ECTOPARASITE FAUNA OF SMALL MAMMALS AND BIRDS IN THE FUJI MANEUVER AREA, HONSHU, JAPAN[1]

WILLIAM SUYEMOTO,[2] JOHN E. SCANLON,[3] AND TEOFILO C. SICAY[4]

This report on the ectoparasite fauna of small mammals and birds in the Fuji maneuver area has resulted from an analysis of data assembled during 8 entomological surveys by the 406th Medical General Laboratory and the Far East Medical Research Unit, United States Army Forces, Far East.

The surveys have been limited geographically to but a small area northeast of Mt. Fuji, generally the same area as that surveyed in 1948 by Kuwata, Berge and Philip (1950). They were originally initiated to evaluate hazards from all arthropod pests present in this area, but with succeeding surveys it became increasingly apparent that the emphasis of field surveys should be restricted to parasites of small mammals and birds. An added incentive to this approach was the reported occurrence of scrub typhus cases among Army personnel on duty at Camp Fuji in the fall of 1948 (Anon., 1948, and Kuwata, *et al.,* 1950). The accessibility of the Fuji maneuver area made it possible to carry on extensive field investigations to permit adequate sampling of the ectoparasite fauna and animal reservoirs throughout the various seasons of the year. An attempt was made to determine the probable vector or vectors responsible for the 1948 outbreak of scrub typhus by studying the seasonal distribution and population of the chigger species during the course of the investigation.

Numerous individuals have participated in the field surveys leading to this report. In addition to the writers and Major Paul W. Oman, under whose general direction the project was undertaken, the following individuals have been engaged in this work: Sgt. Mariano F. Calpo, Cpl. Roy A. Crossman, Pfc William A. Drew, and Pfc Stanley G. Ennis.

The identification of ectoparasites has been made largely by the writers and we are indebted to Mr. F. G. A. M. Smit of Tring, England, for the identification of the female specimen of *Frontopsylla,* and to Dr. E. W. Jameson, Jr. for the identification of the male specimen of *Stenoponia montana.*

Identifications of mammal and bird hosts in this report have been made by Mr. Akiyoshi Nawa, taxidermist and adviser in mammology with this Department. The nomenclature used in listing mammalian hosts follows Kuroda (1953). Names of birds listed follow Shimomura (1942).

SCOPE OF THE SURVEYS

Chronologic. Surveys were scheduled to obtain adequate samplings of arthopod pests, vectors, and animal reservoirs of disease in the Camp Fuji maneuver area during each season of the year. During 1952 surveys were made during the periods 22–24 May, 26–30 August, 22–29 September, 7–11 October and 15–20 December.

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[1] From the Department of Entomology, 406th Medical General Laboratory, and the Far East Medical Research Unit.

[2] Entomologist, 406th Medical General Laboratory.

[3] 1st Lt., MSC, now at First Army Area Laboratory, New York.

[4] Capt., MSC, now at 6003rd A.S.U., US Army Hospital, Ft. Ord, California.

During 1953 surveys were made during periods of 26–30 January, 16–20 March and 4–12 May.

Geographic. The studies were limited to a relatively small region on the northeast slope of Mt. Fuji at elevations of approximately 2500 to 4000 feet. The northeastern limit of the survey was in the vicinity of the Higashiguchi trail, north of Camp Fuji. From this locality to about 300 yards beyond station No. 1 on the Gotembaguchi trail a number of selected areas were studied. Elevations above sea level for the areas studied are 2850 feet for Areas 2, 4, 5, 6, 8 and 10, 2870 feet for Area 3, 3040 feet for Area 7 and 4000 feet for Area 1.

Biologic. Principal effort was concentrated upon the ectoparasites of wild rodents, insectivores and birds in order to determine whether potential vectors of scrub typhus and other mite borne diseases were present and to determine by epidemiologic means, what vector species were responsible for the 1948 outbreak of scrub typhus among troops in the Fuji maneuver area.

Ecologic. Most of the region surveyed is rather uniformly covered with a thick layer of volcanic rock waste of soy bean size and smaller. The soil is generally shallow and in some sections exceedingly spotty. Deep soil is found only along the margins of some of the larger drainage courses. With the exception of Area 1, which is at an elevation of about 4000 feet and in the montane zone of vegetation, the vegetative cover of the areas is rather sparse excepting along the water courses. Area 1 is thickly wooded with *Abies, Quercus, Betula,* and *Acer,* with floor covering of moss, ferns and grasses. The remaining areas are more sparsely vegetated and characterized by extensive grassy sections, low deciduous shrubs, second growth hardwoods, and small wooded sections in which *Thuja, Cryptomeria,* and some *Pinus* predominate.

METHODS

Animal ectoparasites and their hosts. Various methods of collecting ectoparasites were used in the Fuji maneuver area, although the basic approach was to capture warm blooded hosts and examine them for the presence of parasites. Rodents and insectivores were trapped in representative ecologic habitats, and birds were shot wherever possible within the general area. Chiggers were collected during some of the surveys by the use of a black plastic plate laid on the ground to attract the chiggers, and during one survey trip chiggers were collected by using caged laboratory mice as "bait."

SURVEY RESULTS

Animal hosts. Animal hosts fell almost exclusively into three general categories, namely rodents, insectivores and birds. A total of 420 rodents, 83 insectivores, 64 birds and a lagomorph were taken during these surveys. By far the commonest rodent host taken was *Apodemus speciosus,* which occurred in all ecologic habitats explored. The next most abundant mammals were *Apodemus sylvaticus* and *Urotrichus talpoides,* both taken in virtually all habitats explored. *Microtus montebelli,* a vole, though not common, was taken most frequently in Areas 5 and 7. *Eothenomys smithii,* likewise relatively uncommon, was for the most part taken in Area 1 at an altitude of approximately 4000 feet. The birds most consistently encountered and collected were *Saxicola torquata stejnegeri, Chloris sinica minor, Emberiza fucata fucata, Passer montanus saturatus, Parus atricapillus restrictus,*

Parus major minor, Zanthopygia narissina narissina and *Zosterops palpebrosa japonica.*

Chiggers. A total of 16 species of chiggers representing four genera were recovered from rodents, insectivores, and birds (Suyemoto, 1953). Although not numerically abundant, some chiggers were encountered in all areas investigated. The average number of chiggers per host, based on collections from the four most abundant rodents and the one common insectivore, was 9.03. Of the 16 chigger species represented in the Fuji area, all occur on mammal hosts excepting *Neoschöngastia posekanyi,* which was found only on birds. Of the 27 species of birds examined, but 6 were infested with chiggers. Three species of chiggers, *Euschöngastia miyagawai, N. posekanyi,* and *Trombicula scutellaris* were found on birds, namely *Chloris sinica minor, Emberiza cioides ciopsis, E. fucata fucata, Parus major minor, Saxicola torquata stejnegeri, Troglodytes troglodytes fumigatus,* all of which live or feed on or near the ground. The mite plate sampling technic employed during and since the December survey resulted in the collection of 5 species of chiggers, namely *E. miyagawai, Trombicula fuji, T. pallida, T. scutellaris,* and *T. tamiyai.*

The seasonal occurrence of chiggers in the Camp Fuji area indicates that most species involved fall into the so-called "winter" group, as determined by time of occurrence of the parasitic larval stage, with the questionable exceptions of *T. nagayoi* and *N. posekanyi.* These were the only species encountered during the August survey when the number of chigger specimens were exceedingly low. The paucity of our data concerning these two species does not permit generalizations as to whether they can be rightfully assigned to the "summer" group of chiggers. Within seasonal limitations the appearance of larval trombiculids apparently tends to be influenced by weather conditions. With respect to the "winter" group as a whole, the accumulated data indicate that from approximately the end of May the larval trombiculid population on rodents declines rapidly until the advent of cooler weather sometime during September, when the population again increases. Fortuitously, it was possible to "pinpoint" the autumn rise in chigger population during the September field survey. During the course of this field trip, very few chiggers were found on rodents on the first days of trapping. Only 14 chiggers were taken from 54 rodents during the period 23 through 26 September, 1952. A heavy rainfall began on the night of 25 September and continued through 26 September. Beginning 27 September chiggers were abundant in all areas surveyed. *T. scutellaris* was the predominant species in all areas trapped and at that time was also recovered from a bird. The chiggers taken at this time were for the most part unengorged, indicating recent attachment, and many were found on hosts but unattached. During December, January and March, chiggers were recovered by use of mite plates when air temperature was as low as 3° C. During the January survey one specimen of *E. miyagawai* was taken from a plate placed on the ground after brushing aside a 3 to 4 inch layer of snow.

The distribution of chiggers in the various areas surveyed revealed that but 1 of the *Leptotrombidium* chigger group, *T. fuji,* was taken in Area 1, elevation about 4000 feet, even though *T. pallida, T. scutellaris* and others were common at the lower elevations. *T. fuji,* in particular, has been found commonly throughout the Kanto plain area and is common to all areas surveyed in the Fuji maneuver area. By way of contrast, *T. nagayoi* has been found only on Hokkaido and in the higher

elevations of central Honshu. With this exception, there have as yet been no significant distribution patterns detected for the chiggers in the Fuji area. The abundance of chiggers in a given locality appears to be rather closely correlated with the abundance of their rodent hosts, which in turn is influenced by suitable terrain, these animals being more abundant in sections where the soil is fairly deep and vegetative cover luxuriant. Even within an area known to have a high population of chiggers, their distributon appears to be exceedngly spotty, as determined by the plate sampling method.

The disease vector suspects among the chiggers present in the Camp Fuji area are those belonging to the subgenus *Leptotrombidium,* namely *T. fuji, T. kitasatoi, T. pallida, T. palpalis* and *T. scutellaris.* On the basis of data accumulated during our surveys, and assuming that the findings are typical with respect to seasonal occurrence, *T. scutellaris* (known to harbor rickettsiae, Kawaji *et al.,* 1953), is a suspected vector during late September and October, the period during which the scrub typhus cases of 1948 must have been contracted. *T. pallida,* which was present from September to May, is also a suspected vector. The absence of *T. kitasatoi* in September and the occurrence of but one specimen during the October survey, and *T. palpalis,* which is definitely a winter species, would all be excluded from the role of a potential disease vector in connection with the 1948 scrub typhus outbreak. Although definite proof is lacking, it seems unlikely that *T. fuji* can serve as a vector because of its absence in September and its low level of larval population during October, reaching its population peak in December. During the October survey, *T. fuji* occurred at elevations below 2870 feet and it was conspicuously absent from Areas 1 and 7 utilized to a large extent by troops on field maneuvers. Fukuzumi, Obata and Kagiwada (1951) isolated the etiologic agent of scrub typhus from the rodent, *Apodemus speciosus,* and showed by laboratory experiments that *T. pallida* is capable of transmitting the disease, but to date positive proof of the local vector mite is lacking. These studies have served to demonstrate that chiggers are most abundant in the survey area during the fall and winter months, and active at relatively low temperatures. The spotty distribution of chiggers in infested areas makes it impracticable clearly to define "danger areas" and "non-danger areas." The avoidance of chigger attacks, and hence of chigger-borne diseases, would appear to depend largely upon the observance of personal protective measures during the seasons when chiggers are known to be present. Fortunately the standard U. S. Army clothing treatment repellents are effective acaricides, and if used properly can be expected to give good protection. This measure should be supplemented, whenever possible, by avoidance of intimate contact with the ground in infested areas.

Laelaptid mites. Ten species of laelaptid mites were taken from rodents and insectivores. The species most consistently encountered were *Laelaps jettmari* and *Haemogamasus japonicus.* It is of interest to note that *Laelaps* sp. encountered primarily on *Clethrionomys rufocanus* on Hokkaido has been found rather frequently in the Fuji area on *Eothenomys smithii.* In addition, *Neoichoronyssus isabellinus* previously reported in Japan only from Hokkaido occurs also in the Fuji maneuver area. Among the laelaptid mites encountered in the Fuji area, none thus far has been incriminated as a vector of any known disease in Japan.

Lice. Six species of blood-sucking lice, all members of the genera *Hoplopleura*

and *Polyplax,* were collected during the Fuji survey. Inasmuch as the Anoplura complete their life cycle entirely upon the host animal and are relatively host specific (Ferris and Stojanovich, 1951), their distribution within the survey area is coupled with the distribution of the host species and only indirectly with the terrain or other factors. Wherever the proper hosts were taken in numbers sucking lice were collected. Furthermore, lice were collected during all seasons of the year and no particular population trends were detected.

The most frequently collected species were *Hoplopleura affinis* and *Polypax serrata.* Both were recovered from hosts of the genus *Apodemus* and are normally parasites of rodents of this genus. The two species of lice were found on single host animals several times. *Microtus montebelli montebelli* was infested with *Hoplopleura acanthopus* and *Polyplax abscisa,* but the two lice species were not found in multiple infestations of individual hosts. The same was true of the species of lice infesting *Micromys minutus,* namely *Hoplopleura longula* and *Polyplax gracilis.* The latter species is apparently quite rare as it has not been reported since the original description in 1910 from the same host, probably collected in Germany (Fahrenholz, 1910). The Fuji specimens agree well with original and subsequent descriptions. Further notes on these specimens and additional material from Korea have been prepared for presentation elsewhere.

Of particular interest is the absence of Anoplura from *Urotrichus talpoides* in view of the large number of hosts examined. On the contrary the apparent absence of lice from the shrews, *Crocidura russula* and *Sorex caecutiens* is probably due to the small number of animals examined rather than to an absence of lice. The same may be said of the Japanese dormouse, *Glirulus japonicus,* and the rabbit, *Lepus brachyurus.*

The species of lice collected in the Fuji area pose no particular problem in the causation of human disease. Rodent lice have been implicated as rodent to rodent vectors of murine typhus and must be suspected in this role wherever a rodent-borne disease is encountered. But the possibility of these lice being involved in natural rodent to man transmission of disease is extremely remote inasmuch as the rodent-infesting lice will not attack man under natural conditions.

Fleas. Although only small numbers of SIPHONAPTERA were encountered during the course of the surveys, a total of 9 species were taken from rodents and insectivores. The species encountered most frequently was *Paleopsylla nippon* taken primarily from shrew-moles in practically all areas surveyed. *Frontopsylla* sp. recovered from *Apodemus speciosus* for the first time from Japan is of interest historically from an evolutionary viewpoint. The known *Frontopsylla* species of the family CERATOPHYLLIDAE reported from European birds presents an example of convergent evolution (Rothschild and Clay, 1952). *Stivalius* sp. "A" was common only during the summer months. *Stivalius ahalae* from South India and *St. cognatus* from Java are of medical importance in that they are involved in the transmission of bubonic plague. In view of the 1907 plague epidemic in Japan, the possibility of future outbreaks cannot be ignored. This species might well serve as a vector should sylvatic plague become established in Japan.

SUMMARY

Sixteen species of chiggers, belonging to 4 genera, are known to occur in the Fuji military maneuver area. On the basis of seasonal occurrence 2 of these species,

namely *Trombicula pallida* and *T. scutellaris,* qualify as possible vectors during the 1948 outbreak of scrub typhus in this area. Chiggers were scarce, both in number of species and individuals, during the summer months, as shown by surveys in 1952 and 1953, and did not become abundant until late September. No significant distribution pattern is detected for the chiggers in the Fuji maneuver area with the exception of *Trombicula nagayoi* which occurs at relatively high elevation. Protection from the hazards of chigger-borne diseases depend upon use of clothing impregnated with acaricides and avoidance of intimate contact with the ground in infested areas. Chiggers are the only ectoparasites collected during the series of survey trips which may be considered to be medically important.

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INTERNAL PARASITES IN NORTH DAKOTA ANTELOPE[1]

Alice I. Goldsby[2]

and

D. F. Eveleth

Department of Veterinary Science, North Dakota Agricultural College, Fargo, North Dakota

The largest herd of antelope in the western part of the United States is located in an area comprising parts of Montana, Wyoming, and North and South Dakota. Some antelope spend their summers in North Dakota and migrate into adjoining states during the fall and winter.

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[2] Present address: Department of Veterinary Science, University of Wisconsin, Madison, Wisconsin.