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HOST EXPLOITATION BY CHIGGERS (ACARI: TROMBICULIDAE) INFESTING PAPUA NEW GUINEA LAND MAMMALS^{1,2}

By M. Lee Goff³

Abstract: Examination of chiggers from Papua New Guinea revealed 49 species in 11 genera infesting 53 kinds of mammals. One of these chigger species was in the subfamily Leeuwenhoek-iinae and the remaining 48 were in the subfamily Trombiculinae. The accepted concept of chiggers as habitat-specific rather than host-specific ectoparasites is supported by this study. Individual species were reported from as many as 14 host species. The vector species for chigger-borne rickettsiosis, *Leptotrombidium* (*L.*) *deliensis*, was recovered from hosts in disturbed habitats in Papua New Guinea. Endemic species of the genera *Ascoschoengastia* and *Guntheria* were primarily associated with undisturbed moss forest habitats. Greater species diversity and more chiggers per host were recorded for areas of disturbed and transitional habitats than for undisturbed moss forest habitats. While a wide range of hosts was observed for most chigger species, a high degree of parasitope specificity was also present. Frequency of recovery of a given species at a given attachment site ranged from 90.0-100% in 6 of the 7 genera involved. Species of *Schoengastia* were recovered from the perianal site with frequencies ranging from 75-94.5%. Species in the genera *Ascoschoengastia* and *Gahrlipeia* exploiting the intranasal parasitope were recovered from that site with frequencies ranging from 99.7-100%. Excessive idiosomal engorgement was observed in intranasal species, with up to 120× increase in volume. Multiple species cohabitation of a given parasitope on an individual mammal host was more frequent in disturbed habitats (34.8% of the records for *Rattus ruber* at the generic level and 46% at the specific level) than in undisturbed habitats (0.6% of the records for *Rattus niobe* at the generic level and 12.5% at the specific level).

Collectors of chiggers and other ectoparasites for the Bishop Museum have been active on the Island of New Guinea since the early 1960's. In 1967 and 1968, 2 extensive collections of chiggers were made in Papua New Guinea by A. B. Mirza, Wau Ecology Institute, M. Nadchatram, Institute for Medical Research, Malaysia, R. Traub, University of Maryland, and N. Wilson, Bishop Museum. These collections were from 16 localities as shown in FIG. 1 and described in TABLE 1. Elevations at

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TABLE 1. Collection localities for 1967 and 1968 in Papua New Guinea.

MAP LOCALITY NO. (FIG. 1)	LOCALITY DATA*
1	Territory of New Guinea, Chimbu Distr, Arabori, 22 km SE of Chuave, thin moss forest and pandanus, 2300 m, 24–29.XI.1967. Disturbed habitat.
2	Territory of Papua, Central Distr, Brown Riv, 38 km NW of Port Moresby, lowland evergreen forest, nr sea level, 11–23.X.1968. Disturbed habitat.
3	Territory of New Guinea, Morobe Distr, Wau Subdistr, Bulldog Rd, 20 km on foot from Edie Creek, thick moss forest, 2500 m, 31.X–6.XI.1967. Undisturbed and transitional habitats.
4	Territory of New Guinea, Eastern Highlands Distr, Goroka Subdistr, Marafunga, Fatima Riv, 5 km W of Collin's sawmill, moss forest, 2500 m, 10–14.XI.1968. Undisturbed habitat.
5	Territory of New Guinea, Eastern Highlands Distr, Kassam Pass, 32 km NE of Kainantu, submontane disturbed forest, 1400 m, 15–21.XI.1967. Disturbed habitat.
6	Territory of New Guinea, Western Highlands Distr, Lake Kapiago, Limestone Hill, 1550 m, 30.X–5.XI.1968. Disturbed habitat.
7	Territory of Papua, Southern Highlands Distr, Duna Subdistr, Muller Range, edge of Lavani Val, thick moss-forest, 2450 m, 11–17.I.1968. Undisturbed habitat.
8	Territory of Papua, Southern Highlands Distr, Ka Peak, 5 km W of Mendi, thick moss forest and pandanus, 2000 m, 4–13. XII.1967. Disturbed and undisturbed habitats.
9	Territory of Papua, Southern Highlands Distr, N slope of Mt Giluwe, nr Kagaba, 40 road km N of Mendi, beach-moss forest and alpine grassland, 2800–3300 m, 13–25.XII.1967 and 13–27.IX.1968. Undisturbed and transitional habitats.
10	Territory of New Guinea, Eastern Highlands Distr, Goroka Subdistr, Mt Kerigomna nr Marafunga, edge of forest, 2800 m, 14–16.XI.1968. Undisturbed habitat.
11	Territory of New Guinea, Morobe Distr, slope of Mt Missim, ca 10 km NE of Wau, secondary forest and kunai grassland, 1200 m, 20–27.X.1967. Disturbed habitat.
12	Territory of New Guinea, Morobe Distr, Mumeng Subdistr, Mt Shungol, 2000 m, 12–17.XI.1968. Disturbed habitat.
13	Territory of New Guinea, Western Highlands Distr, Hagen Subdistr, Mur Mur Pass, 15 km NE of Tambul, thick moss forest, 2800 m, 27.XII.1967–6.I.1968 and 25.IX–7.X.1968. Undisturbed habitat.
14	Territory of New Guinea, West Sepik Distr, Oksapmin, 1850 m, 13–27.X.1968. Disturbed habitat.
15	Territory of Papua, Central Distr, Sogeri, Sirunumu Rd, 600 m, eucalypt savannah, 2.XI.1968. Disturbed habitat.
16	Territory of New Guinea, Western Highlands Distr, Hagen Subdistr, Wabag Rd, nr Mur Mur Pass, 40 km from Mt Hagen, pandanus forest, 2000 m, 4–5.X.1968. Disturbed habitat.

* Territory of New Guinea = PNG: New Guinea (NE); Territory of Papua = PNG: New Guinea (SE); all districts = Provinces.

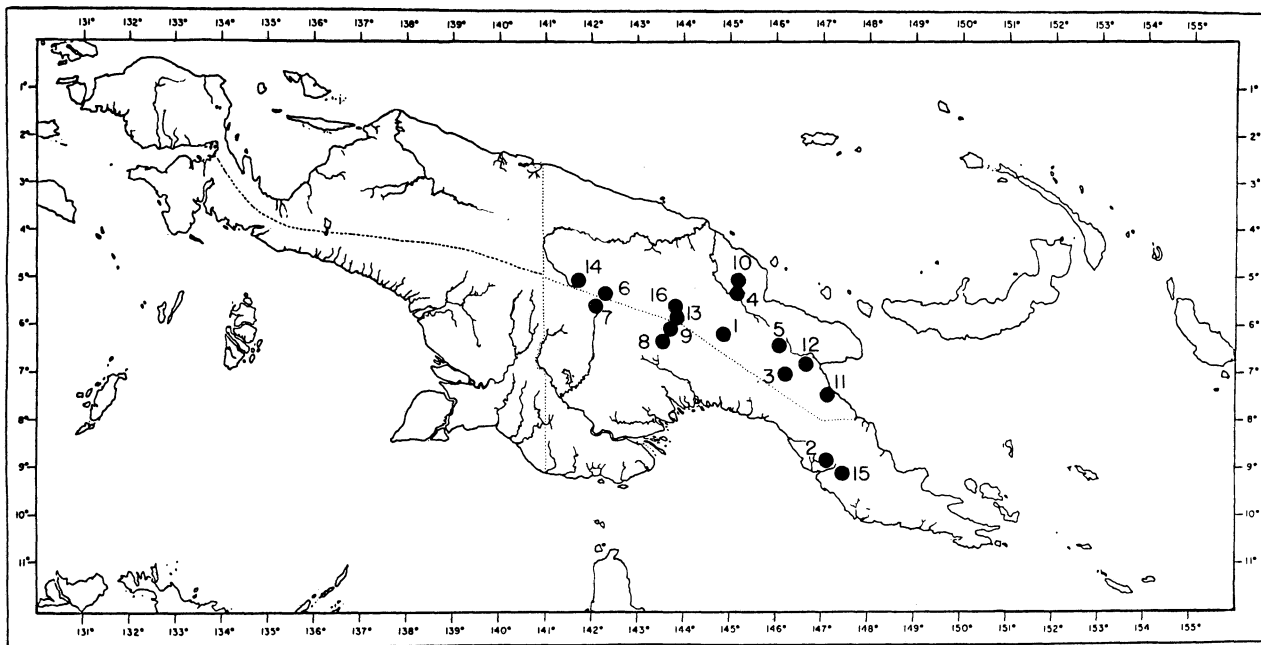


FIG. 1. Collecting localities in Papua New Guinea during 1967 and 1968. Numbers refer to locality data in TABLE 1.

collecting sites ranged from 25 m at the Brown River Forest Station to 3300 m on the slopes of Mt Giluwe. While several kinds of habitats were sampled, most of the collections were from undisturbed moss forest habitats. Exact numbers of mammals examined cannot be determined due to the then-current practice of combining an often-unstated number of host specimens of, presumably, the same species, and discarding most or all of these lots in the field following collection of pooled lots of ectoparasites. Sampling was primarily intended to give a qualitative rather than quantitative picture of ectoparasites infesting the Papua New Guinea mammal fauna. Thus, exact numbers of chiggers per host cannot be determined. Of approximately 2530 mammals collected, 828 were infested with chiggers; and of some 1500 of the total examined for intranasal chiggers, 350 were infested (TABLE 2).

Ziegler (1971) listed 194 species of mammals in 85 genera and 7 orders for New Guinea. Four of these orders (Monotremata, Marsupialia, Chiroptera and Rodentia) contained endemic species, while the remaining 3 orders (Carnivora, Perissodactyla and Artiodactyla) contained only introduced species. No specimens of Perissodactyla and few specimens of Monotremata and Carnivora were examined in connection with this study and none were recorded as a host for chiggers. The Artiodactyla were represented by a single specimen of the domestic pig, *Sus scrofa*, recorded as a host for chiggers. Three of the 4 families of marsupials reported from New Guinea were represented by 28 individuals of 11 species in 9 genera (TABLE 3). Murid rodents were the most frequent hosts for chiggers in the present study. Some 800 murids, comprising 24 species, were recorded as infested by chiggers. Of these, approximately 660 individuals, or 82.5%, were of the genus *Rattus* (TABLE 3). The Moss-forest Rat, *Rattus niobe*, of which 485 specimens were infested by chiggers, was collected most often. The next 2 most frequently infested species were the Variable Spiny Rat, *Rattus ruber*, and the Highland Melomys, *Melomys rubex*.

Analyses of host, habitat and chigger relationships are based entirely on collections made in Papua New Guinea during 1967 and 1968. The 16 localities considered (FIG. 1, TABLE 1) are arranged in order of ascending elevation in Table 4, along with host and chigger species recovered. Some localities represented by a single map symbol have been subdivided in Table 4 (e.g., locality 9 of TABLE 1 is, in reality, 2 localities on the N slope of Mt Giluwe, 1 at 2800 m and the other at 3300 m, but is indicated by a single symbol in FIG. 1).

HOST-HABITAT RELATIONSHIPS

Habitats have been termed disturbed, transitional, or undisturbed for the purposes of this study. Disturbed habitats are those which consist of either scrub, secondary forest or which have been otherwise altered by human activities, such as cultivation. These were encountered at elevations below 2300 m. Undisturbed habitats were moss forests above 2000 m. One locality at 3300 m on the N slope of Mt Giluwe had 2 types of undisturbed vegetation (moss forest and alpine grassland). This habitat was termed transitional. Collectors' field notes did not distinguish between hosts taken

TABLE 2. Classified list of chigger species, mammal hosts and incidence of parasitope exploitation for the 1967 and 1968 collections in Papua New Guinea.

CHIGGER	PARASITOPE	HOST	No. INFESTED
Family Trombiculidae			
Subfamily Trombiculinae			
Tribe Trombiculini			
<i>Eutrombicula hirsti</i>	Dorsal body	Artiodactyla Suidae	<i>Sus scrofa</i> 1
<i>Leptotrombidium deliensis</i>	Ear	Rodentia	
		Muridae	<i>Rattus</i> sp. 26
			<i>R. exulans</i> 1
			<i>R. ruber</i> 6
			<i>R. sordidus</i> 7
	Ear fringe	Rodentia	
		Muridae	<i>Melomys</i> sp. 1
			<i>M. moncktoni</i> 1
			<i>Rattus</i> sp. 2
			<i>R. ruber</i> 2
Eyelid	Rodentia		
	Muridae	<i>Rattus ruber</i> 1	
Legs	Marsupialia		
	Peramelidae	<i>Echymipera kalubu</i> 1	
No data	Marsupialia		
		Dasyuridae	<i>Murexia longicauda</i> 1
	Rodentia		
	Muridae	<i>Hydromys chrysogaster</i> 1	
		<i>Melomys</i> sp. 2	
		<i>Rattus</i> sp. 11	
		<i>R. leucopus</i> 1	
	<i>R. ruber</i> 5		
	<i>R. sordidus</i> 1		
Tribe Schoengastiini			
<i>Ascoschoengastia accola</i>	Ear	Rodentia	
		Muridae	<i>Melomys fellowsi</i> 1
	Intranasal	Marsupialia	
		Phalangeridae	<i>Pseudocheirus cupreus</i> 1
			<i>P. forbesi</i> 3
			<i>Phalanger vestitus</i> 3

TABLE 2. Continued.

CHIGGER	PARASITOPES	HOST	No. INFESTED
		Rodentia	
		Muridae	
		<i>Anisomys imitator</i>	1
		<i>Melomys</i> sp.	7
		<i>M. rubex</i>	2
		<i>Rattus niobe</i>	9
<i>A. elongotarsala</i>	Intranasal	Rodentia	
		Muridae	
		<i>Melomys</i> sp.	1
<i>A. goilala</i>	Intranasal	Rodentia	
		Muridae	
		<i>Melomys</i> sp.	3
		<i>M. rubex</i>	3
		<i>Paraleptomys wilhelmina</i>	2
		<i>Pogonomelomys ruemmleri</i>	5
		<i>Pogonomys</i> sp.	1
		<i>P. sylvestris</i>	2
		<i>Rattus niobe</i>	5
<i>A. improcera</i>	Intranasal	Rodentia	
		Muridae	
		<i>Melomys</i> sp.	17
		<i>M. rubex</i>	12
<i>A. indica</i>	Ear	Rodentia	
		Muridae	
		<i>Hydromys chrysogaster</i>	1
		<i>Rattus</i> sp.	23
	Ear fringe	Rodentia	
		Muridae	
		<i>Melomys moncktoni</i>	1
		<i>Rattus</i> sp.	1
	Ear tragus	Rodentia	
		Muridae	
		<i>Rattus ruber</i>	1
	No data	Rodentia	
		Muridae	
		<i>Rattus</i> sp.	3
		<i>R. leucopus</i>	1
<i>A. indigena</i>	Intranasal	Rodentia	
		Muridae	
		<i>Melomys</i> sp.	1
<i>A. libbymannae</i>	Intranasal	Rodentia	
		Muridae	
		<i>Lorentzimys nouhuysi</i>	1
<i>A. lorentzimys</i>	Intranasal	Rodentia	
		Muridae	
		<i>Lorentzimys nouhuysi</i>	1
		<i>Paraleptomys wilhelmina</i>	1

TABLE 2. Continued.

CHIGGER	PARASITOPES	HOST	No. INFESTED
<i>A. melanesiana</i>	Intranasal	Rodentia	
		Muridae	
		<i>Anisomys imitator</i>	1
		<i>Melomys</i> sp.	13
		<i>M. rubex</i>	9
<i>A. metatarsalis</i>	Intranasal	Rodentia	
		Muridae	
		<i>Melomys</i> sp.	4
		<i>Pogonomelomys ruemmleri</i>	1
		<i>Rattus niobe</i>	276
<i>G. (D.) dasyceri</i>	No data		
<i>G. (D.) omega</i>	Ear fringe	Rodentia	
		Muridae	
		<i>Melomys</i> sp.	1
		<i>Melomys</i> sp.	10
		<i>M. levipes</i>	1
		<i>M. moncktoni</i>	1
		<i>M. rufescens</i>	1
		<i>Rattus exulans</i>	1
		<i>R. leucopus</i>	1
		<i>R. niobe</i>	3
		<i>R. ruber</i>	26
		<i>Uromys caudimaculatus</i>	2
		Ear tragus	Rodentia
Muridae			
Dorsal body	Marsupialia		
	Peramelidae		
Ventral body	Rodentia		
	Muridae		
Legs	Marsupialia		
	Peramelidae		
No data	Marsupialia		
	Dasyuridae		
		<i>Anisomys imitator</i>	1
		<i>Peroryctes longicauda</i>	1
		<i>Echymipera kalubu</i>	1
		<i>Murexia longicauda</i>	1
		<i>Phascolosorex dorsalis</i>	1

TABLE 2. Continued.

CHIGGER	PARASITOPES	HOST	No. INFESTED
		Rodentia	
		Muridae	
		<i>Anisomys imitator</i>	1
		<i>Hydromys chrysogaster</i>	1
		<i>Melomys</i> sp.	1
		<i>M. rufescens</i>	1
		<i>Rattus</i> sp.	1
		<i>R. ruber</i>	11
<i>G. (G.) cassiope</i>	No data	Rodentia	
		Muridae	
		<i>Rattus</i> sp.	4
<i>G. (G.) foliata</i>	Ear	Rodentia	
		Muridae	
		<i>Leptomys elegans</i>	1
		<i>Uromys caudimaculatus</i>	1
	Ear fringe	Rodentia	
		Muridae	
		<i>Rattus niobe</i>	3
		<i>R. ruber</i>	4
	Perianal	Rodentia	
		Muridae	
		<i>Rattus niobe</i>	1
	No data	Marsupialia	
		Dasyuridae	
		<i>Antechinus naso</i>	1
		Peramelidae	
		<i>Peroryctes longicauda</i>	1
		Rodentia	
		Muridae	
		<i>Rattus ruber</i>	1
<i>G. (G.) lavaniensis</i>	No data	Marsupialia	
		Phalangeridae	
		<i>Pseudocheirus cupreus</i>	2
<i>G. (G.) minima</i>	Ear	Rodentia	
		Muridae	
		<i>Rattus leucopus</i>	1
		<i>R. niobe</i>	2
		<i>R. ruber</i>	2
	Ear tragus	Marsupialia	
		Dasyuridae	
		<i>Murexia longicauda</i>	1
		Rodentia	
		Muridae	
		<i>Rattus</i> sp.	2
		<i>R. niobe</i>	1
	Dorsal body	Marsupialia	
		Dasyuridae	
		<i>Murexia longicauda</i>	1

TABLE 2. Continued.

CHIGGER	PARASITOPES	HOST	No. INFESTED
<i>G. (G.) niobensis</i>	No data	Marsupialia	
		Dasyuridae	<i>Antechinus</i> sp. 1
		Rodentia	
	Ear	Muridae	<i>Melomys</i> sp. 1
			<i>Rattus</i> sp. 2
			<i>R. niobe</i> 5
	Ear fringe	Marsupialia	
		Dasyuridae	<i>Phascolosorex dorsalis</i> 1
	Ear tragus	Rodentia	
		Muridae	<i>Rattus niobe</i> 12
Perianal	Rodentia		
	Muridae	<i>Rattus niobe</i> 27	
<i>G. (G.) ornamentata</i>	No data	Marsupialia	
		Dasyuridae	<i>Phascolosorex dorsalis</i> 1
		Rodentia	
	Ear	Muridae	<i>Rattus niobe</i> 1
			<i>Neophascogale lorentzi</i> 1
	Dorsal body	Rodentia	
		Muridae	<i>Rattus niobe</i> 23
	No data	Marsupialia	
		Phalangeridae	<i>Pseudocheirus cupreus</i> 1
	Marsupialia		
	Dasyuridae	<i>Murexia longicauda</i> 1	
		<i>Antechinus naso</i> 1	
		<i>Peroryctes longicauda</i> 2	
	Rodentia		
	Phalangeridae	<i>Pseudocheirus cupreus</i> 1	
	Muridae	<i>Anisomys imitator</i> 1	
		<i>Melomys</i> sp. 1	
		<i>Rattus ruber</i> 2	

TABLE 2. Continued.

CHIGGER	PARASITOPES	HOST	No. INFESTED	
<i>G. (G.) strandmanni</i>	Ear	Marsupialia		
		Dasyuridae	<i>Satanellus albopunctatus</i>	2
		Phalangeridae	<i>Pseudocheirus cupreus</i>	1
		Rodentia		
		Muridae	<i>Anisomys imitator</i>	2
			<i>Melomys</i> sp.	1
			<i>Rattus exulans</i>	3
			<i>R. niobe</i>	86
			<i>R. ruber</i>	6
			<i>R. verecundus</i>	1
	Ear tragus	Rodentia		
		Muridae	<i>Rattus</i> sp.	9
			<i>R. ruber</i>	6
			<i>R. verecundus</i>	2
	No data	Marsupialia		
Dasyuridae		<i>Antechinus</i> sp.	2	
		<i>Phascolosorex dorsalis</i>	1	
Peramelidae		<i>Peroryctes longicauda</i>	1	
Phalangeridae		<i>Phalanger vestitus</i>	1	
Rodentia				
Muridae		<i>Rattus</i> sp.	15	
		<i>R. niobe</i>	9	
	<i>R. ruber</i>	27		
<i>G. (G.) womersleyi</i>	Ear	Marsupialia		
		Dasyuridae	<i>Antechinus wilhelmina</i>	1
			<i>Murexia longicauda</i>	1
			<i>Phascolosorex dorsalis</i>	2
		Rodentia		
		Muridae	<i>Anisomys imitator</i>	1
		<i>Leptomys elegans</i>	1	
		<i>Melomys</i> sp.	1	
		<i>M. rufescens</i>	1	
		<i>Rattus</i> sp.	5	
		<i>R. exulans</i>	3	
		<i>R. leucopus</i>	2	
	<i>R. niobe</i>	24		

TABLE 2. Continued.

CHIGGER	PARASITOPHORE	HOST	No. INFESTED
		<i>R. ruber</i>	5
		<i>R. verecundus</i>	1
		<i>Uromys caudimaculatus</i>	1
	Ear fringe	Rodentia	
		Muridae	
		<i>Anisomys imitator</i>	1
		<i>Rattus niobe</i>	23
		<i>R. ruber</i>	1
		<i>Uromys caudimaculatus</i>	1
	Ear tragus	Marsupialia	
		Dasyuridae	
		<i>Phascolosorex dorsalis</i>	1
		Rodentia	
		Muridae	
		<i>Rattus niobe</i>	18
		<i>R. ruber</i>	4
		<i>R. verecundus</i>	2
	Dorsal body	Rodentia	
		Muridae	
		<i>Rattus niobe</i>	2
	No data	Marsupialia	
		Dasyuridae	
		<i>Antechinus</i> sp.	1
		Rodentia	
		Muridae	
		<i>Melomys</i> sp.	1
		<i>M. rufescens</i>	1
		<i>Rattus niobe</i>	11
		<i>R. ruber</i>	1
<i>Schoengastia brennani</i>	Ear	Rodentia	
		Muridae	
		<i>Rattus niobe</i>	1
	Perianal	Rodentia	
		Muridae	
		<i>Rattus niobe</i>	36
	Tail base	Rodentia	
		Muridae	
		<i>Rattus niobe</i>	1
	No data	Rodentia	
		Muridae	
		<i>Rattus niobe</i>	19
<i>S. diannae</i>	Axillae	Rodentia	
		Muridae	
		<i>Anisomys imitator</i>	1
	Dorsal body	Rodentia	
		Muridae	
		<i>Rattus niobe</i>	19

TABLE 2. Continued.

CHIGGER	PARASITOPES	HOST	No. INFESTED
	Perianal	Marsupialia	
		Dasyuridae	<i>Antechinus wilhelmina</i> 1
			<i>Phascolosorex dorsalis</i> 1
		Peramelidae	<i>Peroryctes longicauda</i> 1
		Rodentia	
		Muridae	<i>Anisomys imitator</i> 1
			<i>Rattus niobe</i> 36
			<i>R. ruber</i> 1
	Tail base	Rodentia	
		Muridae	<i>Rattus niobe</i> 4
	Scrotum	Rodentia	
		Muridae	<i>Rattus niobe</i> 2
	No data	Marsupialia	
		Dasyuridae	<i>Antechinus</i> sp. 1
			<i>A. naso</i> 1
			<i>A. wilhelmina</i> 1
			<i>Phascolosorex dorsalis</i> 2
		Peramelidae	<i>Peroryctes longicauda</i> 1
		Rodentia	
		Muridae	<i>Anisomys imitator</i> 2
			<i>Melomys</i> sp. 2
			<i>Rattus niobe</i> 25
			<i>R. ruber</i> 3
<i>S. taylori</i>	Ear tragus	Rodentia	
		Muridae	<i>Rattus</i> sp. 1
	Perianal	Rodentia	
		Muridae	<i>Rattus</i> sp. 3
<i>S. vandersandei</i>	Axillae	Rodentia	
		Muridae	<i>Rattus</i> sp. 1
	Ear	Rodentia	
		Muridae	<i>Rattus</i> sp. 1
	Perianal	Rodentia	
		Muridae	<i>Rattus</i> sp. 4
<i>S. whartoni</i>	Ear	Rodentia	
		Muridae	<i>Rattus</i> sp. 1

TABLE 2. Continued.

CHIGGER	PARASITOPES	HOST	No. INFESTED
<i>Walchiella impar</i>	Perianal	Rodentia	
		Muridae	<i>Rattus</i> sp. 1
	Ear	Rodentia	
		Muridae	<i>Hydromys chrysogaster</i> 1 <i>Rattus</i> sp. 21 <i>R. ruber</i> 1 <i>R. sordidus</i> 2
	Ear fringe	Rodentia	
		Muridae	<i>Rattus</i> sp. 2 <i>R. ruber</i> 9
	Ear tragus	Rodentia	
		Muridae	<i>Rattus ruber</i> 1
	Legs	Marsupialia	
		Peramelidae	<i>Echymipera kalubu</i> 1
Tribe Gahrlepiini <i>Gahrlepia (W.) disparunguis</i>	Scrotum	Rodentia	
		Muridae	<i>Rattus ruber</i> 1
		Marsupialia	
		Peramelidae	<i>Echymipera kalubu</i> 1
	No data	Rodentia	
		Muridae	<i>Hydromys chrysogaster</i> 1 <i>Melomys rufescens</i> 1 <i>Rattus</i> sp. 6 <i>R. ruber</i> 4
	Ear	Rodentia	
		Muridae	<i>Rattus</i> sp. 23 <i>R. leucopus</i> 3 <i>R. ruber</i> 4 <i>R. sordidus</i> 10
	Ear fringe	Rodentia	
		Muridae	<i>Rattus</i> sp. 11 <i>R. ruber</i> 3
Ear tragus	Rodentia		
	Muridae	<i>Rattus</i> sp. 2 <i>R. ruber</i> 10	

TABLE 2. Continued.

CHIGGER	PARASITOPH	HOST	No. INFESTED
<i>G. (W.) morobiensis</i>	Perianal	Rodentia	
		Muridae	<i>Rattus ruber</i> 1
	No data	Rodentia	
		Muridae	<i>Hydromys chrysogaster</i> 1
			<i>Rattus</i> sp. 2
			<i>R. ruber</i> 13
	Intranasal	Rodentia	
		Muridae	<i>Leptomys elegans</i> 1
			<i>Melomys</i> sp. 15
			<i>M. levipes</i> 2
		<i>M. moncktoni</i> 3	
		<i>M. platyops</i> 8	
		<i>Paraleptomys wilhelmina</i> 1	
		<i>Pogonomelomys</i> sp. 1	
		<i>Rattus leucopus</i> 1	
		<i>R. niobe</i> 1	
		<i>R. ruber</i> 9	
<i>G. (W.) traubaudyi</i>	No data	Rodentia	
		Muridae	<i>Melomys</i> sp. 5
			<i>M. platyops</i> 1
	Intranasal	Rodentia	
		Muridae	<i>Melomys</i> sp. 3

in either of the undisturbed vegetation types represented in the ecotonal areas between them. Thus all hosts taken at this locality are considered to be from a transitional habitat.

Murid rodents were taken from all 3 types of habitats in the 1967 and 1968 collections, but with some variation in species composition among the habitat types (TABLE 4). Species of the genera *Rattus* and *Melomys* were the most common hosts. *Rattus niobe* was taken only in undisturbed habitats (primarily moss forests) and was the predominant species collected there. These habitats were all above 2000 m. Some individuals of *R. niobe* were taken at the locality of 3300 m recorded as transitional. *Rattus ruber* is typically associated with disturbed habitats and was taken only from these habitats at elevations ranging from 780–2800 m.

One or more species of *Melomys* were collected from each of the 3 types of habitats. *Melomys rubex* was the species most frequently collected, with 24 individuals taken, all from transitional or disturbed habitats.

Marsupials, which were not well represented numerically in the 1967 and 1968 collections, accounted for only 28 of the 828 host individuals. The most common were species of the primarily terrestrial family Dasyuridae and the entirely terrestrial family Peramelidae. The New Guinea Marsupial Cat, *Dasyurus albopunctatus* (Dasyuridae), was taken only from undisturbed habitats. In the family Phalangeridae, the arboreal Silky Phalanger, *Phalanger vestitus*, and the largely arboreal Coppery Ring-tail, *Pseudocheirus cupreus*, were taken in undisturbed habitats only and at elevations above 2450 m.

CHIGGER-HABITAT RELATIONSHIPS

Chigger-habitat relationships are not necessarily determined by the activities of the larval stage, but rather by the requirements for development of the post-larval stages (Crossley 1960). The parasitic chigger serves as a mechanism for dispersal and is frequently recovered from hosts in habitats unsuitable for post-larval development. The ability of the post-larval stages to survive is the "anchor" restricting a given species to a given habitat. The more general the requirements of the post-larval stages, the more widespread the chigger stage. Of the 7 chigger genera represented in the 1967 and 1968 collections, 6 have been reported to be widely distributed through the Pacific Islands and Southeast Asia. These are as follows: *Ascoschoengastia*, *Eutrombicula*, *Gahrleipia*, *Leptotrombidium*, *Schoengastia* and *Walchiella*. Although they show a wide geographic distribution, these genera usually have been reported from similar types of habitats throughout their ranges. The remaining genus, *Guntheria*, is primarily of Australian and New Guinea distribution. This was the predominant mammal-infesting genus in the present study and was encountered primarily in undisturbed habitats.

Eleven species of *Ascoschoengastia* were collected in 1967 and 1968. A single species, *Ascoschoengastia indica*, was recovered from disturbed habitats (TABLE 4). It is the only

TABLE 3. List of mammal hosts and chigger species recovered for the 1967 and 1968 collections in Papua New Guinea.

HOST	NO. OF INFESTED HOSTS	CHIGGER	NO. OF RECORDS
Class Mammalia			
Order Marsupialia			
Family Dasyuridae			
<i>Antechinus</i> sp.	2	<i>Guntheria minima</i>	1
		<i>G. strandtmanni</i>	2
		<i>G. womersleyi</i>	1
		<i>Schoengastia diannae</i>	1
<i>A. naso</i> (Long-nosed Marsupial Mouse)	1	<i>Guntheria foliata</i>	1
		<i>G. ornamentata</i>	1
		<i>Schoengastia diannae</i>	1
<i>A. wilhelmina</i> (Lesser Marsupial Mouse)	2	<i>Guntheria womersleyi</i>	1
		<i>Schoengastia diannae</i>	2
<i>Murexia longicauda</i> (Short-haired Marsupial Mouse)	2	<i>Guntheria minima</i>	2
		<i>G. ornamentata</i>	1
		<i>G. womersleyi</i>	1
		<i>G. omega</i>	2
		<i>Leptotrombidium deliensis</i>	1
<i>Neophascogale lorentzi</i> (Long-clawed Marsupial Mouse)	1	<i>Guntheria niobiensis</i>	1
<i>Phascolosorex dorsalis</i>	3	<i>Guntheria niobiensis</i>	2
		<i>G. strandtmanni</i>	1
		<i>G. womersleyi</i>	2
		<i>G. omega</i>	1
		<i>Schoengastia diannae</i>	3
<i>Satanellus albopunctatus</i> (New Guinea Marsupial Cat)	2	<i>Guntheria strandtmanni</i>	2
Family Peramelidae			
<i>Echymipera kalubu</i> (Spiny Bandicoot)	1	<i>Guntheria omega</i>	1
		<i>Leptotrombidium deliensis</i>	1
		<i>Walchiella impar</i>	1
<i>Peroryctes</i> sp.	1	<i>Guntheria omega</i>	1
<i>P. longicauda</i> (Striped Bandicoot)	3	<i>Guntheria foliata</i>	1
		<i>G. ornamentata</i>	2
		<i>G. strandtmanni</i>	1
		<i>G. omega</i>	3
		<i>Schoengastia diannae</i>	2

TABLE 3. Continued.

HOST	NO. OF INFESTED HOSTS	CHIGGER	NO. OF RECORDS
Family Phalangeridae			
<i>Pseudocheirus cupreus</i> (Coppery Ring-tail)	3	<i>Ascoschoengastia accola</i>	1
		<i>Guntheria lavaniensis</i>	2
		<i>G. ornamentata</i>	2
		<i>G. strandtmanni</i>	1
<i>P. forbesi</i> (Moss-forest Ring-tail)	3	<i>Ascoschoengastia accola</i>	3
<i>Phalanger vestitus</i> (Silky Phalanger)	4	<i>Ascoschoengastia accola</i>	3
		<i>Guntheria strandtmanni</i>	1
Order Rodentia			
Family Muridae			
<i>Anisomys imitator</i> (Squirrel-toothed Rat)	8	<i>Ascoschoengastia accola</i>	1
		<i>A. melanestana</i>	1
		<i>Guntheria niobiensis</i>	1
		<i>G. ornamentata</i>	1
		<i>G. strandtmanni</i>	2
		<i>G. womersleyi</i>	2
		<i>G. omega</i>	2
		<i>Schoengastia diannae</i>	4
<i>Hydromys chrysogaster</i> (Common Water Rat)	2	<i>Ascoschoengastia indica</i>	1
		<i>Gahrlepiea disparunguis</i>	1
		<i>Guntheria omega</i>	1
		<i>Leptotrombidium deliensis</i>	2
		<i>Walchiella impar</i>	2
<i>Leptomys elegans</i> (Long-footed Hydromyine)	2	<i>Gahrlepiea morobiensis</i>	1
		<i>Guntheria foliata</i>	1
		<i>G. womersleyi</i>	1
<i>Lorentzimys nouhuysi</i> (New Guinea Jumping Mouse)	1	<i>Ascoschoengastia libbymannae</i>	1
		<i>A. lorentzimys</i>	1
<i>Melomys</i> sp.	67	<i>Ascoschoengastia accola</i>	7
		<i>A. elongotarsala</i>	1
		<i>A. goilala</i>	3
		<i>A. improcera</i>	17
		<i>A. indigena</i>	1
		<i>A. melanesiana</i>	13

TABLE 3. Continued.

HOST	NO. OF INFESTED HOSTS	CHIGGER	NO. OF RECORDS
		<i>A. metatarsalis</i>	4
		<i>Gahrlepiea morobiensis</i>	20
		<i>G. traubaudyi</i>	3
		<i>Guntheria dasyerceri</i>	1
		<i>G. omega</i>	11
		<i>G. minima</i>	1
		<i>G. ornamentata</i>	1
		<i>G. strandtmanni</i>	1
		<i>G. womersleyi</i>	2
		<i>Leptotrombidium deliensis</i>	3
		<i>Schoengastia diannae</i>	2
<i>M. fellowsi</i> (Red-bellied Melomys)	1	<i>Ascoschoengastia accola</i>	1
<i>M. levipes</i> (Long-nosed Melomys)	3	<i>Gahrlepiea morobiensis</i>	2
		<i>Guntheria omega</i>	1
<i>M. lorentzi</i> (Long-footed Melomys)	1	<i>Gahrlepiea morobiensis</i>	1
<i>M. moncktoni</i> (Southern Melomys)	3	<i>Ascoschoengastia indica</i>	1
		<i>Gahrlepiea morobiensis</i>	3
		<i>Guntheria omega</i>	1
		<i>Leptotrombidium deliensis</i>	1
<i>M. platyops</i> (Lowland Melomys)	9	<i>Gahrlepiea morobiensis</i>	9
<i>M. rufescens</i> (Rufescent Melomys)	2	<i>Guntheria omega</i>	2
		<i>G. womersleyi</i>	2
		<i>Walchiella impar</i>	1
<i>M. rubex</i> (Highland Melomys)	24	<i>Ascoschoengastia accola</i>	2
		<i>A. goilala</i>	3
		<i>A. improcera</i>	12
		<i>A. melanesiana</i>	9
<i>Paraleptomys wilhelmina</i> (Short-footed Hydromyine)	3	<i>Ascoschoengastia goilala</i>	2
		<i>A. lorentzimys</i>	1
		<i>Gahrlepiea morobiensis</i>	1
<i>Pogonomelomys</i> sp.	1	<i>Gahrlepiea morobiensis</i>	1
<i>P. ruemmleri</i> (Rummler's Brush Mouse)	5	<i>Ascoschoengastia goilala</i>	5
		<i>A. melanesiana</i>	1
<i>Pogonomys</i> sp.	1	<i>Ascoschoengastia goilala</i>	1

TABLE 3. Continued.

HOST	NO. OF INFESTED HOSTS	CHIGGER	NO. OF RECORDS		
<i>P. sylvestris</i> (Gray-bellied Tree Mouse)	2	<i>Ascoschoengastia goilala</i>	2		
<i>Rattus</i> sp.	24	<i>Ascoschoengastia indica</i>	26		
		<i>Gahrlepieia disparunguis</i>	38		
		<i>Guntheria omega</i>	1		
		<i>G. cassiope</i>	4		
		<i>G. minima</i>	9		
		<i>G. strandmanni</i>	24		
		<i>G. womersleyi</i>	5		
		<i>Leptotrombidium deliensis</i>	39		
		<i>Schoengastia taylori</i>	4		
		<i>S. vandersandei</i>	5		
		<i>S. whartoni</i>	1		
		<i>Walchiella impar</i>	27		
		<i>R. exulans</i> (Polynesian Rat)	4	<i>Guntheria omega</i>	1
				<i>G. strandmanni</i>	3
<i>G. womersleyi</i>	3				
<i>Leptotrombidium deliensis</i>	1				
<i>R. leucopus</i> (Southern Spiny Rat)	4	<i>Ascoschoengastia indica</i>	1		
		<i>Gahrlepieia disparunguis</i>	3		
		<i>G. morobiensis</i>	1		
		<i>Guntheria omega</i>	1		
		<i>G. minima</i>	1		
		<i>G. womersleyi</i>	2		
		<i>Leptotrombidium deliensis</i>	1		
<i>R. niobe</i> (Moss-forest Rat)	485	<i>Ascoschoengastia accola</i>	9		
		<i>A. goilala</i>	5		
		<i>A. melanesiana</i>	276		
		<i>Gahrlepieia morobiensis</i>	1		
		<i>Guntheria omega</i>	3		
		<i>G. foliata</i>	4		
		<i>G. minima</i>	3		
		<i>G. mobiensis</i>	62		
		<i>G. strandmanni</i>	95		
		<i>G. womersleyi</i>	75		
		<i>Schoengastia brennani</i>	57		
		<i>S. diannae</i>	64		

TABLE 3. Continued.

HOST	NO. OF INFESTED HOSTS	CHIGGER	NO. OF RECORDS
<i>R. ruber</i> (Variable Spiny Rat)	83	<i>Ascoschoengastia indica</i>	1
		<i>A. melanesiana</i>	1
		<i>Gahrlepiea disparunguis</i>	30
		<i>G. morobiensis</i>	9
		<i>Guntheria omega</i>	38
		<i>G. foliata</i>	5
		<i>G. minima</i>	7
		<i>G. ornamentata</i>	2
		<i>G. strandtmanni</i>	39
		<i>Guntheria womersleyi</i>	11
		<i>Leptotrombidium deliensis</i>	18
		<i>Schoengastia diannae</i>	4
		<i>Walchiella impar</i>	21
<i>R. sordidus</i> (Dusky Field Rat)	10	<i>Gahrlepiea disparunguis</i>	10
		<i>Leptotrombidium deliensis</i>	8
		<i>Walchiella impar</i>	2
<i>R. verecundus</i> (Slender Rat)	3	<i>Guntheria strandtmanni</i>	3
		<i>G. womersleyi</i>	3
<i>Uromys caudimaculatus</i> (Mottle-tailed Tree Rat)	2	<i>Guntheria omega</i>	1
		<i>G. foliata</i>	1
		<i>G. womersleyi</i>	2
Order Artiodactyla			
Family Suidae			
<i>Sus scrofa</i> (Domestic Pig)	1	<i>Eutrombicula hirsti</i>	1

member of the genus in the present study reported from areas other than Papua New Guinea. The other 10 species, all described from Papua New Guinea, were collected from hosts in either transitional or disturbed habitats.

A single record of *Eutrombicula hirsti* was recorded from the domestic pig, *Sus scrofa*, taken in a disturbed habitat.

Three of the 5 New Guinea species of *Gahrliopia* reported from mammals were collected in 1967 and 1968. *Gahrliopia* (*W.*) *disparunguis* was on hosts in disturbed habitats at elevations from 25 m to 1900 m. The other 2 species, *Gahrliopia* (*W.*) *morobiensis* and *Gahrliopia* (*W.*) *traubaudyi*, were associated with the intranasal parasite and collected from hosts in both disturbed and undisturbed habitats ranging from 25 m to 3300 m.

The genus *Leptotrombidium*, which contains 2 species reported from mammals in Papua New Guinea, was represented only by *Leptotrombidium* (*L.*) *deliensis*. This species was collected from hosts in disturbed habitats at elevations up to 1400 m. This association with disturbed habitats has been frequently observed for species of *Leptotrombidium* implicated as vectors of chigger-borne rickettsiosis (Traub & Wisseman 1974).

Five of the 7 species of *Schoengastia* reported from Papua New Guinea (TABLE 5) were recovered from the 1967 and 1968 collections. Two of these, *Schoengastia vandersandei* and *Schoengastia whartoni*, had been previously described from New Guinea and observed to attack man (Womersley 1952). In the current collections, these were taken from species of *Rattus* trapped in disturbed habitats at elevations from 25 m to 100 m. The records for *Schoengastia brennani* and *Schoengastia diannae* were from hosts in both disturbed and undisturbed habitats, but only above 1900 m.

Walchiella impar was the only *Walchiella* collected from disturbed habitats below 1200 m. This species has been reported from various hosts throughout the Pacific Islands and Southeast Asia (Wharton & Fuller 1952).

Of the 16 species of *Guntheria* recorded from Papua New Guinea (TABLE 5), 10 were represented in this study. Only 3 of these were from hosts taken below 1200 m: *Guntheria* (*G.*) *foliata*, *Guntheria* (*G.*) *womersleyi*, and *Guntheria* (*D.*) *omega*, the last recognized and described as new during the course of this study. While these were the only species of *Guntheria* recovered below 1200 m, each was also found at higher elevations. Above 1400 m, *Guntheria* species were the predominant chiggers in all habitats.

HOST-CHIGGER RELATIONSHIPS

There are 49 species of chiggers recorded as parasitizing mammals in Papua New Guinea (TABLE 5). These represent 11 genera and 2 of the 3 subfamilies of Trombiculidae. Only 1 species, *Whartonia maai*, is in the subfamily Leeuwenhoekinae, and the remaining 48 species are in the Trombiculinae. To date there have been no species assigned to the Apoloniinae reported from Papua New Guinea. The Gahrli-

piini are considered here to be a tribe of the Trombiculinae, as indicated by Nadchatram & Dohany (1974).

Thirty-one chigger species in 7 genera were recovered from hosts in the 1967 and 1968 collections. Host species were commonly infested by several species of chiggers (TABLE 3), with an average for these collections of 4 chigger species per host species. The maximum number of species recorded for a given host species was 13 for *Rattus ruber*. Individual species tended to infest several host species (TABLE 2). Host lists commonly crossed family lines. For example, *Guntheria (D.) omega* was recorded from 14 host species in 3 families and 2 orders.

Of the total of 1319 chigger species records obtained, 1060 had accompanying parasitope or attachment site data (TABLE 2) as recorded in the collectors' field notes.

The most frequently encountered parasitopes were the ear (including ear fringe), intranasal and perianal (including the adjacent areas of tail base, scrotum and part of the dorsal body surface). Dorsum, venter, eyelid and legs were only occasionally recorded as attachment sites (TABLE 2). Personal communication with 2 of the collectors has indicated a certain degree of overlap in their designations of ear and ear fringe. Thus, with the exception of *Guntheria (D.) omega* (recorded from the ear fringe), no attempt was made to segregate chiggers from these parts for analysis, but they were all pooled and treated as from the outer ear parasitope.

While an average of 5 host species was exploited by a given chigger species, a much narrower range of parasitopes was utilized. The general trend was toward an average of 2 parasitopes per chigger species and, at the generic level, an average of 3 parasitopes was recorded (TABLE 2, 6).

Although multiple parasitopes were recorded for most chigger species, there was always 1 parasitope which was clearly occupied more frequently for each given species. In 4 of the 7 genera (*Ascoschoengastia*, *Guntheria*, *Leptotrombidium* and *Walchiella*), all species represented for a given genus tended to occupy the same parasitope. In these genera, 90.0–96.7% of all records for the species were from a single parasitope. In the genus *Guntheria*, *G. (D.) omega* was recorded from the ear fringe in 90% of the records.

The perianal site was listed in field notes for 72.6% of the records for species of *Schoengastia* with an additional 22.2% from the tail base, scrotum and dorsum. As the perianal site is not as clearly delineated as the ear or intranasal parasitopes, a certain amount of error could have occurred in recording from these closely adjacent parasitopes in the field. Due to the proximity of these surrounding parasitopes, the tail base, scrotum and part of the dorsum are included here in the perianal parasitope. Thus, 94.8% of the *Schoengastia* species records were from the perianal site.

Significance of the recovery of 3 specimens of *Eutrombicula hirsti* (Sambon, 1927) from the dorsum of 1 host individual is questionable. However, this parasitope has frequently been observed by the author for other *Eutrombicula* species infesting both reptiles and mammals in North America.

TABLE 4. Host and chigger species related to 1967 and 1968 collecting localities in Papua New Guinea.

MAP LOCAL-ITY NO. (FIG. 1)	ELEVATION	HABITAT TYPE	HOST	CHIGGER			
2	25-100 m	Disturbed	<i>Hydromys chrysogaster</i>	<i>Ascoschoengastia indica</i> <i>Gahrlepiea disparunguis</i> <i>Guntheria omega</i> <i>Leptotrombidium deliensis</i> <i>Walchiella impar</i>			
			<i>Leptomys elegans</i>	<i>Gahrlepiea morobiensis</i>			
			<i>Melomys</i> sp.	<i>Guntheria dasyercii</i> <i>G. omega</i> <i>Leptotrombidium deliensis</i>			
			<i>Melomys moncktoni</i>	<i>Ascoschoengastia indica</i> <i>Gahrlepiea morobiensis</i> <i>Guntheria omega</i> <i>Leptotrombidium deliensis</i>			
			<i>Rattus</i> sp.	<i>Ascoschoengastia indica</i> <i>Gahrlepiea disparunguis</i> <i>Guntheria womersleyi</i> <i>Leptotrombidium deliensis</i> <i>Schoengastia vandersandei</i> <i>S. whartoni</i> <i>Walchiella impar</i>			
			<i>Rattus leucopus</i>	<i>Gahrlepiea morobiensis</i>			
		Disturbed	<i>Rattus sordidus</i>	<i>Gahrlepiea disparunguis</i> <i>Leptotrombidium deliensis</i> <i>Walchiella impar</i>			
			15	600 m	Disturbed	<i>Rattus leucopus</i>	<i>Ascoschoengastia indica</i>
			12	780 m	Disturbed	<i>Rattus ruber</i>	<i>Walchiella impar</i>
			11	1200 m	Disturbed	<i>Echymipera kalubu</i>	<i>Guntheria omega</i> <i>Leptotrombidium deliensis</i> <i>Walchiella impar</i>
						<i>Melomys levipes</i>	<i>Guntheria omega</i>
						<i>Melomys rufescens</i>	<i>Guntheria omega</i> <i>G. womersleyi</i> <i>Walchiella oudemansi</i>
<i>Rattus</i> sp.	<i>Guntheria omega</i>						
<i>Rattus ruber</i>	<i>Ascoschoengastia indica</i> <i>Gahrlepiea disparunguis</i> <i>G. morobiensis</i> <i>Guntheria omega</i> <i>G. foliata</i> <i>G. womersleyi</i> <i>Leptotrombidium deliensis</i> <i>Walchiella impar</i>						
<i>Uromys caudimaculatus</i>	<i>Guntheria omega</i> <i>G. womersleyi</i>						
5	1400 m	Disturbed	<i>Murexia longicauda</i>	<i>Guntheria omega</i> <i>G. minima</i>			

TABLE 4. Continued.

MAP LOCAL- ITY NO. (FIG. 1)	ELEVATION	HABITAT TYPE	HOST	CHIGGER
				<i>G. ornamentata</i>
				<i>G. womersleyi</i>
			<i>Leptomys elegans</i>	<i>Leptotrombidium deliensis</i>
				<i>Guntheria foliata</i>
			<i>Melomys</i> sp.	<i>G. womersleyi</i>
				<i>Guntheria omega</i>
				<i>G. minima</i>
			<i>Melomys platyops</i>	<i>Gahrlepiea morobiensis</i>
			<i>Pogonomys</i> sp.	<i>Gahrlepiea morobiensis</i>
			<i>Pogonomys sylvestris</i>	<i>Ascoschoengastia goilala</i>
			<i>Rattus</i> sp.	<i>Ascoschoengastia goilala</i>
			<i>Rattus exulans</i>	<i>Leptotrombidium deliensis</i>
				<i>Guntheria womersleyi</i>
			<i>Rattus leucopus</i>	<i>Leptotrombidium deliensis</i>
				<i>Gahrlepiea disparunguis</i>
				<i>Guntheria omega</i>
				<i>G. minima</i>
				<i>G. womersleyi</i>
			<i>Rattus ruber</i>	<i>Leptotrombidium deliensis</i>
				<i>Gahrlepiea disparunguis</i>
				<i>Guntheria omega</i>
				<i>G. strandmanni</i>
				<i>Leptotrombidium deliensis</i>
6	1550 m	Disturbed	<i>Melomys</i> sp.	<i>Gahrlepiea morobiensis</i>
			<i>Melomys platyops</i>	<i>Gahrlepiea morobiensis</i>
14	1645–1800 m	Disturbed	<i>Lorentzimys nouhuysi</i>	<i>Ascoschoengastia libbymannae</i>
				<i>A. lorentzimys</i>
			<i>Melomys</i> sp.	<i>Ascoschoengastia goilala</i>
				<i>Gahrlepiea morobiensis</i>
				<i>G. traubaudyi</i>
			<i>Paraleptomys wilhelmina</i>	<i>Ascoschoengastia goilala</i>
				<i>A. lorentzimys</i>
				<i>Gahrlepiea morobiensis</i>
			<i>Pogonomelomys ruemmleri</i>	<i>Ascoschoengastia goilala</i>
			<i>Rattus</i> sp.	<i>Gahrlepiea disparunguis</i>
				<i>Guntheria minima</i>
				<i>G. strandmanni</i>
			<i>Rattus ruber</i>	<i>Gahrlepiea disparunguis</i>
				<i>Guntheria minima</i>
				<i>G. strandmanni</i>
11	1700 m	Disturbed	<i>Melomys rufescens</i>	<i>Guntheria omega</i>
				<i>G. womersleyi</i>
11	1900 m	Transitional and disturbed	<i>Antechinus</i> sp.	<i>Guntheria minima</i>
				<i>G. strandmanni</i>
				<i>G. womersleyi</i>
				<i>Schoengastia diannae</i>
			<i>Phascolosorex dorsalis</i>	<i>Guntheria omega</i>
				<i>G. strandmanni</i>
				<i>Schoengastia diannae</i>

TABLE 4. Continued.

MAP LOCALITY NO. (FIG. 1)	ELEVATION	HABITAT TYPE	HOST	CHIGGER
			<i>Rattus ruber</i>	<i>Gahrlipeia disparunguis</i> <i>Guntheria omega</i> <i>G. minima</i> <i>G. ornamentata</i> <i>G. strandtmanni</i> <i>Schoengastia diannae</i>
			<i>Uromys caudimaculatus</i>	<i>Guntheria foliata</i> <i>G. ornamentata</i> <i>Schoengastia diannae</i>
8	2000 m	Transitional and undisturbed	<i>Antechinus naso</i>	<i>Guntheria foliata</i> <i>G. ornamentata</i> <i>Schoengastia diannae</i>
			<i>Peroryctes longicauda</i>	<i>Guntheria omega</i> <i>G. foliata</i> <i>G. ornamentata</i> <i>G. strandtmanni</i> <i>Schoengastia diannae</i>
			<i>Melomys</i> sp. <i>Melomys rubex</i>	<i>Schoengastia diannae</i> <i>Ascoschoengastia accola</i> <i>A. goilala</i>
			<i>Rattus niobe</i>	<i>Ascoschoengastia goilala</i> <i>Guntheria minima</i> <i>G. strandtmanni</i> <i>Schoengastia brennani</i> <i>S. diannae</i>
			<i>Rattus ruber</i>	<i>Guntheria minima</i> <i>G. strandtmanni</i> <i>G. womersleyi</i>
1	2300 m	Transitional and undisturbed	<i>Anisomys imitator</i>	<i>Guntheria omega</i> <i>G. ornamentata</i> <i>G. strandtmanni</i> <i>G. womersleyi</i> <i>Schoengastia diannae</i>
			<i>Melomys</i> sp.	<i>Ascoschoengastia accola</i> <i>A. elongotarsala</i> <i>A. improcera</i> <i>Gahrlipeia morobiensis</i> <i>Guntheria omega</i>
			<i>Melomys levipes</i> <i>Melomys rubex</i> <i>Rattus exulans</i>	<i>Gahrlipeia morobiensis</i> <i>Ascoschoengastia improcera</i> <i>Guntheria omega</i> <i>G. strandtmanni</i> <i>G. womersleyi</i>
			<i>Rattus ruber</i> <i>Rattus verecundus</i>	<i>Guntheria strandtmanni</i> <i>Guntheria strandtmanni</i> <i>G. womersleyi</i>
7	2450 m	Undisturbed	<i>Phalanger vestitus</i> <i>Pseudocheirus cupreus</i>	<i>Guntheria strandtmanni</i> <i>Guntheria lavaniensis</i> <i>G. ornamentata</i> <i>G. strandtmanni</i>

TABLE 4. Continued.

MAP LOCAL- ITY NO. (FIG. 1)	ELEVATION	HABITAT TYPE	HOST	CHIGGER			
3	2500 m	Undisturbed	<i>Rattus niobe</i>	<i>Ascoschoengastia accola</i> <i>A. melanesiana</i>			
			<i>Peroryctes</i> sp.	<i>Guntheria omega</i>			
			<i>Peroryctes longicauda</i>	<i>Guntheria omega</i> <i>Schoengastia diannae</i>			
			<i>Antechinus wilhelmina</i>	<i>Guntheria womersleyi</i>			
			<i>Phascolosorex dorsalis</i>	<i>Schoengastia diannae</i> <i>Guntheria niobiensis</i> <i>G. womersleyi</i> <i>Schoengastia diannae</i>			
			<i>Phalanger vestitus</i>	<i>Ascoschoengastia accola</i>			
			<i>Pseudocheirus cupreus</i>	<i>Ascoschoengastia accola</i> <i>Guntheria ornamentata</i>			
			<i>Anisomys imitator</i>	<i>Guntheria niobiensis</i> <i>G. womersleyi</i> <i>Schoengastia diannae</i>			
			<i>Rattus niobe</i>	<i>Guntheria omega</i> <i>G. foliata</i> <i>G. niobiensis</i> <i>G. strandtmanni</i> <i>G. womersleyi</i> <i>Schoengastia brennani</i> <i>S. diannae</i>			
			4	2500 m	Undisturbed	<i>Melomys</i> sp.	<i>Ascoschoengastia improcera</i> <i>A. indigena</i> <i>A. melanesiana</i> <i>A. metatarsalis</i> <i>Guntheria ornamentata</i> <i>G. womersleyi</i>
						<i>Melomys rubex</i>	<i>Ascoschoengastia improcera</i> <i>A. melanesiana</i>
						<i>Rattus niobe</i>	<i>Ascoschoengastia melanesiana</i>
						<i>Neophascogale lorentzi</i>	<i>Guntheria niobiensis</i>
<i>Anisomys imitator</i>	<i>Ascoschoengastia accola</i> <i>A. melanesiana</i>						
9	2800 m	Transitional and undisturbed	<i>Melomys</i> sp.	<i>Ascoschoengastia goilala</i> <i>A. melanesiana</i>			
			<i>Melomys fellowsi</i>	<i>Ascoschoengastia accola</i>			
			<i>Melomys rubex</i>	<i>Ascoschoengastia accola</i> <i>A. goilala</i>			
			<i>Rattus</i> sp.	<i>Guntheria strandtmanni</i>			
			<i>Pogonomys</i> sp.	<i>Ascoschoengastia goilala</i>			
			<i>Rattus</i> sp.	<i>Guntheria strandtmanni</i>			
			<i>Rattus niobe</i>	<i>Ascoschoengastia accola</i> <i>A. goilala</i> <i>A. melanesiana</i> <i>Gahrlepiea morobiensis</i> <i>Guntheria strandtmanni</i>			
			<i>Rattus ruber</i>	<i>Ascoschoengastia melanesiana</i> <i>Guntheria strandtmanni</i>			

TABLE 4. Continued.

MAP LOCALITY NO. (FIG. 1)	ELEVATION	HABITAT TYPE	HOST	CHIGGER
13	2800 m	Undisturbed	<i>Satanellus albopunctatus</i>	<i>Guntheria strandtmanni</i>
			<i>Pseudocheirus forbesi</i>	<i>Ascoschoengastia accola</i>
			<i>Melomys</i> sp.	<i>Ascoschoengastia accola</i>
				<i>A. melanesiana</i>
				<i>Guntheria strandtmanni</i>
			<i>Melomys rubex</i>	<i>Ascoschoengastia melanesiana</i>
			<i>Pogonomelomys ruemmleri</i>	<i>Ascoschoengastia goilala</i>
				<i>A. melanesiana</i>
			<i>Rattus niobe</i>	<i>Ascoschoengastia accola</i>
				<i>A. goilala</i>
	<i>A. melanesiana</i>			
		<i>Guntheria strandtmanni</i>		
9	3300 m	Transitional and undisturbed	<i>Antechinus</i>	<i>Guntheria strandtmanni</i>
			<i>Rattus niobe</i>	<i>Guntheria strandtmanni</i>

Ten of the 11 species of *Ascoschoengastia* were almost exclusively intranasal. The remaining species, *Ascoschoengastia indica* (Hirst, 1951), was recovered from the ears of hosts exclusively (27 host records). In 1 instance, *Ascoschoengastia accola* Nadchatram, 1970 was recovered from deep within the ear of a host, but in all other instances it was recovered only from the intranasal parasitope. Nadchatram (1970) has discussed the great physical similarity between intranasal and deep aural habitats. In this light, the recovery of a typically intranasal species of *Ascoschoengastia* from a deep ear parasitope does not appear too unusual.

In the genus *Gahrlepiea*, *G. (W.) morobiensis* and *G. (W.) traubaudyi* were recovered exclusively from the intranasal parasitope, while a third species, *G. (W.) disparunguis*, was recovered almost exclusively from the ear (98.5%) (TABLE 2).

Most mammals were not represented sufficiently to warrant consideration of individual host species exploitation by chigger species. Sufficient samples were available, however, of 2 murid host species, *Rattus niobe* and *Rattus ruber*.

Rattus niobe

Eleven species of chiggers were recorded from *R. niobe*. A total of 2813 chiggers were recovered from 485 individuals of this species, with a mean of 6 chiggers per host. In many instances, ectoparasites from several individuals were pooled, in keeping with the generally qualitative nature of the sampling method. However, 59 specimens of *R. niobe* were processed individually and their ectoparasites kept separately. These were used for the following analysis. All genera and species of chiggers reported for *R. niobe* in Papua New Guinea were represented in this lot of individually processed hosts.

Collections of *R. niobe* were made at 5 localities with different elevations but all

TABLE 5. Species of chiggers reported infesting mammals in Papua New Guinea.

Leeuwenhoekiiinae	
<i>Whartonia maai</i> Nadchatram & Wilson, 1965	
Trombiculinae	
Trombiculini	
<i>Eutrombicula hirsti</i> (Sambon, 1927)	<i>G. echymipera</i> (Womersley & Kohls, 1947)
<i>E. kohlsi</i> (Womersley, 1944)	<i>G. foliata</i> (Gunther, 1940)
<i>E. wichmanni</i> (Oudemans, 1905)	<i>G. hoxieae</i> Goff, 1978
<i>Leptotrombidium akamushi</i> (Brumpt, 1910)	<i>G. inflati</i> Goff, 1978
<i>L. deliensis</i> (Walch, 1922)	<i>G. kallipygos</i> (Gunther, 1938)
<i>Rudnicula templei</i> Nadchatram & Wilson, 1965	<i>G. lavaniensis</i> Goff, 1977
<i>Sasatrombicula keechongi</i> (Nadchatram & Mitchell, 1965)	<i>G. mccullochi</i> (Womersley, 1944)
<i>S. quatei</i> (Nadchatram & Wilson, 1965)	<i>G. minima</i> (Nadchatram & Traub, 1969)
<i>Trombicula gressitti</i> Nadchatram & Wilson, 1965	<i>G. niobiensis</i> Goff, 1977
Schoengastiini	<i>G. omega</i>
<i>Ascoschoengastia accola</i> Nadchatram, 1970	<i>G. ornamentata</i> (Nadchatram & Traub, 1969)
<i>A. elongotarsala</i> Nadchatram, 1970	<i>G. perameles</i> (Womersley, 1939)
<i>A. goilata</i> Nadchatram, 1970	<i>G. shieldsi</i> (Gunther, 1941)
<i>A. improcera</i> Nadchatram, 1970	<i>G. strandtmanni</i> (Nadchatram & Traub, 1969)
<i>A. indica</i> Hirst, 1915	<i>G. womersleyi</i> (Gunther, 1940)
<i>A. indigena</i> Nadchatram, 1970	<i>Schoengastia brennani</i> Goff, 1977
<i>A. libbymannae</i> Nadchatram, 1970	<i>S. diannae</i> Goff, 1977
<i>A. lorentzimys</i> Nadchatram, 1970	<i>S. schuffneri</i> (Walch, 1922)
<i>A. melanesiana</i> Nadchatram, 1970	<i>S. taylori</i> (Gunther, 1940)
<i>A. metatarsalis</i> Nadchatram, 1970	<i>S. vandersandei</i> (Oudemans, 1905)
<i>A. modica</i> Nadchatram, 1970	<i>S. whartoni</i> Womersley, 1952
<i>Guntheria cassiope</i> (Womersley, 1952)	<i>Walchiella impar</i> (Gunther, 1939)
<i>G. dasyercici</i> (Hirst, 1929)	Gahrlipeini
	<i>Gahrlipeia disparunguis</i> (Oudemans, 1929)
	<i>G. fulleri</i> (Vercammen-Grandjean, 1971)
	<i>G. morobiensis</i> (Gunther, 1939)
	<i>G. pinque</i> (Gater, 1932)
	<i>G. traubaudyi</i> Nadchatram, 1970

TABLE 6. Parasitope selection by chigger genera in 1967 and 1968 collections from Papua New Guinea.

GENUS	NO. OF SPECIES IN GENUS	NO. OF INFESTED HOSTS	PARASITOPE	NO. OF RECORDS (%)
Trombiculini				
<i>Eutrombicula</i>	1	1	Dorsal body	1 (100)
<i>Leptotrombidium</i>	1	48	Ear	46 (95.8)
			Eyelid	1 (2.08)
			Legs	1 (2.08)
Schoengastiini				
<i>Ascoschoengastia</i>	10	414	Ear	28 (6.76)
			Intranasal	386 (93.2)
<i>Guntheria</i>	7	338	Ear	327 (96.7)
			Dorsal body	6 (1.8)
			Ventral body	1 (0.3)
			Legs	1 (0.3)
			Perianal	3 (0.9)
<i>Schoengastia</i>	5	117	Axilla	2 (1.7)
			Ear	4 (3.4)
			Dorsal body	19 (16.2)
			Perianal	85 (72.6)
			Tail base	5 (4.3)
			Scrotum	2 (1.7)
<i>Walchiella</i>	1	30	Ear	27 (90.0)
			Legs	2 (6.6)
			Scrotum	1 (3.3)
<i>Gahrlipeia</i>	3	113	Ear	66 (58.4)
			Intranasal	46 (40.7)
			Perianal	1 (0.8)

with undisturbed habitats (TABLE 7). The number of chigger genera represented remained fairly constant from 2000 m to 2800 m, but at 3300 m, only 1 species, *Guntheria* (*G.*) *strandtmanni* (Nadchatram & Traub, 1969) was recovered. *Rattus niobe* specimens from this locality had the greatest number of chiggers per host (mean of 21 chiggers per host), while those collected at 2500 m had the most diverse chigger populations (3 species per host) (TABLE 7). Among the hosts the chiggers exhibited no detectable sexual preference.

More than 1 species per parasitope of an individual *R. niobe* was observed in 12.5% of the hosts. More than 1 genus in the same parasitope of a host individual was much less frequent and was found in only 0.6% of the records. Thus in *R. niobe*, simultaneous occupation of a parasitope by individuals of more than 1 taxon was not unusual, but at the generic level was clearly abnormal.

Simultaneous occupation was not observed with equal frequency in all parasitopes. In 31 of 32 intranasally infested *R. niobe*, *Ascoschoengastia melanesiana* Nadchatram, 1970 was the dominant chigger. This parasitope was shared with *Ascoschoengastia accola* in 1 instance and *Ascoschoengastia goilala* Nadchatram, 1970 in another. *Gahr-*

TABLE 7. Chigger diversity related to elevation for 1967 and 1968 *Rattus niobe* hosts in moss forest.

ELEVATION	NO. OF HOST INDIVIDUALS	NO. OF CHIGGER GENERA	NO. OF SPECIES	SPECIES HOST	MEAN NO. OF CHIGGERS/ HOST
2000 m	7	3	5	2	19
2450 m	6	1	2	1	8
2500 m	100	3	6	3	16
2800 m	363	3	5	1	3
3300 m	3	1	1	1	28

liepia (W.) *morobiensis* infested 1 host individual intranasally. Thus, the intranasal parasitope was occupied by more than 1 species in only 6.3% of the hosts involved. The aural and perianal parasitopes were occupied by 2 or more species much more frequently, with observed incidences of 42.3% and 62.5%, respectively.

Rattus ruber

A total of 83 individuals of *R. ruber* was recorded for the 1967 and 1968 collections. All individuals were recorded as being infested by chiggers; however, a few noninfested individuals may not have been recorded as such due to the practice of pooling hosts in the field for ectoparasite processing. Regardless of this possibility, the incidence of infestation does appear to be greater than the overall 33.8% recorded for *R. niobe*. Of the 83 *R. ruber* specimens, 42 were processed individually for ectoparasites and have been used for the following analyses. As in *R. niobe*, no differences in infestations could be observed between the sexes.

Some 2774 chiggers, representing 13 species, were recovered from the 83 specimens of *R. ruber*. The mean number of chiggers per host was higher for *R. ruber* (33) than for *R. niobe* (6).

TABLE 8. Chigger diversity related to vegetation type and elevation for 1967 and 1968 *Rattus ruber* hosts.

ELEVATION	VEGETATION	NO. OF HOST IN- DIVIDUALS	NO. OF CHIGGER GENERA	NO. OF SPECIES	SPECIES/ HOST	MEAN NO. OF CHIGGERS/ HOST
780 m	Eucalypt savannah	2	1	1	1	24
1250 m	Secondary forest	36	5	8	3	39
1400 m	Forest fringe	13	3	5	2	22
1450 m	Swamp margin	1	2	3	3	63
1645 m	Scrub	2	2	3	2	48
1900 m	Scrub	12	3	6	2	41
2000 m	Pandanus/moss forest	4	1	3	2	18
2300 m	Pandanus/moss forest	2	1	1	1	25
2500 m	Moss forest (Trans.)	6	2	3	1	28
2800 m	Moss forest (Trans.)	5	2	2	1	23

TABLE 9. Relationship between cheliceral blade and parasitope.

PARASITOPE	CHIGGER GENUS	No. OF SPECIES	LENGTH OF BLADE	CONDITION
Dorsal body surface	<i>Eutrombicula</i>	1	44-47 μ m	Tricuspid cap
Ear	<i>Ascoschoengastia</i>	1	35	Tricuspid cap
	<i>Guntheria</i>	13	30-50	Tricuspid cap
	<i>Gahrлиеpia</i>	1	23	Dorsal and ventral subapical tooth
	<i>Leptotrombidium</i>	2	33-36	Tricuspid cap
	<i>Walchiella</i>	1	36	Tricuspid cap
Intranasal	<i>Ascoschoengastia</i>	10	21-28	Weakly developed dorsal and ventral subapical tooth
	<i>Gahrлиеpia</i>	2	20-23	Weakly developed dorsal and ventral subapical tooth
Perianal	<i>Schoengastia</i>	5	60-83	Well developed dorsal row of recurved teeth

Rattus ruber is typically associated with disturbed or transitional habitats, in contrast to *R. niobe*, which is essentially associated only with undisturbed habitats (Mohr 1967). Of the total *R. ruber* specimens collected, only 16% were from transitional habitats and the remainder were from disturbed habitats. Both *R. ruber* and *R. niobe* were collected at 2 localities (2500 and 2800 m) with transitional vegetation, but only *R. ruber* was collected from the 8 localities with disturbed vegetation at lower elevations (TABLE 8).

Collections of *R. ruber* at 1250 m yielded the greatest number of genera (5) and 8 of the 13 species reported for this rodent. The highest level of infestation was observed in a swamp margin habitat at 1400 m, with a mean of 63 chiggers per host individual.

Frequency of simultaneous occupation of a given parasitope was 46% at the specific level and 34.8% at the generic level for *R. ruber*. These values were substantially higher than those for *R. niobe* (12.5% and 0.6%, respectively). This difference may be attributed to the more diverse chigger populations recorded for the disturbed habitats frequented by *R. ruber* (TABLE 7, 8). The greater diversity may also account, at least in part, for the larger numbers of chiggers per host individual when compared with *R. niobe*. Although both the incidence of simultaneous occupation of given parasitopes and mean numbers of chiggers per host were higher for *R. ruber* than for *R. niobe*, parasitope specificity for given chigger species remained unchanged.

DISCUSSION

Sasa (1961) suggested that some species of chiggers were parasitope-specific, but did not believe this to be a general pattern for most species of the Trombiculidae. Traub & Morrow (1955) observed parasitope-specificity in several species of *Gahrлие-*

pia, but did not suggest this to be a pattern for the genus. Traub & Wisseman (1968) have noted that for *Leptotrombidium* (*L.*) *deliensis* the attachment site will vary depending on the host and have attributed this to the host's grooming activities. Thus, they state that *L. deliensis* is found in the ears of rats, the belly and inguinal regions of tree-shrews (*Tupaia*) and in clusters in the eyebrows and eyelids of *Macacus* monkeys. A parallel situation was observed for *L. deliensis* in the present collections, which was recovered from the ears of Muridae, but only from the legs of Peramelidae. A similar situation was observed in *Guntheria* (*D.*) *omega*, which was recovered from the ear fringe of murids in 96% of the records, but only from the legs and body surfaces of peramelids. Within each family of hosts, the parasitope for a given chigger species tends to remain constant.

Vulnerability to host grooming activities was also reflected in the length of the cheliceral blade, the primary means of attachment to the host during engorgement. In the intranasal species, the cheliceral blade is short and poorly armed with teeth (TABLE 9), while in those species infesting the perianal region the cheliceral blade is elongate and armed with a dorsal row of recurved teeth. The cheliceral blade of species infesting ear and dorsum is of intermediate length and armed only with a tricuspid cap.

Species of *Ascoschoengastia* and *Gahrlipeia*, infesting the intranasal habitat, exhibited a parasitope specificity which was independent of host, with recovery frequencies ranging from 99.7% to 100%. Certain similarities exist among species occupying the intranasal habitat. Body setae were shorter and much thinner than for those of other species in these 2 genera frequenting the external exposed surfaces of the hosts. Reduced sclerotization and reduction of the scutum were noted in many intranasal species; posterolateral scutal setae were commonly extrascutal in intranasal species. Idiosomal expansion during engorgement was far in excess of the 20× increase in volume suggested by Audy et al. (1972). Idiosomal measurements for *Gahrlipeia* (*W.*) *morobiensis* ranged from 150 × 130 μm in unengorged individuals to 770 × 630 μm in fully engorged individuals, or roughly a 120× increase in volume. This same pattern has been observed for intranasal species in other genera (Loomis 1963) and appears to be correlated with the protective nature of the intranasal parasitope (Nadchatram 1970). Audy et al. (1972) have suggested that excessive idiosomal engorgement of intranasal species represents an instance of larval neosomy, or intrastadial production of new tissue, even though not as extreme as in the case of *Vatacarus ipoides* Southcott, 1957 (Trombiculinae). This species infests the tracheal passages of sea snakes and shows volume increases of up to 1500× when fully engorged (Audy et al. 1972).

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