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QUANTITATIVE AND QUALITATIVE INVESTIGATIONS INTO THE CULICIDAE-FAUNA OF THE TISZA-BASIN

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Abstract

The Culicidae-fauna of the Tisza-basin was investigated systematically by the author in the years 1973 to 1975. His main aim was to establish by which species and to what extent the main mosquito injury is caused along the Tisza. In this paper, the results of the elaboration of 6315 individuals are dealt with. These were collected, in the interest of this aim, in the course of blood-sucking. On the basis of the investigations until now it is to be established that the mosquito-density along the Tisza (except for one or two points, *e.g.*, Tuzsér) is high. In the Tisza-basin, the main injury is caused by three species. These make 86,81 per cent of the complete material collected in the course of blood-sucking, namely: Aëdes vexans Meig. (41,17 per cent), *Culex modestus* FIC. (26,68 per cent), *Aëdes rossicus* D. G. M. (19,06 per cent). The remarkably high ratio of *Culex modestus* FIC. may have been in connection with the several dead-arms beside the Tisza.

Introduction

One of the most important tasks of combating the injury induced by mosquitoes has always been to organize the entomological preparation. A defence that was not duly founded with a preliminary surveying work not only cannot achieve the result intended but may even engender considerable damages to the people's economy. There are more and more recreation areas along the Tisza banks, too: resort centres, anglers camps, more and more anglers and tourists. The mosquito-bites come, therefore, increasingly into the limelight. And a natural consequence of this is that the measures of defence also increase, respectively that more claims are put in for a more efficient protection. The more successful defensive operations may be promoted by recording the Culicidae-fauna of the Tisza-basin. Other defensive works carried out in other regions of our country were also preceded by similar investigations (MIHÁLYI 1939, 1954, MIHÁLYI—SOÓS 1952).

The research into Culicidae-fauna of the Tisza-basin is justified, even apart from the causes enumerated above. This region is an almost completely blank area on the maps showing the distribution of the Culicidae of our country (MIHÁLYI 1959). The subject may be included well in the programme of the Tisza-Research Working Committee of the Hungarian Academy of Sciences.

I have been induced by these circumstances to launch a detailed programme of work in the framework of the Tisza research, covering a number of years.

I began the systematical, planned research into the Culicidae of the Tisza-basin in 1973. The bulk of investigations fell, however, to 1974 and 1975. In both years, I scoured practically the whole stretch of the Tisza-basin in Hungary (in some areas even on several occasions) (Fig. 1).

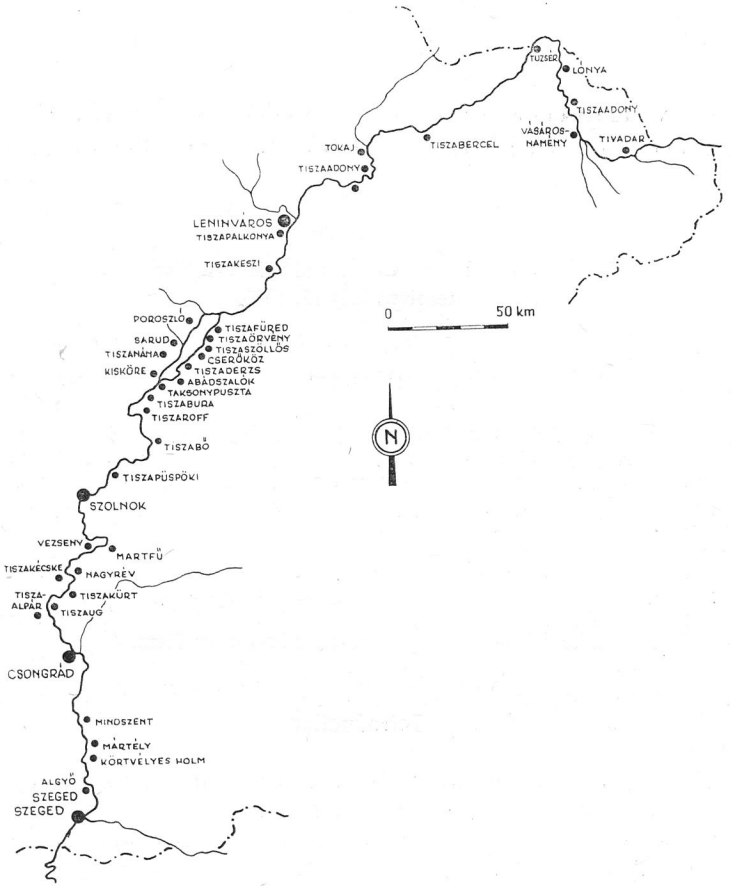

Fig. 1

Collecting work, collecting method

During the three years, approximately 10,000 Culicidae individuals were collected. This may serve for a real basis to carry out a preliminary quantitative evaluation. The present-day picture can, of course, be considerably modified later, in the course of the further researches.

In the collecting work there were applied various methods. It was regarded as a main task, to collect the man-biting species. My collecting method was in part different from the method applied by MIHÁLYI and his co-workers. In case of collecting in the course of blood-sucking, the application of a snifter is namely only successful if the density of mosquitoes is comparatively small. Where there are a great many mosquitoes, the animals attacking man cannot be collected by means of a snifter. I have worked, therefore, on these occasions, with a butterfly-net, generally used for collecting insects. I stopped in the selected place, to collect with the net the animals flying on me. An advantage of this method is that in this way a larger number of animals can be collected. It isn't a matter of secondary importance, either, that in this case I need not wait till the animal bites me (as generally in case of collecting with a snifter). On the other hand, it is an unquestionable disadvantage that the

squamae of animals wear off harder because of beating about with the net — and this makes the determination more difficult.

Mainly in malarial regions, there are used several trap-types by foreign researchers for collecting blood-sucking Culicidae. In this country, the mosquito-collector is not in danger of malaria. Nevertheless, a trap described in the special literature and operated by carbon dioxide was made and tested on the shores of the Balaton by ISTVÁN KECSKEMÉTI but, for the time being, not very successfully.

In places with many mosquitoes, one cannot keep easily in one place more than 5 to 10 minutes long, even if collecting with the netting method. The duration of collecting was changing, it lasted for 5 to 30 minutes. For enabling a rather real comparison, at any data of collection I reduced quantities to one hour. In this way I obtained the theoretical mosquito-density falling to one hour. Reckoning further on with this, I compared the mosquito-density of the single sampling points with one another.

It is a well-known phenomenon that the majority of the mosquito-species attack most intensively towards evening, parallel to the increase in the vapour content of the air. But in order that I may make best use of the time at my disposal, I had to continue my collections from morning till night. Thus, a further problem could be, to take into consideration the differential factor given by the difference between the parts of the day, as well. The elaboration of this method, however, as I know, has not been taken place in our country, as yet.

The elaboration of 6316 mosquito-specimens has served as a basis for calculations. 99,4 per cent of the material collected could be determined. But at the evaluation the rest of the material was also taken into consideration because of the quantitative scientific approach of my work.

At present, I do not deal with the material collected in another way (netting, sniffing up with a snifter, larval material), although I had elaborated that, too. It is to be remarked, anyway, that a complete evaluation of the complete material would evidently give us a different picture because first of all Culex pipiens would have a part in a larger quantity.

The single stretches of the Tisza-basin were not investigated with the same intensity. The area stretching from Szeged to Tiszafüred is most, the reaches between Tokaj and Tuzsér is least explored. I do not think necessary to increase the number of sampling-points (except for the Tisza-basin between Tokaj and Tuzsér) any more in the future. It would be more important to visit all the sampling-points already known at the same time (within a few days) — in Spring, Summer, and Autumn. In this way, we could obtain a more real picture of the species occurring at the sampling points as well as of the mosquito-density.

The Culicidae-fauna of Hungary was investigated by Mihályi and co-workers for a long time. It can be, therefore, considered to be well-known. At any rate, it is characteristic of the mosquitoes, as well, that they have not been collected with the same intensity in the different regions of the country. On the other hand (although in this relation we have in this country still fewer data), the fauna also changes in the course of time. The first individual of Aëdes rossicus in Hungary was caught in Budapest, in 1943. Its place of origin is the southern region of the European part of the Soviet Union. It is not impossible that it lived at the Tisza in a larger number already earlier, too. It seems to be sure that the point is of a species in spreading. The comparison of the results of my faunic survey, performed at the shores of the Balaton in 1973—1974, together with ISTVÁN KECSKEMÉTI (Station of Public Hygiene and Epidemics, County Veszprém) with the results of the culicidological researches continued in the same place by Mihályi and co-workers somewhat more than twenty years earlier, is otherwise furnishing a good example for the faunic change.

Characteristics of the Culicidae-fauna in the Tisza-basin

MIHÁLYI (1963) distinguished six region types in Hungary from the point of view of the mosquito-communities. Namely:

(1) the steppe (Hungarian "puszta"),
(2) the groves and forests of marshy areas on hills and in flatlands,
(3) the flood-plains of rivers,
(4) the forests of lower highlands (below 600 m),
(5) the forests of higher highlands (above 600 m),
(6) waters around the house.

The entire stretch of the Tisza in Hungary may be classified into the region type: "flood-plains of rivers". The flood-plain of the Tisza was not investigated in details by MIHÁLYI *et al.* It was only supposed that the situation was similar, there

too, to that at the rivers investigated by them, first of all at the Danube where the dominant species were *Aëdes vexans* and *Aëdes sticticus,* comprising 80 to 90 per cent of the mosquitoes living there (concomitant species are: *Aëdes caspius, Aëdes rossicus,* and *Aëdes hungaricus*). The real situation, however, is showing a picture that is different enough from this. In the Tisza-basin, the main injury is caused by three species: *Aëdes vexans, Culex modestus, Aëdes rossicus.* These three dominant species amount to 80 to 90 per cent of the material. The concomitant species are, with a regionally changing value. *Aëdes caspius, Aëdes cinereus,* and *Aëdes sticticus* (10 to 12 per cent), and not more than 1 per cent falls to all the other species (Fig. 2).

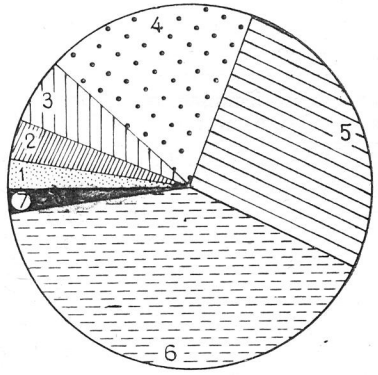

Fig. 2

Aëdes hungaricus could not be collected, so far, in the Tisza-basin. At any rate, it has been proved in case of the Tisza, as well, that the Culicidae-fauna of the river-basins, where the flood-plain is regularly inundated annually, is poor in species. There are missing mainly the spring species, or they only occur in a very insignificant ratio.

Table of the Culicidae-species collected during blood-sucking in the Tisza-basin in 1973 to 1975

No.	species	ind.	percentage
(1)	*Anapheles maculipennis* MEIG.	20	0,32
(2)	*Theobaldia annulata* SCHRK.	2	0,03
(3)	*Mansonia richiardii* FIC.	16	0,25
(4)	*Aëdes cantans* MEIG.	8	0,12
(5)	*Aëdes caspius* PALL.	365	5,77
(6)	*Aëdes cataphylla* DYAR	2	0,03
(7)	*Aëdes cinereus* MEIG.	218	3,45
(8)	*Aëdes dorsalis* MEIG.	9	0,14
(9)	*Aëdes excrucians* WALK.	8	0,12
(10)	*Aëdes flavescens* MÜLL.	2	0,03
(11)	*Aëdes rossicus* D. G. M.	1204	19,06
(12)	*Aëdes sticticus* MEIG.	129	2,04
(13)	*Aëdes vexans* MEIG.	2600	41,17
	Aëdes sp. indet.	38	0,65
(14)	*Culex modestus* FIC.	1685	26,68
(15)	Culex pipiens molestus Forsk.	9	0,14
	Total:	6315	100,00

Values of mosquito-density along the Tisza

The degree of the injury caused by mosquitoes is generally given in the number of mosquitoes biting a man during an hour (mosquito-density). The collections performed for measuring density last, as a rule for 10 to 15 minutes. In measuring the inconvenience we distinguish four degrees:

0 to 1 bite in an hour: practically mosquito-free.
1 to 10 bites in an hour: slight mosquito-injury.
10 to 100 bites in an hour: strong mosquito-calamity.
100 to 1000 bites in an hour: hardly tolerable or unbearable mosquito-calamity.

The values of measurement performed in different places of the Tisza-basin are showing a large enough dispersion. The density values obtained at a few points are illustrated in a diagram (Fig. 3). Lowest mosquito-density was found in the

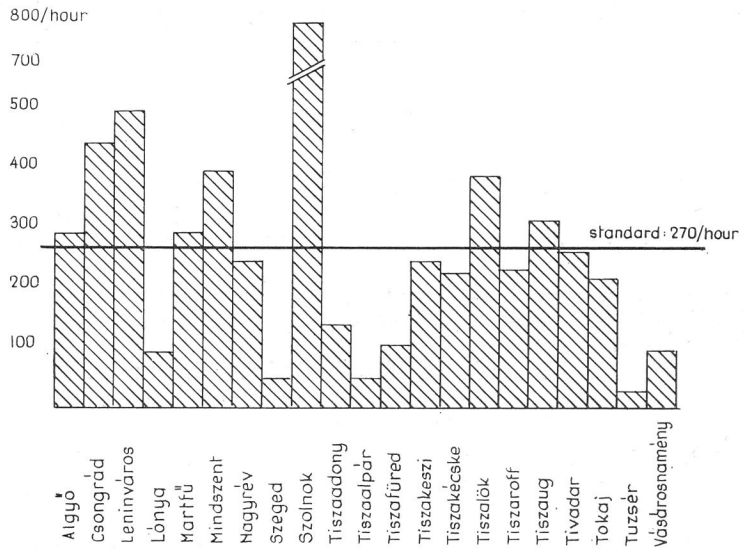

Fig. 3

district of Tuzsér (32), highest at Szolnok (794). As it is visible, at most sampling-points this value is above 100, that is to say, it reaches degree 4 (with the exception of Tuzsér, Szeged, and Vásárosnamény). For the poorness in mosquitoes along the Tisza-reaches at Tuzsér I did not find any explanation because I was in that region not long after the flood-wave left the area. In that region there are necessary further investigations.

The very high value at Szolnok (794) also needs an interpretation, all the more so because there *Aëdes caspius* got to the first place. *Aëdes caspius* occurs everywhere in the Tisza-basin, in lesser number. It is to be found in the sunlit open sectors, grasslands, meadows. In the daytime it hides itself mainly on the dam-sides in the grass. If we go along these places, the females come forward, following us in a shorter or longer sector. If we stop or rather sit down, they attack us furiously.

At Szolnok, south of the camping where the dam leaves the Tisza, a small engine-house is standing, operating probably a water-bailing pump. The top of the house-chimney ends about in the same height as the top of the dam. The combustion products escaping from the chimney (probably with a high CO_2 content), in case of a northern air motion, stream just over the dam. The mosquitoes are attracted by carbon dioxide. They find namely the man and warm-blooded animals primarily on the basis of carbon dioxide streaming out of the body. The effect of carbon dioxide on the mosquitoes is used for collecting the blood-sucking species in certain automatic trap-types.

In the area the mosquito-density was high enough, but on the top of the dam, at a point, I was attacked by an almost unbearable mass of mosquitoes. As I noticed this phenomenon only in a 2—3 m sector and in the same place the flue gas coming from the chimney of the engine-house could also be noticed, I can only think that the mosquitoes moving here and there over the dam, were stopped, gatherd and the density became therefore extremely high. I had already experienced a similar phenomenon in the Tisza-basin in cases when, in rather cool evenings, my car stopped in places with many mosquitoes. Then, however, apart from gases, the warmth emitted from the motor of the car could have a part in attracting the mosquitoes.

Characterisation of the dominant species

The main mosquito-injury is therefore engendered, according to the investigations, by three species in the Tisza-basin. Their participation in the complete material is 86,81 per cent. Let us make ourselves familiar in short with these species.

Aëdes vexans MEIGEN, 1830

It can be easily recognized by the short white rings on its legs. Its abdominal segments are ornamented with stripes consisting of white squamae and growing narrow in the middle.

The ratio of its participation in the Tisza-basin is 41,17 per cent.

Its distribution is holarctic (Europe, North Asia, North America). In our country it may be found everywhere. It is the main cause of the mosquito-injury (a "harassing" mosquito). It flies from April to the end of October. Its larvae develop in sunny, shallow waters. Its imagos migrate far away. Some stained individuals were found as far as 22 km from the breeding place.

Culex modestus FICALBI, 1889

It can be separated from the other *Culex* species easily because the first foot-segment of its posterior foot is shorter than its leg. Its abdomen is above mostly unicoloured brown. It adheres to water. We may meet it most frequently at the waterside of marshes, rice-fields, fish-ponds. It leaves the waterside rarely for a longer distance than 100 m. It vexes us the whole day long, even in a fiery sunshine.

24,8 per cent of the Culicidae material collected by MIHÁLYI *et al.*, at the shore of the Balaton, in the early Nineteen-fifties, was *Culex modestus*. in 1973—1974, on the northern shore of the Balaton, its participation ratio did not reach even the 1 per cent. It is one of the dominant species almost everywhere in the Tisza-basin. Its participation ratio is 26,68 per cent. It is of Mediterranean distribution (southern half of Europe, Asia Minor, Tadzhikistan, India).

It is a thermophilus species, its larvae develop in sunny waters of rich vegetation. It has several generations a year. Its imagos fly from June to early October.

Aëdes rossicus DOLBESKIN, GORITSKAYA & MITROFANOVA, 1930

It is a Mediterranean species, living in the southern regions of the European part of the Soviet Union (Ukraine, Caucasus) and in the Carpathian Basin. MIHÁLYFI supposes it to be much more wide-spread but it is often not identified. But, on the basis of its shorter sucker at its anterior femur and its blackish-brown back, it can be distinguished well from the species of similar habit.

It flies from April to August, attacking the man ferociously the whole day long.

It seems to be a characteristic flood-plain mosquito. Its larvae develop in the inundations of rivers, in the shaded and semi-shaded waters of flood-plains. According to MIHÁLYI, in the flood-plain of the Danube, after inundations, 10 to 60 per cent of the mosquito-fauna may be *Aëdes rossicus*. At the shores of the Balaton it has but a minor role (0,23 per cent). In 1950—1951, it was not yet collected there, at all. According to the investigations so far, it has a considerable part in some stretches of the Tisza-basin, as well (19,06 per cent). Its ratio was particularly high at Szolnok and in the islet Körtvélyes.

Problems of protection

At present I should not like to deal with the problems, possibilities of the protection against biting mosquitoes. I do this partly as protection is primarily a task of practical experts, and partly as I have but a little experimental material to go on with.

Defence must obviously be aimed at the three most important dominant species. It is therefore a matter of course that the properties, way of life of these are primarily to be taken into consideration at planning the protection.

The modes of defence by means of insecticides in a larger area go with expenses of several millions. It would be therefore more expedient to prepare the protective actions with measuring the density so that a superfluous protection may be evitable.

References

MIHÁLYI, F. (1939): A szúnyog elleni védekezés entomológiai előkészítése Hévizen. (Entomological preparation of the protection from mosquito at Hévíz). Állatt. Közlem. *36*, 107—117.

MIHÁLYI, F. (1954): Előzetes vizsgálatok a dunai szúnyogkérdés megoldásához. (Preliminary investigations into solving the problem of mosquitoes along the Danube). — Állatt. Közlem. *44*, 81—86.

MIHÁLYI, F.—SOÓS, Á. (1952): A csípőszunyogok és a malária elleni küzdelem rovartani előkészítése a Balaton partján. (Entomological preparation of the struggle against the biting mosquitoes and malaria at the shores of the Balaton). — „MTA Biol. és Agr.tud. Oszt. Közlem." *3*, 555—575.

MIHÁLYI, F.—SOÓS, Á.—SZTANKAY, SZ.—ZOLTAI, N. (1953): A Balaton-menti községek szunyoghelyzete és a gyakorlati védekezés módjai (Mosquito-situation in the communities at the shores of the Balaton and the ways of the practical defence). — A Magy. Tud. Akad. Biol. Oszt. Közlem. *2*, 35—94.

MIHÁLYI, F. (1959): Revision der aus dem Karpatenbecken stammenden Stechmücken der ungarischen Dipteren-Sammlungen. — Folia Ent. Hung., *12*, 139—162.

MIHÁLYI, F.—MRS. SZTANKAY M. GULYÁS (1963): Magyarország csípő szunyogai (The biting mosquitoes of Hungary). — Budapest.