The genus *Mormisma* Silvestri (Thysanura: Lepismatidae) in the Namib desert

John Irish

State Museum,
P.O. Box 1203,
Windhoek 9000

ABSTRACT

Three new species of *Mormisma* (Thysanura: Lepismatidae) from the Namib desert of South West Africa are described. A key to the known species of *Mormisma* is provided and the place of the genus in the system is discussed. It is proposed that the smooth macrosetae of *Mormisma* may be due to secondary loss of barbs, making *Mormisma* and *Hyperlepisma* a monophyletic group.

CONTENTS

1 INTRODUCTION

Silvestri (1938) described the genus and species *Mormisma peyerimhoffi* from Algerian sand dunes, while Pierre (1958) reported on the ecology of this psammophilous silverfish. Recently Mendes (1984) reported on fresh material of *M. peyerimhoffi*. The first published record of a *Mormisma* species from the Namib desert was by Holm & Scholtz (1980). Study of material available shows at least three *Mormisma* species to be present in the Namib. All are described as new here.

The following institutional abbreviations were used:
SM — State Museum, Windhoek, South West Africa
TM — Transvaal Museum, Pretoria, South Africa
AMNH — American Museum of Natural History, New York

2 SYSTEMATICS

Key to the known species of *Mormisma*

1. Adults with one pair of styli; Sahara desert .... *M. peyerimhoffi* Silvestri

— All stages completely lacking styli; Namib desert 2

2. Antennae short, reaching back to posterior margin of pronotum only (fig. 1) 3

— Antennae long, reaching or surpassing posterior end of abdomen (fig. 26) .... *M. wygodzinskyi* sp. nov.

3. Urotergite IX with 1 + 1 lateral setal fringes ... . *M. setosa* sp. nov.

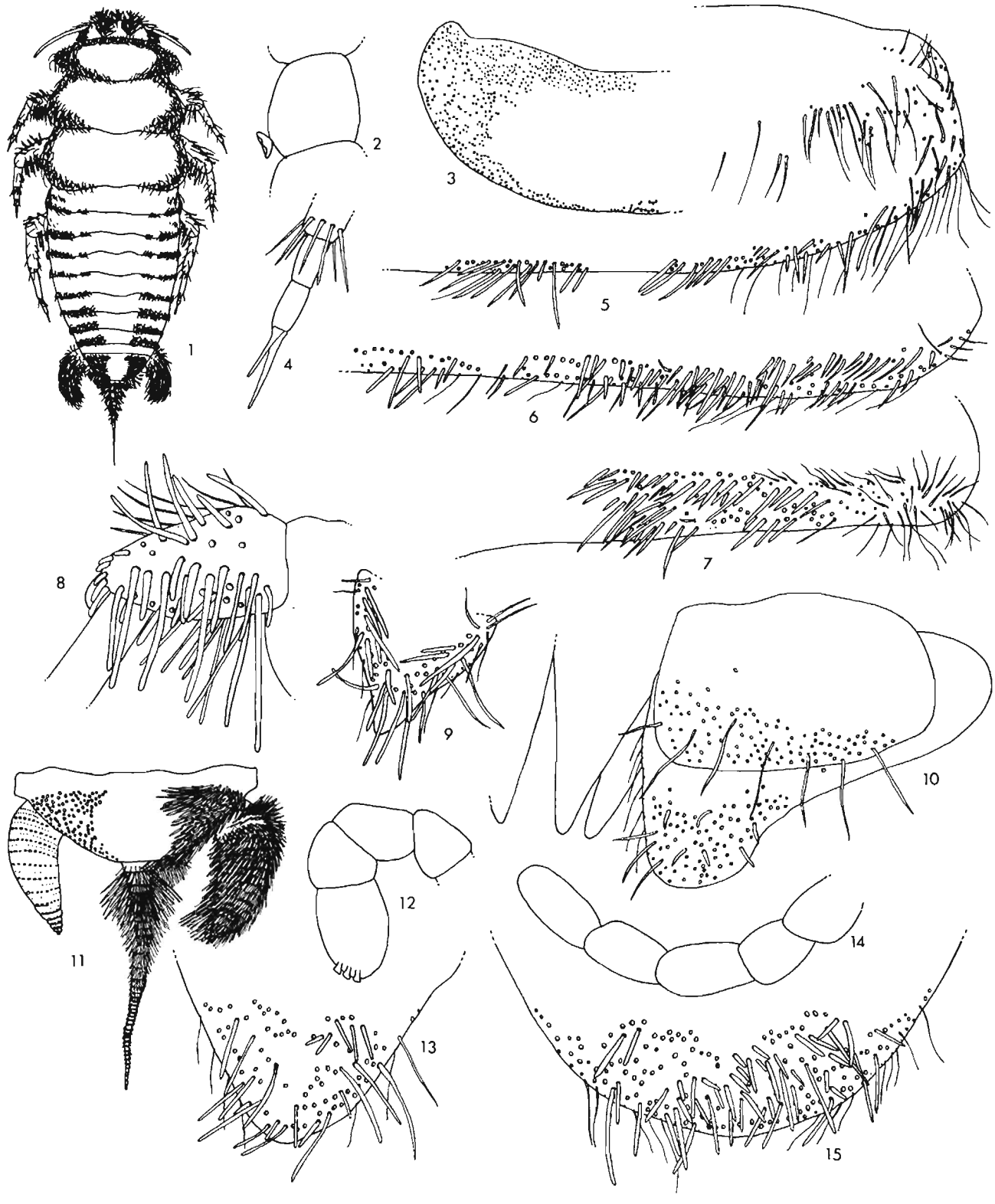
— Urotergite IX completely unsetated .... *M. muricaudata* sp. nov.

Mormisma muricaudata sp. nov. (figs. 1—15)

Hyperlepisma australis Wygodzinsky, 1959: 444, *pro parte.*

Body length of females up to 9 mm, of males up to 6 mm. Body squat and thickset (fig. 1). Ground colour of body pale yellowish white dorsally, whitish ventrally. Hypodermal pigment absent. Scales small, tight-fitting, colourless or at most light tawny yellow dorsally. Macrosetae golden yellow, smooth, often apically bifid.

Maxillary palp short and thick, distal segment lacking sensory papillae (fig. 14). Distal segment of labial palp undilated, longer than wide, with three small sensory



FIGURES 1—15. *Mormisma muricaudata* sp. nov. 1. Body dorsal with setation schematically. 2. Distal antennal segment. 3. Pronotum, lateral. 4. Mesotarsus. 5. Urotergite I, lateral. 6. Urotergite V, lateral. 7. Urotergite VII, lateral. 8. Protibia. 9. Prosternum. 10. Coxites VIII, IX, female. 11. Urotergite X and caudal filaments. 12. Labial palp. 13. Mesosternum. 14. Maxillary palp. 15. Metasternum.

papillae arranged in a straight row (fig. 12). Eyes very small, usually not visible in dorsal aspect, of about 12 ommatidia. Antennae short, reaching back to about the posterior margin of pronotum (fig. 1); setated as in *M. peyerimhoffi.* Sensilla of distal antennal segment illustrated in fig. 2.

Pronotum shaped as in fig. 3; margins and adjacent disc densely setated all round expecting a narrow posteromedian gap. Meso- and metanota similarly setated, but posteromedian gap much wider (fig. 1). Prosternum very small, subcordate (fig. 9). Mesosternum larger, subtriangular (fig. 13). Metasternum widely rounded (fig. 14). Thoracic sterna all with margins and adjacent discs densely setated, as in figures.

Urotergites I to VIII with 1+1 dense lateral setal fringes each (fig. 1). On urotergites I and II these fringes are clearly differentiated into a wide lateral part and a narrow bristlecomb-like submedian part (fig. 5), but the gap between the two parts narrows on successive posteriad urotergites and disappears posteriad of about urotergite V (fig. 6). The fringes also become progressively wider (in the anterio-posterior direction) on successive posteriad urotergites and reach their greatest width on urotergite VIII (fig. 7). The lateral discal parts of urotergite I and to a lesser extent II carry scattered setae in addition to the fringes (fig. 5). The median gap between the lateral setated parts of each urotergite becomes progressively narrower on successive posteriad urotergites (fig. 1). Urotergite IX completely unsetated. Urotergite X subsemicircular, short, with 1+1 fields of dense, incurved macrosetae (fig. 11).

Successive posteriad pairs of legs longer. Mesotarsi not reaching to the posterior end of the abdomen when third legs in normal position (fig. 1). Legs densely clothed with long, robust macrosetae, especially on tibiae (fig. 8). Coxae each with a very wide, transverse, curved multiseriate bristlecomb-like row of setae across the disc. Tarsal claws long, slender and straight, asymmetrical, lacking empodia (fig. 4).

Urosternal setation as in *M. setosa.* Coxites VIII and IX each with a dense and wide posterior setal fringe (fig. 10). Styli absent in both sexes. Ovipositor very short, not surpassing apex of coxite IX, conical (fig. 10). Male lacking parameters.

Caudal filaments short. Cerci swollen, basally unsegmented, densely clothed in whorls of setae. Filum terminale slender (fig. 11).

Material examined

Holotype, female: SM H 45042, Noctivaga dune, 23° 43′ S, 15° 14′ E, 11 August 1981, leg. C. Irish. Type number T 001. (SM)

Allotype, male: SM H 45044, Kahani dune, 23°34′ S, 15° 00′E, 16 November 1981, leg. Osberg. (SM)

Paratypes:

Nymph: South Africa, Namib, Gobabel (*sic!*), V — 1958, R. Paulian, Hyperlepisma australis Wygodzinsky det. 1959. (TM)

Female: Kahani dune, 23° 34′S, 15° 00′E, 18 November 1981, leg. Osberg. (AMNH)

2 Males: SM H 45164, Diamond Area 2 at: 25° 03′ S, 15° 08′E, 25 June 1982, J. Irish (SM).

2 Females: SM H 45169, Kahani dune, 23° 34′S, 15° 00′E, 6 November 1982, J. Irish. (SM)

Male: SM H 45177, Diamond Area 2 at: 25° 28′S, 15° 28′ E, 22 June 1982, J. Irish. (SM)

2 Females, 2 males, 7 nymphs: SM H 45139, Diamond Area 2 at: 24° 53′S, 15° 14′E, 26 June 1982, J. Irish. (SM)

Distribution (fig. 16): Main Namib desert dune area.

Habitat: Most specimens dug out of sand under hummocks of *Stipagrostis sabulicola* (Pilger) De Winter (Poaceae) on the slopes of dunes.

Remarks: Wygodzinsky (1959), in his description of *Hyperlepisma australis,* included what he took to be a nymph of the latter, noting especially the swollen cerci and the long tarsal claws. Examination of the specimen in question clearly places it in *Mormisma muricaudata,* as does the fact that examined nymphs of *H. australis* resemble adults in the aspects mentioned above. *M. muricaudata* resembles the next species closely, see there for distinguishing characters. The name refers to the filum terminale, which is reminiscent of a rat's tail.

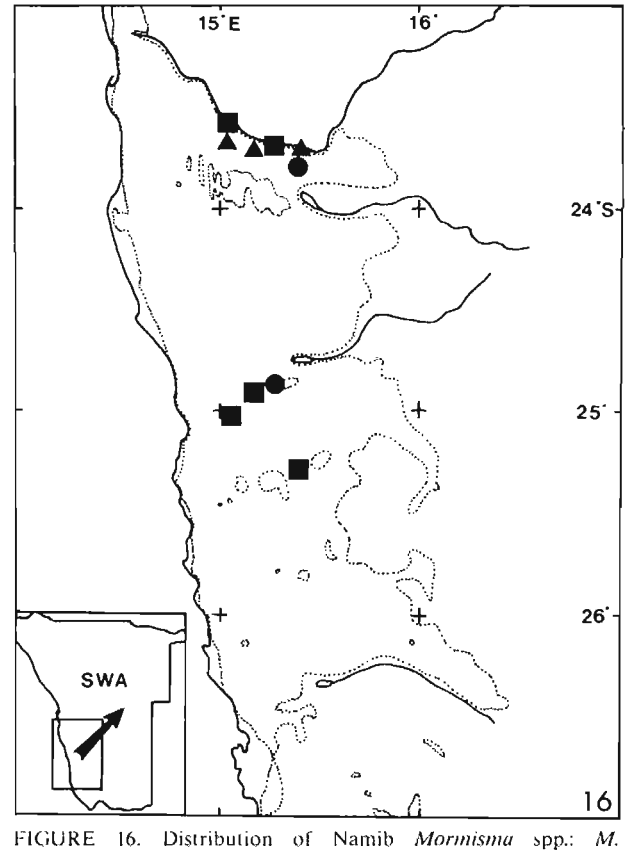
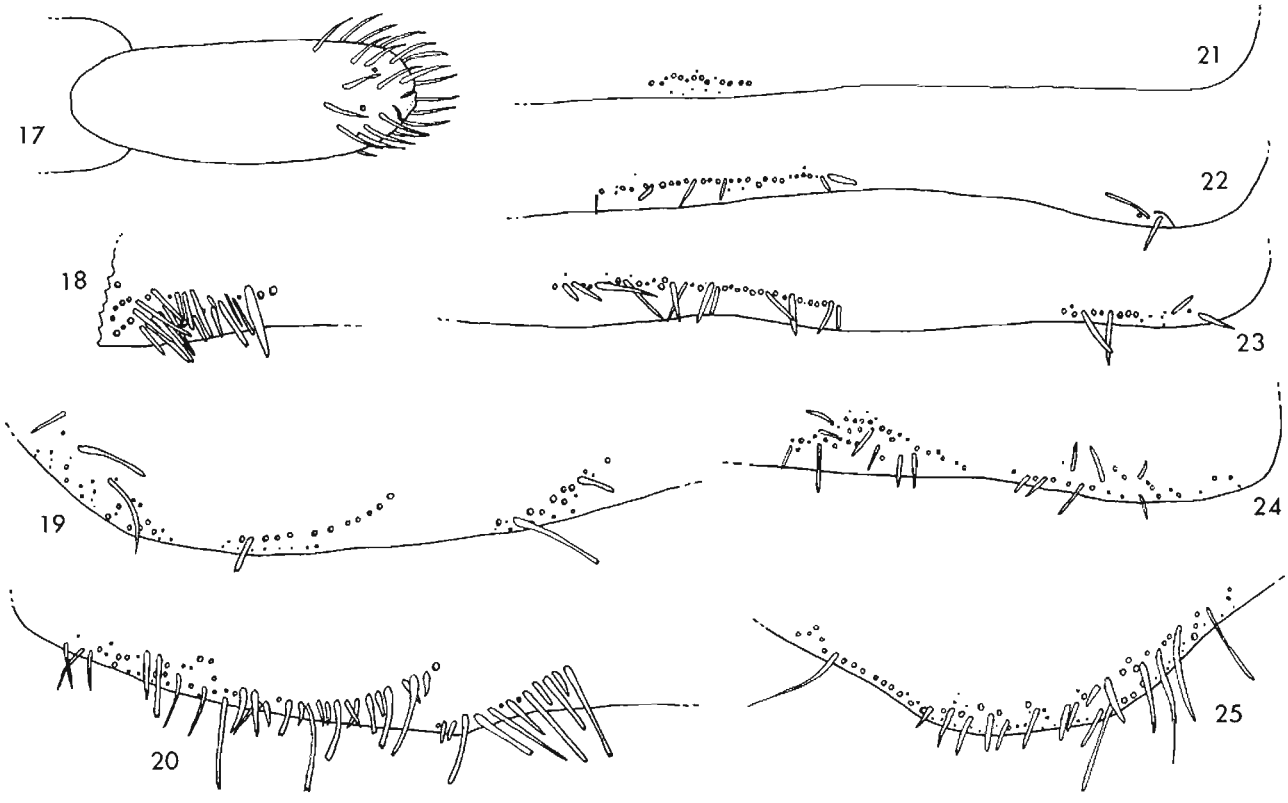


FIGURE 16. Distribution of Namib *Mormisma* spp.: *M. muricaudata* (square), *M. setosa* (circle) and *M. wygodzinskyi* (triangle). Stippled line denotes limits of dune area.



FIGURES 17—25. *Mormisma setosa* sp. nov. 17. Maxillary palp, distal segment. 18. Urotergite IX, lateral. 19. Urotergite II, lateral. 20. Urotergite VI, lateral. 21. Urosternite I, mediolateral. 22. Urosternite III, mediolateral. 23. Urosternite IV, mediolateral. 24. Urosternite VII, mediolateral. 25. Metasternum.

Mormisma setosa sp. nov. (figs 17—25)

Body length of females up to 7 mm. Male unknown. Body squat and thickset, resembling *M. muricaudata*. Ground colour of body pale yellowish white dorsally, whitish ventrally. Hypodermal pigment absent. Scales small, tight-fitting, colourless or at most light tawny yellow dorsally. Macrosetae golden yellow, smooth, often apically bifid.

Maxillary palp short and thick, as in *M. muricaudata*, but distal segment with a single apical sensory papilla (fig. 17). Distal segment of labial palp undilated, longer than wide, with three small sensory papillae arranged in a single row, as in *M. muricaudata*. Eyes as in *M. muricaudata*. Antennae short, reaching back to about the posterior margin of pronotum; setation and distal sensillae as in *M. muricaudata*.

Thoracic nota shaped and setated generally as in *M. muricaudata*: with wide marginal setal fringes, but implantation of macrosetae less dense. Shape of all thoracic sterna, and setation of pro- and mesosterna, as in *M. muricaudata*. Metasternum with a relatively narrow marginal setal fringe only, lacking setae medially on the disc (fig. 25).

Urotergites I to IX with 1+1 lateral setal fringes each, each of which is differentiated into three distinct parts (figs 18, 19, 20): firstly a submedian oblique bristlecomb-like row of macrosetae (fig. 19); secondly, laterad of the preceding, a similar row of macrosetae, which is far removed from the submedian row on the anterior urotergites (fig. 19), but is situated progressively closer to it on successive posteriad urotergites (fig. 20), to lie parallel to and just above the submedian row on urotergite IX (fig. 18); thirdly, still more laterad of the preceding, is an undifferentiated setal group, which is narrowly seperated from the second abovementioned row on the anterior urotergites (fig. 19), but becomes confluent with it posteriad (fig. 20). The lateral discal parts of urotergite I and to a lesser extent II also carry scattered setae in addition to the fringes, as in the preceding species. The median gap between the lateral setated parts of each urotergite becomes progressively narrower on successive posteriad urotergites from I to VIII, but is much wider again on urotergite IX. Urotergite X subsemicircular, short, with 1+1 fields of dense, incurved setae, as in *M. muricaudata*.

Legs and tarsal claws as in *M. muricaudata*.

Urosternites I to VII (female; expected to include VIII in male) with a median setal group each, which is a more or less straight bristlecomb-like row of setae on the anteriad urosternites (figs 21, 22, 23), but becomes progressively wider, multiseriate and crescent-shaped on successive posteriad urosternites (fig. 24). Urosternites III to VII (female, expected to include VIII in male) also with 1+1 lateral setal groups, consisting of

a very small group of at most three or four setae on urosternite III (fig. 22), and a much wider, bristlecomb-like setal fringe on urosternites IV posteriad (figs 23, 24). The gaps between the median and lateral setated parts of each urosternite become progressively narrower on successive posteriad urosternites.

Coxites VIII and IX shaped as in *M. muricaudata,* each with a dense and wide posterior setal fringe. Styli absent. Ovipositor and caudal filaments as in *M. muricaudata.*

Material examined

Holotype, female: SM H 45130, Witberg, 24° 50'S, 15° 16' E, 26 June 1982, J. Irish. Type number T 002. (SM)

Paratype, female: SM H 45043, Mniszechi's Vlei, 23° 43' S, 15° 19' E, 18 January 1981, leg. Praetorius. (SM)

Distribution (fig. 16): Main Namib desert dune area.

Habitat: Holotype dug out of sand under dune hummock, paratype from pittrap on dune slope.

Remarks: *M. setosa* is very near to *M. muricaudata* in general appearance, but may be readily seperated by its setated urotergite IX, to which the name refers. The two species also differ in general urotergal setation, metasternal setation, and the distal sensilla of the maxillary palp.

Mormisma wygodzinskyi sp. nov. (figs 26—36)

Body length of females up to 7 mm, of males up to 6 mm. Body squat and thickset (fig. 26). Ground colour of body pale yellowish white dorsally, whitish ventrally. Hypodermal pigment absent. Scales small, tight-fitting, colourless or at most light tawny yellow dorsally. Macrosetae golden yellow, smooth, often apically bifid.

Maxillary palp short and thick, distal segment lacking sensillae (fig. 33). Distal segment of labial palp undilated, longer than wide, with three small sensory papillae arranged in a straight row (fig. 28). Eyes as in *M. muricaudata.* Antennae long, reaching or surpassing posterior end of body, setated in whorls, lacking sensillae.

Thoracic nota shaped and setated as in preceding two species, though with marginal fringes narrower and setal implantation less dense. Prosternum very small, subcordate, but wider than in preceding species and apically rounder (fig. 31). Meso- and metasterna setated and shaped as in *M. setosa.*

Urotergites I to IX with 1+1 lateral setal fringes each, which are simple and undifferentiated into parts. The fringes are as in fig. 29 on the anteriad urotergites, but become progressively more as in fig. 30 on successive posteriad urotergites. The median gap between the lateral setated parts of each urotergite is wide on urotergite I, becoming progressively narrower from urotergites II to VIII, but is wide again on urotergite IX. Urotergite X short, trapezoid, with 1+1 setal fields (fig. 35).

Successive posteriad pairs of legs longer. Metatarsi surpassing the posterior end of the abdomen when third legs in the normal position (fig. 26). Legs densely clothed in long robust macrosetae, especially on the tibiae, as in the preceding two species, but lacking the transverse coxal discal bristlecomb-like setation. Tarsal claws exceptionally long, slender and apically slightly curved, highly asymmetrical, lacking empodia (fig. 36).

Urosternites I to VII (female) or VIII (male) each with a median bristlecomb-like setal group or groups. On the anteriad urosternites this consists of two separate short fringes which are separated by a gap which is usually narrower than each fringe (fig. 27), but which may be wider; this gap decreases in width posteriad, and the posterior urosternites have the median setal fringe entire. Urosternites III to VII (female) or VIII (male) each also with 1+1 lateral setal groups, which are simple and bristlecomb-like on the anteriad urosternites (fig. 27), but become multiseriate on the posteriad urosternites (fig. 34). Similar to the preceding two species, the lateral setal group on urosternite III is much smaller than those on urosternites IV posteriad. The gaps between the median and lateral setated parts of each urosternite progressively decrease in width on successive posteriad urosternites.

Coxites VIII and IX each with a dense and wide posterior marginal setal fringe (figs. 32, 34). Styli absent in both sexes. Ovipositor very short, not surpassing the apex of coxite IX, conical, as in the previous two species (fig. 32). Male lacking parameres (fig. 34).

Caudal filaments setated as in the previous two species. Cerci moderately swollen, proximally unsegmented. Filum terminale slender. Pronounced sexual dimorphism in relative lengths of caudal filaments, those of females being shorter than those of males (fig. 26). Cercal length expressed as fraction of body length, females: average 0,08 (n = 5), maximum 0,13; males: average 0,15 (n = 8), maximum 0,17. Filum terminale, length expressed as fraction of body length, females: average 0,19 (n = 5), maximum 0,20; males: average 0,39 (n = 8), maximum 0,51.

Material examined

Holotype, female: SM H 45051, Noctivaga dune, 23° 43' S, 15° 14' E, 25 March 1982, leg. Hamilton. Type number T 003. (SM)

Allotype, male: SM H 45115, Mniszechi's Vlei, 23° 43' S, 15° 19' E, 10 December 1981, leg. Fielden. (SM)

Paratypes:

Male: Noctivaga dune, 23° 43' S, 15° 14' E, 21 February 1982, leg. Hamilton. (AMNH)

Male: SM H 45123, Mniszechi's Vlei, 23° 43' S, 15° 19' E, 12 December 1981. (SM)

2 Males: SM H 45103, Noctivaga dune, 23° 43' S, 15° 14' E, 13 January 1982, leg. Fielden. (SM)

Female: SM H 45047, Mniszechi's Vlei, 23° 43′ S, 15° 19′ E, 16 January 1981, leg. Praetorius. (SM)

Male: SM H 45112, Mniszechi's Vlei, 23° 43′ S, 15° 19′ E, 11 December 1981, leg. Praetorius. (SM)

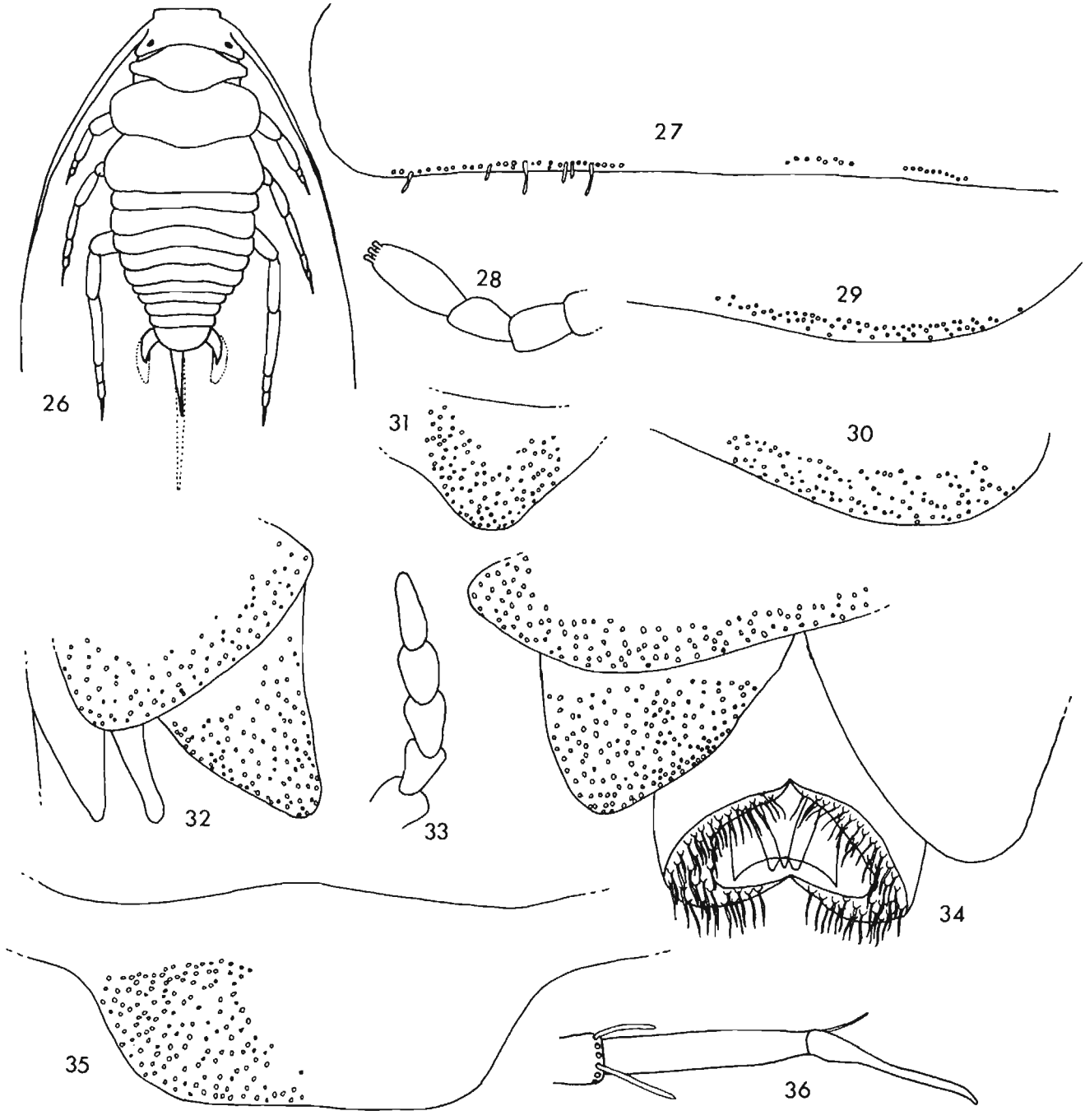
Female: SM H 45045, Noctivaga dune, 23° 43′ S, 15° 14′ E, 11 August 1981, leg. C. Irish. (SM)

2 Females: SM H 45098, Kahani dune, 23° 34′ S, 15° 00′ E, 27 October 1981, leg. C. Irish. (SM)

Male: SM H 45125, Noctivaga dune, 23° 43′ S, 15° 14′ E, 11 January 1982, leg. Fielden. (SM)

Distribution (fig. 16): Known only from a limited area near the northern edge of the main Namib desert dune sea, but further collection will probably show both this and the preceding two species to occur throughout the interior of the dune sea.

Habitat: All specimens from pittraps on the dune slipface.



FIGURES 26—36. *Mormisma wygodzinskyi* sp. nov. 26. Body dorsal; caudal filaments: full line, female; stippled line, male. 27. Urosternite IV, mediolateral. 28. Labial palp. 29. Urotergite III, mediolateral. 30. Urotergite VII, mediolateral. 31. Prosternum. 32. Coxites VIII, IX, female. 33. Maxillary palp. 34. Coxite IX and penis, male. 35. Urotergite X. 36. Mesotarsus.

Remarks: Distinguished from the preceding two species by its much longer antennae, different urosternal and urotergal setations, and different tarsal claws. Named after Dr. Pedro Wygodzinsky (AMNH), who 15 years ago identified Holm & Scholtz's (1980) specimens as *Mormisma* sp. Unfortunately it is not today possible to determine the identity of this *Mormisma* sp., but judging by the results listed in Holm & Scholtz (1980) the observations probably refer to all three species here described, as well as to a as yet undescribed *Mormisma*-like genus which is actually much commoner than *Mormisma* at Gobabeb. The note on "short transformed cerci" indicates *M. muricaudata* and *M. setosa,* but the occurrence on slipfaces excludes these two hummock-dwellers and points to *M. wygodzinskyi* as well as to the undescribed genus. The dramatic increase in activity during strong winds which they describe, I have personally observed only in the undescribed genus. Part of the data in Holm & Scholtz (1980) has also been quoted, as *Morisma* sp. (*sic!*), in Robinson & Seely (1980).

3 DISCUSSION

The occurrence of the strictly dune-living genera *Mormisma* and *Hyperlepisma* Silvestri in both the Namib and Sahara deserts is a curious enigma of lepismatid biogeography. Though it would seem to imply some past connection between dunes of these two deserts, and though the fact that *Mormisma* and *Hyperlepisma* are among the most apomorph lepismatids would further imply that such a connection existed relatively recently in geological time, I am unaware of any supportive evidence, from whatever discipline, for such a claim. There are numbers of animals and plants which have Afro-arid distributions, disjunct between southwestern and northeastern Africa. At least as far as the better documented vertebrate examples go, the animals are either inhabitants of dry savanna (e.g. *Pedetes capensis, Otocyon megalotis, Proteles cristatus, Raphicerus campestris, Rhynchotragus kirki*) which do not range into proper desert, or, if they do (e.g. *Canis mesomelas, Oryx gazella/O. beisa*) are more often found in dry savanna. This implies that the "dry corridor" connecting southwestern and northeastern Africa during some past interpluvial consisted of at most dry savanna, and certainly nothing dry enough to support a 5000 km long dune tract or habitat suitable for ultrapsammophilous lepismatids.

If past contact between the Namib and Sahara representatives of *Mormisma* and *Hyperlepisma* is then unlikely, the obvious alternative would be to consider them products of convergent evolution in response to similar environmental conditions. If this were the case, one would further expect to find constant fundamental taxonomic differences, however minor, between representatives of the apparent same genus in different deserts. At least in the case of *Mormisma*, I could find no external morphological differences of generic significance between *M. peyerimhoffi* (three of Mendes' (1984) specimens examined) and the three Namib *Mormisma* spp. There is thus at this stage no basis on which to separate them taxonomically.

Mormisma and *Hyperlepisma* share a number of apomorph characters. The elongated tarsal claws and loss of empodia are unique in the family. They also share setal proliferation, shortened antennae and caudal filaments, undilated distal segment to the labial palp, similar general urosternal setational patterns, shortened ovipositor and, in most species, a reduced number of labial palpal sensory papillae. Taken individually, most of these shared characters can be interpreted as adaptations to a psammophilous lifestyle. As such they may have evolved seperately in the two genera. Taken collectively, and seen against the background of the highly unusual distribution, they indicate the possible monophyly of *Mormisma* and *Hyperlepisma.*

The main objection to such monophyly would be the fact that *Hyperlepisma* possesses barbed/plumose macrosetae, while *Mormisma* has unbarbed/smooth macrosetae. The character states smooth (plesiomorph) vs. plumose (apomorph) macrosetae is one of two traditionally used to delimit generic groups in the Lepismatidae. The other is the posession of male parameres (plesiomorph) vs. their absence (apomorph). Both *Hyperlepisma* and *Mormisma* lack parameres. Mendes (1978) included *Mormisma* in a phylogram of the smoothsetaed Lepismatidae, but commented on the fact that it fits uncomfortably into the group and seems more closely related to *Hyperlepisma*, a fact he ascribed to convergence. Certainly the large, profusely setated, xerophilous *Mormisma* seems out of place among the mostly small, sparsely setated and mesophilous other genera in the group; possessing as it does characters which in general are more typical of the genera with plumose macrosetae.

Possibly the smoothness of macrosetae in *Mormisma* is the result of secondary loss of setal barbs. The minimal loss of friction during movement under sand, as would be the result of loss of setal barbs, may be advantageous to an animal whose life depends on efficient sand-diving. If one accepts this, the removal of *Mormisma* from the smoothsetaed genus-group considerably strengthens the status of this group, as well as the informal suprageneric system of the family, based on the characters above, which has been in existence for some time. It also removes the only argument against the monophyly of *Mormisma* and *Hyperlepisma* and, while not solving the problem of their disjunct distributions, considerably simplifies the search for such a solution.

The species described here provide additional evidence that *Mormisma* and *Hyperlepisma* may be closely related. It is known that psammophilous adaptation in lepismatids is accompanied by setal proliferation. Such proliferation would logically proceed from the normal condition where one has discreet setal groups

of bristlecombs on specific sclerites, to a condition where the setae in such groups have been multiplied to the extent that adjacent groups become confluent (= setal fringes). Thus the inferred evolutionary trend for psammophilous lepismatids would be from *Hyperlepisma*-like to *Mormisma*-like species, which is the same direction as the implied secondary loss of setal barbs for *Mormisma*. *Hyperlepisma* has 3+3 bristlecombs on most urotergites. On the urotergites of *M. muricaudata* and *M. setosa* the setal fringes, though continuous and typically *Mormisma*-like posteriad, are discontinuous anteriad, and in the case of *M. setosa* 3+3 setal groups may even still be distinguished.

It seems probable that *Mormisma* is simply a highly apomorph derivative of *Hyperlepisma*. The as yet undescribed genus mentioned under *M. wygodzinskyi* above has the setation and appearance of a *Mormisma*, but possesses barbed setae, which further strengthens this notion. A final acceptance of the monophyly of *Mormisma* and *Hyperlepisma* must await detailed study of the mentioned and other undescribed psammophilous Namib genera, as well as the several undescribed Namib *Hyperlepisma* spp and *Hyperlepisma*-like *Ctenolepisma* spp. The recent description of a second Saharan *Hyperlepisma* sp by Mendes (1984), raises the possibility that there may also be still more psammophilous lepismatids present in that desert, and the solution as to the disjunct distribution of *Mormisma* and *Hyperlepisma* will probably not be known before such species are.

4 ACKNOWLEDGEMENTS

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