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Previous volumes (2010-2020): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France
ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d’avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

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TWO NEW SPECIES OF THE GENUS *PSORERGATES* TYRELL, 1883
(ACARINA : PROSTIGMATA : PSORERGATIDAE)
PARASITIC ON INSECTIVORES,
WITH A KEY TO THE KNOWN SPECIES FROM INSECTIVORA HOSTS

BY K. M. T. GIESEN and F. S. LUKOSCHUS*

ABSTRACT: Two new species are described and figured: *Psorergates urotrichi* ex *Urotrichus talpoides* Temminck, and *Psorergates cryptotis* ex *Cryptotis nigrescens* Allen. Specimens from *Crocidura lasiura* Dobson are similar to *Psorergates crocidurae* Lukoschus, 1968, ex *Crocidura russula* (Hermann).

A key to the species from Insectivora hosts is given, and the parallel evolution of hosts and parasites is discussed.

INTRODUCTION

Species of the genus *Psorergates* Tyrell, 1883, are minute itch mites of Rodentia, Insectivora and Scandentia (*Psorergates tupaiæae*), the only *Psorergates* species described to date from this host order (GIESEN & LUKOSCHUS, 1982)). The ten previously described species from Insectivora share the following combination of characteristics:

- dorso-anterior seta of tarsus distinctly shorter than dorso-posterior seta,
- escutcheon-shaped dorsal shield,
- lateral shield setae distinctly remote from shield border,
- short palpal tibial setae,
- gnathosomal setae lobed,
- absence of tibial spine IV,
- genu IV seta longer and stronger than femur IV setae,
- terminal setae of male on long, drop-shaped sclerite.

These species have been placed in the "insectivora-group" by LUKOSCHUS (1968). Specimens

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*Acarologia*, t. XXIV, fasc. 4, 1983.
from three additional host species have been collected and will be described and compared to the previously known species. They share the characteristics of the "insectivora-group" and further support the suggested host-parasite relations.

Psorergates cryptotis sp. nov.

FEMALE, holotype. Venter (Fig. 1), cuticle smooth, subequal legs evenly spaced along podosoma. Epimera I recurved laterally, not circularly closed. Epimera II-IV straight with lateral sclerotized prolongations along the trochanters. Ventral setae (v) relatively long on level of epimera III, genital opening between prominent paramedian lobes, each lobe carrying a pair of terminal setae. Anal opening absent. Trochanters and epimerae connected by strongly sclerotized subcortaneous articulations.

Legs: Trochanter with ventral acute spur, with a piliform seta at its base, and a small sclerotized spur opposite the femoral spur. Basal part of trochanters, like the acute, postero-ventral femoral spur, more strongly sclerotized. Femora I-III with two postero-lateral setae of which the proximal one is thinner and shorter than the distal one. Femur IV with only one seta. Genua I-III with

Fig. 1-3: *Psorergates cryptotis* sp. nov., female (holotype).


(a.m.: antero-median setae; b: black point; d: black point; d.a.: dorso-anterior seta; d.p.: dorso-posterior seta; em: empodium; f: black point; g: black point; gs: gnathosomal setae; ph. b.: pharyngeal bulb; ps: palpial tibial setae; sg: subgnathosomal setae; sp: spur (of palpial tibia); so: solenidia; v: ventral setae.)
very short seta, genu IV with very long, strong seta. Tibia of legs I-III with small ventral spine and dorsally a short seta on all tibiae (Fig. 2). Tarsi with long dorso-posterior (d.p.) seta and short, thin dorso-anterior (d.a.) seta (Fig. 2), the dorso-posterior seta lacking on leg IV. Ventrally a spine on all tarsi. Legs I and II with two solenidia (so), of which the smaller one is enveloped by a skinfold (Fig. 2). Praetarsus with two two-pointed claws, a bilobate empodium, the smaller part situated dorsally between the claws, the bigger part situated ventrally with pointed end.

Dorsum (Fig. 3). Soft parts of cuticle regularly striated. Dorsal sclerotized and punctate shield of escutcheon-like shape with three pairs of lateral setae near shield margins and a pair of antero-median (a.m.) setae. Lateral setae inserted outside of the pores. Black points b, d, f, and g visible on dorsal shield (see also Psorergates talpae Lukoschus, 1968).

Gnathosoma dorsally with a pair of bilobate gnathosomal setae (gs) of which the basal part is two-lobed and the distal part elongate and single-pointed (Figs. 6, 7). Gnathosoma ventrally with a pair of thin subgnathosomal setae (sg) in front of the pharyngeal bulb (ph. b.). Palpal tibia with acute terminal sclerotized spur (sp), a point-like seta, a strong short posterior seta (ps) and laterally a tiny seta. Palpal tarsus ventrally beneath palpal tibia, with two apical, ventro-median directed, claw-like spines and a single-pointed spine-like seta. Chelicerae modified with dentate, dorsally directed, digitus fixus, and stylet-like moving digit.

All measurements in micrometers (μm) in table I.

**MALE**: Allotype (Fig. 4), similar to female, without sexual dimorphism of gnathosomal setation, but with somewhat smaller measurements.

Dorsal shield with three pairs of lateral setae, the first pair distinctly remote from the shield border. A pair of genital setae (ge. s) lateral to and just posterior to the genital opening and a pair of antero-median setae (a.m.) on subequal height but more laterad to the genital opening. Black points b, d, f and g present. Penis and penis sheath simple.

Venter (Fig. 5) like that of female, caudally with only one median lobe with tongue-like sclerotization and two terminal setae. Anal opening absent.

Measurements in table II.

**DEVELOPMENTAL STAGES.** Similar to *Psorergates cinereus* Kok et al., 1971. Eggs relatively large in relation to female. Exspherical. Gnathosoma of proto- and deutonymph near that of the adult in size and form.

**HOST AND LOCALITY**: *Cryptotis n. nigrescens* Allen, 1895. Cerro Punta, Panama. Host in collection of Naturhistorisches Museum (NHM), Wien, Austria. The mites were found on the hind legs at the border of the soft hairy skin.

**DEPOSITION OF TYPES**: Holo- and allotype in NHM, Wien, paratypes in U.S. National Museum of Natural History (Smithsonian Institution), Washington, D.C.; Field Museum of Natural History, Chicago; The Acarology Laboratory, Ohio State University, Columbus; Rijksmuseum van Natuurlijke Historie, Leiden; Institut de Médecine Tropicale Prince Léopold, Antwerp; and in the collection of the authors.

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**Psorergates urotrichi** sp. nov.

**FEMALE**, holotype. Venter (Fig. 8) similar to preceding species, with shorter ventral setae, less strongly sclerotized spurs and no prolongations of the epimera along the trochanters. Genital slit with mushroom-like subintegumental sclerotization between the prominent paramedian lobes, with longer terminal setae than previous species.

Legs with more pronounced differences between the proximal and distal femoral setae. The length of the distal setae of the femora increases from leg I to leg IV. Genual setae of legs I-III short and stout, of leg IV very long and strong. Tarsal claws one-pointed and ventral part of empodia rounded (Fig. 9). Trochanter setae very
TABLE 1. Comparative measurements of species of the genus Psorergates, "insectivora-group".  FEMALES.

<table>
<thead>
<tr>
<th>Species</th>
<th>Length palpaltibial seta</th>
<th>Distance between ventral setae</th>
<th>Gnathosomal setae</th>
<th>Femur IV</th>
<th>Tibia</th>
<th>Lateral shield</th>
<th>Ventral</th>
<th>Body length</th>
<th>Body width</th>
<th>Shield length</th>
<th>Shield width</th>
<th>Length seta tarsus d.a.</th>
<th>Length seta tarsus d.p.</th>
<th>Length setae</th>
<th>Seta femur IV</th>
<th>Shape ventral em podium</th>
<th>Shape ventral em podium</th>
<th>Shape ventral em podium</th>
<th>Shape ventral em podium</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Psorergates urotrichi</em></td>
<td>63.0-73.5</td>
<td>26.0-29.5</td>
<td>9.0-10.0</td>
<td>3.0-4.0</td>
<td>4.0</td>
<td>3.5-4.5</td>
<td>6.5</td>
<td>88.0-110</td>
<td>99.0-108</td>
<td>78.0-96</td>
<td>70.0-75</td>
<td>15.0-18</td>
<td>15.0-18</td>
<td>4.0-6.0</td>
<td>1.5-2.0</td>
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<td>Rounded</td>
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<tr>
<td><em>Psorergates desmanae</em></td>
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<td>26.0-29.5</td>
<td>9.0-10.0</td>
<td>3.0-4.0</td>
<td>4.0</td>
<td>3.5-4.5</td>
<td>6.5</td>
<td>88.0-110</td>
<td>99.0-108</td>
<td>78.0-96</td>
<td>70.0-75</td>
<td>15.0-18</td>
<td>15.0-18</td>
<td>4.0-6.0</td>
<td>1.5-2.0</td>
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<td>Rounded</td>
<td>Rounded</td>
<td>Rounded</td>
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<td>4.0</td>
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<td>6.5</td>
<td>88.0-110</td>
<td>99.0-108</td>
<td>78.0-96</td>
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<td>15.0-18</td>
<td>15.0-18</td>
<td>4.0-6.0</td>
<td>1.5-2.0</td>
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<td>4.0</td>
<td>3.5-4.5</td>
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<td>88.0-110</td>
<td>99.0-108</td>
<td>78.0-96</td>
<td>70.0-75</td>
<td>15.0-18</td>
<td>15.0-18</td>
<td>4.0-6.0</td>
<td>1.5-2.0</td>
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<td>Rounded</td>
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<td>Rounded</td>
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<td>6.5</td>
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<td>99.0-108</td>
<td>78.0-96</td>
<td>70.0-75</td>
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<td>15.0-18</td>
<td>4.0-6.0</td>
<td>1.5-2.0</td>
<td>Rounded</td>
<td>Rounded</td>
<td>Rounded</td>
<td>Rounded</td>
</tr>
</tbody>
</table>

short, half as long as those of *Psorergates cryptotis* sp. nov.

Dorsum (Fig. 12) as in *Psorergates cryptotis* sp. nov. with somewhat longer lateral setae. Black points a, b, c, d, f and g present.

Gnathosoma dorsally with a pair of bilobed gnathosomal setae (Fig. 11), of which the basal part is tridentate and the distal part undulate. Palpal tibia with acute terminal sclerotized spur, a small proximal seta and strong, short distal seta,
TABLE II. Comparative measurements of species of the genus *Psorergates*, "insectivora-group". MALES.

<table>
<thead>
<tr>
<th>Species</th>
<th><em>Psorergates urotrichi</em></th>
<th><em>Psorergates desmanae</em></th>
<th><em>Psorergates talpae</em></th>
<th><em>Psorergates crocidurae</em></th>
<th><em>Psorergates doriae</em></th>
<th><em>Psorergates etruscus</em></th>
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<tr>
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<td>2</td>
<td>2</td>
<td>2</td>
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<tr>
<td></td>
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<td>14-15</td>
<td>14-16</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
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<td>5</td>
<td>3</td>
<td>2</td>
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<td></td>
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<td>rounded</td>
<td>rounded</td>
<td>rounded</td>
<td>acute</td>
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<tr>
<td></td>
<td>body length</td>
<td>119</td>
<td>132-146</td>
<td>108-120</td>
<td>105-114</td>
<td>103-113</td>
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<tr>
<td></td>
<td>body width</td>
<td>91</td>
<td>105-120</td>
<td>90-99</td>
<td>85-93</td>
<td>81-93</td>
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<tr>
<td></td>
<td>shield width</td>
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<td>75-81</td>
<td>62-66</td>
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<td>length setae</td>
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<tr>
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<td>femora I-III</td>
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<td>15-20</td>
<td>25-28</td>
<td>18-23</td>
<td>7-14</td>
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<td>femur IV</td>
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<td>25-36</td>
<td>30-33</td>
<td>20-25</td>
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<tr>
<td>genus I-III</td>
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<td>18</td>
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<td>8-12</td>
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<td>5</td>
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<td>lateral shield</td>
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<td>4-5</td>
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<td>3-4</td>
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<td>2-3</td>
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<td>2-3</td>
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<td>7-10</td>
<td>12-14</td>
<td>11-19</td>
<td>7</td>
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<td>length palpalibital seta</td>
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<td>3-4</td>
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<tr>
<td>length gnathosomal seta</td>
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<td>25-29</td>
<td>24-27</td>
<td>27-30</td>
<td>21</td>
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<tr>
<td>length penis</td>
<td>20</td>
<td>23-24</td>
<td>18</td>
<td>15-16</td>
<td>14-21</td>
<td>14</td>
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<tr>
<td>length penis sheath</td>
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<td></td>
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<tr>
<td>genital setae</td>
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<td>10-11</td>
<td>9</td>
<td>7-8</td>
<td>9-10</td>
<td>7</td>
</tr>
<tr>
<td>a.m. setae</td>
<td>11</td>
<td>9-10</td>
<td>10-11</td>
<td>12-13</td>
<td>15-16</td>
<td>9</td>
</tr>
</tbody>
</table>

**Males of *Psorergates baueri* and *Psorergates mexicanus* are unknown.**
Fig. 4-7: *Psorergates cryptotis* sp. nov., male (allotype).

4. — Dorsum. 5. — Caudal part of venter. 6-7. — Gnathosomal seta.

(*g.s.* : genital setae.)
Fig. 8-10: *Psorergates urotrichi* sp. nov., female (holotype).

twice the length of those of *Psorergates cryptotis* sp. nov. Palpal tarsus (Fig. 10) with two bilobed claw-like spines and a single-pointed spine-like seta.

**MALE**, allotype (Fig. 13) similar to female, with somewhat smaller measurements.

Dorsal shield with genital opening in the middle of an anterior oval sclerotized shield and a pair of genital setae (ge. s) posterolateral to the genital opening. Antero-median (a.m.) setae lateral to genital opening. Antero-median and genital setae forming a rectangular pattern. Black points a, b, c, d, f and g as indicated (Fig. 13). Penis and penis sheath simple.

Venter as in female, caudally with only one median lobe with tongue-like sclerotization and two terminal setae (Fig. 14).

Measurements in table II.

**DEVELOPMENTAL STAGES** similar to other species of the "*insectivora-group*".

**HOST AND LOCALITY**: *Urotrichus talpoides* Temminck, Hakuba Nagano, Japan, 5-V-1973, trapped by K. UCHIKA w A. The mites were found in the epidermis of the concha of the ears.

**DEPOSITION OF TYPES**: Holo- and allotype in National Science Museum (Natural History), Tokyo, Japan; paratypes in U.S. National Museum of Natural History (Smithsonian Institution), Washington, D.C., and in the collection of the authors.

**Psorergates crocidurae** Lukoschus, 1968

*Psorergates crocidurae* LUKOSCHUS, 1968 : 81

The species was described from *Crocidura russula russula* from the Netherlands, but has been found on the same host species in Germany, Belgium, France and Spain. On a specimen preserved in alcohol of *Crocidura lastiura* Dobson, from Charbin in the Museum of Natural History in Vienna, specimens have been collected, which cannot be separated clearly.

The measurements are given in table III.

**KEY TO THE SPECIES OF THE "*INSECTIVORA-GROUP" OF THE GENUS Psorergates**

**FEMALES**

1. — tarsal claws with one point ......................... 4

2. — tarsal claws with two points, two setae on femur IV, tarsal setae d.p. absent .................. 6

3. — ventral part of empodium rounded ............... 8

4. — trochanter setae shorter than 5 μm, genual setae I-II 1 μm, tibial setae 4-5 μm, shield length 70-78 μm, shield width 65-71 μm ..............

**P. urotrichi** sp. nov.
Fig. 11-12: *Psorergates urotrichi* sp. nov., female (holotype).


(*a* : black point; *c* : black point.)
Fig. 13-14: *Psorergates urotrichi* sp. nov., male (allotype).
— trochanter setae longer than 8 μm, genual setae 1-III 3-5 μm, tibial setae 10-15 μm, shield length more than 79 μm, shield width more than 70 μm ............................................. 5

5. — terminal setae 78-90 μm, proximal seta of femur I-III distinctly shorter and thinner than 20-28 μm long distal seta ............................................................

P. desmanaew Lukoschus, 1968
— terminal setae 60-72 μm, proximal seta of femur I-III shorter, but equal strong as distal 28-36 μm long distal seta. P. talpae Lukoschus, 1968

6. — shield length 72-78 μm, shield width 58-60 μm, distance between ventral setae 6-7 μm ........

P. etruscus de Cock et al., 1970
— shield length more than 78 μm, shield width more than 65 μm, distance between ventral setae more than 8 μm .................................................. 7

7. — shield length 78-85 μm, shield width 66-72 μm, terminal setae 49-58 μm, distance between ventral setae 13-18 μm ................

P. crocidurae Lukoschus, 1968
— shield length 86-93 μm, shield width 70-75 μm, terminal setae 44-49 μm, distance between ventral setae 17-24 μm ........

P. doriae Giesen et al., 1982

8. — dorso-posterior seta of tarsus I-III shorter than 10 μm, trochanter setae shorter than 5 μm.

P. squamipes Lukoschus et al., 1974
— dorso-posterior seta of tarsus I-III longer than 13 μm, trochanter setae longer than 5 μm ..... 9

9. — body length 117-135 μm, body width 93-99 μm, femur IV setae 28-33 μm, ventral setae 4 μm, gnathosomal setae 8-9 μm ........

P. sorici Lukoschus, 1968
— body length 138-159 μm, body width 112-131 μm, femur IV seta 19-25 μm, ventral setae 8 μm, gnathosomal setae 11-15 μm........

P. sorici Lukoschus, 1968
— epimera I bent backwards to a closed sucker-like ring, epimera I-IV without sclerotized lateral projections, distance between ventral setae more than 10 μm ..................... 11

P. baueri Lukoschus et al., 1971
— epimera I not ring-forming, epimera I-IV with sclerotized lateral projections, distance between ventral setae more than 10 μm ..................... 11

10. — genu IV seta 22-31 μm, terminal setae 43-62 μm, body length 98-120 μm, shield width 58-65 μm ...

P. cryptotis sp. nov.
— genu IV seta 37-48 μm, terminal setae 60-75 μm, body length 123-135 μm, shield width 78-84 μm ...

P. mexicanus Giesen et al., 1983

KEY TO THE SPECIES OF THE "INSECTIVORA-GROUP" OF THE GENUS Psorergates

MALES

(The males of the species P. baueri and P. mexicanus are unknown).

1. — tarsal claws with one point .................. 4
   — tarsal claws with two or three points .... 2

2. — two setae on femur IV, tarsal claws with three points, tarsal setae d.p. absent, in males genital and a.m. setae in rectangular or trapezoid position ........................................... 6
   — one seta on femur IV, tarsal claws with two points, tarsal setae d.p. present, genital and a.m. setae in males in linear position .......... 3

3. — ventral part of empodium rounded ...... 8
   — ventral part of empodium pointed .........

P. cryptotis sp. nov.

4. — trochanter setae 4 μm, tibial setae 4 μm, genual setae 1 μm ....

P. urotrichi sp. nov.
— trochanter setae more than 7 μm, tibial setae 8-12 μm, genual setae 1-III 3-4 μm 5

5. — terminal setae 72-89 μm, femoral setae 1-III 15-20 μm, shield length 84-90 μm, shield width 75-81 μm ........

P. desmanaew Lukoschus, 1968
— terminal setae 51-54 μm, femoral setae 1-III 25-28 μm, shield length 72-74 μm, shield width 62-66 μm ......

P. talpae Lukoschus, 1968

6. — shield width ± 56 μm, distance between ventral setae ± 7 μm, distance between a.m. setae ± 9 μm, genu IV seta ± 18 μm ........

P. etruscus de Cock et al., 1970
— shield width 61-74 μm, distance between ventral setae more than 10 μm, distance between a.m. setae more than 12 μm, genu IV setae 18-33 μm ..................... 7

7. — trochanter setae 8-9 μm, terminal setae 42-48 μm, femoral setae 1-III 18-23 μm ...

P. crocidurae Lukoschus, 1968
— trochanter setae 3 μm, terminal setae 26-38 μm, femoral setae 1-III 7-14 μm ...

P. doriae Giesen et al., 1982

8. — dorsal shield with convex lateral border ....

P. cinereus Kok et al., 1971
— dorsal shield with concave lateral border .... 9

9. — penis length about 50 μm, tarsal setae d.p. 7 μm, trochanter setae 3 μm ........

P. squamipes Lukoschus et al., 1974
— penis length 36-38 μm, tarsal setae d.p. 14-18 μm, trochanter setae 7 μm ........

P. sorici Lukoschus, 1968
DISCUSSION

The 12 species of *Psorergates* presently known from insectivores (Table 1 and II) can be arranged into four subgroups, with characteristics and species as follows:

**Subgroup**

1. One-pointed tarsal claws, two setae on femur IV, dorso-posterior setae on tarsi present, ventral part of empodium rounded; in males genital and antero-median setae in rectangular arrangement. Included are *Psorergates talpae*, *P. desmanae* and *P. urotrichi*, all from moles, family Talpidae.

2. Two-pointed claws, one seta on femur IV, dorso-posterior setae on tarsi present, ventral part of empodium acute; in males distance between genital and antero-median setae strongly unequal, *a.m.* setae laterad to genital setae. Species in this group are *Psorergates baueri*, *P. mexicanus* and *P. cryptotis* from shrews of the tribe Blarinini (Soricidae).

3. Two-pointed tarsal claws, one seta on femur IV, dorso-posterior setae on tarsi present, ventral part of empodium acute; in males distance between genital and antero-median setae strongly unequal, *a.m.* setae laterad to genital setae. Included are *Psorergates sorici*, *P. cinereus* and *P. squamipes* from *Sorex* and *Anourosorex* of the tribes Soricini and Anourosoricini.

4. Three-pointed tarsal claws, two setae on femur IV, dorso-posterior setae on tarsi absent; in males *a.m.* setae and genital setae in trapezoid position with *a.m.* setae in front of and farther apart than genital setae. Includes *Psorergates crocidurae*, *P. doriae* and *P. etruscus* from white-toothed shrews, tribe Crocidurini.

Characteristics such as reduction of setae, secondary modification of leg segments and modification of male genital region have been regarded to be of evolutionary importance in many families of Acarina.

The arrangement of mites into these subgroups paralleling the systematic arrangement of their hosts suggests parallel evolution of mites within their host groups.

The 12 species described to date from Talpidae and Soricidae surely represent only a small percentage of the species present on the 32 genera and more than 250 species within these families. It will be interesting to see whether additional insectivore psorergatids will share the characteristics of these groups and subgroups, and whether they will support the characteristics suggesting parallel evolution.

ACKNOWLEDGEMENTS

We are obliged to Dr. K. Bauer, Naturhistorisches Museum, Wien, and Dr. K. Uchikawa, Department of Parasitology, Shinshu University, Matsumoto City, for the opportunity to examine the hosts; Dr. A. Fain, Antwerp, for critical review, and Dr. John O. Whittaker Jr., Terre Haute, for correction of the English text.

LITERATURE


Paru en décembre 1983.