

## THE ZAPRIONUS OF MADAGASCAR, WITH DESCRIPTIONS OF FIVE NEW SPECIES (DIPTERA : DROSOPHILIDAE)

Marie-Thérèse CHASSAGNARD (\*) & Shane F. McEVEY (\*\*)

(\*) Laboratoire de Biologie et Génétique Evolutives, Centre National de la Recherche Scientifique, F - 91198 Gif-sur-Yvette Cedex.

(\*\*) Australian Museum (Entomology), P.O. Box A285, Sydney South, New South Wales, 2000, Australia.

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**Mots-clés :** Taxonomy, new species.

**Résumé.** – Les *Zaprionus* de Madagascar, avec description de cinq nouvelles espèces (*Diptera : Drosophilidae*). – Cinq nouvelles espèces du genre *Zaprionus* s.str. sont décrites d'après un matériel récolté à Madagascar en 1987. Quatre espèces, *Z. (Z.) cercus*, n.sp., *Z. (Z.) litos*, n.sp., *Z. (Z.) simplex*, n.sp. et *Z. (Z.) verruca*, n.sp. sont endémiques; une, *Z. (Z.) spinipilus*, n.sp., est connue également du Cameroun. Une sixième espèce proche de *Z. indianus* Gupta a été identifiée mais non décrite. *Zaprionus mascariensis* Tsacas & David, *Z. sepsoides* Duda et *Z. campestris* Chassagnard sont mentionnés pour la première fois à Madagascar; la présence de *Z. armatus* à Madagascar mentionnée précédemment est erronée. Le nombre total des espèces de *Zaprionus* à Madagascar s'élève maintenant à 13, seulement six d'entre elles existent également sur le continent africain.

**Summary.** – Five new species in the genus *Zaprionus* s.st. are described from material collected in Madagascar in 1987. Four species, *Z. (Z.) cercus*, sp.n., *Z. (Z.) litos*, sp.n., *Z. (Z.) simplex*, sp.n. and *Z. (Z.) verruca*, sp.n. are endemic; one, *Z. (Z.) spinipilus*, sp.n., is known also from Cameroon. A sixth species close to *Z. indianus* Gupta has been identified but is not described here. *Zaprionus mascariensis* Tsacas & David, *Z. sepsoides* Duda and *Z. campestris* Chassagnard are recorded for the first time from Madagascar; previous Malagasy records of *Z. armatus* are incorrect. The total number of *Zaprionus* species for Madagascar is now 13 of which only six also occur on the African mainland.

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The genus *Zaprionus* Coquillett, 1902 was initially created for a southern African species; it now comprises 47 species including those described as new below. The subgenus *Zaprionus* includes all those species which are entirely or largely endemic to the Afrotropical Region, while the subgenus *Anaprionus* Okada, 1990 has 11 uniquely south-east Asian and Australasian species (Tsacas & Chassagnard, 1990). A possible phylogeny and a detailed classification for the genus was proposed by Chassagnard (1989); the species described below fit well into the groups she erected.

Morphological terms (McAlpine, 1981) and morphometric formulae have been described previously (McEvey, 1990); other terms are given in the first description below with abbreviations. The form of the ventrobasal margin of the distiphallus is an important taxonomic character in species of *Zaprionus*; to refer to it the convenient French term *col-*

*lerette* (Chassagnard, 1989) is used. Specimens are numbered to facilitate their future recognition; in addition to number and data labels, each specimen has a label reading: "Registered Specimen S F McEvey" which is abbreviated in the following text to: "Reg." Most material was collected during the 1987 CNRS-Ecotrop expedition to Madagascar, and additional specimens were obtained from iso-female cultures bred at Gif-sur-Yvette; the three collectors' names, Shane F. McEvey, Jean R. David and Sylvie Aulard, are abbreviated (SFMcE.JRD.SA) on labels. Repositories include : AM, Australian Museum, Sydney; AMNH, American Museum of Natural History, New York; ANIC, Australian National Insect Collection, Canberra; BGE CNRS, Laboratoire de Biologie et Génétique Evolutives, Centre National de la Recherche Scientifique, Gif-sur-Yvette, France; BM, British Museum of Natural History, London; MP, Muséum national d'Histoire naturelle, Paris; MTok, National Science Museum, Tokyo and Natal Museum, Pietermaritzburg, South Africa.

*Zaprionus (Zaprionus) verruca*, sp.n. (fig. 1-7)

**Holotype male** in MP : Madagascar, Mandraka, ex type strain n° 295.2 BGE CNRS 18-II-1988, founder female coll. 11/13-x-1987, SFMcE.JRD.SA, Reg. 5835. **Paratypes** : 62 males and 37 females in AM, AMNH, BM and MP : MADAGASCAR, Andasibe, Mandraka and Maroantsetra.

**Distinguishing features.** – Frons with median white stripe, fore femur with minute tubercle, otherwise inermous; cercus without ventral expansion; apart from white stripes, scutellum and scutum tan and concolorous. Spermatheca papulose.

**Description.** – *Body length.* 3.1 mm (paratype range males 2.5-3.3 mm, females 3.6-3.7 mm).

*Head.* Arista black with 3 dorsal and 2 ventral rays plus one terminal fork. Frons orange-tan with narrow, silvery-white, pollinose stripes along the border of the eye and in median line, anterior part with many setulae (20-30); ocellar-triangle dark and raised; (frontal width, fw) : (frontal length, fl) = 0.8, (head width, hw) : fw = 2.4. Pedicel silvery-white in line with orbital striation and dark tan; first flagellomere dusky tan and bare. Carina large, reaching clypeus, with rounded profile. Face subshining tan. Palpus tan. Gena broad, uniformly tan; (greatest diameter of eye, o) : (maximum genal width, ch) = 4.6, o : (genal width in line of greatest diameter of eye, j) = 5.1. Vibrissa large, single. Eye dark red, oblong, covered with dense pile; facets of uniform size. Orbital setae (or) widely spaced and in straight line almost parallel with white orbital stripe, proclinate furthest from the eye's edge lying outside stripe, posterior reclinate closest to eye and lying within stripe; or1 : or3 = 1.1, or1 : or2 = 2.0, orbito-index [distance ratio (or1-or3)/(iv-or3)] = 1.4. Ocellar seta (oc) longer than proclinate orbital seta, oc : or1 = 1.1; postocellars (poc) convergent and well-developed, poc : oc = 0.7; inner vertical seta (iv) shorter than posterior orbital, or3 : iv = 0.9.

*Thorax.* Scutum brown, darker than frons, with two distinct white, pollinose, parallel, longitudinal stripes on each side: one lying just lateral to the dorsocentral setae and in line with the fronto-orbital stripe, the other beginning on the anterior part of the postpronotum and ending in the wing axillary area; each stripe is bordered with black especially on the medial side; scutellum apically white. Acrostichal setulae black, in 6 well defined rows anterior to the dorsocentral setae and 4-5 irregular rows between them. Prescutellar acrostichal setae enlarged (anterior dorsocentral seta, adc) : prescutellar = 1.4. Ratio of anterior to posterior dorsocentrals (adc : pdc) = 0.7. Basal scutellar setae convergent; apicals crossed; ratio of their lengths (bsc : asc) = 0.8; pdc : asc = 0.7. Halter tan. Thorax pale tan laterally. Sterno-index = 0.35; mid : ant-katepisternal (kepst) seta = 0.55. Fore femur (fig. 7) bears a minute tubercle ventrally, at 0.6 of the femoral length from the proximal end. Rarely among specimens from a single iso-female strain the tubercle is absent. The tubercle points distally and bears one or two minute setulae. Apart from the dorsal and postero-ventral rows of stout setae, the fore femur is otherwise inermous. The first tarsomere of the foreleg is modified, it bears a protruding lobe with a dense mat of pale tan sensilla; the remaining tarsomeres are relatively short. Midleg with a stout tibial spur ventroapically.

*Wing.* Hyaline, veins tan, CuA<sub>1</sub> feeble near wing margin. Indices of holotype with paratype range (15 males) in parentheses : L : w = 2.5 (2.4-2.8); C-index = 2.7 (1.9-2.8); 4v-index = 1.5

(1.3-1.7); 4c-index = 0.9 (0.8-1.1); 5x-index = 1.0 (1.0-1.3); M-index = 0.4 (0.4-0.5); ac-index = 2.3 (2.1-2.9); b/c = 0.6 (0.6-0.7); C3 fringe 0.5 (0.5-0.55); length 2.7 mm (2.2-2.9 mm).

*Abdomen.* Uniformly tan, apparently lacking distinctive features.

**Female.** Resembles male, morphometric indices of female 5848 agree with most of those of holotype, with deviation greatest in the following ratios : o : j = 7.2, o : ch = 5.9; or1 : or2 = 1.55; poc : oc = 0.6; adc : pdc = 0.6. Foreleg of females lack modified tarsi. Wing indices of 5848 lie within male paratype range, except M-index = 0.3; wing length 3.1 mm (2.8-3.2 mm 5 females).

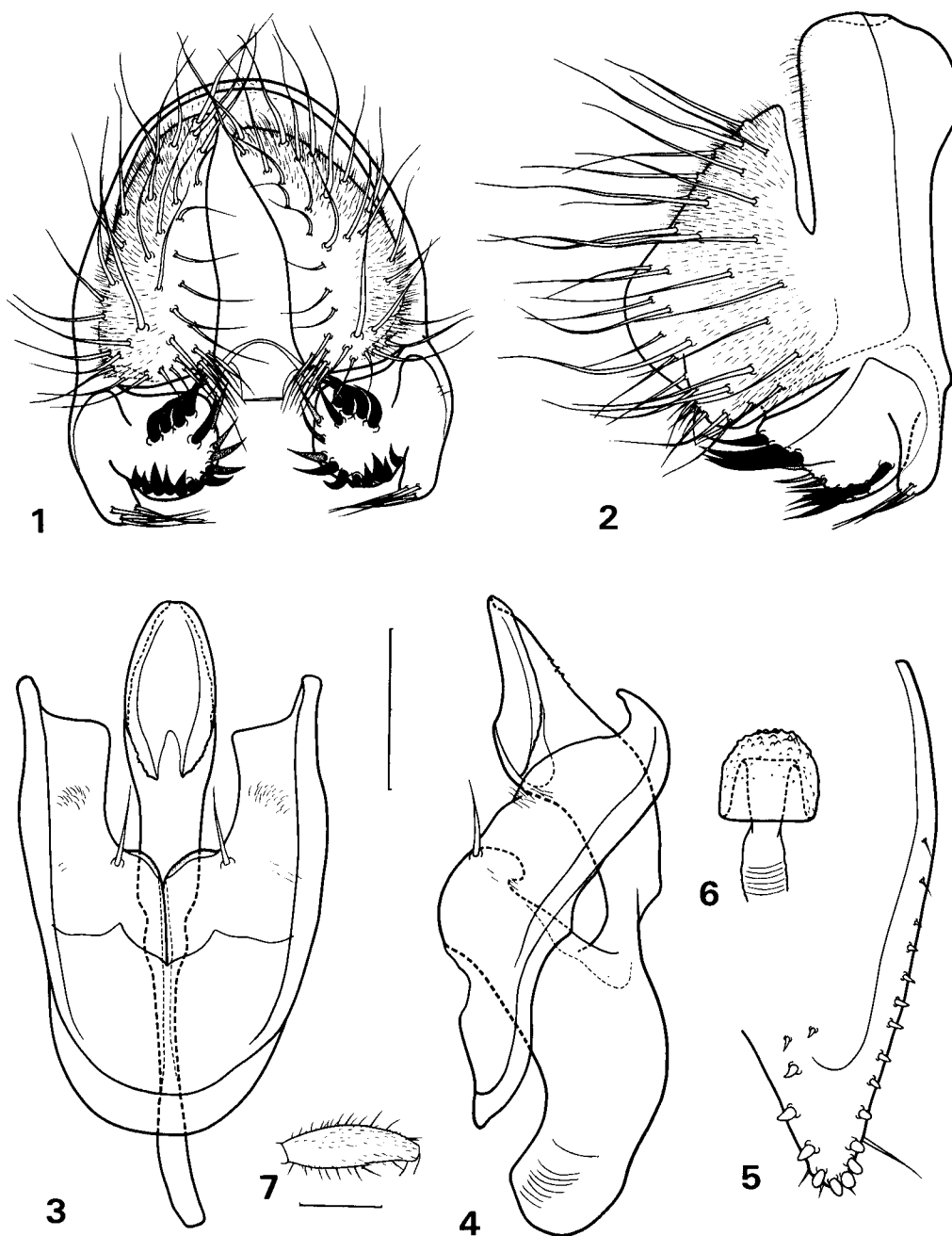


Fig. 1 to 7, *Zaprionus (Zaprionus) verruca*, sp.n. Terminalia of holotype male and female Reg. 5834. – 1, epanandrium caudal view. – 2, *id.*, lateral view. – 3, hypandrium and aedeagus ventral view. – 4, *id.*, lateral view. – 5, ovipositor. – 6, spermatheca. – 7, fore femur anterior view. Scale: 0.1mm.

*Male terminalia* (fig. 1-4). Epanandrium longitudinally narrow, with no long setae along posterior edge; fine pubescence restricted to the posterodorsal edge and with finger-like ventral projection bearing tuft of terminal setae. Cercus pointed in lateral view with a cluster of long setae

ventromedially. Hypandrium elongate and U-shaped, bearing submedian setae and a small area of pubescence centrally on the posterolateral plate. Aedeagus short, robust, curved and weakly serrate dorsally near apex; *collerette* with weak serration. Apodeme shorter than aedeagus (5 : 6), length three times width.

*Female terminalia* (fig. 5-6). Ovipositor with no clearly distinguishing characters; 13-14 peg-like and 3 fine, marginal setae plus 3 supernumerary non-marginal setae. Spermatheca globulous with distinctive roughened, papulose surface, especially apically.

**Distribution.** – Madagascar, widespread in eastern forests; endemic.

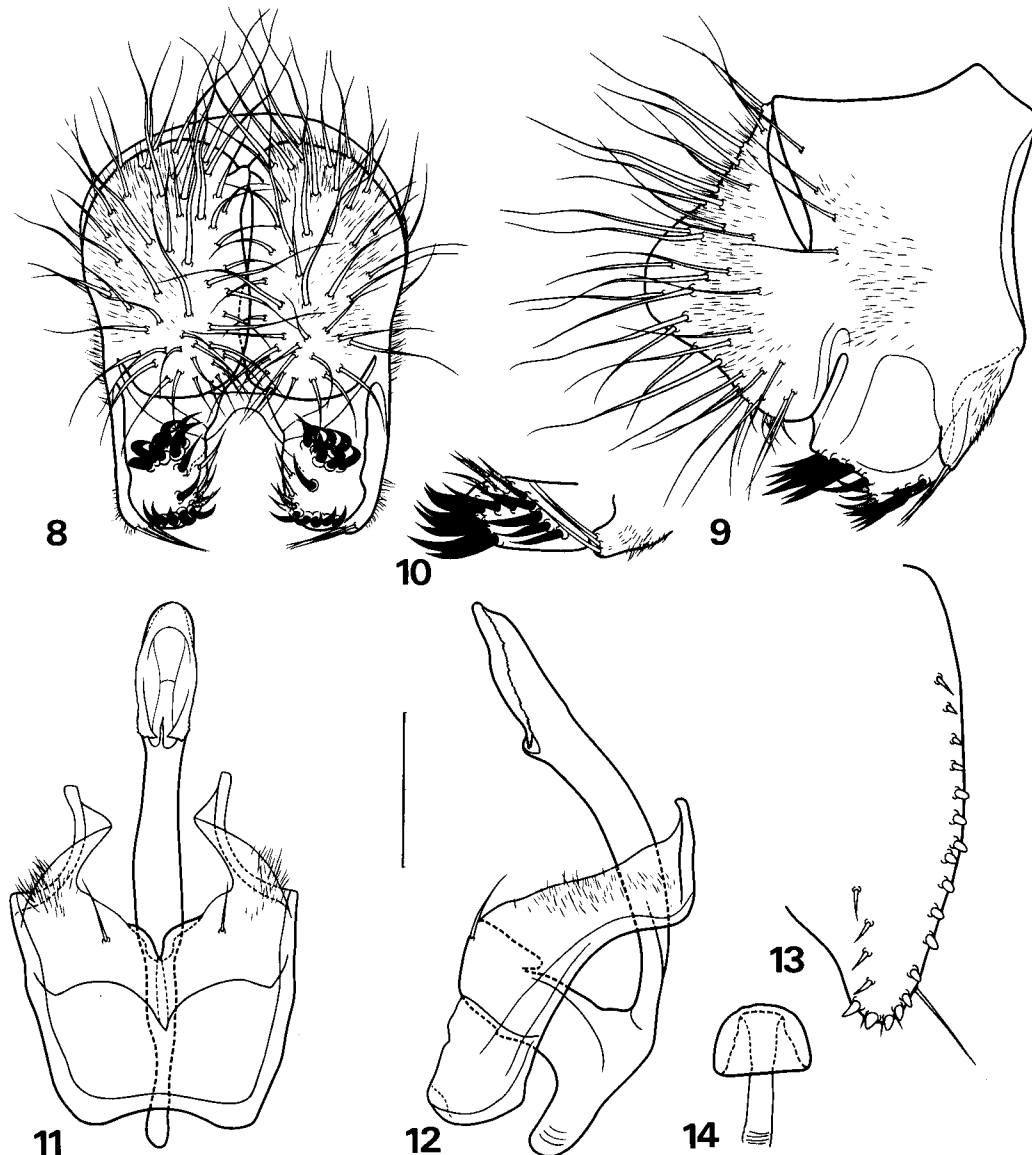


Fig. 8 to 14, *Zaprionus (Zaprionus) simplex*, sp.n. Terminalia of holotype and female from type strain. – 8, epandrium caudal view. – 9, *id.*, lateral view. – 10, surstylus posteroventral view. – 11, hypandrium and aedeagus ventral view. – 12, *id.*, lateral view. – 13, ovipositor. – 14, spermatheca. Scale: 0.1mm.

**Specimens examined :** Holotype and 99 paratypes. Twelve paratypes (males) in MP taken at rotting fruit, with label-data : Madagascar; Mandraka, ca 19°S 48°E, 11/13-X-1987, SFMcE.JRD.SA, Reg. 4122, 4178, 4236 and 4361; Madagascar; Andasibe, ca 19°S 48°E, 13/15-X-1987, SFMcE.JRD.SA, Reg. 4489; Madagascar, Maroantsetra, [15°26'S 49°37'E], 18/26-X-1987, SFMcE.JRD.SA, Reg. 4791, 4817, 4836, 4837, 4841, 5376 and 5380. Remaining paratypes (50 males, 37 females) offspring from 2 females

(the latter not subsequently preserved) collected at Mandraka and bred at Gif-sur-Yvette; pinned 18-II-1988 (Reg. 5821-5848) and 04-X-1989 (Reg. 7173-7232). Specimens Reg. 5835-5848 are from the type-strain, specimens Reg. 5821-5834 are from second strain. Flies Reg. 7173-7202 are from one strain, while 7203-7232 are from the other, correspondence to type-strain uncertain. Specimens Reg. 5836-5845 (males) and 5830-5834, 5848, 7188-7191 (females) in AM; 5846-5847, 7173-7180 (males) and 7192-7201 (females) in AMNH; 7181-7187, 7203-7205 (males) and 7202, 7229-7232 (females) in BM; 5821-5829, 7206-7216 (males) and 7217-7228 (females) in MP.

**Remarks.** – The minute femoral tubercle is often extremely difficult to detect. It resembles the small appendage which protrudes from the femoral integument close to the base of the much larger tubercle in *Z. tuberculatus* Malloch. *Zaprionus verruca*, sp.n. is a member of *Zaprionus* s.str. because the scutum has 4 silvery-white longitudinal bands. Apart from the minuscule protuberance the fore femur is otherwise inermous and in this respect the species is like those in the *groupe-inerme* of Chassagnard (1989). Distinct difference in the male terminalia as described above do, however, provide unequivocal means for identifying this species.

**Etymology.** – The species epithet is a Latin noun meaning wart, a reference to the small tubercle on the fore femur.

#### *Zaprionus (Zaprionus) simplex*, sp. n. (fig. 8-14)

**Holotype male** in MP : Madagascar, Andasibe [ca 19°S 48°E], ex type strain n° 5895 BGE CNRS 24-II-1988, founder female coll. 13/15-X-1987, SFMcE.JRD.SA, Reg. 5895. **Paratypes** : 20 males and 11 females in AM and MP : MADAGASCAR, Andasibe and Maroantsetra.

**Distinguishing features.** – Frons without median white stripe, fore femur inermous, cercus with no ventral expansion, scutellum and scutum orange-tan and concolorous. First tarsomere of male foreleg lacks brush of fine hairs.

**Description.** – *Body length.* 3.0 mm (paratype range males 2.4-3.1 mm, females 3.1-3.2 mm).

*Head.* Arista with 3 dorsal and 2 ventral rays plus a terminal fork. Frons orange-tan with silvery-white, pollinose stripes laterally but not in median line, each bordered brown medially, anterior frontal section with numerous setulae; ocellar triangle raised and black; hw : fw = 2.2, fw : fl = 0.95. Pedicel silvery-white in line with orbital stripe and dark tan; first flagellomere largely dusky tan, white pollinose basally on anterior edge, bare. Carina well-developed. Face subshining tan. Palpus tan. Genal width ratios: o : j = 8.0, o : ch = 7.0. Eye densely pilose. Orbital setae in straight line, in ratio 7 : 5 : 7; oc : or1 = 1.2; poc : oc = 0.7; or3 : iv = 0.9; orbito-index = 1.2.

*Thorax.* Scutum orange-tan, with white longitudinal stripes, each stripe with black edge on inner and outer sides; scutellum neither pointed nor with white or pale apical spot. Acrostichal setulae in 6 well defined rows anterior to the dorsocentral setae and 4 rows between them. Prescutellars enlarged. Basal and apical scutellars subequal, slightly longer than posterior dorsocentral, pdc : asc = 0.9, adc : pdc = 0.7. Sterno-index = 0.4; m : a kepst = 0.6. Fore femur inermous, with no tubercles; setae without basal spurs. First tarsomere of foreleg without brush of fine short hairs.

*Wing.* Hyaline; wing indices of holotype with paratype range (15 males and females) in parentheses: L : w = 2.5 (2.4-2.7), C-index = 2.0 (2.0-2.3), 4v-index = 1.6 (1.5-1.9), 4c-index = 1.1 (1.0-1.2), 5x-index = 1.3 (1.0-1.6), M-index = 0.5 (0.5-0.6), ac-index = 3.0 (2.6-3.4), b/c = 0.7 (0.6-0.7); C3 fringe = 0.7 (0.6-0.7); length = 2.5 (1.9-2.8) mm.

*Abdomen.* Uniformly tan, apparently lacking distinctive features.

**Female.** Resembles male, morphometric indices of female 5916 agree with most of those of holotype, with deviation greatest in the following ratios : oc : or1 = 1.3, poc : oc = 0.6, o : j = 8.9, o : ch = 8.9, L : w = 2.6, C-index = 2.3.

*Male terminalia* (fig. 8-12). Epandrium greatly broadened longitudinally with distinctive depression dorsally and with squared anterodorsal edge when viewed laterally; 4-5 long setae on each side posteriorly and a large ventromedial area of sparsely scattered, fine pilosity. In caudal view epandrium constricted laterally and cercus not attenuated dorsally, the latter without distinctive cluster of long setae ventromedially. Surstylus with irregular series of prensisetae dorsally. Aedeagus extremely elongate and slender; *collerette* finely serrate, with ventrobasal extremities ending abruptly as if cut (fig. 11). Apodeme relatively short, not expanded, ratio with aedeagus 2:5. Posterolateral plate of hypandrium with distinctive pilosity.

*Female terminalia* (fig. 13-14 of Reg. 5916). Ovipositor with 13-14 peg-like and 2-3 short, marginal setae plus 4 supernumerary non-marginal setae. Spermatheca globulous and smooth.

**Distribution.** – Madagascar, central and northeastern; endemic.

**Specimens examined :** Holotype and 31 paratypes. Nine wild-caught flies in MP with label-data : Madagascar, Andasibe, *ca* 19°S 48°E, 13/15-X-1987, SFMcE.JRD.SA, Reg. 4632, 4754 (males) and 4646 (female); Madagascar, Maroantsetra [15°26'S 49°50'E], 18/26-X-1987, SFMcE.JRD.SA, Reg. 5290-5291, 5299, 5303 (males) and 5293 (female), *id.* but at 49°37'E, Reg. 5447 (female); 14 males and 8 females from type-strain: Reg. 5896-5902 (males) and 5910-5913 (females) in AM, Reg. 5903-5909 (males) and 5914-5917 (females) in MP. Wings of all wild-caught and 4 lab-bred flies measured for calculation of index range.

**Remarks.** – This species is close to others with inermous fore femora (*groupe-inerme* Chassagnard, 1989) but is readily distinguished from them by reference to the epandrium. Not all species in *groupe-inerme* have been examined for the tarsal brush which is lacking in males of *Z. simplex*, sp.n., however, it is known that, two members of the group : *Z. inermis* Collart, 1937 and *Z. kolodkinae* Chassagnard & Tsacas, have males possessing well-formed tarsal brushes. Specimens 4632 and 4646 were collected from *Crinum* sp. flowers but no evidence was found that they bred therein.

**Etymology.** – This species is distinctive because it lacks certain markings and structures diagnostic for other Malagasy species, thus *simplex* [*L. simplex*, simple]

### *Zaprionus (Zaprionus) litos*, sp.n. (fig. 15-21)

**Holotype** male in MP : Madagascar, Andasibe, *ca* 19°S 48°E, 13/15-X-1987, SFMcE.JRD.SA, Reg. 4738. **Paratypes** : 2 males and 1 female in MP and Natal Museum : MADAGASCAR, Andasibe and Ankazobe district.

**Distinguishing features.** – Frons with no median white stripe; fore femur inermous; cercus without ventral expansion; scutellum entirely and scutum posteromedially black, with longitudinal white stripes.

**Description.** – *Body length.* 4.3 mm (paratype range males 3.5-4.2 mm, female *ca* 4.5 mm).

*Head.* Arista black with 3 dorsal and 2 ventral rays plus a terminal fork. Frons orange-tan with silvery-white, pollinose, stripes laterally but not in median line, each bordered dark tan medially; anterior frontal area with *ca* 10-15 setulae on each side; ocellar-triangle dark and raised; hw : fw = 2.20, fw : fl = 1.00. Pedicel tan and silvery-white in line with orbital striation; first flagellomere dusky tan and bare. Carina large, reaching clypeus, with rounded profile. Face subshining tan. Palpus tan. Gena broad, uniformly tan; o : j = o : ch = 7. Vibrissa large, single. Eye dark red, oblong, with dense pilosity. Orbital setae widely spaced and in straight line, in approximate ratio 7 : 5 : 7; orbito-index = 1.5. Ocellars long, oc:or1 = 1.20; poc : oc = 0.7; or3 : iv = 0.9.

*Thorax.* Scutum largely orange-tan, concolorous with frons, blackish around bases of prescutellars and in faint, median line tapering anteriorly; two distinct white, pollinose, parallel, longitudinal stripes on each side: one lying just lateral to the dorsocentral setae and in line with the fronto-orbital stripe, the other beginning on the anterior part of the postpronotum and ending in the

wing axillary area; the submedian pair weakly bordered black on medial side. Scutellum black dorsally, tan ventrolaterally, with white, pollinose, lateral stripes continuous with scutum; apex not smoothly rounded, slightly depressed at bases of apical setae, with small white apical spot. Acrostichals in 6 rows anterior to dorsocentrals, 4-5 irregular rows between them. Prescutellars enlarged,  $adc : presc = 1.1$ . Other thoracic setae with ratios  $bsc : asc = 0.9$ ,  $pdc : asc = 0.9$ ,  $adc : pdc = 0.6$  (supernumerary dc just posterior to pdc on right side of holotype  $pdc : sdc = 0.7$ ). Pleura orange-tan, not distinctly paler than scutum, with faint white-pollinose band through lower parts of anepisternum and anepimeron; sterno-index = 0.5, mid:ant-kepst = 0.5. Fore femur with no tubercle and femoral setae without small basal spurs.

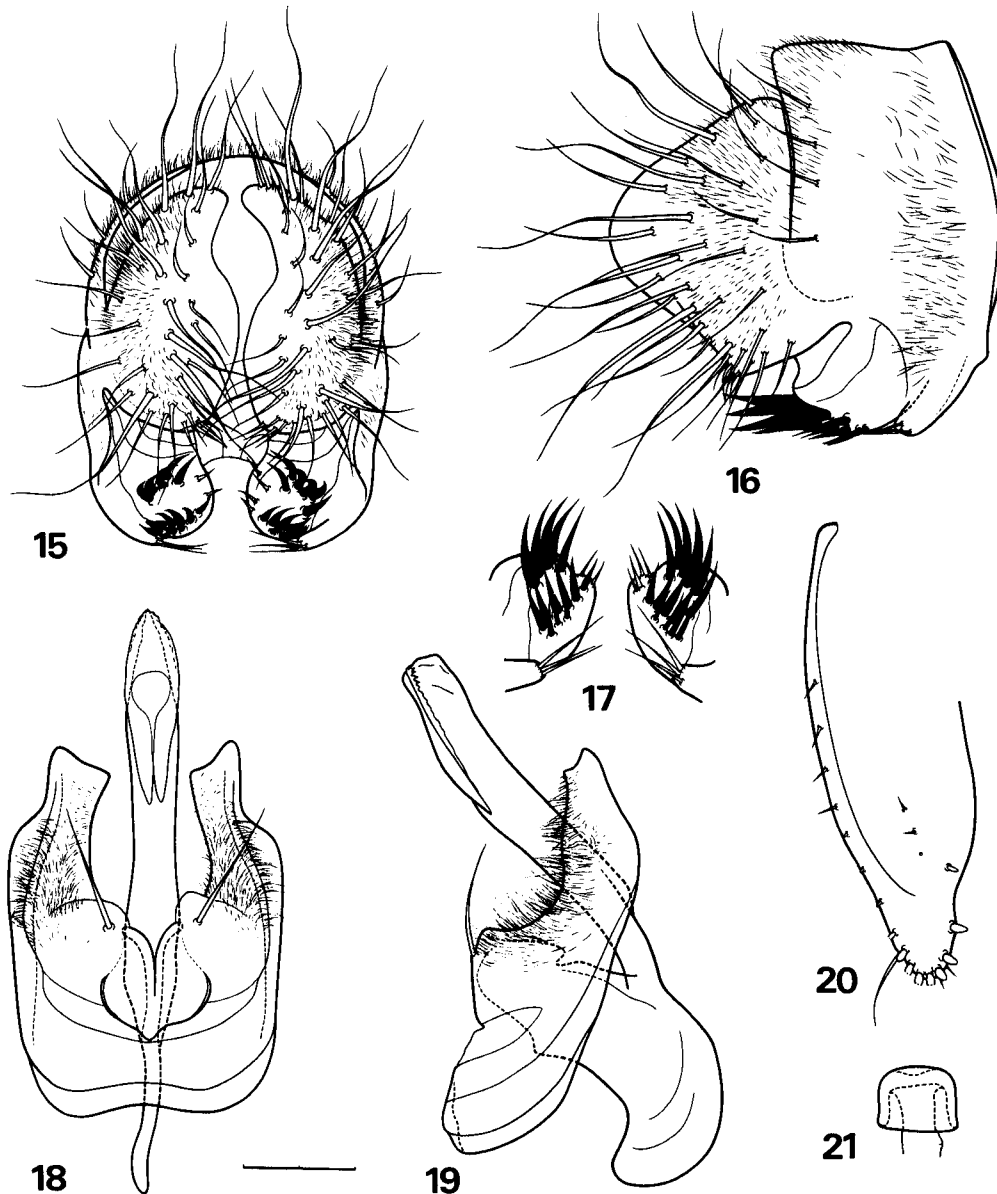


Fig. 15 to 21, *Zaprionus (Zaprionus) litos*, sp.n. Terminalia of holotype and female Reg. 6207. – 15, epandrium caudal view. – 16, *id.*, lateral view. – 17, surstylus posteroventral view. – 18, hypandrium and aedeagus ventral view. – 19, *id.*, lateral view. – 20, ovipositor. – 21, spermatheca. Scale: 0.1mm.

**Wing.** Indices of holotype with paratype range in parentheses:  $L:w = 2.7$  (2.6-2.8), C-index = 2.5 (2.5-2.8), 4v-index = 1.5 (1.4-1.7), 4c-index = 0.9 (0.85-0.95), 5x-index = 1.0 (1.0-1.3), M-index = 0.4, ac-index = 2.7 (2.4-2.8),  $b/c = 0.6$ ; C3 fringe = 0.6 (0.5-0.7); wing length 3.7 (3.2-3.9) mm.

**Abdomen.** Uniformly tan, apparently lacking distinctive features.

**Female.** Resembles male, morphometric indices of paratype female 6207 agree with most of those of holotype, with deviation greatest in the following ratios:  $fw : fl = 0.9$ ,  $or1 : or2 = 1.3$ ,  $oc : or1 = 1.4$ , orbito-index = 1.4. (One female [Reg. 5448], probably of this species but not designated paratype, deviates moreso, as follows :  $or1 : or3 = 1.2$ ,  $or1 : or2 = 1.6$ ,  $oc : or1 = 1.3$ ,  $poc : oc = 0.6$ , orbito-index = 1.1, sterno-index = 0.4, and  $adc : pdc = 0.7$ ). Female foreleg lacks modified tarsi. Wing indices lie within male range; wing-length = 3.8 mm.

**Male terminalia** (fig. 15-19). Epandrium broad longitudinally i.e. in lateral view, with a relatively broad transversal band of pilosity close to the anterior edge and 4-5 long setae accompanied by pilosity along posterior edge. Cercus with median edge sinusoidal. Aedeagus not strongly curved. *Colleterette* weakly serrate apically and smooth basally, basally greatly extended and tapering to a point on each side. Aedeagal apodeme : aedeagus 2 : 3. The posterolateral plate of the hypandrium largely and densely covered with long pubescence.

**Female terminalia** (fig. 20-21). Ovipositor with 10-11 peg-like and 4 fine, small marginal setae plus 4 supernumerary non-marginal setae. Spermatheca globulous and smooth.

**Distribution.** – Madagascar, Ankazobe district and Andasibe; endemic.

**Specimens examined :** Holotype, 3 paratypes and a female with same data as holotype but Reg. 5448 (in MP); the latter excluded from the type series. Two paratypes with same data as holotype but Reg. 4511 and 4514 (males) in MP and 1 female in Natal Museum: Madagascar Centre, Ambohitantely 1600 m, dct Ankazobe, B. Stuckenberg, 6-I-58, Reg. 6207.

**Remarks.** – This species has male terminalia closely resembling *Z. indianus* Gupta, 1970. However the fore femur of *Z. litos*, sp.n. is inermous while *Z. indianus* has distinct barbed setae. Specimen 5448 has an unusual scutellum: it completely lacks apical setae and the white bands are confluent across the apex forming a distinct U-shape. This contrasts with the four type specimens in each of which the white banding is distinctly interrupted by the bases of the apical setae. This phenomenon has previously been observed at very low frequency (0.2 %) in a natural population (Lamto, Ivory Coast) of *Z. ghesquierei* Collart, 1937 (Lachaise, 1976), although it is not known whether this latter case is also associated with the absence of apical setae. Specimen 7321 of *Z. cercus*, sp.n. lacks an apical seta on one side, in this specimen the white striation is asymmetric, being more extensive on the side lacking the seta. Paratype 4514 is aberrant in having *frontal* setae (*sensu* McAlpine), two on the left side, one on the right, all pointing medially; the right side has a supernumerary proclinate orbital anterior to  $or1$ ; frontal chaetotaxy otherwise apparently normal. Female 5448 apparently lacks an anterior reclinate on one side, no socket can be seen in its place. The holotype has a supernumerary dc on one side.

**Etymology.** – The name is a reference to the plain, unadorned morphology of this fly (*litos* λιτὸς Gk, unadorned).

### *Zaprionus (Zaprionus) cercus*, sp.n. (fig. 22-28)

**Holotype male** in MP : Madagascar, Maroantsetra, ex type strain, n° 295.1 BGE CNRS 29-II-1988, founder female coll. 18/26-X-1987, SFMcE.JRD.SA, Reg. 5963. **Paratypes :** 71 males and 50 females in AMNH, MP, BM, MTok and Natal Museum : MADAGASCAR, Maroantsetra and Andasibe.

**Distinguishing features.** – Frons with median white stripe, fore femur inermous; cercus with very distinctive, elongate, ventral expansion; frons orange, scutum brownish.

**Description.** – *Body length.* 3.8 mm (paratype range males 3.7-4.6 mm, females 4.1-4.7 mm).

**Head.** Arista with 4 (rarely 3, sometimes 5) dorsal and 2 (rarely 3) ventral rays, plus a small terminal fork. Frons orange-tan with white, pollinose stripes laterally and in median line; anterior frontal section with many setulae; ocellar triangle raised and black;  $hw : fw = 2.0$ ;  $fw : fl = 0.9$ .



Pedicel largely tan, white in line with orbital stripe; first flagellomere dusky pale tan. Carina large, with slight pollinosity medially. Face pale. Palpus tan. Gena broad,  $o : j = o : ch = 4.7$ . Eye red with dense pile. Orbital setae in line, proclinate far forward, orbito-index 2.0 (1.3 in female 5977); several setulae lie between or1 and or2; or1 : or2 : or3 = 6 : 4 : 5. Ocellar setae long, divergent,  $oc : or1 = 1.2$ ; postocellars well-developed,  $poc : oc = 0.6$ ;  $or3 : iv = 0.8$ .

*Thorax.* Scutum brown, darker than frons, with distinctive white, pollinose longitudinal stripes and a faint, tan, medial, longitudinal stripe fading anteriorly and not continuing on scutellum; scutellum with pale spot (white in some paratypes) and point apically. Acrostichals in 6 well defined rows anterior to dorsocentral setae and 4-5 irregular rows between them. Prescutellar setae

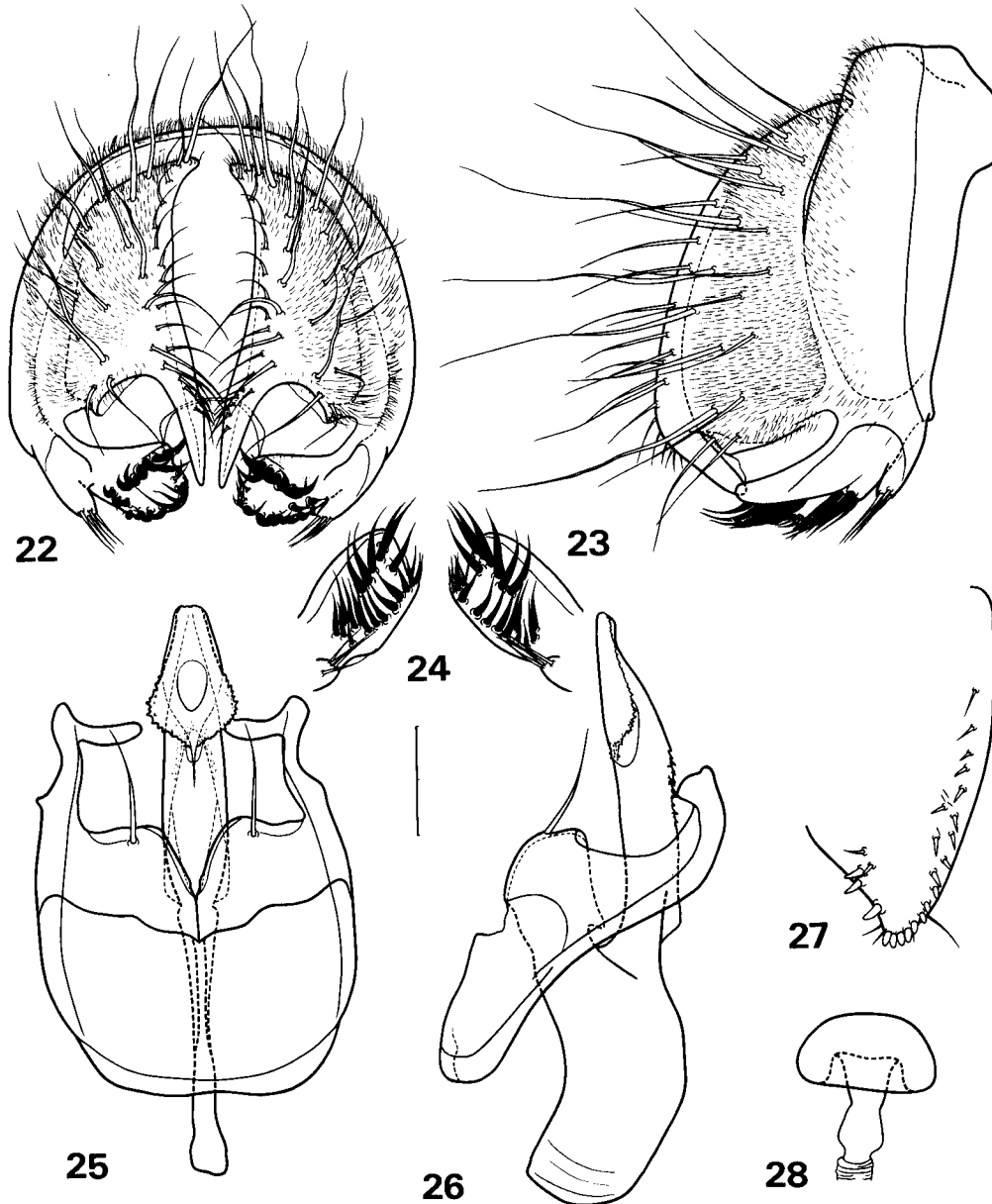


Fig. 22 to 28, *Zaprionus (Zaprionus) cercus*, sp.n. Terminalia of specimens from type strain. – 22, epandrium caudal view. – 23, *id.*, lateral view. – 24, surstylus posteroventral view. – 25, hypandrium and aedeagus ventral view. – 26, *id.*, lateral view. – 27, ovipositor. – 28, spermatheca. Scale: 0.1mm.

enlarged,  $adc:prescutellar = 1.6$ ;  $adc : pdc = 0.7$ ;  $bsc : asc = 0.85$ ;  $pdc : asc = 0.8$ . Sterno-index 0.45;  $m : a\text{ kepst} = 0.4$ . Fore femur with no tubercle and femoral setae without basal spurs.

*Wing.* Hyaline; indices with paratype range in parentheses:  $L:w = 2.5$  (2.4-2.8), C-index = 2.3 (2.3-3.3),  $4v\text{-index} = 1.5$  (1.4-1.8),  $4c\text{-index} = 0.9$  (0.8-1.0),  $5x\text{-index} = 1.0$  (0.9-1.5), M-index = 0.4 (0.4-0.5),  $ac\text{-index} = 2.5$  (2.3-3.1),  $b/c = 0.6$  (0.5-0.7), C3 fringe 0.6 (0.4-0.6), wing length 3.3 (3.0-4.3) mm.

*Abdomen.* Uniformly tan, apparently lacking distinctive features.

*Female.* Resembles male, morphometric indices of female 5977 agree with most of those of holotype, with deviation greatest in the following ratios: fw : fl = 1.0; or1 : or3 = 1.0; oc : or1 = 1.3; poc : oc 0.8; orbito-index = 1.3; L : w = 2.8; C = 3.1; 4v = 1.6; 4c = 0.8; wing length 4.1 mm.

*Male terminalia* (fig. 22-26 of Reg. 5958). Epandrium longitudinally narrow, with pilosity but lacking long setae along posterior margin; ventral finger-like projection short and setulate terminally. Cercus rounded, not triangular in lateral view with a very distinctive, elongate, promi-

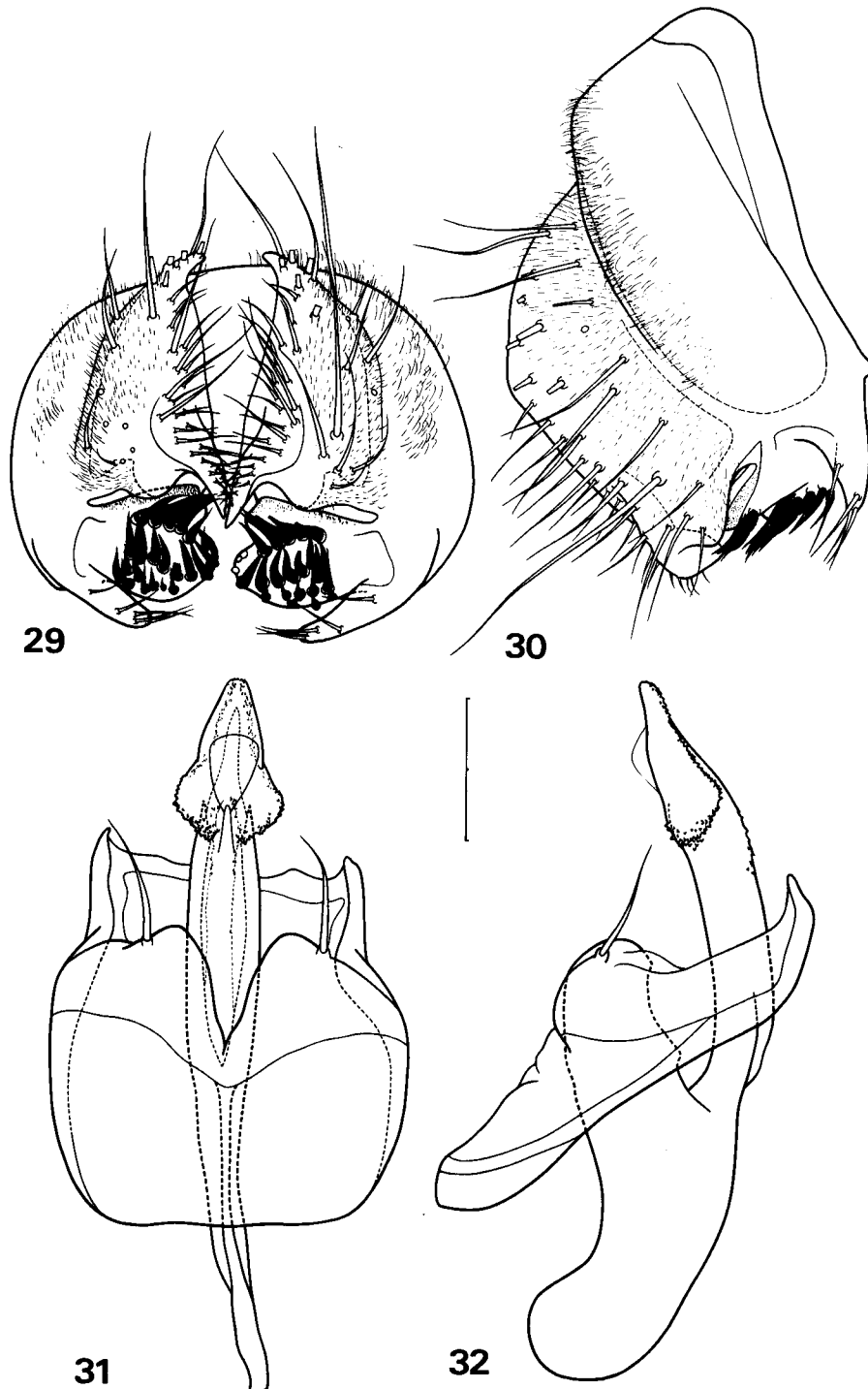


Fig. 29 to 32, *Zaprionus (Zaprionus) inermis* Collart. Terminalia of type. – 29, epandrium caudal view. – 30, *id.*, lateral view. – 31, hypandrium and aedeagus ventral view. – 32, *id.*, lateral view. Scale : 0.1mm.

nence ventromedially, the latter smooth in apical half and setulate basomedially. Surstylus with two curved rows of prenisetae almost forming a circle. Aedeagus straight, serrate dorsomedially; *colerette* expanded and strongly serrate; apodeme : aedeagus = 3 : 4. Posterolateral plate of hypandrium very narrow, long and bending abruptly towards aedeagus.

*Female terminalia* (fig. 27-28 of Reg. 5977). Ovipositor with 11 peg-like and 11 short, marginal setae plus 2 supernumerary non-marginal setae. Spermatheca globulous but flattened dorsoventrally, smooth.

**Distribution.** – Madagascar, Maroantsetra and Andasibe; endemic.

**Specimens examined :** Holotype, 121 paratypes and 3 Maroantsetra females in MP Reg. 4770, 5218 and 5375 excluded from type series. Paratypes with label-data as follows; 12 wild-caught males in MP : Madagascar, Maroantsetra [15°26'S 49°37'E], 18/26-X-1987, SFMcE.JRD.SA, Reg. 4792, 4839, 5053-5054, 5198-5199, 5206, 5219, 5225 and 5377; Madagascar, Andasibe, ca 19°S 48°E, 13/15-X-1987, SFMcE.JRD.SA, Reg. 4574 and 4591. Flies from type-strain (59 males, 50 females): 5958-5962, 7285-7289 (males) and 5973-5977, 7321, 7295-7298 (females) in AM; 5964-5968, 7290-7294 (males) and 7299-7304, 7314-7317 (females) in AMNH; 5968-5972, 7305-7310 (males) and 7318-7322, 7334-7339 (females) in MP; 7311-7313, 7323-7329 (males) and 7340-7344, 7360-7364 (females) in BM; 7330-7333, 7345-7350 (males) and 7365-7369 (females) in MTok; 7351-7359 (males) and 7370-7374 (females) in Natal Museum. Founding female of type-strain not subsequently preserved; flies from the strain pinned 29-II-1988 (Reg. 5958-5977) and 08/14-XI-1989 (Reg. 7285-7374).

The *Z. inermis* type was examined and the terminalia is figured (fig. 29-32); label-data: Congo Belge [Zaire]; Eala, XII-1934, *J. Ghesquière* [on fallen fruit of *Eugenia malaccensis* L. (Myrtaceae)] in Institut Royal des Sciences Naturelles de Belgique.

**Remarks.** – In terms of external morphology *Z. cercus*, sp.n. and *Z. inermis* resemble each other very closely but they may be distinguished by reference to three characters of the male terminalia as follows. The cercal prominence of *Z. inermis* is shorter and almost entirely setulate along median edge. The ventral projection of the epanandrium in *Z. inermis* is setulate along its entire length. The ventral prenisetae of the *Z. inermis* surstylus do not lie in a single row and together with the dorsal row they do not form a circle. *Zaprionus inermis* is a species of western and central Africa (Lachaise, 1972). The cephalic setae of *Z. cercus*, sp.n. are, to a limited extent, distinctive among the Malagasy species of *Zaprionus*. The gap between or1 and or2 is large, or2 is far back, and the frontal setulae extend far back. In addition acr setae are in up to 6 rows between as well as in front of adc and the scutellum is apically pointed.

**Etymology.** – The species epithet denotes the unusual cercal form found in males of this species.

*Zaprionus (Zaprionus) spinipilus*, sp.n. (fig. 33-43)

**Holotype male** in MP : Madagascar, Mandraka [ca 19°S 48°E], ex type strain N° 5849 BGE CNRS 19-II-1988, founder female coll. 11/13-X-1987, SFMcE.JRD.SA, Reg. 5855. **Paratypes :** 24 males and 16 females in AM, AMNH and MP : MADAGASCAR, Mandraka and Andasibe; CAMEROUN, Bafut Nguemba.

**Distinguishing features.** – Frons without median white stripe, fore femur with four prominent setae each accompanied by a short spine basally, cercus with no ventral expansion, scutellum and scutum orange-tan between white bands and concolorous.

**Description.** – *Body length.* 3.5 mm (paratype range males 2.8-3.8 mm, females 3.3-3.7 mm).

*Head.* Arista usually with 3 upper and 2 lower rays plus a terminal fork. Frons orange-tan

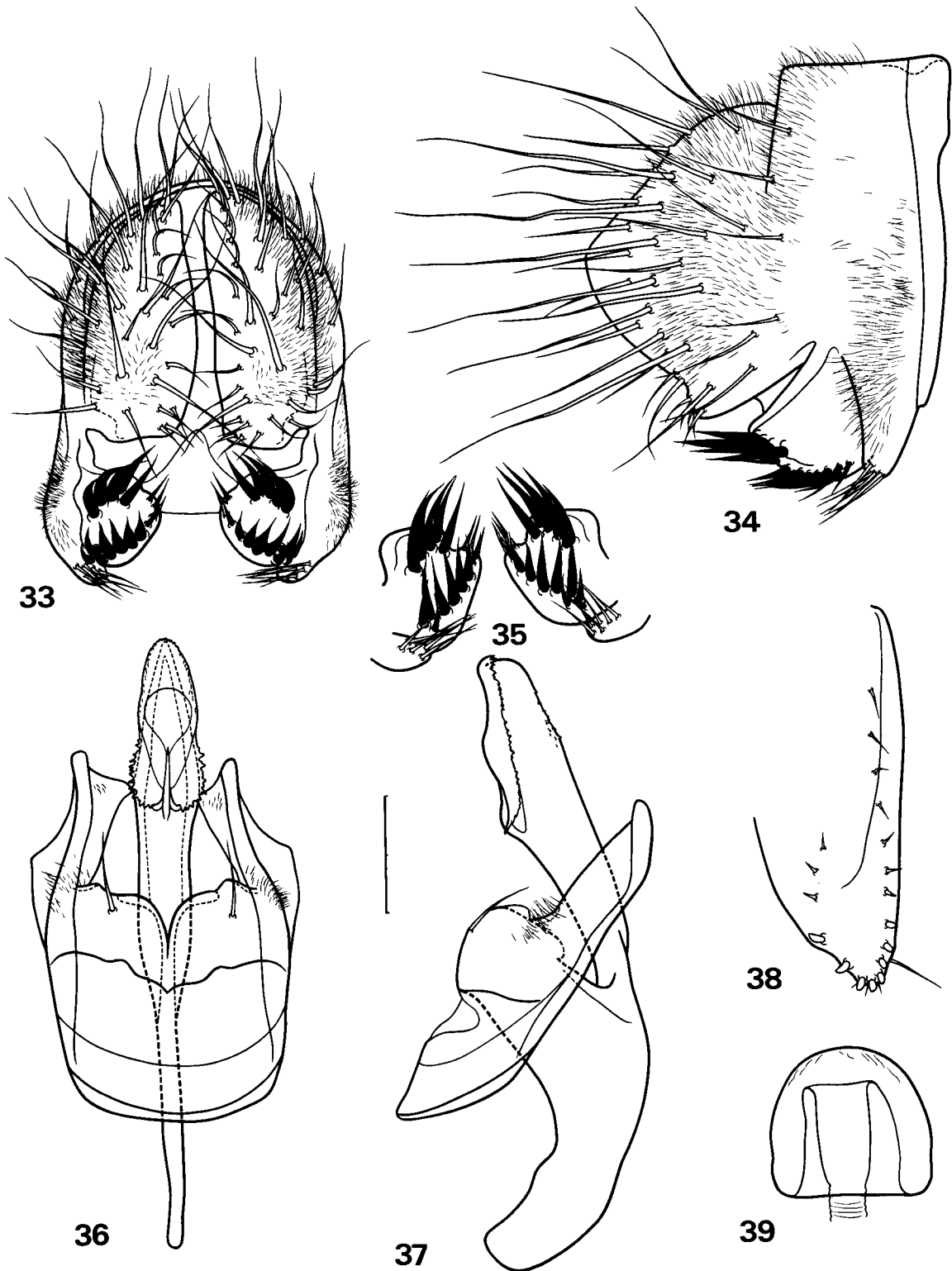


Fig. 33 to 39, *Zaprionus (Zaprionus) spinipilus*, sp.n. Terminalia of specimens from type strain, Reg. 5850 male and 5865 female. – 33, eandrium caudal view. – 34, *id.*, lateral view. – 35, surstylus postero-ventral view. – 36, hypandrium and aedeagus ventral view. – 37, *id.*, lateral view. – 38, ovipositor. – 39, spermatheca. Scale: 0.1mm.

with white, pollinose stripes laterally but not medially; ocellar triangle raised and black; hw : fw = 2.2, fw : fl = 0.9. Pedicel tan and white in line with orbital stripe; first flagellomere dusky pale tan. Carina large, tan. Face pale. Palpus tan. Gena broad, o : j = 9.0, o : ch = 7.2; o : fw = 1.4. Eye red with long dense pile. Orbital setae in line, orbito-index 1.4; 2 minute setulae arise approximately in

line with the orbitals on each side of the or1, pointing laterally; or1 : or2 : or3 = ca 3 : 2 : 3, or1 : or2 = 1.6. Ocellar setae long, divergent, oc : or1 = 1.3, poc : oc = 0.6; inner vertical seta and posterior reclinate orbital seta subequal, iv : ov = 0.85.

**Thorax.** Scutum (1.42 mm) orange-tan, not noticeably darker than frons, with distinctive white, pollinose, longitudinal stripes which continue on scutellum; each stripe is bordered dark tan, especially on the inner side; apex of scutellum slightly pointed with no distinctive pale spot. Acrostichals in 6 well defined rows anterior to dorsocentral setae and 4 irregular rows between them. Frontal width and distance between adc (fw : dc.gap) = 1.1. Prescutellar setae enlarged, adc : prescutellar = 3.1; bsc : asc = 1.0. Sterno-index = 0.5, m : a.kepst = 0.6, p.kepst : pdc = 1.05, pdc : asc = 0.9, adc : pdc = 0.7. Posteroventral setae of fore femur with distinctive basal spurs.

**Wing.** Hyaline; indices with paratype range (10 males, 5 females) in parentheses: L : w = 2.7 (2.45-3.1), C-index = 2.8 (2.4-3.0), 4v-index = 1.3 (1.2-1.5), 4c-index = 0.8 (0.7-0.9), 5x-index = 1.0 (0.8-1.3), M-index = 0.3 (0.3-0.4), ac-index = 2.5 (2.2-3.3), b/c = 0.6 (0.5-0.6); C3 fringe 0.4 (0.4-0.5), wing (mm) 3.1 (2.7-3.6) mm.

**Abdomen.** Uniformly tan, apparently lacking distinctive features.

**Female.** Resembles male, morphometric indices of paratype female 5864 agree with most of those of holotype, with deviation greatest in the following ratios: hw : fw = 2.0, fw : fl = 1.0 and or1 : or2 = 1.9.

**Male terminalia** (fig. 33-37, 40-43). Epandrium with a large ventral projection almost entirely and densely pubescent; posterior border with 3-4 setae and a band of pubescence. Cercus triangular in lateral view. Aedeagus expanded apically; *collerette* expanded and deeply serrate; apodeme and aedeagus subequal in length. Hypandrium with a small pubescent patch at the base of the posterolateral plate.

**Female terminalia** (fig. 38-39). Ovipositor with 8 peg-like and 7 short, marginal setae plus 4 supernumerary non-marginal setae. Spermatheca very large, globulous and smooth.

**Distribution.** – Madagascar, Mandraka and Andasibe; Cameroon, Bafut Nguemba ; Malawi, Nyika Chilinda.

**Specimens examined :** Holotype and 40 paratypes. Label-data of 7 wild-caught paratypes in MP : Madagascar, Mandraka ca 19°S 48°E, 11/13-X-1987, SFMcE.JRD.SA, Reg. 4148, 4233 and 4363-4364 (males); Madagascar, Andasibe ca 19°S 48°E, 13/15-X-1987, SFMcE.JRD.SA, Reg. 4724, 4736 and 4741 (males); 13 males and 5 females from the type-strain : 5854-5858 (males) and 5864-5865 (females) in AM, 5859-5862 (males) and 5866 (female) in AMNH, 5849-5853 (males) and 5863, 5867 (females) in MP; 5 males and 10 females from Cameroun strain N° 187.12 BGE CNRS in MP with label-data: Mission Cameroun, C.N.R.S., RCP 318, Octobre-Novembre 1975, Bafut Nguemba, (Vallée de la Haute Nguemba), Province du Nord Ouest, 5-XI-1975, ex souche 187.12. Five wild-caught males and samples from the 2 strains were dissected. Wings of all wild-caught males were measured for indices; terminalia of 5850 and 5865 are figured. Flies from the type-strain (founding female not subsequently preserved) were pinned 19-II-1988. 16 males and 6 females from Malawi strain N° 296.6 BGE CNRS in MP with label-data : Malawi, Nyika Chilinda, 15-IV-91, ex souche 296.6 (*D. Lachaise* réc.)

**Remarks.** – *Zaprionus spinipilus*, sp.n. has femoral ornamentation like species in Chassagnard's (1989) group comprising «*vittiger* et espèces affines» and it closely resembles *Z. vittiger* Coquillett, 1902. It differs from the latter in having pubescence restricted to the anteroventral part of epandrium; *Z. vittiger* has broad transverse band of pubescence almost reaching dorsal midline and is almost completely free of pubescence along posterior margin (see figure 1 in Tsacas, 1980a); the *Z. spinipilus*, sp.n. hypandrium is less hirsute.

**Etymology.** – The species epithet refers to the form of the femoral setae, a combination of a spine with a short basal spur or barb (*L. spina*, spine; *L. pilus*, hair).

*Zaprionus (Zaprionus) campestris* Chassagnard, 1988

*Zaprionus campestris* (type locality Cameroon) has a pair of short, stout spines ventrally on the fore femur and in this respect it closely resembles *Z. montanus* Collart, 1937 (type loc. Zaire) and differs markedly from all other known Malagasy species; the *Z. montanus* terminalia (Chassagnard, 1989) are quite unlike those of the present species. Two specimens (Reg. 4753 male, 4755 female in MP) were collected during the present survey near village compost at Andasibe; this species is known also from Ivory Coast (Chassagnard, 1989). Male terminalia of Malagasy specimens were compared with those of *Z. campestris* from elsewhere in its range, but no differences could be found. Previous Malagasy records of *Z. armatus* Collart, 1937 (Tsacas *et al.*, 1981; Chassagnard & Tsacas, 1987) are attributed to incorrect identifications of *Z. campestris*.

**Distribution.**— Cameroon; Ivory Coast; Madagascar (**new locality**); Sao Tome.

*Zaprionus (Zaprionus) ghesquierei* Collart, 1937

*Zaprionus ghesquierei* is widespread in the Afrotropical Region; 9 specimens (Reg. 4756, 4795, 4819-20, 5374, 5412, 5435-37 in MP) were taken in Andasibe and Maroantsetra during the present survey.

**Distribution.** — Benin; Cameroon; Central African Republic; Chypre; Congo; Gabon; Ivory Coast; Kenya; Madagascar; Niger; Nigeria; Senegal; South Africa; Tanzania; Turquie; Uganda and Zaire (Burla, 1954; Chassagnard & Kraaijeveld, 1991; Tsacas, 1980b, 1990; Tsacas *et al.* 1981).

*Zaprionus (Zaprionus) indianus* Gupta, 1970 and cryptic species.

*Zaprionus indianus* is a very widespread species with a range extending from Asia to Africa, and it is known from most Indian Ocean islands - Comores, Madagascar, Seychelles, Mauritius and Reunion (Tsacas *et al.*, 1981; David *et al.*, 1989). Dissection of 15 male specimens from Maroantsetra resulted in the classification of two groups: 13 males *Z. indianus* s.st. and 2 males (Reg. 4810 and 4844 in MP) possibly a cryptic species differing in the shape of *collerette* (fig. 44-45). Living material is required to confirm that the two groups represent two species.

**Distribution.** — (*Z. indianus*) : Benin; Burundi; Cameroon; Canary Is; Cape Verde Is; Central African Republic; Comores; Congo; Gabon; India; Ivory Coast; Madagascar; Mali; Mauritius; Niger; Pakistan; Réunion; Rodriguez Is.; Rwanda; Sao Tome; Saudi Arabia; Senegal; Seychelles; St. Helena; Tanzania; Togo; Uganda; Zaire; Zimbabwe (Chassagnard & Kraaijeveld, 1991; Okada & Carson, 1983; Gupta, 1970; Tsacas *et al.*, 1981; Tsacas & David, 1983; Tsacas, 1980b).

*Zaprionus (Zaprionus) kolodkinae* Chassagnard & Tsacas, 1987

This species was common throughout Madagascar. It is absent in Mauritius (David *et al.*, 1989) and not reported from the Seychelles (Lamb, 1914) or Reunion (Tsacas & David, 1975). It is not one of the many southern African *Zaprionus* spp we have examined.

**Distribution.** — Madagascar, endemic.

*Zaprionus (Zaprionus) mascariensis* Tsacas & David, 1975

No morphological differences could be detected in specimens of *Z. mascariensis* from Madagascar and the type locality Mauritius. A crossing experiment between *Z. mascariensis* from these two localities was carried out. Males and females mated freely within seconds of contact. Reciprocal crosses produced fertile offspring with the sexes in balanced ratio. This evidence strongly suggests that the Malagasy and Mauritian populations belong to the same genetic species and that the close morphological resemblance is truly indicative of relatedness.

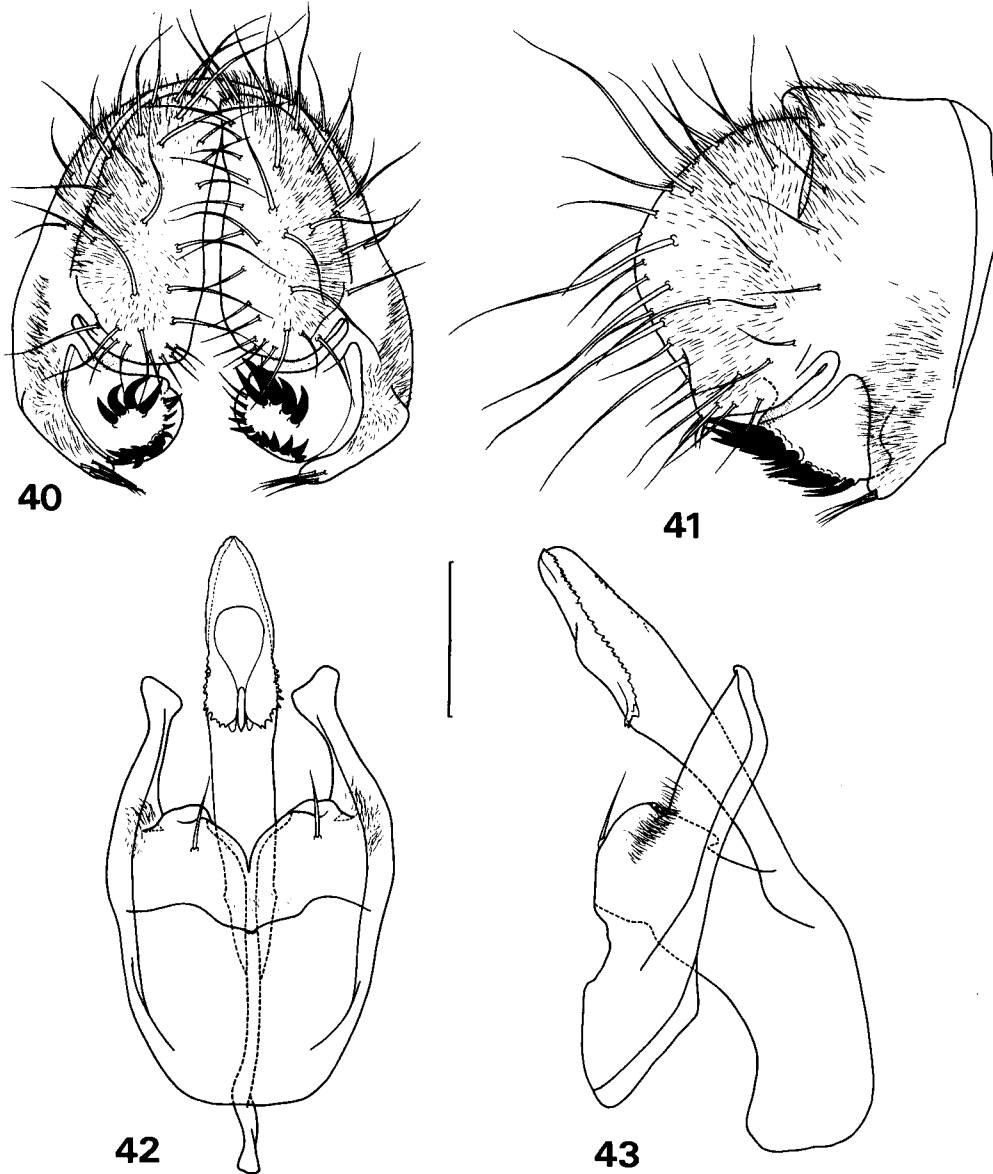


Fig. 40 to 43, *Zaprionus (Zaprionus) spinipilus*, sp.n. Terminalia of Cameroun specimens. – 40, epandrium caudal view. – 41, *id.*, lateral view. – 42, hypandrium and aedeagus ventral view. – 43, *id.*, lateral view. Scale: 0.1mm.

**Distribution.** – Comores; Madagascar (**new locality**); Mauritius; Reunion.

*Zaprionus (Zaprionus) sepsoides* Duda, 1939

*Zaprionus sepsoides* may be distinguished from *Z. tuberculatus* by counting the

number of testicular coils in dissected males. However this is possible only with freshly killed or appropriately preserved specimens. A series of specimens collected by sweeping above rotting pineapple in a village garden at Maroantsetra were pickled in alcohol. This series was dissected and testes were examined (18-X-1989); of the *Zaprionus* spp. possessing a large femoral tubercle, many were determined to be *Z. sepsoides*, but one (Reg. 7264 in AM) was determined to be *Z. tuberculatus* cf. *mascariensis* by examination of testicular and aedeagal form. Pinned material from Maroantsetra has been determined to be either « *sepsoides* or *tuberculatus* » (Reg. 4921, 4789, 4890, 4809, 4812, 4833, 4842, 4895, 5438, 5441).

**Distribution.** – Benin; Cameroon; Central African Republic; Congo; Gabon; Ivory Coast; Madagascar (**new locality**); Uganda.

### *Zaprionus (Zaprionus) tuberculatus* Malloch, 1932

This species, and the above two, are very similar and are difficult to recognize. *Zaprionus mascariensis* and *Z. tuberculatus* can be separated on testicular and aedeagal form as well as by crossing experiments when live material is available. Only one specimen from a village garden at Maroantsetra has been confidently determined to be *Z. tuberculatus* and it may therefore be said that this species is rare in Madagascar at this date. However, given the apparent expansion of the species' range from central Africa northwards and its ability to colonize new areas, one might predict that its abundance in Madagascar will increase.

**Distribution.** – Benin; Burundi; Cameroon; Canary Is; Cape Verde Is; Central African Republic; Comores; Congo; Cyprus; Egypt; Gabon; Ivory Coast; Madagascar; Mauritius; Mozambique; Niger; Nigeria; Reunion; Rodriguez Is.; Rwanda; Senegal; South Africa; Seychelles; St. Helena; Tanzania; Zaire; Zimbabwe.

### Key to the Malagasy species of *Zaprionus*

1. Fore femur with a pair of very stout and short spines ..... *Z. campestris* Chassagnard
- Fore femur not as above ..... 2
2. Fore femur inermous, without tubercles (and females with smooth spermathecae), or with setae lacking basal spurs..... 3
- Fore femur armed with large tubercles, or with a minute tubercle ventrally (and females with papulose spermathecae), or with setae having basal spurs..... 7
3. Cercus with very distinctive, elongate, ventromedial expansion; frons usually with median white stripe ..... *Z. cercus*, sp.n.
- Cercus with no elongate, ventromedial expansion; frons with or without median white stripe..... 4
4. Frons with no median white stripe ..... 5
- Frons with median white stripe..... 6
5. First tarsomere of male foreleg with brush of fine hairs; scutellum entirely and scutum posteromedially black; male terminalia as illustrated (fig. 15-19)... ..... *Z. litos*, sp.n.
- First tarsomere of male foreleg without brush of hairs; scutellum and scutum orange-tan and concolorous; male terminalia as illustrated (fig. 8-12) ..... *Z. simplex*, sp.n.
6. Scutum velvety black, especially posteriorly, between longitudinal white stripes ..... *Z. ghesquierei* Collart



- Scutum not velvety black between longitudinal white stripes ..... *Z. kolodkinae* Chassagnard & Tsacas
- 7. Fore femur with a row of nodes each bearing a short spur together with a long spinulose seta ..... 11
- Fore femur not with a row of nodes or bumps each bearing a spur and spinulose seta ..... 8
- 8. Fore femur with a large tubercle ventrally..... 9
- Fore femur with a microscopic tubercle ventrally, otherwise inermous; frons with median white stripe; male terminalia as illustrated (fig. 1-4) ..... *Z. verruca*, sp.n.
- 9. Male terminalia large; aedeagus with subterminal concavity in dorsoventral view; preapical egg filaments spatulate; testis long ..... *Z. mascariensis* Tsacas & David
- Male terminalia small; aedeagus subterminally convex in dorsoventral view; preapical egg filaments either spatulate or simple, if spatulate then testis short ..... 10
- 10. Testis long, in three coils; preapical egg filaments not spatulate ..... *Z. tuberculatus* Malloch
- Testis short, in one coil; preapical egg filaments spatulate..... *Z. sepsoides* Duda
- 11. *Collerette* expanded, lobate ..... *Z. spinipilus*, sp.n.
- *Collerette* not expanded or lobate ..... 12
- 12. *Collerette* attenuated into a point ..... *Z. indianus* Gupta
- *Collerette* ending abruptly as if cut on angle (fig. 44-45) .. *Zaprionus* sp. aff. *indianus* Gupta

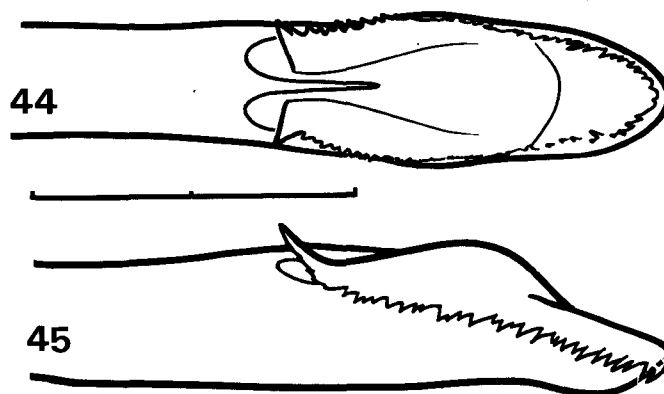


Fig. 44 to 45, *Zaprionus* (*Zaprionus*) sp. aff. *indianus* Gupta. Distiphallus. – 44, ventral view. – 45, lateral view. Scale: 0.1mm.

### Discussion

A number of species were found only at high or low altitude in Madagascar. Ambohitantely, Antananarivo, Mandraka and Ranomafana are above 1200 m, Andasibe is at 1000 m, and all sites at Maroantsetra are between sea level and 500 m. Records showed that *Z. litos*, sp.n., *Z. spinipilus*, sp.n., *Z. campestris* and *Z. mascariensis* were found only at altitude, while *Z. ghesquierei*, *Z. indianus*, *Z. sp aff indianus*, *Z. sepsoides* and *Z. tuberculatus* were found only near sea level. *Zaprionus kolodkinae* was a very common species above 1200 m.

Tsacas *et al.* (1981) list only four species of *Zaprionus* from Madagascar but this information comes mainly from incidental collections in the region around the capital, Antananarivo. The present material is the result of extensive baiting and sweep-net-col-

lecting in various forest, garden and village habitats throughout the eastern part of Madagascar. Large numbers of specimens were attracted to banana baits and trapped inside perforated plastic bottles. Several species, *Z. litos*, sp.n., *Z. campestris* and *Z. sp aff indianus*, are represented by only a few specimens so, it is likely that other species in this genus remain undiscovered.

Species of the *Zaprionus* subgenus *Anaprionus* are typical of the Oriental and Australasian *Zaprionus* fauna and were not found in Madagascar. The Malagasy drosophilid fauna is rich with *Zaprionus* s.str. species as is typical on the African mainland. However, there is high endemicity and this suggests that the island, although obviously

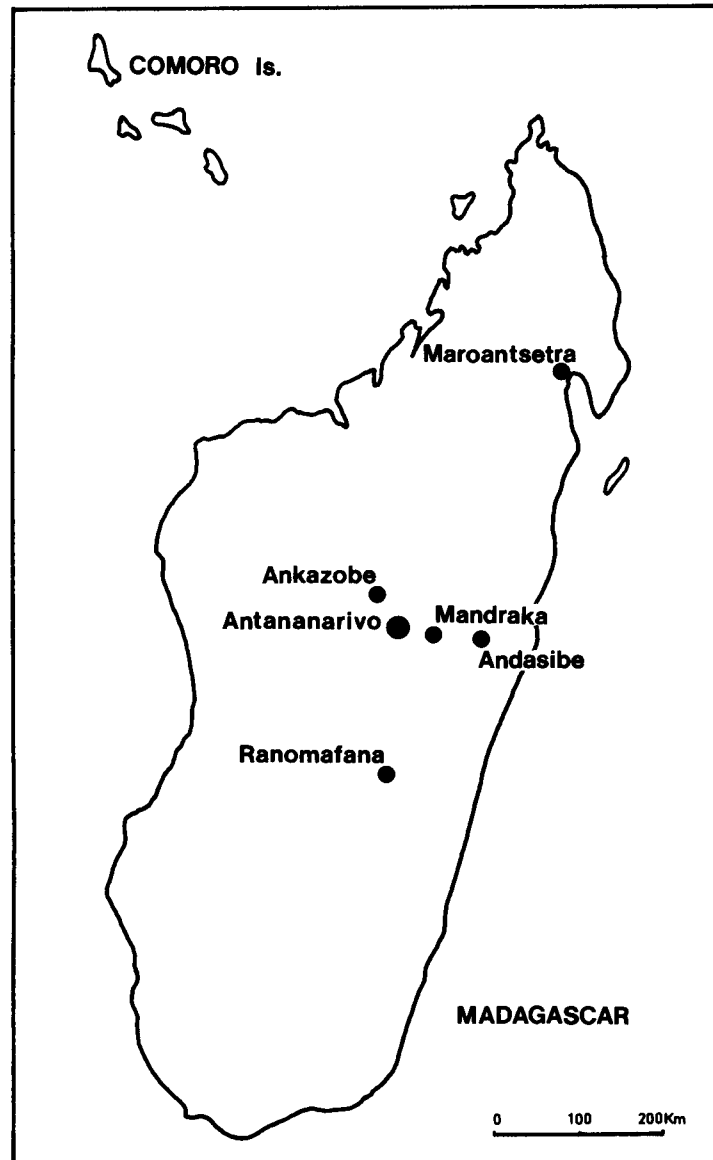


Fig. 46. Collection sites in Madagascar. Five sites near Maroantsetra : Peyrieras house and gardens 15°26'S 49°37'E, Anantoraka 15°30'S 49°36'E, Nosy Mangabe island 15°30'S 49°38'E, Ankofa 15°24'S 49°35'E, Ano'fotsy 15°26'S 49°50'E; three sites near Ranomafana : village gardens 21°16'S 47°27'E, forest near Ambatolahy 21°16'S 47°23'E, hotel/kitchens 21°16'S 47°28'E. Andasibe hotel and village ca 19°S 48°E and nearby Forest Reserve 18°50'S 48°25'E. Mandraka 18°50'S 47°55'E. Antananarivo : Tsimbazaza Parc and city gardens 18°52'S 47°30'E.

sharing biogeographic affinities with Africa and less so with Asia, is sufficiently isolated geographically to allow populations to speciate.

#### Acknowledgments

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