Topical structure and topography of *Demodex* spp. (Acari, Demodecidae) in brown rat *Rattus norvegicus* (Rodentia, Muridae)

Joanna N. Izdebska, Leszek Rolbiecki

Department of Invertebrate Zoology and Parasitology, University of Gdańsk, Wita Stwosza 59, Gdańsk 80-308, Poland; e-mail: biojni@ug.edu.pl

Abstract

The occurrence and localization of mites from Demodecidae family in brown rat Rattus norvegicus skin were analyzed. The presence of four species (Demodex nanus Hirst, 1918, D. norvegicus (Berkenhout, 1769), D. ratti Hirst, 1917, D. ratticola Bukva, 1995) were noted, from which D. nanus, found in 100.0% of the examined rats, was predominant one. The mites from that species exhibited distinct topographical preferences, limiting practically their occurrence only to genital - anal area (96.6%). D. norvegicus was observed entirely in the skin of genital area in 25.0% of hosts. D. ratti in turn, was only noted in the skin of head area, in 35.0% of the hosts. D. ratticola was also noted in head skin, in 75.0% of the rats. The skin mites demonstrate thus distinct topographical preferences in the rat, conditioned probably by the tissue/topical specificity. This may be however also connected to the manners of transmission between the hosts. The observed demodectic mites did not cause any disease symptoms in rats.

Introduction

The mites from Demodecidae family often inhabit strictly specified microhabitats in mammals, in skin or internal organs, e.g. hair follicles, sebaceous glands, Meibomian glands, epidermis or tissues of mouth cavity and anterior parts of alimentary tract (Bukva 1991, Izdebska 2006, 2009, Izdebska and Fryderyk 2011). However, the detailed observations concerning topography in hosts are usually connected with disease symptoms occurrence.

Little is known about asymptomatic arrangement of these mites in various regions of the body. It is also difficult to establish its reasons - it seems that the arrangement of demodectic mites should be strictly correlated with localization of microhabitats typical for them. The information so far point however, that the demodecids may exhibit topographical preferences which do not results entirely from the topical specificity. And thus *Demodex arvicolae apodemi* Hirst, 1918 from a striped field mouse *Apodemus agrarius* (Pallas, 1771), connected with hair follicles of common hair does not demonstrate any regular arrangement consistent with a presence of this kind of hair in the host, and distinctly prefer head region (Izdebska et al. 2011). The reasons of localization choice may be possibly more complex and connected for example to transmission of the mites between the hosts, or mechanical transfer within the host, e.g. during its hygienic practices (Bukva 1990, Izdebska et al. 2011).

Demodectic mites of the brown rat seem to be a convenient model for the analysis of topographical preferences, since as many as four species of *Demodex* which may occur synhospitally, have been described in that host. Three of them were previously noted in Poland, and recently also the next one - *D. ratticola* Bukva, 1995, was demonstrated (Izdebska 2004, 2008, Izdebska and Rolbiecki 2004, 2012).

Material and methods

The study included 20 specimens of brown rat *Rattus norvegicus* (Rodentia, Muridae), obtained in the year 2010 from a few sites from northern Poland (Gdańsk 54°22'N/18°36'E, Główczyce 54°37'N/17°22'E, Tczew 54°06'N/18°47'E). The segments of tissues from the area of head (eyelids, eyes region, cheeks, pinnae, chin, lips, nose), back, abdomen, genital - anal area, auditory meatus, tongue and mouth cavity, were collected from the rats. The skin mites were detected using the method of digesting (Izdebska 2004, Kadulski and Izdebska 2006); the tissues samples were subjected to maceration and decantation, and the found mites specimens were plunged in Faure's liquid. The obtained demodecids specimens were analyzed using the phase contrast microscope.

Results and discussion

Occurrence of Demodex *spp. in brown rats*

Fours species of skin mites of Demodecidae, including *Demodex nanus* Hirst, 1918, *D. norvegicus* (Berkenhout, 1769), *D. ratti* Hirst, 1917 and *D. ratticola* (Fig. 1), were demonstrated in examined rats. The overall prevalence of parasites was 100.0% at a mean intensity of 92.4, and intensity range of 2-291. *D. nanus* appeared to be a dominant species, and was observed in 100.0% of the examined rats with a mean intensity 40.8 and range of intensity 3-132 (Tab.1). As a rule adult stages dominated over the immatures (Fig. 2).

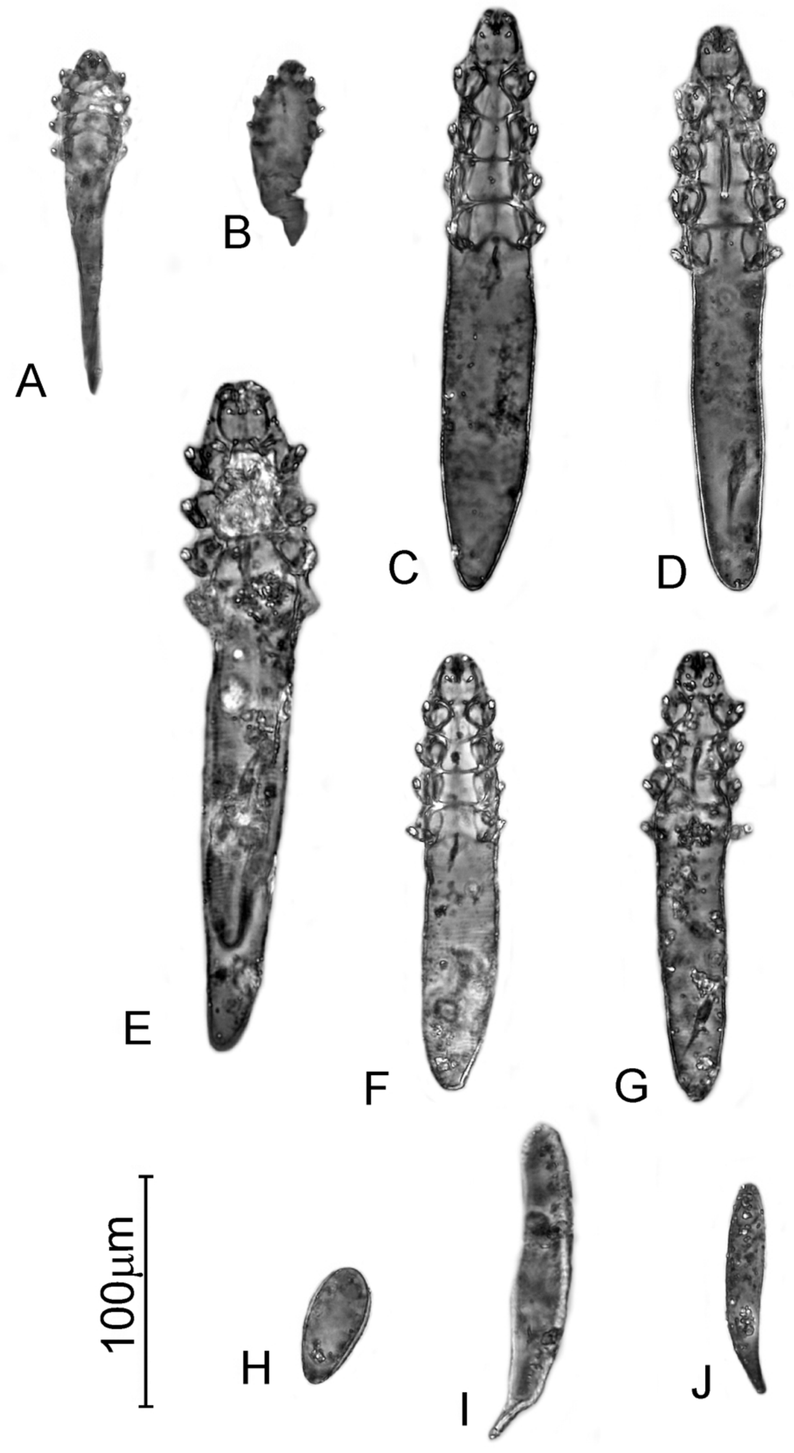
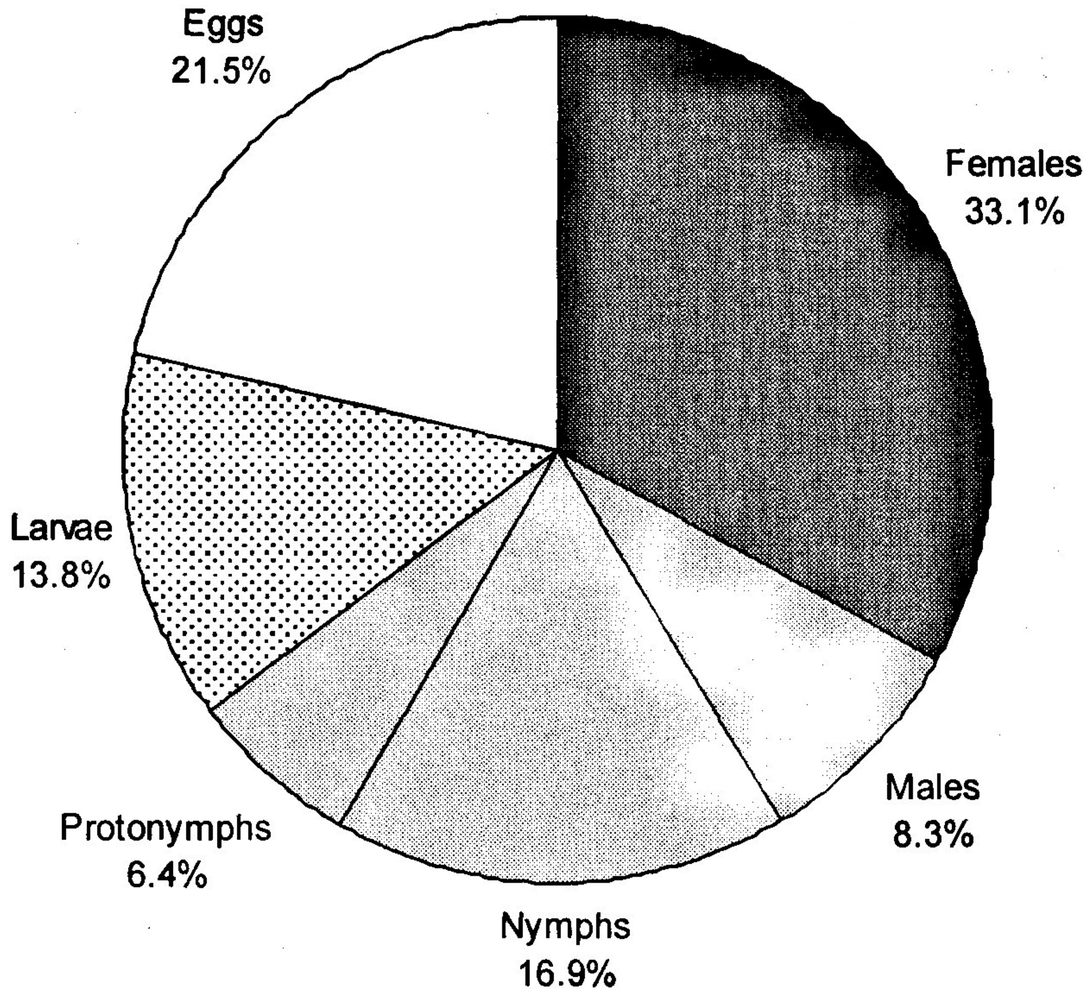


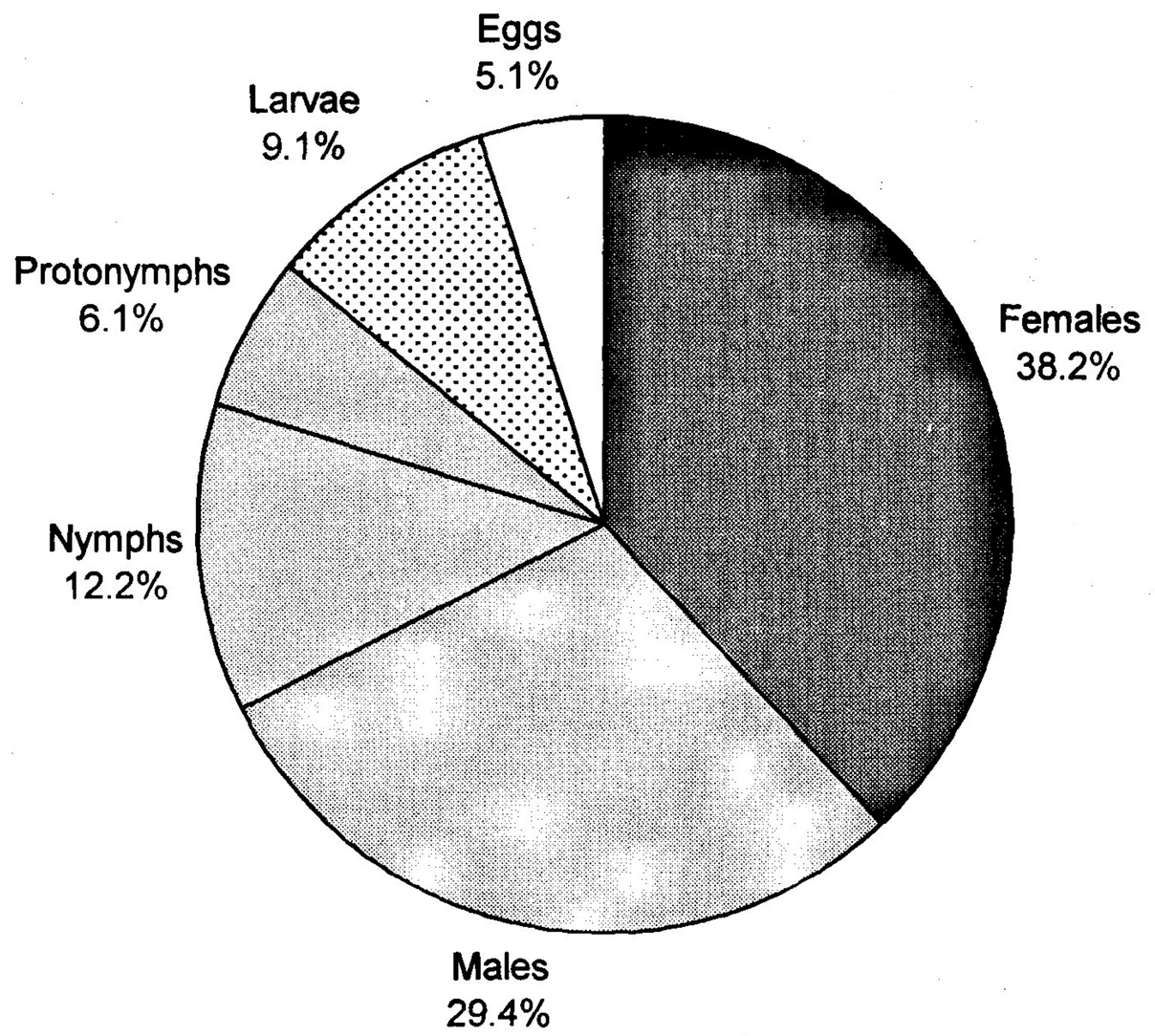
Fig. 1. *Demodex nanus*, female (A), male (B), egg (H), *Demodex norvegicus*, female (C), male (D), egg (I), *Demodex ratti*, male (E), *Demodex ratticola* female (F), male (G), egg (J)

Four species of specific skin mites of Demodecidae have been described so far in the brown rat. *D. ratti* (Hirst 1917, 1919) was recognized as the first one, and then was subject to redescription by Bukva (1995) based on materials from an individual brown rat from Czech Republic (Bukva 1995). It was moreover observed in rats in Russia (Bregetova et al. 1955), and also in Poland (Izdebska 2004, 2008, Izdebska and Rolbiecki 2004, 2012)(Tab. 1).

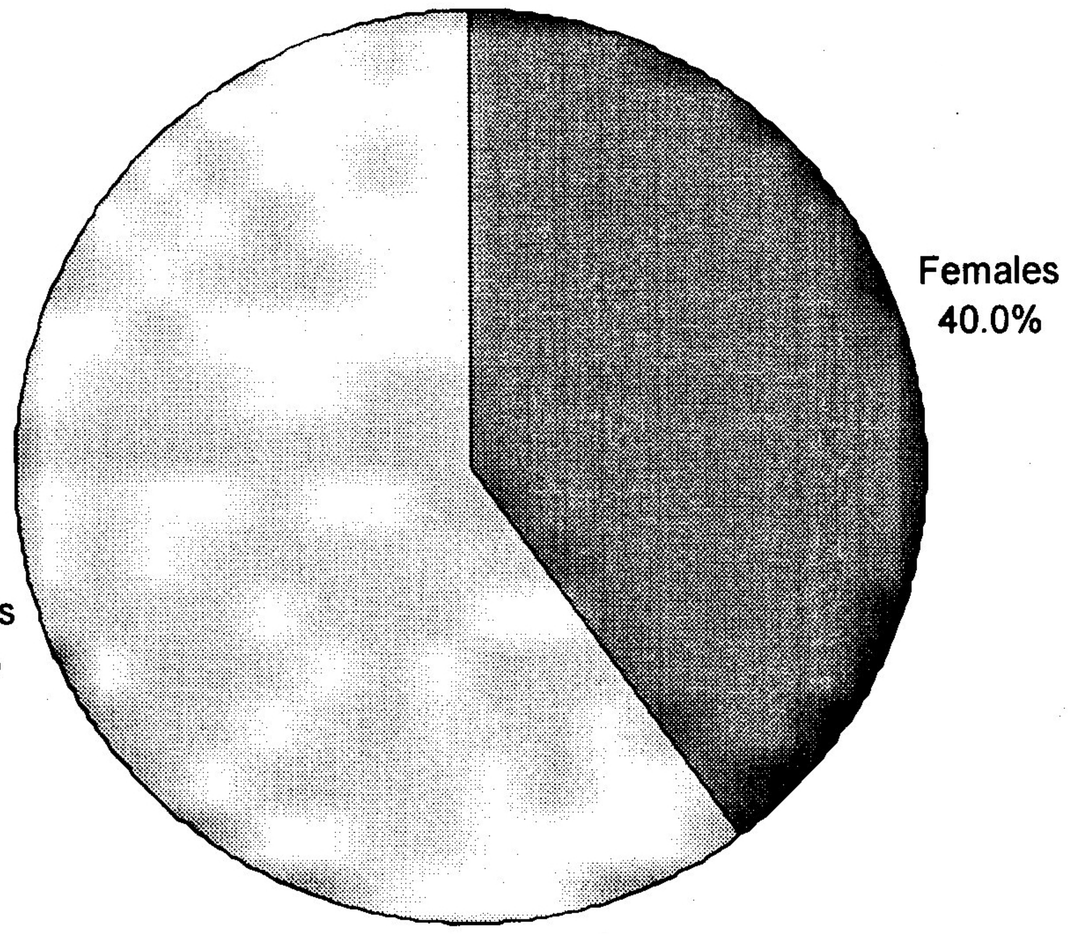
A



B



C



D

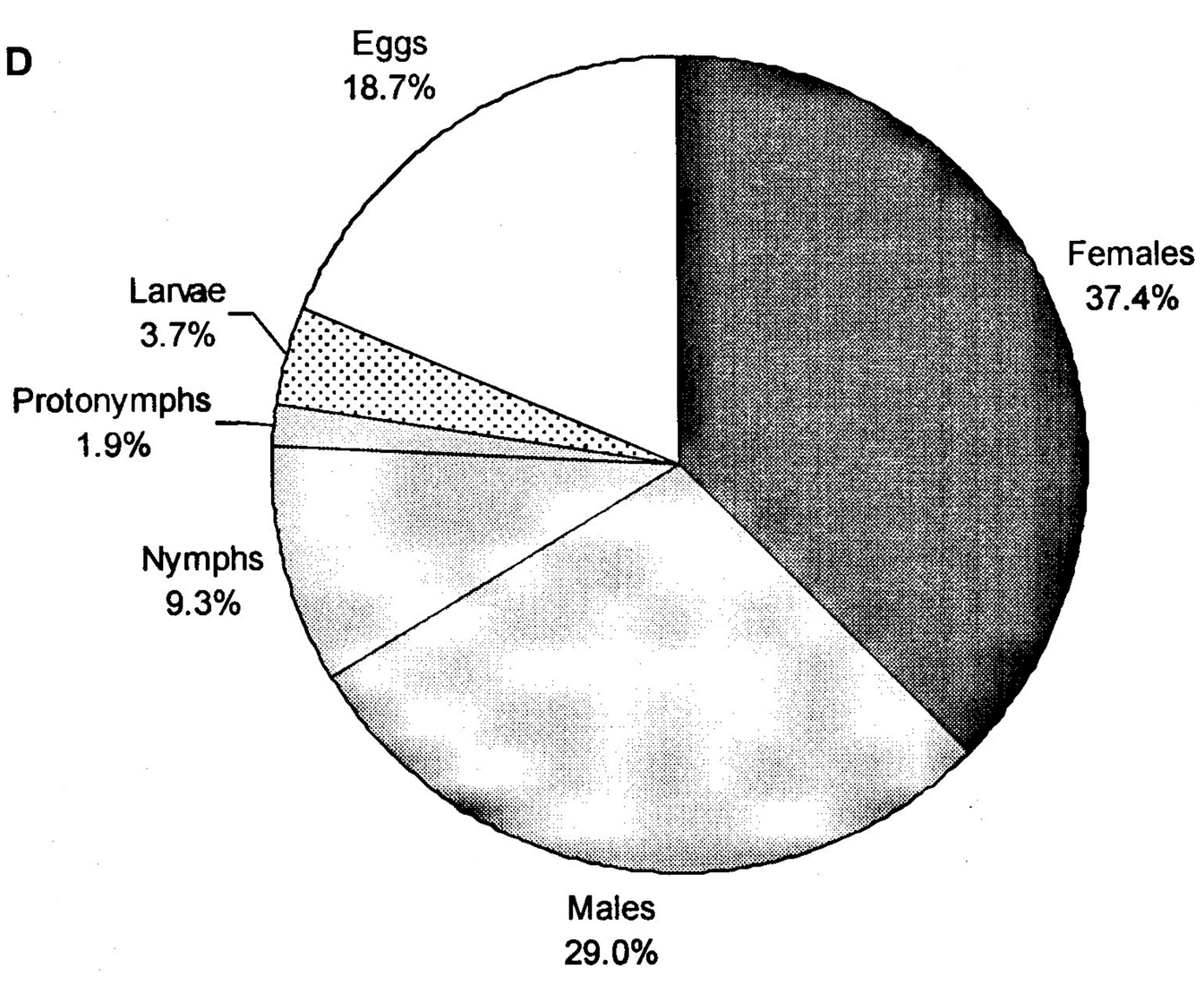


Fig. 2. The population structure of *Demodex nanus* (A), *Demodex norvegicus* (B), *Demodex ratti* (C) and *Demodex ratticola* (D)

The next one, *D. nanus,* was demonstrated in two rat species - *R. norvegicus* and *R. rattus* (Linnaeus, 1758), and was noted in Great Britain, Russia, Germany, Poland (Tab.1), USA, New Zealand (Hirst 1918, 1919, Bregetova et al. 1955, Desch 1987, Izdebska 2004, 2008, Izdebska and Rolbiecki 2004, 2012).

Tab. 1. Level of infection (prevalence, mean intensity, range of intensity) of brown rats with demodectic mites from Poland according to the various authors

	Izdebska (2004)	Izdebska and Rolbiecki (2004)	Izdebska and Rolbiecki (2012)	Present
Demodex nanus	29.0%, 3.0	39.4%, 4.5	100%, 25.2	100%, 40.8, 3-132
Demodex norvegicus	21.0%, 2.0	27.3%, 5.1	30.0%, 3.5	25.0%, 148.0, 5-291
Demodex ratti	7.0%, 2.0	9.1%, 7.7	50.0%, 3.3	35.0%, 3.6, 2-5
Demodex ratticola	-	-	65.0%, 12.7	75.0%, 17.8, 5-40
Total	56.0%	69.7%, 5.8	100%, 36.2	100%, 92.4, 2-291

-: no parasites present

Next, two other species described in brown rats from the area of Czech Republic were noted – *D. norvegicus* and *D. ratticola* (Bukva 1995). Both species were also previously demonstrated in Poland (Izdebska 2004, 2008, Izdebska and Rolbiecki 2004, 2012)(Tab. 1).

The identified demodectic mites did not cause any skin symptoms in rats. However, these mites usually do not cause any pathological changes in their hosts (Flynn 1973).

Demodex spp. localization in rat's skin

The mites of all species demonstrated distinct topographical preferences. Thus *D. norvegicus* was observed entirely in the skin of genital area (Figs 3, 4). The same localization was noted by Bukva (1995) and Izdebska (2004). The next one, *D. nanus*, was currently observed in skin of genital areas (scrotum and penis in males, vagina of females) and also around anal areas. Considerably smaller number of individuals was found in another regions (Figs 3, 4). It was however demonstrated in the previous studies in areas of head, back, abdomen, genital-anal area, and tail (Desch 1987, Izdebska 2004). It is possible that the transmission ways influence its arrangement in rat's skin. Observed in the preset study high abundance of the mites in the genital - anal region may point the mites transfer during sexual contacts.

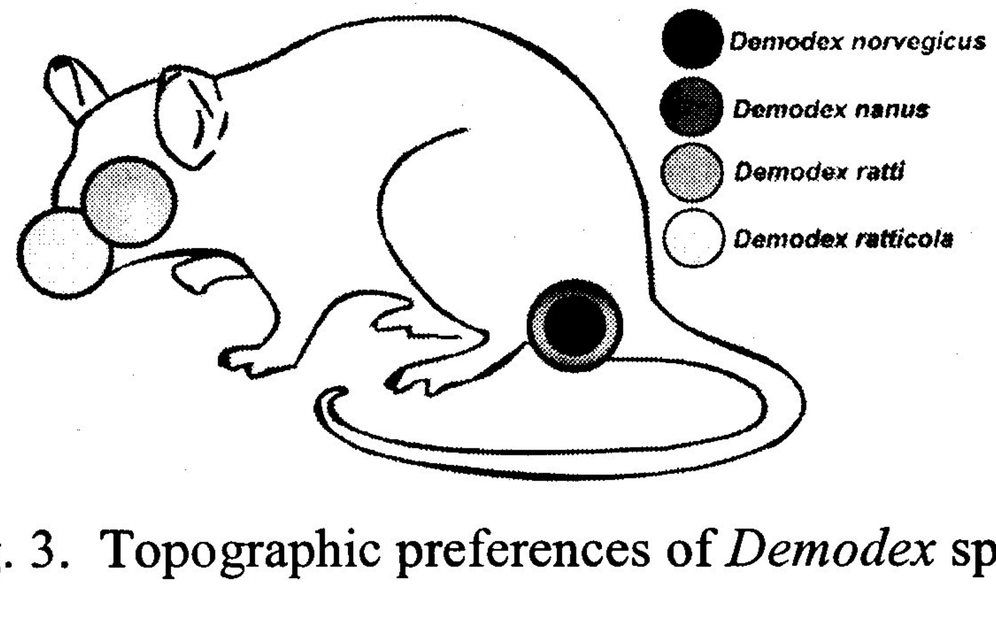
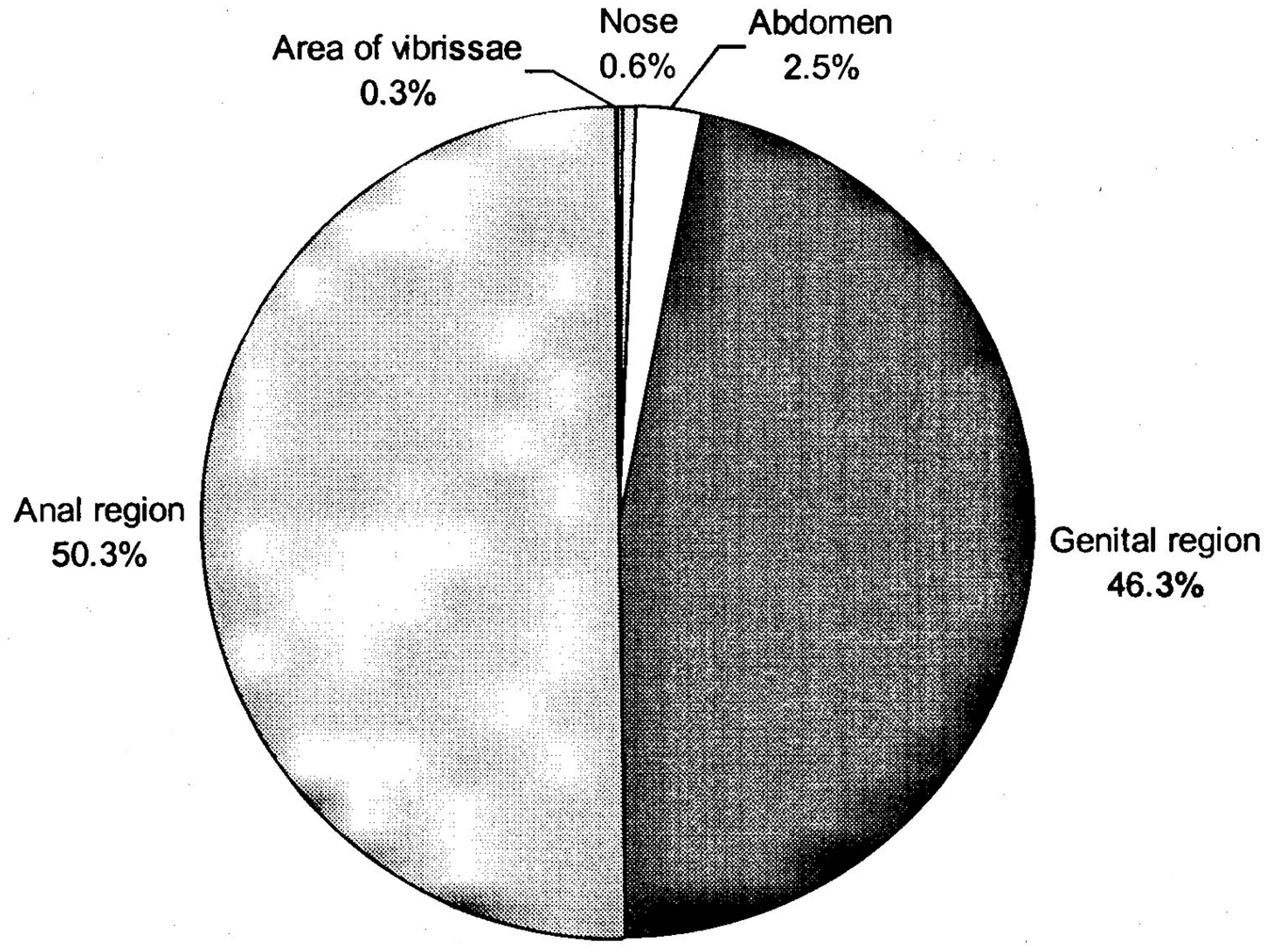
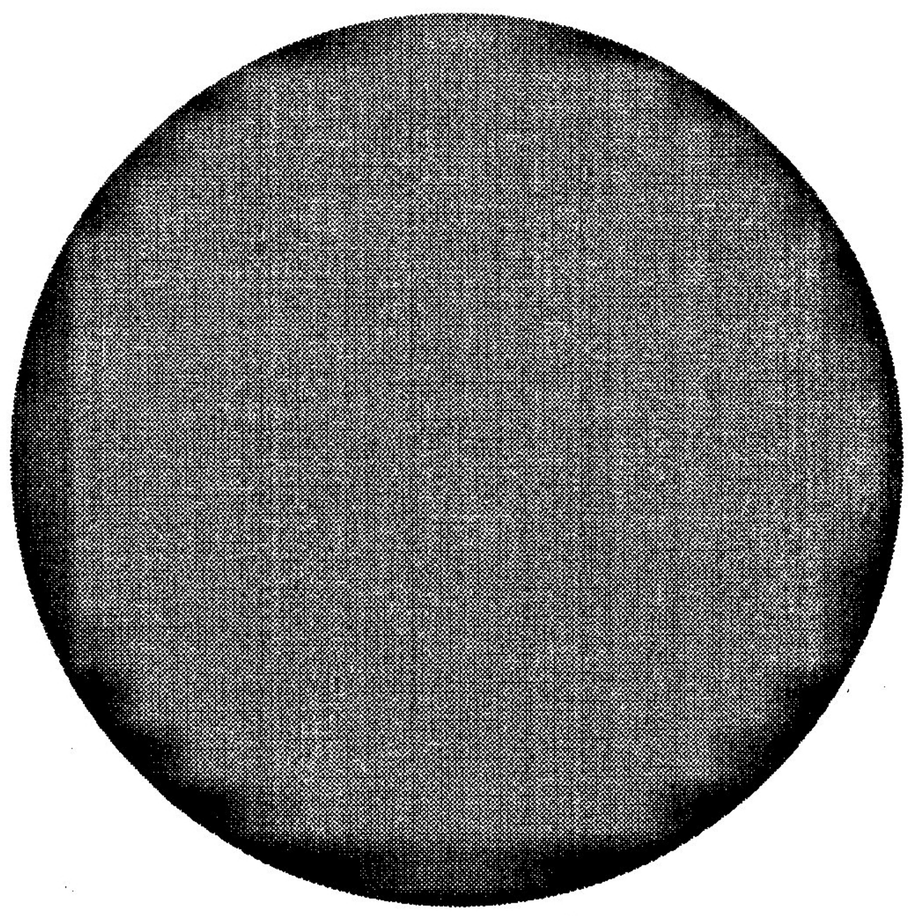


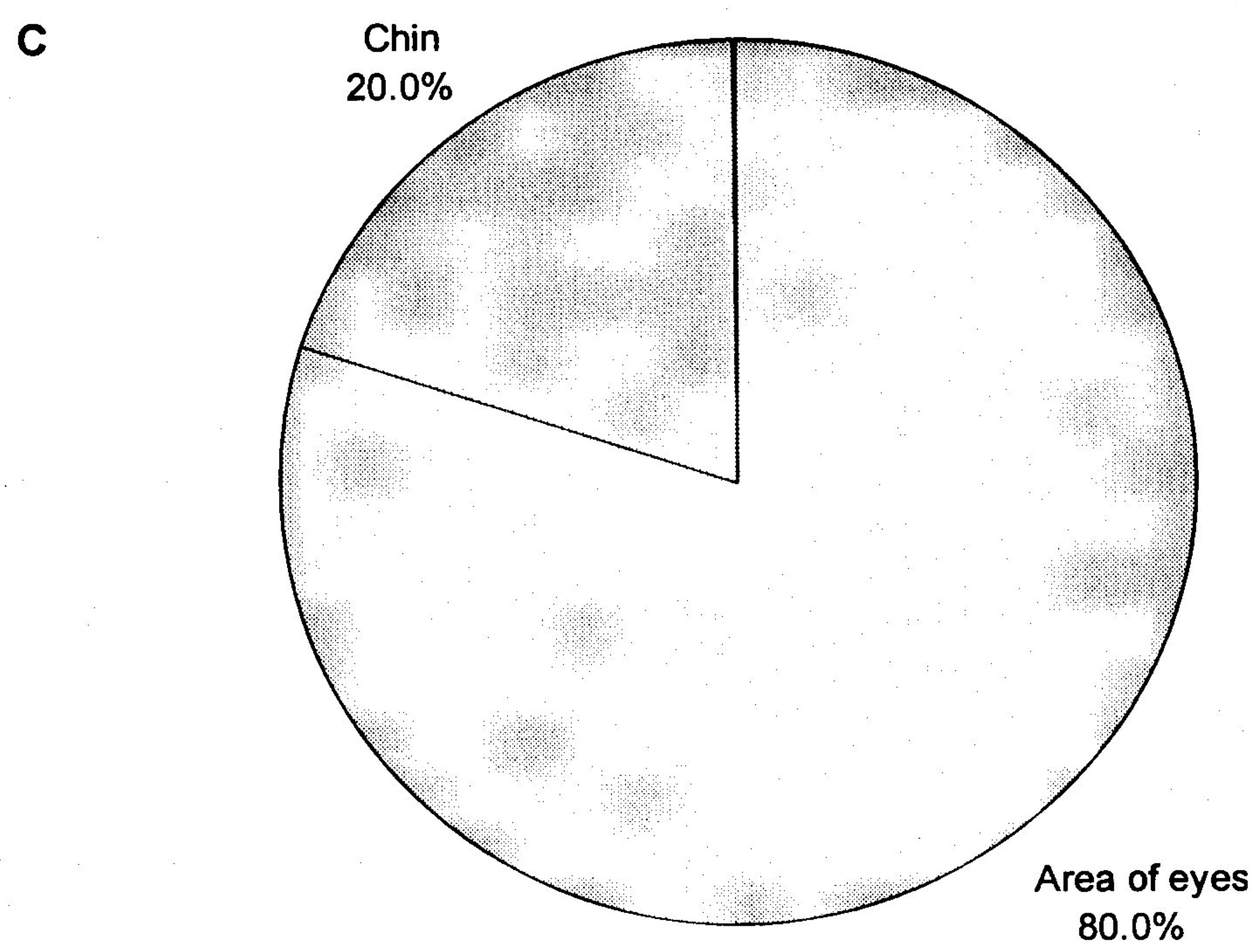
Fig. 3. Topographic preferences of *Demodex* spp. in brown rat

A


Area of vibrissae
0.3%
Nose
0.6%
Abdomen
2.5%
Anal region
50.3%
Genital region
46.3%

B


Genital region
100%



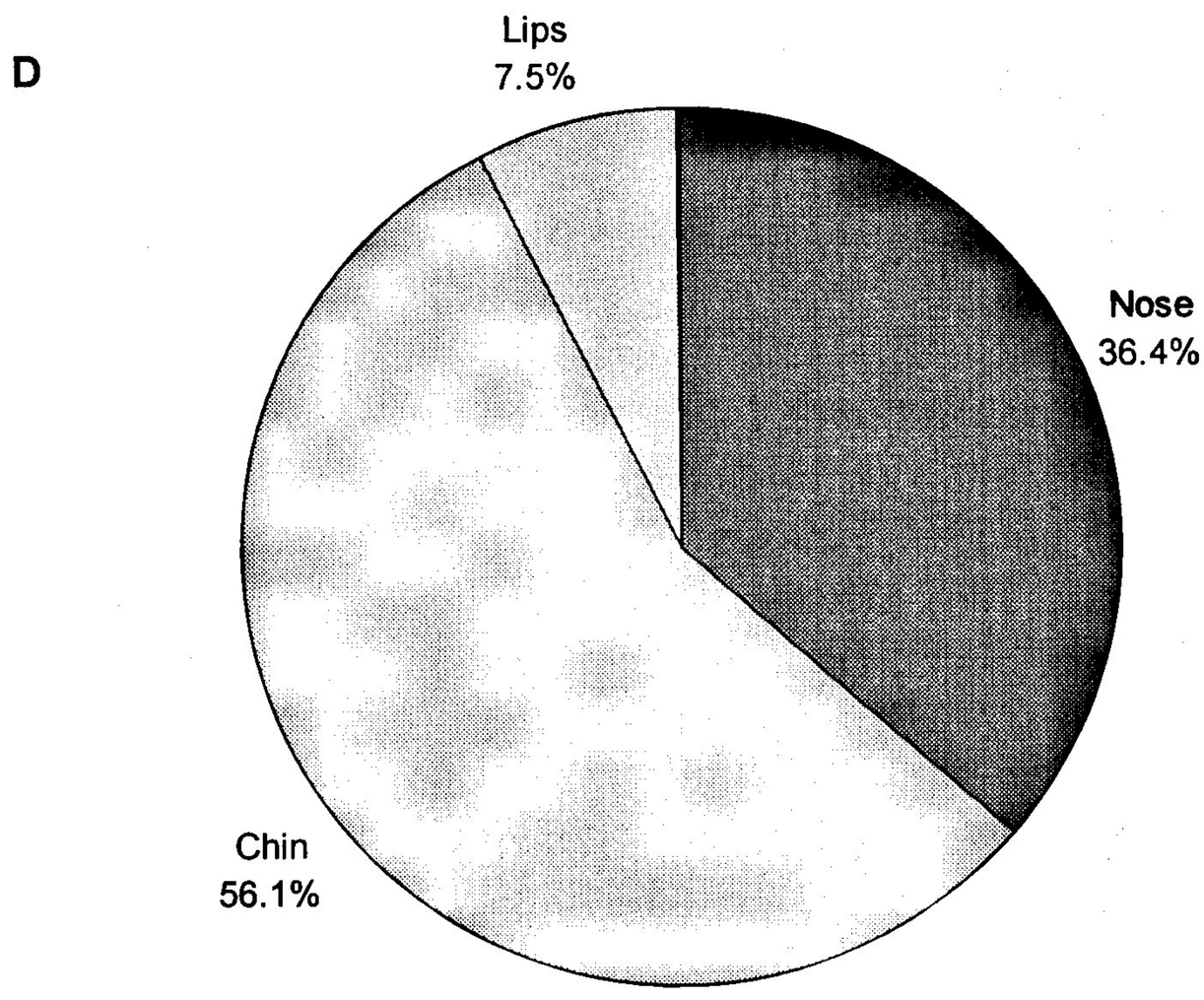


Fig. 4. Topographic preferences of *Demodex nanus* (A), *Demodex norvegicus* (B), *Demodex ratti* (C) and *Demodex ratticola* (D)

D. ratti in turn, was noted only in the skin of head area (Figs 3, 4). Also *D. ratticola* preferred localization within head region, demonstrating however higher infestation parameters and slightly different arrangement (Figs 3, 4). Comparable results are reported by other authors (Bukva 1995, Izdebska 2004, Izdebska and Rolbiecki 2012).

Summing up, the demodectic mites demonstrate distinct topographical preferences in brown rat skin. One of the reasons is undoubtedly tissue/topical specificity. However, an important reason of uneven mites distribution in the skin may be the ways of their transmission between the hosts.

References

1. Bregetova N.G., Bulanova-Zahvatkina E.M., Volgin V.I., Dubinin V.B., Zahvatkin A.A., Zemskaâ A.A., Lange A.B., Pavlovskij E.N., Serdûkova G.V., Šluger E.G. 1955. [Kleŝi gryzunov fauny SSSR]. Izdatel'stvo Akademii Nauk SSSR, Moskva, Leningrad (In Russian).
2. Bukva V. 1990. Transmission of *Demodex flagellurus* (Acari: Demodicidae) in the house mouse, *Mus musculus*, under laboratory conditions. Exp. Appl. Acarol. 10: 53-60.
3. Bukva V. 1991. Structural reduction and topological retrieval: problems in taxonomy of Demodecidae. Mod. Acarol. 1: 293-300.
4. Bukva V. 1995. *Demodex* species (Acari: Demodecidae) parasitizing the brown rat, *Rattus norvegicus* (Rodentia): redescription of *Demodex ratti* and description of *D. norvegicus* sp. n. and *D. ratticola* sp. n. Folia Parasit. 42: 149-160.
5. Desch C.E. 1987. Redescription of *Demodex nanus* (Acari: Demodicidae) from *Rattus norvegicus* and *R.. rattus* (Rodentia). J. Med. Entomol. 24: 19-23.
6. Flynn R.J. 1973. Parasites of laboratory animals. Iowa State University Press, Ames.
7. Hirst S. 1917. Remarks on certain species of the genus *Demodex*, Owen (the *Demodex* of man, the horse, dog, rat, and mouse). Ann. Mag. Nat. Hist. 20: 232-235.
8. Hirst S. 1918. On four new species of the genus *Demodex*, Owen. Ann. Mag. Nat. Hist. 2: 145-146.
9. Hirst S. 1919. Studies on Acari. No. 1. The Genus *Demodex*, Owen. British Museum (Natural History), London.
10. Izdebska J.N. 2004. *Demodex* spp. (Acari: Demodecidae) in brown rat (Rodentia: Muridae) in Poland. Wiad. Parazytol. 50: 333-335.
11. Izdebska J.N. 2006. Adaptation to parasitism in skin mites from the Demodecidae family (Acari, Prostigmata). In: Buczek A., Błaszak C. (eds.), Arthropods. Epidemiological importance. Koliber, Lublin: 31-36.
12. Izdebska J.N. 2008. Nużeńcowate (Demodecidae). In: Bogdanowicz W., Chudzicka E., Pilipiuk I., Skibińska E. (eds.), Fauna Polski - charakterystyka i wykaz gatunków. Tom III. Muzeum i Instytut Zoologii PAN, Warszawa: 128-130, 200-201.
13. Izdebska J.N. 2009. Selected aspects of adaptations to the parasitism of hair follicle mites (Acari, Demodecidae) from hoofed mammals. Eur. Bison Conserv. Newsl. 2: 80-88.
14. Izdebska J.N., Fryderyk S. 2011. Recent data on *Demodex rosus* Bukva, Vitovec et Vlcek, 1985 (Acari, Demodecidae) from oral cavity of yellow-necked field mouse, *Apodemus flavicollis* (Rodentia, Muridae). Wiad. Parazytol. 57: 257-260.
15. Izdebska J.N., Rolbiecki L. 2004. Występowanie *Demodex* spp. w korelacji z poziomem zarażenia helmintami szczura wędrownego *Rattus norvegicus* (Berk.) z aglomeracji miejskiej Trójmiasta. In: Indykiewicz P., Barczak T. (eds.), Fauna miast Europy Środkowej 21. wieku. Wyd. LOGO, Bydgoszcz: 581-584.

16. *Izdebska J.N., Rolbiecki L. 2012. Demodectic mites of the brown rat* Rattus norvegicus *(Berkenhout, 1769) (Rodentia, Muridae) with a new finding of* Demodex ratticola *Bukva, 1995 (Acari, Demodecidae). Ann. Parasitol. (in press).*
17. Izdebska J.N., Rolbiecki L., Fryderyk S. 2011. New data on distribution of *Demodex huttereri* Mertens, Lukoschus et Nutting, 1983 and topical specificity and topography of demodectic mites in striped field mouse *Apodemus agrarius*. Wiad. Parazytol. 57: 261-264.
18. Kadulski S., Izdebska J.N. 2006. Methods used in studies of parasitic arthropods in mammals. In: Buczek A., Błaszak C. (eds.), Arthropods. Epidemiological importance. Koliber, Lublin: 113-118.

ARTHROPODS

The medical and economic importance

Edited by

Alicja Buczek

Czesław Błaszak

AKAPIT

LUBLIN 2012

STAWONOGI

Znaczenie medyczne i gospodarcze

Pod Redakcją

Alicji Buczek
Karedra i Zakład Biologii i Parazytologii
Uniwersytet Medyczny w Lublinie

Czesława Błaszaka
Zakład Morfologii Zwierząt
Uniwersytet im. Adama Mickiewicza w Poznaniu

AKAPIT
LUBLIN 2012

COVER : SEBASTIAN BUCZEK

WYDANIE DOFINANSOWANE PRZEZ KOMITET ZOOLOGII PAN

ISBN 978-83-896162-1-0

AKAPIT
Lublin, ul. Węglowa 3
www.kleszcze.pl