

Mitt. hamb. zool. Mus. Inst.	Band 89	S. 141–156	Hamburg, November 1992 ISSN 0072-9612
------------------------------	---------	------------	--

## Notes on mites of the genus *Pygmephorus* (Acari: Heterostigmata) associated with North American mammals (Part II)

Hieronim Dastych, Gisela Rack & Nixon Wilson<sup>1)</sup>

**Abstract:** Thirteen species of mites of the phoretic genus *Pygmephorus* (Acari: Heterostigmata) have been collected from small mammals in the United States. Further information on the poorly known intraspecific variability of the mites is provided. New synonyms are proposed for the following species: *Pygmephorus erlangensis* Krczal, 1959 (= *P. johnstoni* Smiley & Whitaker, 1979: **syn. nov.**), *P. stammeri* Krczal, 1959 (= *P. krczali* Mahunka, 1969 and *P. tamiassi* Mahunka, 1975: **syn. nov.**) and *P. spickai* Mahunka, 1974 (= *P. mustelae* Rack, 1975: **syn. nov.**). The distribution and ecology of the genus *Pygmephorus* are discussed.

**Keywords:** Acari (Heterostigmata), phoretic *Pygmephorus*, small mammals, North America, taxonomy.

Received 7 October 1991, accepted 17 February 1992.

### Introduction

Mites of the phoretic genus *Pygmephorus* Kramer, 1877 (Heterostigmata, Pygmephoridae) are largely associated with small mammals (Insectivora, Rodentia, Lagomorpha) and occur in their fur or nest. They are also recorded less frequently, from soil, detritus and similar habitats.

During our previous studies on North American *Pygmephorus* (Dastych et al. 1991) we focused on the variability of certain taxa and designated several synonyms. While Dastych et al. (1991) was in print, the Collection of Chelicerata at the Zoological Museum in Hamburg had received numerous additional samples of *Pygmephorus* from the United States. Analysis of this material and some other unpublished collections from North America held in the Museum provided new information worthy of another publication. This paper deals with individual variability of particular species, supplements their original descriptions and discusses the poorly known ecology and distribution of these mites.

### Materials and Methods

The paper is based on 235 specimens of the genus *Pygmephorus* collected in the United States (Alaska, Alabama, Indiana, Iowa, New York, Massachusetts, Oregon) in the years 1951–1988. The mites were sampled from thirteen species of mammals and, in some cases, extracted from their nests or other habitats. The material was initially preserved in

<sup>1)</sup> Anschrift der Verfasser: Dr. Hieronim Dastych, Dr. Gisela Rack: Zoologisches Institut und Zoologisches Museum der Universität Hamburg, Martin-Luther-King-Platz 3, 2000 Hamburg 13, Bundesrepublik Deutschland; Prof. Dr. Nixon Wilson, Department of Biology, University of Northern Iowa, Cedar Falls, Iowa 50614-0421, USA.

	MAMMALS		PYGMEPHORUS																			
	Ii=	n=	B. brevicauda	S. vagreus	So. aquaticus	S. cinereus	Pe. leucopus	Pr. lotor*	C. rutilus*	Pe. sitkensis*	R. norvegicus	Sp. tricephaleatus*	M. erimaea	D. virginiana*	Me. mephitis*	A. rufa pacifica*	S. longirostris	S. bendirii	Mi. longicaudus*	Pe. maniculatus	Ce. cristata	
whitakeri*		85/19	8/4	5/3	4/4	2/2	3/1					1/1	1/1									
spinosus*		20/11	2/2	10/2		2/2	2/2										1/1				1/1	
designatus*		18/4		20/1		6/3	35/1				1/1	1/1		1/1	2/1							
horridus*			15/3		4/2			6/2	1/1									1/1				
plurispinosus		3/2	23/2		13/2			2/2								1/1						
stammeri*		6/3			2/1			1/1	6/1													
scalopi		4/3		49/4																		
rackae		4/4		7/2																		
erlangensis*							2/1				1/1											
idei		1/1					1/1															
trisetosus*			1/1																			
moreohorridus		2/1																				
hastatus		1/1																				
arcuatus*										1/1												1/1
cf. plurispinosus*								1/1														

**Table 1.**

*Pygmephorus* mites found on North American mammals (left numeral the number of specimens, right numeral the number of samples. Asterisk [\*] indicates either taxa of *Pygmephorus* found in Alaska or a new mammalian host. Ii [index of intensity] = average number of mites per infested host: see Margolis et al. (1982), n = number of particular hosts infested with *Pygmephorus* mites.

70% ethanol, later mounted on microslides in gum chloral (chiefly Swan's, but also Berlese's and Hoyer's media) and then examined under phase and interference contrast microscopy. Morphological notations follow Lindquist (1977, 1986) and are explained elsewhere (Dastych & Rack 1991). The synonyms listed for particular species, if not indicated otherwise, are taken from Dastych et al. (1991).

The discussion about ecology and distribution of the mites is based on the total North American material of *Pygmephorus* at our disposal (op. cit., this paper). This comprises 458 specimens from 129 samples. The majority of individuals was collected from mammals (393 mites, 116 samples) and their quantitative distribution in samples is presented in Tab. 1. The remaining specimens were obtained from mammal (11 mites, 3 samples) and bird (2 mites) nests or burrow, or other habitats (52 mites, 8 samples). These numbers exclude previously unpublished data from Jugoslavia, the Netherlands and Panama (5 mites).

The bulk of the material is housed in the Zoologisches Institut und Zoologisches Museum, Universität Hamburg. Representatives of ten species (46 specimens, including a paratype of *P. trisetosus* Dastych & Rack, 1991) are in the reference collection of Wilson. Five species (14 specimens) are deposited in the Florida State Collection of Arthropods, Gainesville.

## Survey of species

### *Pygmephorus ideii* Smiley & Whitaker, 1979 (Fig. 2)

Material examined: 1 female.

Iowa: from *Procyon lotor* (Linnaeus, 1758), St. Lucas, Fayette Co., late Nov 1984, coll. K. M. Franzen.

Remarks: The body is 417  $\mu\text{m}$  long. Setae *e* and *h*<sub>2</sub> are 59  $\mu\text{m}$  and 35  $\mu\text{m}$  long, respectively. Poststernal apodeme and apodemes 5 are inversely "Y" shaped, but the latter ones have strongly reduced branches (Fig. 2). Tibiotarsus I is relatively long. Internal tibiotarsal thickening on the limb wall is well developed. Modified subunguinal seta *s* on tibiotarsus I is relatively long. Setae *FeI d* are terminated as flat, asymmetrical and sharp spines. Setae *TiIV v'* are distinctly barbed.

Distribution: Known from Montana, Iowa and Ohio. Our recent reexamination of earlier published material (Rack 1975) indicated that *P. ideii* had been reported from the U. S. A. (Colorado, Wisconsin) and Japan under the name *P. nidicolus* Mahunka, 1969. It is recorded from 3 taxa of small mammals (Smiley & Whitaker 1979, Dastych et al. 1991, this paper).

### *Pygmephorus stammeri* Krczal, 1959 (Fig. 4)

1969 *Pygmephorus krczali* Mahunka (**new synonym**)

1975 *Pygmephorus tamiasi* Mahunka (**new synonym**)

1979 *Pygmephorus brevicaudae* Smiley & Whitaker

Material examined: 4 females.

Iowa: 2 ♀ from *Sorex cinereus* (Kerr, 1792), Waterloo, Black Hawk Co., 12 Dec 1975, coll. N. Wilson. Massachusetts: 1 ♀ from *Blarina brevicauda* (Say, 1823), Amherst, Hampshire Co., 7 Oct. 1951, coll. L. D. Class. New York: 1 ♀ from tree hole debris, New York City, (Forest Park), Queens, 13 Jun 1973, coll. M. D. Delfinado.

Remarks: The body is 286–356  $\mu\text{m}$  long. The characters observed in these specimens agree well with those found in comparative material from Europe and North America (see Dastych et al. 1991). Recently we synonymized *P. brevicaudae* Smiley & Whitaker with variable *P. stammeri* Krczal (op. cit.). We have had an opportunity to examine the holotype of another similar species, *P. tamiasi* Mahunka, 1975, described and known from only one specimen collected in Indiana (Mahunka (1975). Comparison of the holotype with our material of *P. stammeri* left no doubt that the two taxa are conspecific. Hence, we recognize *P.*

*tamiasi* as a junior synonym of *P. stammeri*. The synonymy of *P. krczali* Mahunka, 1969 with the latter taxon and other related questions are discussed elsewhere (Dastych & Rack 1992).

The holotype of *P. tamiasi* generally agrees with the rather scanty original description. However, in the type-specimen some setae ( $v_1$ ,  $sc_2$ ,  $c_1$ ,  $d_1$ ) are positioned differently than those in the original illustration (op. cit.: Fig. 15). Moreover, setae  $1c$  are divided longitudinally but not separated, i. e. they are not bifurcated as figured by the author. A roundish thickening inside tibiotarsi I and distinctly separated from the lateral wall, is easily recognized in the holotype, but not mentioned in the original description. Such an internal thickening is characteristic for *P. stammeri* (see Dastych et al. 1991). That structure, i. e. a short cylindrical sclerotized connection (?) between dorsal and ventral wall of the limb is visible as a round or slightly oval and strongly chitinized "dot" (op. cit.: Fig. 3). The slightly variable shape of the "dot" depends on positioning of the tibiotarsus. Modified subunguinal seta  $s$  is relatively large and shaped as in Fig. 4. Claws II and III are small, smooth and with thickened bases. The empodia on legs II and III in *P. stammeri* have a more or less distinct incision in the middle of their lateral sides and their anterior parts are covered with delicate vertical striae. The anterior edges of the empodia are usually slightly rounded. There is a strikingly large distance between bases of setae  $e$  and  $f$  and the insertion of the setae can vary within the species. The setae  $e$  are 42  $\mu\text{m}$  long, the length of the setae  $h_2$  is 21 and 17  $\mu\text{m}$  each. One seta  $h_2$  is smooth, the other one has two small barbs. Setae  $ps_1$  to  $ps_3$  are inserted almost transversely, the setae  $ps_1$  and  $ps_2$  have 1–2 hardly discernible barbs.

Distribution: *P. stammeri* is known from Germany (Krczal 1959, Kořir 1975), Poland (Haitlinger 1977); the Sudeten – misidentified as *P. islandicus* Sellnick, 1940: see Dastych & Rack 1992), Romania (Haitlinger 1980), Norway, Japan (Rack 1975) and the U. S. A. In the latter country it has been reported from Alaska and Iowa (Dastych et al. 1991) and, as *P. tamiasi* and *P. brevicaudae*, listed from Indiana (Mahunka 1975, Smiley & Whitaker 1979). New for Massachusetts and New York. In the Nearctic *P. stammeri* has been found on 5 species of small mammals and in a bird nest. In the Palearctic it was reported on 4 mammalian taxa (op. cit., this paper).

### *Pygmephorus designatus* Mahunka, 1973

1975 *Pygmephorus equitrichosus* Mahunka

Material examined: 77 females.

Iowa: 35 ♀ from *Procyon lotor*, Cedar Falls, Black Hawk Co., 22 Oct 1982, coll. N. Wilson; 20 ♀ from *Scalopus aquaticus* (Linnaeus, 1758), as above, 1 Oct 1975, coll. G. B. Porter; 2 ♀ from *Mephitis mephitis* (Schreber, 1776), as above, 8 Apr 1983, coll. N. Wilson; 14 ♀ from *Blarina brevicauda*, Osborne, Clayton Co., 18 May 1975, coll. N. Wilson; 2 ♀ from *Peromyscus leucopus* Rafinesque, 1818, Pella (1.6 km S, 4 km W), Marion Co., 20 Mar 1980, coll. B. Haerther & N. Toll; 2 ♀, same host, Pella (4 km S, Sadlers Woods), Marion Co., 10 Jun 1981, coll. J. B. Bowles; 1 ♀ from *Blarina brevicauda*, Dubuque (Mines of Spain State Park), Dubuque Co., 10 Nov 1983, coll. N. Wilson. Indiana: 1 ♀ from *Blarina brevicauda* nest in rotten log in woods, Hovey (Cypress Slough), Posey Co., 13 Apr 1958, coll. N. Wilson (same sample as listed in Dastych et al. 1991).

Remarks: The body is 241–448  $\mu\text{m}$  long. One specimen with one cheliceral seta  $ch_1$  missing on gnathosoma. Setae  $e$  and  $h_2$  are smooth and blade-like but sometimes they are formed as sharp spines. Their lengths vary and the length of setae  $h_2$  is 69–91 % of the length of setae  $e$  ( $n = 32$ ). One specimen with the setae  $e$  and  $h_2$  of equal length and another one with the setae  $h_2$  even slightly longer than the setae  $e$  (22 and 21  $\mu\text{m}$ , respectively). Caudal setae  $ps_1$  and  $ps_2$  either of equal width or, rarely,  $ps_1$  and  $ps_2$  are slightly thicker than  $ps_3$  and they are more barbed. One specimen with seta  $ps_2$  absent on one side of the body. In another specimen seta  $d$  on the tibiotarsus I is aberrantly shaped as strikingly short (7  $\mu\text{m}$ ) and sharply pointed smooth spine. Modified subunguinal seta  $s$  on tibiotarsus I is long and with two small denticles of different size at the tip. Sclerotized

thickening within tibiotarsus I is relatively small and not as distinct as in *P. spinosus*.

Distribution: Known only from the U. S. A. (Oregon, Iowa, Illinois, Indiana, Virginia, North Carolina: Mahunka 1973, 1974, 1975, Smiley & Whitaker 1979, 1984, Cudmore et al. 1987, Dastych et al. 1991). Recently we reported the species from Niue Island in the South Pacific (op. cit.). To our knowledge, this is the southernmost locality of the genus *Pygmephorus* sensu Kramer, 1877. *P. designatus* has been found on 17 species of small mammals.

*Pygmephorus spinosus* Kramer, 1877

- 1886 *Pygmephorus hirtus* Berlese;  
 1886 *Pygmephorus michaeli* Berlese;  
 1886 *Pygmephorus talpae* Berlese (in: Krczal 1959)  
 1979 *Pygmephorus hamiltoni* Smiley & Whitaker

Material examined: 10 females.

Iowa: 4 ♀ + 1 ♀ from *Blarina brevicauda*, Dickens, Clay Co., 24 Oct 1975; 1 ♀, same host, Cedar Rapids, Linn Co., 8 Nov 1981; 1 ♀ from *Procyon lotor*, Cedar Falls, Black Hawk Co., 31 Dec 1980; 1 ♀ from *Scalopus aquaticus*, as above, 29 Sep 1985: all coll. N. Wilson. Massachusetts: 1 ♀ from *Blarina brevicauda*, Amherst, Hampshire Co., 6 Dec 1951, coll. L. D. Class. Alabama: 1 ♀ from *Sorex longirostris* Bachman, 1837, Auburn, Lee Co., 5 Apr 1975, coll. T. French.

Remarks: The body is 319 – 428 µm long. Cheliceral setae (only *ch*<sub>1</sub> present) are short and smooth, as are caudal setae *ps*<sub>1</sub> and *ps*<sub>2</sub>. Anterior edges of empodia II and III are slightly concave. One specimen has seta *h*<sub>2</sub> especially reduced (2.5 µm long) on one side of the body.

Distribution: This is most widely distributed species of the genus, known from numerous localities in the Holarctic. In Canada it is reported from Winnipeg (Rack 1975) and in the U.S.A. from Oregon, Minnesota, Iowa, Missouri, Indiana and New Jersey (op. cit., Mahunka 1973, 1975, Smiley & Whitaker 1979, Cudmore et al. 1987, Dastych et al. 1991); new for Massachusetts and Alabama. In the Nearctic *P. spinosus* has been found on 12 species of small mammals (op. cit.) and in the Palearctic on at least 10 taxa of such hosts (Krczal 1959, Rack 1975). Aside from several countries in Europe it is known from Mongolia, Japan and India (Sasa 1961, Mahunka 1970, 1971, Rack 1975). The species has also been frequently collected in mammalian nests, various soil and detritus samples, in bat guano (2 ♀, cave near St. Kanzian, E of Trieste, Yugoslavia, 4 Sep 1977, coll. R. Abraham) and, in one case, on a bird (*Fratercula arctica* (Linnaeus, 1758): see Haarløv 1977). No bat is known as a carrier of the genus *Pygmephorus* (see Smiley & Whitaker 1979).

*Pygmephorus whitakeri* Mahunka, 1973

- 1975 *Pygmephorus punctulatus* Rack (in: Smiley & Whitaker 1979)  
 1985 *Pygmephorus sylvilagus* Kaliszewski & Rack

Material examined: 26 females.

Iowa: 4 ♀ + 1 ♀ from *Blarina brevicauda*, Dickens, Clay Co., 24 Oct 1975, 1 ♀ + 1 ♀, same host and locality, 26 Oct 1975: all coll. N. Wilson; 1 ♀ from *Spermophilus tridecemlineatus* Mitchill, 1821, Cedar Falls, Black Hawk Co., 29 Mar 1973, coll. S. S. Tlumacki; 2 ♀ from *Scalopus aquaticus*, same locality, 28 Nov 1975, coll. E. Peterson & T. Denkinger; 2 ♀, as above, 25 Mar 1987 and 1 ♀, 24 Jun 1987, coll. N. Wilson; 3 ♀ from *Procyon lotor*, as above, 21 Jan 1981, coll. N. Wilson; 6 ♀ from *Blarina brevicauda*, as above, 11 Nov 1984, coll. W. E. Picklum; 1 ♀ from *Peromyscus leucopus*, Dunkerton (3.5 miles NE, Bruce Childs Access), Black Hawk Co., 31 Mar 1973, coll. S. S. Tlumacki; 1 ♀ from *Sorex cinereus*, Waterloo, Black Hawk Co., 20 Dec 1975, coll. N. Wilson; 1 ♀, same host, Decorah (1 mile S, 0.5 mile E), Winneshiek Co., 22 Dec 1974, coll. D. G. Albertson. Massachusetts: 1 ♀ from *Blarina brevicauda*, Amherst, Hampshire Co., 6 Dec 1951, coll. L. D. Class.

Remarks: A variable species. The body is 286 – 442 µm long. Setae *e* are 15 – 26 µm long, setae *h*<sub>2</sub> are 6 – 13 µm in length. The length of setae *h*<sub>2</sub> is 26 – 50 % of the length of setae *e* (all data for n = 24). Distances between caudal setae vary and they are either equal on both sides of the body (40 % of all examined specimens) or setae *ps*<sub>2</sub> are inserted closer to setae *ps*<sub>3</sub> (15 %) or the distances are equal on one side of the body and different on the other side (45 %). Setae *FeII d* are setiform or, rarely, rod-like and 26 – 50 µm long. Setae *FeII v* are spinelike and

15 – 30  $\mu\text{m}$  in length. The setae *FeII v''* are usually slightly thicker and less barbed than the setae *FeII d*. The length of setae *FeII v''* is 51 – 71 % of the length of *FeII d*.

Distribution: A widely distributed and common species in the Nearctic. Reported from 31 species of mammalian hosts in the U.S.A. (Alaska, Oregon, California, Kansas, Minnesota, Wisconsin, Iowa, Missouri, Illinois, Indiana, Virginia, New York) and Canada (British Columbia, Alberta, New Brunswick) (Mahunka 1973, 1974, Rack 1975, Smiley & Whitaker 1979, Whitaker et al. 1982, Kaliszewski & Rack 1985, Cudmore et al. 1987, Dastych et al. 1991, this paper). New for Massachusetts.

*Pygmephorus erlangensis* Krczal, 1959

(Fig. 1)

1979 *Pygmephorus wrenschae* Smiley & Whitaker

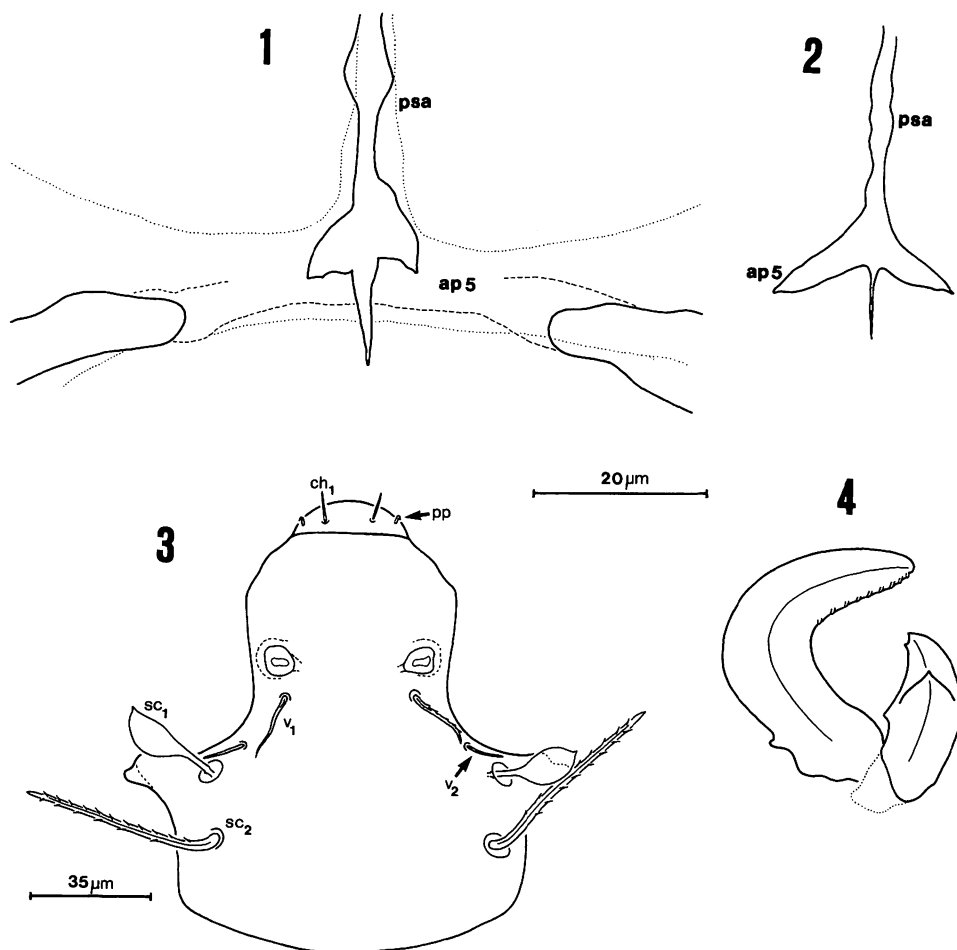
1979 *Pygmephorus johnstoni* Smiley & Whitaker (**new synonym**)

Material examined: 54 females.

Alaska: 1 ♀ from bumble-bee nest in old lemming [= *Dicrostonyx rubicatus* (Richardson, 1839)] burrow, "Half Moon 3 Ranch", near Point Barrow, 24 Jul 1955, coll. B. E. Montgomery (donated by E. A. Cross). Iowa: 2 ♀ from *Procyon lotor*, Charles City, Floyd Co., 21 Sep 1983, coll. P. A. Loughhead. New York: 11 ♀ from forest humus, Colonie, Albany Co., 10 Apr 1973; 5 ♀ from manure pile, 15 May 1973, as above; 12 ♀ from pasture manure, Coeymans, Albany Co., 7 Jul 1974; 9 ♀ from pasture manure, Coeymans Hollow, Rt. 143, 7 Jul 1974; 2 ♀ from barn debris, as above; 9 ♀ from tree hole debris, New York City (Forest Park), Queens, 13 Jun 1973; 2 ♀ from barn hay, Duanesburg, Rt. 20, Schenectady Co., 21 Aug 1974: all coll. by M. D. Delfinado; 1 ♀ from humus (old lawn clippings), Ithaca, Tompkins Co., 2 Nov 1970, coll. M.W. Barry.

Remarks: A variable species. The body is 255 – 462  $\mu\text{m}$  long ( $\bar{x}$  = 363.0,  $n$  = 43). Legs, particularly IIIrd pair, are relatively short and thin compared to the wide body. Gnathosoma is small. The length of setae  $v_1$  varies and they are slightly longer or shorter than setae  $sc_2$ , even in the same specimen. Sometimes the setae are equal in length. Setae  $h_2$  are short and thin, setae  $e$  are longer, blade- or spine-like and both of them are smooth. The setae  $e$  are 16 – 30  $\mu\text{m}$  long ( $\bar{x}$  = 22.4  $\mu\text{m}$ ), the setae  $h_2$  have 4 – 9  $\mu\text{m}$  ( $\bar{x}$  = 6.3) in length. The setae  $h_2$  are 22 – 44 % ( $\bar{x}$  = 28.8) of the length of setae  $e$ . Setae  $2c$  are usually slightly thinner than setae  $2b$  and distinctly shorter, i. e. they are 35 – 56 % ( $\bar{x}$  = 40.8,  $n$  = 14) of the length of setae  $2b$ . Distances between caudal setae vary and they are almost equal or the distance between both setae  $ps_1$  is slightly longer than that between  $ps_1$ ,  $ps_2$  and  $ps_3$ . The setae  $ps_1$  and  $ps_2$  are smooth and the setae  $ps_2$  are slightly shorter. The setae  $ps_3$  are provided with 1 – 2 small barbs or they are smooth. Apodemes 5 are either perpendicular to the main body axis or they are very gently arched and more or less reduced (less sclerotized) in their middle (Fig. 1). Tibiotarsus I is relatively small, slender and lacking internal thickening. Subunguinal seta  $s$  on tibiotarsus I is of median length and terminates with two distinct denticles of almost equal size. Tibiotarsal eupathidium  $ft''$  is moderately long and located on relatively large tubercle. Tips of setae *FeI d* with two small denticles. Setae *TiIVv'* are smooth. Claws are small, those on leg II and III have thickened bases. The claws II have barely discernible ribbing or they are smooth. The claws III are smooth. Empodia are covered with more or less distinct vertical striation. Empodial apex is slightly concave, empodial stalks are short.

The specimens agree well with three syntypes of *P. erlangensis* and also with individuals determined earlier by us (Dastych et al. 1991) as *P. johnstoni* Smiley & Whitaker, 1979. At that time based on examination of holotypes of the latter species and *P. wrenschae* Smiley & Whitaker, 1979 we synonymized these two taxa under the name of *P. johnstoni* Smiley & Whitaker, 1979. Due to the lack of recognizable specific differences between *P. johnstoni* and *P. erlangensis*, we consign *P. johnstoni* as a junior synonym of the latter species.



Figs. 1–4. 1: *Pygmephorus erlangensis* Krczal, posterior apodemes; 2: *Pygmephorus idei* Smiley & Whitaker, posterior apodemes; 3: *Pygmephorus* cf. *plurispinosus* Mahunka, prodorsal shield; 4: *Pygmephorus stammeri* Krczal, claw and subunguinal seta *s* on tibiotarsus I, dorsal view (Fig. 1 is drawn from syntype, Fig. 4 from holotype of *P. tamiasi* (= *P. stammeri*); ap 5 = apodemes 5, psa = poststernal apodeme, *ch*<sub>1</sub> = cheliceral seta, *pp* = supracoxal seta, *v*<sub>1</sub>, *v*<sub>2</sub>, *sc*<sub>1</sub>, *sc*<sub>2</sub> = prodorsal setae).

**Distribution:** In Europe *P. erlangensis* is known from Germany, the Netherlands, Poland, Hungary and Italy (Krczal 1959, Rack 1967, Mahunka 1968, Haitlinger 1977, 1989, Kaliszewski & Rack 1985). The species has been recorded in the U.S.A. under the name *P. johnstoni* from Ohio, Indiana, Oregon (Smiley & Whitaker 1979), Iowa (Dastych et al. 1991) and Canada (New Brunswick: Whitaker et al. 1982). As *P. wrenschae* it has been described from Ohio (Smiley w. Whitaker 1979). *P. erlangensis* is reported also from New Jersey (Manischewitz 1966); new for Alaska and New York.

In the Nearctic *P. erlangensis* has been collected from 5 species of mammalian hosts or their burrow (*B. brevicauda*, *R. norvegicus*, *P. lotor*, *N. gibbsii*, lemming burrow), a bird nest and some soil habitats. In the Palearctic it is recorded from at least 4 mammalian taxa (op. cit.). Interestingly, the species was found in New Jersey on *Rattus norvegicus* (Berkenhout, 1769) throughout the year, being most abundant during winter and early spring (Manischewitz 1966).

#### *Pygmephorus rackae* Smiley & Whitaker, 1979

Material examined: 9 females.

Iowa: 5 ♀ and 2 ♀ from *Scalopus aquaticus*, Cedar Falls, Black Hawk Co., 29 Sep 1985 and 24 Jun 1987, respectively, coll. N. Wilson; 1 ♀ from *Blarina brevicauda*, as above, 16

Oct 1975, coll. J. F. Maughan. Massachusetts: 1 ♀, same host, Amherst, Hampshire Co., 7 Oct 1951, coll. L.D. Class.

Remarks: The body is 266–350 µm long ( $\bar{x}$  = 321.1 µm). Cheliceral setae  $ch_1$  and  $ch_2$  are smooth, supracoxal setae  $pp$  are inserted anteriorly of  $ch_2$ . Setae  $v_2$  usually with 1–3 barbs, in two specimens they are smooth. Setae  $e$  and  $h_2$  are smooth and the setae  $e$  are about half as thick as  $h_2$ . The length of setae  $e$  is 15–23 µm ( $\bar{x}$  = 19.3), setae  $h_2$  are 8–11 µm long ( $\bar{x}$  = 9.5). The length of setae  $h_2$  is 47–55 % of the length of setae  $e$  ( $\bar{x}$  = 49.0 %; all data for  $n$  = 8). Caudal setae are either covered with 1–2 small barbs or smooth. The caudal setae are either equal in length or the setae  $ps_3$  are slightly longer than  $ps_1$  and  $ps_2$ . Apodemes 5 are very gently arched, almost straight and they are shaped with poststernal apodeme as an inverted “T”. Setae  $TiIV v'$  are smooth or with 1–2 tiny barbs. Empodial stalk on leg III is shorter than the length of its empodium.

Distribution: Known from the U.S.A. (Oregon, Minnesota, Iowa, Missouri, Indiana: Smiley & Whitaker 1979, Cudmore et al. 1987, Dastych et al. 1991); new for Massachusetts. Recently we have also found *P. rackae* in Europe (2 ♀ from *Turdus merula* Linnaeus, 1758, The Netherlands, Hamert, 2 Aug 1965, coll. F. S. Lukoschus) on a Blackbird. It is the fourth case of a bird (nest) reported as a host in the genus *Pygmephorus* (see Haarløv 1977, Dastych et al. 1991). In North America the species has been collected from 5 species of small mammals (op. cit.).

### *Pygmephorus scalopi* Mahunka, 1973

1984 *Pygmephorus utmarae* Smiley & Whitaker

Material examined: 50 females.

Iowa: 1 ♀ from *Scalopus aquaticus*, Cedar Falls, Black Hawk Co., 28 Nov 1975, coll. E. Peterson & T. Denking; 46 ♀, same host and locality, 29 Sep 1985, coll. N. Wilson; 1 ♀, as above, 24 Jun 1987, coll. N. Wilson; 1 ♀, as above, 27 Sep 1988, coll. N. Wilson; 1 ♀ from *Blarina brevicauda*, Finchford, 3.5 km S (Cedar Hills Sand Prairie), 30 Oct 1969, coll. M. J. Grabau.

Remarks: The body length is 241–370 µm ( $\bar{x}$  = 306.2). Cheliceral setae  $ch_1$  and  $ch_2$  are smooth, with the exception of one specimen, where one barb is formed unilaterally on seta  $ch_1$ . Setae  $v_1$  are barbed (1–4 barbs, usually 2–3) in 83 % of the examined material and smooth in the remaining specimens (17 %). Setae  $e$  are always smooth but setae  $h_2$  are either smooth (53 % of all specimens) or they are slightly barbed (1–2 barbs). The barbs are tiny, often hardly discernible and they are developed only on one seta  $h_2$  in 22 % of the specimens. The setae  $e$  are 12–26 µm long ( $\bar{x}$  = 19.4 µm), the setae  $h_2$  are 11–20 µm ( $\bar{x}$  = 14.2) in length. The length of setae  $h_2$  is 53–95 % of the length of setae  $e$  ( $\bar{x}$  = 73.5 %; all data for  $n$  = 49). Caudal setae are barbed, with 1–5 barbs each, usually 2–4. Setae  $TiIV v'$  with 1–5 tiny barbs. Empodial stalk on leg III is either longer than its empodium (80 % of specimens) or these structures are equal in length.

*P. scalopi* is very similar to *P. rackae* and most probably these species are closely related. Significant taxonomic differences between these taxa include the shape of posterior apodemes, the size and shape of setae  $h_2$ , caudal setae  $ps_1$  to  $ps_3$  and the size of empodial stalks III. In *P. rackae* the apodemes are formed as an inverted “T” (versus “Y” in *P. scalopi*), setae  $h_2$  are relatively shorter and never barbed (but sometimes smooth also in *P. scalopi*) and empodial stalks III are shorter than the empodium length. The caudal setae in *P. rackae* are relatively longer and with strongly reduced barbs, if not completely smooth. The setae in *P. scalopi* are shorter, distinctly barbed and never smooth. Empodial stalk in *P. scalopi* is either slightly longer than the empodium or equal in length.

Distribution: Known only from the U.S.A. (Minnesota, Iowa, Missouri, Illinois, Indiana: Mahunka 1973, 1974, 1975, Smiley & Whitaker 1979, Dastych et al. 1991) from where it is reported on 6 species of small mammals.



*Pygmephorus plurispinosus* Mahunka, 1975

Material examined: 2 females.

Oregon: 1 ♀ from *Aplodontia rufa pacifica* Merriam, 1899, Mary's Peak, 5 km NW, Lincoln Co., 13 Jan 1981, coll. D. D. Gettinger (donated by F. S. Lukoschus); Iowa: 1 ♀ from *Blarina brevicauda*, Osborne, Clayton Co., 18 May 1975, coll. N. Wilson.

Remarks: The length of the body is 339 and 403  $\mu\text{m}$ . Only one pair of cheliceral setae ( $ch_1$ ) is present. Supracoxal setae  $pp$  are inserted anteriolaterad or laterad of cheliceral setae. Posterior apodemes are shaped as a wide inverted "Y". One specimen with the distances between caudal setae  $ps_1$  and  $ps_2$  relatively larger than usually found in the species. The distances are slightly different on both sides of the body in this specimen. All caudal setae are of equal length.

Distribution: Known from Washington, Oregon, Alaska and Iowa (Mahunka 1975, Smiley & Whitaker 1979, Cudmore et al. 1982, Dastych et al. 1991). Hitherto found on 10 species of mammalian hosts.

*Pygmephorus* near *plurispinosus* Mahunka, 1975

(Fig. 3)

Material examined: 1 female.

Alaska: from *Clethrionomys rutilus* (Pallas, 1778), Juneau, 40 km SE (Limestone Inlet), 1 Jun 1981, coll. J. M. Martin.

Remarks: The body is 463  $\mu\text{m}$  long. The specimen has relatively shorter idiosomal setae which are also thinner on the ventral side compared to those in *P. plurispinosus*. Setae  $v_1$ ,  $v_2$  and  $h_2$  are strikingly short and thin. The tips of setae  $v_1$  do not reach the bases of setae  $sc_1$  (Fig. 3), not to say about the bases of setae  $sc_2$ , as occurs in *P. plurispinosus*. The length of setae  $h_2$  (9  $\mu\text{m}$ ) is only 26 % of the length of setae  $e$  (34  $\mu\text{m}$ ). In *P. plurispinosus* this length ratio is equal 70–100 %. Other characters of taxonomic importance and similar to those in *P. plurispinosus* are one pair of cheliceral setae, smooth and blade-like setae  $FeIII v'$  and inversely "Y" shaped posterior apodemes.

The considered specimen is closely related to *P. plurispinosus*. However, more material is needed to assess its true taxonomic status. One can not exclude that it represents a new taxon with the rank of subspecies or species.

*Pygmephorus horridus* Mahunka, 1973

1975 *Pygmephorus magnisetosus* Rack (in: Smiley & Whitaker 1979)

Material examined: 1 female.

Oregon: from *Sorex bendirii* (Merriam, 1884), Bandon (4 km SE), Coos Co., 13 Jun 1972, coll. C. Maser.

Remarks: The body is 524  $\mu\text{m}$  long. Peculiar tiny granulations on idiosomal setae are strongly reduced. Setae  $e$  have only hardly discernible traces of a few granules. Setae  $h_2$  are smooth, relatively wide and blunt-tipped. The length of setae  $h_2$  (5.5  $\mu\text{m}$ ) is 58 % of the length of setae  $e$ . Modified subungual seta  $e$  on tibiotarsus is relatively long.

Distribution: Widely distributed in the Nearctic where it has been found on 29 species of small mammals (Mahunka 1973, 1974, 1975, Rack 1975, Smiley & Whitaker 1979, Whitaker et al. 1982, Cudmore et al. 1987, Dastych et al. 1991).

*Pygmephorus moreohorridus* Mahunka, 1975

Material examined: 2 females.

Massachusetts: from *Blarina brevicauda*, Amherst, Hampshire Co., 7 Oct and 6 Dec 1951, coll. L. D. Class.

Remarks: The body is elongated, 532 and 580  $\mu\text{m}$  long. Sculpture of the body well defined. Segment D is distinctly elongated, with a pair of longitudinal, slightly arched and sclerotized flat crests (folds) located on lateral sides of the

segment. Gnathosoma with two pairs of cheliceral setae ( $ch_1$  and  $ch_2$ ) and a pair of supracoxal setae  $pp$ . Prodorsal shield with a pair of small horn-like projections located posteriad of setae  $sc_1$ , laterally on the shield edge. Stigmata and bases of setae  $sc_1$  are inserted laterally on prodorsum, i. e. on and slightly below the edge of the shield. Setae  $v_1$  are about 1/3 longer and slightly thicker than setae  $v_2$ , but about 1/3 shorter than setae  $sc_2$ . The setae  $c_2$  are 1/3 thicker than setae  $v_1$  and their length is about 70  $\mu\text{m}$ . Hysterosomal setae  $c_2$  and  $d$  are similar in shape and length to setae  $sc_2$ ; setae  $c_1$  and  $h_2$  are slightly shorter. All these setae are distinctly barbed. Setae  $e$  and  $h_2$  are relatively short and their length is 11–26 and 6–7  $\mu\text{m}$ , respectively ( $n=4$ ). The setae  $e$  are usually blunt-tipped and covered with a few tiny barbs. The setae  $h_2$  are shaped as short, blunt-tipped and smooth spines. The length of the setae  $e$  and  $h_2$  varies and the setae  $h_2$  are 25–64 % of the length of the setae  $e$ . Setae  $1c$  are flattened distally, have barbed and sclerotized edges which are partly separated (bifurcated). Setae  $2c$  are spine-like, slightly barbed and are about 1/3 shorter than setae  $2b$ . Caudal setae  $ps_1$  and  $ps_2$  have either a few hardly discernible barbs or they are smooth. Moreover, setae  $ps_1$  are either slightly longer and thicker than setae  $ps_2$  or they are of equal length. The length of these setae is about 30 % of the length of setae  $ps_3$ . The setae  $ps_3$  are covered with a few distinct barbs and they are about half as thick as the remaining caudal setae. Apodemes 5 are strongly sclerotized, relatively wide and either perpendicular to the main body axis or very gently arched.

Tibiotarsus I is roundish, its claw is large. Modified subunguinal seta  $s$  is moderately sized and terminated with two wide denticles. Tibiotarsal internal thickening is well developed and slightly elongated. Tibial eupathidium  $k''$  is distinctly barbed. Seta  $FeI l'$  is short and smooth. Short, smooth and flattened seta  $FeI d$  is bidentated at its tip. The denticles have slightly different size. Seta  $GeI l''$  is strikingly thick and shaped as a fusiform and barbed spine. Seta  $GeII l''$  is similar in shape to  $GeI l''$  and only slightly shorter. Seta  $TaIII pl'$  is formed as a short and smooth spine. Setae  $TrIV v'$ ,  $FeIV v'$  and  $TaIV pl''$  are spine-like and smooth, seta  $TiIV v'$  is distinctly barbed. The remaining setae on legs are barbed and setiform. Claws II and III are large, ribbed and with thickened bases. Their empodia are covered with delicate vertical striation and have short stalks. Empodia IV are shaped as tiny, corn-like processes.

The species belong to the *forcipatus*-complex (see Dastych & Rack 1991) and can be readily separated from related taxa by its strikingly thickened, fusiform setae  $GeI l''$  and  $GeII l''$ . Interestingly, setal barbs on idiosomal dorsum are relatively large in *P. moreohorridus* compared to those in *P. arcuatus* Dastych & Rack, 1991 and particularly to barbs in *P. forcipatus* Willmann, 1952 and *P. horridus*. Generally, the examined specimens agree with the original description of the species (Mahunka 1975). However, setae  $v_1$  are distinctly longer than  $v_2$  in our material compared to the setae illustrated by Mahunka. Moreover, seta  $FeI d$  is bidentate and not sharp-tipped as that figured by the author (op. cit.: Fig. 5, 9). It should be noted that the legends for Mahunka's Figs. 7 and 9 are incorrectly assigned and should be reversed (op. cit., p. 87).

Distribution: Known from the U.S.A. (Indiana: Mahunka 1975) and Canada (New Brunswick: Whitaker et al. 1982) where it has been found on 9 species of small mammals. New for Massachusetts.

#### *Pygmephorus hastatus* Mahunka, 1973

1966 *Pygmephorus* sp.: Manischewitz

Material examined: 2 females.

Massachusetts: 1 ♀ from *Blarina brevicauda*, Amherst, Hampshire Co., 7 Oct 1951, coll. L. D. Class; 1 ♀ from *Condylura cristata* (Linnaeus, 1758), Hadley, Hampshire Co., 1951, coll. F. P. Sivik.

Remarks: The body length is 347 and 480  $\mu\text{m}$ . Gnathosomal setae  $ch_1$  and  $ch_2$  are short and smooth. Hysterosomal setae  $h_1$  are the longest. Setae  $e, f, h_1$  and  $h_2$  are distinctly thicker than setae  $c_1, c_2$  and  $d$ . On the other hand, the setae  $e$  and  $h_2$  are slightly thicker than the setae  $f$  and  $h_1$  and they are sparsely covered with several tiny barbs. Setae  $e$  are about 1/3 longer than the setae  $h_2$ . A pair of short and flattened crests is located medially of bases of the setae  $e$  and  $f$ . The crests (folds) are directed anteriorly but bent in their distal parts. Similar structures, but straight and not well defined, are developed posteriorly of bases of setae  $d$ . Setae  $1c$  have thickened and barbed edges but they are not separated (bifurcated). Setae  $2c$  are about 1/3 thicker than setae  $2b$  and about 1/3 shorter than the latter setae. Caudal setae, particularly  $ps_1$  and  $ps_2$ , are strikingly thick. Their length formula is:  $ps_2 > ps_3 > ps_1$ . The setae  $ps_1$  and  $ps_2$  are shaped as thick, blunt-tipped and distinctly barbed spines. Setae  $ps_3$  are slightly thinner than the remaining setae. Setae  $ps_1$  and  $ps_2$  are either slightly thicker than other opisthosomal ventral setae or they are as thick as setae  $2c$ . Apodemes 5 and poststernal apodeme are shaped as an inverted "Y", with a wide angle between the former structures.

Tibiotarsus I is roundish, modified subunguinal seta  $s$  is median sized, wide and with delicate ribbing. Internal tibiotarsal thickening is well developed. Tibial eupathidium  $k''$  is smooth. Seta  $FeI d$  is short, slightly bent in its terminal part and sharp-tipped. Setae  $FeI l'$  are needle-like, short and smooth. Setae  $FeII v''$  are shaped as a short, blunt-tipped and barbed spines. Setae  $TaIII pl''$  and  $TaIV pl''$  are short, blade-like and smooth. Setae  $TrIV v'$  are formed as short, slightly barbed spines, seta  $TiIV v'$  is distinctly barbed. Other setae on legs are more or less barbed. The empodia are covered with delicate vertical striation, empodial stalks are short. Empodium IV is small and trilobated.

Our specimens agree with the original illustrations of the species (Mahunka 1973: Figs. 7–12). This highly derived taxon can be easily distinguished from other species by its thickened posteriodorsal hysterosomal setae and peculiarly thickened caudal setae. We believe that one of the *Pygmephorus* sp. listed by Manischewitz (1966) from New Jersey to be *P. hastatus*. His descriptive statements "... somewhat similar to *Pygmephorus microti* ..." and "... The caudal setae are almost as wide as the dorsal setae ..." fit this species (op. cit., p. 195).

Distribution: Known from the U.S.A. (Indiana, Illinois, Virginia, New Jersey) where it has been recorded on 7 species of mammalian hosts (Manischewitz 1966, Mahunka 1973, 1975, Smiley & Whitaker 1979); new for Massachusetts.

*Pygmephorus spickai* Mahunka, 1974

1975 *Pygmephorus mustelae* Rack (**new synonym**)

Material examined: Holotype (♀) of *P. spickai*. The slide has no registration number and no designation as a type (in the original description: "Holotypus, T-1638-74"; see Mahunka 1974). It is labelled: "*Pygmephorus* 2b" (in pencil), "*Geomys bursarius*, Illinois, Madison Co., Collinsville, 11 April 1973 E. D. Spicka 256 ♂" (in drawing ink). "256 ♂" refers to host number and sex. The second label (all in pencil): "*Pygmephorus mustelae spickai* Mahunka", with "*mustelae*" crossed-out. One leg II has the tarsus broken and lacks claws and empodium. Other material: paratype of *P. mustelae* (for data: see Rack 1975).

Remarks: *P. mustelae* Rack, 1975 was recognized as a junior synonym of *P. spickai* Mahunka, 1974 by Rack after the almost simultaneous descriptions of both taxa; however, this conclusion has never been published. Comparison of type-specimens of these species confirmed the above synonymy. The locality and collector in the type data of *P. mustelae*, as listed by Rack (1975), should be corrected to read Murdo and M. L. Boddicker, respectively.

The above species was not present in the material studied; however, the information was included since it referred to a North American species of

*Pygmephorus*. Below we add some morphological data lacking in the original descriptions.

Gnathosoma with two pairs of cheliceral setae and a pair of supracoxal setae *pp*. The latter setae are inserted anteriorly of setae *ch*<sub>2</sub>. Setae *1c* are distinctly bifurcated in one specimen (paratype of *P. mustelae*). In another individual (holotype of *P. spickai*) one seta *1c* is longitudinally divided into two parts but not separated, the second seta *1c* is slightly bifurcated at its tip. Apodemes 5 are very gently arched and almost perpendicular to the main body axis. The characteristically thickened setae on tibia and tarsus of legs II are formed as illustrated by Rack (1975: Fig. 21) and not as originally depicted by Mahunka (1974: Fig. 4). Seta *GeIV v'* is setiform and barbed. Claws II and III are relatively small, smooth and with thickened bases. Their empodia are smooth.

Distribution: This distinct species is known only from 3 specimens collected in Illinois and South Dakota on *Geomys bursarius* (Shaw, 1800) and *Mustela nigripes* Audubon & Bachman, 1851 (op. cit.).

## Discussion

The biology of mites of the genus *Pygmephorus* sensu Kramer, 1877 is remarkably little known. Kramer (1877) regarded *P. spinosus*, type species of the genus, as a parasite of moles and its enlarged tibiotarsi and claws I as an adaptation for grasping hairs of the host. Conversely, Vitzthum (1943) suggested that *P. spinosus* feeds on larvae of insects inhabiting mammalian nests. This view was followed by Krczal (1959) and Hirschmann (1960) who interpreted the characteristic enlargement of claws as a morphological adaptation for grasping prey rather than the fur of mammals. Contrary to this, Košir (1975) recognized the genus *Pygmephorus* (sensu lato) as being fungivorous, and its members (including *P. spinosus* and *P. stammeri*) as specialized for feeding on fungi. We accept this latter view because a high humidity prevails in the mammalian nests and burrows preferred by these mites (Krczal 1959, Smiley & Whitaker 1979) and humidity is positively correlated with the abundance of fungi in such habitats. Also fungi are known to be eaten by several genera within the family Pygmephoridae (e. g. Gurney & Hussey 1967, Wicht 1970, Košir 1975, Smiley & Moser 1976, Ebermann & Rack 1982). Thus, the association of *Pygmephorus* with mammals (or birds) should be seen as phoresy and the morphological modifications as an adaptation to that phenomenon. These adaptations, however, occur only in females. The factors triggering phoresy in *Pygmephorus* are unknown but are understood in the related genus *Petalomium* Cross, 1965. The phoretic behaviour of these ant-associated mites is caused by a deficiency of fungal food (Ebermann & Rack 1982). Males in the genus *Pygmephorus* have been described only recently and are known only in two species (Kaliszewski & Rack 1985), excluding the report of Sellnick (1940) of the possible presence of males in *P. islandicus*. At present it is not clear what mode of reproduction prevails in the genus *Pygmephorus*. There is also a lack of data on postembryonic development of these mites.

There are at least 65 taxa of mammals in the Holarctic known to harbour *Pygmephorus* mites (see references). Our studies (Dastych et al. 1991, this paper) add eight new hosts to this number (marked with an asterisk in Tab. 1) and three birds (nests). It is interesting that among the mammals there are some (*Didelphis virginiana* Kerr, 1792, *Peromyscus maniculatus* Wagner, 1845, *P. leucopus* Rafinesque, 1818 and *Spermophilus tridecemlineatus* Mitchell, 1821) on which Smiley & Whitaker (1979) failed to find any *Pygmephorus* despite a large number of hosts examined. The mites are also known from the following birds or their nests: *Fratercula arctica* (Linnaeus, 1758), *Sturnus vulgaris* Linnaeus,

1758, *Turdus merula* Linnaeus, 1758 and *Riparia riparia* (Linnaeus, 1758), a group of hosts rarely reported (Rack 1967, Haarløv 1977, Dastych et al. 1991).

Our collection originated from 19 species of North American mammals (Tab. 1). Among them, the following hosts have been most frequently infested with mites: *Blarina brevicauda*, *Sorex vagrans*, *Scalopus aquaticus*, *Sorex cinereus* and *Peromyscus leucopus* (index of frequency, in %: 42.0, 10.2, 10.2, 7.7 and 6.0, respectively: see Margolis et al. 1982). They have carried 3–10 species of *Pygmephorus* (Tab. 1) and *Blarina brevicauda* topped the list. This confirms information by Smiley & Whitaker (1979) that at least 12 different *Pygmephorus* species are associated with the last host. The number of *Pygmephorus* species occurring on particular mammalian individual is low and does not exceed three taxa. Most hosts (78 %) carried one, 18 % carried two and only 4 % of examined individuals were infested with 3 *Pygmephorus* species. These results confirm the low host specificity of these mites, a phenomenon noted already by Mahunka (1973, 1974), Smiley & Whitaker (1979) and Whitaker et al. (1982). The least specific species include *P. whitakeri*, *P. horridus* and *P. designatus* which have been recorded from 31, 29 and 17 mammalian taxa, respectively. These numbers represent 25–50 % of all mammal species known to host *Pygmephorus* mites.

We identified a total of 15 taxa of *Pygmephorus* (Tab. 1) of which 13 are presented in this paper. Among them, *P. whitakeri*, *P. spinosus*, *P. designatus*, *P. horridus* and *P. plurispinosus* occurred most often (index of frequency: 30.0, 18.0, 11.1, 8.5 and 7.7 %, respectively). These taxa, plus *P. scalopi*, also turned out to be the most abundant and they seem to be the dominant members of the genus in North America (comp. Mahunka 1974, 1975, Rack 1975, Smiley & Whitaker 1979, Whitaker et al. 1982, Jones et al. 1982, Cudmore et al. 1987). Another common species, *P. mahunkai* Smiley & Whitaker, 1979, was absent from our samples.

The world fauna of the genus *Pygmephorus* sensu Kramer, 1877 currently includes 48 nominal species, when all new synonyms and new taxa are considered (Krczal 1959, Smiley & Whitaker 1979, 1984, Mahunka & Zaki 1984, Kaliszewski & Rack 1985, Mahunka 1986, Dastych & Rack 1991, Dastych et al. 1991, this paper). Among the nominal species 28 occurred in the Nearctic and 27 species have been reported from the Palearctic. Among them common to both regions, and thus Holarctic in distribution are 9 species: *P. spinosus*, *P. stammeri*, *P. erlangensis*, *P. rackae*, *P. islandicus* Sellnick, 1940, *P. forcipatus* Willmann, 1952, *P. brevipes* Savulkin, 1976, *P. ideii* and *P. nidicolus* Mahunka, 1969.

The species with presumably the widest range, *P. spinosus*, was listed from North America for the first time by Mahunka (1973). *P. stammeri* and *P. erlangensis*, originally described from Europe, were reported from the U.S.A. under other names, excluding Manischewitz (1966). Smiley & Whitaker (1984) quoted the distribution of *P. islandicus* as "Germany & Canada". The species was described from Iceland and recently collected there again (Sellnick 1940, Lindroth et al. 1973, Hallas 1981, Hallas & Gravesen 1987). However, the locality in the Sudeten (now Poland: Willmann 1952, 1953) refers to *P. stammeri*. *P. forcipatus* and *P. brevipes* (the latter most likely a species dubia) have been reported recently from Oregon by Cudmore et al. (1987). *P. ideii* was listed from Japan (Rack 1975) under the name *P. nidicolus* and the last-named taxon, described from Mongolia (Mahunka 1969), recently has been reported from Canada (Whitaker et al. 1982). *P. rackae*, a species originally described from the U.S.A. is listed here as a new mite for the European (Dutch) fauna. These widely

distributed taxa found on both sides of the Atlantic are always on different hosts.

Localities in Iceland were, until now, the northernmost known distribution of *Pygmephorus* and comprised *P. islandicus* and *P. spinosus* (op. cit.). Our Alaskan material collected at similar or even higher latitudes includes nine taxa of the genus (Tab. 1) and they represent 60% of all species reported in this survey. This number indicates a rather wide climatic tolerance of the mites. At present, the locality of *P. erlangensis* at Point Barrow is the northernmost record of the genus. By contrast, the southernmost localities of *Pygmephorus* in the New World are those in Middle America (the Dominican Republic: Mahunka 1982) and Panama (1 ♀ of *Pygmephorus* cf. *rackae* Smiley & Whitaker, 1979, from *Scotinomys xerampelinus* (Bangs, 1902), Panama, Chiriqui Province, Escopeta; 16 Jun 1980, coll. R. H. Pine. Donated by the late F. S. Lukoschus). In the Eastern Hemisphere the southernmost record of the genus is from Niue Island in the South Pacific, represented by *P. designatus* found on *Rattus rattus* (see Dastych et al. 1991). Possibly this mite was introduced. Interestingly, there are at least five species of *Pygmephorus* phoretic on *Rattus norvegicus*, i. e. *P. designatus*, *P. mahunkai*, *P. scalopi*, *P. whitakeri*, *P. erlangensis* (Manischewitz 1966, Smiley & Whitaker 1979, op. cit.) These ubiquitous and cosmopolitan mammals should be considered important in the dispersal of these mites. Similarly, birds should be taken into consideration as such a factor, although their role is less well known.

No *Pygmephorus* have been reported from South America (i. e. south of Panama), Africa or Australia. The record of *Pygmephorus crassipes* Lawrence, 1940 from buprestid and cerambycid beetles in South Africa (Lawrence 1940, Zumpt 1961) applies to a related genus, *Pygmephorellus* Cross & Moser, 1971. Interestingly, no species of *Pygmephorus* has been found directly on any arthropod. All available data on the genus suggests a Holarctic distribution. However, it remains to be determined to what degree this pattern has been influenced by historical factors or poor exploration of the mite fauna in the Southern Hemisphere.

Acknowledgments: We would like to thank all person listed for their help with the collections. We are grateful to Dr. H. Krczal (Dossenheim, Germany) for the loan of syntypes of *P. erlangensis* and for a specimen determined as *P. islandicus* from the collection of Willmann. We are much obliged to Mr. R. L. Smiley (Systematic Entomology Laboratory, Beltsville, Maryland), Dr. J. O. Whitaker, Jr. (Indiana State University, Terre Haute, Indiana) and Dr. S. Mahunka (the Hungarian Natural History Museum, Budapest) for their assistance in obtaining access to the type-material of *P. tamiassi* and *P. spickai*. We thank Drs. D. D. Gettinger (Las Cruces, New Mexico), J. E. Keirans (U.S. National Tick Collection, Georgia Southern University, Statesboro), W. B. Nutting (University of Massachusetts, Amherst) and C. E. Yunker (U.S. Veterinary Research Station, Causeway, Zimbabwe) who helped us track down some lacking data on several old microslides.

## Zusammenfassung

Es wurden dreizehn Milben-Taxa der phoretischen Gattung *Pygmephorus* (Heterostigmata, Pygmephoridae) auf Kleinsäugetern in den Vereinigten Staaten von Amerika gefunden und untersucht. Neue Angaben zur bisher wenig bekannten morphologischen Variabilität werden präsentiert. *Pygmephorus johnstoni* Smiley & Whitaker, 1979 wird als jüngeres Synonym von *P. erlangensis* Krczal, 1959 vorgeschlagen, *P. tamiassi* Mahunka, 1975 und *P. krczali* Mahunka, 1969 als solche von *P. stammeri* Krczal, 1959. *P. mustelae* Rack, 1975 ist ein jüngeres Synonym von *P. spickai* Mahunka, 1974. Die Verbreitung der Gattung *Pygmephorus* und einige Aspekte ihrer Ökologie werden diskutiert.

## References

- Berlese, A., 1886: La sottofamiglia dei Tarsonemidi. – Boll. Soc. Ent. Ital., **17**: 125–135. Genova.
- Cudmore, W. W., Whitaker, J. O. & Smiley, R. L., 1987: Mites of the genus *Pygmephorus* in Oregon. – *Acarologia*, **28** (4): 331–332. Paris.
- Dastych, H., Rack, G. & Wilson, N., 1991: Notes on mites of the genus *Pygmephorus* (Acari: Heterostigmata) associated with North American mammals. – *Mitt. hamb. zool. Mus. Inst.*, **88**: 161–174. Hamburg.
- Dastych, H., Rack, G., 1991: Two new species of the genus *Pygmephorus* from Alaskan small mammals (Acari: Heterostigmata). – *Entomol. Mitt. zool. Mus. Hamburg*, **10**: 93–112. Hamburg.
- Dastych, H., Rack, G., in prep.: Redescription of *Pygmephorus islandicus* (Acari: Heterostigmata). – *ibid.*
- Ebermann, E., Rack, G., 1982: Zur Biologie einer neuen myrmecophilen Art der Gattung *Petalomium* (Acari, Pygmephoridae). – *ibid.*, **7**: 175–192.
- Gurney, B., Hussey, N. W., 1967: *Pygmephorus* species (Acarina: Pyemotidae) associated with cultivated mushrooms. – *Acarologia*, **9**(2): 353–358. Paris.
- Haarlov, N., 1977: Ectoparasites (Mallophaga, Siphonaptera, Acarina) from Birds of Jan Mayen Island, Norway. – *Norw. J. Ent.*, **24**: 37–41. Oslo.
- Haitlinger, R., 1977: Parasitological investigation of small mammals of Góry Sowie (Middle Sudetes). VI. Siphonaptera, Anoplura, Acarina. – *Pol. Pis. Entomol.*, **47**: 429–485. Wrocław.
- 1980: Stawonogi (Siphonaptera, Anoplura, Coleoptera, Acarina) zebrane z drobnych ssaków Rumunii. – *Wiad. Parazytol.*, **26** (6): 679–710. Wrocław.
- 1989: Arthropods (Acari, Anoplura, Siphonaptera, Coleoptera) of small mammals of the Babia Góra Mts. – *Acta zool. cracov.*, **32**: 15–56. Kraków.
- Hallas, T. E., 1981: Mites of stored hay in Iceland. – *J. Agr. Res. Icel.*, **13** (1–2): 61–67. Reykjavik.
- Hallas, T. E., Gravesen, S., 1987: Succession of mites and microfungi in stored hay in Iceland. – *Ent. Tidskr.*, **108**: 23–27. Umeå.
- Hirschmann, W., 1960: Die Fäustchenmilbe (*Pygmephorus spinosus*). – *Mikrokosmos*, **49** (9): 262–263. Stuttgart.
- Jones, G. S., Howard, T. H., 1982: Mites, ticks, and fleas of the mice *Zapus hudsonius* and *Napaeozapus insignis* from the maritime provinces and Gaspé Peninsula, Quebec, Canada. – *Cant. Ent.*, **14**: 1031–1035. Ottawa.
- Kaliszewski, M., Rack, G., 1985: Description of female and male of *Pygmephorus sylvilagus* n. sp. and male of *Pygmephorus erlangensis* Krczal, 1959 (Acari, Pygmephoridae). – *Entomol. Mitt. zool. Mus. Hamburg*, **8**: 45–60. Hamburg.
- Košir, M., 1975: Ernährung und Entwicklung von *Pygmephorus mesembrinae* und *P. quadratus* (Pygmephoridae, Tarsonemini, Acari) und Bemerkungen über drei weitere Arten. – *Pedobiologia*, **15**: 313–329. Jena.
- Kramer, P., 1877: Zwei parasitische Milben des Maulwurfs. – *Arch. f. Naturg.*, **43**(1): 248–259. Berlin.
- Krczal, H., 1959: Systematik und Ökologie der Pyemotiden. – In: Stammer H. J.: Beiträge zur Systematik und Ökologie Mitteleuropäischer Acarina, **1** (Teil 2): 385–625. Leipzig.
- Lawrence, R. F., 1940: Three new parasitic mites (Acarina) from South Africa. – *J. Ent. Soc. South Africa*, **3**: 109–115. Pretoria.
- Lindquist, E. E., 1977: Homology of dorsal opisthosomal plates, setae, and cupules of heterostigmatic mites with those of other eleutherengone Prostigmata (Acari). – *Acarologia*, **19**: (1): 97–104. Paris.
- 1986: The world genera of Tarsonemidae (Acari: Heterostigmata): a morphological, phylogenetic, and systematic revision, with a reclassification of family-group taxa in the Heterostigmata. – *Mem. Ent. Soc. Can.*, **136**: 1–517. Ottawa.
- Lindroth, C. H., Andersson, H., Böldvarsson, H. & Richter, S. H., 1973: Surtsey, Iceland (The Development of a New Fauna, 1963–1970, Terrestrial Invertebrates). – *Entomol. Scand.*, Suppl. 5, 280 pp. Copenhagen.
- Mahunka, S., 1968: Studies on the Mite Fauna of Hungary I. (Acari). – *Ann. Hist.-nat. Mus. Nat. Hung.*, **60**: 249–260. Budapest.

- 1969: 176. Pyemotidae and Scutacaridae IV. Ergebnisse der zoologischen Forschungen von Dr. Z. Kaszab in der Mongolei (Acari). – Reichenbachia, **12**: 83–112. Dresden.
  - 1970: Ergebnisse der zoologischen Forschungen von Dr. Z. Kaszab in der Mongolei. 227. Acari: Pygmephoridae. – Ann. Hist.-nat. Mus. Nat. Hung., **62**: 343–362. Budapest.
  - 1971: Tarsonemina (Acari) species from India. The Scientific Results of Dr. G. Topal's Collectins in India. Acta Zool. Acad. Sc. Hung., **17**: 11–49. Budapest.
  - 1973: *Pygmephorus* species (Acari, Tarsonemida) from North American small mammals. – Parasit. Hung., **6**: 247–259. Budapest.
  - 1974: New Data to the Knowledge of *Pygmephorus*-species (Acari: Tarsonemida) Living on Small Mammals in America. – *ibid.*, **7**: 197–200.
  - 1975: Further Data to the Knowledge of Tarsonemida (Acari) Living on Small Mammals in North America. – *ibid.*, **8**: 85–94.
  - 1986: Tarsonemids of the Kiskunság National Park (Acari). – The Fauna of the Kiskunság National Park, Akadémiai Kiadó, pp. 435–455. Budapest.
- Mahunka, S., Zaki, A. M., 1984: Some new Pygmephorid and Scutacarid from Hungary (Acari: Tarsonemina). – Folia Ent. Hung., **45**: 59–68. Budapest.
- Manischewitz, J. R., 1966: Studies on parasitic mites of New Jersey. – J. New York Ent. Soc., **74**: 189–197. New York.
- Margolis, L., Esch, G. W., Holmes, J. C., Kuris, A. M. & Schad, G. A., 1982: The use of ecological terms in Parasitology. – J. Parasitol., **68** (1): 131–133. Lawrence, Kansas.
- Rack, G., 1967: Neue Pyemotidenfunde in Hamburg (Acarina, Pyemotidae). – Entomol. Mitt. zool. Mus. Hamburg, **3** (58): 1–17. Hamburg.
- 1975: Phoretisch auf Kleinsäugetern gefundene Arten der Gattung *Pygmephorus* (Acarina, Pygmephoridae). Mitt. hamb. zool. Mus. Inst., **72**: 157–176. Hamburg.
- Sasa, M., 1961: New mites of the genus *Pygmephorus* from small mammals in Japan (Acarina, Pyemotidae). – Japan J. Exp. Med., **31** (3): 191–208. Tokyo.
- Sellnick, M., 1940: Die Milbenfauna Islands. – Göteb. Kungl. Vet. Vitterh. Samh. Handl., Ser. B, **6** (14): 1–129. Stockholm.
- Smiley, R. L., Moser, J. C., 1976: Two new Phoretomorphic *Siteroptes* from Galleries of the Southern Pine Beetle. – Beitr. Ent., **26**: 307–322. Berlin.
- Smiley, R. L., Whitaker, J. C., 1979: Mites of the genus *Pygmephorus* (Acari: Pygmephoridae) on small mammals in North America. – Acta Zool. Acad. Sc. Hung., **25** (3–4): 383–408. Budapest.
- 1984: Key to New and Old World *Pygmephorus* species and descriptions of six new species (Acari: Pygmephoridae). – Internat. J. Acarol., **10** (2): 59–73. Oak Park, Michigan.
- Vitzthum, H., 1943: Acarina. – In: Bronn, Klassen und Ordnungen des Tierreiches, **5** (Abt. IV, Buch 5): 1–1011. Leipzig.
- Whitaker, J. O., French, T. W. & Smiley, R. L., 1982: Notes on host relationships and host specificity of mites of the genus *Pygmephorus* (Acari: Pygmephoridae) on insectivores and rodents from Mount Carleton Provincial Park, New Brunswick. – Internat. J. Acarol., **8** (4): 233–235. Oak Park, Michigan.
- Wicht, M. C., 1970: Three new species of Pyemotid mites associated with commercial mushrooms. – Acarologia, **12** (2): 262–268. Paris.
- Willmann, C., 1952: Parasitische Milben an Kleinsäugetern. – Z. Parasitenk., **15**: 392–428. Berlin, Göttingen, Heidelberg.
- 1953: Tarsale Sinnesorgane bei der Gattung *Rhagidia* und anderen prostigmatischen Milben. – Zool. Anz., **150** (9–10): 215–223. Leipzig.
- Zumpt, F., 1961: The Arthropod Parasites of Vertebrates in Africa South of the Sahara (Ethiopian Region). Volume 1 (Chelicerata). – Publ. South Afr. Inst. Med. Res., **9** (1): 1–457. Johannesburg.