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TWO NEW FLEAS (SIPHONAPTERA: CERATOPHYLLIDAE: LEPTOPSYLLINAE) OF MADAGASCAR: *TSARACTENUS RODHAINI* N. SP. AND *PARACTENOPSYLLUS* (*CONSOBRINOPSYLLUS* N. SUBGEN.) *GOODMANI* N. SP.

DUCHEMIN J.B.*

Summary:

Following considerable sampling in Malagasy forests, two new species of endemic fleas from Madagascar are described. These are *T. rodhaini* n. sp. and *P. goodmani* n. sp., collected on small mammals. The material of *T. rodhaini* allows us to describe the previously unknown female of the genus *Tsaractenus*. We also complete the initial description of the genus with new diagnostic characters. Although it belongs to *Paractenopsyllus*, *P. goodmani* shows many unique characteristics. To help resolve certain systematic issues involving Malagasy Leptopsyllinae we introduce the new subgenus *Consobrinopsyllus* of *Paractenopsyllus* for *P. goodmani*. Its particular condition makes us consider valuable characters of the genus *Tsaractenus*. Carrying several traits of this genus, *P. goodmani* could constitute an intermediate step between the two endemic Malagasy leptopsylline genera. Considering these new findings the actual taxonomic position of the Malagasy genera among the Leptopsyllinae is discussed.

KEY WORDS : *Tsaractenus* n. sp., *Paractenopsyllus* n. sp., Madagascar.

Résumé : DEUX NOUVELLES PUCES (SIPHONAPTERA: CERATOPHYLLIDAE: LEPTOPSYLLINAE) DE MADAGASCAR : *TSARACTENUS RODHAINI* N. SP. ET *PARACTENOPSYLLUS* (*CONSOBRINOPSYLLUS* N. SUBGEN.) *GOODMANI* N. SP.

Deux nouvelles espèces de puces endémiques sont décrites : T. rodhaini *n. sp. et* P. goodmani *n. sp., toutes deux récoltées sur des micromammifères endémiques.* T. rodhaini *nous a permis de décrire la femelle du genre* Tsaractenus, *jusqu'alors inconnue. Nous avons également complété la description initiale de ce genre avec de nouveaux caractères diagnostiques. Bien qu'elle appartienne au genre* Paractenopsyllus, *l'espèce* P. goodmani *présente plusieurs originalités. Nous avons donc choisi de créer le nouveau sous-genre* Consobrinopsyllus *du genre* Paractenopsyllus. *Seul* P. goodmani *appartient à ce nouveau sous-genre, mais il permettra une meilleure classification des Leptopsyllinae malgaches. Sa situation particulière nous a permis de dégager de nouveaux caractères génériques pour* Tsaractenus. *En partageant plusieurs traits avec ce dernier genre,* P. goodmani *peut constituer une étape intermédiaire entre les deux genres endémiques, les rapprochant du même coup. À la lumière de ces nouvelles données, nous discutons de la situation des genres malgaches au sein des Leptopsyllinae.*

MOTS CLÉS : Tsaractenus *n. sp.*, Paractenopsyllus *n. sp.*, *Madagascar.*

INTRODUCTION

The two leptopsylline flea genera *Paractenopsyllus* Wagner, 1938 and *Tsaractenus* Klein, 1968 contain nine described species, all endemic to Madagascar (Beaucournu & Fontenille, 1993). Only one specimen of *Tsaractenus* was previously known and the female was undescribed (Klein, 1968). After four years of field collections and examinations of large series of Leptopsyllinae fleas, we have identified several new taxa. Two new species are described in this paper. One is referred to the genus *Tsaractenus* and after examination of the holotype of *Tsaractenus grenieri* Klein, 1968 allows us to complete the description of the male members of this genus and to precisely describe the female. Another species possessing certain characters resembling *Tsaractenus*, as well as several unique characters, and belonging to *Paractenopsyllus* necessitates the description of a new subgenus of *Paractenopsyllus*.

RESULTS

TSARACTENUS RODHAINI N. SP.

• Material examined

Holotype male, on the endemic shrew-tenrec *Microgale soricoides* Jenkins, 1993 (n° SMG 10533), Madagascar, Antananarivo, Ambatolampy, Tsinjoarivo, Ankazomena forest (47° 50' E, 19° 42' S), 1,400 m, Jan. 1999, J.-M. Duplantier, J.-B. Duchemin and S.M. Goodman leg.

Allotype female on the endemic shrew-tenrec *Microgale thomasi* Major, 1896 (n° SMG 10520), same date, location and collectors.

Paratypes

- At the type-location

On *M. thomasi* (FMNH 166182): one female.

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On *M. fotsifotsy* Jenkins *et al.* 1997 (FMNH 166144): one male.

- Near the type location

On *M. dobsoni* Thomas, 1884 (DT 48): one male, (DT 60): one male, one female, Madagascar, Antananarivo, Ambatolampy, Tsinjoarivo, Mahatsinjo forest (47° 42' E, 19°41' S), 1,550 m, Jan. 1999, J.M. Duplantier, J.B. Duchemin and S.M. Goodman leg.

- Others localities

On *M. gracilis* (Major, 1896): one male (FMNH 167602), Madagascar, Fianarantsoa, Ambalavao, Sandrisoa forest (47° 02' E, 22° 10' S), 1,600 m, Dec. 1999, S.M. Goodman and L. Andrianaivolambo leg.

On *M. dobsoni*: one female (BMOC 96 1300 077), Madagascar, Toliara, Tolagnaro, Andohahela mountain, (46° 44' E, 24° 34' S), 1,500 m, Nov. 1995, S.M. Goodman and B. O'Connor leg.

On *Eliurus tanala* Major, 1896: one female (BMOC 94 0325 170), Madagascar, Fianarantsoa, Ambalavao, Andringitra National Park (46° 58' E, 22° 11' S), 1,625 m, Dec. 1993, S.M. Goodman and B. O'Connor leg.

• Hosts and distribution

The majority of hosts recorded for *T. rodhaini* belong to species of *Microgale* Thomas, 1882. The most numerous captures were made on *M. dobsoni* and *M. cowani* Thomas, 1882. Beside the species noted above can be added *M. gymnoryncha* Jenkins, Goodman & Raxworthy, 1996. Only one endemic rodent was caught carrying *T. rodhaini*: *Eliurus tanala*.

The collection sites are all situated in the central highlands at elevations ranging from 1,400 to 1,650 m.

• Etymology

This species is named for François Rodhain, Professor at the Pasteur Institute of Paris, who guided my first steps in medical entomology.

• Deposition of types

Holotype and allotype from the same host, deposited in the IRD center of Montpellier, France (Laboratory of taxonomy) where the generitype of this genus is deposited. Paratypes deposited in the Field Museum of Natural History, Chicago, USA; Pasteur Institute of Madagascar; Pr J.C. Beaucournu (Université Rennes, France) and in author's private collection.

• Diagnosis

The male is clearly separable from that of *Tsaractenus grenieri* Klein, 1968 by genital parameres and by the broad genal process. Several specimens allow us to describe female generic characters in place of unknown female of *T. grenieri* and to add precision for the male generic characters after examining the holotype of *T. grenieri*.

• Description

Head (Figs 1, 2): small frontal tubercle inserted very low on the frons, just in front of the clypeus, so it may be indistinguishable and may be confused with a thickening of the clypeus. Frontal row of frons is composed of eight-nine unmodified bristles and one or two thin hairs just before the clypeus. Six long bristles in the male and five in the female above the mouthparts. Genal ctenidium composed of two nearly vertical spines with rounded apecies, the posterior longer than the anterior. The apex of the posterior spine slightly broader than the base. One stout bristle inserted behind the clypeus above the insertion of the maxillary palps. The genal process is highly dilated and rounded, broader than the two spines together. Eye sinuate on it ventral margin. Occipital chaetotaxy composed of three occipital rows: anterior of 3-5, posterior of 6-8 in female and 4-6 in males and a sub marginal row of 8-9 bristles in females and 7-8 in males; one bristle at the caudoventral angle of the occiput. Labial palps reaching the middle of the coxa. The head is characterized in the males by a deep occipital groove carrying numerous thin hairs and extending onto the prothorax. In females the falx does not reach the upper border of the head.

Thorax: prothorax with two rows of bristles, the anterior row is composed of 16-17 bristles on both sides in females and 15 in males. The posterior row is of 16-17 longer bristles, the apex of the lower extending at most to the apex of the pronotal comb which is composed of 40 to 42 spines in females, and from 35 to 39 in males. Mesothorax with four rows of bristles, the anterior sometimes limited to one seta and with two dorsal and one ventral pseudosetae, rarely three in females, sometimes lacking in males. Metathorax with four rows of bristles. One or two marginal spinelets on the posterior margin of the metanotal collar. Metepimeron with three rows of spines, frequently a single bristle inserted between the anterior and the median row, rarely composed of four bristles forming a 4th row; the anterior row of four to six, the median of one to five and one unique posterior bristle. Three bristles on the distal part of the inferior margin of the hind femur. False tibial combs composed of 12-14 strong bristles inserted in notches, and three longer bristles inserted beside the 2nd, the 8th and 13th as a general rule. Four pairs of lateral plantar bristles on hindtarsal segment V, none shifted on the plantar surface.

Abdomen (unmodified segments): first segment with three rows, rarely 1-2 anterior bristles, the principal and posterior rows composed of 10-11 bristles for both sides and lacking marginal spinelets. On the other segments: three rows. Principal row of 9-14 in female, 12-14 in male. A bristle in the principal row beneath the stigmata on segment VII usually lacking in females, if present it belongs to the anterior row rather than the principal or posterior row. One marginal spinelet per side from the segment II to IV, rarely to V. Three ante-

sensilial bristles with ratio starting from the most dorsal of male: 0,33/1/0,8, the lower bristle being constantly about twice longer than the upper one and female: 0,45/1/0,9. Sternite II with one, rarely two bristles on each side, preceded by 3-9 anterior, thin bristles or hairs. Sternites III-VI each with one row of 3-4 in males and 5-6 bristles in females, preceded by 6-15 anterior, thin bristles.

Modified male segments:

Tergite VIII with two long bristles and 1-5 shorter bristles, a straight, upper margin with an apical angle blunted and rounded. Sternite VIII (Fig. 3) with a slightly concave upper margin. The apical margin straight or slightly sigmoid with the upper angle rounded and the lower sometimes with a moderate notch. Two, rarely three, long and sometimes sinuate bristles at the upper angle with two, rarely one, shorter bristles and a patch of 15-21 small bristles, this patch very reduced and composed of 4-5 bristles in one specimen (FMNH 167602). This specimen has one lower bristle along the margin lacking in the other males. Three to five relatively long bristles on the caudoventral angle. Ten to lateral 14 bristles, the upper being the longest and the nearest to the apical angle, and 0-7 shorter bristles along the ventral margin.

Clasper (Fig. 4): basimere massive with a rounded apex, manubrium smoothly curved upward and without marked angle between the vertical and horizontal portions. The posterior margin of the manubrium with a distinct convexity and a rounded apex. Acetabular bristle not seen. Cephalodorsal arm markedly extending beyond the tip of the manubrium. Telomere long and slightly curved cephalad with parallel margins, widening near the apex which extends beyond the tip of the basimere.

Sternite IX (Fig. 5): proximal arm S-shaped with a concave anterior margin, and broadly flattened on its distal half. The most characteristic trait is a membranous junction between the proximal and distal arms of the sternite. Distal portion of the sternite IX elongated and widening from the base to the rounded apex. Setation more developed on the posterior margin. The distal lobe reniform and markedly spiculose.

Phallosome (Fig. 6): anterior margin moderately concave and two broad lateral lobes, a thin up-curved median lobe. Hamulus with an angulated distal arm, a forward curve and a sharp apex. The lower and posterior angle of this arm is strongly sclerotized and extends downward to a strong sharp tooth. Endotendons ending in front and above the tip of the broad lamina media.

Modified female segments:

Sternite VII (Fig. 7): two lobes on the posterior margin, the upper elongated with a pointed apex, the lower much reduced and asymmetrical with a rounded apex. Both lobes separated by a broad sinus. Below the lower lobe is a small sinus terminated by the lower apical angle projecting beyond the nearest lobe. It has a main row of 5-7 sub-marginal bristles, thinning dorsally, the four lower bristles long and strong and the lowest inserted on the inferior angle. An anterior row of 5-10 thinner bristles, but the lower remaining strong and with about 15 anterior thinner bristles.

Anal stylet broad (ratio L/l 1.6-1.9). The ventral long bristle inserted just above the middle. The apical margin of tergite VIII sinuate with a marked convexity and a pointed inferior angle.

Spermatheca (Fig. 8): characteristic without a distinct constriction between the bulga and the hilla, only marked by the strigillae present on the bulga. Bulga ovoid or barrel-shaped with a terminal papilla and a broad hilla with a smoothly rounded apex. If we refer to the strigillae as limit between the bulga and the hilla, the latter is longer than the bulga. It should be noted that the axis of the spermatheca is often horizontal so that the hilla is hidden. In another cases the hilla is situated under the bulga. Ductus bursae elongated with poorly marked curves. Perula circular, its diameter about twice the width of the duct itself.

Dimensions (slide-mounted insects): male 4.0-4.3 mm, female 4.0-4.7 mm

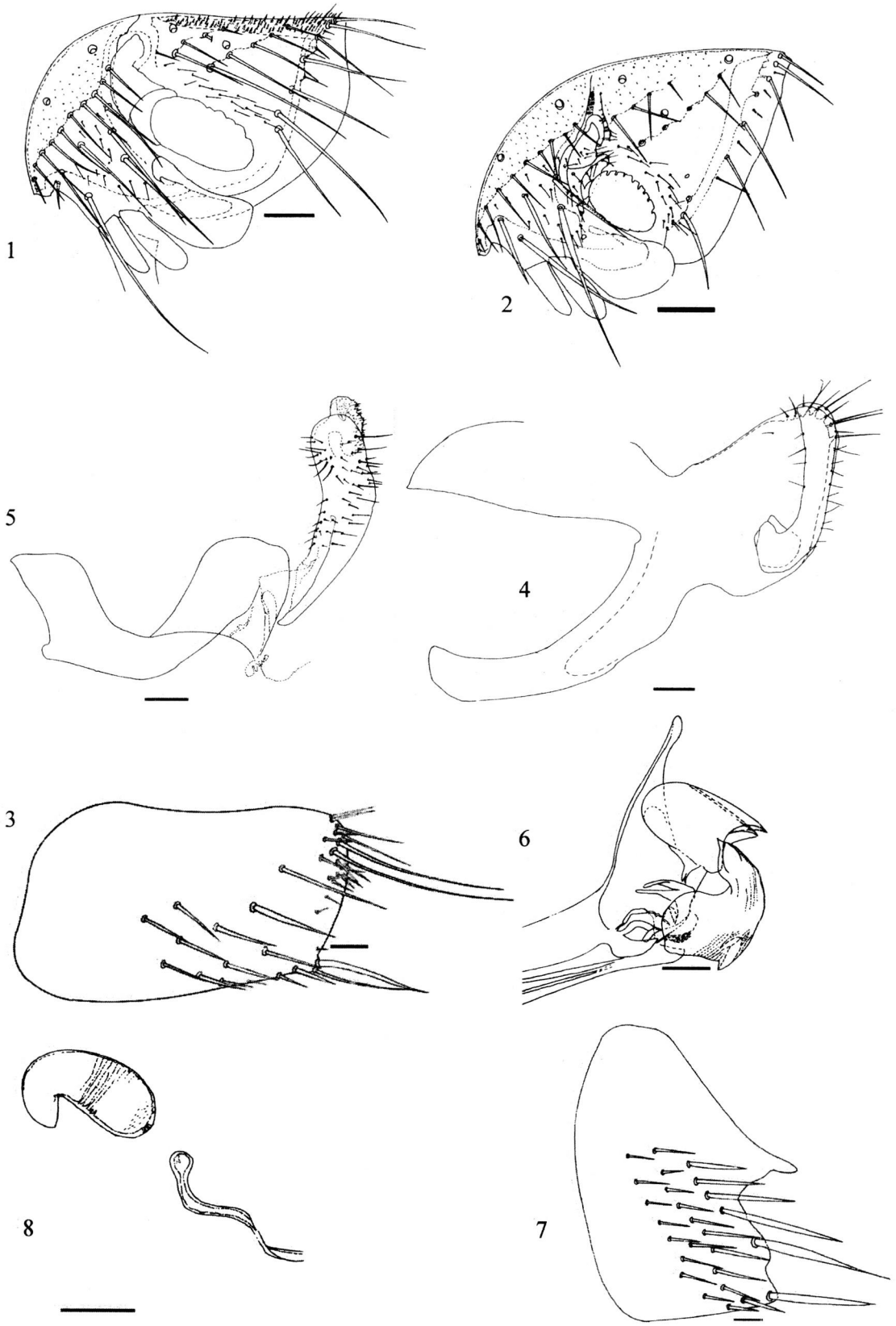
• Diagnosis and complementary description of the genus *Tsaractenus* Klein, 1968.

Tsaractenus rodhaini n. sp. allows us to describe the characteristics of the genus more precisely, particularly in contrast with *Paractenopsyllus*. This description was supplemented by examination of the type of *T. grenieri* housed in the "Institut pour la Recherche et le Développement" (IRD, ex-ORSTOM), Montpellier, France.

As described by Klein (1968) several characters are found in this new species:

- large size, although overlapping with the larger species of *Paractenopsyllus*;
- dark brown color of fresh specimens;
- frontal tubercle arises low on the frons, markedly lower than the middle of the frons in *T. grenieri* and just before the clypeus in *T. rodhaini*;
- oblique frontal row extends almost to the clypeus;
- conspicuous occipital groove in the males;
- genal comb consists of two teeth with their bases in line, in contrast to the members of *Paractenopsyllus* where the lower tooth arises forward of the upper. Their relative lengths are closer in *Tsaractenus* than in *Paractenopsyllus*; in the later the lower is markedly shorter;
- broader shape of the base of the frontal part of the head than in *Paractenopsyllus*.

Finally, others characters are found in *T. rodhaini* and *T. grenieri* but do not appear in the original description as being generic:



Figs 1-8. – *Tsaractenus rodbaini* n. sp.
1: head of male; 2: head of female; 3: sternite VIII of male; 4: clasper of male; 5: sternite IX of male; 6: distal part of phallosome; 7: sternite VII of female; 8: spermatheca and distal part of ductus bursae.
All scale bars = 0,1 mm

- three bristles on the distal part of the inferior margin of the hind femur;
- only four pairs of lateral plantar bristles on segment V of hind tarsus, none shifted onto the plantar surface;
- the proportions of the lengths of the three antepygidial bristles are almost the same in males and females.

The female of *T. rodhaini* presents several characteristics that we will consider as generic until the female of *T. grenieri* or another new species of this genus is found:
- as predicted by Klein, a larger mean size than in males;
- integricipit head;
- terminal papilla of the spermatheca;
- poorly marked junction of the hilla and bulga;
- principal axis of the spermatheca horizontal, the tip of the hilla sometimes arises under the level of the bulga.

All these characteristics confirm the generic position of the taxa as described by Klein, well separating *Tsaractenus* specimens from *Paractenopsyllus*.

• *Consobrinopsyllus* n. subgen. of *Paractenopsyllus* Wagner, 1938

Diagnosis: albeit this subgenus may be considered as intermediate between *Tsaractenus* and *Paractenopsyllus* (Wagner, 1938; Hopkins & Rothschild, 1971) if referring to diagnostic criteria, we affirm that this subgenus belongs to *Paractenopsyllus* rather than to *Tsaractenus* considering the characters of the sexual parameres of the male as well as the female.

According to the characters shared between *Tsaractenus* and *Paractenopsyllus* we propose to name this subgenus *Consobrinopsyllus* (= first cousin flea).

The type of this subgenus is *Paractenopsyllus (Consobrinopsyllus) goodmani* n. sp. described below.

The subgeneric characters are a "*Tsaractenus*-like" head:
. low frontal tubercle although above the eye level;
. two occipital rows of setae plus one submarginal posterior row;
. relatively broad base of the frontal part of the head;
- but:
. without a marked occipital groove in males;
. fracticipit head in females.
- *Paractenopsyllus* generic characters:
. two bristles on the rear margin of the hind femur;
. five pairs of lateral plantar setae on segment V of the hind tarsus;
. lower antepygidial setae much longer in females than in males;
. the spermatheca with the junction between the bulga and the hilla well defined.

Finally, this subgenus is defined by a strongly sclerotized and dilated perula in the females and a sclerotized junction between the horizontal and vertical arms of the sternite IX of the males. Others species of *Paractenopsyllus* genus belong to the subgenus *Paractenopsyllus sensu stricto*, defined by the species *Paractenopsyllus kerguisteli* Wagner, 1938 as generitype.

Consequently, some characters previously described as generic for *Tsaractenus* are now found in *Consobrinopsyllus* n. subgen. and have to be disregarded as diagnostic generic characters:
- three occipital rows of bristles including the submarginal one;
- the low insertion of the frontal tubercle has to be more precise and we propose the threshold of insertion at or above the level of the eye to be generic for *Tsaractenus*.

Paractenopsyllus goodmani n. sp.

• Material examined

Holotype male, on the shrew-tenrec *Microgale soricoides* Jenkins, 1993 (FMNH 167507), Madagascar, Antsiranana, Andapa, Betaolana forest (49° 25' E, 14° 36' S), 1,200 m, Nov. 1999, S.M. Goodman leg. Allotype female on the same animal.

Paratypes:

On the same animal as the holotype and allotype: one female.

On *M. soricoides* (SMG 10893): one male, one female, Madagascar, Antsiranana, Antanambao, Manongarivo Special Reserve (48° 25' E, 14° 01' S), 1,600 m, Mar. 1999, S.M. Goodman leg.

On *M. soricoides* (FMNH 170765): one male, one female, Madagascar, Fianarantsoa, Ranomafana National Park, Vatoharanana forest (47° 26' E, 21° 17' S), 1,025 m, Oct. 2000, J.B. Duchemin, L. Andrianaivolambo and S.M. Goodman leg.

On *M. soricoides* (BMOC 92 1300 003): one female, Madagascar, Toamasina, Moramanga, Mantady Forest (47° 27' E, 18° 51' S), 1,150 m, April 1991, B. O'Connor and S.M. Goodman leg.

• Hosts and distribution

The main host recorded for this species is the endemic shrew-tenrec, *Microgale soricoides*, on which the number of fleas can be very high (25 specimens on the mammal type). Other hosts are species of the same genus: *M. cowani* Thomas, 1882, *M. fotsifotsy* Jenkins *et al.*, 1997, *M. longicaudata* Thomas, 1882, *M. gracilis* (Major, 1896) and one specimen from the endemic rodent *Eliurus grandidieri* Carleton & Goodman, 1998. Collection localities are situated either in the northern mountains at elevations ranging from 1,200 to 1,600 m, or on the eastern slope of the central highland at moderate altitudes at 1,025 to 1,150 m.

• Etymology

This species is named for Steven M. Goodman, naturalist and mammalogist of the WWF Madagascar and

the Field Museum of Natural History, Chicago, who shares so easily his passion for natural history and favours links between ecologists and medical biologists.

• Deposition of types

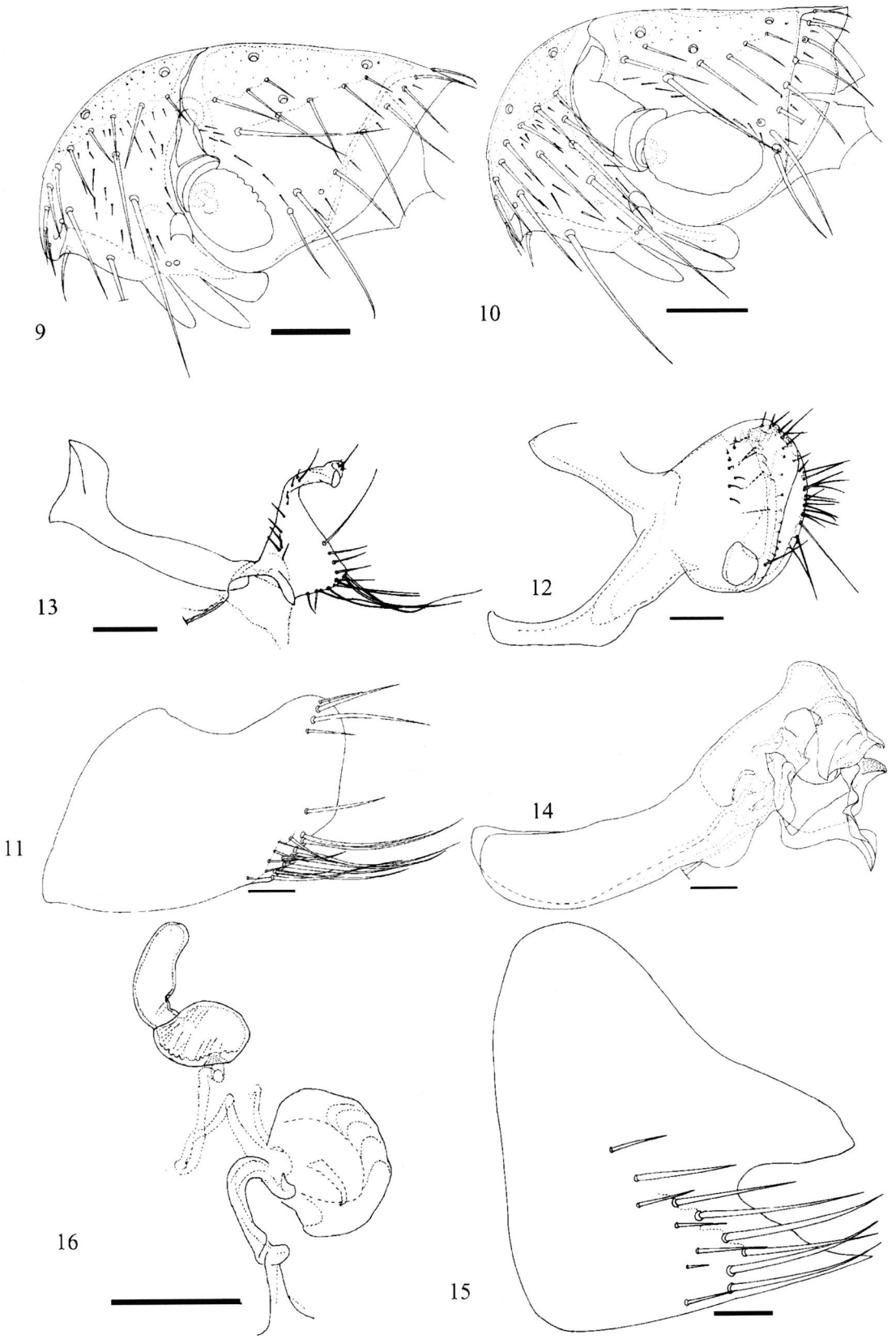
Holotype and allotype deposited in the IRD center of Montpellier, France (Laboratory of taxonomy) where the most important collection of types of this genus is kept. Paratypes with BMOC prefixes deposited in the Field Museum of Natural History, Chicago, USA, where many of the hosts collected during this study are kept. Other paratypes in the Pasteur Institute of Madagascar; Pr J.C. Beaucournu (Université Rennes, France) and the author's private collection.

• Description

According to Klein's (1968) criteria, this species would be placed in the genus *Tsaractenus*. As previously cited, new criteria are proposed for this generic diagnosis and this species is considered by us a member of *Paractenopsyllus*. The species is unique in the genus *Paractenopsyllus* because of hypersclerotized areas: junction of the distal and proximal arms of sternite IX in the male and hypertrophied perula in the female. It is the only representative of the subgenus *Consobrinopsyllus* n. subgen. as described above.

Head (Figs 9-10): frontal tubercle clearly below the middle of the frons in the both sexes unlike in many other species of *Paractenopsyllus* and markedly lower in the female. Submarginal setal row of frons composed of nine, rarely 10 unmodified bristles. Six long bristles in the male and four in the female above the mouthparts. Genal ctenidium of two spines, the upper longer than the lower. One stout bristle inserted behind the clypeus above the insertion of maxillary palps. The genal process is dilated apically in both sexes with a concave dorsal margin, and the process is broader and more rounded in females. Eye sinuate on its ventral margin and poorly pigmented, sometimes vestigial. Occipital chaetotaxy composed of three rows of bristles: anterior of three (2-4), posterior of five, sometimes six and a sub marginal row of seven bristles with one bristle at the caudoventral angle of the occiput. Labial palps reaching the middle of the coxa or a little beyond. Thorax: prothorax with two rows of bristles, the anterior composed of 10-14 bristles on the two sides and the posterior row of 11-13 longer bristles, the apex of the lower one well beyond the pronotal comb which is composed of 26 to 27 spines in the males, from 27 to 31 in females. Mesothorax with thre rows of bristles and with two dorsal (exceptionally one) and one ventral, (exceptionnally two) pseudosetae. Metathorax with three-four rows of bristles, the anterior row sometimes composed of one thin bristle. As on the mesothorax, the length of bristles increases caudally. Usually no marginal spinelet, rarely one on the metanotal collar. Metepimeron with three rows of bristles, the anterior of two to four in males, one to two in females, the median of three and one unique posterior bristle. False tibial combs present composed of 13-14 (12-15) strong bristles inserted on notches, the lower longer and three longer bristles inserted on the same notches as the 2nd, the 8th and 13th as a general rule.

Abdomen (unmodified segments): first segment with three rows of bristles, the principal and posterior composed of 10, sometimes 8-9 in females, one marginal spinelet on each side. On the other segments: two rows, with 1-3 anterior bristles on segments 2-4 sometimes lacking. Principal row of 12-15, with a bristle below the stigmata on the segment VII as a general rule, sometimes lacking in females. Three antesensilial bristles with ratio starting from the most dorsal of male: 0,35/1/0,35 and female: 0,35/1/0,9. Sternite II with one bristle on each side. Sternites III-VI each with one row of three, rarely two long bristles in males and 3-5 bristles in females, completed by 0-1 anterior and thinner bristle. Modified male segments: tergite VIII with three long bristles, a convex upper margin with an apical angle about 90°. Sternite VIII (Fig. 11) with a concave dorsal margin. The apical margin sinuate with a well or poorly marked median incision. Dorsal rounded angle projecting upwards and bearing laterally one thin bristle and 2-3 longer bristles aligned obliquely forward; 6-7 long marginal bristles in the lower angle, the length decreasing from the top to the bottom and 4-7 bristles forward, 1-2 of them strong, the others thinner. Clasper (Fig. 12): basimere with a broad and rounded apex and a dorsal sinuate margin. The distal and the vertical portions of the manubrium forming an angle of about 125°. Telomere long and robust with a curved anterior margin and a posterior margin with well developed setation on a marked convexity, narrowing to the rounded apex, which does not reach the apex of the basimere. Sternite IX (Fig. 13): very characteristic with a strongly sclerotised junction of the distal and proximal arms, this area concave downward forming a yoke. Dorsally the distal third is widely dilated with a posterior lobe bearing numerous hairs and two long, thin bristles in the neighbourhood of the posterior margin. The distal portion is extended interiorly and backwards with a saddle-shaped area articulated with the hamulus. Phallosome (Fig. 14): dorsal lobe broad and convex with two posterior lateral lobes. Hamulus robust and complex, its distal and posterior arms with two lobes, the lower sharpened and curved downward, the upper widening in a dorsal striped concavity. Endotendons ending beyond the apex. Modified female segments: sternite VII (Fig. 15): a large asymmetrical lobe on the posterior margin, its ventral side straight, its dorsal margin sligthly convex just before the apex. The sinus broad, deep and triangular. It has a principal row of seven, rarely eight long sub-marginal bristles, the 4-5 lower stronger bristles thinning dorsally, preceded by six (4-7) thinner bristles. Anal stylet moderately elon-



Figs 9-16. – *Paractenopsyllus (Consobrinopsyllus) goodmani* n. sp.
9: head of female; 10: head of male; 11: sternite VIII of male; 12: clasper of male; 13: sternite IX of male; 14: phallosome; 15: sternite VII of female; 16: spermatheca and ductus bursae.
All scale bars = 0,1 mm.

gated (ratio L/l 1.9-2.5). Spermatheca (Fig. 16): bulga slightly elongated (ratio L/l = 1.4). Hilla markedly longer than the bulga (ration H/B = 1.2) with a rounded apex. Ductus bursae convex forward above a slightly sclerotised dilation. Hypertrophied, semicircular-shaped and sclerotised perula at least slightly as high as the bulga, often markedly higher.

Dimensions (slide-mounted insects): male 2.8-3.1 mm, female 3.2-3.6 mm.

DISCUSSION

These descriptions confirm the generic status of *Tsaractenus* and *Paractenopsyllus*. The geological history of Madagascar and the common morphological traits of these two endemic species, including the shape of the head, pronounced genal process and sub-horizontal genal comb place them closer to each other than to the other genera of Leptopsyllinae. If we refer to Hopkins & Rothschild (1971) followed by Beaucournu & Fontenille (1993) concerning the position of the forecoxa attached to the apex of the prosternum, these two species are close to the Holarctic genus *Peromyscopsylla* I. Fox, 1939. This position seems coherent with the absence of central tuber (Hopkins & Rothschild 1971) but also with the poorly defined junction between hilla and bulga observed in *T. rodhaini*. However this last character and the terminal papilla are also observed in the distant genus *Frontopsylla* Wagner & Ioff, 1926. The integricipit head of the female of *Tsaractenus* places it nearer to *Cratynius* Jordan, 1933. This last genus is the most isolated one among Oriental Leptopsyllinae. The four lateral pairs of setae without a pair on the plantar surface of the segment V of the hindtarsus in *Tsaractenus* may be considered as of little value for classification even if it is a good generic diagnosis marker.

The relations between *Tsaractenus* and *Paractenopsyllus* may be highlighted by the description of *P. goodmani*. Although this species clearly belongs to *Paractenopsyllus*, the particular sexual parameres place it in a peculiar position. Tendencies toward *Tsaractenus* traits of it head and the common endemicity of these two genera make the new subgenus *Consobrinopsyllus* a strong link between these two genera and of probable common origin. All these characters seem to bring together *Tsaractenus*, *Paractenopsyllus* and *Peromyscopsylla* contrasting with the genera *Leptopsylla* Jordan & Rothschild, 1911 of probable Palaearctic origin and *Sigmactenus* Traub, 1950 found in Indo-Australian region (Durden & Beaucournu, 2000). The place of the oriental genus *Cratynius* has to be resolved and the importance given to the integricipit trait of the head probably to be minored. Malagasy genera could be of great importance in this study.

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