

## Psorergatidae mite infestation in the brown rat *Rattus norvegicus* (Rodentia, Muridae): the first record of *Psorergates rattus* (Acariformes, Prostigmata) in Europe

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**Abstract:** *Psorergates rattus* Fain & Goff, 1986 has been found in the brown rat *Rattus norvegicus* (Berkenhout, 1769) in Poland. The species has previously been found only once, in the tail base of the brown rat in the United States. In the present case, ten rats from two localities in Poland (Pomerania) were examined and infestation was discovered in 20% of them, with a total of 12 mites found. This is not only the first discovery of the species in Poland and the second globally, but also the first observation of representatives of Psorergatidae in rodents of the genus *Rattus* in Europe. Moreover, immature specimens of *P. rattus* have been observed for the first time. The infestation was asymptomatic, although in the earlier study mange was observed despite the relatively low density of the mites, which indicates a potential pathogenic threat not only to wild rat populations, but also to laboratory animals and pets.

**Key words:** *Psorergates rattus*, Psorergatidae, skin mites, *Rattus norvegicus*, brown rat

Mites of the family Psorergatidae (Acariformes, Prostigmata) are stationary mono- or oligoxenic skin parasites of mammals of various orders (Giesen, 1990; Walter et al. 2009). They are among the most diminutive mites and animals in general; the adults measure about 100 µm. Because of their small size and the difficulty of detecting them on the host skin, they have not been commonly studied. Thus far, over 70 species have been described (Fain and Goff, 1986; Haitlinger, 1986, 1987; Giesen et al., 1989; Giesen, 1990; Baker, 2005), including 10 found in Poland (Izdebska and Fryderyk, 2012). The majority are known only from a single publication (species descriptions), which is the sole source (Giesen, 1990) of information about these taxa. Close to half of the Psorergatidae species have been observed in rodents, and a significant majority of studies concern infestation of common Eurasian or cosmopolitan muroids of Muroidea, both wild and from laboratories (Tyrrell, 1883; Neumann, 1893; Canestrini, 1894; Flynn and Jaroslow, 1956; Rioux and Golvan, 1961; Fain et al., 1966; Lukoschus et al., 1967; Sosnina, 1970; Spicka, 1975; Haitlinger, 1978, 1987; Grigorjeva, 2007; Izdebska and Fryderyk, 2012). Nine species of the genus *Psorergates* have been observed in murids of Muridae (Fain and Goff, 1986; Bochkov, 2009), but the majority of the reported data refer to hosts of the genera *Mus* and *Apodemus*. There is a scarcity of data on the occurrence of these mites in the true rats, *Rattus*

spp., a numerous and widely distributed group including about 65 species. Thus far, only one Psorergatidae species, *Psorergates rattus* Fain & Goff, 1986, has been identified in these rodents: in brown rat *Rattus norvegicus* (Berkenhout, 1769) from Oahu, Hawaii, USA. Despite the cosmopolitan nature of this rat species, the mite is known only from a single host (Fain and Goff, 1986). Moreover, mites identified only at generic level (*Psorergates*) were found in a brown rat from Japan (Giesen, 1990).

The present study concerned 10 brown rats obtained in 2015 from the region of Pomerania, Poland (Gdynia; 54°31'N, 18°29'E and 54°30'N, 18°32'E). To determine the presence of Psorergatidae and their topography in the hosts, skin fragments from various body parts were obtained, including the head (area around eyes, ears, nose, area of vibrissae, lips, chin, cheeks), dorsum, abdomen, limbs, genital area, anus, and tail. The cuttings were examined for the presence of skin parasites using the digestion and decanting method, developed for analogous studies of Demodecidae mites (Izdebska, 2004). The observed mite specimens were mounted in polyvinyl-lactophenol solution and analyzed under an optical microscope using the phase-contrast technique. Individual specimens were measured, including their meristic features significant for Psorergatidae taxonomy. Diagnostic features that differentiate genera in the Psorergatidae family are the palpal-tibial setae (*dF*) shape and the number and shape

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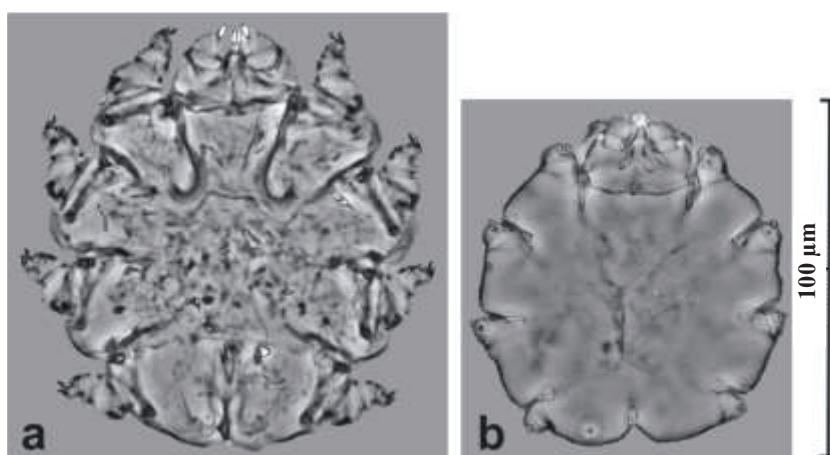
of the dorsal idiosomal setae. The palpal-tibial setae of the genus *Psorergates* are smooth; idiosoma with 4 pairs of dorsal setae in females and with 5 pairs in males. *Psorergates rattus* is characterized by long, well-sclerotized first pair of epimera, forming large loops; the palpal-tibial setae are short (1.2–1.5 µm long) and gnathosomal setae (*n*) reach ca. 9 µm long (Fain and Goff, 1986; Giesen, 1990; Bochkov, 2009). Microscopic preparations were placed in scientific collections within the framework of the Collection of Extant Invertebrates in the Department of Invertebrate Zoology and Parasitology, University of Gdańsk, Poland.

*Psorergates rattus* was found in 2 of the 10 examined rats. A total of 12 mites were found, including 7 female adults and 5 nymphs (Table; Figures 1a and 1b). Thus,

the parameters of infestation were low: the prevalence of infestation was 20%, with a mean intensity of 6 and range of intensity of 4–8. The majority of the mites were found in the skin on the dorsum (4 females, 5 nymphs), and the remainder in the ear pinnae (3 females). They did not cause mange in the host. In an earlier study, *P. rattus* was found at the tail base (Fain and Goff, 1986). Psorergatidae have been found in analogous microhabitats in other rodent species: for example, *P. apodemi* Fain, Lukoschus & Hallmann, 1966 was found on the dorsal skin and in the ear pinnae of *Apodemus sylvaticus* Linnaeus, 1758 (Fain et al., 1966). Ears are the most commonly reported site of Psorergatidae infestation in rodents—a large number of species have been found in this body part (Tyrell, 1883; Michael, 1889; Canestrini, 1894; Fain, 1961; Fain et al., 1966; Lukoschus

**Table.** Body size (ranges, means, standard deviations, in µm) of nymphs and females of *Psorergates rattus* from Poland, in comparison with the data reported by Fain and Goff (1986).

Morphological features	Present study		Fain and Goff (1986)
	Nymphs (n = 5)	Females (n = 7)	Females (n = 6; holotype and 5 paratypes)
Length of gnathosoma	22–25 (23.2 ± 1.3)	24–27 (26.0 ± 1.2)	27–30
Width of gnathosoma	33–35 (33.8 ± 1.6)	33–37 (34.9 ± 1.5)	36–39
Length of idiosoma	72–84 (78.0 ± 4.9)	85–108 (97.0 ± 7.1)	–
Width of idiosoma	86–96 (91.0 ± 4.4)	96–109 (102.1 ± 4.5)	110–117
Length of shield	–	80–90 (83.9 ± 3.6)	88–93
Width of shield	–	83–90 (86.0 ± 2.4)	82–90
Length of vulva	–	8–12 (10.7 ± 1.5)	10
Length of gnathosomal setae	2–4 (3.4 ± 0.9)	5–6 (5.1 ± 0.4)	–
Length of palpal tibial setae	–	1–2 (1.3 ± 0.5)	1.2–1.5
Total length of body	95–108 (101.2 ± 5.1)	112–133 (123.0 ± 6.6)	123–139



**Figure 1.** *Psorergates rattus*: a) female, b) nymph.

et al., 1967, 1971; Ah et al., 1973; Haitlinger, 1978, 1987; Izdebska and Frydryk, 2012).

In this study only females were found among the adult population of *P. rattus*, although immature specimens were observed for the first time. This does not provide a basis for the development of morphological ontogeny, however, as only nymphs were found, which are difficult to verify without determination of the other developmental stages.

This study provides the first report of this species in Poland and the second worldwide. It is also the first time representatives of Psorergatidae have been found in rodents of the genus *Rattus* in Europe. Although skin mites of various systematic groups are common in mammal populations, they rarely produce symptoms, and thus they are infrequently detected in veterinary or parasitological studies (Izdebska and Krawczyk, 2012). The great majority of publications on Psorergatidae stem from observations of mange in hosts, and only a small number discuss the asymptomatic occurrence of the mites. This may be the reason for the absence of previous reports on their occurrence in the brown rat, which has been a common subject of parasitological studies. It would appear that *R. norvegicus*, a cosmopolitan and synanthropic species, also used in laboratories and kept as a pet or food animal, is well studied in terms of its acarofauna: over 40 species associated to varying degrees with the host have been observed in Poland alone (Haitlinger and Jankowska, 2005). However, knowledge

on skin and tissue mites in the brown rat is fragmentary, and existing studies primarily concern Demodecidae, of which five species have been described (Hirst, 1919; Desch, 1987; Bukva, 1995; Izdebska, 2004; Izdebska and Rolbiecki, 2004, 2012, 2014; Izdebska et al., 2017), and Sarcoptidae, of which two species are typical rat parasites (Klompfen and Nachman, 1990; Klompfen, 1992; Bochkov, 2010; Izdebska and Rolbiecki, 2013). Of all groups of skin parasites found in the rat, Psorergatidae has attracted the least scientific attention. Considering the fact that in certain rodents of the superfamily Muroidea, several mite species of this family have been found, it may be assumed that the Psorergatidae fauna of rats is considerably more extensive, but this issue requires comprehensive research.

The presently discussed infestation was asymptomatic, although the previous study provided observations of mange, despite the relatively low density of the mites (the description states that only 12 individuals were found) (Fain and Goff, 1986). Indeed, pathogenic symptoms are a relatively rare occurrence, and furthermore they can be difficult to detect and may imitate other dermatoses. Perhaps, as in the case of other skin mites, the development of parasitosis is not determined solely by the presence of the parasites, but also by the predisposition of the host, such as poor condition or reduced immunity. Psorergatidae may certainly be considered a potential threat to both wild and captive populations of rats.

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