

Occurrence of mites in Norway and the rest of Scandinavia

Mehl R. Occurrence of mites in Norway and the rest of Scandinavia.
Allergy 1998; 53 (Suppl 48): 28–35. © Munksgaard 1998.

This paper gives a faunistic review of mites that have been recorded in the indoor environment, particularly homes, barns, and stored products, in Norway and the other Scandinavian countries. Some preliminary results are given from unpublished investigations in Norway. Seven species of pyroglyphid mites have been recorded: *Dermatophagoides pteronyssinus*, *D. microceras*, *D. farinae*, *D. evansi*, *Euroglyphus maynei*, *Gymnoglyphus longior*, and *Hirstia chelidonis*. *D. pteronyssinus* was the predominant species, followed by *D. microceras* in Scandinavia and *D. farinae* in Denmark. *D. evansi* was detected in poultry houses in Norway.

Lepidoglyphus destructor was the predominant species in barn dust, but large populations of *Acarus*, *Tyrophagus*, *Tydeus*, and *Tarsonemidae* also occurred. In humid homes, *Glycyphagus domesticus* was found in high numbers. The result of quantification of mites depends on the method for examination of dust. When one proposes limits for the concentration of mites in relation to risk of allergic sensitization and provocation of symptoms, reference should be made to a well-described method for sampling and analyzing dust. The number of mites should be given per area, not only per weight unit of dust. The number of mites per area indicates the number of mites in the home. The number of mites per weight unit of dust describes the concentration of mites in the vacuum cleaner.

R. Mehl

Laboratory for Entomology, National Institute of Public Health, Oslo, Norway

Key words: mites; Scandinavia; species.

R. Mehl

Laboratory for Entomology
National Institute of Public Health
PO Box 4404 Torshov
N-0403 Oslo
Norway
Tel. +47 22 04 23 25
Fax. +47 22 35 36 05
E-mail: reidar.mehl@folkehelsen.no

In material from archeological excavations in the old Archbishop's Residence in Trondheim, Norway, dated to about the year 1500, *Euroglyphus maynei* and *Acarus siro* were identified in large numbers (R. Mehl, unpublished results). Mites have a long history in the Scandinavian countries.

Mite infestations in homes, barns, stored products, hay, etc. have been recognized as a problem in Norway for many years. Inquiries on mites were mentioned nearly every year in the annual reports from the Governmental Entomologist during the period from 1891 to 1939. More than 160 cases of mite infestations are mentioned in these reports. References to the reports are given by Mehl (1).

Few papers have been published on mites from the indoor environment in Norway (2–9). A review of medically important mites in Norway and a checklist of Norwegian mites, including a bibliography, have been published by Mehl (1, 10). More than 1000 mite species are recorded, but the estimated number exceeds 4000 species.

Studies on domestic and stored-product mites in Denmark have been published by Haarløv and

Alani (11, 12), Korsgaard (13, 14), Korsgaard & Hallas (15), Revsbech & Andersen (16); in Sweden, by Turos (17), Nordvall et al. (18), Wickman (19), and Wickman et al. (20); and in Finland, by Stenius & Cunningham (21). The fauna of mites in stored hay in Iceland has been investigated by Hallas (22); in Finland, by Terho et al. (23) and Leskinen & Klen (24); in Denmark, by Iversen et al. (25); and in Sweden, by van Hage-Hamsten et al. (26), Härfast et al. (27), and Boström et al. (28).

Published investigations from Norway

In his annual reports, nearly every year during the period 1891–1939, the Governmental Entomologist mentioned inquiries about problems concerning mites in houses and stored products. Mites were a considerable problem in stored grain and flour, mainly in coastal regions and particularly during World War I. The most common species in grain and flour was *Acarus siro*, but *Tyrophagus longior* also occurred frequently in large populations. *Lepidoglyphus destructor* was reported to be

Table 1. Mites in dust from beds and floors. Number of homes where mites were recorded at seven locations: Fredrikstad, Sarpsborg, Moss, Ringerike, Trondheim, Levanger, and Namskogan

	Fred	Sarp	Moss	Ring	Tron	Leva	Nams	Total	%
All mites	8	6	5	6	7	19	30	81	75
<i>D. pteronyssinus</i>	4	5	5	3	3	17	30	67	62
<i>D. micraceras</i>	4	2	1	1		2	1	11	10
<i>E. maynei</i>						1	1	2	2
<i>T. putrescentiae</i>		1			1	1		3	3
<i>Tyrophagus</i> sp.					1	2	2	5	5
<i>G. domesticus</i>	2	3	2	1	2	5	7	22	20
<i>L. destructor</i>		1	1	1	2	1	3	9	8
<i>C. arcuatus</i>					1			1	1
<i>Hypopus</i> , indeterminate					1	1	5	7	6
<i>Tarsonemus</i> sp.	1	2		2	3	4	7	19	18
<i>Cheyletus</i> sp.		2	1		1			4	4
Mesostigmata					1	1	1	3	3
Oribatei				1		1	3	5	5
Unidentified spp.		1		2		3	2	8	7
No. homes	10	10	10	8	10	23	37	108	

found in only a few grain samples. The predatory mite *Cheyletus eruditus* was reported four times and on one occasion in larger numbers than *A. siro*.

In barns, *Glycyphagus domesticus* and *L. destructor* occurred in hay in such high numbers that domestic animals were said to be seriously affected.

In homes, the predominant species was *G. domesticus*. It was reported as a pest almost every year, occurred often in enormous numbers, and was difficult to control. *G. domesticus* occurred particularly in rooms on the ground floor and often in upholstered furniture. Some types of padding were hygroscopic, would become moldy in rooms with high humidity, and would cause the mite problem. Most inquiries about *G. domesticus* came from coastal areas, but also from some locations in the central valleys.

Mites were also reported in stored products such as dried fish, cheeses, prunes, poultry feed, and seeds.

Using immunologic techniques, Dybendal (5) identified *Dermatophagoides pteronyssinus* and *D. farinae* in house dust from schools and homes by their specific allergens. Mites were not identified by microscopy. Information about sampling locations and the year of collection were not given. Samples of dust were collected in different seasons of the year, from April to September and from December to February. The amounts of mite allergens were higher in homes than in schools. From schools, all samples but one contained only very low concentrations of Der p 1 allergens. It seemed, therefore, that these mite species were a minor problem in Norwegian schools. The allergen levels of *D.*

farinae were so low, almost unmeasurable, that *D. farinae* was considered virtually nonexistent in the schools and homes investigated. A higher mite allergen content was found in dust samples from schools in western than eastern Norway.

In one project (HILS), dust samples were collected from mattresses and bedroom floors in 108 homes in seven different locations in Norway from February to April 1993. In this study, we made a comparison of three different techniques for the detection and quantification of mites in house dust (7). The mite fauna found in homes in six towns and one rural community (Namskogan) are shown in Table 1. The largest numbers of mites in fine dust were *Tarsonemus* sp. 1109/0.1 g, *G. domesticus* 1034/0.1 g, and *D. pteronyssinus* 858/0.1 g. *D. farinae* was not found by microscopy. However, the major allergen Der f 1 was identified by immunologic tests in significant amounts in two samples and in trace amounts in 18 dust samples. The explanation may be cross-reactivity of the antisera used.

Dotterud et al. (6) collected samples of house dust from 38 homes and seven schools in Sør-Varanger, Finnmark County, during the period January to March 1994. In a total of 38 samples, the mites identified by microscopy were as follows: *D. pteronyssinus* (64), *L. destructor* (4), *A. siro* (1), and *Tarsonemus* sp. (1). The occurrence of the mites *D. pteronyssinus* and *D. farinae* was also examined by the immunologic technique (ELISA). *D. pteronyssinus* was found in nine homes only, virtually only in mattresses, and not in schools. A high level of Der f 1 was found in one case.

In the project called "the Oslo birth cohort", the

Mehl

Table 2. Number of dwellings where mites were recorded in dust samples from 540 houses in Oslo in 1992–5

<i>Dermatophagoides pteronyssinus</i>	127	23.5%
<i>D. microceras</i>	51	9.4%
<i>D. farinae</i>	1	0.2%
<i>Euroglyphus maynei</i>	5	0.9%
<i>Demodex</i>	82	15.2%
Eriophyidae	124	23.0%
Tetranychidae	58	10.7%

aim of the study was to assess the role of exposure to home dampness and house-dust mites in the development of bronchial obstruction in a cohort of children born in 1992 and 1993 (9). Two separate dust samples were collected from the home, one from the floor in the living room and one from the mattress in the child's bed in 540 homes in Oslo in 1992–5. Dust was collected all through the year, whenever a child developed bronchial obstruction. The samples were analyzed by the method described by Korsgaard & Hallas (15) as improved by darkfield illumination and a glass Petri dish with a grid. We compared this method with the method described by Spieksma & Spieksma-Boezeman (29) and found 3–5 times more mites with the method first mentioned. More than 25 mite species were recorded. We found homes with a high number of house-dust mites of the genus *Dermatophagoides* at all seasons. *D. pteronyssinus* was the most common pyroglyphid mite (Table 2). One single specimen of *D. farinae* was identified. It is noteworthy that the hair-follicle mite *Demodex* and the plant-feeding mites of the family Eriophyidae were found in many children's beds, while plant mites of the family Tetranychidae were found mainly in the living rooms.

Preliminary results from unpublished or ongoing investigations

At present, we are studying the composition of the mite fauna in dwellings in different geographic regions of Norway and in different types of indoor environment such as homes, barns, pig houses, and poultry houses, and in different stored products such as grains, animal feed, potatoes, and onions. Some preliminary results from ongoing or yet unpublished investigations are presented below.

Homes

A preliminary investigation on the mite fauna in homes in Norway was carried out in the autumn of 1971. House dust was collected by ordinary vacuum

cleaning of the floor and furniture during the month of October from 20 dwellings from the south to the north of the country. Dust was examined for mites by the method described by Spieksma & Spieksma-Boezeman (29). *D. pteronyssinus* was recorded in 10 homes (50%), *Dermatophagoides microceras* in three homes (15%), and *Euroglyphus maynei* in one home (5%). In one house at Kvanne, Nordmøre, all three species were found together in the same sample. Locations where *D. pteronyssinus* was found (more than one home in parenthesis) were as follows: Oslo, Kristiansand S, Stavanger (2), Fana, Sandane, Kvanne (2), Trondheim, and Alta. *D. microceras* was found in Fana, Alta, and Kvanne. *Dermatophagoides* spp. were not found in some homes in Oslo, Ås (Akershus), Asker, Kristiansand S, Porsgrunn, Steinkjer, Trondheim (3), and Tromsø.

An additional 10 samples of house dust were collected during the period 1972–84: Drøbak, January 1972; Flekkefjord, October 1974; Son, November 1978; Bergen, April 1980; Laksevåg, April 1980; Stavanger, April and October 1981; Elverum, March 1981; Bærum, April 198; and Valestrandfossen, February 1984. *D. pteronyssinus* was found in eight of these samples. *D. microceras* was found in only one location, Drøbak. No mites were found in Son.

Hospitals

Examination of dust from floors and beds in a hospital in Bærum, collected in September 1991, gave negative results.

Schools

Dust from carpets was collected in a school in Bergen in April 1980 and examined for mites. No mites were found. In Namsos, floor dust was collected from five different rooms in a school in November 1991, and again in June 1992. House-dust mites were not found.

Kindergartens

Three investigations on mites in a total of 41 kindergartens have been carried out. Dust samples from mattresses in eight kindergartens in Nord-Trøndelag County were collected in May 1991. The mite *D. pteronyssinus* was found in small numbers in five of the samples from Stjørdal, Levanger, Overhalla, Namsos, and Namdalseid. Mites were not found in the samples from Steinkjer, Leksvik, and Mosvik.

Dust samples from mattresses in bedrooms and from floors in playrooms were collected from 21

Table 3. Mites in 60 samples from homes

	G.do	L.de	T.lo	T.pu	A.si	H.po	C.er
Dwelling	14	2				13	1
Bedroom	9	2		2		4	
Kitchen	2				1	1	
Living room		1					
Cellar	14	2		1			
Loft	1						
Total	40	7	0	3	1	18	1

G.do: *G. domesticus*, L.de: *L. destructor*, T.lo: *Tyrophagus longior*, T.pu: *Tyrophagus putrescentiae*, A.si: *Acarus siro*, H.po: *Haemogamasus pontiger*, C.er: *Cheyletus eruditus*.

kindergartens in Stovner, Oslo, during March 1993, by Per Nafstad. *D. pteronyssinus* was found in two kindergartens. The mites were found in the playroom, not in the bedroom.

In October 1993, dust samples were collected from 12 kindergartens in Oslo. A few specimens of *D. pteronyssinus* were found in two kindergartens. At both investigations, *Tarsonemus* sp., *Glycyphagus* sp., *Tyrophagus putrescentiae*, Mesostigmata, and Oribatei were present.

Agriculture

In the project "Health effects of dust in the agricultural environment", conducted by the National Institute of Occupational Health, we have collected dust from many habitats and products in storage rooms, animal houses, etc. More than 200 samples were collected for mite analyses during the period 1991–5. Mite species recorded in this project are shown in Table 5 and are marked as "agr". Several species were new to the country. The most interesting species is *Dermatophagoides evansi*, which occurred in poultry houses; e.g., in a specimen from Larvik collected in October 1994. It may also be present in dwellings. *Calloglyphus berlesi* was very numerous in the litter of poultry houses. *Rhizoglyphus robini* was common in onion dust.

Specimens received with inquiries

Inquiries about mites in houses, in food, etc. have been received by our laboratory for identification since 1973 (3). These samples give information about the occurrence of mite species and sometimes indicate that enormous populations of mites are present both in homes and in storage rooms. Mite occurrence in homes, in stored food and animal feed in the period from 1973 to 1993 are shown in Tables 3 and 4. In homes, *G. domesticus* was the predominant species followed by the predatory mite *H. pontiger*. In some cases, large

Table 4. Mites from 40 samples of stored food and animal feed

	G.do	L.de	T.lo	T.pu	A.si	H.po	C.er
Cured meat			8	4			
Dried fish	3		1		2	1	
Stored flour	1	1			1	1	
Stored grain	2	2			2	1	
Animal feed		2	2		4		1
Pet food	2	1	1	2	4		1
Total	8	6	12	6	13	3	2

G.do: *G. domesticus*, L.de: *L. destructor*, T.lo: *Tyrophagus longior*, T.pu: *Tyrophagus putrescentiae*, A.si: *Acarus siro*, H.po: *Haemogamasus pontiger*, C.er: *Cheyletus eruditus*.

populations of *G. domesticus* were found under damp mattresses in children's beds.

Northern Norway

In northern Norway, several investigations on mites and indoor climate are in progress. Preliminary results indicate that large numbers of *D. pteronyssinus* are very commonly found in homes along the coast of Nordland and Troms counties.

All the mite species recorded in dwellings, barns, stored products, and the "agricultural environment" in Norway are listed in Table 5.

Mite investigations in Denmark

In Denmark, the first papers on house-dust mites and allergy were published by Haarløv and Alani (11, 12). Fifty-two samples of dust were collected from mattresses in Copenhagen in 1969 and investigated for mites. Eleven species were recorded: *D. pteronyssinus*, *D. farinae*, *E. maynei*, *Cheyletus eruditus*, *Cheyletus trouessarti*, *A. siro*, *Glycyphagus privatus*, *Acaropsis docta*, *Haemolaelaps* sp., *Tarsonemus* sp., and Belbidae sp. *D. pteronyssinus* and *D. farinae* occurred in 15 and 14 samples, respectively.

During the period 6 April–10 June 1977, Korsgaard (13) investigated 75 homes in Aarhus for house-dust mites. He detected pyroglyphid mites in 87% of the homes. The proportions of the species were *D. pteronyssinus* 57%, *D. farinae* 39%, and *E. maynei* 1%. *A. siro*, *G. domesticus*, *C. eruditus*, and Tarsonemidae spp. were also found in the dust samples.

The fauna of tarsonemid mites was studied by Korsgaard & Hallas (15) in a collection of 310 dust samples taken from 98 apartments in the city of Aarhus, collected from April to June 1977. They were able to distinguish 14 different types of Tarsonemina: *Tarsonemus floricolus*, *Tarsonemus fursarii*, *Tarsonemoides belemnitoides*, *Tarsonemoides ellipticus*, *Daidalotarsonemus vandeveiei*, *Tarsonemoides* spp., *Tarsonemus* spp., *Pyemotes*

Table 5 Mites in Norway from human environment. Habitat of mites is indicated

Astigmata				
Acaridae				
<i>Acarus siro</i>	dom	stp	agr	
<i>Acarus farris</i>			agr	
<i>Acarus immobilis</i>			agr	
<i>Tyrophagus similis</i>				bn
<i>Tyrophagus longior</i>		stp	agr	bn
<i>Tyrophagus neiswanderi</i>	dom			
<i>Tyrophagus palmarum</i>			agr	
<i>Tyrophagus putrescentiae</i>	dom	stp	agr	
<i>Caloglyphus berlesii</i>			agr	
<i>Rhizoglyphus robini</i>			agr	
<i>Thyreophagus entomophagus</i>			agr	
Glycyphagidae				
<i>Glycyphagus domesticus</i>	dom	stp	agr	
<i>Lepidoglyphus destructor</i>	dom	stp	agr	
<i>Lepidoglyphus michaeli</i>			agr	
Labidophoridae				
<i>Gohieria fusca</i>	dom		agr	
Chortoglyphidae				
<i>Chortoglyphus arcuatus</i>	dom		agr	
Pyroglyphidae				
<i>Dermatophagoides pteronyssinus</i>	dom			
<i>Dermatophagoides farinae</i>	dom			
<i>Dermatophagoides microceras</i>	dom			
<i>Dermatophagoides evansi</i>			agr	
<i>Euroglyphus maynei</i>	dom		agr	
<i>Gymnoglyphus longior</i>			agr	bn
<i>Hirstia chelidonis</i>				bn
Anoetidae				
<i>Histioglyphus</i>			agr	
Prostigmata				
Cheyletidae				
<i>Cheyletus eruditus</i>	dom	stp	agr	bn
<i>Eucheyletia taurica</i>			agr	
Tydeidae				
<i>Tydeus</i>	dom		agr	
Tarsonemidae				
<i>Tarsonemus</i>	dom		agr	
Pyemotidae				
	dom		agr	
Tetranychidae				
	dom			
Eriophyidae				
	dom			
Demodicidae				
<i>Demodex</i>	dom			
Mesostigmata				
<i>Androlaelaps casalis</i>			agr	
<i>Haemogamasus pontiger</i>	dom	stp	agr	mn
<i>Dermanyssus gallinae</i>			agr	bn

dom: in houses; agr: agricultural environment; stp: in stored products; bn: in bird nests; mn: in mammal nests.

spp., *Pygmephorus* sp., *Pseudopygmephorus* cf. *haarloevi*, and *Scutacarus quadrangularis*. *T. floricolus* was the predominant species.

Hallas & Korsgaard (30) further studied the annual fluctuations of mites in house dust in Denmark. For one year, from January to Decem-

ber 1980, dust was sampled monthly from a single mattress. Until August, mite counts were at background levels. In September and October, there was a burst in the counts for *D. farinae* and *G. domesticus*. *Tarsonemus rakowieensis* (*T. floricolus*) was second to *D. farinae* in number. A few specimens of other mites were recorded: *Tyrophagus putrescentiae*, *Tydeus interruptus*, *Rhizoglyphus*, *Pyemotes*, *Spinibdella*, *Androlaelaps casalis*, and *Arctoseius butleri*.

Iversen et al. (25) found high quantities of mites in rural dwellings and farms in Denmark. *L. destructor* was the predominant species in grain and straw, and *A. siro* in hay.

Faunistic examination of 72 samples of grain and 18 samples of dust from grain elevators in Aalborg, Denmark, showed that the mites *A. siro*, *L. destructor*, and *T. longior* were found in 73% of grain samples, while all dust samples contained mites (16). The samples were collected from March to April 1985. Other mites recorded were as follows: *Tarsonemus* sp., *Pyemotes* sp., *C. eruditus*, *Gohieria fusca*, *Thyreophagus entomophagus*, *Coproglyphus*, *Mesostigmata*, and *Caloglyphus* sp.

Mite investigations in Finland

Samples of dust from 37 mattresses from houses in southern Finland (Helsinki) and eight mattresses and furniture in houses in eastern Finland were examined for mites by Stenius & Cunnington (21). The samples were collected in 1969–70 and June 1971, respectively. The following species and genera were recorded: *D. pteronyssinus*, *D. farinae*, *E. maynei*, *Tyrophagus*, *Acarus*, *G. domesticus*, *L. destructor*, *Cheyletus*, and *Cortoglyphus*. A preliminary investigation of dust from vacuum cleaners in Helsinki in 1968 gave completely negative results. In southern Finland, the most commonly occurring species appeared to be *D. pteronyssinus*, which was found in 32% of the samples and accounted for nearly 30% of the total mite population, while *D. farinae* was found in 13.5% of samples, but accounted for 62% of the mite population. *E. maynei* was found in 5% of samples. In eastern Finland, *D. pteronyssinus* was found in 75% of samples, *D. farinae* in 50%, and *E. maynei* in 88%. Mite densities were greater in dust from wooden houses heated by stoves (eastern Finland) than in houses of stone or wood with central heating (Helsinki area).

Leskinen & Klen (24) studied the mite fauna of cow barns and hay stores in Finland. The material was collected on 19 farms between September 1981 and April 1982, and from two farms between April 1982 and February 1983. Mites were identified by microscopy. *A. siro* and *Tydeus* sp. were the most

abundant species. *L. destructor*, *T. longior*, *G. domesticus*, and mesostigmatic mites were also common and numerous.

The number of mites in hay stores decreased during the autumn, while in cow barns mites were most abundant in January. There were few or no mites in bales of dry hay free of mold.

The mite fauna of the cow barns and stored hay and grain was studied by Terho et al. (23) in 11 farms in eastern Finland. Storage mites were found in all farms. The most common species or genera were *A. siro*, *Acarus farris*, *G. domesticus*, *L. destructor*, *C. eruditus*, *Tydeus* spp., and *Tarsonemus* spp.

Mite investigations in Iceland and the Faroe Islands

Mites in stored hay in Iceland were studied by Hallas (22), Hallas & Gudmundsson (31), and Hallas & Gravesen (32). Hay in Iceland had high concentrations of mites, and the following species were recorded: *L. destructor*, *Ctenoglyphus plumiger*, *A. farris*, *Tyrophagus longior*, *Tyrophagus similis*, *Caloglyphus rhizoglyphoides*, *Tydeus interruptus*, *Tydeus* sp., *Coccotydeus* sp., *Tarsonemus* sp., *Steneotarsonemus* sp., *C. eruditus*, *Pygmephorus islandicus*, *Androlaelaps casalis*, *Haemogamasus pontiger*, *Digamasellus presepum*, *Cryptostigmata*, *Mesostigmata*, *Kleemannia plumiger*, *Bryobia praetiosa*, *Suidasia* sp., *Stigmaeus* sp., and *Phorytocarpais fimetorum*.

The most prominent members of the hay mite community were the fungus feeders *L. destructor* and *A. farris*, and their predators *T. interruptus* and *C. eruditus*. The high numbers of *Tarsonemus* spp. in stored hay is unique to Iceland.

In stored hay on the Faroe Islands, the following species of mites were identified in 62 samples by Hallas & Solberg (33): *A. farris*, *T. longior*, *T. similis*, *L. destructor*, *G. domesticus*, *Coccotydeus* sp., *Tydeus* sp., *Tarsonemus* sp., *C. eruditus*, *Androlaelaps casalis casalis*, *Proctolaelaps pymaeus*, *Kleemannia plumigera*, and *Cryptostigmata* spp.

Mite investigations in Sweden

Turos (17) collected 368 dust samples from mattresses, floors, rugs, and furniture in 201 dwellings in the Stockholm area from April 1975 to August 1977, throughout the year. From two hospitals in the same area, 68 samples of dust from beds, floors, and furniture were collected. Mites were found in 24 homes. *Dermatophagoides* sp. was found in only three (1.5%) homes. *D. pteronyssinus* was identified in one of them.

Euroglyphus sp. was found in one sample of floor dust from a hospital office.

Nordvall et al. (18) collected 54 dust samples from mattresses in Stockholm in September and October 1986. Mite allergens were identified to species by the immunologic technique. Three species of house-dust mites were detected: *D. pteronyssinus*, *D. farinae*, and *D. microceras*. Der p 1 and Der f 1 antigens were found in a considerable proportion of the dust samples, 24 and 16, respectively, whereas the antigen Der m 1 was found only sparsely (four samples).

Wickman (19) and Wickman et al. (20) studied mites in homes in northern Sweden in a cold temperature and partly subarctic region. Despite a heating season of 7–8 months, very high levels of mite infestation were found in selected dwellings. Dust samples were collected from both mattresses and living-room floors in October 1990. Dust samples from 23 (35%) of 65 houses harbored mites. The following species were identified by microscopy: *D. pteronyssinus*, *D. farinae*, *D. microceras*, *E. maynei*, *L. destructor*, *A. siro*, and *Tarsonemus* sp. The mattresses in 13 of 65 homes were infested with four species of pyroglyphid mites: *D. pteronyssinus* (seven homes), *D. microceras* (three), *D. farinae* (three), and *E. maynei* (one). The peak mite count of pyroglyphid mites was 1392 mites/0.1 g dust. Mite-containing mattress dust samples held either a very high or a very low number of mites. Counts of mites in mattress dust in most cases exceeded those of floor dust.

Härfast et al. (27) investigated dust samples from 30 barns for mites. *L. destructor* infested all the barns and constituted more than 70% of the Astigmata species in 29 barns.

The mite fauna in 32 samples of hay dust of 16 farms on the island of Gotland was analyzed by van Hage-Hamsten et al. (26). Samples were taken in October 1988. Mites were found on all farms, and the degree of infestation varied enormously. Species of five genera were detected. *L. destructor* was the predominant species on 13 of the farms. Tydeidae was the second most common group, although *G. domesticus* was the main species on two farms. *C. eruditus* and *A. siro* were also common. Small numbers of *T. putrescentiae* and *C. lactis* also occurred in some samples. Samples of hay dust from barns were taken from another 30 farms on Gotland in March 1992 and examined for mites (28). *L. destructor* was found in all 30 samples in high numbers. The *Acarus siro*-complex, *G. domesticus*, and *Tyrophagus* spp. were present in almost every sample, but generally in rather low numbers. Twelve species of astigmatic mites were identified, and among them were *Aleuroglyphus*

ovatus, *Tyrophagus palmarum*, *Tyrophagus similis*, *Carpoglyphus munroi*, *Diamesoglyphus intermedius*, and *Gymnoglyphus longior*. *Chortoglyphus arcuatus* were found in 50% of samples. Cheyletidae, Tarsonemidae, and Tydeidae were present in 90–97% of samples in rather high numbers.

Conclusions

Seven species of pyroglyphid mites were recorded: *D. pteronyssinus*, *D. microceras*, *D. farinae*, *D. evansi*, *Euroglyphus maynei*, *Gymnoglyphus longior*, and *Hirstia chelidonis*. *D. pteronyssinus* was the predominant species, followed by *D. microceras* in Scandinavia and *D. farinae* in Denmark. The first papers on house-dust mites were published before the separation of *D. farinae* and *D. microceras* into two species in 1971. *D. evansi* was detected in poultry houses in Norway. *Lepidoglyphus destructor* was the predominant species in barn dust, but large populations of *Acarus*, *Tyrophagus*, *Tydeus*, and Tarsonemidae occurred. In homes with a humid indoor climate, *Glycyphagus domesticus* was found in high numbers.

In this review, only a limited number of publications in which the identification of mites was based on immunologic techniques are cited. Few mites can be identified in this way, and the identification is not always reliable.

The result of quantification of mites depends on the method of examination of dust. When proposing thresholds for concentrations of mites that entail risk of sensitization or provocation of symptoms, reference should be made to the specific method for sampling and analyzing dust. The concentration of mites should be given per area, not only per weight of dust. The number of mites per area unit indicates the number of mites in the house. The number of mites per weight unit of dust describes the concentration of mites in the vacuum cleaner.

References

- Mehl R. Checklist of Norwegian ticks and mites (Acari). Fauna Norvegica Ser B 1979;26:31–45.
- Mehl R. *Haemogamasus pontiger* Berlese (Acari, Mesostigmata) in Norway. Rhizocrinus 1977;9:1–4.
- Mehl R. Henvendelser angående skadedyr, ektoparasitter og andre plagsomme dyr i 1972–1976 [Inquiries about pests and ectoparasites in 1972–1976]. Fauna (Oslo) 1978;31:250–67.
- Mehl R. Skadedyr og parasitter. Oslo: National Institute of Public Health, 1989.
- Dybendal T. Indoor environment and allergy: dust and allergens in schools and homes in Norway. Thesis, University of Bergen, 1992.
- Dotterud LK, Korsgaard J, Falk ES. House-dust mite content in mattresses in relation to residential characteristics and symptoms in atopic and nonatopic children living in northern Norway. Allergy 1995;50:788–93.
- Aas K, Mehl R. Påvisning og kvantitering av husstøvmidd. Fagbladet Allergi i praksis 1996;1:37–40.
- Dotterud LK, Van TD, Kvammen B, Bybendal T, Elsayed S, Falk ES. Allergen content in dust from homes and schools in northern Norway in relation to sensitization and allergy symptoms in schoolchildren. Clin Exp Allergy 1997;27:252–61.
- Nafstad P, Øie L, Mehl R, et al. Residential dampness problems and symptoms and signs of bronchial obstruction in young Norwegian children. Am J Respir Crit Care Med 1998;157:410–14.
- Mehl R. Midder av betydning for sykdommer hos menneske i Norge [Ticks and mites of medical importance in Norway]. Allergologen 1981;4:19–39.
- Alani DM, Haarløv N. The house-dust mite: a possible source of allergen in the environment of patients with atopic dermatitis. J Natl Med Assoc 1972;64:302–5.
- Haarløv N, Alani M. House-dust mites (*Dermatophagoides pteronyssinus* (Trt.), *D. farinae* Hughes, *Euroglyphus maynei* (Cooreman, Fain) in Denmark (Acarina). Entomol Scand 1970;1:301–6.
- Korsgaard J. Husstøvmider (Pyroglyphidae, Acari) i danske boliger [House-dust mites (Pyroglyphidae, Acari) in Danish homes]. Ugeskr Laeger 1979;141:888–92.
- Korsgaard J. Mite asthma and residency: a case-control study on the impact of exposure to house-dust mites in dwellings. Am Rev Respir Dis 1983;128:231–5.
- Korsgaard J, Hallas TE. Tarsonemid mites in Danish house dust. Allergy 1979;34:225–32.
- Revsbech P, Andersen G. Storage mite allergy among grain elevator workers. Allergy 1987;42:423–9.
- Turos M. Mites in house dust in the Stockholm area. Allergy 1979;34:11–18.
- Nordvall SL, Eriksson M, Rylander E, Schwartz B. Sensitization of children in the Stockholm area to house dust mite. Acta Paediatr Scand 1988;77:716–20.
- Wickman M. Residential characteristics and allergic sensitization in children especially to mites. Thesis, Karolinska Institutet, 1993.
- Wickman M, Nordvall SL, Pershagen G, Korsgaard J, Johansen N. Sensitization to domestic mites in a cold temperate region. Am Rev Respir Dis 1993;148:58–62.
- Stenius B, Cunningham AM. House dust mites and respiratory allergy: a qualitative survey of species occurring in Finnish house dust. Scand J Respir Dis 1972;53:338–48.
- Hallas TE. Mites of stored hay in Iceland. J Agric Res Iceland 1981;13:61–7.
- Terho EO, Leskinen L, Husman K, Kärenlampi L. Occurrence of storage mites in Finnish farming environments. Allergy 1982;37:15–19.
- Leskinen L, Klen T. Storage mites in the work environment of farmers. Eur J Respir Dis 1987;71 Suppl 152:101–11.
- Iversen M, Korsgaard J, Hallas T, Dahl R. Mite allergy and exposure to storage mites and house dust mites in farmers. Clin Exp Allergy 1990;20:211–19.
- van Hage-Hamsten M, Johansson E, Wiren A, Johansson SGO. Storage mites dominate the fauna in Swedish barn dust. Allergy 1991;46:142–6.
- Härfast B, Johansson E, Johansson SGO, van Hage-Hamsten M. ELISA method for detection of mite allergens in barn dust: comparison with mite count. Allergy 1996;51:257–61.
- Boström S, Johansson E, Härfast B, et al. Characterization of the mite fauna (Acari) in Swedish barn dust. Int J Acarol 1997;23:127–32.
- Spieksma FTM, Spieksma-Boezeman MA. The mite fauna

- of house dust with particular reference to the house dust mite *Dermatophagoides pteronyssinus* (Trouessart, 1897) (Psoroptidae: Sarcoptiformes). *Acarologia* 1967;**9**:226–41.
30. Hallas TE, Korsgaard J. Annual fluctuations of mites and fungi in Danish house-dust: an example. *Allergol Immunopathol (Madr)* 1983;**11**:195–200.
 31. Hallas TE, Gudmundsson B. Mites of stored hay in Iceland related to quality of hay and storage duration. *J Agric Res Iceland* 1985;**17**:31–7.
 32. Hallas TE, Gravesen S. Succession of mites and micro-fungi in stored hay in Iceland. *Entomol Tidsskr* 1987;**108**:23–7.
 33. Hallas TE, Solberg H. Mites of stored hay on the Faroe Islands (Acari). *Entomol Meddr* 1989;**57**:151–5.