DEMODEX LACRIMÁLIS SPEC. NOV. (DEMODICIDAE : TROMBIDIFORMES) FROM THE MEIBOMIAN GLANDS OF THE EUROPEAN WOOD MOUSE *APODEMUS SYLVÁTICUS*

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Demodicids from the Meibomian glands have been described from a neoarcticvole (NUTTING et al. 1971) and from neotropical bats (DESCH et al. 1972, LUKOSCHUS et al. 1972). These mites have either very long legs, long epimeral scutes or winglike dorsal prominences in immature stages as holdfast adaptations. In three of these species operculate ova and corresponding egg-teeth in larvae expedite hatching. This fact and the unusual shape of the eggs (long Y-shaped, snakelike or droplike with terminal spur) prevent immobile stages of being flushed out of the Meibomian duct. *Demodex lacrimalis* living in narrower gland ducts shares characteristics for rapid hatching of larvae, but is also adapted for survival in small ducts in the immature stages.

METHODS

Under dissection microscope mites were squeeze-plucked from the eyelids of *Apodemus sylvaticus*. Contents of glands were spread in a drop of HOYER's medium, clearing first gland cells, thus rendering possible observation of mites, their isolation and mounting. For observation of the mites in situ whole heads were fixed in BOUIN's solution. After fixation the entire ocular region was excised, embedded in paraffin, sectioned at 7 μ and stained with EHRLICH's haematoxylin and eosin. Specimens were studied with phase microscopy and drawings were made with the aid of a WILD-TREFFENBERG prism.

Demodex lacrimalis spec. nov.

Description (with characters of the genus and extension of generic characteristics by DESCH et al. 1972) :

Demodex lacrimalis is a medium sized member of the genus, largest adult specimen, a male, measuring 304 μ, largest nymph 320 μ, with opisthosoma of these comprising one half to three fourths of total body length. The species is highly variable with respect to length in all stages (see table 1).

TABLE 1. — Meristic data (average values and range) for the stages in life cycle of *Demodex lacrimalis* n. sp. Measurements in microns.

	gnathosoma		podosoma		opisthosoma		total body	penis/vulva
	length	width	length	width	length	width	length	length
(20) female	15	22	66	39	149	32	225	11
	13-16	19-25	64-69	32-46	94-175	24-36	175-262	9-12
(20) male	14	16	64	35	193	31	271	21
	13-16	14-18	59-70	27-44	138-239	25-38	212-304	17-23
(20) nymph	15	20	68	33	204	31	292	
	14-18	15-23	57-79	23-38	175-235	22-35	260-320	
(20) larva	16	17	42	29	150	27	209	
	9-18	14-18	36-54	24-33	94-212	22-32	156-271	
(20) ovum	133	31						
	114-145	26-36						

FEMALE (holotype). — Total length 198 μ, opisthosoma 122 μ, width 38 μ. In 20 paratypes measured, average width 39 μ (32-46), length 225 μ (175-262), opisthosoma 149 μ (94-175).

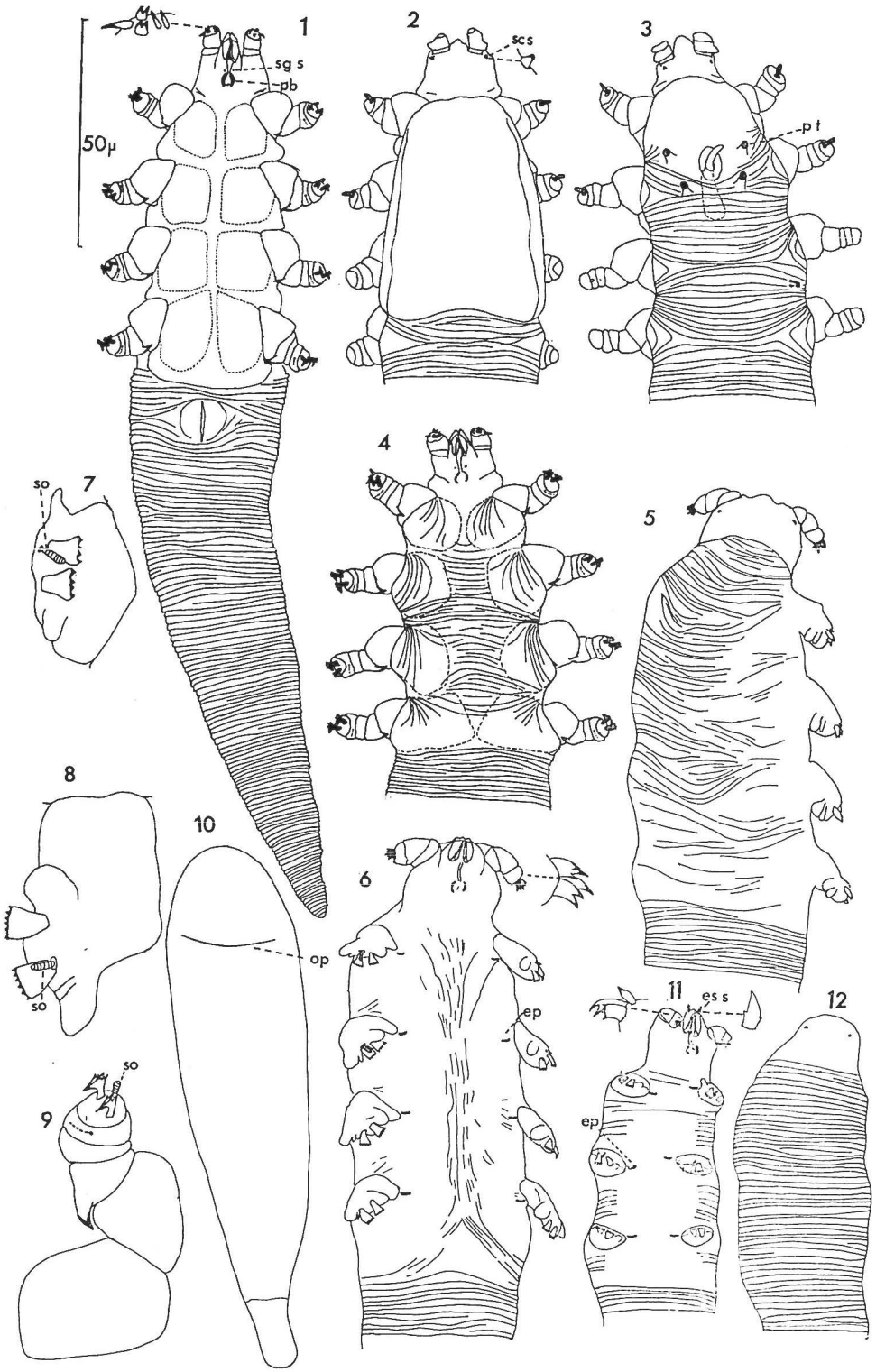
Venter (fig. 1). — Four pairs of six-segmented legs evenly spaced on podosoma. Gnathosoma trapezoidal ; length less than basal width. Length 16 μ, in paratypes ø 15 (13-16), width 20 μ, in paratypes ø 22 μ (19-25). Subgnathosomal setae (*sg*) anterior to oval pharyngeal bulb (*pb*). Palps three-segmented with ventral palptarsi. Palptarsi with two two-pointed claws and three spines. Legs about as long as podosomal width, with large coxal plate beneath body surface, trochanteres triangular, femora with distinct ventro-posterior spur, genua, tibiae and tarsi of about the same length. Two claws inserted ventrally on tarsus. Dorsal side of the claws furrowed with two points on each side (fig. 9). Legs I and II each with one solenidion (*so*). Vulva protuberant, distinctly separated from posterior border of coxae IV by several annuli. Opisthosoma with transverse annulation, proctodeum absent.

Dorsum (fig. 2). — Gnathosoma with little conical supracoxal spines (*sc s*). Dorsal shield in region of legs I-III without podosomal tubercles. Transverse annulation posterior to level of coxae IV.

MALE (allotype). — Total length 267 μ, opisthosoma 202 μ, width 38 μ. In 20 paratypes measured length ø 271 μ (212-304), opisthosoma ø 193 (138-239), width ø 35 (27-44).

Venter (fig. 4). — General shape like female, but coxal plates smaller than in female, only the first and fourth meet medially. On median line of podosoma a regular transverse striation is present in all paratypes. Opisthosoma with transverse annulation, proctodeum absent.

Dorsum (fig. 3). — Little dorsal shield with genital opening in region of legs I and II. Two pairs of long protuberant podosomal tubercles (*pt*), anterior on shield, posterior behind shield border. Penis stout, bent upwards, 17 μ long, in paratypes 21 μ (17-23). Transverse annuli up to posterior border of dorsal shield.



FIGS. 1-12. — *Demodex lacrimalis* sp. n. : female (holotype) venter (1), female (holotype) dorsum (2), male (allotype) dorsum (3), male (allotype) venter (4), nymph dorsum (5), nymph venter (6), leg I of larva (7), nymph (8), female (9), egg (10), larva venter (11), larva dorsum (12). *ep* epimera, *es s* epistomal spine, *op* operculate groove, *pb* pharyngeal bulb, *pt* podosomal tubercle, *sc s* supracoxal spine, *sg s* subgnathosomal seta, *so* solenidion.

EGG (fig. 10). — Spindle-shaped with broad, blunt posterior end, appearing two-segmented. Length ø 133 µ (114-145), width ø 31 µ (26-36). Distinct operculate groove (*op*) anterior on venter.

LARVA. — Total length of 20 specimens measured ø 209 µ (156-271), opisthosoma ø 150 µ (94-212), greatest width ø 29 µ (25-33). Wormlike with three pairs of ventrally inserted legs.

Venter (fig. 11). — Broad unsegmented legs with two lateral lobes and two broad four-pointed claws. Solenidia (*so*) on legs I and II (fig. 7). Gnathosoma without subgnathosomal setae. Large threesegmented palps bent ventro-laterally. Palptarsi with a three-pointed and a two-pointed claw, and only one spine. Epimeral scutes absent, but small well sclerotized epimerae (*ep*), not heretofore recorded in genus *Demodex*. Podosoma striated, opisthosoma with transverse annulation.

Dorsum (fig. 12). — Digitus fixus of chelicerae formed to sharp-pointed epistomal spines (*es s*) in function of egg-teeth. Supracoxal spines very small. Regular transverse annulation on podosoma and opisthosoma.

NYMPH. — Total length of 20 specimens measured ø 292 µ (260-320), opisthosoma 204 µ (175-235), greatest width 33 µ (25-38).

Venter (fig. 6). — Four pairs of unsegmented broad legs, which are inserted more laterally than in larva. Each leg with two broad six-pointed claws, two larger lateral and a smaller inner lobe. Legs I and II with a solenidion (*so*) (fig. 8). Well sclerotized epimerae are present in all legs (*ep*). Gnathosoma and palps like in larva, but claws are larger. Longitudinal striations mediad on podosoma and transverse annulations on opisthosoma.

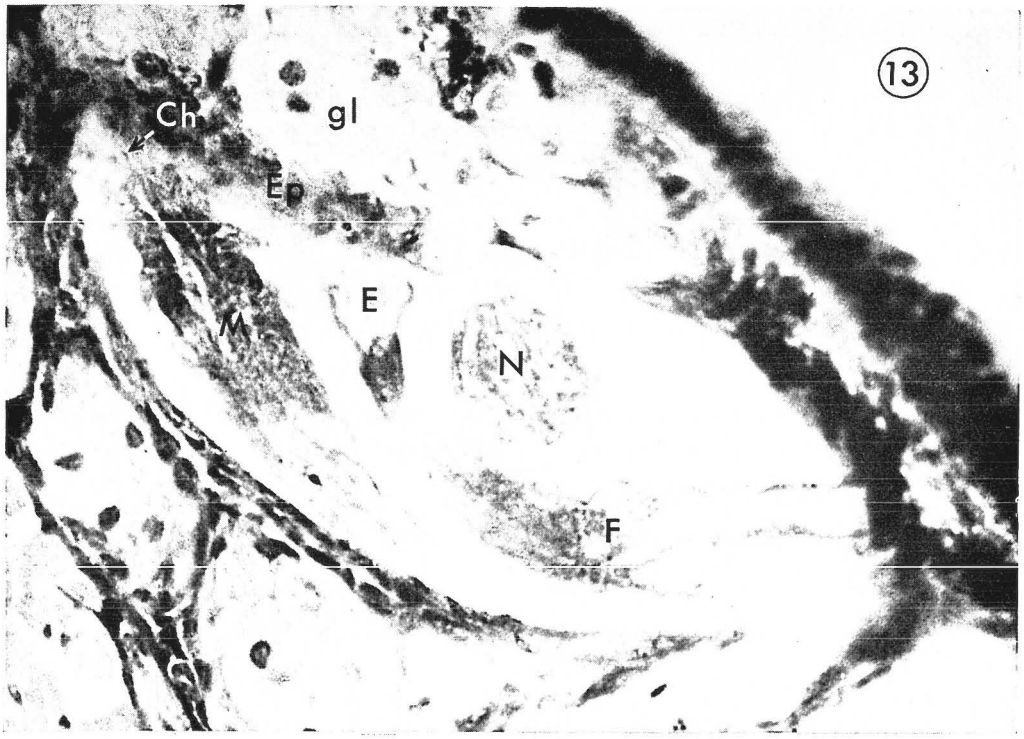
Dorsum (fig. 5). — Epistomal spines absent. Supracoxal spines as in larva. Distinct transverse annulations on podosoma and opisthosoma.

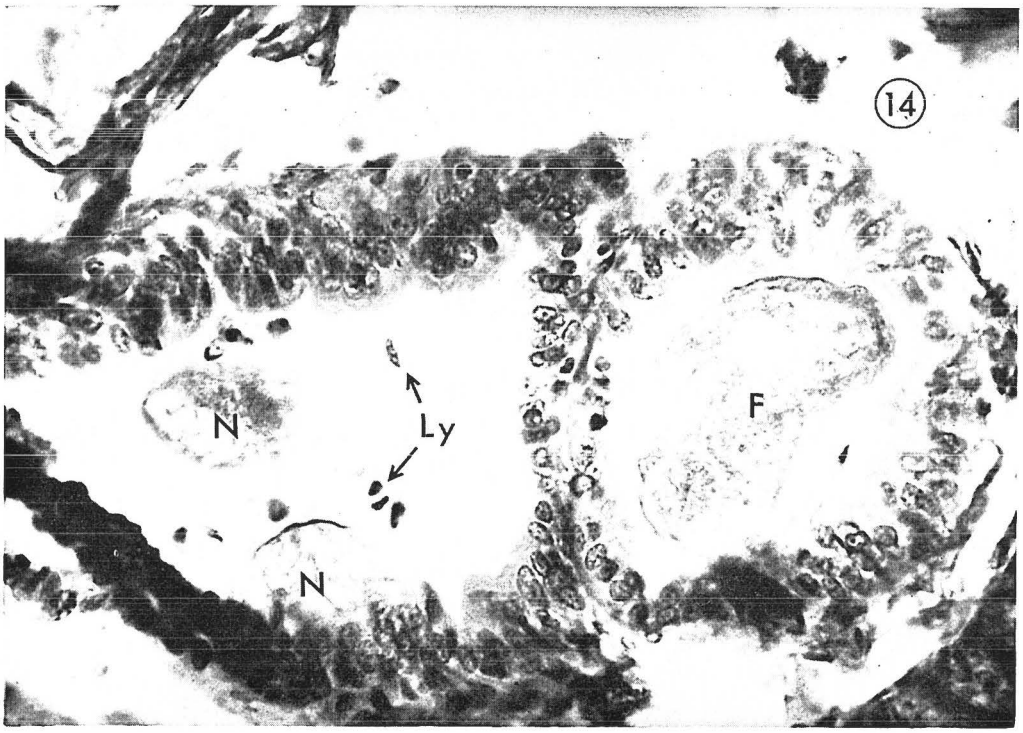
Type host. — *Apodemus sylvaticus* (LINNAEUS).

Localisation in host. — *Demodex lacrimalis* has only been collected from the Meibomian glands, while *Demodex longior* HIRST, 1918 is present in the follicle complex of sensory hairs on the nose, *Demodex apodemi* HIRST, 1918 in the follicles of common hairs, and another yet undescribed species in the follicles of the tail.

Type locality. — 22 parasitized hosts : Nijmegen, The Netherlands, 27, 28, 29, 31 January, 16 and 17 March 1971 ; Pescasseroli, Italy, 20, 22, 23 October 1972.

Deposition of types. — Holotype and allotype : Rijksmuseum van Natuurlijke Historie, Leiden. Paratypes ♀ and ♂ : U S National Museum, Washington ;
British Museum (Natural History), London,
Zoology Department, University of Massachusetts, Amherst, Mass.,
Institut de Médecine Tropicale Prince Léopold, Antwerpen,
Institute of Acarology, Columbus, Ohio,
Museum d'Histoire naturelle, Paris,
Zoologisches Institut und Zoologisches Museum, Hamburg,
Institute of Parasitology, Academy of Sciences, Prague,
Zoölogisch Laboratorium, Kath. Univer. Nijmegen.





FIGS. 13-14. — Sections through infected host tissues. (13) infected duct with feeding male, (14) smaller ducts with lymphocytes infiltrations.

Life cycle

From our study of sections of the ocular region from parasitized *Apodemus sylvaticus* we provide the following notes on the habitat of mites, on the life cycle and the host-parasite relations.

In this host large numbers of small Meibomian glands are present along the border of the upper and lower eyelid and a large multiplebranched gland at the posterior corner of the eye. *D. lacrimalis* is to be found mainly in the large posterior gland, and in smaller numbers in the smaller glands. Posterior glands have a large collection duct of 50-150 μ diameter with smaller branching ducts of 30 μ diameter.

In sections of gravid females only one non embryonated egg has been observed. Egg laying females are orientated with mouth-parts towards collecting duct and bodies within the small ducts, the eggs are situated with broad, blunt posterior ends towards the collecting duct. Embryonated eggs and immatures were found mainly within the small ducts with posteriors always directed towards the large duct, but a few were present also in larger ducts. The smallest duct, in which a mite has been found, measured 20 μ (width of gnathosoma of larvae 14-18 μ). Pedipalps seem to be main locomotor organs of immatures. Immature legs act as holdfast mechanisms in small ducts. Mites feed on cells of gland duct (fig. 13). In parasitized ducts some cells have sickle-shaped nuclei, very lightly coloured nuclei and nuclear debris, indications of cell degeneration, well-known as a reaction of host tissues to insect and mite bites (Allen, 1948 ; Tobias,

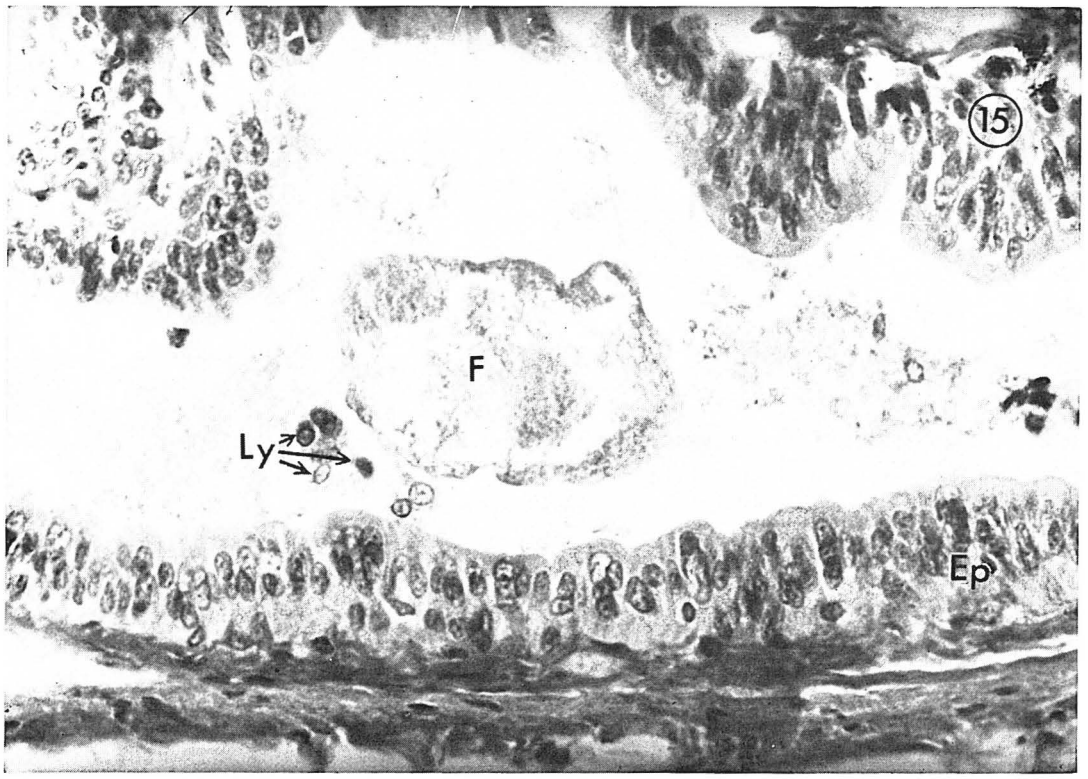


Fig. 15. — Section trough infected host tissues. Large infected duct with infiltrations and debris. *Ch.* chelicerae, *E* egg, *Ep* epithelium of duct, *F* female, *gl* sebaceous gland cells, *Ly* lymphocytes, *M* male, *N* nymph.

1949). In small parasitized ducts and also in collecting ducts large numbers of leucocytes are present (fig. 14, 15). In one case a slight swelling of the gland has been observed. Thus we estimate that the species is a low grade pathogen.

Examination of a large number of specimens expressed from the glands revealed a sex ratio (male/female) of 1 : 2 ; an adult/immature ratio of 8 : 9 in hosts captured during winter. Hosts captured and examined in March, when host reproduction starts, revealed an egg / immature ratio of 2 : 1. This suggests a restriction in mite reproduction during winter due possibly to hormonal factors of the host.

The eyes of *Apodemus sylvaticus* near Nijmegen are commonly parasitized to a high degree by nematodes. No *D. lacrimalis* were found in host animals parasitized by nematodes.

Discussion

Desch et al. (1972) discussed the shape of the eggs and of the holdfast mechanisms of immature stages of the Meibomian gland inhabitants of the genus *Demodex* with respect to duct dimensions.

Demodex molossi Desch et al. 1972, living in 220 μ wide ducts of the neotropical bat *Molossus molossus* has Y-shaped eggs, anchored in the ducts, larvae with long « dorsal wings » and extremely long legs III. Operculate eggs and egg-teeth in larvae permit rapid hatching.

Demodex longissimus Desch et al. 1972, living in 120 μ wide ducts of the neotropical bat *Carollia perspicillata* has snake-like eggs of unusual length (805 μ) with bulbous heads and elongate claw-like legs in larvae and nymphs. Operculate eggs and egg-teeth are similar to those of *D. molossi*.

Demodex gapperi Nutting et al. 1971., living in 50 μ wide ducts of the neoarctic vole *Clethrionomys gapperi* has smaller Y-shaped eggs, larvae with mid-dorsal finger, long legs III, no epimeral scutes and nymphs with prominent legs.

Demodex melanopteri Lukoschus & Jongman, 1972 from the neotropical bat *Eptesicus melanopterus* has long bowed eggs with bulbous heads and caudal spines. The larvae and nymphs have epimeral scutes and all legs are relatively long. Operculate eggs and larval egg-teeth are present.

Demodex lacrimalis sp. n., living in narrow 30 μ wide ducts has fewer adaptations for maintenance of position in these ducts. The pseudosegmented caudal end of the egg may act as an anchor. Operculate opening and larval egg-teeth diminish hazards of being flushed out during the critical phase of hatching. Broadened legs with lateral lobes doubtless provide broad holdfast pressures within the small ducts.

Summary

Demodex lacrimalis sp. n. inhabitant of the Meibomian glands of the European woodmouse *Apodemus sylvaticus* is described and figured in detail. Holdfast adaptations in developmental stages are compared with those of other species of genus from the same habitat in bats and voles.

RÉSUMÉ

Demodex lacrimalis sp. n., habitant les glandes de Meibomius chez le mulot européen *Apodemus sylvaticus*, est décrit et figuré en détail. Les adaptations des nymphes pour la fixation ont été comparées avec celles d'autres espèces du genre du même habitat chez les chauves-souris et les campagnols.

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