Phoretic Relationship of Some Common Manure-Inhabiting Macrochelidae (Acarina: Mesostigmata) to the House Fly¹

RICHARD C. AXTELL

N. C. State of the University of North Carolina at Raleigh

ABSTRACT

House flies, *Musca domestica* (L.), were trapped from mite-infested dairy cattle manure and collected by net inside dairy barns. *Macrocheles muscaedomesticae* (Scopoli) and *M. subbadius* (Berlese) were commonly found attached to the house flies. Although *M. medarius* (Berlese), *M. robustulus* (Berlese) and *Glyptholaspis confusa* (Foà) were present in the manure, only 1 specimen of each of the first 2 species and none of the third were found attached to a house fly. In a comparison of the behavior of macrochelids from laboratory colonies, *M. muscaedomesticae* and *M. subbadius* were phoretic on the house fly and the other 3 species were not.

Several species of Macrochelidae (Acarina: Mesostigmata) commonly occur in domestic animal manure (Axtell 1963a). These mites are predaceous on the eggs and first-instar larvae of the house fly, *Musca domestica* L., and cause substantial reductions in house fly production from manure (Axtell 1961, 1963b). Among the common species are *Macrocheles muscaedomesticae* (Scopoli), *M. subbadius* (Berlese), *M. medarius* (Berlese), *M. robustulus* (Berlese), and *Glyptholaspis confusa* (Foà).

M. muscaedomesticae is usually the most abundant macrochelid in domestic-animal manure and has received the most study. The adult female is phoretic on house flies and is thus disseminated to new areas (Ewing 1913, Pereira and de Castro 1947, Filipponi 1955, Wade and Rodriguez 1961). It has also been reported phoretic on *Musca domestica vicina* Macquart, *Ophyra antrax* Meigen, and *Eristalis tenax* L. by Bregetova and Koroleva (1960). Steve (1959) reported it phoretic on *Fannia canicularis* (L.). It has been found phoretic also on certain beetles and rodents (Bregetova and Koroleva 1960).

Filipponi (1960), working in Italy, collected 67,389 *Musca domestica*, 2,662 *Stomoxys calcitrans* (L.), 1,689 *Fannia canicularis*, and 151 *Haematobia irritans* (L.). The first 3 species of flies were hosts for macrochelid mites (724 *Macrocheles muscaedomesticae*, 682 *M. subbadius*, 76 *M. glaber* Mueller, and 1 *M. subglaber* Filipponi). According to Filipponi, *Musca domestica* was the most important carrier, while *S. calcitrans* was of limited importance and *F. canicularis* was of no importance. These 3 species

of flies carried 83%, 16%, and 0.75%, respectively, of the total number of attached mites. The number of mites per 1000 flies for the 3 species was 11.5, 57.1, and 4.1, respectively. The greater abundance of *M. domestica* made it the principal carrier of macrochelids, however. Filipponi did not report the species of macrochelids found on each species of fly and the technique of handling resulted in only 61% of the mites remaining attached to the flies at the time of microscopic observation.

Macrocheles medarius has been reported phoretic on the adult of the cabbage maggot, *Hylemya brassicae* (Bouché), in a laboratory colony (Chant 1960). No reports of *M. medarius* being phoretic on other Diptera have been found. It has been reported phoretic on rodents (Valle 1958) and certain Coleoptera (Bregetova and Koroleva 1960).

No report has been found of *M. robustulus* being phoretic on Diptera. Bregetova and Koroleva (1960) reported it phoretic on certain Coleoptera. No report has been found of *G. confusa* being phoretic on insects or rodents.

In all these reports on the phoretic relationships of macrochelids to Diptera there was no attempt to compare the species of macrochelids phoretic on flies with the species present in the fly-breeding sites. Consequently, it cannot be determined whether other species of macrochelids were not collected because they were not present in the fly breeding material or because they are not phoretic on flies. Since manure-inhabiting Macrochelidae are important agents controlling house flies (Axtell 1963b), their means of dispersal are of interest. Therefore, a series of experiments was conducted to determine which of the 5 common manure-inhabiting Macrochelidae are phoretic on house flies.

MATERIALS AND METHODS

In all studies conducted, the trapped live flies were placed in a freezer (−10°C). Nearly all the macro-

¹ This investigation was supported in part by research grant No. EF-00454 from the U. S. Public Health Service and grant No. 623-33 from the Faculty Research and Professional Development Fund, N. C. State. Presented at the Entomological Society of America Meeting, St. Louis, Missouri, December 2-5, 1963. Contribution from the Entomology Department, North Carolina Agricultural Experiment Station. Published with approval of the Director of Research, Paper No. 1726 of the Journal Series. The assistance of D. J. Farish is acknowledged. Accepted for publication January 9, 1964.

chelids remained attached to the frozen flies, provided they were handled carefully. It was thus possible to determine for each fly the number and species of mites attached and the site of attachment.

Manure in Piles.—Late third-instar house fly larvae were added to 6 piles of dairy-cattle manure known to have a high mite population. A composite 4-liter sample of this manure yielded, by Tullgren funnel extraction, the following adult female Macrochelidae: 108 *M. muscaedomesticae*, 396 *M. subbadius*, 43 *M. medarius*, and 58 *G. confusa*. The emerging flies were collected with cone-shaped screen traps covering each pile resting on a concrete floor inside a barn. Each cone trap had a base diameter of 60 cm, a height of 75 cm, and tapered to a 1-cm opening at the top leading into a removable cylinder with cloth mesh upper end. This cylinder was replaced daily during the fly-emergence period and the trapped live flies frozen immediately. Mites found on the flies were removed, counted, and slide mounted for identification. The data were pooled for the 6 piles.

Adult Fly Collections.—Adult house flies were collected by net inside the barns at 6 dairy farms in the vicinity of Raleigh, N. C. At each farm, collections were made 2 or 3 different days in August 1963. The captured flies held in screen cages were frozen. At the time of fly collection, a 4-liter composite sample of manure was collected at each farm and the mites extracted by Tullgren funnels.

Manure in Cans.—Manure was obtained from each of the 6 farms where adult flies were collected. The mites were extracted from a 4-liter composite sample of the manure from each farm by Tullgren funnels. The remainder of the manure from each farm was divided equally among 3 metal cans (30 cm diameter $\times$ 32 cm height) resulting in each can being approximately one-half full of manure. Late third-instar larvae of the house fly were added to each can and a cone-shaped screen trap placed on top. Each cone was 30 cm high and led into a removable collecting cylinder with cloth mesh upper end. Overhead fluorescent lamps provided uniform illumination and room temperature was controlled (22° to 26°C). The collecting cylinders were replaced daily during the period of fly emergence and the trapped flies were frozen. The data for each farm were pooled.

Laboratory Mite Population.—Cultures of the 5 common manure-inhabiting Macrochelidae are maintained in this laboratory on a manure substrate with frozen house fly eggs added daily. For each of these species, approximately 100 adult female mites and 25 late third-instar larvae of the house fly were placed into a cylindrical plastic-coated paper container (9 cm diameter $\times$ 6 cm height) one-fourth full of aged CSMA (Chemical Specialties Manufacturers Association) medium (Ralston-Purina Co.). House fly larvae had completed their development in this medium.

On top of each container was fastened a plastic funnel surmounted by a removable clear plastic collecting jar (8 cm diameter $\times$ 5 cm height). Two screened openings (100 mesh, 2 cm diameter) in the side of the funnel and one in the top of the collecting

jar allowed air circulation. Overhead fluorescent lamps provided uniform illumination and room temperature was controlled (22° to 26°C). The collecting jars were replaced several times a day and the trapped live flies were frozen.

RESULTS

From the piles of manure, 2953 house flies were trapped (Table 1). Although 4 species of macrochelids were present in the manure, only 2 (*M. muscaedomesticae* and *M. subbadius*) were phoretic on the house flies. These mites were found on approximately equal numbers of male and female flies. The average number of *M. subbadius* per fly was greater than for *M. muscaedomesticae*. A total of 1885 of the former and 133 of the latter were recovered from the flies. This reflected the relative abundance of those 2 species in the manure. All the phoretic mites were female adults.

The position on the flies to which the mites attached (Fig. 1) was determined for a portion of the catch as shown in Table 2. *M. subbadius* more frequently attached to the posterior ventral surface of the head and to the thorax than did *M. muscaedomesticae*. Both species frequently attached to the ventral side of the abdomen but not always with the anterior end of the mite directed toward the head of the fly as Ewing (1913) stated for *M. muscaedomesticae*.

From the 6 dairy farms, 36,412 house flies were collected (Table 3). The only mite found attached to these flies was *M. muscaedomesticae* (an average of 5 mites per 1000 flies) although other species of Macrochelidae were present in the manure at those farms (Table 4).

When manure from the same 6 farms was held in cans and house fly larvae added, *M. muscaedomesticae* and *M. subbadius* were recovered from the emerging house flies and stable flies (*S. calcitrans*) as shown in Table 4. All 6 of the manure samples contained *M. muscaedomesticae* and in each case that species was phoretic on the emerging flies. Two of the six samples contained *M. subbadius* and in each case that species was phoretic. All 6 of the samples contained *G. confusa*, but in no case was it phoretic. *M. medarius* and *M. robustulus* were present in 5 of the 6 samples but only 1 mite of each species was found on

Table 1.—Extent of phoresy by Macrochelidae on 2953 house flies (*Musca domestica*) trapped from dairy cattle manure. Ithaca, N. Y. August 1961.

Species of Macrochelidae	Sex of flies	
	Female	Male
<i>Macrocheles subbadius</i>		
No. of flies with mites	151	140
No. of phoretic mites	771	1114
Mean no. of mites per fly	5.10	7.97
<i>M. muscaedomesticae</i>		
No. of flies with mites	68	54
No. of phoretic mites	77	56
Mean no. of mites per fly	1.13	1.03

FIG. 1.—*Macrocheles muscaedomesticae* and *M. subbadius* attached to house flies.

a fly. *M. muscaedomestica* was attached to about equal percentages of the house flies and stable flies (Table 5). The number of phoretic *M. subbadius* was too small to justify comparing its frequency of attachment to the 2 species of flies.

The experiment utilizing mites from the laboratory colonies yielded comparable results (Table 6). *M. muscaedomesticae* and *M. subbadius* were phoretic on the house fly while the other 3 species were not. The number of phoretic mites per fly varied from 1 to 25 for *M. muscaedomesticae* and from 1 to 46 for *M. subbadius*.

DISCUSSION

The data presented have been obtained under several different conditions and the results have been

Table 2.—Position of attachment on the house fly by 2 species of Macrochelidae.

Location on fly	<i>Macrocheles subbadius</i>	<i>Macrocheles muscaedomesticae</i>
Ventral: Head	154	1
Thorax	94	3
Abdomen	193	101
Dorsal: Head	31	1
Thorax	18	0
Abdomen	35	2
No. of flies with mites	182	97
No. of phoretic mites	525	108

Table 3.—Extent of phoresy by *Macrocheles muscaedomesticae* on house flies (*Musca domestica*) collected in 6 dairy barns. Raleigh, N. C. August 1963.

Dairy farm	No. of flies	No. of mites
I	4,144	65
II	5,346	5
III	5,589	9
IV	6,845	50
V	13,091	31
VI	1,397	3
Total	36,412	163

consistent. *M. muscaedomesticae* and *M. subbadius* were readily phoretic on flies while the other 3 species were not. The possibility that those 3 species are phoretic on flies under certain restrictive conditions cannot be completely eliminated. If such restricted phoresy does indeed occur, it is doubtful that it is extensive enough or frequent enough to invalidate the conclusion that *M. medarius*, *M. robustulus* and *G. confusa* are not normally phoretic on house flies. Studies are in progress to attempt to establish the factors affecting the rate of phoresy by macrochelids.

The frequent phoresy of *M. muscaedomesticae* and *M. subbadius* on the house fly coincides with the frequent collection of these mites from domestic animal manure inside barns. The lack of phoresy on the

Table 4.—Macrochelidae found phoretic on flies (*Musca domestica* and *Stomoxys calcitrans*) emerging from manure obtained from 6 dairy farms. Raleigh, N. C. August 29–30, 1963.

Species of Macrochelidae	Dairy farm number					
	I	II	III	IV	V	VI
<i>Macrocheles muscaedomesticae</i> ^a	+	+	+	+	+	+
	(2286)	(160)	(1899)	(517)	(1250)	(849)
<i>M. subbadius</i> ^a	*	*	*	(195)	(27)	*
<i>M. robustulus</i>	0 ^b	0	*	0	0	0
<i>M. medarius</i>	*	0	0	0	0 ^b	0
<i>Glyptholaspis confusa</i>	0	0	0	0	0	0

+ = Present in the manure and phoretic on emerging flies.

0 = Present in the manure and not phoretic on emerging flies.

* = Not present in the manure.

^a Number in parentheses = total number of mites attached to flies.^b One mite found attached to a fly.Table 5.—Extent of phoresy by *Macrocheles muscaedomesticae* on house flies (*Musca domestica*) and stable flies (*Stomoxys calcitrans*) emerging from manure obtained from 6 dairy farms. Raleigh, N. C. August 29–30, 1963.

Dairy farm	House fly		Stable fly	
	Total no.	% with mites	Total no.	% with mites
I	1433	45.1	1436	31.6
II	645	15.8	72	12.5
III	1321	44.7	103	56.3
IV	1496	20.7	92	28.3
V	2360	21.4	500	19.6
VI	758	29.9	330	32.4

house fly by the other 3 species helps to explain the less frequent collection of *M. robustulus* and *G. confusa* from manure inside barns. The case of *M. medarius* is an anomaly, since that species is commonly collected from manure inside barns but is apparently rarely phoretic on the house fly.

Although Coleoptera are common in outdoor piles of manure, they are relatively uncommon in manure inside barns (such as dairy cattle calf pens). Dissemination of macrochelids by Coleoptera is probably an important factor contributing to the development of mite populations in outdoor manure, but is probably of minor importance in the case of indoor manure. As a prerequisite to possible manipulation of predaceous mite populations as a means of house fly control, additional data are needed on the role of Coleoptera and Diptera as carriers of macrochelids.

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Table 6.—Extent of phoresy by Macrochelidae on the house fly (*Musca domestica*) under laboratory conditions. Approximately 100 mites + 25 late third-instar house fly larvae per replicate.

Species of Macrochelidae	Rep.	No. of flies		No. of phoretic mites	No. of mites per fly ^b
		Emerg	With mites		
<i>Macrocheles muscaedomesticae</i>	I	25	15	79	5.3 (1–25)
	II	22	18	74	3.7 (1–16)
	III	25	20	69	3.4 (1–8)
<i>M. subbadius</i>	I	24	11	63	5.7 (1–24)
	II	27	17	64	3.8 (1–9)
	III	24	11	72	6.5 (1–46)
<i>M. robustulus</i>	I	24	0	0	
	II	25	0	0	
	III	24	0	0	
<i>M. medarius</i>	I	24	0	0	
	II	24	0	0	
	III	12 ^a	0	0	
<i>Glyptholaspis confusa</i>	I	21	0	0	
	II	24	0	0	
	III	11 ^a	0	0	

^a 50 mites + 12 late third-instar house fly larvae.^b Mean and range based on only the infested flies.

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Reprinted from the

ANNALS OF THE ENTOMOLOGICAL SOCIETY OF AMERICA
Volume 57, Number 5, pp. 584–587, September, 1964