, were derived from Hearn *et al.* (2000); the hydrological systems layer used on Fig. 3.1: 30 from Jenness *et al.* (2007). Figure 3.1: 32 is derived from the *Vegetation Map of Madagascar* by Moat and Smith (2007). Plotted points (57) are based on material examined as part of the systematic revision only, *i.e.*, all represent confirmed identifications. Geographic co-ordinates in decimal degrees are provided in 3.1: Appendix II.

Type label data are quoted exactly as they appear. A division slash (/) denotes the commencement of a new line, two division slashes (//) data on a further label. Significant supplementary or qualifying information is presented in square brackets when considered necessary.

Information on label colour, *etc.*, is only provided for type material. All labels are printed on white card, unless otherwise stated. The glass and cork-bunged genitalia vials used by L. Tsacas, many of which had dried-up or deteriorated, were all replaced and a label appended to each specimen stating “Genitalia vial replaced A.H. Kirk-Spriggs 2006–2008”. Specimens with head missing are also labelled as such, *e.g.*, “Head missing 2008”. Adult morphology follows Cumming and Wood (2009), except in the case of orbital setae.

“Fig.” or “Figs” as cited in the text refers to figures cited in this chapter; “fig.” or “figs” to figures in other publications.

SYSTEMATICS

Key to Afrotropical species of *Axinota* van der Wulp

1. One prominent reclinate (posterior orbital seta), and one tiny reclinate setula (medial orbital setula) close to socket of posterior orbital seta (Figs 3.1: 3, 4); frons markedly narrowed in male (as in Fig. 3.1: 3). Wing (as in Figs 3.1: 7, 8) membrane hyaline throughout; costa with row of short, weak, semi-erect, regular setae for $\frac{2}{3}$ costal length from costal break; scutellum (as in Figs 3.1: 11, 12) with intermediate scutellar setula weakly developed. Epandrium and hypandrium free. Spermatheca globular or mushroom-shaped *Pictiventris* species-group 3
- One prominent reclinate posterior orbital seta, one tiny proclinate setula (medial orbital setula) close to socket of posterior orbital seta and one additional tiny proclinate setula (anterior orbital seta) ventral to socket of posterior orbital seta (Figs 3.1: 1, 2); frons *not* markedly narrowed in male (as in Fig. 3.1: 2). Wing (Figs 3.1: 5, 6) membrane dark brown infusate throughout, or infusate with darker marginal band in r_1 and anterior $\frac{1}{2}$ of r_{2+3} ; costa with row of prominent semi-erect spines for $\frac{2}{3}$ costal length from costal break; scutellum (Figs 3.1: 9, 10) with intermediate scutellar setula well developed. Epandrium and hypandrium fused. Spermatheca barrel-shaped *Fuscipennis* species-group 2
2. Wing (Fig. 3.1: 5) membrane faintly infusate, with darker marginal band in r_1 and anterior $\frac{1}{2}$ of r_{2+3} , dm markedly wider at $dm-cu$ crossvein, this crossvein obliquely angled posteriorly, cua_1 short and broad, fold A_2 extending $\frac{1}{2}$ length of cua_1 ; scutellum (Fig. 3.1: 9) with intermediate scutellar setula inserted closer to outer than inner scutellar setae; abdomen (Fig. 3.1: 13) with extensive grey maculae on tergites 2–5; male terminalia as illustrated (Figs 3.1: 17, 21). Spermatheca barrel-shaped, *without* apical lip (Fig. 3.1: 25) (widespread sub-Saharan Africa) *A. fuscipennis* (Macquart) comb. n.

- Wing (Fig. 3.1: 6) membrane dark brown infusate throughout, *dm* narrower at *dm-cu* crossvein, this crossvein less obliquely angled posteriorly, *cua*₁ long and narrow, fold *A*₂ extending $\frac{2}{3}$ length of *cua*₁; scutellum (Fig. 3.1: 10) with intermediate scutellar setula inserted equidistant between outer and inner scutellar setae; abdomen (Fig. 3.1: 14) with reduced grey sub-triangular maculae on tergites 3–5; male terminalia as illustrated (Figs 3.1: 18, 22). Spermatheca barrel-shaped, with distinct apical lip (Fig. 3.1: 26) (widespread sub-Saharan Africa) *A. quasimodoi* sp. n.
- 3. Ventral (of 2) anepisternal seta markedly stronger and thicker than dorsal; male mesonotum silver-grey-dusted, with narrow medial chocolate-brown vitta and two narrow lateral chocolate-brown vittae; scutellum baso-medially and laterally with chocolate-brown markings (Fig. 3.1: 11); male terminalia as illustrated (Figs 3.1: 19, 23). Female mesonotum uniform grey-dusted, scutellum as in male. Spermatheca globular (Fig. 3.1: 27) (Yemen) *A. ahdabi* sp. n.
- Ventral (of two) anepisternal seta only slightly weaker than dorsal; mesonotum grey-white, blue pollinose throughout (brownish in some specimens), lacking conspicuous vittae or other markings; scutellum baso-medially with pale brown sub-triangular marking (weakly expressed in teneral specimens) (Fig. 3.1: 12); male terminalia as illustrated (Figs 3.1: 20, 24). Spermatheca mushroom-shaped (Fig. 3.1: 28) (Madagascar) *A. kyphosis* sp. n.

Genus *Axinota* van der Wulp, 1886

Axinota van der Wulp, 1886: cvii.

Apsinota van der Wulp, 1887: 178 [footnote]. Unjustified emendation of *Axinota*.

Thaumastophila Hendel, 1914: 112. Type species: *Thaumastophila hyalipennis* Hendel, 1914, by original designation.

Anaseiomyia Malloch, 1930: 328. Type species: *Anaseiomyia uniformis* Malloch, 1930, by original designation.

Type species. *Axinota pictiventris* van der Wulp, 1886, by original designation and monotypy (“gen. n., sp. n.”).

Taxonomic notes. Tsacas (1974) formally recorded the first African species of *Axinota* (as *Apsinota* sp.); a single female specimen from “Prov. d’Analalava,

Maromandia (leg. R. Decary, 1922),” Madagascar, and noted (p. 717) “This corresponds well to the definition of the genus *Apsinota*: frons large, 1 or reclinate, 1 sternopleural, wings hyaline with the costal spines very weak, spermatheca globular (as shown in Delfinado, 1969)” (translation: Marc De Meyer). He also provided a brief description of the external features of the species, but did not name it, presumably due to insufficient material. *Axinota* is evidently very rare in Madagascar, but three additional specimens (one male and one female in ZSM and one female in CAS), have subsequently become available for study. Although these specimens are ex alcohol and therefore somewhat bleached and rubbed, they are here regarded as conspecific with the female specimen from Maromandia, Madagascar, cited by Tsacas (1974). Dissection of the male terminalia reveals its distinctiveness from other described species of the genus and so is described as new below.

Among material examined from NMWC are two specimens (male and female) from the highlands of Yemen, which also belong to the genus *Axinota*, but do not key to any known species, or compare to the genitalia figures provided by Delfinado (1969) and Okada (1966). This second new species is also described below. Both this and the unnamed species from Madagascar (noted above), have hyaline wings with short regular spines on the basal $\frac{2}{3}$ of the costa from costal break and are clearly of Oriental affinity.

These two new species appear to be most closely related to *A. rufipes* Okada, 1966, described from Nepal. According to Delfinado’s (1969) key, this species is sexually dimorphic, the male mesonotum being marked with vittae and the female being uniform blue-grey-dusted. Sexual dimorphism also occurs in the two new species described here and due to limited material and its rather poor condition it has been problematic to associate females with males. Females of the two new species are very similar externally and are only separable on the shape of the spermatheca (a character not yet fully assessed for stability in species of the genus *Axinota*).

The following preliminary generic diagnosis for *Axinota* is based on characters noted by Delfinado (1969), examination of the holotype of *A. pictiventris* van der Wulp (Type species of the genus), examination of the comparative material cited below, and the three new species described herein. A final diagnosis must await the revision of the Oriental species of the genus.

Generic diagnosis

Head either with one prominent reclinate (posterior orbital seta), and one tiny reclinate setula (medial orbital setula) close to socket of posterior orbital seta or with additional tiny proclinate setula (anterior orbital seta); frons either narrow in male or wide in both sexes. Thorax with mesonotum of extreme hunchbacked appearance; wing membrane dark brown infusate throughout, infusate with darker marginal band in r_1 and anterior $\frac{1}{2}$ of r_{2+3} or entirely hyaline; costa either with row of prominent semi-erect setae or row of short, weak, semi-erect, regular setae for $\frac{2}{3}$ of costal length from costal break; scutellum with intermediate scutellar setula weak or well developed. Male terminalia with epandrium and hypandrium either free or fused, surstylus distinctly forked apically; spermatheca globular, or mushroom- or barrel-shaped.

Comparative material examined

Axinota pictiventris van der Wulp, 1886. [INDONESIA]: holotype ♀, “Java / Batavia [handwritten; label discoloured, “Batavia” virtually illegible due to fading] // *Axinota / pictiventris* ns. [handwritten] // Holotype ♀ [printed & handwritten; dark red card] // *Apsinota / pictiventris* / van der Wulp, 1886 / ZMAN type DIPT.1958.1 [pale red card] // *Axinota* ♀ / *pictiventris* van der Wulp, 1886 / det. A.H. Kirk-Spriggs 2009” (ZMAN).

Axinota dissimilis (Malloch, 1930). BHUTAN: 1♀, BHUTAN, Gaylegphu, rice fields, 26.x.–5.xii.1988, C. Dorji, NMW.Z.1989–071, *Axinota dissimilis* (Malloch, 1930) ♀ det. A.H. Kirk-Spriggs 2009 (NMWC). New record for Bhutan.

Axinota sp. n. nr. “*Apsinota* sp. A” *sensu* Delfinado (1969). [MALAYSIA]: 1♂, BORNEO: Sabah, Danum Valley, 5°01'N 117°47'E, 8.ix.1987, 100 m, A.H. Kirk-Spriggs, roadside, secondary forest, *Axinota* sp. n. nr. *Apsinota* sp. A. of Delfinado (1969) ♂ det. A.H. Kirk-Spriggs 2009 (NMWC).

***Axinota fuscipennis* (Macquart, 1844), comb. n.,**

Figs 3.1: 1, 5, 9, 13, 17, 21, 25, 29, 30, 31

Diastata fuscipennis Macquart, 1844: 417, 260.

Curtonotum fuscipenne (Wirth & Tsacas 1980: 672).

Type locality. “Du Sénégal. Donné par M. Guérin au Museum.”

Taxonomic notes. Macquart (1844: 417) described *Diastata fuscipennis* from Senegal (“Du Sénégal. Donné par M. Guérin au Museum.”). He provided a one line Latin description and short French description: “Length. 1–1¼. ♂ Face slate-grey.

Frons black, anteriorly with an obscure shell [“un testacé”: literally translated as shell like of mollusc]; a whitish longitudinal line along the frons and another one at either side; vertex brownish. Antennae black, stylus with long setulae. Thorax convex, grey, slightly slate-grey, with small black dots, in three brown bands, slender; margins pale grey. Abdomen black. Legs pale yellow. Wings brown, dark along exterior margin, this margin with small spikes as in *Helomyzes*.” (translation: Marc De Meyer).

Séguy (1933: 35) recorded “*Cyrtonotum fuscipennis*” (as Drosophilidae) from a single [female] specimen from “Mozambique: haut Nhamapaza, Maringoué (P. Lesne)”. He noted: “Similar to the type described by Macquart (*Dipt. exot.*, II, 3, p. 260 [1843]), which originated from Senegal (Guérin). The specimen collected by M. Lesne is darker in colour, almost black; the silvery markings on the frons are only visible under certain lights, the wings are brown-black and the small crossvein is missing in both wings; this is very probably a teratology.” (translation: Marc De Meyer).

In a first attempt to key the African species of “*Curtonotum*” (as Drosophilidae), Curran (1933) included “*Curtonotum fuscipenne*” and provided a supplementary description of a single female specimen from “Memehtown, Liberia, August 25 (J. Bequaert)”, which he regarded as that species. He evidently did not examine the Macquart types of *Diastata fuscipennis*, as he noted (p. 1) “...the descriptions are not satisfactory as many essential characters were omitted by early authors, and only an examination of the types and the enumeration of these characters will definitely establish their systematic position.”

Neither Séguy nor Curran indicated the formal transfer of *Diastata fuscipennis* to the genus *Curtonotum*, and as both papers appeared in the same year (1933), and neither cited the publication of the other, the earlier of the two represents the formal transfer. Séguy’s paper is dated “June–July” and Curran’s “Nov. 25, 1933”, so that the formal transferral was that of Séguy (1933).

The inclusion of *Diastata fuscipennis* in the genus *Curtonotum* was largely based on the presence of the row of prominent spines on the costal edge (e.g., Curran 1933; Séguy 1933). The presence of such spines in *Axinota* indicates that this character state is not exclusive to the genus *Curtonotum*. In his revision of the African species of *Curtonotum* (excluding Madagascar), Tsacas (1977) only mentioned *Curtonotum fuscipenne* in passing. He noted (p. 166), its historical placement in the genus *Diastata*, but did not treat the species as part of his revision. This is surprising,

as L. Tsacas had identified numerous museum specimens in the 1970s that bear his “*Curtonotum fuscipenne*” determination labels.

However, Wirth and Tsacas (1980: 672) listed *C. fuscipenne* in the *Catalogue of the Diptera of the Afrotropical Region* and recorded the species from Angola, Cameroun, Côte d’Ivoire, Liberia, Mozambique, Nigeria and Senegal. These records were based on the museum specimens (mostly in BMNH and MNHN) examined by Tsacas, together with the Type locality (Senegal), Séguy’s (1933) record for Mozambique, and the Liberian record of Curran (1933), noted above.

Examination and dissection of the syntypes of *Diastata fuscipennis* Macquart, in comparison to amassed museum specimens, has revealed the presence of two closely-related species, both of which occur widely in continental sub-Saharan Africa and are ascribable to the genus *Axinota*.

Included in the examined material is the single male specimen cited by Séguy (1933) from “Mozambique: haut Nhamapaza, Maringoué (P. Lesne)” in MNHN (see above). Although this specimen has the abdomen missing and is in generally poor condition, examination of the wing venation leaves no doubt as to its conspecificity with *A. quasimodoi* sp. n. The specimen cited by Curran (1933) from “Memehtown [= MemoTown, 4.8611, -8.7942], Liberia, August 25 (J. Bequaert)”, purportedly deposited in AMNH (see above) could not be located (D. Grimaldi, pers. comm., 2008), and was not examined, but it is evident from Curran’s supplementary description of the female abdomen (p. 2) “Abdomen black, brown pollinose, the fifth segment with a large pale pollinose spot on either side, the fourth with traces of similar spots.”, that this specimen also belongs to the new species, and that the two records above therefore represent misidentifications.

Redescription (male)

Measurements. Overall length: ca. 2.2–2.7 mm ($n = 7$ males); length of head and thorax combined: 1.4–1.8 mm; length of thorax and scutellum combined: 1.0–1.4 mm; wing length: 2.5–2.7 mm ($n = 5$ males).

Head (as in Fig. 3.1: 2). Compound eye brown-grey, in profile gently and evenly rounded anteriorly, very slightly angular posteriorly, ratio long axis to width: 2:1; frons parallel-sided, ground colour deep chestnut-brown, darkened towards vertex, with pale yellow arc before antennal insertions, at eye margins with narrow,

grey pollinose stripe broadest at antennal bases; orbital plates and ocellar triangle grey-dusted, ocelli grey-white, shiny; orbital plates extending from vertex of head to antennal insertions appearing grey-dusted (dependent on angle of light and viewing), these widened at antennal bases, ocellar triangle extended anteriorly into central grey-dusted, spindle-like vitta, almost reaching antennal bases; posterior orbital seta moderately strong, slightly outcurved, shorter than outer vertical seta, with tiny proclinate medial orbital setulae at base of posterior orbital seta; ocellar setae finer, reaching beyond $\frac{1}{2}$ length of frons; outer vertical seta shorter than inner; postocellar setae small, cruciate; antennal scape and pedicel dirty yellow, silver-dusted, flagellomere 1 black centrally, yellow basally and along apical margin, grey-dusted, longer than wide, with evenly rounded apex, arista with 5–7 long dorsal branches and three ventral branches in addition to terminal fork; ground colour of lunule and face black, faintly grey-dusted throughout, lower part of face subdivided, projecting forward with horizontal indented pre-epistomal line; one pair of fairly strong vibrissae inserted on posterior lateral edge; occiput grey-dusted, black-brown in region immediately behind ocellar triangle, with moderately strong, black postocular setae; gena narrow, grey-dusted in lower $\frac{1}{2}$, abruptly dirty yellow just beyond basal angle. Palpus black-brown.

Thorax. Mesonotum strongly convex, very slightly flattened behind head, with multiple rows of regular, short, black setulae; ground colour dark brown, grey-dusted, with narrow medial chestnut-brown vitta and two narrow lateral brown vittae, all reaching scutoscutellar suture; central vitta ending slightly beyond transverse suture, inner lateral vitta ending just before anterior edge, outer vitta ending equidistant between transverse suture and postpronotum, two pairs of dorsocentral setae, posterior long and strong (subequal to outer scutellar seta), anterior shorter and finer (slightly shorter than inner scutellar seta); one pair of acrostichal setae, slightly shorter than $\frac{1}{2}$ length of posterior dorsocentral seta; presutural seta, strong, reclinate, as long and strong as notopleural seta; two notopleural setae, the anterior slightly stronger; two strong, reclinate supra-alar setae, slightly exceeding length of posterior dorsocentral seta; one reclinate postalar seta, $\frac{2}{3}$ length of posterior dorsocentral seta; postpronotum grey-dusted to dirty yellow, with two equally-sized, strong, postpronotal setae, one reclinate, one proclinate, and three fine setulae; anepisternum grey-dusted with two equally-sized, moderately strong, reclinate anepisternal setae, the more dorsal slightly

stronger, surface with *ca.* 10–25 fine, short setulae arranged concentrically; anepimeron, laterotergite and meron grey-dusted, glabrous; katepisternum grey-dusted, with one strong, dorsally oriented katepisternal seta, with four short, fine setulae at base.

Wing (Fig. 3.1: 5). Long, relatively narrow, tip bluntly pointed, veins chestnut-brown, membrane faintly infusate brown throughout, with markedly darker brown infusate band throughout entire length of r_1 and anterior $\frac{1}{2}$ of r_{2+3} ; costa with prominent costal spines in basal $\frac{2}{3}$ from costal break; R_{2+3} and R_{4+5} sub-parallel; dm broad at $dm-cu$ crossvein; $dm-cu$ crossvein obliquely angled posteriorly; cua_1 relatively short and broad; anal fold extending one-fifth length of cua_1 ; halter dirty white.

Legs. Fore coxa yellow, grey-dusted laterally, with brown preapical seta and two brown setulae on anterior surface; mid- and hind coxa grey-dusted (as on thoracic pleurae), each with one strong, lateral ventrally-directed black seta and one brown setula; tibia and tarsi dirty yellow; all tibia with preapical seta; fore tibia with ctenidium of 7–9 short, closely-approximated, sharp black spinules.

Scutellum (Fig. 3.1: 9). Ground colour chestnut-brown, with slight greyish pruinosity, especially laterally; posterior $\frac{2}{3}$ clothed in fine brown setulae; two pairs of strong scutellar setae, with one weak basal scutellar setula and one strong intermediate scutellar setula; this latter inserted closer to outer than inner scutellar setae.

Abdomen (Fig. 3.1: 13). Ground colour chestnut-brown, clothed in short black setulae; tergites 2–5 with extensive, conspicuous grey-dusted maculae (tergite 2 kidney-shaped, tergite 3 sub-quadrate, tergite 4 sub-triangular, tergite 5 triangular); sternites 2–5 each with lateral grey-dusted band, merging with macula on tergite 4 laterally.

Terminalia (Figs 3.1: 17, 21). Epandrium (Fig. 3.1: 17, *ep*), evenly rounded on dorsal edge, posterior edge obliquely angled, ventral edge with extensive row of short regular to irregular setae; cercus (Fig. 3.1: 17, *ce*) prominent, ventrally orientated; surstylus (Fig. 3.1: 17, *ss*) short, bifurcate, widened apically, with excision wide; postgonite (Fig. 3.1: 17, *pg*) short, sub-triangular; phallus (Fig. 3.1: 21, *ph*, *bp*, *dp*) C-shaped, narrow at junction of phallapodeme and basiphallus; markedly wide at mid-

length, with preapical excavation dorsally, apex with U-shaped inverted excision terminating in narrow recurved hook.

Female. Similar to male, except in the following respects: head (Fig. 3.1: 1) with frons slightly wider; spermatheca (Fig. 3.1: 25) black, uniform, symmetrical, barrel-shaped, with triangular basal section.

Variation. The wing may be more extensively infusate in some specimens, but the marginal band is consistently more apparent. Spermathecae of some specimens vary slightly in overall shape, but never possess the lip apparent in *A. quasimodoi* sp. n. (described below).

Type material examined. SENEGAL: lectotype ♂ (here designated), “Senegal [specific locality unknown] / Guérin [handwritten; white disk] // *Diastata* / *fuscipennis* [handwritten; rectangular card] // 557 bis [handwritten; rectangular card] // LECTOTYPE / *Diastata* ♂ / *fuscipennis* Macquart, 1844 / designated by / A.H. Kirk-Spriggs 2007 [blue card]” (MNHN). Direct-pinned, in poor condition, entire surface covered in mould. Right hindleg detached, glued to data label (white disk), otherwise complete. Dissected, with abdomen and terminalia in micro-vial pinned beneath specimen. Paralectotype ♂ (here designated), same data as lectotype, except “// Type // [printed in red; rectangular card] // PARALECTOTYPE / *Diastata* ♂ / *fuscipennis* Macquart, 1844 / designated by / A.H. Kirk-Spriggs 2007 [blue card]” (MNHN). In poor condition, entire surface covered in mould; direct-pinned; not dissected.

Remarks. In Macquart’s (1844) description he did not specify the number or sex of the type specimens examined. There are two male syntypes in MNHN (both of which bear Macquart’s determination labels), one of which was dissected and is here designated as lectotype; the non-dissected male as paralectotype. Standing by the specific name label for *fuscipennis* in the Macquart collection is the printed number “1035” on a rectangular white card. This number refers to the entry in the official catalogue of the Macquart Collection in MNHN. Macquart’s (1844) reference to “M. Guérin” refers to “Monsieur Guérin”, the type material originating from F.E. Guérin-Méneville (C. Daugeron, pers. comm. 2007).

Additional material examined. (all labelled: *Axinota* ♂ [or ♀] *fuscipennis* (Macquart, 1844) det. A.H. Kirk-Spriggs 2009): [BURUNDI]: 1 [unsexed], “Urundi Rumonge, alt. 780 m., juin 1948, F. François, Sur plage sablonneuse et broussailles près du Lac [on sandy beach and brush near lake], R. I.

Sc. N. B. I. G. 24.452, Muséum Paris, *Curtonotum fuscipenne* Macquart, L. Tsacas det. 1973 [abdomen missing] (MNHN); 1♀, same data (IRSNB). CAMEROON: 1♀, “CAMEROON, Kribi (beach), 28–29.XI.1987, Fini Kaplan (TAU). [DEMOCRATIC REPUBLIC OF CONGO]: 1♂, Musée du Congo, Sankuru, viii.1924, L.¹. Ghesquière (RMCA). GABON: 1♂, Gabon, Port Gentil, vii-12-[19]57, E.S. Ross & R.E. Leech collectors (CAS). GAMBIA: 1♂, 2♀, Gambia: W. Div., Abuko, on mature rice, 27.xi.1993, J.C. Deeming & K.E. Shaw, NMW.Z. 1993–093 (all NMWC); 1♂, GAMBIA (X84): Abuko National Park, 3.iv.1977, M. von Tschirnhaus, rice fields (FBUB); 1♀, same data (ZSM). MALAWI: 1♀, MALAWI (X871): Kasungu National Park, Lifupa Lodge, 23.ix.1993, grazed by hippopotamus along artificial lake (ZSM). [NAMIBIA]: 1♂, Kavango, Popa Falls, 18°07’S, 21°33’E, 26–31.viii.1971, H3679, [State Museum staff]; 1♀, Kavango, Takuasa, SE1720Cd [= Takwasa], 14–19.viii.1971, H3032, [State Museum staff] (both NMNW). NIGERIA: 1♂, 1♀, N. Nigeria: River Bagel at crossing of Bauchi-Dass road, 3.iv.1990, J.C. Deeming, roosting in moist cave in bank of dry river, NMW.Z.1981–001; 1♂, N. Nigeria: Zaria, Dutsin Kura, 5.ii.1970, J.C. Deeming, *Curtonotum fuscipenne* (Macquart) ♂ det. J.C. Deeming 2003 (all NMWC); 1♂, N. Nigeria, nr. Funtua, Mairuwa Dam, 25.iii.1973, L.V. Knutson (USNM); 1♀, Nigeria: Niger State, Zugurma, Rt. F210, 100 km N. Ilonin, 12.xii.1987, Amnon Freidberg (TAU). SOUTH AFRICA: 1♂, South Africa: Natal, Makaheli For., 2632Dd, ca. 5 km NE Mangusi, 30.xi–2.xii.1982, Barraclough, Londt & Stuckenberg, forest; 1♂, South Africa: Natal, Kosi Bay Nat. Reserve, 2632Dd, 30.xi–2.xii.1982, Londt, Barraclough & Stuckenberg, forest & open woodland areas; 2♀, South Africa: Natal, 1.5 km E. Mtunzini, 2831Dd, Umlalazi Nature Res., 27.ix.1980, R. Miller, coastal indigo. forest (all NMSA); 1♀, RSA: Natal, Richards Bay, 28°46’S, 32°04’E, 24.x.1984, loc. 31, leg. R. Danielsson (MZLU). [TANZANIA]: 1♀, Nyassa-See, Langenburg [= Lumbira], 17.iv.[18]99, Fülleborn S., Zool. Mus. Berlin (ZMHB). TOGO: 1♀, Togo: Région des Plateaux: Atakpamé, edge of town, at creek below Catholic Mission, 07°31’20”N, 01°08’12”E, 12.iv.2008, 290 m, M. v. Tschirnhaus, Tg1868, Bank high vegetation with much rubbish, swept, filled into eclector; 1♀, Togo: Région des Plateaux: SE of Kolo-Kopé, near bridge over river Mono, near, 07°47’N, 01°17’E, 10.iv.2008, 210 m, M. v. Tschirnhaus, Tg1863, sand bank of river Mono with Cyperaceae near sheep stables, swept, filled in eclector (both ZSM).

Distribution. Burundi, Cameroon, Democratic Republic of Congo, Gabon, Gambia, Malawi, Namibia, Nigeria, Senegal, South Africa, Tanzania and Togo (Figs 3.1: 29, 30).

Bionomics. The species is apparently largely associated with indigenous and riverine forest. Records from Namibia indicate a specific association with gallery forest and specimens from Nigeria have been collected roosting in a moist cave in bank of a dry riverbed, indicating similar daytime roosting behaviour to some species of *Curtonotum* and *Cyrtona Séguéy sensu lato*.

***Axinota quasimodoi* Kirk-Spriggs, sp. n.,**

Figs 3.1: 2, 6, 10, 14, 18, 22, 26, 29, 30

Curtonotum fuscipenne sensu Curran 1933: 1, part.

Cyrtonotum fuscipennis sensu Séguy 1933: 35, part.

Etymology. The specific epithet *quasimodoi* is named after the character Quasimodo from Victor Hugo's (1831) novel, *Notre-Dame de Paris*, and refers to the extreme hunchbacked appearance of the species.

Description (male)

Measurements. Overall length: ca. 1.8–3 mm ($n = 7$); length of head and thorax combined: 1.7–2.2 mm; length of thorax and scutellum combined: 1.6–2.1 mm; wing length: 3.1–3.6 mm ($n = 5$ males).

Head (Fig. 3.1: 2). As described for *Axinota fuscipennis* (above), except: frons dark brown throughout and flagellomere 1 black throughout; grey-dusted lateral facial vittae complete or divided in some specimens (as in Fig. 3.1: 2). Palpus black-brown.

Thorax. Mesonotum strongly convex, very slightly flattened behind head, with multiple rows of regular, short, black setulae; ground colour brown, grey-dusted, with moderately wide medial chestnut-brown vitta and two lateral brown vittae, all reaching scutoscutellar suture; central vitta ending slightly beyond transverse suture, inner lateral vitta ending just before anterior edge, outer vitta complete or interrupted, ending at postpronotum; other thoracic pleurae and setation as described for *A. fuscipennis* above.

Wing (Fig. 3.1: 6). As described for *Axinota fuscipennis* (above), except: membrane darkly infusate brown throughout, darker in r_1 and anterior $\frac{1}{2}$ of r_{2+3} ; R_{2+3} and R_{4+5} parallel; dm narrow at $dm-cu$ crossvein; $dm-cu$ crossvein only slightly angled posteriorly; cua_1 long and narrow; anal fold long, extending $\frac{2}{3}$ length of cua_1 .

Legs. As described for *A. fuscipennis* above, except: fore tibia with a ctenidium of 7–11 short, widely to closely approximated, sharp black spinules.

Scutellum (Fig. 3.1: 10). Ground colour chestnut-brown, with slight greyish pruinosity, especially in lateral regions (appearing as two bands at lower

magnifications, sometimes yellowish-grey); posterior $\frac{2}{3}$ clothed in fine brown setulae; with two pairs of strong scutellar setae and one weak basal scutellar setula and one strong intermediate scutellar setula; intermediate scutellar setula inserted equidistant between outer and inner scutellar setae.

Abdomen (Fig. 3.1: 14). Ground colour chestnut-brown to black, clothed in short black setulae; tergites 1–2 entirely black, tergites 3–5 with reduced triangular maculae laterally; sternites 2–5 with grey-dusted band, merging with spot on tergite 4 laterally.

Terminalia (Figs 3.1: 18, 22). Epandrium (Fig. 3.1: 18, *ep*), virtually straight on dorsal and posterior edge (not ventrally orientated), ventral edge with row of long irregular setae; cercus (Fig. 3.1: 18, *ce*) prominent, posteriorly-directed; surstylus (Fig. 3.1: 18, *ss*) long, narrow, bifurcate, narrowed apically, with excision narrow; postgonite (Fig. 3.1: 18, *pg*) short, subtriangular; phallus (Fig. 3.1: 22, *ph*, *bp*, *dp*) C-shaped, wide at junction of phallapodeme and basiphallus, markedly wider in apical $\frac{1}{2}$; distiphallus narrow basally, subdivided apically into two overlapping processes, dorsal process developed apically into backward-directed claw.

Female. Similar to male, except in the following respects: frons slightly wider; spermatheca (Fig. 3.1: 26) brown-black, tubular, sub-parallel-sided, with distinct, apical lip, basal section sub-triangular.

Variation. The specimens from Togo (Ayikpara near Kokoté and north of Kessibo-Wawa) (cited below) are smaller than average (wing length: 2.3–2.5 mm ($n = 4$ males, 2 females)) and have the dorsal extension of the distiphallus slightly more angular. As the overall shape of the phallus and epandrium is consistent with specimens from elsewhere within the range of the species this is regarded as intraspecific variation.

Type material examined. TANZANIA: holotype ♂, “TANZANIA: / Usambara Mts. / near Soni, 800m / river, 8.ix.1996 / A. FREIDBERG // HOLOTYPE ♂ / *Axinota* / *quasimodoi* sp. n. / det. A.H. Kirk-Spriggs 2009 [red card]” (TAU). Micro-pinned and staged; in excellent condition. Dissected, with abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE / *Axinota* ♂ [or ♀] / *quasimodoi* sp. n. / det. A.H. Kirk-Spriggs 2009 [blue

card]”): ANGOLA: 1♂ “ANGOLA (A26) / Salazar, I.I.A.A. / 9–15.iii.1972 // Southern / African Exp. / B.M.1972-1 // Muséum Paris [black border] // Gardé! [handwritten] // *Curtonotum* ♀ / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (MNHN); 1♀, same data, except no “Gardé!” and “Muséum Paris” labels (BMNH); 1♂ “ANGOLA (A30) / 7 mls. W.Gabela / 16–18.iii.1972 // Southern / African Exp. / B.M.1972-1 // *Curtonotum* / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (BMNH). [BURUNDI]: 1♀, “Urundi Rumonge / alt. 780 m. 20 IX 1948 / F. François // Dans herbes dutour / trou d’eau [= off grass around a waterhole] [handwritten] // R. I. Sc. N. B. / I. G. 24.452 // Muséum Paris [black border] // *Curtonotum* / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (MNHN); 1♂, “Urundi : Makamba / v-1948 / F.J. François // R. I. Sc. N. B. / I. G. 24.452 // *Curtonotum* / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” [head missing]; 1♂, “Urundi ; Butesti (Moso) [= Butezi] / Terr. Ruland / 27-v-1950 1250m. / F. François [printed & handwritten] // R. I. Sc. N. B. / I. G. 24.452 // *Curtonotum* / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (both IRSNB). CAMAROON: 1♂, “B.CAMEROONS: / Victoria. / 29.ix.1949 / H. Oldroyd. / B.M.1950-2. [printed & handwritten] // *Curtonotum* / *fuscipenne* / Macquart / L. Tsacas det. 1978 [printed & handwritten]” (BMNH); 1♂, “CAMEROON REPUBLIC / West Cameroons / Bille [= River Bille W. of Kumba (H. Disney pers. com. 2007)] / 4.ii.1970 / R.H.L. Disney [printed & handwritten] // *Curtonotum* / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (BMNH); 1♂, “CAMEROUN / Yaoundé-N’Kolbisson / 24.7-1967 / L. MATILE rec. [printed & handwritten; pale blue card] // MUSÉUM PARIS [pale blue card] // *Curtonotum* / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]”; 1♀, “Cameroun / Mbalmayo / Evindissi / 21.7.1967 / L. Matile rec. [handwritten; pale blue card] // MUSÉUM PARIS / Cacaoyers / et Forêt [= cacao trees and forest] [printed & handwritten; pale blue card] // *Curtonotum* ♀ / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (both MNHN); 1♀, “W-Africa: Cameroon: / 50 km S Yaounde: / Mbalmayo: City: (“See / des Bischoffs”). / BARKEMEYER 5.3.1984 // NATAL MUSEUM / Pietermaritzburg / South Africa [pale green paper]” (NMSA); 2♂, 8♀, “Cameroun: Sector E: / Province Sud-Ouest, Dépt. / Fako: Liongo (Community of Muea) NE of / Buéa 04°11’35”N 09°19’27”E / 14.v.2006, 470 m / F. Menzel, Cam23 // River bank along a banana / plantation, wet ruderal / vegetation on lava, swept”; 1♀, “Cameroon: Prov. Nord / Dépt. Faro: village Ndom- / Beoué (NW of Wak) / 07°45’27”N, 13°31’32”E / 8.v.2006, 565m / F. Menzel, CAM11 // River bank of Mayo Ndom- / Beoué, above herb / vegetation near bank, swept”; 2♀, “Cameroon: Prov. Sud- / Ouest / Dépt. Fako: Bakingili NW / of Limbe (mile 11 in / direction of Idenao), / 04°03’25”N, 09°03’15”E / 13–16.v.2006, 2–10 m / F. Menzel, CAM25 // Hotel area of “Seme New / Beach Hotel”, on house / walls at light” (all DEI). CÔTE D’IVOIRE: 6♂, 5♀, “Bandama / 22/2/71 [handwritten] // Muséum Paris / Côte d’Ivoire / Lamto [printed & handwritten] // *Curtonotum* [♂ or ♀] / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]”; 1♂, “Bandama / 9/12/71 [handwritten] // *Crinum jagus* / Amaryllidaceae [handwritten] // Muséum Paris // *Curtonotum* ♀ / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (all MNHN). [DEMOCRATIC REPUBLIC OF CONGO]: 1♂ “Kasai : Terr. De / LUEBO / 1958 / F.J. François [printed & handwritten] // R. I. Sc. N. B. / I. G. 24.452 // Muséum Paris [black border] // *Curtonotum* / *fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (MNHN); 1♂, same data

(IRSNB); 3♂, 1♀, “Congo belge / Baleko [= Baleke] / 27-iii.1946 / F.J. François [printed & handwritten] // R. I. Sc. N. B. / I. G. 24.452 // Muséum Paris [black border] // *Curtonotum / fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (1♂, head detached, glued to card point; 2♂, 1♀, head missing) (all MNHN); 1♂ “B.CONGO:13 / mi.E.Kenge / VIII-4-57 // E.S. Ross & / R.E. Leech / collectors” (CAS); 1♂ “MUSÉE DU CONGO / Elisabethville (R. Lu- / bumbashi) 19-V-1920 / D^r M. Bequaert [printed & handwritten] // Muséum Paris [black border] // *Curtonotum / fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (MNHN); 3♂, 1♀, “MUSÉE DU CONGO / Eala / 22-XI-1931 / H. J. Brédo” (RMCA); 1♂, “Congo Belge / Eala – 27.iii-1936 / J. Ghesquière [printed & handwritten] // R. Mus. Hist. Nat. / Belg. I. G. 10.482 // *Curtonotum / fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]” (IRSNB); 1♂, “BELGIAN CONGO / Katanga / Dilolo / 24-27 vii.1931 / Prof.T.D A.Cockerell” (NMSA); 1♀, “Congo belge : P N U / Lufira au pied-du Mt. / Sombwe 13-15-VII-1949 / M s.G F de Witte 2778a” (RMCA). ETHIOPIA: 1♂, “ETHIOPIA: Erer River, 1330m / Rt.4,20kmE Harar / 9°14.5'N42°14.8'E / 11.xi.2007 / L. FIEDMAN” (TAU). [GHANA]: 1♂, “Kumasi / Ashanti / W. Africa / 21.x.1907 / Dr. W.M. Graham / 1908-245 [printed & handwritten] // ‘caught hovering / in bush path’” (BMNH). MOZAMBIQUE: 1♀, “near Machipanda / Mozambique, 19 Jan. 1955 / R.R.S. P.G. [yellowing card] // *Curtonotum / fuscipennis* Macq. / L. Tsacas det. 1978 [printed & handwritten]” (NMSA). NIGERIA: 1♂, “Ile-Ife, Nigeria / 2 Aug 1969 / Col. J.T. Medler [printed & handwritten] // *Curtonotum / fuscipenne* / Macquart / L. Tsacas det. 1973 [printed & handwritten]”; 1♂, “Ile-Ife, Nigeria / 10 Dec 1969 / Col. J.T. Medler [printed & handwritten] // 69–225 [typed] // C.I.E.COLL. / A3736 [printed & handwritten] // Pres by / Com inst Ent / B M 1970-1” (both BMNH). TANZANIA: 1♀, same data as holotype (TAU); 1♀, “TANZANIA: / Same, Rt. B1 / 22.viii.1996 / A. FREIDBERG” (TAU); 1♀, “TANZANIA / Morogoro / 5.viii.1994 / J.W. Ismay // NMW.Z / 1994-062” (NMWC). TOGO: 2♂, 1♀, “Togo: Région des / Plateaux / Région du / Centre: Ayikpara near / Kokoté (NE of / Nyamassila), at creek Ila / 08°02'03"N, 01°14'11"E / 11.iv.2008, 185 m / F. Menzel, Tog18 // Wet & shadowy creek bed / with mud & much dead / wood & rotting leaf litter, / swept”; 2♂, “Togo: Région des / Plateaux: N of Kessibo- / Wawa, at the border to / Ghana (N of Badou), at / river Wawa / 07°42'11"N, 00°35'26"E / 24.iv.2008, 180 m / F. Menzel, Tog61 // Forest understorey, cocoa / plantation, & sun exposed / vegetable fields, some / Cyperaceae, swept” (all DEI); 1♂, same data, except “/ M. v. Tschirnhaus, Tg1906 // filled / into eclector” (FBUB). UGANDA: 1♂, “UGANDA: / Ruwenzori Range. / xii.1934-i.1935. / B.M.E.Afr.Exp. / B.M.1935-203 // Kyarumba, / 4,500ft. / D.R.Buxton // *Curtonotum / fuscipenne* / Macquart / L. Tsacas det. 1978 [printed & handwritten]” (BMNH); 1♀ “UGANDA: S.E. / Semiliki Forest [*sic*, = Semliki Forest] / 1250m, 8.i.1996 / I. YAROM & A. FREIDBERG” (TAU).

Additional material examined. [DEMOCRATIC REPUBLIC OF CONGO]: 1 [unsexed], Musée du Congo, Eala, iii.1932, H.J. Brédo [abdomen missing] (RMCA). MOZAMBIQUE: 1 [unsexed; labelled ♀ by L. Tsacas], Muséum Paris, Mozambique, Haut Nhamapaza, Maringoué, P. Lesne 1929, *Curtonotum* sp. aff. *fuscipennis* Macq. ♀, L. Tsacas det. 1973 [abdomen missing] (MNHN). TOGO: 1♀, Togo: Région des Plateaux: Fatchiahoé NW of Tado (NW of Tohou), at bridge over creek Ulalli (?Valli), 07°11'32"N, 01°32'14"E, 7.iv.2008, 105 m, M. v. Tschirnhaus, Tg1855,

Between river & field with okra & maize, swept, filled into eclector [in spirit], BMSA(DNA)# 0013 (BMSA).

Distribution. Angola, Burundi, Côte d'Ivoire, Cameroon, Democratic Republic of Congo, Ethiopia, Ghana, Liberia, Nigeria, Mozambique, Tanzania, Togo and Uganda (Figs 3.1: 29, 30).

Bionomics. Label data indicate that the species is apparently largely associated with indigenous and riverine forest. The species has also been collected on house walls at light in Cameroon, indicating crepuscular or nocturnal flight activity.

***Axinota ahdabi* Kirk-Spriggs, sp. n.,**

Figs 3.1: 3, 7, 11, 15, 19, 23, 29, 30

Axinota sp. *sensu* Kirk-Spriggs (2008a: 710), erroneously cited as two females.

Etymology. The specific epithet *ahdabi* is derived from the Romanised Arabic adjective اهدح (ahdab) meaning hunchbacked; reflecting both the extreme hunchbacked appearance of the species and the language spoken in the country of origin, Yemen.

Description (holotype male)

Measurements. Length of head and thorax combined: 1.3 mm; length of thorax and scutellum combined: 1.1 mm; wing length: 2.6 mm ($n = 1$ male).

Head (Fig. 3.1: 3). Compound eye brown-grey, in profile gently and evenly rounded anteriorly, with indentation at midlength of inner margin, ratio long axis to width: 3.3:1.9; frons wider at antennal insertions than at ocellar triangle, ground colour deep chestnut-brown, darkened towards vertex, lateral margins with narrow, yellowish-white pollinose stripe, broadest at antennal bases; orbital plates and ocellar triangle yellowish-grey-dusted, ocelli grey-white, shiny; orbital plates extending from vertex of head to antennal insertions appearing as narrow, yellowish-grey-dusted vittae, these widened at antennal bases, ocellar triangle extended anteriorly into central yellowish-grey-dusted, spindle-like vitta, reaching antennal bases; posterior

orbital seta moderately strong, recumbent, same length as outer vertical seta, with minute reclinate medial orbital setulae at base of posterior orbital seta; ocellar setae of similar length and thickness as posterior orbital seta; outer vertical seta shorter than inner vertical seta; postocellar setae small, cruciate; antennal scape and pedicel dirty yellow, silver-dusted, flagellomere 1 yellowish-brown centrally, yellow basally, longer than wide, with slightly truncate apex, arista with 4–5 long dorsal branches and 2–3 ventral branches in addition to terminal fork; ground colour of lunule and face grey-black, faintly grey-dusted throughout, lower part of face not projecting forward, without horizontal indented pre-epistomal line; one pair of fairly strong vibrissae inserted on posterior lateral edge; occiput grey-dusted, black-brown in region immediately behind ocellar triangle, with moderately strong, black postocular setae; gena very narrow, grey-dusted. Palpus black-brown.

Thorax. Mesonotum strongly convex, evenly rounded, with multiple rows of regular, short, black setulae; ground colour brown, silver-grey-dusted, with narrow medial deep brown vitta and two narrow lateral chocolate-brown vittae; medial vitta reaching scutoscutellar suture, ending slightly beyond transverse suture, inner lateral vittae extending from occiput to mid-length of mesonotum, outer vittae extending from transverse suture to scutoscutellar suture; two pairs of dorsocentral setae, posterior long and strong (shorter than outer scutellar seta), anterior shorter and finer ($\frac{2}{3}$ length of inner scutellar seta), one pair of acrostichal setae, slightly longer than $\frac{2}{3}$ length of posterior dorsocentral seta; presutural seta strong, reclinate, longer and stronger than anterior notopleural seta; two notopleural setae, the anterior slightly stronger; two supra-alar setae, anterior stronger than posterior, slightly exceeding length of posterior dorsocentral seta; one weakly developed reclinate seta, less than $\frac{1}{3}$ length of posterior dorsocentral seta; postpronotum silver-grey-dusted, with two subequal, strong, postpronotal setae (orientation of setae not discernible due to shrinkage); anepisternum silver-grey-dusted with two moderately strong reclinate anepisternal setae at posterior margin, the more ventral stronger and thicker, surface with *ca.* 14 fine, short setulae arranged in dorsal corner and concentrically; anepimeron, laterotergite and meron silver-grey-dusted, glabrous; katepisternum silver-grey-dusted, with one strong, dorsally orientated katepisternal seta, surface with two minute setulae at base.

Wing (Fig. 3.1: 7). Long, relatively broad, tip bluntly pointed, veins pale tan, membrane hyaline throughout; costa with row of short, regular spines for basal $\frac{2}{3}$ from costal break; subcosta complete; R_{2+3} and R_{4+5} slightly divergent; dm moderately broad at $dm-cu$ crossvein; $dm-cu$ crossvein obliquely angled posteriorly; cua_1 relatively short and broad; anal fold only, extending $\frac{1}{2}$ length of cua_1 ; halter pure white.

Legs. Fore coxa yellow, grey-dusted laterally, with brown preapical seta and four or five short, brown setulae on anterior surface; mid- and hind coxa yellow, grey-dusted (as on thoracic pleurae); midcoxa with one strong, black, ventrally-directed lateral seta and two brown setulae; hind coxa with one ventrally-directed, lateral black seta; fore and midtibia and tarsi uniform dirty yellow; hindtibia dirty yellow, with preapical oblique brown band; all tibia with preapical seta; fore tibia with ctenidium of six short, widely-approximated, sharp, black spinules.

Scutellum (Fig. 3.1: 11). Ground colour silver-grey-dusted (as on mesonotum), pale yellowish around apical margin, basal corners and medially with chocolate-brown markings; posterior $\frac{2}{3}$ clothed in fine, brown setulae; two pairs of strong scutellar setae, with one weak basal scutellar setula and one weak intermediate scutellar setula; intermediate scutellar setula inserted closer to outer than inner scutellar setae.

Abdomen (Fig. 3.1: 15). Ground colour deep brown (coloured as vittae on mesonotum), clothed in short black setulae; tergites 3–5 with sub-quadrate to elliptical silver-grey maculae; sternites 2–5 with silver-grey-dusted band, not merging with maculae laterally (as the abdomen of the male holotype was subject to shrinkage, Fig. 3.1: 15 was prepared from the partially macerated abdomen of the female paratype, and is thus distended laterally. In life the abdominal pattern broadly resembles that of *A. kyphosis* sp. n. (Fig. 3.1: 16)).

Terminalia (Figs 3.1: 19, 23). Epandrium (Fig. 3.1: 19, *ep*) evenly rounded dorsally, posterior margin subparallel, ventral lower edge angular, with extensive row of long irregular setae; cercus (Fig. 3.1: 19, *ce*) relatively small, but prominent, postero-laterally-directed; surstylus (Fig. 3.1: 19, *ss*) moderately long, narrow, bifurcated, broad apically, with excision moderately wide; postgonite not clearly defined; phallus (Fig. 3.1: 23, *ph*, *bp*, *dp*) C-shaped, moderately narrow in region of phallapodeme and basiphallus, widening medially to apex of distiphallus; distiphallus

subdivided apically into two overlapping blunt processes; weakly sclerotised lateral process developed preapically into ventrally-directed hook.

Female. Similar to male, except in the following respects: larger, wing length: 3.10 mm ($n = 1$). Head with frons wider, ratio length to width: 1.0:0.5 ($n = 1$); orbital plates wider and more widely-spaced; ocellar triangle extending anteriorly into central yellowish-grey-dusted, spindle-like vitta, wider, not reaching antennal bases. Thorax silver-grey-dusted, with mesonotum yellow in region of postpronotum, lacking brown vittae. Spermatheca (Fig. 3.1: 27) pale brown, sub-elliptical, with long, narrow basal segment.

Variation. Insufficient material is available to assess variability.

Differential diagnosis. External features indicate that the species may be related to *A. rufipes* Okada, 1966, described from Nepal (as Diastatidae). The male phallus of this species does not closely resemble any known species of the genus. A revision of the Oriental species of *Axinota* is required before relationships can be fully established.

Type material examined. YEMEN: holotype ♂, “YEMEN: / Ar Rujum [15°30'N, 43°42'E, 2200 m a.s.l. (A. van Harten, pers. comm. 2007)] / 16.x.2000 / –15.i.2001 / Malaise trap / A. vanHarten / & A.M. Hager [handwritten] // HOLOTYPE ♂ / *Axinota* / *ahdabi* sp. n. / det. A.H. Kirk-Spriggs 2009 [red card]” (NMWC). Card-pointed; in good condition. Dissected, with abdomen and terminalia in micro-vial pinned beneath specimen. Paratype: ♀, “YEMEN: / Ta'izz [13°35'N, 44°02'E, 1400 m a.s.l. (A. van Harten, pers. comm. 2007)] / 5.i-2.ii.1998 / light trap / A. van Harten / & M. Mahyoub // PARATYPE ♀ / *Axinota* / *ahdabi* sp. n. / det. A.H. Kirk-Spriggs 2007 [blue card]” (NMWC). In poor condition, mesonotum badly rubbed most setation on thorax missing, wings folded, left midtibia and tarsus, right hindleg and some apical tarsal segments missing.

Distribution. Yemen (Figs 3.1: 29, 30).

Bionomics. The male holotype from Ar Rujum was collected in a Malaise trap in a tree nursery of the Ministry of Agriculture and Irrigation, on the lower part of the high plains. The surrounding landscape is dominated by *Acacia* (Fabaceae) and *Ziziphus* (Rhamnaceae) trees and *Euphorbia* (Euphorbiaceae) shrubs, with some

cultivated cereal crops. The female paratype from Ta'izz was collected at light on an experimental farm in the quarter Usaifira, on the northern outskirts of the town. The farm was cultivated with permanent fruit crops (citrus, mango), cereals and vegetables. The two localities are quite far from each other (*ca.* 300 km), but both occur in the highlands of Yemen and the specimens were collected at high elevations (2200 and 1400 m a.s.l., respectively) (A. van Harten, pers. comm. 2007). The collection of the female paratype at lights may indicate crepuscular or nocturnal flight activity.

***Axinota kyphosis* Kirk-Spriggs, sp. n.,**

Figs 3.1: 4, 8, 12, 16, 20, 24, 28, 29, 30, 32

Apsinota sp. *sensu* Tsacas (1974: 717).

Etymology. The specific epithet *kyphosis* is a noun in apposition derived from the medical term for extreme curvature of the upper back (hunchbacked) and refers to the extreme hunchbacked appearance of this species.

Description (male)

Measurements. Overall length: *ca.* 2.4 mm (*n* = 1 male); length of head and thorax combined: 1.2 mm; length of thorax and scutellum combined: 1.3 mm; wing length: 3.1 mm (*n* = 1 male).

Head (female, Fig. 3.1: 4). Compound eye reddish-brown (female paratype from “Maromandia”), in profile gently and evenly rounded anteriorly, with indentation at midlength of inner margin, ratio long axis to width: 1.1:0.7; frons wider at antennal insertions than at ocellar triangle, ground colour pale brown, paler towards antennal bases, darkened towards vertex, at eye margins with narrow, yellowish-white pollinose stripe, broadest at antennal bases; orbital plates and ocellar triangle yellowish-grey-dusted, ocelli grey-white, shiny; orbital plates extending from vertex of head to antennal insertions as narrow, yellowish-grey-dusted vittae (dependent on angle of light and viewing), these narrow at antennal bases, ocellar triangle extended anteriorly into central yellowish-grey-dusted, spindle-like vitta, reaching antennal bases; posterior orbital seta moderately strong, recumbent, same length as outer

vertical seta, with minute reclinate medial orbital setulae at base of posterior orbital seta; ocellar setae of similar length, but narrower than posterior orbital seta; outer vertical seta shorter than inner vertical seta; postocellar setae small, cruciate; antennal scape and pedicel dirty yellow-brown, silver-dusted, flagellomere 1 pale yellow to yellowish-brown, slightly darker along leading edge, longer than wide, with squarely rounded apex, arista with five long dorsal branches and two ventral branches in addition to terminal fork; ground colour of lunule and face grey-black, faintly grey-dusted throughout, lower part of face not projecting forward, without horizontal indented pre-epistomal line; one pair of fairly strong vibrissae inserted on posterior lateral edge; occiput grey-dusted, black-brown in region immediately behind ocellar triangle, with moderately strong black postocular setae; gena very narrow, grey-dusted. Palpus black-brown.

Thorax. Mesonotum strongly convex, evenly rounded, with multiple rows of regular, short, black setulae; ground colour brown, greyish-white, blue pollinose throughout, lacking conspicuous vittae or other markings; two pairs of dorsocentral setae, posterior long and strong (shorter than outer scutellar seta), anterior shorter and finer, one pair of acrostichal setae, slightly longer than $\frac{2}{3}$ length of posterior dorsocentral seta; presutural seta strong, reclinate, shorter and weaker than anterior notopleural seta; two notopleural setae, the anterior slightly stronger; two supra-alar setae, anterior stronger than posterior, greatly exceeding length of posterior dorsocentral seta; one reclinate postalar seta, moderately developed, about $\frac{1}{2}$ length of posterior dorsocentral seta; postpronotum silver-grey-dusted, with two sub-equal, strong, postpronotal setae, one proclinate, one downturned; anepisternum silver-grey-dusted with two moderately strong reclinate anepisternal setae at posterior margin, the more ventral slightly weaker, surface with *ca.* 20 fine, short setulae arranged in dorsal corner and concentrically; anepimeron, laterotergite and meron silver-grey-dusted, glabrous; katepisternum silver-grey-dusted, with one strong, dorsally-directed katepisternal seta, surface with two minute setulae posteromedially.

Wing (Fig. 3.1: 8). As described for *A. ahdabi* sp. n. above, except: R_{2+3} and R_{4+5} parallel, slightly divergent apically; *dm* moderately narrow basally, *dm-cu* crossvein slightly angular, obliquely angled posteriorly; *cua*₁ moderately long and broad; anal fold extending less than $\frac{1}{2}$ length of *cua*₁; halter yellowish-white.

Legs. As described for *A. ahdabi* sp. n. above, with ctenidium of 6–7 short, widely-approximated, sharp, black spinules.

Scutellum (Fig. 3.1: 12). Ground colour greyish-white, blue pollinose (as on mesonotum), pale yellowish around apical margin, baso-medially with pale brown sub-triangular marking (weakly expressed in teneral specimens); posterior $\frac{2}{3}$ clothed in fine, brown setulae; two pairs of strong scutellar setae, with one weak basal scutellar setula and one weak intermediate scutellar setula; intermediate scutellar setula inserted closer to outer than inner scutellar setae.

Abdomen (Fig. 3.1: 16, description based on female paratype from “nr Isalo National Park”). Ground colour chestnut-brown, clothed in short black setulae; tergite 1 silver-grey-dusted throughout; tergite 2 silver-grey-dusted, with median brown streak and chestnut-brown maculae in lateral corners at segmental border of tergites 2 and 3; tergites 3–6 distinctly patterned with sub-quadrate to sub-triangular silver-grey maculae; sternites 2–5 with yellow-grey-dusted fascia laterally.

Terminalia (Figs 3.1: 20, 24). Epandrium (Fig. 3.1: 20, *ep*) gently inclined dorsally, posterior margin subparallel, ventral edge with row of long irregular setae; cercus (Fig. 3.1: 20, *ce*) prominent, posteriorly-directed; surstylus (Fig. 3.1: 20, *ss*) long, narrow, bifurcated, narrowed apically, with excision moderately wide; postgonite not discernible; phallus (Fig. 3.1: 24, *ph*, *bp*, *dp*) C-shaped, wide at base of phallapodeme, markedly wider in apical $\frac{2}{3}$; distiphallus wide apically, subdivided into three linear processes; dorsal process spindle-like; medial process slightly downcurved at midlength, with ventrally-directed hook; ventral process shorter than medial process, straight apically.

Female. Similar to male, except in the following respects: head with frons wider, ratio length to width: 5.0:3.5 ($n = 1$); orbital plates wider and more widely-spaced; frons darker basally between silver-dusted stripe at eye margin and orbital plate; ocellar triangle extending anteriorly into central yellowish-grey-dusted, spindle-like vitta, wider than in male, reaching antennal bases (under some lights). Thorax with mesonotum yellow in region of postpronotum. Spermatheca (Fig. 3.1: 28) pale brown, mushroom-shaped, with long, narrow basal segment.

Variation. The male holotype and female paratype (10 km west of Sakaraha) and female paratype (near Isalo), are ex alcohol and have the mesonotum rubbed, revealing a slight golden hue. The silver-blue pruinosity of the mesonotum of these specimens is not as apparent as in the dry-mounted female paratype from Maromandia, and the basal sub-triangular marking of the scutellum is less apparent.

Differential diagnosis. Based on examination of the male terminalia the new species appears to be most closely related to *A. rufipes*, described (as Diastatidae) from Nepal, and subsequently recorded from Thailand by Delfinado (1969: 212). Although Okada's figure of the male phallus (p. 12, fig. 18; illustrated from left side) is somewhat diagrammatic, it is apparent that the apical part of the distiphallus is subdivided into three linear extensions, as in the new species described above (Fig. 3.1: 24, illustrated from right side). The dorsal extension is short in *A. rufipes* and downcurved, whereas in *A. kyphosis* sp. n. it is long and spindle-like; the medial extension is not hooked in *A. rufipes*, but is distinctly hooked in *A. kyphosis* sp. n., and the ventral extension is upcurved apically in *A. rufipes*, but straight in *A. kyphosis* sp. n. The two species are similar in other respects, especially the greyish-white, blue pollinosity and the lack of vittae and other conspicuous patterning on the mesonotum.

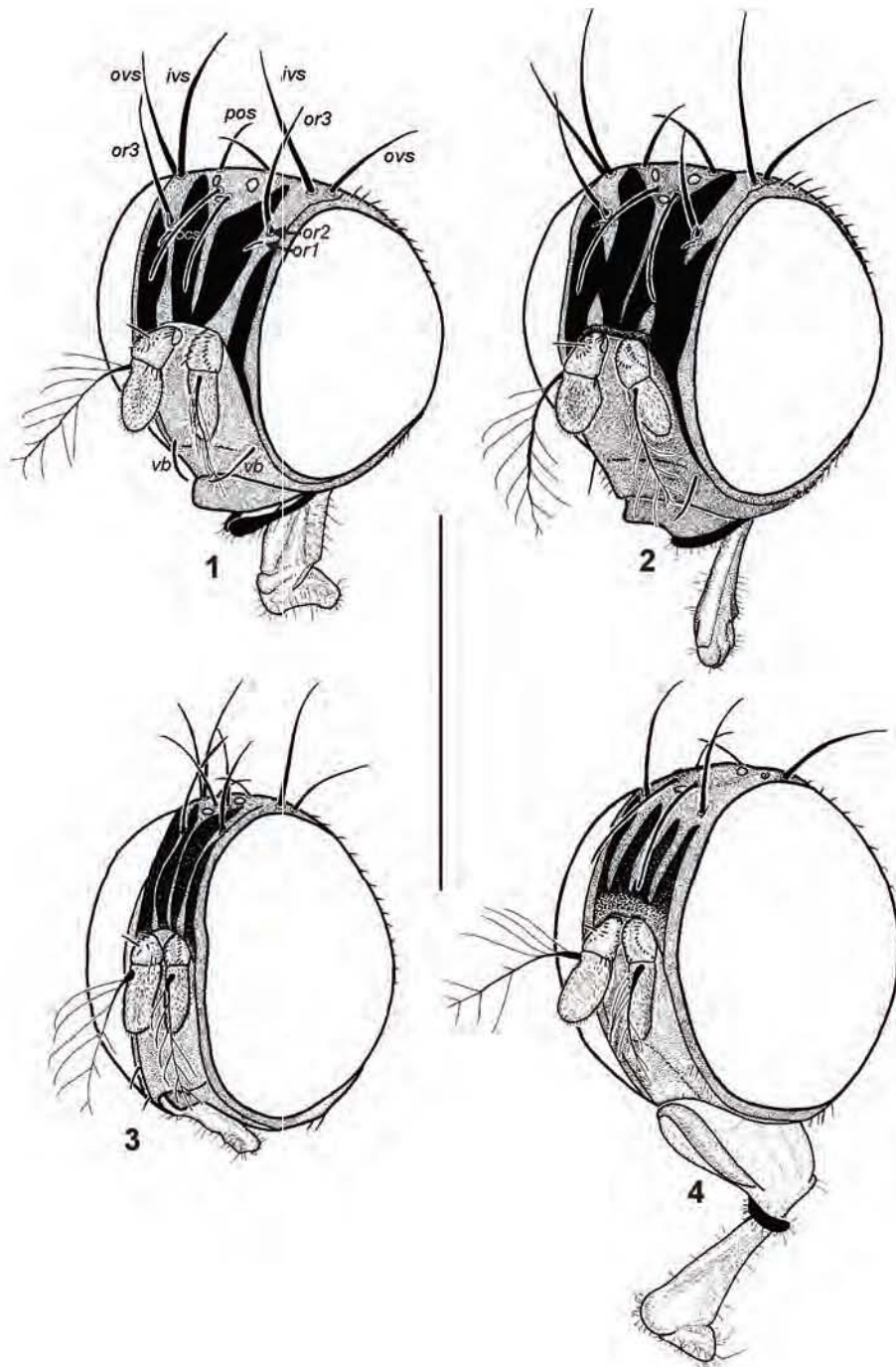
Type material examined. MADAGASCAR: holotype ♂, "Madagascar, Flußbett [= riverbed] / 10 km W von Sakaraha / 22°53'57"S 44°28'12"E, 395 m / Leg. M. Kotrba 8.xi.2003 // "HOLOTYPE ♂ / *Axinota* / *kyphosis* sp. n. / det. A.H. Kirk-Spriggs 2009 [red card]" (ZSM). Card-pointed, teneral or bleached, wings slightly folded and tattered, otherwise in good condition. Dissected, with abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: "PARATYPE ♀ / *Axinota* / *kyphosis* sp. n. / det. A.H. Kirk-Spriggs 2009 [blue card]"): MADAGASCAR: 1♀, same data as holotype (ZSM); 1♀, "MADAGASCAR: Province / Fianarantsoa, near Isalo / National Park, in dry wash / east of Interpretive Center / 22°37.60'S, 45°21.49'E / 12–23.ii.2003, 885 m / M.E.Irwin & R. Harin'Hala / Malaise trap in open area / MA-02-11B-56" [hind leg removed for DNA analysis; reference: BMSA(DNA)#0014] (CAS); 1♀, "MUSÉUM PARIS / MADAGASCAR / PROV D'ANALALAVA / MAROMANDIA R. DECARY, 1922 [pale green card] // *Apsinota* / sp. ♀ / L. Tsacas det. 1974" (MNHN).

Remarks. Tsacas (1974: 717) cited a single female specimen of an *Apsinota* sp. from Maromandia, Madagascar and provided a brief description and an illustration of the spermatheca (p. 719, fig. 9b; reproduced here in Fig. 3.1: 28). As only a single female was then available for study, Tsacas did not name the species. Additional

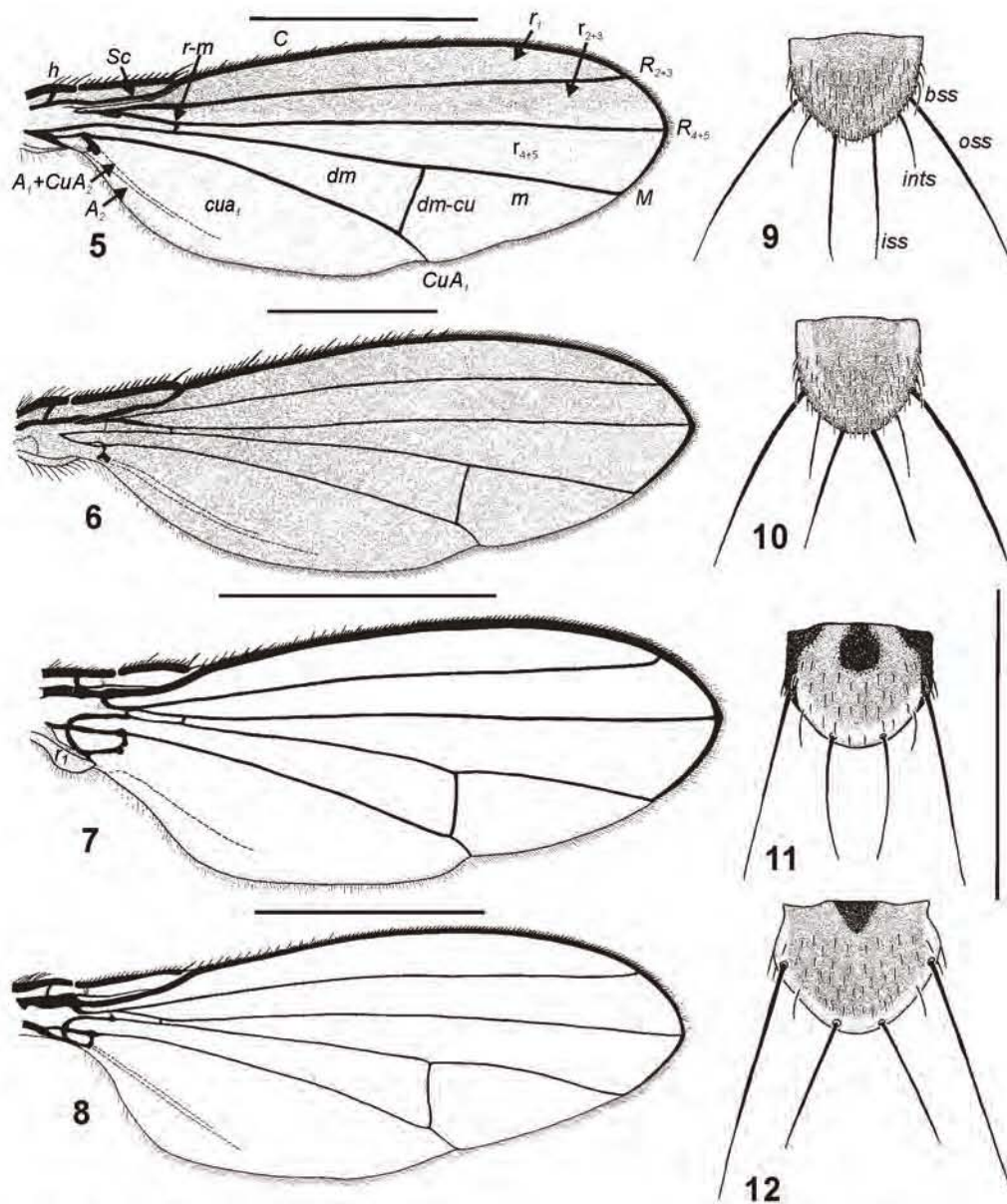
material, including the unknown male, is now available and the species is here named *Axinota kyphosis* sp. n. The original female specimen referred to by Tsacas is here designated as a paratype. As the male holotype is teneral and/or bleached, colour characters cited in the above description are based on the female paratype from “Fianarantsoa, near Isalo” cited above.

Distribution. Madagascar (Figs 3.1: 29, 30, 32).

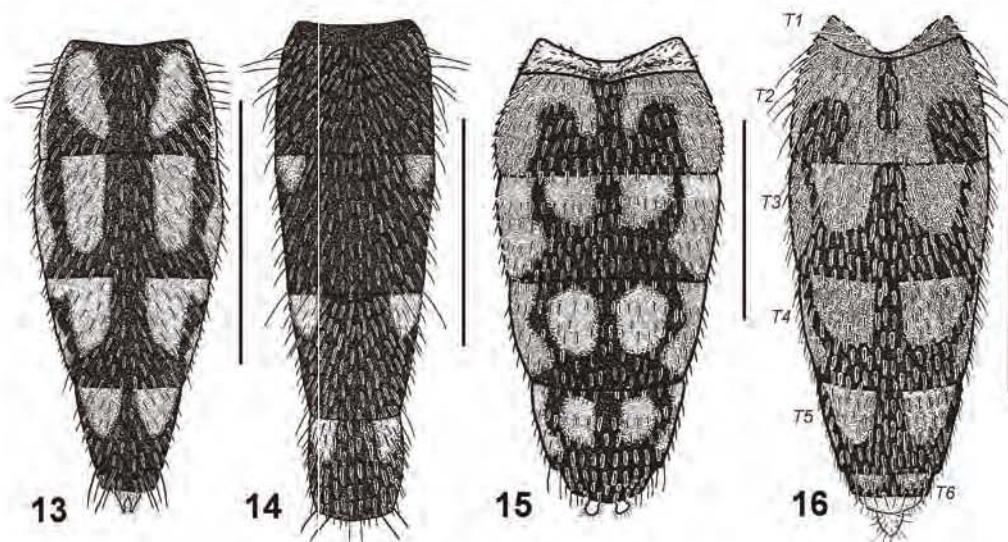
Bionomics. The species is recorded in two vegetation zones in Madagascar, *i.e.*, Plateau grassland-wooded-grassland mosaic and Wooded Grassland-Bushland (*sensu* Moat and Smith 2007) (see Chapter 4). The holotype and paratypes from “10 km W von Sakaraha” were collected by sweeping low vegetation at the side of the river bed (M. Kotrba, pers. comm. 2009). The paratype from “near Isalo National Park” was sampled in a Malaise trap in a “dry wash”.



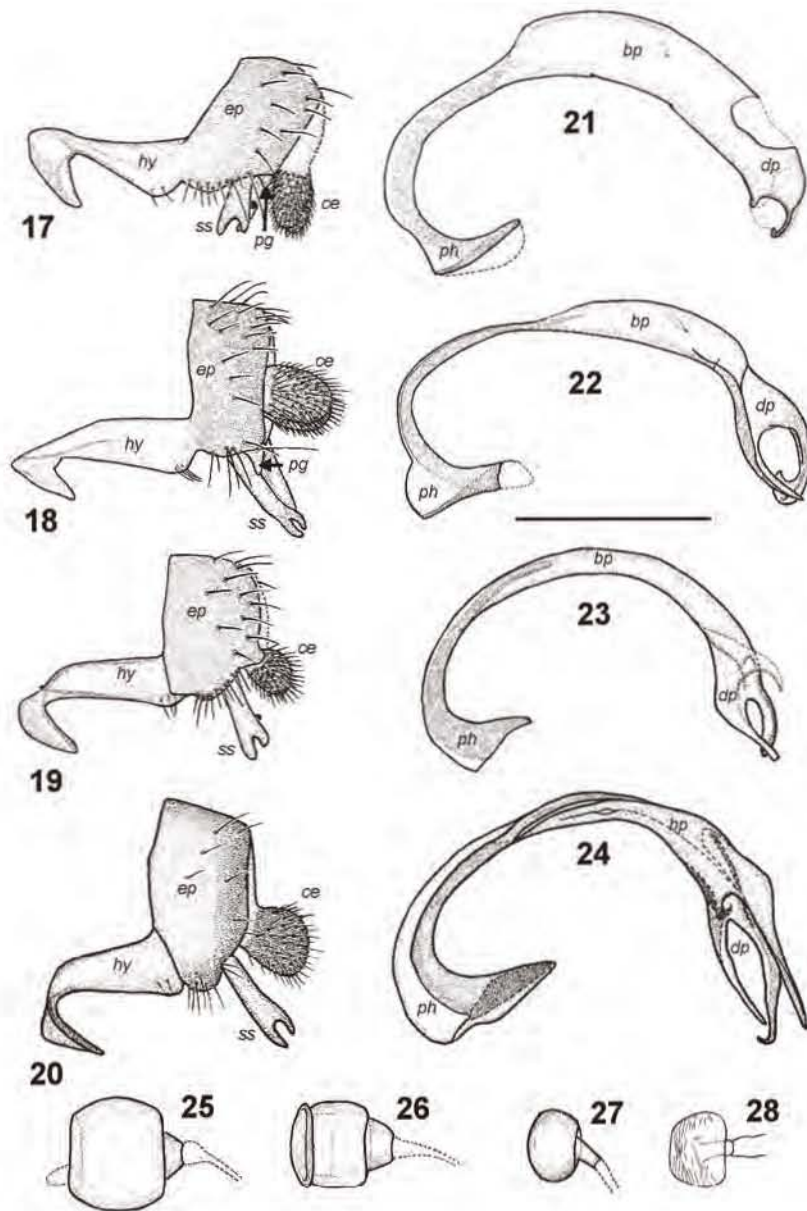
Figs 3.1: 1–4. Head (frontolateral views). 1, *Axinota fuscipennis* (♀ N-T, Gambia, Abuko, NMWC); 2, *A. quasimodoi* (♂ HT, Tanzania, nr. Soni, TAU); 3, *A. ahdabi* (♂ HT, Yemen, Ar Rujum, NMWC); 4, *A. kyphosis* (♀ PT, Madagascar, Maromandia, MNHN) (specimen missing right *ivs*, *ovs* and left *ivs*). Scale bar = 1 mm.



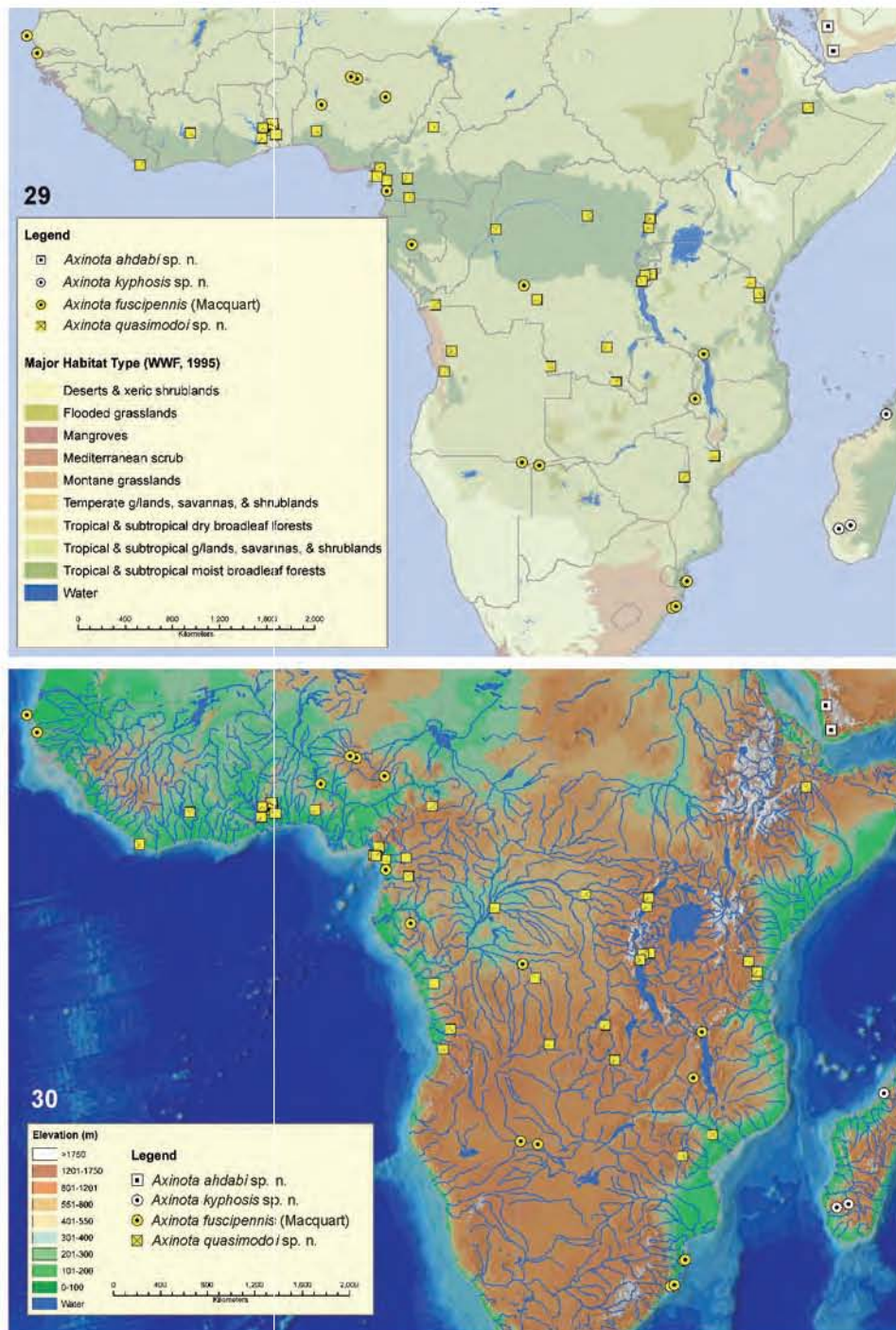
Figs 3.1: 5–12. 5–8: Wing. 5, *Axinota fuscipennis* (♀ N-T, Gambia, Abuko, NMWC); 6, *A. quasimodoi* (♀ PT, Cameroon, Evindissi, MNHN); 7, *A. ahdabi* (♂ HT, Yemen, Ar Rujum, NMWC); 8, *A. kyphosis* (♀ PT, Madagascar, Maromandia, MNHN). 9–12: Scutellum (dorsal view). 9, *A. fuscipennis* (same); 10, *A. quasimodoi* (♀ HT Tanzania, nr. Soni, TAU); 11, *A. ahdabi* (same); 12, *A. kyphosis* (same). Scale bars = 1 mm.



Figs 3.1: 13–16. Abdomen (dorsal view). **13**, *Axinota fuscipennis* (♀ N-T, Nigeria, nr. Funtua, USNM); **14**, *A. quasimodoi* (♂ PT, [Ghana], Ashanti, BMNH); **15**, *A. ahdabi* (♀ PT, Yemen, Ta'izz, NMWC); **16**, *A. kyphosis* (♀ PT, Madagascar, near Isalo National Park, CAS) (tergite 1 omitted from Figs 3.1: 13, 14). Scale bars = 1 mm.



Figs 3.1: 17–28. 17–20: Hypandrium and epandrium (lateral view). 17, *Axinota fuscipennis* (♂ HT, Senegal, MNHN); 18, *A. quasimodoi* (♂ HT, Tanzania, nr. Soni, TAU); 19, *A. ahdabi* (♂ HT, Yemen, Ar Rujum, NMWC); 20, *A. kyphosis* (♂ HT, Madagascar, 10 km W von Sakaraha, ZSM). 21–24: Phallus (lateral view). 21, *A. fuscipennis* (same); 22, *A. quasimodoi* (same); 23, *A. ahdabi* (same); 24, *A. kyphosis* (same). 25–28: Spermatheca (lateral view). 25, *A. fuscipennis* (♀ N-T, Gambia, Abuko, NMWC); 26, *A. quasimodoi* (♀ PT, Tanzania, nr. Soni, TAU); 27, *A. ahdabi* (♀ PT, Yemen, Ta'izz, NMWC); 28, *A. kyphosis* (♀ PT, Madagascar, Maromandia, MNHN; source: Tsacas (1974: 71, fig. 9b)). Scale bar = 0.3 mm.



Figs 3.1: 29–30. Afrotropical distribution of *Axinota*. **29**, Major habitat types of Africa (source of map layers: Hearn *et al.* (2000)) (Major Habitat Types and Vegetation types based on plotted points are provided in Appendix II); **30**, topography and hydrological systems of Africa (sources of map layers: shaded relief and state boundaries: Hearn *et al.* (2000); hydrological systems: Jenness *et al.* (2007)). (The type-locality of *A. fuscipennis*, “Senegal”, for which the specific locality remains unknown, is plotted as Dakar.).

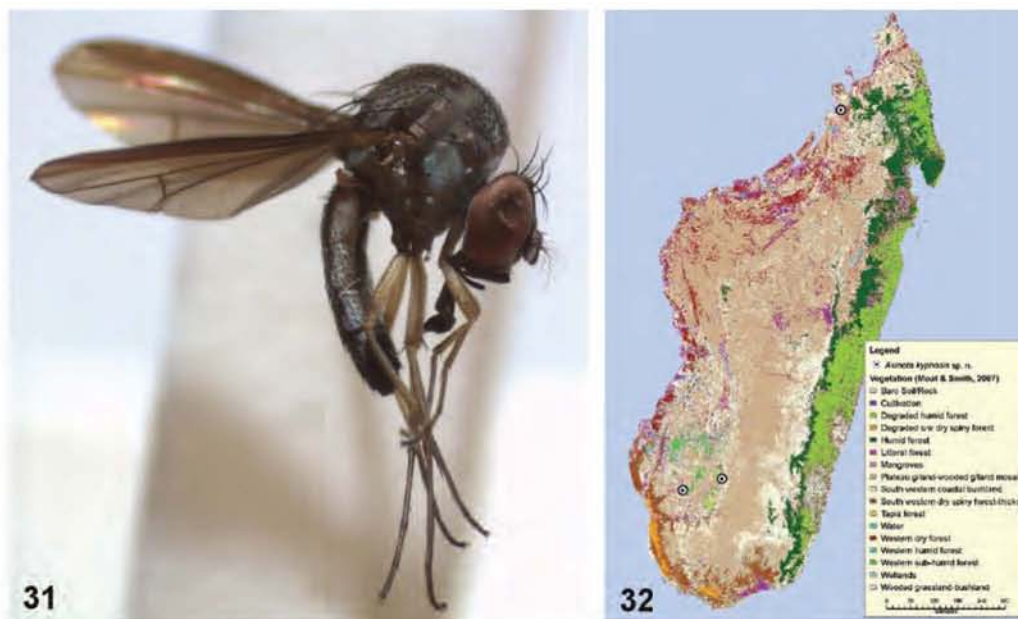


Fig. 3.1: 31. Habitus (lateral) of *Axinota fuscipennis* (♀ N-T, Gambia, Abuko, NMWC). Length: ca. 2.70 mm. 32. Distribution of *Axinota kyphosis* on Madagascar (source of map: Moat and Smith (2007); available on-line at: http://www.vegmad.org/datasets_gis.html).

3.1: Appendix I. Annotated checklist of *Axinota* van der Wulp (Diptera: Curtonotidae) of the world, based on published regional catalogues of Delfinado and Hardy (1977) for the Oriental Region and Wirth and Tsacas (1980) for the Afrotropical Region. Reference was also made to all original publications listed. Type-localities are cited as they appear in the original publications, but modern state names are used in the country distribution lists for each species. A list of institutional codens is provided in the “Material and Methods”. Information is provided on lectotype designations where known, deposition of holotypes and synonymy.

Genus **AXINOTA** van der Wulp

AXINOTA van der Wulp, 1886: cviii. Type species: *Axinota pictiventris* van der Wulp, 1886, by original designation and monotypy (“gen. n, sp. n.”).

APSINOTA van der Wulp, 1887: 178 [footnote]. Unjustified emendation of *Axinota*.

THAUMASTOPHILA Hendel, 1914: 112. Type species: *Thaumastophila hyalipennis* Hendel, 1914: 113, by original designation.

ANASEIOMYIA Malloch, 1930: 328. Type species: *Anaseiomyia uniformis* Malloch, 1930: 329, by original designation.

ahdabi Kirk-Spriggs, **sp. n.** Type locality: “Yemen: Ar Rujum” (NMWC). Afrotropical: Yemen.

dissimilis Malloch, 1930: 330 (*Anaseiomyia*). Type locality: [Malaysia] “Selangor: Kuala Lumpur” (BMNH). Oriental: Bhutan (new record), Peninsula Malaysia and Vietnam.

= *demeijerei* Delfinado, 1969: 206 (*Apsinota*). Type locality: “Vietnam: M’Drak E. of BanMeThuot” (BPBM) (synonymy: Wirth 1977).

fuscipennis Macquart, 1844: 417 (260) (*Diastata*) **comb. n.** Type locality: “Sénégal” (lectotype here designated, MNHN). Afrotropical: Burundi, Cameroon, Democratic Republic of Congo, Gabon, Gambia, Malawi, Namibia, Nigeria, Senegal, South Africa, Tanzania and Togo.

hyalipennis Hendel, 1914: 113 (*Thaumastophila*). Type locality: “Pilam, Formosa” (lectotype designated Delfinado (1969: 208)) (DEI). Oriental: Cambodia and Taiwan.

kyphosis Kirk-Spriggs, **sp. n.** Type locality: “Madagascar: 10 km W von Sakaraha” (ZSM). Afrotropical: Madagascar.

= *Apsinota* sp. *sensu* Tsacas (1974: 717). “Madagascar, Prov. d’Analalava, Maromandia” (MNHN).

obscuripes de Meijere, 1911: 416 (*Apsinota*). Type locality: “Java: Gunung Ungaran” (ZMAN). Oriental: Indonesia (Java).

pictiventris van der Wulp, 1886: cviii. Type locality: “Java: Batavia [= Jakarta]” (ZMAN). Australasian: New Guinea; Oceanian: Solomon Is. (Guadalcanal); Oriental: Indonesia (Ambon Is, Java, Sumatra), Peninsula Malaysia, East Malaysia (Borneo), Nepal, Thailand and Vietnam.

quasimodoi Kirk-Spriggs, **sp. n.** Type locality: “Tanzania: Usambara Mts., near Soni” (TAU). Afrotropical: Angola, Burundi, Côte d’Ivoire, Cameroon, Democratic Republic of Congo, Ethiopia, Ghana, Liberia, Nigeria, Mozambique, Tanzania, Togo and Uganda.

rufipes Okada, 1966: 11 (*Apsinota*). Type locality: “East Nepal: Arun Valley, below Tumlingtar” (BMNH). Oriental: Nepal and Thailand.

- sarawakensis** Delfinado, 1969: 213 (*Apsinota*). Type locality: “Borneo, Sarawak, Kuching, Santubong” (BPBM). Oriental: East Malaysia (Borneo).
- simulans** Delfinado, 1969: 213 (*Apsinota*). Type locality: [Sri Lanka]: “Ceylon: Peradeniya” (BMNH). Oriental: Sri Lanka.
- uniformis** Malloch, 1930: 329 (*Anaseiomyia*). Type locality: “Selangor, Kuala Lumpur” (BMNH). Oriental: Peninsula Malaysia and Philippines.
- = *hardyi* Delfinado, 1969: 207 (*Apsinota*). Type locality: “Philippines: Luzon, Dalton Pass” (BPBM) (synonymy by Wirth 1977).
- sp. indet.** (*Apsinota*) (Delfinado, 1969: 214). “Malaya: Pahang, King George V National Park” (BPBM).

3.1: Appendix II. Geographic co-ordinates (in decimal format) used to map distributions points plotted on Figs 3.1: 29, 30, 32; based on material examined in this study and listed in the material examined sections. Major Habitat Types and Vegetation Types listed below are based on the points plotted on Fig. 3.1: 29 (Major Habitat types) and follow WWF (1995), cited in Hearn *et al.* (2000). The locality of the lectotype and paralectotype of *Axinota fuscipennis* (Macquart), for which the specific locality remains unknown, is not listed.

Genus/species	Country	Locality	Latitude	Longitude	Major habitat type	Vegetation type
<i>Axinota ahdabi</i>	Yemen	Ar Rujum	15.4577778	43.635	Southwestern Arabian foothills savanna	Temperate grasslands, savannas & shrublands
<i>Axinota ahdabi</i>	Yemen	Ta'izz	13.5833333	44.033333	Southwestern Arabian foothills savanna	Temperate grasslands, savannas & shrublands
<i>Axinota fuscipennis</i>	Burundi	Rumonge	-3.9616667	29.4322222	Central Zambesian Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota fuscipennis</i>	Cameroon	Kribi	2.9333333	9.95	Cross-Sanaga-Bioko Coastal Forest	Tropical and subtropical moist broadleaf forests
<i>Axinota fuscipennis</i>	DRC	Sankuru	-4.2833333	20.4166667	Central Congolian Lowland Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota fuscipennis</i>	Gabon	Port Gentil	-1.1666667	11.85	Northwestern Congolian Lowland Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota fuscipennis</i>	Gambia	Abuko	13.4041667	-	Guinean Mangroves	Mangroves
<i>Axinota fuscipennis</i>	Malawi	Kasungu	-13.0333333	33.4833333	Central Zambesian Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota fuscipennis</i>	Namibia	Takwasa	-17.8833333	20.2666667	Kalahari Acacia-Baikiaea Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota fuscipennis</i>	Namibia	Popa Falls	-18.1166667	21.5833333	Zambesian Flooded Grassland	Flooded grasslands
<i>Axinota fuscipennis</i>	Nigeria	Bauchi	10.05	9.85	West Sudanian Savanna	Tropical & subtropical grasslands, savannas, & shrublands
<i>Axinota fuscipennis</i>	Nigeria	Dutsin Kura	11.45	7.6833333	West Sudanian Savanna	Tropical & subtropical grasslands, savannas, & shrublands
<i>Axinota fuscipennis</i>	Nigeria	Mairuwa	11.6	7.2166667	West Sudanian Savanna	Tropical & subtropical grasslands, savannas, & shrublands
<i>Axinota fuscipennis</i>	Nigeria	Zugurma	9.4666667	4.9666667	Guinean Forest-Savanna Mosaic	Tropical & subtropical grasslands, savannas, & shrublands
<i>Axinota fuscipennis</i>	South Africa	Makaheli Forest	-26.9666667	32.75	Maputaland Coastal Forest	Tropical & subtropical moist broadleaf forests

3.1: Appendix II (continued)

Genus/species	Country	Locality	Latitude	Longitude	Major habitat type	Vegetation type
<i>Axinota fuscipennis</i>	South Africa	Kosi Bay	-26.9	32.8666667	Southern Africa Mangroves	Mangroves
<i>Axinota fuscipennis</i>	South Africa	Mtunzini	-28.95	31.75	Maputoland-Pondoland Bushland Thicket	Montane grasslands
<i>Axinota fuscipennis</i>	South Africa	Richards Bay	-28.83	32.0333333	Eastern Cape Coastal Forest	Tropical and subtropical moist broadleaf forests
<i>Axinota fuscipennis</i>	Tanzania	Lumbira	-9.51	34.1333333	Southern Rift Montane Forest	Tropical and subtropical moist broadleaf forests
<i>Axinota fuscipennis</i>	Togo	SE of Kolo-Kopé	7.783333	1.283333	West Sudanian Savanna	Tropical & subtropical grasslands, savannas, & shrublands
<i>Axinota fuscipennis</i>	Togo	Atakpamé	7.522222	1.136667	Guinean Forest-Savanna Mosaic	Tropical & subtropical grasslands, savannas, & shrublands
<i>Axinota kyphosis</i>	Madagascar	Maromandia	-14.2	48.0833333	Madagascar Mangroves	Mangroves
<i>Axinota kyphosis</i>	Madagascar	Sakarha, 10 km W	-22.899167	44.47	Madagascar Dry Forest	Tropical & subtropical dry broadleaf forests
<i>Axinota kyphosis</i>	Madagascar	Fianarantsoa, near Isa	-22.633333	45.363611	Madagascar Central Plateau Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Angola	Gabela	-10.85	14.3666667	Angolan Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	Angola	Salazar	-9.3	14.9166667	Angolan Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	Burundi	Butezi	-3.4227778	30.1516667	Central Zambesian Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	Burundi	Makamba	-3.5092	29.6683	Central Zambesian Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	Burundi	Rumonge	-3.9616667	29.4322222	Central Zambesian Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	Cameroon	village Ndom-Beoué	7.7575	13.525556	Northern Congolian Forest-Savanna Mosaic	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	Cameroon	Bakingili NW of Limb	4.056944	9.054167	Cross-Sanaga-Bioko Coastal Forest	Tropical & subtropical moist broadleaf forests

3.1: Appendix II (continued)

Genus/species	Country	Locality	Latitude	Longitude	Major habitat type	Vegetation type
<i>Axinota quasimodoi</i>	Cameroon	Fako, Lioongo	4.193056	9.324167	Cross-Sanaga-Bioko Coastal Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Cameroon	Kumba	4.643889	9.438611	Cross-Sanaga-Bioko Coastal Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Cameroon	Mbalmayo	3.723611	9.955	Cross-Sanaga-Bioko Coastal Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Cameroon	Victoria	4.012778	9.220278	Cross-Sanaga-Bioko Coastal Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Cameroon	Evindissi	2.4333	11.6833	Northwestern Congolian Lowland Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Cameroon	Yaoundé	3.866667	11.516667	Northwestern Congolian Lowland Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Côte d'Ivoire	Bandama	7.3	-4.933333	Guinean Forest-Savanna Mosaic	Tropical & subtropical grasslands, savannas, & shrublands
<i>Axinota quasimodoi</i>	DRC	Baleke	1.033333	25.266667	Northeastern Congolian Lowland Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	DRC	Eala	0.02	18.283333	Eastern Congolian Swamp Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	DRC	Kenge	-5.766667	13.666667	Western Congolian Forest-Savanna Mosaic	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	DRC	Luebo	-5.35	21.416667	Southern Congolian Forest-Savanna Mosaic	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	DRC	Dilolo	-10.466667	22.466667	Central Zambezian Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	DRC	Elisabethville	-11.666667	27.466667	Central Zambezian Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	DRC	Sombwe	-9	26.75	Central Zambezian Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	Ethiopia	Erer River	9.233333	42.133333	Ethiopian Montane Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Ghana	Ashanti	6.916667	0.533333	Togo Highlands	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Liberia	Memo Town	4.8611	-8.7942	Western Guinean Lowland Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Mozambique	Maringoué	-17.377222	34.972778	Zambezian & Mopane Woodland	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	Mozambique	Machipanda	-19	32.683333	Southern Miombo Woodland	Tropical & subtropical grasslands, savannas & shrublands

3.1: Appendix II (continued)

Genus/species	Country	Locality	Latitude	Longitude	Major habitat type	Vegetation type
<i>Axinota quasimodoi</i>	Nigeria	Ile-Ife	7.466667	4.566667	Nigerian Lowland Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Tanzania	Morogoro	-5.183333	38.4	Northern Zanzibar-Inhambane Coastal Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Tanzania	Same	-4.066667	37.733333	Eastern Arc Montane Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Tanzania	Soni	-4.85	38.366667	Eastern Arc Montane Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Togo	Ayikpara	8.034167	1.236389	West Sudanian Savanna	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	Togo	Fatchiahoé	7.192222	1.537222	Guinean Forest-Savanna Mosaic	Tropical & subtropical grasslands, savannas & shrublands
<i>Axinota quasimodoi</i>	Togo	Wawa	7.703056	0.590556	Togo Highlands	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Uganda	Kyarumba	0.133333	29.95	Albertine Rift Montane Forest	Tropical & subtropical moist broadleaf forests
<i>Axinota quasimodoi</i>	Uganda	Semliki Forest	0.816667	30.066667	Albertine Rift Montane Forest	Tropical & subtropical moist broadleaf forests

3.2.

The East African Afromontane genus *Tigrisomyia* gen. n., with descriptions of four new species²

Preface: A new East Africa genus, *Tigrisomyia* Kirk-Spriggs gen. n., is described; being apparently restricted to high-elevation Afromontane forests associated with the Malawi Rift and Eastern Arc mountain group of Kenya and Tanzania. A diagnosis of the genus is provided. Four new species are described; and are illustrated using pen and ink drawings and light microscopy, namely *T. amnoni* Kirk-Spriggs, sp. n. (Malawi, Tanzania and Zambia), *T. kinskii* Kirk-Spriggs, sp. n. (Malawi), *T. rhayaderi* Kirk-Spriggs, sp. n. (Kenya and Malawi) and *T. scoliosis* Kirk-Spriggs, sp. n. (Tanzania); the first-named species being designated as Type species for the genus. An identification key to the four species is provided based on external characters. The distribution of the four species is mapped, indicating that *T. rhayaderi* sp. n. has a disjunct distribution on the Zomba Plateau (Malawi) and coastal forests of Kenya; *T. kinskii* sp. n. is apparently restricted to Ntchisi Forest (Malawi), and *T. kinskii* sp. n. to the Rebeho (Usagara) Mountains in the Eastern Arc group. *Tigrisomyia amnoni* sp. n. is more widely distributed occurring from the West Usambara Mountains in the north of Tanzania to the Zomba Plateau in the Shire District of southern Malawi (and some intervening relict forests). The historical biogeographical significance of the distribution of the four species is discussed in relation to historical pan-African forest cover in Africa.

Among material amassed from various European, North American and African museums are 24 specimens that are not ascribable to any known genera of Curtonotidae, so a new genus, *Tigrisomyia* gen. n., is here proposed. This new African genus exhibits all the autapomorphies of the family Curtonotidae as defined by McAlpine (1989: 116) in his ground-plan of the family, namely: arista with long dorsal and ventral branches; postpronotum with supplementary setae; mesonotum unusually strongly humped; cells *bm* and *dm* confluent, *i.e.*, crossvein *bm-cu* absent (Figs 3.2: 5–8); *A*₁ (here interpreted as *A*₂) secondarily lengthened; sternite 8 of the male absent; aedeagus (here termed phallus) enlarged, C-shaped, distiphallus antero-ventrally directed (Figs 3.2: 12–14); and aedeagal apodeme (here interpreted as

² **Published as:** Kirk-Spriggs, A.H. 2010b. A revision of Afrotropical Quasimodo flies (Diptera: Curtonotidae: Schizophora). Part II – The East African Afromontane genus *Tigrisomyia* gen. n., with descriptions of four new species. *African Entomology* **18**: 127–146.

phallapodeme) closely and broadly joined to basiphallus. The family Curtonotidae is now known to comprise at least four genera: *Axinota* van der Wulp, 1886, *Curtonotum* Macquart, 1844, *Cyrtona* Séguy, 1938, *sensu lato* and the new genus described herein; all of which occur in the Afrotropical Region.

A morphological and molecular phylogeny of Curtonotidae is currently under preparation and will be published in a subsequent part of this revision (Chapter 2.0). *Tigrisomyia* gen. n. is, however, distinguished from all other genera of Curtonotidae (see Chapter 2.0) (*i.e.*, autapomorphies) in having the thorax strikingly marked (Figs 3.2: 15–22), with a triangular, silver-dusted presutural macula (laterally), dark postsutural maculae and fascia on the anterior edge of the mesonotum (dorsally) and in the structure of the male terminalia (Figs 3.2: 9–14), having the cercus grossly enlarged posteriorly, with 4–5 extremely long, wavy terminal setae, and the distiphallus subdivided into two lengthened segments. Species of the genus are unusual among the Curtonotidae in exhibiting reliable external morphological features to distinguish species. For this reason, one of these, namely: *T. rhayaderi* sp. n., is described from females alone, pending discovery of males.

Close examination and dissection of available material has revealed the presence of four new species, all originating from indigenous Afromontane forests at high to moderately high elevations in the Uluguru-Mlanje and Imatongs-Usambara regional mountain systems (*sensu* White 1978), which comprise (among others), the mountains and plateaus to the east and south of Lake Malawi and the Eastern Arc Mountains group of Tanzania and Kenya. One species is widespread, occurring as far south as the Zomba Plateau in Malawi and as far north as the Usambara Mountains of Tanzania (and intervening forests); two species are apparently confined to small relict Afromontane forest patches in Malawi and Tanzania; while the fourth species has a somewhat disjunct distribution on the Zomba Plateau and the coastal forests of Kenya (near Mombassa).

MATERIAL AND METHODS

Figures of the head and wing (Figs 3.2: 1–8), were prepared from images captured with a Leica Wild M3Z binocular microscope with Nikon E5400 digital camera attached. These were printed, traced and the details added by hand in pen and ink, by constant reference to the specimen concerned. Light micrographs (Figs 3.2:

15–23) were photographed using a ring light and dome (Kerr *et al.* 2008), using the same microscope and camera, and were digitised using Combine ZP Image Stacking Software. All figures were prepared from dry-pinned specimens. Every effort was made to ensure that the same specimen orientation was applied in each case, to allow direct comparison.

Male terminalia were mounted laterally, in a blob of heated and set glycerine jelly. Figures of these structures (Figs 3.2: 9–14), were prepared using a Leica Wild M3Z binocular microscope with a *camera lucida* attachment. Images were enlarged and traced, and details added by hand in pen and ink.

The distribution map (Fig. 3.2: 24) was prepared by converting a list of geographic co-ordinates indicating the point location of specimen records into a spatial data layer in ArcMap 9.3. The specimen location layer was overlaid on topography, vegetation and state boundaries as basic reference layers, in order to assist with the interpretation and location of records. The layers Major Habitat Types (WWF 1995) and country political boundaries used were derived from Hearn *et al.* (2000). Co-ordinates used to plot these maps are provided in square brackets in the “Material examined” sections under each species entry. In the case of pre-independence names, modern place names are also provided in square brackets under each species heading. Each set of co-ordinates was obtained in one of three ways: a) original co-ordinates provided on data labels; b) obtained from various mapping websites powered by Google Earth, or c) original co-ordinates were obtained as personal communications from the collectors themselves (as indicated in the text). These co-ordinates were converted to decimal co-ordinates for mapping purposes.

Type label data are quoted exactly as they appear. A division slash (/) denotes the commencement of a new line, two division slashes (//) data on a further label. Significant supplementary or qualifying information is presented in square brackets when considered necessary. All labels are printed on white card, unless otherwise stated.

Adult morphology follows Cumming and Wood (2009), except in the case of orbital setae.

SYSTEMATICS

Genus *Tigrisomyia* Kirk-Spriggs, **gen. n.**

Type species. Tigrisomyia amnoni Kirk-Spriggs, sp. n., by present designation.

Etymology. The generic epithet *Tigrisomyia* is derived from the Greek *Τίγρις* (the tiger) and suffix *-omyia*, and refers to the unique tiger-like yellow and black fasciae on the abdomen of species of the genus.

Generic diagnosis. The following character states differentiate the genus from *Axinota*, *Curtonotum*, and *Cyrtona sensu lato*. Moderately hunchbacked in profile (Fig. 3.2: 23); head with frons black to brown, or brown, extensively yellow in anterior ½ (Figs 3.2: 1–4), pitted, but sub-shiny; orbital plates and ocellar triangle smooth and shiny (sharply contrasting with rest of frons), anterior and posterior orbital setae strong, median orbital setula weak, with weak supplementary setula positioned parallel to median orbital setula on edge of orbital plate; facial carina uniformly narrow and shallow; flagellomere 1 markedly elongate (ratio 2:0.4), blackish-grey or yellow, with grey or white-grey dusting, often contrasting markedly with scape, arista with very long and numerous dorsal and ventral branches and a lateral row of fewer and shorter branches; thorax (Figs 3.2: 15–22) strikingly marked with silver-dusted triangular macula anterior to transverse suture laterally, with dark macula posterior to transverse suture and dark fascia at anterior margin; disk of mesonotum (Figs 3.2: 15–18) either uniform black to grey, or predominately brown with longitudinal paler dorsocentral vittae; wing (Figs 3.2: 5–8) relatively narrow, evenly rounded to bluntly pointed, faintly infusate yellow throughout; costa with row of weak costal spines differentiated on leading edge, longer and stronger than adjacent vestiture, reaching just beyond vein R_{2+3} (these must be viewed slightly ventrally along leading edge so are not visible on Figs 3.2: 5–8); abdomen yellow with black fasciae or yellow maculae laterally; male terminalia (Figs 3.2: 9–14) with cercus grossly extended posteriorly with 4–5 enormously long, wavy apical setae, surstylus spatulate with apical notch or indentation, phallus with distiphallus subdivided, first division considerably lengthened, second division with two ventral processes and one dorsolaterally expanded projection, phallapodeme deeply incised basally, hypandrium

short and narrow; female terminalia: spermatheca brown, weakly sclerotised, spherical, studded with very fine protuberances.

Key to species of *Tigrisomyia* gen. n.

1. Disk of mesonotum (viewed dorsally) either uniformly black-grey, or predominantly grey, lacking conspicuous longitudinal vittae before scutoscuteellar suture (Figs 3.2: 15, 16); anterior dorsocentral seta long and prominent, at least $\frac{2}{3}$ length of posterior dorsocentral seta (Figs 3.2: 15, 16); dorsal anepisternal seta weakly developed, about $\frac{1}{2}$ length of medial anepisternal seta (Figs 3.2: 19, 20); flagellomere 1 deep brown glabrous in basal corner, otherwise thickly silver-grey-dusted throughout 2
 - Disk of mesonotum (viewed dorsally) brownish-grey, with distinct paler brown longitudinal vittae before scutoscuteellar suture (Figs 3.2: 17, 18); anterior dorsocentral seta extremely weak, usually barely larger than multiple rows of regular setulae on surface (Figs 3.2: 17, 18); dorsal anepisternal seta strongly developed, about $\frac{2}{3}$ length of medial anepisternal seta (Figs 3.2: 21, 22); flagellomere 1 pale yellow-white throughout, thickly silver-white-dusted (strikingly contrasting with brown scape and pedicel) 3
2. Scutellum black, with only very narrow yellow fascia at apical margin (Fig. 3.2: 15); disk of mesonotum (viewed dorsally) uniform black-grey, with black anterior and lateral maculae (Fig. 3.2: 15) (Kenya and Malawi) (male unknown) *T. rhayaderi* sp. n.
 - Scutellum grey with moderately broad yellow marginal fascia around lateral margin (Fig. 3.2: 16); disk of mesonotum (viewed dorsally) predominantly grey, with black anterior and lateral maculae (Fig. 3.2: 16) (Tanzania) *T. scoliosis* sp. n.
3. Mesonotum with prescutellar acrostichal seta (Fig. 3.2: 17) moderately strong and long, $\frac{1}{3}$ length of posterior dorsocentral seta; abdomen (viewed ventrally) with tergites 2–3 entirely black, tergite 4 pale yellow in apical $\frac{1}{2}$; scutellum with sub-triangular grey macula basally and extensive yellow fascia in apical $\frac{1}{2}$ (Fig. 3.2: 17) (Malawi) *T. kinskii* sp. n.
 - Mesonotum with prescutellar acrostichal seta (Fig. 3.2: 18) extremely fine and weak, less than $\frac{1}{3}$ length of posterior dorsocentral seta; abdomen (viewed

ventrally) with tergite 2 entirely black, tergite 3 with triangular yellow macula in apical ½, tergite 4 pale yellow in apical ½; scutellum with narrow yellow lateral fascia throughout (Fig. 3.2: 18) (Malawi, Tanzania and Zambia)
 *T. amnoni* sp. n.

***Tigrisomyia amnoni* Kirk-Spriggs, sp. n.,**

Figs 3.2: 4, 8, 11, 14, 18, 22, 23, 24, 25, 26, 27

Etymology. The specific epithet *amnoni* is named for my friend and colleague Amnon Freidberg who collected the type material of this and some other species included in this revision.

Description (male)

Measurements. Overall length: 3.4–4.4 mm ($n = 1$ male, 4 females); length of head and thorax combined: 1.9–2 mm; length of thorax and scutellum combined: 1.8–1.9 mm; wing length: 4.3 mm ($n = 3$ males).

Head (Fig. 3.2: 4). Compound eye brown to red-brown ($n = 3$), in profile gently and evenly rounded anteriorly, ratio long axis to width: 1.3:0.85; frons slightly tapering inwards to antennal bases (viewed from above), ground colour brown towards vertex, extensively paler yellow-brown in lower ½ from ocellar triangle, markedly paler in region of antennal bases, surface between ocellar triangle and orbital plates pitted, but shiny, surface covered in widely-spaced pale brown microsetulae; orbital plates and ocellar triangle brown, smooth and shiny (contrasting with rest of frons), ocelli brown-grey; orbital plates parallel-sided, extending from vertex of head to ¾ length of frons; shiny region of ocellar triangle extended anteriorly about ½ length of frons (careful examination required); all major head setae rather short; anterior orbital seta moderately strong, proclinate, slightly shorter than posterior orbital seta; posterior orbital seta strong, reclinate, same length as lateral vertical seta, with tiny proclinate, outcurved medial orbital setulae inserted on medial edge of orbital plate, closer to socket of posterior than anterior orbital setae; with one tiny, pale, proclinate (slightly outcurved) supplementary setulae inserted parallel to socket of medial orbital setulae on lateral edge of orbital plate (high magnification and careful examination required); lateral vertical seta strong; medial vertical seta

weaker, $\frac{2}{3}$ length of lateral vertical seta; postocellar setae moderately strong, cruciate, same length as medial vertical seta; ocellar setae strong, of similar length to lateral vertical seta; antennal scape and pedicel dark brown, subshiny, flagellomere 1 dirty yellow throughout, thickly silver-white-dusted (strikingly contrasting with scape and pedicel), markedly longer than wide (ratio 1:0.4), tapering from base to bluntly pointed apex, arista with *ca.* 9–11 extremely long dorsal and *ca.* 5–7 ventral branches in addition to terminal fork, with short supplementary branches positioned at their bases; face grey, with pale brown vitta at eye margin, and shallow carina; one pair of fairly strong vibrissae inserted on posterior lateral edge, with row of genal setae decreasing in size along genal groove; gena narrow, pale tan brown, yellow-grey-dusted; occiput brown, grey-golden-dusted in upper third, paler yellow in lower $\frac{2}{3}$, with moderately weak, black-brown postocular setae; palpus brown.

Thorax. Mesonotum (Fig. 3.2: 18) moderately convex, very slightly flattened behind head, with multiple rows of regular, short, black setulae; ground colour of disk predominantly brownish-grey-dusted with slight golden reflection, and two widely-spaced, demarcated, yellow-brown longitudinal vittae, most apparent in region of scutoscutellar suture, positioned medially to base of posterior dorsocentral setae, with lateral triangular silver-dusted mark anterior to transverse suture, black-golden-dusted macula posterior to transverse suture and similar fascia on anterior edge, these edged with brown; two dorsocentral setae, more anterior extremely weak, usually barely larger than surrounding setation; one pair of extremely fine and weak prescutellar acrostichal seta (not exceeding width of black setulae on mesonotum), one-tenth length of posterior dorsocentral seta; two strong notopleural setae, the posterior shorter; one presutural seta markedly shorter than anterior notopleural seta; two supra-alar setae, strong, reclinate, posterior one longer than posterior dorsocentral seta; one reclinate postalar seta, about $\frac{1}{3}$ length of posterior dorsocentral seta; postpronotum brown, golden-dusted, with two equally-sized, strong, reclinate postpronotal setae and one finer and shorter proclinate postpronotal seta, surface with *ca.* 10–18 fine setulae; anepisternum yellow, grey-dusted with dark brown macula at border of postpronotum, with three reclinate anepisternal setae, dorsal one strongly developed, about $\frac{2}{3}$ length of medial anepisternal seta (Fig. 3.2: 22), surface with *ca.* 13 fine, short setulae arranged concentrically; anepimeron, laterotergite and meron yellow to brown, grey-dusted, glabrous; katapisternum with dark brown macula in anterior $\frac{1}{2}$, dirty yellow in

posterior $\frac{1}{2}$, with two katepisternal setae, one strong posterior, one much weaker and finer anterior, both dorsally-directed, surface with *ca.* 14 short, fine setulae at base and along posterior margin.

Wing (Fig. 3.2: 8). Long, relatively narrow, tip bluntly pointed, veins pale brown, membrane faintly infusate yellowish throughout; R_{2+3} closely approximated with costa basally; R_{4+5} and M markedly convergent apically, and cell r_{4+5} widest in apical $\frac{2}{3}$; cell dm narrow at crossvein $dm-cu$; crossvein $dm-cu$ obliquely angled posteriorly; anal fold long, extending $\frac{1}{2}$ length of cell cu_{a1} ; halter dirty white.

Legs. All legs, including coxae, pale yellow; Fore coxa with four strong preapical setae and *ca.* 10 brown setulae on anterior surface; mid-coxa with two equally strong, black, ventrally-directed lateral setae; hind coxa with one weaker ventrally-directed seta; fore-femur with ctenidium of *ca.* 7–10 short, widely-spaced, sharp, brown spinules.

Scutellum (Fig. 3.2: 18). Disk glabrous, brown-grey-dusted, with narrow yellow lateral fascia around entire margin; two pairs of strong scutellar setae, lateral longer and stronger than medial, with 2–4 smaller intermediate scutellar setulae inserted between lateral and medial scutellar setae.

Abdomen. Ground colour brown, strikingly marked with yellow lateral maculae, surface clothed in short black setulae; tergite 1 yellowish, with brown median mark; tergite 2 yellow with brown median line and narrow black apical fascia; tergites 3–5 brown with distinct, clearly demarcated, yellow maculae laterally.

Terminalia (Figs 3.2: 11, 14). Epandrium brown, distinctly V-shaped basally, with anterior edge obliquely angled backwards, with strong, black, overlapping setae throughout, those along ventral edge longer and stronger (Fig. 3.2: 11, *ep*); hypandrium moderately broad, short and down-curved in profile (Fig. 3.2: 11, *hy*); surstylus long, spatulate, with “elbow” medially, bearing apical indentation sub-medially and micro-setulae at apical corners (Fig. 3.2: 11, *ss*); cercus grossly extended posteriorly, bearing 4–5 extremely long, wavy terminal setae and sparse, erect setae on dorsal and lateral surface (Fig. 3.2: 11, *ce*); phallus formed of narrow C-shaped structure, phallapodeme and basiphallus fused, phallapodeme narrowly and deeply incised basally (Fig. 3.2: 14, *ph*, *bp*), distiphallus distinctly subdivided into two segments (Fig. 3.2: 14, *dp1*, *dp2*), first division of distiphallus moderately long, slightly angled medially, second division of distiphallus moderately long, upcurved,

with two ventrally-directed, fairly straight processes and single dorsal laterally expanded projection; apical $\frac{1}{2}$ of basiphallus enclosed in membranous sheath this moderately widened in basal $\frac{1}{2}$ (Fig. 3.2: 14, *msh*), with dorsal plate (Fig. 3.2: 14, *dopl*) that adjoins base of first division of distiphallus.

Female. Similar to male, except in the following respects: (overall length: 3–3.9 mm; wing length: 2.9–3.9 mm ($n = 4$ females)); spermatheca dark brown, weakly sclerotised, spherical, surface studded with fine protuberances.

Variation. The colour of the palpus varies from pale brown, pale brown with darker ventral margin to brown–black throughout. The prescutellar acrostichal setae are slightly larger in some specimens, but never reach or exceed $\frac{2}{3}$ the length of the medial anepisternal seta.

Differential diagnosis. This species appears to be closely related to *T. kinskii* sp. n., in having the disk of the mesonotum predominantly brown, with usually distinct paler brown longitudinal vittae, the anterior dorsocentral seta extremely weak, and dorsal anepisternal seta strongly developed. The male terminalia of the two species share a spatulate surstylus, with a distinct median “elbow”, but *T. amnoni* sp. n. differs from *T. kinskii* sp. n. in exhibiting only a shallow sub-medial apical excision. *Tigrisomyia amnoni* sp. n. also differs in the degree of yellow fascia on the margin of the scutellum, in having clearly demarcated yellow maculae on tergites 3–5, and in having the wing narrower and bluntly pointed, with vein R_{2+3} closely approximated with the costa basally, veins R_{4+5} and M markedly convergent apically, and cell r_{4+5} widest in apical $\frac{2}{3}$.

Type material examined. TANZANIA: holotype ♂, “TANZANIA: / [West] Usambara Mts. / Gologolo Forest [4°42'0"S, 38°13'60"E] / 1900m / 23.viii.1996 / A. FREIDBERG // HOLOTYPE ♂ / *Tigrisomyia* / *amnoni* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (TAU). Micro-pinned and staged; in excellent condition, except: left wing slightly folded, right wing detached and glued to data label. Dissected, with abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ [or ♀] / *Tigrisomyia* / *amnoni* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]”): [MALAWI]: 2♀, “Zomba [15°23'S, 35°20'E] / Nyasaland / IV.1958 [handwritten] // COLL / B & P STUCKENBERG” (NMSA). TANZANIA: 2♂, 5♀, same data as holotype; 1♂, “TANZANIA: / Njombe [9°20'60"S, 34°46'0"E] 10kmSE / Rt. B4, 2000m / 27-28.viii.1996 / A. FREIDBERG”; 1♂,

“TANZANIA: / Ngozi Crater [9°00'S, 33°26'E (A. Freidberg, pers. comm. 2009)] / nrRt.A345 2000- / 2200m, 1.ix.1996 / A. FREIDBERG” (all TAU); 1♂, “Tanzania, Uzungwe [*sic* = Udzungwa] Mts. / Mwanihana Forest above Sanje [7°49'60"S, 36°49'60"E] / 1000 m, 01.viii.1981 / M. Stolze & N. Scharff leg. / Zool. Museum, Copenhagen”; 1♀, “Tanzania, West Usambara Mts. / Mazumbai [4°48'0"S, 38°30'0"E], 1600 m / 01.viii.1980 / M. Stolze & N. Scharff leg. / Zool. Museum, København” (both ZMUC); 1♀, “TANZANIA: / [West] Usambara Mts. / Lushoto [4°46'60"S, 38°16'60"E], 1300m / 24.viii.1996 / A. FREIDBERG” (TAU). ZAMBIA: 1♀, “ZAMBIA: Nyika / National Park / Chowo Forest [10°35'S, 33°42'E (A. Freidberg, pers. comm. 2009)] / 28.ix.1998 / F. KAPLAN & / A. FREIDBERG” (TAU).

Remarks. The male terminalia of the specimens from Njombe and Mwanihana in Tanzania are identical with the holotype and paratypes from Gologolo Forest. Although records from some localities (Lushoto and Mazumbai in Tanzania; Zomba, in Malawi; and Chowo in Zambia), are represented by females alone, these specimens are consistent in the patterning of the abdomen and scutellum with *T. amnoni* sp. n.

Distribution. Malawi, Tanzania and Zambia (Fig. 3.2: 24).

Bionomics. This species is widely distributed, but restricted to high-elevation Afromontane forests associated with the Malawi Rift: Zomba Plateau, Chowo Forest (on the Zambian side of the Nyika Plateau), the Eastern Arc mountain group and other isolated forest relicts in Tanzania (*i.e.*, Mwanihana Forest, Gologolo Forest, Lushoto; Njombe, Ngozi Crater and Mazumbai) (see Chapter 4).

***Tigrisomyia kinskii* Kirk-Spriggs, sp. n.,**

Figs 3.2: 3, 7, 10, 13, 17, 21, 24

Etymology. The specific epithet, *kinskii*, is named after the iconic German actor Klaus Kinski (1926–1991), who played the hunchback in the 1965 “spaghetti western”, *For a Few Dollars More*, reflecting the hunchbacked appearance of this species.

Description (male)

Measurements. Overall length: 3.7–4 mm ($n = 2$ males); length of head and thorax combined: 1.9–3 mm; length of thorax and scutellum combined: 1.8–1.9 mm; wing length: 4–4.9 mm ($n = 3$ males).

Head (Fig. 3.2: 3). Compound eye red-brown ($n = 3$), in profile gently and evenly rounded anteriorly, ratio long axis to width: 1.4:0.95; frons slightly tapering inwards to antennal bases (viewed from above), ground colour brown towards vertex, extensively paler yellow-brown in lower $\frac{1}{2}$ from ocellar triangle, markedly paler in region of antennal bases, surface between ocellar triangle and orbital plates pitted, but shiny, surface covered in widely-spaced pale brown micro-setulae; orbital plates and ocellar triangle brown, smooth and shiny (contrasting with rest of frons); ocelli brown-grey; orbital plates parallel-sided, extending from vertex of head to $\frac{2}{3}$ length of frons; shiny region of ocellar triangle extended anteriorly about $\frac{1}{2}$ length of frons (careful examination required); all major head setae rather short; anterior orbital seta (Fig. 3.2: 3, *or1*) moderately strong, proclinate, same length as posterior orbital seta; posterior orbital seta (Fig. 3.2: 3, *or3*) strong, reclinate, shorter than lateral vertical seta, with tiny proclinate, outcurved medial orbital setula (Fig. 3.2: 3, *or2*) inserted on medial edge of orbital plate, equidistant between posterior and anterior orbital setae; with one tiny, pale, proclinate (slightly outcurved) supplementary setulae inserted parallel to socket of medial orbital setulae on lateral edge of orbital plate (high magnification and careful examination required); lateral vertical seta (Fig. 3.2: 3, *ovs*) strong; medial vertical seta (Fig. 3.2: 3, *ivs*) weaker, $\frac{2}{3}$ length of lateral vertical seta; postocellar setae (Fig. 3.2: 3, *pos*) moderately strong, cruciate, same length as medial vertical seta; ocellar setae (Fig. 3.2: 3, *ocs*) strong, of similar length to lateral vertical seta; antennal scape and pedicel dark brown, subshiny, flagellomere 1 pale yellow-white throughout, thickly silver-white-dusted (very strikingly contrasting with scape and pedicel), longer than wide (ratio 1:0.4), tapering from base to bluntly pointed apex, arista with *ca.* 9–10 extremely long dorsal and *ca.* 5–6 ventral branches in addition to terminal fork, with short supplementary branches positioned at their bases; face grey, with pale brown vitta at eye margin and shallow carina; one pair of fairly strong vibrissae (Fig. 3.2: 3, *vb*) inserted on posterior lateral edge, with row of genal setae decreasing in size along genal groove; gena narrow, pale tan brown, yellow-

grey-dusted; occiput brown, grey-golden-dusted in upper third, paler yellow in lower $\frac{2}{3}$, with moderately weak, black-brown postocular setae; palpus brown.

Thorax. Mesonotum (Fig. 3.2: 17) moderately convex, very slightly flattened behind head, with multiple rows of regular, short, black setulae; ground colour of disk brownish-grey-dusted with slight golden reflection, and two widely-spaced, clearly demarcated, yellow-brown longitudinal vittae, wider towards scutoscutellar suture, positioned medially to base of posterior dorsocentral setae, with lateral triangular silver-dusted mark anterior to transverse suture, black-golden-dusted macula posterior to transverse suture and similar fascia on anterior edge, these edged with brown; two dorsocentral setae, more anterior extremely weak, usually barely larger than surrounding setation; one pair of prescutellar acrostichal setae, $\frac{1}{3}$ length of posterior dorsocentral seta; two strong notopleural setae, the posterior slightly shorter; one presutural seta shorter than anterior notopleural seta; two supra-alar setae, strong, reclinate, the more posterior longer than posterior dorsocentral seta; one reclinate postalar seta, about $\frac{1}{2}$ length of posterior dorsocentral seta; postpronotum brown, golden-dusted, with two equally-sized, strong, reclinate postpronotal setae and one finer and shorter proclinate postpronotal seta, surface with *ca.* 10 fine setulae; anepisternum yellow, grey-dusted with dark brown macula at border of postpronotum, with three reclinate anepisternal setae, the more dorsal strongly developed, about $\frac{2}{3}$ length of medial anepisternal seta (Fig. 3.2: 21), surface with *ca.* 20 fine, short setulae arranged concentrically; anepimeron, laterotergite and meron yellow to brown, grey-dusted, glabrous; katepisternum with, dark brown macula in anterior $\frac{1}{2}$, dirty yellow in posterior, with two katepisternal setae, one strong posterior, one weaker and finer anterior, both dorsally-directed, surface with *ca.* 14 short, fine setulae at base and along posterior margin.

Wing (Fig. 3.2: 7). Long, relatively broad, tip bluntly and evenly rounded, veins pale brown, membrane faintly infusate yellowish throughout; R_{2+3} narrowly approximated with costa basally; R_{4+5} and M sub-parallel-sided, M slightly upcurved towards apex; cell r_{4+5} widest in apical $\frac{2}{3}$; cell dm relatively wide at crossvein $dm-cu$; crossvein $dm-cu$ straight; anal fold long, extending $\frac{1}{3}$ length of cell cua_1 ; halter dirty white.

Legs. All legs, including coxae, pale yellow; Fore coxa with three strong preapical setae and *ca.* 17 brown setulae on anterior surface; mid-coxa with two

equally strong, black, ventrally-directed lateral setae; hind coxa with one weaker ventrally-directed seta; fore-femur with ctenidium of *ca.* 11 short, widely-separated, sharp, brown spinules.

Scutellum (Fig. 3.2: 17). Disk glabrous, with sub-triangular grey macula basally and extensive yellow macula in apical $\frac{1}{2}$; two pairs of strong scutellar setae, lateral longer and stronger than medial, with 4–5 smaller intermediate scutellar setulae inserted between lateral and medial scutellar setae.

Abdomen. Ground colour yellow, with dark fasciae at segmental borders, surface clothed in short black setulae; tergite 1 yellowish throughout, with dark macula medially; tergite 2 yellow with narrow black apical fascia; tergites 3–5 with sub-triangular black maculae reaching $\frac{1}{2}$ length of tergites; tergite 5 with additional black fascia on apical margin.

Terminalia (Figs 3.2: 10, 13). Epandrium brown, V-shaped basally, with anterior edge obliquely angled backwards, with strong, black, overlapping setae throughout, those along ventral edge longer and stronger (Fig. 3.2: 10, *ep*); hypandrium narrow, short and straight in profile (Fig. 3.2: 10, *hy*); surstylus long, with “elbow” medially, apical section with distinct angulate notch in upper third and micro-setulae at apical corners (Fig. 3.2: 10, *ss*); cercus grossly extended posteriorly, bearing 4–5 extremely long, wavy terminal setae and sparse, but long erect setae on dorsal and lateral surface (Fig. 3.2: 10, *ce*); phallus formed of narrow C-shaped structure, phallapodeme and basiphallus fused, phallapodeme narrowly and deeply incised basally (Fig. 3.2: 13, *ph*, *bp*), distiphallus distinctly subdivided into two segments (Fig. 3.2: 13, *dp1*, *dp2*), first division of distiphallus moderately short, slightly expanded towards apex, second division of distiphallus darker than first division of distiphallus, moderately short, upcurved, with two ventrally-directed, fairly straight processes and single dorsal laterally expanded projection; apical $\frac{1}{2}$ of basiphallus enclosed in membranous sheath this distinctly widened in basal $\frac{1}{2}$ (Fig. 3.2: 13, *msh*), with dorsal plate (Fig. 3.2: 13, *dopl*) that adjoins base of first division of distiphallus.

Female. Unknown.

Variation. Insufficient material is available to assess variation.

Differential diagnosis. This species appears to be closely related to *T. amnoni* sp. n., in having the disk of the mesonotum predominantly brown, with usually distinct paler brown longitudinal vittae, the anterior dorsocentral seta extremely weak, and the more dorsal anepisternal seta strongly developed. The male terminalia of the two species share the distinctly spatulate surstylus with a median “elbow”, but *T. kinskii* sp. n. differs from *T. amnoni* sp. n. in exhibiting a distinct, angulate sub-medial apical notch. *Tigrisomyia kinskii* sp. n. also differs in the degree of yellow fascia at the margin of the scutellum, in having tergites 3–5 with sub-triangular basal black maculae only, rather than clearly demarcated maculae, and in having the wing broader, with the apex more evenly rounded, vein R_{2+3} more widely separated from the costa basally, veins R_{4+5} and M less markedly convergent apically, and cell r_{4+5} sub-parallel-sided for most of its length.

Type material examined. MALAWI: holotype ♂, “MALAWI: Centre / Ntchisi Forest [13°20'S, 34°2'E] / 1500–1700m / 17-18.ix.1998 / F. KAPLAN & / A. FREIDBERG // HOLOTYPE ♂ / *Tigrisomyia / kinskii* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (TAU). Micro-pinned and staged; in excellent condition. Dissected, with abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (both labelled: “PARATYPE ♂ / *Tigrisomyia / kinskii* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]”): MALAWI: 2♂, same data as holotype (TAU).

Distribution. Malawi (Fig. 3.2: 24).

Bionomics. This species is associated with high elevation Afromontane forest (1500–1700 m a.s.l.) and is apparently restricted to Ntchisi Mountain in Malawi (see Chapter 4).

***Tigrisomyia rhayaderi* Kirk-Spriggs, sp. n.,**

Figs 3.2: 1, 5, 15, 19, 24

Etymology. The specific epithet *rhayaderi* is named after the fictitious character Philip Rhayader, the hunchback in Paul Gallico’s 1941 novel, *The Snow Goose*, reflecting the hunchbacked appearance of this species.

Description (female)

Measurements. Overall length: 3.3–3.8 mm; length of head and thorax combined: 1.8–2.1 mm; length of thorax and scutellum combined: 1.7–2 mm; wing length: 3.8–3.9 mm ($n = 2$ females).

Head (Fig. 3.2: 1). Compound eye red-brown to dark brown ($n = 2$), in profile gently and evenly rounded anteriorly, ratio long axis to width: 1.4:1; frons slightly tapering inwards to antennal bases (viewed from above), ground colour black to dark brown throughout, slightly paler brown before antennal insertions, surface between ocellar triangle and orbital plates pitted, but shiny, surface covered in widely-spaced black micro-setulae; orbital plates and ocellar triangle black, smooth and shiny (contrasting with rest of frons), ocelli brown-grey; orbital plates parallel-sided, extending from vertex of head to about $\frac{1}{2}$ length of frons; shiny region of ocellar triangle extended anteriorly about $\frac{1}{3}$ length of frons; anterior orbital seta (Fig. 3.2: 1, *or1*) moderately strong, proclinate about $\frac{2}{3}$ length of posterior orbital seta; posterior orbital seta (Fig. 3.2: 1, *or3*) strong, reclinate, with tiny proclinate medial orbital setulae inserted on medial edge of orbital plate, equidistant between sockets of anterior and posterior orbital setae; with one tiny, proclinate (slightly outcurved) supplementary setula inserted parallel to socket of medial orbital setula on lateral edge of orbital plate (high magnification and careful examination required) [medial vertical setae, ocellar setae, lateral vertical setae and postocellar setae all missing or damaged on type specimens and cannot be described, but socket sizes indicate that these setae are of similar sizes to those here described for the other species of the genus]; antennal scape and pedicel dark brown, thinly silver-grey-dusted, flagellomere 1 deep brown in basal corner, otherwise thickly silver-grey-dusted throughout, markedly longer than wide (ratio 1.4:5), tapering from base to bluntly pointed apex, arista with *ca.* 14 extremely long dorsal and about nine ventral branches in addition to terminal fork, with short supplementary branches positioned at their bases; face grey-black, with brown vitta at eye margin and shallow carina; one pair of fairly strong vibrissae (Fig. 3.2: 1, *vb*) inserted on posterolateral edge, with row of genal setae decreasing in size along genal groove; gena narrow, pale tan-brown, grey-dusted below genal groove; occiput black, grey-dusted, black-brown in region immediately behind ocellar triangle, with moderately strong, black postocular setae; palpus black.

Thorax. Mesonotum (Fig. 3.2: 15) moderately convex, very slightly flattened behind head, with multiple rows of regular, short, black setulae; ground colour of disk uniformly black-grey-dusted, with lateral triangular silver-dusted mark anterior to transverse suture, black-golden-dusted macula posterior to transverse suture and similar fascia on anterior edge, these edged with grey-dusted border; two pairs of dorsocentral setae, posterior long and strong, anterior about $\frac{2}{3}$ length of posterior; one pair of prescutellar acrostichal setae, shorter than $\frac{1}{2}$ length of posterior dorsocentral seta; two strong notopleural setae, the posterior slightly shorter; [presutural seta missing on examined specimens, but socket size indicates seta of similar size to other species described herein]; two supra-alar setae, strong, reclinate, posterior one equal in length to posterior dorsocentral seta; one reclinate postalar seta, about $\frac{1}{2}$ length of posterior dorsocentral seta; postpronotum silver-grey-dusted, with two equally-sized, strong, reclinate postpronotal setae and one finer and shorter proclinate postpronotal seta, surface with *ca.* 10 fine setulae; anepisternum brown, grey-dusted, except extreme posterior border dirty yellow, with three reclinate anepisternal setae, the ventral and medial strong, dorsal one weakly developed, slightly ventrally-directed about $\frac{1}{2}$ length of medial anepisternal seta (Fig. 3.2: 19), surface with *ca.* 18 fine, short setulae arranged concentrically; anepimeron, laterotergite and meron yellow to grey-dusted, glabrous; katapisternum with dark, silver-dusted macula in anterior $\frac{1}{2}$, dirty yellow in posterior, with two katapisternal setae, one strong posterior, one weaker and finer anterior, both dorsally-directed, surface with six short, fine setulae at base and row of fine setulae along posterior margin.

Wing (Fig. 3.2: 5). Long, relatively narrow, tip evenly rounded, veins pale brown, membrane faintly infusate yellowish throughout, veins R_{2+3} and R_{4+5} sub-parallel; cell *dm* narrow at crossvein *dm-cu*; crossvein *dm-cu* obliquely angled posteriorly; anal fold long, extending $\frac{2}{3}$ length of cell *cua*₁; halter dirty white.

Legs. All legs, including coxae, pale yellow; Fore coxa with three strong preapical setae and *ca.* 13 brown setulae on anterior surface; mid-coxa with two equally strong, lateral black, ventrally-directed setae; hind coxa with one weaker ventrally-directed seta; fore-femur with ctenidium of about seven short, closely-approximated, sharp, brown spinules.

Scutellum (Fig. 3.2: 15). Disk glabrous, ground colour black, with very narrow yellow fascia at apical margin; two pairs of strong scutellar setae, the lateral longer

and stronger than medial, with 2–3 smaller intermediate scutellar setulae inserted between lateral and medial scutellar setae.

Abdomen. Ground colour yellow, with dark fasciae at segmental borders, surface clothed in short black setulae; tergite 1 yellowish throughout; tergite 2 yellow with narrow black apical fascia; tergites 3–4 yellow with sub-triangular black maculae in basal corners and faint median line; tergite 5 black in basal $\frac{1}{2}$, with two lateral yellow maculae separated by medial line.

Spermatheca. Dark brown, weakly sclerotised, spherical, surface studded with fine protuberances.

Male. Unknown.

Variation. Insufficient material is available to assess variation.

Differential diagnosis. This species appears to be most closely related to *T. scoliosis* sp. n., having the disk of the mesonotum predominantly black-grey, the anterior dorsocentral seta long and prominent and the more dorsal anepisternal seta weakly developed. *Tigrisomyia rhayaderi* sp. n. differs from *T. scoliosis* sp. n., however, in having the scutellum black, with only a very narrow yellow fascia at the apical margin. As the male of *T. rhayaderi* sp. n. remains unknown, differences in the male terminalia of the two species cannot be assessed.

Type material examined. KENYA: 1♀, “KENYA: Rt. B8 / near Takaungu / 50kmN Mombasa [sic – Mombassa] / 03°42’S 39°49’E / 12.viii.2003 / S. KLEYNBERG // HOLOTYPE ♀ / *Tigrisomyia rhayaderi* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (TAU). Micro-pinned and staged; in excellent condition (but see “Remarks” below). Not dissected. Paratype ♀ (labelled: “PARATYPE ♀ / *Tigrisomyia rhayaderi* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]”): [MALAWI]: 1♀, “NYASALAND / Zomba Plateau [15°23’S, 35°20’E] / iv.1957 / N.H.L.Krauss / BM 1957-458” (BMNH). Micro-pinned and staged; in poor condition, left wing, all head setae, all legs except right fore femora and fore tibia and left hindleg missing. Dissected, abdomen and spermathecae in micro-vial pinned beneath specimen.

Remarks. This species is only known from two females, but is sufficiently distinct to warrant description without reference to the male terminalia. The holotype

female is otherwise in excellent condition, but is missing all major head setae, except: right anterior orbital seta, posterior orbital seta, lateral vertical seta (damaged), ocellar seta (damaged); and right anterior orbital seta (damaged) (Fig. 3.2: 1). The paratype female from Zomba Plateau is missing all head setation, except left postocellar seta (damaged). It is therefore not possible to provide a full description of head setation for this species.

Distribution. Kenya and Malawi (Fig. 3.2: 24).

Bionomics. This species is only recorded from two localities: the high Zomba Plateau (*ca.* 1700 m (Dowsett-Lemaire 1989)) in Malawi and at sea level in the vicinity of Takaungu, south of Kilifi in the Coastal Province of Kenya. The two localities are *ca.* 1413 km apart and represent entirely different habitat types. Whether the species is associated both with Afromontane and coastal/mangrove forest or represents a mislabelled specimen from elsewhere remains open to question (see Chapter 4).

***Tigrisomyia scoliosis* Kirk-Spriggs, *sp. n.*,**

Figs 3.2: 2, 6, 9, 12, 16, 20, 24

Etymology. The specific epithet *scoliosis* is a noun in apposition derived from the medical term for lateral curvature of the upper back (hunchbacked) and refers to the hunchbacked appearance of this species.

Description (male)

Measurements. Overall length: 3.6 mm ($n = 1$ male); length of head and thorax combined: 1.7 mm; length of thorax and scutellum combined: 1.70 mm; wing length: 3.5–3.9 mm ($n = 2$ females).

Head (Fig. 3.2: 2). Compound eye red brown ($n = 3$), in profile gently and evenly rounded anteriorly, ratio long axis to width: 1.4:1; frons slightly tapering inwards to antennal bases (viewed from above), ground colour dark brown, slightly paler brown in lower $\frac{1}{2}$ from ocellar triangle, surface between ocellar triangle and orbital plates pitted, but shiny, surface covered in widely-spaced brown micro-setulae;

orbital plates and ocellar triangle black, smooth and shiny (contrasting with rest of frons), ocelli brown-grey; orbital plates parallel-sided, extending from vertex of head to just over $\frac{2}{3}$ length of frons; shiny region of ocellar triangle extended anteriorly about $\frac{1}{3}$ length of frons (careful examination required); all major head setae relatively long; anterior orbital seta moderately strong, proclinate, slightly shorter than posterior orbital seta; posterior orbital seta strong, reclinate, slightly shorter than lateral vertical seta, with tiny proclinate medial orbital setulae inserted on medial edge of orbital plate, closer to socket of posterior than anterior orbital seta; with one tiny, proclinate (slightly outcurved) supplementary setula inserted parallel to socket of medial orbital setulae on lateral edge of orbital plate (high magnification and careful examination required); lateral vertical seta slightly weaker than medial; medial vertical seta strong, slightly incurved; postocellar setae moderately strong, cruciate; ocellar setae strong, but shorter than medial vertical seta; antennal scape and pedicel dark brown, thinly silver-grey-dusted, flagellomere 1 deep brown in basal corner, otherwise thickly silver-grey-dusted throughout, markedly longer than wide (ratio 1:0.4), tapering from base to bluntly pointed apex, arista with *ca.* 14 extremely long dorsal and about nine ventral branches in addition to terminal fork, with short supplementary branches positioned at their bases; face grey-black, with brown vitta at eye margin and shallow carina; one pair of fairly strong vibrissae inserted on posterior lateral edge, with row of genal setae decreasing in size along genal groove; gena narrow, pale tan-brown, greydusted in lower $\frac{1}{2}$; occiput black, grey-dusted, black-brown in region immediately behind ocellar triangle, with moderately strong, black postocular setae; palpus black.

Thorax. Mesonotum (Fig. 3.2: 16) moderately convex, very slightly flattened behind head, with multiple rows of regular, short, black setulae; ground colour of disk grey-dusted with slight golden reflection, with two widely-spaced, longitudinal vittae discernible that run through bases of dorsocentral seta, with lateral triangular silver-dusted mark anterior to transverse suture, black-golden-dusted macula posterior to transverse suture and similar fascia on anterior edge; two pairs of dorsocentral setae, posterior long and strong, anterior about $\frac{2}{3}$ length of posterior; one pair of prescutellar acrostichal setae, $\frac{1}{3}$ length of posterior dorsocentral seta; two strong notopleural setae, posterior one slightly shorter; one presutural seta as long and strong as anterior notopleural seta; two supra-alar setae, strong, reclinate, posterior one equal in length

to posterior dorsocentral seta; one reclinate postalar seta, about $\frac{1}{2}$ length of posterior dorsocentral seta; postpronotum silver-grey-dusted, with two equally-sized, strong, reclinate postpronotal setae and one finer and shorter proclinate postpronotal seta, surface with about nine fine setulae; anepisternum brown, grey-dusted throughout, with three reclinate anepisternal setae, the ventral and medial strong, the more dorsal weakly developed, slightly downcurved about $\frac{1}{2}$ length of medial anepisternal seta (Fig. 3.2: 20), surface with *ca.* 18 fine, short setulae arranged concentrically; anepimeron, laterotergite and meron yellow to grey-dusted, glabrous; katepisternum with dark, brown macula in anterior $\frac{1}{2}$, dirty yellow in posterior, with two katepisternal setae, one strong posterior, one weaker and finer anterior, both dorsally-directed, surface with about eight short, fine setulae at base and row of fine setulae along posterior margin.

Wing (Fig. 3.2: 6). Long, relatively narrow, tip bluntly pointed, veins pale brown, membrane faintly infusate yellowish throughout; veins R_{2+3} and R_{4+5} slightly diverging in apical $\frac{1}{2}$; cell *dm* narrow at crossvein *dm-cu*; crossvein *dm-cu* obliquely angled posteriorly; anal fold long, extending $\frac{1}{3}$ length of cell *cua*₁; halter dirty white.

Legs. All legs, including coxae, pale yellow; Fore coxa with three strong preapical setae and *ca.* 17 brown setulae on anterior surface; mid-coxa with two equally strong, black, ventrally-directed lateral setae; hind coxa with one weaker ventrally-directed seta; fore-femur with ctenidium of about nine short, closely-approximated, sharp, brown spinules.

Scutellum (Fig. 3.2: 16). Disk glabrous, ground colour grey, with moderately broad yellow fascia around entire margin; two pairs of strong scutellar setae, lateral longer and stronger than medial, with two smaller intermediate scutellar setulae inserted between lateral and medial scutellar setae.

Abdomen. Ground colour yellow, with dark fasciae at segmental borders, surface clothed in short black setulae; tergite 1 yellowish throughout; tergite 2 yellow with narrow black apical fascia; tergites 3–4 with sub-triangular black maculae in basal corners only; tergite 5 yellow, with faint black mark medially at apical edge.

Terminalia (Figs 3.2: 9, 12). Epandrium brown, subquadrate basally, broadest medially, with strong, black, overlapping setae throughout, those along ventral edge longer and stronger (Fig. 3.2: 9, *ep*); hypandrium narrow, short and ventrally-directed in profile (Fig. 3.2: 9, *hy*); surstylus wedge-shaped, relatively short, with very slight

indentation sub-medially and micro-setulae at apical corners (Fig. 3.2: 9, *ss*); cercus grossly extended posteriorly (angle of projection not significant), with four long, thick setae terminally and sparse, erect setae on dorsal and lateral surface (Fig. 3.2: 9, *ce*); phallus formed of narrow C-shaped structure, phallapodeme and basiphallus fused, phallapodeme widely, moderately deeply incised basally (Fig. 3.2: 12, *ph*, *bp*), distiphallus distinctly subdivided into two segments (Fig. 3.2: 12, *dp1*, *dp2*), first division of distiphallus long and narrow, sub-parallel-sided, slightly down-curved towards apex, second division of distiphallus moderately short, upcurved, with two ventrally-directed, spatulate processes and single dorsal laterally expanded projection; apical ½ of basiphallus enclosed in sub-parallel-sided membranous sheath (Fig. 3.2: 12, *msh*), with dorsal plate (Fig. 3.2: 12, *dopl*) that adjoins base of first division of distiphallus.

Female. Similar to male, except in the following respects: larger (overall length: 3.9 mm; wing length: 4.0 mm ($n = 1$ female)); spermatheca dark brown, weakly sclerotised, spherical, surface studded with fine protuberances.

Variation. Insufficient material is available to assess variation.

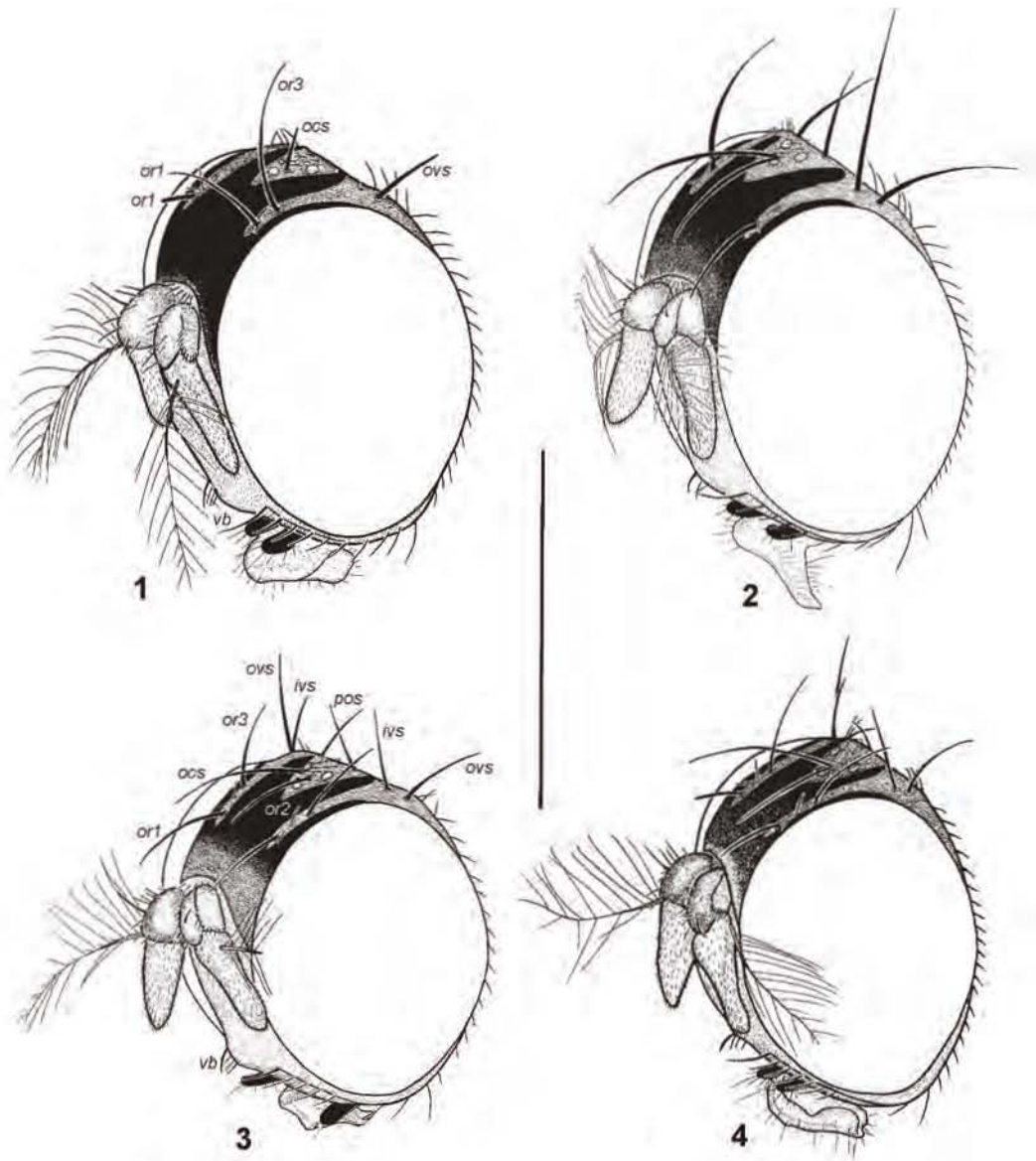
Differential diagnosis. This species appears to be most closely related to *T. rhayaderi* sp. n., having the disk of the mesonotum predominantly black-grey, the anterior dorsocentral seta long and prominent and the more dorsal anepisternal seta weakly developed. *Tigrisomyia scoliosis* sp. n. differs from *T. rhayaderi* sp. n., however, in having the scutellum grey with a moderately broad yellow fascia around the entire margin. As the male of *T. rhayaderi* sp. n. remains unknown, differences in the male terminalia of the two species cannot be assessed.

Type material examined. [TANZANIA]: holotype ♂, “MPWAPWA. [6°21’S, 36°29’E] / TANGANYIKA. / P.A. BUXTON. 7:1954. // Pres. By / P.a. Buxton, / B.M.1946-746 [handwritten] // HOLOTYPE ♂ / *Tigrisomyia / scoliosis* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (BMNH). Micro-pinned and staged; in excellent condition, except left hind tarsus missing. Dissected, with abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (both labelled: “PARATYPE ♂ [or ♀] / *Tigrisomyia / scoliosis* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]”): [TANZANIA]: 1♂, 1♀, same data as holotype (BMNH).

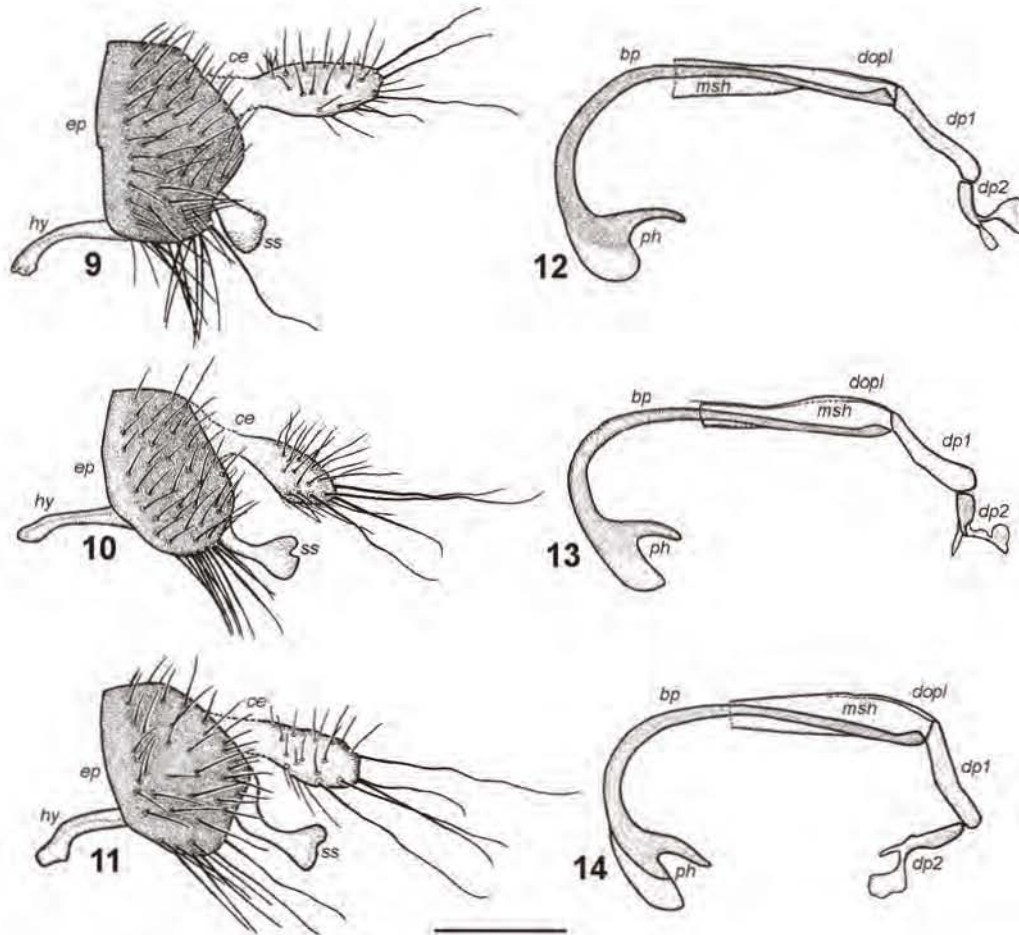
Remarks. The type material was collected at “Mpwapwa, Tanganyika” by P.A. Buxton in the mid-1950s. Mpwapwa was the site of Tanzania’s oldest veterinary research institute situated at Kikombo, which was later moved to Temeke in Dar es Salaam in the late 1950s. P.A. Buxton was a veterinary entomologist who worked principally on *tsetse* and so there is a strong probability that he collected the type material in forests surrounding that station. Greenway (1933: 28) provided a sketch map (p. 29) which illustrates the veterinary station area at Mpwapwa at the base of the Rebeho (Usagara) Mountains and it is this locality that is plotted in Fig. 3.2: 24.

Distribution. Tanzania (Fig. 3.2: 24).

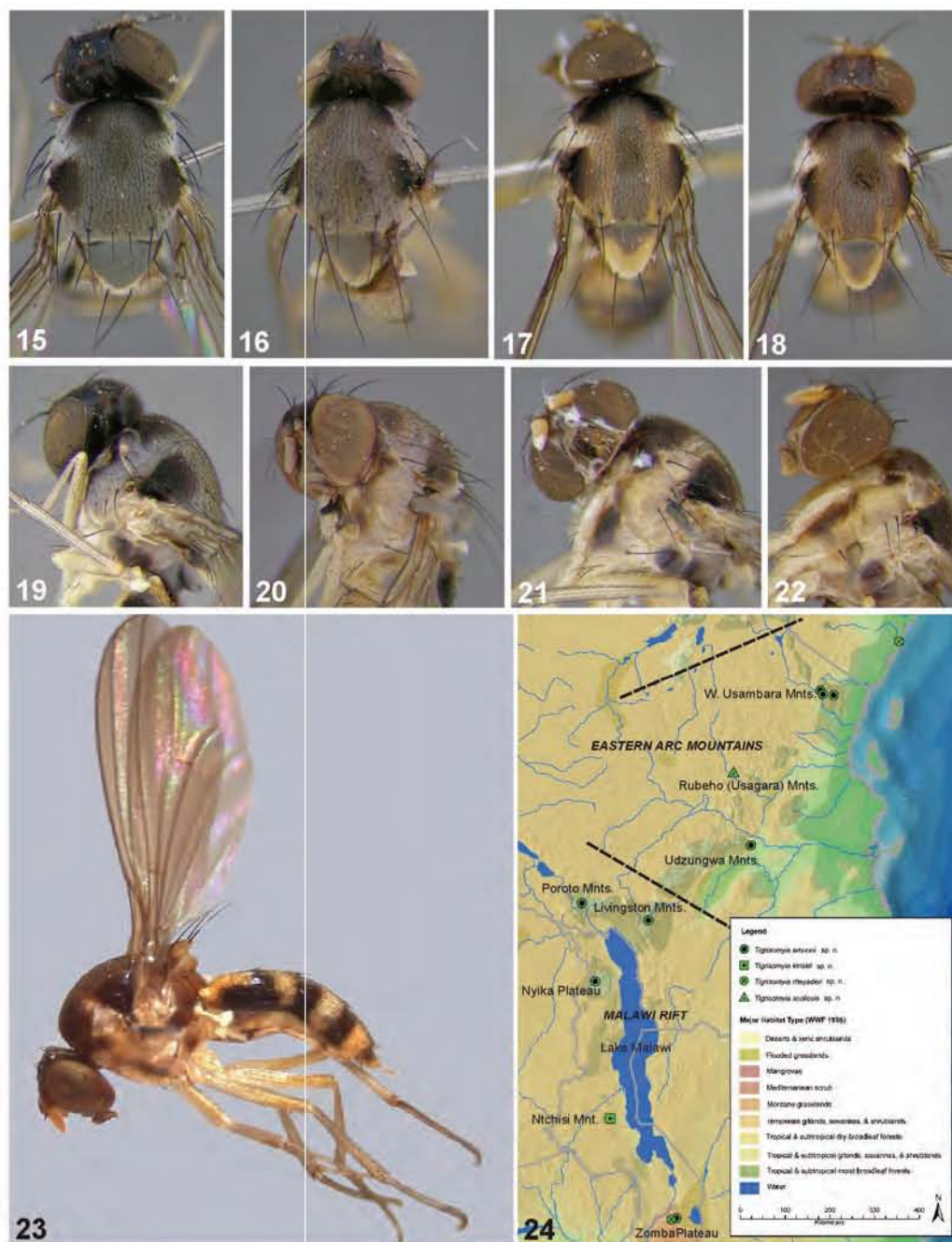
Bionomics. This species is associated with high elevation Afromontane forest. The Type locality, Mpwapwa, lies at 3500 ft = *ca.* 1066 m (Greenway 1933), and the species is apparently restricted to the Rebeho (Usagara) Mountains, which form part of the Eastern Arc mountain group of central Tanzania (see Chapter 4).



Figs 3.2: 1–4. Head (frontolateral view). 1, *Tigrisomyia rhayaderi* sp. n. (♀ HT, Kenya, near Takaugu, TAU); 2, *T. scoliosis* sp. n. (♀ PT, [Tanzania], Mpwapwa, BMNH); 3, *T. kinskii* sp. n. (♂ PT, Malawi, Centre Ntchisi Forest, TAU); 4, *T. ammoni* sp. n. (♂ PT, Tanzania, Gologolo Forest, TAU). Scale bar= 1 mm.



Figs 3.2: 9–14. 9–11: Hypandrium and epandrium (lateral view). 9, *Tigrisomyia scoliosis* sp. n. (♂ HT, [Tanzania], Mpwapwa, BMNH); 10, *T. kinskii* sp. n. (♂ PT, Malawi, Centre Ntchisi Forest, TAU); 11, *T. ammoni* sp. n. (♂ HT, Tanzania, Gologolo Forest, TAU). 12–14: Phallus (lateral view). 12, *T. scoliosis* sp. n. (same); 13, *T. kinskii* sp. n. (same); 14, *T. ammoni* sp. n. (same). [The male of *T. rhayaderi* sp. n. is unknown.]. Scale bar = 0.3 mm.



Figs 3.2: 15–24. 15–18: Light micrographs of mesonotum and scutellum (dorsal view). 15, *Tigrisomyia rhayaderi* sp. n. (♀ HT, Kenya, near Takaugu, TAU); 16, *T. scoliosis* sp. n. (♂ HT, [Tanzania], Mpwapwa, BMNH); 17, *T. kinskii* sp. n. (♂ HT, Malawi, Centre Ntchisi Forest, TAU); 18, *T. amnoni* sp. n. (♂ HT, Tanzania, Gologolo Forest, TAU). 19–22: Same (lateral view); 19, *T. rhayaderi* sp. n. (same); 20, *T. scoliosis* sp. n. (♂ PT, same); 21, *T. kinskii* sp. n. (same); 22, *T. amnoni* sp. n. (same). Not to scale. 23, Habitus (lateral) of *T. amnoni* sp. n. (♀ PT, Tanzania, Gologolo Forest, TAU; length: 3.9 mm). 24, Distribution of the species of *Tigrisomyia* gen. n. in the Eastern Arc Mountains and Malawi Rift of East Africa.



Figs 3.2: 25–27. Habitus photographs of *Tigrisomyia ammoni* sp. n. in life. Photographed at Mufindi in the Eastern Arc Mountains of Tanzania (photographs © Steve Marshall; reproduced with permission).

3.3

The Malagasy species of *Curtonotum* Macquart, with descriptions of six new species³

Preface: The Madagascan fauna of the genus *Curtonotum* Macquart, 1844 is reviewed. Type material of the seven species described by Tsacas in 1974 (*C. balachowskyi*, *C. boeny*, *C. keiseri*, *C. pauliani*, *C. sakalava*, *C. sternithrix* and *C. stuckenbergi*) was studied and additional material of five of these is noted, substantially increasing their known distributions. Six of the seven species described by Tsacas are endemic to Madagascar; unpublished records indicate, however, that *C. pauliani*, occurs in Namibia and South Africa on the African continental mainland. Six additional endemic species are described as new: *C. coroneformis* sp. n., *C. gladiiformis* sp. n., *C. griveaudi* sp. n., *C. irwini* sp. n., *C. parkeri* sp. n., and *C. rinhatinana* sp. n. The head and thorax, frons, wing, fifth sternite and hypandrium of the male of the 13 species are illustrated for the first time, as well as the highly diagnostic male phallus, both laterally and dorsally at the junction of the basiphallus and distiphallus. A key to species based on male characters is provided, and species distributions are mapped and interpreted. The biogeographical significance of the Madagascan species is discussed. An annotated checklist of Madagascan Curtonotidae is presented, and co-ordinates used to plot maps and a list of vegetation types in which species occur are provided.

Four genera of Curtonotidae are currently known worldwide, *i.e.*, *Axinota* van der Wulp, 1886, *Cyrtona* (s.l.) Séguy, 1938, *Tigrisomyia* Kirk-Spriggs, 2010 and *Curtonotum* Macquart, 1844, all of which occur in the continental Afrotropical Region; *Tigrisomyia* exclusively so. *Curtonotum* is the most species-rich genus and is found in all zoogeographical regions of the world except Australasia/Oceania and Antarctica, although Klymko and Marshall (2011) point out that *Curtonotum* in its current broad sense is paraphyletic with respect to *Axinota*, and suggest restricting the name *Curtonotum* to a monophyletic New World group. Two genera are known to occur on Madagascar, *Axinota*, represented by a single species, *A. kyphosis* Kirk-Spriggs, 2010a, of supposed Oriental origin and *Curtonotum* (3.3: Appendix I).

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Notably, the genus *Cyrtona* (s.l.), which is extremely species-rich in the continental Afrotropical Region, is apparently absent.

The *Curtonotum* fauna of Madagascar has remained a neglected group and nothing is currently known of their biology and immature stages. Species in the continental Afrotropical Region are known to roost in the burrows of small mammals, hollow trees and overhangs of riverbeds, *etc.* (e.g., Kirk-Spriggs 2008b; Meier *et al.* 1997; Tsacas 1977) and, at least in the case of species occurring in xeric regions, are known to develop as scavengers in the damaged egg pods of locusts and grasshoppers (Orthoptera) (Greathead 1958; Kirk-Spriggs 2008b; Meier *et al.* 1997). A more complete review of the known biology of the genus will be presented in Part IV of this revision (Chapter 3.4).

Specimens of *C. balachowskyi* Tsacas from Madagascar are subject to infestations of the entomophagous fungus *Laboulbenia curtonoti* Rossi and Kirk-Spriggs (Ascomycota), a species with an elongated rhizoid which penetrates the host's cuticle (Rossi and Kirk-Spriggs 2011). An infestation of a different, undescribed *Laboulbeniales* species was also observed on a specimen of *C. sakalava* Tsacas during the course of this study, but occurred in insufficient numbers to facilitate description.

In a first attempt to treat the taxonomy of the Madagascan species of the genus, Tsacas (1974) described and named seven endemic species and identified, but did not name, five apparent others. Tsacas' study was, however, based on only 38 specimens. These were collected by Renaud Paulian (1913–2003), then Deputy Director of the Institut Scientifique de Madagascar, and colleagues from 1956 to 1960. This was supplemented with material sampled by Raymond Decary (1891–1973) in 1922, and Alfred “Fred” Jakob Keiser-Jenny (1895–1969) and his wife collected from May to October 1958. The study also included specimens collected by Brian Roy Stuckenberg (1930–2009), during his second Madagascan expedition from November 1957 to April 1958.

All specimens studied by Tsacas (1974), including all types, were borrowed for study from the respective institutions. A few additional specimens came to light in material loaned from Tel Aviv University, Israel, Zoologische Staatssammlung, München, Germany, and the KwaZulu-Natal Museum, Pietermaritzburg, South Africa, but by far the most substantial number of specimens now available for study result from Michael E. Irwin's extensive Arthropod Survey of Madagascar's

Protected Areas (1998–2009), deposited in the California Academy of Sciences, San Francisco, USA.

Tsacas (1974) illustrated the spermathecae of five named and two unnamed Madagascan species, but did not describe these structures or assess their variability. Kirk-Spriggs (2008c), however, assessed intra- and inter-specific variability in spermathecal form of three continental Afrotropical species in the *Curtonotum cuthbertsoni* complex (*sensu* Tsacas 1977), with obclavate spermathecae and concluded that variability was too great to allow specific differentiation. For this reason (with the notable exceptions of *C. sternithrix*, which has dark rings around the sockets of all thoracic setae, and *C. sakalava*, which is unique in having the lateral maculae of the abdominal tergites developed into a continuous band in both sexes), only the males can be identified with certainty and then only following detailed examination of the male terminalia.

As noted above, Tsacas (1974) identified, but did not name, five “species” from Madagascar (*Curtonotum* sp. cf. *balachowskyi* n. sp. species a, *C.* cf. *balachowskyi* n. sp. species b, *C.* sp. cf. *pauliani*, n. sp. species c, *Curtonotum* sp. d, and *Curtonotum* sp. e), only the first of which is represented by a male and can be reliably determined. Close examination of the male terminalia of this specimen, in direct comparison to the types, reveals its conspecificity with *C. balachowskyi* Tsacas. As these specimens were not formally named they have no bearing in nomenclature and the remaining female specimens must be regarded as indeterminate *Curtonotum* spp.

Earlier parts of this revision deal with the genus *Axinota* (Kirk-Spriggs 2010a, Chapter 3.1) and the East African endemic genus *Tigrisomyia* (Kirk-Spriggs 2010b, Chapter 3.2). Part IV will consider the species of *Curtonotum* occurring in the continental part of the Afrotropical Region and will include a more thorough account of species complexes and group associations (Chapter 3.4).

MATERIAL AND METHODS

Preparation of spirit-preserved specimens

Material resulting from the Arthropod Survey of Madagascar’s Protected Areas (1998–2009) and other material loaned from the California Academy of Sciences were sampled using Malaise traps and was initially preserved in 96%

ethanol. Only part of the material resulting from this extensive survey was available for study as numerous samples remain unsorted. These specimens were prepared in the following manner: specimens were placed on dry tissue paper to absorb excess alcohol and were then placed in vials of 2-ethoxy ethanol and left to stand overnight. The 2-ethoxy ethanol was then decanted and replaced with ethyl acetate, and again left overnight. Specimens were then removed and air-dried on tissue paper before being glued to card points using *Seccotine* and having the appropriate labels added. Ex-alcohol specimens are bleached to some extent and many have been rubbed or have setation missing; colours of dry-pinned specimens can be expected to be brighter.

Dissection

All undissected male specimens included in this study were dissected for the purpose of identification. Abdomens were removed with watchmaker's forceps and macerated in 10% potassium hydroxide in a heated block before being transferred to 70% ethanol with a few drops of glacial acetic acid in an excavated glass block. Following dissection, abdomens and male terminalia were stored in a micro-vial with glycerol pinned beneath each specimen. The cork-bunged glass genitalia vials used by L. Tsacas, many of which had dried up or deteriorated, were all replaced and a label was appended to each specimen stating "Genitalia vial replaced A.H. Kirk-Spriggs [2006–2008]".

Preparation of figures and images

Figures of the head, thorax and frons (Figs 3.3: 1–26), were prepared from images captured with a Leica EZ4HD stereo microscope with built-in digital camera. These were photographed using a ring light and dome (Kerr *et al.* 2008) in a range of focal planes and were digitised using Combine ZP Image Stacking Software.

Wings were detached and placed between two glass slides. Images (Figs 3.3: 27–35, 37–39) were captured with a Leica Wild M3Z binocular microscope with Nikon E5400 digital camera attached. Fig. 3.3: 36 was prepared using the Leica EZ4HD microscope.

Male terminalia were mounted laterally or dorsally, in a blob of heated and then cooled glycerine jelly. Figures of these structures (Figs 3.3: 40–91) were prepared using a Leica Wild M3Z binocular microscope with a *camera lucida*

attachment. Images were enlarged and traced, and details added by hand in pen and ink by constant referral to the specimen. Scale bars were added using a 0.5 mm graticule slide.

Measurements

Measurements were taken with a graticule eye piece on a Leica Wild M3Z binocular microscope, calibrated with a 0.5 mm graticule slide.

As the descriptions and redescrptions are based on the holotype in most cases, measurements are provided for the holotype only. In some cases overall lengths of series of specimens were taken prior to dissection and in such cases a range of lengths is provided. In some cases overall lengths could not be provided as specimens were dissected beforehand. In such cases the measurements provided by Tsacas (1974) are included (where applicable), or combined length of the head and thorax and thorax and scutellum alone are provided. Tsacas did not specify how his measurements were made, but overall length measurements appear to have included the wings (*i.e.*, measured from the head to the tips of the wings), rather than the combined lengths of the head, thorax and abdomen, so are larger by comparison with the measurements provided here.

Overall length was measured from the anteriormost point of the frons to the tip of the abdomen (viewed laterally). Length of head and thorax combined was measured from the anteriormost point of the frons to the scutoscutellar suture (viewed dorsally).

Length of thorax and scutellum combined was measured from the anterior margin of the mesonotum (immediately posterior to head) to the anterior tip of the scutellum (viewed dorsally).

The eye height/length ratio was measured from the most ventral to the most dorsal point of the eye and through the eye medially (viewed laterally).

Genal height was measured immediately below the ventro-medial part of the eye (viewed laterally).

Frons length represents the distance between the ventral margin (immediately above the point of antennal insertion), to the posterior ocelli (viewed dorsally). Frons width represents the distance between the lateral margins of the frons, measured at the midpoint between the posterior ocelli and the ventral margin of the frons.

Length of the wing was measured from the humeral crossvein (Fig. 3.3: 27, *h*) to the apex of the second radial vein (Fig. 3.3: 27, R_{4+5}).

Descriptions

A full redescription is provided for *C. balachowskyi* Tsacas, the most widely distributed species of the genus in Madagascar. Redescriptions and descriptions of other species are compared to this and differences and additional characters noted only. A full description or redescription of the male terminalia is provided in all cases.

Distribution maps

Each set of specimen locality co-ordinates listed in 3.3: Appendix II was obtained in one of two ways: (a) original co-ordinates provided on data labels, later converted to decimal co-ordinates; or (b) obtained from Internet geo-referencing websites powered by Google Earth™.

Distribution maps were prepared by converting the list of geographic co-ordinates indicating the point location of specimen records into a spatial data layer in ArcMap 9.3. The specimen location layer was overlaid on the *Vegetation Map of Madagascar* by Moat and Smith (2007). Plotted points are based on material examined as part of the systematic revision only, *i.e.*, all represent confirmed identifications.

Vegetation types cited in the text follow Moat and Smith (2007), as listed in 3.3: Appendix II, biomes follow Yoder and Nowak (2006) (Fig. 3.3: 105), biogeographical zones Boumans *et al.* (2007) and Wilmé *et al.* (2006) (Fig. 3.3: 106) and bioclimatic zones Cornet (1974) and Schatz (2000) (Fig. 3.3: 107).

Labels

Type label data are quoted exactly as they appear. A division slash (/) denotes the commencement of a new line, two division slashes (//) data on a further label. Significant supplementary or qualifying information is presented in square brackets when considered necessary. Information on label colour, *etc.* is only provided for type material. All labels are printed on white card unless otherwise stated. Specimens with the head missing are also labelled as such, *e.g.*, “Head missing 2008”. Adult morphology follows Cumming and Wood (2009) and for the male terminalia Marshall *et al.* (2010).

SYSTEMATICS

Key to adult males of Malagasy species of *Curtonotum* Macquart

(Examination of the male terminalia is required in all cases.)

1. Wing membrane deep brown infusate throughout (Figs 3.3: 27–29); distiphallus either with narrow, ventrally-directed, lateral spine and two smaller basal spines (Figs 3.3: 46, 47, indicated with arrows), or with patch of finger-like spinules basally and tuft of hairs submedially (Fig. 3.3: 45) 2
 - Wing membrane only faintly brown infusate, sometimes marginally darker in r_1 and anterior $\frac{1}{2}$ of r_{2+3} and/or in region of $dm-cu$ crossvein only (Figs 3.3: 30–39); distiphallus lacking ventrally-directed spines or other spinular modifications (if spines present, then these forming anterior margin of basiphallus) 4
2. Three strong postpronotal setae; all setae on mesonotum and thoracic pleura with distinct dark brown ring around each socket (Fig. 3.3: 3); extensively developed lateral maculae and medial fascia of abdominal tergites black; sternites 4 and 5 modified, with comb of long, regular spinules on anterior margin, sternite 6 with deep V-shaped apical excision (Fig. 3.3: 86); distiphallus with patch of finger-like spinules basally and tuft of hairs submedially (Fig. 3.3: 45) *C. sternithrix* Tsacas
 - Two strong postpronotal setae; all setae on mesonotum and thoracic pleura without distinct dark brown ring around each socket (Figs 3.3: 1, 2); extensively developed lateral maculae and medial fascia of abdominal tergites brown; sternites 4 and 5 unmodified, sternite 6 dove-tailed (Figs 3.3: 79, 80); distiphallus with conspicuous, ventrally-directed, long, lateral spine and two smaller spines (Figs 3.3: 46, 47, indicated with arrows) 3
3. Frons (Fig. 3.3: 14) pale brown, with conspicuous deep brown vittae reaching ventral margin; $dm-cu$ crossvein angle and curvature as illustrated (Fig. 3.3: 27); phallus weakly sclerotised at lateral margins of basiphallus (viewed dorsally) (Fig. 3.3: 46); prominent ventrally-directed spine on distiphallus narrow, smaller spines positioned in baso-lateral region (Fig. 3.3: 46) *C. keiseri* Tsacas
 - Frons (Fig. 3.3: 15) pale yellow, slightly darker posteriorly and medial to orbital plates (if frons slightly darker, vittae never strong or reaching ventral margin); $dm-cu$ crossvein angle and curvature as illustrated (Fig. 3.3: 28); phallus heavily-sclerotised at lateral margins of basiphallus (viewed dorsally) (Fig. 3.3: 47);

- prominent ventrally-directed spine on distiphallus broad, smaller spines positioned in left and right lateral regions (Fig. 3.3: 47) *C. stuckenbergi* Tsacas
4. Epandrium (viewed laterally) with oblique semicircular excavation along ventro-apical margin, ventral lobe forming a blunt point, from which two very strong, long black setae originate (Figs 3.3: 67, 68); anterior margin of basiphallus with finger- or spine-like ventro-medial projection (Figs 3.3: 70, 71, 73, 74) 5
- Epandrium (viewed laterally) evenly-rounded or straight at ventro-apical margin, with extensive group of irregular, long setae along ventral margin (Figs 3.3: 49–51, 58–60, 69, 76); anterior margin of basiphallus without finger- or spine-like ventro-medial projection 6
5. Frons pale dirty yellow, faintly darker towards vertex and between orbital plates, both vittae inconspicuous (Fig. 3.3: 23); sternite 6 with dense setulae (Fig. 3.3: 88); surstylus short, wide basally (Fig. 3.3: 67); *dm–cu* crossvein angle and curvature as illustrated (Fig. 3.3: 36); basiphallus evenly rounded basally, with conspicuous internal bulge in basal fifth (Fig. 3.3: 70); distiphallus with medial finger-like, slightly curved, ventrally-directed projection (Figs 3.3: 70, 73) *C. boeny* Tsacas
- Frons pale brown to dark brown, forming conspicuous vittae, reaching ventral margin (Fig. 3.3: 24); sternite 6 with sparse setulae (Fig. 3.3: 89); surstylus long, narrow basally (Fig. 3.3: 68); *dm–cu* crossvein angle and curvature as illustrated (Fig. 3.3: 37); basiphallus straight in basal third, with slight internal bulge at midlength (Fig. 3.3: 71); distiphallus with medial spine-like, ventrally-directed projection (Figs 3.3: 71, 74) *C. griveaudi* sp. n.
6. Phallus highly modified; basiphallus (Fig. 3.3: 63) grossly expanded, forming extensive, extremely wide, sclerotised, half moon-shaped plate, strongly concave on left side, with large, heavily sclerotised sperm pump (Figs 3.3: 63a, 63b), possibly inserted in left concavity; *dm–cu* crossvein angle and curvature as illustrated (Fig. 3.3: 35) *C. rinhatinana* sp. n.
- Phallus not highly modified; basiphallus not grossly expanded, narrow (Figs 3.3: 52–54, 61, 62, 72, 77); sperm pump absent; *dm–cu* crossvein angle and curvature not as in Fig. 3.3: 35) 7
7. Hypandrium short, with broad-based sub-angulate-truncate dorsobasal lobe (Figs 3.3: 69, 76); sternite 6 as illustrated (Figs 3.3: 90, 91); basal section of distiphallus either with a conspicuous, short, dorsomedial keel (Fig. 3.3: 77, 78), or with conspicuous, short dorsomedial spine (Figs 3.3: 72, 75) 8

- Hypandrium long, with broad-based rounded or subtriangular dorsobasal lobe (49–51, 58, 59); sternite 6 as illustrated (Figs 3.3: 81–85); distiphallus lacking a keel or short, dorsomedial spine 9
- 8. Very small species, wing length *ca.* 1.6 mm; frons (Fig. 3.3: 26) markedly wider at vertex than at ventral margin; ocellar triangle large, extending *ca.* one third length of frons; lateral margins of tergites 2–4 collectively forming an unbroken facia (viewed at low magnification); *dm–cu* crossvein angle and curvature as illustrated (Fig. 3.3: 39); distiphallus with conspicuous, short, dorsomedial keel (Figs 3.3: 77, 78)
..... *C. sakalava* Tsacas
- Larger species, wing length *ca.* 3.2 mm; frons (Fig. 3.3: 25) subparallel-sided; ocellar triangle small, extending *ca.* one-fifth length of frons; lateral margins of tergites 2–4 with well-separated, subelliptical macula basally; *dm–cu* crossvein angle and curvature as illustrated (Fig. 3.3: 38); distiphallus with short, dorsomedial spine (Figs 3.3: 72, 75) (Madagascar, Namibia and South Africa) ... *C. pauliani* Tsacas
- 9. Sternite 6 broader than long, subquadrate (Figs 3.3: 84, 85), either with very short setulae, only marginally longer at apical margin (Fig. 3.3: 84), or with extremely long setulae at apical margin (Fig. 3.3: 85); basiphallus in apical region, either with distinct raised, angulate fold on left margin (Fig. 3.3: 64), or with two spines, one medial and one submedial (Fig. 3.3: 65) 10
- Sternite 6 narrower in basal *ca.* third, expanded laterally, with V-shaped or U-shaped apical excision, with moderately strong setulae at apical margin (Figs 3.3: 81–83); basiphallus (in apical region) either with left lateral margin developed into a long, curved, ventrally-directed spine and smaller medial spine (Fig. 3.3: 55), or with distinct raised keel and spinose area laterally on distiphallus (Figs 3.3: 56, 57) 11
- 10. Frons (Fig. 3.3: 20) subparallel-sided, pale dirty yellow, faintly darker towards vertex and between orbital plates, otherwise two vittae inconspicuous; *dm–cu* crossvein angle and curvature as illustrated (Fig. 3.3: 33); basiphallus (Fig. 3.3: 64) with right lateral margin evenly rounded, with slightly raised margin, forming even projection apically, left lateral margin with distinct, angulate, raised fold
..... *C. balachowskyi* Tsacas
- Frons (Fig. 3.3: 21) markedly wider at vertex than at ventral margin, pale brown, darker brown towards vertex and between orbital plates, forming conspicuous vittae that reach ventral margin; *dm–cu* crossvein angle and curvature as illustrated (Fig. 3.3: 34); basiphallus (Fig. 3.3: 65) with right lateral margin evenly rounded and flat,

- developed into a bluntly pointed ventro-medial spine, with much smaller spine baso-laterally *C. gladiiformis* sp. n.
11. Basiphallus moderately narrow in apical third (viewed dorsally), with left lateral margin developed into a long, curved, ventrally-directed spine and smaller medial spine (Fig. 3.3: 55); *dm-cu* crossvein angle and curvature as illustrated (Fig. 3.3: 30) ...
..... *C. irwini* sp. n.
- Basiphallus laterally expanded in apical third (viewed dorsally) (Figs 3.3: 56, 57), with distinct raised keel in left apical region and spinose area on lateral margin of distiphallus; *dm-cu* crossvein angle and curvature not as Fig. 3.3: 30 12
12. Distiphallus (Fig. 3.3: 56) with sclerotised area subdivided medially, with thin ventrally-directed spine in membranous window, right lateral section with three short, dark-tipped spines (viewed dorsolaterally; not visible on Fig. 3.3: 56); *dm-cu* crossvein angle and curvature as illustrated (Fig. 3.3: 31) *C. parkeri* sp. n.
- Distiphallus (Fig. 3.3: 57) with baso-lateral, upturned, sclerotised, crown-like projection, this subtriangular (viewed laterally) (Fig. 3.3: 54); *dm-cu* crossvein angle and curvature as illustrated (Fig. 3.3: 32) *C. coroneiformis* sp. n.

Genus *Curtonotum* Macquart, 1844

Refer to 3.3: Appendix I for synonymy.

Curtonotum balachowskyi Tsacas, 1974

Figs 3.3: 7, 20, 33, 58, 61, 64, 84, 98

Curtonotum balachowskyi: Tsacas 1974: 710; figs 4a–d (p. 711); fig. 8f (p. 718). Type locality: “Madagascar: Mananjary”.

Curtonotum sp. cf. *balachowskyi* n. sp. species b (*sensu* Tsacas 1974: 712).

Redescription: *Male* (primarily based on field-pinned HT).

Measurements: Overall length 2.8–4.8 mm ($n = 47$, N-T); length of head and thorax combined 2.8 mm; length of thorax and scutellum combined 2.9 mm; wing length 4 mm.

Head (Figs 3.3: 7, 20). Compound eye probably green-brown iridescent in living examples, in profile gently and evenly rounded anteriorly, slightly triangularly

produced posteriorly, eye height/length ratio: 12:7 ($n = 1$, HT); frons (Fig. 3.3: 20) subparallel-sided, slightly wider than long, frons length/width ratio: 7:85 ($n = 1$, HT), very slightly wider at vertex than at ventral margin, ground colour pale dirty yellow, faintly darker towards vertex and between orbital plates, otherwise both vittae inconspicuous, surface with a few minute pale to dark brown setulae, positioned at medial margin of orbital plates; orbital plates and ocellar triangle silver-grey pruinose; ocelli clear grey with 4–5 minute dark setulae arranged in two closely-approximated regular rows between posterior ocelli; orbital plates extending from vertex of head to 0.9 length of frons, slightly indented at lateral margin between posterior and anterior orbital setae; lateral margins with narrow silver pruinose fascia (adjacent to eye margin), widest at antennal insertions; posterior orbital seta moderately strong, slightly outcurved, shorter than outer vertical seta, with tiny proclinate medial orbital seta inserted antero-medially to socket of posterior orbital seta; anterior orbital seta moderately strong, *ca.* $\frac{1}{2}$ length of ocellar setae; ocellar setae finer, almost reaching ventral margin of frons; outer vertical seta shorter than inner; postocellar setae strong, cruciate, slightly shorter than outer vertical seta; antennal scape and pedicel dirty pale brown, silver-grey pruinose, flagellomere 1 concolourous with pedicel basally, darkened apically, silver-grey pruinose as in face, longer than wide, apex bluntly-pointed, arista with 9–11 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; lunule and face uniform silver-grey pruinose throughout, face with broad silver fascia (adjacent to eye margin), facial carina developed as a low ridge, extending $\frac{1}{2}$ length of face, pre-epistomal line indented; clypeus brown, especially laterally; 1 pair fairly strong vibrissae inserted on posterior lateral margin and 10 much finer setae bordering genal groove; occiput yellow to grey pruinose with moderately strong, black postocular setae; gena narrow, eye height/genal height ratio: 12:1 ($n = 1$, HT), silver pruinose, abruptly dirty brown beyond basal angle; palpus black-brown, brown microtrichose.

Thorax (Fig. 3.3: 7). Mesonotum moderately convex, very slightly flattened behind head, with multiple rows of regular, short, black, overlapping setulae; silver-grey pruinose, with four parallel chestnut-brown pruinose vittae on dorsal surface, 2 median vittae extending from anterior margin to region of anterior dorsocentral seta socket, 2 lateral vittae shorter, extending from $\frac{2}{3}$ length to region of posterior dorsocentral seta socket, 2 pairs of dorsocentral setae, posterior long and strong

(shorter than lateral scutellar seta), anterior shorter and finer (shorter and finer than medial scutellar seta); 1 pair acrostichal setae shorter than anterior dorsocentral seta; presutural seta moderately strong, reclinate, as long and strong as posterior notopleural seta; 2 notopleural setae the anterior slightly longer than posterior; 1 strong, reclinate supra-alar seta slightly exceeding length of posterior dorsocentral seta; 2 reclinate postalar seta moderately strong, same size as acrostichal setae; postpronotum dirty yellow-grey pruinose, with 2 strong postpronotal setae, the more dorsal longer and reclinate, the more ventral shorter and proclinate, with 10–12 finer black-brown setulae; anepisternum silver-grey pruinose with 3 moderately strong anepisternal setae, the dorsal and medial reclinate, stronger and of equal length, the more ventral shorter, slightly dorsally-directed, surface with 18 fine setulae scattered across surface, some larger and arranged in 2 groups of 3; anepimeron, laterotergite and meron silver-grey pruinose, glabrous; katepisternum silver-grey pruinose, with 2 katepisternal setae, the more ventral strong, slightly dorsally-directed, the more dorsal much smaller and finer, *ca.* 0.2 length of ventral katepisternal setae, surface with 16 short, fine setulae at base and along posterior margin.

Scutellum. Silver-grey pruinose as on mesonotum, with faint medial brown pruinose vitta basally (under some lights); anterior four-fifths clothed in black, irregular, overlapping setulae; 2 pairs of strong scutellar setae, 1 weak basal scutellar setula and 1 weak intermediate scutellar setula, the latter inserted closer to lateral than medial scutellar setae (four-fifths distance between medial and lateral scutellar setae).

Legs. Fore coxa silver-yellow pruinose with two moderately strong, brown, ventrally-directed preapical setae and comb of finer setulae medially, with 8–10 brown setulae on anterior surface; mid and hind coxa yellow-grey pruinose, mid-coxa with 2 very strong, lateral, ventrally-directed, black setae and comb of finer setae medially and 3 brown setulae; hind coxa with 1 weaker lateral black seta and 1 brown setula; femora, tibia and tarsi uniform dirty yellow; fore tibia with 4 strong setae on lateral margin, the second basal seta shorter than other three, with ctenidium of 10–12 short, sharp, black spinules, separated from each other by one or more basal spinule widths.

Wing (Fig. 3.3: 33). Long, relatively narrow, tip evenly-rounded, veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in r_1 and anterior $\frac{1}{2}$ of r_{2+3} and in region of $dm-cu$ crossvein; costa with prominent costal spines in basal four-fifths from costal break; R_{4+5} slightly anteriorly-

produced in basal third, R_{2+3} and R_{4+5} subparallel, r_{2+3} expanded apically; $dm-cu$ crossvein slightly obliquely angled posteriorly, evenly curved medially; cua_1 relatively long and narrow; anal fold extending $\frac{1}{2}$ length of cua_1 ; halter dirty yellow.

Abdomen. Ground colour of tergites 1–5 yellow-grey pruinose, clothed in relatively long black, overlapping setulae, arranged in regular rows, those at apical margins longer and stronger; tergite 1 simple, devoid of maculae; tergite 2 with oblique, subrectangular brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with narrow, V-shaped concolourous median fascia and well-separated and reduced concolourous T-shaped dorsolateral macula, lateral margin of tergites 2–5 with subelliptical concolourous macula in basal $\frac{1}{2}$; sternite 4, quadrate, sternite 5 rectangular, subparallel-sided, $0.25\times$ longer than sternite 4, both unmodified, with brown setulae arranged in irregular rows, those along apical margins slightly longer and stronger; sternite 6 (Fig. 3.3: 84) subquadrate (may appear narrower than Fig. 3.3: 84 in undissected specimens), narrowed in basal two-fifths, with shallow, broad, subtriangular excision apically, with faint brown maculae medially and fascia laterally, merging apically, clothed in short black irregular brown setulae in apical $\frac{2}{3}$, those at apical margin longer and more prominent.

Terminalia (Figs 3.3: 58, 61, 64). Hypandrium (Fig. 3.3: 58, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded to slightly angulate in profile); hypandrial arms narrow basally, expanded apically (viewed laterally), with 2 setulae proximal to postgonite, the more lateral ventrally directed, the medial ventro-medially directed (obscured by epandrium on Fig. 3.3: 58), sclerotised area of medial lobes (viewed dorsally), parallel-sided, medial membranous area narrow, clothed in tiny spinules, separated in basal $\frac{1}{2}$, slightly overlapping in apical $\frac{1}{2}$; postgonite (Fig. 3.3: 58, *pg*) long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 3.3: 58, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly-rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 3.3: 58, *ce*) not prominent, longest setae as long as medium setae on ventral margin of epandrium; surstylus (Fig. 3.3: 58, *ss*) long, widest basally, slightly curved in apical $\frac{2}{3}$; phallus (as in Figs 3.3: 61, *ph*, *bp*, *dp*; 64, *bp*, *dp*) C-shaped, moderately sclerotised, brown; phallapodeme (Fig. 3.3: 61, *ph*), fused to basiphallus, subtriangular (viewed laterally), with basal margin

developed into two short, flat projections in basal two-fifths, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 61, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.3: 61, *bp*) narrow and regular for most of its length, with very slight internal bulge at point of first bend in basal three-fifths; apical section (Fig. 3.3: 64, *bp*) broad, right lateral margin evenly rounded with slightly raised margin, forming even projection apically, left lateral margin with distinct raised fold; distiphallus (Figs 3.3: 61, 64, *dp*) long, scimitar-like (viewed laterally), narrow (viewed dorsally).

Variation: The even projection on the right anterior margin of the basiphallus is somewhat variable in shape and angle in some specimens, other terminalia characters are consistent, however, and this is here regarded as intraspecific variation only.

Differential diagnosis: This species differs from other species occurring on Madagascar in having the medial lobes of the hypandrium (viewed dorsally), parallel-sided, with a narrow medial membranous area clothed in tiny spinules. Interpretation of its relationships to other species occurring in the Afrotropical Region must await the outcome of phylogenetic study.

Type material examined. Holotype: ♂ MADAGASCAR: “MADAGASCAR Fia / Mananjary / 11.VIII.[19]58.F.KEISER [pink paper] // HOLOTYPE [red card] // CURTONOTUM / *balachowskyi* / ♂ holotype n.sp. / L. TSACAS DET. 1974 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* / *balachowskyi* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008” (MNHN). In excellent condition; re-staged on new poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “*Curtonotum* / *balachowskyi* ♂ [or ♀] / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008”): MADAGASCAR: 1♀ same data as holotype except: “// PARATYPE [printed; red card] // CURTONOTUM / *balachowskyi* n.sp. / ♂ paratype / L. TSACAS DET. 1974 [printed & handwritten]”; 1♀ same except: “// CURTONOTUM / *balachowskyi* n.sp. / ♀ paratype / L. TSACAS DET. 1974 [printed & handwritten]” (both NHMB); 1♀ same except: “6.VIII.[19]58 // ALLOTYPE [printed; red card] // CURTONOTUM / *balachowskyi* / ♀ allotype n.sp. / L. TSACAS DET. 1974 [printed & handwritten]”; 1♂, “Ambila / [?Sunaibo - illegible] [handwritten] // VIII.[19]52 / (R.P.) [= R. Paulian] [handwritten] // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // PARATYPE [red card] // CURTONOTUM / *balachowskyi* / ♂ paratype n.sp. / L. TSACAS DET. 1974 [printed & handwritten] // MUSÉUM PARIS” [head detached, glued to data label] (both MNHN); 1♂, “MADAGASCAR Tam. / Tamatave / 23.X.[19]58 F.KEISER [pink paper] // PARATYPE [red card] //

CURTONOTUM / *balachowskyi* / ♂ paratype n.sp. / L. TSACAS DET. 1974 [printed & handwritten]" (NHMB).

Additional material examined (all labelled: "*Curtonotum balachowskyi* Tsacas, 1974 ♂ det. A.H. Kirk-Spriggs 2010"): MADAGASCAR: *d'Analalava Prov.*: 1♂ Maromandia, R. Decary 1922, "*Curtonotum* sp. cf. *balachowskyi* n. sp. espece b, L. Tsacas det. 1974" (MNHN); *Fianarantsoa Prov.*: 1♂ near Isalo National Park, at stream east of Interpretive Center, 22°37.60'S:45°21.49'E, 13–19.i.2002, 750 m, M.E. Irwin & R. Harin'Hala, Malaise trap in open area (MA-02-11A-11); 1♂ near Isalo National Park, in dry wash east of Interpretive Center, 22°37.60'S:45°21.49'E, 12–22.vi.2002, 885 m, M.E. Irwin & R. Harin'Hala, Malaise trap in open area (MA-02-11B-32); 4♂ 50 km S of Farafangana, Mahabo Mananivo, Ampitavananima Forest, 23°7.79'S:47°43.02'E, 13–20.i. 2007, 34 m, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap low altitude littoral rainforest (MG-35-01); same except: 1♂ 20–26.i.2007 (MG-35-02); 1♂ 26.i–4.ii.2007 (MG-35-03); 1♂ 4–10.ii.2007 (MG-35-04); 1♂ 10–17.ii.2007 (MG-35-05); 1♂ 17–24.iii.2007 (MG-35-10); 1♂ 24–31.iii.2007 (MG-35-11); 2♂ 14–21.v.2007 (MG-35-18); 5♂ 21–25.v.2007 (MG-35-19); 1♂ 29.v–2.vi.2007 (MG-35-20); 1♂ 2–10.vi.2007 (MG-35-21); 1♂ 10–15.vi.2007 (MG-35-22); 2♂ 15.vi–1.vii.2007 (MG-35-23); 5♂ 14–19.vii.2007 (MG-35-26); 2♂ 3–11.viii.2007 (MG-35-30); 3♂ 11–27.viii.2007 (MG-35-31); 2♂ 27.viii–6.ix.2007 (MG-35-32); 1♂ 6–13.ix.2007 (MG-35-33); 6♂ 13–20.ix.2007 (MG-35-34). *Tuléar Prov.*: 1♂ Zombitse National Park, near national road, 22°50.43'S:44°43.87'E, 26.xi–2.xii.2001, 825 m, R. Harin'Hala, Malaise trap, deciduous spiny forest (MA-02-13B-04); 1♂ Beza Mahafaly Reserve, Parcelle I near research station, 23°41.19'S:44°35.46'E, 15.x–10.xi.2001, 165 m, M.E. Irwin, F.D. Parker & R. Harin'Hala, Malaise trap in dry deciduous forest (MA-02-14A-01); 2♂ Mikea Forest, 97 ft, 22°54.22'S:43°28.53'E, 6–16.xii.2001, Malaise trap, deciduous dry forest, R. Harin'Hala & M.E. Irwin (MG-18A-05); same except: 2♂ 16–26.xii.2001 (MG-18A-06); 1♂ 26.xi–27.xii.2001 (MG-18A-07); 1♂ 27.xii.2001–6.i.2002 (MG-18A-08); 1♂ 19.ii–1.iii.2002 (MG-18A-14); 1♂ 8–18.iii.2002 (MG-18A-16); 2♂ 18–29.iv.2002 (MG-18A-20); 1♂ 9–19.v.2002 (MG-18A-22); 1♂ 22.vi–2.vii.2002 (MG-18A-26); 1♂ 2–13.vii.2002 (MG-18A-27); 1♂ 23.vii–6.viii.2002 (MG-18A-29); 1♂ 19.viii–3.ix.2002 (MG-18A-31); 3♂ 29.vi–6.vii.2003 (MA-02-18A-60); 2♂ 6–17.vii.2003 (MA-02-18A-61); 2♂ 17–27.vii.2003 (MA-02-18A-62); 5♂ 27.vii–3.viii.2003 (MA-02-18A-63); 2♂ Mikea Forest, 22°54.80'S:43°23.93'E, 20–27.xi.2001, 120 ft, R. Harin'Hala & M.E. Irwin, Malaise trap, spiny forest (MG-18B-03); same except: 3♂ 6–16.xii.2001 (MG-18B-05); 1♂ 16–26.xii.2001 (MG-18B-06); 1♂ 6–16.i.2002 (MG-18B-09); 1♂ 16–17.i.2002 (MG-18B-10); 1♂ 28.iii–8.iv.2002 (MG-18B-18); 1♂ 18–29.iv.2002 (MG-18B-20); 1♂ 29.iv–9.v.2002 (MG-18B-21); 1♂ 19–29.v.2002 (MG-18B-23); 1♂ 19.viii–3.ix.2002 (MG-18B-31); 1♂ Beroboka village 45 km NE Morondava, 19°58.65'S:44°39.92'E, 26–30.x.2007, 420 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, Antsarongaza gallery forest (MG-45B-06); same except: 1♂ 6–13.xi.2007 (MG-45B-08) (all CAS). *Mgajunga Prov.*: 1♂ Ampijoroa National Park, 160 km North of MGevatanana on RN 04, 16°19.16'S:46°48.80'E, 2–9.vii.2003, 140 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, deciduous forest (MG-25-05); same except: 1♂ 10–17.viii.2003 (MG-25-10) (all CAS); 1♂ 7–14.ix.2003 (MA-25-14) [in spirit], BMSA(DNA)#0042 (BMSA); 1♂ 2–9.xi.2003 (MG-25-22); 1♂ 9–20.xi.2003 (MG-25-23); 3♂ 30.xi–8.xii.2003 (MG-25-

25); 1♂ 16–27.x.2004 (MG-25-34); 1♂ 21.i–7.ii.2005 (MG-25-42); 3♂ 17–19.ii.2005 (MG-25-43). *Antananarivo Prov.*: 1♂ Ambohitantely, 46 km NE of Ankazobe, 18°11.88'S:47°16.89'E, 28.xii.2003–10.i.2004, 2300 ft, R. Harin'Hala & M.E. Irwin, Malaise trap, forêt sclerophylle (MG-27-12); 6♂ same except: 10–20.i.2004 (MG-27-13); 1♂ same except: 1–12.ii.2004 (MG-27-15). *Majunga Prov.*: 2♂ Ambovomamy Belambo, 20 km NW of Port Berger, 15°27.07'S:47°36.80'E, 4–14.i.2007, 33 m, R. Harin'Hala, M.E. Irwin & F. Parker, Malaise, secondary growth on white sand (MG-33-01); same except: 3♂ 21–22.i.2007 (MG-33-03); 1♂ 22–27.i.2007 (MG-33-04); 1♂ 7–13.ii.2007 (MG-33-07); 1♂ 13–18.ii.2007 (MG-33-08) (all CAS); 1♂ 18–25.ii.2007 (MG-33-09) [in spirit], BMSA(DNA)#0044 (BMSA); 1♂ 3–10.iii.2007 (MG-33-11); 1♂ 10–18.iii.2007 (MG-33-12); 1♂ 18–26.iii.2007 (MG-33-13); 1♂ 6–12.iv.2007 (MG-33-16); 9♂ Besalampy District, Marofototra dry forest, 17 km W of Besalampy, 16°43.30'S:44°25.42'E, 24.ix–1.x.2007, 170 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, dry wash in forest (MG-42A-01); 1♂ Besalampy District, Marofototra palm forest 17 km W of Besalampy, 16°43.30'S, 44°25.42'E, 1–8.x.2007, 35 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, palm trees on sand (MG-42B-02); same except: 6♂ 8–15.x.2007 (MG-42B-03); 13♂ 15–22.x.2007 (MG-42B-04) [1 head missing]; 6♂ 22–29.x.2007 (MG-42B-05); 2♂ 29.x–5.xi.2007 (MG-42B-06); 5♂ 2–12.xi.2007 (MG-42B-07); 9♂ 12–19.xi.2007 (MG-42B-08); 9♂ 19–26.xi.2007 (MG-42B-09); 5♂ 26.xi–3.xii.2007 (MG-42B-10); 9♂ 3–10.xii.2007 (MG-42B-11); 8♂ 10–17.xii.2007 (MG-42B-12); 5♂ 17–24.xii.2007, (MG-42B-13); 4♂ Maintirano District, Asondrodava dry forest, 15 km N of Maintirano, 17°57.92'S:44°2.13'E, 27.ix–8.x.2007, 200 ft, M.E. Irwin & R. Harin'Hala, Malaise trap in dry forest (MG-43A-01); same except: 4♂ 8–15.x.2007 (MG-43A-02); 5♂ 22–29.x.2007 [1 with wing detached and glued to point] (MG-43A-04); 1♂ 29.x–5.xi.2007 (MG-43A-05); 2♂ 5–12.xi.2007 (MG-43A-06); 4♂ 12–17.xi.2007 (MG-43A-07); 1♂ 17.xi–3.xii.2007 (MG-43A-08); 2♂ 3–10.xii.2007 (MG-43A-09); 6♂ 10–17.xii.2007 (MG-43A-10); 26♂ 17–24.xii.2007 (MG-43A-11); 5♂ 24–31.xii.2007 (MG-43A-12); 18♂ 31.xii.2007–7.i.2008 (MG-43A-13); 23♂ 7–14.i.2008 (MG-43A-14); 18♂ 14–21.i.2008 (MG-43A-15); 27♂ 21–28.i.2008 (MG-43A-16); 28♂ 28.i–4.ii.2008 (MG-43A-17); 23♂ Maintirano District, Asondrodava dry forest 15 km N of Maintirano, 17°57.92'S:44°2.13'E, 27.ix–8.x.2007, 200 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, dry forest at dune (MG-43B-01); same except: 7♂ 8–15.x.2007 (MG-43B-02); 12♂ 15–22.x.2007 (MG-43B-03) [1 head missing]; 11♂ 22–29.x.2007 (MG-43B-04); 5♂ 29.x–5.xi.2007 (MG-43B-05); 1♂ 5–12.xi.2007 (MG-43B-06); 3♂ 12–17.xi.2007 (MG-43B-07) (all CAS); 1♂ 10–17.xii.2007 (MG-43B-11) [in spirit], BMSA(DNA)#0053 (BMSA); 3♂ 17–24.xii.2007 (MG-43B-12); 5♂ 24–31.xii.2007 (MG-43B-13); 4♂ 31.xii.2007–7.i.2008 (MG-43B-14) (all CAS); 1♂ 14–21.i.2008 (MG-43B-16) [in spirit], BMSA(DNA)#0055 (BMSA); 2♂ 21–28.i.2008 (MG-43B-17). *Toamasina Prov.*: 1♂ Mobot site, Analalava, 7 km SW of Foulpointe, 17°42'32"S:49°27'29"E, 15–21.ix.2007, 80 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, low altitude dense humid forest (MG-37A-01) (all CAS).

Distribution (Fig. 3.3: 98): The most widely distributed species of the genus in Madagascar, distributed in six vegetation types (3.3: Appendix II), in the Dry Deciduous Forest, Central Highlands and Evergreen Rainforest biomes. Occurring in

nine biogeographical zones and all bioclimatic zones (Figs 3.3: 105–107; 3.3: Tables 1–3).

Curtonotum boeny Tsacas, 1974

Figs 3.3: 10, 23, 36, 67, 70, 73, 88, 101

Curtonotum boeny: Tsacas 1974: 712; figs 5a–9 (p. 713), fig. 8c (p. 718). Type locality: “Madagascar: Ambato-Boeny”.

Redescription: Male (primarily based on field-pinned HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 3.2–4.5 mm ($n = 6$, N-T); length of head and thorax combined 2.1 mm; length of thorax and scutellum combined 1.95 mm; wing length 3.2 mm ($n = 1$, HT).

Head (Figs 3.3: 10, 23). Eye prominent, eye height/length ratio: 9:5 ($n = 1$, HT); frons (Fig. 3.3: 23), slightly wider than long, frons length/width ratio: 50:55 ($n = 1$, HT), markedly wider at vertex than at ventral margin; arista with 8 long dorsal branches and 3 ventral branches in addition to terminal fork; face with narrow silver fascia (adjacent to eye margin); 1 pair of weak vibrissae inserted on posterior lateral margin and 10 much finer setae bordering genal groove; occiput grey pruinose throughout; gena narrow, eye height/genal height ratio: 9:1 ($n = 1$, HT), silver pruinose, slightly dirty yellow beyond basal angle; palpus brown.

Thorax (Fig. 3.3: 10). Mesonotum with two narrow, weakly-defined, parallel, medial chestnut-brown pruinose vittae on dorsal surface, extending from anterior margin to region of anterior dorsocentral seta socket; anterior dorsocentral seta much shorter and finer than medial scutellar seta; reclinate supra-alar seta, slightly shorter than posterior dorsocentral seta; thoracic pleurae silver-grey, yellow pruinose in their centres; postpronotum silver-grey pruinose, with 8–10 fine black-brown setulae; anepisternum silver-grey pruinose, with yellow pruinose patches medially, with 19–20 fine setulae, the 5 larger grouped together at posterodorsal margin; katepisternum

with dorsal katepisternal seta *ca.* 0.3 length of ventral katepisternal seta, with 18 short, fine setulae at base and along posterior margin.

Scutellum. As on mesonotum; two pairs of strong scutellar setae, 1 weak basal scutellar setula and 1 weak intermediate scutellar setula, the latter inserted equidistant between lateral and medial scutellar setae.

Legs. Fore coxa with 8–10 brown setulae on anterior surface; hind coxa with lateral black seta; fore tibia with ctenidium of 8 short spinules.

Wing (as in Fig. 3.3: 36). Veins brown, membrane hyaline with very faint brown infuscation, slightly darker in region of *dm-cu* crossvein; *dm-cu* crossvein obliquely angled.

Abdomen. Tergite 1 simple, devoid of maculae; tergite 2 with oblique, sub-ovoid brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with large broad, V-shaped concolourous median fascia and large concolourous T-shaped dorsolateral maculae, these close to, but not fully merging with, median fascia; lateral margin of tergites 2–5 with subelliptical concolourous macula in basal $\frac{1}{2}$; sternite 4 quadrate, weakly sclerotised; sternite 5 slightly longer than sternite 4, lateral margins rounded, with oblong brown macula on either side, both unmodified, with sparse brown setulae arranged in irregular rows, those along apical margins of sternite 5 slightly longer and stronger; sternite 6 (Fig. 3.3: 88) subquadrate (may appear narrower than Fig. 3.3: 88 in undissected specimens), slightly expanded medially, with moderately deep, subtriangular excision apically, brown in apical four-fifths, clothed in closely-packed, long, curved, overlapping brown setulae in apical four-fifths.

Terminalia (Figs 3.3: 67, 70, 73). Hypandrium (Fig. 3.3: 67, *hy*) rather flattened and long, with broad-based, rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (subtriangular in profile); hypandrial arms of even width (viewed laterally), with 2 setulae proximal to postgonite, the more lateral ventrally directed, the medial ventro-medially directed (obscured by epandrium on Fig. 3.3: 67), sclerotised area of medial lobes (viewed dorsally), with slightly rounded margins, not overlapping (not convex); postgonite (Fig. 3.3: 67, *pg*) long, thin and straight; epandrium (Fig. 3.3: 67, *ep*) subtriangular (in lateral view), with deep, oblique excavation along ventral margin, ventral lobe forming a blunt point from which two very strong, long setae originate; cercus (Fig. 3.3: 67, *ce*) not prominent,

longest setae as long as medium setae on dorsal margin of epandrium; surstylus (Fig. 3.3: 67, ss) long, widest basally, slightly curved in apical $\frac{2}{3}$; phallus (as in Figs 3.3: 70, *ph*, *bp*, *dp*; 73, *bp*, *dp*) C-shaped, moderately sclerotised, brown; phallapodeme (Fig. 3.3: 70, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, broad, subtriangular projections in basal two-fifths, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 70, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.3: 70, *bp*) broader in basal $\frac{1}{2}$, slightly narrowed in apical $\frac{1}{2}$, with large, conspicuous internal bulge at point of first bend in basal fifth; apical section (Fig. 3.3: 73, *bp*) moderately broad, right lateral margin with raised keel, projecting medially as long, finger-like projection; distiphallus (Figs 3.3: 70, 73, *dp*) long, with slight curve at midlength, very narrow (viewed laterally and dorsally).

Variation: The frons appears slightly darker in ex-alcohol specimens.

Differential diagnosis: This species is closely related to *C. griveaudi* sp. n., differing in the colour of the frons and antennae, the shape of the wing and the shape of the male terminalia. Both share the peculiar subtriangular form of the epandrium with the lateral setation reduced to two long and strong setae originating from the blunt point formed by the ventral margin. *Curtonotum boeny* differs from *C. griveaudi* sp. n., however, in having the hypandrial arm narrowed apically, the surstylus shorter and wider basally, the presence and position of the conspicuous internal bulge on the phallus and the apical shape of the basiphallus, with the more pronounced finger-like medial projection. The ranges of the two species overlap, but it is not known whether they occur sympatrically.

Type material examined. Holotype: ♂ MADAGASCAR: “MADAGASCAR Maj. / Ambato-Boeni / 23.VI.[19]58 F. KEISER [pink paper] // HOLOTYPE [red card] // CURTONOTUM / *boeny* n.sp. / Holotype ♂ / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum / boeny* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008” (MNHN). In excellent condition; pinned and double-mounted on card triangle; right wing detached and glued to point; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “*Curtonotum / boeny* ♀ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008–2010”): MADAGASCAR: 1♀ same labels as holotype, except: “// ALLOTYPE [red card] // CURTONOTUM / *boeny* n.sp. / Allotype ♀ / L. TSACAS DET. 1973 [printed & handwritten]” [left wing detached and glued to card] (MNHN); 2♀

same except: “// PARATYPE [red card] // CURTONOTUM / *boeny* n.sp. / Paratype ♀ / L. TSACAS DET. 1973 [printed & handwritten]” (NHMB).

Remarks: Tsacas (1974: 713) cited the date of collection of the type series as “23.v.58”, but the labels actually read “23.VI.58”. He further noted that the holotype and 1 paratype were deposited in MNHN and that the allotype and 1 paratype were deposited in NHMB. In truth, the holotype and allotype are deposited in MNHN and 2 paratypes in NHMB.

Additional material examined (all labelled: “*Curtonotum / boeny* ♂ [or ♀] / Tsacas, 1974 / det. A.H. Kirk-Spriggs 2010”): MADAGASCAR: *Mahajanga Prov.*: 4♂ Parc National Tsingy de Memaraha, 3.4 km 93° E Bekopaka, Tombeau Vazimba, 19°08’31”S:44°49’41”E, 50 m, 6–10.xi.2001, leg. [B.] Fisher, [C.] Griswold *et al.*, tropical dry forest, Malaise trap (MAD49), BLF4233 (CAS).

Distribution (Fig. 3.3: 101): Occurring in the Wooded Grassland-Bushland and Western Dry Forest vegetation types, in the Dry Deciduous Forest biome. In the North West and West biogeographical zones and Dry bioclimatic zone (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II).

***Curtonotum coronaeformis* Kirk-Spriggs, sp. n.,**

Figs 3.3: 6, 19, 32, 51, 54, 57, 83, 97

Etymology: From Latin *corona* (crown) and *formis* (in the form of), and refers to the crown-like lateral extension of the distiphallus of this species.

Description: Male (primarily based on ex spirit-preserved HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 2.9 mm; length of thorax and scutellum combined 2.4 mm; wing length 3.7 mm.

Head (Figs 3.3: 6, 19). Compound eye prominent, probably green-brown iridescent in living examples, eye height/length ratio: 10:7 ($n = 1$, HT); frons (Fig. 3.3: 19), slightly wider than long, frons length/width ratio: 5:6 ($n = 1$, HT), markedly wider at vertex than at ventral margin, ground colour pale yellow to pale brown,

darker brown towards vertex and between orbital plates forming conspicuous vittae that reach ventral margin; orbital plates and ocellar triangle golden-grey pruinose; orbital plates extending from vertex of head to *ca.* 0.8 length of frons, margins regular; antennal scape and pedicel dirty pale brown, silver-grey pruinose, flagellomere 1 very long, *ca.* 2.5× longer than wide, apex evenly-rounded, yellow basally, darkened apically, yellow-grey pruinose, arista with 8–9 long dorsal branches and 3 ventral branches in addition to terminal fork; lunule and face silver-grey pruinose, yellow pruinose beneath flagellomere 1; gena narrow, eye height/genal height ratio: 10:1 ($n = 1$, HT), silver pruinose throughout; palpus pale-brown.

Thorax (Fig. 3.3: 6). Mesonotum as described for *C. boeny*; acrostichal setae, much shorter than anterior dorsocentral seta; supra-alar seta, slightly shorter than posterior dorsocentral seta; postalar setae longer and stronger than acrostichal setae; postpronotum yellow-grey pruinose, with 6 finer black-brown setulae; anepisternum silver-grey pruinose, with yellow pruinose patches medially, surface with 18 fine setulae, some larger and arranged in 2 groups of 3 and 4; katepisternum silver-grey to silver-yellow pruinose, with 13 short, fine setulae at base and along posterior margin.

Scutellum. As on mesonotum, with very faint medial brown pruinose vitta basally (under some lights), slightly paler yellow pruinose at posterior margin; weak intermediate scutellar setula inserted at four-fifths distance between medial and lateral scutellar setulae.

Legs. Fore coxa with 22 brown setulae on anterior surface; fore tibia with ctenidium of 10–11 short, sharp black spinules.

Wing (as in Fig. 3.3: 32). Veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in r_1 and in region of *dm-cu* crossvein; *dm-cu* crossvein oblique, in shape of uninterrupted arc.

Abdomen. Tergites 3–5 with broad V-shaped, median fascia adjoining and slightly merging with large, concolourous T-shaped dorsolateral maculae; lateral margin of tergites 2–5 with subelliptical concolourous macula in basal $\frac{1}{2}$ to $\frac{2}{3}$; sternite 4 with posterior and lateral margins evenly rounded, apical margin straight; sternite 5 rectangular, similarly shaped to sternite 4, slightly longer and wider medially, with 2 small ovoid baso-medial maculae, sternites 4 and 5 unmodified, with long, dense, brown setulae arranged in irregular rows, those along lateral margins

longer and stronger; sternite 6 (Fig. 3.3: 83) narrowed basally, evenly rounded laterally (may appear narrower than Fig. 3.3: 83 in undissected specimens), with broad, deep apical excision and brown maculae medially and fascia laterally, merging apically, clothed in long, black, irregular, medially-directed, brown setulae in apical four-fifths, those at apical margin longer and more prominent.

Terminalia (Figs 3.3: 51, 54, 57). Hypandrium (Fig. 3.3: 51, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded to slightly angulate in profile); hypandrial arms constricted in apical $\frac{2}{3}$ (viewed laterally), with 2 setulae proximal to postgonite, the more lateral ventrally directed, the medial ventro-medially directed (obscured by epandrium on Fig. 3.3: 51), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex, closely abutting, not overlapping; postgonite (Fig. 3.3: 51, *pg*) long, thin, spindle-like; epandrium (Fig. 3.3: 51, *ep*) broad (viewed laterally), evenly-rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 3.3: 51, *ce*) not prominent, longest setae longer than setae on dorsal margin of epandrium; surstylus (Fig. 3.3: 51, *ss*) long and narrow, slightly curved in apical $\frac{2}{3}$; phallus (as in Figs 3.3: 54, *ph*, *bp*, *dp*, 57, *bp*, *dp*) C-shaped, moderately sclerotised, brown; phallapodeme (Fig. 3.3: 54, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, narrow, rounded projections in basal two-fifths, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 54, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.3: 54, *bp*) broad basally, narrowed just beyond midlength; apical section (Fig. 3.3: 57, *bp*) expanded and broad, right lateral margin with ventral projection, left margin with distinct raised keel; distiphallus (Figs 3.3: 54, 57, *dp*) long, narrow and curved, with extensive broad membranous section, baso-laterally with upturned, sclerotised, crown-like projection (subtriangular viewed laterally).

Variation: The size and number of teeth and smaller serrations at the margin of the upturned, sclerotised, crown-like projection of the distiphallus are variable. This is here interpreted as intraspecific variation only, since other terminalia characters are constant.

Differential diagnosis: This species is closely related to *C. parkeri* sp. n.; the shape, maculae and setation of abdominal sternites 4 and 5 are virtually identical, the apical region of the basiphallus is markedly expanded in both species, with very similar left and right raised keels and both share the raised and spinose right sclerotised area of the basiphallus. In *C. coroneiformis* sp. n., however, the basiphallus is less markedly narrowed medially and less expanded in the apical third, and the raised and spinose right sclerotised area of the distiphallus is conspicuously developed, with a series of regular to irregular spines. The two species occur sympatrically.

Type material examined. Holotype ♂ “MADAGASCAR: Province / Fianarantsoa, near Isalo / National Park, in dry wash / east of Interpretive Center / 22°37.60'S, 45°21.49'E / 23.ii–5.iii.2002, 885 m / M.E. Irwin & R. Harin'Hala / Malaise trap in open area / MA-02-11B-57 // HOLOTYPE ♂ / *Curtonotum / coroneiformis* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (CAS). In good condition; card-pointed; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ / *Curtonotum / coroneiformis* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]”): 3♂ same data as holotype, except (1 labelled: “BMSA(DNA)#0049”) [1 right wing detached and glued to card]; same except: 1♂ “12–22.vi.2002, MA-02-11B-32”; 1♂ “6–14.xii.2002, MA-02-11B-49” (all CAS).

Distribution (Fig. 3.3: 97): Apparently confined to the Wooded Grassland-Bushland vegetation type, in the Central Highlands biome. In the Central biogeographical zone and Subarid bioclimatic zone (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II).

***Curtonotum gladiiformis* Kirk-Spriggs, sp. n.,**

Figs 3.3: 8, 21, 34, 59, 62, 65, 85, 99

Etymology: From Latin *gladius* (sword) and *formis* (in the form of), and refers to the sword-like shape of the distiphallus of this species.

Description: Male (primarily based on ex spirit-preserved HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 2.9 mm; length of thorax and scutellum combined 2.6 mm ($n = 1$, HT); wing length 4.4 mm ($n = 1$, PT).

Head (Figs 3.3: 8, 21). Eye prominent, eye height/length ratio: 11:7 ($n = 1$, HT); frons (Fig. 3.3: 21), slightly wider than long, frons length/width ratio: 7:8 ($n = 1$, HT), ground colour pale brown, darker brown towards vertex and between orbital plates forming conspicuous vittae that reach ventral margin; orbital plates and ocellar triangle golden-grey pruinose; ocelli clear brown; orbital plates extending from vertex of head to 0.8 length of frons, lateral margins with narrow silver pruinose fascia (adjacent to eye margin), slightly wider at antennal insertions; posterior orbital seta moderately strong, slightly longer than outer vertical seta; antennal scape and pedicel brown-grey pruinose, flagellomere 1 yellow pruinose basally, pitchy brown, grey pruinose apically, arista with 8–9 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; lunula yellow-grey pruinose; face with narrow silver fascia (adjacent to eye margin); occiput grey pruinose; gena narrow, eye height/genal height ratio: 10:1 ($n = 1$, HT), silver pruinose throughout, very slightly darker beyond basal angle; palpus pale brown, brown microtrichose.

Thorax (Fig. 3.3: 8). Mesonotum as described for *C. boeny*; presutural seta (missing on holotype and paratypes); anterior notopleural seta markedly longer than posterior; supra-alar seta shorter than posterior dorsocentral seta; postalar setae longer and stronger than acrostichal setae; postpronotum silver-yellow pruinose, with 11 finer black-brown setulae; anepisternum silver-grey pruinose, silver-yellow pruinose medially, surface with 24 fine setulae, some larger and arranged in 2 groups of 3; anepimeron, laterotergite and meron silver-grey to yellow-grey pruinose; katepisternum silver-grey to yellow-grey pruinose with darker grey macula in anterior $\frac{1}{2}$, dorsal katepisternal setae *ca.* 0.4 length of ventral katepisternal setae, with 11 short, fine setulae at base and along posterior margin.

Scutellum. As on mesonotum, slightly paler yellow pruinose at posterior margin; weaker intermediate scutellar setula inserted at four-fifths distance between medial and lateral scutellar setulae.

Legs. Fore coxa with 9 brown setulae on anterior surface; mid-coxa with 8 brown setulae; fore tibia with ctenidium of 12 spinules.

Wing (as in Fig. 3.3: 34). Broad basally, tip evenly rounded, veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in region of *dm-cu* crossvein; *dm-cu* crossvein evenly arched; halter dirty white.

Abdomen. Tergite 1 simple, devoid of maculae; tergite 2 with oblique, subrectangular brown-black pruinose dorsolateral macula on either side and faint medial fascia; tergites 3–5 with broad, V-shaped concolourous median fasciae and well separated and extensive concolourous T-shaped dorsolateral macula, these close, but not merging with medial fascia, lateral margin of tergites 2–5 with subquadrate concolourous macula in basal $\frac{2}{3}$; sternite 4, weakly sclerotised, quadrate, sides evenly narrowing to straight apical margin; sternite 5 similar, but wider and longer, both unmodified, with long, brown, sparse setulae arranged in irregular rows, lateral setulae longer and stronger; sternite 6 (Fig. 3.3: 85) much broader than long (may appear narrower than Fig. 3.3: 85 in undissected specimens), with very shallow apical excision and faint, transverse, brown maculae apically, clothed in extremely long, sparse, black, irregular setulae, especially along apical margin.

Terminalia (Figs 3.3: 59, 62, 65). Hypandrium (Fig. 3.3: 59, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded to slightly angulate in profile); hypandrial arm constricted medially (viewed laterally), with 2 setulae proximal to postgonite, the more lateral strong, ventrally-directed, the medial much smaller and weaker (or absent) (obscured by epandrium on Fig. 3.3: 59), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex medially, closely abutting, not overlapping; postgonite (Fig. 3.3: 59, *pg*) long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 3.3: 59, *ep*) broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long, regular to irregular, ventrally-directed setae; cercus (Fig. 3.3: 59, *ce*) not prominent, longest setae longer than dorsal setae of epandrium; surstylus (Fig. 3.3: 59, *ss*) long, widest basally, slightly curved in apical $\frac{2}{3}$; phallus (as in Figs 3.3: 62, *ph*, *bp*, *dp*; 65, *bp*, *dp*) C-shaped, very large, moderately sclerotised, brown; phallapodeme (Fig. 3.3: 62, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, narrow, subtriangular projections in basal two-fifths, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 62, *ea*) free, duct inserted at junction of phallapodeme

and basiphallus; basiphallus (Fig. 3.3: 62, *bp*) broad in basal region, with conspicuous internal bulge, then narrowed, moderately constricted in *ca.* apical $\frac{2}{3}$ (viewed dorsally); apical section (Fig. 3.3: 65, *bp*) broad, right lateral margin evenly rounded and flat, developed into a bluntly-pointed ventro-medial spine, with much smaller spine baso-laterally; distiphallus (Figs 3.3: 62, 65, *dp*) moderately sclerotised, extremely long, sword-like, with conspicuous curved indentation in basal third (viewed laterally), sclerotised area subdivided basally, with triangular window.

Variation: In the two PT the basiphallus is not as markedly constricted in the apical $\frac{2}{3}$ as in Fig. 3.3: 62 and this may be the result of slight distortion in phallus of the HT.

Differential diagnosis: This species is probably most closely related to *C. balachowskyi* Tsacas. Both share the similarly-shaped scimitar-like distiphallus, with the incurved basal area (viewed laterally) and the subquadrate sternite 6, with a very shallow apical excision. *Curtonotum gladiiformis* differs from *C. balachowskyi*, however, in having the lateral margin of the apical border of the basiphallus developed into a medial and submedial spine, as opposed to *C. balachowskyi*, in which the right lateral border forms a distinct, angulate fold, and in having the setae on sternite 6 much longer on the apical margin.

Type material examined. Holotype: ♂ “MADAGASCAR: Province / Fianarantsoa, near Isalo / National Park, in dry wash / east of Interpretive Center / 22°37.60'S, 45°21.49'E / 28.iii–9.iv.2003, 885 m / M.E. Irwin & R. Harin'Hala / Malaise trap in open area / MA-02-11B-60 // HOLOTYPE ♂ / *Curtonotum / gladiiformis* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (CAS). In good condition, some head setae missing; card-pointed; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ / *Curtonotum / gladiiformis* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]”): 1♂ same data as holotype, except: “3–10.ii.2002, MA-02-11B-14” [right wing detached and glued to card]; 1♂ “6–14.xii.2002, MA-02-11B-49 // BMSA(DNA)#0050” (both CAS).

Distribution (Fig. 3.3: 99): Apparently confined to the Wooded Grassland-Bushland vegetation type, in the Central Highlands biome. In the Central biogeographical zone and Subarid bioclimatic zone (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II).

***Curtonotum griveaudi* Kirk-Spriggs, sp. n.,**

Figs 3.3: 11, 24, 37, 68, 71, 74, 89, 102

Etymology: The species is named in honour of Paul Elexis Jacques Griveaud (1907–1980), in recognition of his contribution to our knowledge of Madagascan entomology.

Description: Male (primarily based on ex spirit-preserved HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 2.2 mm; length of thorax and scutellum combined 2.2 mm ($n = 1$, HT); wing length 3.5 mm ($n = 1$, N-T).

Head (Figs 3.3: 11, 24). Eye prominent, eye height/length ratio: 10:6 ($n = 1$, HT); frons (Fig. 3.3: 24), markedly wider at vertex than at ventral margin, frons length/width ratio: 1:5 ($n = 1$, HT), ground colour pale brown to dark brown, darker brown towards vertex and between orbital plates forming conspicuous vittae that reach ventral margin; ocellar triangle golden-grey pruinose, ocelli clear brown; orbital plates extending from vertex of head to 0.8 length of frons, markedly wider at socket of posterior orbital seta; lateral margins with narrow silver pruinose fascia (adjacent to eye margin), slightly wider at antennal insertions; posterior orbital seta moderately strong, slightly longer than outer vertical seta; antennal scape and pedicel brown-grey pruinose, flagellomere 1 yellow pruinose basally, pitchy brown, grey pruinose apically, arista with 10 long dorsal branches and 4 ventral branches in addition to terminal fork; lunule brown, face with narrow silver fascia (adjacent to eye margin); occiput grey pruinose; gena narrow, eye height/genal height ratio: 10:1 ($n = 1$, HT), silver pruinose throughout, very slightly darker beyond basal angle; palpus pale brown, brown microtrichose.

Thorax (Fig. 3.3: 11). Mesonotum as described for *C. boeny*; anterior dorsocentral setae much shorter and finer than medial scutellar seta; postalar setae moderately strong, slightly longer and stronger than acrostichal setae; postpronotum

silver-grey pruinose, with 7–8 finer black-brown setulae; anepisternum silver-grey pruinose, with yellow pruinose patches medially, surface with 28 fine setulae, some larger and arranged in 2 groups of 3 and 4; anepimeron, laterotergite and meron silver-grey to yellow pruinose; katepisternum silver-grey to yellow pruinose, with dorsal katepisternal setae *ca.* 0.2 length of ventral katepisternal setae, with 18 short, fine setulae at base and along posterior margin.

Scutellum. As on mesonotum, with very faint medial brown pruinose vitta basally (under some lights), slightly paler yellow pruinose at posterior margin; weak intermediate scutellar setula inserted closer to lateral than medial scutellar setae.

Legs. Fore coxa with 18 brown setulae on anterior surface; mid-coxa with 16 brown setulae; fore tibia with ctenidium of 10 spinules.

Wing (as in Fig. 3.3: 37). Veins brown, membrane hyaline with very faint brown infuscation, very slightly darker in posterior $\frac{1}{2}$ of r_1 and anterior $\frac{1}{2}$ of r_{2+3} and in region of $dm-cu$ crossvein; $dm-cu$ crossvein strongly, obliquely angled in even arc.

Abdomen. Tergite 1 simple, devoid of maculae; tergite 2 with oblique, sub-ovoid brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with large, broad V-shaped median fascia and large concolourous T-shaped dorsolateral macula, these close or adjoining, but not fully merging with median fascia; lateral margin of tergites 2–5 with subelliptical concolourous macula in basal $\frac{1}{2}$; sternite 4, long, rectangular, weakly sclerotised; sternite 5 same length as sternite 4, lateral margins curved, with oblong brown macula on either side, both unmodified, with very sparse brown setulae arranged in irregular rows, those along lateral margins of sternite 5 slightly longer and stronger; sternite 6 (Fig. 3.3: 89) rather broad apically, narrow basally (may appear narrower than Fig. 3.3: 89 in undissected specimens), with moderately shallow, subtriangular excision apically, brown in apical four-fifths, clothed in sparse, long, straight, overlapping brown setulae in apical four-fifths.

Terminalia (Figs 3.3: 68, 71, 74). Hypandrium (Fig. 3.3: 68, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (subtriangular in profile); hypandrial arms expanded apically, with sclerotised ventrally-directed arc (viewed laterally), setulae absent, sclerotised area of medial lobes (viewed dorsally), with slightly rounded margins, not overlapping (not convex); postgonite (Fig. 3.3: 68, *pg*) long, thin and straight; epandrium (Fig. 3.3: 68, *ep*) subtriangular (in lateral view), with deep, oblique semicircular excavation along

ventral margin, ventral lobe forming a blunt point, from which two very strong, long setae originate; cercus (Fig. 3.3: 68, *ce*) not prominent, longest setae as long as medium setae on dorsal margin of epandrium; surstylus (Fig. 3.3: 68, *ss*) drawn out, very long and narrow, slightly wider basally and curved in apical four-fifths; phallus (as in Figs 3.3: 71, *ph*, *bp*, *dp*, 74, *bp*, *dp*) C-shaped, weakly sclerotised, pale brown; phallapodeme (Fig. 3.3: 71, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, broad, subtriangular projections in basal two-fifths, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 71, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.3: 71, *bp*) broad and straight in basal $\frac{1}{2}$, broadest at first bend, with slight internal bulge, then markedly narrowed (narrowest at second bend); apical section (Fig. 3.3: 74, *bp*) very broad, right margin laterally expanded and evenly rounded, with slightly raised margin, left lateral margin with distinct raised fold, projecting medially as short, spine-like ventro-medial projection; distiphallus (Figs 3.3: 71, 74, *dp*) long, evenly curved, scimitar-like (viewed laterally), narrow (viewed dorsally).

Variation: The frons is darker in some specimens, almost chestnut-brown; even in specimens with a paler brown frons the two longitudinal brown vittae are strikingly apparent.

Differential diagnosis: This species is closely related to *C. boeny* Tsacas; differing in the colour of the frons and antennae, the shape of the wing and the shape of the male terminalia. Both share the peculiar subtriangular form of the epandrium, with the lateral setation reduced to two long, strong setae originating from the blunt point formed by the ventral margin. *Curtonotum griveaudi* sp. n. differs from *C. boeny*, however, in having the hypandrial arm much broader apically and the surstylus considerably longer and narrower basally. The species further differ in the presence and position of the low internal bulge of the phallus, with the basal section of the phallus quite straight, and the apical shape of the basiphallus, with its reduced lateral keel and short, spine-like ventro-medial projection. The ranges of the two species overlap, but it is not known whether they occur sympatrically.

Type material examined. Holotype: ♂ “Madagascar: Majunga / Prov., Maintirano District / Asondrodava dry forest / 15km N of Maintirano / 17°57.92’S 44°2.13’E / 24–31.xii.2007, 200 ft / M.E. Irwin & R. Harin’Hala / Malaise trap, dry forest / at dune, MG-43B-13 // HOLOTYPE ♂ / *Curtonotum / griveaudi* sp. n. / A.H. Kirk-Spriggs 2011 [red card]” (CAS). In good condition, right Fore leg missing; card-pointed; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ [or ♀] / *Curtonotum / griveaudi* sp. n. / A.H. Kirk-Spriggs 2011 [blue card]”): 1♂ “Madagascar: Tuléar / Province, Mikea Forest, / NW of Manombo / 22°54.22’S, 43°28.53’E / 6–17.vii.2003, 30 m / M.E. Irwin & R. Harin’Hala / Malaise trap in deciduous / dry forest / MA-02-18A-61”; 1♂ “Madagascar: Province / Fianarantsoa, near Isalo / National Park, in dry wash / east of Interpretive Center / 22°37.60’S:45°21.49’E / 6–14.xii.2002, 885 m / M.E. Irwin & R. Harin’Hala / Malaise trap in open area / MA-02-11B-49”; 1♂ “Madagascar: Tuléar / Province, Beza Mahafaly / Reserve, Parcelle I near / research station / 23°41.19’S:44°35.46’E / 9–20.ix.2002, 165 m / R. Harin’Hala, Malaise / trap in dry deciduous forest / MA-02-14A-35 // BMSA(DNA)#0047” (all CAS); 1♂ 2♀ “Madagascar NE, Sambava Beach, 14.iv.1991, A. Freidberg & Fini Kaplan” [♂ with phallus missing from vial; left wing detached and glued to card] (all TAU).

Additional material examined (labelled: “*Curtonotum / griveaudi* ♂ / sp. n. / A.H. Kirk-Spriggs 2011”): MADAGASCAR: *Majunga* Prov.: 1♂ Maintirano District, Asondrodava dry forest 15 km N of Maintirano, 17°57.92’S:44°2.13’E, 10–17.xii.2007, 200 ft, M.E. Irwin & R. Harin’Hala, Malaise trap, dry forest at dune (MG-43B-11) [in spirit], BMSA(DNA)#0054 (BMSA).

Distribution (Fig. 3.3: 102): Occurs in the Wooded Grassland-Bushland and South Western Dry Spiny Forest-Thicket vegetation types, in the Arid Spiny Bush, Central Highlands and Dry Deciduous Forest biomes. In the West and South biogeographical zones and Dry and Subarid bioclimatic zones (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II).

***Curtonotum irwini* Kirk-Spriggs, sp. n.,**

Figs 3.3: 4, 17, 30, 49, 52, 55, 81, 95

Etymology: The species is named in honour of Michael Edward Irwin, in recognition of his contribution to our knowledge of Madagascan Diptera.

Description: Male (primarily based on ex spirit-preserved HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 3.85–4.55 mm ($n = 8$, PT); length of head and thorax combined 2.5 mm; length of thorax and scutellum combined 2.3 mm ($n = 1$, HT); wing length 3.2 mm ($n = 1$, PT).

Head (Figs 3.3: 4, 17). As described for *C. gladiiformis* sp. n., except: eye height/length ratio: 12:8 ($n = 1$, HT); frons (Fig. 3.3: 17), frons length/width ratio: 6:7 ($n = 1$, HT); posterior orbital seta moderately strong, slightly shorter than outer vertical seta; arista with 9–10 long dorsal branches and 4–6 ventral branches in addition to terminal fork; gena narrow, eye height/genal height ratio: 12:1 ($n = 1$, HT), silver pruinose, slightly darker beyond basal angle; palpus pale brown.

Thorax (Fig. 3.3: 4). Mesonotum as described for *C. boeny*, except: presutural seta moderately strong, shorter and weaker than posterior notopleural seta; postpronotum with 7 finer black-brown setulae; anepisternum silver-grey pruinose, with silver-yellow pruinose areas, surface with 18 fine setulae, some larger and arranged in 2 groups of 3 and 2; anepimeron, laterotergite and meron silver-grey to silver-yellow pruinose; katepisternum silver-grey to silver-yellow pruinose, with darker macula in anterior $\frac{1}{2}$, with dorsal katepisternal setae *ca.* 0.3 length of ventral katepisternal setae, with 18 short, fine setulae at base and along posterior margin.

Scutellum. As described for *C. gladiiformis* sp. n.

Legs. Fore coxa with 13 brown setulae on anterior surface; mid-coxa with 7 brown setulae; fore tibia with ctenidium of 14 spinules.

Wing (as in Fig. 3.3: 30). Veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in region of *dm-cu* crossvein; *dm-cu* crossvein acutely angled with interrupted arc; halter dirty white.

Abdomen. Tergite 1 simple, devoid of maculae; tergite 2 with oblique, sub-ovoid brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with large broad, V-shaped concolourous median fascia and large concolourous T-shaped dorsolateral macula, these close or adjoining, but not fully merging with median fascia; lateral margin of tergites 2–5 with subelliptical concolourous macula in basal $\frac{1}{2}$; sternites 4–5, as described for *C. coroneiformis* sp. n.; sternite 6 (Fig. 3.3: 81), narrowed basally, evenly rounded laterally (may appear narrower than Fig. 3.3: 81 in undissected specimens), with broad, shallow apical excision and brown maculae

medially and fascia laterally, merging apically, clothed in long, black, irregular, apically-directed, brown setulae in apical $\frac{1}{2}$, those at apical margin much longer and more prominent.

Terminalia (Figs 3.3: 49, 52, 55). Hypandrium (Fig. 3.3: 49, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded to slightly angulate in profile); hypandrial arm constricted apically (viewed laterally), with 2 setulae proximal to postgonite, the more lateral strong, ventrally directed, the medial much smaller and weaker (obscured by epandrium on Fig. 3.3: 49), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex medially, closely abutting, not overlapping; postgonite (obscured by surstylus on Fig. 3.3: 49) long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 3.3: 49, *ep*) broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 3.3: 49, *ce*) not prominent, longest setae as long as setae on dorsal margin of epandrium; surstylus (Fig. 3.3: 49, *ss*) long, widest basally, slightly curved in apical $\frac{2}{3}$; phallus (as in Figs 3.3: 52, *ph*, *bp*, *dp*, 55, *bp*, *dp*) C-shaped, heavily -sclerotised, brown; phallapodeme (Fig. 3.3: 52, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, narrow, subtriangular projections in basal two-fifths, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 52, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.3: 52, *bp*) broad in *ca.* basal $\frac{1}{2}$, with slight internal bulge at midlength, then markedly narrowed, strongly constricted in *ca.* apical $\frac{2}{3}$ (viewed dorsally); apical section (Fig. 3.3: 55, *bp*) moderately broad, right lateral margin evenly rounded, left lateral margin developed into long, curved ventrally-directed spine, with smaller spine medially; distiphallus (Figs 3.3: 52, 55, *dp*) broad basally, sclerotised area extensive, abruptly narrowed towards apex, basal section with membranous window, apical section narrow and spindle-like.

Variation: The length of the larger, curved ventrally-directed spine of the distiphallus is variable in some specimens. Other terminalia characters are constant and this is here interpreted as intraspecific variation only.

Differential diagnosis: This species is probably most closely related to *C. parkeri* sp. n. and *C. coroneiformis* sp. n. All share the extensively-developed sclerotised area of the distiphallus and sternite 6 is very similar in all three species. It differs from *C. parkeri* and *C. coroneiformis*, however, in lacking a raised lateral, spinose ridge on the distiphallus and in having the right lateral margin of the basiphallus developed into a long, curved, ventrally-directed spine, with smaller spine medially.

Type material examined. Holotype: ♂ “MADAGASCAR: Tuléar Province / Zombitse National Park / near ANGAP office, 840 m / 22°53.19'S:44°41.53'E / 28.ii–6.iii.2002 / California Acad of Sciences / R. Harin'Hala, Malaise trap / deciduous spiny forest / MA-02-13A-18 // HOLOTYPE ♂ / *Curtonotum / irwini* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (CAS). In fair condition, wings slightly tattered and mesonotum rubbed; card-pointed; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ / *Curtonotum / irwini* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]”): MADAGASCAR: same data as holotype, except: 2♂ “15.x–9.xi.2001, MA-02-13A-01”; 12♂ “9–19.xi.2001, MA-02-13A-02”; 3♂ “19–26.xi.2001, MA-02-13A-03”; 3♂ “26.xi–2.xii.2001, MA-02-13A-04”; 6♂ “2–7.xii.2001, MA-02-13A-05”; 1♂ “7–14.xii.2001, MA-02-13A-06”; 5♂ “14–16.xii.2001, MA-02-13A-07”; 2♂ “16–22.xii.2001, MA-02-13A-08”; 1♂ “22–29.xii.2001, MA-02-13A-09”; 8♂ “29.xii.2001–5.i.2002, MA-02-13A-10”; 4♂ “5–12.i.2002, MA-02-13A-11”; 1♂ “19–26.i.2002, MA-02-13A-13”; 5♂ “5–14.ii.2002, MA-02-13A-15”; 12♂ “14–21.ii.2002, MA-02-13A-16”; 7♂ same data as holotype; 1♂ “6–13.iii.2002, MA-02-13A-19”; 1♂ “13–20.iii.2002, MA-02-13A-20”; 9♂ “27.iii–3.iv.2002, MA-02-13A-22”; 3♂ “3–11.iv.2002, MA-02-13A-23”; 2♂ “11–16.iv.2002, MA-02-13A-24”; 2♂ “16–23.iv.2002, MA-02-13A-25”; 2♂ “23.iv–1.v.2002, MA-02-13A-26”; 3♂ “1–9.v.2002, MA-02-13A-27”; 4♂ “9–19.v.2002, MA-02-13A-28”; 3♂ “19–27.v.2002, MA-02-13A-29”; 2♂ “27.v–4.vi.2002, MA-02-13A-30”; 5♂ “4–12.vi.2002, MA-02-13A-31”; 1♂ “12–23.vi.2002, MA-02-13A-32”; 4♂ “3–13.vii.2002, MA-02-13A-34”; 1♂ “13–25.vii.2002, MA-02-13A-35”; 3♂ “8–19.viii.2002, MA-02-13A-37”; 4♂ “19.viii–3.ix.2002, MA-02-13A-38”; 1♂ “13–24.ix.2002, MA-02-13A-40”; 2♂ “24.ix–5.x.2002, MA-02-13A-41”; 1♂ “5–31.x.2002, MA-02-13A-42”; 1♂ “31.x–16.xi.2002, MA-02-13A-43”; 2♂ “4–20.i.2003, MA-02-13A-47”; 4♂ “MADAGASCAR: Tuléar / Prov., Zombitse National / Park, near national road / 22°50.43'S, 44°43.87'E / 15.x–9.xi.2001, 825 m / R. Harin'Hala, Malaise / trap, deciduous spiny forest / MA-02-13B-01”; same except: 1♂ “9–19.xi.2001, MA-02-13B-02”; 1♂ “19–26.xi.2001, MA-02-13B-03”; 2♂ “26.xi–2.xii.2001, MA-02-13B-04”; 2♂ “7–14.xii.2001, MA-02-13B-06”; 7♂ “14–16.xii.2001, MA-02-13B-07”; 2♂ “22–29.xii.2001, MA-02-13B-09”; 7♂ “29.xii–5.i.2002, MA-02-13B-10”; 1♂ “5–12.i.2002, MA-02-13B-11”; 3♂ “26.i–5.ii.2002, MA-02-13B-14”; 1♂ “5–14.ii.2002, MA-02-13B-15”; 4♂ “14–21.ii.2002, MA-02-13B-16”; 3♂ “28.ii–6.iii.2002, MA-02-13B-18”; 3♂ “6–13.iii.2002, MA-02-13B-19”; 3♂ “13–20.iii.2002, MA-02-13B-20”; 2♂ “20–27.iii.2002, MA-02-13B-21”; 1♂ “27.iii–3.iv.2002, MA-02-13B-22”; 1♂ “16–23.iv.2002, MA-02-13B-25”; 1♂ “19–27.v.2002, MA-02-13B-29”; 2♂ “27–13.vii.2002, MA-02-13B-30”; 2♂ “13–25.vii.2002, MA-02-13B-31”; 1♂ “25.vii–

1.viii.2002, MA-02-13B-32”; 1♂ “1–14.viii.2002, MA-02-13B-33”; 5♂ “14–25.viii.2002, MA-02-13B-34 [1 with right wing detached and glued to card]”; 4♂ “25.viii–3.ix.2002, MA-02-13B-35”; 1♂ “MADAGASCAR: Tuléar / Province, Beza Mahafaly / Reserve, Parcelle I near / research station / 23°41.19’S, 44°35.46’E / 15.x–10.xi.2001, 165 m / M.E. Irwin, F.D. Parker & / R. Harin’Hala, Malaise / trap in dry deciduous forest / MA-02-14A-01”; same except: 2♂ “28.xi–4.xii.2001, MA-02-14A-04”; 2♂ “4–11.xii.2001, MA-02-14A-05”; 2♂ “11–18.xii.2001, MA-02-14A-06”; 2♂ “18–25.xii.2001, MA-02-14A-07”; 1♂ “25.xii.2001–2.i.2002, MA-02-14A-08”; 3♂ “2–9.i.2002, MA-02-14A-09”; 1♂ “16–18.i.2002, MA-02-14A-11”; 1♂ “25.i–1.ii.2002, MA-02-14A-13”; 2♂ “8–15.ii.2002, MA-02-14A-15”; 1♂ “22.ii–1.iii.2002, MA-02-14A-17”; 2♂ “1–7.iii.2002, MA-02-14A-18”; 1♂ “14–22.iii.2002, MA-02-14A-20”; 1♂ “28.vi–7.vii.2002, MA-02-14A-28”; 1♂ “18–28.vii.2002, MA-02-14A-30”; 1♂ “28.vii–9.viii.2002, MA-02-14A-31”; 1♂ “9–16.viii.2002, MA-02-14A-32”; 1♂ “16–28.viii.2002, MA-02-14A-33”; 2♂ “9–20.ix.2002, MA-02-14A-35”; 3♂ “20.ix–5.x.2002, MA-02-14A-36”; 1♂ “MADAGASCAR: Tuléar / Province, Beza Mahafaly / Reserve, Parcelle II near / Bellevue, 23°41.39’S, 44°34.53’E / 15.x–10.xi.2001, 180 m / M.E. Irwin, F.D. Parker & / R. Harin’Hala, Malaise trap / in spiny forest / MA-02-14B-01”; same except: 1♂ “4–11.xii.2001, MA-02-14B-05”; 1♂ “MADAGASCAR: Majunga / Ampijoroa National Park / 160 km N of Maevatanana / on RN 04 / 16°19.16’S, 46°48.80’E / 30.xi–8.xii.2003, 43 m / M.E. Irwin & R. Harin’Hala / Malaise trap in deciduous / Forest / MA-25-25”; 1♂ “MADAGASCAR: Tuléar Province / Sous Prefecture Fort Dauphin / Andohahelo National Park / Ihazofotsy Parcelle III, 190 ft / 24°49.85’S, 46°32.17’E / 11–22.vi.2003 / Malaise trap, dry/spiny forest / M.E. Irwin, F. Parker & R. Harin’Hala / MG-21-22” (all CAS).

Additional material examined (all labelled: “*Curtonotum irwini* sp. n. det. A.H. Kirk-Spriggs 2010”): MADAGASCAR: Tuléar Prov., 1♂ Zombitse National Park, near ANGAP office, 22°53.19’S:44°41.53’E, 21–28.ii.2002, 840 m, R. Harin’Hala, Malaise trap, deciduous spiny forest (MA-02-13A-17) [in spirit], BMSA(DNA)#0018; 1♂ same except: [in spirit], BMSA(DNA)#0019; 1♂ Beza Mahafaly Reserve, Parcelle I near research station, 23°41.19’S:44°35.46’E, 19.v–8.vi.2002, 165 m, R. Harin’Hala, Malaise trap in dry deciduous forest (MA-02-14A-25) [in spirit], BMSA(DNA)#0059. Majunga Prov.: 1♂ Ampijoroa National Park 160 km N of Maevatanana on RN 04, 16°19.16’S:46°48.80’E, 8–17.xii.2003, 43 m, M.E. Irwin & R. Harin’Hala, Malaise trap - in deciduous forest (MA-25-26) [in spirit], BMSA(DNA)#0058 (all BMSA).

Distribution (Fig. 3.3: 95): Occurring in the Western Dry Forest, South Western Dry Spiny Forest-Thicket, Wooded Grassland-Bushland and Western Sub-humid Forest vegetation types, in the Arid Spiny Bush and Dry Deciduous Forest biomes. In the Central and South biogeographical zones and Dry and Subarid bioclimatic zones (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II).

Curtonotum keiseri Tsacas, 1974

Figs 3.3: 1, 14, 27, 40, 43, 46, 79, 92

Curtonotum keiseri: Tsacas 1974: 706, 707 (figs 2e–f). Type locality: “Madagascar, Joffreville”.

Redescription: Male (primarily based on field-pinned HT and PT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 5 mm; length of head and thorax combined 3 mm; length of thorax and scutellum combined 3 mm ($n = 1$, PT); wing length 3.8 mm ($n = 1$, N-T).

Head (Figs 3.3: 1, 14). As described for *C. gladiiformis* sp. n., except: eye height/length ratio: 13:8 ($n = 1$, PT); frons (Fig. 3.3: 14), frons length/width ratio: 6:7 ($n = 1$, PT), orbital plates extending 0.9 length of frons; posterior orbital seta moderately strong, slightly shorter than outer vertical seta; flagellomere 1 yellow pruinose basally and along posterior margin, dark grey pruinose centrally and on anterior margin, arista with 10–11 long dorsal branches and 4 ventral branches in addition to terminal fork; gena narrow, eye height/genal height ratio: 12:1 ($n = 1$, HT), silver pruinose, slightly darker beyond basal angle; vibrissae strongly developed; palpus pale brown.

Thorax (Fig. 3.3: 1). Mesonotum with the 2 median vittae wide, 2 lateral vittae shorter, clearly defined; supra-alar seta, *ca.* twice length of posterior dorsocentral seta; postalar setae, moderately strong, slightly exceeding length of acrostichal setae; postpronotum with 13 finer, black-brown setulae; anepisternum surface with 33 fine setulae, some larger and arranged in 2 groups of 3 and 5; anepimeron, laterotergite and meron silver-grey to yellow-grey pruinose; katepisternum silver-grey to yellow-grey pruinose, dorsal katepisternal seta *ca.* 0.3 length of ventral katepisternal seta, with 18 short, fine setulae at base and along posterior margin.

Scutellum. As described for *C. gladiiformis* sp. n.

Legs. Fore coxa with 13 brown setulae on anterior surface; mid-coxa with 6 brown setulae; fore tibia with ctenidium of 12–14 short, sharp, black spinules.

Wing (as in Fig. 3.3: 27). Long and broad, tip evenly-rounded, veins chestnut-brown, membrane deep-brown infusate throughout, darker in r_1 and anterior $\frac{1}{2}$ of r_{2+3} and in region of $dm-cu$ crossvein; $dm-cu$ crossvein with even arc dorsally; halter dirty yellow.

Abdomen. Tergite 1 with oblique, small, subrectangular brown-black pruinose dorsolateral macula on either side and narrow medial fascia; tergite 2 with larger subrectangular brown-black maculae and similar medial fascia; tergites 3–5 with very wide, V-shaped concolourous median fascia and large concolourous T-shaped dorsolateral macula, these fully merging with medial fascia in anterior third, lateral margin of tergites 2–5 with subelliptical, large, concolourous macula in basal $\frac{1}{2}$; sternites 4–5 as described for *C. coronaeformis* sp. n.; sternite 6 (Fig. 3.3: 79) dove-tailed (may appear narrower than Fig. 3.3: 79 in undissected specimens), narrowed in basal third, with deep triangular excision apically, apical lobes evenly rounded, with dark brown maculae laterally, clothed in short, black, irregular, brown setulae in apical $\frac{2}{3}$, those at lateral and apical margins longer and more prominent.

Terminalia (Figs 3.3: 40, 43, 46). Hypandrium (Fig. 3.3: 40, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (subtriangular to slightly angulate in profile); hypandrial arm constricted medially (viewed laterally), with 2 parallel setulae proximal to postgonite, of similar length (obscured by epandrium on Fig. 3.3: 40), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex medially, closely abutting, overlapping; postgonite (Fig. 3.3: 40, *pg*) long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 3.3: 40, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 3.3: 40, *ce*) not prominent, longest setae longer than setae on dorsal margin of epandrium; surstylus (Fig. 3.3: 40, *ss*) long, widest basally, slightly curved in apical $\frac{2}{3}$; phallus (as in Figs 3.3: 43, *ph*, *bp*, *dp*, 46, *bp*, *dp*) C-shaped, moderately sclerotised, brown; phallapodeme (Fig. 3.3: 43, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, broad, subtriangular projections in basal fifth, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 43, *ea*) free, duct inserted at junction of phallapodeme and basiphallus (missing from specimens illustrated in Fig. 3.3: 43);

basiphallus (Fig. 3.3: 43, *bp*) broad basally and in region of first bend, then narrowed to apex, markedly narrowed in apical third (viewed dorsally); apical section (Figs 3.3: 43, 46, *bp*) broad basally, sclerotised area extensive, abruptly narrowed towards apex, basal section with membranous window, with one narrow, but strong, straight, ventrally-directed lateral spine (indicated with arrow on Fig. 3.3: 46) and two smaller spines, positioned in baso-lateral region, left margin of sclerotised area with irregular row of small tubules.

Variation: Insufficient material is available to assess variability.

Differential diagnosis: This species is closely related to *C. stuckenbergi* Tsacas, differing in the colour of the frons (brown with distinct vittae in *C. keiseri* and yellow with indistinct vittae in *C. stuckenbergi*) the colour of flagellomere 1 and the shape of the male terminalia. Both share the deep brown, infusate wing membrane, the dove-tailed sternite 6, and the straight, ventrally-directed, lateral spine and two smaller spines on the distiphallus. *Curtonotum keiseri* differ from *C. stuckenbergi*, however, in the angle and degree of curvature of the *dm-cu* crossvein of the wing, in the lateral margins of the phallus being only moderately sclerotised, and in the smaller spines of the distiphallus positioned in the baso-lateral region, rather than the left and right lateral regions. The ranges of the two species do not overlap, and they occur allopatrically.

Type material examined. Holotype: ♂ MADAGASCAR: “MADAGASCAR.D.-S. / Joffreville / 25.V.[19]58 F. KEISER [pink paper] // HOLOTYPE [red card] // CURTONOTUM / *keiseri* n.sp. / Holotype / L. TSACAS DET. 1973 [printed & handwritten] // BM [handwritten] // MUSÉUM PARIS // *Curtonotum* / *keiseri* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2006” [head missing] (MNHN). In poor condition, head and all legs except left fore femur, fore tibia, left hind femur and hind tibia missing; direct-pinned; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratype: ♂ “MADAGASCAR.D.-S. / Mtge. D’Ambre [= Montagne d’Ambre] / 24.V.[19]58 F.KEISER [pink paper] // PARATYPE [red card] // CURTONOTUM / *keiseri* n.sp. / paratype / L. TSACAS DET. 1973 [printed & handwritten] // *Curtonotum* / *keiseri* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008” (NHMB).

Additional material examined (labelled: “*Curtonotum keiseri* Tsacas, 1974 ♂ det. A.H. Kirk-Spriggs 2011”): MADAGASCAR: 1♂ Madagascar N., Ambohitra, 800 m, Joffreville, 9–12.iv.1991, A. Freidberg & Fini Kaplan [left wing detached and glued to card] (TAU).

Distribution (Fig. 3.3: 92): Apparently confined to the Humid Forest vegetation type in the Evergreen Rainforest biome. In the North biogeographical zone and Dry bioclimatic zone (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II).

***Curtonotum parkeri* Kirk-Spriggs, sp. n.**

Figs 3.3: 5, 18, 31, 50, 53, 56, 82, 96

Etymology: The species is named in honour of Frank Parker, in recognition of his contribution to our knowledge of Madagascan Hymenoptera.

Description: Male (primarily based on ex spirit-preserved HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 3.65–4.4 mm ($n = 4$, PT); length of head and thorax combined 2.8 mm; length of thorax and scutellum combined 2.3 mm; wing length 4.1 mm ($n = 1$, HT).

Head (Figs 3.3: 5, 18). As described for *C. gladiiformis* sp. n., except: eye height/length ratio: 10:6 ($n = 1$, HT); frons (Fig. 3.3: 18), frons length/width ratio: 5:6 ($n = 1$, HT), arista with 7 or 8 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; gena narrow, eye height/genal height ratio: 12:1 ($n = 1$, HT), silver pruinose, slightly darker beyond basal angle; palpus pale brown.

Thorax (Fig. 3.3: 5). Mesonotum as described for *C. boeny*; presutural seta moderately strong, shorter than posterior notopleural seta; supra-alar seta twice as long as posterior dorsocentral seta; postalar setae longer and stronger than acrostichal setae; postpronotum with 6 finer black-brown setulae; anepisternum silver-grey pruinose, with silver-yellow pruinose areas, surface with 20 fine setulae, some larger and arranged in 2 groups of 3 and 4; anepimeron, laterotergite and meron silver-grey to silver-yellow pruinose; katepisternum silver-grey to silver-yellow pruinose, with darker macula in anterior $\frac{1}{2}$, dorsal katepisternal seta fine, *ca.* 0.3 length of ventral katepisternal seta, with 16 short, fine setulae at base and along posterior margin.

Scutellum. As described for *C. gladiiformis* sp. n.

Legs. Fore coxa with 14 brown setulae on anterior surface; mid-coxa with 7 brown setulae; fore tibia with ctenidium of 13 spinules.

Wing (as in Fig. 3.3: 31). Veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in region of *dm-cu* crossvein; *dm-cu* crossvein with even arc; halter dirty white.

Abdomen. Tergite 1 simple, devoid of maculae; tergite 2 with oblique, subovoid brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with large, broad, V-shaped, concolourous median fascia and large, concolourous T-shaped dorsolateral macula, these close or adjoining, but not fully merging with median fascia; lateral margin of tergites 2–5 with subelliptical, concolourous macula in basal $\frac{1}{2}$; sternites 4 and 5 as described for *C. coroneiformis* sp. n.; sternite 6 (Fig. 3.3: 82) markedly expanded laterally (may appear narrower than Fig. 3.3: 82 in undissected specimens), narrowed basally with shallow, broad, subtriangular excision apically, with dark brown maculae medially, clothed in long, dense, irregular brown setulae, those at apical margin longer and more prominent.

Terminalia (Figs 3.3: 50, 53, 56). Hypandrium (Fig. 3.3: 50, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (subtriangular to slightly angulate in profile); hypandrial arm constricted apically (viewed laterally), with 2 setulae proximal to postgonite, the more lateral strong, ventrally directed, the medial much smaller and weaker (obscured by epandrium on Fig. 3.3: 50), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex medially, closely abutting, overlapping; postgonite long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 3.3: 50, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long regular to irregular, apically-directed setae; cercus (Fig. 3.3: 50, *ce*) not prominent, longest setae longer than medium setae on dorsal margin of epandrium; surstylus (Fig. 3.3: 50, *ss*) long, widest basally, slightly curved in apical $\frac{2}{3}$; phallus (as in Figs 3.3: 53, *ph*, *bp*, *dp*, 56, *bp*, *dp*) C-shaped, strongly sclerotised, brown; phallapodeme (Fig. 3.3: 53, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, narrow, subtriangular projections in basal two-fifths, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 53, *ea*) free, duct inserted at junction of phallapodeme and basiphallus;

basiphallus (Fig. 3.3: 53, *bp*) broad in basal third, with slight internal bulge at first bend, very markedly narrowed in apical $\frac{2}{3}$ (viewed dorsally); apical section (Fig. 3.3: 56, *bp*) extremely broad, right lateral margin evenly rounded with semicircular raised margin, left lateral margin with distinct raised keel; distiphallus (Figs 3.3: 53, 56, *dp*) broad basally, sclerotised area extensive, divided medially, with thin ventrally-directed spine in membranous window, right lateral section with three short, dark-tipped spines (viewed dorsolaterally), apical section narrow, bent and spindle-like.

Variation: No significant variation is noted.

Differential diagnosis: This species is closely related to *C. coroneiformis* sp. n.; the shape, maculae and setation of abdominal sternites 4 and 5 are virtually identical, the apical region of the basiphallus is markedly expanded in both species, with very similar left and right raised keels, and both share the raised and spinose right sclerotised area of the basiphallus. In *C. parkeri* sp. n., however, the basiphallus is more markedly narrower medially and expanded in the apical third, and the raised and spinose right sclerotised area of the distiphallus is less conspicuously developed, with three short, dark-tipped spinules. The two species occur sympatrically.

Type material examined. Holotype: ♂ “MADAGASCAR: Tuléar Province / Zombitse National Park / near ANGAP office, 840 m / 22°53.19'S, 44°41.53'E / 28.ii–6.iii.2002 / California Acad of Sciences / R. Harin'Hala, Malaise trap / deciduous spiny forest / MA-02-13A-18 // HOLOTYPE ♂ / *Curtonotum / parkeri* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (CAS). In good condition, some setation of head missing; card-pointed; right wing detached and glued to card; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ / *Curtonotum / parkeri* sp. n. / A.H. Kirk-Spriggs 2010 [blue card]”): MADAGASCAR: 3♂ same data as holotype (CAS); same except: 3♂ “29.xii.2001–5.i.2002, MA-02-13A-10”; 1♂ “26.i–5.ii.2002, MA-02-13A-14”; 4♂ “14–21.ii.2002, MA-02-13A-16”; 3♂ “27.iii–3.iv.2002, MA-02-13A-22”; 1♂ “1–9.v.2002, MA-02-13A-27”; 1♂ “MADAGASCAR: Tuléar / Prov., Zombitse National / Park, near national road \ 22°50.43'S, 44°43.87'E / 20–27.iii.2002, 825 m / R. Harin'Hala, Malaise / trap, deciduous spiny forest / MA-02-13B-21”; 2♂ “MADAGASCAR: Province / Fianarantsoa, radio tower / 22 km SW of Ilakaka, near / Fianarantsoa/Tuléar border / 22°46.75'S, 45°1.50'E / 27.ii–6.iii.2002, 1100 m / M.E. Irwin & R. Harin'Hala / Malaise in Uapacca forest / MA-02-12-10”; 1♂ “MADAGASCAR: Tuléar / Province, Andohahela Nat'l / Park, Tsimelahy, Parcelle II / 24°56.21'S, 46°37.60'E / 6–16.i.2003, 180 m / M.E. Irwin, F. Parker & / R. Harin'Hala, Malaise trap / in transitional forest / MA-02-20-12”; 1♂ “MADAGASCAR: Province / Fianarantsoa, near Isalo /

National Park, in dry wash / east of Interpretive Center / 22°37.60'S, 45°21.49'E / 10–17.ii.2002, 885 m / M.E. Irwin & R. Harin'Hala / Malaise trap in open area / MA-02-11B-15"; same except: 1♂ "22–30.vi.2002, MA-02-11B-33"; 1♂ "4–13.v.2002, MA-02-11B-27"; 1♂ "6–14.xii.2002, MA-02-11B-49"; 1♂ "2–12.ii.2003, MA-02-11B-55"; 1♂ "MADAGASCAR: Tuléar / Province, Beza Mahafaly / Reserve, Parcelle I near / research station / 23°41.19'S, 44°35.46'E / 7–18.vii.2002, 165 m / R. Harin'Hala, Malaise / trap in dry deciduous forest / MA-02-14A-29" (all CAS)

Additional material examined (all labelled "*Curtonotum parkeri* sp. n. det. A.H. Kirk-Spriggs 2010"): MADAGASCAR: *Fianarantsoa Prov.*: 1♂ near Isalo National Park, in dry wash east of Interpretive Center, 22°37.60'S:45°21.49'E, 9–17.xi.2001, 885 m, M.E. Irwin & R. Harin'Hala, Malaise trap in open area (MA-02-11B-02) [in spirit], BMSA(DNA)#0017; 1♂ same except: 14–22.vi.2003 (MA-02-11B-67) [in spirit], BMSA(DNA)#0061; 1♂ radio tower, 22 km SW of Ilakaka near Fianarantsoa/Tuléar border, 22°46.75'S:45°1.50'E, 27.ii–6.iii.2002, 1100 m, M.E. Irwin & R. Harin'Hala, Malaise in Uapacca forest (MA-02-12-10) [in spirit], BMSA(DNA)#0041; 1♂ same except: 16–27.ii.2002 (MA-02-12-09) [in spirit], BMSA(DNA)#0060 (all BMSA).

Distribution (Fig. 3.3: 96): Occurring in Tapia Forest and Wooded Grassland-Bushland vegetation types in the Central Highlands, Evergreen Rainforest and Dry Deciduous Forest biomes. In the South and South East biogeographical zones and Subarid bioclimatic zone (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II).

Curtonotum pauliani Tsacas, 1974

Figs 3.3: 12, 25, 38, 69, 72, 75, 90, 103

Curtonotum pauliani: Tsacas, 1974: 715; figs 7a–d (p. 716), fig. 8b (p. 718). Type locality: [Madagascar] "Nosy Mitsio".

Redescription: Male (primarily based on ex-alcohol N-T).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 3.1–4.1 mm ($n = 13$, N-T); length of head and thorax combined 2.3 mm; length of thorax and scutellum combined 2.15 mm; wing length 3.2 mm ($n = 1$, N-T).

Head (Figs 3.3: 12, 25). Eye height/length ratio: 9:6 ($n = 1$, N-T); frons (Fig. 3.3: 25), subparallel-sided, slightly wider than long, frons length/width ratio: 5:7 ($n =$

1, N-T), ground colour pale dirty yellow, with paler yellow demarcated ventral border, faintly darker towards vertex and between orbital plates, otherwise both vittae inconspicuous, not reaching ventral border; ocelli clear grey (brown in some specimens); orbital plates short, extending from vertex of head to *ca.* 0.7 length of frons; posterior orbital seta moderately strong, marginally longer than outer vertical seta; postocellar setae markedly shorter than outer vertical seta; flagellomere 1 yellow pruinose basally, darker in apical $\frac{1}{2}$, slightly silver-grey pruinose, just over *ca.* twice as long as wide, apex bluntly rounded, arista with 3–5 dorsal and 3 or 4 ventral branches in addition to terminal fork; vibrissae weak; gena narrow, eye height/genal height ratio: 9:1 ($n = 1$, N-T); palpus brown, brown microtrichose.

Thorax (Fig. 3.3: 12). Mesonotum with 2 median conspicuous, broad, reddish-brown vittae and 2 lateral, shorter vittae; posterior dorsocentral setae longer and stronger than medial scutellar seta; presutural seta slightly longer and weaker than posterior notopleural seta; anterior notopleural setae longer than posterior; postpronotum silver-grey pruinose, with 9–12 finer black-brown setulae; anepisternum silver-grey pruinose with yellow-grey patch medially, with 15 fine setulae, some larger and arranged in 2 groups of 4; katepisternum silver-grey to silver-yellow pruinose, with darker macula in anterior $\frac{1}{2}$, dorsal katepisternal seta, *ca.* 0.4 length of ventral katepisternal seta, with 12 short, fine setulae at base and along posterior margin.

Scutellum. Silver-grey pruinose, as on mesonotum, with faint medial brown pruinose vitta basally (under some lights); intermediate scutellar setula (if present) inserted equidistant between lateral and medial scutellar setae.

Legs. Fore coxa with 15 brown setulae on anterior surface; fore tibia with 4 strong setae on lateral margin, the second basal seta of similar length to other three, with ctenidium of 13 short, sharp black spinules.

Wing (as in Fig. 3.3: 38). Short, broad basally, tip evenly-rounded, veins chestnut-brown, membrane very faintly infusate brown throughout, marginally darker in r_1 and anterior $\frac{1}{2}$ of r_{2+3} and in region of *dm-cu* crossvein; *dm-cu* crossvein slightly obliquely angled posteriorly, quite straight; *cua*₁ relatively short and broad; r_{2+3} markedly expanded apically; halter dirty white.

Abdomen. Tergite 2 with oblique, subrectangular brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with very narrow, V-shaped concolourous median fascia and well separated and greatly reduced concolourous T-shaped dorsolateral macula, lateral margin of tergites 2–5 with subelliptical concolourous macula in basal third; sternite 4, quadrate with evenly-rounded apical margin; sternite 5 rectangular, subparallel-sided, with straight apical margin, *ca.* $\frac{1}{3}$ longer than sternite 4, both unmodified, with sparse, brown setulae arranged in irregular rows, those along lateral margins slightly longer and stronger; sternite 6 (Fig. 3.3: 90) subquadrate (may appear narrower than Fig. 3.3: 90 in undissected specimens), subparallel-sided, with shallow, broad, excision apically, with faint brown maculae laterally, clothed in short to long, irregular brown setulae in apical $\frac{1}{2}$, laterally and at apical margin longer and more prominent.

Terminalia (Figs 3.3: 69, 72, 75). Hypandrium (Fig. 3.3: 69, *hy*) short, with broad-based subangulate-truncate dorsobasal lobe, posterior bridge markedly dorsally and ventrally produced (angulate in profile); hypandrial arms very broad, slightly narrower basally, than apically (viewed laterally), ventrally developed into blunt point apically, with 2 equally strong setulae proximal to postgonite, both ventro-medially-directed (obscured by epandrium on Fig. 3.3: 69), sclerotised area of medial lobes (viewed dorsally), straight basally, well-separated for $\frac{2}{3}$ of their length, abutting in apical third; postgonite (Fig. 3.3: 69, *pg*) short and broad in basal $\frac{2}{3}$, narrowed to apex; epandrium (Fig. 3.3: 69, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly-rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long regular to irregular, ventrally-directed setae; cercus (Fig. 3.3: 69, *ce*) slightly prominent, longest setae as long as medium setae on ventral margin of epandrium; surstylus (Fig. 3.3: 69, *ss*) short, wide and straight; phallus (as in Figs 3.3: 72, *ph*, *bp*, *dp*, 75, *bp*, *dp*) C-shaped, weakly sclerotised; phallapodeme (Fig. 3.3: 72, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two moderately flat, subtriangular projections in basal two-fifths, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 72, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.3: 72, *bp*) broad basally and at midlength, otherwise uniform; apical section (Fig. 3.3: 75, *bp*) fairly broad, right lateral margin evenly rounded with latromedial raised keel, left margin straight, developed into tiny, recurved spine;

distiphallus (Figs 3.3: 72, 75, *dp*) long and narrow, curved in medial and apical regions (viewed laterally), basal section with conspicuous, short dorsomedial spine.

Variation: The external characters of this species are more variable than in other species occurring on Madagascar; especially the relative lengths of the setation. Very slight differences also occur in the degree of development of the small basal spine between the basiphallus and distiphallus, otherwise the male terminalia appear consistent and such variation is here regarded as intraspecific.

Differential diagnosis: This species is most closely related to *C. cuthbertsoni* Tsacas, 1977, and to a complex of seven, as yet undescribed species, all occurring in the continental Afrotropical Region. All possess one or more baso-medial spines on the dorsal margin of the distiphallus. The Madagascan species, *C. sakalava* Tsacas, which has a conspicuous baso-medial keel on the distiphallus, shares the similarly-shaped hypandrium, with the broad-based, wide and angulate dorsobasal lobe and broad hypandrial arms, and this species is here tentatively ascribed to the same complex, pending a detailed phylogenetic analysis.

Type material examined. Holotype: ♂ MADAGASCAR: “Madagascar Nord-Ouest / Nosy Mitsio / 13–14.I.[19]60 / R. Paulian // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // HOLOTYPE [red card] // CURTONOTUM / *pauliani* / Holotype ♂ n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* / *pauliani* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2006” [head missing] (MNHN). In fair condition, head, right fore leg, left fore tarsus and hind leg missing; re-staged on nu-poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE [red card] // CURTONOTUM / *pauliani* / n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // *Curtonotum* / *pauliani* ♂ [or ♀] / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2006”): MADAGASCAR: 1♀ same labels as holotype, except: “ALLOTYPE [red card] // CURTONOTUM / *pauliani* / n.sp. / L. TSACAS DET. 1973 [printed & handwritten]” [wing detached, glued to card]; 2♂ same labels as holotype [1 head missing]; 1♀ same labels as holotype, except: “EXEMP. / DESS. [printed; orange card]”; 1♀ same labels as holotype, except: “ouile gameha / ma tres large / Anomalie ♀ [handwritten]”; 1♂ “Madagascar Nord-Ouest / dct. Majunga / forêt Ankarafantsitka [= Ankarafantsika] 120m / XII-[19]59 / Raharizonina // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // MUSÉUM PARIS” [head missing]; 1♂ “MUSEUM PARIS / MADAGASCAR / PROV. D’ANALALAVA / MAROMANDIA / R. DECARY 1922 [grey card] // PARATYPE [red card] // Specimen / missing from mount / 2006”; 1♂ 1♀ same labels, except: “Pr A18 / ♂ [handwritten] [head missing]” (all MNHN).

Additional material examined (all labelled: “*Curtonotum pauliani* Tsacas, 1974 ♂ det. A.H. Kirk-Spriggs 2008–2011”): MADAGASCAR: 2♂ Madagascar, Ankarafantsika (Forest Reserve), near Marovoay, 1.xii.1959, E.S. Ross Collector [1 labelled: “*Curtonotum pauliani* Tsacas, L. Tsacas det. 1976”; 1 with right wing detached and glued to point]. *Mahajanga Prov.*: 13♂ Parc National Tsingy de Memaraha, 3.4 km 93° E Bekopaka, Tombeau Vazimba, 19°08'31"S:44°49'41"E, 50 m, 6–10.xi.2001, leg. [B.] Fisher, [C.] Griswold *et al.*, tropical dry forest, Malaise trap (MAD49), BLF4233 [1 with right wing detached and glued to card] (all CAS). *Majunga Prov.*, 1♂ Besalampy District, Marofototra palm forest 17 km W of Besalampy, 16°43.30'S:44°25.42'E, 3–10.xii.2007, 35 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, palm trees on sand (MG-42B-11) [in spirit], BMSA(DNA)#0062; 1♂ same except: BMSA(DNA)#0063 (both BMSA); 1♂ same except: 10–17.xii.2007 (MG-42B-12); 2♂ same except: 17–24.xii.2007 (MG-42B-13) (all CAS); 1♂ Ampijoroa National Park, 160 km N of Maevatanana on RN 04, 16°19.16'S:46°48.80'E, 30.xi–8.xii.2003, 43 m, M.E. Irwin & R. Harin'Hala, Malaise trap in deciduous forest (MA-25-25) [in spirit], BMSA(DNA)#0043 (BMSA).

Distribution: The only non-endemic species, occurring in Madagascar, Namibia and South Africa (Kirk-Spriggs in prep.) and probably represents a relatively recent introduction onto Madagascar. Its occurrence in the Sambirano bioclimatic zone may indicate recent introduction *via* the circulation system of the Indian monsoon. In Madagascar (Fig. 3.3: 103) occurring in the Western Dry Forest and Wooded Grassland-Bushland vegetation types in the Sambirano Rainforest, Dry Deciduous Forest and Evergreen Rainforest biomes. In the Sambirano, North East, North West and West biogeographical zones and Dry and Humid bioclimatic zones (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II).

***Curtonotum rinhatinana* Kirk-Spriggs, sp. n.,**

Figs 3.3: 9, 22, 35, 60, 63, 63a, 63b, 66, 87, 100

Etymology: The specific epithet is a combination of the names Rinha and Tina Harin'Hala, in recognition of their contribution to Malagasy dipterology.

Description: *Male* (based on unique field-pinned HT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 2.7 mm; length of thorax and scutellum combined 2.6 mm; wing length 4.1 mm.

Head (Figs 3.3: 9, 22). Eye height/length ratio: 11:7 ($n = 1$, HT); frons (Fig. 3.3: 22), subparallel-sided, slightly wider than long, frons length/width ratio: 6:8 ($n = 1$, HT), slightly wider at vertex than at ventral margin, ground colour pale dirty yellow, vittae conspicuous, reaching ventral margin; orbital plates and ocellar triangle silver-grey pruinose, ocelli clear brown; orbital plates extending from vertex of head to 0.8 length of frons; lateral margins with very narrow silver pruinose fascia (adjacent to eye margin), widest at midlength of face (posterior and anterior orbital setae, postocellar and vertical setae missing on unique HT and cannot be described); ocellar setae short, only extending *ca.* 0.7 length of frons; antennal scape and pedicel dirty pale brown, silver-grey pruinose, flagellomere 1 concolourous with pedicel, darkened in apical $\frac{2}{3}$, especially along anterior margin, slightly silver-grey pruinose, 2.5 $\times$ as long as wide, apex evenly-rounded (right flagellomere 1 and left arista missing from HT and arista cannot be described); lunule brown, shiny; face uniform silver-grey pruinose throughout, with very narrow silver fascia (adjacent to eye margin), region between this fascia and ptilinal fissure yellow-silver pruinose, facial carina developed as a prominent ridge, extending $\frac{2}{3}$ length of face, vibrissae strong; occiput grey pruinose; gena narrow, eye height/genal height ratio: 11:1 ($n = 1$, HT), silver pruinose, abruptly dirty brown beyond basal angle; palpus thin, black, brown basally, brown microtrichose.

Thorax (Fig. 3.3: 22). Mesonotum (badly rubbed on unique HT), as described for *C. boeny* Tsacas, except: acrostichal setae slightly shorter than anterior dorsocentral seta (presutural and notopleural setae missing on HT and cannot be described); postalar setae, moderately strong, longer than acrostichal setae; postpronotum (postpronotal setae missing on HT, but socket size indicates two present), with 8 finer, black-brown setulae; anepisternum silver-grey pruinose, with yellow pruinose patch in centre, with 3 moderately strong anepisternal setae (the more ventral missing on HT, but size of socket indicates this to be smaller and finer than dorsal and medial setae), with 20 fine setulae, some larger and arranged in 2 groups of 3 and 2; katepisternum with ventral katepisternal seta strong, the more dorsal much smaller and finer, *ca.* 0.3 length of ventral katepisternal setae, surface with 15 short, fine setulae at base and along posterior margin.

Scutellum. Uniform, golden-silver-grey pruinose (medial vitta not discernable on HT, baso-medial area rubbed); weak intermediate scutellar setula inserted four-fifths distance between medial and lateral scutellar setae.

Legs. Fore coxa with 8 diminutive brown setulae on anterior surface; mid-coxa with 2 very strong, lateral, ventrally-directed black setae, 1 very strong medial seta and 5 brown setulae; fore tibia with 4 strong setae on lateral margin, the second basal seta of similar length to other three, with ctenidium of 9–10 short, sharp, black spinules, separated from each other by one or more basal spinule widths.

Wing (as in Fig. 3.3: 35). Relatively short and very broad, tip slightly angularly rounded; veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in medial region of r_1 and in region of $dm-cu$ crossvein; $dm-cu$ crossvein sub-vertical, with indentation in basal $\frac{1}{2}$; halter pale yellow.

Abdomen (Tergites 1–2 damaged on macerated abdomen of HT): Ground colour of tergites unknown; tergites 3–5 with narrow, V-shaped concolourous median fascia and well separated and greatly reduced concolourous T-shaped dorsolateral macula, apparently not merging with fascia, lateral margin of tergites 2–5 with subelliptical concolourous macula in basal $\frac{1}{2}$; sternite 4, quadrate, evenly rounded laterally, with straight apical margin; sternite 5 rectangular, evenly -rounded at sides, slightly less than twice length of sternite 4, with faint lateral macula, both unmodified, with sparse brown setulae arranged in irregular rows, those along lateral and apical margins of sternite 4 slightly longer and stronger; sternite 6 (Fig. 3.3: 87) subquadrate (may appear narrower than Fig. 3.3: 87 in undissected specimens), narrowed basally, evenly rounded laterally, with very shallow, broad excision apically, with indistinct medial macula and fascia laterally, clothed in short, brown, regular setulae in apical $\frac{2}{3}$, those at apical margin sparse, longer and more prominent.

Terminalia (Figs 3.3: 60, 63, 66). Hypandrium (Fig. 3.3: 60, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded to slightly angulate in profile); hypandrial arms narrow basally, expanded apically (viewed laterally), with 2 setulae proximal to postgonite, the more lateral ventrally directed, the medial ventro-medially directed (obscured by epandrium on Fig. 3.3: 60), sclerotised area of medial lobes (viewed dorsally), parallel-sided, well separated; postgonite (Fig. 3.3: 60, *pg*) very short, relatively broad, with slight

undulating anterior margin; epandrium (Fig. 3.3: 60, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin angled, ventral margin with row of long regular to irregular, apically-directed setae; cercus (Fig. 3.3: 60, *ce*) not prominent, longest setae longer than setae on dorsal margin of epandrium; surstylus (Fig. 3.3: 60, *ss*) very short, widest basally, slightly curved in apical $\frac{1}{2}$; phallus (as in Figs 3.3: 63, *ph*, *bp*, *dp*, 66, *bp*, *dp*) highly modified, heavily sclerotised, brown, especially along anterior margin; phallapodeme (Fig. 3.3: 63, *ph*) fused to basiphallus, subtriangular and flat, with heavily-sclerotised region basally (viewed laterally); ejaculatory apodeme detached during dissection (Fig. 3.3: 66, *ea*) but free, with duct probably inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.3: 63, *bp*) grossly expanded, forming extensive, extremely wide, sclerotised, $\frac{1}{2}$ -moon-shaped plate, strongly concave on left side, arm of basiphallus discernable through plate cuticle for basal $\frac{1}{2}$ and apical $\frac{2}{3}$; distiphallus (Figs 3.3: 63, 66, *dp*) extremely short, with relatively broad, sclerotised basal section (viewed laterally, Fig. 3.3: 66, *dp*), right margin indented laterally, with crenulated margin, right lateral margin with membrane with short forked process (may have become detached from lateral margin during dissection), blade ending in acute point, left margin with black-brown sclerotised, apically recurved bar, with curved, downwardly-directed process at point of bend; sperm pump (Figs 3.3: 63a, 63b) heavily sclerotised, brown, with rugose surface, capsulate, ovoid, with apical extension and distinct sclerotised lip around apical opening (this became detached during dissection and its position in relation to the rest of the terminalia complex cannot be accessed).

Variation: Insufficient material is available to assess variability.

Differential diagnosis: Although similar in external characters to other species of the genus occurring in Madagascar (inasmuch as the poor condition of the unique holotype allows comparison), the bizarre structure of the basiphallus and the presence of what is here interpreted as a sclerotised sperm pump, may preclude any direct association. This is the only known species worldwide to possess such a structure and this may be an ancient species, that has been retained as a relict on Madagascar. Associations with other species (if they exist), must await the outcome of the detailed phylogenetic analysis.

Type material examined. Holotype: ♂ “MADAGASCAR: / Ankarafantsika / (Forest Reserve) / near Marovoay / XII-1-1959 // E. S. Ross / Collector // HOLOTYPE ♂ / *Curtonotum / rinhatinana* sp. n. / A.H. Kirk-Spriggs 2010 [red card]” (CAS). In fair condition, mesonotum rubbed, some head setation missing and tarsi damaged; one wing detached and glued to card; card-pointed; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Distribution (Fig. 3.3: 100): Apparently confined to the Western Dry Forest vegetation type in the Dry Deciduous Forest biome. In the North West biogeographical zone and Dry bioclimatic zone (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II).

Curtonotum sakalava Tsacas, 1974

Figs 3.3: 13, 26, 39, 76–78, 91, 104

Curtonotum sakalava: Tsacas, 1974: 713; figs 6a–d (p. 714). Type locality: “Madagascar: Quest, Morondava”.

Redescription: Male (primarily based on ex-alcohol N-T).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 1.9–3.5 mm ($n = 42$, N-T); length of head and thorax combined 1.8 mm; length of thorax and scutellum combined 1.6 mm; wing length 2.3 mm ($n = 1$, N-T).

Head (Figs 3.3: 13, 26). Eye prominent, eye height/length ratio: 8:5 ($n = 1$, N-T); frons (Fig. 3.3: 26), slightly wider than long, frons length/width ratio: 40:45 ($n = 1$, N-T), markedly wider at vertex than at ventral margin, ground colour pale dirty yellow, dark brown towards vertex and between orbital plates, vittae interrupted at point of ocellar triangle, not reaching ventral margin; orbital plates and ocellar triangle golden-grey pruinose; orbital plates wide, extending from vertex of head to 0.9 length of frons; ocellar triangle large, extending third length of frons; posterior orbital seta longer than outer vertical seta; anterior orbital seta shorter than $\frac{1}{2}$ length of ocellar setae; postocellar setae shorter than outer vertical seta; flagellomere 1 yellow basally and along anterior margin, darker medially, silver-grey pruinose, $2.5\times$

as long as wide, arista with 6–7 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; facial carina slightly yellow pruinose, developed as a low ridge, extending $\frac{2}{3}$ length of face, clypeus black, much narrower than face; vibrissae moderately strong, and 10 very small, brown setae bordering genal groove; occiput golden-grey pruinose; gena narrow, eye height/genal height ratio: 8:50 ($n = 1$, N-T), silver pruinose, abruptly golden-brown beyond basal angle; palpus black-brown.

Thorax (Fig. 3.3: 26). Mesonotum golden-grey pruinose, with 2 median conspicuous, broad, brown pruinose vittae and 2 lateral, shorter vittae; posterior dorsocentral setae same length as lateral scutellar seta; postalar setae slightly longer than acrostichal setae; postpronotum golden-grey pruinose, with 4 finer black-brown setulae; anepisternum silver-grey pruinose, with 12 fine setulae, some larger and arranged in 2 groups of 3; katepisternum silver-grey pruinose, yellow-grey pruinose anteriorly, ventral katepisternal seta finer, *ca.* 0.2 length of ventral katepisternal setae, surface with 12 short, fine setulae at base and along posterior margin.

Scutellum. Uniform, golden-grey pruinose throughout; intermediate scutellar setula inserted three-fifths distance between medial and lateral scutellar setae.

Legs. Fore coxa with 9 brown setulae; mid and hind coxa silver-yellow pruinose, mid-coxa with 3 brown setulae; hind coxa with 2 brown setula; fore tibia usually with 4 strong setae on lateral margin, the second basal seta of similar length to other three, with ctenidium of 7–9 short, sharp black spinules.

Wing (as in Fig. 3.3: 39). Short, broad basally, tip evenly-rounded, veins chestnut-brown, membrane very faintly infusate brown throughout, marginally darker in r_1 and anterior $\frac{1}{2}$ of r_{2+3} and in region of $dm-cu$ crossvein; $dm-cu$ crossvein obliquely angled posteriorly, with slight curvature at midlength; halter dirty yellow.

Abdomen. Tergite 2 with oblique, subrectangular brown-black pruinose dorsolateral macula on either side and small, medial macula in apical third; tergites 3–5 with narrow, V-shaped concolourous median fascia and broad, concolourous T-shaped dorsolateral macula, these separated from medial fascia; lateral margin of tergites 2–3 with extensive concolourous macula for full length of tergite, tergite 4 with macula extending $\frac{1}{2}$ length of tergite (collectively forming an unbroken fascia, viewed at low magnification); sternite 4, quadrate, with straight apical margin; sternite 5 rectangular, evenly rounded at sides, third longer than sternite 4, both with

sparse, brown setulae, those along lateral margins slightly very longer and stronger; sternite 6 (Fig. 3.3: 91) subquadrate (may appear narrower than Fig. 3.3: 91 in undissected specimens), with shallow, broad excision apically, with faint brown maculae laterally, clothed in short, irregular, brown setulae, those at apical margin longer and more prominent.

Terminalia (Figs 3.3: 76–78). Hypandrium (Fig. 3.3: 76, *hy*) short, with broad-based sub-angulate-truncate dorsobasal lobe, posterior bridge markedly dorsally and ventrally produced (angulate in profile); hypandrial arms broad, slightly narrower basally, than apically (viewed laterally), with 2 equally strong setulae proximal to postgonite, both ventro-medially-directed, sclerotised area of medial lobes (viewed dorsally), straight basally, well-separated for $\frac{2}{3}$ of their length, abutting in apical third; postgonite (Fig. 3.3: 76, *pg*) short and broad in basal $\frac{2}{3}$, narrowed to apex; epandrium (Fig. 3.3: 76, *ep*) slightly broader dorsally than ventrally (viewed laterally), flat on dorsal margin, posterior margin straight, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 3.3: 76, *ce*) slightly produced, longest setae as long as longest setae on ventral margin of epandrium; surstylus (Fig. 3.3: 76, *ss*) short, wide and straight; phallus (as in Figs 3.3: 76, *ph*, *bp*, *dp*, 77, *bp*, *dp*) C-shaped, weakly sclerotised; phallapodeme (Fig. 3.3: 77, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two flat, narrow, flat projections in basal two-fifths, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 77, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.3: 77, *bp*) slightly broader basally, then narrow and regular for most of its lengths; apical section (Fig. 3.3: 78, *bp*) moderately broad, right lateral margin evenly rounded with slightly raised keel, left lateral margin even; distiphallus (Figs 3.3: 77, 78, *dp*) long, narrow and evenly curved (viewed laterally), basal section with conspicuous, short dorsomedial keel.

Female Similar to male, except in the following respects: overall length 1.9–2.9 ($n = 17$, N-T); frons very slightly wider, abdomen longer.

Variation: The frons is more extensively brown between the orbital plates in some specimens, with the vittae more conspicuous. Fore tibia with 3 strong, lateral setae, rather than 4, in some specimens.

Differential diagnosis: This is the smallest described species of the genus worldwide. It is probably not closely related to other species occurring on Madagascar, but shares some genitalic features in common with *C. cuthbertsoni* Tsacas, 1977, and to a complex of seven as yet undescribed species occurring in the continental Afrotropical Region. The degree of development of the maculae on the abdominal tergites and the strong baso-medial keel of the distiphallus, however, may preclude its direct association with this group.

Type material examined. Holotype: ♂ MADAGASCAR: “Morondava / forêt sud / de Befasy / I-[19]56 R.P. [= R. Paulian] // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // HOLOTYPE [red card] // CURTONOTUM / sakalava / Holotype n.sp. / L. TSACAS DET. 1974 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* / sakalava Tsacas, 1974 ♂ / A.H. Kirk-Spriggs *vidit* 2006 // Specimen / missing from mount / 2006” (MNHN). The specimen is entirely missing from the mount, but the abdomen and terminalia are stored in vial beneath the specimen.

Additional material examined (all labelled: “*Curtonotum sakalava* Tsacas, 1974 ♂ [or ♀] det. A.H. Kirk-Spriggs 2008–2010”): MADAGASCAR: *Tuléar Prov.*: 2♂ 2♀ SW coast N of Tuléar (= Toliara), hotel area “Mora Mora”, 14.ii.1984, M. von Tschirnhaus, dry forest near sand beach (X1179) (ZSM); 1♂ Mahafaly Plateau, 6.2 km 74° NE of Itampolo, 24°39'13"S:43°59'48"E, 21–25.ii. 2002, 80 m, spiny forest thicket, Malaise trap, [B.] Fisher, [C.] Griswold *et al.* (MAD29), BLF5759; 1♂ Forêt de Mahavelo, Isantoria River, 24°45'30"S:46°09'26"E, 28.i–1.ii.2002, 110 m, spiny forest thicket, Malaise trap, [B.] Fisher, [C.] Griswold *et al.* (MAD48), BLF5237; 1♀, Sous Prefecture Fort Dauphin, Andohahela National Park, Ihazofotsy Parcelle III, 24°49.85'S:46°32.17'E, 21.x–2.xii.2002, 190 ft, Malaise trap, dry/spiny forest, M.E. Irwin, F. Parker & R. Harin'Hala (MG-02-21-01C); same except: 1♂ 1♀ 12–16.xii.2002 (MG-21-03); 2♀ 15–26.i.2003 (MG-21-04); 1♂ 2♀ 15–26.i.2003 (MG-21-07); 1♂ 18–29.iii.2003 (MG-21-13); 1♀ 21–28.iv.2003 (MG-21-16); 1♀ 28.iv–6.v.2003 (MG-21-17); 1♂ 6–13.v.2003 (MG-21-18); 1♀ 3–11.vi.2003 (MG-21-21); 2♂ 1♀ 29.vi–6.vii.2003 (MG-21-24); 1♂ 1♀ 24.viii–3.ix.2003 (MG-21-30); 2♂ 23–30.xi.2003 (MG-21-39); 3♂ 7–19.xii.2003 (MG-21-42); 4♂ 3–14.i.2004 (MG-21-44); 1♂ Sous Prefecture Fort Dauphin, 74 km S of Tsihombe, 120 ft, Cap Ste Marie Special Reserve, 25°35.36'S:45°09.78'E, 8–18.x.2003, Malaise trap, spiny bush, R. Harin'Hala & M.E. Irwin (MG-23-44); 1♂ Mikea Forest, 22°54.22'S:43°28.53'E, 19.viii–3.ix.2002, 97 ft, Malaise trap, deciduous dry forest, R. Harin'Hala & M.E. Irwin (MG-18A-31); same except: 1♀ 27.vii–3.viii.2003 (MA-02-18A-63); 1♀ 12–23.xi.2003 (MA-02-18A-74); 1♂ Mikea Forest, 22°54.80'S:43°23.93'E, 28.iii–8.iv.2002, 120 ft, Malaise trap, spiny forest, R. Harin'Hala & M.E. Irwin (MG-18B-18); 1♂ Zombitse National Park, near ANGAP office, 22°53.19'S:44°41.53'E, 28.ii–6.iii.2002, 840 m, R. Harin'Hala, Malaise trap, deciduous spiny forest (MA-02-13A-18); same except: 1♀ 19–27.v.2002 (MA-02-13A-29); 1♂ 19.viii–3.ix.2002 (MA-02-13A-38); 1♀ 5–31.x.2002 (MA-02-13A-42); 1♀

28.ii–10.iii.2003 (MA-02-13A-51); 1♂ Zombitse National Park, near national road, 22°50.43'S:44°43.87'E, 5–12.i.2002, 825 m, R. Harin'Hala, Malaise trap, deciduous spiny forest (MA-02-13B-11); same except: 1♂ 20–27.iii.2002 (MA-02-13B-21); 1♂ 2♀ Beza Mahafaly Reserve, Parcelle I near research station, 23°41.19'S:44°35.46'E, 15.x–10.xi.2001, 165 m, M.E. Irwin, F.D. Parker & R. Harin'Hala, Malaise trap in dry deciduous forest (MA-02-14A-01); same except: 2♂ 10–21.xi.2001 (MA-02-14A-02); 1♂ 1♀ 21–28.xi.2001, R. Harin'Hala (MA-02-14A-03); 1♂ 21–28.xi.2001 (MA-02-14A-04); 5♂ 3♀ 4–11.xii.2001 (MA-02-14A-05); 4♂ 11–18.xii.2001 (MA-02-14A-06); 1♂ 1♀ 18–25.xii.2001 (MA-02-14A-07); 2♂ 25.xii.2001–2.i.2002 (MA-02-14A-08); 1♂ 2–9.i.2002 (MA-02-14A-09); 4♂ 2♀ 16–18.i.2002 (MA-02-14A-11); 3♂ 1♀ 18–25.i.2002 (MA-02-14A-12); 3♂ 3♀ 8–15.ii.2002 (MA-02-14A-15); 3♂ 1♀ 15–22.ii.2002 (MA-02-14A-16); 1♂ 1♀ 22.ii–1.iii.2002 (MA-02-14A-17) (all CAS); 2♂ 1–7.iii.2002 (MA-02-14A-18) [in spirit], (BMSA(DNA)#0020 & BMSA(DNA)#0021) (BMSA); 1♀ 7–14.iii.2002 (MA-02-14A-19); 2♂ 22–29.iii.2002 (MA-02-14A-21); 1♂ 29.iii–10.iv.2002 (MA-02-14A-22); 2♂ 10–29.iv.2002 (MA-02-14A-23); 2♂ 29.iv–19.v.2002 (MA-02-14A-24); 1♀ 19.v–8.vi.2002 (MA-02-14A-25); 1♂ 8–18.vi.2002 (MA-02-14A-26); 2♂ 28.vi–7.vii.2002 (MA-02-14A-28); 3♂ 7–18.vii.2002 (MA-02-14A-29) [1 head missing]; 3♂ 1♀ 18–28.vii.2002 (MA-02-14A-30); 1♂ 1♀ 28.vii–9.viii.2002 (MA-02-14A-31); 3♂ 9–16.viii.2002 (MA-02-14A-32) [1 head missing]; 2♂ 1♀ 16–28.viii.2002 (MA-02-14A-33); 5♂ 1♀ 28.viii–9.ix.2002 (MA-02-14A-34); 6♂ 2♀ 9–20.ix.2002 (MA-02-14A-35); 3♂ 1♀ 20.ix–5.x.2002 (MA-02-14A-36); 1♀ 5–20.x.2002 (MA-02-14A-37); 1♀ 20–28.x.2002 (MA-02-14A-38); 5♂ 10–22.xi.2002 (MA-02-14A-40); 1♀ 22.xi–2.xii.2002 (MA-02-14A-41); 4♂ 1♀ 2–12.xii.2002 (MA-02-14A-42); 3♀ 12–17.xii.2002 (MA-02-14A-43); 1♀ 17–20.xii.2002 (MA-02-14A-44); 1♂ 1♀ 20–24.xii.2002 (MA-02-14A-45); 2♂ 24.xii.2002–2.i.2003 (MA-02-14A-46); 2♂ 2♀ 9–23.i.2003 (MA-02-14A-48); 1♂ 1♀ 23.i–4.ii.2003 (MA-02-14A-49); 2♂ 1♀ 4–6.ii.2003 (MA-02-14A-50); 3♂ 2–13.iii.2003 (MA-02-14A-52); 1♂ 23.iii–2.iv.2003 (MA-02-14A-54); 1♂ 1♀ 21–29.iv.2003 (MA-02-14A-57); 1♂ 1♀ 29.iv–7.v.2003 (MA-02-14A-58); 1♀ 1–15.vi.2003 (MA-02-14A-62); 2♀ Beza Mahafaly Reserve, Parcelle II near Bellevue, 23°41.39'S:44°34.53'E, 15.x–10.xi.2001, 180 m, M.E. Irwin, F.D. Parker & R. Harin'Hala, Malaise trap, in spiny forest (MA-02-14B-01); same except: 2♂ 28.xi–4.xii.2001 (MA-02-14B-04); 1♂ 11–18.xii.2001 (MA-02-14B-06); 1♀ 18–25.xii.2001 (MA-02-14B-07); 1♂ 2♀ 25.xii.2001–2.i.2002 (MA-02-14B-08); 1♂ 2–9.i.2002 (MA-02-14B-09); 1♂ 16–18.i.2002 (MA-02-14B-11); 1♀ 18–25.i.2002 (MA-02-14B-12); 1♂ Andohahela National Park, Tsimelamy, Parcelle II, 24°56.21'S:46°37.60'E, 4–11.xi.2002, 180 m, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap, in transitional forest (MA-02-20-03); same except: 1♀ 26.xi–2.xii.2002 (MA-02-20-06); 1♀ 2–9.xii.2002 (MA-02-20-07); 5♂ 2♀ 17–27.xii.2002 (MA-02-20-10); 9♂ 4♀ 6–16.i.2003 (MA-02-20-12); 4♂ 3♀ 16–26.i.2003 (MA-02-20-13); 1♂ 1♀ 26.i–5.ii.2003 (MA-02-20-14); 1♀ 5–15.ii.2003 (MA-02-20-15); 2♂ 2♀ 15–26.ii.2003 (MA-02-20-16); 5♂ 4♂ 26.ii–8.iii.2003 (MA-02-20-17); 7♂ 8–18.iii.2003 (MA-02-20-18); 3♂ 5♀ 18–28.iii.2003 (MA-02-20-19); 1♀ 28.iii–8.iv.2003 (MA-02-20-20); 1♀ 29.vi–10.vii.2003 (MA-02-20-31); 1♂ 10–20.vii.2003 (MA-02-20-32); 1♂ 17–24.viii.2003 (MA-02-20-36); 1♂ 24–31.viii.2003 (MA-02-20-37); 1♂ 1♀ 31.viii–10.ix.2003 (MA-02-20-38); 1♂ 10–21.ix.2003 (MA-02-20-39); 1♂ 21.ix–1.x.2003m (MA-02-20-40); 1♂ 1♀ 30.x–9.xi.2003 (MA-02-20-44); 2♂ 3♀ 30.xi–11.xii.2003 (MA-02-20-47); 1♀ 11–21.xii.2003 (MA-

02-20-48); 1♂ 3♀ 23.xii.2003–5.i.2004 (MA-02-20-50); 1♀ 15–28.i.2004 (MA-02-20-52); 1♂ 28.i–12.ii.2004 (MA-02-20-53); 1♂ 12–23.ii.2004 (MA-02-20-54); 2♂ 1♀ 23.ii–6.iii.2004 (MA-02-20-55); 1♂ Andohahela National Park, Ihazofotsy Parcelle III, 24°49.85'S:46°32.17'E, 2–12.xii.2002, 80 m, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap, in dry spiny forest (MA-02-21-02); same except: 2♂ 26.xii.2002–5.i.2003 (MA-02-21-05); 1♀ 5–15.i.2003 (MA-02-21-06); 1♂ 26.i–3.ii.2003 (MA-02-21-08); 2♂ 29.iii–10.iv.2003 (MA-02-21-14); 2♂ 1♀ 10–21.iv.2003 (MA-02-21-15); 3♂ 7–17.xii.2003 (MA-02-21-41); 1♀ 17–19.xii.2003 (MA-02-21-42); 2♀ 19.xii.2003–3.i.2004 (MA-02-21-43); 1♂ 3–14.i.2004 (MA-02-21-44); 1♂ 14.ii–1.iii.2004 (MA-02-21-47); 3♂ 2–11.iv.2004 (MA-02-21-49); 3♂ 2♂ Sous Prefecture Fort Dauphin, 58 km SW of Fort Dauphin, 8 km NW of Amboasary, Berenty Special Reserve, 25°00.40'S:46°18.20'E, 14–24.iv.2003, 280 ft, Malaise trap, gallery forest, M.E. Irwin & R. Harin'Hala (MG-22-22); same except: 2♂ 25.v–4.vi.2003 (MG-22-26); 1♂ 7–22.viii.2004 (MG-22-54); 5♀ Berenty Special Reserve, 8 km NW Amboasary, 25°00.40'S:46°18.20'E, 25–26.x.2002, 85 m, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap, gallery forest (MA-02-22-01) [1 with right wing detached and glued to card]; same except: 1♂ 6♀ 26.x–2.xi.2002 (MA-02-22-02); 3♂ 6♀ 2–9.xi.2002 (MA-02-22-03); 1♂ 2♀ 9–16.xi.2002 (MA-02-22-04); 5♂ 2♀ 16–23.xi.2002 (MA-02-22-05) [1♂ head missing]; 4♂ 2♀ 23–30.xi.2002 (MA-02-22-06); 3♂ 2♀ 30.xi–7.xii.2002 (MA-02-22-07); 3♂ 3♀ 7–14.xii.2002 (MA-02-22-08); 1♂ 2♀ 16–27.xii.2002 (MA-02-22-10); 5♂ 6♀ 27.xii.2002–7.i.2003 (MA-02-22-11); 2♂ 6♀ 7–17.i.2003 (MA-02-22-12); 2♂ 1♀ 17–26.i.2003 (MA-02-22-13); 3♂ 26.i–5.ii.2003 (MA-02-22-14); 2♀ 5–15.ii.2003 (MA-02-22-15); 2♂ 5♀ 15–25.ii.2003 (MA-02-22-16); 1♀ 25.ii–7.iii.2003 (MA-02-22-17); 1♂ 2♀ 17–24.iii.2003 (MA-02-22-19); 1♂ 1♀ 24.iii–3.iv.2003 (MA-02-22-20); 1♀ 25.v–4.vi.2003 (MA-02-22-26); 1♂ 8–15.xi.2003 (MA-02-22-29); 1♀ 22–30.xi.2003 (MA-02-22-31); 1♀ 4–15.ii.2004 (MA-02-22-39); 2♂ 30.iv–14.v.2004 (MA-02-22-46); 7♂ Berenty Special Reserve, 85 m, 8 km SW of Fort Dauphin, 8 km NW of Amboasary, 25.ii–7.iii.2003, 25°00.40'S:46°18.20'E, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap gallery forest (MA-02-22-17); same except: 4♂ 5–15.ii.2003 (MA-02-22-15); 3♀ Berenty Special Reserve, 8 km NW Amboasary 25°01.26'S:46°18.33'E, 10–19.vi.2003, 35 m, M.E. Irwin, F. Parker & R. Harin'Hala, Malaise trap, spiny forest (MA-02-22A-01); same except: 1♂ 5♀ 8–15.xi.2003 (MA-02-22A-02); 5♂ 5♀ 15–22.xi.2003 (MA-02-22A-03); 2♂ 2♀ 22–30.xi.2003 (MA-02-22A-04); 2♂ 30.xi–7.xii.2003 (MA-02-22A-05); 1♂ 1♀ 14–21.xii.2003 (MA-02-22A-07); 2♂ 21.xii.2003–1.i.2004 (MA-02-22A-08); 1♂ 2–13.i.2004 (MA-02-22A-09); 1♂ 1♀ 13–23.i.2004 (MA-02-22A-10); 1♂ 23.i–4.ii.2004 (MA-02-22A-11); 1♂ 15–28.ii.2004 (MA-02-22A-13); 1♀ 28.ii–24.iii.2004 (MA-02-22A-14); 1♂ 24.iii–4.iv.2004 (MA-02-22A-15); 2♂ 1♀ 4–15.iv.2004 (MA-02-22A-16); 1♀ 15–29.iv.2004 (MA-02-22A-17); 1♀ 11–23.vi.2004 (MA-02-22A-19); 1♀ 4–18.vii.2004 (MA-02-22A-20); 1♂ 1♀ 4–18.vii.2004 (MA-02-22A-21); 4♂ 2♀ 18–31.vii.2004 (MA-02-22A-22); 1♂ 31.vii–15.viii.2004 (MA-02-22A-23); 1♀ 15–29.viii.2004 (MA-02-22A-24); 2♂ 1♀ 8–21.ix.2004 (MA-02-22A-26); 1♂ 21.ix–7.x.2004 (MA-02-22A-27) (all CAS); 3♀ District of Morondava, Beroboka village, 45 km NE of Morondava, 19°58.65'S:4°39.98'E, 30.x–6.xi.2007, Antsaronganjaza dry forest (MG-45A-07); same except: 1♂ 6–14.xii.2007 (MG-45A-12) (all CAS); 1♂ Beroboka village 45 km NE Morondava, 19°58.65'S:4°39.92'E, 30.xi–6.xii.2007, 420 ft, M.E. Irwin & R. Harin'Hala, Malaise trap, Antsarongaza gallery forest (MG-45B-11) [in spirit], BMSA(DNA)#0056 (BMSA). *Fianarantsoa*

Prov.: 1♂ near Isalo National Park, at stream east of Interpretive Center, 22°37.60'S:45°21.49'E, 4–13.v.2002, 750 m, M.E. Irwin & R. Harin'Hala, Malaise trap in open area (MA-02-11A-27); same except: 1♀ 27.v–4.vi.2002 (MA-02-11A-30); 1♀ 10–25.vii.2002 (MA-02-11A-35); 1♀ 22–29.xi.2002 (MA-02-11A-47); 1♂ 17–28.iii.2003 (MA-02-11A-58); 1♂ 28.iii–9.iv.2003 (MA-02-11A-59); 1♀ near Isalo National Park, in dry wash east of Interpretive Center, 22°37.60'S:45°21.49'E, 15.x–9.xi.2001, 885 m, M.E. Irwin, F.D. Parker & R. Harin'Hala, Malaise trap (MA-02-11B-01); same except: 1♀ 16–21.xii.2001 (MA-02-11B-07); 1♀ 21–29.xii.2001 (MA-02-11B-08); 2♂ 13–19.i.2002 (MA-02-11B-11); 1♂ 3–10.ii.2002 (MA-02-11B-14); 1♀ 17–24.ii.2002 (MA-02-11B-16); 1♀ 30.iii–7.iv.2002 (MA-02-11B-22); 1♀ 7–15.iv.2002 (MA-02-11B-23); 1♂ 4–13.v.2002 (MA-02-11B-27); 1♀ 13–20.v.2002 (MA-02-11B-28); 1♀ 20–27.v.2002 (MA-02-11B-29); 1♀ 25.vii–9.viii.2002 (MA-02-11B-36); 1♀ 23.viii–7.ix.2002 (MA-02-11B-38); 1♂ 22.ix–3.x.2002 (MA-02-11B-40); 1♂ 14–22.xii.2002 (MA-02-11B-50); 1♀ 28.iii–9.iv.2003 (MA-02-11B-60). *Majunga Prov.*: 1♂ Ampijoroa National Park, 160 km N of Maevatanana on RN 04, 16°19.16'S:46°48.80'E, 9–20.xi.2003, 43 m, M.E. Irwin & R. Harin'Hala, Malaise trap in deciduous forest (MA-25-23) [in spirit], BMSA(DNA)#0057 (BMSA); same except: 1♂ 19–26.x.2003 (MA-25-20) (CAS).

Distribution (Fig. 3.3: 104): Widely distributed in five vegetation types (3.3: Appendix II), in the Dry Spiny Bush and Dry Deciduous Forest biomes. In the North West, West and South biogeographical zones and Dry and Subarid bioclimatic zones (Figs 3.3: 105–107; 3.3: Tables 1–3).

Curtonotum sternithrix Tsacas, 1974

Figs 3.3: 3, 16, 29, 42, 45, 48, 86, 94

Curtonotum sternithrix: Tsacas, 1974: 708; figs 3a–e (p. 709), fig. 8e (p. 718). Type locality: “Madagascar Est, Antanambe”.

Redescription: Male (primarily based on field-pinned HT and PT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 5.6 mm; length of head and thorax combined 3.8 mm; length of thorax and scutellum combined 3.1 mm; wing length 4.6 mm.

Head (Figs 3.3: 3, 16). Eye height/length ratio: 15:9 ($n = 1$, HT); frons (Fig. 3.3: 16), markedly produced (Fig. 3.3: 3), parallel-sided, frons length/width ratio: 18:21 ($n = 1$, HT), ground colour uniform dark brown, faintly paler medially and in

region of ventral margin, lacking any trace of vittae, surface with a few minute pale to dark brown setulae; orbital plates and ocellar triangle golden-silver-grey pruinose, orbital plates and ocellar triangle extremely short, the former extending less than $\frac{1}{2}$ length of frons, lateral margins with moderately wide, sharply-contrasting, silver pruinose fascia (adjacent to eye margin), widest at antennal insertions; anterior orbital seta strong, *ca.* $\frac{2}{3}$ length of ocellar setae; ocellar setae short, only reaching *ca.* $\frac{2}{3}$ length of frons; flagellomere 1 brown, silver-grey pruinose, yellow-brown basally, moderately short, *ca.* twice as long as wide, apex squarely rounded, arista with 11 or 12 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; lunule and face uniform silver pruinose throughout, face with extremely broad silver fascia (adjacent to eye margin), not contrasting markedly with face, facial carina developed as a prominent ridge; 1 pair of moderately weak vibrissae; occiput with strong, black postocular setae; gena wide, eye height/genal height ratio: 1:10 ($n = 1$, HT), silver pruinose, abruptly dirty brown beyond basal angle; palpus narrow, yellow-brown, black microtrichose.

Thorax (Fig. 3.3: 3). All setae on thorax with prominent dark red ring around each socket, markedly so on mesonotum; mesonotum brown, silver-grey pruinose, with two poorly defined narrow chestnut-brown pruinose vittae; anterior dorsocentral seta much shorter and finer (*ca.* $\frac{1}{2}$ length of medial scutellar seta); presutural seta moderately strong, longer and stronger than posterior notopleural seta; postalar setae shorter and finer than acrostichal setae; postpronotum with 3 strong postpronotal setae, the more dorsal longer and reclinate, the medial and ventral shorter and proclinate, with 12–14 finer setulae; anepisternum with more ventral anepisternal setae reclinate, surface with 34 moderately long setulae, those between anepisternal setae longer; ventral katepisternal seta very long and strong, dorsal strong, over $\frac{1}{2}$ length of ventral, with 22 short, fine setulae at base and along posterior margin.

Scutellum. Golden-brown pruinose, darker than mesonotum, without medial brown pruinose vitta basally, apical margin yellow pruinose; 1 weak basal scutellar setula and 2 weak intermediate scutellar setula, the more medial inserted at four-fifths distance between medial and lateral scutellar setae.

Legs. Fore coxa with 21 brown setulae; femora, tibia and tarsi slightly reddish-yellow; tibia darker reddish apically; fore tibia with 4 strong setae on lateral margin,

the second basal seta same length as first basal, with ctenidium of 10–13 long, sharp black spinules, separated from each other by two or more basal spinule widths.

Wing (as in Fig. 3.3: 29). Long and narrow, especially *cua*₁ and *m* cells, tip evenly-rounded, veins chestnut-brown, membrane deep infusate brown throughout, darker in *r*₁ and anterior ½ of *r*₂₊₃ and in region of *dm-cu* crossvein; *dm-cu* crossvein sub-vertical, with slight curvature posteriorly; halter dirty yellow.

Abdomen. Ground colour of tergites 1–5 reddish-yellow to grey pruinose, silver pruinose laterally and at apical margins of tergites; tergite 1 with small, oblique black-brown macula laterally and concolourous medial fascia, these merging slightly at apical margin; tergites 2–5 with extremely broad V-shaped, black median fascia and extensive, concolourous, T-shaped dorsolateral macula, all extensively merging with medial fascia; lateral margin of tergites 2–5 with large, subrectangular, concolourous macula in basal ½ to ⅔; sternite 4 (Fig. 3.3: 86), modified, quadrate, evenly rounded apically and laterally, with comb of 16 long, thick, black-brown spinules on apical margin, surface with sparse irregular brown setae; sternite 5 (Fig. 3.3: 86), modified, ovoid, grossly expanded laterally, with raised sub-medial area in apical ⅓, bearing batch of short regular spines arranged in an arc, each side with comb of eight long, thick, black-brown, apically-directed spines, spinose region with faint brown macula, surface with short setae arranged in irregular rows; sternite 6 (Fig. 3.3: 86) narrow at base, laterally expanded (may appear narrower than Fig. 3.3: 86 in undissected specimens), with deep and broad, V-shaped excision apically, with faint brown maculae medially and fascia laterally, merging apically, clothed in very short, irregular black-brown setulae for most of length, those at apical margin slightly longer and more prominent.

Terminalia (Figs 3.3: 42, 45, 48). Hypandrium (Fig. 3.3: 42, *hy*) long, with broad-based rounded-angulate dorsobasal lobes; posterior bridge dorsally and ventrally produced (angulate in profile); hypandrial arms broad basally, narrowed apically (viewed laterally), with 2 setulae proximal to postgonite, the more lateral ventrally directed, the medial ventro-medially directed (obscured by epandrium on Fig. 3.3: 42), sclerotised area of medial lobes (viewed dorsally), narrow basally and apically, medially expanded and semicircular, here slightly overlapping (not convex); postgonite (obscured by surstylus on Fig. 3.3: 42) long, thin and straight, with slight undulating anterior margin; epandrium (Fig. 3.3: 42, *ep*) diminutive in proportion to

hypandrium, slightly longer than broad (viewed laterally), evenly-rounded on dorsal margin, ventral margin markedly indented, here glabrous, with extensive row of long regular to irregular, apically-directed setae along ventro-apical margin; cercus (Fig. 3.3: 42, *ce*) not prominent, longest setae not exceeding longest setae at ventro-apical margin of epandrium; surstylus (Fig. 3.3: 42, *ss*) very long and narrow, widest basally, slightly curved in apical $\frac{2}{3}$; phallus (as in Figs 3.3: 45, *ph*, *bp*, *dp*, 48, *bp*, *dp*) C-shaped, strongly sclerotised, brown; phallapodeme (Fig. 3.3: 45, *ph*) fused to basiphallus, basal portion produced and rounded (viewed laterally), with basal margin developed into two extensive, very broad, flat projections in basal $\frac{2}{3}$, bifurcated, broad and dovetailed at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 45, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.3: 45, *bp*) wide in basal $\frac{1}{2}$, expanded at junction of basiphallus and distiphallus, here with extensive mat of long, translucent, finger-like, overlapping spinules that continue on baso-ventral surface of distiphallus; apical section (Fig. 3.3: 48, *bp*) broad, right lateral margin divided, forming even projection apically; distiphallus (Figs 3.3: 45, 48, *dp*) extremely long and broad, with extensive membranous area, left lateral margin with membranous fold, clothed in short wart-like spinules, sclerotised area subdivided basally and medially with extensive membranous window, and conspicuous tuft of hairs submedially (viewed laterally).

Variation: Insufficient material is available to assess variability.

Differential diagnosis: Not closely related to any other species occurring on Madagascar. It exhibits a number of distinctive features, including the presence of three, rather than two, strong humeral setae, and is the only Afrotropical species described to date with conspicuous brown rings around the sockets of the thoracic setae. The abdominal sternites and phallus are highly modified and distinctive. Interpretation of its relationship to other species on the continental Afrotropical Region must await the outcome of a detailed phylogenetic analysis.

Type material examined. Holotype: ♂ MADAGASCAR: “Madagascar Est / Antanambé 8m / 1.IV.[19]58 / B. Stuckenberg // HOLOTYPE [red card] // CURTONOTUM / *sternithrix* / Holotype ♂ n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* / *sternithrix* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008” (MNHN). In excellent condition, left wing detached

and glued to mount; re-staged on nu-poly mount; not dissected. Paratypes (all labelled: “*Curtonotum / sternithrix* ♂ [or ♀] / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008”): MADAGASCAR: 1♀ “Manambato / (Anove) // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // COM. INST. ENT. / COLL. NO14644 // ALLOTYPE [red card] // CURTONOTUM / *sternithrix* / Allotype ♀ n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS” [left wing detached and glued to card] (MNHN). 1♂ “Manambato / (Anove) // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // PARATYPE [red card] // CURTONOTUM / *sternithrix* / paratype ♂ n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // à renvoyer à / Stuckenberg à le / place du le Holotype / unique ici L. Tsacas 1975” (NMSA).

Distribution (Fig. 3.3: 94): Occurring in Plateau Grassland-Wooded Grassland Mosaic and Degraded Humid Forest vegetation types, in the Evergreen Rainforest biome. In the Northern Central East and South East biogeographical zones and Humid bioclimatic zone (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II). Stuckenberg’s specimen label refers to site 28 in his unpublished report of his second Madagascan Expedition (1957–1958) (Kirk-Spriggs 2012). The entry for 1 April 1958 reads: “(28) ANTANAMBE – night stop and some collecting.”

Curtonotum stuckenbergi Tsacas, 1974

Figs 3.3: 2, 15, 28, 41, 44, 47, 80, 93

Curtonotum stuckenbergi: Tsacas, 1974: 705; figs 2a–d (p. 707), fig. 8g (p. 718). Type locality: “Madagascar, Ambohitantely”.

Redescription: Male (primarily based on field-pinned HT and PT).

As redescribed for *C. balachowskyi*, differing in the following respects:

Measurements: Overall length 8 mm (Tsacas 1974: 706); length of head and thorax combined 2.9 mm; length of thorax and scutellum combined 3.5 mm ($n = 1$, HT); wing length 5.7 mm ($n = 1$, PT).

Head (Figs 3.3: 2, 15). Eye height/length ratio: 12:8 ($n = 1$, HT); frons (Fig. 3.3: 15), frons length/width ratio: 7:8 ($n = 1$, HT), orbital plates extending 0.8 length of frons; posterior orbital seta moderately strong, slightly shorter than outer vertical seta; flagellomere 1 yellow pruinose basally, otherwise grey pruinose throughout,

arista with 7–8 long dorsal branches and 3 ventral branches in addition to terminal fork; gena narrow, eye height/genal height ratio: 12:1 ($n = 1$, HT), silver pruinose, slightly darker beyond basal angle; vibrissae weakly developed; palpus pale brown.

Thorax (Fig. 3.3: 2). Mesonotum with the 2 median vittae narrow, 2 lateral vittae shorter, clearly defined; supra-alar seta, *ca.* twice length of posterior dorsocentral seta; postalar setae, moderately strong, slightly exceeding length of acrostichal setae; postpronotum with 11 finer black-brown setulae; anepisternum with 15 fine setulae, some larger and arranged in 2 groups of 2 and 3; anepimeron, laterotergite and meron silver-grey to yellow-grey pruinose; katepisternum silver-grey to yellow-grey pruinose, dorsal katepisternal seta very fine and short, *ca.* 0.1 length of ventral katepisternal seta, with 13 short, fine setulae at base and along posterior margin.

Scutellum. As described for *C. gladiiformis* sp. n.

Legs. Fore coxa with 8 brown setulae on anterior surface; mid-coxa with 8 brown setulae; fore tibia with ctenidium of 12 short, sharp black spinules.

Wing (as in Fig. 3.3: 28). Long and broad, tip evenly rounded, veins chestnut-brown, membrane deep-brown infusate throughout, darker in r_1 and anterior $\frac{1}{2}$ of r_{2+3} and in region of $dm-cu$ crossvein; $dm-cu$ crossvein obliquely angled and moderately straight; halter dirty yellow.

Abdomen. Abdominal tergites as described for *C. keiseri*; sternites 4–5 as described for *C. coronaeformis* sp. n.; sternite 6 (Fig. 3.3: 80) dove-tailed (may appear narrower than Fig. 3.3: 80 in undissected specimens), markedly narrowed basally, widened laterally, with deep triangular excision apically, apical lobes squarely rounded, with dark brown maculae laterally, clothed in short, irregular brown setulae in apical $\frac{2}{3}$, those at lateral and apical margins longer and more prominent.

Terminalia (Figs 3.3: 41, 44, 47). Hypandrium (Fig. 3.3: 41, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (subtriangular to slightly angulate in profile); hypandrial arm constricted medially (viewed laterally), with 2 parallel setulae proximal to postgonite of similar length (obscured by epandrium on Fig. 3.3: 41), sclerotised area of medial lobes (viewed dorsally), with margins evenly rounded, convex medially, closely abutting, overlapping; postgonite (Fig. 3.3: 41, *pg*) long, thin and straight, with slight

undulating anterior margin; epandrium (Fig. 3.3: 41, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long regular to irregular, apically-directed setae; cercus (Fig. 3.3: 41, *ce*) not prominent, longest setae longer than setae on dorsal margin of epandrium; surstylus (Fig. 3.3: 41, *ss*) moderately short, widest basally, slightly curved in apical $\frac{2}{3}$; phallus (as in Figs 3.3: 44, *ph*, *bp*, *dp*, 47, *bp*, *dp*) C-shaped, heavily sclerotised, especially lateral margins of apical section of basiphallus (viewed dorsally), dark brown; phallapodeme (Fig. 3.3: 44, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two large, flat and broad, subtriangular projections in basal $\frac{2}{3}$, widely bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.3: 44, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.3: 44, *bp*) broad basally and in region of first bend, then narrowed to apex, markedly narrowed in apical third (viewed dorsally); apical section (Figs 3.3: 44, 47, *bp*) very broad basally, with evenly-rounded lateral margins, sclerotised area extensive, abruptly narrowed towards apex, basal section with large membranous window, with one very strong, thick, straight, ventrally-directed lateral spine (indicated with arrow on Fig. 3.3: 47) and two smaller spines, positioned in left and right baso-lateral regions, membranous lateral extension with extensive series of small tubules.

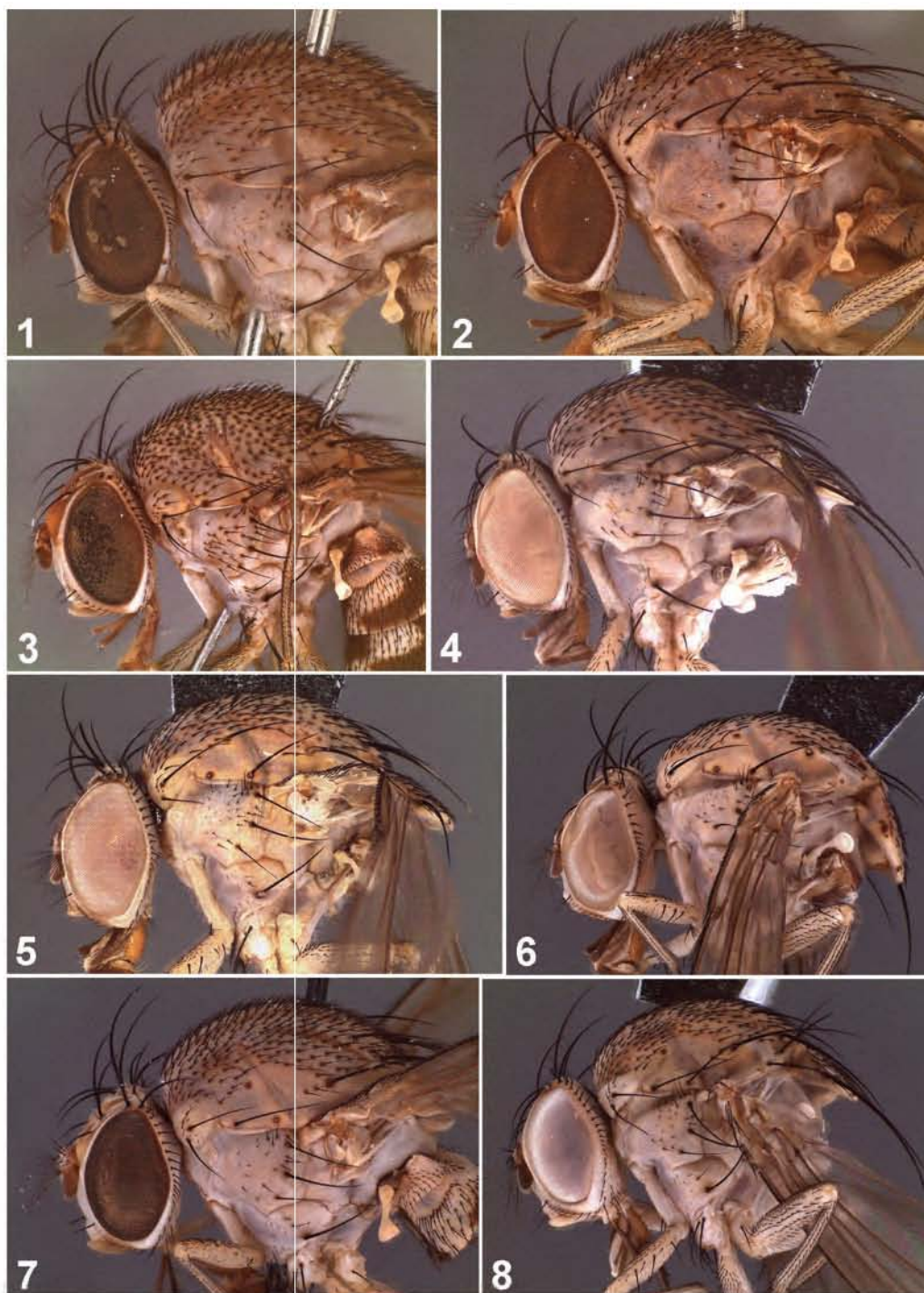
Variation: Insufficient material is available to assess variability.

Differential diagnosis: This species is closely related to *C. keiseri*, differing in the colour of the frons (yellow with indistinct vittae in *C. stuckenbergi* and brown with distinct vittae in *C. keiseri*), the colour of flagellomere 1, and in the shape of the male terminalia. Both share the deep brown, infuscate wing membrane, the dovetailed sternite 6, and straight, ventrally-directed lateral spine and two smaller spines on the distiphallus. *Curtonotum stuckenbergi* differs from *C. keiseri*, however, in the angle and degree of curvature of the *dm-cu* crossvein of the wing, in having the lateral margins of the phallus heavily-sclerotised and the smaller spines of the distiphallus positioned in the left and right lateral regions, rather than baso-laterally. The ranges of the two species do not overlap, and they occur allopatrically.

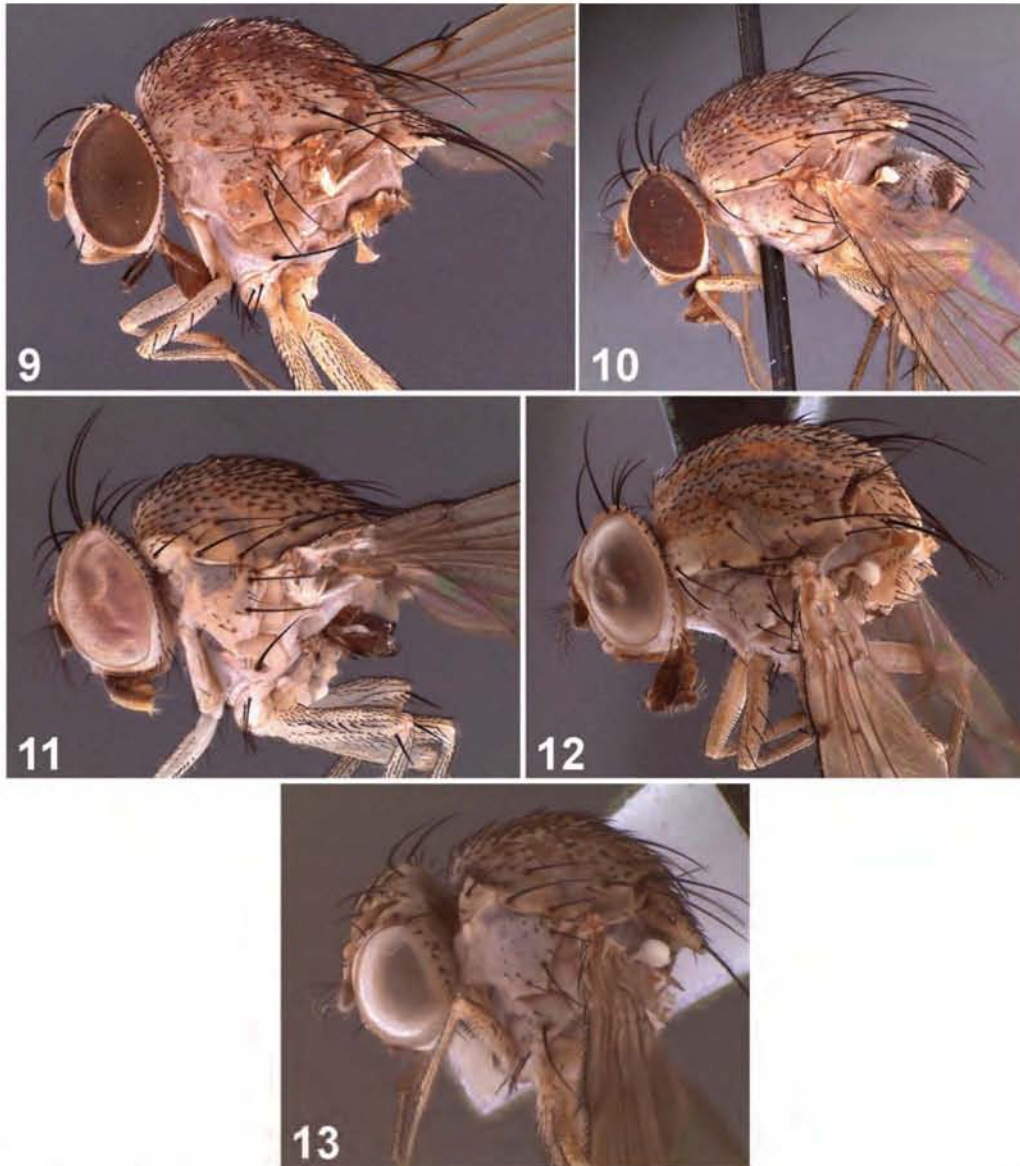
Type material examined. Holotype: ♂ MADAGASCAR: “Madagascar Centre / Ambohitantely 1600m / dct Ankazobe / B. Stuckenberg // 6.i.[19]58 [type-written; white paper] // HOLOTYPE [red card] // CURTONOTUM / *stuckenbergi* / Holotype n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* ♂ / *stuckenbergi* Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008” (MNHN). In excellent condition; re-staged on nu-poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratype (labelled: “*Curtonotum* ♂ / *stuckenbergi* Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2008”): MADAGASCAR: 1♀ “MADAGASCAR Tan. / Ambohitantely / 10.VI.[19]58 F.KEISER [pink paper] // ALLOTYPE [red card] // CURTONOTUM / *stuckenbergi* / Allotype n.sp. / L. TSACAS DET. 1973 [printed & handwritten]” [left right wing detached and glued to card] (NHMB).

Remarks: Tsacas (1974: 706) notes “10-v-1958” as the date of capture of the allotype ♀; in truth the label reads “10.VI.58.”

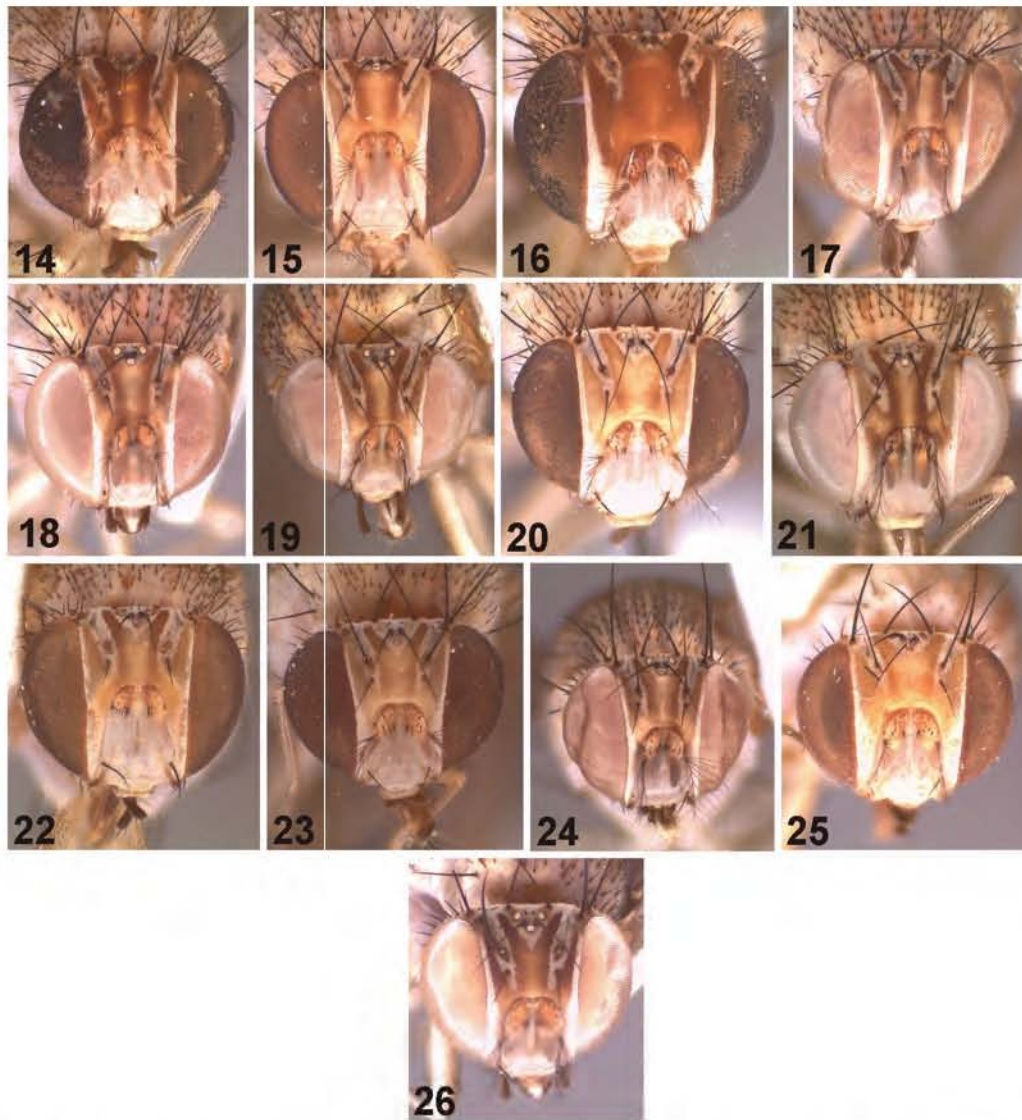
Distribution (Fig. 3.3: 93): Apparently confined to the Humid Forest vegetation type in the Central Highlands biome. In the Central biogeographical zone and Subhumid bioclimatic zone (Figs 3.3: 105–107; 3.3: Tables 1–3; 3.3: Appendix II). The description of this species is based on two specimens collected at the same locality; one by Brian Stuckenberg in January and one by “Fred” Keiser in June 1958. “Ambohitantely” as listed on Stuckenberg’s specimen labels refers to site 7 in his unpublished report of his second Madagascan Expedition (1957–1958) (Kirk-Spriggs 2012). The entry for 6 January 1958 reads: “(7) AMBOHITANTELY FOREST, ANKAZOBE DIST. – by car, approx. 120 kms. N.-W. of Tananarive, a residual patch of forest in savannah country of fair relief. Numerous small patches of forest in the vicinity suggest that the whole area was once forested and has recently been denuded. A number of peculiar species taken.”



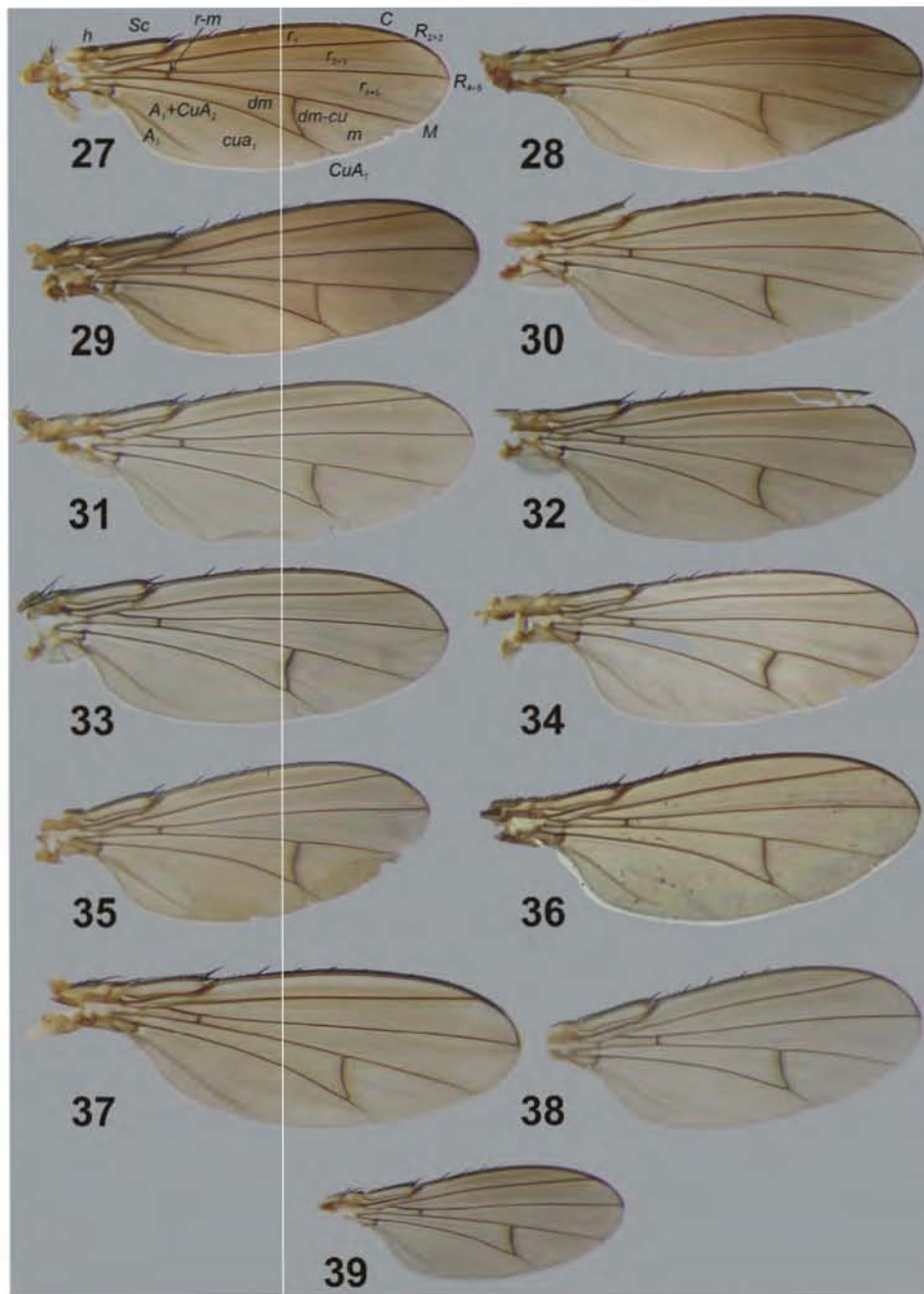
Figs 3.3: 1–8. Head and thorax: (lateral view) of *Curtonotum* spp. (males). 1, *C. keiseri* (PT, Mtge. D'Ambre, NHMB); 2, *C. stuckenbergi* (HT, Ambohitantely, NMHN); 3, *C. sternithrix* (HT, Antananambe, MNHN); 4, *C. irwini* sp. n. (PT, Zombitse National Park, CAS); 5, *C. parkeri* sp. n. (PT, same, CAS); 6, *C. coroneiformis* sp. n. (PT, near Isalo National Park, CAS); 7, *C. balachowskyi* (HT, Fia Mananjary, MNHN); 8, *C. gladiiformis* sp. n. (HT, Fianarantsoa, CAS). Not to scale.



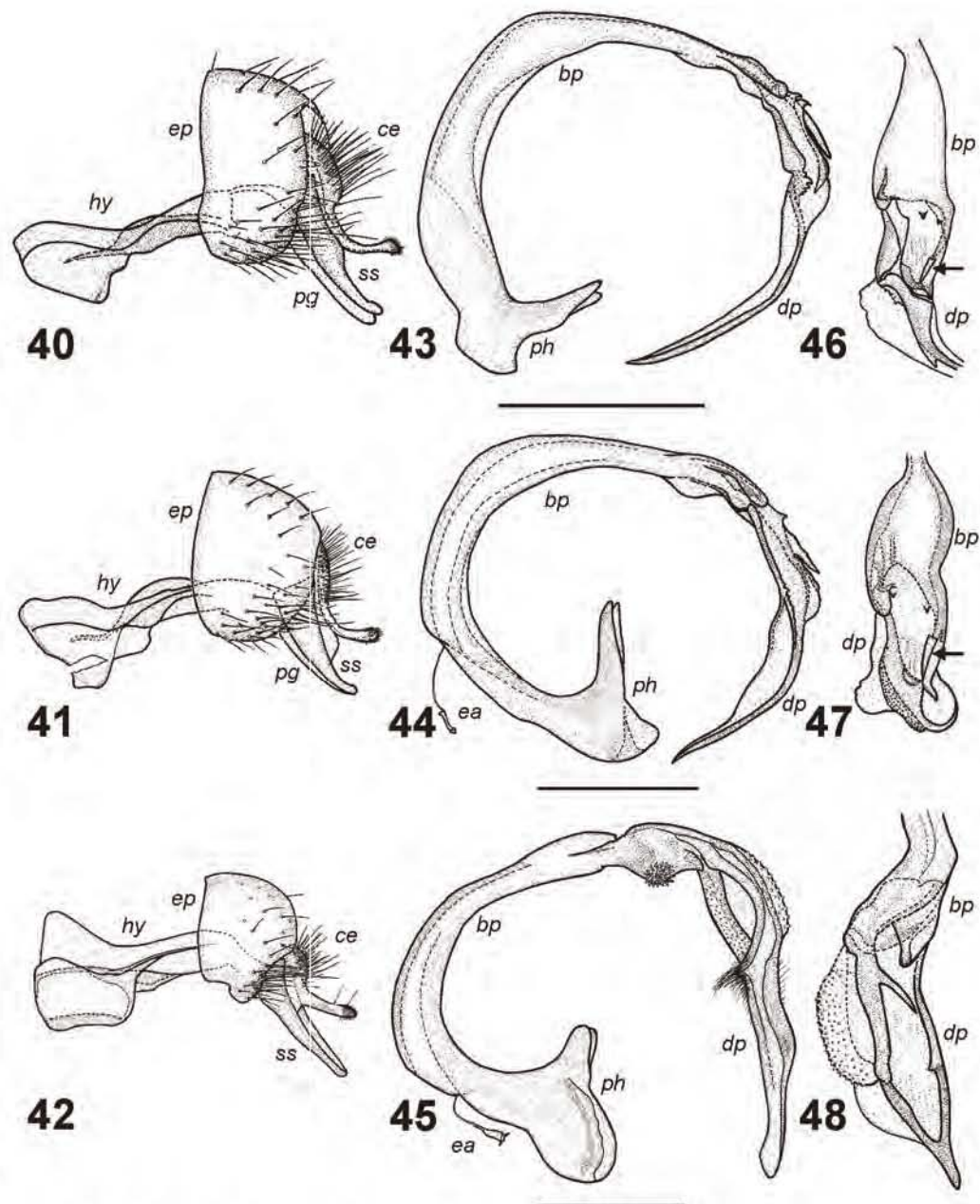
Figs 3.3: 9–13. Head and thorax (lateral view) of *Curtonotum* spp. (males). **9**, *C. rinhatinana* sp. n. (HT, Ankarafantsika, CAS); **10**, *C. boeny* (HT, Ambato-Boeni, MNHN); **11**, *C. griveaudi* sp. n. (HT, Asondrodava dry forest, CAS); **12**, *C. pauliani* (N-T, Tsingy National Park, CAS); **13**, *C. sakalava* (N-T, Berenty Special Reserve, CAS). Not to scale.



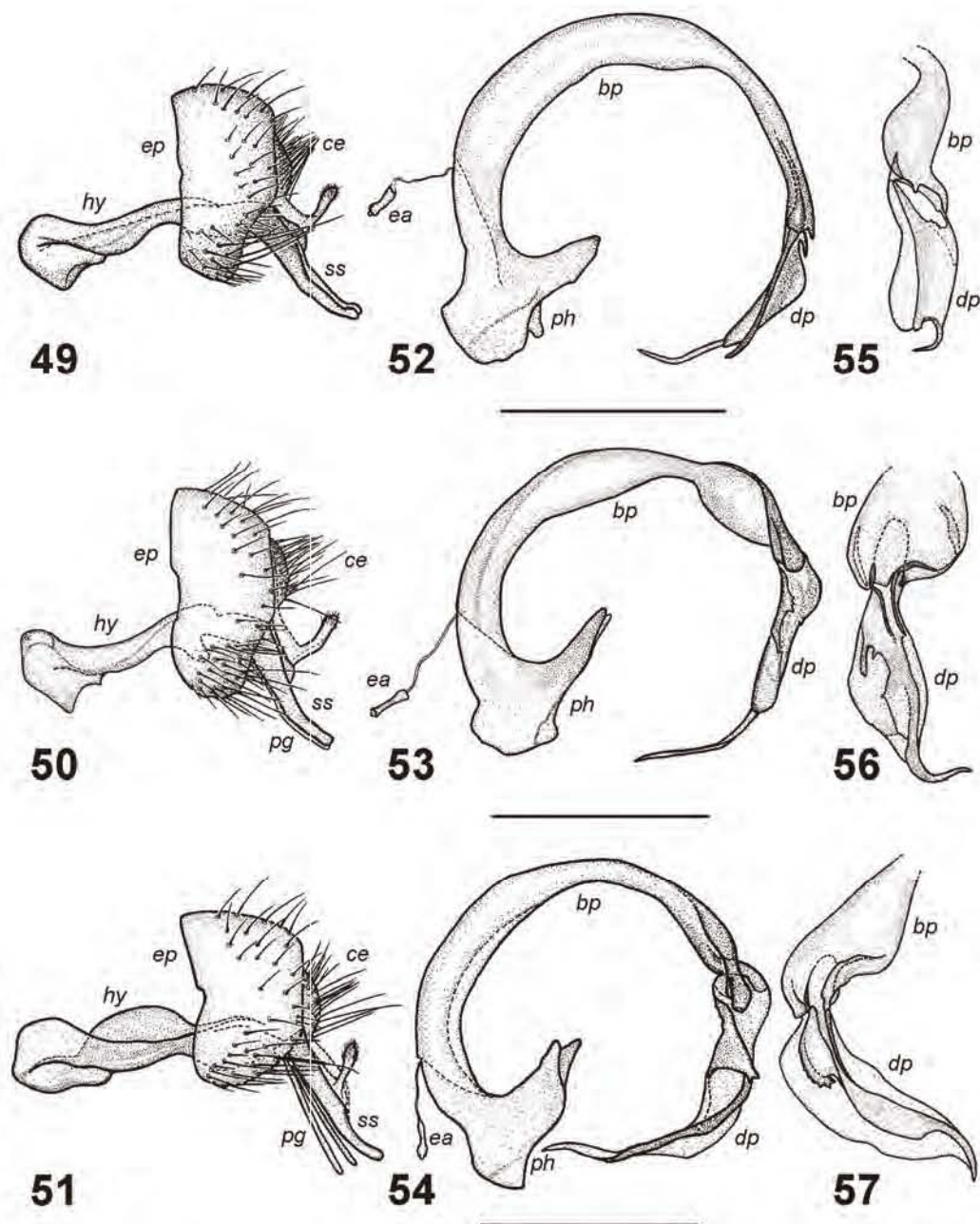
Figs 3.3: 14–26. Frons (dorsal view) of *Curtonotum* spp. (males). **14**, *C. keiseri* (PT, Mtge. D'Ambre, NHMB); **15**, *C. stuckenbergi* (HT, Ambohitantely, MNHN); **16**, *C. sternithrix* (HT, Antanambe, MNHN); **17**, *C. irwini* sp. n. (HT, Zombitse National Park, CAS); **18**, *C. parkeri* sp. n. (HT, same, CAS); **19**, *C. coroneiformis* sp. n. (HT, Fianarantsoa, CAS); **20**, *C. balachowskyi* (HT, Fia Mananjary, MNHN); **21**, *C. gladiiformis* sp. n. (HT, Fianarantsoa, CAS); **22**, *C. rinhatinana* sp. n. (HT, Ankarafantsika, CAS); **23**, *C. boeny* (HT, Ambato-Boeni, MNHN); **24**, *C. griveaudi* sp. n. (HT, Asondrodava dry forest, CAS); **25**, *C. pauliani* (N-T, Ankarafantsika, CAS); **26**, *C. sakalava* (N-T, Andohahela National Park, CAS). Not to scale.



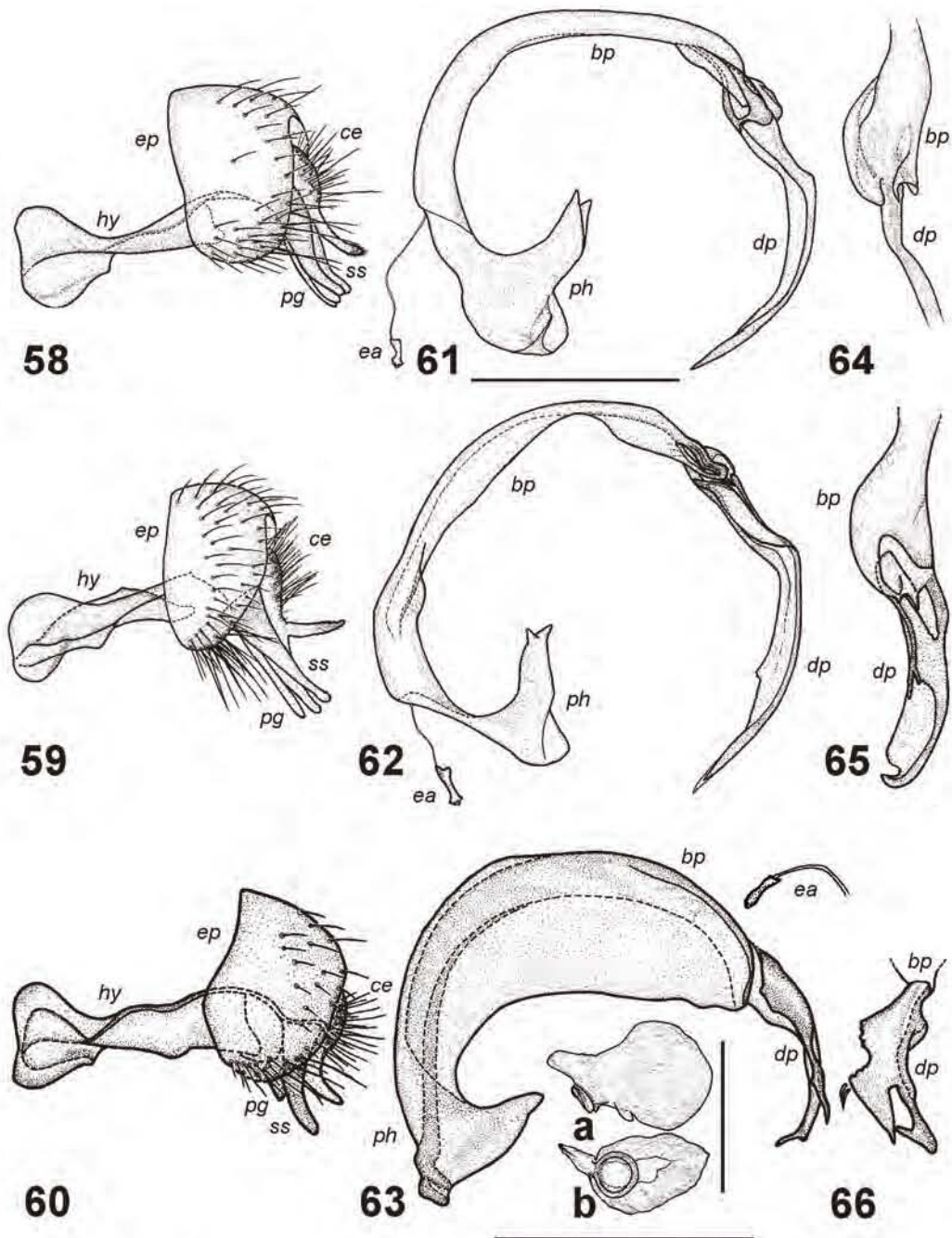
Figs 3.3: 27–39. Wing of *Curtonotum* spp. (males, unless otherwise stated). 27, *C. keiseri* (N-T, Joffreville, TAU); 28, *C. stuckenbergi* (♀ AT, Ambohitantely, NMSA); 29, *C. sternithrix* (PT, Manambato, NMSA); 30, *C. irwini* sp. n. (PT, Zombitse National Park, CAS); 31, *C. parkeri* sp. n. (HT, same, CAS); 32, *C. coroneiformis* sp. n. (PT, near Isalo National Park, CAS); 33, *C. balachowskyi* (N-T, Asondrodava dry forest, CAS); 34, *C. gladiiformis* sp. n. (PT, near Isalo National Park, CAS); 35, *C. rinhatinana* sp. n. (HT, Ankarafantsika, CAS); 36, *C. boeny* (♀ PT, Ambata-Boeni, MNHN); 37, *C. griveaudi* sp. n. (N-T, Sambava Beach, TAU); 38, *C. pauliani* (N-T, Tsingy National Park, CAS); 39, *C. sakalava* (N-T, Berenty Special Reserve, CAS). Not to scale.



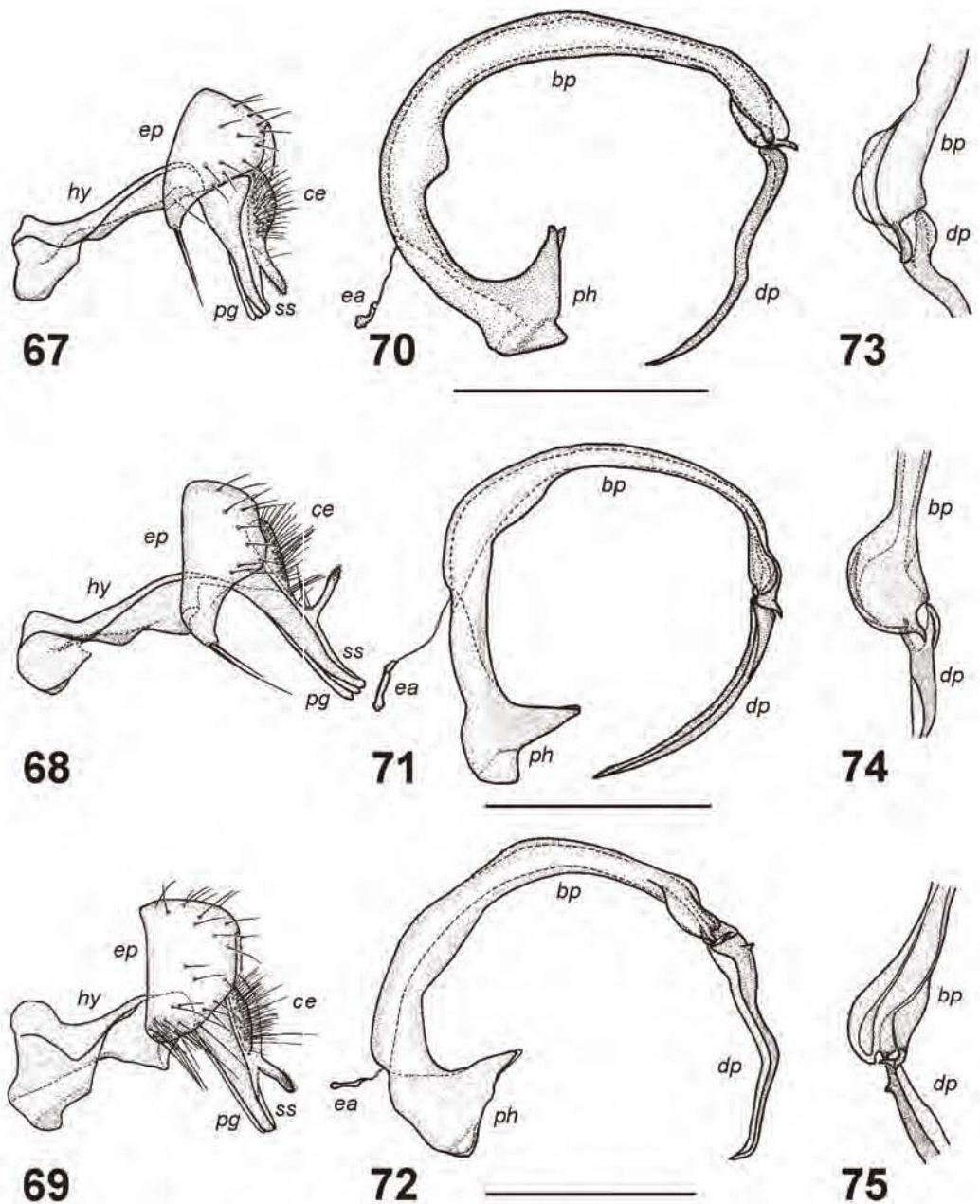
Figs 3.3: 40–48. Male terminalia of *Curtonotum* spp. **40–42:** Hypandrium and epandrium, lateral view: **40**, *C. keiseri* (N-T, Ambohitra, TAU); **41**, *C. stuckenbergi* (HT, Ambohitantely, NMHN); **42**, *C. sternithrix* (PT, Manambato, MNHN). **43–45:** Phallus, right lateral view: **43**, *C. keiseri*, ejaculatory apodeme missing; **44**, *C. stuckenbergi*; **45**, *C. sternithrix*. **46–48:** Basiphallus and distiphallus junction, dorsal view: **46**, *C. keiseri*, ventrally-directed lateral spine indicated with arrow; **47**, *C. stuckenbergi*, ventrally-directed lateral spine indicated with arrow; **48**, *C. sternithrix*. Scale bars = 0.5 mm.



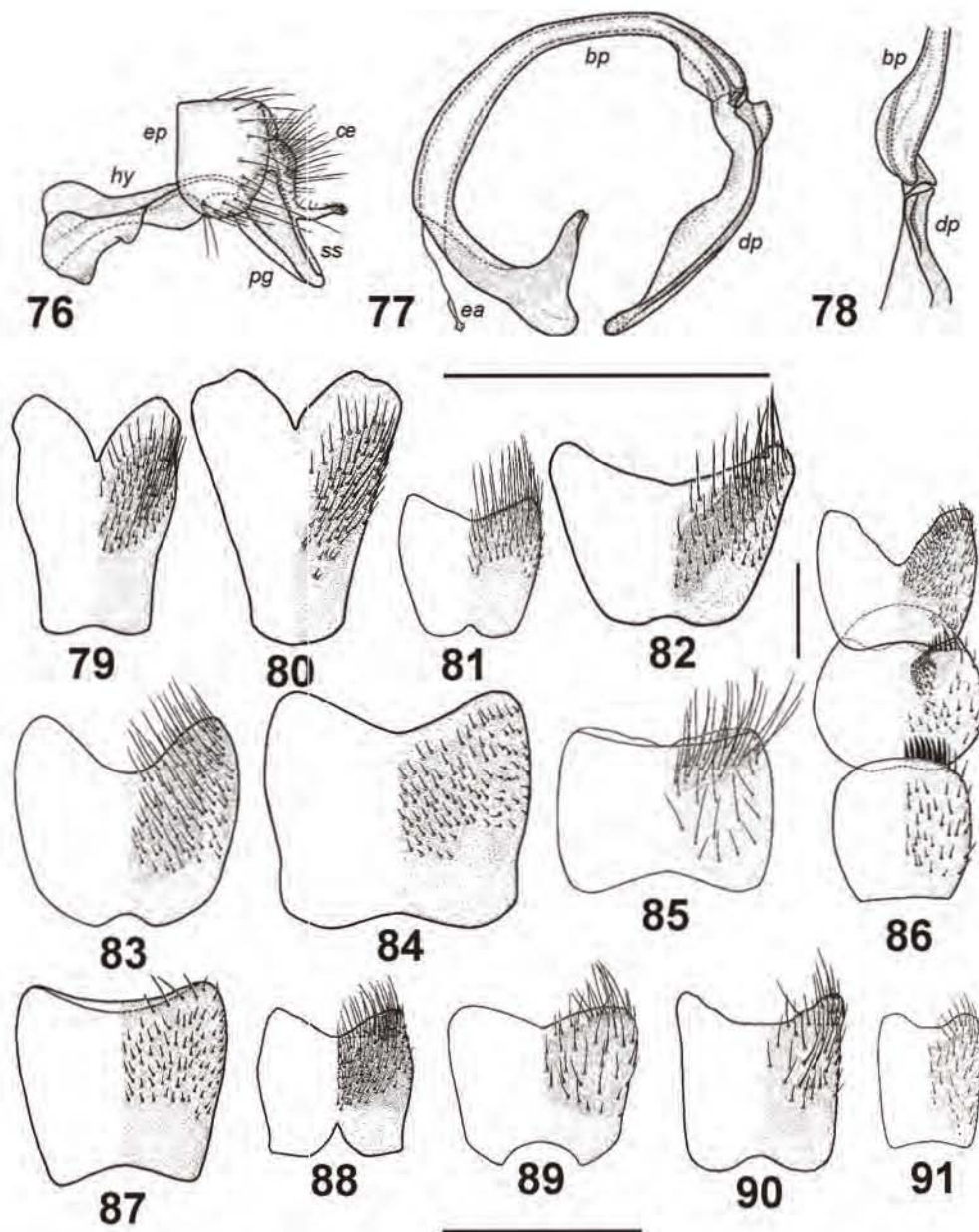
Figs 3.3: 49–57. Male terminalia of *Curtonotum* spp. **49–51:** Hypandrium and epandrium, lateral view; **49**, *C. irwini* sp. n. (HT, Zombitse National Park, CAS); **50**, *C. parkeri* sp. n. (PT, same, CAS); **51**, *C. coroneiformis* sp. n. (HT, Fianarantsoa, CAS). **52–54:** Phallus, right lateral view: **52**, *C. irwini*; **53**, *C. parkeri*; **54**, *C. coroneiformis*. **55–57:** Basiphallus and distiphallus junction, dorsal view: **55**, *C. irwini*; **56**, *C. parkeri*; **57**, *C. coroneiformis*. Scale bars = 0.5 mm.



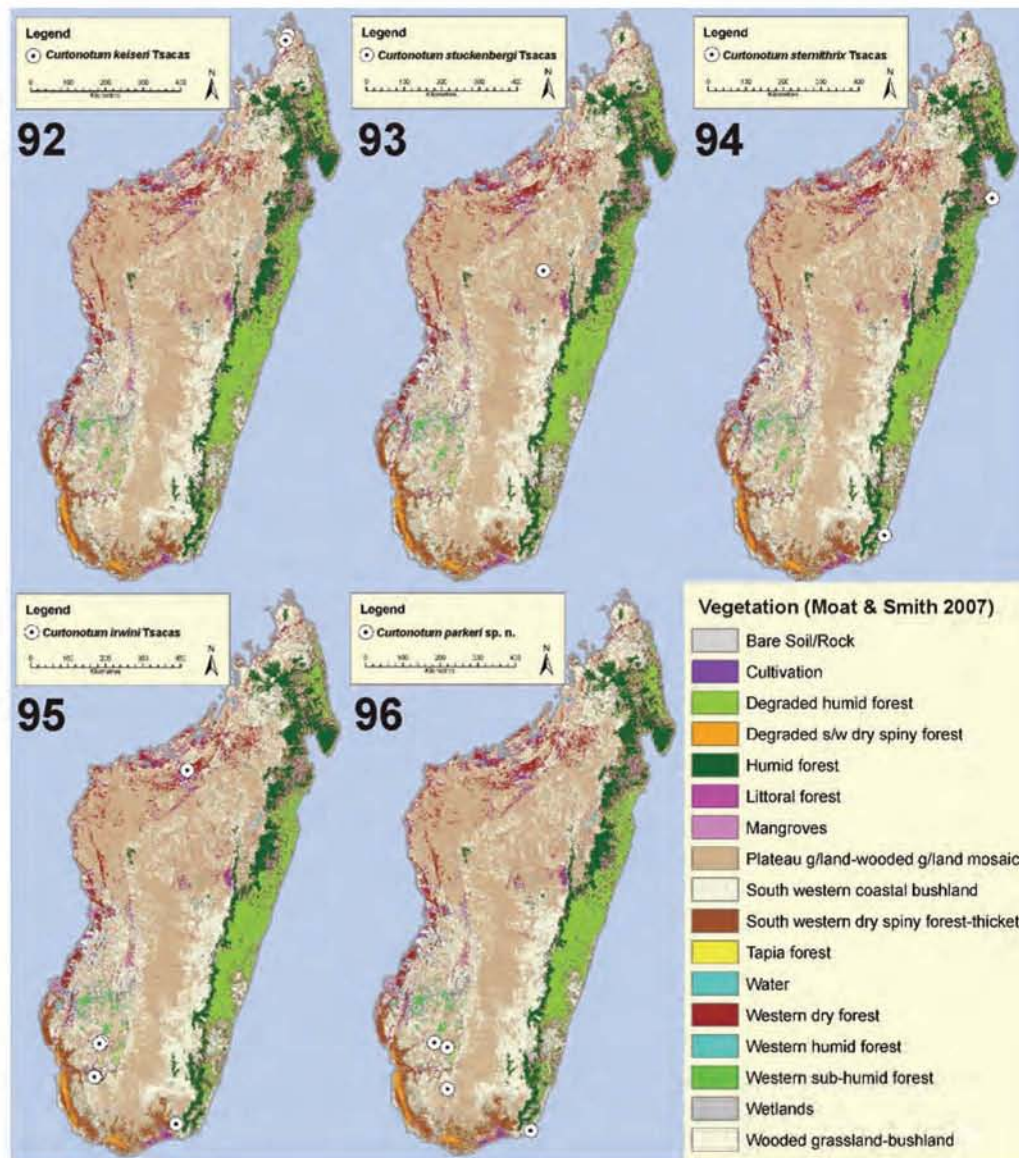
Figs 3.3: 58–66. Male terminalia of *Curtonotum* spp. **58–60:** Hypandrium and epandrium, lateral view: **58**, *C. balachowskyi* (N-T, Fianarantsoa, CAS); **59**, *C. gladiiformis* sp. n. (PT, same, CAS); **60**, *C. rinhatinana* sp. n. (HT, Ankarafantsika, CAS). **61–63:** Phallus, right lateral view: **61**, *C. balachowskyi* (HT, Mananjary, MNHN); **62**, *C. gladiiformis* (HT, Fianarantsoa, CAS); **63**, *C. rinhatinana*, ejaculatory apodeme detached during dissection, but probably normally inserted at junction of phallapodeme and basiaphallus; **63a**, *C. rinhatinana*, sperm pump, lateral view; **63b**, *C. rinhatinana*, sperm pump, ? ventral view. **64–66:** Basiphallus and distiphallus junction, dorsal view: **64**, *C. balachowskyi*; **65**, *C. gladiiformis*; **66**, *C. rinhatinana*. Scale bars = 0.5 mm.



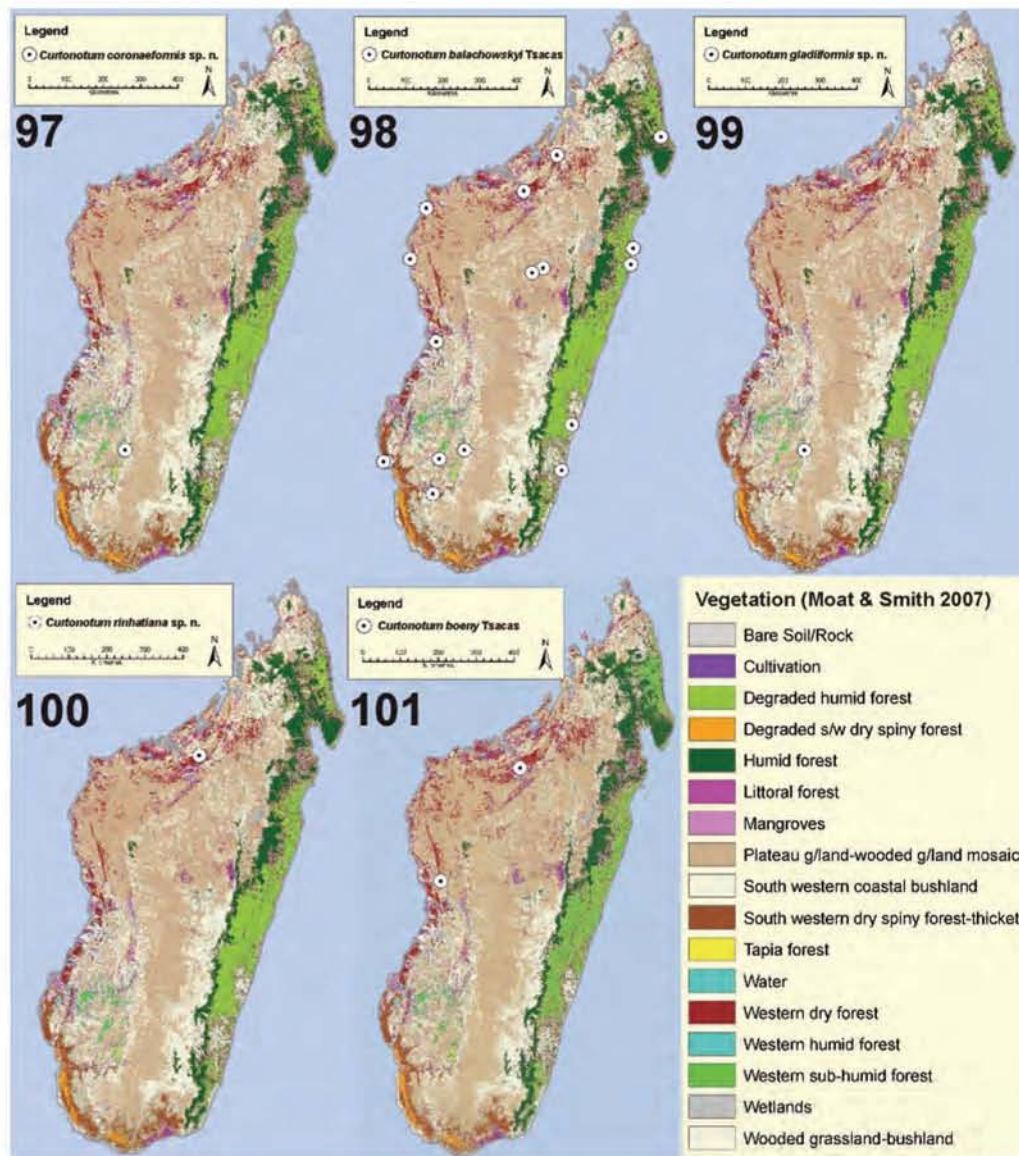
Figs 3.3: 67–75. Male terminalia of *Curtonotum* spp. 67–69: Hypandrium and epandrium, lateral view: 67, *C. boeny* (N-T, E. Bekopaka, CAS); 68, *C. griveaudi* sp. n. (PT, Asondrodava, CAS); 69, *C. pauliani* (N-T, E. Bekopaka, CAS). 70–72: Phallus, right lateral view: 70, *C. boeny*; 71, *C. griveaudi*; 72, *C. pauliani*. 73–75: Basiphallus and distiphallus junction, dorsal view: 73, *C. boeny*; 74, *C. griveaudi* (PT, Mahafaly Reserve, CAS); 75, *C. pauliani*. Scale bars=0.5 mm.



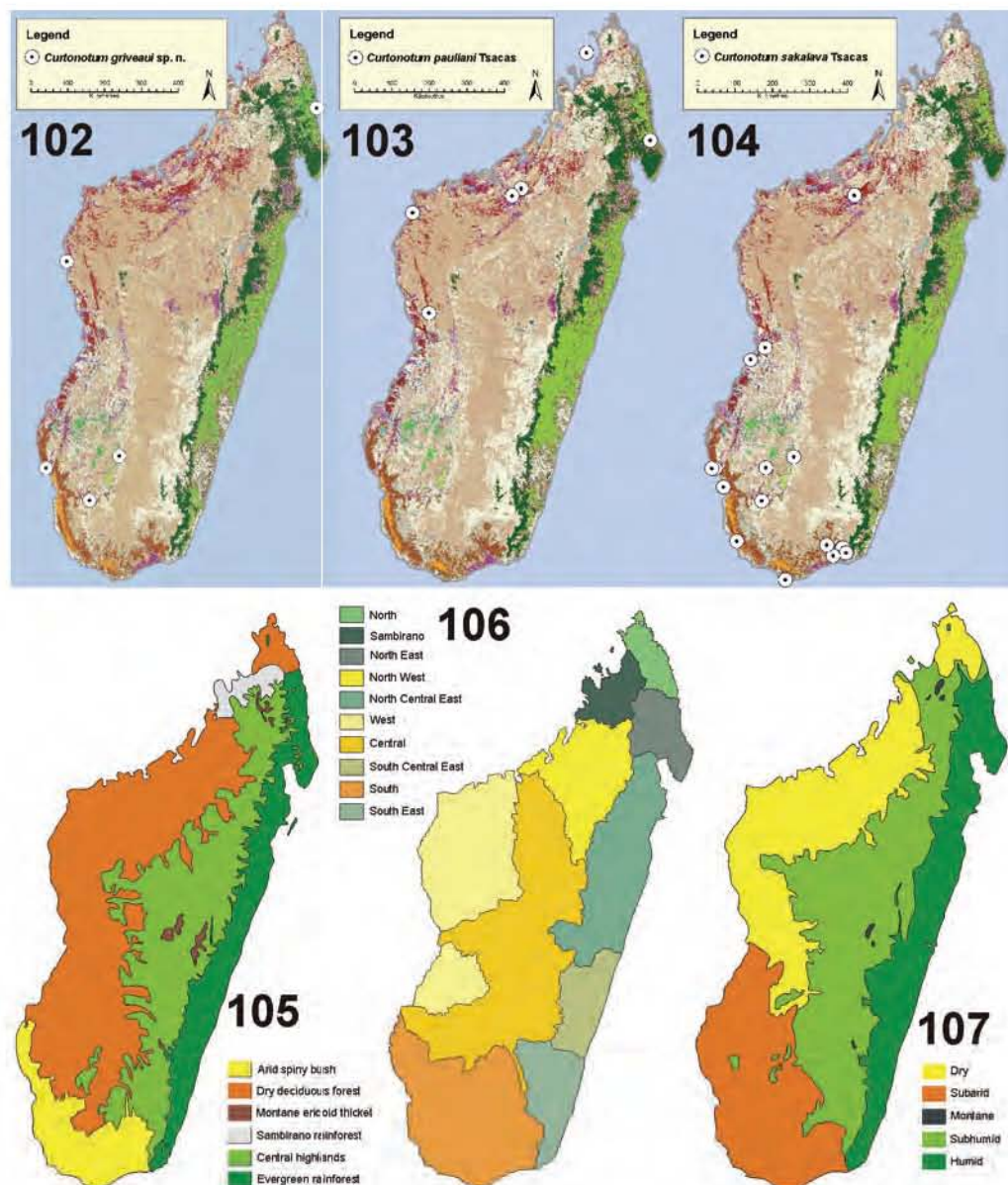
Figs 3.3: 76–78. *Curtonotum sakalava*, male terminalia. 76, Hypandrium and epandrium, lateral view (N-T, Berenty Special Reserve, CAS); 77, Phallus, right lateral view (HT, Morondava, MNHN); 78, Basiphallus and distiphallus junction, dorsal view. 79–91: Sternites 6 (79–85, 87–91) and 4–6 (86) of *Curtonotum* spp. (males): 79, *C. keiseri* (N-T, Ambohitra, TAU); 80, *C. stuckenbergi* (HT, Ambohitantely, NMHN); 81, *C. irwini* sp. n. (PT, Zombitse National Park, CAS); 82, *C. parkeri* sp. n. (PT, same, CAS); 83, *C. coroneiformis* sp. n. (PT, Fianarantsoa, CAS); 84, *C. balachowskyi* (N-T, same, CAS); 85, *C. gladiiformis* sp. n. (N-T, same, CAS); 86, *C. sternithrix* (PT, Manambato, MNHN); 87, *C. rinhatinana* sp. n. (HT, Ankarafantsika, CAS); 88, *C. boeny* (N-T, E. Bekopaka, CAS); 89, *C. griveaudi* sp. n. (PT, Mahafaly Reserve, CAS); 90, *C. pauliani* (N-T, E. Bekopaka, CAS); 91, *C. sakalava* (N-T, Berenty Special Reserve, CAS). Scale bars = 0.5 mm.



Figs 3.3: 92–96. Distribution of Malagasy *Curtonotom* spp. 92, *C. keiseri*; 93, *C. stuckenbergi*; 94, *C. sternithrix*; 95, *C. irwini* sp. n.; 96, *C. parkeri* sp. n.



Figs 3.3: 97–101. Distribution of Malagasy *Curtonotom* spp. 97, *C. coroneiformis* sp. n.; 98, *C. balachowskyi*; 99, *C. gladiiformis* sp. n.; 100, *C. rinhatiana* sp. n.; 101, *C. boeny*.



Figs 3.3: 102–104. Distribution of Malagasy *Curtonotom* spp. **102**, *C. griveaudi* sp. n.; **103**, *C. pauliani*; **104**, *C. sakalava*. See Figs 92–101 for vegetation key. **105–107.** **105:** The biomes of Madagascar (after Yoder and Nowak 2006); **106**, Biogeographic zonation of Madagascar, following Boumans *et al.* (2007) and partly Wilmé *et al.* (2006) (after Glaw and Vences 2007); **107**, Bioclimatic zonation of Madagascar, following Cornet (1974) and Schatz (2000) (after Glaw and Vences 2007).

3.3: Table 1. Distribution of the Malagasy species of *Curtonotum* according to biome types. Biome classification follows Yoder and Nowak (2006) (Fig. 105). Coding: (+) presence, (–) absence, (*) remnant fragment of main biome type.

Species	Biome classification						No. of biomes
	Arid Spiny		Montane Ericoid		Evergreen		
	Bush	Dry Deciduous Forest	Thicket	Sambirano Rainforest	Central Highlands	Rainforest	
<i>C. balachowskyi</i>	+	+	—	—	+	+	4
<i>C. boeny</i>	—	+	—	—	—	—	1
<i>C. coroneaeformis</i> sp. n.	—	—	—	—	+	—	1
<i>C. gladiiformis</i> sp. n.	—	—	—	—	+	—	1
<i>C. griveaudi</i> sp. n.	+	+	—	—	+	—	3
<i>C. irwini</i> sp. n.	+	+	—	—	—	—	2
<i>C. keiseri</i>	—	—	—	—	—	+	1
<i>C. parkeri</i> sp. n.	—	+	—	—	+	+	3
<i>C. pauliani</i>	—	+	—	+	—	+	3
<i>C. rinhatinana</i> sp. n.	—	+	—	—	—	—	1
<i>C. sakalava</i>	+	+	—	—	+	—	3
<i>C. sternithrix</i>	—	—	—	—	—	+	1
<i>C. stuckenbergi</i>	—	—	—	—	+	—	1
Total no. of species	4	8	0	1	7 (5*)	5 (1*)	

3.3: Table 2. Distribution of the Malagasy species of *Curtonotum* by biogeographic zone. Biogeographic zones follow Boumans *et al.* (2007) and partly Wilmé *et al.* (2006) (after Glaw and Vences 2007: 13) (Fig. 106). Coding: (+) presence, (–) absence, (*) borderline between two zones.

Species	Biogeographic zones											No. of zones
	North	Sambirano	North East	North West	North East	North West	Central East	Central West	South Central East	South West	South East	
<i>C. balachowskyi</i>	–	–	+	+	+	+	+	+	+	+	+	8
<i>C. boeny</i>	–	–	–	–	–	+	+	+	–	–	–	2
<i>C. coroneaeformis</i> sp. n.	–	–	–	–	–	–	–	–	–	+	–	1
<i>C. gladiiformis</i> sp. n.	–	–	–	–	–	–	–	–	–	+	–	1
<i>C. griveaudi</i> sp. n.	–	–	+	–	–	+	–	–	–	+	–	3
<i>C. irwini</i> sp. n.	–	–	–	–	–	–	+	–	–	+	–	2
<i>C. keiseri</i>	+	–	–	–	–	–	–	–	–	–	–	1
<i>C. parkeri</i> sp. n.	–	–	–	–	–	–	–	–	–	+	+	2
<i>C. pauliani</i>	–	+	+	–	–	+	+	+	–	–	–	4
<i>C. rinhatinana</i> sp. n.	–	–	–	+	–	–	–	–	–	–	–	1
<i>C. sakalava</i>	–	–	–	–	–	+	+	+	–	+	–	3
<i>C. sternithrix</i>	–	–	–	–	+	–	–	–	–	–	+	2
<i>C. stuckenbergi</i>	–	–	–	–	–	–	+	+	–	–	–	1
Total no. of species	1	1	3	2 (1*)	2	5	6	1	7 (2*)	3 (1*)		

3.3: Table 3. Distribution of the Malagasy species of *Curtonotum* by bioclimatic zone. Bioclimatic zones follow Cornet (1974) and Schatz (2000) (after Glaw and Vences 2007: 13) (Fig. 107). Coding: (+) presence, (–) absence, (*) remnant fragment of main bioclimatic zone.

Species	Bioclimatic zones				No. of zones
	Dry	Subarid	Montane	Subhumid	Humid
<i>C. balachowskyi</i>	+	+	–	+	+
<i>C. boeny</i>	+	–	–	–	–
<i>C. coronaeformis</i> sp. n.	–	–	–	+	–
<i>C. gladiiformis</i> sp. n.	–	–	–	+	–
<i>C. griveaudi</i> sp. n.	+	+	–	+	+
<i>C. irwini</i> sp. n.	+	+	–	–	–
<i>C. keiseri</i>	–	–	–	–	+
<i>C. parkeri</i> sp. n.	–	+	–	+	+
<i>C. pauliani</i>	+	–	–	+	+
<i>C. rinhatinana</i> sp. n.	+	–	–	–	–
<i>C. sakalava</i>	+	+	–	+	–
<i>C. sternithrix</i>	–	–	–	–	+
<i>C. stuckenbergi</i>	–	–	–	+	–
Total no. of species	7	5	0	8 (5*)	6 (1*)

3.3: Appendix I. Annotated checklist of Curtonotidae of Madagascar. Type localities are cited as they appear on the original type specimen labels. Information is provided on deposition of holotypes and synonymy.

Genus **AXINOTA** van der Wulp, 1886

AXINOTA: van der Wulp 1886: cviii. Type species: *Axinota pictiventris* van der Wulp, 1886, by original designation (“gen. n, sp. n.”).

APSINOTA van der Wulp, 1887: 178 [footnote]. Unjustified emendation of *Axinota*.

THAUMASTOPHILA Hendel, 1914: 112. Type species: *Thaumastophila hyalipennis* Hendel, 1914: 113, by original designation.

ANASEIOMYIA Malloch, 1930: 328. Type species: *Anaseiomyia uniformis* Malloch, 1930: 329, by original designation.

kyphosis Kirk-Spriggs, 2010a: 115. Type locality: “Madagascar: 10 km W von Sakaraha” (HT, ZSM). Afrotropical: Madagascar.

= *Apsinota* sp. *sensu* Tsacas (1974: 717). “Madagascar, Prov. d’Analalava, Maromandia” (PT, MNHN).

Genus **CURTONOTUM** Macquart, 1844

CURTONOTUM: Macquart 1844: 350 (193). Type species: *Musca gibba* Fabricius, 1805 [preoccupied], by original designation. [The name of the Type species is a junior primary homonym preoccupied by *Musca gibba* Müller, 1776: 175 and *M. gibba* Rossi, 1794: 73. *Curtonotum taeniatum* Hendel, 1913: 629 was accepted as the replacement name by Thompson and Pont (1993)].

CYRTONOTUM Agassiz, 1846: 108. Unjustified emendation of *Curtonotum* Macquart, 1844.

DIPLOCENTRA Loew, 1862: 13. [Unnecessary] new replacement name for *Curtonotum* Macquart, 1844.

SELIACANTHA Bezzi, 1895: 66. *Nomen nudum*, attributed to Rondani and proposed in synonymy (with *Diplocentra* Loew, 1862). Name from a collection label. Also Bezzi (1902: 192).

SELIDACANTHA Bezzi, 1895: 66. *Nomen nudum*, proposed as an emendation of the likewise unavailable *Seliacantha* Bezzi, 1895: 66. Also Bezzi (1902: 192).

balachowskyi Tsacas, 1974: 710. Type locality: “Madagascar, Mananjary” (HT, MNHN). Afrotropical: Madagascar.

= *Curtonotum* sp. cf. *balachowskyi* n. sp. species b (*sensu* Tsacas 1974: 712).

boeny Tsacas, 1974: 712. Type locality: “Madagascar, Ambato-Boeny” (HT, MNHN). Afrotropical: Madagascar.

coronaeformis sp. n. Type locality: “Madagascar, Fianarantsoa, near Isalo National Park” (HT, CAS).
Afrotropical: Madagascar.

gladiiformis sp. n. Type locality: “Madagascar, Fianarantsoa, near Isalo National Park” (HT, CAS).
Afrotropical: Madagascar.

griveaudi sp. n. Type locality: “Madagascar, Asondrodava dry forest, 15 km N of Maintirano” (HT, CAS). Afrotropical: Madagascar.

irwini sp. n. Type locality: “Madagascar: Zombitse National Park” (HT, CAS). Afrotropical: Madagascar.

keiseri Tsacas, 1974: 706. Type locality: “Madagascar, Joffreville” (HT, MNHN). Afrotropical: Madagascar.

parkeri sp. n. Type locality: “Madagascar: Zombitse National Park” (HT, CAS). Afrotropical: Madagascar.

pauliani Tsacas, 1974: 715. Type locality: [Madagascar] “Nosy Mitsio” (HT, MNHN). Afrotropical: Madagascar, Namibia and South Africa.

rinhatinana sp. n. Type locality: “Madagascar: Ankarafantsika Forest Reserve” (HT, CAS).
Afrotropical: Madagascar.

sakalava Tsacas, 1974: 713. Type locality: “Madagascar Quest, Morondava” (HT, MNHN).
Afrotropical: Madagascar.

sternithrix Tsacas, 1974: 708. Type locality: “Madagascar Est, Antanambe” (HT, MNHN).
Afrotropical: Madagascar.

stuckenbergi Tsacas, 1974: 705. Type locality: “Madagascar, Ambohitantely” (HT, MNHN).
Afrotropical: Madagascar

3.3: Appendix II. Geographical co-ordinates used to map distributions plotted on Figs 92–104, based on material examined in this study and listed in the material examined sections. Vegetation types listed follow Moat and Smith (2007).

Species	Locality	Latitude	Longitude	Vegetation type
<i>C. balachowskyi</i>	Ambila	-22.000000	47.966667	Degraded Humid Forest
<i>C. balachowskyi</i>	50 km S of Farafangana, Mahabo Mananivo, Ampitavananima Forest	-23.116667	47.716667	Wooded Grassland-Bushland
<i>C. balachowskyi</i>	Ambohitantely, 46 km NE of Ankazobe	-18.183333	47.266667	Plateau Grassland-Wooded Grassland Mosaic
<i>C. balachowskyi</i>	Ambovomamy Belambo, 20 km NW of Port Berger	-15.450000	47.600000	Wooded Grassland-Bushland
<i>C. balachowskyi</i>	Ampijoroa National Park	-16.316667	46.800000	Western Dry Forest
<i>C. balachowskyi</i>	Beza Mahafaly Reserve, Parcelle I near research station	-23.683333	44.583333	South Western Dry Spiny Forest-Thicket
<i>C. balachowskyi</i>	Mananjary	-18.300000	47.000000	Plateau Grassland-Wooded Grassland Mosaic
<i>C. balachowskyi</i>	Mikea Forest (1)	-22.900000	43.466667	South Western Dry Spiny Forest-Thicket
<i>C. balachowskyi</i>	Mikea Forest (2)	-22.900000	43.383333	Coastal Buffer
<i>C. balachowskyi</i>	near Isalo National Park, at stream east of Interpretive Center	-22.616667	45.350000	Wooded Grassland-Bushland
<i>C. balachowskyi</i>	Tamatave	-18.100000	49.400000	Degraded Humid Forest
<i>C. balachowskyi</i>	Beroboka village 45 km NE Morondava	-19.977500	44.665333	Wooded Grassland-Bushland
<i>C. balachowskyi</i>	Asondrodava dry forest, 15 km N of Maintirano	-17.965333	44.035500	Wooded Grassland-Bushland
<i>C. balachowskyi</i>	Marofototra dry forest, 17 km W of Besalampy	-16.721667	44.423667	Western Dry Forest
<i>C. balachowskyi</i>	Analalava, 7 km SW of Foulpointe	-17.705333	49.454833	Degraded Humid Forest
<i>C. balachowskyi</i>	Matomandia	-15.000000	50.133333	Wooded Grassland-Bushland
<i>C. balachowskyi</i>	Zombitse National Park, near national road	-22.833333	44.740833	Plateau Grass.-Wooded Grassland Mosaic

3.3: Appendix II. (Continued)

Species	Locality	Latitude	Longitude	Vegetation type
<i>C. boeney</i>	Ambato-Boeni	-16.450000	46.750000	Wooded Grassland-Bushland
<i>C. boeney</i>	Parc National Tsingy de Memaraha	-19.133333	44.816667	Western Dry Forest
<i>C. coronaeformis</i> sp. n.	near Isalo National Park	-22.626667	45.358167	Wooded Grassland-Bushland
<i>C. gladiiformis</i> sp. n.	near Isalo National Park	-22.626667	45.358167	Wooded Grassland-Bushland
<i>C. griveaudi</i> sp. n.	near Isalo National Park	-22.626667	45.358167	Wooded Grassland-Bushland
<i>C. griveaudi</i> sp. n.	Asondrodava dry forest, 15 km N of Maintirano	-17.965333	44.035500	Wooded Grassland-Bushland
<i>C. griveaudi</i> sp. n.	Beza Mahafaly Reserve, Parcelle I	-23.686500	44.591000	South Western Dry Spiny Forest-Thicket
<i>C. griveaudi</i> sp. n.	Mikea Forest, NW of Manombo	-22.903667	43.475500	South Western Dry Spiny Forest-Thicket
<i>C. griveaudi</i> sp. n.	Sambava Beach	-14.266667	50.166667	Plateau Grassland-Wooded Grassland Mosaic
<i>C. irwini</i> sp. n.	Zombitse National Park, near national road	-22.833333	44.740833	Plateau Grassland-Wooded Grassland Mosaic
<i>C. irwini</i> sp. n.	Ampijoroa National Park, 160 km N of Maevatanana on RN 04	-16.316667	46.800000	Western Dry Forest
<i>C. irwini</i> sp. n.	Beza Mahafaly Reserve, Parcelle I near research station	-23.683333	44.583333	South Western Dry Spiny Forest-Thicket
<i>C. irwini</i> sp. n.	Sous Prefecture Fort Dauphin Andohahela National Park	-24.816667	46.533333	South Western Dry Spiny Forest-Thicket
	Ihazofotsy Parcelle III			
<i>C. irwini</i> sp. n.	Beza Mahafaly Reserve, Parcelle II near Bellevue	-23.683333	44.566667	Wooded Grassland-Bushland
<i>C. irwini</i> sp. n.	Zombitse National Park, near ANGAP office	-22.883333	44.683333	Western Sub-humid Forest

3.3: Appendix II. (Continued)

Species	Locality	Latitude	Longitude	Vegetation type
<i>C. keiseri</i>	Joffreville	-12.483333	49.200000	Humid Forest
<i>C. keiseri</i>	Montagne d'Ambre	-12.616667	49.150000	Humid Forest
<i>C. parkeri</i> sp. n.	near Isalo National Park, in dry wash east of Interpretive Center	-23.000000	45.000000	Tapia Forest
<i>C. parkeri</i> sp. n.	Zombitse National Park, near national road	-23.000000	45.000000	Tapia Forest
<i>C. parkeri</i> sp. n.	Andohahela National Park, Tsimelaha, Parcelle II	-25.000000	47.000000	Wooded Grassland-Bushland
<i>C. parkeri</i> sp. n.	radio tower, 22 km SW of Ilakaka, nr. Fianarantsoa/Tulear border	-23.000000	45.000000	Tapia Forest
<i>C. parkeri</i> sp. n.	Beza Mahafaly Reserve, Parcelle I	-24.000000	45.000000	Wooded Grassland-Bushland
<i>C. parkeri</i> sp. n.	Zombitse National Park, near ANGAP office	-23.000000	45.000000	Tapia Forest
<i>C. pauliani</i>	Ankarafantsika	-16.150000	47.033333	Western Dry Forest
<i>C. pauliani</i>	Maromandia	-15.000000	50.133333	Wooded Grassland-Bushland
<i>C. pauliani</i>	Ampijoroa National Park, 160 km N of Maevatanana on RN 04	-16.319333	46.813333	Western Dry Forest
<i>C. pauliani</i>	Marofototra palm forest, 17 km W of Besalampy	-16.721667	44.423667	Western Dry Forest
<i>C. pauliani</i>	Nosy Mitsio	-12.900000	48.600000	Wooded Grassland-Bushland
<i>C. pauliani</i>	Parc National Tsingy de Memaraha	-19.133333	44.816667	Western Dry Forest
<i>C. rinhatinana</i> sp. n.	Ankarafantsika Forest Reserve	-16.150000	47.033333	Western Dry Forest
<i>C. sakalava</i>	Andohahela National Park (1)	-24.816667	46.533333	South Western Dry Spiny Forest-Thicket
<i>C. sakalava</i>	near Isalo National Park	-22.626667	45.358167	Wooded Grassland-Bushland
<i>C. sakalava</i>	Andohahela National Park (2)	-24.933333	46.616667	South Western Dry Spiny Forest-Thicket

3.3: Appendix II. (Continued)

Species	Locality	Latitude	Longitude	Vegetation type
<i>C. sakalava</i>	Berenty Special Reserve	-25.000000	46.300000	Mangroves
<i>C. sakalava</i>	Beza Mahafaly Reserve	-23.683333	44.583333	South Western Dry Spiny Forest-Thicket
<i>C. sakalava</i>	Cap Ste Marie Special Reserve	-25.583333	45.150000	South Western Dry Spiny Forest-Thicket
<i>C. sakalava</i>	Forêt de Mahavelo	-24.750000	46.150000	South Western Dry Spiny Forest-Thicket
<i>C. sakalava</i>	Mahafaly Plateau	-24.650000	43.983333	South Western Dry Spiny Forest-Thicket
<i>C. sakalava</i>	Mikea Forest (1)	-22.900000	43.466667	South Western Dry Spiny Forest-Thicket
<i>C. sakalava</i>	Mikea Forest (2)	-22.900000	43.383333	Plateau Grassland-Wooded Grassland Mosaic
<i>C. sakalava</i>	Morondava	-20.284722	44.317500	Plateau Grassland-Wooded Grassland Mosaic
<i>C. sakalava</i>	N of Tuléar (= Toliara)	-23.350000	43.666667	Plateau Grassland-Wooded Grassland Mosaic
<i>C. sakalava</i>	Ampijoroa National Park	-16.319333	46.813333	Western Dry Forest
<i>C. sakalava</i>	Beroboka village, 45 km NE Morondava	-19.977500	44.665333	Wooded Grassland-Bushland
<i>C. sakalava</i>	Beroboka village	-19.977500	44.666333	Wooded Grassland-Bushland
<i>C. sakalava</i>	Zombitse National Park	-22.883333	44.683333	Western Sub-humid Forest
<i>C. sternithrix</i>	Antanambe	-16.430000	49.850000	Degraded Humid Forest
<i>C. sternithrix</i>	Manambato	-24.516700	47.266700	Plateau Grassland-Wooded Grassland Mosaic
<i>C. stuckenbergi</i>	Ambohitantely	-18.166667	47.283333	Humid Forest

3.4

The continental Afrotropical species of *Curtonotum* Macquart, with descriptions of thirteen new species

Preface: The continental Afrotropical fauna of the genus *Curtonotum* Macquart, 1844 is revised and a diagnosis of the genus is provided. The Afrotropical Region is species-rich with 49% of the world fauna, followed by the Neotropical Region with 39%. Known biology, behaviour and published information on immature stages of the genus are briefly reviewed. Type material of 12 of the 13 named species (*C. angolense* Tsacas, *C. campsiphallum* Tsacas, *C. cuthbertsoni* Duda, *C. herrero* Tsacas, *C. pauliani* Tsacas, *C. platyphallum* Tsacas, *C. quinquevittatum* Curran, *C. sahelense* Tsacas, *C. sao* Tsacas, *C. simile* Tsacas, *C. striatifrons* Malloch and *C. tigrinum* Séguy), was studied and errors in previous interpretations and designation of type specimens are resolved. *Curtonotum pauliani* is the only species occurring on both the continental African mainland and Madagascar. The type specimen of *C. maculiventris* (Enderlein) is lost and a neotype is here designated. One species synonymy is proposed: *C. tigrinum* Séguy, 1933 = *C. maculiventris* (Enderlein, 1917), **syn. n.** Additional material of the aforementioned species is noted, substantially increasing their known distributions. Thirteen species are described as new, namely: *C. bicuspis* sp. n., *C. cimbebas* sp. n., *C. constance* sp. n., *C. freidberg* sp. n., *C. gonzo* sp. n., *C. hay* sp. n., *C. litoralis* sp. n., *C. marriott* sp. n., *C. mcgregor* sp. n., *C. moffatt* sp. n., *C. tsacas* sp. n., *C. uncinatum* sp. n. and *C. unicuspis* sp. n. The head and thorax, frons, wing, fifth sternite and hypandrium of the male of the 25 named species are illustrated for the first time, as well as the highly diagnostic male phallus, from both the right and left sides laterally. The genus is divided into species-groups based on the outcome of the phylogenetic analysis presented in Chapter 2.0. A key to species based on male characters is provided, and species distributions are mapped and interpreted according to major vegetation types, topography and humidity zones. The biogeographical significance of the continental Afrotropical species is discussed in Chapter 4. Co-ordinates used to plot maps and a list of Major Habitat Types and Vegetation Types in which species occur are provided as 3.4: Appendix.

The Curtonotidae (“Quasimodo flies” or “hunchbacked flies”) were formerly regarded as a small family of ephydroid flies, easily recognised by their hunchbacked and mottled appearance. The family occurs in all zoogeographical regions of the world, except Antarctica. As currently defined, it comprises four genera, *i.e.*, *Axinota* van der Wulp, 1886, *Cyrtona* Séguy, 1938 (*s.l.*), *Tigrisomyia* Kirk-Spriggs, 2010 and *Curtonotum* Macquart, 1844, all of which occur on the continental Afrotropical

Region; *Tigrisomyia* exclusively so. *Cyrtona* and *Tigrisomyia* are not recorded from the island of Madagascar.

Curtonotum is the largest and most widely distributed genus, occurring in all zoogeographical regions of the world, except Oceania / Australasia and Antarctica and is the only genus that occurs in the New World. Klymko and Marshall (2011), however, suggested restricting the name *Curtonotum* to a clade of Neotropical species and that clade is here regarded as *Curtonotum* (s.s.).

Seventy-six species are now known worldwide (including the 13 newly described herein): Afrotropical Region (37 species; 49%), Neotropical (30; 39%), Palaearctic (4; 5%), Oriental (3; 4%) and Nearctic (2; 3%). It must be borne in mind, however, that the Neotropical *C. murinus* and *C. vulpinus* species-groups are not fully revised and once revised, these percentages may change significantly. Only two species are recorded from more than one Region, the predominantly Palaearctic *C. anus* (Meigen, 1830), which extends eastwards into Pakistan in the Oriental and the predominantly Afrotropical *C. simile* Tsacas, 1977, which extends north-eastwards into Israel, Oman and the United Arab Emirate in the Palaearctic (Kirk-Spriggs and Freidberg 2007). These figures indicate that the Afrotropical Region has the world's richest *Curtonotum* fauna and that Africa is possibly the region of diversification for the group.

This Chapter is the second part of the revision of Afrotropical species of the genus *Curtonotum*. The first part (Kirk-Spriggs 2011, Chapter 3.3) exclusively revises the Malagasy species; this contribution species occurring in the continental Afrotropical Region.

BIOLOGY, BEHAVIOUR AND IMMATURE STAGES

What is known regarding the biology and behaviour of the genus *Curtonotum* (specifically) has been summarised by Tsacas (1977), Meier *et al.* (1997) and more recently by Kirk-Spriggs and Freidberg (2007), Kirk-Spriggs (2008b, 2011), Marshall *et al.* (2010) and Klymko and Marshall (2011).

In the Afrotropical Region, species of the genus occur in a range of habitat types and biomes, including: desert; semi-desert; wooded steppe, arid and mesic savannas; tropical forest margins; tropical grasslands; coastal forests; and mid- to

high-elevation montane forest. Some species are restricted to the southern African Great Escarpment or East African Rift Valley or to isolated mountain ranges.

Cuthbertson (1936) was the first to record the habit of daylight roosting in Aardvark, *Orycteropus afer* (Pallas) (Orycteropidae), and Warthog, *Phacochoerus aethiopicus* (Pallas) (Suidae), burrows in Africa, noting this behaviour in *C. quinquevittatum* Curran, 1933 (as *quinquevittata*) and *C. cuthbertsoni* Duda, 1935, in Southern Rhodesia (Zimbabwe). He suggested (p. 54) that the latter species: “Probably breeds in the faeces of these burrowing animals.” Warthogs are unable to dig their own burrows, but take over and sometimes enlarge those vacated by other larger burrowing mammals, especially Aardvarks (Cumming 1975; White and Cameron 2008). For this reason the identity of the mammal hosts may be questionable.

Roosting behaviour was further noted by Tsacas (1977) for *C. sao* Tsacas, 1977 (actually in company with *C. saheliense* Tsacas, 1977— see *Bionomics* under that species heading), in the burrow of Porcupine, *Atherurus africanus* Gray (Hystricidae), in Nigeria, and for *C. maculiventris* (Enderlein, 1917) (as *C. tigrinum* Séguy) in Warthog burrows in the Kruger National Park of South Africa.

In a study conducted in Zimbabwe, Pollock (2002) noted that during the dry season *C. quinquevittatum* rests by day in burrows of Warthog and Aardvark, but also in other natural and artificial holes, such as culverts. He noted that the greatest numbers of flies were found in recently vacated Warthog burrows, where flies occurred in their hundreds. He noted that flies vacate these burrows about half an hour before sunset and return in the early morning, about sunrise. He noted that upon dissection flies were found to have a full crop of clear liquid, suggesting that this may be nectar and that flies may spend the night visiting flowers.

In a study conducted during the hot-dry season in the Caprivi Region of Namibia, Kirk-Spriggs (unpublished), sampled adults from used and disused Aardvark burrows in the Mesic Savanna Biome. *Curtonotum bicuspis* sp. n., *C. uncinatum* sp. n., and *C. unicuspis* sp. n. all occurred at rest together in a single burrow, as did *C. bicuspis* sp. n., *C. cuthbertsoni* (s.s.) and *C. unicuspis* sp. n. in another (see below).

Kirk-Spriggs and Freidberg (2007), have noted that although roosting in mammal burrows appears to be a widespread behaviour, at least in the African species of *Curtonotum*, there is no proven association with mammals or their dung and it is

likely that adult flies are crepuscular or nocturnal; only roosting in such situations to avoid daytime heat, especially in the arid and hyper-arid deserts in which many roosting species occur. Crepuscular or nocturnal habits in Afrotropical species are further indicated by the fact that five species recorded in this study have been collected at light, *i.e.*, *C. gonzo* sp. n., *C. maculiventris*, *C. simile*, *C. uncinatum* sp. n. and *C. unicuspis* sp. n.

Indeed, some species of *Curtonotum* exhibit preferences for other dimly lit or shaded environments (Meier *et al.* 1997). Tsacas (1977), for example, recorded *Curtonotum saheliense* (as *C. sahelensis*) from a hollow Baobab, *Adansonia digitata* L. (Bombacaceae) and other species have been recorded from overhangs of dry river beds, at the base of a cliff in deep shade and on bushes shaded by Baobab and fig trees (Meier *et al.* 1997; Kirk-Spriggs 2008b). *Curtonotum tsacas* sp. n. roosts during daylight in natural and man-made hollows in closed-canopy coastal forests in South Africa (pers. obs).

Greathead (1958) recorded *Curtonotum simile* (as *Cyrtonotum cuthbertsoni*, Drosophilidae), from damaged egg pods of the Desert locust, *Schistocerca gregaria* Forstål (Orthoptera: Acrididae). He noted that adults were found on dung, dead locusts and on sand wetted by camel urine. He concluded that they were probably saprophagous on damaged, putrefying egg pods rather than being truly parasitic and further noted that the damage they caused to locust eggs was minimal, as compared to insects causing primary attack (see also Stower *et al.* 1958). Meier *et al.* (1997) reared the Nearctic species *C. helvum* (Loew, 1862) in the laboratory from a decaying grasshopper egg pod. Tsacas (1977) recorded *C. maculiventris* (as *C. tigrinum*) from fresh dung of the African Bush Elephant, *Loxodonta africana* (Blumenbach) (Elephantidae), and noted its occurrence in forest, gallery forest, and bushes along river banks. Braack (1986) recorded *C. bicuspis* sp. n. (as *C. cuthbertsoni*) from the carcass of an Impala in Kruger National Park, South Africa. Species of the *Uncinatum* species-group have been observed existing disused and collapsed pit latrines at dawn in the Caprivi Region of Namibia and *C. bicuspis* sp. n., *C. uncinatum* sp. n. and *C. unicuspis* sp. n. were attracted to decomposing fungi bait at dawn in the Kavango Region of Namibia (pers. obs.).

The Palaearctic and Oriental species *C. anus* is associated with sandy or muddy shores of rivers or lakes (Meier *et al.* 1997; Kirk-Spriggs and Freidberg 2007). Meier *et al.* (1997) noted that the Nearctic species *C. helvum* is crepuscular or

nocturnal, although Marshall *et al.* (2010) note its occurrence on sand during overcast days. Klymko and Marshall (2011) noted that the species has been regularly collected at light. Meier *et al.* regarded *C. helvum* as being principally associated with moist habitats in the vicinity of fresh water, although a more recent study, Klymko and Marshall (2011), note that the two Nearctic species occur in open, sandy habitats, with *C. helvum* occurring only on sand-dunes and *C. floridense* Klymko & Marshall only in scrub habitat in Florida. Meier *et al.* (1997) observed mating behaviour in *C. helvum*. It was recorded as copulating in the evenings, with copulating pairs found on low vegetation. Klymko and Marshall (2011) provide further details on grooming and mating behaviour of the same species, but oviposition was not observed.

Neotropical species are found in a variety of humid environments, including: riparian habitats in dry forests; freshwater and marine shorelines and forest openings in primary rainforests and high-elevation cloud forests. Some species have been found on dung baits at higher elevations and in association with trees falls near sea level and both sexes reliably appear at branch tips before dusk on isolated floodplane trees and shrubs. Adults have also been observed feeding on unidentified fragments of decomposing material on leaf surfaces (Klymko and Marshall 2011, fig. 12). Schmitz *et al.* (2007) reported collecting over 45,000 curtonotids (as Drosophilidae) in mangrove forests of southern Brazil, using banana-baited traps hung from trees. Fischer (1933) used traps baited with fruit juices (*i.e.*, banana, pear, and peach) and vinegar to collect the type series of *C. punctithorax* Fischer (Klymko and Marshall 2011).

Published information on the immature stages of the genus *Curtonotum* were reviewed by Ferrar (1987), Meier *et al.* (1997) and Kirk-Spriggs (2008b) and this information will not be repeated here.

Some addition information was published subsequently, however. Klymko and Marshall (2011), report that the puparium of an undescribed Neotropical species in the *Curtonotum murinum* species complex from Peru, was dug from soil associated with *Philanthus* (Hymenoptera: Crabronidae) nests, and suggested that they may develop as kleptoparasites on the paralysed bees with which the nest was stocked. It is interesting to note that the breeding medium is similar to that of the known associations of Afrotropical species of the genus, which develop in subterranean damaged locust and grasshopper egg pods.

HISTORICAL REVIEW OF AFROTROPICAL *CURTONOTUM*

Macquart (1844) described *Diastata fuscipennis* based on 2♂ from “Du Sénégal”. This species was formerly transferred to the genus *Curtonotum* by Séguy (1933) (Kirk-Spriggs 2010a, Chapter 3.1) and was included in the key to “*Curtonotum*” published by Curran in the same year. It was not treated in detail by Tsacas (1977), but was listed as a species of *Curtonotum* in Wirth and Tsacas (1980). Type material of this species was reviewed by Kirk-Spriggs (2010a, Chapter 3.1) and the species was formerly transferred to the *Fuscipennis* species-group of the genus *Axinota*.

Enderlein (1917), therefore, described the first Afrotropical species of *Curtonotum* (as currently defined), *Diplocentra maculiventris*; the description of which was based on a single ♀ specimen from Asmara, Eritrea.

In 1930, Malloch described the second, *Cyrtotonotum striatifrons*, based on two specimens (sexes unspecified), from Bahr el Ghazal, Chad. In the same paper he erroneously attributed material of the as then undescribed species, *C. quinquevittatum* Curran, 1933, from Lomagundi, Southern Rhodesia (Zimbabwe) to the Palaearctic species *C. anus*.

In 1933, Séguy described a third species, *Cyrtotonotum tigrinum*, based on two ♀ from Haut-Nhamapaza, Mozambique.

In the same year, Curran (1933) described *Curtonotum quinquevittatum* (as *C. quinquevittata*), from Southern Rhodesia (Zimbabwe), based in part on material collected together with that cited by Malloch, as *C. anus* (noted above), and made a first attempt to key the then known African species of “*Curtonotum*”. In his key he included six species, only two of which are today regarded as *Curtonotum*, i.e., *C. striatifrons* and *C. quinquevittata*. *Diplocentra maculiventris* (not then recognised as Curtonotidae) and *C. tigrinum* (described in the same year), were not included, and a fifth included species, *Curtonotum quadrimacula* (Walter, 1849), was subsequently transferred to the genus *Homoneura* van der Wulp, 1891, of the Lauxaniidae by Miller (1980).

In 1935, Duda described *Curtonotum cuthbertsoni*, based on 4♂, 4♀ from Balla Balla, Southern Rhodesia (Zimbabwe).

No additional species of Afrotropical *Curtonotum* were then described until 1974, when Tsacas published his provisional review of the Curtonotidae of

Madagascar. In this work he described seven species, all then regarded as being endemic to Madagascar, namely: *C. balachowskyi*, *C. boeny*, *C. keiseri*, *C. pauliani*, *C. sakalava*, *C. sternithrix* and *C. stuckenbergi*. An identification key was not provided.

Three years later, in 1977, Tsacas' revision of the continental Afrotropical species of *Curtonotum* appeared. In this work he included all continental Afrotropical species described to that date and described seven others, i.e., *C. angolense* (as *C. angolensis*) (from Angola), *C. campsiphallum* (Zaire [= Democratic Republic of Congo]), *C. herrero* (Angola, S.-O. Africa [= Namibia]), *C. platyphallum* (Liberia), *C. saheliense* (as *C. saheliensis*) (Chad, Mali, Niger, Senegal, Sudan), *C. sao* (Chad, Nigeria) and *C. simile* (as *C. similis*) (Arabia [= South Yemen]). Tsacas included an identification key to all species, except *C. fuscipenne* (Macquart, 1844) and *C. maculiventris*. Tsacas noted (p. 170), that following examination of the unique ♀ holotype of the last-named species, it was impossible to distinguish this from *C. striatifrons* and *C. tigrinum*. *Curtonotum fuscipenne* was briefly mentioned, but not treated in that work.

Tsacas recognised eight phenotypes of *C. cuthbertsoni* (Types I–VIII), based on variation in the shape of the junction of the basiphallus and distiphallus (figs 3 c [Type I], 4 Types II–VIII). Tsacas regarded these “Types” as geographical races of one highly variable species and listed their known distributions by “Type”.

Wirth and Tsacas (1980), catalogued the 19 species described to that date, with the addition of *C. fuscipenne*. They noted Malloch's (1930) misidentification of *C. quinquevittatum* as *C. anus* (Meigen), corrected the grammatical spellings of the specific names: *C. angolensis* (= *C. angolense*), *C. saheliensis* (= *C. saheliense*) and *C. similis* (= *C. simile*) and provided additional country locality information for *C. cuthbertsoni sensu* Tsacas (1977) and *C. fuscipenne*, based on material examined by Tsacas in Muséum national d'Histoire naturelle, Paris and the Natural History Museum, London.

Curtonotum simile (as *C. similis*) was formerly recorded from Israel in the Palaearctic Region by Papp (1998) and was further recorded from the United Arab Emirates (Kirk-Spriggs 2008a) and from Eritrea and Oman (Kirk-Spriggs and Freidberg 2007).

Kirk-Spriggs (2008c) examined variability in the spermathecal form of three closely-related species ascribed to the *Curtonotum cuthbertsoni* species-group,

cuthbertsoni complex (*sensu* Tsacas 1977), namely: *C. cuthbertsoni* (Type III of Tsacas, 1977), *C. sahelense* and *C. simile*. He noted that while general trends in shape were noted within species, variation is overlapping, both between individuals of the same species and within pairs of spermathecae from the same specimen. It was concluded, therefore, that spermathecal form is not a useful character to distinguish females of the three species, and that the use of spermathecae as diagnostic characters in the genus must be viewed critically and with a high degree of scepticism.

In part III of this revision, Kirk-Spriggs (2011, Chapter 3.3), revised the Malagasy species of *Curtonotum* and described and figured six additional new endemic species, namely: *C. coronaeformis*, *C. gladiiformis*, *C. griveaudi*, *C. irwini*, *C. parkeri* and *C. rinhatinana*. He provided an identification key to males of all species occurring on Madagascar and substantially increased the known distribution ranges of many of the species described by Tsacas (1974).

MATERIAL AND METHODS

Dissection

All male specimens included in this study were dissected. Abdomens were removed with watchmaker's forceps and macerated in 10% potassium hydroxide in a heated block. Once macerated, these were transferred to 70% ethanol with a few drops of glacial acetic acid in an excavated glass block. Following dissection, abdomens and male terminalia were stored in a micro-vial with glycerol pinned beneath each specimen. The glass and cork-bunged genitalia vials used by L. Tsacas, many of which had dried-up or deteriorated, were all replaced and a label appended to each specimen stating "Genitalia vial replaced A.H. Kirk-Spriggs [2006–2008]".

Preparation of figures and images

Figures of the head and thorax and frons (Figs 3.4: 1–48), were prepared from images captured with a Leica EZ4HD stereo microscope with build-in digital camera. These were photographed using a ring light and dome (Kerr *et al.* 2008) at a range of focal planes and were digitised using Combine ZP Image Stacking Software. Wings were detached and placed between two glass slides. Photographic images (Figs 3.4: 67–85) were captured with the same microscope and were digitised using the same software.

Illustrations of the head of the *Striatifrons* species-group (Figs 3.4: 49–54), and the wing and scutellum of the *Striatifrons* and *Platyphallum* species-groups (Figs 3.4: 55–66), were initially prepared from images captured with the same make and model microscope. These were traced and details added by hand in pen and ink.

Male and female terminalia were mounted laterally or dorsally, in a blob of heated and set glycerine jelly. Figures of these structures (Figs 3.4: 86–101, 113–216) were prepared using a Leica Wild M3Z binocular microscope with a *camera lucida* attachment. Images were enlarged and traced, and details added by hand in pen and ink by constant referral to the specimen. Scale bars were added using a 0.5 mm graticule slide.

Spermathecae (Figs 3.4: 108–112) were prepared from macerated specimens. Images were captured from specimens temporarily mounted under a cover slip in glycerol, using Nikon ECLIPSE 50i compound microscope with Nikon DS-U3 DS Camera Control Unit. All images were edited and arranged into plates using the program CoralDraw 12.

Measurements

Measurements were taken with a graticule eye piece on a Leica Wild M3Z binocular microscope, calibrated with a 0.5 mm graticule slide.

Measurements are provided for 5 specimens exhibiting a range of sizes if available. If fewer specimens are available, then the number (*n*) on which the range of measurements was based is indicated. In cases where the female is known, only wing length is provided, as this is regarded as the more reliable gage of size. In some cases overall lengths could not be provided as specimens were dissected beforehand. In such cases the measurements provided by Tsacas (1974) are included (where applicable), or combined length of the head and thorax and thorax and scutellum alone are provided. Tsacas did not specify how his measurements were made, but overall length measurements appear to have included the wings (*i.e.*, measured from the head to the tips of the wings), rather than the combined lengths of the head, thorax and abdomen, so are larger by comparison with the measurements provided here.

Overall length was measured from the anteriormost point of the frons to the tip of the abdomen (viewed laterally). Length of head and thorax combined was measured from the anteriormost point of the frons to the scutoscutellar suture (viewed dorsally).

Length of thorax and scutellum combined was measured from the anterior margin of the mesonotum (immediately posterior to head) to the anterior tip of the scutellum (viewed dorsally).

The eye height/length ratio was measured from the most ventral to the most dorsal point of the eye and through the eye medially (viewed laterally).

Genal height was measured immediately below the ventro-medial part of the eye (viewed laterally).

Frons length represents the distance between the ventral margin (immediately above the point of antennal insertion), to the posterior ocelli (viewed dorsally). Frons width represents the distance between the lateral margins of the frons, measured at the midpoint between the posterior ocelli and the ventral margin of the frons.

Length of the wing was measured from the humeral crossvein to the apex of the second radial vein (R_{4+5}).

Descriptions

A full description or redescription is provided for one species in each of the species-groups occurring in the continental Afrotropical Region, usually the commonest and most widely distributed species of the group for which the female is known. This species is listed first, followed by the other species in the group in alphabetical order. Redescriptions and descriptions of other species in the same species-group are then compared to this and differences and additional characters noted only.

Distribution maps

Each set of specimen locality coordinates listed in 3.4: Appendix was obtained in one of three ways: a) original coordinates provided on data labels, later converted to decimal coordinates; b) details provided by the collectors; or c) obtained from Internet geo-referencing websites powered by Google Earth™.

Distribution maps were prepared by converting the list of geographic coordinates indicating the point location of specimen records into a spatial data layer in ArcMap 9.3. The specimen location layer was overlaid on topography, vegetation, humidity zones and state boundaries in order to assist with the interpretation and location of records. The layers Major Habitat Types and country political boundaries and the shaded relief used on Figs 3.4: 217–221, 223–224, 226–230, were derived

from Hearn *et al.* (2000). The recently promulgated states of Sudan and southern Sudan are not mapped, but records are indicated as such in the material examined sections. Humidity zones (PET: Potential Evapotranspiration) used for Figs 222, 225 follow UNEP (1992). Overall coverage of records for the genus *Curtonotum* in the Afrotropical Region (including those noted for Madagascar in Chapter 3.3), are presented in Fig. 3.4: 217. Plotted points are based on material examined as part of the systematic revision only, *i.e.*, all represent confirmed identifications. Geographic coordinates in decimal degrees are provided in 3.4: Appendix. Major Habitat Types as listed in the text and in 3.4: Appendix, follow Hearn *et al.* (2000).

Labels

Type label data are quoted exactly as they appear. A division slash (/) denotes the commencement of a new line, two division slashes (//) data on a further label. Significant supplementary or qualifying information is presented in square brackets when considered necessary. Information on label colour, *etc.*, is only provided for type material. All labels are printed on white card, unless otherwise stated. Specimens with head missing are also labelled as such, *e.g.*, “Head missing 2008”. Adult morphology follows Cumming and Wood (2009) and for the male terminalia Marshall *et al.* (2010).

Comparative material examined.

The following specimens were examined from other zoogeographical regions for comparative purposes:

Curtonotum helvum (Loew, 1862)

1♀, [Canada]: Ontario, Sandbanks P.P., Picton, 29.viii.[19]81, K.N. Barber, debu01008133, *Curtonotum helvum* (Loew) det. J. Klymko 2008 (DEBU).

Curtonotum anus (Meigen, 1830)

1♀, Israel: Park HaYarden, 24.vi.1982, A. Freidberg (TAU).

SYSTEMATICS

Key to adult males of continental Afrotropical species of *Curtonotum* Macquart

(Examination of the male terminalia is required in all cases. For key to Malagasy species see Kirk-Spriggs 2011, Chapter 3.3.)

1. Frons (in profile) conspicuously projecting forwards at point of antennal insertion (Figs 3.4: 1–6, 50, 52, 54), distinctly parallel-sided (viewed dorsally) (Figs 3.4: 25–30); distiphallus subdivided into two elements: a baso-ventral process and apico-dorsal process (Figs 3.4: 92–94, 119–122); spermatheca either tubular, elongated and studded with fine protuberances (Figs 3.4: 105–107), or long, obclavate (Figs 3.4: 108–110); usually much larger species, length *ca.* > 5 mm (although much smaller individuals are known) 2
- Frons (in profile) not, or only marginally, projecting forwards at point of antennal insertion (Figs 3.4: 7–24), distinctly narrower towards oral margin (viewed dorsally) (Figs 3.4: 31–48); either distiphallus with baso-ventral process developed into a short, blade-like, partially serrated process (Figs 3.4: 136–141, 146–153), or formed of single undivided straight process (Figs 3.4: 157–162, 166–171, 175–180, 184–189); spermatheca short, obclavate with folded and rugose surface (Kirk-Spriggs 2008c, figs 1–65); usually much smaller species, length *ca.* < 5 mm 7
2. Orbital plates short, extending less than ½ length of frons (Figs 3.4: 25–27); orbital setae inserted close to one another in group proximal to vertex of frons (Figs 3.4: 1–3, 25–27, 49–54); male sternite 6 quadrate, with two divergent medial setae (Figs 3.4: 86–88, *dms*); hypandrial arms extremely narrow (Figs 3.4: 89–91, *hy*); phallapodeme only partly fused to basiphallus; basiphallus with conspicuously projecting, but narrow “lateral wing”; distiphallus distinctly recurved (Figs 3.4: 92–97); female cercus fused to tergite 10, with long terminal setulae (Figs 3.4: 98–101, *t10+ce*); spermatheca tubular, elongated, studded with fine protuberances (Figs 3.4: 105–107) *Striatifrons* species-group 3
- Orbital plates long, extending more than ⅔ length of frons (Figs 3.4: 28–30); orbital setae widely-spaced, anterior orbital seta inserted more medially on frons (Figs 3.4: 4–6, 28–30); male sternite 6 apically expanded, with U- or V-shaped apical excision, without divergent medial setae (Figs 3.4: 113–115); hypandrial

- arms broad, with broad-based rounded-truncate dorsobasal lobe (Figs 3.4: 116–118, *hy*); phallapodeme fully fused to basiphallus; basiphallus with distinct lateral projection; distiphallus less strongly recurved (Figs 3.4: 119–122); female cercus fused to tergite 10, distinctly spinose (Figs 3.4: 123–128, *t10+ce*); spermatheca long, obclavate (Figs 3.4: 108–110) *Platyphallum* species-group 5
3. Lateral wing of basiphallus with two basal projections (resembling a moose antler) (Figs 3.4: 92, 95, *lw*); male sternite 6 with extensive medial and lateral macula (Fig. 3.4: 86); *dm-cu* crossvein as illustrated in Fig. 3.4: 55; spermatheca (Fig. 3.4: 105) *C. herrero* Tsacas
- Lateral wing of basiphallus either with single angulate lateral projection (Fig. 3.4: 96, *lw*), or without basal projections (Fig. 3.4: 97, *lw*); male sternite 6 either transverse with reduced lateral macula (Fig. 3.4: 87), or quadrate without macula (Fig. 3.4: 88) 4
4. Lateral wing of basiphallus elongate, straight, wide basally, with single angulate baso-lateral projection (Figs 3.4: 93, 96, *lw*); male sternite 6 transverse with reduced lateral macula (Fig. 3.4: 87); *dm-cu* crossvein as illustrated in Fig. 3.4: 56; spermathecae (Fig. 3.4: 106) *C. maculiventris* (Enderlein)
- Lateral wing of basiphallus short, curved in apical third, wide basally, without lateral projections (Figs 3.4: 94, 97, *lw*); male sternite 6 quadrate, without maculae (Fig. 3.4: 88); *dm-cu* crossvein as illustrated in Fig. 3.4: 57; spermathecae (Fig. 3.4: 107) *C. striatifrons* Malloch
5. Lateral margin of basiphallus with angulate, subrectangular extension (Fig. 3.4: 119); male sternite 6 with lateral margins gently curved and U-shaped apical excision (Fig. 3.4: 113); *dm-cu* crossvein as illustrated in Fig. 3.4: 58; spermatheca (Fig. 3.4: 108) *C. marriott* sp. n.
- Lateral margin of basiphallus either with finger-like, evenly-rounded extension and serrated edge (Figs 3.4: 120, 121), or with finger-like, evenly-rounded extension and shallow, wide apical excision (Fig. 3.4: 122); male sternite 6 with lateral margins straight with V-shaped apical excision (Figs 3.4: 114, 115); spermathecae (Figs 3.4: 109, 110) 6
6. Lateral margin of basiphallus with finger-like, extension and serrated edge (Figs 3.4: 120, 121); male sternite 6 with shallow V-shaped apical excision (Fig. 3.4: 114); *dm-cu* crossvein as illustrated in Fig. 3.4: 59; spermatheca (Fig. 3.4: 109)
..... *C. moffatt* sp. n.

- Lateral margin of basiphallus with finger-like, evenly-rounded extension and shallow, wide apical excision (Fig. 3.4: 122); male sternite 6 with narrow V-shaped apical excision (Fig. 3.4: 115); *dm-cu* crossvein as illustrated in Fig. 3.4: 60; spermatheca (Fig. 3.4: 110) *C. platyphallum* Tsacas
- 7. Lateral lobe of epandrium with 1 very strong seta and group of shorter setae (Figs 3.4: 133–135, 142–145); distiphallus with baso-ventral process developed into a short, blade-like, partially hooked or serrated process (Figs 3.4: 136–141, 146–153) *Campsiphallum* species-group 8
- Lateral lobe of epandrium with numerous strong setae of variable length; distiphallus formed of single undivided straight process (Figs 3.4: 157–162, 166–171, 175–180, 184–189) 14
- 8. Basiphallus broad, expanded apically; baso-ventral process of distiphallus short or broad; membranous portion of distiphallus broad (Figs 3.4: 137, 140, 146, 150, 148, 152, 149, 153) 9
- Basiphallus markedly narrowed apically; baso-ventral process of distiphallus elongate; membranous portion of distiphallus narrow (Figs 3.4: 136, 139, 138, 141, 147, 151) 12
- 9. Baso-ventral process of distiphallus reduced to a spur-like process (Figs 3.4: 148, 152); male sternite 6 as illustrated in Fig. 3.4: 195; *dm-cu* crossvein as illustrated in Fig. 3.4: 72 *C. sao* Tsacas
- Baso-ventral process of distiphallus more extensively developed, forming a plate with a row of more-or-less developed teeth-like serrations on posterior margin (Figs 3.4: 137, 140, 146, 150, 149, 153) 10
- 10. Baso-ventral process of distiphallus subquadrate, with 3 teeth-like spines on posterior margin (Figs 3.4: 137, 140); male sternite 6 as illustrated in Fig. 3.4: 191; *dm-cu* crossvein as illustrated in Fig. 3.4: 68 *C. campsiphallum* Tsacas
- Baso-ventral process of distiphallus either subtriangular with 2 teeth-like spines on posterior margin, or semicircular with 3 prominent teeth-like spines on posterior margin (Figs 3.4: 146, 150, 149, 153); *dm-cu* crossvein as illustrated in Figs 3.4: 70, 73..... 11
- 11. Baso-ventral process of distiphallus subtriangular, with 2 teeth-like spines on posterior margin (Figs 3.4: 146, 150); male sternite 6 as illustrated in Fig. 3.4: 193; *dm-cu* crossvein as illustrated in Fig. 3.4: 70 *C. hay* sp. n.

- Baso-ventral process of distiphallus semicircular with 3 prominent teeth-like spines on posterior margin (Figs 3.4: 149, 153); male sternite 6 as illustrated in Fig. 3.4: 196; *dm-cu* crossvein as illustrated in Fig. 3.4: 73 *C. tsacas* sp. n.
- 12. Baso-ventral process of distiphallus with distinct basal spine in addition to ventrally developed process (Figs 3.4: 136, 139); male sternites 5 and 6 as illustrated in Fig. 3.4: 190; *dm-cu* crossvein as illustrated in Fig. 3.4: 67
..... *C. angolense* Tsacas
- Baso-ventral process of distiphallus without basal spine (Figs 3.4: 138, 141, 147, 151); *dm-cu* crossvein as illustrated in Figs 3.4: 69, 71 13
- 13. Baso-ventral process of distiphallus broad basally with one larger preapical spine and one smaller apical spine (Figs 3.4: 138, 141); male sternites 5 and 6 as illustrated in Fig. 3.4: 192; *dm-cu* crossvein as illustrated in Fig. 3.4: 69
..... *C. freidberg* sp. n.
- Baso-ventral process of distiphallus large and widely separated from distiphallus, arc-shaped, with 3 or 4 long spines on anterior margin preapically and apically (Figs 3.4: 147, 151); male sternites 5 and 6 as illustrated in Fig. 3.4: 194; *dm-cu* crossvein as illustrated in Fig. 3.4: 71 *C. quinquevittatum* Curran
- 14. Male sternite 5 laterally expanded, sternites 4–5 with modified setae (Fig. 3.4: 197); hypandrium with dorsal extension of dorsobasal lobe long and narrow (Fig. 3.4: 154); basiphallus with expanded, subdivided mid section and cordiform extension of distiphallus (Figs 3.4: 157, 160)
..... *Gonzo* species-group; one species *C. gonzo* sp. n.
- Male sternite 5 not laterally expanded, sternites 4–5 with unmodified setae; hypandrium with dorsal extension of dorsobasal lobe short and broad (Figs 3.4: 155, 156, 163–165, 172–174, 181–183); basiphallus undivided, distiphallus without cordiform extension (Figs 3.4: 158, 159, 161, 162, 166–171, 175–180, 184–189) 15
- 15. Basiphallus with long, obliquely angled, posteriorly-directed spine basally (Figs 3.4: 158, 159, 161, 162); male sternite 6 as illustrated in Figs 3.4: 198, 199
..... *Saheliense* species-group 16
- Basiphallus with one or two dorsally-directed basal spines (Figs 3.4: 166–171, 175–180, 184–189); male sternite 6 as illustrated in Fig. 3.4: 200
..... *Uncinatum* species-group 17

16. Basal region of distiphallus (viewed dorsally) with small spine on right side, widely separated from junction of basiphallus and distiphallus (Fig. 3.4: 161); male sternite 6 with shallow U-shaped apical excision (Fig. 3.4: 198); *dm-cu* crossvein as illustrated in Fig. 3.4: 75 *C. sahelense* Tsacas
- Basal region of distiphallus (viewed dorsally) with small spine on left margin near junction of basiphallus and distiphallus, immediately below base of prominent elongated spine on basiphallus (Fig. 3.4: 162); male sternite 6 with deeper V-shaped apical excision (Fig. 3.4: 199); *dm-cu* crossvein as illustrated in Fig. 3.4: 76 *C. simile* Tsacas
17. Extreme apex of dorsal edge of basiphallus developed into an apical spine or hook (Figs 3.4: 176–177, 179–180) 18
- Extreme apex of dorsal edge of basiphallus evenly-rounded, not developed into spine or hook (Figs 3.4: 166–171, 175, 178, 184–189) 19
18. Extreme apex of dorsal edge of basiphallus developed into an apical hook or extension; more apical dorsal spine of distiphallus broad basally with straight edges (Figs 3.4: 176, 179), with additional much smaller spine towards apex (not visible of Fig. 3.4: 179); *dm-cu* crossvein obliquely angled with medial bend (Fig. 3.4: 81) *C. litoralis* sp. n.
- Extreme apex of dorsal edge of basiphallus developed into an acute apical spine (Figs 3.4: 177, 180); more apical dorsal spine of distiphallus with edges very slightly angled, acutely pointed, much smaller spine towards apex absent; *dm-cu* crossvein less obliquely angled, medial bend less apparent (Fig. 3.4: 82) *C. mcgregor* sp. n.
19. Dorsal spines of distiphallus very weakly developed; basal spine only visible in lateral view (Figs 3.4: 184, 187); *dm-cu* crossvein as illustrated (Fig. 3.4: 83) *C. pauliani* Tsacas
- At least more apical dorsal spine of distiphallus well-developed (Figs 3.4: 166–171, 175, 178, 185–189); *dm-cu* crossvein as illustrated (Figs 3.4: 77–80, 84, 85) 20
20. Basal spine of distiphallus developed into a distinct, straight, dorsally-directed hook-like process (Figs 3.4: 185, 188); *dm-cu* crossvein as illustrated in Fig. 3.4: 84 *C. uncinatum* sp. n.

- Basal spine of distiphallus not developed into a distinct dorsally-directed hook (Figs 3.4: 166–171, 175, 178, 186, 189); *dm–cu* crossvein as illustrated in Figs 3.4: 77–80, 85 21
- 21. Basal spine of distiphallus either forming a long, straight, erect spine (Figs 3.4: 166, 169), or a medium-sized, upright, slightly curved and posteriorly-directed spine (Figs 3.4: 175, 178); *dm–cu* crossvein as illustrated in Figs 3.4: 77, 80 22
- Basal spine of distiphallus short or absent (Figs 3.4: 167–171, 186, 189); *dm–cu* crossvein as illustrated in Figs 3.4: 78, 79, 85 23
- 22. Basal spine of distiphallus forming a long, straight, erect spine (Figs 3.4: 166, 169); *dm–cu* crossvein as illustrated in Fig. 3.4: 77 *C. bicuspis* sp. n.
- Basal spine of distiphallus forming a medium-sized, upright, slightly curved and posteriorly-directed spine (Figs 3.4: 175, 178); *dm–cu* crossvein as illustrated in Fig. 3.4: 80 *C. cuthbertsoni* Duda
- 23. Basal spine of distiphallus partially subdivided into one strongly and one weakly sclerotised short blades (Figs 3.4: 168, 171); *dm–cu* crossvein as illustrated in Fig. 3.4: 79 *C. constance* sp. n.
- Basal spine of distiphallus very short or absent, not subdivided (Figs 3.4: 167, 170, 186, 189); *dm–cu* crossvein as illustrated in Figs 3.4: 78, 85 24
- 24. More apical spine of distiphallus relatively broad basally and sharp; basal spine very short, but erect and sharp (Figs 3.4: 167, 170); *dm–cu* crossvein as illustrated in Fig. 3.4: 78 *C. cimbebas* sp. n.
- More apical spine of distiphallus relatively narrow and blunt; basal spine absent (Figs 3.4: 186, 189); *dm–cu* crossvein as illustrated in Fig. 3.4: 85 *C. unicuspis* sp. n.

Genus *Curtonotum* Macquart, 1844

Refer to 2.0: Appendix III for synonymy.

Diagnosis

Small to medium-sized (1.9–7.7 mm; Neotropical species generally larger: 4–12 mm), distinctly robust, hunchbacked flies. Afrotropical species greyish to brown, often with vitae or speckles on thorax and pigment patterns on abdomen. *Head*: compound eye probably green-brown iridescent in living examples, in profile gently and evenly rounded anteriorly, slightly triangularly produced posteriorly; two pairs of

long, prominent fronto-orbital setae, the anterior pair proclinate, the posterior pair reclinate, with a minute reclinate seta positioned between them, close to base of posterior orbital setae socket; frons wide in both sexes. Arista plumose with long dorsal and ventral branches. *Thorax*: Mesonotum moderately convex, very slightly flattened behind head, with multiple rows of regular, short, black, overlapping setulae; 1 pair of strong dorsocentral setae and one pair of acrostichal setae; anepisternum with 2–3 long setae and some short setulae; one very long katepisternal seta accompanied by a short dorsal one. *Scutellum*: disk entirely clothed in setulae, with two pairs of strong marginal setae. *Wing*: greyish to grey-brown infusate, *dm-cu* crossvein usually markedly infusate; costa (*c*) with humeral and subcostal breaks and subcosta complete, with a variable number of prominent costal spines beyond *R*₁ longer and stronger than adjacent vestiture. *Legs*: all tibiae with preapical dorsal setae; fore femur with row of short, but strong spinules posteroventrally along distal ½ or ⅓, variable in number. *Abdomen*: long, cylindrical, telescopic, generally pale in colour with brown maculae or T-shaped lateral markings. Phallapodeme, basiphallus and distiphallus fused and asymmetrical, forms C-shaped structure. Female abdomen with tubular ovipositor, cerci sometimes fused, with spine-like setae or setulae. Spermathecae flattened, short and obclavate with a folded or rugose surface or long, tubular and studded with protuberances.

Striatifrons species-group

Notes. The *Striatifrons* species-group is defined as having sternite 6 with a pair of divergent medial setae (Figs 3.4: 86–88), the basiphallus only partially fused to the phallapodeme and the distiphallus distinctly recurved (Figs 3.4: 92–94), the lateral wing of the basiphallus forming a distinct basally expanded, but narrow blade (Figs 3.4: 92–97) and tergite 10 fused to fused cerci (*e.g.*, Figs 3.4: 98–101).

Curtonotum maculiventris (Enderlein, 1917),

Figs 3.4: 2, 26, 51, 52, 56, 62, 87, 90, 93, 96, 98, 99, 103, 106, 218.

Diplocentra maculiventris: Enderlein, 1917: 69. Type locality: “Eritrea: Asmara”. Type lost; neotype here designated: [Tanzania]: “Nyassa-See, Langenburg”.

Curtonotum maculiventris: Tsacas (1977: 170).

Curtonotum maculiventris: Wirth and Tsacas (1980: 672).

Curtonotum maculiventris: Kirk-Spriggs (2008c: 251).

= *Cyrtonotum tigrinum* Séguy, 1933: 35, **syn n.** Type locality: “Mozambique: Haut-Nhamapaza”.

Curtonotum tigrinum: Tsacas (1977: 168; figs 12 a–f, p. 169).

Curtonotum tigrinum: Wirth and Tsacas (1980: 672).

Curtonotum tigrinum: Meier *et al.* (1997: 10).

Curtonotum tigrinum: Kirk-Spriggs (2007, figs 5–8).

Curtonotum tigrinum: Kirk-Spriggs (2008c: 251).

Curtonotum tigrinum: Klymko and Marshall (2011: 8).

Redescription: Male (based on field-pinned N-T).

Measurements: Overall length 7–7.7 mm; length of head and thorax combined 4.0–4.9 mm; length of thorax and scutellum combined 3.7–3.9 mm; wing length 4.2–6.1 mm ($n = 5$, N-T).

Head (Figs 3.4: 2, 26, 51, 52). Eye height/length ratio: 17:9 ($n = 1$, N-T); frons (Fig. 3.4: 26) conspicuously projecting forwards at point of antennal insertion (viewed in profile), evenly parallel-sided, wider than long, frons length/width ratio: 12:14 ($n = 1$, N-T), ground colour pale dirty yellow, with two conspicuous red-brown vittae extending full length of frons, surface with minute inconspicuous brown setulae; orbital plates and ocellar triangle yellow-grey pruinose; ocelli clear grey with 6 minute dark setulae arranged in two closely-approximated regular rows between posterior ocelli; orbital plates short, only extending from vertex of head to $\frac{1}{3}$ length of frons; lateral margins with narrow silver pruinose fascia (adjacent to eye margin), widest at antennal insertions; orbital setae inserted proximal to one another; posterior orbital seta moderately strong, slightly outcurved, shorter than outer vertical seta, with tiny proclinate medial orbital seta inserted antero-medially to socket of posterior orbital seta; anterior orbital seta strong, slightly shorter than ocellar setae; ocellar setae same thickness, extending four-fifths length of frons; outer vertical seta slightly shorter than inner; postocellar setae strong, cruciate, shorter than outer vertical seta; antennal scape and pedicel dirty pale brown, flagellomere 1 concolourous with pedicel basally, darkened apically, grey pruinose, longer than wide, apex bluntly-pointed, arista with 14–15 long, closely approximated dorsal branches and 4 ventral branches in addition to terminal fork; lunule and face uniform silver-grey pruinose throughout, face with broad silver fascia (between eye margin and ptilinal fissure), facial carina developed as a low medially impressed ridge, extending full length of

face, clypeus brown; 1 pair weak vibrissae inserted on posterior lateral margin and 13 much finer setae bordering genal groove; occiput silver to grey pruinose with strong, black postocular setae; gena very wide, eye height/genal height ratio: 17:2 ($n = 1$, N-T), silver pruinose, with dark macula at basal angle; palpus brown, brown microtrichose.

Thorax (Fig. 3.4: 2). Silver to grey pruinose, with four wide, parallel chestnut-brown pruinose vittae on dorsal surface, 2 median vittae extending full length, 2 lateral vittae shorter, extending from $\frac{2}{3}$ length to region of posterior dorsocentral seta socket, 2 pairs of dorsocentral setae, posterior long and strong (shorter than lateral scutellar seta), anterior shorter and finer (*ca.* $\frac{1}{2}$ length of posterior); 1 pair acrostichal setae same length as anterior dorsocentral seta; presutural seta moderately strong, reclinate, weaker and shorter than posterior notopleural seta; 2 notopleural setae of similar length; 1 strong, reclinate supra-alar seta same length as posterior dorsocentral seta; 2 strong reclinate postalar setae slightly shorter than posterior dorsocentral seta; postpronotum silver-grey pruinose, with 3 strong postpronotal setae, the more dorsal as long and strong as anterior notopleural seta, medial slightly longer and stronger than presutural seta, ventral less than $\frac{1}{2}$ length of medial, with 28 finer black-brown setulae; anepisternum silver-grey pruinose with 3 strong anepisternal setae and 2 moderately strong intermediate setae, surface with 28 fine setulae scattered across surface; laterotergite and meron silver-grey pruinose, glabrous; katepisternum silver-grey pruinose, with 2 katepisternal setae, the more ventral strong, slightly dorsally-directed, the more dorsal much smaller and finer, *ca.* $\frac{1}{3}$ length of ventral katepisternal setae, surface with 14 very short, fine setulae at base and along posterior margin.

Scutellum (Fig. 3.4: 62). Silver-grey pruinose as on mesonotum, with faint medial brown pruinose vitta basally; disk clothed in black, irregular, overlapping setulae; 2 pairs of strong scutellar setae, with variable number of weaker basal and intermediate scutellar setulae.

Legs. Fore coxa silver-grey pruinose with two moderately strong, brown, ventrally-directed preapical setae and comb of finer setulae medially, with 5 brown setulae on anterior surface; mid and hind coxa silver-grey pruinose, mid-coxa with 2 very strong, lateral, ventrally-directed, black setae and comb of finer setae medially and 4 brown setulae; hind coxa with 1 weaker lateral black seta and 3 or 4 brown setulae; femora, tibia and tarsi uniform dirty yellow; fore tibia with 4–6 strong setae

on lateral margin, their relative sizes variable, with ctenidium of 17 long, sharp, black spinules, closely-packed, separated from each other by one basal spinule width.

Wing (Fig. 3.4: 56). Long, relatively narrow, tip evenly-rounded, veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in region of *dm-cu* crossvein; costa with prominent costal spines in basal four-fifths from costal break; *dm-cu* crossvein with medial angle; *cua*₁ relatively long and narrow; anal fold extending less than ½ length of *cua*₁; halter dirty yellow.

Abdomen (Fig. 3.4: 2). Ground colour of tergites 1–5 silver-yellow to grey pruinose, clothed in relatively long black, overlapping setulae, arranged in regular rows, those at apical margins longer and stronger; tergite 1 simple, devoid of maculae; tergite 2 with oblique, subquadrate brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with narrow, median fascia and well-separated and reduced concolourous subelliptical dorsolateral macula, lateral margin of tergites 2–5 with subtriangular maculae in basal ½; sternite 6 (Fig. 3.4: 87) transverse, subquadrate (may appear narrower than Fig. 3.4: 87 in undissected specimens), with reduced brown macula laterally, clothed in short black irregular brown setulae, those at apical margin longer and more prominent, with pair of preapical divergent medial setae; tergites 6 and 7 present, although weakly defined.

Terminalia (Figs 3.4: 90, 93, 96). Hypandrium (Fig. 3.4: 90, *hy*) extremely long and narrow, dorsobasal lobe only marginally wider (viewed laterally), posterior bridge formed by strikingly asymmetric large, quadrate, slightly concave plate; hypandrial arms converging apically and adjoining postgonites, no setulae proximal to postgonite, medial lobes (viewed dorsally) sclerotised basally, membranous, except on lateral margins; postgonite (Fig. 3.4: 90, *pg*) long, thin and straight, closely approximated and fused basally, with apex upturned, hook-like; epandrium (Fig. 3.4: 90, *ep*) broader ventrally than dorsally (viewed laterally), straight on dorsal and posterior margins, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 3.4: 90, *ce*) elliptical, moderately prominent, without elongate fused ventral process, longest setae as long as longest setae on ventral margin of epandrium; surstylus (Fig. 3.4: 90, *ss*) short, broad and scale-like, coming to blunt point; phallus (as in Figs 3.4: 93, *ph*, *bp*, *dp*, *lw*; 96, *lw*, *dp*) C-shaped, strongly recurved apically, heavily sclerotised, brown; phallapodeme (Fig. 3.4: 93, *ph*) only partially fused to basiphallus (connected on dorsal margin only), subtriangular

(viewed laterally), with basal margin developed into two large lateral lobes, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.4: 93, *ea*) flat, subtriangular, inserted proximal to phallapodeme; basiphallus (Fig. 3.4: 93, *bp*) broad and regular for most of its length; apical section (Fig. 3.4: 96, *dp*, *lw*) with acutely angled internal projection and conspicuous lateral wing with broad angulate baso-lateral projection with serrated margin and narrow black spine; distiphallus (Figs 3.4: 93, 96, *dp*) divided into two elements a baso-ventral process and apico-dorsal process with complex arrangement of projections as illustrated.

♀ Similar to ♂, except in the following respects: wing length 4.9–6.2 mm ($n = 5$, N-T). Postabdomen (Figs 3.4: 98, 99); sternite 8 (Figs 3.4: 98, 99, *s8*) weakly sclerotised and reduced; sternite 10 (Figs 3.4: 98, 99, *s10*) dorsoventrally flattened throughout, undivided; tergite 10 (Figs 3.4: 98, 99, *t10+ce*) fused to fused cercus, with long terminal setulae, auxiliary sclerites in region of sternite 7 as illustrated in Fig. 3.4: 103); and steramathecae illustrated in Fig. 3.4: 106.

Variation. As with *C. herrero* Tsacas (see below), this species exhibits an extreme range of sizes, with the smallest specimen examined having a wing length of only 4.2 mm (normal range 5.8–6.1 mm).

Differential diagnosis. *Curtonotum maculiventris* is mainly separable from its congeners, *C. herrero* and *C. striatifrons*, on head shape (compare Figs 3.4: 49–54), form of the terminalia, especially the shape of the distiphallus, the lateral wing of the basiphallus (Figs 3.4: 92–97) and of sternite 6 (Figs 3.4: 86–88) (see above key for details). Females of the three species can be separated on the shape of the auxiliary sclerites in the region of sternite 7 (Figs 3.4: 102–104) and the shape and structure of fine protuberances on the spermatheca (Fig. 3.4: 105–107).

Type material examined. *Curtonotum maculiventris*, [TANZANIA]: neotype ♂ (here designated), “Nyassa-See / Langenburg [= Lumbira] / IV.[18]99 / Fülleborn S. [printed & handwritten; blue card] // *Diplocentra* / *maculiventris* / Enderl. ♂ / Dr.Enderlein det.1920 [handwritten & printed] // Zool. Mus. / Berlin // NEOTYPE / *Diplocentra* / *maculiventris* Enderlein, 1917 / designated by / A.H. Kirk-Spriggs 2008 [printed; blue card]” (ZMHB). In fair condition, some setae on thorax missing, basal section of right wing and right mid tarsus damaged; direct-pinned; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Curtonotum tigrinum, MOZAMBIQUE: holotype ♀, “MUSÉUM PARIS / MOZAMBIQUE / HAUT NHAMAPAŽA / FORÉT / S. DE MARINGOUÉ [= Maringüe] / P. LESNE 1929 [printed; pale blue card, black border] // Crottin frais / d’éléphant / 10 juin [handwritten] // TYPE [printed in red] // *Cyrtonotum / tigrinum* ♀ / type / E. SÉGUY det. 1933 [handwritten & printed] // HOLOTYPE [printed in black; red card] // *Curtonotum* ♀ / *tigrinum* Séguy, 1933 / A.H. Kirk-Spriggs *vidit* 2006” (MNHN). In good condition, right and left mid tarsus missing, right and left hind tarsus damaged; direct-pinned; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (both labelled: “*Curtonotum* ♀ / *tigrinum* Séguy, 1933 / A.H. Kirk-Spriggs *vidit* 2006”): MOZAMBIQUE: 1 ♀, same labels as holotype except: “11 Juin // PARATYPE [printed in black; red card] // *Curtonotum / tigrinum* Séguy / Paratype (cotype) / L. Tsacas 1976” (MNHN); 1 ♀, “MUSÉUM PARIS / ZAMBÉZE / BAS SANGADZÉ / PINDIRI A CHEMBA / P. LESNE 1929 [printed; pale blue card, black border] // 7 AVRIL // *Cyrtonotum / tigrinum* ♀ / cotype / E. SEGUY det. 1933 [handwritten & printed]” (both MNHN).

Remarks. Enderlein (1917: 69) described *Diplocentra maculiventris* based on a single ♀ specimen citing (p. 70) “Nordostafrika. Eritrea. Asmara. Dezember 1907. 1 ♀ gesammelt von Kristensen.” as the Type locality and noting, “Type im Stettiner Zoologischen Museum.” The type specimen was transferred to the Polish Academy of Sciences from the Stettiner Zoologischen Museum following World War II. Tsacas (1977: 170–171, as *Curtonotum*) examined the type for his revision of the genus *Curtonotum* stating “The type of this species is deposited at the Zoological Institute of the Polish Academy of Sciences in Warsaw, and was put at our disposal by Dr E. Nikolajczyk [*sic* = Mikolajczyk] ... Study of the type allows us to place *maculiventris* in the *striatifrons*-group. It is virtually impossible to differentiate it from *striatifrons* and *tigrinum*. The identity of this species can therefore not be confirmed until corresponding male material is located” (translation M. De Meyer).

The type specimen of *Diplocentra maculiventris* is missing from MZPW (W. Tomaszewska, pers. comm. 2006), although a name for that species is present in the original drawer of specimens transferred from Stettin. Moreover, there is no record of the type specimen having been transferred to the MZPW from Stettin in the catalogue by Kleine, or of the specimen having been loaned subsequent to Tsacas’ examination. It must be concluded therefore, that the specimen is lost and a neotype is here designated in accordance with Articles 75.3.4 and 75.1 of *ICZN*, in order to fix the identity of the name.

A male in the ZMHB, bearing the labels “Nyassa-See, Langenburg, IV.99, Fülleborn S. *Diplocentra maculiventris* ♂ Dr Enderlein det. 1920” is proposed as neotype. Although Enderlein’s identification of this specimen post-dates the appearance of the description of *Diplocentra maculiventris* by three years, it is the only specimen located bearing an Enderlein *Diplocentra maculiventris* det. label. This specimen is identical with the three ♀ types of *Curtonotum tigrinum* Séguy, 1933 (in MNHN), and to Tsacas’ (1977) supplementary description and illustrations of the male. As the description of *Curtonotum maculiventris* (Enderlein, 1917), predates that of *Curtonotum tigrinum* Séguy, 1933, the latter is placed as a junior synonym.

Additional material examined (all labelled: “*Curtonotum maculiventris* (Enderlein, 1917) ♂ [or ♀] det. A.H. Kirk-Spriggs 2006”): BOTSWANA: 1♂, 1♀, Botswana (B22), R. Semowane, 20°25’S, 26°23’E, 23–24.iv.1972, Southern African Exp. B.M.1972–1, *Curtonotum tigrinum* Séguy L. Tsacas det. 1976 (BMNH). [BURUNDI]: 2♂, 1♀, Musée du Congo, Urundi: Rumonge, 1934, A. Lestrade, BM, *Curtonotum tigrinum* Séguy L. Tsacas det. 197[6] (RMCA). [CHAD]: 1♀, Muséum Paris, Kiem-Kaga ou Kiembaga (Région Boisée) [= Kiemkaga], Mission Chari-Tchad, Dr. J. Decorse, Mai 1904, *Curtonotum tigrinum* Séguy L. Tsacas det. 1977 (MNHN). CÔTE D’IVOIRE: 1♀, Museum Paris, Côte d’Ivoire, Laguna d’Ebrié [= Legune Ebrie], Pouillot, 1912, *Curtonotum tigrinum* Séguy L. Tsacas det. 1977 (MNHN). [DEMOCRATIC REPUBLIC OF CONGO] (ZAÏRE): 1♂, 1♀, Coll. Mus. Congo, Tanganyika: Moba, 780 m, VIII-X.1953, H. Bomans, *Curtonotum tigrinum* Séguy L. Tsacas det. 1976 (RMCA). [MALAWI]: 1♂, 1♀, Florence Bay, Lake Nyasa, 5.xi.07, Capt. Hardy Coll. R.A.M.C., 1908.90, [♂ labelled: *Curtonotum striatifrons* Mall. 13 ex. det. J.C. Deeming 1965], *Curtonotum tigrinum* Séguy L. Tsacas det. 1976; 1♀, Brit. Centr. Africa, Upper Shire [= Mangochi], 1,500 ft., 20.i.1906, E.L. Rhoades, 1907–147, *Curtonotum tigrinum* Séguy L. Tsacas det. 1976; 1♀, Brit. Centr. Africa, [no locality], 1907, Dr. J.E.S. Old, 1907–348, *Curtonotum tigrinum* Séguy L. Tsacas det. 1976 (all BMNH); 3♂, 1♀, Brit. Centr. Africa, Fort Johnston, 1,500 ft., 13.iii.1906, E.L. Rhoades, 1907–147, *Curtonotum tigrinum* Séguy L. Tsacas det. 1976 (3♂, 1♀ BMNH; 1♂ MNHN). NIGERIA: 4♂, 1♀, N. Nigeria, River Bagel at crossing of Bauchi-Dass road, 3.iv.1990, J.C. Deeming, roosting in moist cave in bank of dry river, NMNW.1981–001 [1♂ labelled *Curtonotum striatifrons* Malloch ♂ det. J.C. Deeming 1990] (NMWC). SOUTH AFRICA: 1♂, 1♀, South Africa, Transvaal, Kruger Park, 9.xii.1972, Timbavati River banks riparian bush, road S-39, B. & P. Stuckenberg, *Curtonotum tigrinum* Séguy L. Tsacas det. 1976 [♂ head missing]; 2♂, 1♀, South Africa, Transvaal, Kruger Park, xii.1972, Sabie River 4 Km E Skukuza, *Ficus* gallery forest, 2431Dc, B. & P. Stuckenberg, *Curtonotum tigrinum* Séguy L. Tsacas det. 1976 [♀ head missing]; 1♂, So. Africa, Transvaal, Pafuri, N, Kruger NL Pk., 22–23.iv.1981, 22°27’S, 31°17’E, nr. Levuhu Riv., R.M. Miller & P.A. Stabbins (all NMSA); 1♀, S. Afr., N. Tvl, Phalaborwa, 23°57’S, 31°05’E, xii.1989, S. Vokes (AMGS); 1♂, South Africa, Natal, Mtubatuba, 24–25.iii.1968, Paul J. Spangler, *Curtonotum tigrinum* Séguy L. Tsacas det. 1973 (USNM); 2♀, M’fongosi, Zululand, W.E. Jones, Mar.–Apr. 1934 (SAMC);

1♂, South Africa, TVL, Kruger Nat. Park, Pafuri, 22.26S 31.12E, 29.i.1984, M.W. Mansell, Collected at light, Curtonotidae, *Curtonotum cuthbertsoni* Duda (PPRI). SUDAN: 2♂, 1♀, Sudan, Roseires, 16.v.1944, Sudan Govt., Com. Inst. Ent. Coll. No. 11245, *Cyrtotum striatifrons* Mall. van Emden det. 1949, Pres. by Com. Inst. Ent. B.M.1950–323, *Curtonotum tigrinum* Séguy L. Tsacas det. 1976 [1♂ head missing] (BMNH). [TANZANIA]: 1♂, 2♀, Nyassa-See, Langenburg [= Lumbira], IV.[18]99, Fülleborn S; 3♂, 1♀, same except: V.[18]98; 1♀, same except: Ende III.–Ant IV.[18]98; 1♂, same except: Ende IV.[18]98 (all ZMHB); 1♀, East Africa: Dar-es-Salaam, 14.i.1918, A.W.J. Pomeroy, 1919–276, *Curtonotum tigrinum* Séguy L. Tsacas det. 1976; 1♂, Tanzania, [no locality], 19, Ex Coll. W.H. Potts, B.M. 1967–472, 6412, *Curtonotum tigrinum* Séguy L. Tsacas det. 1976 (both BMNH). [ZIMBABWE]: 2♂, 1♀, S. Rhodesia, Chipinda Pools [= Chipinga], Lower Lundi R., Tsetse Fly Ops., 28.x.1960, R. Goodier [1♂ labelled: 1377; 1♂ labelled: 1378; ♀ labelled: 1379], *Curtonotum tigrinum* Séguy L. Tsacas det. 1976 [♀ head missing]; same except: 2♂, 25.x.1960, 1343; 1♂, 21.x.1960, 1319; 1♂, 22.x.1960, 1335; 1♀, 23.x.1960, 1337 (all BMNH); 1♂, Zimbabwe, Zambezi, 16°08'S 30°15'E, SE Angwa Bridge M3, Sept. 1988, leg. J. Weyrich, *Curtonotum tigrinum* Ség. ♂ det. Schacht, , Zoologische Staatssammlung München; 1♀, Zimbabwe, Zambezi, 16°10'S 29°25'E, Rukometje-Res. St. RM2, Juni 1988, leg. J. Weyrich, Zoologische Staatssammlung München (both ZSM).

Distribution. Botswana, Burundi, Chad, Côte d'Ivoire, Democratic Republic of Congo, Malawi, Mozambique, Nigeria, South Africa, Sudan, Tanzania and Zimbabwe (Fig. 3.4: 218). A species largely confined to medium to high elevations between *ca.* 801–1200 m, although there are two isolated coastal records.

Bionomics. Occurring in 13 habitat types; predominantly in Tropical and Subtropical Grasslands, Savannas and Shrublands, with records from Tropical and Subtropical Moist Broadleaf Forests and Montane Grasslands vegetation types (3.4: Appendix). Collected at light and from fresh dung of the African Bush Elephant in Mozambique and roosting in a moist cave in a dry riverbank in Nigeria. Tsacas (1977: 147, as *C. tigrinum*) further notes a report by Stuckenberg (*in lit.*) that in the Kruger National Park, South Africa “... [the species] was found to live in burrows in the ground occupied by warthogs, and seemed invariably to be present in such burrows, resting on the walls a few feet down from the entrance.”

Curtonotum herrero Tsacas, 1977,

Figs 3.4: 1, 25, 49, 50, 55, 61, 86, 89, 92, 95, 102, 105, 218.

Curtonotum herrero: Tsacas, 1977: 156; fig. 5 a–e, p. 156. Type locality: [Namibia] “S.-O. Africa (29): Kahn River, 8 km W. Usakos”.

Curtonotum herrero: Wirth and Tsacas (1980: 672).

Curtonotum herrero: Kirk-Spriggs (2008c: 251).

Curtonotum herrero: Klymko and Marshall (2011: 8).

Redescription: *Male* (primarily based on field-pinned N-T).

As redescribed for *C. maculiventris* (above), differing in the following respects:

Measurements: Overall length unknown; 6–9 mm (Tsacas 1977: 157); length of head and thorax combined 3.5–4.5 mm; length of thorax and scutellum combined 2.8–3.8 mm; wing length 3.6–6.0 mm ($n = 5$, N-T).

Head (Figs 3.4: 1, 25, 49, 50). Eye height/length ratio: 15:9 ($n = 1$, N-T); frons (Fig. 3.4: 25) length/width ratio: 11:13 ($n = 1$, N-T); arista with 10–11 dorsal branches and 2 or 3 ventral branches in addition to terminal fork; eye height/genal height ratio: 15:3 ($n = 1$, N-T).

Thorax (Fig. 3.4: 1). Postpronotum with 18 fine black-brown setulae; the more dorsal katepisternal seta *ca.* $\frac{1}{2}$ length of ventral katepisternal setae.

Scutellum (Fig. 3.4: 61).

Legs. Fore tibia with ctenidium of 16–18 long, sharp, black spinules.

Wing (Fig. 3.4: 55). *dm–cu* crossvein virtually straight.

Abdomen. Sternite 6 (Fig. 3.4: 86) subquadrate (may appear narrower than Fig. 3.4: 86 in undissected specimens) with extensive brown macula laterally and antero-medially, setulae at apical margin long and prominent, with pair of preapical divergent medial setae.

Terminalia (Figs 3.4: 89, 92, 95). Hypandrium (Fig. 3.4: 89, *hy*); postgonite (Fig. 3.4: 89); epandrium (Fig. 3.4: 89, *ep*); cercus (Fig. 3.4: 89, *ce*); surstylus (Fig. 3.4: 89, *ss*); phallus (as in Figs 3.4: 92, *ph*, *bp*, *dp*, *lw*; 95, *lw*, *dp*); phallapodeme (Fig. 3.4: 92, *ph*); ejaculatory apodeme (Fig. 3.4: 92, *ea*); basiphallus (Fig. 3.4: 92, *bp*) apical section (Fig. 3.4: 95, *dp*, *lw*) with conspicuous lateral wing with two basal

projections (resembling moose antler); distiphallus (Figs 3.4: 92, 95, *dp*) with complex arrangement of projections as illustrated.

♀ Similar to ♂, except in the following respects: wing length 3.9–6.1 mm ($n = 4$, N-T). Auxiliary sclerites in region of sternite 7 as illustrated in Fig. 3.4: 102 and Spermatheca as illustrated in Fig. 3.4: 105.

Variation. As is the case with *C. maculiventris* (noted above), this species exhibits an unusually extreme range of sizes, with the smallest specimen examined having a wing length of only 3.6 mm (normal range 5.4–6.0 mm). Such size extremes may be directly related to the larval breeding medium, early pupariation often being triggered by poor larval food availability with smaller resultant imagoes.

Differential diagnosis. *Curtonotum herrero* is mainly separable from its congeners, *C. maculiventris* and *C. striatifrons*, on head shape (compare Figs 3.4: 49–54), form of the terminalia, especially the shape of the distiphallus, the lateral wing of the basiphallus (Figs 3.4: 92–97) and of sternite 6 (Figs 3.4: 86–88) (see above key for details). Females of the three species can be separated on the shape of the auxiliary sclerites in the region of sternite 7 (Figs 3.4: 102–104) and the shape and structure of fine protuberances on the spermatheca (Fig. 3.4: 105–107).

Type material examined. [NAMIBIA]: holotype ♂, “Holo- / type [paper disc with pale red border] // S.W. AFRICA (29) / [blue line] Kahn River, 5 mls. / N. Usakos / 30–31.i.1972 // Southern / African Exp. / B.M.1972–1 // HOLOTYPE [printed; dark red card] // CURTONOTUM / *herrero* / n.sp. / L. TSACAS DET. 1976 [printed & handwritten] // *Curtonotum* / *herrero* Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006” (BMNH). In fair condition, left wing, right fore tibia and fore tarsus; left fore tarsus, left and right hind tibia and hind tarsus missing; scutellar setae missing or damaged; re-staged on nu-poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “CURTONOTUM / *herrero* n.sp. / L. TSACAS DET. 1976 [printed & handwritten] // *Curtonotum* / *herrero* Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006”): ANGOLA: 1♀, “Para- / type [paper disc with yellow border] // ANGOLA (A15) / [blue line] R.Giraul, 10 mls. / NE. Mocamedes / 27–29.ii.1972 // Southern / African Exp. / B.M.1972–1” (BMNH); 1♂, “ANGOLA: / 10 mi. SW. of / Quirimbo ♂ / VI-1-[19]58, 180m // E.S. Ross & / R.E. Leech / collectors // PARATYPE [printed; dark red card]” (CAS). [NAMIBIA]: 1♂, “Para- / type [paper disc with yellow border] // S.W.AFRICA (31) / Okahandja / 2–4.ii.1972 // Southern / African Exp. / B.M.1972–1” (BMNH); 1♂,

“S.W.AFRICA (31) / Okahandja / 2-4.ii.1972 // Southern / African Exp. / B.M.1972-1 // PARATYPE [printed; red card]” (MNHN).

Remarks. Tsacas (1977: 157) lists two male paratypes from Okahandja, but only one is present in the BMNH collection. The second specimen is in fact deposited in MNHN. Tsacas (1977: 157) also lists the label data of the paratype from Angola as “16 km S.W. of Quirimbo ...”, in truth the label reads “10 mi. SW of Quirimbo ...”.

Additional material examined (all labelled “*Curtonotum herrero* Tsacas, 1977 det. A.H. Kirk-Spriggs 2006”): [NAMIBIA], 1♂, S.W. Africa, Okahandja, 3–9.ii.1928, R.E. Turner, Brit. Mus. 1928–119 (BMNH); 1♂, Okahandja [SE2116Dd], 29.3.[19]52, [ex coll. Fritz Gaerdes] (NMSA); 1♂, same data, except: 29.iii.[19]52, *Curtonotum herrero* sp. n. L. Tsacas det. 1977 (MNHN); 10♂, 3♀, Khorixas District, River on Amkarab 269 at: 19°50′12″S 14°42′16″E, 24–26.v.2001, A.H. Kirk-Spriggs & E. Marais, Malaise traps (NMNW); 1♂, Windhoek District, Davelsaub 29, 22°25′58″S 16°09′5″E, 01.iii.2004, A.H. Kirk-Spriggs, ephemeral riverbed (NMNW).

Distribution. Angola and Namibia (Fig. 3.4: 218). Restricted to higher elevations in the Namibian and Angolan sections of the Great Escarpment.

Bionomics. Occurring in six habitat types; predominantly in Deserts and Xeric Shrublands, with one record from the Tropical and Subtropical Grasslands, Savannas and Shrublands vegetation type (3.4: Appendix). Sampled with Malaise traps in ephemeral riverbeds in Namibia.

Curtonotum striatifrons Malloch, 1930,

Figs 3.4: 3, 27, 53, 54, 57, 63, 88, 91, 94, 97, 100, 101, 104, 107, 218.

Cyrtotum striatifrons: Malloch, 1930: 325; figs 6 a–c, p. 158. Type locality: [Chad]: “Bahr el Ghazal”.

Curtonotum striatifrons: Curran (1933: 3).

Curtonotum striatifrons: Tsacas (1977: 166; figs 11 a–e, p. 167).

Curtonotum striatifrons: Wirth and Tsacas (1980: 672).

Curtonotum striatifrons: Kirk-Spriggs (2008c: 251).

Curtonotum striatifrons: Klymko and Marshall (2011: 8).

Redescription: Male (primarily based on field-pinned N-T).

As redescribed for *C. maculiventris* (above), differing in the following respects:

Measurements: Overall length unknown; 9 mm (Tsacas 1977: 168); length of head and thorax combined 3.9 mm; length of thorax and scutellum combined 3.6 mm; wing length 5.8 mm ($n = 1$, N-T).

Head (Figs 3.4: 3, 27, 53, 54). Eye height/length ratio: 16:10 ($n = 1$, N-T); frons (Fig. 3.4: 27) length/width ratio: 10:13 ($n = 1$, N-T); arista with 11–13 dorsal branches and 2–5 ventral branches in addition to terminal fork; clypeus pale brown; 1 pair very weak vibrissae and 9 much finer setae bordering genal groove; gena very wide, eye height/genal height ratio: 16:3 ($n = 1$, N-T).

Thorax (Fig. 3.4: 3).

Scutellum (Fig. 3.4: 63).

Legs. Fore femur with ctenidium of 16–17 black spinules.

Wing (Fig. 3.4: 57). *dm–cu* crossvein very gently curved.

Abdomen. Sternite 6 (Fig. 3.4: 88) quadrate (may appear narrower than Fig. 3.4: 88 in undissected specimens), with macula apparently absent (only macerated specimen available), clothed in short black irregular brown setulae, those at apical margin longer and more prominent, with pair of preapical divergent medial setae.

Terminalia (Figs 3.4: 91, 94, 97). Hypandrium (Fig. 3.4: 91, *hy*); postgonite (Fig. 3.4: 91); epandrium (Fig. 3.4: 91, *ep*); cercus (Fig. 3.4: 91, *ce*); surstylus (Fig. 3.4: 91, *ss*); phallus (as in Figs 3.4: 94, *ph*, *bp*, *dp*, *lw*; 97, *lw*, *dp*); phallapodeme (Fig. 3.4: 94, *ph*); ejaculatory apodeme (Fig. 3.4: 94, *ea*); basiphallus (Fig. 3.4: 94, *bp*) apical section (Fig. 3.4: 97, *dp*, *lw*) with small acutely angled internal projection and conspicuous lateral wing without projections or serrations and black spine; distiphallus (Figs 3.4: 94, 97, *dp*) with complex arrangement of projections as illustrated, extreme apex with semicircular projections.

♀ Similar to ♂, except in the following respects: wing length 5.7 mm ($n = 1$, LT). Postabdomen as illustrated in Figs 3.4: 100, 101, auxiliary sclerites in region of sternite 7 as illustrated in Fig. 3.4: 104 and steramathecae as illustrated in Fig. 3.4: 107.

Variation. As the species is only known from 3 specimens, insufficient material is available to assess variability.

Differential diagnosis. *Curtonotum striatifrons* is mainly separable from its congeners, *C. herrero* and *C. maculiventris*, on head shape (compare Figs 3.4: 49–54), form of the terminalia, especially the shape of the distiphallus, the lateral wing of the basiphallus (Figs 3.4: 92–97) and of sternite 6 (Figs 3.4: 86–88) (see above key for details). Females of the three species can be separated on the shape of the auxiliary sclerites in the region of sternite 7 (Figs 3.4: 102–104) and the shape and structure of fine protuberances on the spermatheca (Figs 3.4: 105–107).

Type material examined. CHAD: lectotype ♀ (here designated), “Type [paper disc; red border] // W.T.R.L. [printed vertically on card] / L. Bahr-el-Ghazal / C. Capt. Bourdillion / D. 12.6.22 / No. 14164 / [printed & handwritten horizontally] // WTRL [printed vertically on card] / Ent. Coll. / 14164 [printed & handwritten] // Pres. By / Imp. Inst. Ent. / Brit. Mus. / 1931-454 // *Cyrtonotum / striatifrons* / Type / Det. / J.R. Malloch // LECTOTYPE ♀ / *Cyrtonotum / striatifrons* Malloch, 1930 / designated by / A.H. Kirk-Spriggs 2008” (BMNH). In good condition, right antenna missing; left mid tarsus missing, right hind tarsus damaged; re-staged on nu-poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Remarks. Malloch (1930: 326) described the female of this species, citing the type material as: “*Type*, and one paratype, Bahr el Ghazal, 14.vi.1922, No. 14165, W. T. R. L. (*Capt. Boutdillon*). Returned to the Imperial Bureau of Entomology.”

A single female specimen, bearing these labels, plus the label “*Cyrtonotum / striatifrons* / Type / Det. / J.R. Malloch” is housed in the BMNH, to which the collection of the Imperial Bureau of Entomology was transferred in 1931. The whereabouts of the female paratype bearing the same labels is unknown. As it is not clear whether Malloch labelled the cited paratype as “*Type*” or “*Paratype*”, this specimen is here regarded as a syntype, not the holotype, as referred to by Tsacas in his 1977 paper. In the same paper Tsacas erroneously regarded a second male specimen from Gadau in northern Nigeria as the “*Allotype*” and described and illustrated the unknown male on the basis of this specimen. Although representing the then unknown male of *C. striatifrons*, this specimen was not cited as a “*Type*” by Malloch, it does not bear a Malloch determination label, its date of capture (6.1933) post-dates the publication of the description of the species by three years, and it has

no type status or bearing in nomenclature. The yellow rimmed “Paratype” label on this specimen was added later and also has no bearing.

Malloch (1930: 326) cited the collector of the type material as “*Capt. Boutdillion*”, whereas Tsacas (1977: 168) cites this as “*Capt. Bontdillon*”, the former being correct. Tsacas further cites the date of capture of the type as “14.VI.1922” although the label bears the date “12.6.22”.

The female syntype from Bahr el Ghazal is here designated as lectotype.

Additional material examined (all labelled: “*Curtonotum striatifrons* Malloch, 1930 ♂ [or ♀] det. A.H. Kirk-Spriggs 2006”): NIGERIA: 1♂, (erroneously cited as the “Allotype” of *Curtonotum striatifrons* by Tsacas 1977: 166), N. Nigeria: Gadau, vi.1933, Buxton & Lewis, Pres.by Imp. Inst. Ent., B.M.1934–137, *Cyrtonotum striatifrons* Mall. det. G.A.K. Marshall, *Curtonotum striatifrons* Allotype ♂ Malloch L. Tsacas det. 1976 (BMNH). SUDAN: 1♀, Muséum Paris, Soudan-Egyptien, Roseires, Haut nil Blue, Ch. Alluaud, Décembre 1909 (MNHN).

Distribution. Chad, Nigeria and Sudan (Fig. 3.4: 218). The three known records for the species indicate that it is restricted to the Dry Savanna climatic zone, not to the true Sahel (or Wooded Steppe) climatic zone, and occurs in the 1600–2000 mm Potential Evapotranspiration zone.

Bionomics. Occurring in three major habitat types and in the Tropical and Subtropical Grasslands, Savannas and Shrublands vegetation type (3.4: Appendix).

Platyphallum species-group

Notes. The *Platyphallum* species-group is defined as having the basiphallus with extensive angulate, ventrally expanded and concave process and the lateral wing of basiphallus forming a broad lateral extension of the basiphallus (Figs 3.4: 119–122).

***Curtonotum marriott* Kirk-Spriggs, sp. n.,**

Figs 3.4: 4, 28, 58, 64, 108, 113, 116, 119, 123, 124, 219.

Etymology. The specific epithet *marriott* is a noun in apposition, named in honour of Moore Marriott (1885–1949), British comedy actor of the 1930s, who played the toothless old loon in company with Will Hay and Graham Moffatt.

Description: Male (primarily based on field-pinned HT).

Measurements: Overall length unknown (the ♀ measures 6.0 mm; $n = 1$, PT); length of head and thorax combined 3.3–3.4 mm; length of thorax and scutellum combined 3.2–3.4 mm ($n = 2$, HT/PT); wing length 5.0 mm ($n = 1$, HT).

Head (Figs 3.4: 4, 28). Eye height/length ratio: 13:8 ($n = 1$, HT); frons (Fig. 3.4: 28) conspicuously projecting forwards at point of antennal insertion (viewed in profile), evenly parallel-sided, wider than long, frons length/width ratio: 9:12 ($n = 1$, HT), ground colour pale dirty yellow, with two pale brown vittae extending full length of frons, surface with minute, but conspicuous brown setulae; orbital plates and ocellar triangle silver-grey pruinose; ocelli clear grey with 6 minute dark setulae arranged in two closely-approximated regular rows between posterior ocelli; orbital plates long, extending from vertex of head to more than $\frac{2}{3}$ length of frons; lateral margins with narrow silver pruinose fascia (adjacent to eye margin), widest at antennal insertions; posterior and anterior orbital setae widely spaced, the latter inserted beyond $\frac{1}{2}$ length of frons; posterior orbital seta moderately strong, slightly outcurved, shorter than outer vertical seta, with tiny proclinate medial orbital seta inserted immediately ventral to socket of posterior orbital seta; anterior orbital seta rather weak, $\frac{2}{3}$ length of ocellar setae; ocellar setae thicker, extending four-fifths length of frons; outer vertical seta slightly shorter than inner; postocellar setae strong, cruciate, shorter than outer vertical seta; antennal scape and pedicel dirty pale brown, flagellomere 1 concolourous with pedicel basally, darkened apically, grey pruinose, longer than wide, apex bluntly-pointed, arista with 9–11 long, widely-spaced dorsal branches and 3–5 ventral branches in addition to terminal fork; lunule and face uniform silver-grey pruinose throughout, face with broad silver fascia (between eye margin and ptilinal fissure), facial carina developed as a moderately pronounced low ridge, extending full length of face; clypeus pale yellow; 1 pair weak vibrissae inserted on posterior lateral margin and 16 much finer setae bordering genal groove; occiput silver to grey pruinose with strong, black postocular setae; gena very wide, eye height/genal height ratio: 13:1 ($n = 1$, HT), silver pruinose, with dark macula at basal angle; palpus black-brown, brown microtrichose.

Thorax (Fig. 3.4: 4). Silver to grey pruinose, with four wide, parallel chestnut-brown pruinose vittae on dorsal surface, 2 median vittae extending posteriorly to region of anterior dorsocentral seta socket, 2 lateral vittae shorter, extending from $\frac{2}{3}$ length to region of posterior dorsocentral seta socket, 2 pairs of dorsocentral setae, posterior long and strong (shorter than lateral scutellar seta), anterior shorter and finer (*ca.* $\frac{1}{2}$ length of posterior); 1 pair acrostichal setae same length as anterior dorsocentral seta; presutural seta moderately strong, reclinate, weaker and shorter than posterior notopleural seta; 2 notopleural setae of similar length; 1 strong, reclinate supra-alar seta same length as posterior dorsocentral seta; 2 strong reclinate postalar setae slightly shorter than posterior dorsocentral seta; postpronotum yellow silver-grey pruinose, with 2 strong postpronotal setae of same size, finer and shorter than anterior notopleural seta, with 19 finer black-brown setulae; anepisternum silver-grey pruinose with 3 strong anepisternal setae and 2 moderately strong intermediate setae, surface with 34 fine setulae scattered across surface, with one group of 5 longer in posterior corner; laterotergite and meron silver-grey pruinose, glabrous; katepisternum silver-grey pruinose, with 2 katepisternal setae, the more ventral strong, dorsally-directed, the more dorsal much smaller and finer, *ca.* $\frac{1}{3}$ length of ventral katepisternal setae, surface with 25 short, fine setulae at base and along posterior margin.

Scutellum (Fig. 3.4: 64). Silver-grey pruinose as on mesonotum, with faint medial brown pruinose vitta basally; disk clothed in black, irregular, overlapping setulae; 2 pairs of strong scutellar setae, with variable number of weaker basal and intermediate scutellar setulae.

Legs. Fore coxa silver-grey pruinose with two moderately strong, brown, ventrally-directed preapical setae, with 20 brown setulae on anterior surface; mid and hind coxa silver-grey pruinose, mid-coxa with 2 very strong, lateral, ventrally-directed, black setae and comb of finer setae medially and 10 black setulae; hind coxa with 1 weaker lateral black seta, one ventral black seta and group of brown setulae; femora, tibia and tarsi uniform dirty yellow; fore tibia with 4 strong setae on lateral margin, distance between most basal and second basal greater, with ctenidium of 12–17 very short, sharp, black spinules, widely-spaced, separated from each other by 1–3 basal spinule widths.

Wing (Fig. 3.4: 58). Long, relatively narrow, tip evenly-rounded, veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in region of *dm-cu* crossvein; costa with prominent costal spines in basal four-

fifths from costal break; *dm-cu* crossvein with acute angle; *cua*₁ relatively long and narrow; anal fold extending less than ½ length of *cua*₁; halter dirty yellow.

Abdomen. Ground colour of tergites 1–5 yellow-grey pruinose, clothed in relatively long black, overlapping setulae, arranged in regular rows, those at apical margins longer and stronger; tergite 1 simple, devoid of maculae; tergite 2 with oblique, subrectangular brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with wide, concolourous median fascia and well-separated and reduced concolourous T-shaped dorsolateral macula, lateral margin of tergites 2–5 with subelliptical concolourous macula in basal ½ to third; sternite 6 (Fig. 3.4: 113) medially expanded (may appear narrower than Fig. 3.4: 113 in undissected specimens), with sides evenly rounded, with relatively deep, U-shaped apical excision, clothed in short black irregular brown setulae, those at apical margin longer and more prominent.

Terminalia (Figs 3.4: 116, 119). Hypandrium (Fig. 3.4: 116, *hy*) short and broad, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded to slightly angulate in profile); hypandrial arms curved, narrow basally, expanded apically (viewed laterally), with 1 setulae proximal to postgonite (obscured by epandrium on Fig. 3.4: 116), sclerotised area of medial lobes (viewed dorsally), expanded medially, narrowed apically, not overlapping; postgonite (Fig. 3.4: 116, *pg*) weakly sclerotised, long, narrow and straight, free basally; epandrium (Fig. 3.4: 116, *ep*) slightly broader dorsally than ventrally (viewed laterally), straight on dorsal margin, posterior margin slightly angled posteriorly, ventral margin with extensive row of long, regular to irregular, apically-directed setae; cercus (Fig. 3.4: 116, *ce*) not prominent, longest setae longer than longest setae on ventral margin of epandrium, with elongate fused ventral process; surstylus (Fig. 3.4: 116, *ss*) relatively long, widest basally, narrowed in apical ⅔; phallus (as in Fig. 3.4: 119, *ph*, *bp*, *dp*) C-shaped, heavily sclerotised, brown; phallapodeme (Fig. 3.4: 119, *ph*) fully fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two narrow lateral lobes, bifurcated at point of connection with hypandrium; ejaculatory apodeme (missing from specimen figured in Fig. 3.4: 119) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Fig. 3.4: 119, *bp*) narrow and regular for basal ½, then abruptly narrowed, with heavily sclerotised spur-like extension of left side clearly visible through cuticle, inner lateral

margin developed into convex, prominent angulate, subrectangular extension, with semicircular indentation before distiphallus; distiphallus (Fig. 3.4: 119, *dp*) short, subdivided into forked baso-ventral process (Fig. 3.4: 119, *bvp*) and straight apico-dorsal process.

♀ Similar to ♂, except in the following respects: wing length 4.7–5.1 mm ($n = 2$, PT). Postabdomen (Figs 3.4: 123, 124) sternite 8 (Figs 3.4: 123, 124, *s8*) weakly sclerotised and reduced; sternite 10 (Figs 3.4: 123, 124, *s10*) laterally flattened proximally, with medial division; tergite 10 (Figs 3.4: 123, 124, *t10+ce*) fused to free cerci spinose; spermatheca (Fig. 3.4: 108) long, smooth, obclavate.

Variation. As only 4 specimens are known, insufficient material is available to assess variability.

Differential diagnosis. *Curtonotum marriott* sp. n. is mainly separable from its congeners, *C. moffatt* sp. n. and *C. platyphallum*, on the form of the male terminalia, especially the shape of the distiphallus (Figs 3.4: 119–122) and of male sternite 6 (Figs 3.4: 113–115) (see above key for details). Females of *Curtonotum marriott* sp. n. can be separated from its congeners by the 2 distinct basal spots on sternite 6 (Figs 3.4: 123–124), that are absent in *C. moffatt* sp. n. and *C. platyphallum*. Given the degree of inter- and intraspecific variation in the shape of the spermatheca (Fig. 3.4: 108) in other species with obclavate spermathecae, it is unlikely that the shape of this structure has any value in distinguishing the species.

Type material examined. NIGERIA: holotype ♂, “Ibadan / Nigeria / Afr iv.24.[19]36 [printed & handwritten] // VanZwal- / uwenburg / &McGough // HOLOTYPE ♂ / *Curtonotum / marriott* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (USNM). In good condition; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ / *Curtonotum / marriott* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”): CAMEROON: 1♂, 2♀, “CAMEROON / Kribi (beach) / 28–29,XI.1987 / FINI KAPLAN” (TAU).

Distribution. Cameroon and Nigeria (Fig. 3.4: 219). Records of this species are too few to draw many conclusions regarding habitat preferences. The Cameroonian record is coastal bordering the Guineo-Congolian rainforest, while Ibadan in Nigeria lies 128 km from the coast and approximately 48 km inside the

northern boundary of the Lowland Rain Forest zone of Western Nigeria, although these forests differ from the wetter forests to the south in the higher proportion of deciduous trees. Pending additional records the distribution is best interpreted as transitional between the Guineo-Congolian rainforest and savanna (*e.g.*, White and Werger 1978; Kirk-Spriggs 2003).

Bionomics. Occurring in the Atlantic Equatorial Coastal Forest and Nigerian Lowland Forest major habitat types and in the Tropical and Subtropical Moist Broadleaf Forests vegetation type (3.4: Appendix).

***Curtonotum moffatt* Kirk-Spriggs, *sp. n.*,**

Figs 3.4: 5, 29, 59, 65, 109, 114, 117, 120, 121, 125, 126, 219.

Etymology. The specific epithet *moffatt* is a noun in apposition, named in honour of Graham Moffatt (1919–1965), British comedy actor of the 1930s, who played the insolent, overweight, schoolboy in company with Will Hay and Moore Marriott.

Description: Male (primarily based on field-pinned HT).

As described for *C. marriott* *sp. n.* (above), differing in the following respects:

Measurements: Overall length unknown (the ♀ measures 5.1 mm; $n = 1$, PT); length of head and thorax combined 3.5–4.0 mm; length of thorax and scutellum combined 3.1–3.7 mm; wing length 5.2–5.9 mm ($n = 4$, HT, PT).

Head (Figs 3.4: 5, 29). Eye height/length ratio: 14:8 ($n = 1$, HT); frons (Fig. 3.4: 29) length/width ratio: 9:12 ($n = 1$, HT); arista with 10–11 dorsal branches and 4–5 ventral branches; face with narrow silver fascia ($\frac{1}{2}$ width between eye margin and ptilinal fissure), edge adjacent to ptilinal fissure coloured as on frons; 14 fine setae bordering genal groove; eye height/genal height ratio: 14:2 ($n = 1$, HT).

Thorax (Fig. 3.4: 5). Postpronotum with 23 fine setulae; anepisternum with 30 fine setulae; dorsal katepisternal setae *ca.* $\frac{1}{2}$ length of ventral, with 25 short, fine setulae.

Scutellum (Fig. 3.4: 65).

Legs. Fore coxa with 16 brown setulae; fore tibia with ctenidium of 16–17 spinules.

Wing (Fig. 3.4: 59). *dm–cu* crossvein with acute medial angle.

Abdomen. Sternite 6 (Fig. 3.4: 114) apically expanded (may appear narrower than Fig. 3.4: 114 in undissected specimens), with sides evenly straight, with relatively shallow, V-shaped apical excision, clothed in short black irregular brown setulae, those at apical margin longer and more prominent.

Terminalia (Figs 3.4: 117, 120, 121). Hypandrium (Fig. 3.4: 117, *hy*) with 2 setulae proximal to postgonite (obscured by epandrium on Fig. 3.4: 117); postgonite (Fig. 3.4: 117, *pg*); epandrium (Fig. 3.4: 117, *ep*); cercus (Fig. 3.4: 117, *ce*); surstylus (Fig. 3.4: 117, *ss*); phallus (as in Fig. 3.4: 120, *ph*, *bp*, *dp*); phallapodeme (Fig. 3.4: 120, *ph*); ejaculatory apodeme (Fig. 3.4: 120); basiphallus (Fig. 3.4: 120, 121, *bp*) narrow and regular in basal third, then abruptly narrowed, with heavily sclerotised spur-like extension of left side clearly visible through cuticle, inner lateral margin developed into convex, prominent finger-like projection with adjoining clearly serrated margin (Fig. 3.4: 121); distiphallus (Fig. 3.4: 120, *dp*) short, subdivided into apically expanded, unforked baso-ventral process (Fig. 3.4: 120, *bvp*) and straight ventrally-directed apico-dorsal process.

♀ Similar to ♂, except in the following respects: wing length 5.0–5.8 ($n = 3$, PT); spermatheca (Fig. 3.4: 109) long, smooth, obclavate.

Variation. No significant variation is noted.

Differential diagnosis. *Curtonotum moffatt* sp. n. is mainly separable from its congeners, *C. marriott* sp. n. and *C. platyphallum*, on the form of the male terminalia, especially the shape of the distiphallus (Figs 3.4: 119–122) and of male sternite 6 (Figs 3.4: 113–115) (see above key for details). Given the degree of inter- and intraspecific variation in the shape of the spermatheca (Fig. 3.4: 109) in other species with obclavate spermathecae, it is unlikely that the shape of this structure has any value in distinguishing the species.

Type material examined. UGANDA: holotype ♂, “Uganda / Katona // Mujenje [= Muyenje] / 1913.VIII // HOLOTYPE ♂ / *Curtonotum / moffatt* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (HNHM). In good condition, some tarsi damaged; direct-pinned; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ / *Curtonotum / moffatt* sp. n. / A.H. Kirk-Spriggs 2011”): [CENTRAL AFRICAN REPUBLIC]: 1♂, “Carnot-Buav / Glajanga’s / Tessmann S. / 9-14.1.14 [printed; blue card] // Zool. Mus. / Berlin”; 1♀, “Uamgebiet [= Uam Region] / Bosum [= Bozoum] 1-10.5.[19]14 / Tessmann S. [printed; blue card] // Zool. Mus. / Berlin” (both ZMHB). UGANDA: 1♂, 2♀, same data as holotype (HNHM); 2♂, “VICTORIA NYANZA / ARCIP. DI SESSE [= Ssese Islands] / BUGALA [= Bugala Island] 1908 / Dr. E. BAYON // Museo Civico / di Genova [printed; pale blue card]” (MSNG)

Distribution. Central African Republic, Cameroon and Uganda (Fig. 3.4: 219). Pending additional records the distribution is best interpreted as transitional between the Guineo-Congolian rainforest and savanna (*e.g.*, White and Werger 1978; Kirk-Spriggs 2003).

Bionomics. Occurring in three major habitat types; predominantly in Tropical and Subtropical Grasslands, Savannas and Shrublands, with a single record from the Tropical and Subtropical Moist Broadleaf Forests vegetation type (3.4: Appendix).

Curtonotum platyphallum Tsacas, 1977,

Figs 3.4: 6, 30, 60, 66, 110, 115, 118, 122, 127, 128, 219.

Curtonotum platyphallum: Tsacas, 1977: 157; figs 6 a–c, p. 158. Type locality: “Liberia: Robertsport, Talla”.

Curtonotum platyphallum: Wirth and Tsacas (1980: 672).

Curtonotum platyphallum: Kirk-Spriggs (2008c: 251).

Redescription: Male (based on field-pinned HT and ♀ N-T).

As described for *C. marriott* sp. n. (above), differing in the following respects:

Measurements: Overall length unknown; 8.5 mm (Tsacas 1977: 159); wing length 4.4 mm ($n = 1$, HT). [Although detailed photographs were made beforehand, the unique holotype ♂ was returned to the AMNH prior to a full compliment of measurements having been formulated, measurements and ratios provided below are,

therefore, from the single ♀ N-T specimen]: length of head and thorax combined 3.0 mm; length of thorax and scutellum combined 2.8 mm ($n = 1$, ♀ N-T).

Head (Figs 3.4: 6, 30). Eye height/length ratio: 12:8 ($n = 1$, ♀ N-T); frons (Fig. 3.4: 30) length/width ratio: 7:10 ($n = 1$, ♀ N-T); arista with 10 long dorsal branches and 3–4 ventral branches; face with narrow silver fascia ($\frac{1}{2}$ width between eye margin and ptilinal fissure), edge adjacent to ptilinal fissure coloured as on frons; 10 fine setae bordering genal groove; gena wide, eye height/genal height ratio: 12:2 ($n = 1$, ♀ N-T).

Thorax (Fig. 3.4: 6). Postpronotum with 22 fine black-brown setulae; anepisternum surface with 33 fine setulae, with one group of 3 longer in posterior corner; katepisternum with 19 short, fine setulae.

Scutellum (Fig. 3.4: 66).

Legs. Fore coxa with 18 brown setulae; mid-coxa with 7 black setulae; fore tibia with ctenidium of 14–15 black spinules.

Wing (Fig. 3.4: 60). *dm–cu* crossvein with even curve.

Abdomen. Sternite 6 (Fig. 3.4: 115) long, narrow basally, expanded apically, (may appear narrower than Fig. 3.4: 115 in undissected specimens), with sides straight, with relatively deep, V-shaped apical excision, clothed in short black irregular brown setulae, those at apical margin longer and more prominent.

Terminalia (Figs 3.4: 118, 122). Hypandrium (Fig. 3.4: 118, *hy*) with number of setulae proximal to postgonite unknown (obscured by epandrium on Fig. 3.4: 118); postgonite (Fig. 3.4: 118, *pg*); epandrium (Fig. 3.4: 118, *ep*); cercus (Fig. 3.4: 118, *ce*); surstylus (Fig. 3.4: 118, *ss*) long; phallus (as in Fig. 3.4: 122, *bp*, *dp*) [as the basal section of the phallus is missing from the unique male specimen (HT), the phallapodeme, basal section of basiphallus and ejaculatory apodeme cannot be described]; apical $\frac{1}{2}$ of basiphallus (Fig. 3.4: 122, *bp*) with lateral margin finger-like, evenly-rounded extension and shallow, wide apical excision; distiphallus (Fig. 3.4: 122, *dp*) short, subdivided into unforked baso-ventral process (Fig. 3.4: 122, *bvp*) and straight apico-dorsal process.

♀ Similar to ♂, except in the following respects: wing length 4.6 mm ($n = 1$, N-T). Postabdomen as illustrated in Figs 3.4: 127, 128; stermathecae as illustrated in Figs 3.4: 110.

Variation. As only 2 specimens are known, insufficient material is available to assess variability.

Differential diagnosis. *Curtonotum platyphallum* sp. n. is mainly separable from its congeners, *C. marriott* sp. n. and *C. moffatt* sp. n., on the form of the male terminalia, especially the shape of the distiphallus (Figs 3.4: 119–122) and of male sternite 6 (Figs 3.4: 113–115) (see above key for details). Given the degree of inter- and intraspecific variation in the shape of the spermatheca (Fig. 3.4: 110) in other species with obclavate spermathecae, it is unlikely that the shape of this structure has any value in distinguishing the species.

Type material examined. LIBERIA: holotype ♂, “Talla // Robertsport / Liberia 1943 / F. Snyder XI–13 [printed & handwritten] // HOLOTYPE [printed in bold; red card] // CURTONOTUM / pharyphal - / pum n. sp. / L. TSACAS DET. 1976 [printed & handwritten] // *Curtonotum / platyphallum* Tsacas, 1977 / A.H. Kirk-Spriggs vidit 2006” [head missing] (AMNH). In good condition, although head missing; direct-pinned; dissected, abdomen and terminalia in micro-vial pinned beneath specimen; phallapodeme and basal part of basiphallus missing.

Additional material examined (labelled: “*Curtonotum platyphallum* Tsacas, 1977 ♀ det. A.H. Kirk-Spriggs 2011”). LIBERIA: 1♀, Liberia: 8 mi. NW Zorzor, 12.viii.1966, E.S. Ross & K. Lorenzen (CAS).

Distribution. Endemic to Liberia (Fig. 3.4: 219). The two records indicate that the species is restricted to the western Guineo-Congolian rainforests and coastal habitats of Liberia. Pending additional records the distribution is probably best interpreted as transitional between the Guineo-Congolian rainforest and savanna (*e.g.*, White and Werger 1978; Kirk-Spriggs 2003).

Bionomics. Occurring in Guinean Mangroves and Western Guinean Lowland Forest habitat types; in Mangroves and Tropical and Subtropical Moist Broadleaf Forests vegetation types (3.4: Appendix).

Campsiphallum species-group

Notes. The *Campsiphallum* species-group is defined as having the lateral lobe of the epandrium with 1 very strong seta and a group of shorter setae (Figs 3.4: 133–135, 142–145), and the baso-ventral process of the distiphallus developed into a short, blade-like, partially serrated process (Figs 3.4: 136–141, 146–153).

Curtonotum campsiphallum Tsacas, 1977,

Figs 3.4: 8, 32, 68, 134, 137, 140, 191, 201, 202, 220, 221.

Curtonotum campsiphallum: Tsacas, 1977: 151; figs 2 a–b, p. 151. Type locality: [Democratic Republic of Congo] “Zaire: Bumba”.

Curtonotum campsiphallum: Wirth and Tsacas (1980: 672).

Curtonotum campsiphallum: Kirk-Spriggs (2008c: 251).

Redescription: Male (primarily based on field-pinned HT).

Measurements: Overall length unknown; 4.5–5 mm (Tsacas 1977: 153) (the ♀ measures 4.4 mm; $n = 1$, N-T); length of head and thorax combined 2.1–2.6 mm; length of thorax and scutellum combined 2.2–3.0 mm; wing length 3.1–3.4 mm ($n = 5$, N-T).

Head (Figs 3.4: 8, 32). Eye height/length ratio: 10:6 ($n = 1$, N-T); frons (Fig. 3.4: 32) sides narrowed anteriorly, slightly wider than long, frons length/width ratio: 6:8 ($n = 1$, N-T), wider at vertex than at ventral margin, ground colour pale dirty yellow, faintly darker at vertex between orbital plates and ocellar triangle and between orbital plates and eye margin, medial vittae inconspicuous, surface with a few minute pale to dark brown setulae; orbital plates and ocellar triangle silver-grey pruinose; ocelli clear grey with 6 minute dark setulae arranged in two closely-approximated regular rows between posterior ocelli; orbital plates extending from vertex of head to 0.8 length of frons, lateral margins with very narrow silver pruinose fascia (adjacent to eye margin), widest at antennal insertions; posterior and anterior orbital setae inserted proximally, the latter inserted beyond $\frac{1}{2}$ length of frons; posterior orbital seta moderately strong, same length as outer vertical seta, with tiny proclinate medial orbital seta inserted immediately ventral to socket of posterior orbital seta; anterior

orbital seta moderately strong, *ca.* $\frac{1}{2}$ length of ocellar setae; ocellar setae finer, extending four-fifths length of frons; outer vertical seta shorter than inner; postocellar setae strong, cruciate, slightly shorter than outer vertical seta; antennal scape and pedicel dirty pale brown, silver-grey pruinose, flagellomere 1 concolourous with pedicel basally, darkened apically, silver-grey pruinose, longer than wide, with evenly rounded apex, arista with 9–11 long dorsal branches and 4 or 5 ventral branches in addition to terminal fork; lunule and face uniform silver-grey pruinose throughout, face with broad silver fascia (adjacent to eye margin), facial carina developed as a low ridge, extending $\frac{2}{3}$ length of face; clypeus brown, especially laterally; 1 pair moderately strong vibrissae inserted on posterior lateral margin and 8 much finer setae bordering genal groove; occiput yellow to grey pruinose with moderately strong, black postocular setae; gena narrow, eye height/genal height ratio: 10:1 ($n = 1$, N-T), silver pruinose, abruptly dirty brown beyond basal angle; palpus black-brown, brown microtrichose.

Thorax (Fig. 3.4: 8). Silver-grey pruinose, with four narrow parallel chestnut-brown pruinose vittae on dorsal surface, 2 median vittae extending from anterior margin to region of anterior dorsocentral seta socket, 2 lateral vittae shorter, extending from $\frac{2}{3}$ length to region of posterior dorsocentral seta socket, 2 pairs of dorsocentral setae, posterior very long and strong (shorter than lateral scutellar seta), anterior shorter and finer (*ca.* $\frac{1}{2}$ length of posterior); 1 pair acrostichal setae finer, but as long as anterior dorsocentral seta; presutural seta moderately strong, reclinate, as long and strong as anterior notopleural seta; 2 notopleural setae the anterior slightly longer than posterior; 1 strong supra-alar seta slightly exceeding length of posterior dorsocentral seta; 2 postalar setae moderately strong, same size as acrostichal setae; postpronotum dirty yellow-grey pruinose, with 2 strong postpronotal setae, the more dorsal longer and reclinate, the more ventral shorter and proclinate, with 9 finer black-brown setulae; anepisternum silver-grey pruinose with 3 strong anepisternal setae and 2 moderately strong intermediate setae, surface with 22 fine setulae scattered across surface, 3 arranged in a group in posterior corner; anepimeron, laterotergite and meron silver-grey pruinose, glabrous; katepisternum silver-grey pruinose, with 2 katepisternal setae, the more ventral strong, slightly dorsally-directed, the more dorsal much smaller and finer, *ca.* 0.4 length of ventral katepisternal setae, surface with 11 short, fine setulae at base and along posterior margin.

Scutellum. Silver-grey pruinose as on mesonotum, with faint medial brown pruinose vitta basally; disk clothed in black, irregular, overlapping setulae; 2 pairs of strong scutellar setae, with variable number of weaker basal and intermediate scutellar setulae.

Legs. Fore coxa silver-yellow pruinose with two moderately strong, brown, ventrally-directed preapical setae and comb of finer setulae medially, with 14 brown setulae on anterior surface; mid and hind coxa yellow-grey pruinose, mid-coxa with 2 very strong, lateral, ventrally-directed, black setae and comb of finer setae medially; hind coxa with 1 weaker lateral black seta, 1 brown setula and one strong ventral seta; femora, tibia and tarsi uniform dirty yellow; fore tibia with 6 strong setae on lateral margin, the second basal seta usually shorter than other five, with ctenidium of 13–16 short, sharp, black spinules, separated from each other by one or more basal spinule widths.

Wing (Fig. 3.4: 68). Long, relatively broad, tip evenly-rounded, veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in region of *dm-cu* crossvein; costa with prominent costal spines in basal four-fifths from costal break; *dm-cu* crossvein with medial angle; *cua*₁ relatively long and narrow; anal fold extending less than ½ length of *cua*₁; halter dirty yellow.

Abdomen. Ground colour of tergites 1–5 silver-yellow to grey pruinose, 1–2 slightly reddish-brown dorsally, clothed in relatively long black, overlapping setulae, arranged in regular rows, those at apical margins longer and stronger; tergite 1 simple, devoid of maculae; tergite 2 with oblique, subquadrate brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with broad, brown median fascia and well developed “T-shaped” brown lateral maculae, those on tergites 4 and 5 merging with median fascia, lateral margin of tergites 2–5 with subtriangular maculae in basal ½; sternite 6 (Fig. 3.4: 191) laterally expanded (may appear narrower than Fig. 3.4: 191 in undissected specimens), narrowed basally and apically, with deep, subtriangular apical excision, with faint brown maculae laterally, clothed in very short black irregular brown setulae; tergite 6 absent, sternite 7 weakly sclerotised.

Terminalia (Figs 3.4: 134, 137, 140). Hypandrium (Fig. 3.4: 134, *hy*) long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded in profile); hypandrial arms narrow basally, expanded apically (viewed laterally), with 2 setulae proximal to postgonite, sclerotised area of

medial lobes (viewed dorsally), wide medially, narrowed apically, widely separated, postgonite (Fig. 3.4: 134, *pg*) free basally, long, as broad as surstylus; epandrium (Fig. 3.4: 134, *ep*) markedly broader dorsally than ventrally (viewed laterally), evenly-rounded on dorsal margin, posterior margin slightly angled, ventral margin with one very long and strong seta and extensive row of smaller, regular to irregular, apically-directed setae; cercus (Fig. 3.4: 134, *ce*) narrow, usually partially retracted into epandrium, longest setae as long as spine-like seta on ventral margin of epandrium, with elongate fused ventral process; surstylus (Fig. 3.4: 134, *ss*) widest basally, slightly curved apically; phallus (as in Figs 3.4: 137, *ph*, *bp*, *dp*; 140, *bp*, *dp*) C-shaped, moderately sclerotised, brown; phallapodeme (Fig. 3.4: 137, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two broad lateral lobes, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.4: 137, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Figs 3.4: 137, 140, *bp*) broad, expanded apically, with brown, heavily sclerotised subquadrate baso-ventral process with 3 large teeth-like serrations on posterior margin and one or two smaller serrations on anterior margin; distiphallus (Figs 3.4: 137, 140, *dp*) long, scimitar-like (viewed laterally), membranous area broad.

♀ Similar to ♂, except in the following respects: wing length 3.4–4.9 ($n = 5$, N-T). Postabdomen (Figs 3.4: 201, 202) sternite 8 (Figs 3.4: 201, 202, *s8*) weakly sclerotised and reduced; sternite 10 (Figs 3.4: 201, 202, *s10*) laterally flattened proximally, with medial division; tergite 10 (Figs 3.4: 201, 202, *t10+ce*) fused to free cerci, with long terminal setulae. The obclavate spermatheca was illustrated by Tsacas (1977: 151, fig. 2b), but given intraspecific variation this has little value in differentiating the species.

Variation. There is some variation in the number and size of teeth-like serrations on the anterior margin of the baso-ventral process of the phallus, other characters are consistent, however, and this is here regarded as intraspecific variation only.

Differential diagnosis. *Curtonotum campsiphallum* is probably most closely-related to a group of three species having the basiphallus relatively broad and

expanded apically and the membranous area of the distiphallus broad (*C. sao*, *C. hay* sp. n. and *C. tsacas* sp. n.). It is most closely related to the last two named species, both of which share the short plate-like baso-ventral process with a series of teeth-like serrations on the posterior margin. They are separable by use of the above key.

Type material examined. [DEMOCRATIC REPUBLIC OF CONGO]: holotype ♂, “HOLOTYPUS [printed; pink card, black border] // COLL. MUS. CONGO / Bumba / -XII-1939–I-1940 / H. De Saeger // HOLOTYPE [printed; red card] // CURTONOTUM / *campisiphallum* / Holotype n.sp. / L. TSACAS DET. 1976 [printed & handwritten] // *Curtonotum* ♂ / *campisiphallum* Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006” (RMCA). In poor condition, right flagellomere 1, all legs, except left fore tibia and fore tarsus and right hind tibia and hind tarsus missing, most setation on head and thorax missing; originally micro-pinned and double-mounted, but subsequently glued to strip; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “*Curtonotum* / *campisiphallum* ♂ [or ♀] / Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006”): [DEMOCRATIC REPUBLIC OF CONGO]: 1♀, same labels as holotype, except: “// ALLOTYPUS [printed; pink card, black border] // ALLOTYPUS [printed; red card] // CURTONOTUM / *campisiphallum* / Allotype n.sp. / L. TSACAS DET. 1976 [printed & handwritten]”; 1♂, 3♀, same except: “// PARATYPUS [printed; pink card, black border] // PARATYPE [printed; red card] // CURTONOTUM / *campisiphallum* / Paratype n.sp. / L. TSACAS DET. 1976 [printed & handwritten]” [1♂, 1♀ with additional label “BM [handwritten; pale blue card]” (all RMCA).

Remarks. Tsacas (1977: 253) cited the deposition of the type material as “... I.R.S.N., Bruxelles [IRSNB]. 2 paratypes au Muséum de Paris [MNHN].” All the type material is in fact deposited in RMCA.

Additional material examined (all labelled: “*Curtonotum campisiphallum* Tsacas, 1977 ♂ [or ♀] det. A.H. Kirk-Spriggs 2006–2008”): CAMEROON: 5♂, 2♀, Cameroon, Limbe (shore), 14–15.xi.1987, Fini Kaplan; 5♂, 4♀, same except: A. Freidberg; 1♂, Cameroon, Rt. N9, 20 Km E Sangmelima, 7.xi.1987, A. Freidberg (all TAU); 1♀, Mission Cameroun, C.N.R.S. RCP 318, Octobre–Novembre 1975, Province de l’Ouest (Foumban), Massif du Nkogam, Plateau de Kounden, Alt. 1400 m, 14–20.x.1975, *Solanum aculeastrum*, Muséum Paris (MNHN). [CENTRAL AFRICAN REPUBLIC]: 1♂, Uamgebiet, Bosum [= Bozoum], 21–30.4.[19]14, Tessmann, S., Zool. Mus. Berlin; 1♀, same except: 11–20.5.[19]14 (both ZMHB). CÔTE D’IVOIRE: 1♂, Côte d’Ivoire, Comoé Nat. Park [Comoé National Park], Kakpin camp, 16–18.iv.1989, 08°40’N, 03°12’W, J.G.H. Londt, Malaise and savanna woodland (NMSA); 1♂, Côte d’Ivoire: N’Man, Zogoualé, Cascades Mont la Dent, 7°25’N 7°34’W, 16.ii.1998, C. Kassebeer & S. Hilger, X1320–31 (ZSM). [GHANA]: 1♂, Mus. Westerm., Guinea [= Teshi], near Accra, C.R.W. Wiedemann (T. Pape, pers. comm. 2008)] (ZMUC).

Distribution. Cameroon, Central African Republic, Côte d'Ivoire, Democratic Republic of Congo and Ghana (Fig. 3.4: 220, 221). Records indicate a specific association with the western and central Guineo-Congolian rainforests or their margins (Fig. 3.4: 221).

Bionomics. Occurring in eight major habitat types; Tropical and Subtropical Moist Broadleaf Forests and Tropical and Subtropical Grasslands, Savannas and Shrublands vegetation types (see 3.4: Appendix).

Curtonotum angolense Tsacas, 1977,
Figs 3.4: 7, 31, 67, 133, 136, 139, 190, 220, 221.

Curtonotum angolensis: Tsacas, 1977: 149; fig. 1, p. 150. Type locality: "Angola: 5 mls. NE. Negola".

Curtonotum angolense: Wirth and Tsacas (1980: 671).

Curtonotum angolense: Kirk-Spriggs (2008c: 251).

Redescription: Male (primarily based on field-pinned HT, PT).

As redescribed for *C. campsiphallum* (above), differing in the following respects:

Measurements: Overall length unknown; 4.5–5 mm (Tsacas 1977: 150); length of head and thorax combined 1.9–2.5 mm; length of thorax and scutellum combined 1.8–2.3 mm; wing length 2.7–3.5 mm ($n = 5$, PT).

Head (Figs 3.4: 7, 31). Eye height/length ratio: 8:6 ($n = 1$, PT); frons (Fig. 3.4: 31) very slightly wider than long, frons length/width ratio: 5:6 ($n = 1$, PT); arista with 9–10 dorsal branches and 4–6 ventral branches; 7 fine setae bordering genal groove; occiput grey pruinose; gena narrow, eye height/genal height ratio: 8:1 ($n = 1$, PT), silver pruinose throughout.

Thorax (Fig. 3.4: 7). Mesonotum golden-grey pruinose, with four narrow parallel brown pruinose vittae rather poorly defined; postpronotum with 7 fine setulae; anepisternum surface with 17 fine setulae; kataposternum surface with 13 short, fine setulae.

Legs. Fore coxa with 9 brown setulae; fore tibia with ctenidium of 10–11 short, sharp, black spinules.

Wing (Fig. 3.4: 67). *dm-cu* crossvein with only slight medial angle.

Abdomen. Tergites 3–5 with well developed “T-shaped” brown lateral maculae, but not merging with median fascia; sternites 5 and 6 (Fig. 3.4: 190); sternite 5 large, elliptical and laterally expanded, especially subbasally, extensive lateral maculae fused in basal $\frac{2}{3}$; sternite 6 narrow basally, subquadrate with broad, shallow U-shaped apical excision, extensively darkened, except in basal V-shaped region, clothed in moderately short setae, those on inner margins longer and stronger (both sternites 5 and 6 may appear narrower than Fig. 3.4: 190 in undissected specimens).

Terminalia (Figs 3.4: 133, 136, 139). Hypandrium (Fig. 3.4: 133, *hy*) very short, with reduced broad-based rounded-truncate dorsobasal lobe, sclerotised area of medial lobes (viewed dorsally), wide apically, there overlapping, postgonite (Fig. 3.4: 133, *pg*); epandrium (Fig. 3.4: 133, *ep*) slightly broader dorsally than ventrally (viewed laterally); cercus (Fig. 3.4: 133, *ce*); surstylus (Fig. 3.4: 133, *ss*); phallus (as in Figs 3.4: 136, *ph*, *bp*, *dp*; 139, *bp*, *dp*); phallapodeme (Fig. 3.4: 136, *ph*); ejaculatory apodeme (Fig. 3.4: 136, *ea*); basiphallus (Figs 3.4: 136, 140, *bp*) narrow, slightly wider at midlength, narrow apically, with brown, heavily sclerotised elongate baso-ventral process with distinct hook-like basal “spine” and one large tooth-like serration on posterior margin and one smaller serration on anterior margin; distiphallus (Figs 3.4: 136, 139, *dp*) long, heavily sclerotised, scimitar-like (viewed laterally), membranous area narrow.

♀ Unknown.

Variation. No significant variation is noted.

Differential diagnosis. *Curtonotum angolense* is probably most closely-related to a group of two other species having the vittae on the mesonotum weakly defined, male sternite 5 expanded or otherwise modified, the basiphallus narrow and elongated and the membranous area of the distiphallus narrow (*C. quinquevittatum* and *C. freidberg* sp. n.). They are separable by use of the above key.

Type material examined. ANGOLA: holotype ♂, “Holo- / type [paper disc; red border] // ANGOLA (A37) / 5 mls. NE. Negola / 25.iii.1972 // Southern / African Exp. / B.M.1972-1 // CURTONOTUM / *angolensis* / n.sp. / Holotype / L. TSACAS DET. 1976 [printed & handwritten] // *Curtonotum* ♂ / *angolensis* Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006” (BMNH). In good condition: left hind leg missing; re-staged on nu-poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “CURTONOTUM / *angolensis* / n.sp. / L. TSACAS DET. 1976 [printed & handwritten] // *Curtonotum* ♂ / *angolensis* Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006”): ANGOLA: 1♂, same labels as holotype, except: “Para- / type [paper disc; yellow border]”; 30♂, “ANGOLA: / 10 mi. NE of / Sada Bandeira [Sá da Bandeira = Lubango] / V-20- [19]58, 1700 m // E.S. Ross & / R.E. Leech / collection // PARATYPE [printed in bold; red card]” (all CAS); 1♂, same except: “Muséum Paris” (MNHN); 104♂, “ANGOLA: 10 mi. NE / of Sá da Bandeira. / 1700 m. 20-V-1958 / E. S. Ross & / R. E. Leech // PARATYPE [printed in bold; red card]”; 5♂, “ANGOLA: / Cacula / elev. 1530m / V-25-[19]58 // E.S. Ross & / R.E. Leech / collection // PARATYPE [printed in bold; red card]” (all CAS); 1♂, same except: “Muséum Paris” (MNHN).

Remarks. Tsacas (1977: 150) cited a total of 146 paratypes, but only 136 specimens are labelled as paratypes in total; 134 in CAS and two in MNHN. Tsacas (1977: 150) listed two ♂ paratypes from 5 mls. NE. Negola, but only one is present in the BMNH collection. Tsacas (*ibid.*) erroneously cited the holotype data as “8 km NE Negola”, rather than “2 mls. NE Negola”, the latter being correct.

Additional material examined (all labelled: “*Curtonotum angolense* Tsacas, 1977 ♂ det. A.H. Kirk-Spriggs 2006”): ANGOLA: 1♂, Angola, Cacula, elev. 1530 m, 25.v.[19]58, E.S. Ross & R.E. Leech collection; 8♂, Angola, 10 mi. NE of Sá da Bandeira [= Lubango], 20.v.[19]58, 1700 m, E.S. Ross & R.E. Leech collection [1 head missing] (all CAS).

Distribution. Endemic to Angola (Fig. 3.4: 220, 221). The species is apparently restricted to the Angolan Escarpment at high elevations (1700 and 1530 m) in mountains ranges near Lubango (Fig. 3.4: 220). Negola (the type locality) also forms part of the same mountain range and is part of the Southern African Escarpment.

Bionomics. Occurring in the Angolan Miombo Woodland habitat type; Tropical and Subtropical Grasslands, Savannas and Shrublands vegetation type (see 3.4: Appendix).

***Curtonotum freidberg* Kirk-Spriggs, sp. n.,**

Figs 3.4: 9, 33, 69, 135, 138, 141, 192, 220, 221.

Etymology. The specific epithet *freidberg* is a noun in apposition, named in honour of Amnon Freidberg, in recognition of his contribution to our knowledge of African Diptera.

Description: Male (primarily based on field-pinned HT).

As redescribed for *C. campsiphallum* (above), differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 1.2–1.9 mm; length of thorax and scutellum combined 1.6–1.8 mm; wing length 2.7–3 mm ($n = 5$, PT).

Head (Figs 3.4: 9, 33). Eye height/length ratio: 7:4 ($n = 1$, HT); frons (Fig. 3.4: 33) wider than long, frons length/width ratio: 4:7 ($n = 1$, HT), orbital plates wide; anterior orbital seta inserted beyond $\frac{1}{2}$ length of frons at lateral edge of orbital plate; posterior orbital seta slightly longer than outer vertical seta; arista with 7–8 long dorsal branches and 3 or 4 ventral branches; vibrissae strong with 7 fine setae bordering genal groove; gena narrow, eye height/genal height ratio: 7:1 ($n = 1$, HT), silver pruinose throughout.

Thorax (Fig. 3.4: 9). Mesonotum golden-grey pruinose, with four narrow parallel brown pruinose vittae rather poorly defined; acrostichal setae finer and shorter than anterior dorsocentral seta; postpronotum with 8 fine black-brown setulae; anepisternum surface with 15 fine setulae scattered across surface, 2 arranged together in posterior corner; katepisternum surface with 13 short, fine setulae.

Legs. Fore coxa with 7 brown setulae on anterior surface; fore tibia with ctenidium of 9–10 short, sharp, black spinules.

Wing (Fig. 3.4: 69). *dm-cu* crossvein acutely angled posteriorly.

Abdomen. Tergites 3–5 with well developed “T-shaped” brown lateral maculae, but not merging with median fascia; sternites 5 and 6 (Fig. 3.4: 192); sternite 5 subrectangular, with distinct sclerotised black, indented arc subapically; sternite 6

narrowed in basal $\frac{2}{3}$, then expanded apically, lateral maculae longitudinally, medially divided, with sparse short setulae, those at apical margin longer and stronger (both may appear narrower than Fig. 3.4: 192 in undissected specimens).

Terminalia (Figs 3.4: 135, 138, 141). Hypandrium (Fig. 3.4: 135, *hy*) short; hypandrial arms narrow basally (viewed laterally), sclerotised area of medial lobes (viewed dorsally) well separated; postgonite (Fig. 3.4: 135, *pg*); epandrium (Fig. 3.4: 135, *ep*); cercus (Fig. 3.4: 135, *ce*); surstylus (Fig. 3.4: 135, *ss*); phallus (as in Figs 3.4: 138, *ph*, *bp*, *dp*; 141, *bp*, *dp*); phallapodeme (Fig. 3.4: 138, *ph*); ejaculatory apodeme (Fig. 3.4: 138, *ea*); basiphallus (Figs 3.4: 138, 141, *bp*) narrow, basally, not expanded apically, with brown, sclerotised, elongate baso-ventral process, with one medium-sized tooth-like serration on posterior margin and one smaller serration on anterior margin, whole structure forming a submedially contracted plate viewed from left side (Fig. 3.4: 141); distiphallus (Figs 3.4: 138, 141, *dp*) brown, heavily sclerotised, long, scimitar-like (viewed laterally), membranous area narrow.

♀ Unknown.

Variation. No substantial variation is noted.

Differential diagnosis. *Curtonotum freidberg* sp. n. is probably most closely-related to a group of two other species having the vittae on the mesonotum weakly defined, male sternite 5 expanded or otherwise modified, the basiphallus narrow and elongated and the membranous area of the distiphallus narrow (*C. quinquevittatum* and *C. angolenese*). They are separable by use of the above key.

Type material examined. MALAWI: holotype ♂, “MALAWI: North / Vipha Mts., 1500m / Rt.M1, 21-22.ix.1998 / 10km S Chikangawa / F. KAPLAN & / A. FREIDBERG // HOLOTYPE ♂ / *Curtonotum / freidberg* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (TAU). In good condition; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ / *Curtonotum / freidberg* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”): 6♂, same data as holotype (TAU).

Distribution. Malawi (Fig. 3.4: 220, 221). Apparently confined to higher elevation (1500 m) Afromontane forests of the Great Rift Valley, in the Vipha Mountains of north-central Malawi (Fig. 3.4: 220).

Bionomics. Occurring in the Southern Rift Montane Forest habitat type; Tropical and Subtropical Moist Broadleaf Forests vegetation type (3.4: Appendix).

***Curtonotum hay* Kirk-Spriggs, sp. n.,**

Figs 3.4: 10, 34, 70, 142, 146, 150, 193, 220, 221.

Etymology. The specific epithet *hay* is a noun in apposition, named in honour of multi-talented comic genius Will Hay (1888–1949), whose British comedy films of the 1930s continue to give immense pleasure to millions.

Description: Male (primarily based on field-pinned HT).

As redescribed for *C. campsiphallum* (above), differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 2.1–2.5 mm; length of thorax and scutellum combined 2.2–2.3 mm ($n = 4$, HT, PT); wing length 3.6–3.9 mm ($n = 3$, HT, PT).

Head (Figs 3.4: 10, 34). Eye height/length ratio: 9:7 ($n = 1$, HT); frons (Fig. 3.4: 34) length/width ratio: 5:7 ($n = 1$, HT); arista with 10–11 long dorsal branches and 4 or 5 ventral branches; 10 fine setae bordering genal groove; eye height/genal height ratio: 9:1 ($n = 1$, HT).

Thorax (Fig. 3.4: 10). Postpronotum with 11 fine setulae; anepisternum with 26 fine setulae; katepisternum with 15 fine setulae.

Legs. Fore coxa with 12 brown setulae; fore tibia with ctenidium of 10–12 moderately long, sharp, black spinules.

Wing (Fig. 3.4: 70). *dm–cu* crossvein angulate in anterior $\frac{2}{3}$.

Abdomen. Sternite 6 (Fig. 3.4: 193) slightly expanded apically (may appear narrower than Fig. 3.4: 193 in undissected specimens), narrowed basally with sides straight, with shallow U-shaped apical excision and faint brown maculae laterally, clothed in very short black irregular brown setulae.

Terminalia (Figs 3.4: 142, 146, 150). Hypandrium (Fig. 3.4: 142, *hy*) hypandrial arms short and broad (viewed laterally); postgonite (Fig. 3.4: 142, *pg*);

epandrium (Fig. 3.4: 142, *ep*) cercus (Fig. 3.4: 142, *ce*); surstylus (Fig. 3.4: 142, *ss*); phallus (as in Figs 3.4: 146, *ph*, *bp*, *dp*; 150, *bp*, *dp*); phallapodeme (Fig. 3.4: 146, *ph*) ejaculatory apodeme (Fig. 3.4: 146, *ea*); basiphallus (Figs 3.4: 146, 150, *bp*) broad, expanded apically, with brown, heavily sclerotised subtriangular baso-ventral process with 2 teeth-like spines on posterior margin; distiphallus (Figs 3.4: 146, 150, *dp*) short, scimitar-like (viewed laterally), membranous area broad on both sides.

♀ Unknown.

Variation. As only 4 specimens are known, insufficient material is available to assess variation.

Differential diagnosis. *Curtonotum hay* sp. n. is probably most closely-related to a group of three species having the basiphallus relatively broad and expanded apically and the membranous area of the distiphallus broad (*C. sao*, *C. campsiphallum* and *C. tsacas* sp. n.). It is most closely related to the last two named species, both of which share the short plate-like baso-ventral process with a series of teeth-like serrations on the posterior margin. They are separable by use of the above key.

Type material examined. UGANDA: holotype ♂, “Uganda / Katona // Muienje [= Muyenje] / 1913.VIII. // HOLOTYPE ♂ / *Curtonotum* / *hay* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (HNHM). In good condition; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ / *Curtonotum* / *hay* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”): UGANDA: 2♂, same labels as holotype (HNHM); 1♂, “May, 1914, / UGANDA, Uny- / oro, Hoima, / 3700 feet. / Coll. Kitten- / berger. Dd.’19 / C.A. Wiggins.” (OUMNH).

Distribution. Uganda (Fig. 3.4: 220, 221). Apparently confined to higher elevations (*ca.* 1120 m) in the Great Rift Valley of east-central Uganda (Fig. 3.4: 220).

Bionomics. Occurring in the Victoria Basin Forest-Savanna Mosaic and Albertine Rift Montane Forest major habitat types; Tropical and Subtropical Grasslands, Savannas and Shrublands and Tropical and Subtropical Moist Broadleaf Forests vegetation types (3.4: Appendix).

Curtonotum quinquevittatum Curran, 1933,
Figs 3.4: 11, 35, 71, 143, 147, 151, 194, 223, 224.

Curtonotum quinquevittata Curran, 1933: 3. Type locality: [Zimbabwe] “S. Rhodesia, Lomagundi”.
?*Cyrtonotum anus sensu* Malloch, 1930: 327, *non* Meigen, 1830: 95 (*Diastata*), *auctt.* misidentification
(synonymy by Curran (1933: 3).
Curtonotum quinquevittata: Cuthbertson (1936: 54).
Curtonotum quinquevittatum: Wirth and Tsacas (1980: 672).
Curtonotum quinquevittatum: Meier *et al.* (1997: 10).
Curtonotum quinquevittatum: Pollock (2002: 1734, figs 8 a–b, p. 1735).
Curtonotum quinquevittatum: Kirk-Spriggs (2008c: 251).

Redescription: Male (primarily based on field-pinned N-T).

As redescribed for *C. campsiphallum* (above), differing in the following respects:

Measurements: Overall length unknown; 4 mm (Tsacas 1977: 161) (the ♀ measures 4.3–4.6 mm; $n = 2$, N-T); length of head and thorax combined 1.6–2.5 mm; length of thorax and scutellum combined 1.5–2.5 mm; wing length 2.6–3.6 mm ($n = 5$, N-T).

Head (Figs 3.4: 11, 35). Eye height/length ratio: 10:6 ($n = 1$, N-T); frons (Fig. 3.4: 35) slightly wider than long, frons length/width ratio: 5:7 ($n = 1$, N-T); arista with 8–10 long dorsal branches and 5 ventral branches; lunule and face uniform grey pruinose throughout, 9 fine setae bordering genal groove; gena narrow, eye height/genal height ratio: 10:1 ($n = 1$, N-T), silver pruinose throughout.

Thorax (Fig. 3.4: 11). Mesonotum golden-grey pruinose, with four narrow parallel brown pruinose vittae rather poorly defined; postpronotum with 10 fine black-brown setulae; anepisternum with 19 fine setulae scattered across surface; katepisternum with 12 short, fine setulae.

Legs. Fore coxa with 12 brown setulae; fore tibia with ctenidium of 8–9 short, sharp, black spinules.

Wing (Fig. 3.4: 71). *dm–cu* crossvein with submedial angle.

Abdomen. Tergites 3–5 with well developed “T-shaped” brown lateral maculae, but not merging with median fascia; sternites 5 and 6 (Fig. 3.4: 194); sternite 5 large, elliptical and laterally expanded, lateral maculae with longitudinal division medially; sternite 6 narrow basally, laterally expanded with broad, shallow V-shaped apical excision, extensive maculae laterally, clothed in moderately long setae, those on inner margins longer and stronger (both sternites 5 and 6 may appear narrower than Fig. 3.4: 194 in undissected specimens).

Terminalia (Figs 3.4: 143, 147, 151). Hypandrium (Fig. 3.4: 143, *hy*) rather short, with reduced broad-based rounded-truncate dorsobasal lobe; hypandrial arms (in profile) much broader in anterior ½, with evenly curved dorsal margin, sclerotised area of medial lobes (viewed dorsally), widely expanded into two concave plates, closely proximal, but not overlapping; postgonite (Fig. 3.4: 143, *pg*); epandrium (Fig. 3.4: 143, *ep*); cercus (Fig. 3.4: 143, *ce*); surstylus (Fig. 3.4: 143, *ss*); phallus (as in Figs 3.4: 147, *ph*, *bp*, *dp*; 151, *bp*, *dp*); phallapodeme (Fig. 3.4: 147, *ph*); ejaculatory apodeme (Fig. 3.4: 147, *ea*); basiphallus (Figs 3.4: 147, 151, *bp*) narrow, broadest medially, not expanded apically, with brown, heavily sclerotised, elongate and well separated baso-ventral process, with 2 large, well spaced teeth-like serrations on posterior margin and one smaller serration on anterior margin; distiphallus (Figs 3.4: 147, 151, *dp*) long, heavily sclerotised, widest at mid length, scimitar-like (viewed laterally), membranous area very narrow.

♀ Similar to ♂, except in the following respects: wing length 2.9–3.8 mm ($n = 4$, N-T). The obclavate spermatheca was illustrated by Tsacas (1977: 160, fig. 7e), but given intraspecific variation this has little value in differentiating the species.

Variation. Some variation is apparent in the size, shape and number of teeth-like serrations on the dorsal and ventral margins of the baso-ventral process of the distiphallus. Given that other characters are consistent this is here regarded as falling within the range of intraspecific variation.

Differential diagnosis. *Curtonotum quinquevittatum* is probably most closely-related to a group of two other species having the vittae on the mesonotum weakly defined, male sternite 5 expanded or otherwise modified, the basiphallus narrow and

elongated and the membranous area of the distiphallus narrow (*C. angolense* and *C. freidberg* sp. n.). They are separable by use of the above key.

Type material examined. [ZIMBABWE]: holotype ♂, “xii.[19]28 / Lomagundi / S. Rhodesia / A. Cuthbertson [handwritten & printed] // 2288 / S Rhodesia / Dept. Agric. [handwritten & printed] // Holotype ♂ / CURTONOTUM / *quinquevittatum* / Curran / designi par / L. TSACAS 1973 [handwritten & printed] // Curtonotum / TYPE / *quinquevittatum* / Curran. ♂♀ / No. [handwritten & printed] // *Curtonotum* ♂ / *quinquevittatum* Curran, 1933 / A.H. Kirk-Spriggs *vidit* 2009” (AMNH). In fair condition, dissected, abdomen and terminalia in micro-vial pinned beneath specimen; mounted on same pin as female paratype (see below). Paratypes (labelled: “*Curtonotum* ♀ / *quinquevittatum* Curran, 1933 / A.H. Kirk-Spriggs *vidit* 2006–2009”): [ZIMBABWE]: 1♀, same data as holotype and on same pin (AMNH); 1♀, “XII.28 / Lomagundi / S. Rhodesia / A. Cuthbertson [handwritten & printed] // Accession / No. 10005 [handwritten & printed] // 3704 [handwritten] // *Curtonotum* / PARATYPE / *quinquevittata* / Curran ♀ / No. [handwritten & printed]” (PPRZ).

Remarks. There is some confusion regarding the identification of the types of this species and subsequent interpretation of type material. In his original description Curran (1933: 4) refers to: “TYPES.—Holotype, male, allotype, female, Lomagundi, S. Rhodesia, December, 1928. Paratypes: four females, Lomagundi, December, 1928 (A. Cuthbertson); male and female, Lourenco Marques, January–March, 1914 (H.A. Junod)”. The type series therefore comprises the male holotype, plus six females and one male paratypes. In the introduction to the paper Curran notes (p. 1) “The types of the new species are deposited in The American Museum of Natural History”.

Later Cuthbertson (1936: 54) stated: “... some of the type specimens were collected in burrows of warthog and antbear near Balla Balla from January–March, 1933. Probably breeds in the faeces of these burrowing animals. The paratype female is in the Department Collection.” The “Department Collection” to which Cuthbertson refers is the Department of Agriculture, Salisbury [= Bulawayo], the collection of which is now housed in PPRZ, Harare. The specimen concerned was here examined and confirmed as one of the four genuine ♀ paratypes listed by Curran (see above).

Tsacas (1977: 161) examined the male holotype and allotype (mounted on the same pin) in AMNH (misspelling the type locality as “Lonsagundi” rather than Lomagundi) and interpreting 4 ♀ specimens from the same locality as the holotype deposited in the BMNH as paratypes. He noted that the 2 specimens from Lourenço

Marques cited as paratypes by Curran could not be examined. Tsacas did not examine specimens deposited in PPRZ.

Only the holotype male and female allotype (on the same pin), from Lomagundi are deposited in AMNH. Neither the four paratypes from the same locality nor the two paratypes from Lourenço Marques could be located in the AMNH collection.

Examination of material in PPRZ reveals a female specimen from Lomagundi that is clearly labelled as a paratype by Curran. This indicates that Curran labelled his paratypes as such. The fact that specimens collected at the same locality on the same date are deposited in USNM (see below), indicates that Cuthbertson (or the researchers he sent material to), distributed specimens to various museums and there is no reason in this case to assume that the BMNH specimens are paratypes. The four specimens from Lomagundi in the BMNH, interpreted as paratypes by Tsacas do not bear Curran's paratype label and are therefore not paratypes and the three outstanding paratypes cited by Curran must be regarded as lost.

As noted and synonymised by Curran (1933: 3), J.R. Malloch (1930: 327) misidentified this species as *C. anus* Meigen, "... represented by four examples in my African material ..." Malloch cited the locality of these specimens (p. 328) as "Lomagundi, S. Rhodesia, vi.-vii.1929, No. 2288, Dept. Agric. (A. Cuthbertson). A pair taken *in copula*." There are four ♀ specimens from Lomagundi, S. Rhodesia, labelled "*C. anus* Mg." in USNM. Two of these (on the same pin) labelled "xii.1928" and two (on the same pin) labelled "VI-VII 1929". The first of these bears Malloch's *C. anus* Mg. det label. Despite Malloch only citing "A pair taken *in copula*" in the "Locality" section of the paper, he clearly stated that he examined four specimens in all (see above). As all four are female, Malloch must have assumed that these were taken *in copula* as they are pinned together on the same minuten. Curran stated that the types of *Curtonotum quinquevittatum* are deposited in AMNH and there is no evidence to suggest that these four specimens have any type status. These specimens are here tentatively identified as *C. ?quinquevittatum*, as dissected males are required for definitive identification.

Additional material examined (all labelled: "*Curtonotum quinquevittatum* Curran, 1933 ♂ det. A.H. Kirk-Spriggs 2009"): ANGOLA: 1♂, Angola, Benguela, [no date], F.C. Wellman, *Curtonotum quinquevittatum* Curran, L. Tsacas det. 1976 (USNM); 3♂, Angola, Cacula, elev. 1530 m, 25.v.[19]59,

E.S. Ross & R.E. Leech Collection [1 labelled *Curtonotum quinquevittatum* Curran, L. Tsacas det. 1976]; 16♂, Angola, 10 mi. NE of Sá da Bandeira [= Lubango], 1700 m, 20.v.1958, E.S. Ross & R.E. Leech Collection [12 labelled *Curtonotum quinquevittatum* Curran, L. Tsacas det. 1976] (all CAS); 2♂, same except: Muséum Paris [1 head missing] (MNHN). [DEMOCRATIC REPUBLIC OF CONGO]: 1♂, Congo belge: P.N.U., Lusinga (1.760 m), 2–4.v.1949, Mis. G.F. de Witte, 2604a (RMCA); 1♂, alto Uelle, Congo B., Dungu, IV.1927, F.S. Patrizi, Museo Civico di Genova (MSNG). MALAWI: 14♂, Malawi: North Viphya Mts., 1500 m, Rt.M1, 21–22.ix.1998, 10 km S. Chikangawa, F. Kaplan & A. Freidberg (TAU). TANZANIA: 1♂, Tanzania, Matombo, Morogoro reg., 4.II.1987, No. 36., 32., leg. Pócs & Zicsi (HNHM). [ZIMBABWE]: 2♀, Lomagundi, S. Rhodesia, Dept. Agric., xii.1928, 2288 S. Rhodesia Dept. Agric., *Curtonotum anus* Mg. det. J.R. Malloch; 2♀, same except: VI–VII.1929, *Cyrtotum anus* Mg. (all USNM). TOGO: 1♂, Togo: Région du Centre: Montagne Gabongala, Forêt du Mont Balat (Balam) between Diguina & Gassi Gassi (NW of Diguina Konta), 08°11'47"N, 00°55'19"E, 28.iv.2008, 440 m, F. Menzel, Tog74, Sparsely forested mountain slope & top of mountain range (above the mountain foot with the above coordinates) with dry forest, fire influenced ground, violet flowers of *Kaempferia aethiopica* (Zingiberac.) within herb stratum, swept [in spirit], BMSA(DNA)# 0010 (BMSA). ZIMBABWE: 2 unsexed, S. Rhodesia, Lomagundi, xii.[19]28, A. Cuthbertson, 2288, S Rhodesia Dept. Agric., B.M.1932–470, PARATYPE *Curtonotum quinquevittata* L. TSACAS DET. 1976"; 2♀, same data, except: *Curtonotum* ♀♀ *quinquevittata* Curr. (type series, but not types = *nigripalpis* Hend. = *cuthbertsoni* Duda (unpublished synonym.) det. J.C Deeming 1964" [both specimens on same pin with lower of two dissected with abdomen in micro-vial pinned beneath specimen] (the aforementioned 4 specimens erroneously cited as "paratypes" by Tsacas 1977: 161) (all BMNH). COUNTRY UNKNOWN [probably Mozambique]: 1♂, Savane, D, VG., F. 3.5.71, Paris Museum (MNHN).

Distribution. Angola, Democratic Republic of Congo, Malawi, ?Mozambique, Tanzania, Togo and Zimbabwe (Fig. 3.4: 223, 224). This species occurs at higher elevations (ca. 801–1200 m), but is widely distributed in sub-Saharan Africa. It predominantly occurs in eastern Africa, with a single record in West Africa and is apparently restricted to the Angolan section of the Great Escarpment in the southwest.

Bionomics. Occurring in eight major habitat types; predominantly in Tropical and Subtropical Grasslands, Savannas and Shrublands, with records from the Tropical and Subtropical Moist Broadleaf Forests vegetation type (3.4: Appendix). Recorded as roosting in the burrows of Aardvark and Warthog in Zimbabwe by Cuthbertson (1936, as S. Rhodesia) and Pollock (2002).

Curtonotum sao Tsacas, 1977,

Figs 3.4: 12, 36, 72, 144, 148, 152, 195, 223, 224.

Curtonotum sao: Tsacas, 1977: 163; figs 9 a–c, p. 164. Type locality: “Nigeria: Gadau”.

Curtonotum sao: Wirth and Tsacas (1980: 672).

Curtonotum sao: Meier *et al.* (1997: 10).

Curtonotum sao: Kirk-Spriggs (2008c: 251).

Redescription: Male (primarily based on field-pinned N-T).

As redescribed for *C. campsiphallum* (above), differing in the following respects:

Measurements: Overall length unknown; 4.5–5 mm (Tsacas 1977: 164); length of head and thorax combined 1.8–2.5 mm; length of thorax and scutellum combined 1.7–2.2 mm ($n = 4$, N-T); wing length 2.6–3.3 mm ($n = 3$, N-T).

Head (Figs 3.4: 12, 36). Eye height/length ratio: 9:6 ($n = 1$, N-T); frons (Fig. 3.4: 36) markedly narrow, wider than long, frons length/width ratio: 5:7 ($n = 1$, N-T); arista with 8–10 dorsal branches and 4 ventral branches; 10 fine setae bordering genal groove; gena narrow, eye height/genal height ratio: 9:1 ($n = 1$, N-T), silver pruinose throughout; palpus pale brown.

Thorax (Fig. 3.4: 12). Anepisternum with 25 fine setulae 3 arranged in a group in posterior corner; katepisternum surface with 15 short, fine setulae.

Legs. Fore tibia with 5 or 6 strong setae on lateral margin, with ctenidium of 7–8 short, sharp, black spinules.

Wing (Fig. 3.4: 72). *dm–cu* crossvein evenly arched.

Abdomen. Tergites 3–5 with narrow, brown median fascia and weakly developed “T-shaped” brown lateral maculae, none merging with median fascia, lateral margin of tergites 2–5 with reduced subtriangular maculae in basal third; sternite 6 (Fig. 3.4: 195) markedly expanded apically (may appear narrower than Fig. 3.4: 195 in undissected specimens), narrowed basally with shallow U-shaped, apical excision, without maculae, clothed in very short black irregular brown setulae, with four setae around apical margin longer and stronger.

Terminalia (Figs 3.4: 144, 148, 152). Hypandrium (Fig. 3.4: 144, *hy*) short, sclerotised area of medial lobes (viewed dorsally), broadest apically, widely separated; postgonite (Fig. 3.4: 144, *pg*); epandrium (Fig. 3.4: 144, *ep*); cercus (Fig. 3.4: 144, *ce*); surstylus (Fig. 3.4: 144, *ss*); phallus (as in Figs 3.4: 148, *ph*, *bp*, *dp*; 152, *bp*, *dp*); phallapodeme (Fig. 3.4: 148, *ph*); ejaculatory apodeme (Fig. 3.4: 148, *ea*); basiphallus (Figs 3.4: 148, 152, *bp*) broad, markedly expanded apically, with brown, heavily sclerotised scale-like baso-ventral process with 1 or 2 large teeth-like serrations on posterior margin and one smaller spine on ventral margin; distiphallus (Figs 3.4: 148, 152, *dp*) long, scimitar-like (viewed laterally), membranous area broad.

♀ Similar to ♂, except in the following respects: wing length 4.5 mm (Tsacas 1977: 164). The obclavate spermatheca was figured by Tsacas (1977: 164, fig. 9c), but as the type series was captured in the same Porcupine burrow as a series of *C. sahelense* and the spermathecae of these two species are virtually identical (see Tsacas 1977, fig. 8c), coupled with intraspecific variation, this has little value in differentiating the species.

Variation. No substantial variation is noted.

Differential diagnosis. *Curtonotum sao* is probably most closely-related to a group of three species having the basiphallus relatively broad and expanded apically and the membranous area of the distiphallus broad (*C. hay* sp. n., *C. campsiphallum* and *C. tsacas* sp. n.). They are separable by use of the above key.

Type material examined. NIGERIA: holotype ♂, “Holo- / type [paper disc with red border] // GADAU, NIGERIA / 12N 10E / 3.1933 / BUXTON & LEWIS [printed & handwritten] // BURROW OF / PORCUPINE [handwritten] // Pres. by / Imp. Inst. Ent. / B.M.1934-137 // *Cyrtonotum / nigripalpis*, Hend. / Det. G.A.K. Marshall. [handwritten & printed] // CURTONOTUM / *sao* n.sp. / Holotype / L. TSACAS DET. 1976 [printed & handwritten] // *Curtonotum / sao* Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006” (BMNH). In excellent condition; re-staged on nu-poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “*Curtonotum / sao* Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006”): NIGERIA: 1♀, same data as holotype, except: “CURTONOTUM / *sao* n.sp. / Allotype / L. TSACAS DET. 1976 [printed & handwritten]” (BMNH). CHAD: 1♂, “MUSEUM PARIS / RIVE S.-E. TCHAD / BOL / (MISSION TILHO) / Dr R.

GAILLARD 1910 [printed; pale blue card] // JUILLET // PARATYPE [printed; red card] // CURTONOTUM / *sao* n.sp. / Paratype / L. TSACAS DET. 1976 [printed & handwritten]; 1♂, same labels except: “phallus penden // Ac. 3343” (both MNHN).

Additional material examined (all labelled: “*Curtonotum sao* Tsacas, 1977 ♂ det. A.H. Kirk-Spriggs 2006”): NIGERIA: 3♂, same data as holotype (*topotypic*), except: London School of Hygiene & Tropical Medicine Coll. BMNH(E) 1996–140 (BMNH); 1♂, N. Nigeria, Bauchi, Yankari Game Reserve, 24.iii.1980, R. Dransfield, NMW.Z.1981–125, *Curtonotum sao* Tsacas ♂ det. J.C. Deeming 1982 (NMWC).

Distribution. Chad and Nigeria (Fig. 3.4: 223, 224). Occurs in both the Dry Savanna and Sahel (or Wooded Steppe) climatic zones, in the 1600–2000 and 2000–2400 m Potential Evapotranspiration zones.

Bionomics. Occurring in the Sahelian *Acacia* Savanna and West Sudanian Savanna major habitat types; Tropical and Subtropical Grasslands, Savannas and Shrublands vegetation type (3.4: Appendix). Collected resting in the burrows of Porcupine, in company with *C. sahelense* Tsacas, in Nigeria.

***Curtonotum tsacas* Kirk-Spriggs, sp. n.,**

Figs 3.4: 13, 37, 73, 145, 149, 153, 196, 203, 204, 223, 224.

Etymology. The specific epithet *tsacas* is a noun in apposition, named in honour of Léonidas Tsacas (MNHN) in recognition of his substantial contribution to our knowledge of Afrotropical *Curtonotum*.

Description: Male (primarily based on field-pinned HT).

As redescribed for *C. campsiphallum* (above), differing in the following respects:

Measurements: Overall length unknown (the ♀ measures 3.2–3.7 mm; $n = 2$, PT); length of head and thorax combined 1.7–2.5 mm; length of thorax and scutellum combined 1.7–2.4 mm; wing length 2.8–3.7 mm ($n = 5$, HT, PT).

Head (Figs 3.4: 13, 37). Eye height/length ratio: 10:6 ($n = 1$, HT); frons (Fig. 3.4: 37) markedly narrow, frons length/width ratio: 5:7 ($n = 1$, HT), ground colour

pale dirty yellow-brown, markedly darker brown or pitchy (see notes on variation below), at vertex between orbital plates and ocellar triangle and between orbital plates and eye margin, medial vittae conspicuous; flagellomere 1 pitchy black apically, arista with 9–10 dorsal branches and 4 ventral branches; 11 fine setae bordering genal groove; gena narrow, eye height/genal height ratio: 10:1 ($n = 1$, HT), silver pruinose throughout.

Thorax (Fig. 3.4: 13). Postpronotum with 12 fine black-brown setulae; anepisternum surface with 25 fine setulae, 2 arranged in a group in posterior corner; katepisternum with 20 setulae at base and along posterior margin.

Legs. Fore coxa with 9 brown setulae on anterior surface; fore tibia with ctenidium of 9–13 black spinules.

Wing (Fig. 3.4: 73). Membrane markedly infusate brown or pitchy brown (see notes below on variation); *dm-cu* crossvein with acutely angled bend.

Abdomen. Tergite 1 simple, with oblique, subquadrate brown-black pruinose dorsolateral macula on either side only; tergite 2 with wide median fascia and oblique, subquadrate brown-black pruinose dorsolateral macula on either side; tergites 3–5 with broad, brown median fascia and well developed “T-shaped” brown lateral maculae, all merging with median fascia, lateral margin of tergites 2–5 with subtriangular maculae in basal $\frac{2}{3}$; sternite 6 (Fig. 3.4: 196) laterally expanded (may appear wider than Fig. 3.4: 196 in undissected specimens), broad basally with deep, subtriangular V-shaped apical excision, extensively darkened, especially medially, clothed in very short black irregular brown setulae.

Terminalia (Figs 3.4: 145, 149, 153). Hypandrium (Fig. 3.4: 145, *hy*) hypandrial arms broad basally, expanded apically (viewed laterally), sclerotised area of medial lobes (viewed dorsally), very wide medially, abutting and overlapping; postgonite (Fig. 3.4: 145, *pg*); epandrium (Fig. 3.4: 145, *ep*) as wide dorsally as ventrally (viewed laterally), dorsal margin moderately straight; cercus (Fig. 3.4: 145, *ce*); surstylus (Fig. 3.4: 145, *ss*); phallus (as in Figs 3.4: 149, *ph*, *bp*, *dp*; 153, *bp*, *dp*); phallapodeme (Fig. 3.4: 149, *ph*); ejaculatory apodeme (Fig. 3.4: 149, *ea*); basiphallus (Figs 3.4: 149, 153, *bp*) relatively broad, expanded apically, with brown, heavily sclerotised semicircular baso-ventral process, with 3 large teeth-like serrations on

posterior margin; distiphallus (Figs 3.4: 149, 153, *dp*) long, scimitar-like (viewed laterally), membranous area broad.

♀ Similar to ♂, except in the following respects: wing length 3.1–3.5 mm ($n = 4$, PT); postabdomen as illustrated in Figs 3.4: 203, 204.

Variation. Freshly collected specimens from Kosi Bay have the markings on the frons darker than the HT and the wing is also more darkly infusate. The male terminalia are identical however. There is some variation in the number and size of teeth-like serrations on the posterior margin of the baso-ventral process of the phallus, other characters are consistent, however, and this is regarded as intraspecific variation only.

Differential diagnosis. *Curtonotum tsacas* sp. n. is probably most closely-related to a group of three species having the basiphallus relatively broad and expanded apically and the membranous area of the distiphallus broad (*C. sao*, *C. hay* sp. n. and *C. campsiphallum*). It is most closely related to the last two named species, both of which share the short plate-like baso-ventral process with a series of teeth-like serrations on the posterior margin. They are separable by use of the above key.

Type material examined. SOUTH AFRICA: holotype ♂, “SOUTH AFRICA: KZ-Natal / Enseleni Nature Reserve / 28°41’S, 32°03’E masl / Date: 26/07/1980 / Coll. R. Miller // HOLOTYPE ♂ / *Curtonotum* / *tsacas* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (NMSA). In good condition; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ [or ♀] / *Curtonotum* / *tsacas* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”): ETHIOPIA: 1♂, “ETHIOPIA: GAMO / GOFA, Arba Minch / Springs, 1300m / 5.ii.2000.I.YAROM / & A. FREIDBERG” (TAU). KENYA: 1♂, “KENYA (N.W.) / Kainuk, on / Morun River / 25.XI.1989 / A. FREIDBERG / & FINI KAPLAN” (TAU). [MOZAMBIQUE]: 1♀, “Port. East Africa. / Amatongas Forest. / Near Gondola. / 4.II.1959 / A.C. van Bruggen.” [head missing] (PPRI). SOUTH AFRICA: 1♂, “DUKUDUKU BETWEEN / ST LUCIA & MATUBATUBA / ZULULAND, S. AFRICA / B. & P. STUCKENBERG / 7-8 APRIL 1960 // CURTONOTUM / n. sp. ? aff. *cam* / *psiphallus* n.sp. / L. TSACAS DET. 1976 [printed & handwritten] [head missing] (NMSA); 2♂, 4♀, “RSA: KwaZulu-Natal, Kosi / Bay Nat. Res., picnic area / 26°57’52”S, 32°48’51”E / 15.xii.2010, 6 m / A.H. Kirk-Spriggs // Sweeping / dune forest & / woodland” [2♂ labelled “// BMSA(DNA)#0064” and “// BMSA(DNA)#0065”; labelled “// BMSA(D)29847–29850; BMSA(D)30210–30211”] (BMSA).

Distribution. Ethiopia, Kenya, Mozambique and South Africa (Fig. 3.4: 223, 224). Exhibits a typical Rift Valley distribution pattern (see Chapter 4).

Bionomics. Occurring in 5 major habitat types; predominantly in Tropical and Subtropical Moist Broadleaf Forests, with records from Tropical and Subtropical Grasslands, Savannas and Shrublands and Mangroves (3.4: Appendix). In South Africa the species occurs in closed-canopy coastal dune forest and woodland and appear to shelter in natural hollows in the forest floor during daylight hours.

Gonzo species-group

Notes. The *Gonzo* species-group is defined as having sternite 5 expanded laterally and sternites 4–5 with modified setae (Fig. 3.4: 197) and the basiphallus with an expanded subdivided mid section and a cordiform extension of the distiphallus (Figs 3.4: 157, 160).

***Curtonotum gonzo* Kirk-Spriggs, sp. n.,**

Figs 3.4: 14, 38, 74, 154, 157, 160, 197, 205, 206, 223, 224.

Etymology. The specific epithet *gonzo* is a noun in apposition, named after “Gonzo the Great”, a puppet character from Jim Henson’s Muppet Show, as the anterior ½ of the phallus resembles his head and “beak”.

Description: Male (primarily based on field-pinned HT).

Measurements: Overall length 3.4 mm ($n = 1$, HT) (a ♀ measures 3.8 mm; $n = 1$, PT); length of head and thorax combined 2.1 mm; length of thorax and scutellum combined 1.9–2.1 mm ($n = 5$, HT, PT); wing length 2.3–3 mm ($n = 4$, HT, PT).

Head (Figs 3.4: 14, 38). Eye height/length ratio: 9:6 ($n = 1$, PT); frons (Fig. 3.4: 38) subparallel-sided, as wide as long, frons length/width ratio: 6:6 ($n = 1$, PT), very slightly wider at vertex than at ventral margin, ground colour dirty yellow-white, faintly darker at vertex between orbital plates and ocellar triangle, medial vittae conspicuous, surface with a few minute, but clearly discernable, pale to dark brown setulae; orbital plates and ocellar triangle silver-grey pruinose; ocelli clear grey with 6

minute dark setulae arranged in two closely-approximated regular rows between posterior ocelli; orbital plates extending from vertex of head to 0.8 length of frons, lateral margins with very narrow silver pruinose fascia (adjacent to eye margin), widest at antennal insertions; posterior and anterior orbital setae inserted proximally, the latter inserted beyond $\frac{1}{2}$ length of frons; posterior orbital seta moderately strong, same length as outer vertical seta, with tiny proclinate medial orbital seta inserted immediately ventral to socket of posterior orbital seta; anterior orbital seta moderately strong, *ca.* $\frac{1}{2}$ length of ocellar setae; ocellar setae finer, extending four-fifths length of frons; outer vertical seta shorter than inner; postocellar setae strong, cruciate, slightly shorter than outer vertical seta; antennal scape and pedicel dirty yellow-white, silver-grey pruinose, flagellomere 1 concolourous with pedicel basally, darkened apically, silver-grey pruinose, longer than wide, with evenly rounded apex, arista with 6–7 long widely-spaced dorsal branches and 2 or 3 ventral branches in addition to terminal fork; lunule and face uniform silver-grey pruinose throughout, face with broad silver fascia (adjacent to eye margin), facial carina developed as a low ridge, extending $\frac{2}{3}$ length of face; clypeus brown, especially laterally; 1 pair strong vibrissae inserted on posterior lateral margin and 9 much finer setae bordering genal groove; occiput yellow to grey pruinose with moderately strong, black postocular setae; gena narrow, eye height/genal height ratio: 9:1 ($n = 1$, PT), silver pruinose, abruptly dirty brown beyond basal angle; palpus black-brown, brown microtrichose.

Thorax (Fig. 3.4: 14). Silver-grey pruinose, with four narrow parallel chestnut-brown pruinose vittae on dorsal surface, 2 median vittae extending from anterior margin to region of anterior dorsocentral seta socket, 2 lateral vittae shorter, extending from $\frac{2}{3}$ length to region of posterior dorsocentral seta socket, 2 pairs of dorsocentral setae, posterior very long and strong (shorter than lateral scutellar seta), anterior shorter and finer (*ca.* three-quarters length of posterior); 1 pair acrostichal setae finer, but as long as anterior dorsocentral seta; presutural seta moderately strong, reclinate, as long and strong as posterior notopleural seta; 2 notopleural setae the anterior slightly longer than posterior; 1 strong supra-alar seta slightly exceeding length of posterior dorsocentral seta; 2 postalar setae moderately strong, same size as acrostichal setae; postpronotum dirty yellow-grey pruinose, with 2 strong postpronotal setae, the more dorsal longer and reclinate, the more ventral shorter and proclinate, with 8 finer black-brown setulae; anepisternum silver-grey pruinose with 3 strong

anepisternal setae and 2 moderately strong intermediate setae, surface with 24 fine setulae scattered across surface, 3 arranged in a group in posterior corner; anepimeron, laterotergite and meron silver-grey pruinose, glabrous; katepisternum silver-grey pruinose, with 2 katepisternal setae, the more ventral strong, slightly dorsally-directed, the more dorsal much smaller and finer, *ca.* 0.4 length of ventral katepisternal setae, surface with 12 short, fine setulae at base and along posterior margin.

Scutellum. Silver-grey pruinose as on mesonotum, disk clothed in black, irregular, overlapping setulae; 2 pairs of strong scutellar setae, with variable number of weaker basal and intermediate scutellar setulae.

Legs. Fore coxa silver-yellow pruinose with two moderately strong, brown, ventrally-directed preapical setae and comb of finer setulae medially, with 15 brown setulae on anterior surface; mid and hind coxa yellow-grey pruinose, mid-coxa with 2 very strong, lateral, ventrally-directed, black setae and comb of finer setae medially; hind coxa with 1 weaker lateral black seta, 1 brown setula and one strong ventral seta; femora, tibia and tarsi uniform dirty yellow; fore tibia with 5 strong setae on lateral margin of variable length, with ctenidium of 9–10 short, sharp, black spinules, separated from each other by one or more basal spinule widths.

Wing (Fig. 3.4: 74). Long, relatively broad, tip evenly-rounded, veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in region of *dm-cu* crossvein; costa with prominent costal spines in basal four-fifths from costal break; *dm-cu* crossvein with gentle medial angle; *cua*₁ relatively short and narrow; anal fold extending less than ½ length of *cua*₁; anal lobe broad, squarely rounded; halter dirty white.

Abdomen. Ground colour of tergites 1–5 silver-yellow to grey pruinose, clothed in relatively long black, overlapping setulae, arranged in regular rows, those at apical margins longer and stronger with dark rings around the bases of the sockets; tergite 1 simple, devoid of maculae; tergite 2 with oblique, subquadrate brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with narrow, brown median fascia and well developed “T-shaped” brown lateral maculae, but not merging with median fascia, lateral margin of tergites 2–5 with subtriangular maculae in basal ½; sternites 3 to 6 (Fig. 3.4: 197) laterally expanded, sternite 5 especially so (sternites 3 to 6 may appear narrower than Fig. 3.4: 197 in undissected specimens); sternites 4

and 5 with modified extremely long and thick setae; sternite 6 narrow basally, expanded apically, with sides evenly rounded and shallow and broad U-shaped apical excision and group of long strong setae medially; tergite 6 absent, sternite 7 weakly sclerotised.

Terminalia (Figs 3.4: 154, 157, 160). Hypandrium (Fig. 3.4: 154, *hy*) long, with moderately broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced; hypandrial arms narrow basally, expanded apically (viewed laterally), with 2 very long setulae proximal to postgonite, sclerotised area of medial lobes (viewed dorsally), closely abutting; postgonite (Fig. 3.4: 154, *pg*) free basally, long and narrow; epandrium (Fig. 3.4: 154, *ep*) broader dorsally than ventrally (viewed laterally), gently curved on dorsal margin, posterior margin slightly angled, ventral margin with group of long, strong regular to irregular setae of variable length; cercus (Fig. 3.4: 154, *ce*) narrow, usually partially retracted into epandrium, longest setae shorter than long setae on ventral margin of epandrium, with elongate fused ventral process; surstylus (Fig. 3.4: 154, *ss*) widest basally, long and narrow, slightly curved apically; phallus (as in Figs 3.4: 157, *ph*, *bp*, *dp*; 160, *bp*, *dp*) C-shaped, heavily sclerotised, brown; phallapodeme (Fig. 3.4: 157, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two broad lateral lobes, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.4: 157, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Figs 3.4: 157, 160, *bp*) very broad basally and for most of length, slightly expanded apically, preapically with weakly sclerotised “window”, left side with expanded blade, right side reduced to cordiform extension which continues down right side of distiphallus (may be homologous with baso-ventral process); distiphallus (Figs 3.4: 157, 160, *dp*) long, scimitar-like (viewed laterally), membranous area narrow.

♀ Similar to ♂, except in the following respects: wing length 3.0 mm ($n = 2$, PT). Postabdomen (Figs 3.4: 205, 206); sternite 8 (Figs 3.4: 205, 206, *s8*) weakly sclerotised and reduced; sternite 10 (Figs 3.4: 205, 206, *s10*) laterally flattened proximally, with medial division; tergite 10 (Figs 3.4: 205, 206, *t10+ce*) fused to free cerci, spinose with some sparse short terminal setulae.

Variation. Some variation is apparent in the ground colour of the frons. In the Nigerian and Cameroonian specimens this is dirty white, while in the Ghanaian specimens the vittae and dark areas between the orbital plates are darker brown. The male terminalia is consistent, however, and this is here regarded as intraspecific variation only.

Differential diagnosis. *Curtonotum gonzo* sp. n. is sufficiently different from other species in the genus to be ascribed to a species-group of its own (*Gonzo* species-group). The form of the phallus in particular is fundamentally different from other described species of the genus. Whether the Madagascan endemic species *C. sternithrix* Tsacas belongs to this species-group remains in question. The two species share a number of similarities, including the laterally expanded male sternite 5, modified setae on male sternites 4 and 5, and the cordiform structure of the basiphallus. The two species differ dramatically in other respects however and the characters noted are more likely plesiomorphic characters of the common ancestor of the two species. Only a molecular study would help resolve relationships.

Type material examined. [GHANA]: holotype ♂, “Kwadaso / 21.7.1969. [handwritten] // light trap / on field / UV light [handwritten] // leg Endrödy- / Younga S. [handwritten] // HOLOTYPE ♂ / *Curtonotum / gonzo* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (HNHM). In good condition. Dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE ♂ [or ♀] / *Curtonotum / gonzo* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”): CAMEROON: 1♂, “Cameroon: Prov. Nord / Dépt. Faro: village Ndom- / Beoué (NW of Wak) / 07°45'27"N, 13°31'32"E / 8.v.2006, 565m / F. Menzel, CAM11 // River bank of Mayo Ndom- / Beoué, above herb / vegetation near bank, / swept” (DEI). [GHANA]: 2♂, 2♀, same data as holotype (all HNHM). NIGERIA: 1♂, “N. NIGERIA: / River Bagel / at crossing of / Bauchi-Dass / road, 3.iv.1990 / J.C. Deeming [handwritten] // roosting in / moist cave / in bank of / dry river [handwritten] // NMW.Z. / 1981-001” [terminalia on micro-slide] (NMWC).

Distribution. Cameroon, Ghana and Nigeria (Fig. 3.4: 223, 224). Records indicate that the species may be mainly associated with fragmented rainforest remnants.

Bionomics. Occurring in 3 major habitat types; predominantly in Tropical and Subtropical Grasslands, Savannas and Shrublands and in Tropical and Subtropical

Moist Broadleaf Forests (3.4: Appendix). Collected at UV-light in Ghana and roosting in moist cave in the bank of a dry riverbed in Nigeria.

Saheliense species-group

Notes. The *Saheliense* species-group is defined as having the distiphallus with a very long, obliquely angled, posteriorly-directed spine basally (Figs 3.4: 161, 162).

Curtonotum simile Tsacas, 1977,

Figs 3.4: 16, 40, 76, 156, 159, 162, 199, 207, 208, 222.

Curtonotum similis: Tsacas, 1977: 165; figs 10 a–b, p. 164. Type locality: “Arabia: S. Othman, N. Aden”.

Cyrtonotum cuthbertsoni: *sensu* Greathead (1958), *auctt.* misidentification.

Curtonotum cuthbertsoni: *sensu* Stower *et al.* (1958: 29), *auctt.* misidentification.

Curtonotum simile: Wirth and Tsacas (1980: 672).

Curtonotum sahelense (?): *sensu* Meier *et al.* (1997: 16), *nec sensu* Kirk-Spriggs (2008b: 229), *auctt.* misidentification.

Curtonotum similis: Papp (1998: 501).

Curtonotum simile: Kirk-Spriggs and Freidberg (2007: 139, figs 3–4, 6, 12–16, 19, 20).

Curtonotum simile: Kirk-Spriggs (2008a: 706, figs 1–10, plate 1).

Curtonotum simile: Kirk-Spriggs (2008b: 233, figs 13–19, 24, 25, 31, 35–37).

Curtonotum simile: Kirk-Spriggs (2008c: 249; figs 56–65).

Redescription: Male (primarily based on field-pinned HT).

Measurements: Overall length unknown; 5.5 mm (Tsacas 1977: 166) (the ♀ measures 3.5–4.9 mm; $n = 2$, N–T); length of head and thorax combined 2.0–2.6 mm; length of thorax and scutellum combined 1.8–2.5 mm ($n = 4$, N–T); wing length 2.8–3.4 mm ($n = 3$, N–T).

Head (Figs 3.4: 16, 40). Eye height/length ratio: 10:6 ($n = 1$, N–T); frons (Fig. 3.4: 40) sides marginally narrowed anteriorly, very slightly wider than long, frons length/width ratio: 6:7 ($n = 1$, N–T), slightly wider at vertex than at ventral margin, ground colour pale dirty yellow-white, faintly darker at vertex between orbital plates and ocellar triangle, medial vittae conspicuous, surface with a few minute very pale setulae; orbital plates and ocellar triangle silver-grey pruinose; ocelli clear grey with 6

minute dark setulae arranged in two closely-approximated regular rows between posterior ocelli; orbital plates extending from vertex of head to 0.8 length of frons, lateral margins with very narrow silver pruinose fascia (adjacent to eye margin), widest at antennal insertions; posterior and anterior orbital setae inserted proximally, the latter inserted beyond $\frac{1}{2}$ length of frons; posterior orbital seta moderately strong, same length as outer vertical seta, with tiny proclinate medial orbital seta inserted antero-medially to socket of posterior orbital seta; anterior orbital seta moderately strong, *ca.* $\frac{1}{2}$ length of ocellar setae; ocellar setae finer, extending four-fifths length of frons; outer vertical seta shorter than inner; postocellar setae strong, cruciate, slightly shorter than outer vertical seta; antennal scape and pedicel dirty pale brown, silver-grey pruinose, flagellomere 1 concolourous with pedicel basally, darkened apically, silver-grey pruinose, longer than wide, with evenly pointed apex, arista with 7–8 long dorsal branches and 3 or 4 ventral branches in addition to terminal fork; lunule and face uniform silver-grey pruinose throughout, face with broad silver fascia (adjacent to eye margin), facial carina developed as a low ridge, extending $\frac{2}{3}$ length of face; clypeus brown, especially laterally; 1 pair weak vibrissae inserted on posterior lateral margin and 8 much finer setae bordering genal groove; occiput yellow to grey pruinose with moderately strong, black postocular setae; gena narrow, eye height/genal height ratio: 10:1 ($n = 1$, N-T), silver pruinose throughout; palpus pale brown, brown microtrichose.

Thorax (Fig. 3.4: 16). Silver-grey-yellow pruinose, with four broad parallel chestnut-brown pruinose vittae on dorsal surface, 2 median vittae markedly widened anteriorly, extending from anterior margin to region of anterior dorsocentral seta socket, 2 lateral vittae shorter, extending from $\frac{2}{3}$ length to region of posterior dorsocentral seta socket, 2 pairs of dorsocentral setae, posterior very long and strong (shorter than lateral scutellar seta), anterior shorter and finer (*ca.* $\frac{1}{2}$ length of posterior); 1 pair acrostichal setae finer, but as long as anterior dorsocentral seta; presutural seta moderately strong, reclinate, as long and strong as posterior notopleural seta; 2 notopleural setae the anterior slightly longer than posterior; 1 strong supra-alar seta slightly exceeding length of posterior dorsocentral seta; 2 postalar setae moderately strong, same size as acrostichal setae; postpronotum silver-grey-yellow pruinose, with 2 strong postpronotal setae, the more dorsal longer and reclinate, the more ventral shorter and proclinate, with 10 finer black-brown setulae;

anepisternum silver-grey-yellow pruinose with 3 strong anepisternal setae and 2 moderately strong intermediate setae, surface with 11 fine setulae scattered across surface, 3 arranged in a group in posterior corner; anepimeron, laterotergite and meron silver-grey-yellow pruinose, glabrous; katepisternum silver-grey-yellow pruinose, with 2 katepisternal setae, the more ventral strong, slightly dorsally-directed, the more dorsal much smaller and finer, *ca.* 0.4 length of ventral katepisternal seta, surface with 16 short, fine setulae at base and along posterior margin.

Scutellum. Silver-grey-yellow pruinose as on mesonotum; disk clothed in black, irregular, overlapping setulae; 2 pairs of strong scutellar setae, with variable number of weaker basal and intermediate scutellar setulae.

Legs. Fore coxa silver-yellow pruinose with two moderately strong, brown, ventrally-directed preapical setae and comb of finer setulae medially, with 10 brown setulae on anterior surface; mid and hind coxa yellow-grey pruinose, mid-coxa with 2 very strong, lateral, ventrally-directed, black setae and comb of finer setae medially; hind coxa with 1 weaker lateral black seta, 1 brown setula and one strong ventral seta; femora, tibia and tarsi uniform dirty yellow; fore tibia with variable number of strong setae on lateral margin, with ctenidium of 7–8 short, sharp, black spinules, separated from each other by one or more basal spinule widths.

Wing (Fig. 3.4: 76). Long, relatively broad, tip evenly-rounded, veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in region of *dm–cu* crossvein; costa with prominent costal spines in basal four-fifths from costal break; *dm–cu* crossvein with medial angle; *cua*₁ relatively long and narrow; anal fold extending less than ½ length of *cua*₁; anal lobe broad, squarely rounded; halter dirty yellow.

Abdomen. Ground colour of tergites 1–5 silver-yellow to grey pruinose, clothed in relatively long black, overlapping setulae, arranged in regular rows, those at apical margins longer and stronger; tergite 1 simple, devoid of maculae; tergite 2 with elongate, narrow brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with narrow, brown median fascia and greatly reduced “T-shaped” brown lateral maculae, all well separated from median fascia, lateral margin of tergites 2–5 with reduced subtriangular maculae in basal third; sternite 6 (Fig. 3.4: 199) apically expanded (may appear narrower than Fig. 3.4: 199 in undissected specimens),

narrowed basally with deep V-shaped apical excision, clothed in long black irregular brown setulae, especially medially and apically; tergite 6 absent, sternite 7 weakly sclerotised.

Terminalia (Figs 3.4: 156, 159, 162). Hypandrium (Fig. 3.4: 156, *hy*) very long, with broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded in profile); hypandrial arms narrow basally, expanded apically (viewed laterally), with 2 long, widely-spaced setulae proximal to postgonite, sclerotised area of medial lobes (viewed dorsally), closely abutting apically, but well separated; postgonite (Fig. 3.4: 156, *pg*) free basally, long and narrow; epandrium (Fig. 3.4: 156, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly-rounded on dorsal margin, posterior margin slightly angled, ventral margin with extensive row of long irregular, ventrally and apically-directed setae; cercus (Fig. 3.4: 156, *ce*) narrow, partially retracted into epandrium, longest setae as long as setae on ventral margin of epandrium, with elongate fused ventral process; surstylus (Fig. 3.4: 156, *ss*) elongate, widest basally, slightly curved apically; phallus (as in Figs 3.4: 159, *ph*, *bp*, *dp*; 162, *bp*, *dp*) C-shaped, moderately sclerotised, brown; phallapodeme (Fig. 3.4: 159, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two broad lateral lobes, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.4: 159, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Figs 3.4: 159, 162, *bp*) broad basally, narrowed medially, apically expanded, with extremely long, obliquely angled, posteriorly-directed spine basally; distiphallus (Figs 3.4: 159, 162, *dp*) long, scimitar-like (viewed laterally), membranous area narrow, basal region (viewed dorsally) with small spine on left margin near junction of basiphallus and distiphallus, immediately below base of prominent elongated spine on basiphallus.

♀ Similar to ♂, except in the following respects: wing length 3.2–3.9 mm ($n = 3$, N-T). Postabdomen (Figs 3.4: 207, 208); sternite 8 (Figs 3.4: 207, 208, *s8*) weakly sclerotised and reduced; sternite 10 (Figs 3.4: 207, 208, *s10*) laterally flattened proximally, with medial division; tergite 10 (Figs 3.4: 207, 208, *t10+ce*) fused to free cerci, with long terminal setulae.

Variation. No significant variation is noted.

Differential diagnosis. The two species in the *Saheliense* species-group, *C. simile* and *C. saheliense* are distinguished by the presence of the extremely long, obliquely angled, posteriorly-directed spine in the basal region of the basiphallus. The two sister species are very similar externally and are separable by the position of the smaller spine on the distiphallus and by the shape of the sclerotised basal area. The two species can be separated by use of the above key.

Type material examined. [YEMEN]: holotype ♂, “Type [paper disc; red border] // ARABIA: / S. Othman [= Shaykh ‘Uthmān] / 17.iii.1895 / C.G. Nurse. / B.M.1934–8. [handwritten & printed] // S. Othman / Nr Aden / 17.3.95 [handwritten] // Aedeagus missing / from Tsacas’ original vial // CURTONOTUM / *similis* n.sp. / Holotype / L. TSACAS DET. 1976 [handwritten & printed] // *Curtonotum* ♂ / *simile* Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006” (BMNH). In good condition: right mid tarsus and hind tarsus damaged; re-staged on nu-poly mount; epandrium and abdomen in micro-vial pinned beneath specimen, phallus missing from original vial. Paratypes (all labelled: “*Curtonotum* ♂ / *simile* Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006”): [YEMEN]: 1♂, same data as holotype, except: “Para- / type [paper disc; yellow border] // CURTONOTUM / *similis* n.sp. / Paratype / L. TSACAS DET. 1976 [handwritten & printed]” (BMNH); 1♂, same labels, except no label “Para- / type [paper disc; yellow border]”: “*Curtonotum* / *anus* Meig. / 3♂s / det. J.C. Deeming 1965 [handwritten & printed] // MUSÉUM PARIS” (MNHN).

Remarks. Tsacas (1977: 166) cites 2♂ paratypes in the BMNH; the second specimen is in fact deposited in MNHN. Tsacas (*ibid.*) erroneously cited the name of the collector as “C.G. Nurce” rather than “C.G. Nurse”, the latter being correct.

Additional material examined (all labelled: “*Curtonotum simile* Tsacas, 1977 ♂ [or ♀] det. A.H. Kirk-Spriggs 2006–2008”): ERITREA: 4♂, 5♀, Eritrea, Ailet egg field, em. 20.i.1956, D.J. Greathead, Natural Resources Institute coll. BMNH(E) 1997–28 [with associated puparia]; 1♂, 3♀, same except: 22.i.1956, from egg pods of *S. gregaria* [1♂, 2♀ with associated puparia]; 4♂, 3♀, Eritrea, Sheb, egg pods, 10.i.1957, D.J. Greathead, Natural Resources Institute coll. BMNH(E) 1997–28 [4♂, 2♀ with associated puparia]; 5♀, 15 mls N. Massawa (Greathead 1958: 38), Eritrea, 21.ii.[19]54, Natural Resources Institute coll. BMNH(E) 1997–28; 1♂, 3♀, same except: emerged 10.iii.1954, from egg pods (all BMNH); 8♂, 10♀, Africa or. Katona, Assab, [1]907. V–VI (HNHM); 1♀, same data, except: Zool. Mus. Berlin (ZMHB); 10♂, 10♀, same except: [1]907. VII (HNHM). ISRAEL: 1♀, Nahal Perat [W. Kelt], 25.iii.1975, A. Freidberg, *Curtonotum similis* Tsacas, det L. Papp, 1994; 1♂, Qalya, 28.ix.1995, A. Freidberg; 1♂, Arava Valley, Moshav Hazeva, Wadi Shahak, between agricultural fields, el. -110 m, Sharkey Malaise trap, 30°46.33'N, 35°16.32'E [GPS], 22.iii.1995, M. Irwin; 1♂, Hazeva Field School, 30°46'N, 35°15'E, Malaise trap, 4.x.1997, S. Plotkin; 1♀, Nahal Hiyon, Rt. 40, near Ne'ot Smadar, 13.x.1997, A. Freidberg; 1♀, Ne'ot Smadar, 21.vi.1995, A.

Freidberg; same except: 11♂, 10♀, 7.viii.1995, A. Freidberg; 1♂, 7.viii.1995, I. Yarom; 7♂, 11♀, 17.viii.1995, A. Freidberg; 16♂, 23♀, 20.ix.1995; 26♂, 25♀, 10.x.1995; 2♂, 2♀, 2.viii.1995, I. Yarom; 1♂, 3♀, 29.viii.1995, A. Freidberg; 1♀, 13.x.1996; 1♂, Samar, 21.vii.1982, Sh. Alterman, *Curtonotum similis* Tsacas, det. L. Papp, 1994; 1♂, 1♀, Elifaz, sewage, 5.iv.1997, A. Freidberg; 1♂, [Park] Timna', gate, 3.iv.1997, A. Freidberg; 1♀, [10 km south to] Elat, Taba, 29°29'N, 34°55'E, 7.v.2002, A. Freidberg (all TAU). OMAN: 1♀, Oman: Batinah, Şohār, 5.xii.1992, J.C. Deeming, at light, NMW.Z.1981-001; 2♂, 3♀, Oman: Muscat, Al Khuwair, x.1990, J.C. Deeming, NMW.Z.1981-001; same except: 1♂, 3-4.i.1988, M. Ebejer, NMW.Z.1985-032; 2♂, 1♀, 31.xii.1987; 1♂, 20.i.1988; 1♀, 5-9.i.1988; 1♂, 4-5.i.1988, *Curtonotum* sp. nr. *similis* Tsacas (distiphallus lacking reclinate basal spine) det. J.C. Deeming 1990; 1♂, Oman: Muscat, Wattayeh, 17-20.iv.1988, M.D. Gallagher, *Curtonotum similis* Tsacas, det. J.C. Deeming '93, NMW.Z.1981-001; 2♀, Oman: Muscat, Al Khuwair, 27-30.iv.1997, M.D. Gallagher (all NMWC); 1♂, Oman, Qurm Hotel garden, 5.iv.[19]85, PAÖ (MZLU). UNITED ARAB EMIRATES: 1♀, Oman, Ras al-Kheima [= U.A.E.: Ra's al Khaymah], 10.vi.[19]57, G. Popov, from pod of *Acrotylus* sp. No. 18, Natural Resources Institute coll. BMNH(E) 1997-28 (BMNH) [with associated puparium]; ♂, U.A.E., Al-Ajban, 1-8.iv.2006, A. van Harten, Malaise trap; 6♂, 1♀, U.A.E., Sharjah Desert Park, 30.iv-31.v.2005, A. van Harten, light trap; 1♂, 3♀, U.A.E.: Wadi Madaq, 1-8.vii.2006, light trap, A. van Harten (all NMWC); 3♂, United Arab Emirates: Ras Al Khayman, Farm, 25°47.91'N 56°04'29'E, 300m, 16.iii.2008, leg. J.-H. Stuke (J-HS). [YEMEN]: 1♀, Arabien, 54539, Zool. Mus. Berlin (ZMHB); 1♂, 1♀, Yemen, Ta'izz, viii.1999, A. van Harten & A. Awad, light trap; 2♀, Yemen, 12 Km NW of Manakhah, 5.v-17.vi.2002, A. van Harten, Malaise trap (all NMNW).

Distribution. Palaearctic: Israel, Oman, United Arab Emirates; Afrotropical: Eritrea, Yemen (Fig. 3.4: 222). Predominantly occurring in the Arabian Peninsula, but also across the Red Sea in Eritrea, as far east as Oman and as far north as Israel in the Palaearctic Region. Although not recorded from Saudi Arabia its occurrence there should be expected.

Bionomics. Occurring in 6 major habitat types; almost exclusively in Deserts and Xeric Shrublands, with two records in the Temperate Grasslands, Savannas and Shrublands vegetation type (3.4: Appendix). Adults have been taken at light in Oman, the United Arab Emirates and Yemen (Kirk-Spriggs 2008b), indicating crepuscular or nocturnal adult activity. Reared from the damaged egg pods of *Schistocerca gregaria* (Forskål) in Eritrea (Greathead 1958, as *Cy. cuthbertsoni*) and of *Acrotylus* sp. in Oman (see above). Greathead (1958) found adult flies in Eritrea on dung, dead locusts and sand wetted by camel urine. Larvae occurred on locust egg pods crushed and exposed during the sampling of egg fields, generally in the top layers of eggs, usually

more than 10 larvae per pod. A mush of decaying eggs was produced by their feeding action; pupariation took place in this mush, or in soil within one inch of the remains of the pod. He concluded that larval development was completed in two days and that the period from pupariation to eclosion was 23–25 days.

Curtonotum saheliense Tsacas, 1977,
Figs 3.4: 15, 39, 75, 155, 158, 161, 198, 222.

Curtonotum saheliensis: Tsacas, 1977: 161; figs 8 a–e, p. 162. Type locality: [Niger]: “Guerimari”.

Curtonotum saheliense: Wirth and Tsacas (1980: 672).

Curtonotum saheliense: Meier *et al.* (1997: 10).

Curtonotum saheliense (?): *sensu* Meier *et al.* (1997: 16), *nec sensu* Kirk-Spriggs (2008b: 229), *auctt.* misidentification.

Curtonotum saheliense: Kirk-Spriggs and Freidberg (2007: 135).

Curtonotum saheliense (?): *sensu* Kirk-Spriggs (2008b: 229), *nec sensu* Meier *et al.* (1997: 16).

Curtonotum saheliense: Kirk-Spriggs (2008c: 248, figs 46–55).

Redescription: Male (primarily based on field-pinned N-T).

As redescribed for *C. simile* (below), differing in the following respects:

Measurements: Overall length unknown; 4–4.5 mm (Tsacas 1977: 163); length of head and thorax combined 2.1–2.6 mm; length of thorax and scutellum combined 1.9–2.4 mm; wing length 2.8–3.6 mm ($n = 5$, N-T).

Head (Figs 3.4: 15, 39). Eye height/length ratio: 11:7 ($n = 1$, N-T); frons (Fig. 3.4: 39) slightly wider than long, frons length/width ratio: 8:6 ($n = 1$, N-T); flagellomere 1 with squarely rounded apex; 9 fine setae bordering genal groove; gena narrow, eye height/genal height ratio: 11:1 ($n = 1$, N-T).

Thorax (Fig. 3.4: 15). Mesonotum with 2 median vittae not markedly widened anteriorly; postpronotum with 9 fine black-brown setulae; anepisternum surface with 14 fine setulae; katepisternum surface with 15 short, fine setulae.

Legs. Fore coxa with 15 brown setulae on anterior surface; fore tibia with ctenidium of 10–11 short, sharp, black spinules.

Wing (Fig. 3.4: 75). Virtually identical to that of *C. simile*.

Abdomen. Sternite 6 (Fig. 3.4: 198) apically expanded (may appear narrower than Fig. 3.4: 198 in undissected specimens), with shallow U-shaped apical excision.

Terminalia (Figs 3.4: 155, 158, 161). Hypandrium (Fig. 3.4: 155, *hy*) long, with very broad-based rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded in profile); hypandrial arms broad basally, expanded apically (viewed laterally); postgonite (Fig. 3.4: 155, *pg*); epandrium (Fig. 3.4: 155, *ep*); cercus (Fig. 3.4: 155, *ce*); surstylus (Fig. 3.4: 155, *ss*); phallus (as in Figs 3.4: 158, *ph*, *bp*, *dp*; 161, *bp*, *dp*); phallapodeme (Fig. 3.4: 158, *ph*); ejaculatory apodeme (Fig. 3.4: 158, *ea*); basiphallus (Figs 3.4: 158, 161, *bp*); distiphallus (Figs 3.4: 158, 161, *dp*) with basal region (viewed dorsally) having small spine on right side, widely separated from junction of basiphallus and distiphallus.

♀ Similar to ♂, except in the following respects: wing length 3–4 mm (Tsacas 1977: 163). The obclavate spermatheca was illustrated by Tsacas (1977: 162, fig. 8c), but given intraspecific variation this has little value in differentiating the species.

Variation. No significant variation is noted.

Differential diagnosis. The two species in the *Saheliense* species-group, *C. sahelense* and *C. simile* are distinguished by the presence of the extremely long, obliquely angled, posteriorly-directed spine in the basal region of the basiphallus. The two sister species are very similar externally and are separable by the position of the smaller spine on the distiphallus and by the shape of the sclerotised basal area. The two species can be separated by use of the above key.

Type material examined. NIGER: holotype ♂, “MUSEUM PARIS / GUERIMARI / (MISSION TILHO) / Dr. R. GAILLARD 1910 [printed; pale blue card] // OCTOBRE [printed, black border] // HOLOTYPE [printed; red card] // CURTONOTUM / *saheliensis* / Holotype n.sp. / L. TSACAS DET. 1976 [printed & handwritten] // *Curtonotum* / *saheliense* Tsacas, 1977 / A.H. Kirk-Spriggs *vidit* 2006 // Specimen / missing from mount / 2006” (MNHN). The specimen is entirely missing from the mount, but the abdomen and terminalia are stored in micro-vial pinned beneath specimen. Paratypes (all labelled: “*Curtonotum sahelense* Tsacas, 1977 ♂ [or ♀] A.H. Kirk-Spriggs *vidit* 2006”): [CHAD]: 5♀, same labels as holotype, except: “PARATYPE [printed; red card]” [4 with additional “♀” label; 3 head missing]; 1 with additional label “Guerimari / oct. 08 [handwritten; blue border] [3 head missing]” (MNHN); 1♂, 1♀, “Para- / type [paper disc with yellow border] // 20 III

1966 OUARAI 299 [= Ouarrai] / Moyen Chari, Tchad / Coll. J.C. Hitchcock, Jr. [printed & handwritten] // 24 Hrs [handwritten] // CURTONOTUM / *saheliensis* / n.sp. / L. TSACAS DET. 1976 [printed & handwritten]”; 1♀, same labels except: “48 Hrs [handwritten] // *Curtonotum nigripalpis* Hend. / det. B. H. Cogan 1967” (all BMNH); 1♀, same except: “MUSÉUM PARIS // Head & abdomen / missing / iii.2006” (MNHN); 1♂, “Para- / type [paper disc with yellow border] // Abgarra [= Chad: Abgara] Fung P / W. Rutledge / Oct., 26 / swarming on / hollow tebeldi / Sudan Govt. [printed & handwritten] // Pres. by / Imp. Inst. Ent. / Brit. Mus. / 1933-14. // Ent. Coll. / C10242 [printed; black border] // *Cyrtonotum nigripalpis* H. / F. Hendel det. [printed & handwritten] // CURTONOTUM / *saheliensis* / n.sp. / L. TSACAS DET. 1976 [printed & handwritten]”; 1♀, same data except: “Pres. by / Imp. Inst. B.M. 1938-407 // *Cyrtonotum nigripalpis* H. / F. Hendel det. [printed & handwritten] // CURTONOTUM / *saheliensis* / n.sp. / L. TSACAS DET. 1976 [printed & handwritten]” (both BMNH). 1♀, “MUSEUM PARIS / BAS CHARI / FORT LAMY / MISSION CHARI-TCHAD / D^r J. DECORSE 1904 [printed, black border] // JUILLET [printed, black border] // ♀ // PARATYPE [printed; red card] // CURTONOTUM / *saheliensis* / n. sp. / L. TSACAS DET. 1976 [handwritten & printed]” (MNHN). MALI: 1♂, “Para- / type [paper disc with yellow border] // MALI / REPUBLIC / Macina / DIOURA / CAGE 32 / OICMA / 19/9/65 [printed & handwritten] // CURTONOTUM / *saheliensis* / n.sp. / L. TSACAS DET. 1976 [printed & handwritten]”; 1♀, same except: “in locust egg pods [on reverse]” [head missing] (both BMNH). [NIGER]: 1♀, “MUSEUM PARIS / RÉG. DE ZINDER / SULTANAT DU DAMAGHÉRIM / DUNGASS / (MISSION TILHO) / Dr R. GAILLARD 1910 [printed; pale blue card] // NOVEMBRE [printed, black border] // SEPTEMBRE [printed, black border] // ♀ // PARATYPE [printed; red card] // CURTONOTUM / *saheliensis* / n. sp. / L. TSACAS DET. 1976 [handwritten & printed]” (MNHN). SENEGAL: 1♂, 7♀, “SENEGAL / Linguère / (Ndilla) / IX-1967 [printed; pale blue card] // MUSÉUM PARIS / Mission IFAN- MUSÉUM / A. DESCARPENTRIES, / T. LEYE et A. VILLIERS [printed; discoloured card] // PARATYPE [printed; red card] // CURTONOTUM / *saheliensis* / n. sp. / L. TSACAS DET. 1976 [handwritten & printed]” (MNHN). 1♂, 1♀ entirely missing from mount, but the ♂ abdomen and terminalia are stored in micro-vial pinned beneath specimen; 1♀, head & thorax only; 2♀, thorax only; 1♀, “Senegal / Linndé / 14-IX-1967 [handwritten] // MUSÉUM PARIS / Mission IFAN- MUSÉUM / A. DESCARPENTRIES, / T. LEYE et A. VILLIERS // PARATYPE [printed; red card] // CURTONOTUM / *saheliensis* / n. sp. / L. TSACAS DET. 1976 [handwritten & printed]” [head missing] (MNHN). [SUDAN]: 1♀, “MUSEUM PARIS / SOUDAN / NIORO [= Niaro] / F. de ZELTNER 1909 [printed, black border] // SEPTEMBRE [printed, black border] // ♀ // PARATYPE [printed; red card] // CURTONOTUM / *saheliensis* / n. sp. / L. TSACAS DET. 1976 [handwritten & printed]” [head missing] (MNHN).

Additional material examined (all labelled: “*Curtonotum saheliense* Tsacas, 1977 ♂ [or ♀] det. A.H. Kirk-Spriggs 2006–2009”): [CHAD]: 1♂, Wadi Ditila, Canton Dibininthi, 13°35'N, 15°18'E [Ditila], Ngouri Sous-préf. Lac Préf., Tchad, 1.ix.1991, P.C. Matteson, Gambo, NMW.Z.1993–063, *Curtonotum saheliensis* Tsacas det. J.C. Deeming '93 (NMWC); 1♂, Museum Paris, Kamen et Zone N., Asséchée du Tchad, Mao a Nguigmi (Mission Tilho), Dr. R. Gaillard, 1910, Septembre, Paris Museum (MNHN). GAMBIA: 7♂, 5♀, Gambia: N. Bank Division, Kaba District, Chogin [Kaba

Kotor], 21.viii.1997, swept from groundnut crop, coll. D.J. Mann & B.A. Woodcock (NMNW); 1♀, Gambia: N. Bank Div., Upper Baddibu Dist., Passy Mut, tomato plot, 22.viii.1997, D.J. Mann; 1♀, Gambia: Central River Div. (N), Naini Distr., Sokuta [= Sukuta], sorghum field, 24.viii.1997, D.J. Mann; 2♂, 1♀, same except: on pre-flowering sorghum w. heavy aphid infestation, 24.viii.1997, OUMNH–1998–006, D.J. Mann Colln. Pres. By Mann, *Curtonotum sahelensis* Tsacas 1♂ 2♀ det. J.C. Deeming '98 (all OUMNH). GHANA: 1♂, Ghana: Abofour, 2.iv.1966, leg [S.] Endrödy-Younga (HNHM). MALI: 2 (sex unknown), Mali: nr. Gao, 3.ix.1959, G. Popov, ex *Schistocerca* egg pods, Natural Resources Institute coll. BMNH(E) 1997–28 [with associated puparium] (BMNH); 10♂, 6♀, Mali: Mourdiah, 3–12.x.1986, M. Matthews, NMW.Z.1987–144; 1♀, same except: 25.ix–3.x.1986 (NMWC). NIGERIA: 1♂, Nigeria, Igbetti, W. State: 7 Feb 1971, Col. J.T. Medler, DT-39, Paris Muséum; 1♂, N. Nigeria, Zaria, Samaru, i–iii.1977, J.C. Deeming, leaf-cluttered vegetable garden; 1♂, same except: 30.ix.1975; 1♂, same except: 8.ii.1977; 2♂, N. Nigeria, Kano, Kadawa, 28.ix.1974, J.L. Musa, ex cotton plot; 2♂, N. Nigeria, Kano, Gumel, 26.ix.[19]74, J.L. Musa; 3♂, N. Nigeria, Katsina Prov., Malumfashi, 25.ix.1974, J.L. Musa, ex groundnuts; 1♂, N. Nigeria, Katsina Prov., Daura, 25.ix.1974, J.L. Musa, ex cowpea plot; 2♂, Nigeria: Shagamu, K State, xii.1971, J.T. Medler Coll.; 1♂, N.W. Kantagna State [illegible], N. Nigeria, 10.xii.[19]74, M.A. Cornes (all MNHN); 1♂, N. Nigeria, Bauchi, Yankari Game Reserve, 30.i.1982, R. Brightwell, riverine woodland, NMW.Z.1981–125; same except: 1♂, 2.i.1982; 1♂, 3–6.iv.1981; 2♂, 27–28.ii.1982, *Pteleopsis* woodland; 1♂, 27–28.ii.1982, Transitional zone woodland to savanna (all NMWC); 1♂, Gadau, Nigeria, 12°N 10°E, iii.1933, Buxton & Lewis, burrow of porcupine, London School of Hygiene & Tropical Medicine coll. BMNH(E)1996–140 (BMNH); 1♂, N. Nigeria-Kankiya Distr., Kankiya Prov., Katsina, 20.ii.1965, Coll. L. Segers (ZSM). TOGO: 1♂, Togo: Région des Plateaux: SE of Anié, at river Anié near railway bridge, 07°44'19"N, 01°11'59"E, 10.iv.2008, 150 m, M. v. Tschirnhaus, Tg1865, Bank vegetation & leaf litter, swept, filled into elector. (Diopsidae mass occurrence on dicots.) [= Menzel: TOG17] [in spirit], BMSA(DNA)0008; 1♂, same except: [in spirit], BMSA(DNA)0009 (both BMSA)

Distribution. Chad, Gambia, Ghana, Niger, Nigeria, Mali, Senegal, Sudan and Togo (Fig. 3.4: 222). Tsacas (1977) regarded the species as being chiefly associated with the Sahel climatic zone. Records indicate, however, that it occurs predominantly in the Dry Savanna climatic zone or is transitional between this zone and the Sahel climatic zone. It occurs in a range of Potential Evapotranspiration zones, from 400–2400 m.

Bionomics. Occurring in 6 major habitat types; almost exclusively in the Tropical and Subtropical Grasslands, Savannas and Shrublands vegetation type (3.4: Appendix). Swarming on a hollow Baobab (as “tebeldi”) in Chad and from the burrows of Porcupine, in company with *Curtonotum sao* Tsacas, in Nigeria.

Uncinatum species-group

Notes. The *Uncinatum* species-group is defined as having the distiphallus with two dorsally-directed basal spines or dorsal ridge (Figs 3.4: 166–171, 175–180, 184–189; Kirk-Spriggs 2011, 3.3: 77, 78).

***Curtonotum uncinatum* Kirk-Spriggs, sp. n.,**

Figs 3.4: 23, 47, 84, 182, 185, 188, 200, 211, 212, 225, 229.

Curtonotum cuthbertsoni: Duda, 1935: 31, Type III of Tsacas (1977: 153).

Curtonotum sp. n. (*C. cuthbertsoni*, Type III of Tsacas, 1977): Kirk-Spriggs (2008c: 245; figs 13–45).

Etymology. The specific epithet *uncinatum* is derived from the Latin *uncinatus* (= shaped like a hook), and refers to the hook-like extension of the distiphallus of this species.

Description: Male (primarily based on field-pinned HT).

Measurements: Overall length unknown; length of head and thorax combined 1.7–3 mm; length of thorax and scutellum combined 1.6–2.8 mm; wing length 2.7–4.2 mm ($n = 5$, HT, PT).

Head (Figs 3.4: 23, 47). Eye height/length ratio: 11:7 ($n = 1$, HT); frons (Fig. 3.4: 47) sides slightly narrowed anteriorly, slightly wider than long, frons length/width ratio: 7:8 ($n = 1$, HT), slightly wider at vertex than at ventral margin, ground colour pale dirty yellow-white, medial brown vittae conspicuous, reaching ventral margin, surface with a few minute pale setulae; orbital plates and ocellar triangle silver-grey pruinose; ocelli clear brown with 2–6 minute dark setulae arranged in two closely-approximated regular rows between posterior ocelli; orbital plates extending from vertex of head to 0.8 length of frons, lateral margins with very narrow silver pruinose fascia (adjacent to eye margin), widest at antennal insertions; posterior and anterior orbital setae inserted proximally, the latter inserted at or just beyond $\frac{1}{2}$ length of frons; posterior orbital seta moderately strong, same length as outer vertical seta, with tiny proclinate medial orbital seta inserted antero-medially to socket of posterior orbital seta; anterior orbital seta moderately strong, *ca.* $\frac{1}{2}$ length of

ocellar setae; ocellar setae finer, extending four-fifths length of frons; outer vertical seta shorter than inner; postocellar setae strong, cruciate, slightly shorter than outer vertical seta; antennal scape and pedicel dirty pale brown, silver-grey pruinose, flagellomere 1 concolourous with pedicel basally, darkened apically, silver-grey pruinose, longer than wide, with evenly rounded apex, arista with 7–8 long dorsal branches and 3 ventral branches in addition to terminal fork; lunule and face uniform silver-grey pruinose throughout, face with broad silver fascia (adjacent to eye margin), facial carina developed as a low ridge, extending $\frac{2}{3}$ length of face; clypeus brown, especially laterally; 1 pair moderately strong vibrissae inserted on posterior lateral margin and 11 much finer setae bordering genal groove; occiput yellow to grey pruinose with moderately strong, black postocular setae; gena narrow, eye height/genal height ratio: 11:1 ($n = 1$, HT), silver pruinose throughout; palpus black-brown, brown microtrichose.

Thorax (Fig. 3.4: 23). Dark silver-grey pruinose, with four parallel chestnut-brown pruinose vittae on dorsal surface, 2 conspicuous median vittae extending from anterior margin to region of anterior dorsocentral seta socket, 2 inconspicuous lateral vittae shorter, extending from $\frac{2}{3}$ length to region of posterior dorsocentral seta socket, 2 pairs of dorsocentral setae, posterior very long and strong (shorter than lateral scutellar seta), anterior shorter and finer (*ca.* $\frac{1}{2}$ length of posterior); 1 pair acrostichal setae finer, but as long as anterior dorsocentral seta; presutural seta moderately strong, reclinate, as long and strong as posterior notopleural seta; 2 notopleural setae the anterior slightly longer than posterior; 1 strong supra-alar seta slightly exceeding length of posterior dorsocentral seta; 2 postalar setae moderately strong, same size as acrostichal setae; postpronotum dirty yellow-grey pruinose, with 2 strong postpronotal setae, the more dorsal longer and reclinate, the more ventral shorter and proclinate, with 9 finer black-brown setulae; anepisternum silver-grey pruinose with 3 strong anepisternal setae and 2 moderately strong intermediate setae, surface with 17 fine setulae scattered across surface, 4 arranged in a group in posterior corner; anepimeron, laterotergite and meron silver-grey pruinose, glabrous; katepisternum silver-grey pruinose, with 2 katepisternal setae, the more ventral strong, slightly dorsally-directed, the more dorsal much smaller and finer, *ca.* 0.4 length of ventral katepisternal setae, surface with 18 short, fine setulae at base and along posterior margin.

Scutellum. Silver-grey pruinose as on mesonotum, with faint medial brown pruinose vitta basally; disk clothed in black, irregular, overlapping setulae; 2 pairs of strong scutellar setae, with variable number of weaker basal and intermediate scutellar setulae.

Legs. Fore coxa silver-yellow pruinose with two moderately strong, brown, ventrally-directed preapical setae and comb of finer setulae medially, with 21 brown setulae on anterior surface; mid and hind coxa yellow-grey pruinose, mid-coxa with 2 very strong, lateral, ventrally-directed, black setae and comb of finer setae medially; hind coxa with 1 weaker lateral black seta and one strong ventral seta with a few proximal weaker brown setulae; femora, tibia and tarsi uniform dirty yellow; fore tibia usually with 6 strong setae on lateral margin, if 6 present then the second basal seta usually shorter than other five, with ctenidium of 11–12 short, sharp, black spinules, separated from each other by one or more basal spinule widths.

Wing (Fig. 3.4: 84). Long, relatively broad, tip evenly-rounded, veins chestnut-brown, membrane very faintly infusate brown throughout, very slightly darker in region of *dm-cu* crossvein; costa with prominent costal spines in basal four-fifths from costal break; *dm-cu* crossvein with submedial angle; *cua*₁ relatively long and narrow; anal fold extending less than ½ length of *cua*₁; halter dirty yellow.

Abdomen. Ground colour of tergites 1–5 silver-yellow to grey pruinose, clothed in relatively long black, overlapping setulae, arranged in regular rows, those at apical margins longer and stronger; tergite 1 simple, devoid of maculae; tergite 2 with elongate, narrow brown-black pruinose dorsolateral macula on either side only; tergites 3–5 with narrow, brown median fascia and greatly reduced “T-shaped” brown lateral maculae, all well separated from median fascia, lateral margin of tergites 2–5 with reduced subtriangular maculae in basal third; sternite 6 (Fig. 3.4: 200) elongate (may appear narrower than Fig. 3.4: 200 in undissected specimens), slightly narrowed, subparallel-sided, with deep, V-shaped apical excision, and faint brown maculae laterally, clothed in long black irregular brown setulae, especially medially and apically; tergite 6 absent, sternite 7 weakly sclerotised.

Terminalia (Figs 3.4: 182, 185, 188). Hypandrium (Fig. 3.4: 182, *hy*) long, with broad-based slightly angulate to rounded-truncate dorsobasal lobe, posterior bridge dorsally and ventrally produced (rounded in profile); hypandrial arms narrow basally, expanded apically (viewed laterally), with 2 long, widely-spaced setulae

proximal to postgonite, sclerotised area of medial lobes (viewed dorsally), closely abutting apically, but well separated; postgonite (Fig. 3.4: 182, *pg*) free basally, long and narrow; epandrium (Fig. 3.4: 182, *ep*) slightly broader dorsally than ventrally (viewed laterally), evenly-rounded on dorsal margin, ventral margin with extensive row of long irregular, ventrally and apically-directed setae; cercus (Fig. 3.4: 182, *ce*) narrow, usually partially retracted into epandrium, longest setae as long as spine-like seta on ventral margin of epandrium, with elongate fused ventral process; surstylus (Fig. 3.4: 182, *ss*) long and narrow, widest basally, with blunt apex; phallus (as in Figs 3.4: 185, *ph*, *bp*, *dp*; 188, *bp*, *dp*) C-shaped, moderately sclerotised, brown; phallapodeme (Fig. 3.4: 185, *ph*) fused to basiphallus, subtriangular (viewed laterally), with basal margin developed into two broad lateral lobes, bifurcated at point of connection with hypandrium; ejaculatory apodeme (Fig. 3.4: 185, *ea*) free, duct inserted at junction of phallapodeme and basiphallus; basiphallus (Figs 3.4: 185, 188, *bp*) wide basally, expanded into narrow lateral expansion apically; distiphallus (Figs 3.4: 185, 188, *dp*) long, scimitar-like (viewed laterally), membranous area broad, with basal “spine” developed into a distinct straight, parallel process with apical dorsally-directed hook-like, more apical spine dorsally-directed and straight, apex bluntly pointed.

♀ Similar to ♂, except in the following respects: wing length 2.9–3.2 mm ($n = 5$, PT). Postabdomen (Figs 3.4: 211, 212); sternite 8 (Figs 3.4: 211, 212, *s8*) weakly sclerotised and reduced; sternite 10 (Figs 3.4: 211, 212, *s10*) laterally flattened proximally, with medial division; tergite 10 (Figs 3.4: 211, 212, *t10+ce*) fused to free cerci, with long terminal setulae.

Variation. There is some slight variation in the length and degree of curvature of the basal spine of the distiphallus. The shape is quite consistent, however, and is here regarded as intraspecific variation only.

Differential diagnosis. *Curtonotum uncinatum* sp. n. belongs to a group of eight species here ascribed to the *Uncinatum* species-group. Tsacas (1977) formerly regarded seven of these as varieties of *C. cuthbertsoni* Duda, but differences in the form of the distiphallus, all be them slight, are consistent and these are here regarded as good species, as supported by molecular evidence from three of these. All have the

base of the distiphallus developed into one or two basal spines or processes, which, together with the apical shape of the basiphallus, differ between species. *Curtonotum uncinatum* sp. n. can be separated from other species in the species-group by reference to the above key.

Type material examined. NAMIBIA: holotype ♂, “Namibia: KATIMA MULILO DIST. / Kubunyana camp: Kwando River / 17.87'S 23.33'E / 28-30.x.2003 / A.H. & M.K. Kirk-Spriggs / Malaise trap sample // Namibian National / Insect Collection / National Museum / P.O. Box 1203 / Windhoek, Namibia [printed; blue card] // HOLOTYPE ♂ / *Curtonotum uncinatum* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (NMNW). In excellent condition; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE / *Curtonotum* ♂ [or ♀] / *uncinatum* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”: BOTSWANA: 1♂, “Botswana / Qwihaba Hills / 20°01'S 21°21'E / 11–14.VII.1993 / E. Marais” (NMNW); 2♂, “BOTSWANA: / Tlokweng / 13.iii.1990 / J. Mashonja / [on reverse] NMW.Z. / 1990–020 [handwritten]”; 1♂, “BOTSWANA: / Tlokweng / malaise trap / 6–13.ii.1990 / J.M. Mashonja / [on reverse] NMW.Z. / 1990–020 [handwritten]” (all NMWC); 1♂, “V.—L. Kal. Exp. / Kuke Pan. / 21–30/3/1930” (NMSA); 1♂, “BOTSWANA: SE District / GABORONE VILLAGE / Museum – garden / 18-25.XI.1993, Malaise trap / Bert, A.V. VIKLUND leg. // Riksmuseum / Stockholm [printed; green card]”; 1♂, “BOTSWANA: SEROWE / Farmer’s Brigade / Mercury light trap / VIII 1989, SE 2226 BD / V.I. FORSHAMMER // Riksmuseum / Stockholm [printed; green card]”; 1♂, “BOTSWANA: Serowe XII 1989 / Farmer’s Brigade SE2226BD / Mercury vapour light / Per Forshammer // Riksmuseum / Stockholm [printed; green card]” (all NHRS); 1♂, “Mabeleapudi / Botswana / 6/1/1973 / E. Holm / Light trap [typewritten]” (PPRI). NAMIBIA: 9♂, same data as holotype; 1♂, “Namibia: KATIMA MULILO DIST. / Salambala forest / 17°50'02"S 24°36'20"E / 23-29.xii.2002 / A.H. & M.K. Kirk-Spriggs / Malaise trap sample”; 3♂, “Namibia: KATIMA MULILO DIST. / Salambala camp site / 17°50'01"S 24°36'09"E / 22-24.ii.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise trap”; 2♂, “Namibia: KATIMA MULILO DIST. / Salambala campsite / 17°50'01"S 24°36'06"E / 08-10.ii.2004 / A.H. Kirk-Spriggs / Malaise trap”; 3♂, “Namibia: WEST CAPRIVI PK. / Fort Doppies / 17°49'28"S 23°18'49"E / 20-21.x.1999 / [A.H.] Kirk-Spriggs [T.] Pape [W.] Hauwanga”; 7♂, “Namibia: WEST CAPRIVI PK. / Kwando River Susuwe / 17°45'37"S 23°20'55"E / 28.ix-02.x.1998 / A.H. Kirk-Spriggs / Malaise trap dry woodland”; 1♂, “Namibia: RUNDU DIST. / Matende River / 17°54'46"S 19°35'16"E / 20-21.i.1998 / [E.] Marais & [A.H.] Kirk-Spriggs / malaise trap primary forest”; 2♂, “Namibia: RUNDU DIST. / 1 km S. of Katara / 17°50'25"S, 18°54'26"E / 22-23.i.1998 / [A.H.] Kirk-Spriggs & [E.] Marais / malaise traps primary forest” [1 head missing]; 1♂, “Namibia: BWABWATA PARK / Bum Hill campsite (Kwando R.) / 17°46'42"S 23°20'28"E / 10-13.ii.2004 / A.H. Kirk-Spriggs / Malaise trap”; 3♂, “Namibia: RUNDU DIST. / Mile 46 / 18°18'39"S 19°15'29"E / 25-27.iii.2003 / A.H. Kirk-Spriggs / attracted to decomposing fungi”; 1♂, “Namibia: RUNDU DIST. / Mile 46 / 18°18'39"S 19°15'29"E / 25-27.iii.2003 / A.H. Kirk-Spriggs / Malaise traps”; 2♂, “Namibia: RUNDU DISTRICT / Mile 46 Agric. Research Sta. / 18°18'22"S 19°15'24"E / 21-24.iv.2001 / [E.] Marais, [S.]

Kasch & [K.] Vohland // *Acacia* dominated interdune / Malaise trap : BIOTA # / 01.101.01.7.04"; 1♂, "Namibia: KHORIXAS DIST. / Amkarub 269, granite hill at: / 19°49'17"S 14°39'53"E / 24-26.v.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise traps"; 1♂, "Namibia: RUNDU DIST. / Simanya: Okavango River / 17°33'17"S 18°32'30"E / 23-24.i.1998 / E. Marais & A.H. Kirk-Spriggs / Malaise trap primary woodland"; 1♂, "Namibia: MARIENTAL DIST. / Morester 451 / 24°06'47"S 19°58'37"E / 16.xi-13.xii.1998 / E. Marais / pres. pitfall traps"; 1♂, "Namibia: BRANDBERG / Mason Shelter / 21°04'39"S, 14°05'43"E / 05-14.iii.2002 / A.H. Kirk-Spriggs & E. Marais / Malaise trap riverbed"; 1♂, "KAUDOM GAME RESERVE / at: 18°56'S 20°57'E / 11-30.I.1991 / E. Marais / Pitfall traps"; 1♂, "Welverdiend 328 / KEETMANSHOOP / SE 2519 Dd / 8-13 Oct.1972 [State Museum staff] // H 9527"; 1♂, "Andara / SE 1821 Ab / KAVANGO / 20-25. Aug 1971 [State Museum staff] // H 3346" [head missing]; 6♂, "Namibia: OPUWA DIST. / Ekuju / village: Kunene R. / 17°19'30"S 13°48'56"E / 11-12.x.1999 / [A.H.] Kirk-Spriggs [T.] Pape [W.] Hauwanga / Malaise traps, riverine forest"; 2♂, "Namibia: OKAHANDJA DIST. / Erichsfelde 44 / 21°35'46"S 16°56'16"E / 20-22.iii.2003 / A.H. Kirk-Spriggs / Malaise traps"; 1♂, "Namibia: OKAHANDJA DIST. / Omatako Ranch 305 / 21°30'46"S 16°44'00"E / 22-24.iii.2003 / A.H. Kirk-Spriggs / Malaise traps"; 1♂, "Namibia: RUNDU DIST. / 20 km E Rundu / 17°55'46"S 19°58'43"E / 17-18.x.1999 / [A.H.] Kirk-Spriggs [T.] Pape [W.] Hauwanga / hanging trap baited feces"; 1♂, same except: "Malaise trap sample"; 3♂, "Namibia: OPUWA DIST. / 35 km E Epupa: Kunene River / 17°03'37"S 13°29'32"E / 09-11.x.1999 / [A.H.] Kirk-Spriggs [T.] Pape [W.] Hauwanga / Malaise trap shaded woodland"; 2♂, "Namibia: EENHANA DISTRICT / 29 km E Okongo / 17°37'22"S 17°28'44"E / 14-15.x.1999 / [A.H.] Kirk-Spriggs [T.] Pape [W.] Hauwanga / Malaise traps dry woodland"; 1♂, "Namibia: TSUMKWE DIST. / Trekkersboom / 19°18'00"S 20°39'42"E / 28.xii.1998 / A.H. Kirk-Spriggs / sweeping grasses in wet area"; 1♂, "Hamakari Süd 373 / OTJIWARONGO DISTR. / 20°40'S 17°23'E / 26.X.-20.XI.1991 / M. Pusch / Pres. pitf. traps"; 1♂, "Otjivasandu [sic! = Otjovasandu] / 19°15'S 14°30'E / ETOSHA NAT. PK. / 13.v.1986 / E. Griffin / [handwritten]"; 10♂, "Namibia: GOBABIS DIST. / Somerkoms 521 / 22°00'59"S 19°57'22"E / 06-08.ii.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise trap"; 1♂, same except: "light trap sample"; 1♂, "Namibia: GOBABIS DIST. / Somerkoms 521 / 22°01'59"S 19°57'22"E / 06-08.ii.2001 / [A.H.] Kirk-Spriggs, [E.] Marais & [M.] Wheeler / 2 McPhail traps baited with Nu / lure & mono-ethylene glycol"; 1♂, "Namibia: GOBABIS DIST. / Somerkoms 521 / 22°01'59"S 19°57'22"E / 06-08.ii.2001 / M. Wheeler & E. Marais / fogging *Terminalia sericea*"; 1♂, same except: "fogging *Acacia erioloba*"; 20♂, "Namibia: OTJINENE DISTRICT / Epukiro River, 3km N at: / 21°22'26"S 20°06'09"E / 09-11.ii.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise trap sample"; 1♂, "Namibia: OTJINENE DISTRICT / Epukiro River, 3km N at: / 21°22'26"S 20°06'09"E / 09-11.ii.2001 / [A.H.] Kirk-Spriggs, [E.] Marais & [M.] Wheeler / 2 McPhail traps baited with Nu / lure & mono-ethylene glycol"; 37♂, "Namibia: GOBABIS DIST. / De Hoek 878 / 21°56'26"S 20°58'55"E / 03-06.ii.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise trap samples"; 4♂, "Namibia: TSUMKWE DISTRICT. / 2 Km W Xawasha pan / 19°09'57"S 20°52'55"E / 26-27.xii.1998 / [A.H.] Kirk-Spriggs, [E.] Marais & [D.J.] Mann / Malaise traps"; 1♂, "Namibia: TSUMKWE DISTRICT. / Xawasha pan / 19°09'58"S 20°54'40"E / 26-27.xii.1998 / [A.H.] Kirk-Spriggs & [E.] Marais / Malaise trap sample"; 1♂, "Nakatwa / MUDUMU GAME RESERVE / 18°11'S 23°25'E / 08-13.III.1992 / M.Pusch &

E.Marais; 1♂, “Takuasa / SE 1720 Cd [= Takwasa] / KAVANGO / 14–19 Aug 1971 [State Museum staff] // H 3029” [head missing]; 15♂, “Namibia: EENHANA DISTRICT / 29 km E Okongo / 17°37'22"S 17°28'44"E / 14.x.1999 / A.H. Kirk-Spriggs // At rest in burrows of / *Orycteropus afer* (Pallas) / Orycteropidae”; 1♂, “Namibia: KARIBIB DISTRICT. / Tsaobismund 85 at: / 22°22'40"S 15°44'58"E / 13-15.iv.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise traps”; 2♂, “Namibia: ETOSHA NAT. PK. / Namutoni EE Centre / 18°48'S 17°02'E / 04-05.iii.1998 / [A.H.] Kirk-Spriggs & [E.] Marais / Malaise trap”; 2♂, “Namibia: BUSHMANLAND / CDM Camp: Tsumkwe / SE1920Cb / v.1993 / S.V. Green / pittraps”; 1♂, “Buffalo Base / WEST CAPRIVI PARK / 18°08'S 21°41'E / 03–05.IV.1990 / E.Marais”; 3♂, “Namibia: MUDUMU GAME / RES. / Nakatwa / 18°11'S 23°25'E / 08–13.iii.1992 / E. Marais & M. Pusch / Malaise trap”; 1♂, “Namibia: MUDUMU NAT. PK. / at: 18°10'S 23°25'E / 25.xi-04.xii.1991 / E. Marais / Malaise trap”; 44♂, 49♀, “Arnhem 222 / WINDHOEK / SE 2218 Ca / 23-27 Oct.1972 [State Museum staff] // H 9678”; 6♂, “Namibia: ETOSHA NAT. PK. / Beiseb / 18°31'S 17°03'E / 13-18.iii.1997 / E. Marais / Malaise trap”; 2♂, “NAMIBIA: Popa Falls / 18°07'S/21°35'E / 31.x-2.xi.1997 / leg. F. KOCH”; 4♂, “NAMIBIA: Mahango Game Res. / 18°14'S/21°43'E / 31.xi.2001 / leg. F. KOCH”; 17♂, 20♀, “Namibia: MARIENTAL DIST, / Viljoenskroon 507 / 26°08'39"S 19°57'11"E / 7-9.ii.1998 / [A.H.] Kirk-Spriggs & [E.] Marais / Malaise traps”; 5♂, 5♀, “Namibia: MARIENTAL DIST, / Viljoenskroon 507 / 25°10'S 19°58'E / 25.iv-02.v.1999 / G. Olivier / Malaise trap”; same except: 9♂, 1♀, “24.i-02.ii.1998”; 6♂, 11♀, “02-15.ii.1998”; 5♂, 5♀, “15-22.ii.1998”; 18♂, 7♀, “22.ii-08.iii.1998”; 32♂, 26♀, “08-29.iii.1998”; 2♂, “29.iii-05.iv.1998”; 2♀, “05-12.iv.1998”; 6♂, 6♀, “12-26.iv.1998”; 3♂, 5♀, “26.iv-02.v.1998”; 1♂, 2♀, “02-10.v.1998”; 5♂, 6♀, “10-17.v.1998”; 5♂, 4♀, “12-18.xi.1998”; 2♂, 1♀, “15-18.xi.1998”; 2♀, “19-25.xi.1998”; 3♂, 5♀, “???”; 1♂, 3♀, “03-09.xii.1998”; 2♂, “16-23.xii.1998”; 6♂, 2♀, “31.xii-06.i.1999”; 14♂, 14♀, “07-13.i.1999”; 2♂, 8♀, “13-21.i.1999”; 3♂, 3♀, “24-31.i.1999”; 12♂, 8♀, “30.i-05.ii.1999”; 3♂, 2♀, “25-28.ii.1999”; 2♂, “30.v-09.vi.1999”; 2♂, “24-30.i.1999”; 1♂, 2♀, “24-30.i.1999”; 4♂, 2♀, “02-09.v.1999” (all NMNW); 1♂, “Okahandja / 25.10.[19]51 [F. Gaerdes] [handwritten] // CURTONOTUM / *cuthbertsoni* ♂ / ♂ Duda / L. TSACAS DET. 1976 [printed & handwritten]” (NMSA); 2♂, “S.W.AFRICA (31) / Okahandja / 2-4.ii.1972 // Southern / African Exp. / B.M.1972-1 // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed & handwritten]” (BMNH). SOUTH AFRICA: 1♂, “Kalahari Gemsbok / Natnl. Park, S. Afr. / Exp. 16–24.V.1956 / Strathmore. / H.K. Munro. / sweeping / dry grass. (PPRI); 9♂, “South Africa: N. Cape / Witsand Nature Reserve / 28°33.615'S 22°29.105'E / 31.i–1.ii.2004, 1160 m / J.G.H. Londt & T. Dikow / *Acacia* savanna & dune area (all NMSA). ZIMBABWE: 1♂, “ZIMBABWE: Lake Kyle Dam / 20°13'S/31°00'E / 7-9.xi.1997 / leg. F. KOCH (NMNW)”;

Additional material examined (labelled “*Curtonotum uncinatum* sp. n., det. A.H. Kirk-Spriggs 2011”): SOUTH AFRICA: 1♂, RSA: Free State, Brandfort, Soetdoring Nature Reserve, Kruger’s Drift, 28°51.303'S, 26°02.302'E, 5–6.iv.2009, A.H. & M.K. Kirk-Spriggs, Malaise traps *Acacia* savanna [in spirit] BMSA(DNA)# 0006 (BMSA).

Distribution. Botswana, Namibia, South Africa and Zimbabwe (Fig. 3.4: 225, 229). Virtually confined to the xeric southwest arid region of southern Africa (Fig. 3.4: 229), and occurring in the 800–1200 and 1200–1600 mm Potential Evapotranspiration zones (Fig. 3.4: 225).

Bionomics. Occurring in 9 major habitat types; predominantly in Deserts and Xeric Shrublands, Tropical and Subtropical Grasslands, Savannas and Shrublands and Flooded Grasslands vegetation types (3.4: Appendix). Sampled at MV-light in Botswana and Namibia and by sweeping dry grass in Botswana. In Malaise and pitfall traps, in hanging traps baited with faeces, and in McPhail traps baited with Nu-lure and mono-ethylene glycol in Namibia. At rest in burrows of the Aardvark (in company with *C. bicuspis* sp. n. and *C. unicuspis* sp. n.) in Namibia and attracted to decomposing fungi (in company with *Curtonotum bicuspis* sp. n. and *C. unicuspis* sp. n.) in Namibia. Fogged from *Terminalia sericea* Burch. ex DC. (Combretaceae) and *Acacia erioloba* E.Mey (Fabaceae) in Namibia.

***Curtonotum bicuspis* Kirk-Spriggs, sp. n.,**
Figs 3.4: 17, 41, 77, 163, 166, 169, 225, 227.

Curtonotum cuthbertsoni: Duda, 1935: 31, Type II of Tsacas (1977: 153).

Curtonotum cuthbertsoni: Braack (1986: 94, table 1), *auctt.* misidentification.

Etymology. The specific epithet *bicuspis* is derived from the Latin *bis* (= two) and *cuspis* (= spike), and refers to the two spike-like extension of the distiphallus of this species.

Description: Male (primarily based on field-pinned HT).

As described for *C. uncinatum* (above), differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 1.5–2.6 mm; length of thorax and scutellum combined 1.5–2.5 mm; wing length 2.4–3.9 mm ($n = 5$, HT, PT).

Head (Figs 3.4: 17, 41). Eye height/length ratio: 10:6 ($n = 1$, HT); frons (Fig. 3.4: 41) length/width ratio: 6:7 ($n = 1$, HT); arista with 8–9 long dorsal branches and 3 or 4 ventral branches; 9 fine setae bordering genal groove; gena narrow, eye height/genal height ratio: 10:1 ($n = 1$, HT).

Thorax (Fig. 3.4: 17). Postpronotum with 8 fine black-brown setulae; anepisternum with 15 fine setulae, 2 together in posterior corner; katepisternum with 14 short, fine setulae.

Legs. Fore coxa with 17 brown setulae; fore tibia with ctenidium of 12–14 black spinules.

Wing (Fig. 3.4: 77). *dm–cu* crossvein acutely angled posteriorly.

Abdomen. Sternite 6 as in Fig. 3.4: 200.

Terminalia (Figs 3.4: 163, 166, 169). Hypandrium (Fig. 3.4: 163, *hy*); postgonite (Fig. 3.4: 163, *pg*); epandrium (Fig. 3.4: 163, *ep*); cercus (Fig. 3.4: 163, *ce*); surstylus (Fig. 3.4: 163, *ss*); phallus (as in Figs 3.4: 166, *ph*, *bp*, *dp*; 169, *bp*, *dp*); phallapodeme (Fig. 3.4: 166, *ph*); ejaculatory apodeme (Fig. 3.4: 166, *ea*); basiphallus (Figs 3.4: 166, 169, *bp*) wide basally, expanded into narrow quite broad expansion apically; distiphallus (Figs 3.4: 166, 169, *dp*) long, scimitar-like (viewed laterally), membranous area broad, with basal “spine” of distiphallus forming a long, straight, erect process, more apical spine broad basally, margins straight, coming to acute point, slightly ventrally-directed (two spines very widely spaced).

♀ Unknown.

Variation. There is some slight variation in the length of the basal spine of the distiphallus. The shape is quite consistent, however, and is here regarded as intraspecific variation only.

Differential diagnosis. *Curtonotum bicuspis* sp. n. belongs to a group of eight species here ascribed to the *Uncinatum* species-group that are virtually identical externally and are only separable based on minor differences in the male phallus (see Differential diagnosis under *C. uncinatum* sp. n. for details). *Curtonotum bicuspis* sp.

n. can be separated from other species in the species-group by reference to the above key.

Type material examined. NAMIBIA: holotype ♂, “Namibia: KATIMA MULILO DIST. / Salambala campsite / 17°50′01″S 24°36′06″E / 08-10.ii.2004 / A.H. Kirk-Spriggs / Malaise trap // Namibian National / Insect Collection / National Museum / P.O. Box 1203 / Windhoek, Namibia [printed; blue card] // HOLOTYPE ♂ / *Curtonotum / bicuspis* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (NMNW). In excellent condition; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE / *Curtonotum* ♂ / *bicuspis* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”): ANGOLA: 1♂, “ANGOLA (A10) [blue line] / R.Curoca, 7 mils. / NE. P.Alexandre / 25–26.ii.1972 // Southern / African Exp / B.M.1972-1 // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1976 [printed & handwritten]” (BMNH); 4♂, “ANGOLA: / 7 mi.N Vila ♂ / Perreira d’Eca / V-17-[19]58, 1100m // E.S. Ross & / R.E. Leech / Collection // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1976 [printed & handwritten] [3 head missing]” (CAS). [BOTSWANA]: 1♂, “V.—L. Kal. Exp. / Tsotsoroga Pan / 17/6/–9/7/[19]30.” (NMSA). [DEMOCRATIC REPUBLIC OF CONGO]: 1♂, “Congo belge: P.N.U. / Mabwe (r. E. lac Upemba) / (585 m.) 12-19.I.1949 / Mis. G.F. de Witte. 2214a” (RMCA). KENYA: 1♂, “KENYA / Mombasa / Waa / 26.iii.[19]53 [printed & handwritten] // From felled Cashew tree [handwritten] // COM. INST. ENT. / COLL. NO. 13216 [printed & handwritten] // Pres. by / Com Inst Ent / B M 1953–747 [printed & handwritten] // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1976 [printed & handwritten]” (BMNH). [MOZAMBIQUE]: 1♂, “NYAKA / P. E. Afr. / R. F. Lawrence / [on reverse] Feb. / 1924 [printed & handwritten]” (SANC); 1♂, “Umbeluzi PEA / 19.9.[19]29 / HKMunro [printed & handwritten]” (PPRI). NAMIBIA: 5♂, same data as holotype; 6♂, “Namibia: KATIMA MULILO DIST. / Salambala forest / 17°50′02″S 24°36′20″E / 23-29.xii.2002 / A.H. & M.K. Kirk-Spriggs / Malaise trap sample”; 5♂, “Namibia: KATIMA MULILO DIST. / Salambala camp site / 17°50′01″S 24°36′09″E / 22-24.ii.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise trap”; 10♂, “Namibia: KATIMA MULILO DIST. / Salambala camp site / 17°50′01″S 24°36′09″E / 01-04.iii.2001 / A.H. Kirk-Spriggs / Malaise trap”; 1♂, “Namibia: KATIMA MULILO DIST. / Salambala, 4km NE of / 17°49′21″S 24°36′07″E / 25.ii-01.iii.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise trap sample”; 1♂, “Namibia: KATIMA MULILO DIST. / Salambala pan / 17°50′00″S 24°35′58″E / 01-04.iii.2001 / A.H. Kirk-Spriggs / Malaise trap”; 2♂, “Namibia: WEST CAPRIVI PK. / Kwando River Susuwe / 17°45′37″S 23°20′55″E / 28.ix-02.x.1998 / A.H. Kirk-Spriggs / Malaise trap dry woodland”; 1♂, “Namibia: RUNDU DIST. / Matende River / 17°54′46″S, 19°35′16″E / 20-21.i.1998 / [E.] Marais & [A.H.] Kirk-Spriggs / malaise trap primary forest”; 3♂, “Namibia: RUNDU DIST. / 1 km S. of Katara / 17°50′25″S, 18°54′26″E / 22-23.i.1998 / [A.H.] Kirk-Spriggs & [E.] Marais / malaise traps primary forest”; 2♂, “Namibia: BWABWATA PARK / Bum Hill campsite (Kwando R.) / 17°46′42″S, 23°20′28″E / 10-13.ii.2004 / A.H. Kirk-Spriggs / Malaise trap”; 3♂, “Namibia: RUNDU DIST. / Mile 46 / 18°18′39″S, 19°15′29″E / 25-27.iii.2003 / A.H. Kirk-Spriggs / attracted to decomposing fungi”; 5♂, “Namibia: RUNDU DIST. / Mile 46 / 18°18′39″S, 19°15′29″E / 25-27.iii.2003 / A.H. Kirk-Spriggs / Malaise traps”; 2♂, “Namibia: RUNDU DISTRICT / Mile 46 Agric. Research Sta. / 18°18′22″S,

19°15'24"E / 21-24.iv.2001 / [E.] Marais, [S.] Kasch & [K.] Vohland // *Acacia* dominated interdune / Malaise trap : BIOTA # / 01.101.01.7.04"; 9♂, "Namibia: KHORIXAS DIST. / Amkarub 269, granite hill at: / 19°49'17"S, 14°39'53"E / 24-26.v.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise traps" [1 head missing]; 4♂, "Namibia: RUNDU DIST. / Simanya Okavango River / 17°33'17"S, 18°32'30"E / 23-24.i.1998 / [A.H.] Kirk-Spriggs & [E.] Marais / malaise traps riverine forest"; 1♂, "Ghaub 47 / 19°28'S, 17°00'E / TSUMEB DISTRICT / 16-26 Jul. 1986 / J. Irish / Malaise trapping"; 2♂, "Namibia: RUNDU DIST. / Hamoye Nat. Forest / 18°12'S, 19°43'E / 05-08.iii.1999 / E. Marais / Malaise trap"; 1♂, "Namibia: TSUMKWE DISTRICT. / 2 Km W Xawasha pan / 19°09'57"S 20°52'55"E / 26-27.xii.1998 / [A.H.] Kirk-Spriggs, [E.] Marais & [D.J.] Mann / Malaise traps"; 1♂, "Namibia: KAUDOM GAME PK. / 10 Km W of Dussi / 18°48'32"S 20°43'57"E / 29-30.xii.1998 / [A.H.] Kirk-Spriggs, [E.] Marais & [D.J.] Mann / Malaise traps"; 2♂, "Nakatwa / MUDUMU GAME RESERVE / 18°11'S 23°25'E / 08-13.III.1992 / M.Pusch & E.Marais"; 2♂, "Takuasa / SE 1720 Cd [= Takwasa] / KAVANGO / 14-19 Aug 1971 [State Museum staff] // H 3029"; 4♂, "Namibia: EENHANA DISTRICT / 29 km E Okongo / 17°37'22"S 17°28'44"E / 14.x.1999 / A.H. Kirk-Spriggs // At rest in burrows of / *Orycteropus afer* (Pallas) / Orycteropidae"; 1♂, "Namibia: WEST CAPRIVI / Chwaha River, 3 km NE at: / 17°58'S 22°28'E / 04-10.iv.1990 / E. Marais / pres. & bait traps"; 1♂, "Namibia: KATIMA MULILO / DIST. / Simataa: Salambala B6 / 17°48'36"S 24°32'18"E / 24-27.ii.2001 / E. Marais & A.H. Kirk-Spriggs / Malaise traps"; 1♂, "Namibia: EASTERN CAPRIVI / Menziasubila Mulapo / 17°51'S 23°27'E / 25.xi.1991-05.i.1992 / E. Marais / pres. pitf. traps"; 9♂, "NAMIBIA: Mahango Game Res. / 18°14'S/21°43'E / 31.xi.2001 / leg. F. KOCH"; 5♂, "Namibia: KHORIXAS DIST. / River on Amkarub 269 at: / 19°50'12"S, 14°42'16"E / 24-26.v.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise traps" (all NMNW); 1♂, "S.W AFRICA (31) / Okahandja / 2-4.ii.1972 // Southern / African Exp / B.M.1972-1 // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed & handwritten] // MUSÉUM PARIS" (MNHN); 3♂, "S.W.AFRICA (W50) / Gobiswater Fm., / 12 mls. N. / Grootfontein / 5.iv.1972 ♂ // Southern / African Exp / B.M.1972-1 // [2 labelled] CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed & handwritten]" (BMNH); 51♂, "NAMIBIA: Katima Mulilo Dist. / Ndopu village, 1km SE Bukalo / -17.7166667, 24.5166667 / 20.iv.2006 / A.H. Kirk-Spriggs / From single burrow // Resting in burrow of / *Ardvaark* / (*Orycteropus afer* / (Orcycteropidae)" (AMGS); 11♂, "NAMIBIA: Katima Mulilo Dist. / Ndopu village, 1 km SE Bukalo / -17.7166667, 24.5166667 / 20.iv.2006 / A.H. Kirk-Spriggs / resting in burrows of Aardvark" [labelled "// BMSA(D)29878-BMSA(D)29888" (BMSA). SOUTH AFRICA: 2♂, "RSA: Sodwana Bay NP / 27°37'S/32°41'E / 7-10.iv.2001 / leg. F. KOCH" (NMNW); 4♂, "S AFRICA: N. Province #64 / Blouberg Nature Reserve / 23°02'S:29°04'E 2900 ft / Date: 22.xi.1997 / Coll. [D.A.] Barraclough & [S.] James / On trunk of Baobab tree"; 1♂, "6656 // SO.AFRICA: Transvaal / Pafuri,N Kruger NL.Pk. / 22-23.IV.1981 22°27'S / nr. Levuhu Riv. 31°17'E / RM Miller&PA Stabbins // Registered / Specimen / S F McEvey"; 3♂, "South Africa, Natal Prov / Zululand, 20 mi.S Ndumu / Game Res. Camp (2732Aa) / Nov. 29, 1971, ME&BJ Irwin / dry scrub forest; 320 ft // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1976 [printed & handwritten] // [1 specimen with label "A second vial / containing ♀ / genitalia of a / second specimen / pinned together [handwritten]]"; 1♂, "SOUTH AFRICA. Transvaal / Kruger Park 9-XII-1972 / Sabie River 4 km E Skukuza / *Ficus* gallery

forest / B & P Stuckenberg 2431Dc" (all NMSA); 1♂, "SOUTH AFRICA:Transvaal / n.Kruger National Park / Pafuri. 22°27'S 31°17'E / 15 Jan.1979, L. Braack / ex. Impala carcass [printed & handwritten]" (BMNH); 1♂, "RSA: Natal, / Richards Bay / 28°46'S, 32°04'E / 24.x.1984 loc. 31 / leg. R. Danielsson" (MZLU); 2♂, "SOUTH AFRICA / Natal, Mtubatuba / III-24&25-1968 / Paul J. Spangler // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1976 [printed & handwritten]" (USNM); 1♂, "S.AFRICA N. ZULULAND / INGWAVUMA MANZEN- / GWENYA 27.15S32.44E / Malaise trap, coastal / bush P.E.HULLEY / 8. xii [19]82 [printed & handwritten]" (AMGS); 1♂, "SOUTH AFRICA, Tvl. / D'Nyala Nat Res Ellis / ras 23.45'S 27.49'E / 850m 24-26.ix.1990 / M.W.Mansell // Handnetted / during day" (PPRI); 13♂, "RSA: KZN, Ndumo Game R. / main road at: / 26°54.288'S, 32°17.974'E / 4-8.xii.2009 / A.H. Kirk-Spriggs // Malaise traps / sand [forest] & broad-leaved / deciduous forest' [labelled "// BMSA(D)29855; 29889-29900"]; 4♂, "RSA: KZN, Ndumo Game R. / main camp area at: / 26°54.652'S, 32°19.719'E / 27-30.xi.2009 / A.H. Kirk-Spriggs // Malaise traps / broad-leaved deciduous / woodland" [labelled "// BMSA(D)29856-BMSA(D)29859"] (all BMSA); 1♂, "SOUTH AFRICA: KZ-Natal / Mambassa Huttet Camp, / 28°42.9'S: 29°36.7'E, / Thornveld, near Tugela / River, 14-17.iv.1998, / R.M. Miller" (NMSA). ZIMBABWE: 1♂, "Zimbabwe, Kotwa / 17°06'S 32°38'E / Chimana Causway, 24.7.1986; M. Llig/S. Potel [printed & handwritten]; same except: 1♂, "26.7.1986"; 4♂, "27.7.1986"; 1♂, "28.7.1986"; 2♂, "29.7.1986"; 2♂, "31.7.1986"; 1♂, "4.8.1986"; 2♂, "5.8.1986"; 7♂, "9.8.1986"; 2♂, "10.8.1986"; 1♂, "14.8.1986"; 3♂, "15.8.1986"; 4♂, "16.8.1986"; 2♂, "17.8.1986"; 3♂, "18.8.1986"; 3♂, "19.8.1986"; 4♂, "20.8.1986"; 1♂, "21.8.1986"; 1♂, "24.8.1986"; 1♂, "26.8.1986"; 2♂, "27.8.1986"; 1♂, "28.8.1986"; 1♂, "29.8.1986"; 3♂, "30.8.1986"; 3♂, "31.8.1986"; 1♂, "1.9.1986"; 1♂, "2.9.1986"; 2♂, "3.9.1986"; 1♂, "5.9.1986"; 1♂, "6.9.1986"; 1♂, "7.9.1986"; 1♂, "8.9.1986"; 1♂, "10.9.1986"; 1♂, "17.9.1986" (all ZSM).

Additional material examined (all labelled: "*Curtonotum bicuspis* sp. n. ♂ [or ♀] det. A.H. Kirk-Spriggs 2006-2008"): SOUTH AFRICA: 1♂, Namibia: Katima Mulilo Dist., Ndopu village, 1 km SE Bukalo, -17.7166667, 24.5166667, 20.iv.2006, A.H. Kirk-Spriggs, resting in burrows of Aardvark [in spirit], BMSA(DNA)# 0002; 1♂, same except: [in spirit], BMSA(DNA)# 0003 (BMSA).

Distribution. Angola, Botswana, Democratic Republic of Congo, Kenya, Mozambique, Namibia, South Africa and Zimbabwe (Fig. 3.4: 225, 227). Widespread in the mesic savannas of southern Africa, as far north as Kenya, but largely absent from the arid south-west arid region (Fig. 3.4: 227).

Bionomics. Occurring in 15 major habitat types; predominately in Tropical and Subtropical Grasslands, Savannas and Shrublands and Tropical and Subtropical Moist Broadleaf Forests, but also in four other vegetation types (3.4: Appendix). Sampled in Malaise and pitfall traps and from the carcass of an Impala *Aepyceros melampus*

(Lichtenstein, 1812) (Bovidae), from a felled Cashew tree *Anacardium occidentale* L. (Anacardiaceae), and on the trunk of a Baobab (in company with *Curtonotum cuthbertsoni* Duda and *C. unicuspis* sp. n.) in South Africa. Attracted to decomposing fungi at dawn (in company with *C. uncinatum* sp. n. and *C. unicuspis* sp. n.), and at rest in burrows of the Aardvark (in company with *C. uncinatum* sp. n., *C. unicuspis* sp. n.) in Namibia. Also in same Aardvark burrow as *C. cuthbertsoni* Duda and *C. unicuspis* sp. n. in north-eastern Namibia.

***Curtonotum cimbebas* Kirk-Spriggs, sp. n.,**

Figs 3.4: 18, 42, 78, 164, 167, 170, 226.

Curtonotum cuthbertsoni: Duda, 1935: 31, Type VII of Tsacas (1977: 153).

Etymology. The specific epithet *cimbebas* is a noun in apposition, derived from “Cimbebas”; the archaic name for the area between Cape Negro and the Tropic of Capricorn on the southwest African seaboard.

Description: Male (primarily based on field-pinned HT).

As described for *C. uncinatum* (above), differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 2–2.7 mm; length of thorax and scutellum combined 1.9–2.6 mm; wing length 3.3–3.8 mm ($n = 5$, HT, PT).

Head (Figs 3.4: 18, 42). Eye height/length ratio: 11:6 ($n = 1$, HT); frons (Fig. 3.4: 42) wider than long, frons length/width ratio: 6:8 ($n = 1$, HT), very slightly wider at vertex than at ventral margin; arista with 7–9 long dorsal branches and 2 or 3 ventral branches; gena narrow eye height/genal height ratio: 11:1 ($n = 1$, HT).

Thorax (Fig. 3.4: 18). Anepisternum with 13 fine setulae 3 arranged in a group in posterior corner; katepisternum with 14 short, fine setulae.

Legs. Fore coxa with 7 brown setulae; fore tibia with ctenidium of 9–10 short, sharp, black spinules.

Wing (Fig. 3.4: 78). *dm–cu* crossvein vertical with even arch; anal lobe broad.

Abdomen. Sternite 6 as in Fig. 3.4: 200.

Terminalia (Figs 3.4: 164, 167, 170). Hypandrium (Fig. 3.4: 164, *hy*); postgonite (Fig. 3.4: 164, *pg*); epandrium (Fig. 3.4: 164, *ep*); cercus (Fig. 3.4: 164, *ce*); surstylus (Fig. 3.4: 164, *ss*); phallus (as in Figs 3.4: 167, *ph*, *bp*, *dp*; 170, *bp*, *dp*); phallapodeme (Fig. 3.4: 167, *ph*); ejaculatory apodeme (Fig. 3.4: 167, *ea*); basiphallus (Figs 3.4: 167, 170, *bp*) wide basally, expanded into quite broad lateral expansion apically; distiphallus (Figs 3.4: 167, 170, *dp*) long, scimitar-like (viewed laterally), membranous area broad, basal “spine” very short, but erect and sharp, more apical spine relatively broad basally and sharp.

♀ Unknown.

Variation. No significant variation is noted.

Differential diagnosis. *Curtonotum cimbebas* sp. n. belongs to a group of eight species here ascribed to the *Uncinatum* species-group that are virtually identical externally and are only separable based on minor differences in the male phallus (see Differential diagnosis under *C. uncinatum* sp. n. for details). *Curtonotum cimbebas* sp. n. can be separated from other species in the species-group by reference to the above key.

Type material examined. NAMIBIA: holotype ♂, “Namibia: KARIBIB DISTRICT. / Tsaobismund 85 at: / 22°22’40”S 15°44’58”E / 13-15.iv.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise traps // Namibian National / Insect Collection / National Museum / P.O. Box 1203 / Windhoek, Namibia [printed; blue card] // HOLOTYPE ♂ / *Curtonotum / cimbebas* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (NMNW). In excellent condition; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE / *Curtonotum* ♂ / *cimbebas* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”): NAMIBIA: 9♂, same data as holotype; 1♂, “Namibia: NAUKLUFT PK / Tsams Ost spring / 24°14’45”S, 16°06’17”E / 26-27.xi.1997 / [A.H.] Kirk-Spriggs & [E.] Marais / Malaise trap”; 5♂, “Namibia: NAUKLUFT PK / Naukluft spring / 24°15’78”S, 16°14’08”E / 28-30.xi.1997 / [A.H.] Kirk-Spriggs & [E.] Marais / Malaise trap”; 5♂, “Namibia: WINDHOEK DISTRICT / Greylingshof 107: Gaub Canyon / 23°29’S 16°46’E / 02-03.x.1999 / A.H. Kirk-Spriggs & T. Pape / Malaise trap sample” (all NMNW); 5♂, “South West Africa / Gobabeb 30.I.1978 / Kuiseb River Bed / O. Lomholdt leg.” (ZMUC).

Distribution. Endemic to Namibia (Fig. 3.4: 226). Apparently confined to the Namibian Escarpment and immediate vicinity.

Bionomics. Occurring in the Nama Karoo and Namib Desert major habitat types; predominately in the Deserts and Xeric Shrublands vegetation type (3.4: Appendix). Sampled in Malaise traps in the vicinity of springs in the Naukluft Mountains, which form part of the Namibian Escarpment, and in the ephemeral riverbeds of the Kuiseb and Tsaobis Rivers of Namibia.

***Curtonotum constance* Kirk-Spriggs, sp. n.,**

Figs 3.4: 19, 43, 79, 165, 168, 171, 226.

Curtonotum cuthbertsoni: Duda, 1935: 31, Type VIII of Tsacas (1977: 153).

Etymology. The specific epithet *constance* is a noun in apposition, and is named after my daughter Constance Marina.

Description: Male (based on field-pinned HT).

As described for *C. uncinatum* (above), differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 2.8 mm; length of thorax and scutellum combined 2.7 mm; wing length 4.4 mm ($n = 1$, HT).

Head (Figs 3.4: 19, 43). Eye height/length ratio: 11:7 ($n = 1$, HT); frons (Fig. 3.4: 43) slightly wider than long, frons length/width ratio: 6:8 ($n = 1$, HT); [posterior orbital and inner vertical setae missing from unique holotype, but positions and socket size indicate similar orientation and seta size as other species in the *Uncinatum* species-group]; flagellomere 1 with slightly pointed apex, arista with 9 long dorsal branches and 4 ventral branches; 10 fine setae bordering genal groove; gena narrow, eye height/genal height ratio: 11:1 ($n = 1$, HT); palpus tan-brown, brown microtrichose.

Thorax (Fig. 3.4: 19). [The mesonotum is rubbed in the unique holotype and the four parallel chestnut-brown pruinose vittae are not visible; the dorsocentral, acrostichal, anterior notopleural and supra-alar setae are missing, but positions and socket size indicate similar orientation and seta size as other species in the *Uncinatum* species-group]; postpronotum with 12 fine black-brown setulae; [all anepisternal and katepisternal setae and setulae missing, but positions and socket size indicate similar orientation and seta size as other species in the *Uncinatum* species-group].

Scutellum. [Scutellar setae missing, but positions and socket size indicate similar orientation and seta size as other species in the *Uncinatum* species-group].

Legs. Fore coxa with 12 brown setulae; fore tibia apparently with 6 strong setae on lateral margin, with the second basal seta shorter than other five, with ctenidium of 11 short, sharp, black spinules.

Wing (Fig. 3.4: 79). [Conspicuous costal spines missing, but clearly present in undamaged specimens]; *dm-cu* crossvein acutely angled medially; anal lobe broad; halter dirty yellow.

Abdomen. Sternite 6 as in Fig. 3.4: 200.

Terminalia (Figs 3.4: 165, 168, 171). Hypandrium (Fig. 3.4: 165, *hy*); postgonite (Fig. 3.4: 165, *pg*); cercus (Fig. 3.4: 165, *ce*); surstylus (Fig. 3.4: 165, *ss*); phallus (as in Figs 3.4: 168, *ph*, *bp*, *dp*; 171, *bp*, *dp*); phallapodeme (Fig. 3.4: 168, *ph*); ejaculatory apodeme (Fig. 3.4: 168, *ea*); basiphallus (Figs 3.4: 168, 171, *bp*) wide basally, expanded medially with broad lateral expansion apically; distiphallus (Figs 3.4: 168, 171, *dp*) long, scimitar-like (viewed laterally), membranous area broad, with basal “spine” of distiphallus partially subdivided into one strongly and one weakly sclerotised short blades, more apical spine quite broad basally with straight dorsal margin and slightly curved ventral.

♀ Unknown.

Variation. Insufficient material is available to assess variability.

Differential diagnosis. *Curtonotum constance* sp. n. belongs to a group of eight species here ascribed to the *Uncinatum* species-group that are virtually identical externally and are only separable based on minor differences in the male phallus (see

Differential diagnosis under *C. uncinatum* sp. n. for details). *Curtonotum constance* sp. n. can be separated from other species in the species-group by reference to the above key.

Type material examined. ANGOLA: unique holotype ♂, “ANGOLA: / 7 mi. N. Vila ♂ / Perreira d’Eca / V-17-[19]58, 1100m // E.S.Ross & / R.E.Leech / collectors // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed and handwritten] // MUSÉUM PARIS // HOLOTYPE ♂ / *Curtonotum* / *constance* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (MNHN). In good condition, mesonotum rubbed and some legs missing; left wing detached and glued to card; dissected, abdomen and terminalia in micro-vial pinned beneath specimen.

Distribution. Angola (Fig. 3.4: 226). Only known from a single record on the Angolan/Namibian border in the mesic savanna. The type locality, Vila Perreira d’Eça lies at an elevation of ca. 1150 m.

Bionomics. Occurring in the Angolan Mopane Woodland major habitat type; Tropical and Subtropical Grasslands, Savannas and Shrublands vegetation type (3.4: Appendix).

Curtonotum cuthbertsoni Duda, 1935,
Figs 3.4: 20, 44, 80, 172, 175, 178, 225, 228.

Curtonotum cuthbertsoni: Duda, 1935: 31; fig. 2, p. 28. Type locality: [Zimbabwe] “S. Rhodesia: Balla Balla”.

Curtonotum cuthbertsoni: Cuthbertson (1936: 54).

Curtonotum cuthbertsoni: Greathead (1958, figs 1–6), *auctt.* misidentification.

Curtonotum cuthbertsoni: Stower *et al.* (1958: 29), *auctt.* misidentification.

Curtonotum cuthbertsoni: Duda, 1935: 31, Type I of Tsacas (1977: 152).

Curtonotum cuthbertsoni: Wirth and Tsacas (1980: 672).

Curtonotum cuthbertsoni: Meier *et al.* (1997: 10).

Curtonotum cuthbertsoni: Pollock (2002: 1736).

Redescription: Male (primarily based on field-pinned N-T).

As described for *C. uncinatum* (above), differing in the following respects:

Measurements: Overall length unknown; 5.5 mm (Tsacas 1977: 154); length of head and thorax combined 1.9–2.6 mm; length of thorax and scutellum combined 1.9–2.7 mm; wing length 3.0–4.3 mm ($n = 5$, N-T).

Head (Figs 3.4: 20, 44). Eye height/length ratio: 9:6 ($n = 1$, N-T); frons (Fig. 3.4: 44) slightly wider than long, frons length/width ratio: 6:8 ($n = 1$, N-T); arista with 10–12 long dorsal branches and 3 or 4 ventral branches; 9 fine setae bordering genal groove; gena narrow, eye height/genal height ratio: 9:1 ($n = 1$, N-T).

Thorax (Fig. 3.4: 20). Postpronotum with 8 fine setulae; anepisternum surface with 18 fine setulae; katepisternum with 15 short, fine setulae.

Legs. Fore coxa with 20 brown setulae; fore tibia with ctenidium of 14–15 short, sharp, black spinules.

Wing (Fig. 3.4: 80). Very broad; *dm–cu* crossvein with submedial angle.

Abdomen. Sternite 6 as in Fig. 3.4: 200.

Terminalia (Figs 3.4: 172, 175, 178). Hypandrium (Fig. 3.4: 172, *hy*); postgonite (Fig. 3.4: 172, *pg*); epandrium (Fig. 3.4: 172, *ep*); cercus (Fig. 3.4: 172, *ce*); surstylus (Fig. 3.4: 172, *ss*); phallus (as in Figs 3.4: 175, *ph*, *bp*, *dp*; 178, *bp*, *dp*); phallapodeme (Fig. 3.4: 175, *ph*); ejaculatory apodeme (Fig. 3.4: 175, *ea*); basiphallus (Figs 3.4: 175, 178, *bp*) wide basally, slightly expanded medially, with narrow lateral expansion apically; distiphallus (Figs 3.4: 175, 178, *dp*) long, scimitar-like (viewed laterally), membranous area broad, with basal “spine” forming a medium-sized, upright, slightly curved and posteriorly-directed spine, more apical spine broad basally, with sides straight and acute apex.

♀ Similar to ♂, except in the following respects: wing length 4.5 mm (Tsacas 1977: 163). The obclavate spermatheca was illustrated by Tsacas (1977: 152, fig. 3e), but given intraspecific variation this has little value in differentiating the “species”. As the specimens illustrated and measured were not specified by Tsacas it is impossible to ascribe these to any of the 8 species *C. cuthbertsoni* (*sensu* Tsacas) is here divided into.

Variation. No significant variation is noted.

Differential diagnosis. *Curtonotum cuthbertsoni* belongs to a group of eight species here ascribed to the *Uncinatum* species-group that are virtually identical externally and are only separable based on minor differences in the male phallus (see Differential diagnosis under *C. uncinatum* sp. n. for details). *Curtonotum cuthbertsoni* can be separated from other species in the species-group by reference to the above key.

Type material examined. [ZIMBABWE]: lectotype ♂ (here designated), “Balla-Balla / S. Rhodesia, / Jan. 1933 / A. Cuthbertson [printed & handwritten; black border] // 3475 [handwritten; red ink] // Top front specimen / LECTOTYPE ♂ / *Curtonotum* / *cuthbertsoni* Duda, 1935 / designated by / A.H. Kirk-Spriggs 2008 [printed; blue card]” (PPRZ). In fair condition; re-staged on nu-poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paralectotypes (here designated) (all labelled: “PARALECTOTYPE / *Curtonotum* ♂ [or ♀] / *cuthbertsoni* Duda, 1935 / designated by / A.H. Kirk-Spriggs 2008”): [ZIMBABWE]: 1♂, 4♀, same data as lectotype and pinned to same mount (PPRZ); 1♀, “Balla-Balla, / S. Rhodesia, / Jan. 1933 / A. Cuthbertson [printed & handwritten; black border] // *Curtonotum* / *cuthbertsoni* / Duda ♀ d. Duda [handwritten] // Pres. by / Imp. Inst. Ent. / B.M.1934–557” (BMNH); 1♀, “Balla-Balla, / S. Rhodesia, / Jan. 1933 / A. Cuthbertson [printed & handwritten; black border] // *Curtonotum* / *cuthbertsoni* / Duda / oben ♀ / unten ♂ / det Duda [handwritten] // Pres. by / Imp. Inst. Ent. / B.M.1934–557 // Zool. Mus. / Berlin” (ZMHB).

Remarks. Duda (1935: 31) cites 4♂ and 4♀ in the type series of *Curtonotum cuthbertsoni* from: “S. RHODESIA : Balla-Balla, Jan. 1933 (A. Cuthbertson), 3495”, stating in the introduction to that work that the studied specimens were obtained from Sir Guy A.K. Marshall of the Imperial Institute of Entomology, London. Cuthbertson (1936: 54) provides additional information on the types stating, “The type specimen was collected at the mouth of a warthog burrow in January 1933, in Glass Block Ranch near Balla Balla. Type in the British Museum.”

There are currently three specimens housed in the BMNH labelled “Balla-Balla”, by A. Cuthbertson; 1♀ syntype date “Jan. 1933” and 1♂, 1♀ date “V.1933”. Although these last two mentioned specimens bear Duda’s determination labels, they are not syntypes, as the date differs from that cited in the original publication. Despite this, Tsacas (1977: 154) erroneously designated the ♂ specimen as lectotype (although the specimen does not bear his lectotype label), stating “Malloch did not designate a type, so I designated as lectotype the dissected male. The labels bearing “type” that are found on a ♂ and a ♀ have been added afterwards and do not have any

value as type designation. The ♂ lectotype bears the following labels: 1, ‘type’; 2, Balla-Balla, S. RHODESIA, V.1931, A. Cuthbertson; 3, ‘3495’; 4, *Curtonotum cuthbertsoni*; 5, Pres. by Imp. Inst. Ent. B.M. 1934–557. Paratypes: 1♀ with the same indications, 1♀, same locality, but ‘av. 1933’. I could not study the other 3♂♂ and 2♀♀ indicated by Duda in the original description. British Museum (N.H.), London” (translation M. De Meyer).

Tsacas was incorrect in referring to these specimens as “paratypes” as these were not designated as such by Duda himself and also wrongly tallied the number of syntypes cited by Duda. Tsacas’ reference to Malloch (presumably Malloch (1930); the only Malloch paper to which he refers), is confusing, as Malloch makes no mention of *C. cuthbertsoni*.

An additional ♀ syntype dated “Jan. 1933” originating from the BMNH and now housed in Oswald Duda’s collection in ZMHB was also located and examined. This specimen bears Duda’s determination label and exactly the same data labels as the ♀ syntype in the BMNH and the specimens deposited in PPRZ cited below.

Six additional specimens (2♂, 4♀), from “Balla Balla, Jan. 1933” on the same double mount, not previously examined by Tsacas, were located and examined in PPRZ (where Alexander Cuthbertson’s collection is now deposited). The Accession Register of the PPRZ collection (Numbers 1–5849), lists the same specimens under the accession entry for “3495A” (M. Cumming, pers. comm. 2006). Although these specimens do not bear Duda’s determination label they are, nevertheless, syntypes and are suitable for the selection of a lectotype. These syntypes are a mixed series of two species and only the two males can be identified with certainty. These true syntypes combined (1♀, BMNH; 1♀, ZMHB; and 2♂, 4♀, PPRZ) make up the full compliment of “types” cited by Duda (1935: 31), although the sexes do not exactly correspond. Duda has, however, made other errors in sexing specimens of this group (*e.g.*, *Parapsinota sublineata* Duda). The lectotype is here selected as the top front ♂ specimen (dissected) pinned with the same micro-pin as 1♀ and 1♂ (dissected), the last mentioned representing *C. unicuspis* sp. n. Three additional females on a separate minutien are pinned to the same double mount and these females cannot be determined with certainty. Three additional specimens in PPRZ (1♀, 2 unsexed as abdomens missing) bear the labels “Balla Balla, V. 1931, 3495” and are not syntypic.

Additional material examined (all labelled: “*Curtonotum cuthbertsoni* Duda, 1935 ♂ [♀ or unsexed] det. A.H. Kirk-Spriggs 2008”): BOTSWANA: 1♂, Botswana: Tlokweng, 13.iii.1990, J. Mashonja, NMW.Z.1990–020; 1♂, same except: Malaise trap, 6–13.iii.1990, J.M. Mashonja; 1♂, same except: Malaise trap in sorghum field, *Curtonotum cuthbertsoni* Duda ♂ det. J.C. Deeming 1990 (all NMWC). [KENYA]: 1♂, Muséum Paris, Afrique Orient. Anglaise, entre la riviere Tana et cours sept. du Guasa Nyero (1200 a 2000 m. Janvier 1910) G. Vasses 1911, *Curtonotum cuthbertsoni* Duda L. Tsacas det. 1975 [head missing] (MNHN); 1♂, Kenya: Coast Province, Muhaka Field Station, 04°19.76’S 39°31.55’E, 20.xi.1999, 45 m, A.H. Kirk-Spriggs, sweeping [head missing] (NMNW). [MOZAMBIQUE]: 1♂, Luabo, Lower Zambezi River, Port. East Africa, P.J. Usher, ix. 1957, *Curtonotum cuthbertsoni* Duda, L. Tsacas det. 1976 [head missing] (NMSA). NAMIBIA: 2♂, NAMIBIA: Katima Mulilo Dist., Ndopu village, 1km SE Bukalo, -17.7166667, 24.5166667, 20.iv.2006, A.H. Kirk-Spriggs, From single burrow, Resting in burrow of *Ardvaark* (*Orycteropus afer* (Orcycteropidae) (AMGS). SOUTH AFRICA: 3♂, Ndumu Reserve, Ingwavuma District, Tongaland, S. Africa, B. & P. Stuckenberg, 1–10.xii.1963, *Curtonotum cuthbertsoni* Duda, L. Tsacas det. 1976 [1 head missing]; 1♂, South Africa: Natal, Ndumu Game Reserve Rest Camp, 2632Cd, 95m, 23–9.xi.1977, Malaise, [D.] Brothers & J. Guillardmod; 1♂, Oribi Gorge Reserve, Umzimkulwana Valley, Natal, South Africa, B. & P. Stuckenberg, 21–28.xi.1960, *Curtonotum cuthbertsoni* Duda, L. Tsacas det. 1976; 1♂, 6561, South Africa: Natal, 20 km W. Tugela Ferry, 26–27.ii.1977, 2830CA, Raymond M. Miller, Malaise trap, Registered specimen, S.F. McEvey; 1♂, S. Africa: Natal #6, Kube Yini Game Res., 27°48’S 32°14’E, 360m, Date: 10–14.i.1994, Natal Musm Expedition; 3♂, S. Africa: N. Province #64, Blouberg Nature Reserve, 23°02’S:29°04’E, 900 ft, Date: 22.xi.1997, Coll. [D.A.] Barraclough & [S.] James, on trunk of Baobab tree; 1♂, South Africa: Natal, New Germany, 13.iii.1984, D.J. Brothers; 5♂, “SOUTH AFRICA. Transvaal, Kruger Park 9-XII-1972, Sabie River 4 km E Skukuza, *Ficus* gallery forest / B & P Stuckenberg 2431Dc, *Curtonotum cuthbertsoni* Duda, L. Tsacas det. 1975 [4 head missing] (all NMSA); 1♂, M’fongosi, Zululand, W.E. Jones, Apr–May 1934; 1♂, same except: Mar–Apr 1935 (both SANC); 2♂, South Africa, Trsvl., Mooketsi, 14-18-Feb.1968, Krombein & [P.J.] Spangler, [1 labelled] *Curtonotum cuthbertsoni* Duda, L. Tsacas det. 1975 (USNM); 1♂, South Africa: Hartbeespoort, 25km W. Pretoria, 30.xii.1994, A Freidberg (TAU); 3♂, SOUTH AFRICA, Tvl., D’Nyala Nat Res Ellis, ras 23.45’S 27.49’E, 850 m, 24–26.ix.1990, M.W. Mansell, Handnetted during day (PPRI). [TANZANIA]: 1♂, Africa or., Katona, Shirati, 1909.ii. (HNHM). UGANDA: 1♂, May, 1914, Uganda, Unyoro, Hoima, 3700 feet., Coll. Kittenberger, dd.’19, C.A. Wiggins (OUMNH); 5♂, Uganda, Ankole, Kichwamba, V-1-5-1968, P.J. Spangler, *Curtonotum cuthbertsoni* Duda, L. Tsacas det. 1975 (3♂ USNM; 1♂ MNHN); 1♂, Kyarumba, 4,500ft., D.R. Buxton, Uganda, Ruwenzori Range, xii.1934–i.1935, B.M. E. Afr. Exp., B.M. 1935–203 (BMNH); 2♂, Uganda, Katona, Mujenje [= Muyenje], 1913.IX; 2♂, same except: 1913.VIII (all HNHM). [ZIMBABWE]: 1♂ (formerly erroneously designated as lectotype by Tsacas (1977: 157)), Type, Balla-Balla, S. Rhodesia, V.1931, A. Cuthbertson, 3495, *Curtonotum cuthbertsoni*, Pres. by Imp. Inst. Ent., B.M.1934–557, Designated as lectotype by Tsacas 1977: 157, *Curtonotum* ♂ *cuthbertsoni* Duda, 1935; 1♀, Type, Balla-Balla, S. Rhodesia, v.1931, A. Cuthbertson, 3495, *Curtonotum cuthbertsoni* Duda ♂ ♀, Typus det Duda ♀ gesichtet, Pres. by Imp. Inst. Ent., B.M.1934–557 (both BMNH); 1♀, 2 unsexed, Balla-Balla, S.

Rhodesia, V.1931, A. Cuthbertson, 3495, *Curtonotum* ? *cuthbertsoni* Duda, 1935 ♀ + 2 unsexed det. A.H. Kirk-Spriggs 2008 [2 with abdomens missing] (PPRZ); 1♂, Rhodesia, Victoria Falls Nat'l Park, IV-3-6-1968, Paul Spangler, *Curtonotum cuthbertsoni* Duda, L. Tsacas det. 1975, Muséum Paris (MNHN); 1♂, Trelawney, 20.i.[19]54, M.I. Myers, *Curtonotum cuthbertsoni* Duda, L. Tsacas det. 1976 (NMSA); 1♂, Salisbury [= Harare], Mashonaland, G.A.K. Marshall (CUMZ); 1♂, Zimbabwe, Kotwa, 17°06'S 32°38'E, Chimana Causway, 15.viii.1986; M. Llig/S. Potel; same except: 1♂, 18.viii.1986; 1♂, 19.viii.1986; 2♂, 20.viii.1986; 1♂, 26.viii.1986; 1♂, 31.viii.1986 (all ZSM).

Distribution. Botswana, Kenya, Mozambique, Namibia, South Africa, Tanzania, Uganda and Zimbabwe (Fig. 3.4: 225, 228). With an apparently disjunctive distribution in East and south-eastern Africa in mesic savanna country; absent from the arid south-west arid region (Fig. 3.4: 228).

Bionomics. Occurring in 16 major habitat types; predominantly in Tropical and Subtropical Grasslands, Savannas and Shrublands and Tropical and Subtropical Moist Broadleaf Forests, plus two other vegetation types (3.4: Appendix). In Malaise traps in *Ficus* gallery forest in South Africa, swept from grasses beneath trees in Kenya (pers. obs.), and on the trunk of a Baobab (in company with *Curtonotum bicuspis* sp. n. and *C. unicuspis* sp. n.) in South Africa. Resting in the burrows of Aardvark (in same burrow as *C. bicuspis* sp. n. and *C. unicuspis* sp. n.) in north-eastern Namibia.

***Curtonotum litoralis* Kirk-Spriggs, sp. n.,**

Figs 3.4: 21, 45, 81, 173, 176, 179, 209, 210, 226.

Curtonotum cuthbertsoni: Duda, 1935: 31, Type VI of Tsacas (1977: 153).

Etymology. The specific epithet *litoralis* is derived from the Latin *litoralis* (= of or belonging to the shore) and refers to the East African coastal distribution of this species.

Description: Male (primarily based on field-pinned HT).

As described for *C. uncinatum* (above), differing in the following respects:

Measurements: Overall length unknown (a ♀ measures 4.3 mm; $n = 1$, PT); length of head and thorax combined 2.1–2.7 mm; length of thorax and scutellum combined 1.9–2.6 mm ($n = 4$, HT, PT); wing length 2.8–4.1 mm ($n = 5$, HT, PT).

Head (Figs 3.4: 21, 45). Eye height/length ratio: 11:7 ($n = 1$, PT); frons (Fig. 3.4: 45) very slightly wider than long, frons length/width ratio: 6:7 ($n = 1$, HT); arista with 10–11 long dorsal branches and 4 ventral branches; 10 fine setae bordering genal groove; eye height/genal height ratio: 11:1 ($n = 1$, PT).

Thorax (Fig. 3.4: 21). Postpronotum with 10 fine setulae; anepisternum surface with 18 fine setulae, 3 arranged in a group in posterior corner; katepisternum with 13 short, fine setulae.

Legs. Fore coxa with 14 brown setulae; fore tibia with ctenidium of 12–14 short, sharp, black spinules.

Wing (Fig. 3.4: 81). *dm–cu* crossvein moderately angled posteriorly with slight medial angle.

Abdomen. Sternite 6 as in Fig. 3.4: 200.

Terminalia (Figs 3.4: 173, 176, 179). Hypandrium (Fig. 3.4: 173, *hy*); postgonite (Fig. 3.4: 173, *pg*); epandrium (Fig. 3.4: 173, *ep*); cercus (Fig. 3.4: 173, *ce*); surstylus (Fig. 3.4: 173, *ss*); phallus (as in Figs 3.4: 176, *ph*, *bp*, *dp*; 179, *bp*, *dp*); phallapodeme (Fig. 3.4: 176, *ph*); ejaculatory apodeme (Fig. 3.4: 176, *ea*); basiphallus (Figs 3.4: 176, 179, *bp*) wide basally, expanded into narrow lateral expansion apically, extreme apex of dorsal edge developed into hook or extension; distiphallus (Figs 3.4: 176, 179, *dp*) long, scimitar-like (viewed laterally), membranous area broad, with basal “spine” dorsally directed, moderately strong with acute apex, more apical dorsal spine of distiphallus broad basally with straight edges, with additional much smaller spine towards apex (not visible of Fig. 3.4: 179).

♀ Similar to ♂, except in the following respects: wing length 3.3–4.2 mm ($n = 3$, PT). Postabdomen as illustrated in Figs 3.4: 209, 210.

Variation. The apical hook on the basiphallus is not distinctly hooked in some specimens, but forms a long process. In most specimens examined there is an

additional distinct more apical spine on the left edge of the distiphallus (not visible in Figs 3.4: 176, 179). This may be reduced in some specimens, but is always apparent with careful examination. Other characters are consistent and this is here regarded as intraspecific variation only.

Differential diagnosis. *Curtonotum litoralis* sp. n. belongs to a group of eight species here ascribed to the *Uncinatum* species-group that are virtually identical externally and are only separable based on minor differences in the male phallus (see Differential diagnosis under *C. uncinatum* sp. n. for details). *Curtonotum litoralis* sp. n. can be separated from other species in the species-group by reference to the above key.

Type material examined. KENYA: holotype ♂, “Kenya: COAST PROVINCE / Muhaka Field Station / 04°19.76’S 39°31.55’E / 20.xi.1999, 45 m / A.H. Kirk-Spriggs / sweeping // Namibian National / Insect Collection / National Museum / P.O. Box 1203 / Windhoek, Namibia [printed; blue card] // HOLOTYPE ♂ / *Curtonotum litoralis* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (NMNW). In excellent condition; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE / *Curtonotum* ♂ [or ♀] / *litoralis* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”): KENYA: 1♂, “Kenya, Tiwi Beaches / 04°14’S, 39°36’E / 14–23.viii.1975 / B. Petersen leg.” (ZMUC). [TANZANIA]: 4♂, 3♀, “ZANZIBAR. / 1-11.1925 / H.J. Snell // Pres. by / Imp.Inst.Ent. / Brit.Mus. / 1932-335 // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed & handwritten] // [1♂ labelled] “*Curtonotum nigripalpis* / 5♂ 4♀ Hendel / det.J.C. Deeming 1964 [printed & handwritten]”; 1♂ same except: “♂ 3♀” [2♂ head missing] (3♂, 3♀ BMNH; 1♂ MNHN).

Distribution. Kenya and Tanzania (Zanzibar) (Fig. 3.4: 226). As is the case with its congener, *C. mcgregor* sp. n., this species is primarily coastal, apparently confined to low elevation coastal forests and mangroves.

Bionomics. Occurring in the Northern Zanzibar-Inhambane Coastal Forest and Mangroves major habitat types; in Tropical and Subtropical Moist Broadleaf Forests and Mangroves vegetation types (3.4: Appendix). Swept from grasses beneath trees in Kenya (pers. obs.).

***Curtonotum mcgregor* Kirk-Spriggs, sp. n.,**

Figs 3.4: 82, 174, 177, 180, 226.

Curtonotum cuthbertsoni: Duda, 1935: 31, Type IV of Tsacas (1977: 153).

Etymology. The specific epithet *mcgregor* is a noun in apposition, named after Gillian Kathleen McGregor, who has assisted enormously in the preparation of distribution maps used in this revision.

Note. As the HT specimen has the head missing and is fragmented and the PT specimen is missing from the mount (only the abdomen and male terminalia is retained), only a limited description of the species is possible. The male terminalia is, however, sufficiently distinct to warrant the naming of the species and to facilitate its identification and the species is named to fully clarify those taxa identified as “Types” of *C. cuthbertsoni* by Tsacas (1977).

Description: Male (primarily based on field-pinned N-T).

As described for *C. uncinatum* (above), differing in the following respects:

Measurements: Overall length unknown; wing length 3.7 mm ($n = 1$, HT).

Thorax. Although mesonotum damaged at least two medial parallel chestnut-brown pruinose vittae apparent; [posterior section of mesonotum missing and dorsocentral, acrostichal, presutural, posterior notopleural and supra-alar setae cannot be described]; postpronotum with 2 strong postpronotal setae, the more dorsal longer and reclinate, the more ventral shorter and proclinate [rubbed and exact number of finer setulae cannot be determined]; anepisternum surface with *ca.* 10 fine setulae, 2 arranged in group in posterior corner; katepisternum surface with 15 short, fine setulae.

Scutellum. [Only left outer scutellar seta present].

Legs. Fore coxa with 18 brown setulae on anterior surface; [hind coxa damaged, all legs, except left fore femora and tibia missing]; fore tibia probably with 6 strong setae on lateral margin; ctenidium of 11 short, sharp, black spinules.

Wing (Fig. 3.4: 82). *dm-cu* crossvein with submedial angle.

Abdomen. Sternite 6 as in Fig. 3.4: 200.

Terminalia (Figs 3.4: 174, 177, 180). Hypandrium (Fig. 3.4: 174, *hy*); postgonite (Fig. 3.4: 174, *pg*); epandrium (Fig. 3.4: 174, *ep*); cercus (Fig. 3.4: 174, *ce*) with longest setae as long as longest seta on ventral margin of epandrium; surstylus (Fig. 3.4: 174, *ss*) widest basally, slightly curved apically; phallus (as in Figs 3.4: 177, *ph*, *bp*, *dp*; 180, *bp*, *dp*); phallapodeme (Fig. 3.4: 177, *ph*); ejaculatory apodeme (Fig. 3.4: 177, *ea*); basiphallus (Figs 3.4: 177, 180, *bp*) wide basally, expanded into narrow lateral expansion apically, extreme apex of dorsal edge developed into an acute apical spine; distiphallus (Figs 3.4: 177, 180, *dp*) long, scimitar-like (viewed laterally), membranous area broad, with basal “spine” short and curved, more apical dorsal spine with edges very slightly angled, acutely pointed.

♀ Unknown.

Variation. As this species is only known from the fragmented holotype and missing paratype variability cannot be assessed.

Differential diagnosis. *Curtonotum mcgregor* sp. n. belongs to a group of eight species here ascribed to the *Uncinatum* species-group that are virtually identical externally and are only separable based on minor differences in the male phallus (see Differential diagnosis under *C. uncinatum* sp. n. for details). *Curtonotum mcgregor* sp. n. is probably most closely related to *C. litoralis* sp. n. and can be separated from other species in the species-group by reference to the above key.

Type material examined. [MALAWI]: holotype ♂, “Nyasaland. / Dr.J.E.S. Old. / Port Herald / VII 1912 [printed & handwritten] // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed & handwritten] // HOLOTYPE ♂ / *Curtonotum* / *mcgregor* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (BMNH). In poor condition; head missing, fragmented and glued to card point; dissected, abdomen and terminalia in micro-vial pinned beneath specimen, hypandrium and epandrium missing. Paratype (labelled “PARATYPE / *Curtonotum* ♂ / *mcgregor* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”): [MOZAMBIQUE]: 1♂, MARROMEU LOWER / ZAMBEZI RIVER / PORT EAST AFRICA / P J USHER // Salone Forest / Rainy Season / 1956 [handwritten] // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed & handwritten] [specimen missing from mount, but abdomen and terminalia in micro-vial pinned beneath specimen]” (NMSA).

Distribution. Malawi and Mozambique (Fig. 3.4: 226). As is the case with its congener, *C. litoralis* sp. n., this species is apparently confined to low elevation coastal regions.

Bionomics. Occurring in the Zambezian and Mopane Woodland and Zambezian Coastal Flooded Savanna major habitat types; in Tropical and Subtropical Grasslands, Savannas and Shrublands and Flooded Grasslands vegetation types (3.4: Appendix).

Curtonotum pauliani Tsacas, 1974,
Figs 3.4: 22, 46, 83, 181, 184, 187, 226.

Curtonotum pauliani: Tsacas, 1974: 715; figs 7a–d (p. 716), fig. 8b (p. 718). Type locality: [Madagascar] “Nosy Mitsio”.

Curtonotum pauliani: Kirk-Spriggs (2008c: 246, fig. 6, 251).

Curtonotum pauliani: Kirk-Spriggs (2011); figs 12, 25, 38, 69, 72, 75, 90, 103.

Remarks: This species was redescribed and figured by Kirk-Spriggs (2011, Chapter 3.3), only figures are included here for comparative purposes: head and thorax (Fig. 3.4: 22); frons (Fig. 3.4: 46); wing (Fig. 3.4: 83); male terminalia (Fig. 3.4: 181, 184, 187).

Differential diagnosis. *Curtonotum pauliani* belongs to a group of eight species here ascribed to the *Uncinatum* species-group that are virtually identical externally and are only separable based on minor differences in the male phallus (see Differential diagnosis under *C. uncinatum* sp. n. for details). *Curtonotum pauliani* can be separated from other species in the species-group by reference to the above key.

Type material examined: MADAGASCAR: holotype ♂, “Madagascar Nord-Ouest / Nosy Mitsio / 13–14.I.[19]60 / R. Paulian // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // HOLOTYPE [red card] // CURTONOTUM / *pauliani* / Holotype ♂ n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // MUSÉUM PARIS // *Curtonotum* / *pauliani* ♂ / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2006” [head missing] (MNHN). In fair condition, head, right fore leg, left fore tarsus and hind leg missing; re-staged on nu-poly mount; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE [red card] // CURTONOTUM /

pauliani / n.sp. / L. TSACAS DET. 1973 [printed & handwritten] // *Curtonotum pauliani* ♂ [or ♀] / Tsacas, 1974 / A.H. Kirk-Spriggs *vidit* 2006”): MADAGASCAR: 1♀, same labels as holotype, except: “ALLOTYPE [red card] // CURTONOTUM / *pauliani* / n.sp. / L. TSACAS DET. 1973 [printed & handwritten]” [wing detached, glued to card]; 2♂, same labels as holotype [1 head missing]; 1♀, same labels as holotype, except: “EXEMP. / DESS. [printed; orange card]”; 1♀, same labels as holotype, except: “ouile gameha / ma tres large / Anomalié ♀ [handwritten]”; 1♂, “Madagascar Nord-Ouest / dct. Majunga / forêt Ankarafantsitka [= Ankarafantsika] 120m / XII-[19]59 / Raharizonina // INSTITUT / SCIENTIFIQUE / MADAGASCAR [pale grey card] // MUSÉUM PARIS” [head missing]; 1♂, “MUSEUM PARIS / MADAGASCAR / PROV. D’ANALALAVA / MAROMANDIA / R. DECARY 1922 [grey card] // PARATYPE [red card] // Specimen / missing from mount / 2006”; 1♂, 1♀, same labels, except: “Pr A18 / ♂ [handwritten] [head missing]” (all MNHN).

Additional material examined (both labelled “*Curtonotum pauliani* Tsacas, 1974, det. A.H. Kirk-Spriggs 2011”): NAMIBIA: 1♂, Namibia: OPUWA DIST., Ekuju village: Kunene R., 17°19’30”S 13°48’56”E, 11–12.x.1999, [A.H.] Kirk-Spriggs, [T.] Pape, [W.] Hauwanga, Malaise traps, riverine forest (NMNW). SOUTH AFRICA: 1♂, 6664, SO. AFRICA: Natal, 15 km SE Rorke’s Drift, 28°30’S, 30°30’E, 30.v.1982, R.M. Miller (NMSA).

Distribution. Madagascar, Namibia and South Africa (Fig. 3.4: 226). The only species known to occur in the continental Afrotropical Region and on the island of Madagascar.

Bionomics. In southern Africa the species occurs in the Nama Karoo and Drakensburg Afromontane Grassland and Woodland major habitat types; Deserts and Xeric Shrublands and Montane Grasslands vegetation types (3.4: Appendix). This species has been sampled in a Malaise trap in riverine forest in Namibia. A detailed account of habitat associations in Madagascar was provided by Kirk-Spriggs (2011; Chapter 3.3).

***Curtonotum unicuspis* Kirk-Spriggs, sp. n.,**

Figs 3.4: 24, 48, 85, 183, 186, 189, 225, 230.

Curtonotum cuthbertsoni: Duda, 1935: 31, Type V of Tsacas (1977: 153).

Etymology. The specific epithet *unicuspis* is derived from the Latin *unus* (= one) and *cuspis* (= spike), and refers to the single blunt, spike-like extension of the distiphallus of this species.

Description: Male (primarily based on field-pinned HT).

As described for *C. uncinatum* (above), differing in the following respects:

Measurements: Overall length unknown; length of head and thorax combined 1.6–3 mm; length of thorax and scutellum combined 1.5–2.7 mm; wing length 2.9–4.3 mm ($n = 5$, HT, PT).

Head (Figs 3.4: 24, 48). Eye height/length ratio: 9:6 ($n = 1$, HT); frons (Fig. 3.4: 48) slightly wider than long, frons length/width ratio: 6:7 ($n = 1$, HT); arista with 9 long dorsal branches and 4 ventral branches; 9 fine setae bordering genal groove; gena narrow, eye height/genal height ratio: 9:1 ($n = 1$, HT).

Thorax (Fig. 3.4: 24). Postpronotum with 8 fine black-brown setulae; anepisternum surface with 14 fine setulae; katepisternum with 17 short, fine setulae.

Legs. Fore coxa with 17 brown setulae; fore tibia with ctenidium of 14 short, sharp, black spinules.

Wing (Fig. 3.4: 85). *dm–cu* crossvein angled posteriorly with submedial curve.

Abdomen. Sternite 6 as in Fig. 3.4: 200.

Terminalia (Figs 3.4: 183, 186, 189). Hypandrium (Fig. 3.4: 183, *hy*); postgonite (Fig. 3.4: 183, *pg*); epandrium (Fig. 3.4: 183, *ep*); cercus (Fig. 3.4: 183, *ce*); surstylus (Fig. 3.4: 183, *ss*); phallus (as in Figs 3.4: 186, *ph*, *bp*, *dp*; 189, *bp*, *dp*); phallapodeme (Fig. 3.4: 186, *ph*); ejaculatory apodeme (Fig. 3.4: 186, *ea*); basiphallus (Figs 3.4: 186, 189, *bp*) wide basally, gradually narrowed into lateral expansion apically; distiphallus (Figs 3.4: 186, 189, *dp*) long, scimitar-like (viewed laterally), membranous area broad, basal “spine” absent, more apical spine relatively narrow and blunt.

♀ Unknown.

Variation. No significant variation is noted.

Differential diagnosis. *Curtonotum unicuspis* sp. n. belongs to a group of eight species here ascribed to the *Uncinatum* species-group that are virtually identical externally and are only separable based on minor differences in the male phallus (see Differential diagnosis under *C. uncinatum* sp. n. for details). *Curtonotum unicuspis* sp. n. can be separated from other species in the species-group by reference to the above key.

Type material examined. NAMIBIA: holotype ♂, “Namibia: KATIMA MULILO DIST. / Salambala camp site / 17°50’01”S 24°36’09”E / 01-04.iii.2001 / A.H. Kirk-Spriggs / Malaise trap // Namibian National / Insect Collection / National Museum / P.O. Box 1203 / Windhoek, Namibia [printed; blue card] // HOLOTYPE ♂ / *Curtonotum unicuspis* sp. n. / A.H. Kirk-Spriggs 2011 [printed; red card]” (NMNW). In excellent condition; dissected, abdomen and terminalia in micro-vial pinned beneath specimen. Paratypes (all labelled: “PARATYPE / *Curtonotum unicuspis* sp. n. / A.H. Kirk-Spriggs 2011 [printed; blue card]”): [BURUNDI]: 1♂, “COLL. MUS. CONGO / Urundi: Rumonge 800 m. / 7-III-1953 / P. Basilewsky // BM [handwritten; blue card] // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed & handwritten]” (RMCA). [MOZAMBIQUE]: 1♂, “NYAKA / P. E. Afr. / R. F. Lawrence / [on reverse] Feb. / 1924 [printed & handwritten]”; 1♂, “INHAMBANE / P. E. Afr. / R. F. Lawrence / [on reverse] Jan. / 1924 [printed & handwritten]” (both SANC); 1♂, “Umbeluzi PEA / 19.9.[19]29 / HKMunro [printed & handwritten]” (PPRI). NAMIBIA: 1♂, same data as holotype; 1♂, “Namibia: KHORIXAS DISTRICT / Leeukop 664 / 19°53’15”S, 14°21’44”E / 26-30.x.2001 / A.H. Kirk-Spriggs & E. Marais / light trap”; 2♂, “Namibia: KATIMA MULILO DIST. / Salambala forest / 17°50’02”S 24°36’20”E / 23-29.xii.2002 / A.H. & M.K. Kirk-Spriggs / Malaise trap sample”; 3♂, “Namibia: KATIMA MULILO DIST. / Salambala camp site / 17°50’01”S 24°36’09”E / 22-24.ii.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise trap”; 1♂, “Namibia: KATIMA MULILO DIST. / Salambala, 4km NE of / 17°49’21”S 24°36’07”E / 25.ii-01.iii.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise trap sample”; 1♂, “Namibia: KATIMA MULILO DIST. / Salambala camp site / 17°50’01”S 24°36’09”E / 23-28.xii.2002 / A.H. & M.K. Kirk-Spriggs / hanging trap baited mango”; 4♂, “Namibia: WEST CAPRIVI PK. / Fort Doppies / 17°49’28”S 23°18’49”E / 20-21.x.1999 / [A.H.] Kirk-Spriggs [T.] Pape [W.] Hauwanga”; 1♂, “Namibia: RUNDU DIST. / Simanya Okavango River / 17°33’17”S, 18°32’30”E / 23-24.i.1998 / [A.H.] Kirk-Spriggs & [E.] Marais / malaise traps riverine forest”; 1♂, “Namibia: RUNDU DIST. / 1 km S. of Katara / 17°50’25”S, 18°54’26”E / 22-23.i.1998 / [A.H.] Kirk-Spriggs & [E.] Marais / malaise traps primary forest”; 2♂, “Namibia: W. CAPRIVI PARK / Nova, 5km N / 18°09’56”S, 21°44’31”E / 16-18.xii.1999 / [E.] Marais, [D.J.] Mann, [D.] Newman / MMN8 – warthog burrows”; 1♂, same except: “MMN8 – malaise”; 2♂, “Namibia: RUNDU DIST. / Mile 46 / 18°18’39”S, 19°15’29”E / 25-27.iii.2003 / A.H. Kirk-Spriggs / attracted to decomposing fungi”; 2♂, “Namibia: RUNDU DIST. /

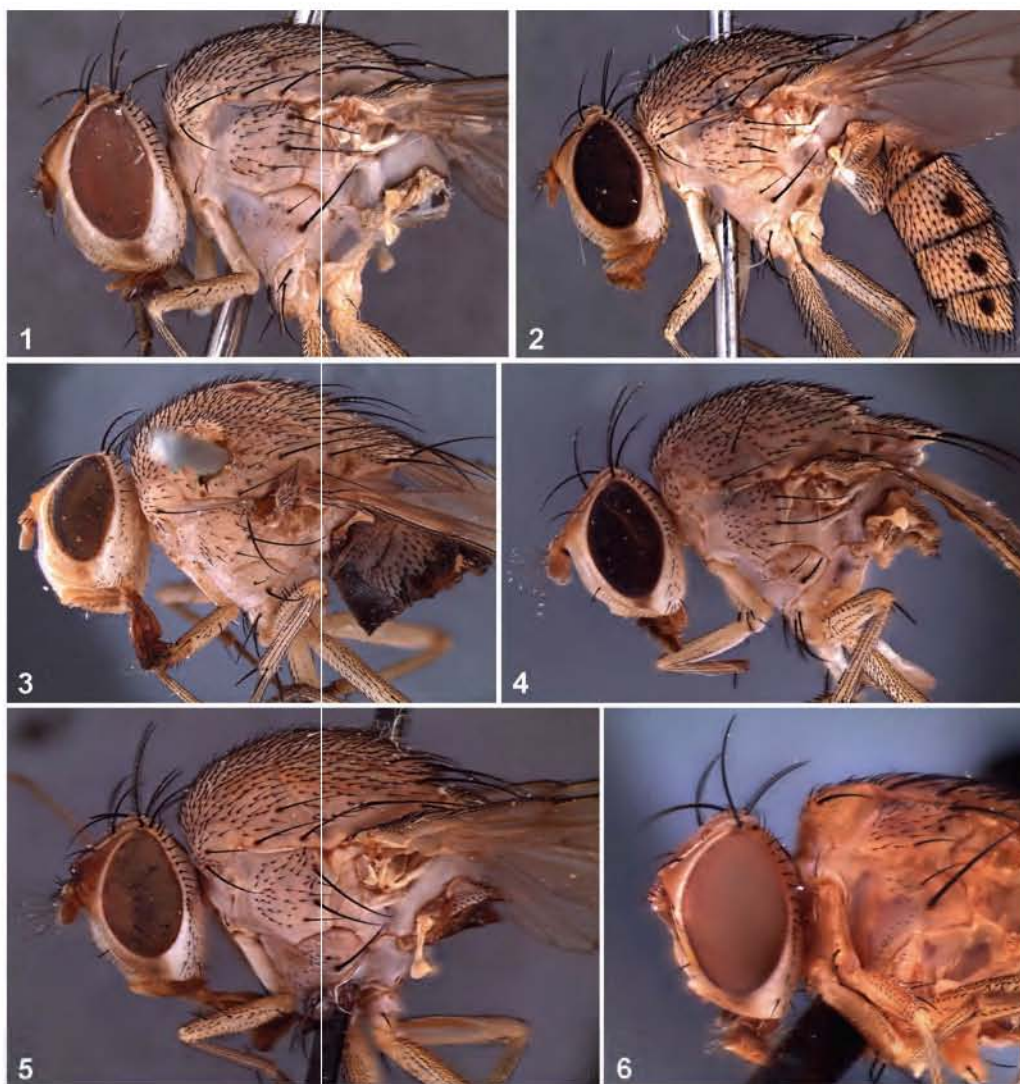
Mile 46 / 18°18'39"S, 19°15'29"E / 25-27.iii.2003 / A.H. Kirk-Spriggs / Malaise traps"; 2♂, "Namibia: RUNDU DIST. / Simanya Okavango River / 17°33'17"S, 18°32'30"E / 23-24.i.1998 / [A.H.] Kirk-Spriggs & [E.] Marais / malaise traps riverine forest"; 1♂, "Namibia: RUNDU DIST. / Hamoye Nat. Forest / 18°12'S, 19°43'E / 05-08.iii.1999 / E. Marais / Malaise trap"; 1♂, "Namibia: RUNDU DIST. / 20 km E Rundu / 17°55'46"S, 19°58'43"E / 17-18.x.1999 / [A.H.] Kirk-Spriggs [T.] Pape [W.] Hauwanga / Malaise trap sample"; 1♂, "Namibia: WEST CAPRIVI / Chwaha River, 3 km NE at: / 17°58'S 22°28'E / 04-10.iv.1990 / E. Marais / pres. & bait traps; 1♂, "Namibia: KATIMA MULILO / DIST. / Simataa: Salambala B6 / 17°48'36"S 24°32'18"E / 24-27.ii.2001 / E. Marais & A.H. Kirk-Spriggs / Malaise traps; 1♂, "Namibia: MUDUMU NAT. PK. / at: 18°10'S 23°25'E / 25.xi-04.xii.1991 / E. Marais / Malaise trap"; 1♂, "NAMIBIA: Mahango Game Res. / 18°14'S/21°43'E / 31.xi.2001 / leg. F. KOCH (NMNW)"; 3♂, "Namibia: KHORIXAS DIST. / River on Amkarub 269 at: / 19°50'12"S, 14°42'16"E / 24-26.v.2001 / A.H. Kirk-Spriggs & E. Marais / Malaise traps" (all NMNW). 2♂, "S.W.AFRICA (W50) / Gobiswater Fm., / 12 mls. N. / Grootfontein / 5.iv.1972 ♂ // Southern / African Exp / B.M.1972-1 // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed & handwritten]" (BMNH); 16♂, "NAMIBIA: Katima Mulilo Dist. / Ndopu village, 1km SE Bukalo / -17.7166667, 24.5166667 / 20.iv.2006 / A.H. Kirk-Spriggs / From single burrow // Resting in burrow of / Ardvaark / (*Orycteropus afer* / (Orcycteropidae)" (AMGS); 4♂, "NAMIBIA: Katima Mulilo Dist. / Ndopu village, 1 km SE Bukalo / -17.7166667, 24.5166667 / 20.iv.2006 / A.H. Kirk-Spriggs / resting in burrows of Aardvark" [labelled "// BMSA(D)29874-29877" (BMSA). SOUTH AFRICA: 1♂, "SOUTH AFRICA:Transvaal / n.Kruger National Park / Pafuri. 22°27'S 31°17'E / 31 Jan.1979, L. Braack / [on reverse] Day 1 31/1/79 / 1200 4AD / Bird [printed & handwritten]" (BMNH); 1♂, SOUTH AFRICA / Trsvl. Mooketsi / 14-18-Feb.1968 / Krombein & Spangler" (USNM); 1♂, SOUTH AFRICA / Natal, Mtubatuba / III-24&25-1968 / Paul J. Spangler // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed & handwritten] // MUSÉUM PARIS" (MNH); 3♂, "S AFRICA: N. Province #64 / Blouberg Nature Reserve / 23°02'S:29°04'E 2900 ft / Date: 22.xi.1997 / Coll. [D.A.] Barraclough & [S.] James / On trunk of Baobab tree"; 2♂, "Ndumu Reserve / Ingwavuma District / Tongaland, S. Africa / B. & P. Stuckenberg / 1-10 December 1963 // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1976" (all NMSA); 3♂, "RSA: Natal, / Richards Bay / 28°46'S, 32°04'E / 24.x.1984 loc. 31 / leg. R. Danielsson" (MZLU); 1♂, "RSA: KZN, Ndumo Game R. / main camp area at: / 26°54.652'S, 32°19.719'E / 27-30.xi.2009 / A.H. Kirk-Spriggs // Malaise traps / broad-leaved deciduous / woodland // BMSA(D)29860"; 7♂, "RSA: KZN, Ndumo Game R. / main road at: / 26°54.288'S, 32°17.974'E / 4-8.xii.2009 / A.H. Kirk-Spriggs // Malaise traps / sand [forest] & broad-leaved / deciduous forest" [labelled "// BMSA(D)29901-29907"]; 1♂, "RSA: KZN, Ndumo Game R. / pan at: / 26°54.288'S, 32°17.974'E / 9-10.xii.2009 / A.H. Kirk-Spriggs // Malaise traps / grassy / floodplain // BMSA(D)29931" (all BMSA). [TANZANIA]: 1♂, "COLL. MUS. CONGO / Tanganyika: Moba, 780 m. / VIII-X-1953 / H. Bomans // CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET. 1975 [printed & handwritten]" (RMCA). [ZIMBABWE]: 1♂, "Balla-Balla / S. Rhodesia, / Jan. 1933 / A. Cuthbertson [printed & handwritten; black border] // 3475 [handwritten; red ink] // [bottom front specimen on mount only]" (PPRZ); 2♂, RHODESIA / Victoria Falls / Nat'l Park / IV-3-6-1968 / Paul Spangler // [1 labelled] CURTONOTUM / *cuthbertsoni* / Duda / L. TSACAS DET.

1975 [printed & handwritten]" (USNM); 1♂, "Zimbabwe, Kotwa / 17°03'S 32°46'E / Broken Causeway / 28.7.1986 / M. Llig/S. Potel [printed & handwritten]; 1♂, "Zimbabwe, Kotwa / 17°06'S 32°38'E / Chimana Causeway, 27.7.1986; M. Llig/S. Potel [printed & handwritten]; same except: 1♂, "29.7.1986"; 1♂, "4.8.1986"; 1♂, "5.8.1986"; 1♂, "6.8.1986"; 1♂, "7.8.1986"; 2♂, "9.8.1986"; 1♂, "17.8.1986"; 2♂, "18.8.1986"; 1♂, "20.8.1986"; 1♂, "23.8.1986"; 1♂, "26.8.1986"; 1♂, "27.8.1986"; 2♂, "29.8.1986"; 1♂, "30.8.1986"; 1♂, "2.9.1989"; 1♂, "3.9.1989"; 1♂, "4.9.1989"; 3♂, "10.9.1989"; 1♂, "12.9.1989 (all ZSM).

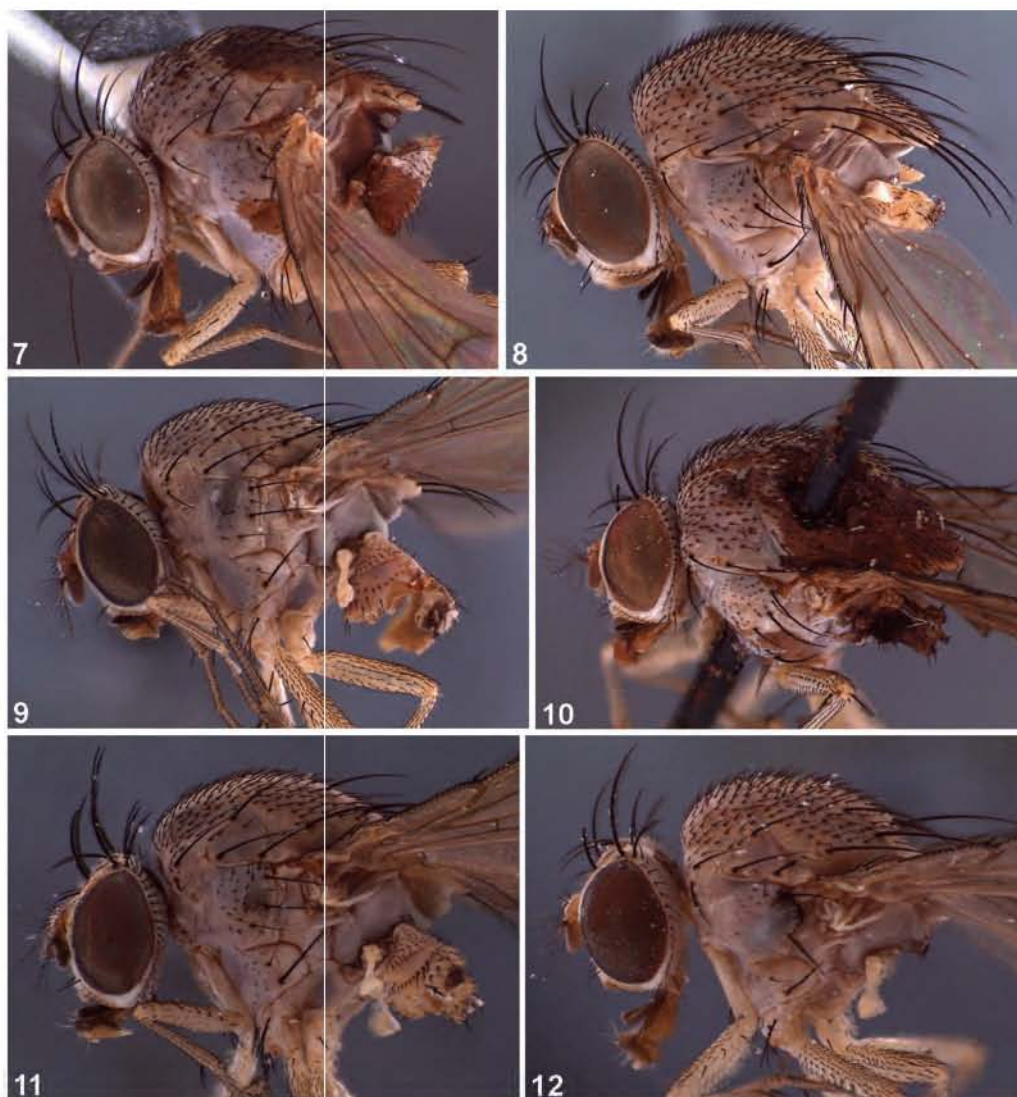
Additional material examined (labelled "*Curtonotum unicuspis* sp. n., det. A.H. Kirk-Spriggs 2011"): SOUTH AFRICA: 1♂, Namibia: Katima Mulilo Dist., Ndopu village, 1 km SE Bukalo, - 17.7166667, 24.5166667, 20.iv.2006, A.H. Kirk-Spriggs, resting in burrows of Aardvark [in spirit], BMSA(DNA)# 0004; 1♂, same except: [in spirit], BMSA(DNA)# 0005 (BMSA).

Distribution. Burundi, Mozambique, Namibia, South Africa, Tanzania and Zimbabwe (Fig. 3.4: 225, 230). Virtually confined to the mesic savannas of southern Africa, with a single record for Burundi farther north.

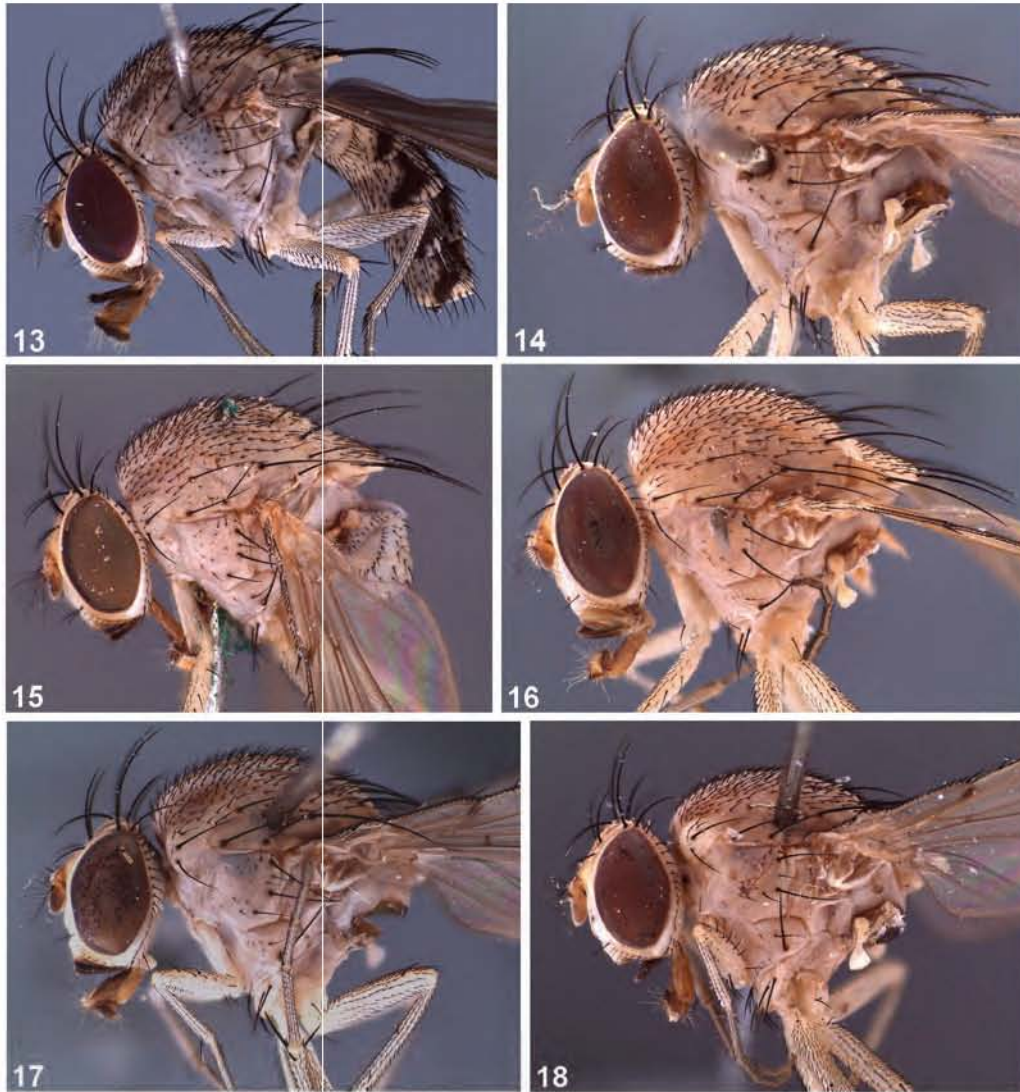
Bionomics. Occurring in 12 major habitat types; predominantly in Tropical and Subtropical Grasslands, Savannas and Shrublands and Tropical and Subtropical Moist Broadleaf Forests, plus three other vegetation types (3.4: Appendix). Sampled at UV-light, in Malaise and pitfall traps and hanging trap baited with mango in Namibia. In Warthog burrows and attracted to decomposing fungi (in company with *Curtonotum bicuspis* sp. n. and *C. uncinatum* sp. n.) in Namibia. In same Aardvark burrow as *C. bicuspis* sp. n. and *C. cuthbertsoni* Duda in north-eastern Namibia. On the trunk of a Baobab (in company with *Curtonotum bicuspis* Duda and *C. unicuspis* sp. n.) in South Africa. In primary and riverine forests in Namibia.



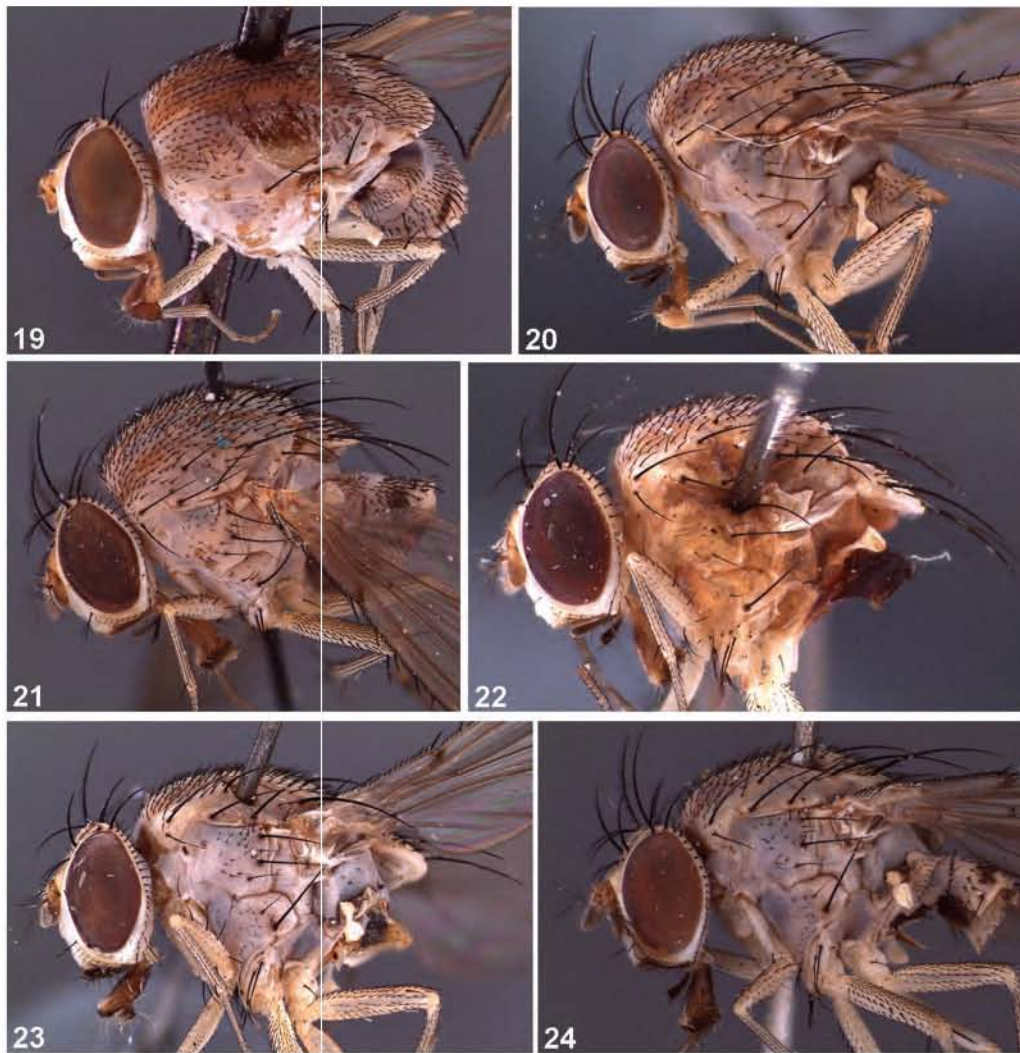
Figs 3.4: 1–6. Head and thorax (lateral view) of Afrotropical *Curtonotum* spp. (male unless stated). **1**, *C. herrero* (N-T, Namibia, Amkarub 269, NMNW); **2**, *C. maculiventris* (N-T, [Zimbabwe], Chipinda Pools, BMNH); **3**, *C. striatifrons* (LT, Chad, Bahr el Ghazal, BMNH); **4**, *C. marriott* sp. n. (PT, Cameroon, Kriba (beach), TAU); **5**, *C. moffatt* sp. n. (PT, Uganda, Mujenje, HNHM); **6**, *C. platyphallum* (♀ N-T, Liberia, 8 mi. NW Zorzor, CAS). Not to scale.



Figs 3.4: 7–12. Head and thorax (lateral view) of Afrotropical *Curtonotum* spp. (all males). 7, *C. angolense* (PT, Angola, 10 mi. NE Sá da Bandeira, CAS); 8, *C. campsiphallum* (N-T, Cameroon, Limbe (shore), TAU); 9, *C. freidberg* sp. n. (PT, Malawi, Viphya Mnts., TAU); 10, *C. hay* sp. n. (PT, Uganda, Mujenje, HNHM); 11, *C. quinquevittatum* (N-T, Malawi, Viphya Mnts., TAU); 12, *C. sao* (N-T, Nigeria, Gadau, BMNH). Not to scale.



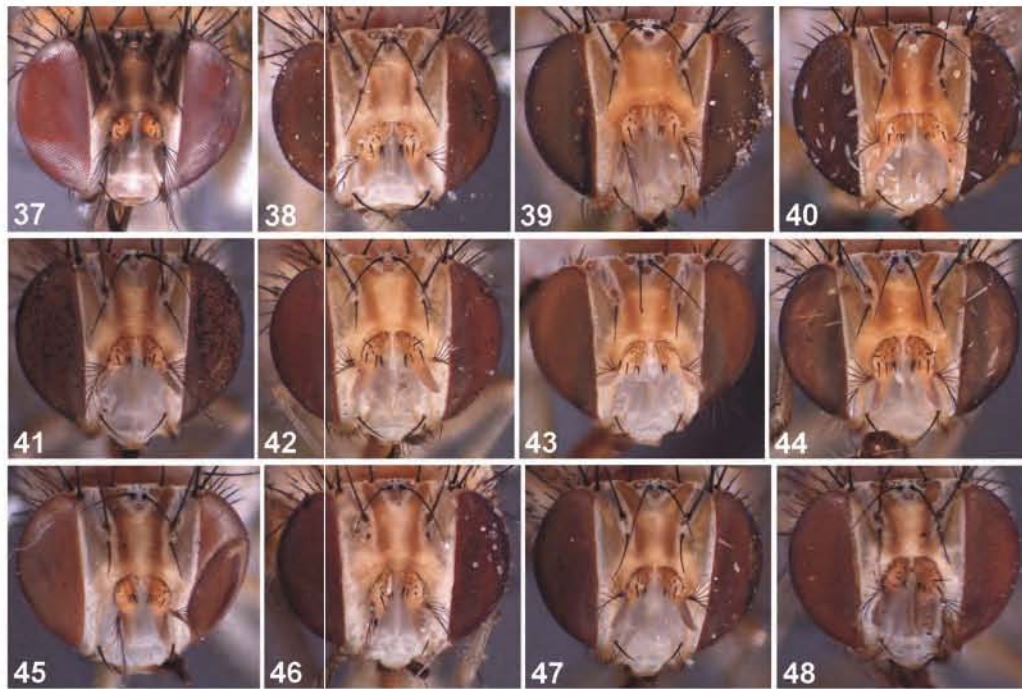
Figs 3.4: 13–18. Head and thorax (lateral view) of Afrotropical *Curtonotum* spp. (male unless stated). **13**, *C. tsacas* sp. n. (♀ PT, South Africa, Kosi Bay Nature Reserve, BMSA); **14**, *C. gonzo* sp. n. (PT, Nigeria, River Bagel, NMWC); **15**, *C. saheliense* (N-T, Nigeria, Katsina, ZSM); **16**, *C. simile* (N-T, Israel, Ne'ot Semadar, TAU); **17**, *C. bicuspis* sp. n. (HT, Namibia, Salambala campsite, NMNW); **18**, *C. cimbebas* sp. n. (HT, Namibia, Tsaobismund 85, NMNW). Not to scale.



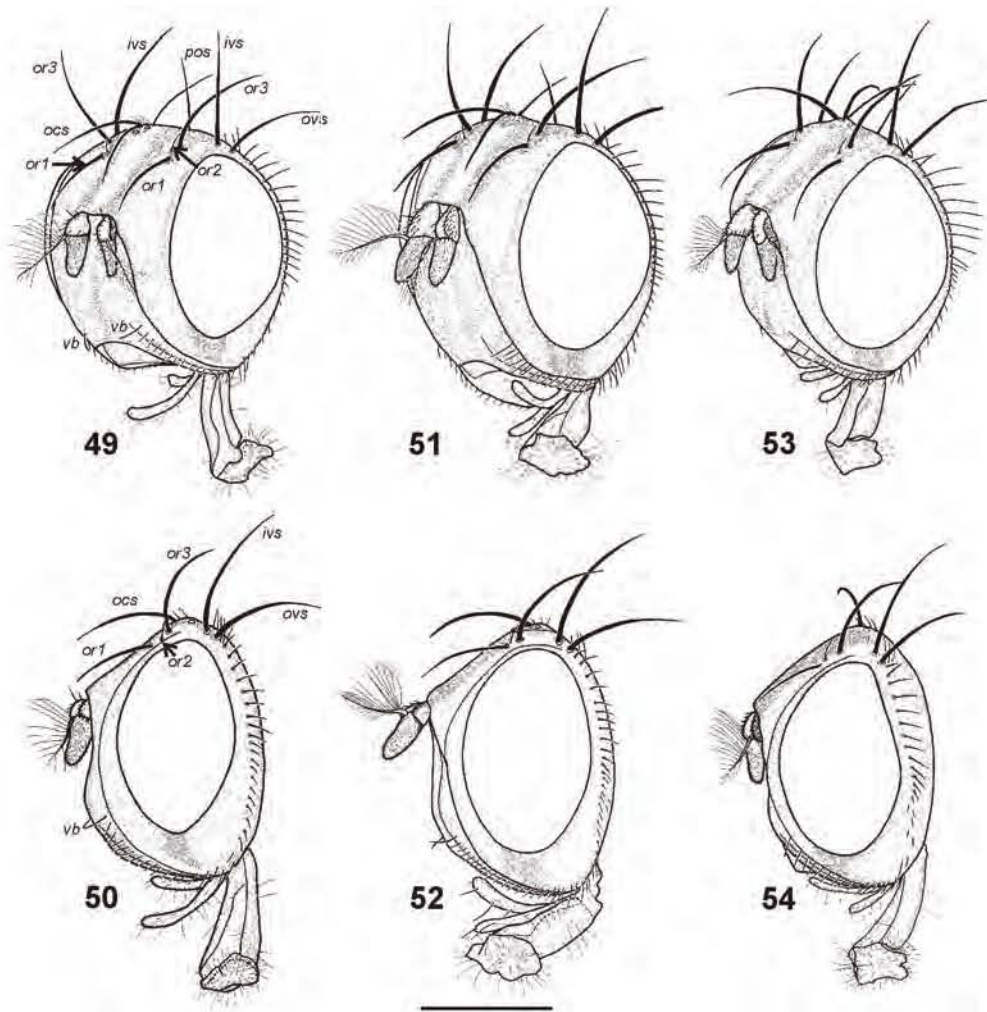
Figs 3.4: 19–24. Head and thorax (lateral view) of Afrotropical *Curtonotum* spp. (all males). **19**, *C. constance* sp. n. (HT, Angola, 7 mi. N Vila Perreira d'Eça, MNHN); **20**, *C. cuthbertsoni* (N-T, South Africa, Hartbeespoort, TAU); **21**, *C. litoralis* sp. n. (PT, [Tanzania], Zanzibar, BMNH); **22**, *C. pauliani* (N-T, Namibia, Ekuju, NMNW); **23**, *C. uncinatum* sp. n. (PT, Namibia, Kubunyana camp, NMNW); **24**, *C. unicuspis* sp. n. (PT, Namibia, Mile 46, NMNW) [head of *C. mcgregor* sp. n. missing from HT and PT cannot be illustrated]. Not to scale.



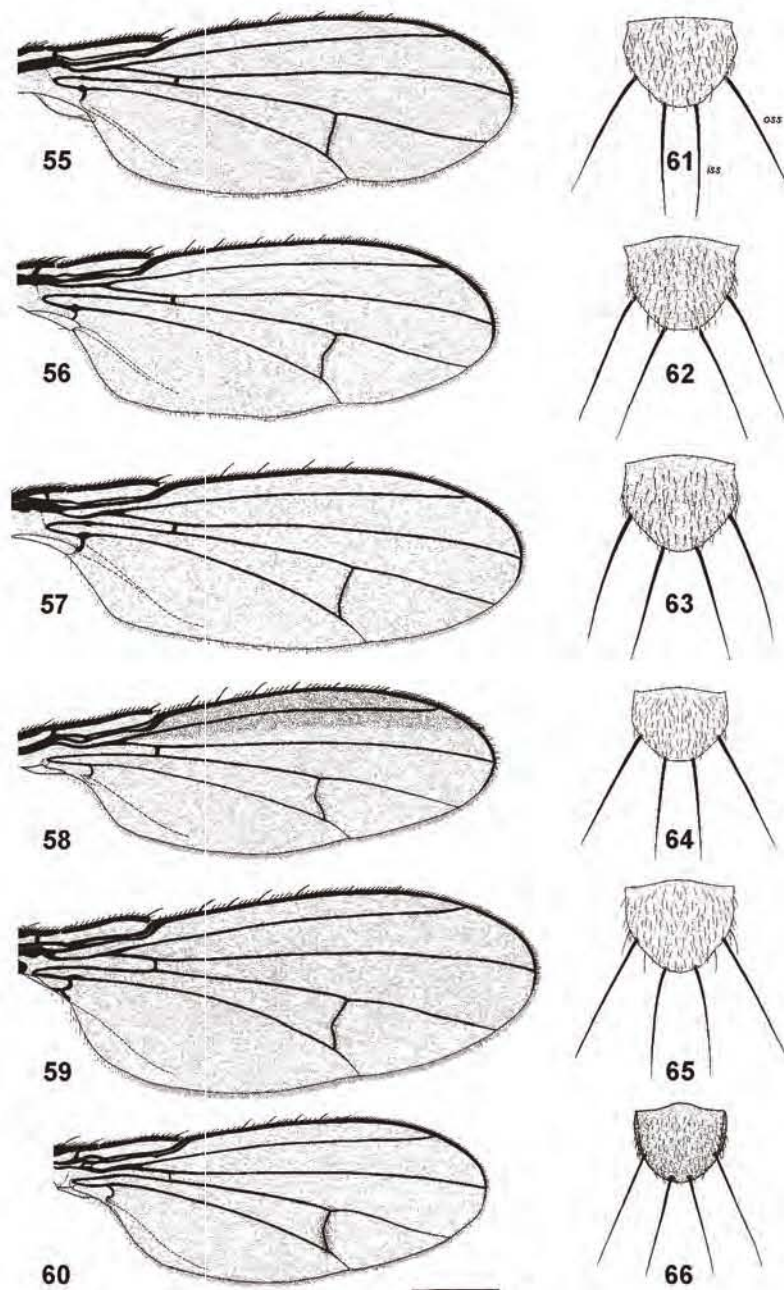
Figs 3.4: 25–36. Frons of Afrotropical *Curtonotum* spp. (male unless stated). **25**, *C. herrero* (N-T, Namibia, Amkarub 269, NMNW); **26**, *C. maculiventris* (N-T, [Zimbabwe], Chipinda Pools, BMNH); **27**, *C. striatifrons* (N-T, Nigeria, Gadau, BMNH); **28**, *C. marriott* sp. n. (♀ PT, Cameroon, Kriba (beach), TAU); **29**, *C. moffatt* sp. n. (PT, Uganda, Mujenje, HNHM); **30**, *C. platyphallum* (♀ N-T, Liberia, 8 mi. NW Zorzor, CAS); **31**, *C. angolense* (PT, Angola, 10 mi. NE Sá da Bandeira, CAS); **32**, *C. campsiphallum* (N-T, Cameroon, Limbe (shore), TAU); **33**, *C. freidberg* sp. n. (PT, Malawi, Viphyia Mnts., TAU); **34**, *C. hay* sp. n. (PT, Uganda, Mujenje, HNHM); **35**, *C. quinquevittatum* (N-T, Malawi, Viphyia Mnts., TAU); **36**, *C. sao* (N-T, Nigeria, Gadau, BMNH). Not to scale.



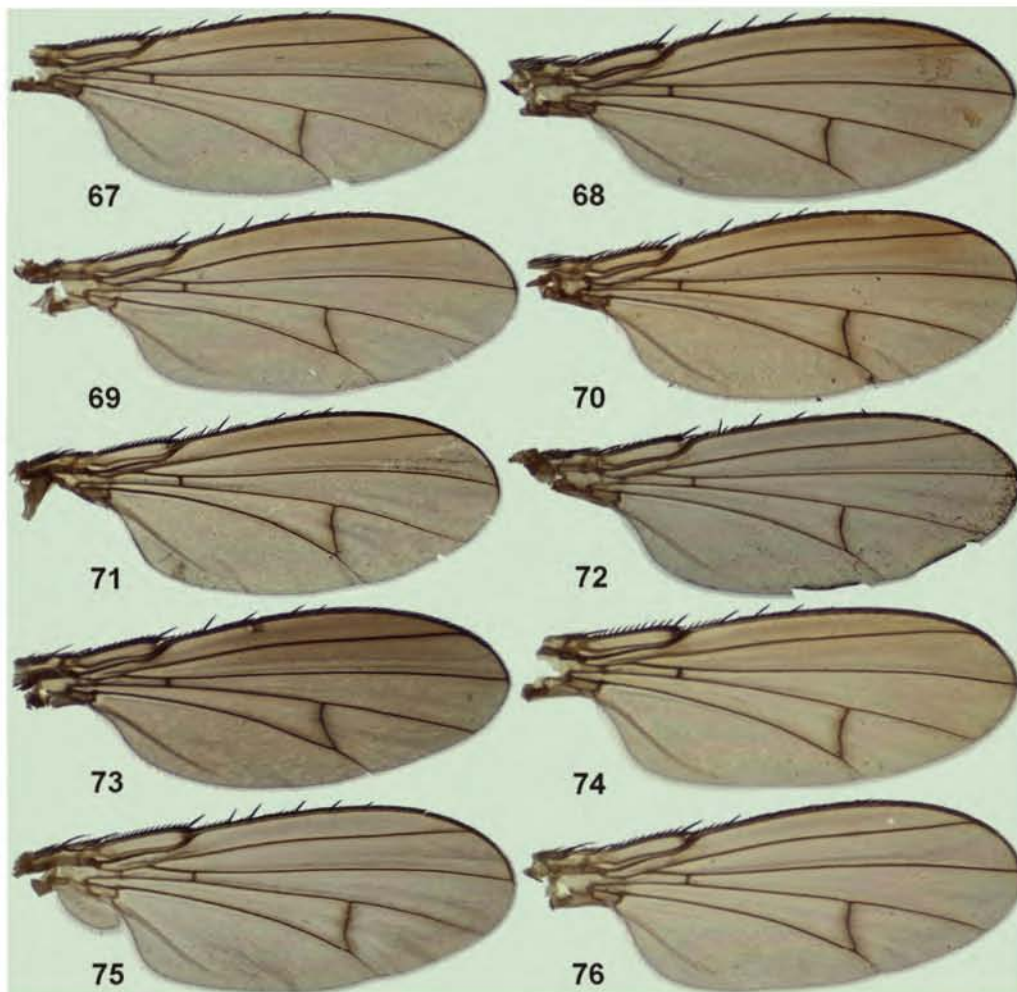
Figs 3.4: 37–48. Frons of Afrotropical *Curtonotum* spp. (all males). **37**, *C. tsacas* sp. n. (PT, South Africa, Kosi Bay Nature Reserve, BMSA); **38**, *C. gonzo* sp. n. (PT, Nigeria, River Bagel, NMWC); **39**, *C. sahelense* (N-T, Nigeria, Katsina, ZSM); **40**, *C. simile* (PT, Arabia [= Yemen], S. Othman, MNHN); **41**, *C. bicuspis* sp. n. (HT, Namibia, Salambala campsite, NMNW); **42**, *C. cimbebas* sp. n. (HT, Namibia, Tsaobismund 85, NMNW); **43**, *C. constance* sp. n. (HT, Angola, 7 mi. N Vila Perreira d'Eça, MNHN); **44**, *C. cuthbertsoni* (N-T, Uganda, Ankole, USNM); **45**, *C. litoralis* sp. n. (HT, Kenya, Muhaka Field Station, NMNW); **46**, *C. pauliani* (N-T, Namibia, Ejuru village, NMNW); **47**, *C. uncinatum* sp. n. (PT, Namibia, Salambala campsite, NMNW); **48**, *C. unicuspis* sp. n. (PT, Namibia, Mile 46, NMNW) [head of *C. mcgregor* sp. n. missing from both HT and PT cannot be illustrated]. Not to scale.



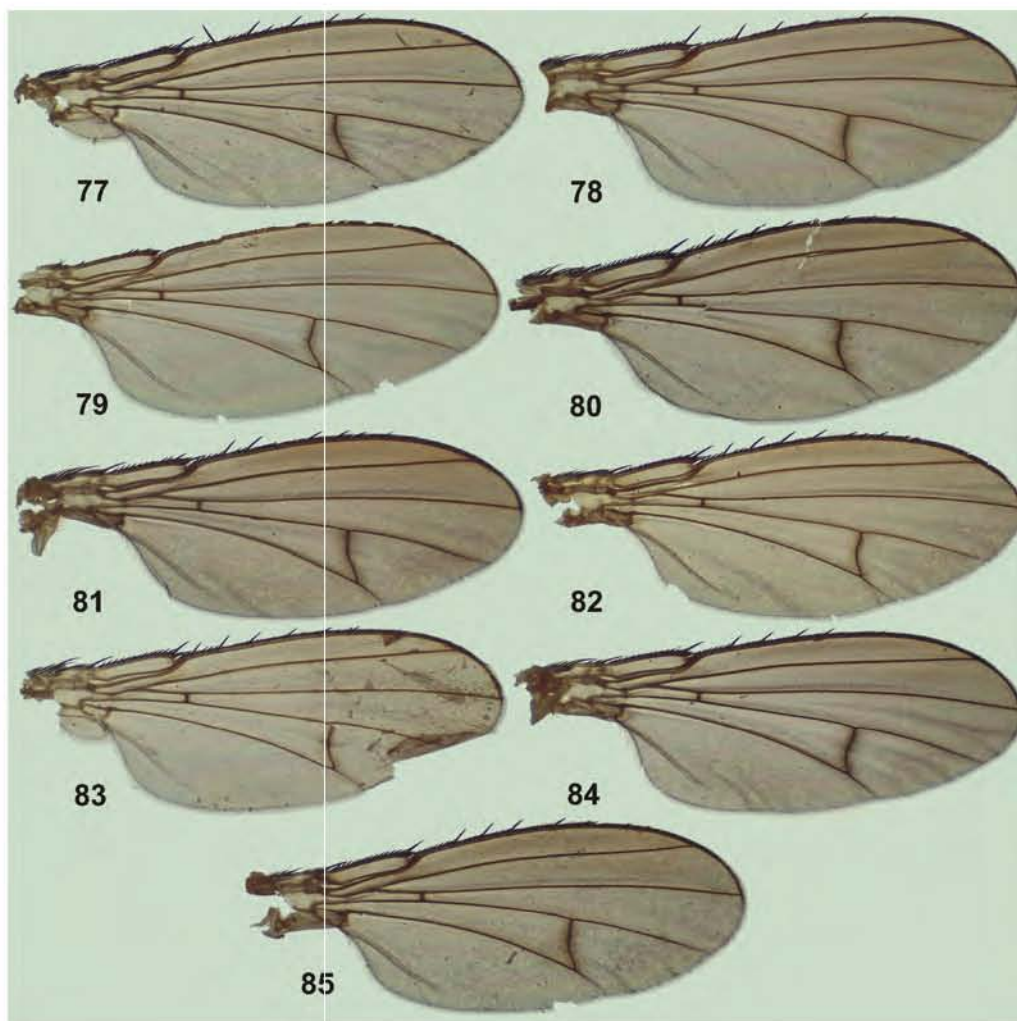
Figs 3.4: 49–54. Head of Afrotropical *Curtonotum* spp. (all males). **49**, *C. herrero*, frontolateral view (N-T, Namibia, Amkarub 269, NMNW); **50**, Same, lateral view; **51**, *C. maculiventris*, frontolateral view (N-T, S. Rhodesia [= Zimbabwe], Chipinda Pools, BMNH); **52**, Same, lateral view; **53**, *C. striatifrons*, frontolateral view (N-T, Nigeria, Gadau, BMNH); **54**, Same, lateral view. Scale bar = 1 mm.



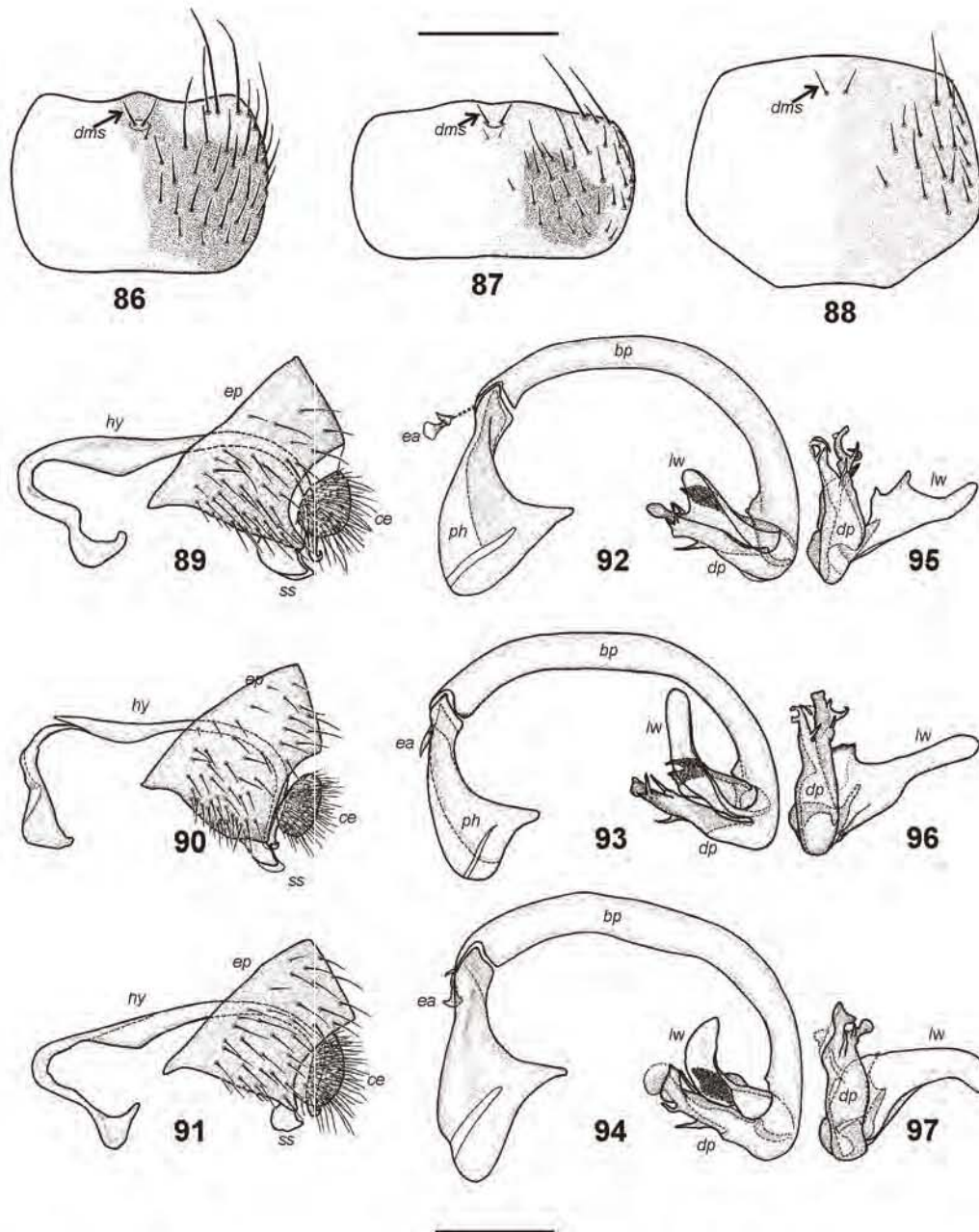
Figs 3.4: 55–60. Wing of Afrotropical *Curtonotum* spp. (male unless stated). **55**, *C. herrero* (N-T, Namibia, Amkarub 269, NMNW); **56**, *C. maculiventris* (N-T, S. Rhodesia [= Zimbabwe], Chipinda Pools, BMNH); **57**, *C. striatifrons* (♀ LT, Sudan, Bal el Ghanal, BMNH); **58**, *C. marriott* sp. n. (♀ PT, Cameroon, Kriba beach, TAU); **59**, *C. moffatt* sp. n. (HT, Uganda, Mujenje, HNHM); **60**, *C. platyphallum* (HT, Liberia, Robertsport, AMNH). **61–66:** Scutellum of Afrotropical *Curtonotum* spp. **61**, *C. herrero* (same); **62**, *C. maculiventris* (same); **63**, *C. striatifrons* (N-T, Nigeria, Gadau, BMNH); **64**, *C. marriott* (same); **65**, *C. moffatt* (♀ PT, Uganda, Mujenje, HNHM); **66**, *C. platyphallum* (same). Scale bar = 1 mm.



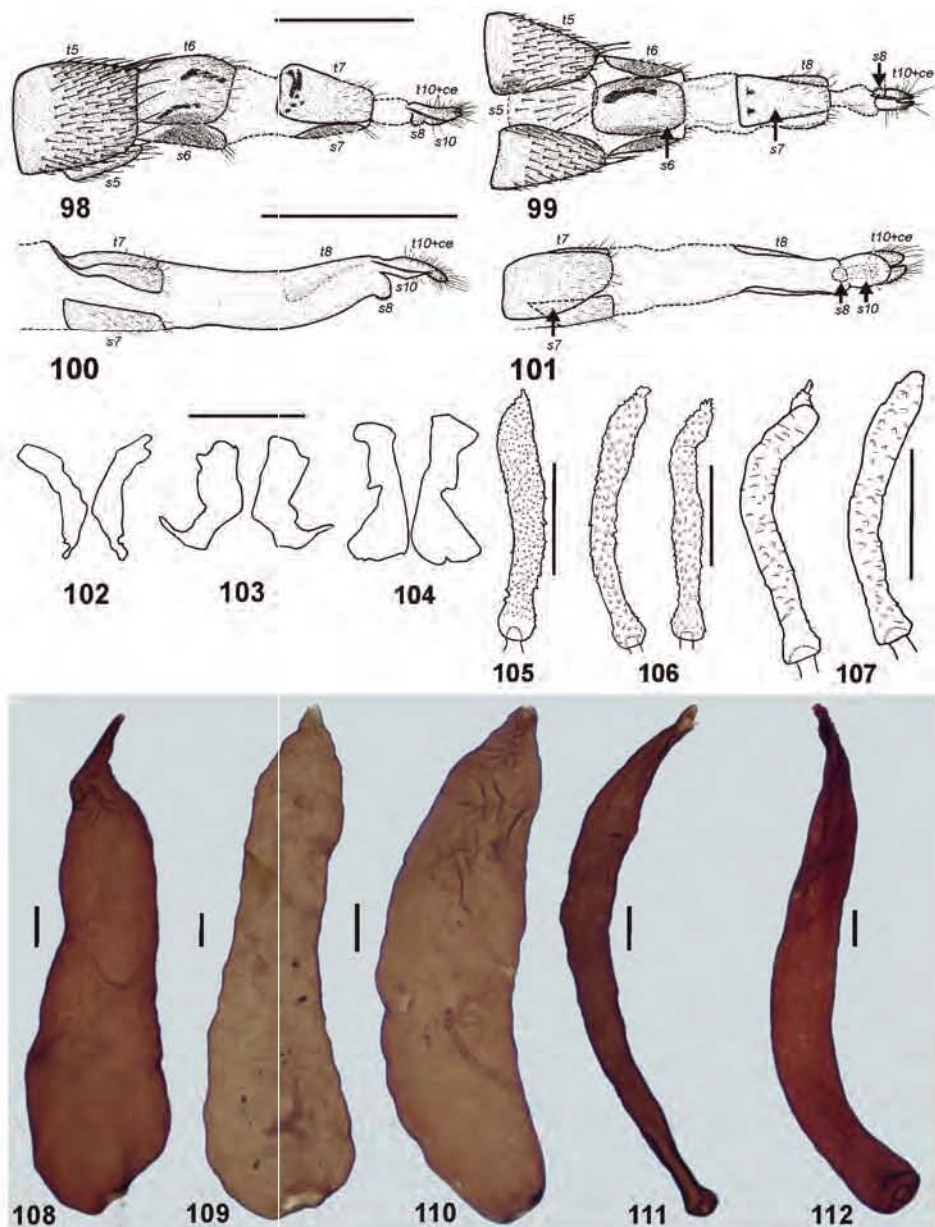
Figs 3.4: 67–76. Wing of Afrotropical *Curtonotum* spp. (all males). 67, *C. angolense* (PT, Angola, 10 mi. NE of Sá da Bandeira, CAS); 68, *C. campsiphallum* (N-T, Cameroon, Limbe (shore), TAU); 69, *C. freidberg* sp. n. (PT, Malawi, Viphya Mts., TAU); 70, *C. hay* sp. n. (HT, Uganda, Mujenje, HNHM); 71, *C. quinquevittatum* (N-T, Malawi, Viphya Mts., TAU); 72, *C. sao* (N-T, Nigeria, Gadau, BMNH); 73, *C. tsacas* sp. n. (PT, South Africa, Kosi Bay Nature Reserve, BMSA); 74, *C. gonzo* sp. n. (HT, [Ghana], Kwadaso, HNHM); 75, *C. saheliense* (N-T, Nigeria, Samaru, MNHN); 76, *C. simile* (N-T, Oman, Ourm, MZLU). Not to scale.



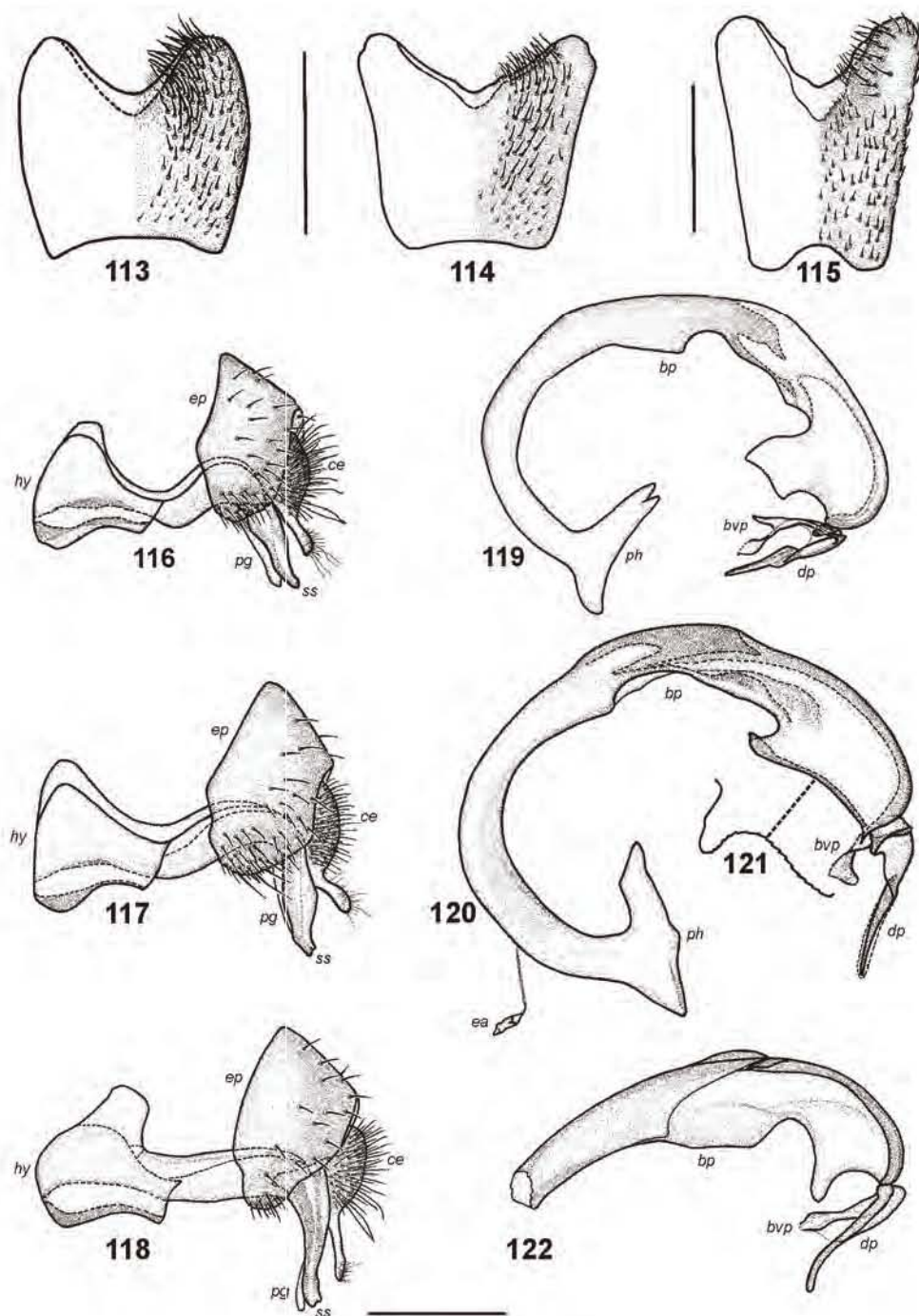
Figs 3.4: 77–85. Wing of Afrotropical *Curtonotum* spp. (all males). **77**, *C. bicuspis* sp. n. (PT, Namibia, Salambala forest, NMNW); **78**, *C. cimbebas* sp. n. (PT, Namibia, Tsams Ost spring, NMNW); **79**, *C. constance* sp. n. (HT, Angola, 7 mi. N Vila Perreira d'Eça, MNHN); **80**, *C. cuthbertsoni* (N-T, Zimbabwe, Chimana Causeway, ZSM); **81**, *C. litoralis* sp. n. (HT, Kenya, Muhaka Field Station, NMNW); **82**, *C. mcgregor* sp. n. (Nyasaland [= Malawi], Port Herald, BMNH); **83**, *C. pauliani* (N-T, Namibia, Ekuju village, NMNW); **84**, *C. uncinatum* sp. n. (PT, Namibia, Salambala campsite, NMNW); **85**, *C. unicuspis* sp. n. (HT, Salambala campsite, NMNW). Not to scale.



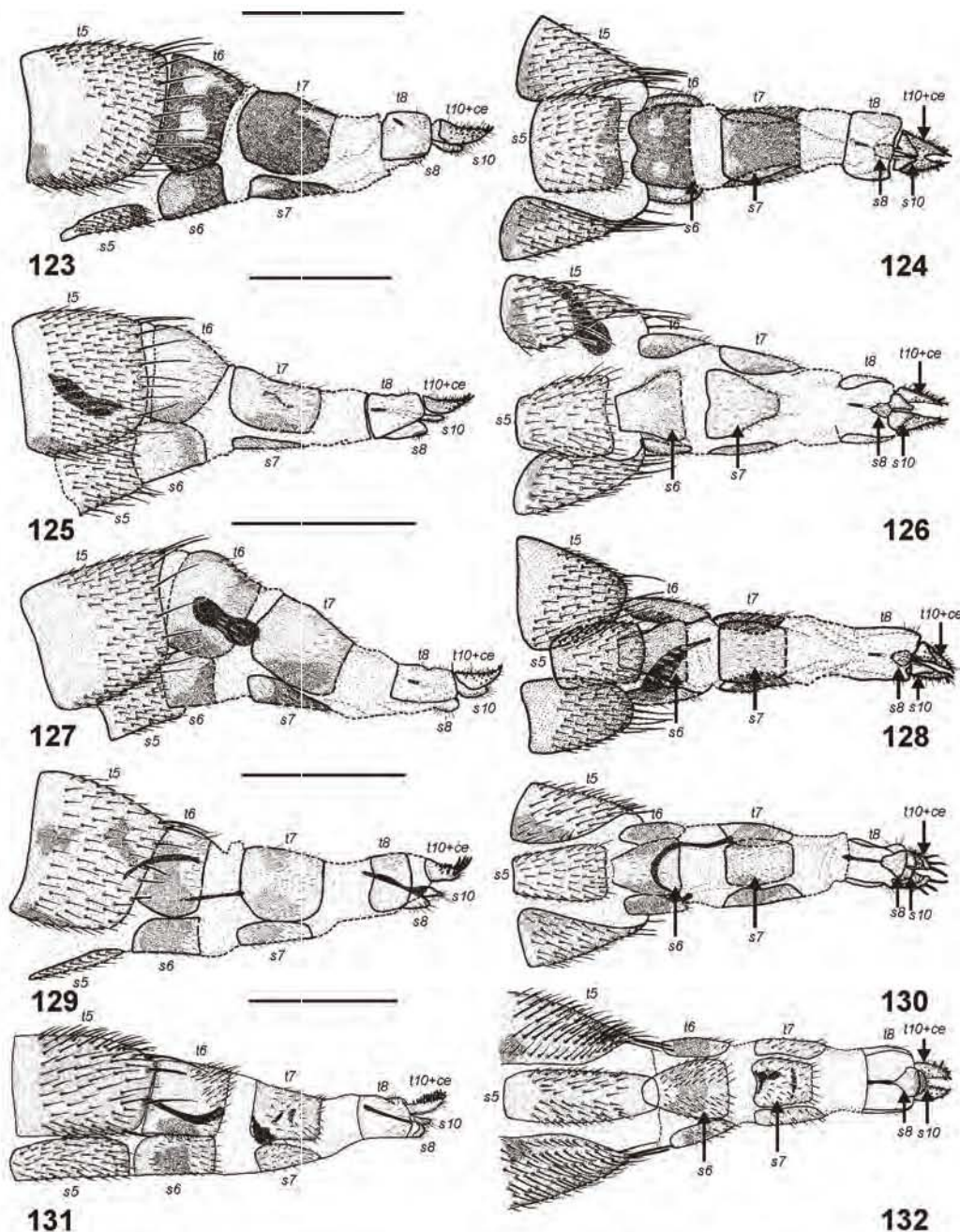
Figs 3.4: 86–97. Male terminalia of Afrotropical *Curtonotum* spp. **86–88:** Sternite 6 (ventral view): **86**, *C. herrero* (N-T, Namibia, Amkarab 269, NMNW); **87**, *C. maculiventris* (N-T, Nigeria, River Bagel, NMWC); **88**, *C. striatifrons* (PT, Nigeria, Gadau, BMNH). **89–91:** Hypandrium and epandrium (lateral view): **89**, *C. herrero* (same); **90**, *C. maculiventris* (same); **91**, *C. striatifrons* (same). **92–94:** Phallus (right lateral view): **92**, *C. herrero* (same) [ejaculatory apodeme removed and illustrated dorsally]; **93**, *C. maculiventris* (same); **94**, *C. striatifrons* (same). **95–97:** Detail of distiphallus (ventral view): **95**, *C. herrero* (same); **96**, *C. maculiventris* (same); **97**, *C. striatifrons* (same). Scale bars = 0.5 mm.



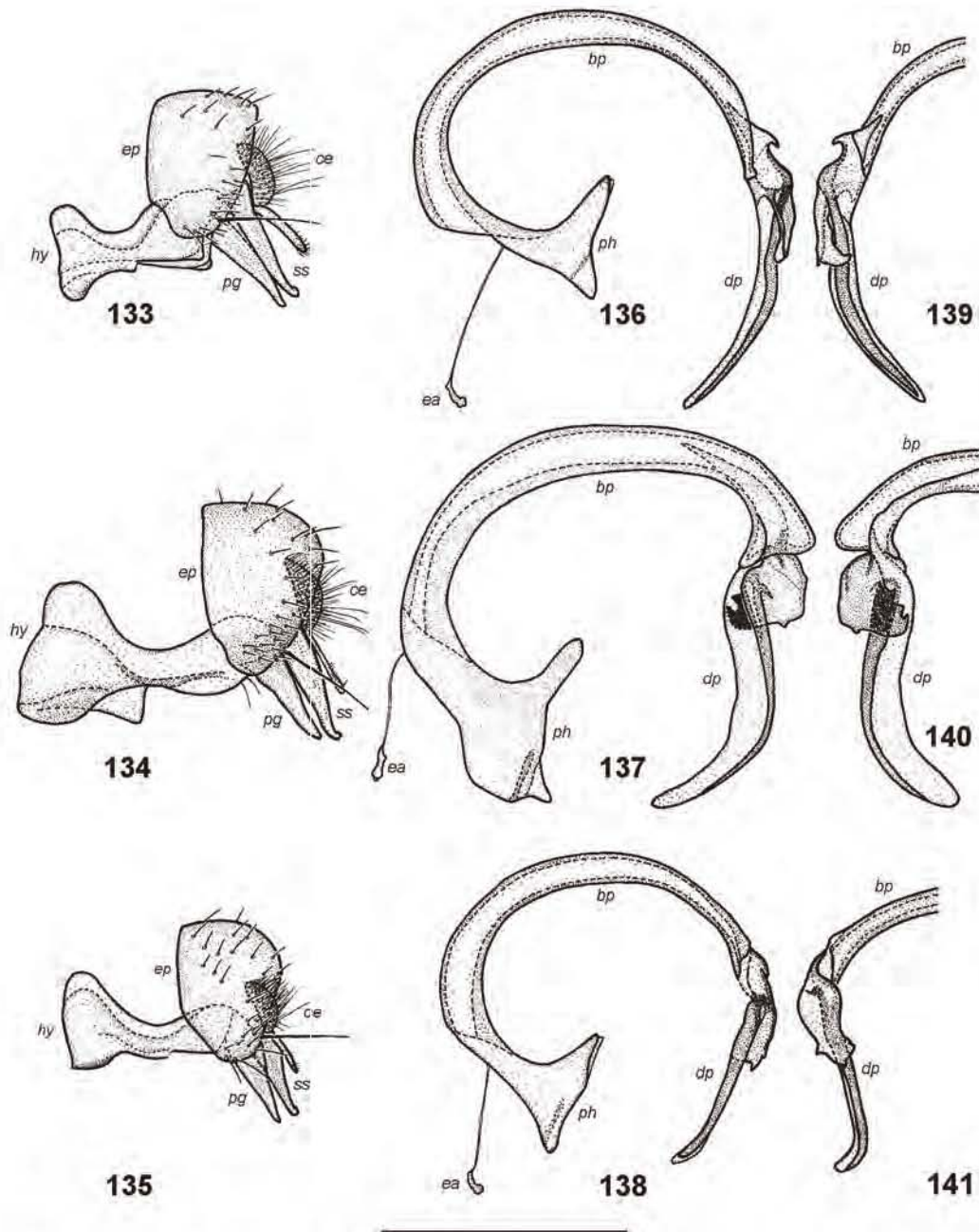
Figs 3.4: 98–107. Females of Afrotropical *Curtonotum* spp. **98–101:** Postabdomen: **98**, *C. maculiventris* (lateral) (N-T, Nigeria, River Bagel, NMWC) [not fully distended]; **99**, Same (ventral); **100**, *C. striatifrons* (lateral) (N-T, Sudan, Roseires, MNHN) [*t7* distorted]; **101**, Same (ventral). **102–104:** Auxiliary sclerites in region of sternite 7: **102**, *C. herrero*; **103**, *C. maculiventris*; **104**, *C. striatifrons*. **105–107:** Spermathecae: **105**, *C. herrero*; **106**, *C. maculiventris*; **107**, *C. striatifrons* (Figs 3.4: 102–107 from Tsacas (1977); fig. 6 and 9, as *C. tigrinum*). **108–112:** Spermathecae of *Curtonotum* spp. **108**, *C. marriotti* sp. n. (PT, Cameroon, Kribi (beach), TAU); **109**, *C. moffatt* sp. n. (PT, Uganda, Katona, HNHN); **110**, *C. platyphallum* (N-T, Liberia, 8 mi. N.W. Zorzor, CAS); **111**, *C. helvum* (N-T, [Canada], Sandbanks P.P., Picton, DEBU); **112**, *C. anus* (lateral) (Israel, Park HaYarden, TAU). Scale bars: 98–101 = 1 mm; 102–107 = 0.2 mm; 108–112 = 50 μ m.



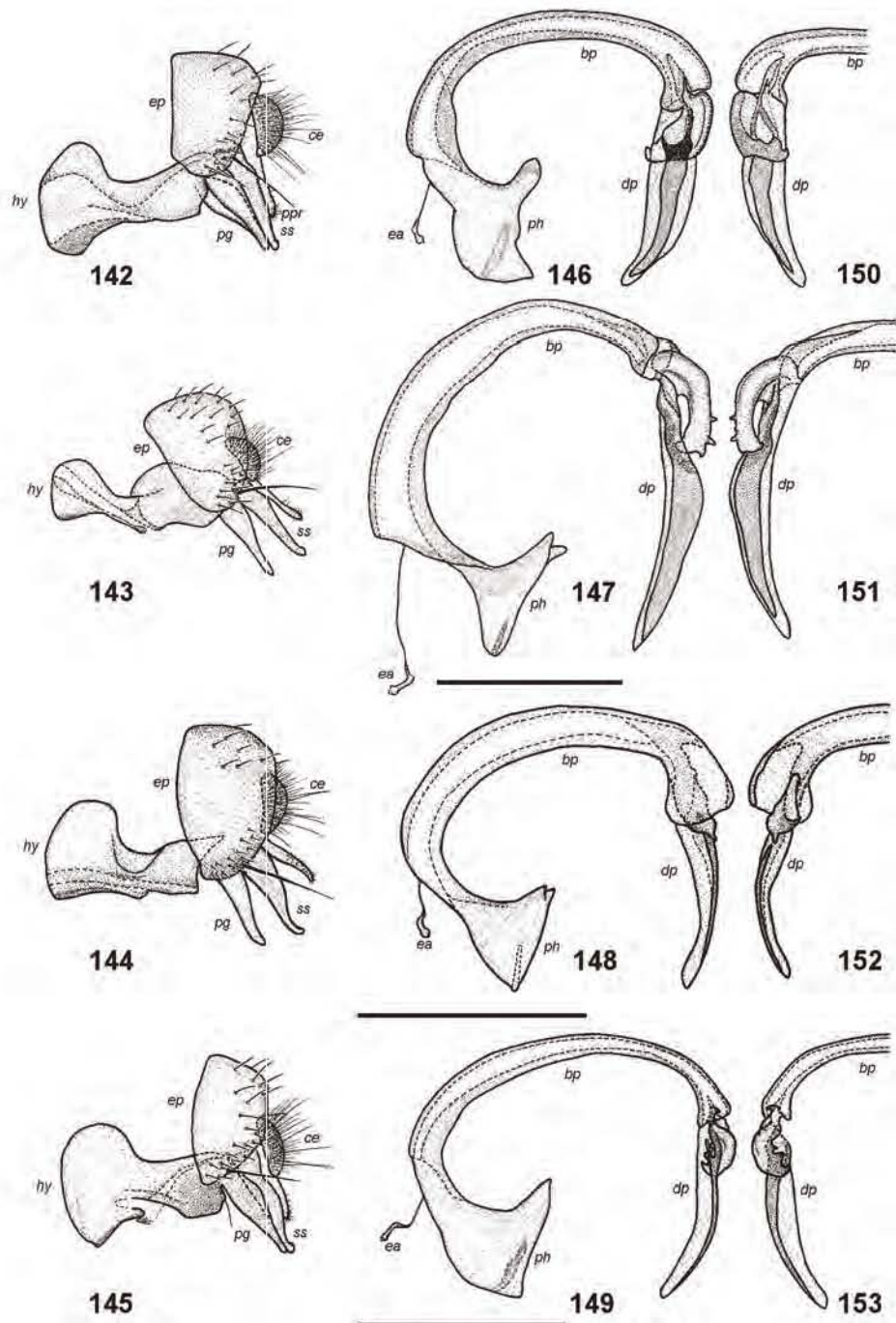
Figs 3.4: 113–122. Male terminalia of Afrotropical *Curtonotum* spp. **113–115:** Sternite 6 (ventral view): **113**, *C. marriott* sp. n. (PT, Cameroon, Kriba beach, TAU); **114**, *C. moffatt* sp. n. (PT, Uganda, Katona, HNHM); **115**, *C. platyphallum* (HT, Liberia, Robertsport, AMNH). **116–118:** Hypandrium and epandrium (lateral view): **116**, *C. marriott* (same); **117**, *C. moffatt* (same); **118**, *C. platyphallum* (same). **119–122:** Phallus (right lateral view): **119**, *C. marriott* (same) [ejaculatory apodeme missing]; **120**, *C. moffatt* (same); **121**, Same, detail of serrated edge; **122**, *C. platyphallum* (same). Scale bars = 0.5 mm.



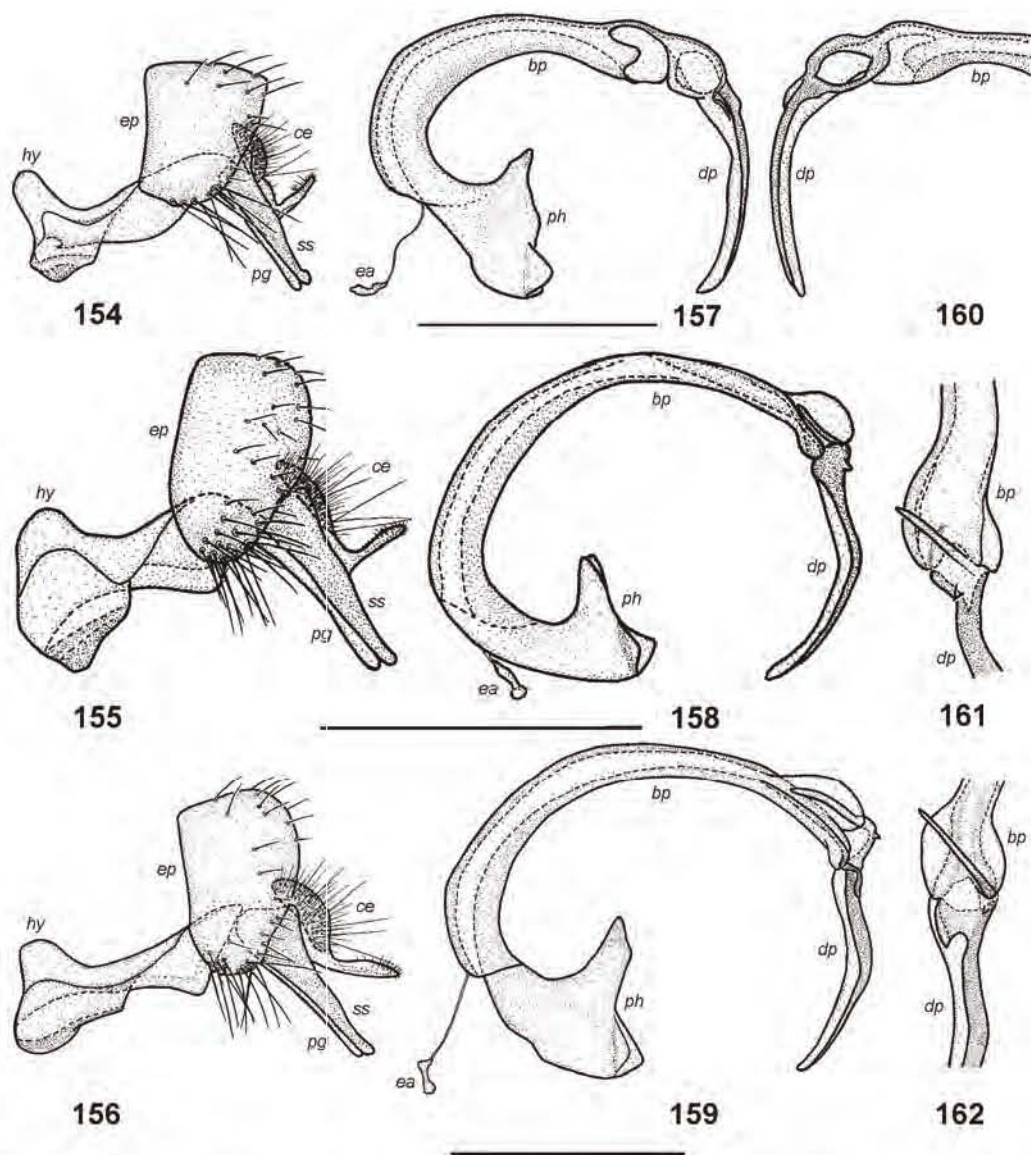
Figs 3.4: 123–128. Female postabdomen of Afrotropical *Curtonotum* spp. **123**, *C. marriotti* sp. n. (lateral) (PT, Cameroon, Kriba beach, TAU); **124**, Same (ventral); **125**, *C. moffatti* sp. n. (lateral) (PT, Uganda, Katona, HNHM); **126**, Same (ventral); **127**, *C. platyphallum* (lateral) (N-T, Liberia, 8 mi. NW Zorzor, CAS); **128**, Same (ventral). **129–132**: Comparative material of non-Afrotropical *Curtonotum* spp.: **129**, *C. helvum* (lateral) (N-T, [Canada], Sandbanks P.P., Picton, DEBU); **130**, Same (ventral); **131**, *C. anus* (lateral) (Israel, Park HaYarden, TAU); **132**, Same (ventral) (Figs 3.4: 131, 132 after Kirk-Spriggs and Freidberg 2007, figs 17, 18). Scale bars = 1 mm.



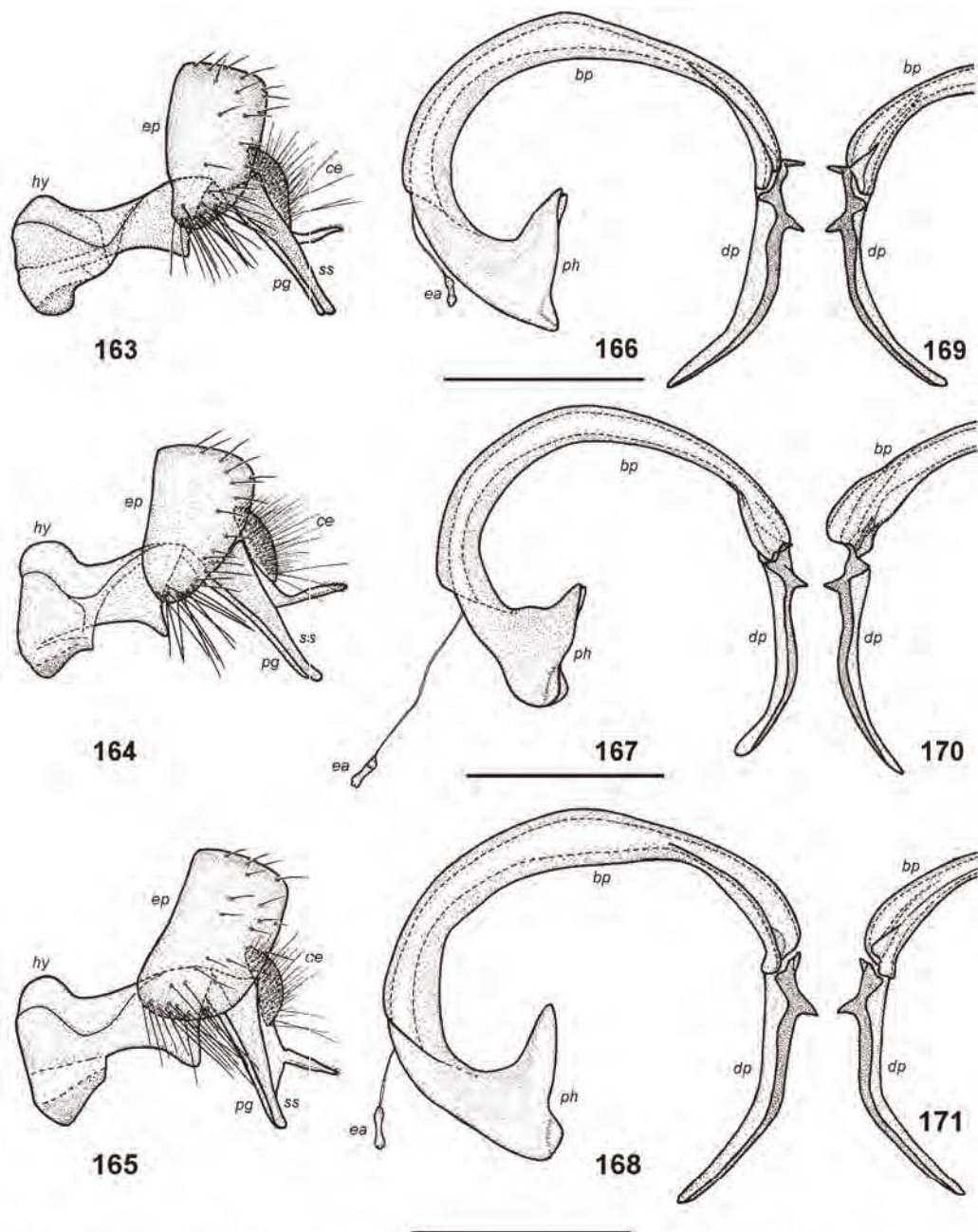
Figs 3.4: 133–141. Male terminalia of Afrotropical *Curtonotum* spp. **133–135:** Hypandrium and epandrium (lateral view): **133**, *C. angolense* (N-T, Angola, 10 mi. NE of Sá da Bandeira, CAS); **134**, *C. campsiphallum* (N-T, Cameroon, Limbe (shore), TAU); **135**, *C. freidberg* sp. n. (HT, Malawi, Viphya Mts., TAU). **136–138:** Phallus (right lateral view): **136**, *C. angolense* (same); **137**, *C. campsiphallum* (same); **138**, *C. freidberg* (same). **139–141:** Apical section of phallus (left lateral view): **139**, *C. angolense* (same); **140**, *C. campsiphallum* (same); **141**, *C. freidberg* (same). Scale bar = 0.5 mm.



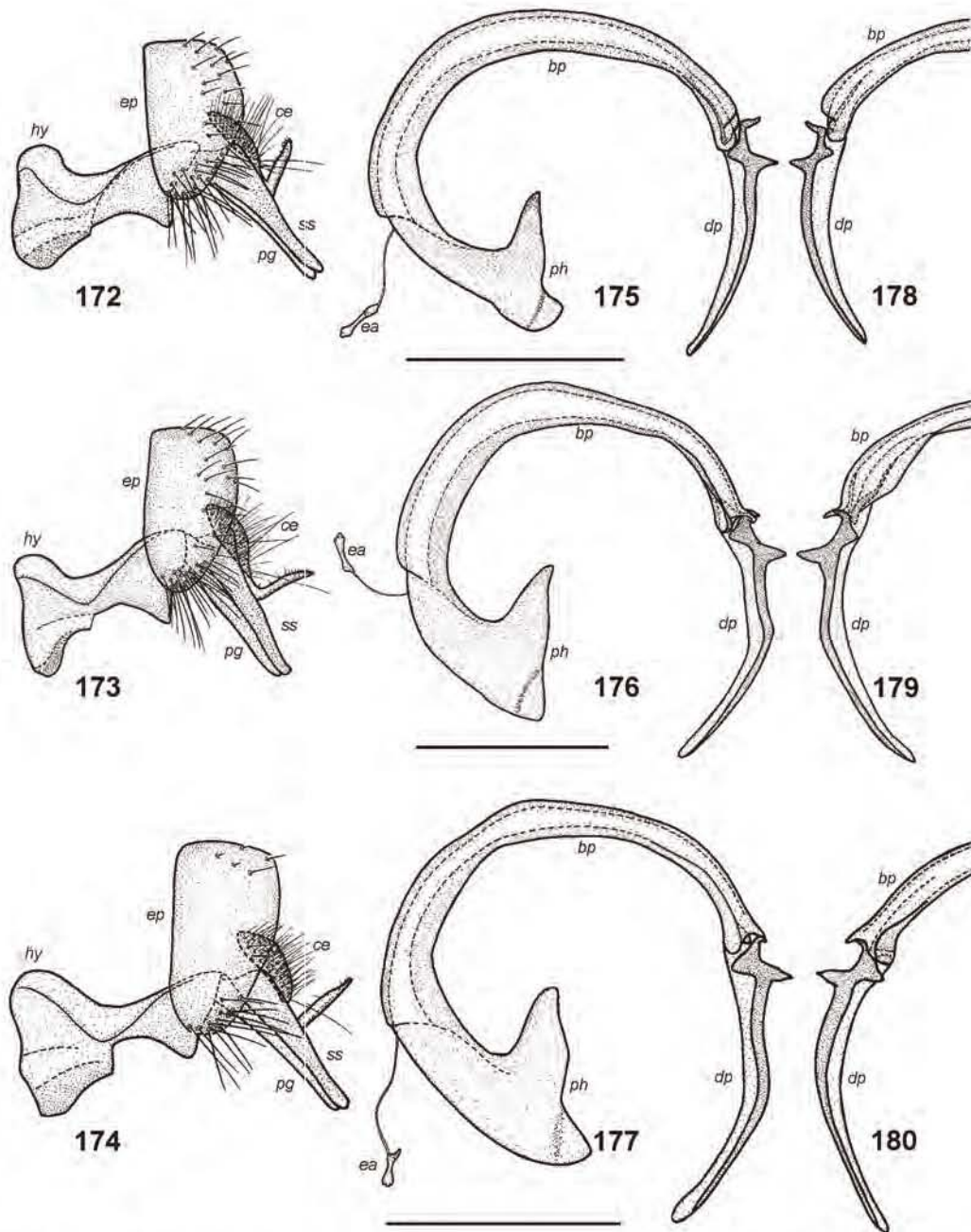
Figs 3.4: 142–153. Male terminalia of Afrotropical *Curtonotum* spp. **142–145:** Hypandrium and epandrium (lateral view): **142**, *C. hay* sp. n. (HT, Uganda, Mujenge, HNHM); **143**, *C. quinquevittatum* (N-T, Malawi, Viphya Mts., TAU); **144**, *C. sao* (N-T, Nigeria, Gadau, BMNH); **145**, *C. tsacas* sp. n. (PT, South Africa, Kosi Bay Nature Reserve, BMSA). **146–149:** Phallus (right lateral view): **146**, *C. hay* (same); **147**, *C. quinquevittatum* (same); **148**, *C. sao* (same); **149**, *C. tsacas* (same). **150–153:** Apical section of phallus (left lateral view): **150**, *C. hay* (same); **151**, *C. quinquevittatum* (same); **152**, *C. sao* (same); **153**, *C. tsacas* (same). Scale bars = 0.5 mm.



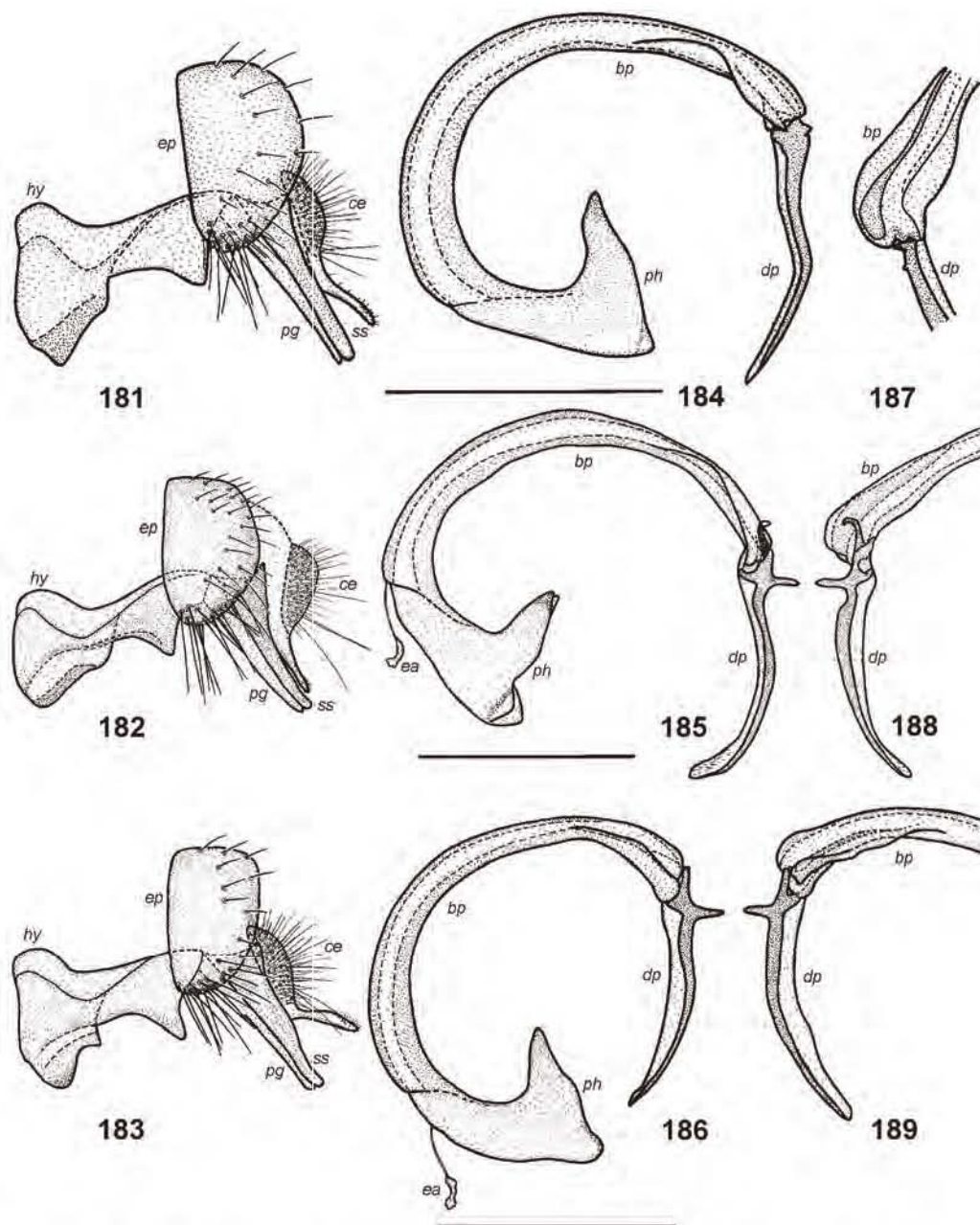
Figs 3.4: 154–162. Male terminalia of Afrotropical *Curtonotum* spp. **154–156:** Hypandrium and epandrium (lateral view): **154**, *C. gonzo* sp. n. (HT, [Ghana], Kwadaso, HNHM); **155**, *C. sahelense* (N-T, Nigeria, Zaria, NMWC); **156**, *C. simile* (N-T, UAE, Wadi Maidag, NMWC). **157–159:** Phallus (right lateral view): **157**, *C. gonzo* (same); **158**, *C. sahelense* (same); **159**, *C. simile* (same); **160**, Apical section of phallus (left lateral view), *C. gonzo* (same); **161–162:** Junction basiphallus and distiphallus (dorsal view): **161**, *C. sahelense* (same); **162**, *C. simile* (same). Scale bars = 0.5 mm.



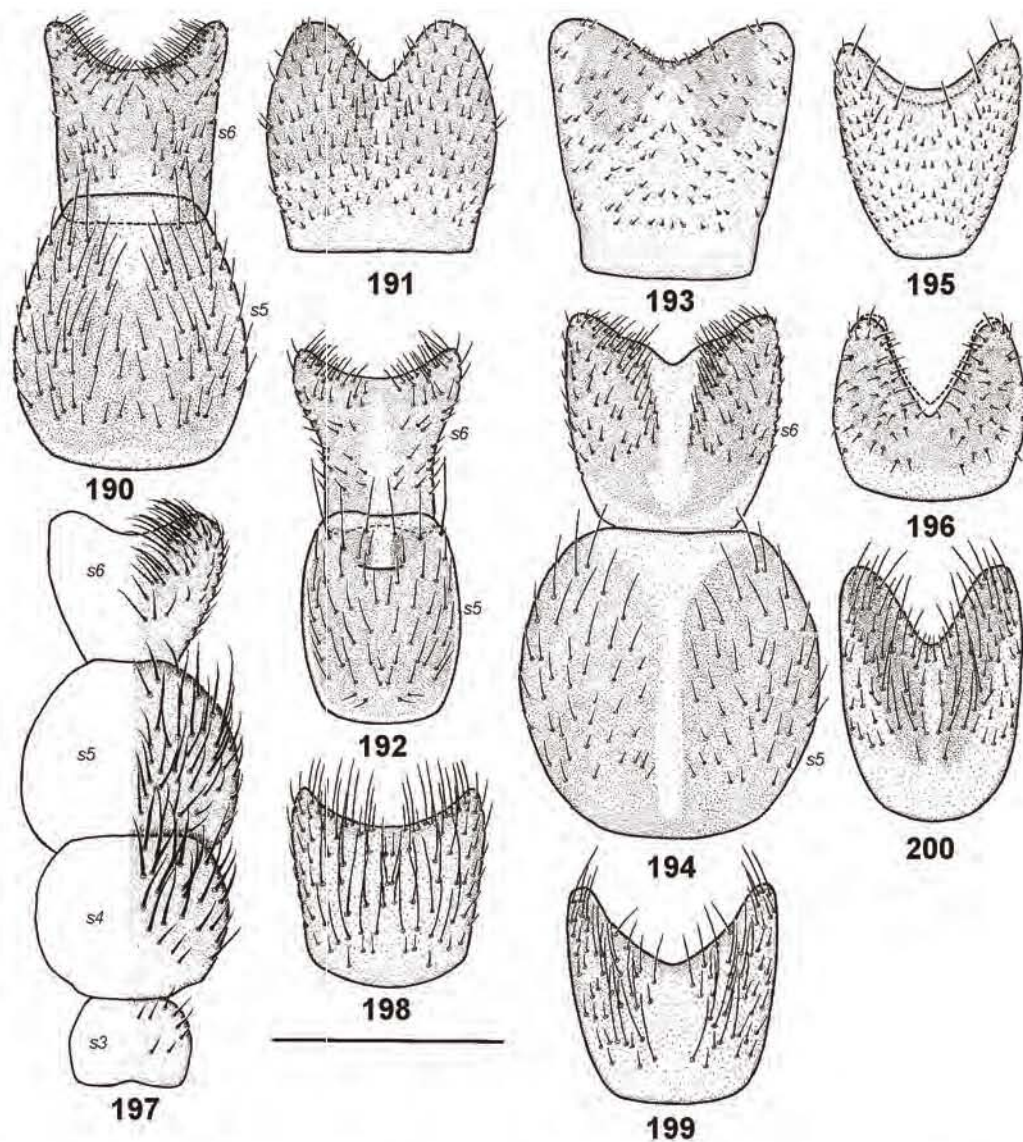
Figs 3.4: 163–171. Male terminalia of Afrotropical *Curtonotum* spp. **163–165:** Hypandrium and epandrium (lateral view): **163**, *C. bicuspis* sp. n. (PT, Namibia, Susuwe, NMNW); **164**, *C. cimbebas* sp. n. (HT, Namibia, Tsaobismund 85, NMNW); **165**, *C. constance* sp. n. (HT, Angola, 7 mi. N Vila Perreira d'Eça, MNHN). **166–168:** Phallus (right lateral view): **166**, *C. bicuspis* (same); **167**, *C. cimbebas* (same); **168**, *C. constance* (same). **169–171:** Apical section of phallus (left lateral view): **169**, *C. bicuspis* (same); **170**, *C. cimbebas* (same); **171**, *C. constance* (same). Scale bars = 0.5 mm.



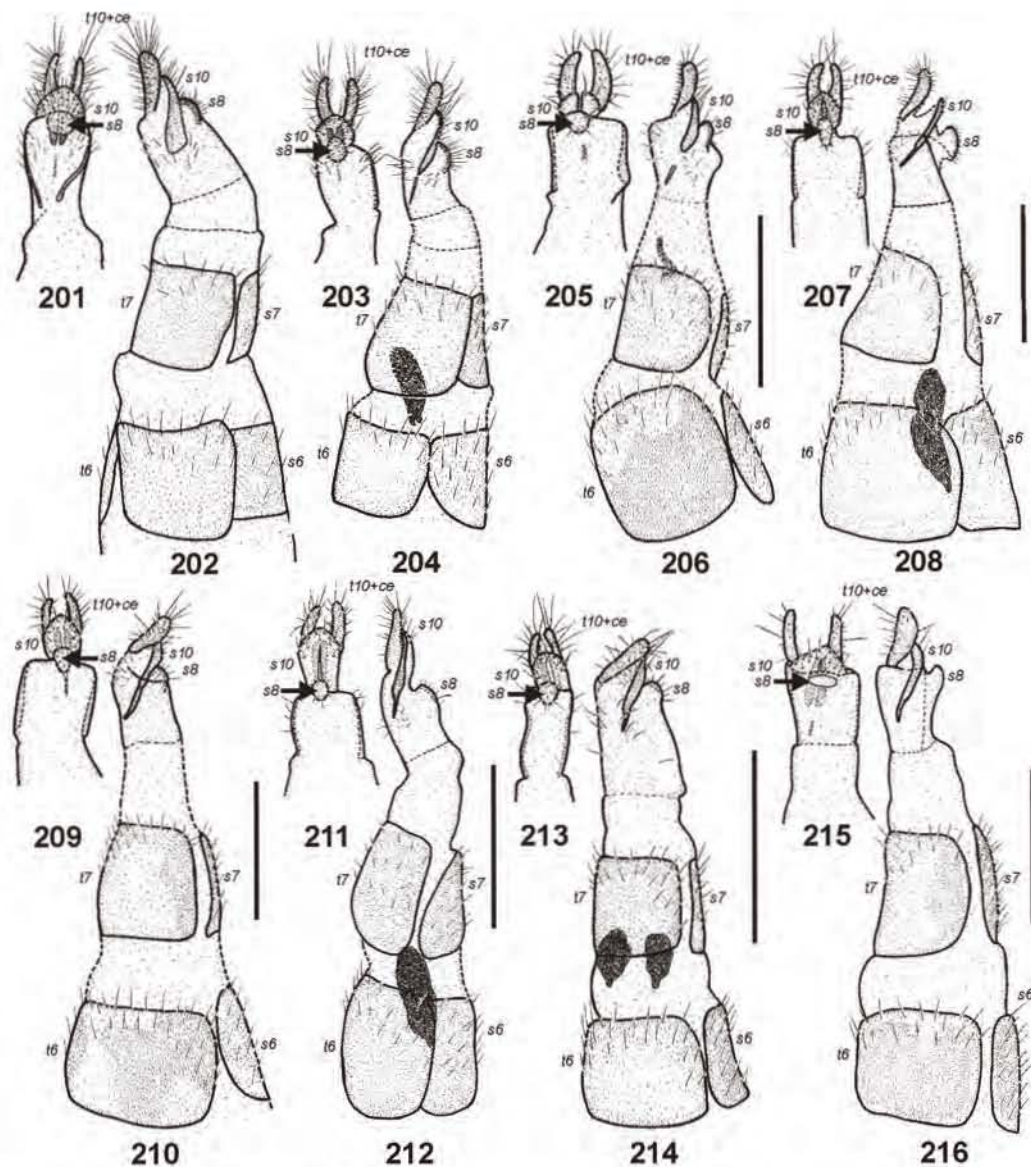
Figs 3.4: 172–180. Male terminalia of Afrotropical *Curtonotum* spp. **172–174:** Hypandrium and epandrium (lateral view): **172**, *C. cuthbertsoni* (N-T, South Africa, D'Nyala Nature Reserve, PPRI); **173**, *C. litoralis* sp. n. (HT, Kenya, Muhaka Field Station, NMNW); **174**, *C. mcgregor* sp. n. (PT, Portuguese East Africa [= Mozambique], Marromeu, NMSA). **175–177:** Phallus (right lateral view): **175**, *C. cuthbertsoni* (same); **176**, *C. litoralis* (same); **177**, *C. mcgregor* (same). **178–180:** Apical section of phallus (left lateral view): **178**, *C. cuthbertsoni* (same); **179**, *C. litoralis* (same); **180**, *C. mcgregor* (same). Scale bars = 0.5 mm.



Figs 3.4: 181–189. Male terminalia of Afrotropical *Curtonotum* spp. **181–183:** Hypandrium and epandrium (lateral view): **181**, *C. pauliani* (N-T, Namibia, Ekuju village, NMNW); **182**, *C. uncinatum* sp. n. (PT, Namibia, Kubunyana, NMNW); **183**, *C. unicuspis* sp. n. (PT, Namibia, Salambala, NMNW). **184–186:** Phallus (right lateral view): **184**, *C. pauliani* (same) [ejaculatory apodeme missing]; **185**, *C. uncinatum* (same); **186**, *C. unicuspis* (same). **187**, Junction basiphallus and distiphallus (dorsal view), *C. pauliani* (same); **188–189:** Apical section of phallus (left lateral view): **188**, *C. uncinatum* (same); **189**, *C. unicuspis* (same). Scale bars = 0.5 mm.



Figs 3.4: 190–200. Male sternites of Afrotropical *Curtonotum* spp. **190**, *C. angolense* (N-T, Angola, 10 mi. NE of Sá da Bandeira, CAS); **191**, *C. campsiphallum* (N-T, Cameroon, Limbe (shore), TAU); **192**, *C. freidberg* sp. n. (PT, Malawi, Viphyia Mts., TAU); **193**, *C. hay* sp. n. (HT, Uganda, Mujenge, HNHM); **194**, *C. quinquevittatum* (N-T, Malawi, Viphyia Mts., TAU); **195**, *C. sao* (N-T, Nigeria, Gadau, BMNH); **196**, *C. tsacas* sp. n. (PT, Kenya, Kaimuk, TAU); **197**, *C. gonzo* sp. n. (PT, [Ghana], Kwadaso, HNHM); **198**, *C. sahelense* (N-T, Nigeria, Yankari Game Reserve, NMWC); **199**, *C. simile* (N-T, UAE, Wadi Maidan, NMWC); **200**, *C. uncinatum* sp. n. (PT, Namibia, Kubunyana, NMNW). Scale bars: 190–196, 198–200 = 0.5 mm; 197 = 0.6 mm.



Figs 3.4: 201–216. Examples of female postabdomen of Afrotropical *Curtonotum* spp. **201**, *C. campsiphallum* (N-T, Cameroon, Limbe (shore), TAU), ventral; **202**, Same, lateral; **203**, *C. tsacas* sp. n. (PT, South Africa, Kosi Bay Nature Reserve, BMSA), ventral; **204**, Same, lateral; **205**, *C. gonzo* sp. n. (PT, [Ghana], Kwadaso, HNHM), ventral; **206**, Same, lateral; **207**, *C. simile* (N-T, UAE, Wadi Maidag, NMWC), ventral; **208**, Same, lateral; **209**, *C. litoralis* sp. n. (PT, [Tanzania], Zanzibar, BMNH), ventral; **210**, Same, lateral; **211**, *C. uncinatum* sp. n. (N-T, Namibia, Regenstein 32, NMNW), ventral; **212**, Same, lateral; **213**, *C. sakalava* (N-T, Madagascar, Berenty Special Reserve, CAS), ventral; **214**, Same, lateral; **215**, *C. balachowskyi* (N-T, Madagascar, Ambovamy Belambo, TAU), ventral; **216**, Same, lateral. Scale bars=0.5 mm.

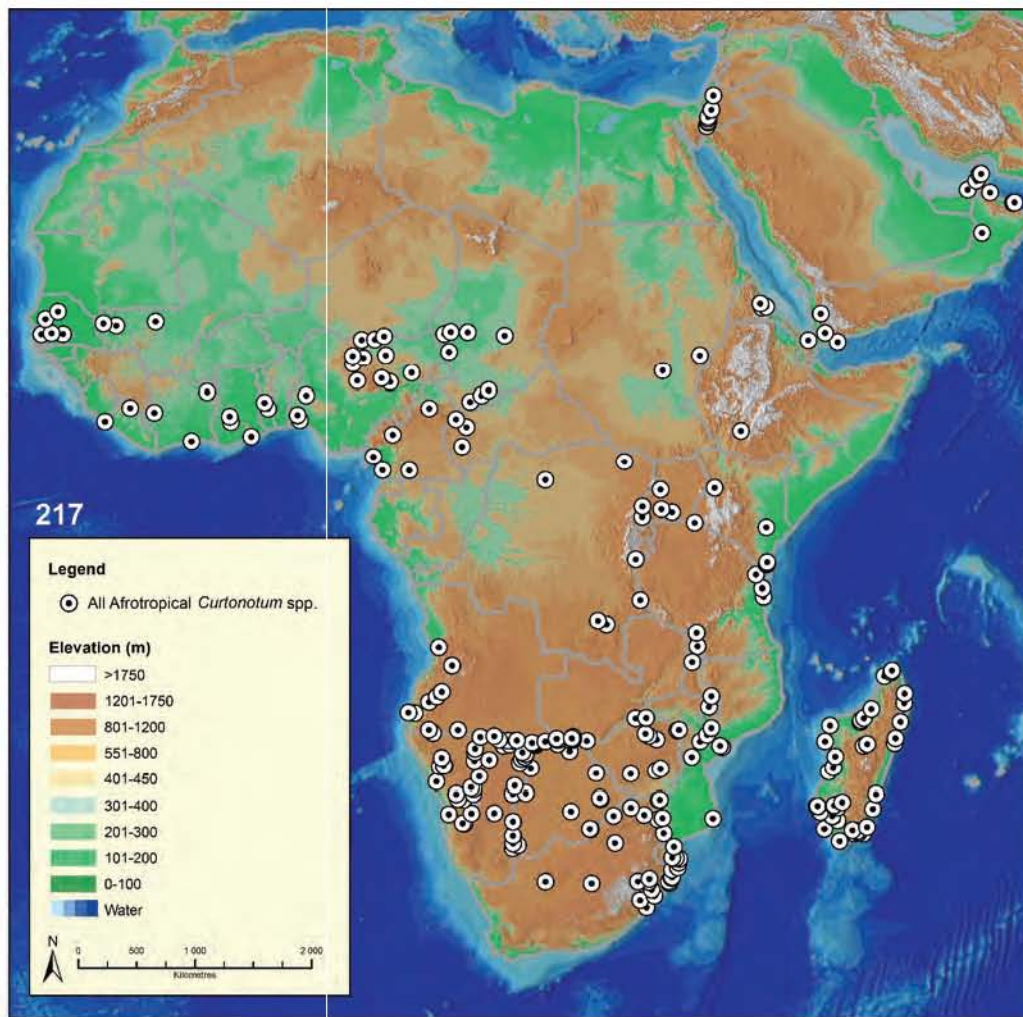


Fig. 3.4: 217. Overall coverage of records for the genus *Curtonotum* in the Afrotropical Region (including species recorded from Madagascar by Kirk-Spriggs (2011), Chapter 3.3).

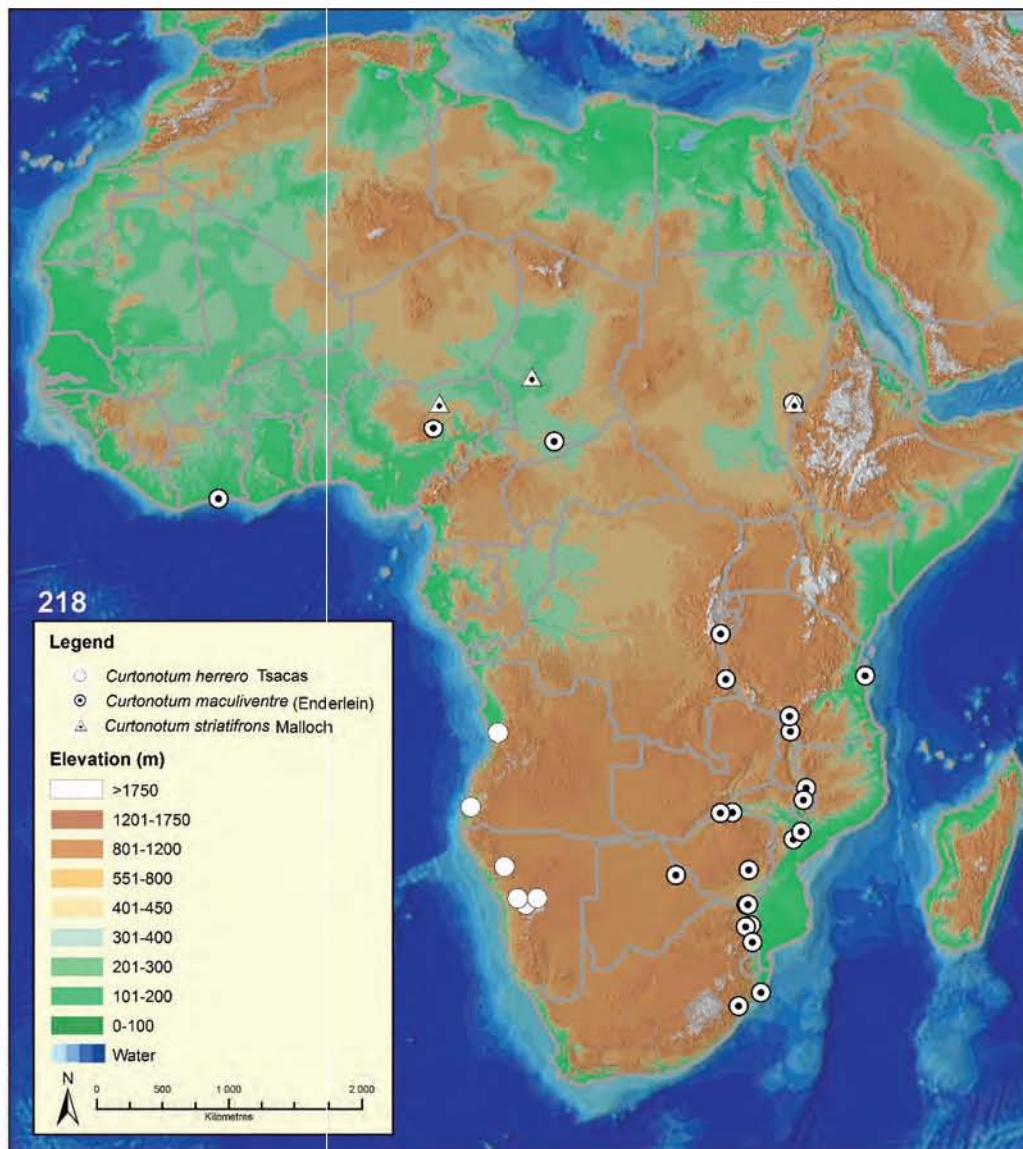


Fig. 3.4: 218. Distribution of continental Afrotropical species of *Curtonotum*. Topographical, *C. herrero*, *C. maculiventre*, *C. striatifrons*.

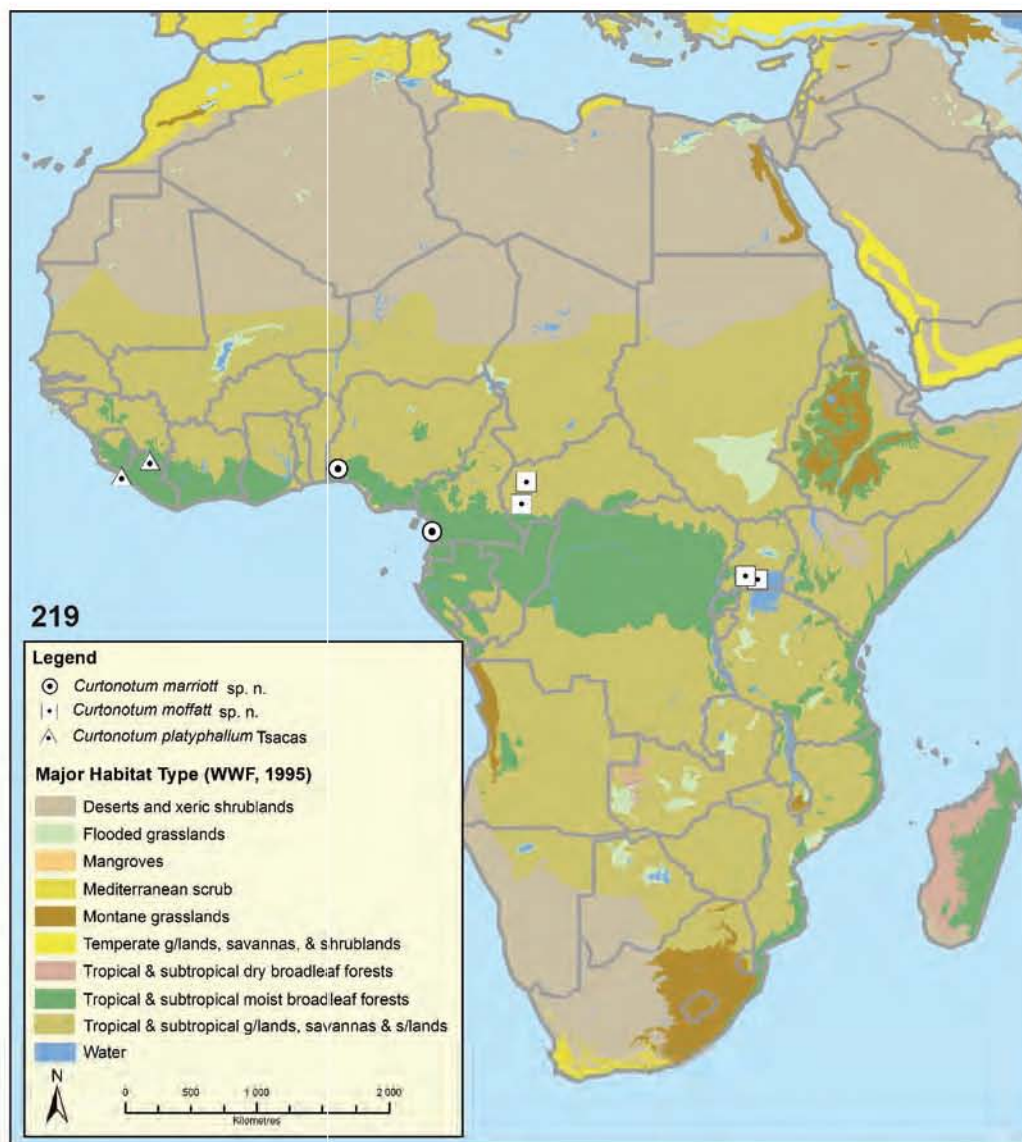


Fig. 3.4: 219. Distribution of continental Afrotropical species of *Curtonotum*. Major Habitat Types, *C. marriott* sp. n., *C. moffatt* sp. n., *C. platyphallum*.

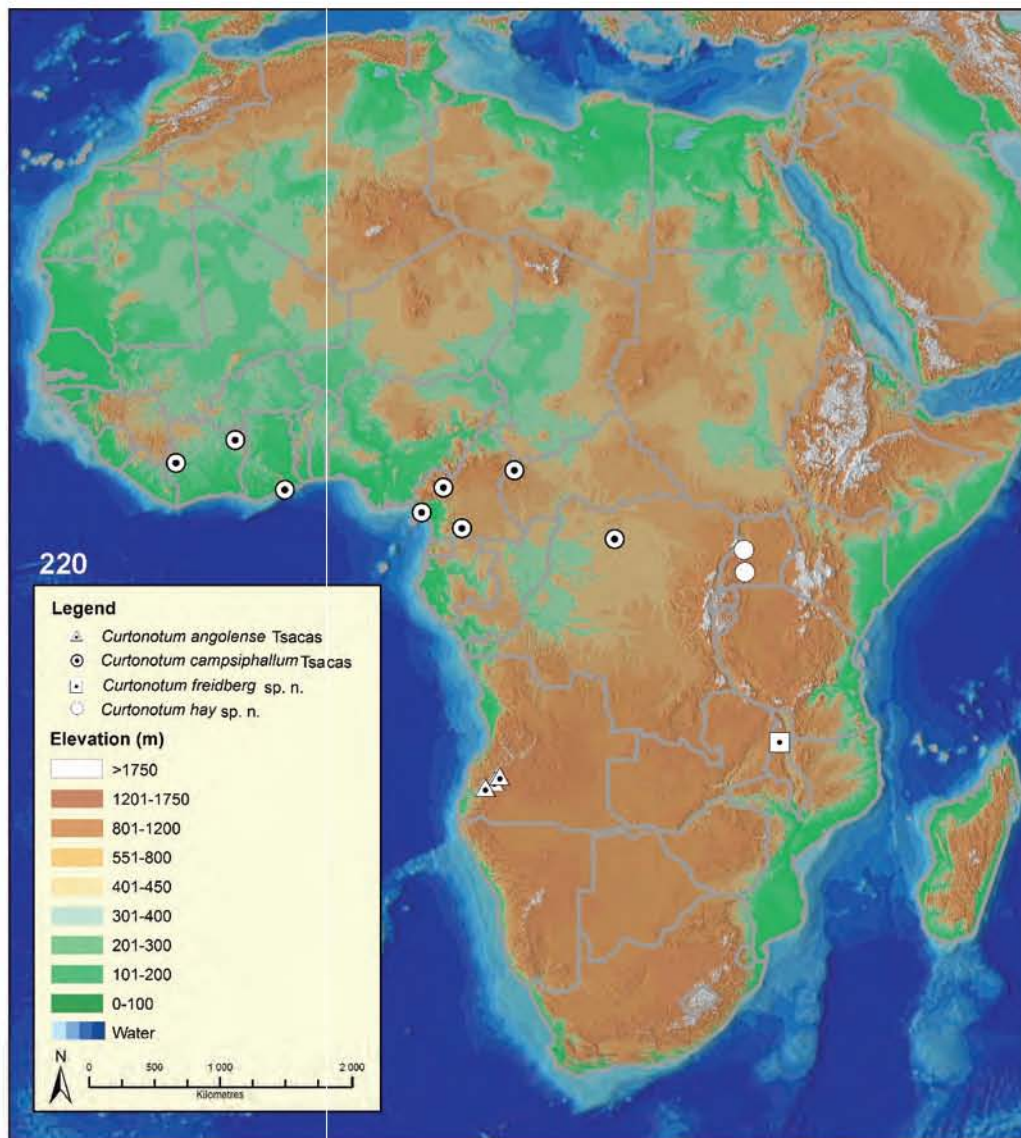


Fig. 3.4: 220. Distribution of continental Afrotropical species of *Curtonotum*. Topographical, *C. angolense*, *C. campsiphallum*, *C. freidberg* sp. n., *C. hay* sp. n.

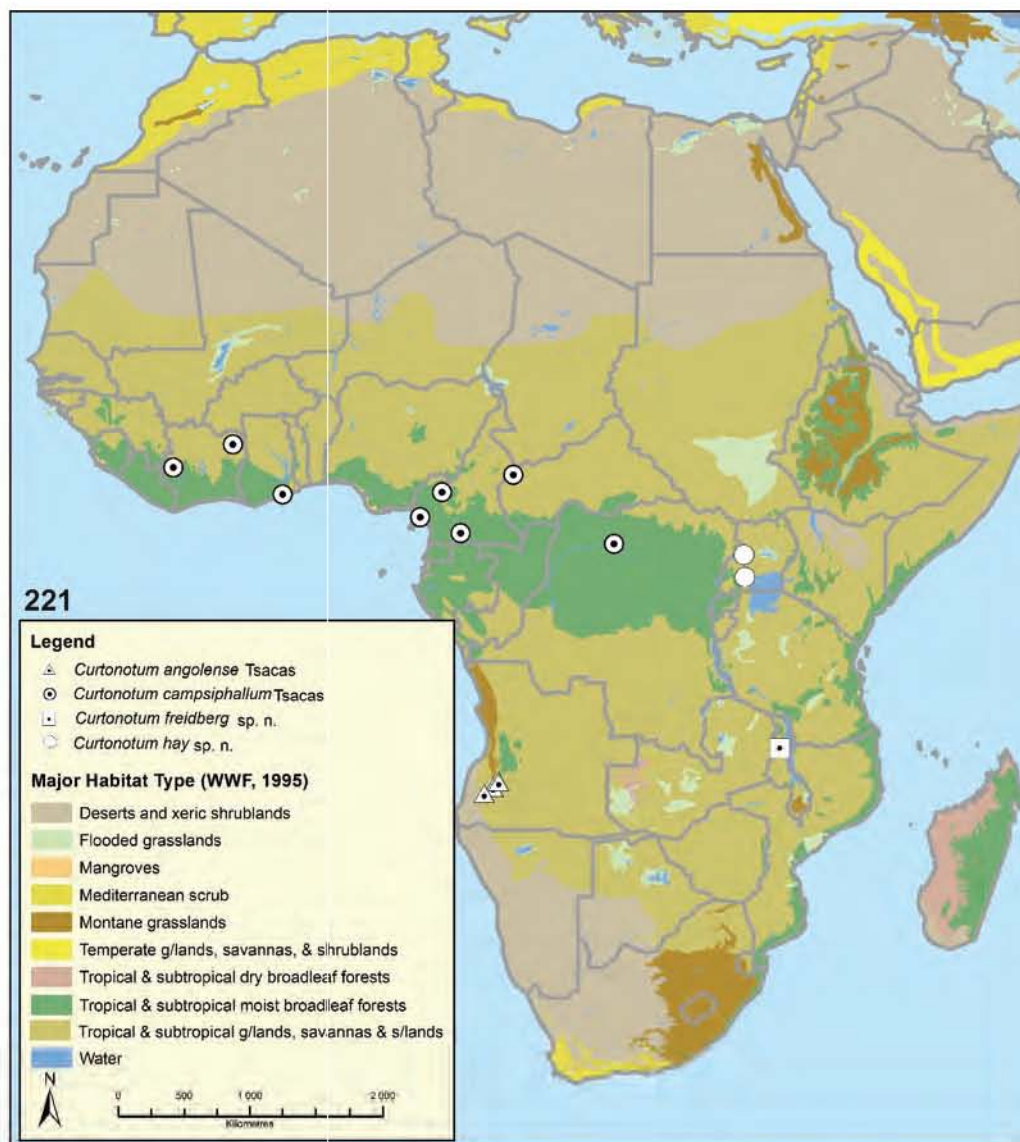


Fig. 3.4: 221. Distribution of continental Afrotropical species of *Curtonotum*. Major Habitat Types, *C. angolense*, *C. campsiphallum*, *C. freidberg* sp. n., *C. hay* sp. n.

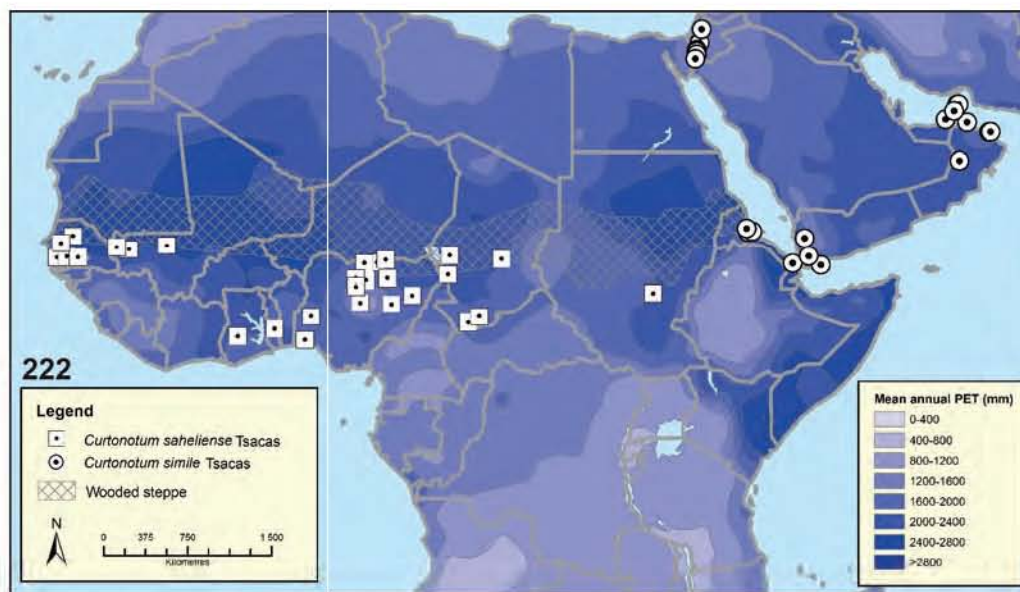


Fig. 3.4: 222. Distribution of continental Afrotropical species of *Curtonotum*. Major humidity zones of Africa, *C. saheliense*, *C. simile*.

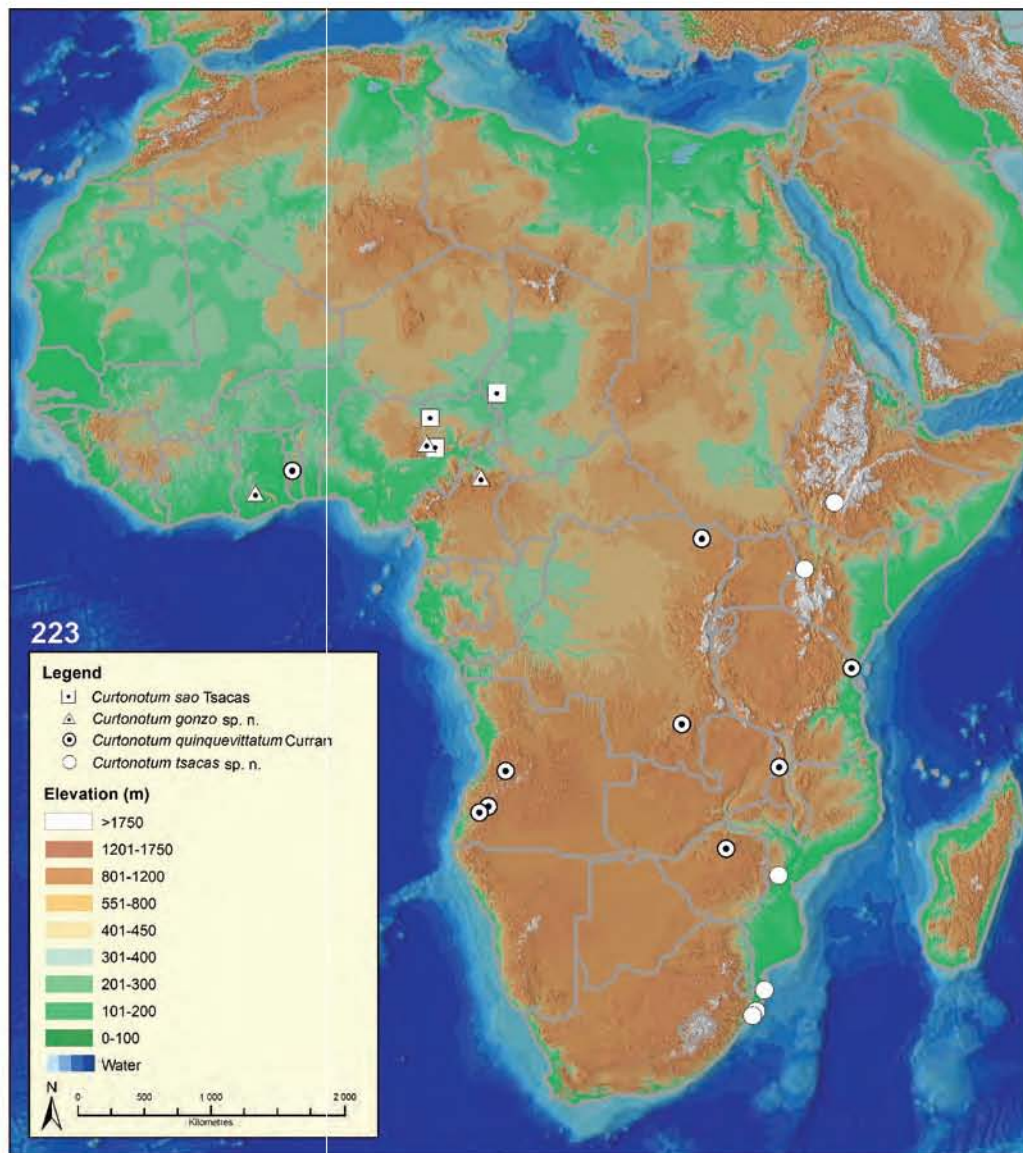


Fig. 3.4: 223. Distribution of continental Afrotropical species of *Curtonotum*. Topographical, *C. sao*, *C. gonzo* sp. n., *C. quinquevittatum*, *C. tsacas* sp. n.

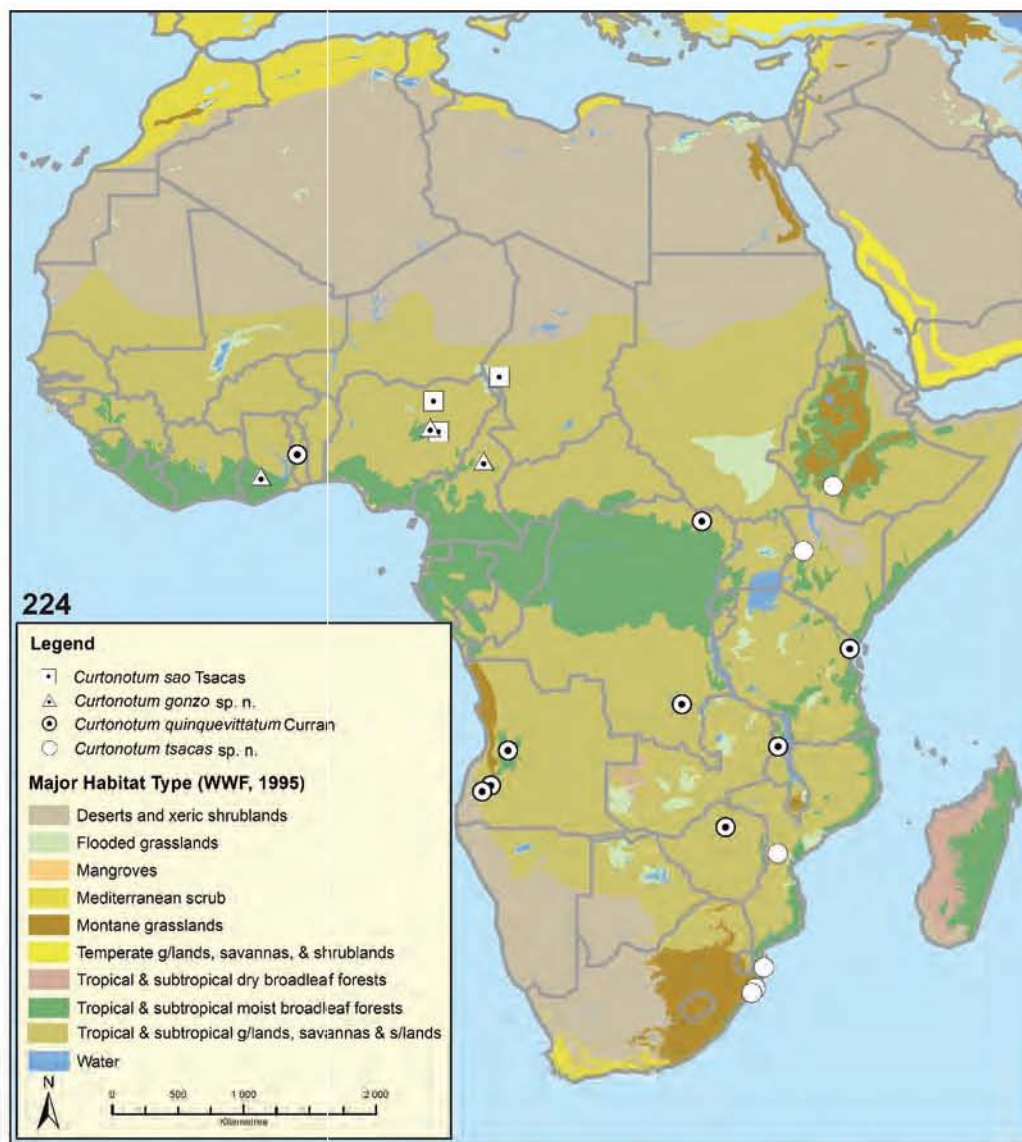


Fig. 3.4: 224. Distribution of continental Afrotropical species of *Curtonotum*. Major Habitat Types, *C. sao*, *C. gonzo* sp. n., *C. quinquevittatum*, *C. tsacas* sp. n.

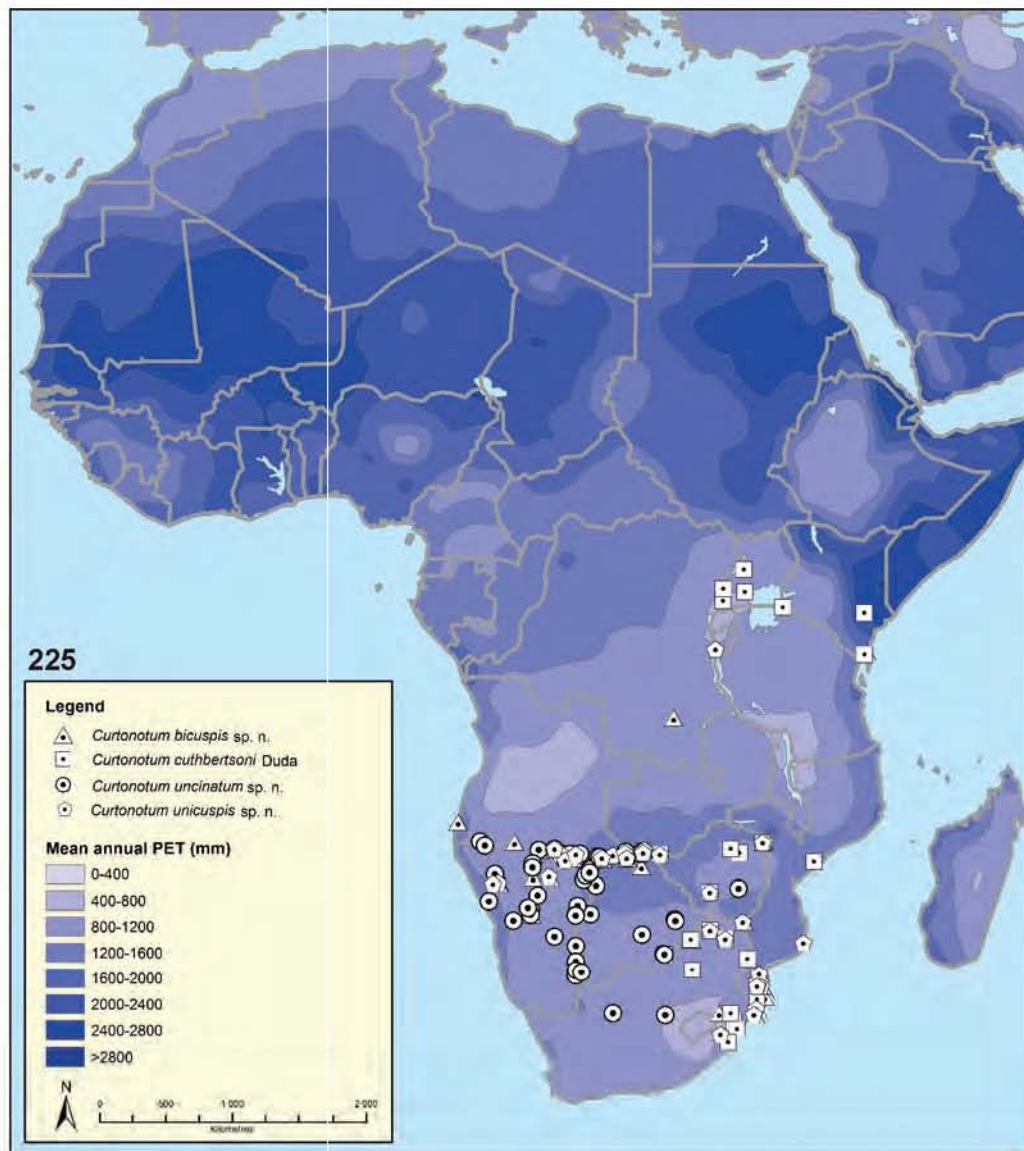


Fig. 3,4: 225. Distribution of continental Afrotropical species of *Curtonotum*. Major humidity zones of Africa, *C. bicuspis* sp. n., *C. cuthbertsoni*, *C. uncinatum* sp. n., *C. unicuspis* sp. n.

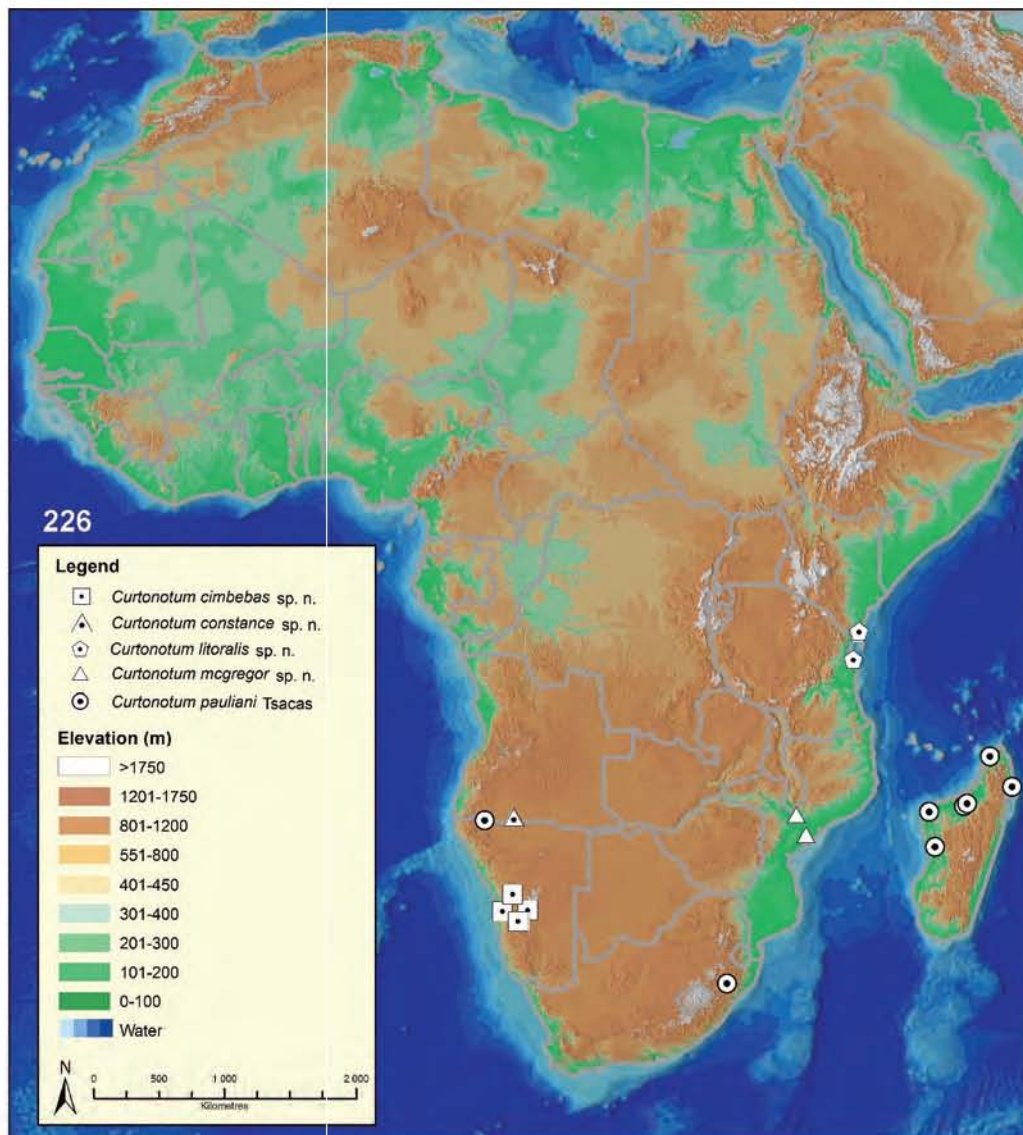
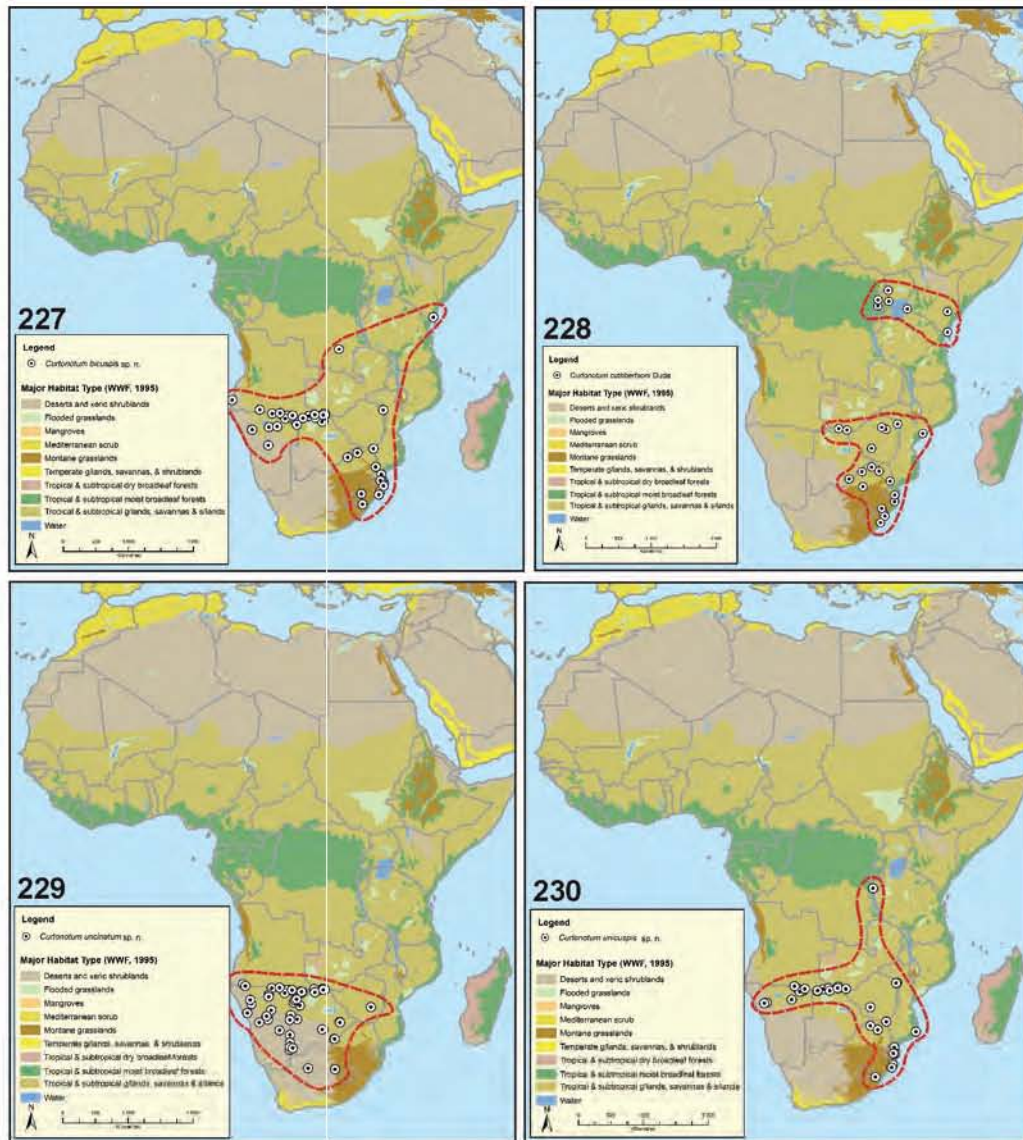


Fig. 3.4: 226. Distribution of continental Afrotropical species of *Curtonotum*. Topographical, *C. cimbebas* sp. n., *C. constance* sp. n., *C. litoralis* sp. n., *C. mcgregor* sp. n., *C. pauliani*.



Figs 3.4: 227–230. Distribution of continental Afrotropical species of *Curtonotum*. 227, Major Habitat Types: *C. bicuspis* sp. n.; 228, Same, *C. cuthbertsoni*; 229, Same, *C. uncinatum* sp. n.; 230, Same, *C. unicuspis* sp. n. The implied range of each species indicated with dashed line.

3.4: Appendix. Geographical co-ordinates for continental Afrotropical *Curtonotum* spp. used to map distributions plotted on Figs 217–230, based on material examined in this study and listed in the material examined sections (refer to Fig. 217 for coverage of records). Major Habitat Types and Vegetation Types listed below are based on points plotted on figures and follow WWF (1995), cited in Hearn *et al.* (2000). Abbreviations: CAR = Central African Republic; DRC = Democratic Republic of Congo; UAE = United Arab Emirates.

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. angolense</i>	Angola	Cacula	-14.5	14.12	Angolan Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. angolense</i>	Angola	Negola	-14.13	14.5	Angolan Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. angolense</i>	Angola	Sá da Bandeira	-14.92	13.5	Angolan Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspidis</i> sp. n.	Angola	Curoca	-15.72	11.92	Kaokoveld Desert	Deserts & Xeric Shrublands
<i>C. bicuspidis</i> sp. n.	Angola	Vila Pereira d'Eça	-17.07	15.73	Angolan Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspidis</i> sp. n.	Botswana	Tsotsoroga Pan	-18.72	24.35	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspidis</i> sp. n.	DRC	Mabwe	-8.65	26.52	Central Zambezian Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspidis</i> sp. n.	Kenya	Mombasa, Waa	-4.17	39.58	East African Mangroves	Mangroves
<i>C. bicuspidis</i> sp. n.	Mozambique	Nyaka	-30.15	29.77	Drakensburg Afriomontane Grassland & Woodland	Montane Grasslands
<i>C. bicuspidis</i> sp. n.	Mozambique	Umbeluzi	-26.03	32.39	Maputaland Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. bicuspidis</i> sp. n.	Namibia	Amkarub 269	-19.82	14.65	Nama Karoo	Deserts & Xeric Shrublands
<i>C. bicuspidis</i> sp. n.	Namibia	Amkarub 269	-19.83	14.7	Nama Karoo	Deserts & Xeric Shrublands
<i>C. bicuspidis</i> sp. n.	Namibia	Bukalo, Ndopu Village	-17.72	24.52	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspidis</i> sp. n.	Namibia	Bum Hill campsite	-17.77	23.33	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspidis</i> sp. n.	Namibia	Chwaha River, 3 km NE	-17.97	22.47	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspidis</i> sp. n.	Namibia	Dussi, 10 Km W	-18.8	20.72	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspidis</i> sp. n.	Namibia	Ghaub 47	-19.47	17	Angolan Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspidis</i> sp. n.	Namibia	Gobiswater	-19.38	18.15	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. bicuspis</i> sp. n.	Namibia	Hamoye Nat. Forest	-18.2	19.72	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Katara, 1 km S.	-17.83	18.9	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Mahango Game Res.	-18.23	21.72	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Matende River	-17.9	19.58	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Menziasubila Mulapo	-17.85	23.45	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Mile 46	-18.3	19.25	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Nakatwa	-18.18	23.42	Zambezian Flooded Grassland	Flooded Grasslands
<i>C. bicuspis</i> sp. n.	Namibia	Okahandja	-21.98	16.92	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Okongo, 29 km E	-17.62	17.47	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Salambala forest	-17.83	24.6	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Salambala pan	-17.83	24.58	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Salambala, 4 km NE	-17.6	24.6	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Simanya	-17.55	18.53	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Simataa, Salambala B6	-17.8	24.53	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Susuwe	-17.75	23.33	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Takwasa	-17.88	20.27	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	Namibia	Xawasha pan, 2 km W	-19.15	20.87	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	South Africa	Blouberg Nature Reserve	-23.03	29.07	Southern Rift Montane Forest	Montane Grasslands
<i>C. bicuspis</i> sp. n.	South Africa	Ellisras	-23.67	27.73	Southern Africa Bushveld	Tropical & Subtropical Grasslands, Savannas & Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. bicuspis</i> sp. n.	South Africa	Mambasa Hutted Camp	-28.7	29.6	Drakensburg Afriomontane Grassland & Woodland	Montane Grasslands
<i>C. bicuspis</i> sp. n.	South Africa	Manzengwenya	-27.25	32.73	Maputaland Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. bicuspis</i> sp. n.	South Africa	Mtubatuba	-28.42	32.18	Eastern Cape Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. bicuspis</i> sp. n.	South Africa	Ndumo Game Reserve, main camp area at:	-26.9	32.52	Maputaland Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. bicuspis</i> sp. n.	South Africa	Ndumo Game Reserve	-26.87	32.25	Maputaland Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. bicuspis</i> sp. n.	South Africa	Pafuri	-22.45	31.28	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	South Africa	Richards Bay	-28.82	32.03	Eastern Cape Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. bicuspis</i> sp. n.	South Africa	Skukuza	-24.98	31.6	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. bicuspis</i> sp. n.	South Africa	Sodwana Bay National Park	-27.62	32.68	Maputaland Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. bicuspis</i> sp. n.	Zimbabwe	Chimana Causway	-17.1	32.63	Southern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. campsiphallum</i>	Côte d'Ivoire	Komoe National Park	9	-3.5	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. campsiphallum</i>	Côte d'Ivoire	Zogoualé, Cascades Mont la Dent	7.42	-7.57	Western Guinean Lowland Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. campsiphallum</i>	Cameroon	Limbe	4.01	9.22	Cross-Sanaga-Bioko Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. campsiphallum</i>	Cameroon	Massif du Nkogam	5.73	10.7	Cameroonian Highlands Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. campsiphallum</i>	Cameroon	Sangmelima	2.93	11.98	Northwestern Congolian Lowland Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. campsiphallum</i>	CAR	Bozoum	6.92	15.58	Northern Congolian Forest-Savanna Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. campsiphallum</i>	DRC	Bumba	2.18	22.47	Western Congolian Swamp Forest	Tropical & Subtropical Moist Broadleaf Forests

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. campsiphallum</i>	Ghana	Teshi	5.58	-0.1	Guinean Forest-Savanna Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cimbebas</i> sp. n.	Namibia	Gobabeb	-23.55	15.03	Namib Desert	Deserts & Xeric Shrublands
<i>C. cimbebas</i> sp. n.	Namibia	Greylingshof 107	-23.48	16.77	Nama Karoo	Deserts & Xeric Shrublands
<i>C. cimbebas</i> sp. n.	Namibia	Naukluft spring	-24.25	16.23	Nama Karoo	Deserts & Xeric Shrublands
<i>C. cimbebas</i> sp. n.	Namibia	Tsams Ost spring	-24.23	16.1	Nama Karoo	Deserts & Xeric Shrublands
<i>C. cimbebas</i> sp. n.	Namibia	Tsobismund 85	-22.37	15.73	Nama Karoo	Deserts & Xeric Shrublands
<i>C. constance</i> sp. n.	Angola	Vila Pereira d'Eça, 7 miles N	-17.07	15.73	Angolan Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	Botswana	Tlokweng	-24.67	25.97	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	Kenya	Muhaka Field Station	-4.33	39.52	Northern Zanzibar-Inhambane Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. cuthbertsoni</i>	Kenya	River Tana	-1.5	39.5	Northern <i>Acacia-Commiphora</i> Bushland & Thicket	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	Mozambique	Luabo	-18.39	36.11	East African Mangroves	Mangroves
<i>C. cuthbertsoni</i>	Namibia	Bukalo, Ndopu Village	-17.72	24.52	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	South Africa	Blouberg Nature Reserve	-23.03	29.07	Southern Rift Montane Forest	Montane Grasslands
<i>C. cuthbertsoni</i>	South Africa	Ellisras	-23.67	27.73	Southern Africa Bushveld	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	South Africa	Hartbeespoort	-25.73	27.85	Southern African Bushveld	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	South Africa	Kruger National Park	-24.98	31.6	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	South Africa	Kube Yini Game Reserve	-27.8	32.23	Drakensburg Afromontane Grassland & Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	South Africa	M'fongosi	-29.33	30.67	Maputoland-Pondoland Bushland Thicket	Montane Grasslands
<i>C. cuthbertsoni</i>	South Africa	Mooketsi	-23.6	30.1	Southern Africa Bushveld	Montane Grasslands
<i>C. cuthbertsoni</i>	South Africa	Ndumo Game Reserve	-26.87	32.25	Maputaland Coastal Forest	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	South Africa	New Germany	-29.8	30.88	Eastern Cape Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. cuthbertsoni</i>	South Africa	Oribi Gorge Reserve	-30.7	30.28	Eastern Cape Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. cuthbertsoni</i>	South Africa	Tugela Ferry	-28.73	30.45	Drakensburg Afriomontane Grassland & Woodland	Montane Grasslands
<i>C. cuthbertsoni</i>	Tanzania	Shirati	-1.13	33.98	Southern <i>Acacia-Commiphora</i> Bushland & thicket	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	Uganda	Hoima	1.44	31.34	Victoria Basin Forest-Savanna Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	Uganda	Kichwamba	-0.68	29.93	Victoria Basin Forest-Savanna Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	Uganda	Kyarumba	0.13	29.95	Albertine Rift Montane Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. cuthbertsoni</i>	Uganda	Muyenje	-0.08	31.42	Albertine Rift Montane Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. cuthbertsoni</i>	Zimbabwe	Balla Balla	-20.45	29.05	Southern Africa Bushveld	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	Zimbabwe	Chimana Causway	-17.1	32.63	Southern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	Zimbabwe	Harare	-17.82	31.04	Southern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	Zimbabwe	Trelawney	-17.53	30.45	Southern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. cuthbertsoni</i>	Zimbabwe	Victoria Falls National Park	-17.92	25.67	Zambezi & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. freidberg</i> sp. n.	Malawi	North Viphya Mountains	-11.83	33.8	Southern Rift Montane Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. gonzo</i> sp. n.	Cameroon	village Ndom-Beoué	7.76	13.53	Northern Congolian Forest-Savanna Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. gonzo</i> sp. n.	Ghana	Kwadaso	6.7	-1.65	Eastern Guinean Lowland Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. gonzo</i> sp. n.	Nigeria	Bauchi-Dass road	10.05	9.85	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. hay</i> sp. n.	Uganda	Hoima	1.44	31.34	Victoria Basin Forest-Savanna Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. hay</i> sp. n.	Uganda	Muyenje	-0.08	31.42	Albertine Rift Montane Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. herrero</i>	Angola	Moçamedes [= Namibe]	-15.77	12.4	Kaokoveld Desert	Deserts & Xeric Shrublands
<i>C. herrero</i>	Angola	Quirimbo	-10.68	14.27	Angolan Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. herrero</i>	Namibia	Amkarab 269	-19.83	14.7	Nama Karoo	Deserts & Xeric Shrublands
<i>C. herrero</i>	Namibia	Davelsaub 29	-22.42	16.15	Nama Karoo	Deserts & Xeric Shrublands
<i>C. herrero</i>	Namibia	Okahandja	-21.98	16.92	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. herrero</i>	Namibia	Usakos	-22	15.6	Nama Karoo	Deserts & Xeric Shrublands
<i>C. litoralis</i> sp. n.	Kenya	Muhaka Field Station	-4.33	39.52	Northern Zanzibar-Inhambane Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. litoralis</i> sp. n.	Kenya	Tiwi Beaches	-4.23	39.6	East African Mangroves	Mangroves
<i>C. litoralis</i> sp. n.	Tanzania	Zanzibar	-6.17	39.18	Northern Zanzibar-Inhambane Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. maculiventris</i>	Botswana	Semowane	-20.42	26.38	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Burundi	Rumonge	-3.96	29.43	Central Zambezian Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Côte d'Ivoire	Legune Ebrie	5.22	-4.7	Eastern Guinean Lowland Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. maculiventris</i>	Chad	Kiemkaga	9.13	18.1	East Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	DRC	Moba	-7.05	29.78	Central Zambezian Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Malawi	Florence Bay	-10.6	34.2	Central Zambezian Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Malawi	Fort Johnston	-14.47	35.27	Eastern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Malawi	Upper Shire	-15.28	35.08	South Malawi Montane Forest Grassland Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Mozambique	Maringüe	-17.96	34.39	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Mozambique	Sangadze	-17.44	34.94	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. maculiventris</i>	Nigeria	Bauchi-Dass road	10.05	9.85	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	South Africa	Kruger National Park	-23.83	31.5	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	South Africa	M'fongosi	-29.33	30.67	Maputoland-Pondoland Bushland Thicket	Montane Grasslands
<i>C. maculiventris</i>	South Africa	Mtubatuba	-28.42	32.18	Eastern Cape Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. maculiventris</i>	South Africa	Pafuri	-22.42	31.3	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	South Africa	Pafuri	-22.43	31.2	Southern Rift Montane Forest	Montane Grasslands
<i>C. maculiventris</i>	South Africa	Phalaborwa	-23.93	31.15	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	South Africa	Skukuza	-24.98	31.6	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Sudan	Roseires	11.85	34.38	East Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Tanzania	Dar-es-Salaam	-6.8	39.28	Northern Zanzibar-Inhambane Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. maculiventris</i>	Tanzania	Lumbira	-9.57	34.13	Southern Rift Montane Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. maculiventris</i>	Zimbabwe	Angwa Bridge	-16.13	30.25	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Zimbabwe	Chipinga	-20.05	31.35	Southern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. maculiventris</i>	Zimbabwe	Rukometje Research Station	-16.17	29.42	Southern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. marriott</i> sp. n.	Cameroon	Kribi	2.95	9.92	Atlantic Equatorial Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. marriott</i> sp. n.	Nigeria	Ibadan	7.23	3.47	Nigerian Lowland Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. mcgregor</i> sp. n.	Malawi	Port Herald	-16.92	35.27	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. moffatt</i> sp. n.	CAR	Bosum	6.32	16.38	Northern Congolian Forest-Savanna Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. moffatt</i> sp. n.	CAR	Bosum	6.32	16.38	Northern Congolian Forest-Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. moffatt</i> sp. n.	CAR	Carnot	4.8	16.05	Northern Congolian Forest-Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. moffatt</i> sp. n.	Uganda	Bugala Island	-0.32	32.24	Victoria Basin Forest-Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. moffatt</i> sp. n.	Uganda	Muyenje	-0.08	31.42	Albertine Rift Montane Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. pauliani</i>	Madagascar	Ampijoroa National Park, 160 km N of Maewatanana	-16.32	46.81	Madagascar Dry Forest	Tropical & Subtropical Dry Broadleaf Forests
<i>C. pauliani</i>	Madagascar	Ankarafantsika	-16.15	47.03	Madagascar Dry Forest	Tropical & Subtropical Dry Broadleaf Forests
<i>C. pauliani</i>	Madagascar	Marofototra palm forest, 17 km W of Besalampy	-16.72	44.42	Madagascar Dry Forest	Tropical & Subtropical Dry Broadleaf Forests
<i>C. pauliani</i>	Madagascar	Maromandia	-15	50.13	Madagascar Lowland Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. pauliani</i>	Madagascar	Nosy Mitsio	-12.9	48.6	Madagascar Dry Forest	Tropical & Subtropical Dry Broadleaf Forests
<i>C. pauliani</i>	Madagascar	Parc National Tsingy de Memaraha	-19.13	44.82	Madagascar Dry Forest	Tropical & Subtropical Dry Broadleaf Forests
<i>C. pauliani</i>	Namibia	Ekuju village, Kunene R	-17.32	13.8	Nama Karoo	Broadleaf Forests
<i>C. pauliani</i>	South Africa	Rorke's Drift	-28.5	30.5	Drakensburg Afromontane Grassland & Woodland	Deserts & Xeric Shrublands
<i>C. platyphallum</i>	Liberia	Robertsport	6.75	-11.37	Guinean Mangroves	Montane Grasslands
<i>C. platyphallum</i>	Liberia	Zorzor, 8 miles NW	7.78	-9.43	Western Guinean Lowland Forest	Mangroves
<i>C. quinquevittatum</i>	Angola	Benguela	-12.1	15.28	Angolan Afromontane Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. quinquevittatum</i>	Angola	Cacula	-14.5	14.12	Angolan Miombo Woodland	Tropical & Subtropical Moist Broadleaf Forests
<i>C. quinquevittatum</i>	Angola	Sá da Bandeira	-14.92	13.5	Angolan Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. quinquevittatum</i>	DRC	Dungu	3.62	28.57	Northeastern Congolian Lowland Forest	Tropical & Subtropical Grasslands, Savannas & Shrublands
						Tropical & Subtropical Moist Broadleaf Forests

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. quinquevittatum</i>	DRC	Lusinga	-8.93	27.2	Central Zambesian Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. quinquevittatum</i>	Malawi	North Viphya Mountains	-11.83	33.8	Southern Rift Montane Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. quinquevittatum</i>	Tanzania	Matombo	-5.13	38.7	Northern Zanzibar-Inhambane Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. quinquevittatum</i>	Togo	Montagne Gabongala	8.2	0.92	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. quinquevittatum</i>	Zimbabwe	Lomagundi	-17.37	30.2	Southern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Chad	Ditila	13.67	15.18	Sahelian <i>Acacia</i> Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Chad	Mao	8.25	16.67	East Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Gambia	Kaba Kotor	13.48	-16.28	Guinean Forest-Savanna Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Gambia	Passy Mut	13.57	-15.5	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Gambia	Sukuta	13.5	-14.6	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Ghana	Abofour	7.13	-1.75	Eastern Guinean Lowland Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. sahelienne</i>	Mali	Gao	14.15	-10.5	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Mali	Macina	14.32	-11.5	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Mali	Mourdiah	14.47	-7.47	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Niger	Abgara	13.37	19.33	Sahelian <i>Acacia</i> Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Niger	Dungass	13.07	9.34	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Niger	Fort Lamy	12.11	15.05	Sahelian <i>Acacia</i> Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. sahelienne</i>	Niger	Guerimari	13.32	10.03	Sahelian <i>Acacia</i> Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Niger	Ouarrai	8.75	17.55	East Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Nigeria	Bauchi, Yankari Game Reserve	9.75	10.5	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Nigeria	Daura	13.04	8.32	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Nigeria	Gadau	11.83	10.17	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Nigeria	Gumel	9.85	7.98	Guinean Forest-Savanna Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Nigeria	Igbetti	8.75	4.13	Guinean Forest-Savanna Mosaic	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Nigeria	Kadawa	11.65	8.45	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Nigeria	Katsina	10.47	12.17	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Nigeria	Malumfashi	11.8	7.62	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Nigeria	Samaru	11.17	7.63	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Nigeria	Shagamu	6.85	3.65	Nigerian Lowland Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. sahelienne</i>	Senegal	Linguère	15.25	-15	Sahelian <i>Acacia</i> Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Senegal	Limdé	14.65	-15.97	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Sudan	Niaro	10.63	31.52	Sahelian <i>Acacia</i> Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sahelienne</i>	Togo	Anté, SE of	7.74	1.2	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sao</i>	Chad	Bol	13.5	14.68	Sahelian <i>Acacia</i> Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. sao</i>	Nigeria	Gadau	11.83	10.17	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. sao</i>	Nigeria	Yankari Game Reserve	9.75	10.5	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. simile</i>	Eritrea	Ailet	15.57	39.15	Ethiopian Xeric Grassland & Shrubland	Deserts & Xeric Shrublands
<i>C. simile</i>	Eritrea	Assab	13.01	42.74	Eritrean Coastal Desert	Deserts & Xeric Shrublands
<i>C. simile</i>	Eritrea	Massawa	15.62	39.48	Ethiopian Xeric Grassland & Shrubland	Deserts & Xeric Shrublands
<i>C. simile</i>	Eritrea	Sheb	15.87	39.03	Ethiopian Xeric Grassland & Shrubland	Deserts & Xeric Shrublands
<i>C. simile</i>	Israel	[Park] Timna'	29.78	35	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	Israel	Elifaz	29.78	35.02	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	Israel	Hazeva Field School	30.77	35.25	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	Israel	Moshav Hazeva	30.77	35.27	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	Israel	Nahal Hiyyon	30.2	35.02	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	Israel	Nahal Perat	31.85	35.42	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	Israel	Ne'ot Smadar	30.05	35.02	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	Israel	Samar	29.83	35.02	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	Israel	Taba	29.48	34.92	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	Oman	Al Khuwair	23.62	58.63	Persian Gulf Nubo-Sindian tropical desert & semi-desert	Deserts & Xeric Shrublands
<i>C. simile</i>	Oman	Qurm Hotel garden	23.6	58.52	Persian Gulf Nubo-Sindian tropical desert & semi-desert	Deserts & Xeric Shrublands
<i>C. simile</i>	Oman	Şohār	24.38	56.75	Persian Gulf Nubo-Sindian tropical desert & semi-desert	Deserts & Xeric Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. simile</i>	Oman	Wattayeh	23.62	58.63	Persian Gulf Nubo-Sindian tropical desert & semi-desert	Deserts & Xeric Shrublands
<i>C. simile</i>	UAE	Al-Ajban	24.6	55.02	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	UAE	Ra's al Khaymah	25.78	55.93	Persian Gulf Nubo-Sindian tropical desert & semi-desert	Deserts & Xeric Shrublands
<i>C. simile</i>	UAE	Ra's al Khaymah farm	25.81	56.07	Persian Gulf Nubo-Sindian tropical desert & semi-desert	Deserts & Xeric Shrublands
<i>C. simile</i>	UAE	Sharjah Desert Park	25.28	55.7	Persian Gulf Nubo-Sindian tropical desert & semi-desert	Deserts & Xeric Shrublands
<i>C. simile</i>	UAE	Wadi Madaq	21.32	56.13	Arabian desert & East Sahero-Arabian xeric shrublands	Deserts & Xeric Shrublands
<i>C. simile</i>	Yemen	Manakhah, 12 km NW	15.08	43.7	Southwestern Arabian foothills savanna	Temperate Grasslands, Savannas & Shrublands
<i>C. simile</i>	Yemen	Shaykh 'Uthmān	12.88	45	Arabian Peninsula coastal fog desert	Deserts & Xeric Shrublands
<i>C. simile</i>	Yemen	Ta'izz	13.58	44.03	Southwestern Arabian foothills savanna	Temperate Grasslands, Savannas & Shrublands
<i>C. striatifrons</i>	Chad	Bahr-el-Ghazal	13.64	16.49	Sahelian <i>Acacia</i> Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. striatifrons</i>	Nigeria	Gadau	11.83	10.17	West Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. striatifrons</i>	Sudan	Roseires	11.85	34.38	East Sudanian Savanna	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. tsacas</i> sp. n.	Ethiopia	Arba Minch Springs	6.03	37.55	Ethiopian Montane Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. tsacas</i> sp. n.	Kenya	Kainuk, on Morun R	1.57	35.52	Northern <i>Acacia-Commiphora</i> Bushland & Thicket	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. tsacas</i> sp. n.	Mozambique	Amatongas	-19.17	33.76	Southern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. tsacas</i> sp. n.	South Africa	Dukuduku	-28.37	32.23	Eastern Cape Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. tsacas</i> sp. n.	South Africa	Enseleni Nature Reserve	-28.68	31.98	Eastern Cape Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. tsacas</i> sp. n.	South Africa	Kosi Bay Nature Reserve	-26.95	32.8	Southern Africa Mangroves	Mangroves

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. uncinatum</i> sp. n.	Botswana	Gaborone Village	-24.65	25.91	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Botswana	Kuke Pan	-23.32	24.45	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Botswana	Mabelepuudi	-22.28	26.68	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Botswana	Qwihaba Hills	-20.02	21.35	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Botswana	Serowe	-22.38	26.72	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Botswana	Tlokweg	-24.67	25.97	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Katara, 1 km S	-17.83	18.9	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Xawasha pan, 2 km W	-19.15	20.87	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Rundu, 20 km E	-17.92	19.97	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Okongo, 29 km E	-17.62	17.47	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Epupa, 35 km E, Kunene R	-17.05	13.48	Nama Karoo	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Amkarub 269	-19.82	14.65	Nama Karoo	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Andara	-18.07	21.45	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Arnhem 222	-23.45	18.53	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Beiseb	-18.52	17.05	Angolan Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Brandberg, Mason Shelter	-21.07	14.08	Namib Desert	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Buffalo Base	-18.13	21.68	Zambezian Flooded Grassland	Flooded Grasslands
<i>C. uncinatum</i> sp. n.	Namibia	Bukalo, Ndopu Village	-17.72	24.52	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Bum Hill campsite, Kwando R	-17.77	23.33	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Tsumkwe, CDM Camp	-19.6	20.5	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	De Hoek 878	-21.93	20.97	Kalahari Xeric Savanna	Deserts & Xeric Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. uncinatum</i> sp. n.	Namibia	Ekuju village, Kunene R	-17.32	13.8	Nama Karoo	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Epuikiro River, 3 km N at:	-21.37	20.1	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Erichsfelde 44	-21.58	16.93	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Fort Doppies	-17.82	23.3	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Hamakari Süd 373	-20.67	17.38	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Kaudom Game Reserve	-18.93	20.95	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Kubunyana camp	-17.87	24.33	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Susuwe, Kwando R	-17.75	23.33	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Mahango Game Reserve	-18.23	21.72	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Matende River	-17.9	19.58	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Mile 46	-18.3	19.25	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Morester 451	-24.1	19.97	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Mudumu National Park at:	-18.17	23.42	Zambezian Flooded Grassland	Flooded Grasslands
<i>C. uncinatum</i> sp. n.	Namibia	Nakatwa	-18.18	23.42	Zambezian Flooded Grassland	Flooded Grasslands
<i>C. uncinatum</i> sp. n.	Namibia	Namutoni EE Centre	-18.8	17.03	Etosha Pan Halophytics	Flooded Grasslands
<i>C. uncinatum</i> sp. n.	Namibia	Okahandja	-21.98	16.92	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Omatako Ranch 305	-21.5	16.73	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Otjovasandu	-19.23	14.48	Nama Karoo	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Popa Falls	-18.12	21.58	Zambezian Flooded Grassland	Flooded Grasslands
<i>C. uncinatum</i> sp. n.	Namibia	Salambala forest	-17.83	24.6	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Simanya, Okavango R	-17.55	18.53	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Somerkoms 521 (1)	-22	19.95	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Somerkoms 521 (2)	-22.02	19.95	Kalahari Xeric Savanna	Deserts & Xeric Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. uncinatum</i> sp. n.	Namibia	Takwasa	-17.88	20.27	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Trekkersboom	-19.3	20.65	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	Namibia	Tsaobismund 85 at: Viljoenskroon 507 (1) Viljoenskroon 507 (2) Welverdiend 328 Xawasha pan	-22.37	15.73	Nama Karoo	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia		-26.13	19.95	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia		-25.17	19.97	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia		-25.77	19.98	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Namibia		-19.15	20.9	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. uncinatum</i> sp. n.	South Africa	Soetdoring Nature Reserve	-28.85	26.03	Highveld Grassland	Montane Grasslands
<i>C. uncinatum</i> sp. n.	South Africa	Strathmore	-25.9	20.35	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	South Africa	Witsand Nature Reserve	-28.72	22.48	Kalahari Xeric Savanna	Deserts & Xeric Shrublands
<i>C. uncinatum</i> sp. n.	Zimbabwe	Lake Kyle Dam	-20.22	31	Southern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Burundi	Rumonge	-3.96	29.43	Central Zambesian Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Mozambique	Inhambane	-23.87	35.38	Southern Zanzibar-Inhambane Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. unicuspis</i> sp. n.	Mozambique	Nyaka	-30.15	29.77	Drakensburg Afromontane Grassland & Woodland	Montane Grasslands
<i>C. unicuspis</i> sp. n.	Mozambique	Umbeluzi	-26.03	32.39	Maputaland Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. unicuspis</i> sp. n.	Namibia	Amkarub 269	-19.83	14.7	Nama Karoo	Deserts & Xeric Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Bukato, Ndopu Village	-17.72	24.52	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Chwaha River, 3 km NE	-17.97	22.47	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Fort Doppies	-17.82	23.3	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Gobiswater	-19.38	18.15	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Hamoye Nat. Forest	-18.2	19.72	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. unicuspis</i> sp. n.	Namibia	Katara, 1 km S	-17.83	18.9	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Leeukop 664	-19.88	14.35	Nama Karoo	Deserts & Xeric Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Mahango Game Reserve	-18.23	21.72	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Mile 46	-18.3	19.25	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Mudumu National Park at:	-18.17	23.42	Zambezian Flooded Grassland	Flooded Grasslands
<i>C. unicuspis</i> sp. n.	Namibia	Nova, 5 km N	-18.15	21.73	Zambezian Flooded Grassland	Flooded Grasslands
<i>C. unicuspis</i> sp. n.	Namibia	Rundu, 20 km E	-17.92	19.97	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Salambala forest	-17.83	24.6	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Salambala, 4 km NE	-17.6	24.6	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Simanya	-17.55	18.53	Kalahari <i>Acacia-Baikiaea</i> Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Namibia	Simataa, Salambala B6	-17.8	24.53	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	South Africa	Blouberg Nature Reserve	-23.03	29.07	Southern Rift Montane Forest	Montane Grasslands
<i>C. unicuspis</i> sp. n.	South Africa	Mooketsi	-23.6	30.1	Southern Africa Bushveld	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	South Africa	Mtubatuba	-28.42	32.18	Eastern Cape Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. unicuspis</i> sp. n.	South Africa	Ndumo Game Reserve, main camp area at:	-26.9	32.52	Maputaland Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. unicuspis</i> sp. n.	South Africa	Ndumo Game Reserve, pan at:	-26.9	32.28	Maputaland Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. unicuspis</i> sp. n.	South Africa	Ndumo Game Reserve	-26.87	32.25	Maputaland Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests
<i>C. unicuspis</i> sp. n.	South Africa	Pafuri	-22.45	31.28	Zambezian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	South Africa	Richards Bay	-28.82	32.03	Eastern Cape Coastal Forest	Tropical & Subtropical Moist Broadleaf Forests

3.4: Appendix (Continued).

Genus/species	Country	Locality	Latitude	Longitude	Major Habitat Type	Vegetation type
<i>C. unicuspis</i> sp. n.	Tanzania	Moba	-3.96	29.43	Central Zambesian Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Zimbabwe	Balla Balla	-20.45	29.05	Southern Africa Bushveld	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Zimbabwe	Broken Causway	-17.05	32.77	Zambesian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Zimbabwe	Chimana Causway	-17.1	32.63	Southern Miombo Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands
<i>C. unicuspis</i> sp. n.	Zimbabwe	Victoria Falls National Park	-17.92	25.67	Zambesian & Mopane Woodland	Tropical & Subtropical Grasslands, Savannas & Shrublands

SYSTEMATIC AND BIOGEOGRAPHICAL DISCUSSION⁴

REVISION OF AFROTROPICAL *AXINOTA*

(CHAPTER 3.1)

The distributions of the two species of the *Axinota fuscipennis* species-group occurring in sub-Saharan Africa are illustrated in Figs 3.1: 29 and 30. These maps show that *A. fuscipennis* and *A. quasimodoi* occur sympatrically over at least part of their respective ranges, although *A. quasimodoi* is the more widely distributed of the two. Figure 3.1: 30, which maps the major hydrological systems in Africa, shows that the majority of records are closely associated with hydrological features: *A. fuscipennis* with the Gambia, Niger, Congo, Okavango, and Zambezi drainage systems, together with the margins of Lake Malawi and coastal forested regions of Durban, South Africa; *A. quasimodoi* with the Congo (and other West and central African rivers), the Zambezi drainage systems and the great salt lakes of the Rift Valley. This evidence, coupled with bionomic label data (cited above), indicates that both species are associated with gallery (riverine) forests that border such systems. The occurrence of both species in a range of Major Habitat and Vegetation Types (3.1: Appendix II) also bears evidence to such a hydrological forest association.

From the Mid-Cretaceous (100 million years ago (Ma)) to the Oligo-Miocene (30–25 Ma) tropical forests formed a continual belt that stretched across the African continent from coast to coast (Kirk-Spriggs and Stuckenberg 2009: fig. 6.4), allowing the range expansion in species associated with forest margins. By the Mio-Pleistocene (15–7 Ma) these forests had begun to recede due to climate change. The present-day Congo forest is of more recent age and is underlain by 200–300 m of sand dune deposits thought to be of Mid-Miocene age (15–11 Ma), indicating that the present-day Congo was a vast desert during that period (Senut *et al.* 2009: fig. 1).

⁴ **Includes** Discussion sections published in Kirk-Spriggs (2010a, 2010b, 2011) and unpublished text related to Chapters 2.0 and 3.4.

Quaternary paleoclimatic variation has clearly played a significant role in the distribution of organisms on continental landmasses (Kirk-Spriggs and McGregor 2009; Wilmé *et al.* 2006). During periods of glaciation, when the climate was cooler and dryer, habitats at lower elevations experienced more arid conditions; during interglacial periods hotter and wetter conditions ensued. This led to the sequential retraction and expansion of tropical forests (Kirk-Spriggs and Stuckenberg 2009). Even with such climatic shifts, orographic precipitation allowed for the continuation of river systems and associated riverine forest habitats along hydrological systems that had sources in montane zones (Wilmé *et al.* 2006).

It is here postulated that proto-*Axinota* developed in association with tropical forests. As these forests receded, remnant populations were retained within the more mesic riverine forest habitats and these, together with forests associated with the great salt lakes of the Rift Valley, acted as corridors for dispersal into other areas of continental Africa in the case of *A. fuscipennis* as far south as the coastal forests of Durban in South Africa.

Axinota kyphosis is clearly rare in Madagascar (Fig. 3.1: 32). Examination of over 300 specimens of Curtonotidae, from the “Arthropod Survey of Madagascar’s Protected Areas (1998–2009)”, revealed only a single female specimen (Fianarantsoa, near Isalo National Park). In all, the species has only been sampled at three localities in two vegetation types, *i.e.* Plateau grassland-wooded-grassland mosaic and Wooded grassland-bushland (*sensu* Moat and Smith 2007), both of which occur in the Dry and Sub-arid Bioclimatic Zones (*sensu* Cornet 1974; Schatz 2000) respectively, to the west of the central/eastern Madagascan highlands (Fig. 3.1: 32). The occurrence of *A. kyphosis* in the dry and sub-arid zones of Madagascar is somewhat surprising, given that the distribution of Oriental species of *Axinota* indicates a primary association with rainforest, or at least humid riverine forests. It should be borne in mind, however, that the three records on which the distribution is currently based are widely dispersed in the north and south of Madagascar and that the range of the species is probably wider in the arid to semi-arid west of Madagascar than records suggest.

The superfamily Ephydroidea includes the families Camillidae, Curtonotidae, Diastatidae (including Campichoetidae), Drosophilidae and Ephydriidae, and is a reasonably well-supported monophyletic group in the acalyptrate flies (Griffiths 1972; Grimaldi 1990; Hennig 1958, 1971; Kirk-Spriggs 2008b; McAlpine 1989). Schizophora, in general were absent from the Cretaceous (*ca.* 145–65 Ma), and the

phylogenetic-stratigraphic pattern of the Cretaceous Muscomorpha *sensu* Woodley (1989), indicates that those that were present represent near-basal taxa (Platypezoidea, Phoridae *sensu lato* and stem-groups). This fact, coupled with the existence of near-basal and stem-group members of Camillidae, Drosophilidae and Diastatidae *sensu lato* in Baltic amber, indicate that the divergence of ephydroid families probably occurred during the Paleocene (*ca.* 65–61 Ma). By the Early Miocene (*ca.* 23.7 Ma) modern genera had evolved, so there was probably a vast radiation of acalyptrates in general during the Eocene (*ca.* 54.8–33.7 Ma) (*e.g.*, Grimaldi and Engel 2005; Wiegmann *et al.* 2011).

The family Curtonotidae was until recently only purportedly known from a single compression fossil (*Curtonotum gigas* Théobald), of Early Oligocene age (*ca.* 33.9 Ma) from Les Camoins, Provence, France (Evenhuis 1994). This fossil was subsequently reappraised by Kirk-Spriggs (2007) and was demonstrated not to represent the family Curtonotidae. Fossil inclusions of two species, one new *Curtonotum* sp. and a new extinct genus of Curtonotidae, have recently been discovered in Miocene amber from the Dominican Republic (Grimaldi and Kirk-Spriggs, *in press*). Iturralde-Vincent and MacPhee (1996) noted that according to available biostratigraphic and paleogeographic data, amberiferous deposits in the Dominican Republic were formed in a single sedimentary basin during the late Early Miocene through early Middle Miocene (20–15 Ma). This now provides a minimum Miocene age of 20–15 Ma for the Curtonotidae in the fossil record.

The Jurassic separation of Madagascar from Gondwana and the recent Paleocene development of the Ephydroidea preclude a “Gondwanan origin” for the Ephydroidea (including Curtonotidae) and other means of explaining their occurrence on Madagascar must, therefore, be considered.

There has been little consensus among biologists in respect to the origins of Madagascar’s unique biota (Wilmé *et al.* 2006), although most appear to agree that this resulted either from vicariance (in the case of “ancient” groups), or from some form of long-distance dispersal event followed by founder effect speciation, and various means of *ad hoc* “sweepstake” and “stepping stone” scenarios (*e.g.*, Cranston 2005), have been promulgated to explain this (de Wit 2003; Krause *et al.* 1997). In respect to Apoidea (Hymenoptera), Eardley *et al.* (2009) have, for example, recently suggested dispersal *via* vegetation rafts arising from tsunamis, or from extreme floods

in East Africa (the larger rivers depositing suitable material into the Mozambique Channel), to explain faunal connections between continental Africa and Madagascar.

Diptera are of course highly mobile and a recent review (Kirk-Spriggs and McGregor 2009) has highlighted the significance of aerial dispersal in the colonization of oceanic islands and as a means of mixing faunas within and between zoogeographical realms and regions.

In a review of the Diptera of Madagascar, Irwin *et al.* (2003) discussed the origins and composition of the fauna. Endemism in the Brachycera is rather high with 17% of genera and 79% of species found only there. They note that in the family Asilidae, for example, 82% of genera occurring in Madagascar also occur in the Afrotropical Region, 29% in the Oriental Region, 29% in the Australasian Region, 25% in both the Palearctic and Nearctic Regions, and 18% in the Neotropical Region. While an examination of genera, rather than species, may not represent the best gauge of cross-regional associations, it does indicate that the Malagasy Diptera fauna may be derived from regions other than the Afrotropics alone, including the Oriental Region, or be relictual. Tsacas (1974) described seven species of the curtonotid genus *Curtonotum* Macquart from Madagascar, all endemic, and an additional five endemic species now await description (Kirk-Spriggs, in prep.). Tsacas (1974) suggested that these species are derived from continental African origin. Recent examination of species-group associations of this genus from Madagascar (Kirk-Spriggs, in prep.) indicate that this fauna may be derived from more than one proto-*Curtonotum* dispersal event, although this requires a phylogeny with adequate taxon sampling.

The close affinities of *A. kyphosis* with *A. rufipes*, from Nepal and Thailand is strongly indicative of Oriental affinity, and the occurrence of the former in Madagascar is probably the result of aerial dispersal of an *Axinota* species from the Oriental Region, long after Madagascar reached its current emplacement in the Indian Ocean. A similar explanation for the occurrence of the genus *Parapachycerina* Stuckenberg (Lauxaniidae) on Madagascar has, for example, has recently been proposed by Davies and Miller (2008).

The distribution of *Axinota ahdabi* at elevations of 1400 and 2200 m in the highlands of Yemen is also worthy of discussion (Figs 3.1: 29, 30). The highlands of Yemen are scarp mountains (Hijaz and Asir ranges) trending NW–SE, parallel to the Red Sea and form the western edge of the Arabian Shield. These mountains reach

their maximum elevation at 3760 m in Yemen (Guba and Glennie 1998). Cranston (2005) noted that geological evidence of sea-level changes (*e.g.*, Adams *et al.* 1983) suggests that the Arabian Peninsula lay predominantly beneath the Tethys, with the exception of high ground bordering the Rift Valley along the northwest trending Red Sea (which includes the highlands of Yemen). The retreat of the Tethyan Sea in the Late Palaeogene (Oligocene, *ca.* 34–24 Ma) exposed the present-day Arabian Peninsula. This was followed by aridification of the Arabian Peninsula at the beginning of the Miocene, with intensification during the Pliocene and Quaternary (Pickford 1999, 2000; Pickford *et al.* 2006).

The Polar Continental air masses that affect the Arabian Peninsula in winter originate from central Asia (Fisher and Membery 1998: fig. 2.1). Assuming these air masses were similar in the recent geological past, it is here postulated that such air masses may have been instrumental in the dispersal of proto-*Axinota* from Asia to the Arabian Peninsula, perhaps during the Pliocene. It is also worth noting that in the later Tertiary Asian climate was undergoing massive disruption, chiefly due to the development of monsoonal weather systems. Considerable climatic instability would have ensued during this period and wind tracks may have been radically different from those of today. It is perfectly feasible that conditions then were far more conducive to long distance wind dispersal than they are today (*e.g.*, Wang *et al.* 2005).

As the climate became more arid the species may have retreated into the uplands of the Asir range; climatic conditions and vegetation at higher elevations being conducive to establishment and cladogenesis.

An alternative hypothesis is that the distribution pattern of some curtonotids in the Afrotropics may have also been influenced by the change of drainage systems of Central Africa during the Cenozoic (Stankiewicz and de Wit, 2006). With changing topography of the continent over the Cenozoic, the air circulation pattern may have also changed, and the above hypothesis of the dispersal of *Axinota* from Asia to Yemen be explained by simple dispersal from the African mainland to the Arabian Peninsula and then further into Asia.

REVISION OF *TIGRISOMYIA* (CHAPTER 3.2)

Aside from the single Kenyan coastal record of *Tigrisomyia rhayaderi* (noted in Chapter 3.2), the genus *Tigrisomyia* is recorded exclusively from high- to medium-elevation Afromontane forests associated with the Eastern Arc mountain group of Tanzania (hereafter referred to as Eastern Arc), and with isolated mountains and plateaus that skirt the Malawi section of the Great Rift Valley (Fig. 3.2: 24).

The highly fragmented moist forests that today form the Eastern Arc Mountains of Tanzania and Kenya (Fig. 3.2: 24) are well known for their biological diversity and high degree of floral and faunal endemism (*e.g.*, Lovett, 1988, 1989; Lovett *et al.* 1988; Burgess *et al.* 1998a, 2007), and the Eastern Arc/Coastal Forests have collectively been ranked as the second-most important “endemism hotspot” on mainland Africa (Burgess *et al.* 1998a; Myers *et al.* 2000). This “hotspot” is believed to contain at least 1500 endemic plants, 16 mammals, 22 birds, 50 reptiles and 33 amphibians (Lovett and Wasser 1993; Burgess *et al.* 1998b; Burgess and Clarke 2000; Myers *et al.* 2000), although additional species have been described since these figures were published. Although the flora and fauna of larger animals have been relatively well studied on at least some of the mountains in the Eastern Arc, the most species-rich group of all, the invertebrates, have received disproportionately less attention. Burgess *et al.* (1998a: 43, table 3) noted that 265 invertebrate species are regarded as endemic to single mountain blocks and that the most endemic-rich mountains are the East and West Usambaras, the Udzungwas and (especially) the Ulugurus. They noted, however, that data indicate a strong bias in collecting effort and this is apparent both in terms of taxa sampled and geographical coverage. This number of invertebrate endemics is sure to rise considerably. The Diptera, which is regarded as one of the four largest orders of the Insecta, with over 19 689 described species in the Afrotropical Region alone (Kirk-Spriggs and Stuckenberg 2009: 170), is not treated in their analysis and appears to be largely unstudied. Those records that do exist are scattered throughout the taxonomic literature and a dedicated survey of the Diptera of both the Eastern Arc and the Rift valley forests is desirable, both having been identified as priority areas for targeted biodiversity studies of the Diptera by Kirk-Spriggs and Stuckenberg (2009: 183).

Afromontane forests associated with mountains and plateaus that occur to the north, south and west of Lake Malawi along the southeast Rift Valley are today similarly fragmented to the Eastern Arc forests (Fig. 3.2: 24). In a review of phytogeography of evergreen forests of Malawi, Dowsett-Lemaire (1989: 7, fig. 1), mapped 31 distinct Afromontane forest fragments. The most extensive of these are (from north to south), the Nyika Plateau, the North Viphya Plateau (comprising: Uzumara, Chimaliro and Choma), the South Viphya Plateau (including: Nthungwa, Chamambo, Kawandama and Lwanjati-Champila), and to the south, Mount Mulanje. Many of these occur in heavily populated areas and are subject to intensive and destructive agricultural practices, and have today been reduced to mere forest remnants through anthropogenic activities, especially fire and the establishment of plantations (Dowsett-Lemaire 1985, 1989). These forests, and indeed most forests associated with the ancient crystalline mountains of the Great Rift Valley in general, have received little attention entomologically. Detailed accounts of the physiography and vegetation of Malawi are provided by Hedberg (1951), Brass (1953), Chapman (1962, 1968), Pike and Rimmington (1965), Chapman and White (1970), Young and Young (1978), Dowsett-Lemaire (1985, 1989) and Porembski (1996).

Of the four new species of *Tigrisomyia*, described in Chapter 3.2, one species (*T. scoliosis*) occurs only in the Eastern Arc forests, one (*T. kinskii*) only in the Malawi Rift forests, one (*T. rhayaderi*) in the Rift Valley forests and coastal region of Kenya, and one (*T. amnoni*) is more widespread in both the Rift Valley and Eastern Arc forests.

Tigrisomyia scoliosis is currently known only from a single locality, Mpwapwa (6°21'S 36°29'E), in the Rubeho (Usagara) Mountains, situated immediately northeast of the Udzungwa Mountains in the Eastern Arc (Fig. 3.2: 24). The Rubeho Mountains comprise six forest patches (including Mpwapwa) (Newmark 1998), and estimations of collective natural forests cover range from 499–654 km² (Fjeldså *et al.* 1997a,b; Burgess *et al.* 1998a; Newmark 1998). In an early account, Greenway (1933) described the vegetation of Mpwapwa.

Tigrisomyia kinskii is apparently restricted to high-elevation Afromontane forest (1500–1700 m a.s.l.) in Ntchisi Forest (13°20'S 34°2'E). Ntchisi Mountain (Fig. 3.2: 24) is one of a number of peaks above 1600 m in the Dowa Hills, which lie to the southwest of Lake Malawi. Ntchisi is, however, the only one still bearing forest and today represents the most isolated Afromontane forest in Malawi, situated 107 km

from the southern tip of the Viphyia Plateau to the north and 93 km from the nearest forested hill to the south (Chongoni Mountain). Most of the 223 ha of forest that occurs on the mountain (1989 data), is *Aningeria* lower submontane forest, but below 1450 meters is ca. 30 ha of mid-altitude *Aningeria-Newtonia* forest that occur in some sheltered gullies (Dowsett-Lemaire 1989).

Tigrisomyia rhayaderi is recorded from two geographically disjunct localities, the Zomba Plateau (15°23'S 35°20'E, ca. 1700 m (Dowsett-Lemaire 1989)), situated to the east of the Shire River in southern Malawi, and Takaungu (03°42'S 39°49'E, 0 m a.s.l.), south of Kilifi on the Kenyan coast. The Zomba Plateau comprises an extensive upland plateau, ca. 24 km² of which occurs above 1700 m and retains Afromontane forest (Dowsett-Lemaire 1989). Takaungu is not in any of the designated coastal forest reserves, and the only substantial forest in the area is mangrove forest associated with the Takaungu Creek. There are four possible scenarios to explain this disjuncture: 1) the species is more widely distributed in the intervening areas than available material indicates; 2) one of the two type specimens originates from elsewhere and is mislabelled; 3) one of two specimens arrived at the other area through some odd stroke of chance and does not naturally occur there; or 4) discovery of males from the same two localities may reveal that the material from these two localities is not conspecific. The situation can only be clarified through additional collecting.

Tigrisomyia amnoni is the most widely distributed species of the genus (Fig. 3.2: 24), and occurs on the Zomba Plateau, and in Chowo Forest (10°35'S 33°42'E, ca. 2090–2200 m (Dowsett-Lemaire 1985)) on the Zambian side of the Nyika Plateau, situated on the northwest side of Lake Malawi. It also occurs in two localities on the opposite shores of Lake Malawi in Tanzania, namely Ngozi Crater (9°00'S 33°26'E, 2200 m a.s.l.), which forms part of the Mporoto Ridge Catchment Forest Reserve located at the western end of the Poroto Mountains, and Njombe (9°20'60"S 34°46'0"E, 2000 m a.s.l.), which forms part of the Kipengere Range (also known as the Livingstone Mountains) in southwest Tanzania. In the Eastern Arc Mountains the species occurs in Mwanihana Forest (7°49'60"S 36°49'60"E, 1000 m a.s.l.) in the Udzungwa Mountains, and at three localities in the West Usambara Mountains, namely: Gologolo Forest (4°42'0"S 38°13'60"E, 1900 m a.s.l.), Lushoto (4°46'60"S 38°16'60"E, 1300 m a.s.l.), and Mazumbai (4°48'0"S 38°30'0"E, 1600 m a.s.l.). All of the above-mentioned localities are Afromontane and are vegetated with mid-altitude

to upper montane forest. A dedicated survey of other high-elevation Afromontane forests bordering the Malawi Rift and the Eastern Arc Mountains would probably reveal that the species also occurs in intervening forested areas.

White (1978: 467, fig. 1) divided the Afromontane forests into seven regional montane systems, which in East Africa form a broken chain from the Ethiopian highlands in the north to the Cape Peninsula in the south. White (1978: 466) was quick to point out, however, that these seven divisions were identified for practical convenience only and may not necessarily reflect floral or faunal relationships or affinities. He regarded the forest patches that today form the Afromontane forests of eastern Africa as an “archipelago” of “islands”; their isolation, coupled with the influence of biotic and abiotic factors, presumably being conducive to extinction and/or cladogenesis. Like islands, each mountain and plateau has its own characteristic flora and fauna (Happold and Happold 1989).

Examination of the distribution of *Tigrisomyia* (Fig. 3.2: 24) indicates that the genus transects both the Uluguru-Mlanje and Imatongs-Usambara regional mountain systems proposed by White (1978: 467); the Usambara Mountains occurring in the latter system. Dowsett-Lemaire (1989: 114) discussed this in respect to the flora and avifauna and noted that the position of the Usambara Mountains could equally be part of White’s Uluguru-Mlanje regional mountain system, as many species of plants and birds reach their northern limit there. The distribution of *Tigrisomyia* also transects the “Eastern Arc” and “Malawi (Tanganyika) Rift and southern Africa” regional mountain systems proposed for birds by Moreau (1966), that has been applied “traditionally” to recognise montane bird endemism in Africa (*e.g.*, Fjeldå and Bowie 2008).

The wide distribution of *Tigrisomyia amnoni*, which occurs from the Usambara Mountains in the north to the Zomba Plateau in the south, as opposed to the extreme isolation of other species of the genus, is an intriguing biogeographical question. Blackburn and Measey (2009) noted that within biodiversity “hotspots” there are at least some species that occur both within the hotspot and in neighbouring or even distant regions. Such species may have either originated in such hotspots, or conversely, have originated in other regions before invading hotspots. A similar distribution pattern to that exhibited by *T. amnoni* (Fig. 3.2: 24) is apparent in at least two species of frogs, *Hyperolius spinigularis* Stephens (Hyperoliidae), which occurs in the Usambara, Uluguru and Udzungwa Mountains in the Eastern Arc, with outlier

populations on Mount Mulanje in Malawi (Menegon *et al.* 2008, table 2), and *Arthroleptis xenodactyloides* Hewitt (Arthroleptidae), that occurs in the Taita and Shimba Hills, West and East Usambara Mountains, Pemba Island, Uluguru Mountains, Malundwe Hills and the Udzungwa Scarp with outlier populations in the Misuku Hills at the northwest of Lake Malawi and on the Zomba Plateau and Mount Mulanje in Malawi (Blackburn and Measey 2009, fig. 1). In a study of *A. xenodactyloides*, Blackburn and Measey (2009) applied phylogenetic comparative techniques to estimate the region of origin and directional dispersal. The results of this study indicated that the ancestral region of origin of *A. xenodactyloides* occurred within the Eastern Arc prior to dispersal southwards into the southern Rift Mountains, which probably occurred in the Pleistocene. A similar model of the origin and dispersal of *T. amnoni* might be applied here but, as the current study is based on museum specimens alone, no molecular study could be undertaken and this must await dedicated sampling throughout the known range of the genus.

The origins and history of the vegetation in East Africa has had a profound impact on the modern distribution of the flora and fauna of the region. The graticule shift hypothesis proposes that the position of the Earth's poles of rotation have changed over geological time, which led to shifts in the position of the tropical belt over the Earth's surface (Pickford 1999). Sedimentological evidence also indicates that the present-day Congo forests that occur in Gabon, Congo, western Uganda and Angola were part of a vast desert during the Miocene and that the supposed permanence of the position of Africa's rainforests since the Oligocene is a myth. The modern rainforest occurs on very thin soil (1–2 m in depth), overlaying up to 250 m of Aeolian sands, indicating that the extant tropical rainforest of the Congo only set root in the area in relatively recent geological time (Maley 1996; Pickford 1999; Senut *et al.* 2009: fig. 1). Such a northwards shift in tropical zones is also evidenced by Miocene palaeobotanical remains of tropical African origin recorded as plant fossils in France, Germany, Poland, Switzerland, Hungary and as far north as Sweden (Pickford 1999).

Miocene East African plant communities are all of tropical affinities and this implies that East Africa would have been positioned between the two tropics from the Mid-Cretaceous to the Oligo-Miocene, when tropical forests formed a continuous belt that stretched across the African continent from coast to coast (*e.g.*, Clarke and Burgess 2000; Kirk-Spriggs and Stuckenberg 2009: 163, fig. 6.4). During early and

earliest Middle Miocene times, northern Africa was also clothed in tropical forest and woodland, while during the Late Miocene its vegetation affinities shifted toward savanna and semi-arid types (Pickford 1999). The northwards displacement of Africa during plate tectonic activity (*ca.* 10° of northwards longitudinal shift since the Eocene), provides only a partial explanation of vegetation distribution in Africa and displacement alone cannot explain the geological and palaeontological data, although according to Owen (1983) the position of East Africa and the whole continent has little changed from the Palaeocene until recently. The establishment of dry-shod contact between Africa and Eurasia at the end of the Lower Miocene coincides with major increase in the degree of seasonality in world climates, while closure of the chock point of the Isthmus of Panama during the Pliocene likely sparked the onset of high-latitude Quaternary glaciations through the reorganization of oceanic currents (Pickford 1999). The Neogene and Quaternary were marked by a succession of changes which affected the climate and played an important role in modifying African flora and faunas. As a result of global and local events, the forested environments began to dry out and the faunal composition changed in relation to altitude.

The East African expansion of grasslands began in the Upper Miocene (*ca.* 8–7 Ma (million years ago)), but remained a low component of the environment until the Late Pliocene (Senut *et al.* 2009). As the grasslands and savannas expanded, at the expense of moist lowland forests, these forests were only retained at high elevations on mountains and plateaus that occur along the Rift Valley escarpments and in the Eastern Arc and these upland forest remnants retained local populations that gradually became genetically divergent, but remained morphologically very much alike (Fjeldså and Bowie 2008). During the last glacial maximum (26000–19000 years B.P.), the temperature of the Atlantic Ocean dropped 4–5 °C (Zinderen Bakker 1982), whereas that of the Indian Ocean in the area of eastern Tanzania was similar to that of present (Prell *et al.* 1980). This implies that during the last glacial maximum the climate of Eastern Tanzania was similar to that of today (Lovett *et al.* 1988), resulting in the overall climatic stability of forests in eastern Africa.

The ancient crystalline mountains that form the Eastern Arc and those associated with the Malawi Rift system were probably in existence from the Cretaceous (*e.g.*, Sowerbutts 1972; Lovett *et al.* 1988; van der Beek *et al.* 1998; Daszinnies *et al.* 2008), and the strong floristic affinities of Afromontane forests in the Eastern Arc and the Malawi Rift mountains with species occurring in the extant

forests of the Guineo-Congolian rainforest have been noted by numerous authors. Dowsett-Lemaire (1989: 120), for example, noted that Afromontane near-endemic trees have satellite populations in mid-altitude forest in south-central Africa (on the Zaïre–Zambezi watershed) and in some upland areas of Congo, Gabon and Cameroon, suggesting a former connection *via* an Eocene pan-African rainforest. Lovett *et al.* (1988) note similar affinities in the angiosperm flora of the Eastern Arc. Evidence of such linkages is also apparent in some genera of African Odonata. While most forest dragonflies apparently have their “centres of origin” in the lowland rainforests of central Africa, *Coryphagrion grandis* Morton and *Hadrothemis scabrifrons* Ris are relict-endemics that exhibit broader distribution ranges and bear evidence to the pan-African forest belt across Africa. Other examples in the Odonata are the genera *Umma* Kirby and *Chlorocnemis* Sélys, both of which have *ca.* 10 extant species in the central African rainforest, with one species each in the Eastern Arc (Clausnitzer 2003).

It has been suggested that this pan-African forest either broke up only once, at the onset of East African aridification during the Oligocene–Early Miocene (*ca.* 33–20 Ma), or expanded and contracted on multiple occasions following this initial break-up (Couvreur *et al.* 2008). In a significant recent study Couvreur *et al.* (2008) used molecular phylogenies and Bayesian divergence dates to establish the origin of African forest linkages of the plant family Annonaceae. This study provided strong evidence that East African endemic lineages of Annonaceae have multiple origins, dated to significantly different times spanning the Oligocene and Miocene epochs and that these successive origins (*ca.* 33, 16 and 8 Ma) coincide with known periods of aridification and geological activity in Africa that would have recurrently led to the isolation of the Guineo-Congolian rainforest from the Eastern Arc.

The distinctive nature of *Tigrisomyia* species assemblages at high elevations and the high degree of endemism in both the Eastern Arc and the Malawi Rift mountains, many of which are being increasingly depleted due to human activities, indicates the importance of conserving existing forests in these two regions and urgent steps are therefore required if their continued survival is to be ensured.

REVISION OF MALAGASY *CURTONOTUM* (CHAPTER 3.3)

Vicariance versus dispersal hypotheses

Two causal factors have been suggested to explain the origins of Madagascar's unique biota: Gondwanan vicariance and Cenozoic "sweepstake" dispersal (*e.g.*, Cox 1998; Heads 2009; Trewick 2000; Yoder and Nowak 2006).

The Schizophora in general were absent from the Cretaceous, those that were present being ancient taxa (Platypezoidea, Phoridae *sensu lato* and stem groups) (*e.g.*, Grimaldi and Engel 2005; Wiegmann *et al.* 2011). The presence of ancient and stem-group members of the families Camillidae, Drosophilidae and Diastatidae *sensu lato* (including Campichoetidae) in Baltic amber (*e.g.*, Hennig 1965; Tschirnhaus and Hoffeins 2009), indicate that the divergence of ephydroid families probably occurred during the early Paleogene. The vast radiation of acalyprates in general probably took place in the Eocene (*e.g.*, Hennig 1965) and modern genera evolved by the Early Miocene (Arillo and Ortuño 2005). The recent discovery of verified fossil inclusions of Curtonotidae in Miocene amber from the Dominican Republic (Grimaldi and Kirk-Spriggs, *in press*), formed in a single sedimentary basin, during the early Miocene through early Middle Miocene (Iturralde-Vincent and McPhee 1996), now provides a minimum age for the Curtonotidae in the fossil record. The Curtonotidae are, therefore, far too recent in geological terms to be considered as Gondwanan relicts and only the second of the above-mentioned hypotheses need be considered here.

Cenozoic "sweepstake" dispersal represents transoceanic distribution of African founder individuals from 65.5 Mya to the present (Yoder and Nowak 2006; Vences *et al.* 2009). Rafting or flight remains the predominant explanation for such dispersal events. In a recent study using palaeogeographic reconstructions and palaeo-oceanographic modelling, Ali and Huber (2010) concluded that strong surface currents flowed from north-east Mozambique and Tanzania eastwards towards Madagascar during the Palaeogene, and concord perfectly with conditions favourable for "sweepstake" dispersal of founder individuals from continental Africa. They conclude, therefore, that rafting (at least in the case of small mammals), may have been the dominant means of transoceanic dispersal during the Cenozoic era, but that this was not apparent after the early Miocene when oceanic currents had evolved to their current configuration.

In the case of the Insecta and some other invertebrate groups, it has been suggested that aerial dispersal (termed "Anemochore dispersal" in some of the literature), may be as plausible an explanation for founder individual dispersal, and

there is much indirect evidence for dispersal among the Pacific islands (*e.g.*, Kirk-Spriggs 2010a; Kirk-Spriggs and McGregor 2009, for review). Kirk-Spriggs (2010a) further suggested that the occurrence of the curtonotid *Axinota kyphosis* on Madagascar (a species of presumed Oriental origin), may have resulted from founder individual transoceanic dispersal via the circulation system of the Indian monsoon.

In a review of published phylogenetic studies of various floral and faunal groups occurring on Madagascar (*i.e.*, plants, invertebrates, vertebrates and birds), Yoder and Nowak (2006) concluded that there are numerous endemic clades of Malagasy taxa whose closest sister group relationships are to African taxa, and that there appears to be an overwhelming indication of Cenozoic dispersal. They found that nearly ½ the plants, invertebrates and vertebrates included in these studies exhibit sister group relationships to African taxa, indicating that the majority of lineages ancestral to Malagasy endemics had their relatives or ancestors in Africa. Although this study has been superseded by other studies on similar themes, the general conclusions stated here remain apparent.

In a review of the Diptera on Madagascar, Irwin *et al.* (2003) noted, that endemism among the Diptera is extremely high on Madagascar, with 80% of species being endemic to the island. In the case of the genus *Curtonotum*, partly revised here, 25 species (of which 13 are undescribed) occur in the continental Afrotropical Region, representing 65% of the regional fauna, while 13 species (of those 6 newly-described) occur on Madagascar, representing 35% of the Afrotropical fauna as a whole (Kirk-Spriggs in prep.). Only one species, *C. pauliani*, known from unpublished records from Namibia and South Africa, occurs both on Madagascar and the mainland Afrotropical Region (Kirk-Spriggs in prep.). It should be borne in mind, however, that the continental Afrotropical fauna of the genus is far better sampled and represented in collections than it is for Madagascar, and additional dedicated sampling on the island is sure to reveal further undescribed species.

Even prior to his 1977 study of the continental Afrotropical species of the genus, Tsacas (1974), suggested that the seven described Malagasy species of *Curtonotum* were derived from continental Africa and noted the close affinities of *C. pauliani* (Madagascar) to *C. cuthbertsoni* Duda and *C. quinquevittatum* Curran (both continental Afrotropical species), these three species being so similar externally that only the shape of the phallus allowed specific differentiation. In a later study, Kirk-

Spriggs (2010a) intimated that the Malagasy *Curtonotum* faunal lineage may be derived from more than one dispersal event.

Madagascar's biomes and other interpretations

Climatic and biotic disparities that are evident within Madagascar led to various proposals to subdivide the island into discrete subunits that correspond broadly to its major biomes. These have been defined by bioclimatic factors (*e.g.*, Schatz 2000), vegetation and elevation (*e.g.*, Humbert 1955; Koechlin 1972), or by faunal composition (*e.g.*, Angel 1942; Vences *et al.* 2009). Three such interpretations are discussed here: the biomes of Madagascar, after Yoder and Nowak (2006) (Fig. 3.3: 105), biogeographic zonation, following Boumans *et al.* (2007) and partly Wilmé *et al.* (2006), after Glaw and Vences (2007: 13) (Fig. 3.3: 106), and bioclimatic zonation, following Cornet (1974) and Schatz (2000), after Glaw and Vences (2007: 13) (Fig. 3.3: 107).

Modern practice divides Madagascar into six distinct biomes (Fig. 3.3: 105), as briefly outlined below. The major biomes exhibit sharp borders, even in the lowlands, and display a remarkable east-west trend in precipitation, from tropical humid to subarid bioclimatic extremes (Fig. 3.3: 107) (Vences *et al.* 2009).

Evergreen Rainforest. Humidity transported by the eastern trade winds precipitates on the eastern slopes of the eastern mountain chains, which creates a marked rainfall gradient from the tropical humid north-east and east to the subarid south-west of the island (Vences *et al.* 2009). Evergreen lowland rainforest cloaks the east coast of the island, extending *ca.* 100 km inland up the eastern mountains (Yoder and Nowak 2006). These forests receive 2500–4000 mm precipitation per year, with a significant dry season at lower elevations and a shorter one at higher elevations. Hence these slopes support broadleaf Evergreen Rainforest (Wells 2003).

Central Highlands. At elevations of 800 m and extending well into the interior of the island, the rainforest gives way to the Central Highlands, dominated by moist montane forest (Yoder and Nowak 2006).

Montane Ericoid Thicket. At higher elevations, above 2000 m, the moist montane forests of the Central Highlands are replaced by high elevation thickets, dominated by ericoid (Ericaceae) shrubs (Yoder and Nowak 2006). Three major

massifs occur in the north, central and south, that reach elevations of up to 2900 m (Vences *et al.* 2009, fig. 1; Wilmé *et al.* 2006).

Dry Deciduous Forest (or Central Grasslands). In the western half of Madagascar, below elevations of 800 m, montane forest shifts to Dry Deciduous Forest, dominated by sclerophyllous trees and shrubs, as this area falls within the rain shadow created by the eastern mountains. Deforestation and heavy grazing have impacted heavily on the Central Highlands and Dry Deciduous Forest biomes and today the central parts of the island consists largely of degraded and depauperate grasslands, although some areas protected from fires, such as the wet floors of deep-sided gullies, retain some forest remnants (Yoder and Nowak 2006; Wells 2003). Minute Humid Forest relicts are also harboured on isolated massifs within the drier regions of the island (Vences *et al.* 2009).

Arid Spiny Bush (or Southern Spiny Bush). The arid south-west extension of the deciduous forests become extremely arid, as the influence of the 30° latitude subtropical arid belt become apparent (Yoder and Nowak 2006). This part of Madagascar receives less than 300 mm of rain per year in its driest parts and the streams are ephemeral. It is covered with highly xerophytic “spiny bush” that includes the endemic botanical family Didiereaceae and many other endemic succulents, baobabs and other plants and this biome includes most of Madagascar’s endemic flora (Wells 2003).

Sambirano Rainforest. In the extreme north-west of Madagascar around Ambanja and the Sambirano River valley, a region of deciduous forest receives heavy seasonal rainfall that results from the Indian monsoonal circulation. This seasonal influx of precipitation produced a rainforest distinct biome known as Sambirano, which is geographically and biologically distinct from the eastern rainforest (Yoder and Nowak 2006).

Distribution and biome associations of the Malagasy Curtonotum fauna

The distributions of the Malagasy species of *Curtonotum* are tabulated according to the three interpretations of biome-related subunits noted above (Figs 3.3: 105–107) (Tables 3.3: 1–3).

Table 3.3: 1 interprets the biome concept of Yoder and Nowak (2006) (Fig. 3.3: 105). If these data are examined, it can be seen that the Dry Deciduous Forest

biome has the most species represented (8), followed by the Central Highlands (7; five of which occur in isolated biome remnants in the south-west). The Evergreen Rainforest has five species (one of which occurs in the isolated forest remnant to the far north of the island), and the Arid Spiny Bush has four species. Only one species is recorded from the Sambirano Rainforest and none from the Montane Ericoid Thicket. Seven of the 13 species occur in a single biome, one in two, four in three and one in four.

Table 3.3: 2 interprets biogeographic zonation, following Boumans *et al.* (2007) and partly Wilmé *et al.* (2006), after Glaw and Vences (2007: 13) (Fig. 3.3: 106). According to this concept seven species occur in the South (two of which occur at the borderline between two zones), six in the Central zone, five in the West and three each in the North East and South East. The North, Sambirano and South Central East have one species each. One species occurs in eight zones, one in four, two in three, four in two and five species in one alone.

Table 3.3: 3 interprets bioclimatic zonation, following Cornet (1974) and Schatz (2000), after Glaw and Vences (2007: 13) (Fig. 3.3: 107). From these data it is apparent that the greater number of species occur in the Subhumid zone (eight; five of which occur in remnant fragments of the zone), followed by the Dry (eight), the Humid (six; one fragmented), and the Subarid (five). No species are recorded from the Montane and six of the 13 recorded species occur in more than one zone.

Collectively, these interpretations indicate that biome exclusiveness is largely inconclusive for many *Curtonotum* spp. and that the biome-restricted patterns that are glaringly apparent in some other floral and faunal groups are considerably less marked for species of the genus.

The distribution of the 13 species occurring on Madagascar (illustrated in Figs 3.3: 92–104), can be briefly summarised as follows: two species, *C. sternithrix* and *C. keiseri* are restricted to the Evergreen Rainforest biome; *C. sternithrix* to the main eastern rainforest and *C. keiseri* exclusively to Parc National de la Montagne d’Ambre, a volcanic massif (maximum elevation 1475 m), covered in montane forest that rises from the surrounding dry areas. The sister species of *C. keiseri*, namely *C. stuckenbergi*, is restricted to the Central Highlands biome, in Ambohitantely Forest Reserve, which lies at elevations between 1300 and 1650 m. Two species, *C. coronaeformis* sp. n. and *C. gladiiformis* sp. n., are apparently restricted to the Central Highlands biome fragment in the south-central region of Madagascar, both being only

recorded from Fianarantsoa, near Parc National de la Isalo. *Curtonotum coronaeformis* sp. n., and its sister species *C. parkeri* sp. n., occur sympatrically, with *C. parkeri* sp. n. restricted to the south of the island. *Curtonotum rinhatinana* sp. n. is restricted to the Dry Deciduous Forests at Ankarafantsika National Park in the north-west of Madagascar, which forms a mosaic of dense, Dry Deciduous Forest. Two species: *C. sakalava* and *C. irwini* sp. n., although occurring in more than one biome type, are predominantly associated with the Arid Spiny Bush and the Dry and Subarid bioclimatic zones. *Curtonotum boeny* is restricted to the Dry Deciduous Forest biome, recorded from two localities: Ambato-Boeni and Parc National Tsingy de Memaraha. Its sister species, *C. griveaudi* sp. n., is much more widely distributed, occurring in the north-east, west and south-west of the island. *Curtonotum pauliani* occurs mainly in the north-east of Madagascar and is the only species of the genus recorded as occurring in the Sambirano Rainforest biome. Lastly, *C. balachowskyi* is widely distributed in Madagascar and occurs in four of Madagascar's biome types.

Vences *et al.* (2009) noted that radiations of Malagasy lineages resulted in a wealth of microendemics restricted to small ranges within the landmass of Madagascar and that species formation may have been influenced by bioclimatic disparities between the arid west and humid east (see also Dewar and Richard 2007). Populations of widespread species adapted to humid conditions remain isolated in Humid Forest relicts in predominantly dry areas during periods of cool and dry climate and, over time, diverge to become separate species without adapting to different climatic conditions. This may explain the microendemic species of *Curtonotum* (noted above) that are apparently restricted to specific isolated, afforested mountains and/or to biome fragments in the dryer western and northern regions of Madagascar (Vences *et al.* 2009). The previous assumption that deforestation of the Central Highlands and Dry Deciduous Forest biomes and subsequent forest fragmentation is wholly anthropogenic is a myth. This is evidenced by pre-anthropogenic charcoal and fossil data that demonstrate Pleistocene oscillation in the extent of these biomes and their associated vegetation cover (Bond *et al.* 2008; Burney *et al.* 2003; Vences *et al.* 2009).

Lineages of the Malagasy *Curtonotum* fauna will become more apparent once the combined morphological and molecular phylogeny of the Curtonotidae as a whole is published in Part IV of this revision, and Bayesian divergence dates are established for some of the African and Madagascan clades.

PHYLOGENY OF CURTONOTIDAE & REVISION OF CONTINENTAL
AFROTROPICAL *CURTONOTUM*
(CHAPTERS 2.0 & 3.4 COMBINED)

Spatial data coverage

Before an assessment can be made of biogeographical patterns exhibited in the continental Afrotropical species of *Curtonotum*, it is first necessary to assess the overall coverage of records within the Afrotropical Region and evaluate the strengths and weaknesses of the dataset.

It is inevitable that in a study such as this, which is largely based on the examination of museum specimens, there will be inconsistencies in the coverage of spatial information. The map presented in Fig. 3.4: 217 represents topographical distribution of all records for the genus *Curtonotum* from the Afrotropical Region and the Arabian Peninsula, including records for the island of Madagascar dealt with by Kirk-Spriggs (2011, Chapter 3.3). From this map it is apparent that the spatial coverage of records in the Region is extremely patchy, with vast tracts, particularly of African savanna country in central western Africa, West Africa and the Horn of Africa being under-represented.

Kirk-Spriggs (2003) noted that overall coverage of the Region is extremely poor with much of the available museum material having been collected during Africa's colonial past, often with specific agricultural or medical problems in mind. Contrary to popular belief, sampling conducted in the national parks of the Belgian Congo in the 1950s was not from the equatorial rainforests of central Africa, but from mesic savanna with gallery forest bordering rivers and streams, although some sampling was conducted in parks bordering the Great Rift Valley (*e.g.*, photographs and habitat descriptions in De Witte 1966). Kirk-Spriggs (2003) further noted that very few modern African states are actively working toward the sampling and ultimate bioinventory of their respective country's faunas and floras and new specimens and information are not readily forthcoming as a result. An example of one such study is the bioinventory study of the Diptera of Namibia, conducted by the National Museum of Namibia between 1997 and 2003, for which Diptera were systematically sampled throughout the country (Kirk-Spriggs and Stuckenberg 2009).

Records resulting from that survey, that are mapped on Fig. 3.4: 217, clearly indicate that, with the possible exception of the KwaZulu-Natal Province of South Africa (in the same region as the KwaZulu-Natal Museum), Namibia is the best sampled country in Africa for *Curtonotum*.

Fig. 3.4: 217 indicates that the genus is here recorded from 28 of the 43 sub-Saharan African states, but not from: Benin, Burkina Faso, Congo (Brazzaville), Djibouti, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Lesotho, Rwanda, Sierra Leone, Somalia, Swaziland and Zambia. Zambia alone, with a surface area of 752,614 km², represents a substantial gap in our coverage of southern Africa.

Although the genus is well-represented in Madagascar, with 13 species, 12 of which are apparently endemic (Kirk-Spriggs 2011; Chapter 3.3), the genus is not recorded from other oceanic islands of the Atlantic or Indian Oceans (including Ascension, Cape Verde, Comoros, Mauritius, Mayotte, Príncipe, Réunion, Sainte Helena, São Tomé, Seychelles, Socotra and Tristan da Cunha islands). One species is, however, recorded from the island of Zanzibar off the coast of Tanganyika.

Only one species, *C. simile*, occurs in Yemen in the Afrotropical part of the Arabian Peninsula, as well as Oman, the United Arab Emirates and Israel in the Palaearctic. The species is not recorded from Saudi Arabia, but should be expected to occur there and probably also across the Red Sea in Djibouti and Ethiopia.

Tsacas (1977) recorded the range of the genus *Curtonotum* as a whole as being from the 50 degree parallel in Eurasia and North America, noting that to the south the genus does not surpass 30 degrees in Africa and South America. New records presented here, indicate that the most northern record for an Afrotropical species of the genus (*C. simile*) is 30°51'N in Israel and the most southern record is 30°52'S for *C. cuthbertsoni* from the Eastern Cape Province of South Africa.

Phylogeny and distribution of species-groups of Afrotropical Curtonotum

The *Striatifrons* species-group comprises three species, none of which could be included in the molecular analysis. Results of the parsimony analysis (Fig. 2.0: 105 a), however, indicate that the species-group may be sister to a clade comprising the three Neotropical species of *Curtonotum* (s.s.) included in the analysis. The *Striatifrons* species-group is here regarded as a very ancient, perhaps the most ancient extant species-group of *Curtonotum*, as evidenced by unique features, such as the

divergent medial setae on male sternite 6 (also a features of the extinct fossil genus *Depressonotum* from Dominican Amber (Grimaldi and Kirk-Spriggs, in press), only partial fusion of the phallapodeme and basiphallus, the recurved distiphallus and the presence of the elongated lateral wing of the basiphallus. The dichotomy between *Curtonotum* (s.s.) and the *Striatifrons* species-group may be explained by the Neotropical species retaining some ancient features with the *Striatifrons* species-group, that have been lost in other Afrotropical species-groups.

Curtonotum striatifrons is confined to the xeric Dry Savanna climatic zone, bordering the Sahara Desert in the 1600–2000 mm Potential Evapotranspiration zone, *C. herrero* is restricted to the Namibian and Angolan sections of the Great Escarpment, and *C. maculiventris* has a much wider distribution, but is largely confined to medium to high elevations between ca. 801–1200 m and principally occurs along the Great Rift Valley.

The *Anus* species-group (*sensu* Kirk-Spriggs and Freidberg 2007; Klymko and Marshall 2011), comprises two Nearctic and three Palaearctic species. Results of the molecular analysis consistently place these two last-named species in a well supported clade that is sister to the remainder of the Old World *Curtonotum* (Figs 2.0: 100–104). Results of the parsimony analysis (Fig. 2.0: 105 a), that includes all Afrotropical taxa however indicate a trichotomy between the *Anus*, *Platyphallum* and *Rinhatinana* species-groups. The *Anus* and *Platyphallum* species-groups are undoubtedly closely related, given that both groups share the fused and spinose female cerci. *Curtonotum rinhatinana* also has the distiphallus sub-divided into two separate elements, here regarded as ancient feature of the genus.

The *Platyphallum* species-group, namely: *C. marriott* sp. n., *C. moffatt* sp. n. and *C. platyphallum*, all exhibit a transitional distribution between the Guineo-Congolian rainforest and savanna and probably represent an ancient group of species linked to the expansion and retraction of the Pan-African rainforest (see Discussion above).

The *Campsiphallum* species-group comprises seven species, two of which were included in the molecular analysis presented in Chapter 2.0. Results from that analysis (Figs 2.0: 100–103) and the combined molecular and morphological datasets (Fig. 2.0: 104) indicate that *Campsiphallum* species-group is sister to a clade comprising the *Uncinatum* and *Saheliense* species-groups. Results of the parsimony

analysis (Fig. 2.0: 105 a), differs, however, indicating that the *Campsiphallum* species-group is sister to the Madagascan endemic *Boeny* species-group.

Four species of the species-group are known from very limited ranges (Figs 3.4: 220, 221, 223, 224). *Curtonotum angolense* is restricted to the Angolan section of the Great Escarpment. Three species are known from isolated Afromontane forests bordering the Great Rift Valley, *C. freidberg* sp. n. to the Viphya Mountains of north-central Malawi (Figs 3.4: 220, 221), *C. hay* sp. n. from the Albertine Rift montane forests of Uganda (Figs 3.4: 220, 221), and *C. tsacas* sp. n. from the Ethiopian Highlands, through the Rift Valley forests and into the coastal lowland forests of South Africa (Figs 3.4: 223, 224). *Curtonotum sao* occurs in the more arid Dry Savanna and Sahel (or Wooded Steppe) climatic zones bordering the Sahara Desert.

Two species of the species-group are more widely distributed. *Curtonotum campsiphallum* has a specific association with the western and central Guineo-Congolian rainforests or its borders (Fig. 3.4: 220, 221) and *C. quinquevittatum* occurs at higher elevations (ca. 801–1200 m), but is widely distributed in sub-Saharan Africa (Fig. 3.4: 223, 224).

The *Gonzo* species-group may comprise two species, neither of which could be included in the molecular analysis, their position therefore remains unresolved. Results of the parsimony analysis (Fig. 2.0: 105 a), which includes all Afrotropical taxa, puts the *Gonzo* species-group as sister to a clade comprising the *Anus*, *Platyphallum* and *Rinhatinana* species-groups. *Curtonotum gonzo* sp. n. is probably mainly associated with fragmented rainforest remnants. *Curtonotum sternithrix*, a Madagascan endemic species shares several characters with *C. gonzo* sp. n. and is very tentatively ascribed to this group.

The *Saheliense* species-group comprises two allopatric sister species, *C. saheliense* and *C. simile* that are either confined to xeric regions bordering the Sahara Desert, or to the coastal margins of the Arabian Desert (Fig. 3.4: 222). Only one of these (*C. saheliense*) was included in the molecular analysis presented in Chapter 2.0. Results from that analysis (Figs 2.0: 100–103) and the combined molecular and morphological datasets (Fig. 2.0: 104) confirm the *Saheliense* species-group to be sister to the *Uncinatum* species-group. Results of the parsimony analysis (Fig. 2.0: 105 a), which includes all Afrotropical taxa, however, indicates that the *Saheliense* species-group is sister to a much larger clade comprising the *Uncinatum* species-group, plus seven other species-groups.

As noted above, Tsacas (1977) regarded *C. saheliense* (as *saheliensis*) to be restricted to the Sahel (or Wooded Steppe) vegetation zone. Even considering fluctuations in the latitudinal range of the Sahel, dependant on seasonal changes and rainfall patterns (*e.g.*, Kandji *et al.* 2006), records plotted here (Fig. 3.4: 222), indicate that the majority of records originate from the Dry Savanna vegetation zone (or Sudano-Sahelian belt), with some records considerably farther south in the Moist savanna vegetation zone (see also map in Greathead 1970: 90).

The distribution pattern of *C. simile* is of special interest, given its sister species relationship with *C. saheliense*. It is the only species that occurs on the Arabian Peninsula, the only species that occurs on both sides of the Red Sea (where its eastwards dispersal was probably curtailed by the Ethiopian Highlands) and the only Afrotropical species that extends into the Palaearctic Region. The extent of the Afrotropical parts of the Arabian Peninsula has been discussed by Kirk-Spriggs and Stuckenberg (2009: 157), where it was noted that recent sampling of Diptera in the Arabian Peninsula (especially the United Arab Emirates and Oman), together with published studies of the Rhopalocera (Larsen 1984) and the Neuroptera (Hölzel 1998) have questioned the limited Arabian Peninsula range of the Afrotropical Region (*sensu* Crosskey 1980), with Israel being regarded by some as the “faunal crossroads” between the Afrotropical, Palaearctic and Oriental Regions (*e.g.*, Furth 1975; Por 1975).

The *Uncinatum* species-group comprises ten species, nine of which were formerly regarded by Tsacas (1977) as phenotypes of the single species *C. cuthbertsoni*. Tsacas was, however, working with very limited material and as considerable additional material of the “group” is now available for study the status of these phenotypes can now be more accurately assessed. As noted above, these are here regarded as good species, given that they exhibit usually slight, but consistent differences in the shape of the basiphallus and distiphallus. The *Uncinatum* species-group is also regarded as of relatively recent origin (in evolutionary terms), as the crown-group is young and extinction has eliminated the “older” species. Speciation within the group likely occurred following the retraction of the Pan-African forest and the establishment of the xeric and mesic savanna and grassland biome mosaic.

Four species of the *Uncinatum* species-group were included in the molecular analyses presented in Chapter 2.0. Results from that analysis (Figs 2.0: 100–103) and the combined molecular and morphological datasets (Fig. 2.0: 104) indicate the

Uncinatum species-group to be sister to the *Saheliense* species-group. Results of the parsimony analysis (Fig. 2.0: 105 a), which includes all Afrotropical taxa, indicates that the *Uncinatum* species-group form part of a much larger clade comprising seven other species-groups that are also sister to the *Saheliense* species-group.

Four species of the species-group are known from very limited ranges (Fig. 3.4: 226). *Curtonotum cimbebas* sp. n. is restricted to the Namibian section of the Great Escarpment and close environs (as is *C. herrero* noted above). The Namibian Escarpment is well known as one of two Namibian endemism hotspots and there are numerous other examples of endemics in the flora and fauna (Barnard 1998; Kirk-Spriggs and Stuckenberg 2009). *Curtonotum constance* sp. n. is only known from a single high elevation (1150 m) locality in mesic savanna on the Angolan/Namibia border.

The two closely-related sister species, *C. mcgregor* sp. n. and *C. litoralis* sp. n., exhibit a distribution that is limited to the lowland humid forests of the coastal belt of eastern Africa (Fig. 3.4: 226). These forests occur from the extreme south-eastern corner of Somalia to the region of Port Elizabeth in South Africa and are ancient forests which resulted from the higher precipitation instigated by the warm waters of the Agulhas Current, that in turn draws more tropical elements of the flora and fauna southwards (Kirk-Spriggs 2003). These forests are one of Africa's biodiversity hotspots and are well known areas of endemism. Today these forests are highly fragmented due to human pressure.

The case of *C. pauliani* is of special interest. Originally described from Madagascar and thought to be endemic to the island (see above), it has now come to light in two widely separated localities, one in South Africa and one on the Namibian/Angolan border (Fig. 3.4: 226).

Four species, *C. bicuspis* sp. n., *C. cuthbertsoni*, *C. uncinatum* sp. n. and *C. unicuspis* sp. n. are quite widespread savanna species (Figs 3.4: 225, 227–230). These occur sympatrically at least at the extreme edges of their ranges (Fig. 3.4: 225, 227–230), especially in the 1200–2000 Potential Evapotranspiration zone (Fig. 3.4: 225). *Curtonotum uncinatum* sp. n. occurs principally in more xeric savannas of south-western Africa and the Kalahari *sandveld* (Fig. 3.4: 229), *C. bicuspis* sp. n. and *C. unicuspis* sp. n. share a similar mesic savanna distribution (Fig. 3.4: 227, 230) and *C. cuthbertsoni* occurs in the more mesic savannas of eastern Africa, with a somewhat disjunct distribution in eastern and southern Africa (Fig. 3.4: 228).

It is worth mentioning one distribution pattern that has been relatively well documented in the flora and fauna of the Afrotropical Region, being the disjunct distribution that is especially apparent in the two distinct desert regions north and south of the Equator, that are separated by *ca.* 3200 km of intervening country with substantially higher precipitation. These two regions occur in north-eastern Africa (Horn of Africa) and south-western Africa. Both these areas are extremely rich in endemic desert-adapted species and numerous examples of genera, species and even families restricted one or both are known (Kirk-Spriggs 2003). Two species of the *Uncinatum* species-group, *i.e.*, *C. uncinatum* sp. n. and *C. cimbebas* sp. n. (Figs 3.4: 226, 229) are more-or-less confined to the more xeric regions of south-western Africa, overall coverage of records (Fig. 3.4: 217), indicates that there are no records of the genus from the Horn of Africa; whether this is indicative of poor sampling effort or that the genus is absent from the region remains uncertain. Additional sampling in Somalia and eastern Ethiopia is required, but surprisingly no obvious disjuncture is apparent.

CONCLUSION

All 7 aims outlined in the Introduction were met during the preparation of this thesis, *i.e.*, an assessment of current taxonomic knowledge of Afrotropical Curtonotidae was undertaken (1); studies of primary types were conducted and type designations resolved (except in the case of *Cyrtona sensu lato*); (2); a molecular phylogeny was developed (3); a morphological cladistic phylogeny was developed and the family reclassified (4); a systematic revision of the family Curtonotidae is presented (5); including illustrated identification keys (6); and the zoogeography and species radiation of the group in Africa and the Middle East is discussed (7). The genus *Cyrtona sensu lato* was not revised in full, but examples are included in the molecular and morphological analyses resulting in at least partial resolution of the clade.

Additional suitably preserved specimens of species in genera of the “*Tigrisomyia* + *Cyrtona sensu lato* clade”, Afrotropical species of the *Striatifrons*, *Platyphallum* and *Gonzo* species-groups, plus unplaced Oriental species of *Curtonotum* are still required for inclusion in a molecular analysis, in order to help resolve relationships within and between these taxa.

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