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TRANSLATION FROM RUSSIAN. GROKHOVSKAYA, I. M. and NGUYEN HUAN HOE* (1969). Characteristics of the fauna, ecology, and geographic distribution of bloodsucking arthropods in Vietnam. Zool. Zh. 48(5):629-634.

In Vietnam, about 300 species and subspecies of bloodsucking arthropods have been revealed (Anophelini, Culicini, Phlebotominae, Aphaniptera, Gamasoidea, and Ixodidae). Specific features of each group are recorded in respect to the natural features of Vietnam. The bloodsucking arthropod fauna in Vietnam is chiefly represented (70%) by Indo-Malayan elements, by species common in the fauna of other regions (Australian, Palearctic, and Ethiopian, 25%) and by a small group of cosmopolites (5%). Comparison is made of distributional features of bloodsucking arthropods on the basis of the characteristics of their associations with the habitat environment and the host. The greatest number of widespread species was recorded among fleas, gamasid mites, and ixodid ticks. The fauna of the mountain area in northern Vietnam is the richest and most unique.

The study of the Vietnam fauna and characteristics of its distribution is of great interest owing to the extreme originality of this tropical country. Materials for this report were collections of insects (mosquitoes, fleas), mites (trombiculid, gamasid), and ixodid ticks, made by us in 9 provinces of the Democratic Republic of Vietnam in 1956 (Thai Nguyen, Con Cuong, Cao Bang, Khazyang, Lao Kay, Kuangtri, Ngean, Tan'khoe, and Khadong). Ectoparasites were collected from domestic and wild animals (rodents, insectivores, and Chiroptera) and from their habitats. A total of 1,500 small mammals belonging to 23 species and subspecies was trapped and over 50,000 specimens of bloodsucking arthropods belonging to 150 species and subspecies were collected. Literature data on bloodsucking parasites of Vietnam were also used for general evaluation of the bloodsucking fauna of this country.

GENERAL CHARACTERISTIC OF THE FAUNA

The bloodsucking arthropod fauna of Vietnam consists of numerous species and subspecies. The following have been recorded in the territory of this country: 110 Anophelini and Culicini mosquito species and subspecies, 11 sandfly species (Phlebotominae), 17 flea species and subspecies (Aphaniptera), 43 trombiculid mite species (Trombiculidae), 35 gamasid mite species (Gama-

* Institute of Epidemiology and Microbiology, USSR Academy of Medical Sciences (Moscow) and Ministry of Health of the Democratic Republic of Vietnam (Hanoi).

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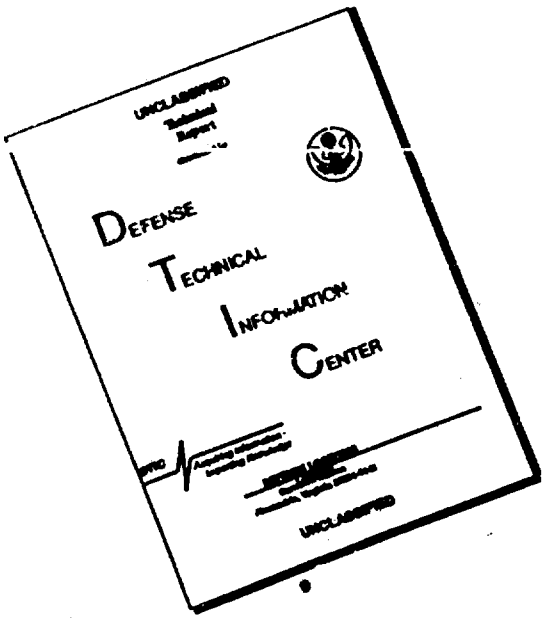

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soidea), and 44 ixocid tick species and subspecies (Ixodidae) (Grokhovskaya, 1967). The bloodsucking species composition will undoubtedly be subsequently considerably enriched especially due to (finding) arthropods that live in natural habitats and parasitize wild mammals and birds.

Hygrophilous forest species distinctly predominate among the bloodsucking fauna of Vietnam. The mosquito group is richly represented, especially the genera Culex, Anopheles, and Aedes. Different mosquitoes reproduce in forest water reservoirs: mountain streams, rivers, tree holes, trimmed bamboo, and leaf axils (Saf'yanova et al., 1964). The ixodid tick fauna is rich in species especially of hygrophilous tick forms belonging to the genus Haemaphysalis (Toumanoff, 1944; Grokhovskaya et al., 1968). Among Hyalomma ticks, only H. dromedarii indosinensis has been recorded in southern regions of the country. The presence of the genera Amblyomma and Aponomma is characteristic of the ixodid fauna in Vietnam. The trombiculid mite group is also represented by numerous species (Grokhovskaya and Nguen Huan Hoe, 1969), especially in the subfamily Trombiculinae (15 genera, 31 species). Of these, only the genus Leptotrombidium includes 7 species, Helenicula 4 species, and others 1 or 2 species each. Parasitic gamasid mites are represented by a much smaller number of species. Among these, mites of the genera Laelaps, Hirstionyssus, and Steatonyssus predominate distinctly. Representatives of the family Haemogamasidae and of the genus Eulaelaps are absent in our collections (Grokhovskaya et al., 1961). Few nest parasites are found among fleas of Vietnam; most fleas inhabit the fur cover (Rostigayev and Grokhovskaya, 1966). Sandflies of Vietnam belong to the genus Sergentomyia. The genus Phlebotomus is represented only by 2 species (Ph. argentipes and Ph. stantoni).

GEOGRAPHIC EVALUATION OF THE FAUNA

The Vietnam fauna of bloodsucking arthropods and ticks consists chiefly of Indo-Malayan elements (70%), species common in the fauna of other regions (Australian, Palearctic, and Ethiopian) (25%), and a small group of cosmopolites (5%) (Fig. 1). The largest number of Indo-Malayan endemic species in Vietnam was recorded among sandflies (100%), among malaria mosquitoes (93%) and trombiculid mites (88%). There are no cosmopolitan species in these groups in Vietnam. Ixodid ticks, gamasid mites, and fleas are more widely distributed. There are numerous cosmopolite species among fleas (24%) and gamasid mites (17%). Of 43 trombiculid mite species found in Vietnam, only 5 are found in other zoogeographical regions (Australian and Palearctic). In Vietnam, only the common genera of trombiculid mites (Schuteedenichia) of the Ethiopian Region are found. The distribution of sandfly species is also restricted. Most belong to representatives of the Indo-Malayan fauna and some are found only in Vietnam. The chief number of sandfly species belong to the subgenus Sergentomyia of the Zeylonica group. Sandflies of this group are widespread in humid

areas of the Ethiopian region. Among bloodsucking mosquitoes, Anopheles are the most specific species in Vietnam. Of 28 species known in Vietnam, only 2 are found in the Palearctic Region. Anopheles species common in Vietnam are not found in the Ethiopian zoogeographic region. More numerous common species occur in the transition region between the Indo-Malayan and Australian regions. The distribution areas of the Culicini mosquito group is broader. Of 90 species and subspecies recorded in Vietnam, 29 are encountered in the Australian Region and in the transition region between the Indo-Malayan and Australian regions. Sixteen Vietnamese species are found in the Palearctic Region, of these 11 are common in the USSR where most are confined to the Primor'ye Region.

Most ixodid tick species are representatives of the Indo-Malayan fauna (70%) 2 (cosmopolites not included) have been recorded in the Ethiopian Region, 6 were also found in the Australian Region, chiefly New Guinea, and 6 parasitize in the Palearctic Region. Rhipicephalus sanguineus and Boophilus annulatus are cosmopolites. In Vietnam, there are permanent Indo-Malayan parasitic gamasid mites of the genus Laelaps of which the hosts are rats inhabiting these areas exclusively, as well as parasites of mole rats (Rhizolaelaps), local squirrels (Hirstionyssus), and bats (Steatonyssus). Among gamasids of Vietnam, there are species common in the Palearctic and Ethiopian faunas; 6 species recorded in Vietnam are widely distributed in the tropical belt and sometimes penetrate into more northern areas.

Of 17 flea forms recorded from Vietnam, 10 are specific of the Indo-Malayan Region. Among fleas of Vietnam, species common in the Australian and Palearctic regions are recorded. The cosmopolites are Pulex irritans, Xenopsylla cheopis, Leptopsylla segnis, and Ctenocephalides felis felis.

Thus, if we observe the distribution of different representative blood-sucking groups in Vietnam, the greatest predominance of the Indo-Malayan fauna representatives can be noticed. This is distinctly apparent by the example of sandflies, malaria mosquitoes, and trombiculid mites, of which only a small number of forms extend beyond the range of the Indo-Malayan Region. The greatest number of cosmopolites is recorded among gamasid mites, ixodid ticks, and fleas.

DISTRIBUTION OF BLOODSUCKING ARTHROPODS ACCORDING TO THE LANDSCAPES OF NORTHERN VIETNAM

In the Democratic Republic of Vietnam (according to the Fridland terminology), there are distinguished 3 landscape areas: mountains, hills, and plains. The mountain area occupies much of the country and is distinguished by a variety of topographic forms, soil, rich vegetation and vertebrate fauna.

Primary tropical forest is preserved only in certain localities of mountain areas. Hilly areas directly adjoin the mountains and occupy a transition situation between them and the plains. The area occupied by hills is smaller than that occupied by mountains and plains. Tropical forests in this landscape are almost all cleared. In certain places they have been replaced by secondary forests. The territory is characterized by a high population density. Plains occupy a small part of the country. These are the comparatively recently formed delta or maritime formations. The Vietnam plains, characterized by flat and monotonous relief and lacking forests, are mostly used for rice crops. The animal kingdom is poor and forest forms are almost completely absent while domestic animals are numerous. The main human population of the country is concentrated in the plains.

Mountain areas are characterized by the greatest variety of species and singularity of bloodsucking arthropods (Fig. 2). Species found only in the mountains comprise 43% of the total faunal composition of the mountainous areas (altogether 43 species). Most representatives of the new gamasid and trombiculid species described by us (30 of 39 recently described species from North Vietnam) were collected in mountains. Numerous bloodsucking arthropods associated with a specific host or with definite areas are characteristic of Vietnam mountain areas. These species usually occupy small distribution areas and are found only within this territory; 22% of the mountain area fauna (21 species) is distributed in all landscapes of Vietnam. Most of these species occur beyond the range of Vietnam and the Indo-Malayan Region and are also distributed universally (L. nuttalli, L. echidninus, X. cheopis, R. sanguineus, and H. annulatus). Within the mountain range, these species are attracted to the main places, human settlements. They more frequently parasitize synanthropic rodents or domestic animals. Despite a great variety of bloodsucking species, the numbers of individual species are small, but synanthropic species are usually numerous.

The numbers of bloodsucking insect species and ticks recorded in the hilly area are fewer than those in the mountain area (Fig. 2); 28% (21 species) are characteristic of this area only. Of 39 recently described species, 15 were found here. The most special fauna is recorded in areas where forest has been preserved. These are sometimes small shrub areas among cultivated fields; 28% (21 species) are common in all landscapes.

In plains, the bloodsucking arthropod fauna is remarkably poorer than that of the mountain and hill areas (Fig. 2). Only 29% of the total species number are characteristic of the plains. From these areas, only 3 new species were described. Most bloodsucking species are associated with domestic animals. Half of the species consist of forms common in all landscapes. Conditions in the plains created by man are favorable for development of synanthropic species and

allow them to reach great numbers (C. bursa, L. nuttalli, L. echidninus, R. sanguineus, B. annulatus, and C. felis orientis).

CONCLUSIONS

The species variety of bloodsucking arthropods in Vietnam is determined by specific natural characteristics of this country. The small Vietnam territory is characterized by a great changeability of the relief, soil, and vegetation, which make a diversity of habitats for vertebrate and invertebrate animals. These conditions undoubtedly increase the species-forming processes. As a tropical country, Vietnam is characterized by a warm, humid climate and is distinguished by great stability during long geological periods (Dobbi, 1952). In such climatic conditions ("natural thermostat"), arthropods are active during the entire year, which accelerates the selection process. From analysis of the characteristics of the vertebrate animal fauna, Gaither(1936), Kolosov (1945), and Dobbi (1952) consider that the southeastern Asia region is an active species-forming center. While studying different bloodsucking arthropod groups, we found new species, as well as forms which differed from typical forms according to several criteria and had been recorded earlier in other southeastern Asia regions. Morphological differences of these forms were insufficient for classification into individual species and subspecies (Saf'yanova, et al., 1964, Rostigayev and Grokhovskaya 1966, Shluger et al., 1960, 1960a, 1961, Grokhovskaya 1968). The greatest number of forms differing from typical species forms was recorded in Vietnam among ectoparasites distinguished by strict adaptation to the host (Laelaps mites among gamasids) or to a definite habitat (trombiculid mites). The diversity of the Vietnam fauna and recorded by us a great changeability of forms (gamasid, and trombiculid mites, fleas, and mosquitoes) confirms the opinion of several authors that the natural conditions of this area are favorable for active forming of species.

The distribution of bloodsucking arthropod species, despite historical reasons, is stipulated to a great degree by their ecological characteristics. In our case, this is distinctly apparent from examples of distribution of bloodsucking insects and ticks in the Vietnam territory and beyond its range. The distribution area of several bloodsucking arthropods (gamasid mites, fleas, and ixodid ticks) is determined by the character of their host distribution. Certain bloodsucking species of this group have restricted distribution areas owing to their specific association with a host of a small distribution area (individual representatives of the genus Laelaps). When such specific associations with definite hosts and considerable ecological pliability are absent, the distribution of other ectoparasites is considerably broader (L. echidninus, L. nuttalli, and R. sanguineus). The distribution areas of other bloodsucking species is determined by environmental conditions favorable for development of their nonpara-

sitic stages (trombiculid mites, sandflies, and mosquitoes). Representatives of these groups are not associated with strictly definite hosts and parasitize for a short period only in one developmental stage.

However, their free living stages show a strict requirement in the choice of habitats (soil type and microclimate). Thus such arthropods are characterized by a mosaiclike, restricted distribution.

During study of the distribution area and its range, the different abilities for dissemination of different representive groups should undoubtedly be considered. Some are able to move actively (mosquitoes) in search of necessary conditions of life while others are associated with the soil and their migrations are insignificant (trombiculid mites).

The fauna of bloodsucking arthropods in the mountain regions of Vietnam is distinguished by a special singularity. It consists of numerous forms with restricted distribution. Most species found in mountains are not numerous. The plains fauna consists of synanthropic species which are numerous within the entire Vietnam territory.

Summary (Original in English)

In Vietnam about 300 species and subspecies of bloodsucking Arthropoda were found (Anophelini, Culicini, Phlebotominae, Aphaniptera, Gamasoidea, Ixodidae). Specific features of each group are mentioned in respect to the peculiarity of the nature in Vietnam. The fauna of bloodsucking Arthropoda in Vietnam is represented mainly by Indo-Malayan elements (70%), by the species common with the fauna of other regions (Australian, Palearctic, Ethiopian) (25%) and by a small group of cosmopolites (5%). A comparison of peculiarities in distribution of bloodsucking arthropods with the character of their relationships with the environment and the host is provided. The greatest number of widespread species occur among fleas, gamasid and ixodid ticks. The fauna of the mountain territory of North Vietnam is most rich and peculiar.

Legend

Fig. 1. Zoographic composition of the bloodsucking arthropod fauna in Vietnam. I - Vietnam fauna as a whole, II - trombiculid mites, III - gamasid mites, IV - ixodid ticks, V - Anopheles mosquitoes, VI - Culicini mosquitoes, VII - fleas, VIII - sandflies, 1 - Indo-Malayan species, 2 - species found in other regions, 3 - cosmopolites.

Fig. 2. Composition of the bloodsucking arthropod fauna in the landscapes of northern Vietnam. I - mountain areas, II - hilly areas, III - plains; 1 - endemic species in a landscape, 2 - species common in all landscapes; common species: 3 - in mountains and hills, 4 - mountains and plains, and 5 - hills and plains.

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