Notommima parallela, a new genus and species of fruit fly from Kenya allied to Notomma Bezzi (Diptera: Tephritidae)

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Abstract
Notommima parallela gen. et sp. nov. is described from Kenya based on adults, third-instar larvae, and puparia. The larvae infest the fruits of Hunteria zeylanica (Retz.) Gardn. (Apocynaceae). Important characters are illustrated, including drawings and photographs. Notommima is compared to several other superficially similar genera and found most similar to Notomma. However, these two genera differ in several small but significant morphological characters as well as an important biological trait (Notommima is frugivorous; Notomma is a twig-gall inducer), that justify establishing the new genus.

Keywords: Apocynaceae, frugivorous, fruit, Hunteria zeylanica, Trypetinae

Introduction
Taxonomy lies at the meeting point between science and art, in which both objective and subjective considerations are relevant and practiced. Taxonomists have always been bothered by the need to determine the rank of their taxa, which, even today, has no satisfying objective method. The rule of the thumb, “be a splitter at the species level and a lump at the genus level”, is merely a general compass that can seldom solve specific and detailed problems satisfactorily.

The case described in this paper deals with adults and immatures of a new tephritid species that were reared by the junior author from fruits of Hunteria zeylanica (Retz.) Gardn. (Apocynaceae) in Kenya. This case poses the dilemma of whether to act as splitters or lumpers, i.e. include the new species in an already-described genus or create a new genus for it. This general problem is often narrowed down to questions such as how many characters are needed and how significant they should be in order to justify the creation of a new genus (or other taxon), and especially how much weight to give to...
biological characters, when the majority and most influential characters usually used to define a group are morphological and anatomical. The adult specimens of the new species described below bear strong resemblance to species of Notomma Bezzi, a primarily Afrotropical genus, and run to this genus using the most modern key to Afrotropical Trypetinae (Hancock 1986). However, based on the literature and our unpublished data, all known Notomma species are associated with Mimosoideae (Fabaceae) and probably induce the formation of twig galls (two species are documented as such, two other species are strongly suspected as such, and practically all the species have been collected on or near Mimosaceae), whereas the newly described species exhibits completely different biological attributes.

We were therefore confronted with the dilemma of whether to lump this frugivorous new species in Notomma, together with all other currently included species that are known or assumed to be cecidogenous on Mimosoideae, or to erect for it a new genus. A critical comparison of adult morphological characters of the new species with most species of Notomma resulted in the discovery of several small but significant distinguishing characters (Table I). These characters, together with strong biological evidence, justify the erection of a new genus. A support for our discrimination between biological and morphological characters is provided by the observation that Tephritidae in general are notorious for exhibiting homoplasy in structural characters, whereas biological characters, such as host preference, appear to be much more stable and reliable. Therefore, on the basis of the total evidence we decided to erect a new genus for the new species.

Table I. Comparison of characters between four similar genera of Afrotropical Trypetinae.

| Genus character                      | Notommima | Notomma | Notommoides | Xanthorrhachista |
|-------------------------------------|-----------|---------|-------------|------------------|
| Face with distinct carina and foveae| +         | –       | –           | +                |
| Ratio of head width to frons width  | 3.4       | 2.2     | 2.7         | 2.6              |
| Arista (short) plumose              | +         | (bare)  | +           | +                |
| Eye bands (in life)                 | –         | +       | ?           | ?                |
| General colouration                 | Yellow    | Usually green when alive, grayish-to brownish-yellow when pinned | Whitish-yellow | Brownish-yellow |
| Setae pale (+) or dark (–)          | + (yellow)| – (blackish)| + (whitish)| – and+(varying yellow to black) |
| Black spots on suture               | –         | +       | –           | +                |
| Vein M ratio (ultimate section/ penultimate section) | 2       | 2.5–5  | 1.3         | 0.8              |
| Setulae on R₄₅₆₇           Extensive | Few and sparse | Extensive | Extensive |
| Wing with one or two clear and complete bands | 2       | 1–2    | 1           | 2                |
| T₆ of female less than half as long as T₅ | +       | –       | –           | +                |
| Tip of oviscape setose              | –         | + (dorsally and ventrally) | + (ventrally) | + (ventrally) |
| Aculeus                             | Needle-like | ± cylindrical or laterally compressed | Short, tip penta-fid | Arrow-like with serrated tip |
| Spermathecae                        | 2         | 2       | 3           | 2                |
| Host associations                   | Frugivorous; Apocynaceae | Cecidogenous; Fabaceae | ? | Frugivorous; Solanaceae |
Methods

Morphological terminology follows White et al. (1999). Ratios are based on at least three measurements. Specimens described in this paper are deposited in the following institutions: International Centre of Insect Physiology and Ecology, Nairobi, Kenya (ICiffe), Musée Royale d’Afrique Centrale, Tervuren, Belgium (MRAC), Natural History Museum, London, UK (BMNH), National Museum of Kenya, Nairobi, Kenya (NMK), National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (NMNH), National Collection of Insects, Plant Protection Research Institute, Pretoria, South Africa (SANC), Texas A&M University, College Station, Texas, USA (TAMU), Zoological Museum, Tel Aviv University, Tel Aviv, Israel (TAU). Drawings were made using the program Illustrator, version 9 (TM).

Taxonomy

**Notommima** Freidberg and Copeland, n. gen.
Type species: *Notommima parallela* n. sp., by present designation.

*Notommima* is a typical Trypetinae (Plate 1) (e.g. *sensu* Freidberg and Kugler, 1989), although within this subfamily it is difficult to place it in any monophyletic clade. Superficially it is similar to *Malica* Richter, *Notomma* Bezzi, *Notommoides* Hancock, *Xanthorrhachis* Bezzi, *Xanthorrhachista* Bezzi, and *Craspedoxanthitea* Hardy, as all these genera primarily contain yellow species with one or more yellow longitudinal bands on the wing. However, these genera belong to several different tribes (Korneyev 1999). *Xanthorrhachis* belongs to the Gastrozonina (Dacini), a group exclusively associated with bamboo and other grasses, in which the female is usually equipped with broad, dorsoventrally flattened and strongly sclerotized aculeus. *Craspedoxanthitea* belongs to the Acidoxanthina (Trypetini), a group apparently associated with large flowers, and characterized by a needle-like aculeus and round epandrium, without projecting lateral surstyli. *Xanthorrhachista* was placed in the Ceratitidina (Dacini) (Norrbon et al. 1999); *Notomoides* was placed in the Trypetini (Freidberg 1994), a group primarily comprising leaf-miners, although this assignment has later been questioned (Han 1999); and *Malica* and *Notomma* were placed in the Notommatina (Carpomyini) (Korneyev 1999). However,
the assignments of the last four genera are doubtful, as the taxonomic and phylogenetic position of these genera, their groups, or both, are not clear. *Notomma, Notommoides*, and *Xanthorrhachista* are Afrotropical, and therefore more prone to be confused with *Notommima*. Table I presents the main differences between these four genera. The table shows that there are enough substantial differences between *Notommima* and any of the other genera to enable easy separation and justify the erection of this new genus.

**Etymology**

This new genus is named after the superficial resemblance to *Notomma*. The gender is feminine.

**Comments**

While considering the erection of this new genus and studying various species of *Notomma*, the situation was compounded by the discovery of a single rearing record of *Notomma bioculatum* Bezzi from fruit. Following our reasoning in erecting the new genus *Notommima*, i.e. by choosing to separate genera based, in part, on large biological gaps, *N. bioculatum* could also be separated from the other species of *Notomma*, and *Hermannloewia* Bezzi (the original genus in which it was described) could be resurrected from synonymy for it. However, since there is only a single specimen labelled as frugivorous, we postpone any further taxonomic changes until additional, confirming records are obtained. The possibility of including *N. bioculatum* and the new species together in the same genus (*Hermannloewia*) is rejected because the former species has all the external morphological characters of *Notomma* (e.g. Table I).

**Notommima parallela** Freidberg and Copeland, n. sp. (Figures 1–13)

**Diagnosis**

This species differs from all the species of similar Afrotropical genera by the characters listed in Table I. It is particularly similar to some species of *Notomma* with two parallel bands along the wing. However, these species have a band over crossvein DM-Cu that *N. parallela* does not have.

**Adult description**

**Head** (Figure 1). *Structure*: short and high, length: height: width ratio 5.8:9.4:10.0; frons curved, not protuberant; frons length to frons width ratio: at vertex: 1.4–1.5; at level of lunule: 1.6; frons width to head width ratio about 0.3; face slightly (0.8–0.9) lower than frons and slightly higher than antennal length, with distinct triangular carina, carina about twice as high as wide at ventral facial margin, extending dorsally almost to antennal bases, these touching each other; face laterally with deep fovea; ventral facial margin slightly but distinctly protuberant; gena-antenna ratio 1.1–1.2; occiput generally rather strongly convex, although dorsally flat or slightly concave; eye oval, short and high, about twice as long as high; first flagellomere three times as long as high, rounded apically; arista long and thin, about 1.5 times as long as antenna, short plumose, plumosity 0.35–0.50 times as wide as antenna. Proboscis capitate, large; palpus oval, about twice as long as wide.
Figures 1–4. *Notommima parallela* n. sp. (1) Head, lateral view. (2) Epandrium, posterior view. (3) Male terminalia, lateral view. (4) Glans.
Chaetotaxy: setae honey-yellow, all major setae well-developed except ocellar short, about as long as ocellar triangle or slightly longer; orbital setae 1 or 2, if 2, then subequal; frontal setae 3, equal; postocular setae about 10–12, long, in rather regular row.

*Colouration and vestiture:* general colouration yellow, with some irregular brownish areas, dull, except orbital plate and periphery of ocellar triangle shiny; no microtrichia except, perhaps, on orbit and parafacial. Setulae yellow to brown, orbit and frontal vitta with numerous setulae; pedicel with long yellow dorsobasal setula and numerous dense, short, brown spine-like setulae (not shown in Figure 1).

**Thorax. Structure:** Scutum square; scutellum triangular, slightly convex dorsally, broadly rounded apically.

*Chaetotaxy:* all major setae present and honey-yellow, including medial and lateral scapular setae; dorsocentral seta slightly longer than, and aligned slightly anterior to, acrostichal seta; both about as long as scutellum and considerably shorter than both basal and apical scutellar setae; two well-developed anepisternal setae.

*Coloration and vestiture:* scutum and scutellum almost entirely covered by pile of dense, fine, yellow setulae; thorax almost entirely yellow, subshiny, scutum sometimes discoloured, blackish; total of five conspicuous round black similar spots with diameter slightly less than distance between acrostichal setae: one (pair) posteroventral to intra-alar seta; one dorsomedially on scutellum, short distance from base; one (pair) lateromedially on subscutellum; fine whitish microtrichia barely visible, more so on scutum. Calypteres subequal, moderately long, yellow; halter yellow.

**Legs.** Yellow, without overt features; setae and setulae predominantly yellow.

**Wing** (Figure 5). *Wing length:* 4.5–5.7 mm; *length: width ratio:* about 2.5.

*Venation:* vein R₁ dorsally densely setulose without gap, ventrally with several setulae distally; vein R₄₊₅ straight; vein R₄₊₅ slightly curved posteriorly beginning at about distal half of ultimate section, densely setulose both dorsally and ventrally, including four or five setulae dorsally beyond crossvein DM-Cu, and setulae extending ventrally to about crossvein DM-Cu; vein M strongly curved posteriorly, slightly but distinctly divergent from vein R₄₊₅, ultimate section about twice as long as penultimate section, latter 1.5–1.8 times as long as crossvein R-M; cell dm at apex about twice as wide as at base; cell bcu with elongate and more or less triangular posterodistal lobe, lobe about as long as crossvein BM-Cu.

*Pattern:* basically comprising two predominantly yellow longitudinal bands over hyaline background, although microtrichia mostly dark grey in hyaline areas, resulting in more or less distinct infuscation, especially in cell cu₁; anterior yellow band extends from wing...
Figures 6–8. *Notommima parallela* n. sp. (6) Aculeus, whole. (7) Aculeus, tip. (8) Spermatheca.
Figures 9–13. *Notommima parallela* n. sp., third-instar larva. (9) Cephalopharyngeal skeleton. (10) Antenna and maxillary sense organ. (11) Anterior spiracle. (12) Anal plate. (13) Posterior spiracle.
base to apex, mostly filling entirely gap between vein C and vein R4+5, slightly penetrating distally into cell r4+5, with small conspicuous blackish spots as follows: one at base of pterostigma (near costal spine), one just proximal to crossvein R-M, and one near vein C slightly distal to crossvein R-M; in addition, distal to crossvein DM-Cu, band margined narrowly by brownish-gray, with small hyaline ‘windows’: one aligned with crossvein DM-Cu along vein R4+5; one at tip of vein R2+3, and one along most of costal section of cell r2+3. Second yellow band extending from wing base along vein M to tip of vein, where narrowed and margined by brown-gray, with more or less distinct such margin also in middle of cell dm; second band mostly parallel to first band, although slightly divergent at distal 0.25. Yellow hue present around posterodistal lobe of cell bcu; small gray to blackish spot present around intersection of vein Cu1 and crossvein DM-Cu.

Abdomen. Yellow, subshiny, sometimes partly discoloured, blackish, without distinct microtrichia, with fine yellow dense setulae and strong yellow marginal setae. Female’s tergite 6 about 0.33 as long as tergite 5.

Male terminalia. Epandrium rounded in posterior view (Figure 2), with triangular lateral surstylus, not quite pointed and slightly bent at tip, with medial surstylus extending slightly beyond middle of lateral surstylus, with two prensisetae and series of six setulae (sensilla?) more dorsally. Epandrium long in lateral view (Figure 3), lateral surstylus about as long as epandrium, forming distinct angle with it. Hypandrium without overt features, and cerci about as voluminous as epandrium (Figure 3). Glans (Figure 4) rather heavily sclerotized, especially dorsally, sclerotized bar present at joint of glans, vesica reduced, not visible.

Female terminalia. Oviscape narrow, basal half cylindrical, distal half conical, coloration and vestiture as in preabdomen. Tergal–oviscapal measure about 4. Aculeus (Figure 6) unusually elongate (about 18 times as long as wide), nearly needle-like, tip trifid (Figure 7); spermathecae 2, pyriform (Figure 8), surface with rather fine, indistinct wrinkles and tubercles.

Third-instar larva (N=25)

Typical frugivorous tephritid maggot, length: 6.0–8.5 mm; width: 1.0–1.5 mm.

Cephalopharyngeal skeleton (Figure 9): robust, mouth hook about as high as long, with relatively blunt apical tooth, no preapical tooth, only shallow bulge; attachment of hypopharyngeal sclerite to both mouth hook and pharyngeal sclerite wide; anterior sclerite, parastomal bar and labial sclerite distinct; dental sclerite not observed; ventral cornu slightly smaller than dorsal cornu, with small window.

Antenna and maxillary sense organ: as in Figure 10.

Anterior spiracle (Figure 11): with single row of 15–18 tubules (N=10).

Anal plate (Figure 12): without obvious tubercles. Distance between posterior spiracles about equal to spiracular width.

Posterior spiracle (Figure 13): spiracular openings peanut-like, about twice as long as wide, dorsal two approximately parallel to each other and to those of second spiracle; ventral opening in 30–45° to other two; spiracular hairs few and poorly branched (two to five branches per group), short and difficult to see.
Puparium \((N=30)\)

Length: 3.5–5.0 mm; width: 1.5–2.5 mm; yellow to brown, dull, rather smooth, without overt features; segmentation and creeping welts distinct.

Material examined

Holotype: female (NMK), Kenya: Coast Province, Sabaki, alt. 29 m, \(3^\circ 09.403^\prime S, 40^\circ 08.164^\prime E\), 18 March 2001, R. S. Copeland, ex fruit of *Hunteria zeylanica* (ICIPE/USDA collection \# 1113). Paratypes (NMK, ICIPE, SANC, MRAC, NHM, NMNH, TAMU, TAU): same collection data as holotype (12 males, nine females). Additional paratypes: Coast Prov., Sabaki, \(3^\circ 09.403^\prime S, 40^\circ 08.164^\prime E\), 15 m, 8 February 2001, ex fruit of *Hunteria zeylanica* (ICIPE/USDA collection \# 1544) (14 males, 18 females). Same, but 4 January 2001 (ICIPE/USDA collection \# 948) (four males, one female). Coast Prov., Sabaki, \(3^\circ 09.403^\prime S, 40^\circ 08.164^\prime E\), 29 m, 21 November 2001, ex fruit of *Hunteria zeylanica* (ICIPE/USDA collection \# 1000) (eight males, 11 females). Coast Prov., Sabaki, alt. 29 m, \(3^\circ 09.403^\prime S, 40^\circ 08.164^\prime E\), 5 May 2001, ex fruit of *Hunteria zeylanica* (ICIPE/USDA collection \# 1243) (three males, four females). Coast Prov., Watamu, \(3^\circ 20.444^\prime S, 40^\circ 01.642^\prime E\), 19 m, 9 February 2001, ex fruit of *Hunteria zeylanica* (ICIPE/USDA collection \# 985) (one female). Coast Prov., Watamu, \(3^\circ 20.49^\prime S, 40^\circ 01.66^\prime E\), 19 m, 4 May 2001, ex fruit of *Hunteria zeylanica* (ICIPE/USDA collection \# 1264) (one male), all collected and reared by R. S. Copeland.

Biology

*Notommima parallela* was discovered during a long-term project (1999–2003) on the frugivorous tephritids of Kenya (Copeland et al. 2002, 2004), in which the junior author conducted most of the field and laboratory work, including the rearing from fruit. During the project, more than 827,000 fruits representing 768 plant species were sampled. However, *N. parallela* was found only in the fleshy and latex-rich fruits of *Hunteria zeylanica* growing in drier, exposed, and wind-swept habitats at the Kenya coast. *Notommima parallela* was reared from five of six collections of *H. zeylanica* growing on the approximately 10–20 m high dunes just north of the entrance of the Sabaki River into the Indian Ocean. At this site, 97 flies were reared from 535 fruits (711 g), with a mean number for positive collections of 0.182 (range 0.096–0.453) *N. parallela* per fruit. Adults were also reared from two of seven collections of *H. zeylanica* at Watamu, growing approximately 1 km from the ocean on coral rag remnants of what was probably originally a *Combretum schumannii–Cassipourea* association of lowland dry forest (Moomaw 1960). Here, it was present in much smaller numbers, with only two flies reared from 2158 fruits. In one of the Watamu samples, *N. parallela* co-occurred with the recently described *Ceratitis perseus* De Meyer and Copeland, 2005. *Notommima parallela* was not reared from four *H. zeylanica* collections of a total of 32 fruits made within Arabuko-Sokoke forest (near to, but further inland than, Watamu), nor was it recovered from 30 fruits of *H. zeylanica* collected with other riverine vegetation at Bate, upstream along the Sabaki River.

Etymology

The specific epithet denotes the two parallel yellow bands on the wing.
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