

On the identity of the Natal fruit fly *Ceratitis rosa* KARSCH (Diptera, Tephritidae)

by Marc DE MEYER

Abstract

The identity of *Ceratitis (Pterandrus) rosa* KARSCH is discussed. *Ceratitis rosa* var. *fasciventris* (BEZZI) is considered as a separate species from *C. rosa* sensu stricto. Both species are redescribed with discussion on host plants, geographic distribution and additional evidence regarding their status.

Key words: Diptera, Tephritidae, *Ceratitis*, Afrotropics.

Introduction

Tephritidae are picture-winged flies of variable size and world-wide distribution. Although commonly named "fruit flies", the larval development can also take place in other parts of the host plants including flowers, seeds and stems. The currently acknowledged classification is presented by NORRBOOM *et al.* (1998). The genus *Ceratitis* belongs to the subtribe Ceratitidina (tribe Dacini) which is predominantly an Afrotropical group. All species of this genus are true fruit flies in the sense that the larvae develop in fruit (either fleshy parts or the seeds), and several of them are considered major pests of commercial fruits and crops. *Ceratitis* species of economic significance were listed by WHITE & ELSON-HARRIS (1992). Besides the mediterranean fruit fly (*C. capitata* (WIEDEMANN)), which is widespread over many parts of the world and attacking a wide variety of fruits, the Natal fruit fly, *Ceratitis (Pterandrus) rosa* KARSCH, is also listed as a major pest. It is a species originally from the African continent but with adventive populations on the Mascarenes (Mauritius and la Réunion). It is known to attack a wide variety of indigenous and commercial fruits. The Natal fruit fly is capable of outcompeting and displacing the mediterranean fruit fly in areas where both are introduced. In Mauritius, it displaced *C. capitata* as the major pest within four years of accidental introduction (HANCOCK, 1989). Recent studies in Réunion, where both species are adventive, show that it distinctly prefers higher elevations and a wetter climate than *C. capitata* (NORMAND *et al.*, 2000). DE MEYER (2001) outlined its occurrence in southern Africa where it also seems to prefer higher altitudes. It therefore holds a serious risk to spread and become established in areas outside its

normal distribution range, should it be accidentally introduced.

An unambiguous identification is therefore essential for any further studies on this pest species. *Ceratitis rosa* is included in the subgenus *Pterandrus* (HANCOCK, 1984, DE MEYER, 1999). In the literature two forms are recognised: *C. rosa* s.s. and *C. rosa* var. *fasciventris* (BEZZI). Both names are used and the distinction is not always clear. A study of type material and long series of both taxa, has shown that they should be considered as two distinct entities, with species status. In the male sex, they are morphologically separated by distinct secondary sexual characters, while females cannot be separated unambiguously. They also demonstrate a largely allopatric distribution pattern. The confusion between both entities is probably based on a misrecognition of the original species concept of *C. rosa*. This paper gives a redescription of both, with a discussion on the historical confusion that has led to the misrecognition, as well as an outline on distribution and additional evidence that may support their distinction.

Material and methods

Specimens from the following institutions were studied:
AMG: Albany Museum Grahamstown, South Africa (F. GESS)
BMNH: Natural History Museum, London, England (I.M. WHITE, N.P. WYATT)
BPBM: Bernice P. Bishop Museum, Honolulu, Hawaii (N. EVENHUIS)
CIRAD: Centre de coopération internationale en recherche agronomique pour le développement, Réunion Branch, Réunion (J.F. VAYSSIERES/S. QUILICI)
CNEARC: Centre National d'Etudes Agronomiques des Régions Chaudes, Montpellier, France (A. BARBET)
KBIN: Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussel, Belgium (P. GROOTAERT)
KMMA: Koninklijk Museum voor Midden Afrika, Tervuren, Belgium
MNHN: Muséum national d'Histoire Naturelle, Paris, France (J. CHARBONNEL, L. MATILE)

MNHU: Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (M. KOTRBA)

NMK: National Museums of Kenya, Nairobi, Kenya (K. MAES)

NMSA: Natal Museum, Pietermaritzburg, South Africa (D. BARRACLOUGH)

PPRI: Plant Protection Research Institute, Pretoria, South Africa (M.W. MANSELL)

TAU: Tel Aviv University, Tel Aviv, Israel (A. FREIDBERG)

USNM: United States National Museum of Natural History, Washington D.C., U.S.A. (A. NORRBOM)

Type material was studied for all available names including junior synonyms. Terminology in the descriptions follows WHITE & ELSON-HARRIS (1992), except for wing banding which is according to FREIDBERG (1991). Drawings were made with a drawing tube attached on a dissecting or compound microscope. Measurements of wing length and approximate body length (average + range) are given in mm and were based on 10 specimens of each sex. Body length measurements are without oviscape for females. As in other revisions by the author (DE MEYER, 1996, 1998) lectotypes and paralectotypes are designated for those species described on a series of syntypes. In accordance with rule 74.7. of the International Code of Zoological Nomenclature (4th Edition, 1999), the designation is explicitly mentioned at each individual case and sufficient information is given. With reference to rule 74.7.3 of the code, the taxonomic purpose of this practice is to ensure taxonomic stability in the species recognition. Geographic distribution data mention all countries from which material was studied. Family designation for host plant data is based on BRUMMITT (1992). Particular details on sources of hosts and whether they need to be confirmed, are listed separately.

Taxonomic account

Ceratitis (Pterandrus) fasciventris (BEZZI) stat. nov.
(Figs 1, 2a, b)

Pterandrus rosa var. *fasciventris* BEZZI, 1920: 228.

Pterandrus flavotibialis HERING, 1935: 158.

Type material examined. Lectotype (hereby designated), ♂, UGANDA, 17.VIII.1911, G. GOWDEY (BMNH). Paralectotype (hereby designated) ♀, same date and locality as lectotype (BMNH). Lectotype *flavotibialis* (hereby designated), ♂, CONGO (D.R.), Rutshuru, November 1934, "Nr D 7376", C. SEYDEL (BMNH). Paralectotype (hereby designated), ♀, same date and locality as lectotype (BMNH).

Additional material. ANGOLA: 1♂, Bruco, 26.II-2.III.1972 (BMNH). CONGO (D.R.): 1♂ 1♀, Bobandana, Kivu, December 1937, J. GHESQUIÈRE (KMMA); 4♂♂

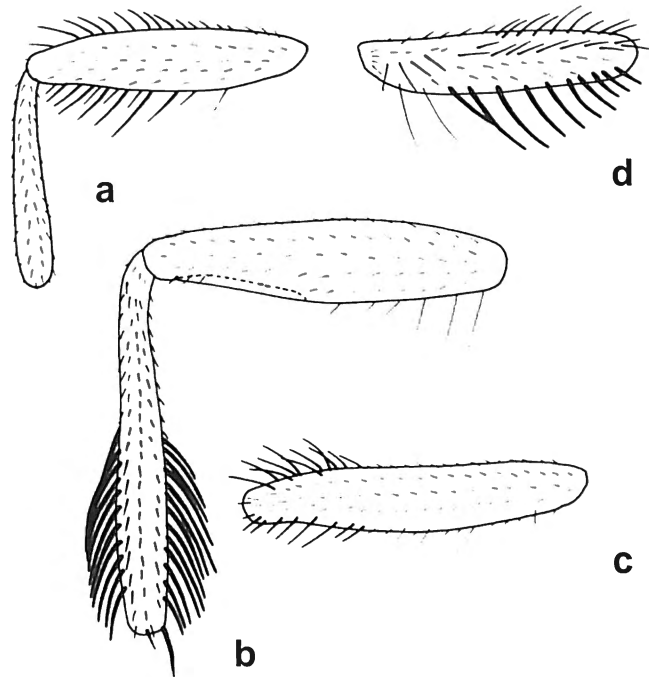


Fig. 1 — Male leg feathering of *Ceratitis fasciventris* in anterior view: a, front femur and tibia, b, mid femur and tibia, c, hind femur; posterior view: d, front femur.

5♀♀, Bukavu, April 1938, J. GHESQUIÈRE (KBIN); 1♂, Elisabethville, February 1958, "à la lumière", C. SEYDEL; 1♂ 1♀, Ituri, Logo, 15.VI.1937, H.J. BRÉDO; 1♂ 2♀♀, Katombe, Katanga, February 1935, "D. 7376", C. SEYDEL (KMMA); 1♂, Mahagi, 11.XII.1959, "récolté sur caféier", J. DUBOIS; Mulungu, 2♂♂ 5♀♀, 6.VII.1938, 2♀♀ specimens with extra label "s/ Eryobotrya japonica", HENDRICKX; 12♂♂ 16♀♀, November 1938, HENDRICKX; Parc National de Garamba, 1♂, II/id/10, 11.IX.1951, "2419"; 1♂, II/fd/17, 3.IV.1952, "3279", both DE SAEGER (KMMA); Rutshuru, 127♂♂ 140♀♀, January 1937-March 1938 [different dates], some specimens labelled "ex baies de caféier", J. GHESQUIÈRE (KBIN); 1♂ 1♀, 26.XII.1933, 1285m, G.F. DE WITTE; 1♂, 29-30.XII.1933, 1285m, G.F. DE WITTE; 3♀♀, 2.VII.1935, G.F. DE WITTE; 1♂, 24.IV.1936, L. LIPPENS; 2♂♂, 19.V.1936, L. LIPPENS; 1♀, Rutshuru (riv. Musugereza), 10.VII.1935, 1100m, G.F. DE WITTE (all KMMA); Rwankwi, 1♀, 23.XII.1943; 1♀, 31.III.1946, both J. LEROY (KMMA); 2♂♂ 1♀, Sake, May 1937, J. GHESQUIÈRE (KBIN); 1♀, Tshengelero (nr Munagana), 21.VIII.1934, 1750m, G.F. DE WITTE (KMMA). ETHIOPIA: 1♂, Kaffa, Badabuna forest, 17.XI.1964, "ex coffee berry", D. GREATHEAD (BMNH); 1♀, Limu, Buntu, 19.XI.1964, "on coffee", D. GREATHEAD (BMNH); 1♀, Yrgalem, 11.V.1961, "at lighted tent", L.W. TELLER (USNM). GUINEA: 2♂♂, Macenta, October-November 1953, R. PIJOL (MNHN); Kankan, 17-20.VI.1995, 1♂, mango "P.P. CUISSE Mme"; 1♂, mango "P.P. Miami", both J.F. VAYSSIERES (CIRAD). IVORY COAST: 9♂♂, Kor-

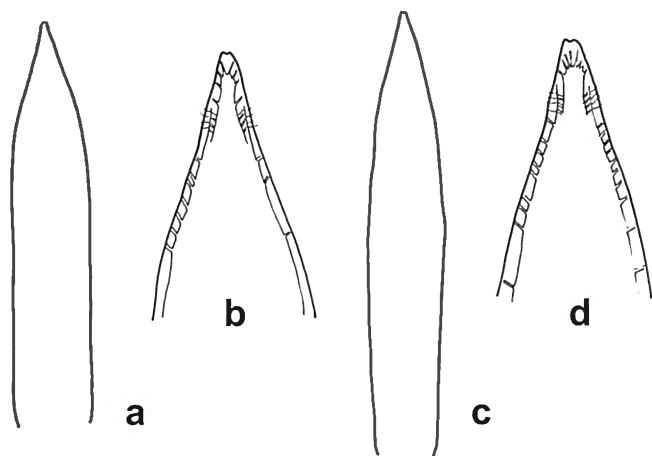


Fig. 2 — Female aculeus of *Ceratit* *fasciventris*: a, full length, b, tip; *Ceratit* *rosa*: c, full length, d, tip.

hogo, June-September 1999, “mango orchards near city of Korhogo”, A. BARBET (CNEARC). KENYA: 1♂ 2♀♀, Busia, 1000m, 29.II.1995, “emerged from coffee berries”, Vaamonde (BMNH); 1♂, Doondu, Kiambu distr., 1540m, 29.IV.1988, “on coffee arabica”, I. WHITE & CIBC (BMNH); 3♂♂ 2♀♀, Kabete, November 1969, “bred from damaged peaches” (BMNH); 1♀, Kakamega, Bokum, 25.X.1949, R. PELLEY (USNM); Kakamega forest, 1♂, 5200ft, 20.XII.1970, A. STUBBS (BMNH); 1♂ 1♀, 24.XI.1982, WHITTINGTON & LONDT (NMSA); 5♂♂ 6♀♀, 14.I.1996, I. YAROM & A. FREIDBERG (TAU); Karura, June 1936, “ex *Rawsonia*” V. VAN SOMEREN, 1♂ (NMK); 1♀ (PPRI); 1♂ 1♀, Migori, 26.V.1995, “on guava” (ICIPE); Nairobi, April 1936, “loquat”, KRAUSS 5♂♂ 13♀♀ (USNM); 15♂♂ 16♀♀ (BPBM); “*Dorvyalis caffra*”, 4♂♂ 2♀♀; June 1936, 1♂, “ex *Rawsonia*”, VAN SOMEREN (PPRI); 3♂♂ 14♀♀, “*Rawsonia usambarensis*”, KRAUSS (USNM); August 1937, 1♂, “ex coffee”, VAN SOMEREN (NMK); 1♂, 1937, “ex loquat”, VAN SOMEREN (NMK); 1♂, “ex keiapple”, VAN SOMEREN (PPRI); 1♀, September 1937, “ex keiapple” VAN SOMEREN (USNM); 1♀, November 1937, “ex *Dorvyalis*”, VAN SOMEREN (NMK); 1♂, April 1938, “ex *Rawsonia*”, VAN SOMEREN (NMK); 2♂♂, 15.VII.1949, “ex coffee”, SKINNER & MCGOUGH (USNM); 1♀, July 1949, SKINNER & MCGOUGH (USNM); 1♀, 26.XI.1949, “ex *Warburgia ugandensis*”, J. MCGOUGH (USNM); 2♂♂ 1♀, 25.V.1950, “McG107B” [= ex *Drypetes* acc. Munro’s archives], MCGOUGH (USNM); 1♂, Ngong, June 1939, “ex *Drypete*”, VAN SOMEREN (NMK); 1♂ 1♀, unknown locality, “fr coffee CIE A20210” (BMNH). MALI: 1♂, Madina, 5.VII.2000, J.F. VAYSSIÈRES (CIRAD). NIGERIA: 3♀♀, Zaria, Samaru, 17.VI.1978, “on mango fruits”, S.A. APEJI (BMNH); RWANDA: 1♂, Contref. Est. Muhavura, 28.I.1953, 2100m, P. BASILEWSKY (KMMA). SAO THOME: 1♂, 28.V.1973, “cacao”, J. DERRON (BMNH). SIERRA LEONE: 4♂♂ 12♀♀, Freetown, March 1936, “*Anisophyllea laurina*”, VAN ZWALUWENBURG & MCGOUGH (USNM); 3♂♂ 4♀♀, Njala, May 1947,

“M877” [= ex *Anisophyllea laurina* acc. Munro’s archives], F.A. SQUIRE (PPRI). UGANDA: 2♀♀, unknown locality, F. BIANCHI (USNM); 1♀, Ankole, Kichwamba, 23-29.IV.1968, P.J. SPANGLER (USNM); 12♂♂ 5♀♀, Budonga, May 1936, “*Myranthus arboreus*”, BIANCHI (USNM); 3♀♀, Busingiro, May 1936, “guava”, F. BIANCHI (USNM); 1♂, Kamengo, 8.IX.1949, VAN SOMEREN; 1♂, Kampala, 29.VII.1929, “ex avocado peach” [?, last word partly illegible], H. HARGREAVES; 1♂, Kibale forest, April 1973, “ex *Pencovia turbinata*”, P. WASER; 1♂, KISORO, J. GHESQUIÈRE (KBIN); 1♂, W. Nile, 13.XI.1958, J.BOWDEN (TAU); 1♂, unknown locality, D. BRUCE (all BMNH).

Description.

Body length: 4.47 (3.95-5.15) mm; wing length: 4.96 (4.45-5.75) mm.

Male

Head. Antenna yellow-orange. First flagellomere twice to three times as long as pedicel. Arista with short to medium long hairs; ventrally hairs shorter and sparser, especially basally. Frons yellow; with short scattered hairs which are distinctly darker than frons. Frontal bristles well developed. Face yellowish white. Genal bristle dark; genal setulae dark, well developed.

Thorax. Postpronotum yellowish white, without spot. Scutal pattern as in fig. 1f: ground colour dark grey, sometimes with orange tinge; with streaks and darker markings but no distinct spots, except prescutellar white markings separate, usually joined with pale spot, occasionally merged. Scapular setae dark. Scutellum yellowish white, basally usually without dark spots, rarely with two separate spots; apically with three separate spots, reaching till halfway, sometimes till basal third. Anepisternum with lower half yellow-brown; pale pilosity.

Legs yellow except where otherwise noted; setation typical for subgenus, mixed pale and dark. Front leg (Fig. 1), anteriorly at most slightly darker yellow; femur without bushy feathering posteriorly, only row of dispersed, long and usually black hairs posteriorly, postero-dorsally and posteroventrally shorter and pale; ventral bristles black. Mid leg (Fig. 1b), femur with dispersed pale hairs at base ventrally; mid tibia not broadened; anteriorly with inconspicuous silvery shine in distal half when viewed from certain angle; ventrally and dorsally with dark feathering along distal half. Hind femur at apical fourth with longer hairs dorsally and ventrally.

Wing. Banding with brown or yellow-brown markings. Clear and complete interruption after R1 between marginal and discal bands; cubital band free; medial band absent; crossvein r-m at middle of discal cell, sometimes just before middle. Vein R1 extending beyond crossvein r-m. Crossvein dm-cu posteriorly more outwards than anteriorly.

Abdomen. Yellow. Tergite 2 and 4 with pale grey band in posterior half, anterior margin sometimes with narrowly brownish coloured. Tergite 3 with distinct black-brown band along posterior half; rarely more complete

brown. Tergite 5 with basal half brownish, sometimes divided medially into two spots, or only narrowly brownish along anterior margin.

Female. As male except for the following characters: Lower half anepisternum brown or yellow-brown. cross-vein dm-cu variable. Legs without feathering; front femur with posterodorsal row usually partly dark; front femur posteroventrally with pale pilosity. Oviscape shorter than preabdomen. Aculeus as in fig. 2a,b

Comments. NORRBOM *et al.* (1998) mention that syntypes of *flavotibialis* were also deposited in the collection of Hamburg but were destroyed. From the original publication, it is however not certain type material was deposited at any stage in Hamburg.

Distribution: Angola, Congo (D.R.), Ethiopia, Guinea, Ivory Coast, Kenya, Mali, Nigeria, Rwanda, Sao Thome, Sierra Leone, Uganda and Zambia (the latter based on records for "rosa" from Zambia by HANCOCK (1987) which are, in fact, referring to *fasciventris* (HANCOCK, pers. comm.)). See discussion for more details on distribution pattern of both species.

Host plants. Because this species was incorporated in *rosa* no separate host data are known. From the material examined the following commercial host plants can be listed: avocado (*Persea americana*), cacao (*Theobroma cacao*), coffee (*Coffea* sp.), guava (*Psidium guajava*), keiapple (*Dovyalis caffra*), loquat (*Eriobotrya japonica*), mango (*Mangifera indica*), and peach (*Persea persica*).

Ceratitis (Pterandrus) rosa KARSCH

(Figs 2c, d; 3)

Ceratitis rosa KARSCH, 1887: 1.

Type material examined. Holotype, ♂, MOZAMBIQUE, "Delagoabai", R. MONTEIRO (MNHU).

Additional material. KENYA: 1♂ 1♀, Diani Beach, July 1951, KRAUSS (PPRI); 1♂ 1♀, Mtwapa, 4.XI.1969, H.L. ADENYA, "ex guava" (BMNH); Rabai, August 1937, "caught on bait", V. VAN SOMEREN, 2♀♀ (NMK); 2♀♀ (PPRI); 1♂, Shimba Hills, July 1939, V. VAN SOMEREN, "ex fruit Nr 2" (BMNH). LESOTHO: 1♀, Mamathes, 22.III.1950, A. JACOT-GUILLARMOD (AMG). MALAWI: 1♂, Bvumbwe, 9.II.1988, "ex ripe peach" (BMNH); 1♀, Limbe, 22.IX.1916, R.C. WOOD (BMNH); 1♀, Livingstonia, 21.II.1942, 4400ft, R.C. WOOD (BMNH); 1♀, Zomba, 1.III.1915, "mango fruit", C. MASON (BMNH). MAURITIUS: 1♂, Black River, 17.VI.1971; Macchabee Forest, 1♂, 1.VI.1971; 1♂, 8.VI.1971, all A.M. HUTSON (BMNH). MOZAMBIQUE: Luabo, 7♀♀, January 1956, P. USHER (NMSA); 1♀, September 1957, P.I. STUCKENBERG (NMSA); 2♂♂ 2♀♀, Namaacha, 24.VI.1949, "ex loquat", SKINNER & MCGOUGH (USNM). REUNION:

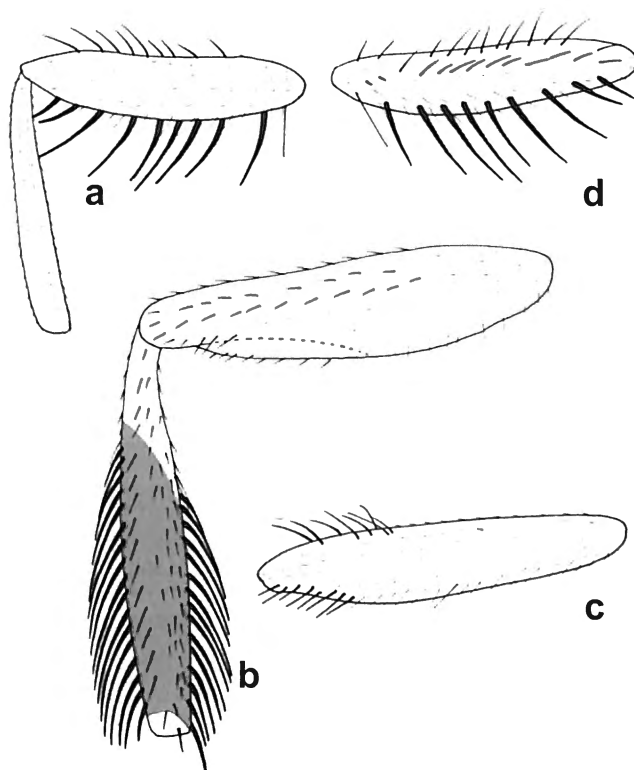


Fig. 3 — Male leg feathering of *Ceratitis rosa* in anterior view: a, front femur and tibia, b, mid femur and tibia, c, hind femur; posterior view: d, front femur.

20♂♂ 20♀♀, Station de Bassin Plat, St Pierre (Laboratory rearing stock), 22.II.2000, S. QUILICI (CIRAD). SOUTH AFRICA: Cedara, 1♀, January 1933 (USNM); 1♀, April 1949, "ex Solanum auriculatum", SKINNER & MCGOUGH (USNM); 1♀, Dukuduku, March 1949, "51A" [= ex *Strychnos* acc. Munro's archives], J. MCGOUGH (USNM); Durban, 1♂, 24.II.1915, H.M. MILLER (BMNH); 1♂, 2.V.1915, L. BEVIS (BMNH); 1♀, 21.VIII.1916, C.P. VAN DER MERWE (BMNH); 2♀♀, February 1932, W. MARRIOTT, bait trap (NMSA); 1♂, March 1932, W. MARRIOTT, bait trap (NMSA); 1♂ 1♀ [no date given] (USNM); 1♀, Durban Seaton Pk, November 1936, W. MARRIOTT (KMMA); 1♂, Empangeni, 2838'S 3142'E, 5-15.I.1990, Reavell (NMSA); 2♂♂ 3♀♀, Enon Farm, Richmond, January 1964, B & P. STUCKENBERG (NMSA); 1♂ 1♀, Gilllits, 11.IX.1960, B. & P. STUCKENBERG (NMSA); Eshowe, 1♀, 2.IV.1949, "ex *Strychnos*"; 1♂, 12.IV.1949, "ex guava"; 1♂, April 1950, "106" [= ex chinese guava acc. Munro's archives], all J. MCGOUGH (USNM); 1♂, Grahamstown, 28.IV.1949, "reared from squash", MCGOUGH & SKINNER (USNM); Hilton Road, 1♀, 21.XII.1953, P. GRAHAM (NMSA); 1♂, January 1954, B. STUCKENBERG (NMSA); 1♀, Karkloof Forest, 9km S & 6km W of Rietvlei, 21-25.II.1978, 1525m, DAVIS & AKERBERGE (USNM); 1♂ 1♀, Kwambonambi, March 1949, "50A" [= ex guava acc. Munro's archives], J. MCGOUGH (USNM); 1♀, nr Lilani, Ahrens district, April 1962, B. & P. STUCKENBERG (NMSA); 1♂, Louis Trichardt, March 1928, G.G. HAY (KMMA); 1♂, Maritzburg

[?= Pietermaritzburg], December 1912, "on peaches", G. FULLER (BMNH); 1♀, Mtubatuba, 24-25.III.1968, P.J. SPANGLER (USNM); 2♂♂, Ngoya forest, Mtunzini distr., 19-21.III.1968, POTGIETER & GOODE (NMSA); 3♀♀, Pearl, November 1959, A.C. MYBURGH (USNM); Pietermaritzburg, 1♂, December 1912, C. FULLER (NMSA); 1♂, 10.I.1923 (NMSA); 2♀♀, 3.II.1949, J. MCGOUGH (USNM); 1♂, 21.II.1962, B. & P. STUCKENBERG (NMSA); 1♂, November 1976, town bush, R. MILLER (NMSA); 1♀, 8.II.1994, "on pawpaw", K. R. CRADOCK (NMSA); Pietermaritzburg, Montrose, 2934'45''S 3020'4''E, 1♂, 22.III.1992, banana bait, J. LONDT (NMSA); 2♂♂ 1♀, 30.III.1992, "garden/house", J. LONDT (NMSA); 1♂, Port Elisabeth, January 1957, KRAUSS (USNM); 1♂, Port St. Johns, 20-25.XI.1961, B. & P. STUCKENBERG (NMSA); Pretoria, 1♂, 15.II.1914, G.A.H. BEDFORD (BMNH); 1♀, 6.III.1914 (BMNH); 1♂, 7.IV.1914 (NMSA); 1♀, 10.V.1916, "from guavas" (NMSA); 1♀, 7.III.1931, G. VAN SON (NMSA); 4♀♀, 10.II.1971, J.H. POTGIETER (NMSA); 1♀, 10.I.1995, A. FREIDBERG (TAU); 1♂ 4♀♀, Pretoria, Lynwood, 1400m, 11.I.1994, "ex *Ficus carica*", M. MANSELL (PPRI); 32♂♂ 25♀♀, Stellenbosh, Cape Prov., January 1949, A.C. MYBURGH (USNM); 1♂, Umlalazi Nat. Res., E. Mtunzini, 16.VII.1978, R. MILLER, coastal indigenous forest (NMSA); 1♀, Umtumvuna nat. Reserve, 15.VII.1983, "attracted to jam in wooded stream gully", J. MANNING (NMSA). TANZANIA: Amani, 27.II.1936, "strawberry guava", F. BIANCHI, 5♂♂ 11♀♀ (BPBM); 10♂♂ 19♀♀ (USNM); 30♂♂ 22♀♀, March 1936 (some specified as 19.III.1936), "strawberry guava", BIANCHI & KRAUSS (USNM); "Myrianthus arboreus", 1♂, 27.II.1936; 13♂♂ 17♀♀, March 1936, all BIANCHI (USNM); Arusha, June 1936, "coffee arabica", F. BIANCHI 11♂♂ 13♀♀ (USNM); 3♂♂ 2♀♀ (BPBM); Engare Sero, nr Arusha, March 1936, 20♂♂ 20♀♀ "guava"; 13♂♂ 10♀♀, "collected strawberry guava"; 4♂♂ 3♀♀, "collected orange"; 1♂ 6♀♀, 25.III.1936, "collected quince", all F. BIANCHI (USNM); 1♂ 5♀♀, March 1936, "guava", F. BIANCHI (USNM); Lushoto, 16♂♂ 20♀♀, December 1935; 1♀, January 1936, all "ex peach", F. BIANCHI (USNM); 1♂ 5♀♀, 24.VIII.1996, 1300m, A. FREIDBERG (TAU); 1♀, Makoa, 22-23.II.1952 (BMNH); Morogoro, 1♂, 9.VI.1925, "ex *Psidium japonicum*"; 1♂, 26.V.1925, "ex *Anona muricata*"; 2♂♂, July 1922, "guava", all A.H. RITCHIE (BMNH); 1♂, Moshi, 1-15.I.1935, "ex *coffea arabica* cherry", A. RITCHIE (BMNH); 9♂♂ 21♀♀, Segoma, 25.II.1936, "guava", BIANCHI & KRAUSS, 9♂♂ 21♀♀ (BPBM); 1♀ (USNM); Tengeru, 1♂ 1♀, 28.II.1979; 1♀, 14.III.1980, all "from guava fruit", F. JONGELEER, (BMNH); Vickers Est., nr Arusha, 5♂♂ 12♀♀, 29.III.1936, "on coffee"; 2♂♂ 1♀, 30.III.1936, "on peach", all F. BIANCHI (USNM). ZIMBABWE: 1♂ 3♀♀, Harare, 25.III.1976, "bred from avocado", P.HULLEY (AMG); 1♀, January 1959, "B.R.S. P.G." (PPRI).

Description.

Body length: 4.96 (4.25-5.30) mm; wing length: 5.34 (4.50-5.75) mm.

Male

Head. Antenna yellow. First flagellomere twice to three times as long as pedicel. Arista with short to medium long hairs; ventrally hairs shorter and sparser, especially basally. Frons yellow; with short scattered hairs which are distinctly darker than frons. Frontal bristles well developed. Face yellowish white. Genal bristle dark; genal setulae dark, well developed.

Thorax. Postpronotum yellowish white, without spot, although sometimes darker yellow around postpronotal seta. Scutal pattern similar to figs 1e and 1f: ground colour greyish-brown with orange tinge; with streaks and darker markings but no distinct spots except, prescutellar white markings separate, usually joined with paler spot. Scapular setae dark. Scutellum yellowish white, basally usually with two dark separate spots, sometimes less distinct; apically with three separate spots, reaching till basal third. Anepisternum with lower half darker yellow-brown; hairs pale.

Legs (Fig. 3) yellow except where otherwise noted; setation typical for subgenus, mainly pale. Front leg, femur without bushy feathering posteriorly, only dispersed rows of long black hairs posterodorsally, posteroventrally shorter and pale; ventral bristles black. Mid leg (Fig. 3b), femur with few dispersed pale hairs ventrally; mid tibia moderately broadened; anteriorly black with conspicuous silvery shine when viewed from certain angle in distal 2/3 to 3/4 (black colour sometimes inconspicuous in teneral specimens but silvery shine is always present) with black feathering dorsally along distal 3/4 and ventrally along distal 2/3, occasionally along distal 3/4. Hind femur at apical fourth with longer hairs dorsally and ventrally.

Wing. Banding with yellow-brown markings. Clear and complete interruption after R1 between marginal and discal bands; cubital band free; medial band absent; crossvein r-m at middle of discal cell. Vein R1 extending beyond crossvein r-m. Crossvein dm-cu posteriorly more outwards than anteriorly.

Abdomen. Yellow. Tergite 2 and 4 with pale grey band in posterior half, anterior margin sometimes with narrowly brownish coloured, especially laterally. Tergite 3 with posterior half patchily brownish coloured, anterior half yellow-brown, both parts not clearly demarcated; sometimes more complete brown. Tergite 5 with basal half brownish, sometimes divided medially into two spots.

Female. As male except for the following characters: First flagellomere yellow-orange. Cross-vein dm-cu posteriorly more inwards than anterior end. Anepisternum in lower part rarely with darker hairs below. Legs without feathering; front femur posteroventrally with pale pilosity, at least in basal part, distally sometimes dark hairs. Oviscape shorter than preabdomen. Aculeus as in figs 2c,d (specimens from Luabo, Mozambique seem to have an aculeus tip which is without and indentation but otherwise completely fit the description of *rosa*. They are tentatively placed here).

Distribution: Kenya, Lesotho, Malawi, Mauritius, Mozambique, Réunion, South Africa, Tanzania and Zimbabwe. Other records are uncertain because of confusion with *fasciventris*.

Host plants. Recorded from a wide variety of host plants; see WHITE & ELSON-HARRIS (1992) for a review. Material examined confirmed records from guava (*Psidium guajava*), strawberry guava (*P. littorale*), peach (*Persea persica*), loquat (*Eriobotrya japonica*) and arabica coffee (*Coffea arabica*). Furthermore from *Annona muricata*, *Ficus carica*, *Myrianthus arboreus*, *Solanum auriculatum*, and *Strychnos* sp. Specimens were also collected on orange, pawpaw and quince but not certain whether they were actually reared from these plants.

Taxonomic history

As mentioned in the introduction *C. fasciventris* was considered merely as a variation of *C. rosa*. The latter was described by KARSCH (1887) based on a single male from "Delagoabai". In his original description KARSCH partly indicates two characters important for a correct identification: the feathering and silvery shine of the mid tibia ("die Mittelschienen mit blauschwarzen Schuppenwimpern, an der Aussenseite silberweiss glänzend tomentirt") and the brownish banding of the abdomen ("Hinterleib dicht grau bestäubt, der zweite Ring oberhalb mit braunem Hinterrande"). He does not mention the black colouration in the feathered part of the mid tibia. All these characters are still clearly observable in the holotype. BEZZI (1920) describes *fasciventris* as a mere variation, based on it having "well developed blackish bands on the abdomen" which he further elaborates in the description ("the abdomen in both sexes shows a distinct, complete, blackish, rather shining cross band on the apical half of the second segment"). Otherwise he reports that the feathering of the legs is as in *rosa*, both also does not mention any difference in colouration of the mid tibia. Finally HERING (1935) described *flavotibialis*, which he stated is related to *rosa* and *fasciventris*, but can be differentiated by the mid tibia being completely yellow ("die Mittelschienen, abgesehen von der dunklen Behaarung, einfarbig gelb sind, bei den verglichenen Arten sind sie aussen nur basal gelb, sonst violettschwärzlich, mit einem weisslichen Schimmer auf den dunklen Partien"). *C. flavotibialis* and *fasciventris* were placed in synonymy, apparently by COGAN & MUNRO (1980) although it is not explicitly mentioned in their publication as a new synonymy.

Morphological differentiation

Study of type material of *flavotibialis* and *fasciventris* has shown that both are indeed identical. Both species have completely yellow legs, without conspicuous silvery shine, and with the black feathering reaching at most till

half-way. The abdominal tergite 3 (erroneously called second in the references quoted above) has a distinct black band along the posterior half while the anterior part is yellow, although in some types this is not clearly visible anymore because of greasing. The type of *rosa*, on the other hand has the mid tibia largely black coloured and with conspicuous silvery shine, the feathering reaching further than half-way, and the abdominal tergite 3 largely patchy brownish posteriorly and not clearly demarcated from the anterior part. Study of long series of both taxa has shown that these characters are more or less reliable, with only a few aberrant species found (mainly darker colouring also present in mid tibia of *fasciventris* species, but never black). The fact that BEZZI, when describing the variation *fasciventris*, failed to recognise the fact that *rosa* s.s. also has the abdominal tergite 3 partly darker coloured, as well as the differences in the mid tibia, probably resulted in the confusion regarding the species recognition. Since both species are not always easy to differentiate because of overlap of secondary characters, this consequently resulted in the failure to recognize *fasciventris* and *rosa* as two different entities. Males of *rosa* can be differentiated from *fasciventris* by the feathering and coloration of mid tibia. Feathering in *rosa* is longer than in *fasciventris*. In this regard, we measured the entire tibia length (tl), and the outer feathering length (efl), and calculated the ratio $((\text{efl} \times 100) / \text{tl})$ in 70 *rosa* and 39 *fasciventris* specimens. Representatives of all geographic regions where both species occur, were incorporated. The ratios were plotted in a curve with discrete intervals of 2 units (Fig. 4). The graph shows that very little overlap is found between both entities but that a distinct bimodal curve is produced. The feathered part of the tibia is usually darkly coloured with a distinct silvery shine in *rosa*, while yellow and not silvery in *fasciventris*. In teneral specimens of *rosa* the dark colour is not always distinct but silvery shine is. Some material of *fasciventris* from western Africa is however slightly aberrant in that the feathered part of the tibia is also partly or largely darkened (but without a silvery shine). At the present moment we consider these conspecific with *fasciventris* from Central and eastern Africa.

The females are more difficult to differentiate. There are some tendencies. In *rosa* specimens, the scutellum usually bears two basal spots, which are not always discernible in *fasciventris*. *C. rosa* specimens have a largely patchy brownish band on abdominal tergite 3, while in *fasciventris* the banding is more strictly delimited. There is however, a considerable overlap, so that female species recognition is not unambiguous and one has to rely on associated males or geographic origin of the material (cf. below).

Additional evidence

DE MEYER (2001) produced a distribution map for both species. The original distribution of *rosa* seems to be restricted to southern to eastern Africa. It is found in

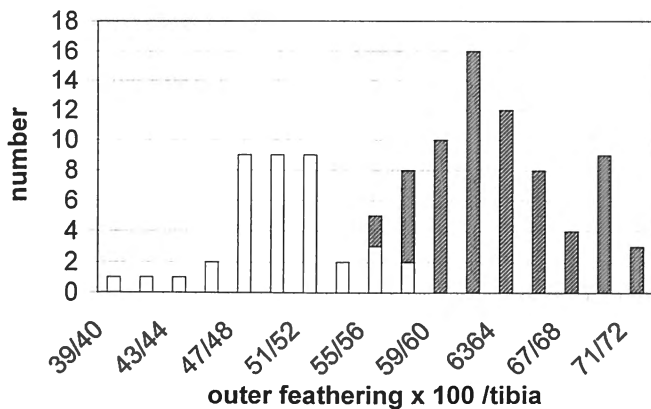


Fig. 4 — Ratio of length with outer feathering (x100) to total length of male mid tibia in *Ceratitis fasciventris* (white columns) and *Ceratitis rosa* (striped columns).

South Africa along the Cape Coast and into the higher regions of northeastern South Africa, continuing northwards into eastern Zimbabwe (east of the Bulawayo-Harare axis). Furthermore Mozambique, Malawi, and reaching northwards into eastern Africa till the border between Kenya and Tanzania, partly extending into Kenya along the coast. The occurrence of *C. rosa* in Mauritius and Réunion is due to accidental introductions. *C. fasciventris* has a more scattered distribution. It is mainly a Central Africa species venturing into Ethiopia and Kenya but reaching southwards only till the above mentioned border and not reaching the Kenyan coast. In Central Africa it is mainly found in the Kivu region of Congo, venturing southwards till the border with Zambia. It is also reported from a number of isolated localities in western Africa and Angola/North Namibia. The male specimens from western Africa are slightly aberrant from the others (cf above). Both species therefore show an allopatric distribution. There is only one area in Kenya where both species apparently co-occur but this needs further investigation (S. LUX & N. ZENZ, pers. comm.).

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Recently DOUGLAS & HAYMER (2001) studied ribosomal ITS1 polymorphisms in *C. capitata* and *C. rosa*. ITS (internal transcribed spacer) sequences from ribosomal DNA tend to harbor polymorphisms that can be used for molecular systematic studies of lower level taxonomic relationships, since it concerns non coding and relatively fast evolving regions (DOUGLAS & HAYMER, 2001). In this study, a substantial difference in the size of the ITS1 region was observed between individuals of *C. rosa* from Kenya and South Africa. The difference seems to be the result of a single insertion or deletion event and this type of polymorphism is unusual for comparisons involving only geographically defined strains of the same species. Study of voucher specimens (courtesy of G. FRANZ, Seibersdorf) have revealed that it concerns her representatives of *rosa* from South Africa and *fasciventris* of Kenyan populations. However, under laboratory conditions, it was shown that both strains can interbreed and produce viable offspring in both sexes (FRANZ, pers. comm.). The male offspring of these crosses shows a variation in the feathering of the mid leg. This study is in progress in order to study the molecular variation in this offspring. So far, no record from hybridisation of wild populations has been found, nor is the feathering variation of the male mid leg observed in any specimens collected in the wild. Hybridisation in natural populations has therefore not been demonstrated.

Acknowledgements

I would like to thank all curators and institutions who have put material at my disposal. Many thanks to Bob COPELAND (Nairobi, Kenya), Gerald FRANZ (Seibersdorf, Austria), Dave HANCOCK (Cairns, Australia), Dave HAYMER (Hawaii, USA), Slawomir LUX (Nairobi, Kenya), Bob WHARTON (Texas, USA), Ian WHITE (London, UK) and Nikolaus ZENZ (Nairobi, Kenya) for their useful comments on certain aspects of this manuscript. Special thanks to Gerald FRANZ for putting material of the hybridisation experiments at my disposal. Mrs N. VAN NOPPEN kindly produced part of the artwork. This study was in part financed by grants of USAID (Nr PCE-G-00-98-00048-00 to Texas A&M University, in collaboration with ICIPE and the African Fruit Fly Initiative) and by the Fonds voor Wetenschappelijk Onderzoek-Vlaanderen.

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