Prof. Dr. Gabriel Kolosváry

G. Kolosváry was born in Cluj (Rumania) August 18, 1901. His mother was Alice Stein and his father Dr. Bálint Kolosváry Professor of civil law. He had completed his elementary and secundary education between 1907—1919 in Cluj, and entered the University of Szeged, where in 1925 he got the degree of Doctor of Zoology and Geology. In 1926 he got his teacher's diploma. He started in research work in 1923 at the Institute for Zoology of the University Szeged, from 1929 to 1954 he worked in Budapest at the National Museum in the zoological department and the gallery of paleontology. In 1931 he became privat-docent of the University Szeged. As a museologist he travelled in Jugoslavia, Italy and Transylvania. From 1954 he was Head of the Institute for Systematic Zoology of the University of Szeged, reorganized in 1967 as Institute for Zoo-Morphology and Systematic of Attila József University, Szeged.

He was elected as correspondent member of the Hungarian Academy of Sciences in 1960. In 1956 he got the medal of "Eminent Worker of Higher Education" in 1965 he was honoured with the Bogdánffy Prize of the Hungarian Hydrological Association.

His scientific work is extremely rich and manysided. He was not only an eminent professor but also a devoted propagandist of science. Before the second world war he mainly dealt with spiders and had got worldwide recognition as an arachnologist. He was greatly attacted by sea-life, and he worked up *Echinodermata* collected by Hungarian "Najade" expedition. Researches of *Cirripedia* had been a favorite subject till the end of his life. As testified by several of his publications, he was greatly interested in problems of animal psychology. Variation studies had also been attractive field for him. After the second world war he started on researches in fossil coralls, as requested by the Hungarian Geological Society. His work in the field was of high importance and supplied a great want in our country. On the request of foreign institutions he worked up fossil coralls from Jugoslavia, Czechoslovakia and Britain. Being asked by Sovjet researches he examined *Cirripedia* died out in the Sovjet Union. To promote these researches he visited Moskow (1959), Czechoslovakia (1964), Rumania (1966) and the German Democratic Republic (1967). He looking at these zoofossils as living organisms that they had been long time ago. He incessantly emphasized that zoologists must bear an interest towards fossil animals as well, since without this problems of evolution in the living world could not solved.

A regular study of the living world of river Tisza was started under his guidance ,in 1955. There had been, naturally, devoted researches of this field, too, but mostly they were working alone, in a restricted field, without any financial support. Directed by Professor Kolosváry, under the sponsorship of the Hungarian Academy of Sciences, including both moral and financial support, a research group was formed in 1955, and they have been incessantly working in this field from that time on. This work was started by a common shipping tour down the river Tisza and then smaller groups were sent out discover smaller spots.

Professor Kolosváry himself regularly took part in these expeditions. His personal interest turned towards spongiae, moss animals and harvest spiders, but he summarized results of other researches as well. Results of work up to this time are summarized in the series "Das Leben der Tisza" and volumes I—IV of "Tiscia". He was the editor-in-chief of this latter publication.

G. Kolosváry kept intensive and close connection with foreign scientists, too. His correspondence covered almost the whole world, his lectures, papers had been read at various international congresses.

His lectures at the university, constantly being illustrated by clever and animated table-drawings, were attractive at the highest scientifical level.

Professor Kolosváry was a very modest, taciturn, warm man, having deep humanist ideas in his heart. In everybody he estimed his fellow-comrade. For his students he was like their father. His memory remains written with letters of dedication in our hearts forever and the history of science remembers his work for long years to come.

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CLIMATIC AND MICROCLIMATIC PECULIARITIES OF THE TISZA AND ITS INUNDATION AREA

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Within the framework of the complex works of Tisza investigations carried out continuously for more than a decade, I have been studying the climatic peculiarities of the Tisza and its inundation area, their macro- and microclimatic conditions. In my present work there are made known the climatic data that depart from the adjacent plain climate. For this study I have used the data on the subject obtained from the station net of the Hungarian Meteorological Institute (HMI 1960) as well as my microclimatic observations performed in vorious sectors of the Tisza-valley.

Evaluation of the macroclimatic conditions

The Tisza and its inundation area are an independent geomorphological terrain of the Hungarian Plain where — particularly in respect of the microclimatic peculiarites — evein the climate is differring from that of the environment, as a result of the considerable water mass of the river and of the variedly extended inundation area. On the basis of the macroclimatic conditions, the Hungarian sector of the inundation area of the Tisza can be divided into three parts:

1) The Upper Tisza (between Tiszabecs and Tokaj),
2) The Middle Tisza (between Tokaj and Csongrád),
3) The South Tisza (between Csongrád and the frontier of the country).

Except the Upper Tisza, the most typical characteristic of the climatic conditions of the areas enumerated is a warm-arid and even hot summer that is the most characteristic of the regon of the Middle Tisza.

In the regional development of the single meteorological factors we can find also some individual peculiarities of the three districts. The annual amount of clouds is growing from South to North, the difference being, however, not more than 5—10 percent. The lowest annual value is in the area of the South Tisza, as well as in that of the Middle Tisza (50—55 p.c.). In the winter season, a greater lot of clouds can be observed everywhere than in the summer half-year. In the winter half-year, namely, the sunshine supply is considerably decreased by the often occurring fog. On the other hand, in summer there are the most cloudless conditions in the area of the Middle and South Tisza, even in national relation. In August, the mean degree of the cloud cover falls short even of 35 percent. Thus, a result of the small cloud cover is plenty of sunshine. In the region of the South Tisza that means 2.100 hours, in that of the Middle Tisza 2.000 hours, at the North Tisza, however, only 1.900 hours in annual average. The favourable sunshine manifests itself mainly in the summer half-year. We may observe plenty of sunshine particularly in the region of the Tisza-valley between Szolnok and Csongrád. In winter, however, there is but a lesser difference between the single region types concerning the amount of sunshine.

There is a great difference between the Tisza regions also on the basis of air temperature. According to the annual mean temperatures, the area of the South Tisza is our warmest region. Here is the annual average temperature higher than 10,5°C. In the middle sector, between Csongrád and Tokaj, it is already only 10°C, and at the Upper Tisza it is between 8,5—10,5°C, on the average.

In winter, the South Tisza region is but temperately cold. The average temperature of the month January is about —1,5°C, there are as many as 25—30 winter days. In the area of the Middle Tisza, the conditions are somewhat colder, the January value being —2, —3°C. The coldest region is that of the Upper Tisza, the average temperature of the month January being between —3 and —4°C there.

The maor differences in temperature observed in the winter half-year are in summer less characteristic of the geographical regions. The warmest region is that of the South Tisza where the daily average temperature exceeds 10°C already between April 5—10, and the July mean temperature surpasses 22°C. Here occur the most summer days in this country (85—90 on the average), and here are also the most hot days (25—30).

One of the most important characteristics of the region is a hot summer, expressed not only in the mean temperatures but also in a great frequency of a strong rise in temperature. A prolonged warm autumn is characteristic of this area, the daily average temperature sinking under 10°C only after Cctober 25th. Similar conditions can be observed in the Middle Tisza-valley, as well, where the value of the average temperature in July is lower only 0,5°C. The annual precipitation is here, however, less, being in the middle sector, in this regard, comparatively drier conditions.

On the other hand, the 19—20,5°C July mean temperatures of the North Tisza region are referring to somewhat cooler summers. Here is the regional distribution of temperature of zonal structure, decreasing more and more from South towards North.

Inside the single parts of the regions, the regional distribution of precipitation is producing highly various conditions. It is generally characterizing that the Middle Tisza region is the driest part, here is the annual value of precipitation between 500—550 mm, and in the area of the Zagyva-mouth it remains even under 500 mm. In the annual formation of the relatively little annual precipitation, an aridity of a particularly higher degree is observed in the summer and autumn months.

In the area of the South Tisza there are, however, more favourable conditions. Here is the precipitation growing from N towards S. While the annual average precipitation in the region of the Körös-mouth is not higher than 500 mm, at the Maros-mouth it is already 580 mm. The month the most abundant in rainfall is July, with a monthly amount of 60—70 mm. The most arid month is January with a precipitation of 30—35 mm. In this area, also the second maximum in autumn can be demostrated well (Table 1).

Table 1. Average precipitations of pentades between 1890-1960 /Szeged/

Pentades:	1	2	3	4	5	6
January	4,7	6,1	5,9	7,6	4,1	5,1
February	7,2	7,0	7,2	5,1	4,4	3,5
March	6,9	7,5	5,1	3,2	5,0	9,6
April	6,3	7,9	8,6	9,9	8,3	8,0
May	11,9	11,8	9,1	8,8	10,5	13,8
June	12,7	10,4	13,2	11,3	9,5	9,0
July	10,0	9,3	9,5	8,0	9,1	8,0
August	8,5	8,6	8,9	6,0	6,9	7,5
September	8,4	5,2	9,7	6,3	6,1	7,7
October	7,2	8,6	6,8	6,3	7,5	13,4
November	8,5	8,3	7,1	9,5	6,8	5,5
December	6,8	6,6	7,2	5,0	5,0	8,1

Here is the Sub-Mediterranean formation of precipitation characteristic of the 25 percent of the 25 percent of the years. In the second half of the summer, however, as compared with other areas of this country, here is the probability of prolongated rainless periods much higher, i.e., the tendency of the inundation area of the South Tisza to aridity is at the end of summer of a very high degree (Table 2).

Table 2. The percentage of a probability of rainless periods longer than five days /1/ and longer than ten days /2/ in Szeged, between 1936 and 1960

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1	17	21	28	17	14	17	32	30	39	30	19	20
2	4	7	12	5	4	2	11	12	15	11	6	6

As compared with the enumerated ones, the greatest difference concerning the regional distribution of precipitation has been observed at the Upper Tisza. In the region of the Upper Tisza between Tiszabecs and Záhony, in an area of the Plain which is one of its richest parts, the annual value is 650—700 mm. In other parts, however, the annual precipitation is between 550 and 650 mm. At relatively low temperatures, owing to a less evapotranspiration, the conditions of humidity are here more favourable than in the more southern parts. Here is the highly productive rainfall characteristic in both parts of the summer period. Only September may be considered as a particuarly arid month. In winter, the number of snowy and snow-covered days is in this area the highest one. At the same time, the average thickness of snow-cover is smaller than in the Middle and South Tisza-valleys. In the South Tisza region, e.g., the number of snow-covered days changes only between 33 and 36, and even there are winters without any lasting snow-cover.

In the macroclimate of the Tisza and its environment, as a consequence of the conditions of percipitation, temperature and evaporation, there is generally a strong scarcity in the annual water balance. There isn't to be observed any annual water-balance in state of equilibrium, in any part of the area. Scarcity of water is meaning in this case the scarcity of water supply in the covering stratum of soil that takes place if the average annual precipitation has for months been lower than the potential evapotranspiration and does not surpass the capacity of preserving the subsoil water. The Upper Tisza may be considered to have the most favourable situation, the second one being the area of the South Tisza and the last one that of the Middle Tisza (Table 3).

Table 3

Upper Tisza region	
Between Tiszabecs-Dombrád	scarcity of water 50- 75 mm
Between Dombrád-Tiszabercel	scarcity of water 75-100 mm
Between Tiszabercel-Tokaj	scarcity of water 100-125 mm
Middle Tisza region	
Between Tokaj-Tiszapalkonya	scarcity of water 125-150 mm
Between Tiszapalkonya-Szolnok	scarcity of water 150-175 mm
Between Szolnok-Tiszaföldvár	above 175 mm
Between Tiszaföldvár-Tiszaug	scarcity of water 150-175 mm
Between Tiszaug-Szentes	above 175 mm
South Tisza region	
Between Szentes-Algyő	scarcity of water 150-175 mm
Between Algyő-Frontier of the country	scarcity of water 125-150 mm

The annual amount of the scarcity of water demostrated in the Table above can, of course, be taken into account only in its general aspects. That value can be modified considerably by local factors and the data of microclimate.

Between the scarcity of water of the area and the humidity of air

Table 4. Percentage of air humidity-its value for 14 hours, on the average of many years

	In winter period		Percent
Upper Tisza-valley			
Between	Tiszabecs-Vásárosnamény		78-80
"	Vásárosnamény-Tuzsér		76-78
"	Tuzsér-Tiszalök		74-76
Middle Tisza-valley			
Between	Tiszalök-Kisköre	below	74
"	Kisköre-Szolnok		74-76
"	Szolnok-Martfü		76-78
"	Martfü-Tiszaug	above	78
South Tisza-valley			
Between	Tiszaug-Frontier of the country		76-78
	In spring period		
Upper Tisza-valley			
Between	Tiszabecs-Kisar		52-54
"	Kisar-Mezőladány		50-52
"	Mezőladány-Tokaj	below	50
Middle Tisza-valley			
Between	Tokaj-Csongrád	below	50
South Tisza-valley			
Between	Csongrád-Szeged		50-52
"	Szeged Southern frontier of the country		52-54
	In summer period		
Upper Tisza-valley			
Between	Tiszabecs-Mezőladány		50-52
"	Mezőladány-Tokaj		48-50
Middle Tisza-valley			
Between	Tokaj-Tiszapalkonya		46-48
"	Tiszapalkonya-Kisköre		44-46
"	Kisköre-Csongrád	below	44
South Tisza-valley			
Between	Csongrád-Szeged	about	44
"	Szeged-Southern frontier of the country		44-46
	In autumn period		
Upper Tisza-valley			
Between	Tiszabecs-Záhony		60-62
"	Záhony-Tuzsér		62-64
"	Tuzsér-Tokaj		60-62
Middle Tisza-valley			
Between	Tokaj-Tiszafüred		58-60
"	Tiszafüred-Csongrád	below	58
South Tisza-valley			
Between	Csongrád-Southern frontier of the country		58-60

a close correlation has been observed. In the parts where the annual balance is closed with a major amount missing, the absolute value of air humidity is relatively smaller.

From the point of view of the investigation of the ecological connections and habitat endowments, we are reviewing in this study the conditions observed in the macroclimate of the Tisza-valley, on the basis of the lowest daily average values of the relative air humidity measured for several years (Table 4).

The values published so far may mostly serve as comparative data at revelation of the microclimatic conditions. The microclimaic values developed as a result of the mass of water, the natural endowments of the habitats in stagnant water and inundation area, are differring from the above mentioned ones. The particular climate of the river and of its inundation strip, made known below, develops in the course of the interaction of the latter factors.

Evaluation of the microclimatic conditions

In various sectors of the inundation area of the Tisza the microclimatic investigations were mostly carried out in the summer period. During these investigations our aim was to collect data concerning the interaction of water mass and environs (inundation area), the microclimatic peculiarities of the various plant associations in the inundation area, the data of the river valley (bed and inundation area) that climatically differ from the conditions of the adjacent plain.

Table 5. Temperature in °C in the area of the South Tisza region Algyő

June 1955	Szeged		Algyő	
	Meteor. Observ. of the Univ.	Airport	Right bank	Left bank
16th: daily average	19,4	18,6	18,6	19,1
maximum	24,4	24,3	21,5	22,3
minimum	12,6	10,5	12,5	12,4
17th: daily average	21,8	21,1	20,2	21,1
maximum	26,3	26,6	24,1	25,8
minimum	16,6	15,2	15,0	15,0
18th: daily average	18,6	17,5	17,8	18,2
maximum	22,2	22,3	20,0	21,0
minimum	15,4	14,4	15,0	15,1
19th: daily average	22,8	21,8	21,5	-
maximum	27,0	26,9	24,6	-
minimum	14,6	11,5	11,5	-

For the investigations (macro- and microclimatic determinations) we have used instruments accepted internationally and applied in researches; apart from climatic observations, also other investigations (soil, hydrographic, morphological researches) have been carried out.

The mciroclimatic temperature of the various substratum surfaces of the inundation area has a considerable influence on the macroclimatic values, as well. In the inundation area of the Tisza, the daily average temperature of air in Summer is generally 1—2°C cooler than that of the plain surroundings (Table 5).

If investigated for a longer time, there can be observed even in the gloomy, rainy periods some difference of temperature between the inundation area and the free surface of its environment (Meteorologycal Station, Szeged) (Fig. 1).

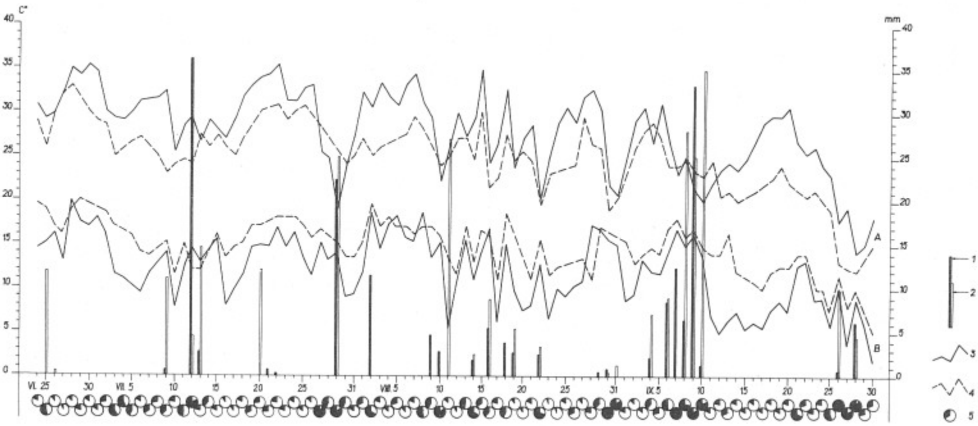

Fig. 1. Maximums of air temperature (A) and maximums of radiation (B) in the inundation area of the Tisza and in the Meteorological Station (Airport) of Szeged.

1. Precipitation in the airport in mm
2. Precipitation of the station in the inundation area in mm
3. Temperature graph of the station in the airport
4. Temperature graph of the station in the inundation area
5. Duration of sunshine in 100 percent of the possible sunshine

Its character is cooler partly owing to the orographic situation (valley-effect), partly to the composition to the peculiar microclimates of the habitats of various ecology. There belong to the substrata that develop the particular climate of the Tisza-valley: the shrubberies covered densely with undergrowth, the grassy and clear surfaces, the surface of water ,as well as the orographic peculiarity.

The role of surface form in influencing the microclimate

The Tisza-valley is in time of cooling down (at radiating, clear nights) a reservoir of cold air. In the Tisza-valley of Hungary, this peculiarity is expressed the most sharply in the mountainous region at Tokaj. Here causes the amount of cold air that slides down on the S-S.E. slope of the 515 m high mountain in the neighbourhood of the river bed and inundation area cooler microclimatic conditions as compared with other Tisza regions in the Plain. The consequences of this climatic fact appears also in the augmentation of the biotops preferring cold climates (Fig. 2).

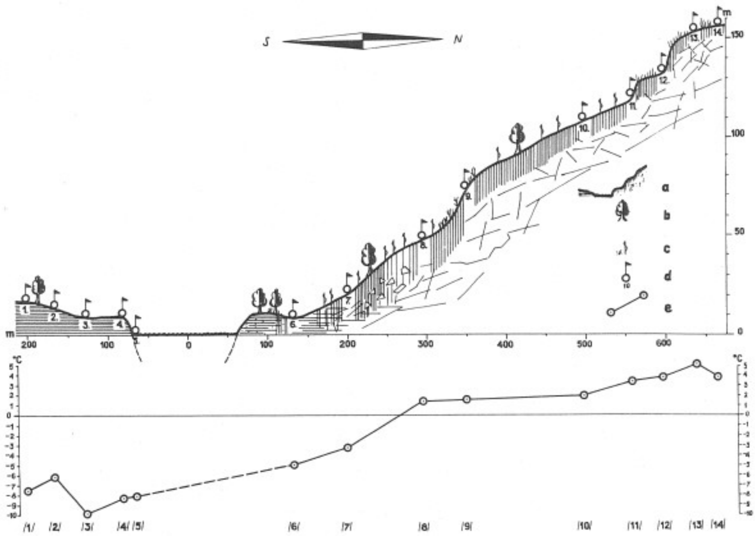

Fig. 2. Minimum values of radiation in the cross-section of the Tisza-valley, in the region of the Tokaj mountains (October 27th 1961).
a) surface form of the valley
b) tree groups
c) surfaces with grapes and grass
d) sites of the microclimatic investigations
e) values of radiation minimums in °C

The radiation values of the figure are demostrating a major inversion as well as the warmer situation of the slope of southern exposition of the Tokay mountains, contrasting sharply with its environs. The cooler air that fills in the valley is getting Warm but slowly in a calm, radiating weather as compared with the environment, and the difference of temperature disappears only in the late morning hours (Table 6).

The air layer neor to the surface of the mountainside of southern exposition is warmer even at the time of temperature maximum than the flat surface of the Tisza-valley and adjacent plain. Here in the low air layer get on well the size of the angle of scope, the degree of being exposed, as well as the stone material of surface. In our figure, also the temperature modifying effect of the mass of water can be found, but it is perceptible only in the strip of river bed.

Similarly to the Tisza-valley in the environs of Tokaj, cooler conditions can be observed in other Tisza regions, as well. In these places the accumulation of the cold air amesses coming from the fall in temperature at nght isn't first of all a result of orographic factors but that of the reciprocal effects of the woods with closed foliage in the

Table 6. Air temperature on 5 cm, in the stations placed on the cross-section of Fig. 1 (Tokaj, October 28th 1961)

Station:	1	2	3	4	5	6	7
8^h	4,5	2,5	-1,5	2,0	4,0	-0,1	2,0
Station:	8	9	10	11	12	13	14
8^h	4,0	6,1	6,0	6,4	10,0	6,1	6,7

inundation area and of the clearings among these woods. In orographic sense — at cooling down in the Tisza regions of the Plain — the dams in the inundation area have got a remarkable role, too; the deep clearings of the outer and inner sides of dams are, namely, generally the places of acumulation of the cold air (Fig. 3).

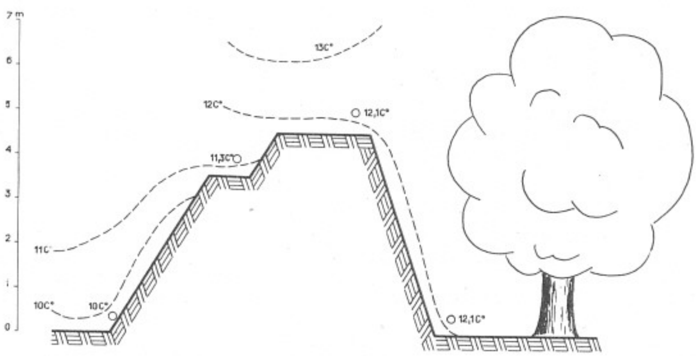

Fig. 3. The effect of the dam configuration upon the territorial distribution of air temperature, at cooling down.

This practically means that the irrigated cultures and orchards in the neighbourhood of the dam system of the Tisza-valley often suffer frost damages at the late falls in the spring temperature.

Microclimatic effects of water mass, water surface

As known, the climate of the inundation area is influenced by the temperature of the river water, as well.

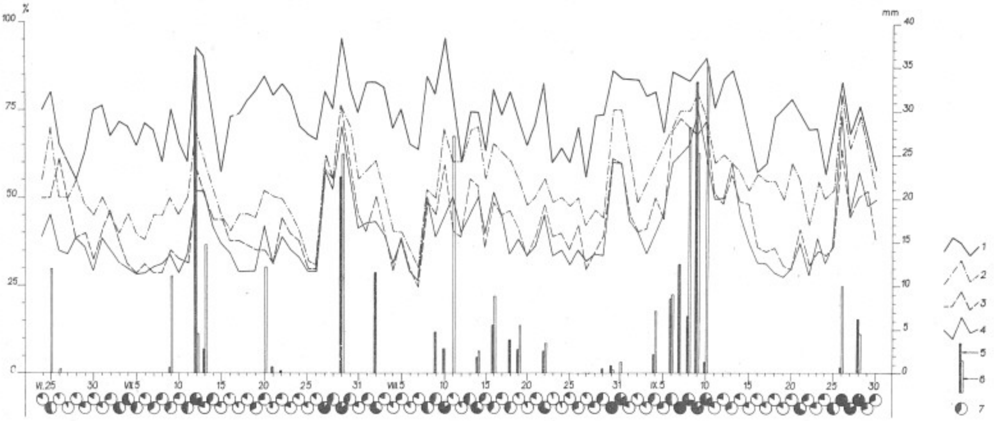

Fig. 4. The 24 hrs lowest relative air humidity on the surfaces of various substrata.
1. values of air humidity in wood
2. values of air humidity in a willowy thinned out
3. values of air humidity in the airport
4. values of air humidity in a clearing of an inundation area
5. precipitation in mm in the airport
6. precipitation in mm in the inundation area
7. duration of sunshine in 100 percent of the possible sunshine

The water course of the river, the territorial and temporal distribution of precipitation, the close interconnection between the conditions of humidity are expressed in the development of the temperature of river water, as well. Opposite to an arid ground form, at the heat economy of a river water the situation is, however, inverse; therefore, in respect of the heat economy, the water remains rather under the heat traffic of a dry surface.

In case of the river Tisza, we may render account of a well formed course of annual temperature; the fluctuation of the water temperature is not at all as extreme as that of a surface of another type. In case of this river, a daily fluctuation of 24 hours can be observed mostly only in case of small water. The curves of the monthly water temperature are indicating, anyway, a tendency to a uniform warming up or cooling down (Table 7).

At low water it frequently occurs, anyhow, that the daily water temperature differs from the monthly course and follows the alteration of the air temperature. In a case like that, if weather is extreme, the daily fluctuation of the water temperature can reach 3—4°C, and exceptionally even 6°C.

A warmer temperature value can be observed in the Tisza regions between Szolnok and Csongrád. The decrease in temperature of the South Tisza-valley is caused by the cooling effect of the water mass of the Köröses and of the Maros.

It is generally known that the influence of the mass of water on the microclimate is considerable in the microregions near the river bed.

The water surface as a substratum surface generally means one of the extremes opposite to the soil. The water, besides its considerable capacity of reflecting the light, is absorbing nearly fully the rays arrived

Table 7. Monthly mean values of water temperature of the Tisza on the basis of many years (1954/63) of values

	I.	II.	III.	IV.	V.	VI.	
Tiszabecs	0,9	0,9	3,8	8,6	13,7	18,2	
Vásárosnamény	0,9	0,8	3,3	9,5	15,0	20,5	
Záhony	0,8	0,7	3,4	9,4	15,1	19,9	
Tokay	0,6	0,7	4,0	10,5	16,0	20,2	
Polgár	0,7	0,3	3,0	11,2	16,0	20,2	
Tiszafüred	0,7	0,7	3,6	9,9	15,7	20,3	
Szolnok	1,0	1,0	4,1	10,6	16,3	20,9	
Csongrád	0,8	0,8	3,8	10,3	15,8	20,8	
Szeged	1,5	0,9	3,9	10,3	16,1	20,7	
	VII.	VIII.	IX.	X.	XI.	XII.	Year
Tiszabecs	20,0	19,6	16,2	10,6	6,2	2,4	10,0
Vásárosnamény	21,4	20,6	17,1	10,6	6,8	2,3	10,7
Záhony	21,6	21,2	17,4	11,1	6,7	2,2	10,8
Tokay	22,2	21,8	17,9	11,9	7,5	2,3	11,3
Polgár	21,9	22,4	19,7	13,9	8,7	2,4	11,2
Tiszafüred	22,2	21,8	18,6	12,2	7,2	2,4	11,3
Szolnok	22,7	22,5	19,2	13,0	7,9	2,8	11,9
Csongrád	22,6	22,4	18,9	13,0	11,0	2,4	11,9
Szeged	22,6	22,3	19,1	12,8	7,7	2,6	11,7

at its surface, preserving the heat and giving, therefore, but minimal amount of heat to the air layer over the water. In case of a river water, this property causes practically only an insignificant stratification of water temperature. Inside the water space, namely, owing to being intermingled, the temperature gradient is mostly equalized (Table 8).

Table 8. Water temperatures in °C in case of a two metres water column (Tokaj, August 10th 1959)

h	12	14	16	18	20	22	24	2	4	6
Water surface	20,0	20,5	20,9	20,0	20,0	20,0	19,9	19,8	19,9	20,0
Water bottom	19,1	19,2	19,3	19,0	18,9	18,9	18,8	18,4	18,4	19,3

As a result of the peculiar heat economy of the river water, in summer we observed a considerable decrease of temperature is the 40—50 cm cross-section of the air layer over the water. In case of a clear, raditing weather, e.g., the daily (24 hours) temperature amplitude of the water surface is not more than 0,8—1,2°C, that of the air layer over the water 6—8°. In higher regions, the value of the daily amplitude is fast increasing. In a height of 100 cm over the water surface already values higher than 10°C are characteristic. Here get a role the advections of the air mass of various temperatures of the environment, as well. *The mass of water has, therefore, an influence modifying the temperature considerably only on the lowest layers of air.*

A similar situation has been observed also in horizontal sense; i.e., with the distance from the mass of water, the role of that mass — that influences the microclimate — fast decreases (Table 9).

Table 9. Air temperature in °C, 10 cm over the surface, in the Tisza-valley at Tokaj (between 13-14 h), in the time of temperature maximum

August 11th 1959.	C°
1. At the left bank, 10 m far from water	27,4
2. 10 m from the left bank, over water	25,0
3. At the centre line of the river, over water	24,4
4. 10 m from the right bank, over water	25,2
5. At the right bank, 10 m from water	27,0
6. At the right bank, 20 m from water	28,6
7. At the right bank, 50 m from water	30,5
August 13th 1959.	
1. At the right bank, 2 m from water	25,6
2. 10 m from the right bank, over water	25,4
3. At the centre line of the river	25,0
4. 10 m far from the left bank, over water	25,8
5. At the left bank, 10 m from water	27,4
6. At the left bank, 20 m from water	28,4
7. At the left bank, 100 m from water	30,1

It is proved by the above data that in summer, in a clear, calm weather, *in the bed inundation area the cooling effect of the mass of water is less expressed.*

A particulary quick change in temperature, resp. cooling effect can be observed if the river flows in a deepened bed as compared with the inundation area. During our investigations, e.g., in case of a bed side of 30° angle of gradient (4 m level difference), in a distance of 8 m from water, 10°C difference could already be measured in the air temperature (A n d ó, 1959).

Air-temperature conditions of habitats of a different ecology

In the daytime, in summer ,the radiation balance on the surface of a plain environment of the Tisza has a strongly positive direction and, therefore, the gradient of the surface air layer is positive, as well. In the wood substance of the inundation area, however, similarly to the

Table 10. Temperature maximums of various substrata in the South Tisza-valley, in the summer of 1963

Date	July				August			
	A	B	C	D	A	B	C	D
1.	38,0	35,5	29,0	43,5	34,5	33,5	23,0	32,1
2.	33,0	34,0	25,0	30,0	31,5	30,0	26,0	30,4
3.	32,5	32,5	24,0	29,2	35,5	35,0	25,0	33,3
4.	34,5	34,0	24,5	29,0	33,0	33,0	25,5	32,8
5.	35,0	35,0	25,0	30,0	35,5	34,0	25,0	31,7
6.	35,5	37,0	25,0	31,2	36,5	34,5	26,0	33,2
7.	37,0	36,0	26,0	31,5	37,0	35,0	27,0	34,3
8.	36,0	35,0	27,0	32,2	32,5	30,0	24,5	31,0
9.	27,0	29,0	20,5	24,6	33,0	30,0	23,5	29,3
10.	32,5	33,0	22,0	27,4	25,6	23,0	22,0	22,0
11.	34,0	33,0	23,0	29,4	27,0	25,0	24,0	26,2
12.	30,0	30,0	22,0	25,6	31,0	27,5	27,0	29,9
13.	30,0	30,5	22,0	28,1	28,0	25,0	22,0	27,1
14.	30,5	28,5	24,0	28,7	31,0	26,5	23,5	29,3
15.	30,0	31,0	25,0	28,0	35,5	30,0	24,0	34,7
16.	29,0	30,0	22,5	27,0	23,0	22,5	20,5	24,2
17.	33,0	33,0	23,5	29,2	28,0	25,5	22,5	26,6
18.	37,0	36,0	24,5	31,7	34,0	29,5	23,5	32,6
19.	37,0	36,5	25,0	33,0	25,0	21,0	18,0	23,7
20.	36,5	37,0	24,5	33,9	29,5	25,0	20,0	27,1
21.	37,0	37,5	25,0	34,1	30,5	27,0	24,5	28,6
22.	35,0	35,5	25,0	32,4	20,0	17,5	16,5	20,1
23.	37,0	39,5	24,5	31,2	28,0	24,0	20,0	25,0
24.	35,5	36,0	25,0	31,3	31,5	26,0	21,0	28,6
25.	36,5	37,5	24,0	32,7	34,0	29,0	23,0	30,4
26.	37,5	38,0	24,5	33,0	32,0	27,0	21,5	28,7
27.	25,0	27,0	18,5	25,3	34,0	29,5	23,5	31,9
28.	26,5	29,0	18,0	24,7	34,0	30,0	24,5	32,6
29.	20,5	20,5	16,0	19,4	30,0	28,0	24,0	30,2
30.	23,5	25,5	18,0	23,8	19,5	18,5	16,0	21,7
31.	30,5	29,0	20,0	27,1				

water surface, a negative temperature gradient develops. As a result of that, the lower air layer is colder all day than it is in the foliage zone, resp. in the parts above the foliage zone. The reason of that is that in wood the direct radiation getting to the soil surface is highly decreased. According to data measured with Campbell-Stokes's instrument measuring the duration of sunshine, in wood the radiation time was not more than half an hour opposite to the 14 hours value of a plantless surface (A n d ó, 1956, 1958, 1959).

Here is the vertical distribution of temperature of radiative type. At rise in temperature, we every day find the highest temperature in the level orf foliage. An explanation for that is partly that even the little solar radiation that penetrates is hindered by the dense undergrowth from getting to the soil and causing a greater rise of temperature, partly that owing to the wood foliage being strongly closed the warmest so-called "active" level develops in the upper foliage level of wood instead of the soil surface. It can be noticed that in the daytime, the warm convections rise from the foliage level, as well as from the adjacent clearings. The warmer air is stratified in the foliage zone while in the lower wood levels there are cool and comparatively damp microclimatic conditions.

Comparing with one another the plantless clearing in the inundation area *(A)*, the grassland *(B)*, the wood in the inundation area *(C)*, as well as the daily maximums in temperature of the meteorological station in Szeged, outside the inundation area 10—12 km from it *(D)*, we see that in summer the wood in the inundation area is 5—10°C cooler than its environment (Table 10).

It is worth while being mentioned that in the daytime the temperature of the clearings in the inundation area is often higher than of the adjacent plain area. That may be explained by being highly sheltered from the wind owing partly to the dam system and partly to the wood vegetation. Particularly in case of a wind blowing at right angles to the line of the river-valley there can be observed some calmness in the inundation area, while in case of a wind blowing in the same direction as the river-valley is lying, only the wood substance is in a situation sheltered strongly from the wind.

To sum up, it can be established that in summer in the daytime the woods with closed foliage in the inundation area have a cooler substratum as compared with their environment that, like the surface of the river water, is considerably differing from the extreme temperature data so characteristic of the Hungarian Plain.

At night, as it is cooling down, the wood substance with closed foliage is a warm substratum as compared with its environs. In the course of the investigations in the summer of 1955, in an area of a size of 100 sq.m, there were found 3—4°C differences of radiation minimums between the clearing and the associations with closed foliage. These data are supported, in an increased degree, also by the investigations of a longer period in the summer of 1963. In this case, as well, the radiation minimum of the plantless surface of an area of the size of 100 sq.m or so *(A)*, of a surface covered by weed and undergrowth *(B)*, by a wood substance in the inundation area with closed foliage *(C)*, as well as of a substance with pruned and weeded willow-bushes *(D)* (Table 11). From the substrata enumerated, the wood with a rich underwood and closed foliage in the inundation area is as a rule warmer at night than the other ones, preserving this property in dull weather, as well. At clear nights, of course, the difference of temperature increases in a high degree. The cause of that is partly that the closed foliage of dense leaves behaves like a hothouse and partly that the infiltration of the cold air from the foliage level is strongly impeded by the leaves. At the same time, on a plantless surface the eradiation is undisturbed, and even the cold air accumulates there from the leafage of the adjacent wood. A consequence of that process is a difference of 8—10°C in the surface temperature.

Table 11. Radiation minimum values in °C, in the South Tisza-valley, in the summer of 1963 (holm Atka)

Date	July				August				September			
	A	B	C	D	A	B	C	D	A	B	C	D
1.	17,5	17,0	19,0	17,5	14,0	15,0	15,0	13,0	–	–	–	–
2.	16,5	17,0	18,5	16,0	17.0	21,0	17,5	18,5	10,0	14,0	13,0	11,5
3.	16,0	15,0	17,0	15,0	14,0	16,0	17,0	16,0	12,0	12,0	14,0	12,0
4.	11,0	–	–	–	–	–	–	–	–	–	–	–
5.	10,0	11,0	16,0	13,0	12,5	17,0	17,0	14,5	12,0	12,0	14,0	12,0
6.	10,5	10,5	14,0	12,0	14,0	16,0	17,0	14,5	15,0	15,5	17,0	15,0
7.	10,0	11,0	–	–	11,5	15,0	16,0	14,0	–	–	–	–
8.	11,5	11,5	–	–	10,5	17,0	17,0	15,0	15,0	15,0	16,0	15,0
9.	7,0	12,0	15,0	17,5	15,0	16,5	17,0	15,5	–	–	–	–
10.	6,0	8,0	11,5	10,0	11,5	14,5	–	–	12,0	14,0	14,5	13,5
11.	12,0	13,0	15,0	13,0	9,0	–	–	–	13,0	14,0	14,0	14,0
12.	14,0	10,5	12,0	10,5	8,0	10,5	11,5	9,5	9,5	7,0	14,0	13,0
13.	12,5	10,8	12,0	10,5	10,0	17,0	17,0	10,5	9,5	8,5	16,5	10,0
14.	12,0	–	–	–	12,0	12,5	13,0	15,5	9,5	9,0	12,0	10,0
15.	10,5	14,0	16,0	14,0	14,0	16,0	16,5	15,0	–	–	–	–
16.	10,0	12,0	13,5	11,5	14,0	14,0	16,0	14,5	12,0	11,0	11,0	8,5
17.	9,0	11,0	14,5	12,0	10,0	10,5	11,0	15,0	8,0	9,5	10,0	8,0
18.	10,0	11,5	15,0	13,0	11,0	12,0	18,5	18,5	9,0	11,0	12,0	10,0
19.	14,0	14,2	17,0	15,5	9,5	9,5	–	–	10,0	11,0	12,5	11,0
20.	15,0	15,0	17,0	15,5	8,0	8,0	–	–	10,5	12,0	12,5	11,0
21.	16,5	–	–	–	9,0	10,0	11,0	9,0	–	–	–	–
22.	16,0	16,0	18,0	16,0	10,0	12,0	15,5	12,5	–	–	–	–
23.	17,5	17,6	18,0	16,0	9,5	10,0	11,5	9,5	7,0	8,5	10,0	8,0
24.	17,0	17,0	18,0	16,0	11,0	11,5	12,5	10,0	7,0	8,5	10,0	8,0
25.	15,5	16,0	17,0	15,0	8,5	9,0	–	–	5,0	7,0	7,5	5,0
26.	14,5	–	–	–	11,0	11,5	13,0	10,5	11,0	10,0	11,5	10,0
27.	16,0	–	–	–	12,0	12,5	13,5	11,5	6,0	7,0	8,0	8,0
28.	13,0	–	–	–	15,0	15,5	16,0	13,0	6,0	9,5	10,0	8,0
29.	13,0	15,0	15,5	14,0	15,0	16,0	17,0	14,5	–	–	–	–
30.	8,5	11,5	13,5	11,0	16,5	18,0	16,5	15,5	2,0	3,5	5,0	3,0
31.	9,0	12,0	13,5	11,5	16,5	18,0	16,0	16,0	–	–	–	–

Air humidity in the inundation area

Apart from temperature, also other factors of microclimate of the wood in the inundation area (humidity, surface temperature, air current, etc.) develop peculiarely. There excels from them first of all the air humidity, getting — like that on the water surface — very high values here (Table 12).

Table 12. The daily average values of air humidity, in a clear weather, on 50 cm, in the South Tisza-valley (Algyő, June 16th 1955)

	relative air humidity	vapour pressure	air temperature in °C
1. water surface	78,8	14,4	20,0
2. edge of bed	62,2	14,4	24,1
3. wood in the inundation area	58,8	13,7	24,1
4. substance of willow-bushes	54,1	12,9	25,3

In the Tisza inundation area where the relative air humidity is about 15—20 p.c. greater than in the adjacent plain, in a clear, calm weather it can be observed, too, that the nearby mass of water increases the air humidity. This effect is, of course, less present in a gloomy, rainy weather because, after it ceased raining, the humidity content of air above the wood and willow-bush surfaced is higher than even over the surface of water (Table 13).

Table 13. The daily average values of air humidity, in a gloomy, rainy weather, on 50 cm, in the South Tisza-valley (Algyő June 18th 1955)

	relative air humidity	vapour pressure	air temperature in °C
1. water surface	79,0	14,1	19,5
2. edge of bed	72,3	14,4	21,0
3. wood in the inundation area	79,5	15,6	21,0
4. substance of willow-bushes	84,2	15,4	21,1

The air humidity of higher degree is caused by the precipitation evaporated from the surface of vegetation, as well as the fast and intensive vaporization of the damp soil.

The soil of the wood substance with closed foliage in the inundation area is moist and damp in the great part of summer what, in addition to the dense underwood, increases the humidity content of air, as a result of an increased evaporation. Consequently, it can often be observed that in a wood the relative and absolute vapour content is higher than even the humidity of air over the water surface (Table 14).

Table 14. Relative air humidity in the inundation area of the South Tisza (June 18th 1955)

h	10	11	12	13	14	15	16	17
wood	67	72	77	85	97	95	91	84
water surface	66	70	74	84	83	86	84	85
edge of bed	64	65	63	77	82	76	78	81

Relative humidity in the inundation area of the Middle Tisza (Tiszalök) (October 28th 1961)

h	11	12	13	14	15	16
water surface:						
50 cm	65	54	42	52	46	89
100 cm	46	48	42	43	46	65
willow-bushes						
50 cm	51	45	45	48	68	92
100 cm	53	43	43	44	79	90
wood						
50 cm	67	56	49	58	89	97
100 cm	69	56	56	58	90	90

Relative air humidity in the inundation area of the Upper Tisza (Tokaj) (October 29th 1961)

Between	5-6	10-12	18-20 o'clock
1. water surface	92	83	92
2. willow-bushes	97	86	89
3. orchard in the inundation area	99	87	88
4. clearing in the inundation area	97	69	81

The territorial distribution of air humidity in the inundation area, in a calm weather, develops according to the substrata (Fig. 4). From the substrata the substance of wood has the peculiarity differring for the most part from that of the others. Here, in the summer period, doesn't sink even the lowest value of air humidity below 55 percent. On the other hand, on the surface of a clearing in the inundation area, as well as in the adjacent plain area, even a value about 25 percent could be observed. Comparing the values enumerated with the mean air-humidity values of the summer period of Table 4, it is obvious that in the Tisza-valley the water surface and the wood region are the substrata that develop the peculiarity of air humidity of the inundation area.

As a result of being wind-screened and of low temperature, the temporal change of air humidity in the wood substance of the inundation area is of slow course. It could be observed that here are two (night and day) periods of the development of air humidity well separated from each other. While the values of the day period changed in an extreme way, in the night period there were everywhere less unstable air-humidity conditions of a uniform course. At night the relative air humidity is between 85—100 p.c., in the daytime this value changes between 30—80 p.c., depending upon the substrata.

As the water mass of the marsh and river affords a continous vapour supply for the air-space of the wood in the inundation area, the daily course of vapour pressure in the inundation area is identical with that of temperature, i.e., the daily course of vapour pressure is uniwave. It isn't, however, characteristic on the higher lying loess and quicksand surfaces, outside the inundation area of the Tisza, any more. Here is the double wave characteristic in the course of vapour pressure; minimum situations can be noticed in the morning and evening. In the latter case, opposite to the more humid climate of the inundation area, the characteristic of vapour pressure can be told to be a typical continental one (Andó, 1955, 1956). As a summary of the microclimatic investigations carried out in the Hungarian Plain we may establish that already above the areas lying 5—10 km from the inundation area, the daily course of vapour pressure has a double wave. This characteristic appears even in the course of the rainy period in June (European monsoon); the daily course of vapour pressure has a single wave in the inundation area, even in the most arid weather.

From the very humid atmosphere of the inundation area, if a stronger fall in temperature comes, there can arise vapour, dew, and even local fog, as well. It cannot be said that the formation of dew were of identical development and strength. The areas of the most intensive dew formation are the substrata of low temperature and high vapour content, like e.g. a wood and the narrow strip along the bank line; the clearings in the inundation area and the agricultural regions are less important. The air commotion, too, contributes considerably to the dewless characteristic of the atter ones. In cases of a stronger cooling down, the formation of fog can also be noticed at the edge of bank where the absolute vapour content is very high.

Conditions of soil temperature and soil moisture in the inundation area

The general physical state of the air stratum near the soil is highly influenced by temperature and moisture of the soil. The various soil can take up heat of different amount into their strata near the surface, and they become accordingly warm. It is generally known that a moist soil can absorb usually more heat than the same soil in a dry state; and that in case of a moist soil, a larger part of heat is used for evaporation and for warming up the deeper lying strata, and only a smaller part of it is used for warming up the air.

The distribution of soil moisture in the inundation area, in addition to its covered character, is an important factor of the territorial development of soil temperature (Table 15).

In the comparatively homogenous alluvium of the inundation area

Table 15. Soil temperature, in a depth of 2 cm, in a clear day in the inundation area of the South Tisza (Algyő, June 16th 1955)

	Dam top	Wood of closed foliage	Half--moist mud	Dry mud	Thinned--out willows
minimum °C	14,0	12,2	15,0	16,5	13,8
maximum °C	30,0	19,1	26,0	30,5	28,2
Δ	16,0	6,9	11,3	14,0	14,4

	Upper part of the bed side	Central part of the bed side	Lower part of the bed slope	Water bottom (1,5 m)
minimum °C	13,6	12,8	13,0	18,9
maximum °C	28,2	27,6	23,1	19,6
Δ	14,6	12,8	10,1	0,7

the temperatures of the surfaces investigated are differing from one another considerably. The differences can be explained with being covered variously by plants and with the different soil moisture. From the substrata enumerated we have, of course, to evaulate separately the soil temperature of the surface covered with river water, produced by water mixing and the temperature accompanying it. Here is the daily oscillation of 0,7°C nothing else than an alteration regulated by the water temperature developing independently from the daily course of air temperature. E.g., we demonstrate the hourly temperature of a clear day, in connection with that, from the muddy clay surface below the river water (Table 16).

Table 16. Soil temperature of a surface covered with 0,5 m deep river water, on a clear, radiating day (Algyő, June 16th 1955)

at	1	2	3	4	5	6	7 o'clock	
	19,3	19,0	19,2	19,9	19,4	19,5	20,0	
at	8	9	10	11	12	13	14	15 c'clock
	19,4	19,4	19,7	19,6	19,4	20,0	19,9	19,8
at	16	17	18	19	20	21	22 c'clock	
	20,0	19,8	19,4	19,3	19,9	19,5	19,6	

The temperature difference caused by the various soil mosture can be illustrated in the most characteristic way with the data concerning soil temperature on the bed side (Table 17).

Table 17. The moisture content of the bed side in percentage, referred to dry weight, and the soil temperature values of the hourly 2 cm stratum (Algyő, June 16th 1955)

between (cm)	I lower		II central		III upper
	parts of the bed slope (p.c.)				
2 - 5	33,77		16,87		14,97
10 - 15	33,99		17,25		12,05
15 - 20	36,13		17,73		9,89

c'clock	6	7	8	9	10	11
I	13,0	14,7	16,4	18,5	20,0	21,3
II	14,1	16,4	18,8	21,8	24,4	26,4
III	14,6	16,8	20,2	23,2	25,3	27,6

c'clock	12	13	14	15	16	17
I	21,5	22,3	23,1	22,2	22,4	22,3
II	27,5	26,0	26,4	25,2	23,8	23,3
III	27,8	28,2	27,9	27,8	26,7	25,8

On the bed side of 30° slope angle and 70° exposition, the difference of soil temperature, observed inside a distance of 8—10 m, shows correlation with the territorial distribution of soil moisture. In case of the deeper soil stratum in upper and central parts of bed, the daily amplitude of temperature is 10—15°C, and in the lower levels only 5—10°C. This distribution of temperature is explaining the increase of moisture content and the more intensive rise in temperature of the deeper strata.

In a like way, the teritorial distribution in connection with moisture and plant coverage is expressed in other regions of the inundation area, as well. In the inundation area there can be distinguished two characteristic surface types in this respect: the shaded one and the clearing. While the shaded soil surface of woods in the inundation area is damp even in the most arid period of summer, the surface of clearings in the inundation area dries up strongly. For comparing the two areas in respect of soil temperature, we demostrate the temperature differences in 10 cm depth in the soil stratum (Table 18).

Table 18. Differences of soil temperatures in °C, between a wood and a clearing in the inundation area, in the summer of 1963 (Holm Atka)

A/ In a clear, arid, warm weather

h		8	10	12	14	16	18
July	1st	4,4	4,7	4,5	6,0	5,4	6,4
July	2nd	5,1	5,0	5,4	5,6	6,3	7,5
July	3rd	5,4	5,1	5,2	5,4	5,8	6,1
July	5th	5,1	5,4	6,1	6,8	6,5	7,8
July	6th	5,7	5,8	6,0	7,2	6,9	8,2
July	16th	3,2	3,2	3,6	5,1	5,0	5,7
July	17th	3,5	3,4	4,5	5,8	6,4	6,7
July	18th	4,5	4,5	5,6	6,8	7,8	8,0
July	19th	4,9	5,4	6,2	7,4	7,6	5,2
July	20th	4,1	4,4	5,2	5,4	8,7	7,8

B/ In a gloomy, rainy, cool weather

h		8	10	12	14	16	18
July	29th	4,0	4,1	4,4	4,7	4,7	4,8
July	30th	3,2	3,0	3,2	3,9	4,0	4,0
July	31sh	2,8	3,1	3,5	4,2	4,3	5,2
August	1st	2,8	3,2	3,1	6,2	4,0	4,2
August	2nd	2,8	3,0	2,9	3,1	3,8	3,9
August	12th	1,9	2,0	2,8	3,2	3,4	3,9
August	13th	2,2	2,3	2,5	3,3	3,2	3,8
August	14th	2,1	2,2	2,5	2,8	3,3	3,4
August	15th	2,0	2,0	2,4	3,5	3,4	3,9
September	5th	2,0	2,0	3,0	3,5	3,5	4,4
September	6th	2,4	2,7	3,0	3,7	3,7	4,0
September	11th	0,8	0,5	1,5	2,3	2,7	3,1

In a clear, arid, warm weather, in the daytime there develop 4—6°C temperature differences. In a gloomy, rainy weather the soil of wood is 2—3°C cooler than the surface of clearing. With the data above we have demostrated in general outlines the most important characteristics of the soil temperature in the inundation area. The soil temperature alterations connected with the soil-moisture differences and shade-effects are contributing with further data to the knowledge of the microclimatic characteristics of the single substrata.

Aerodynamic conditions of the inundation area

Evaluating shortly the aerodynamic conditons of the inundation area, we can establish that the territorial distribution of temperature and air humidity depends considerably upon the wind conditions. The orographical data and plant coverage of the inundation area modify considerably the strength of air motion in case of the various wind directions. On the basis of our measurements, in case of the Tisza-valley of N-S direction, we can observe a 60—75 p.c. decrease in wind strength at NW, W, SW, E wind directions while only 10—20 p.c. at N, S wind directions. In forming a lee in the inundation area, there plays first of all the flora (wood) an important role. In the single regions the Tisza inundation area, the inundation wood strips that border the river valley exert a considerable effect in case of winds which blow at right angles to the river valley. They change the structure of air current, divide the large eddies of the stream into smaller ones, that conducts in the parts protected, in the surface air layer, to a decrease of intensity of the vertical turbulence. On the other hand, in the higher layers over the wood (till a height of 500 m or so), the turbulent exchange increases. The increase of air masses towards the wood strips causes some decrease of temperature and increase of relative humidity in the inundation area because the evaporation will be less in the protected areas, owing to a diminution of wind velocity and a weakening of the turbulent exchange.

The cooler situation of the inundation area as compared with its surroundings has an influence on the stoppage of the formation of up currents that are otherwise frequent above the adjacent plain surfaces. Particularly in calm or only weakly windy summer days we may notice a full absence of up currents above the inundation area (P a p, 1957). In case of weaker air motions, at the valley line, also a confluence of air is frequent, i.e., the Tisza-valley can be characterized like a wind reservoir, as well.

In this work we did not endeavour to afford a regional summary of taxonomic character. From the results of the microclimatic investigations performed in the single Tisza regions, there were investigated mostly only the typical values and basic connections that are characteristic of the peculiarities of the inundation area. We expect to have promoted with this work the successful solution of the tasks of the complex investigations.

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ÜBER DAS PHYTOSESTON DER EUTROPHIERTEN THEISS (TISZA) I. BEOBACHTUNGEN IM JULI 1968

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(Eingegangen am 20. Dezember 1968)

Einleitung

Das Trophitätsproblem — und innerhalb dessen die Frage der Eutrophie — wurde bisher in der limnologischen Literatur vornehmlich in bezug auf die Stillgewässer erörtert. Beobachtungen über Algenmassenvermehrungen in Flüssen, die auf einen eutrophierten Zustand des betreffenden Flusses hindeuten sollen, wurden bislang nur spärlich veröffentlicht. Auch kam es nicht zu einer Verallgemeinerung dieser Einzelbeobachtungen.

Um dieses Problem auf einer breiteren Basis behandeln zu können, habe ich Studien an individuenreichen Phytosestonbeständen von Flüssen ausgeführt. Untersuchungen, die sich auf längere Zeitspanne erstreckten, ergaben, zu welchen Zeitpunkten und durch welche ökologische Gesamtsituation bestimmt solche massenartige Vermehrung des Phytosestons bei den Flüssen Theiss (Tisza), Donau und Drau zu erwarten sind (Uherkovich, 1968a, 1968b, 1969). Diese vorausgehenden Erfahrungen haben mir mitgeholfen, um Zeit und Raum schon voraus bestimmen zu können, in denen ich mit solchen individuenreichen Phytosestonbeständen rechnen kann. Auf diese Weise habe ich auch in jenem Falle verfahren, den ich in dieser Arbeit ausführlich besprechen möchte.

Vom Frühjahr bis Mitte des Sommers 1968 herrschte im Donaubecken eine Periode, die durch anhaltend höhere Temperaturen und minimale Niederschlagsmengen charakterisiert war. Diese Witterungsverhältnisse hatten einen für diese Jahreszeiten ungewohnt tiefen Wasserstand zu Folge. Der niedrige Wasserstand mit seiner geringeren Turbulenz verringerte die Schwebestoffe und das begünstigte das Lichtklima des Wassers. Die grosse Durchsichtigkeit und die hohen Temperaturen des Wassers hielten wochenlang ungestört an und sicherten für längere Zeit sehr günstige Möglichkeiten einer intensiven Photosynthese. Die ständig anwesende Abwasserbelastung des Flusses gibt dann als „düngender Faktor" unter diesen Verhältnissen einen Anstoss zur regeren Algenvermehrung. Sämtliche Nährstoffe des Flusswassers

„realisieren sich" unter diesen anhaltend günstigen ökologischen Verhältnissen und lassen eine richtige massenhafte Vermehrung des Phytosestons zustande kommen.

Die Theiss (Tisza) ist ein stark regulierter Fluss, der in zusammengedrängter Flussrinne fliesst. Die grösseren Wassertiefen, ferner der verhältnismässig hohe Gehalt an Schwebestoffen (das Wasser führt viel Löss, Lehm, feinkörnigen Sand) bestimmen im Fluss im grössten Teil des Jahres eher schlechte als gute Lichtklimaverhältnisse. Die Spätsommer-Frühherbst-Periode mit anhaltend niedrigem Wasserstand und noch immer ziemlich hohen Wassertemperaturen pflegt bei "normalen" (durchschnittlichen) Witterungsverhältnissen, in "normalen" Jahren die Periode der Produktionsmaxima im Phytoseston, der "eutrophierte Zustand" des Flusses zu sein. Im Jahre 1968 haben sich die ökologischen Verhältnisse, die sonst in der Theiss (Tisza) im Spätsommer-Frühherbst zustande kommen, breits im Spätfrühjahr-Frühsommer entfaltet.

Das Phytoseston im Mittel- und Unterlauf des Flusses im Juli 1968

Um das Phytoseston der Theiss (Tisza) in der ersten Hälfte des Monats Juli 1968 einer eingehenderen Analyse unterwerfen zu können, habe ich eine vereinfachte Längsprofiluntersuchung im Fluss gemacht. Da nach vorausgehenden Erfahrungen die Produktionsmaxima des Phytosestons in der Theiss (Tisza) fast immer im Mittel- und Unterlauf zur Entfaltung gelangen, war es angebracht, bei dieser Länsprofiluntersuchung meine ersten Proben bei Szolnok zu nehmen, um dadurch die Charakteristika der unteren Hälfte des Mittellaufes und des Beginns des Unterlaufes gleichermassen ausfindig zu machen. Die Probeentnahme (Schöpfproben und Netzproben) bei Szolnok geschah am 6. 7. 1968.

Um die weiteren Proben annähernd aus demselben flussabwärts herabgleitenden Wasserkörper erhalten zu könen, habe ich meine nächsten Proben bei Szeged am 8. 7. 1968 genommen. Diese Proben sollten für die typischen Verhältnisse des Flussunterlaufes als massgebend gelten.

Die Schöpfproben wurden nach der quantitativen Methode von Utermöhl (1958) bearbeitet und die gewonnenen Ergebnisse in Ind./l-Werten ausgedrückt. (Die Begründung, warum statt Zellenzahl/l-Werten Ind./l-Werte genommen werden, s. bei Uherkovich, 1966b.)

I. Die quantitative Zönosenanalyse der Phytosestonprobe von Szolnok (6. 7. 1968) ergab ein Gesamtindividuenwert von 5 342 000 Ind./l. 50,42% von diesem machten die Kieselalgen aus. Innerhalb dieser waren die *Cyclotella*-Arten (30,88%), *Attheya zachariasii* (3,07%), *Melosira granulata* var. *angustissima* (4,13%), *Nitzschia acicularis* (2,58%) und *Synedra acus* (3,96%) vorherrschend 33,09% der Gesamtbevölkerung machten die *Chlorococcales*-Taxa aus; in dieser Gruppe waren die Algen *Actinastrum hantzschii* (2,24%), *Ankistrodesemus angustus* (10,74%) *Didymocystis tuberculata* (3,33%), *Scenedesmus acuminatus* (2,17%), *Scenedesmus anomalus* (3,44%) vorherrschend. Algen, die zu den übrigen systematischen Gruppen gehören, machten insgesamt 7,71% der Gesamtpopulation aus. Ausserdem war noch die Wasserpilzart *Planctomyces békefii* mit einem auffallend hohen Individuenwert (469 000 Ind./l, 8,78%) vertreten.

II. Die Probe von Szeged (8. 7. 1968) war mit dem Gesamtindividuenwert von 3 663 000 Ind./l etwas individuenarmer als jene von Szolnok. Das Phytoseston bei Szeged bestand zu diesem Zeitpunkt zu 39,80% aus Kieselalgen; der Kieselalgen-Anteil hat also sowohl relativ als auch absolut gewertet abgenommen. Innerhalb der Kieselalgen waren die *Cyclotella*-Arten (24,08%), *Melosira granulata* (3,39%, eine Zunahme!), *Melosira granulata* var. *angustissima* (3,00%), *Nitzschia acicularis* (2,07%) vorherrschend. Es scheint also eine Zunahme bei *Melosira granulata* und eine Abnahme bei *Synedra acus* (bei Szeged bloss 1,75%) eingetreten zu sein, sonst sind aber die Hauptwesenszüge des Kieselalgenanteils unverändert geblieben.

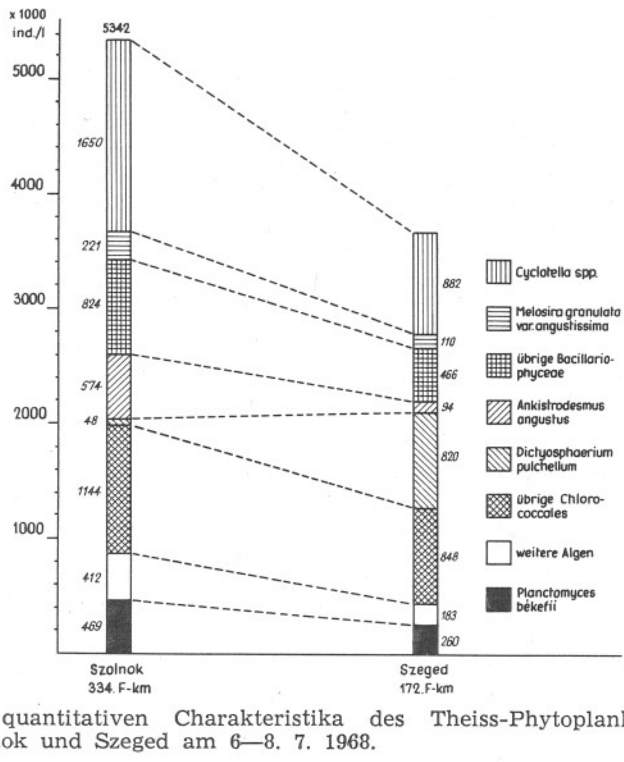

Abb. 1. Die quantitativen Charakteristika des Theiss-Phytoplanktons zwischen Szolnok und Szeged am 6—8. 7. 1968.

Der *Chlorococcales*-Anteil des Phytosestons bei Szeged hat 48,10% der Gesamtpopulation ausgemacht; hier ist also eine relative Zunahme zu verzeichnen, doch ist in absoluten Werten der *Chlorococcales*-Anteil auf dem selben Niveau geblieben (bei Szolnok 1 766 000, bei Szeged 1 762 000 Ind./l). Vorherrschende Arten: *Actinastrum hantzschii* (1,58%), *Ankistrodesmus acicularis* (2,07%), *Ankistrodesmus angustus* (2,57%, signifikante Abnahme gegenüber der Probe von Szolnok), *Dictyosphaerium pulchellum* (22,39, sprunghafte Vermehrung!), *Hofmania lauterbornii* (1,58%, gegenüber 0,04% bei Szolnok!), *Didymocystis planctonica*

(1,48% auffallande Zunahme gegenüber 0,34% bei Szolnok und *Didymocystis tuberculata* (2,29%).

Der art- und individuenreicher *Chlorococcales*-Anteil des *Phytosestons* hat sich zwischen Szolnok und Szeged im stromabwärts herabgleitenden Wasserkörper vor allem dadurch verändert, dass sich die Algen *Dictyosphaerium pulchellum, Didymocystis planctonica* und *Didymocystis tuberculata* weit stärker vermehrt haben, als die übrigen Algentaxa.

Die Wasserpilzart *Planctomyces békefii* war auch hier mit einer hohen Individuenzahl (7,10%) auffallender Bestandteil des Phytosestons.

Taxonomische Aufzählung der vorgefundenen Mikrophyten

Das Vorkommnis der einzelnen Taxa in den betreffenden Proben wurde in unserer Aufzählung folgendermassen vermerkt:

I = Probeentnahme bei Szolnok, 6. 7. 1968.

II = Probeentnahme bei Szeged, 8. 7. 1968.

Die zwischen Klammern gesetzten Zahlen beziehen sich auf die bei der quantitativen Zönosenanalysen festgestellten Ind./l-Werten.

Wo das durch die zuständigen Literaturangaben in genügendem Masse begründet ist, wird angegeben, zu welcher Stufe der Organismus im Saprobiensystem gehört; diesbezüglich werden die üblichen Symbole (o, β-m, α-m und deren Kombination) verwendet. Das Einordnen in das Saprobiontensystem geschah auf Grund der Arbeiten von Fjerdingstad (1965), Liebmann (1962), Margalef (1955), Sládeček (1963), Uherkovich (1961), Zelinka und Marvan (1961).

Cyanophyta
Anabaena hassalii (Kütz.) Wittr. — II (1 000)
A. spiroides Klebahn — II (4 000)
Aphanizomenon flos-aquae (L.) Ralfs — I, II (2 000) — β-α — m
Lyngbya limnetica Lemm. — I (86 000), II (8 000)
Merismopedia glauca (Ehrbg.) Naeg. — I, II (32 000)
M. punctata Meyen — I, II — β — α — m
M. tenuissima Lemm. — I (16 000), II (16 000) — β — α — m
Microcystis aëruginosa Kütz. — I, II — β — m
Oscillatoria tenuis Agh. — II — α — m
Euglenophyta
Euglena sp. — I (8 000), II (2 000)
Phacus sp. — I (8 000), II (4 000)
Pyrrophyta
Gymnodinium sp. — I (74 000), II (8 000)
Ceratium hirundinella (O.F.M.) Schrank f. *furcoides* (Schroed.) Huber-Pest. — I — β — m
Chrysophyta — Chrysophyceae
Dinobryon divergens Imhof — I, II (4 000) — o — β — m
D. sertularia Ehrbg. — I — β — m
D. sociale Ehrbg. — I (2 000), II — (β — m ?)
Mallomonas tonsurata Teiling — I (12 000), II — (o — β — m ?)
Chrysophyta — Bacillariophyceae

Asterionella formosa Hassal — II — β — m
Attheya zachariasii J. Brun — I (164 000), II (8 000)
Caloneis amphisbaena (Bory) Cleve — I — β — α — m
Cyclotella meneghiniana Kütz. — I, II — β — α — m
Cyclotella spp. — I (1 650 000), II (882 000)
Cymatopleura elliptica (Bréb.) W. Smith — I — o — β — m
C. solea (Bréb.) W. Smith — II — β — α — m
Fragilaria capucina Desmaz. — I — o — β — m
F. crotonensis Kitton — I, II — o — β — m
Melosira granulata (Ehrbg.) Ralfs — I (8 000), II (124 000) — β — m
M. granulata var. *angustissima* Müll. — I (221 000), II (110 000) — — β — m
M. varians Agh. — I, II (4 000) — β — m
Navicula cryptocephala Kütz. — I (4 000), II — β — α — m
Nitzschia acicularis W. Smith — I (138 000), II (76 000) — β — α — m
N. gracilis Hantzsch — I (14 000)
N. longissima (Bréb.) Ralfs var. *closterium* (W. Smith) v. *Heurck* — I, II (24 000)
N. palea (Kütz.) W. Smith — I (62 000), II (32 000) — α — m
Pinnularia microstauron (Ehrbg.) Cleve — I — o (o — β — m ?)
Stephanodiscus dubius (Fricke) Hust. — I (28 000), II (28 000)
Surirella biseriata Bréb. var. *bifrons* (Ehrbg.) Hust. — I
S. linearis W. Smith — I
S. linearis var. *helvetica* (Brunnth.) Meister — I (6 000), II
S robusta Ehrbg. var. *splendida* (Ehrbg.) v. Heurck — I, II
S. tenera Gregory — I
S. tenera var. *nervosa* A. Schmidt — I, II
Synedra actinastroides Lemm. — I (94 000), II (62 000)
S. acus Kütz. — I (212 000), II (64 000) — β — m
S. ulna (Nitzsch) Ehrbg. — I (4 000), II (2 000) — β — α — m
Chlorophyta — Chlorophyceae
Chlorococcales
Actinastrum hantzschii Lagerh. — I (120 000), II (58 000) — o — β — m
Ankistrodesmus acicularis (A. Br.) Korschik. — I (8 000), II (76 000) — β — α — m
A. angustus Bern. — I (574 000), II 94 000) — β — m
A. arcuatus Korschik. — II (2 000)
A. longissimus (Lemm.) Wille var. *acicularis* (Chod.) Brunnth. — I (8 000), II (74 000) — (β — m ?)
Chodatella citriformis Snow — I
Coelastrum cubicum Naeg. — I (2 000), II (8 000) — β — m
C. microporum Naeg. — I (4 000), II (54 000) — β — m
C. sphaericum Naeg. — I (62 000), II (8 000) — (o — β — m ?)
Crucigenia apiculata Schmidle — I (2 000), II (2 000) — β — m
C. quadrata Morren — I (12 000), II (4 000) — β — m
C. tetrapedia (Kirchner) W. et G. S. West — I (8 000), II (18 000) — β — m
Dictyosphaerium ehrenbergianum Naeg. — I (4 000), II (8 000)
D. pulchellum Wood — I (48 000), II (820 000) — β — α — m

Didymocystis inconspicua Korschik. — I (16 000), II
D. planctonica Korschik. — I (18 000), II (54 000) — (β — m ?)
D. tuberculata Korschik. — I. (178 000), II (84 000)
Hofmania lauterbornii (Schmidle) Wille — I (2 000), II (58 000)
Kirchneriella lunaris (Kirchner) Moebius — I — β — m
K. obesa (W. West) Schmidle — I (18 000), II (8 000)
Lagerheimia wratislawiensis Schroed. — I (12 000), II (20 000)
Micractinium pusillum Fres. — I (46 000), II (54 000) — β — m
Oocystis borgei Snow — I (β — α — m ?)
Oocystis spp. — I (24 000), II (32 000)
Pediastrum boryanum (Turp.) Menegh. — I (4 000), II (12 000) — β — α — m
P. duplex Meyen — I (8 000), II (32 000) — β — α — m
P. simplex (Meyen) Lemm. — I, II — β — m
P. tetras (Ehrbg.) Ralfs — I — β — m
Polyedriopsis spinulosa Schmidle — II
Rhaphidionema spirotaenia (G. S. West) Korschik. — II (2 000)
Scenedesmus acuminatus (Lagerh.) Chod. — I (116 000), II (18 000) — β — α — m
S. acuminatus f. *maximus* Uherkov. — II
S. acutus Meyen f. *costulatus* (Chod.) Uherkov. — I (8 000), II (2 000) — β — α — m
S. anomalus (G. M. Smith) Tiff. — (184 000), II (12 000) — (α — m ?)
S. arcuatus Lemm. — I (4 000), II (2 000)
S. circumfusus Hortob. var. *bicaudatus* Hortob. f. *granulatus* Hortob. — I
S. denticulatus Lagerh. — I (4 000), II (4 000) — β — m
S. denticulatus var. *linearis* Hansg. — I (4 000), II — β — m
S. ecornis (Ralfs) Chod. — I — β — α — m
S. ecornis var. *disciformis* Chod. — I — β — α — m
S. ellipsoideus Chod. — I (8 000), II (8 000)
S. intermedius Chod. — I (8 000), II (4 000) — β — m
S. intermedius var. *bicaudatus* Hortob. — I, II (4 000)
S. opoliensis P. Richt. — I (52 000), II (54 000) — β — α — m
S. protuberans Fritsch — I (24 000), II (2 000)
S. quadricauda (Turp.) Bréb. — I (32 000), II (4 000) — β — m
S. spinosus Chod. — I (54 000), II (4 000) — o — β — m
Schroederia setigera (Schroed.) Lemm. — I (2 000), II — (β — m ?)
Siderocelis ornata Fott — I, II (2 000)
Tetraëdron incus (Teiling) G. M. Smith — I (4 000), II
Tetrastrum glabrum (Roll) Ahlstr. et Tiff. — I (4 000), II (4 000)
T. punctatum (Schmidle) Ahlstr. et Tiff. — I (4 000), II (8 000)
T. staurogeniaeforme (Schroed.) Lemm. — I, II (4 000) — β — m

Chlorophyta — Chlorophyceae
(ausser *Chlorococcales*)

Chlamydomonas spp. — I (86 000), II (18 000)
Eudorina elegans Ehrbg. — I, II — β — m
E. illinoisensis (Kofoid) Pascher — I
Gonium pectorale Müller — II — β — α — m
Pandorina morum (Müller) Bory — I (4 000), II — β — α — m

C h l o r o p h y t a — C o n j u g a t o p h y c e a e
Closterium acerosum (S c h r a n k) E h r b g. — II — β — α — m
C. acerosum var. *tumidum* B o r g e — I (2 000), II (1 000)
C. acutum B r é b. var. *ceratium* (P e r t y) K r i e g e r — II
C. acutum var. *variabile* (L e m m.) K r i e g e r — II (1 000)
C. macilentum B r é b. — I
C. pronum B r é b. I, II (12 000)
C. setaceum E h r b g. var. *elongatum* W. et G. S. W e s t — I, II (4 000)
Staurastrum anatinum C o o k e et W i l l e var. *pelagicum* W. et G. S. W e s t — I, II
S. paradoxum M e y e n — I, II (8 000)
M y c o p h y t a
Planctomyces békefii G i m e s i — I (469 000), II (260 000) — β — α — m

Zusammenfassende Besprechung der Ergebnisse

In der ersten Hälfte des Sommers 1968 entfaltete sich — vor allem durch günstige meteorologische Verhältnisse bestimmt — im Mittel- und Unterlauf der Theiss (Tisza) ein ausgeprägt individuen- und artenreiches Phytoseston, dessen Auftreten wohl als ein Zeichen des eutrophierten Zustandes des Wassers zu deuten ist.

In der mengenmässigen Zusammensetzung der untersuchten Phytosestonbestände war der Chlorococcales-Anteil — für Verhältnisse in Fliessgewässern — sehr gross und taxonomisch abwechslungsreich. Der Kieselalgen-Anteil war dagegen minderer als die gewohnten Werte in Flussbeständen. Auffallend war ferner der hohe Individuen/l-Wert der Wasserpilzart Planctomyces békefii und ungewöhnlich die zahlenmässig unbedeutende Teilnahme der Blaualgen und Euglenophyten in den untersuchten Beständen.

Durch Erwägung dieser Gesamtsituation sind wir wohl berechtigt anzunehmen, dass wir hier mit einem durch Eutrophierung geformtes Phytoseston zu tun haben. Das Phytoseston war zu dieser Zeit in der Theiss (Tisza) auch in engerem Sinne des Wortes von richtigem Planktoncharakter (vgl. U h e r k o v i c h, 1966b).

Die Zugehörigkeit der vorgefundenen Mikrophyten zu den einzelnen taxonomischen, bzw. saprobiologischen Gruppen lässt sich durch folgende Übersicht veranschaulichen =

	o-βm	β-m	β-α-m	α-m	Kein Saprobiont (oder unsicher)	Taxa zusammen
Cyanophyta	-	1	3	1	4	9
Euglenophyta	-	-	-	-	2	2
Pyrrophyta	-	1	-	-	1	2

Chrysophyita chrysophyceae	1	1	-	-	2	4
Chrysophyta Bacillariophyceae	4	5	6	1	12	28
Chlorophyta Chlorococcales	2	16	9	-	26	53
Chlorophyta übrige Chlorophyceae	-	1	2	-	2	5
Chlorophyta Conjugatophyceae	-	-	1	-	8	9
Mycophyta	-	-	1	-	-	1
Sämtliche Mikrophyten	7	25	22	2	57	113

Taxonomisch und ökologisch sind unter den vorgefundenen Taxa die Vorkommnisse der drei Didymocystis-Arten und der Art Hofmania lauterbornii am auffallendsten. (Bei der taxonomischen Beurteilung dieser Algen stützte ich mich an Bourrelly, 1968 und Korshikov, 1953). Die *Didymocystis*-Arten habe ich bei dieser Gelegenheit zum ersten Male in der Theiss (Tisza) angetroffen, aber auch die *Hofmania lauterbornii* wurde in dem Fluss bisher bloss in zwei Fällen vernommen. Dieesmal sind diese Algen in nicht unbedeutenden Individuenzahlen vorgekommen.

Ein weiteres kennzeichnendes Merkmal der taxonomischen Zusammensetzung dieser Phytosestonbestände ist die hohe Anzahl an *Scenedesmus*-Taxa. (Die *Scenedesmus*-Taxa werden taxonomisch nach der Arbeit Uherkovich, 1966a gedeutet). Unter den 17 *Scenedesmus*-Taxa ist besonders auffällig die bedeutende Individuenzahl der Art *Scenedesmus anomalus*, deren Auftreten meiner Beobachtung nach immer an einem eutrophierten Zustand eines eher β — α — m als β — m Gewässers gebunden ist. Unter den *Scenedesmus anomalus*-Exemplaren gab es einige mit signifikant kürzeren Stacheln (Fig. 3) und solche mit mehr-weniger köpfig ausgebildeten Zellenden (Fig. 10). Letzterer Morphotyp erinnert gewissermassen an die Zellumrissform der Art *Scenedesmus producto-capitatus* Schmula. Vor einer Beschreibung beider Formen möchte ich noch an weiteren Exemplaren anderer Proben ergänzende Beobachtungen machen.

Zur Tatsache, dass sich der Gesamtindividuenwert von Szolnok bis Szeged verringert, ist nicht leicht Stellung zu nehmen. (Sonst ist gewöhnlich eine Zunahme in der Populationsdichte an dieser Strecke zu verzeichnen.) Die Abnahme des Individuenwertes von der ausgeprägt β — m Art *Ankistrodesmus angustus* und die Zunahme der Individuen von der β — α — m Art *Dictyosphaerium pulchellum*, ferner die Abnahme des Gesamtindividuenwertes im allgemeinen kann man vielleicht so deuten, dass der Fluss auf der Strecke Szolnok—Szeged vorübergehend eine Verschlechterung seines saprobiologischen Gütebildes erfährt. Dies dürfte gerade durch die industriellen Abwässer von Szolnok hervorgerufen werden.

Die quantitative Zusammensetzung des Phytosestons in der Theiss (Tisza) zwischen Szolnok und Szeged, am 6-8. 7. 1968

	I		II	
	Szolnok, VII. 6.		Szeged, VII. 8.	
	ind./l	%	ind./l	%
Attheya zachariasii	164 000	3,07	8 000	0,22
Cyclotella spp.	1 650 000	30,88	882 000	24,08
Melosira granulata	8 000	0,15	124 000	3,39
M.granulata var. angustissima	221 000	4,13	110 000	3,00
M.varians	+		4 000	0,11
Navicula cryptocephala	4 000	0,08	+	
Nitzschia acicularis	138 000	2,58	76 000	2,07
N.gracilis	14 000	0,26		
N.longissima var. closterium	+		24 000	0,66
N.palea	62 000	1,16	32 000	0,87
Stephanodiscus dubius	28 000	0,52	28 000	0,76
Surirella linearis var. helvetica	6 000	0,11		
Synedra actinastroides	94 000	1,76	62 000	1,69
Synedra acus	212 000	3,96	64 000	1,75
Synedra ulna	4 000	0,08	2 000	0,05
übrige Bacillariophyceae	90 000	1,68	42 000	1,15
sämtliche Bacillariophyceae	2 695 000	50,42	1 458 000	39,80
Actinastrum hantzschii	120 000	2,24	58 000	1,58
Ankistrodesmus acicularis	8 000	0,15	76 000	2,07
A.angustus	574 000	10,74	94 000	2,57
A.arcuatus			2 000	0,05
A.longissimus var. acicularis	8 000	0,15	74 000	2,02
Coelastrum cubicum	2 000	0,04	8 000	0,22
C.microporum	4 000	0,08	54 000	1,48
C.sphaericum	62 000	1,16	8 000	0,22
Crucigenia apiculata	2 000	0,04	2 000	0,05
C.quadrata	12 000	0,22	4 000	0,11
C.tetrapedia	8 000	0,15	18 000	0,49
Dictyosphaerium ehrenbergianum	4 000	0,08	8 000	0,22
D.pulchellum	48 000	0,90	820 000	22,39
Didymocystis inconspicua	16 000	0,30	+	
D.planctonica	18 000	0,34	54 000	1,48
D.tuberculata	178 000	3,33	84 000	2,29
Hofmania apendiculata	2 000	0,04	58 000	1,58
Kirchneriella obesa	18 000	0,34	8 000	0,22
Lagerheimia wratislawiensis	12 000	0,22	20 000	0,55
Micractinium pusillum	46 000	0,88	54 000	1,48
Oocystis spp.	24 000	0,45	32 000	0,87
Pediastrum boryanum	4 000	0,08	12 000	0,33
P.duplex	8 000	0,15	32 000	0,87
Rhaphidionema spirotaenia			2 000	0,05
Scenedesmus acuminatus	116 000	2,17	18 000	0,49
S.acutus f. costulatus	8 000	0,15	2 000	0,05
S.anomalus	184 000	3,44	12 000	0,33
S.arcuatus	4 000	0,08	2 000	0,05
S.denticulatus	4 000	0,08	4 000	0,11
S.denticulatus var. linearis	4 000	0,08	+	
S.ellipsoideus	8 000	0,15	8 000	0,22
S.intermedius	8 000	0,15	4 000	0,11
S.intermedius var. bicaudatus	+		4 000	0,11
S.opoliensis	52 000	0,97	54 000	1,48
S.protuberans	24 000	0,45	2 000	0,05
S.quadricauda	32 000	0,60	4 000	0,11
S.spinosus	54 000	1,01	4 000	0,11
übrige Scenedesmus spp.	28 000	0,52	12 000	0,33
Schroederia setigera	2 000	0,04	+	
Siderocelis ornata	+		2 000	0,05
Tetraedron incus	4 000	0,08	+	
Tetrastrum glabrum	4 000	0,08	4 000	0,11
T.punctulatum	4 000	0,08	8 000	0,22
T.staurogeniaeforme	+		4 000	0,11

übrige Bacillariophyceae	90 000	1,68	42 000	1,15
sämtliche Bacillariophyceae	2 695 000	50,42	1 458 000	39,80
Actinastrum hantzschii	120 000	2,24	58 000	1,58
Ankistrodesmus acicularis	8 000	0,15	76 000	2,07
A. angustus	574 000	10,74	94 000	2,57
A. arcuatus			2 000	0,05
A. longissimus var. acicularis	8 000	0,15	74 000	2,02
Coelastrum cubicum	2 000	0,04	8 000	0,22
C. microporum	4 000	0,08	54 000	1,48
C. sphaericum	62 000	1,16	8 000	0,22
Crucigenia apiculata	2 000	0,04	2 000	0,05
C. quadrata	12 000	0,22	4 000	0,11
C. tetrapedia	8 000	0,15	18 000	0,49
Dictyosphaerium ehrenbergianum	4 000	0,08	8 000	0,22
D. pulchellum	48 000	0,90	820 000	22,39
Didymocystis inconspicua	16 000	0,30	+	
D. planctonica	18 000	0,34	54 000	1,48
D. tuberculata	178 000	3,33	84 000	2,29
Hofmania apendiculata	2 000	0,04	58 000	1,58
Kirchneriella obesa	18 000	0,34	8 000	0,22
Lagerheimia wratislawiensis	12 000	0,22	20 000	0,55
Micractinium pusillum	46 000	0,88	54 000	1,48
Oocystis spp.	24 000	0,45	32 000	0,87
Pediastrum boryanum	4 000	0,08	12 000	0,33
P. duplex	8 000	0,15	32 000	0,87
Rhaphidionema spirotaenia			2 000	0,05
Scenedesmus acuminatus	116 000	2,17	18 000	0,49
S. acutus f. costulatus	8 000	0,15	2 000	0,05
S. anomalus	184 000	3,44	12 000	0,33
S. arcuatus	4 000	0,08	2 000	0,05
S. denticulatus	4 000	0,08	4 000	0,11
S. denticulatus var. linearis	4 000	0,08	+	
S. ellipsoideus	8 000	0,15	8 000	0,22
S. intermedius	8 000	0,15	4 000	0,11
S. intermedius var. bicaudatus	+		4 000	0,11
S. opoliensis	52 000	0,97	54 000	1,48
S. protuberans	24 000	0,45	2 000	0,05
S. quadricauda	32 000	0,60	4 000	0,11
S. spinosus	54 000	1,01	4 000	0,11
übrige Scenedesmus spp.	28 000	0,52	12 000	0,33
Schroederia setigera	2 000	0,04	+	
Siderocelis ornata	+		2 000	0,05
Tetraedron incus	4 000	0,08	+	
Tetrastrum glabrum	4 000	0,08	4 000	0,11
T. punctulatum	4 000	0,08	8 000	0,22
T. staurogeniaeforme	+		4 000	0,11
übrige Chlorococcales	48 000	0,90	32 000	0,87
sämtliche Chlorococcales	1 766 000	33,09	1 762 000	48,10
Anabaena spiroides			4 000	0,11
A. hassalii			1 000	0,03
Aphanizomenon flos-aquae	+		2 000	0,05
Lyngbya limnetica	86 000	1,61	8 000	0,22
Merismopedia glauca	+		32 000	0,87
M. tenuissima	16 000	0,30	16 000	0,44
übrige Cyanophyta	24 000	0,45	28 000	0,76
Euglena spp.	8 000	0,15	2 000	0,05
Phacus spp.	8 000	0,15	4 000	0,11
Gymnodynium spp.	74 000	1,38	8 000	0,22
Dinobryon divergens	+		4 000	0,11
D. sociale	2 000	0,04	+	
Mallomonas tonsurata	12 000	0,22	+	
Chlamydomonas spp.	86 000	1,61	18 000	0,49
Pandorina morum	4 000	0,08	+	
Closterium acerosum var. tumidum	2 000	0,04	1 000	0,03
C. acutum var. variabile			1 000	0,03
C. pronum	+		12 000	0,33
C. setaceum var. elongatum			4 000	0,11
Staurastrum paradoxum	+		8 000	0,22
Weitere Algen	90 000	1,68	30 000	0,82
Algen ausser Kieselalgen und Chlorococcales	412 000	7,71	183 000	5,00
Planctomyces békeffi	469 000	8,78	260 000	7,10
sämtliche Mikrophyten	5 342 000	100%	3 663 000	100%

Zwischen Eutrophität und Saprobität des Wassers eine eindeutige Grenze aufzustellen ist grade bei solchen Gewässern an grossen Schwierigkeiten geknüpft, die zur β — m "Saprobitätsstufe" gehören. Diese und ähnliche Schwierigkeiten — im Zusammenhang mit diesem Problemenkreis — werden unter anderen bei Caspers und Schulz (1960, 1962), bzw. bei Uhlmann (1967) betont exponiert.

Aus meinem in dieser Arbeit dargelegten Tatsachenmaterial möchte ich zu keiner verfrühten Verallgemeinerung gelangen, sondern möchte eher Material für eine spätere zusammenfassendere Betrachtung des Problems "Eutrophierung in Fliessgewässern" darbieten.

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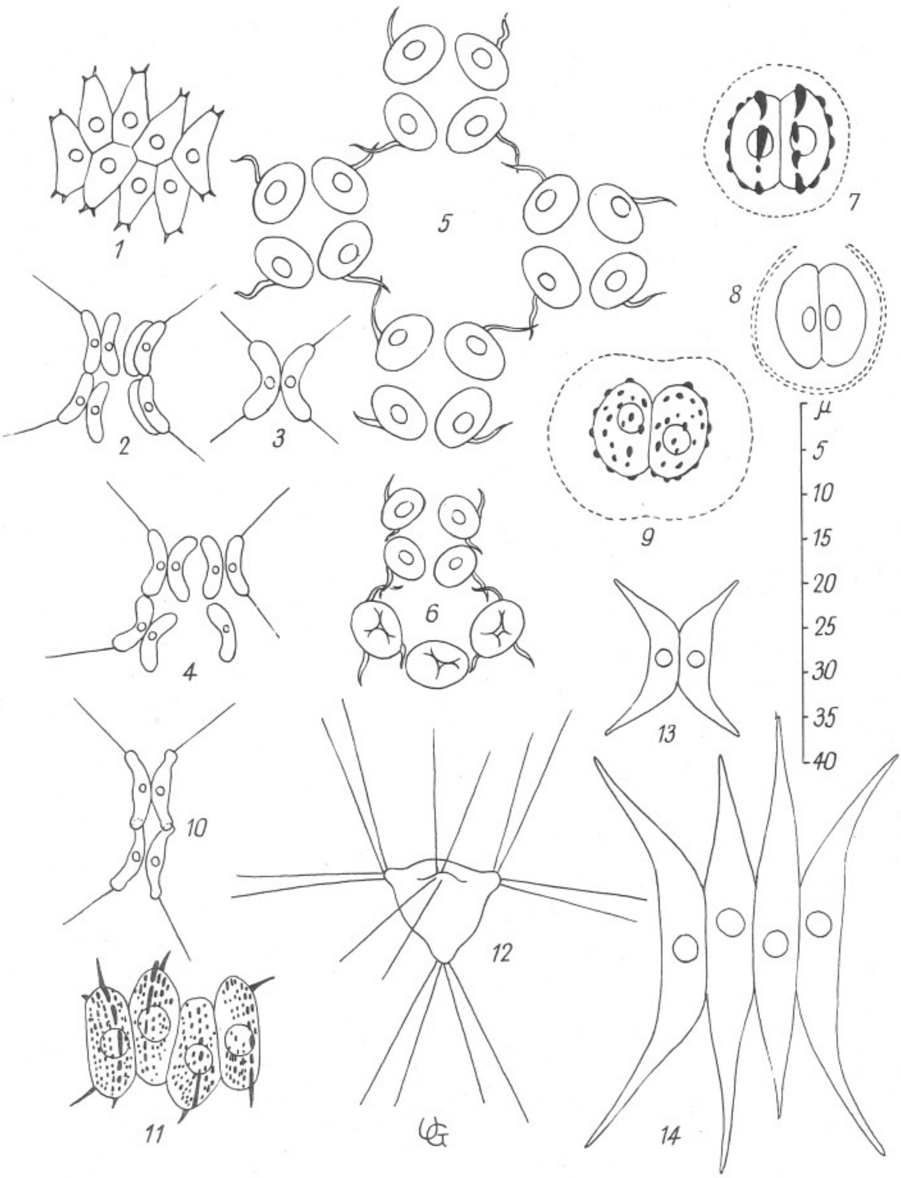
Tafelerklärung

1. *Scenedesmus denticulatus* (ungewöhnlicher Morphotyp mit eigenartiger Zönobienform und abweichenden Randzellen), 2—4. *Scenedesmus anomalus* (Fig. 3: besondere Form mit kurzen Stacheln), 5—6. *Hofmania lauterbornii*, 7. *Didymocystis inconspicua*, 8. *Didymocystis planctonica*, 9. *Didymocystis tuberculata*, 10. *Scenedesmus anomalus* (? Form mit köpfigen Zellenden), 11. *Scenedesmus circumfusus* var. *bicaudatus* f. *granulatus*, 12. *Polyedriopsis spinulosa*, 13. *Scenedesmus acuminatus* (selten vorkommendes zweizelliges Zönobium), 14. *Scenedesmus acuminatus* f. *maximus* (Fig. 2—11, 13 Algen aus den Proben von Szolnok, 6. 7. 1968; Fig. 1, 12, 14 Algen aus den Proben von Szeged, 8. 7. 1968).

TAFEL I



TISCIA (SZEGED) 5. 1969.

DATA TO THE AUTUMN MUSHROOM FLORA IN THE INUNDATION AREA OF THE TISZA IN THE NEIGHBOURHOOD OF SZEGED

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Introduction

The mushroom flora of this country from the Southern part of the Plain is known very imperfectly, particularly as to the hatted mushrooms. This region, however, according to my observations, has plenty of habitats growing a varied mushroom flora. My investigations have so far been carried out in the environs of Szatymaz, Sándorfalva, Kiskundorozsma, Tápé, Deszk and Szőreg. At present I am discussing the autumn vegetation of the large mushrooms in the inundation area of the Tisza in the neighbourhood of Szeged.

For the botanists investigating moshrooms the characteristic habitat of the inundation areas affords good oppotunities. It is a field hardly investigated from this point of view that promises much to be discovered. Anyway, I have doubtlessly found mushrooms in a much higher number of species and specimens in other areas fo the region covered with woods. The cause of that is first of all that the inundation areas lie under water generally for a longer time in every year that hinders in a high degree the mycelia is spreading and the growing bodies in their development. Water ispreserved by the fixed argillaceous soil for a long time, a ventillation is therefore not secured properly. The same soil becomes stone-hard in aridity, ahrinking strongly, that is similarly unfavourable for the development of mycelia and growing bodies. I shall deal with this question separately after discussing the occurrence of the single mushrooms.

We cannot have a perfect knowledge of the vegetation in the inundation areas of the Tisza without knowing the mushrooms growing there. For taking the large mushrooms of the inundation areas into consideration, I have performed several collections, with regard to the circumtances of mushroom life under both rainy and arid weather conditions. My several collections, however, have more and more confirmed the conviction in me that the inundation areas, although they are of woody, moist soil in their over whelming majority, i.e., good habitats for growing mushrooms, may yet be considered as areas relatively poor in mushrooms.

Description of the autumn mushroom flora in the inundation area of the Tisza in the environs of Szeged

1. *Coprinus atramentarius* Fr. (Wrinkled inkmushroom).

I have found them in a large group at the foot of a willow. In the group there were 27 well-developed specimens. The willow may formerly have been damaged, it let out sap from beneath its rind.

2. *Coprinus comatus* Fr. (Downy ink-mushroom).

It is one of the most frequent mushrooms of the inundation area. It appears already on the next day after rain. It can be observed scattered, in groups of 2—3—5, almost everywhere. South of Szeged, in a sector of 300 m, I found 18 groups at a collection of October 15, 1968. Its habitat is highly varied, being found at the grassy fringes of woods, among the dense, bushy underwood, and even in a soil without any vegetation, as well. They could be collected in comparatively arid days, too, till the autumn frosts came.

3. *Coprinus micaceus Fr.* (Garden ink-mushroom).

Its habitat is, by and large, similar to that of *Coprinus comatus*. After rains it appears in large numbers and in crowds. Its groups with much higher specimen numbers prefer the grassy areas along the fringes of woods. The sizes of those grown in the inundation area are, according to my observations, much smaller than of those grown in other woods and first of all round the houses.

4. *Psathyrella disseminata* Fr. (Disseminated crumbly mushroom).

This mushroom of small size was found on moulding willow and polar stumps, on croumbling branch pieces in very large groups. Its occurrence depends not vary much on the precipitation. It semms so that the moisture necessary for its development can be ensured by the water supply of the moulding stumps, the morning dew and the higher vapour content of air. It perishes very soon; sometimes I found it in the early morning hours, and at noon I could find only a very few remains of it.

5. *Collibia dryophila* Fr. (Mushroom of rusty stem).

It is frequent but found only on willow and poplar stumps, on their dead chumps. It penetrates deep with its rottlike formation into the moulding wood material, occurring the most frequently at the fringes of woods, as a rula on the shaded side. It always grows in groups. On two occasions, I collected them on the cut, decaying stump of *Amorpha fruticosa*, in a comparatively dry weather, As in case of the former species, I attribute its occurrence in an arid weather similarly to the moisture accumulated in the mouldering wood-stump.

6. *Lentinus tigrinus* Fr. (Fopular mushroom).

It may be observed, as a rule, also on dead branch pieces, poplar and willow stumps, and even in the mouldering material of soil. I have often noticed that on the soil I could always find it but alone, in 1—2 specimens. On wet stumps, it has generally occurred in smaller groups, on willows always more often than on populars. Stometimes I have collected them on stems of living willows, in that case, anyhow, always one by one.

7. *Trametes versicolor I.* (Butterfly-amadou).

This is the most common tinder fungus, occuring almost everywhere. I have observed it also here in the inundation area but only on a few occasions. On old willow and poplar stumps, I have collected them only in two cases.

8. *Trametes suaveolens* (L.) Fr. (Anise tinder).

According to my observations, it is the most frequent tinder fungus of the inundation area. Its distribution here is probably prometed by the easily mouldering sapwood of the willows. It is wellknown as a tree-damaging mushroom and can easily be recognized by its characteristic anise scent. They can be found in any part of the inundation area, both older and aounger specimens, but always only on villows. The growing body develops on the stem, generally in a height of 1,50—2,50 m, as a rule, immediately below the foliage. The willow plantations of the inundation area are everywhere highly infected. There are places where they can be found on 40 percent of the tree substance. On three occasions, I have found their deformed, scattered specimens on willow stumps cut quite low (5—10 cm), on their horizontal surfaces.

9. *Fomes igniarius* (L.) Gill. (Glowing tinder).

This tinder species, living on willows, is not at all so frequent in our country as it is mentioned in the determining book, Large mushrooms of Hungary, by Bánhegyi — Bohus — Kalmár. A much more frequent species is, at least in the inundation areas, *Trametes suaveolens.* This species occurs, in every case, only on quite old willows, on their mouldering stems. It does not reach, however, the numerical quantity of the former species in old willow-plantations, either.

10. *Schizophyllum commune* Fr. (Mushroom of split lamellae).

I often found this very characteristic species of small size in the inundation area, mainly on the branches of *Amorpha fruticosa,* on willows, and on the thicker stems of *Gleditsia triacanthos,* as well. It takes generally place on trees but I have noticed that it occurs in groups and in greater quantities where the underwood was before burnt and consequently, also the rind of trees, shrubs has burned, bursted. In places like these, its appearance in large numbers may be taken for certain.

11. *Hebeloma sacchariolens* Quél. (Fallow mushroom of swet scent).

It occured scarcely in the inundation areas in the environment of Szeged. I found them in the early autumn, before the night frosts came, in moist places covered with undergrowth densely, collected bit by bit, never in larger groups. They appeared rarely, ony in a quite humid soil, in shaded places, one day or two after raining.

12. *Boletus scaber* Fr. (Flap mushroom with sweet stem).

It is the most frequent mushroom of the poplars in the inundation area, being edible, too. It occurs generally, first of all in older poplar woods and even in poplar alleys. The appearance of the growing body is a close effect of the quantity of precipitation. It appears 2—3 days after rainy days. Then I found them one by one but in a larger amount, on every occasion. It prefers the brushwoods covered with undergrowth, the regions of dwarf acacia, bushes. and it is frequent in the lighter clearings, as well. Also 8—12 days after greater rains, I collected a larger amount of them, younger specimens, too. It is probably a root-connected mushroom of poplars. That is supoprted by finding them always in poplar woods, poplar groves.

13. *Boletus chrysenteron* Fr. (Golden flap mushroom).

It is a chanterelle of small size that occurs only scarcely, rarely in the inundation areas, first of all after a major, lasting rain, in ashen groves beside poplar woods, in the early autumn. I found it then sporadically.

I notice that the discussion of the species enumerated is not full. For describing the entire mushroom flora of the inundation areas I shall need the collective activity of several years; it is one of may aims in the future. This article is intended to be an introduction in the hope that I am contributing with it to the Hungarian Tisza research, as intensive and as wide-ranging as it is possible.

Summary

At last, taking into consideration the conditions that have an influence on the distribution of mushrooms, I have paid due attention to the following, at their appearance in the inundation area:

1. The inundation areas are exposed to a sistematically repeated inundation, sometimes more times a year, often for long periods. That makes imposible from the very first the mycelia develop; resp. the mycelia already developed soon perish because of their being closed from oxygen. This also gives a reason why the mushrooms of small size, that have a shorter growing time, can be found in an overwhhelmin quantity in our inundation areas.

2. The distribution of mushrooms is not promoted by the soil structure, either. The soil of inundation areas is fixed, clayey, of a dense structure, having an influence both on the formation of growing bodies and of mycelia. It the compact soil that is storngly cleft in an arid weather, in the rainless periods the mycela soon tear, perish. That is getting on particularly in the neighbourhood of Szeged where the number of sunny hours is wellknown high and, at the same time, the precipitation is little.

3. At last, the formation of a rich mushroom flora is not promoted by the undergrowth of the inundation areas, either. For developing the most frequent mycorrhyza connections, there are missing from the deciduous trees the oak, beech, ash-trees, acacia, fir-trees and the lawn grass species. In the inundation areas, there can count from this point of view only the willow and poplar woods.

In addition to all these, in the year of the investigation (1968) the precipitation was smaller than the average, the consequence of wich is the local and periodical occurrence of mushrooms.

On the basis of the data mentioned above, I would like to sum up,

according to my general observations, the distribution of mushrooms in the inundation areas, as follows.:

In the inundation areas, the majority is formed by species that were of a short growing time, of small size, and perishing early.

The majority of mushrooms found here is formed by species growing on trees (xylophagous ones). There are dominant, among them, too, the species living in mouldering material, dead logs, pieces of branches.

The least favourable for the development of mushrooms is an area covered with a dense undergrowth. I have found the regions covered densely with *Rubus caesius, Ajuga reptans, Lysimachia nummularia* to be the poorest one.

Willow and poplar, like two dominant wood tipes, are showing in the inundation areas, from the point of view of the mushroom flora, an essential difference. The poplars grow mushrooms in a much more varied, quantity, richer in number of species and size. The willow woods are much poorer.

I have found the most variegated and largest species number along the dams of the inundation areas and at the fringes of wooded areas. At these fringes of woods, first of all on the logs, decaying branch pieces, and even in the soil, lying in the shade of the bordering trees, the number of species and specimens was much higher than in the thicket of the woods in the inundation areas. According to the points of the compass, the most varied picture has been shown by the western, north-western sides. These places were much moister, and that alone is explaining why I have found there the majority of the species listed.

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FAUNISTICAL AND ECOLOGICAL INVESTIGATIONS OF ORTHOPTERA IN THE REGION OF THE MIDDLE-TISZA (KISKÖRE)

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The Tisza-valley has a peculiar position in the zoogeographic picture of the Hungarian Plain. Varga (1962) is treating separately, also in his zoogeographic classification of, the *Tisio-Crisicum* that, in his opinion, is near to the region beyond the Tisza in zoological respect. In literature the attempts are anyway frequent, to make a zoogeographic characterization of an area by using the data of *Orthoptera fauna* (Matvejev, 1951; Maran, 1960; A. Liana, 1966). The works of Gausz (1966, 1967) and Gallé and Gausz (1968) began a systematic, orthopterologic elaboration of the Tisza valley with similar aims. This paper is containing the results of investigations of the author in July 17—30. 1968.

Geographical, climatic conditions

The collecting area takes place in the region of the Middle-Tisza in Hungary, in the district of villages Abádszalók, Kisköre and Pusztataskony. The height fo the area above sea level is 116 m. The average annual temperature is 10—11°C, with a mean temperature of —2,5°C in January and 21°C in July. The annual precipitation is 500—550 mm, of which 300 mm fall to the breeding season. The average of humidity is 60—65 percent, the dominant wind direction is N.E., S.W. The soil is adobe bound weakly: the sand fraction is considerable. The data are according to Bacsó (1959).

Methods

The methods of the quantitative collections are contained in the paper of Gallé and Gausz (1968). In biotops, if necessary, at every collection-, there were 4×100 grass-net strokes, performed advancing in a straight line, and in the mean time the members of the family *Tettigoniidae* were collected one by one. If the direction of making way is duly changed, the repetition of collection is not necessary in the same biotop. The data enumerated in the Tables are the results of two collections.

I give the state of *Orthoptera* populations after a time-collection for one hour in the plant associations *Echinochloo-Polygonetum* and *Lolio-Potentilletum* of the inundation area, resp. in the associations

Artemisio-Festucetum pseudovinae and *Festuco pseudovinae-Quercetum* of the protected inundation area. The single collections are containing also the percentage of larval specimens of the biotop in question. The physiognomical evaluation is given according to Nagy (1949) and Harz (1957, 1962). The spectral distribution of fauna is applied according to Harz (1957, 1962), that of feeding types according to Gangwere (1961). Soó's work (1964) is taken for basis at denominating the plant associations.

Characterization of biotops and coenoses

All the coenoses investigated are in a genetic connection with the vegetation along the river Tisza. Therefore, the collections took generally place according to plant associations. Sometimes, however, it was necessary to carry out separete collections even in case of identical associations if an important abiotic factor (shading, exposition) or inside the same association the structure of vegetation had changed. In the following, the single units of collection are made known.

1. Young wood planted in the inundation area. First of all young poplar wood with ruderal underwood (substance *Populus alba — Populus canadensis*). The association is *Echinochloo-Polygonetum lapathifolii chenopodietosum albi*. Coverage is changing strongly (80—85 p.c.) as well as the height of vegetation.

2. Meadow in the inundation area (meadow at Szalók).

a) *Glycyrrhizetum echinatae echinochloetosum*. Poor association, strongly grazed, fully covered; the height of vegetation is 5—8 cm.

b) *Agrostetum albae hungaricum caricetosum acutiformis*. Moorland of high vegetation in good state in case of a moderate pasturing. Coverage is full, its height being 25—35—(45) cm. Its underwood is more humid as compared with the former biotop.

c) *Caricetum gracilis Trifolium hybridum facies*. With a more heterogeneous plant height (15—25—30 cm.) than that of the former cover. The two latter associations often form a mixed substance.

3. Reedy meadow in the inundation area. *Scirpo-Phragmitetum alismetosum lanceolati*. It is an association strongly upset by grazing and a systematic reed-cut, with uncertain cover and plant height.

4. Grass-land in the inundation area. Substance of *Caricetum vulpinae* with a constant height (30—40 cm) strongly humid underwood, a cover of 90—95 p.c. It is in an immediate contiguity with the associations of the wood *Salicetum albae fragilis* in the inundation area and of the border cenosis of the dam side.

5. Moist, weedy, grazing-meadov. Association *Lolio-Pontentilletum anserinae*, coverage 95—100 p.c., height 5—7—10 cm.

6. Dam side. The side towards the inundation area is generally of N.W.-exposition. It is formed by the susbstances, often mixed, of *Alopecuretum pratensis festucetosum pseudovinae* and *Alopecuretum pratensis ranunculetosum acris Rumex acetosa facies*. Heigh 5—10—15—(25) cm, with full coverage. On the side towards the plough-land there can usually be found only *Alopecuretum pratensis festucetosum*

pseudovinae with an undefinable complex of weed-associations *(Daucus, Silene, Erigeron, Polygonum, Xanthium)*. Exposition is S.W., cover 90—95 p.c., height 5—10—15 cm. On the outer side of dams there are here and there planted oak-woods; the vegetation is here somewhat more homogeneous. Because of the great variation of dam-side conditions, the fauna was established with six collections, the details being contained in the part concerning the *Saltatoria* fauna.

7. Underwood of a coniferous wood planted in the protected inundation area, being a *Pinus nigra* substance planted supposedly in the place of an oakwood felled. On the basis of underwood, the association is *Festuco pseudovinae-Quercetum roboris*, full cover, height 5—10—25 cm. The area is highly shaded, with a sodic steppe in its neighbourhood.

8. Alkali granzing-land in the protected inundation area. *Artemisio-Festucetum pseudovinae pannonicum festucetosum pseudovinae*, height is the most frequently 3—5—10 cm, coverage 75—90 p.c., here and there with rock-spots.

The Saltatoria associations of biotops

The collections in 15 biotops, resp. proceedings have resulted in 728 imagos and 179 larvae of 34 species. Apart from that, we collected 150 specimens or so, for establishing the qualitative relations in the single biotops. The additional data are mentioned in due places, without taking them into consideration in analysing the quantitative relations of the assocaition. We had better to use the word proceeding for the collections on the dam side, instead of biotop.

Table 1

Ec. type	Area type	Species	No.	P.c.
Mes.	Eu.-Sib.	Phaneroptera falcata Poda.	2	5.72
Hyg.	Central Eu.	Leptophyes albovittata Koll.	2	5.72
Hyg.	Palearc.	Conocephalus fuscus Fabr.	2	5.72
Hyg.	Eu.-Sib.	Conocephalus dorsalis Latr.	2	5.72
Hyg.	Eu.	Pholidoptera griseoaptera Deg.	5	14.30
Mes.	Eu.	Ephipiggera ephipigger Fieb.	1	2.86
Hyg.	Palearc.	Tetrix tenuicornis Sahlb.	1	2.86
Hyg.	Eu.-Sib.	Chrysochraon dispar Germ.	1	2.86
Xer.	Palearc.	Glyptobothrus biguttulus L.	4	11.34
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	6	17.16
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	2	5.72
		larvae	6	17.16

1. Young wood with weedy underwood in the inundation area. They are first of all hygrophilous species, with graminivorous feeding in a low percentage. Here isn't developed any definite *Saltatoria* associaton. The significant species are: *Chrysochraon dispar* Germ. and *Ephipiggera ephipigger* Fieb. The former species is mentioned by Nagy (1953) like a moorland factor near to being annihilated in the Hungarian Plain. *Ephipiggera ephipigger* Fieb. is mainly a species in the hilly country here; altough mentioned by Móczár (1942) from the surroundings of Jászberény, its occurence in the Plain is nevertheless remarkable. On the other hand, in the Polish Plain it is considered as common by A. Liana (1966). Among the data of collections, the *Tettigonia viridissima* L. collected separately is not taking place.

2. Meadow in the inundation area.

a) The *Orthoptera* fauna of the weed association of grazing-land character is not constant, either. It is formed mainly by the associations of the surrounding high reed-grass, being therefore of strongly hygrophilous character. The percentage of larvae is corresponding to the average, the species of carnivorous feeding are missing.

Table 2

Ec. type	Area type	Species	No.	D p,c.
Hyg.	Palearc.	Tetrix subulatus L.	1	2.43
Hyg.	Eu.-Sib.	Mecostethus grossus L.	1	2.43
Hyg.	Eu.-Sib.	Parapleurus alliaceus Germ.	3	7.36
Mes.	Eastern Eu.	Stenobothrus crassipes Charp.	1	2.43
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	23	56.10
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	6	14.58
		larvae	6	14.58

b) Moorland of moist subsoil. It is a biotop densely populated by a stable *Orthoptera* fauna, an association corresponding by and large to the species composition of the *Saltatoria* population group *Mecostethus grossus* mentioned by Nagy (1949). In Gausz's collections along the Tisza this association does not occur and its role is negligible also in the area at the Upper-Tisza (Gallé — Gausz, 1968). Aslo the hygrophilic marshland species *Conocephalus fuscus* Fabr. and *Conocephalus dorsalis* Latr. are important in the association.

c) Moorland of drier subsoil. The *Orthoptera* density is much greater than even that of the former biotop. A slight increase of the number of the mesophilous elements and the decrease of dominance of the *Conocephalus* species are characteristic of it. The amount of soil moisture and its temperature are important factors in developing the annual picture of *Orthoptera* populations; therefore, the egg deposition of hygrophilous elements is promoted by the comparatively wetter weather in that year

(Choudhouri, 1958). Anderson and Wright (1952) suppose, however, even during a single season, strong changes in the association, as a consequence of the qualitative alterations of vegetation. Changes of that type are very considerable in developing the associations of the inundation area that is labile from the climactic point of view. Because

Table 3

Ec. type	Area type	Species	No.	D p.c.
Mes.	Eu.-Sib.	Phaneroptera falcata Poda.	1	1.64
Hyg.	Palearc.	Conocephalus fuscus Fabr.	4	6.56
Hyg.	Eu.-Sib.	Conocephalus dorsalis Latr.	10	16.40
Hyg.	Eu.-Sib.	Roeseliana roeselii Hgb.	1	1.64
Hyg.	Eu.-Sib.	Mecostethus grossus L.	5	8.20
Hyg.	Eu.-Sib.	Parapleurus alliaceus Germ.	26	42.64
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	5	8.20
		larvae	9.	14.72

of the yearly repeated inundations, the occurence of the *Parapleurus-Mecostethus* association that is characteristic here only of the inundation area cannot be explained after all. There couldn't be demonstrated either

Table 4

Ec. type	Area type	Species	No.	D p.c.
Hyg.	Palearc.	Conocephalus fuscus Fabr.	2	1.60
Hyg.	Eu.-Sib.	Roeseliana roeselii Hgb.	1	0,80
Hyg.	Palearc.	Tetrix tenuicornis Sahlb.	2	1.60
Hyg.	Eu.-Sib.	Mecostethus grossus L.	13	10.40
Hyg.	Eu.-Sib.	Parapleurus alliaceus Germ.	17	13.60
Mes.	Eu.-Sib.	Omocestus haemorrhoidalis Charp.	4	3.20
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	52	41.60
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	8	6.40
Mes.	Eu.-Sib.	Chorthippus longicornis Latr.	10	8.00
		larvae	16	12.80

of these species being present during the collections performed outside the inundation area.

3. Reedy meadow in the inundation area. The moistest biotop, its fauna is considerably poorer, the number of larvae is, on the other hand,

high enough. The species are, for the most part, in connection with the view, *Dociostaurus macroccanus* Thunbg. is interesting reappearing adjacent plant association *Caricetum gracilis*. From the faunistic point of in Hungary often only after interruptions of longer periods. It is worth while being mentioned separately that a male specimen and a female one of one of the most xerophilous *Orthoptera* species have been collected from cut reed stumps.

Table 5

Ec. type	Area type	Species	No.	D p.c.
Hyg.	Palearc.	Conocephalus fuscus Fabr.	4	8.51
Hyg.	Eu.-Sib.	Conocephalus dorsalis Latr.	9	19.17
Hyg.	Palearc.	Tetrix subulata L.	3	6.39
Hyg.	Palearc.	Tetrix tenuicornis Sahlb.	1	2.13
Hyg.	Eu.-Sib.	Mecostethus grossus L.	4	8.51
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	16	34.82
Xer.	Southern Eu.	Dociostaurus maroccanus Thunbg.	2	4.26
		larvae	17	36.21

4. Grass-land in the inundation area. It is a territory of somewhat deeper site than the former biotop, being in connection with the plant associations of the dam side. The association agrees with the *Orthoptera* populations of the mean plain mesophilous-hygrophilous meadows. It is a little poorer in species but the percentage of larvae is high.

Table 6

Ec. type	Area type	Species	No.	D p.c.
Hyg.	Central Eu.	Leptophyes albovittata Koll.	2	3.56
Hyg.	Palearc.	Conocephalus fuscus Fabr.	12	21.46
Hyg.	Eu.-Sib.	Conocephalus dorsalis Latr.	15	26.80
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	3	5.34
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	1	1.78
Mes.	Eu.-Sib.	Chorthippus longicornis Latr.	4	7.12
		larvae	19	33.94

5. Grazing-land in the inundation area. As compared with the former association in the inundation area, it is a biotop somewhat more xerophilous. This is proved also by the occurence of *Calliptamus italicus*

L. and *Omocestus haemorrhoidalis* Charp. The bulk of association is formed, however, also here by the hydrophilous *Chorthippus* species; the carnivorous and forbivorous elements missing almost completely.

Table 7

Ec. type	Area type	Species	No.	D p.c.
Hyg.	Palearc.	Tetrix subulata L.	1	1.33
Hyg.	Palearc.	Tetrix tenuicornis Sahlb.	2	2.66
Xer.	Palearc.	Calliptamus italicus L.	3	4.00
Hyg.	Eu.-Sib.	Mecostethus grossus L.	2	2.66
Mes.	Eu.-Sib.	Omocestus haemorrhoidalis Charp.	1	1.33
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	30	40.04
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	18	24.04
Mes.	Eu.-Sib.	Chorthippus longicornis Latr.	4	5.32
		larvae	14	18.62

6. Dam side

a) The lower one-third of the side towards the inundation area. The border cenosis of *Salicaetum albae fragilis,* as well, belongs to the association *Alopecuretum pratensis ranunculetosum acris.* In spite of the characteristic species of ecotone *(Homorocoryphus nitidulus* Scop., *Leptohyes albovittata* Koll.), an increase of the number of mesophilous

Table 8

Ec. type	Area type	Species	No.	D p.c.
Hyg.	Central Eu.	Leptophyes albovittata Koll.	3	5.76
Hyg.	Palearc.	Homorocoryphus nitidulus Scop.	1	1.92
Hyg.	Eu.-Sib.	Roeseliana roeselii Hgb.	1	1.92
Hyg.	Palearc.	Tetrix tenuicornis Sahlb.	3	5.76
Xer.	Med.	Pezotettix giornae Rossi	2	3.84
Mes.	Eastern Eu.	Stenobothrus crassipes Charp,	3	5.76
Mes.	Eu.-Sib.	Omocestus haemorrhoidalis Charp.	3	5.76
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	8	15.42
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	12	23.14
Mes.	Eu.-Sib.	Chorthippus longicornis Latr.	2	3.84
		larvae	14	26.88

elements can rather be observed. Nevertheless, the role of species of the association *Stenobothrus crassipes — Omocestus haemorrhoidalis* characteristic of the river sectors in the Southern Plain of Hungary — is negligible. On the other hand, *Pezotettix giornae* Rossi can be found.

b) The upper two-thirds of the side towards the inundation area, an association identical with the former one. On the top of dam, the usual weed-association along ways, *Schlerochloo — Polygonetum avicularis,* can be observed, its *Orthoptera fauna* is, however, negligible, therefore I haven't performed any separate collection there. Yet it is necessary to record the strongly xerophilous species *Stenobothrus stigmaticus*

Table 9

Ec.type	Area type	Species	No.	D p.c.
Hyg.	Central Eu.	Leptophyes albovittata Koll.	3	5.25
Hyg.	Eu.-Sib.	Conocephalus dorsalis Latr.	1	1.75
Hyg.	Eu.-Sib.	Roeseliana roeselii Hgb.	2	3.50
Mes.	Eastern Eu.	Stenobothrus crassipes Charp.	14	24.60
Mes.	Eu.-Sib.	Omocestus haemorrhoidalis Charp.	1	1.75
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	11	19.30
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	3	5.25
Mes.	Eu.-Sib.	Chorthippus longicornis Latr.	6	10.50
Xer.	Palearc.	Glyptobothrus brunneus Thunbg.	1	1.75
		larvae	14	24.60

Ramb., *Calliptamus italicus* L. and *Acrida hungarica* Herbst, found there. Apart from these data a strong increase in number of the xerophilous species is remarkable, altough their dominance is not significant. This is proved by the dominant species of the associatoin being *Stenobothrus crassipes* Charp. and also the highly xerophilous *Glyptobothrus brunneus* Thunbg. being observed there.

c) The upper two-thirds of the dam-side towards the protected inundation area, with S.E.-exposition. As compared with the former biotop, it can be observed, that there is a further increase of xerophilous and mesophilous elements. The rates of the dominancy are characteristic for the *Orthoptera* associations of the plain, and the *Euchorthippus declivus* Bris. is an important species of the association.

d) The lower one-third part of the side towards the protected inundation area, with S.E. — exposition. As compared with the former biotop, it is more shaded, of a moister microclimate, with a varied species association. The association is characterized by species of opposite ecological demands coexisting. From the carnivorous species, *Tessalana vittata* Charp. is worthy of attention, collected first from the biotops

Table 10

Ec. type	Area type	Species	No.	D p.c.
Hyg.	Central Eu.	Leptophyes albovittata Koll.	3	6.12
Mes.	Eastern Eu.	Stenobothrus crassipes Charp.	8	16.32
Mes.	Eu.-Szib.	Omocestus haemorrhoidalis Charp.	3	6.12
Xer.	Palearc.	Glyptobothrus brunneus Thungb.	3	6.12
Xer.	Palearc.	Glyptobothrus biguttulus L.	7	14.28
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	4	8.16
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	6	12.24
Mes.	Eu.-Sib.	Chorthippus longicornis Latr.	2	4.08
Mes.	Central Eu.	Euchorthippus declivus Bris.	3	6.12
		larvae	10	20.40

along the Tisza. The association is also characterized by the appearence of *Omocestus ventralis* Zett. and the increasing dominance of *Euchorthippus declivus* Bris.

Table 11

Ec type	Area type	Species	No.	D p.c.
Hyg.	Palearc.	Homorocoryphus nitidulus Scop.	2	2.94
Xer.	Southern Eu.	Tessalana vittata Charp.	3	4.41
Hyg.	Eu.-Sib.	Roeseliana roeselii Thunbg.	1	1.47
Hyg.	Palearc.	Tetrix tenuicornis Sahlb.	1	1.47
Mes.	Eastern Eu.	Stenobothrus crassipes Charp.	5	7.35
Mes.	Eu.-Sib.	Omocestus haemorrhoidalis Charp.	4	5.88
Xer.	Palearc.	Omocestus ventralis Zett.	3	4.41
Xer.	Palearc.	Glyptobothrus brunneus Thungb.	2	2.94
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	14	20.62
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	9	13.23
Mes.	Eu.-Sib.	Chorthippus longicornis Latr.	5	7.35
Mes.	Central Eu.	Euchorthippus declivus Bris.	8	11.76
		larvae	11	16.17

e) The upper two-thirds of the side towards the protected inundation area, with E-exposition, and an older oak-wood, planted at the lower part of dam. Owing to the more unfavourable exposition and stronger shade, the fauna is more hygrophilous as compared with the former biotop. The xerophilous species are missing except *Tessalana vittata* Charp. Owing to the poor vegetation and the unfavourable microclimatic conditions, also the density of specimens and percentage of larvae is considerably lower.

Table 12

Ec. type	Area tyipe	Species	No.	D p.c.
Hyg.	Central Eu.	Leptophyes albovittata Koll.	1	2.77
Xer.	Southern Eu.	Tessalana vittata Charp.	2	5.54
Xer.	Palearc.	Glyptobothrus biguttulus L.	1	2.77
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	7	19.49
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	4	11.08
Mes.	Eu.-Sib.	Chorthippus longicornis Latr.	12	33.42
		larvae	9	24.93

f) The lower one-third part of the side towards the protected inundation area, with E-exposition; the border cenosis is common with the underwood of the oak-wood planted. As a consequence of the better quality of vegetation, the density of individual specimens is higher. Also here I have collected a female specimen of *Dociostaurus maroccanus* Thunbg. The higher dominance of *Chorthippus longicornis* Latr. is asserting itself, as well, as compared with other *Chorthippus* species.

Table 13

Ec. type	Area type	Species	No.	D p.c.
Hyg.	Palearc.	Tetrix tenuicornis Sahlb.	2	3.22
Hyg.	Palearc.	Tetrix subulata L.	1	1.61
Mes.	Eu.-Sib.	Omocestus haemorrhoidalis Charp.	2	3.22
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	16	25.86
Hyg.	Eu.-Sib.	Chorthippus dorsatus Zett.	9	14.57
Mes.	Eu.-Sib.	Chorthippus longicornis Latr.	18	28.98
Xer.	Southern Eu.	Dociostaurus maroccanus Thunbg.	1	1.61
		larvae	13	20.93

7. Underwood of a pinewood planted in the protected inundation area. Mesophilous and hygrophilous elements are in high percentage. From grasshoppers, the carnivorous forms are more significant, semini-

vorous forms are more significant, seminivorous species have not been found. The xerophilous *Platycleis affinis* Fieb. may have immigrated from the adjacent steppes, like *Oedipoda coerulescens* L., as well.

Table 14

Ec.type	Area type	Species	No.	D p.c.
Hyg.	Eu.	Pholidoptera griseoaptera Deg.	1	1.16
Xer.	Ponto-Med.	Platycleis affinis Fieb.	2	2.32
Xer.	Southern Eu.	Tessalana vittata Charp.	5	5.80
Xer.	Palearc.	Oedipoda coerulescens L.	2	2.32
Mes.	Eu.-Sib.	Omocestus haemorrhoidalis Charp.	5	5.80
Xer.	Palearc.	Glyptobothrus biguttulus L.	9	10.44
Hyg.	Palearc.	Chorthippus albomarginatus De Geer	28	32.68
Mes.	Eu.-Sib.	Chorthippus longicornis Latr.	3	3.48
Mes.	Central Eu.	Euchorthippus declivus Bris.	14	16.24
		larvae	17	19.76

8. Alkali grazing-land in the protected inundation area. The weedy, poor alkali steppe has reminded us very much of the *Orthoptera* fauna of sodic steppe with wormwoods in the region beyond the Tisza, given by Nagy (1943). The difference is perhaps only that here the dominance of *Dociostaurus brevicollis* Eversm. is insignificant and also elements of transitory character may be found in large numbers. Species of decisive importance are: *Omocestus petraeus* Bris., *Aiolopus thalassinus* Fabr. The number of larvae is very low, the dominant species are present, almost without any exception ,in the form of imagos.

Table 15

Ec.type	Area type	Species	No.	D p.c.
Xer.	Ponto-Med.	Platycleis affinis Fieb.	1	2.00
Xer.	Southern Eu.	Tessalana vittata Charp.	1	2.00
Xer.	Palearc.	Oedipoda coerulescens L.	1	2.00
Xer.	Med.	Aiolopus thalassinus Fabr.	9	18.00
Mes.	Eu.-Sib.	Omocestus haemorrhoidalis Charp.	5	10.00
Xer.	Southern Eu.	Omocestus petraeus Bris.	12	24.00
Mes.	Central Eu.	Euchorthippus declivus Bris.	14	28.00
Xer.	Southern Eu.	Dociostaurus brevicollis Eversm.	3	6.00
		larvae	4	8.00

Evaluation of the Orthoptera fauna of the area

We find the considerable differences in the ecological comprison of *Orthoptera* observed in the northern, resp. southern parts of the Hungarian Plain in Gausz's monograph (1968). A similar evaluation of the collecting stations at Kisköre is advisable, as well. It is important to notice that the first line of the data recited is giving the percentage of species number, and the second line that of specimen number. In cenological respect, the latter data are, of course, more important.

The ecological demand of species

	I	II
Xerophilous ones	41,18	10,90
Mesophilous ones	20,58	23,10
Hygrophilous ones	38,24	66,00

The biogeographic spectrum of species

	I	II
Europo-Siberian ones	29,40	39,82
Central-European ones	5,88	7,35
Palearctis ones	32,34	41,74
European ones	5,88	0,96
Ponto-Mediterranean ones	2,94	0,41
Southern-European ones	14,70	3,97
Eastern-European ones	2,94	4,25
Mediterranean ones	5,88	1,50

The amount of larvae is 24.52 percent of the imagos, on the average. In faunistical respect, there are remarkable the *Ephipiggera ephipigger* Fieb., rare in the Plain, the *Chrysochraon dispar* Germ. collected in marshy biotops, and the *Dociostaurus maroccanus* Thunbg., collected generally rarely.

The *Saltatoria* associations are generally of character analogous to the *Orthoptera* associations from the Nyírség described by Nagy (1943). It is anyway important to notice that the psammophilous species are here entirely missing. A part of the biotops inside the inundation area is suitable for feeding natural, stable associations, and even a part of species could be found only in the meadows of the inundation area (*Chrysochraon dispar* Germ., *Parapleurus alliaceus* Germ., *Mecostethus grossus* L.). The populations of low density of *Conocephalus fuscus* Fabr. — *Conocephalus dorsalis* Latr. are typically characteristic of the shaded associations of closer substance with high reed-grass.

In short sectors, resp. levels of the dam side a variation of abiotic factors may cause, even without any change in the plant associations, important differences in the development of density of the *Saltatoria* specimens and of the internal pattern of associations. The percentage of larvae is showing a similar value in nearly every biotop (save the sodic steppe). A cause of that is that in this year the drier period of the summer aspect was considerably shorter than the average, without determinating the vegetation even on the dam sides of southern exposition. The same causes give some explanation of the differences in the picture of fauna, too, to the advantage of the species of hygrophilous ecological demand.

It is proved also by collections in the adjacent biotops that the faunistic picture of the immediate environs of the Tisza is strongly specialized, the conditions of associations showing rather great differences even in a distance of some kms apart from the river.

The role of *Roeseliana roeselii* Thunbg. that is nearly the unique character carnivorous species in other collecting stations along the Tisza is taken here by *Tessalana vittata* Charp. The density value of *Tettigonoidea* is corresponding to the average. In the fauna spectrum, a decisive dominance of the Europo-Siberian and Palearctic elements can be observed, the percentage of Mediterranean elements being negligible as compared with the biotops in the southern Plain of Hungary.

Summary

In the course of collections carried out in the environs of Kisköre, I have demonstrated 34 Orthoptera species in that area. The faunistically interesting species are: *Ephipiggera ephipigger* Fieb., *Chysochraon dispar* Germ., *Dociostaurus maroccanus* Thunbg. The species found are almost without exception from plain areas.

The major association types are: 1. wood in the inundation area (*Pholidoptera griseoaptera* Deg. — *Chorthippus albomarginatus* De Geer), — 2. weed association in the inundation area (*Chorthippus albomarginatus* De Geer — *Chorthippus dorsatus* Zett.), — 3. shaded high reed-grass in the inundation area (*Chorthippus albomarginatus* De Geer — *Conocephalus fuscus* Fabr. — *Conocephalus dorsalis* Latr.), — 4. moist moorland in the inundation area (*Chorthippus albomarginatus* De Geer — *Parapleurus alliaceus* Germ. — *Mecostethus grossus* L.), — 5. dam side (*Stenobothrus crassipes* Charp. — *Chorthippus albomarginatus* De Geer — *Chorthippus dorsatus* Zett.), — 6. meadow in the protected inundation area (*Glyptobothrus biguttulus* L. — *Chorthippus albomarginatus* De Geer — *Euchorthippus declivus* Bris.), — 7. alkali grazing-land in the protected inundation area (*Aiolopus thalassinus* Fabr. — *Omocestus petraeus* Bris. — *Euchorthippus declivus* Bris.).

In respect of the ecological demand of species, the number of hygrophilous elements is the most important, altough the marking out of the collective area in a direct connection with the Tisza-valley has some role therein. In the biogeographic spectrum the Europo-Siberian, Palearctic and Central-European species are the most important ones.

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TISCIA (SZEGED) 5. 1969.

OCCURRENCE OF HYPANIA INVALIDA (GRUBE) IN THE TISZA (ANNELIDA, POLYCHAETA)

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Introduction

As I have investigated the benthos of Tisza only at the Szeged region, so far, from the habitats here I could not get systematically *Hypania invalida,* therefore I cannot give any detailed information about it, as yet. Nevertheless, the occurrence itself being so interesting, I am considering a short publication as necessary.

In fresh waters, from the constituents of the zoobenthos the *Polychaeta* have but a little role, owing to their low species number. Their appearance and distribution are rather a zoogeographic and ecological curiosity, meaning a new datum of occurrence possibly only for the local faunalist. A datum like that is also the observation of *Hypania invalida* in the Tisza, meaning at the same time the first occurrence of the species in Hungary, as well.

Material and method

In the course of my zoobenthos investigations, *Hypania invalida* was found from two collections (October 28, 1965; August 12, 1968), at both occasions, with a low number of specimens. The habitat has been the Szeged sector of the Tisza, above the swimminghouse "Béke", in a distance of about 10 m from the bank, from a depth of 3—4 m. The speed of stream was 0,5—1,1 m/sec. according to the mean data of the investigations performed in the time of the summer low water. In the time of the collection of 1965, according to the data measured 20 cm below the water surface ,the water temperature was 9,5°C, pH: 7,78; O_2-consumption: 8,8 mg/l; dissolved O_2: 12,0 mg/l, saturation: 103%; total dry material: 459 mg/l; total floating material 40 mg/l. The substratum in this place is sandy, with rubbles, resp. mostly with slag. Tlese physiographic conditions of the rived agree with B. Russev' s (Russev — Marinov, 1964) data according to which *Hypania invalida* is mainly a member of the scoriorpheophilous biocoenosis.

For collecting I have used Ekman — Birge's silt dredger, and fixed the material selected in $4^0/_0$ formaldehyd. The worms were found partly in their living pipes, partly free, and several empty living pipes have been found in other habitats, as well.

Discussion

Some data about the occurrence of *Hypania invalida* in European rivers have been published by a lot of authors, so far (Annenkvova, 1929, 1930, Brezeanu — Popescu — Arion, 1962, Brtek, 1953, Dudich, 1967, Olivari, 1961, Popescu, 1962, Popescu — Prunescu — Arion, 1961, Russev, 1959, Russev — Marinov, 1964, Weber, 1964). According to the researchers mentoined, it wandered up into the Danube from the Black Sea (Weber, 1964). *Hypania invalida* — in contradistinction to the other two species, *Hypaniola kowalewskii* (Grimm) and *Manajunkia caspica* (Annenkova), that migrated similarly to the Danube — has got even to the Austrian Danube reaches. In Brtek's opinino "...the species that can be observed above the Iron Gate of the Danube, too, have got acclimatized to the freseh-water life much earlyer than those getting up only till the Iron Gate." (Brtek, 1953).

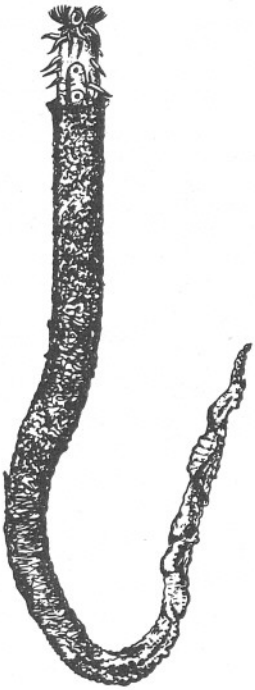

Fig. 1. *Hipania invalida* (Grube)

By finding this species with a low specimen number like here, it is not excluded that it occurs possibly in other places of the Tisza in a much larger amount, and I haven't any material collected from other sectors of the river bed yet. From the fact that *Hypania invalida* has got so widespread in the European rivers, the conclusion may be drawn that the species is an euryecic one with a wide tolerance limit. It can be seen from Annenkova's data, as well, that from the five Ponto-Caspian *Polychaeta* relict species enumerated by her just *Hypania invalida* has shown the widest limits of distribution in the Caspian and Black Seas themselves (Annenkova, 1929, 1930).

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TISCIA (SZEGED) 5. 1969.

MOULTING ECOLOGICAL PROBLEMS OF WILD-DUCKS IN THE TISZA BASIN

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In the organization of the International Wildfowl Research Bureau Hungary serves the programme of the European protection of wild fowls partly by counting systematically her migrating fowl masses, partly by the ecological investigation, of her peculiar biotypes. The Tisza investigation, owing to the role of the Tisza basin in directing the fowl migrations of continental significance and to its valuable nesting fauna, is also qualified for participating in these investigations. The problem of river basin becomes conspicuous particularly in connection with wild ducks because a considerable part of the duck populations in the Carpathian basin is attracted by the biotop in the inundation area. I have therefore been interested in observing, both in respect of nature conservation and that of fowl economy, how the living conditions of this area can satisfy the demands of the species in question. In moulting aspect, an investigation of ecological endowments is particularly desirable. In that time the ducks become partly or fully incapable of flying for twenty-thirty days and it is a problem of vital importance for them to get in this crucial period a perfect protection and a sure base of nourishment by the summer environs.

In the period 1947—1968, I continued observing the phenomena of the moult of wild ducks in the river region between Szeged and Csongrád. During these observations it was striking how strongly the behaviour of the duck species hatching or grouping here in the moulting period is influenced by the peculiar ecological conditions in the inundation area. At the ducks moulting in the Tisza basin, we may often notice phenomena given anyway from the local conditions, without a possibility to generalize the facts experienced here for other biotops. I am trying to elucidate all this below, by summing up my collections.

The biotop of duck moulting

The moulting ducks can be found, except the living water, in any types of the biotops described in several monographs in the inundation area of the Tisza. Their actual value is, however, determined by the formation of water conditions. The surest are the conditions of stagnant waters rich in submersed and riverside vegetation and with constant water, a scarcity of water being generally unknown. Only the regions of standing water cannot be taken into consideration where the area is too disturbed by breeding home ducks on a large scale or in case of another intensive economic exploitation of the area.

In contradiction to the always favourable stagnant waters, the meadows, holes and wood pools in the inundation area are continuously depending upon the inundations, being therefore subejct to fluctuations between favourable and unfavourable cycles. If the green flood is protracted late and the high waters without outlet last even in July and August, then an ideal moulting area is to be found in their neghbourhood. On the other hand, in arid summers the waterless inundation areas become entirely depopulated.

In the Table below, the occurrence of the moulting duck species observed by me in the Tisza basin are demonstrated in the single biotops:

Table 1

	A. paltyr-hynchos	A. querque-dula	A. stre-pera	A. A-cuta	A. nyro-ca	A. feri-na
Stagnant water	x		x		x	x
Hole	x	x			x	
Meadow pool	x	x	x	x	x	
Wood pool	x				x	

Behaviour of ducks moulting in the inundation area of the Tisza

The deplumation of our commonest species, *Anas platyrhynchos,* may be generalized as follows. At the beginning of nesting, the drakes keep remaining near the brooder for a while but later on, together with the egg-laying ducks staying away from hatching, they form populous groups visiting in that way the moulting areas frequently very far from the brooding place. A scarce and individual phenomenon is also a case considered when the moulting drake persists remaining close to its mate, in the brooding area. It is not cleared up, as yet, when an in which percentage the far straying drakes find their way back to their mates stayed in the brooding place, after having moulted. (Literary summary in Bezzel, 1964, Stresemann, 1950, 1966, Szijj, 1965). On the other hand, in the Tisza region, investigated by me, the moulting of Anas platyrhynchos took place in that way: Here moult very probably only the members of a local population. For twenty years, I could observe only on two occasions relatively more populous flocks of *Anas* drakes (Szentes-backwater at Labodár, June 19th 1964, about 40 specimens and June 8th 1965, about 50 specimens). Apart from these exceptions, in favourable years of larger inundations, either, a more remarkabie flocking proving the presence of moulting flocks arrived from other places. At the same time, I have not noticed that the moulting substance kept in evidence locally at the beginning of brooding period, would have decreased as a consequence of migrations to other remote moulting places. For the *Anas platyrhynchos* at the Tisza, the moulting behaviour declared to be rare by literature is characteristic. Here stay the drakes generally close to their mates in the neighbourhood of the brooding place. In the summer months, at my observations in the early morning and in the evening, I could repeatedly be ascertained of that, meeting their specimens of limited flying ability. Later on, when the young ones are already on water, on the surfaces of holes and back-waters we have often seen also old drakes of moulting plumage, together with layers leading their youngs.

Both the consequent absence of drake flocks coming from other places and the moulting behavior so obvious at the *Anas* population of the Tisza basin may be explained with the adjacent inundation area. The middle sector of the Tisza in its present form cannot mean a force of attraction to the drakes of *Anas platyrhynchos* any more that migrate in flocks of many hundred specimens from various regions of the Carpathian basin to moulting stations. Such bird masses can be connected traditionally only to areas that assure the very particular ecological requirements of the moulting period in the framework of huge natural endowments from year to year. There can be found any constant moulting flockings like those only in the deserted marshy steppes in the Hortobágy, in the Danube islands, or in the huge reedy parts of the lakes Fertő and Velence. In the inundation area of the Middle Tisza, however, only the biotop of a smaller extent in itself is stable, the summer existence of the other biotops is uncertain. In case of the drakes that remained in family bonds at the nearby brooding place, during moulting, too, I think on a theory seeming very plausible. It is possible that in the ideal biotop of the pre-regularization inundation area of the Tisza just the moulting behaviour used to be natural that to-day, in the European biotops worried with the influences of civilization, is generally but a rarity. Why would have migrated the *Anas* drakes of the immense ancient moorlands of the Tisza in an age as the birds unable to fly could remain undisturbed with pleanty of easily available food in the brooding area itself. Perhaps the once created traditions have continued from generation to generation in case of the duck populations devoted to the region. This innervated behaviour has not changed necessarily by the inundation area diminished in the meantime, as the relatively lesser quantity of the nesting duck mates left behind can be satisfied even under the present conditions in a plenty similar ot the ancient one.

On a world scale, we are knowing comparatively little about the moulting of *Anas querquedula*. It is mentioned in Soviet studies that in the deltas of Dnieper, Donets, Oka, Volga and in the Azovi-moorlands flocks of *Anas querquedula* collected from Western Siberia, White-Russia and Ukraine moult. Nesters from Western Europe visit by far the greatest number the Dutch moorlands in the season of moisting. Literary summary in Impekoven, 1964). Bezzel (1964) is mentioning small *Anas querquedula* associations of 10—20 specimens mixed among *Anas platyrhynchos* from the Bavarian fishponds; according to him, major moulting flocks appear only in exceptional cases. The moulting problems of the Hungarian population haven't been treated of by the literature, as yet. From the duck species moulting in the inundation area of the Middle Tisza, I have found the *Anas querquedula* the most faithful to the area. Even in the driest summers, some moulting specimens of them are not missing. In the years poor in water, their behaviour is similar to that of *Anas platyrhynchos* here, the moulting drakes can be observed scatterred near to their brooding places. If, however, there are favourable water conditions in the summer inundation area, there appear also outsider *Anas querquedula* drakes in large flocks. In the river region at Hódmezővásárhely, their number is generally changing between 50 and 100. I observed their most conspicuous meeting in the summer of 1965 as, from the last week of July till the middle of August, 400 specimens of them, containing about 90 p.c. drakes, were staying in a single flock on the water of 2—300 acres known under the name pool Kollantó of the meadow Barcirét. In the biotop of the Kollantó there dominated partly a grass getting to the waist, partly a young willow-plantation, with bowering foliage, dense and pathless. The grassy and wooded area was then covered uniformly with a 10—20 cm deap water, the ducks looking consistently for places where they could get till the soil with their bills dived under water. The meeting place in the Barcirét may be considered as a typical biotop of the moult of *Anas querquedula* as that species was forced into the biotop of the deep-water holes only seasons of aridity. If there is water in the pool Kollantó, the specimens of *Anas querquedula* of the inundation area moult exclusively there. At the end of August, the drakes are already flying well and then the novement of moulting converges inseparably with the autumn migration. The moult of layers extends, according to the literature, from August till December. At the Tisza I could observe only non-nesting layers joined drake flocks. The autumn layer moult falls already into the migration in the area investigated.

From the swimming ducks, *Anas acuta* and *Anas strepera* (grey ducks) that brood here comparatively rarely, moult seasonably in the inundation area of the Tisza. A requirmement of the presence of both species is plenty of water in the inundation area as a consequence of a late inundation. As their characteristic biotop the Kollantó can be mentioned, described above, and in addition to it, the grey duck can be found also in the so-called Little-Atka branch of the stagnant water at Atka but always only in a low quantity of a few numbers. I found the highest specimen number of *Anas acuta* similarly in the summer of 1965 as in Barcirét a flock of *Anas platyrhynchos* of about 400 specimens were gathering. Then about 20 specimens of *Anas acuta* lay in hiding in the grassy pools of the Kollantó. From grey ducks *(Anas strepera)* a major number arrived only on a single occassion at the inundation area. On May 20th 1968, about 30 ducks of this species consisting first of all of drakes, were assembling in the willow wood of the Barcirét. In the time of writing this paper, their further behaviour is not known, as yet.

Aythyax nyroca is similarly a species of ducks occurring and moulting every year. Its specimens changing their plumage may be observed in every biotop. At any rate, in the negihbourhood of holes, meadows in the inundation area and wood pools we can mostly see but sing le specimens, but in the biotop of the stagnant water the moult in flocks. Their maximum moulting meetings were: Zsúpsziget, August 19th 1960: 30 specimens; Little-Atka branch of backwater Atka, July 31st 1967; 63 specimens. The ducks were staying in the time of the change of plumage in the hidden open waters of the stagnant water protected with dense vegetation, or in the biotop of similar character in the deeper holes. If disturbed, they are mostly looking for a protection in the riverside vegetation, like the swimming species. The under-water escape is not so characteristic of this species as of the diving duck. Their moulting is prolongated. The plumage change of the drake lasts from May till August. The moulting period of layers is not cleared up in literature. I observed in the backwaters of the Tisza some laying *Aythya nyroca* specimens of limited flying capacity in the period from the end of July till the end of August.

Aythya ferina, a duck species characteristic of the alkali pools of the Plain, moults only scarcely in the stagnant water. Its maximum gathering, noticed on a single occasion, is connected with the island Atka, as I observed about 30 of them in the backwater on July 15th 1967. Its moulting time and behaviour in the region of the Tisza agrees in every respect with those published in literature (Stresemann, 1940, Bezzel, 1964).

Food base of the moulting regions in the inundation area

For a moulting wild duck that is strongly limited in its movement and becomes more and more careful also the problem of getting food is growing worse. One of the main requirements of a moulting region is to afford plenty of easily available food supply. The varied and rich food supply of the moulting regions at the Tisza that is rich in marshy vegetation and in an inferior water fauna is well known, its further detailing, therefore, would be superfluous.

Analysing, anyway, the stomach content of ducks, changing without exception their plumage, collected in the period of June—August, it was manifest even on the basis of my modest material of investigation that the ducks preferred in that period to consume, green plant parts. This tendency was also seen from the stomach content of moulting ducks collected at sodic pools of the Plain (Kakasszék, Sóstó at Orosháza, Kardoskút, Gyopáros). Below I demonstrate in a Table the result of my material concerning food investigation collected in the inundation area at Hódmezővásárhely. The figures indicated are referring to the occurring cases of the single species of food.

Timeliness of investigation of the biotops in the inundation area of the Tisza

Atlhough in the last decades the duck moulting in the Tisza basin has not afforded any more spectacular mass phenomena, it is still an important task to investigate the conditions of the inundation area. The Tisza, even if it has a much smaller inundation area in our days, has preserved its ancient character in several places, and the present ecological investigation can; spare, therefore, a knowledge of the ancient conditions. The economic forms of exploitation in progress are theatening, unfortunately, this particular biotop with far-reaching changes. Our

Table 2

Greed vegetable specimens: food	Anas platyr-hynchos /17/	Anas querque dula /15/	Anas acuta /2/	Aythya nyroca /6/	Aythya ferina /2/
Lemna sp.	14	10	2	3	2
Chara sp.	6	6		1	
Grains:					
Setaria glauca	2			1	
Polygonum sp.	1				
Cyperaceae sp.	1				
Carex sp.				1	
Trifolium sp.	1				
Animal food:					
Dytiscidae sp.	1				
Nepa rubra	1				
Broken chitin	1				
Planorbis sp.				2	

small reservations, in spite of their undisturbed biotops, are containing too little area for answering a number of essential ecological problems. Under such conditions, the Tisza investigation has to perform urgent and divergent tasks to elucidate in due time the unsettled questions of this ancient world on the brink of ruin.

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OPILIONIDEN DER OBEREN UND MITTLEREN TISZA-GEGEND

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Einleitung

Seit Beginn der von der Ungarischen Akademie der Wissenschaften institutiv finanziell unterstützten biologischen Tisza-Forschungen (1955) sammele ich die Opilioniden-Faunendaten des Tiszatales. Behilflich bei diesen Sammlungen waren mir meine Schüler, meine Frau und Herr Dr. G. Csizmazia, ebenfalls ein gewesener Schüler von mir, — der auch an den diesmaligen Sammlungen teilnahm —, denen ich auch an dieser Stelle meinen herzlichen Dank aussprechen möchte. Von unseren ausländischen Mitarbeitern muss ich auch das Mitwirken der Bukarester Forscherin, Dr. Stephanie Avram, anerkennend hervorheben. Ein Artikel über die Opilioniden der Tisza — erchienen in Band IV der "Tiscia" —, der unsere Kenntnisse um die Beschreibung einer neuen Art bereichert hat, ist ebenfalls von ihr geschrieben. Das Ergebnis unserer über ein Jahrzehnt fortgesetzten Tätigkeit ergänzt die bereits erschienenen zusammenfassenden Arbeiten und ist auch der neuesten Literaturzusammenfassung eingefügt worden.

Faunistisch zeigt sich eine entschiedene zoographische Integration des nördlichen Tisza-Tales. So gelangen die Mitostomen und Nemastomen bis nach Tiszanagyfalu hinab; die zweite Stufe beginnt hier; die im südlichen und mittleren Fulusslauf dominierenden Phalangien beginnen nach Norden von Taszatardos seltener zu werden. *Gyas annulatus* und *Leiobunum tisciae* zeigen zwischen Kisar und Tiszabecs die nördlichste Zone an.

In ökologischer Hinsicht bringt das Tisza-Tal infolge des hier herrschenden speziellen Mikro- und Mesoklimas eine interessante Modifizierung und Anpassung der Lebensweise der ganzen Opilioniden-Fauna zustande.

Besprechung des Materials

Nemastoma lugubre bimaculatum Fabricius

Bisheriges Vorkommen in Ungarn: Cserhátszentivány und als Ergebnis der Tisza-Forschungen: Dombrád, Szabolcsveresmart und Komoró. — Neues Vorkommen an der südlichen Tisza: in Tiszanagyfalu-Inundationsräume am rechten Flussufer. Terrikol-detritikoler Bewohner feuchter Wälder. Ein Pullus-Exemplar. Aug. 1968.

Nemastoma elegans Soerensen

Ein männliches und ein weibliches Pullus-Exemplar. Fundort: Gergelyiugornya, grosse Waldung am rechten Flussufer. Für die Fauna Ungarns, und so auch für die Fauna des Tisza-Tales ein neues Element! Bisher ausschliesslich aus Siebenbürgen und aus den Karpathen — als typische montane Art bekannt. Aug. 1968.

Astrobunus meadi Thorell

Hydrophil-detritikol-humikole Art, im Tisza-Tal häufig — zeitweilig zusammen mit *Oligolophus* massenhaft anzutreffen. Neue Fundorte: Tiszavárkony, Nagyrév, Tiszaföldvár, Szolnok-Zagyvaköz, Nagykörü, Tiszasüly, Pusztataskony, Abádszalók, Tiszaörvény, Poroszló, Tiszavalk, Tiszatarján, Tiszadada, Tiszadob, Tiszanagyfalu, Vencsellő, Tiszabercel, Tiszacsermely und Dombrád. — Insgesamt 115 Exemplare. Aug. 1968.

Nelima glabra L. Koch (Syn.: *N. nigripalpis* Roewer)

Ebenfalls feuchtigkeitsliebend. Kommt als plantikoler und in Baumhöhlen-, bzw. als Interieur-Bewohner verlassener menschlicher Behausungen von die synatropen Opilien verdrängend. Interessant ist, dass sie sich beim Häuten wenig verstecken und abgestreifte Häute auch an exponeriten Stellen zum Vorschein kommen. Häufig können auch frisch gehäutete, kaum pigmentierte Exemplare gesammelt werden. Die Häutung wird oft auch an kahlen Baumstämmen vollzogen. Dies bedeutet einen Unterschied gegenüber dem Häuten der übrigen Opilioniden im Verborgenen. Neue Fundorte sind: Tiszavárkony, Nagyrév, Tiszaföldvár, Tiszasüly, Kisköre, Tiszaörvény, Tiszatarján, Tiszaszederkény, Tiszavalk, Tiszadob, Vencsellő, Tiszabercel, Tiszacsermely, Dombrád und Tuzsér. Insgesamt 70 Exemplare. Aug. 1968.

Oligolophus tridens C. L. Knoch

In den Wäldern des Inundationsraumes der Tisza ebenfalls häufige terrikol-humikol-detritikole Art, häufig gemeinsam mit *Astrobunus* und massenhaft. Kommt auch aus modernden Baumstümpfen zum Vorschein. In unserem neuen Material von den folgenden Stellen eingeholt: Tiszavárkony, Szolnok-Zagyvaköz, Tiszaörvény, Tiszavalk, Tiszadob, Tiszanagyfalu, Tiszacsermely und Dombrád. Insgesamt 11 Exemplare. — Aug. 1968.

Phalangium opilio Linné

Obzwar Uibquist, im nördlichen Tisza-Tal doch seltener als die vorgenannten Arten. Eher plantikoler Natur, oder liebt sich als vordringende Art im Strauchniveau niederzulassen, liebt auch sonnige Stellen, zieht sich jedoch bei trockener Witterung ebenfalls an feuchtere Stellen zurück. Neue Fundorte sind: Tiszavárkony, Szolnok-Zagyvaköz, Pusztataskony (besonders an Heuwiesen an den Schutzdammhängen), Abádszalók, Tiszatardos, Tiszanagyfalu. Insgesamt 12 Exemplare. — Stellenweise synantrop. Aug. 1968.

Opilio saxatilis C. L. Koch

Nach der Diagnostik von Cirdei vielleicht auch mit der Art *Opilio parietinus* De Geer synonym zu nehmen. Eine strenge Trennung dieser beiden Arten scheint mir nicht angebracht. Allerdings teile ich auf Grund der neuesten Arbeit von Szalay — ich zitiere das diagnostische Hauptmerkmal: "... der Strinsaum von Carapax in der Mitte stark vorgewölbt" — unsere neueren Daten als die Art von C. L. Koch mit:

gesammelt von Herrn Dr. M. Marián im Inundationsraum des rechten Flussufers bei Tiszatarján und aus verlassenen *Riparia riparia*-Nestern bei Szeged-Veszős. Zeit: Aug. bzw. Okt. 1968. Interessant ist erneut zu erwähnen, dass an der Korom-Insel des zum Wasserableitungssystem der Tisza gehörenden Fehértó (Weisser See) und an den Schutzwällen im Detritus und in *Larus*-Nestern, gleichzeitig aber auch an der Wand des Jägerhauses beim Fehértó reichlich Exemplare synantrop anzutreffen sind. Ihre parietikolen und detritikolen Eigenschaften sind ebenso vermischt wie ihre morphologischen Eigenschaften. Betreffs der Lebensweise bestehen zwischen ihnen nur ontogenetische Unterschiede, indem die jungen (Pallus) eher in der freien Natur anzutreffen sind, die adulten aber hauptsächlich synatrop, so parietikol sind. Ihre detritikolen Partner sind: Staphyliniden, Insektenlarven, Milben, Lycosiden, junge Clubioniden und Bembidionen.

Zusammenfassung

1. Der neue, südlichste Fundort von *Nemastoma lugubre bimaculatum* ist: Tiszanagyfalu.

2. *Nemastoma elegans* ist ein Novum für die ungarische und die Tisza-Fauna, ihr Fundort ist: Gergelyiugornya.

3. Ob se sich bei *Opilio saxatilis* und *O. parietinus* um zwei Arten handelt, ist noch zweifelhaft. Es ist nicht ausgeschlossen, dass von zwei Lebensformen einer Art — als Dimorphismus — die Rede ist.

4. Die zoogeographische Integration des nördlichen Tisza-Abschnittes hat durch neue Daten eine weitere Beweisführung erhalten.

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OCCURRENCE AND DISTRIBUTION OF URNATELLA GRACILIS Leidy (KAMPTOZOA) IN THE EASTERN MAIN CANAL (HUNGARY)

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Urnatella gracilis has been known in the fauna of Hungary for nearly a decade, but, up to now no more than a few places of occurrence have been reported. Kolosváry and Abricossov (1960) were the first to describe its occurrence in the river Tisza near Szeged, Szolnok and Tiszafüred. Recent investigations (Kolosváry, 1964a, b, 1966) have discovered further occurrences in the Tisza river-system at Gyála, in the estuary of the Maros river, at Szentes, Tiszalök and Gyomakiadány. Since 1962 *Urnatella gracilis* has been found in the Hungarian reaches of the Danube, too, although no colony has been collected as yet from the bed of the Danube. Sebestyén (1962) found it in a waterworks connected with the Danube (Dunaújváros), while quite recently (Lukacsovics and Pécsi, 1967) it was found in great masses in a natural luake (Öreg Lake, Tatabánya) at a distance of 25 km from the Danube.

In the course of investigations on the Eastern Main Canal, on March 22, 1968, colonies of *Urnatella gracilis* were observed at an extremely low water-level (1—1,5 m lower than normal) on the water-side stonework, under the road bridge between Balmazújváros and Hajdúböszörmény (Fig. 1:14).

The Eastern Main Canal is a 98 km long artificial canal running roughly nort-south. It takes its source from the Tisza between the villages of Tiszalök and Tiszadada, and ends at the outlet sluice near Bakonszeg (Fig. 1:31). The average width of the bed is 35 m, and the depth, at working water-level, gradually decreases from 4 m to 2 m between Tiszavasvári and Bakonszeg. The bottom of the bed is covered with clay and mud, and long stretches of the banks are covered with clumps of reeds 0,5—4 m wide. Apart from the paved sector of the bank near Tiszavasvári, there are no stoneworks, except under all but three bridges and in the vicinity of constructive works.

The Eastern Main Canal is slow moving, with a maximum speed of 30 cm/sec. From automn till early spring the water intake into the Canal is negligible (2 cu.m/sec) or nothing. Volume of water let in from the Tisza through the lock-gate at Tiszavasvári.

Making use of the possibilities offered by the extremely low water-level, observations were made along the whole length of the Canal, particular attention being paid to the bridges, paved sectors of the banks, and constructive works.

The greatest masses of *Urnatella gracilis* were found under the bridges between Balmazújváros and Hajdúböszörmény (Fig. 1:14), and Földes and Hajdúszovát (Fig. 1:27). The colonies appeared under both bridges with sharp borders and without any transition, while the banks immediately before the bridges were completely free of them. On the bridge between Földes and Hajdúszovát no colonies were found on either bank after the bridge, while after the bridge between Balmazújváros and Hadjúböszörmény, there were sharp differences between the two banks in the occurrence of colonies. On the bank nearer Balmazújváros (right bank) no more colonies were found on the reeds after the bridge, while on the Hajdúböszörmény bank (left bank) colonies were observed as far as 250 to 300 m after the bridge on reeds, stones and piles, their quantity gradually decreasing with the distance from the bridge. This was the only case along the whole length of the Canal that colonies of *Urnatella gracilis* had settled on unpaved sectors of the bank on reeds as well.

There were three further places where *Urnatella gracilis* occurred in considerable, though slighter, quantities than at the above-mentioned places (Fig. 1:15, 16, 18). On all these three bridges, colonies were detected only on stones under the bridge, the sectors before and after the bridge proving free of *Urnatella*. Below 10 other bridges (Fig. 1:4—9, 11, 21, 23, 24) the occurrence was quite insignificant, in many cases a few colonies being observed only on one stone or another.

Upstream from the road brigde between Debrecen and Budapest (Fig. 1:23), we found three brigdes without stonework (Fig. 1:10, 17, 19), and two further bridges with stonework immediately after the inlet from the Tisza (Fig. 1:1, 2), while downstream from the road bridge there were four bridges with paved banks (Fig. 1:25, 28—30), where no *Urnatella* colonies were found. The lack of *Urnatella* colonies may be due to the fact that there is no suitable base for settlement (ie. the bank was unpaved) or the stonework was so thickly covered with mud and *Dreissena polymorpha* Pall. masses that no appropriate base remained for *Urnatella* to settle.

It is precisely the mud and the *Dreissena* along the bank and on the stones which considerably influences the distribution of *Urnatella gracilis* along the whole Eastern Main Canal. For a dividing line we may take the road bridge between Debrecen and Budapest (Fig. 1:23), which we assume divides the Canal into two, the northern and southern sectors. Above this line, the quantity of mouddy, aqueous deposit being relatively small,

Fig. 1. The diagram of the places examined in the Eastern Main Canal. 1 = single-track railway bridge on the Nyiregyháza — Ohatpuszta line; 2 = road bridge between Tiszalök and Tiszadada; 3 = lock-gate at Tiszavasvári; 4 = road bridge between Tiszavasvári and Tiszadob; 5 = road bridge between Tiszavasvári and Polgár; 6 = 5th road bridge; 7 = road bridge between Hajdúnánás and Polgár; 8 = road bridge between Hajdúnánás and Polgár; 9 = road bridge between Hajdúnánás and Tiszacsege; 10 = road bridge between Debrecen and Polgár; 11 = road bridge between Hajdúböszörmény and Pród; 12 = reservoir K-V; 13 = water-level regulator sluice gate near Balmazújváros; 14 = road bridge between Haj-

dúböszörmény and Balmazújváros; 15 = single-track railway bridge on the Debrecen — Füzesabony line; 16 = road bridge between Debrecen and Tiszacsege; 17 = road bridge between Balmazújváros and Hajdúszoboszló; 18 = road bridge between Debrecen and Tiszafüred; 19 = road bridge between Hajdúszoboszló and Angyalháza; 20 = water-level regulator sluice gate near Hajdúszoboszló; 21 = road bridge between Hajdúszoboszló and Nádudvar; 22 = intake sluice K-VIII; 23 = road bridge between Debrecen and Budapest; 24 = double-track railway bridge on the Debrecen — Budapest line; 25 = road bridge between Kaba and Hajdúszovát; 26 = intake sluice K-IX; 27 = road bridge between Földes and Hajdúszovát; 28 = road bridge between Földes and Debrecen; 29 = road bridge between Földes and Berettyóújfalu; 30 = single-track railway bridge on the Püspökladány — Biharkeresztes line; 31 = outlet sluice near Bakonszeg.

Urnatella is not prevented from settling, whereas below this bridge the surface of submerged stones, piles and constructive works is covered with a 0,5—1 cm thick layer of mud, thus making the base unfavourable for *Urnatella* to settle. This dividing line is also apparent in the mass-occurrence of *Dreissena polymorpha,* too, which in the reach above the line is found only in extremely slight quantities, clinging to shells *(Anodonta, Unio),* piles and constructive works. In the reach below the bridge its occurrence becomes large-scale, covering all submerged bases with a continuous coating. The only exception in the southern reach is the bridge between Földes and Hajdúszovát (Fig. 1:27), where the stonework of the banks are less muddy and the occurrence of *Dreissena* is again relatively slight, resulting in the settlement of considerable masses of *Urnatella gracilis* on the stones.

Investigations on the stones of the constructive works (sluice gates, water intake sluices) and the two bridges near the Tisza (Fig. 1:1, 2), no colonies of *Urnatella* being found. The reason is as yet unknown, since they would serve as suitable bases for settlement. At the same time, directly beside the water-level regulator sluice near Hajdúszoboszló (Fig. 1:20), colonies were found on the stones in the middle of the bed and in the initial paved sector of the outlet of the intake work K-IX (Fig. 1:25).

Since in the course of previous investigation (Kolosváry, 1966), *Urnatella* was discovered in the Tisza, near Tiszalök, it can be assumed that the species was brought into the Eastern Main Canal from the river Tisza. The most probable means of propagation seems to be navigation, sice during the summer period there are boats (chiefly tugs and barges) from the Tisza plying on the Eastern Main Canal.

In view of the present investigations, it can be stated that *Urnatella gracilis* occurs over almost the whole length of the Eastern Main Canal. Taking into consideration its more and more frequent occurrence, in the river-system of the Tisza and along the Danube, we may conclude that *Urnatella gracilis* will become within a relatively short period of time a constant component of the fauna of our rivers and the other waters adjoining them.

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MYRMECOLOGICAL INVESTIGATIONS IN THE ENVIRONS OF KISKÖRE

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Altough the myrmecological investigations along the Tisza, begun in 1963, extended over all the three Tisza sectors (Gallé, 1966a, 1966b, 1967b; Gallé and Gausz, 1968), only comparatively few of the observations published from thirteen areas, so far, are dealing with the biotops of the Middle-Tisza. First of all for supplying this defect, in 1968 I chose the northen part of the middle sector of the Tisza for the site of my investigations. The second barrage of Tisza to be built in the environs of Kisköre will highly change the face of the area. Another aim of my investigations has been to study and recognise the original *Formicoidea* fauna getting under inundation.

Characterization of the area

My investigations were carried out in the inundation area, on the dams and in the protected flood area at the left bank of the Tisza, near to the villages Pusztataksony, Kisköre, and Abádszalók. Data of my observations: July 17—30 1968.

The area belongs climatologically to the northern regions of the Middle-Tisza with a somewhat cooler climate (the annual mean temperature being under 10°C) and scanty in rainfall (the annual precipitation rising hardly above 500 mm).

The inundation area of the Tisza is broad, here and there of more kms, a large part of it being under the influence of the repeated spring inundations. The areas are covered dominantly by grazing-lands and planted woods of a substance of young poplars, and in a smaller part by grove-spots of an old substance of *Salicetum albae-fragilis,* the latter ones occurring with both *Salix* and *Populus* con-socions alike.

The exposition of dam sides is generally: N.W.-S.E. On the N.W.-dam side eexposed to the inundation area there occurred, according to my observations, the plant association *Alopecuretum pratensis ranunculetosum acris* appearing with *Rumex* facies that is characteristric of the Upper-Tisza. On the S.E.-dam side exposed to the protected flood area there grew here and there a form of this association, becoming a poor *Alopecuretum pratensis festucetosum pseudovinae,* and in other places there grows a weed vegetation as a result anthropogeneous influences. On the top of the dam the weed border *Schlerochloo-Polygonetum avicularis*, elsewhere generally occurring, can be found but in a few spots.

There were carried out some collections beside the inundation area, as well, in the protected flood area, first of all in grazing-land *Artemisio-Festucetum pseudovinae,* being somewhat alkalized to solonetz, and in an adjacentwood having at present a substance of *Pinus nigra* and being planted in the place of *Festuco pseudovinae-Quercetum.* I have performed a few collections also in an oak-wood of planted substance at the external side of dam.

Methods

At collection and evaluation of the populations I have followed the methods given in the former publications (Gallé, 1966b, 1967a). In the wood and meadows of the inundation area there couldn't take place any exact quantitative collection, because of the very low population density; and not as a consequence of coherence of the wood biotops of an old *Salicetum* substance of higher myrmecological significance, but of their connected character. On the dam sides and on the steppe covered with an *Artemisio-Festucetum pseudovinae* association, squares of a size of 1 sq.m have been applied.

In this way, the speceis of a lesser nest density (e.g. *Formica)* were collected bit by bit, while for collecting the species visiting flowers and plant-lice I have used grass-nets in the grass-like coenoses. As, however, with the latter method only individual speciemens could be collected, an exact dispersion of the colony cannot be established and we may evaluate the results of the grass netting only qualitatively.

For characterizing the ant fauna ecologically and faunistically, I am typifyig the *Hymenoptera* ecologically (according to Móczár, 1953) and using the general types of distribution.

Enumeration of the species collected

From the area 21 *Formicoidea* species have been collected, during the coenological collections 324 nests were taken into account. The following enumeration is containing the names of the species collected, the places of their occurence, the ecological and area types of species:

Ponera coarctata Latr. — on dam sides; an euryoecic eremophilous, Euro-Mediterranean species.

Myrmica ruginodis Nyl. — from the grazing-land in the inundation area; euryoecic hylophilous species, Euro-Siberian.

Myrmica scabrinodis Nyl. — from dam sides, from pine- and oak woods planted in the protected flood areas; hyper-euryoecic intermediary, Euro-Siberian species.

Myrmica rugulosoides For. — from dam sides; hypereuryoecic intermediary, species.

Leptothorax tuberum F. var. *unifasciata* Latr. — from pinewoods

planted in the protected flood area; euryoecic eremophilous, Euro-Turanian species.
Tetramorium caespitum Latr. — from weed associations in the inundation area and dam sides; hyper-euryoecic intermediary, palearctic species.
Dolichoderus quadripunctatus L. — from poplar-woods in the inundation area, pinewood, in the protected flood area; euryoecic eremophilous, Ponto-Mediterranean species.
Tapinoma erraticum Latr. — from dam sides, pinewoods planted in the protected flood area; euryoecic eremophilous Euro-Turanian species.
Plagiolepis vindobonensis Lomn. — from dam sides; euryoecic eremophilous, South European species.
Camponotus truncatus Spin. — from a pinewood planted in the protected flood area; atenooecic eremophilous, Euro-Mediterranean species.
Camponotus lateralis Ol. var. *piceus* Leach. — from dam sides, pinewoods in the protected flood area; euryoecic eremophilous, Euro-Mediterranean species.
Camponotus caryae Fitch. var. *fallax* Nyl. — from a poplar wood in the inundation area, from a pinewood planted in the protected flood area; stenooecic eremophilous, Euro-Mediterranean species.
Lasius niger L. — from woods and meadows in the inundation area, from dam sides, grazing-lands in the protected flood areas; hyper-euryoecic intermediary, palearctic species. Its sub-species occurring in a pinewood planted in the protected food area is *Lasius niger* L. ssp. *lasioides* Emery.
Lasius alienus Foerst. — from a grazing-land in the protected flood area; euryoecic eremophilous, palearctic species.
Lasius affinis Schenck. — from dam sides, pinewoods planted in the protected flood area; euryoecic eremophilous, Euro-Siberian species.
Formica sanguinea Latr. — from the dam sides; euryoecic eremophilous, palearctic species.
Formica fusca L. — from dam sides; euryoecic hylophilous, palearctic species. Its very found in the same place is *Formica fusca* var. *glebaria* Nyl.
Formica rufibarbis F. — from dam sides, grazing-lands in the protected flood area, pinewoods planted in the protected flood area; euryoecic eremophilous, Euro-Siberian species.
Formica gagates Latr. — from dam sides; euryoecic eremophilous, Ponto-Mediterranean species.
Formica rufa L. — from dam sides; euryoecic hylophilous, Euro-Siberian species.

From the species in the Tisza-valley we could not find *Ponera coarctata* Latr. so far. Not only for the Tisza-valley but for whole Hungary a new sub-species is *Lasius niger lasioides* Emery, the nest of wich I have observed in a woods of *Festuco pseudovinae-Quercetum roboris pinetosum nigrae,* in the protected flood area.

Formicidae populations of some biotops and the quantitativ relations of these populations

In the various biotops the composition and character of the ant population are determined by the physiognomy of biocoenoses and the abiotic ecological complexions.

1. Inundation area. *Formicidae* have occurred in the inundation area in three different biotopic types.

a) Woods in the inundation area. First of all the ant populations of the *Salicetum* groves of old substance are very considerable. The ant populations of the soil are poor owing to the strong influence of flood. The species of the soil levels occurring with a very little and poor colony dispersion is *Lasius niger* L. In like manner, *Lasius niger* L. nestles in the trunks of the old, hollow willows, as well. In the *Salicetum* with poplar consocion, too, there are two various levels. In the soil level, *Lasius niger* L. are nestling here and there; while in the foliage level — where the characteristric, strongly damp environmental influence of the lower levels of the wood in the inundation area is no mor felt — also eremophilous species have settled down: *Dolichoderus quadripunctatus* L. (EE) and *Camponotus caryae* Fitch. var. *fallax* Nyl. (SE). The dominant species of them is *Dolichoderus quadripunctatus* L. nesting in every older poplar.

b) Grazing-land, meadows in the inundation area. The are very damp and can generally be characterized by the plant associations *Glycyrrhizetum echinatae echinochloetosum* and *Lolio-Potentilletum anserinae*. In compliance with the ecological milieu, also the ant population is respensed by a hygrophilous dominant species, *Myrmica ruginodis* Nyl. (EH), and less frequently by *Lasius niger* L. (HI), like an accessory species.

c) Weed borders. The third coenoses of physiognomic type in the inundation area are the weed borders *(Schlerochloo-Polygonetum avicularis* and *Amarantho-Chenopodietum albi)*. In the biotops covered with these associations, *Tetramorium caespitum* was found like a nestling species by the flood. *Tetramorium caespitum* L. (HI) appeared as a species preferring the weed border, also in the course of other investigation at the Tisza.

2. Dam sides. The population of both dam sides are similar in character that may be explained by the flora of dam sides consisting of assocoations of identical construction. The list of species of the ant populations of dam sides can be seen in Table I. The Table containing the dominance and constancy of species (D percent and C/1 sq.m., both referred to the nests) is showing well the similarities and differences between the ant fauna of the two dam sides. On the dam sides of N.W.-exposition *Solenopsis fugax* Latr. and *Lasius niger* L. are the constant-dominant species. The quantity of *Solenopsis fugax* Latr. does not change, on the dam side of S.E.-exposition either, partly because both dam sides are affording satisfying environmental conditions to this species of wide ecological amplitude, partly because it is differing from the other species by its obligate endogeious way of life, taking part but a little in the natural struggle for life of the other species and thus

being not displaced by other species. The smaller dominance of *Lasius niger* L. on the dam sides of S.E.-exposition is explained by the fact that its role and place are taken over by species of similar biocoenotic

Table 1

e.t.	species	D p.c.	C	D p.c.	C	D p.c.	C
	Exposition of dam side:	N.W.		S.E.		Mean	
EE	Ponera coarctata Latr.	1,16	1	-	-	0,58	0,5
HI	Myrmica scabrinodis Nyl.	2,32	1	10,67	6	6,50	3,5
HI	Myrmica rugulosoides For.	-	-	1,78	1	0,89	0,5
HI	Solenopsis fugax Latr.	46,40	10	46,28	8	46,34	9,0
HI	Tetramorium caespitum Latr.	2,32	2	7,12	2	4,72	2,0
EE	Tapinoma erraticum Latr.	-	-	7,12	4	3,56	2,0
EE	Plagiolepis vindobonensis Lomn.	-	-	3,56	2	1,78	1,0
EE	Camponotus lateralis Ol. var. piceus Leach.	2,32	1	1,78	1	2,05	1,0
HI	Lasius niger L.	41,76	10	14,28	4	28,00	7,0
EE	Lasius affinis Schenck.	1,16	1	3,56	2	2,36	1,5
EE	Formica sanguinea Latr.	-	-	0,89	+	0,445	+
EH	Formica fusca L.	1,16	1	1,78	1	1,47	1,0
EE	Formica gagates Latr.	-	-	0,89	+	0,445	+
EE	Formica rufibarbis F.	1,16	1	+	+	0,58	0,5
EH	Formica rufa L.	+	+	-	-	+	+

\+ = The nest of species at the border of the quadrat or only individual have occurred.

role but being more thermophilous, like *Myrmica scabrinodis* Nyl. and *Myrmica rugulosoides* For., and that this side of the dam is showing a tendency to become weedy; in the weed associations, however, *Lasius niger* L. is not a significantly constant-dominant species. The weedy character is shown, anyway, also by the increased of *Tetramorium caespitum* L. on the outer dam side, while *Tapinoma erraticum* Latr. and *Plagiolepis vindobonensis* Lomn. are thermophilous, getting a suitable abiotic chance to live only on this dam side. On the basis of the investigations so for, this datum conserning *Plagiolepsis vindobonensis* Lomn. is meaning the most nothern site of occurence of the *Plagiolepis* species of southern distribution along the Tisza. The tendency of the substance of *Plagiolepis* decreasing towards North is shown also by the dominance of *Plagiolepis* that is here smaller than in the more southern habitats. *Formica sanguinea* Latr. in its large colony found on the dam-"side" kept the species *Formica rufibarbis* F. and *Camponotus lateralis* Ol. var. *piceus* Leach. like slaves. Two-third part of the substance of *Formica fusca* L. belongs to the *glebaria* Nyl. varietas on the N.W. side of the dam while on the outer dam side only *glebaria* occurred.

As mentioned, the weed border *Schlerochloo-Polygonetum avicularis* on the top of the dam is here of smaller myrmecological significance. Where it occurs, its characteristic and lonely species is *Tetramorium caespitum* Latr. while *Messor structor* Latr. that is also frequent in this coenosis in the area to the south of Kisköre, is no more occurring here and to the north from here.

3. Protected graznig-land in the inundation area. On its sodic soil, the total coverage of the vegetation deteriorated by grazing is 60—70 percent. Corresponding to the vegetation of monotonous and poor construction, the *Formicida* part of zoo-coenosis is represented only as many as three species:

Table 2

Ec. type	species	D p.c.	C/lm^2
HI	Lasius niger L.	86,00	10
EE	Lasius alienus Foerst.	10,32	3
EE	Formica rufibarbis F.	3,44	1

Although this coenosis is similar to that of dam sides in respect of physiognomy, it is separated from that, apart from the poorer vegetation, by the drier environmental influence, too. It is explained by the difference in the abiotic ecological factors that beside *Lasius niger* L. also the expressively thermophilous *Lasius alienus* Foerst. appears.

4. Pinewood. In the underwood of the pinewood of rare substance planted in the protected flood area, that of the original oakwood *(Festuco pseudovinae-Quercetum roboris)* is preserved. The coverage of grass level is 96—98 percent. The ant fauna of soil level is corresponding to that of steppe oakwoods, first of all owing to the dominant species *Leptothorax tuberum unifasciata* Latr. and *Myrmica scabrinodis* Nyl.:

Table 3

Ec. type	species	D p.c.	N-m^2
HI	Myrmica scabrinodis Nyl.	61,42	2
EE	Leptothorax tuberum F. var. unifasciata Latr.	24,90	5
EE	Camponotus lateralis Ol. var. piceus Leach.	4,98	15
HI	Lasius niger L. ssp. lasioides Em.	1,66	75
EE	Tapinoma erraticum Latr.	1,66	75
SE	Camponotus truncatus Spin.	1,66	75
EE	Formica rufibarbis F.	+	

Owing to the highly different constancy of species, I have gives more practically the minimiareal of the nests of the species in question, expressed in square metres (N-m^2). From the species enumerated, *Tapinoma erraticum* nestled at the edge of wood, its presence being, therefore, not characteristric of the pinewood. In like way, *Formica rufibarbis* F., too, is a species establishing a contact between two coenoses, nestling in the adjacent grazing-land, and its members visit the wood coenosis first of all for insect husting, and partly for gathering the honeydew of plant-lice (probably *Cinara* species) living on the young pine-shoots. I have found the nest of the otherwise obligately arboricolous *Camponotus truncatus* Spin. in a tree-branch brokedown and, as the members of this colony are partcipating in the traffic of the materials of soil level, it is reasonable to indicate this species also in the Table concerning the soil.

The species nesting on pine trunks and branches are: *Leptothorax tuberum* F. var. *unifasciata* Latr., *Dolichoderus quadripunctatus* L., *Camponotus truncatus* Spin., *Camponotus caryae* Fitch. var. *fallax* Nyl.; the dominant species of the population is *Dolichoderus quadripuctatus* L., the occurrence of which on pines along the Tisza was not knows so far.

5. Oakwood planted. In the course of the collection in the oakwood planted in the protected flood area only a single species, *Myrmica scabrinodis* Nyl. was found. Supposedly the anthropogeneous influence, the physiognomical under-development of coenosis, as well as the subsoil are ethe factors responsible for the other species missing that are characteristic of the steppe oakwoods.

Faunistic and ecological characterization of the ant fauna

The 21 ant species collected in the district of the villages Kisköre—Pusztataskony—Abádszalók belong to the Palearctic, Euro-Siberian, Euro-Turanian, European, Euro-Mediterranean and Ponto-Mediterranean area types.

The percentage of the fauna elements on the basis of species numbers it as follows:

Palearctic	30 percent
Euro-Siberian	25 percent
Euro-Turanian	15 percent
European	5 percent
Euro-Mediterranean	20 percent
Ponto-Mediterranean	5 percent

Comparing these values with the percentage got at the Upper-Tisza (Gallé and Gausz, 1968), it is obvious that at the Upper-Tisza the Euro-Siberian and European species are represented in a higher percentage while in the district of Kisköre the essentially greater percentage of the Euro-Mediterranean species is remarkable. As the quantity of the Euro-Mediterranean species in Tiszakürt — that belongs also to the Middle-Tisza — was 21,44 pc., we may set down as a fact that the area investigated at present, on the basis of the ant fauna, is still belonging faunistically to the Middle-Tisza.

The distribution of the ecological types is:

Table 4

ecological types	on the basis of	
	No. of species p.c.	D.p.c. p.c.
stenooecic eremophilous /SE/	9,08	0,532
euryoecic eremophilous /EE/	54,48	29,508
hyper-euryoecic intermediary /HI/	22,70	51,206
euryoecic hylophilous /EH/	13,62	18,754

As it is apperant, the euryoecic eremophilous type is dominant among the ecological types in respect of the number of species. Anyhow, the percentages calculated on the basis of species numbers do agree, aside from some minor differences, with the percentages got from other Tisza sectors (Gallé and Gausz, 1968) while the percentages on the basis of dominances are more similar to the values got from the Upper-Tisza.

Summary

In the course of the myrmecological collections carried out the district of Kisköre — Abádszalók — Pusztataskony, the occurence of 21 *Formicoidea* species could be observed. From these species, *Ponera coarctata* Latr., and from the sub-species: *Lasius niger lasioides* Emery are new for the Tisza. The ecological character and the faunistic peculiarities of the ant fauna are demonstrating a mixed character of the termophilous-xerophytic substances at the Middle-Tisza and of populations having plenty of montanic elements at the Upper-Tisza. The species form five different ant populations in connection with the abiotic and biotic conditions of the biotops of various types.

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DATA TO THE TRYPETIDAE FAUNA OF THE TISZA-VALLEY (DIPTERA)

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Hejőbába
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The *Trypetidae* fauna of this country is comparatively well-known. This is a consequence of the family containing also economic parasites. E.g., *Rhagoletis cerasi* L., a parasite of cherries, generally known. The larvae of any *Trypetidae* species are herbivorous. The majority of them develops in the bloom of *Compositae;* some species of them, however, develop in stems, roots, fruit, and even in leaves.

I have collected *Trypetidae,* besides other *Diptera,* in the Tisza-valley since 1960. Early in 1968, I decided to elaborate the material collected. Therefore, in 1968 I collected the species of the family more intensively, and even I dealt with their growing from plant parts.

From the territory of this country, there have been demonstrated, so far, about 105 *Trypetidae* speciese. The number of species found in the Tisza-valley is not too high, about one-third of all the species living in our country. Nevertheless, some interesting species have been found, first of all from the district of Tiszatarján where my collecting work was the most intensive.

Below I am enumerating the species demostrated so far from the Tisza-valley, and their habitats. I let known the area of their distribution in the Palearcticum and am referring to their occurrence in this country, as well, mentioning the food plants of the single species and describing my observations in connection with these species.

1. *Euribia stigma* Lw.

It is living in Central and Southern Europe, in this country mainly in the Hungarian Plain. Its larva develops in the bloom of *Achillea millefolium.* In the Tisza-valley, it was found in the blooms of *Achillea millefolium* and *Chrysanthemum vulgare.* I have observed it, anyway, even during netting the riverside plants.

Habitats: Hejő-mouth, October 9th, 1962; Oszlár, June 12th, 1963; Tiszatarján, May 8th, 1962; June 3rd 1968; September 16th, 1968.

2. *Euribia cardui* L.

Found in Europe and Siberia. In this country it is not frequent, being observed only in a few places, first of all in mountainous districts.

From the Plain, it is published only from Dunaföldvár, Makó, and Szeged in the literature at my disposal. Its larcae develop in the stem of *Cirsium arvense* causing galls of nut-size there. The data of Szeged are published by Béla Ambrus from the Tisza-valley where he has found the gall caused by the fly on the stem of *Cirsium arvense*.

Habitats: Oszlár, in the backwater of the Tisza, May 25th, 1961; Szeged, July 1960 (Ambrus).

3. *Euribia quadrifasciata* Meig.

It is living in Europe and North-Africa. In this country it is a widespread, common speceis. Interestingly, it has been observed, so far, only in two points of the Tisza-valley. In the collection of the Museum of Natural Sciences there are some specimens collected in Szolnok but it is unknown if these were found in the inundation area of the Tisza. Its larvae develop in the capitula of various *Centaurea* species.

Habitats: Tiszatarján, May 25th, 1963; June 24th, 1968; Vásárosnamény, July 14th, 1960.

4. *Euribia cuspidata* Meig.

It is a European species, found in various places of this country, as well. I could not find it, so far, in the Tisza-valley; at any rate, also it is contained in the collection of the Museum of Natural Sciences with Szolnok habtiat, lke the species mentioned above. Its larva has been grown from the bloom of *Centaurea* species.

5. *Myopites inulae* v. Rös.

It is living in Central and Southern Europe. In this country it is not frequent. We have known it, so far, only from the mountainous districts. Therefore, its collection from the Tisza-valley is enriching the fauna of the Hungarian Plain with a new datum. Its larva has been grown from the bloom of *Inula* species.

Habitat: Tiszatarján, September 2nd, 1968.

Fig. 2. Map 1: Habitats of *Myopites inulae* v. Rös. in this country.

6. *Platyparella discoidea* Fabr.

It is living in Northern and Central Europe. In Hungary it is rare. Its observation in the Tisza-valley similarly enriches the fauna of the Hungarian Plan with a new datum. Its food plant is not known as yet. Te specimen found in the Tisza-valley is interesting if only because it completes the knowledge of the flying period of species that, according to the investigations so far, seemed to last from the end of April till the end of May. According to the new datum, however, the species flies in early June, too.

Habitat: Tiszatarján, June 5th, 1962.

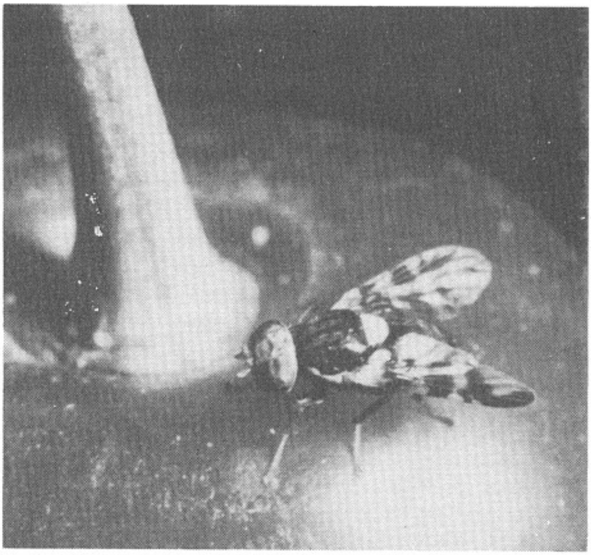
Map 2: Habitats of *Platyparella discoidea* Fabr. in this country.

7. *Rhagoletis cerasi* L.

It is living in Central and Northern Europe. In Hungary it is everywhere common. Its larva develops in cherries *(Prunus avium)* causing their being "worm-eaten". More seldom it damages morellos *(Prunus cerasus)*, as well. I have found its larva in many places of the Tisza-valley. Well-developed speciemens could be collected, anyway, but in Tiszatarján, from *Prunus cerasus.*

Fig. 1: Drawing of *Rhagoletis cerasi* L. (cherry fly).

Habitats: Oszlár, Tiszakeszi, Tiszapalkonya, Tiszatarján (larca). Tiszatarján, June 16th, 1968 (imago).



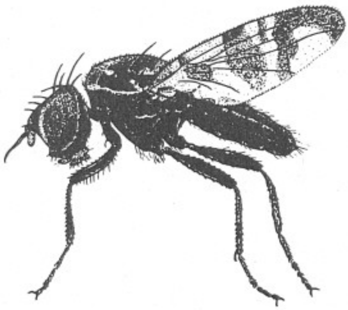


Fig. 1. *Rhagoletis cerasi* L. (A male specimen, according to Csiby).

8. *Trypeta zoë* Meig.

It is living in Central and Northern Europe. In Hungary it is not frequent. So far, it could be collected mainly from the mountainous districts. Its larva develops in the leaves of many kinds of plants. In the Tisza-valley only a single specimen of it could be found, but also that is considerable completing our knowledge concerning the distribution of the species.

Habitat: Tiszatarján, July 11th, 1968.

Map 3: Habitats of *Trypeta zoë* Meig in this country.

9. *Myiolia caesio* Harris.

It is a European species. In this country it has been found in many places, without being common. In the Tisza-valley it is not frequent, either. It was found during netting the riverside plants. Its food plant is known exactly.

Habitats: Tiszatarján, June 16th, 1968; Tiszatarján, backwater of the Tisza, May 24th, 1968.

10. *Chaetorellia jaceae* Rob.-Desv.

It is living in Europe and West-Asia. In Hungary it is frequent everywhere. Its larva develops in the blooms of *Centaurea* species and *Cirsium vulgare*. In the Tisza-valley, I have grown it from the blooms of *Centaurea jacea, Centaurea pannonica,* and *Cirsium vulgare*. I collected several speciemens from the bloom of *Arctium lappa*.

Habitats: Tiszapalkonya, September 4th, 1965; Tiszafüred, August 2nd, 1968; Taszatarján, June 24th, September 3rd, September 16th, 1968.

11. *Chaetostomella cylindrica Rob.-Desv.*

It is living in Europe, West-Asia, and North-Africa. In Hungary it is wide-spread mainly in the mountainous districts. Its larvae develop in the blooms of a lot of plants *(Arctium, Carduus, Centaurea,* etc.). In the Tisza-valley, I have grown it from the bloom of *Centaurea cyanus*.

Habitats: Hejő-bank, May, 16th, 1963; Tiszatarján, June, 16th, June, 24th, 1968.

12. *Orellia punctata* Schrk.

It is living in Central and Eastern Europe. In Hungary it is common everywhere, first of all in the Plain and in the hilly countryes. This species is strangely not to be found in Tiszatarján. Its larva develops in the blooms of *Tragopogon* species.

Habitat: Tiszaladány, August 25th, 1964.

13. *Orellia falcata* Scop.

It is living in Central and Southern Europe. In this country it can be collected everywhere. Its larvae live in the root stem of *Tragopogon* and *Scorzonera* species.

Habitat: Hejő-bank, May 16th, 1963; Tiszatarján, June loth, 1962.

14. *Orellia tussilaginis* Fabr.

It is a European species, in this country it is frequent everywhere. Its larva develops in the bloomhead of *Centaurea jacea, Arctium lappa, Arctium tomentosum,* etc. In the Tisza-valley it is a common species, as well. I have collected the most of the specimens found here from the bloom of *Arctium lappa.*

Habitats: Tiszakeszi, August 19th, 1968: Tiszatarján, July 10th, 1967; August 6th, 1968; Tokaj, September 1st, 1968.

15. *Orellia ruficauda* Fabr.

It is found in Central and Northern Europe, as well as in Central Asia. In this country, it is wide-spread mainly in the plains. Its larvae develop mainly in the capitula of *Cirsium* species. In the Tisza-valley, there was found only one specimen, so far.

Habitat: Tiszatarján, May 25th, 1963.

16. *Acinia biflexa* Lw.

It is living in Central and Western Europe. In this country it can be observed in the plains but it is not common. Its larva develops in the bloom of *Inula britannica.* I have succeeded in growing some of them from that plant, as well.

Habitats: Tiszafüred, August 2nd, 1968; Tiszatarján, May 25th, 1963; June 16th, 1968.

17. *Xyphosia miliaria* Schrk.

It has been observed in the most parts of Europe. In this country it is common everywhere. It is interesting that in the Tisza-valley only a single specimen has been found, so far. Its larva develops in the blooms of *Carduus mutans* and *Cirsium* species.

Habitat: Tiszatarján, July 7th, 1967.

18. *Ictericodes japonica* Wied.

It is known from Central Europe and Japan. In Hungary it has been found but in a few places, mainly in the Plain. It is not frequent in the Tisza-valley, either. Its larva lives in the bloom of *Inula britannica.*

Habitats: Tiszafüred, August 2nd, 1968; Tiszatarján, June 24th, 1968.

19. *Stylia bidentis* Rob.-Desv.

It can be found in Europe, in the environment of the Mediterranean, and in Central Asia. In this country it is common first of all in the Plain and in the hilly countryes. Its larvae develop in the blooms of *Bidens cernua, Bidens tripartita, Centaurea rhenana* and *Chrysanthemum vulgare.* Also in the Tisza-valley it can be collected everywhere, being the *Trypetida* species observed in the greatest specimen number. I have collected a lot of them from the bloom of *Chrysanthemum vulgare.* This plant is living in large numbers in some regions of the Tisza-valley (e.g.), at the bank of the Hejő brook or in Tiszatarján). It is therefore understandable why this *Trypetida* species has been found in that region in large quantities. I have grown a lot of specimens from the blooms of *Chrysanthemum vulgare* and *Bidens cernua.*

Habitat: Hejő-bank, October 9th, November 7th, 1962; Oszlár, June 17th, 1963; Tiszafüred, August 2nd, October 20th, 1968; September 18th, 1958 (pasturage Zsirkó); Tiszatarján, September 23rd, October 7th, 1962; June 24th, September 3rd, September 15th, September 16th, September 30th, October 3rd, October 11th, 1968; Tiszapalkonya, September 18th, 1960; Vásárosnamény, July 14th, 1960; Tiszakeszi, October 18th, 1968; Szeged, October 1st, 1932 (Zilahi-S.).

20. *Stylia tesselata* Lw.

It is a wide-spread species from North-Africa through Europe till Central Asia. In this country it is general throughout the country. Its larva develops in the blooms of several plants (*Leontodon* species, *Taraxacum officinale,* etc.). In the Tisza-valley, I have grown it from the bloom of *Taraxacum officinale.*

Habitat: Tiszatarján, July 18th, 1968.

21. *Oxyna flavipennis* Lw.

It is a European species. In this country it is common everywhere. Its larva causes galls on the foot of the root of *Achillea millefolium.* It is common in the Tisza-valley, as well. Some specimens of it have been found in the blooms of *Achillea millefolium.*

Habitats: Hejő-bank, June 16th, 1968; Tiszatarján, June 16th, June 24th, 1968.

22. *Oxyna parietina* L.

It is a European species. In Hungary it is not frequent, an it seems to prefer first of all the lower mountainous countryes. I have found literary data concerning plains only from the plain in North-Eastern Hungary (Fertőd). Its occurrence in the Tisza-valley enriches, therefore, the *Diptera* fauna of the Plain with a new datum. Its larva lives in the stem of *Artemisia* vulgaris.

Habitats: Hejő-bank, May 16th, 1963; Tiszatarján, backwater of the Tisza, May 24th, 1968.

Map 4: Habitats of *Oxyna parietina* L. in this country.

23. *Sphenella marginata* Fall.

24. *Ensina sonchi* L.

It is a species occurring in the whole of Europe, being common also everywhere in this country. Its larva develops in the capitula of several plants. In the Tisza-valley I have succeeded in growing one specimen of it from the capitulum of *Tragopogon major.*

Habitats: Tiszapalkonya, September 18th, 1960; Tiszatarján, June 10th, 1962; June 12th, 1968.

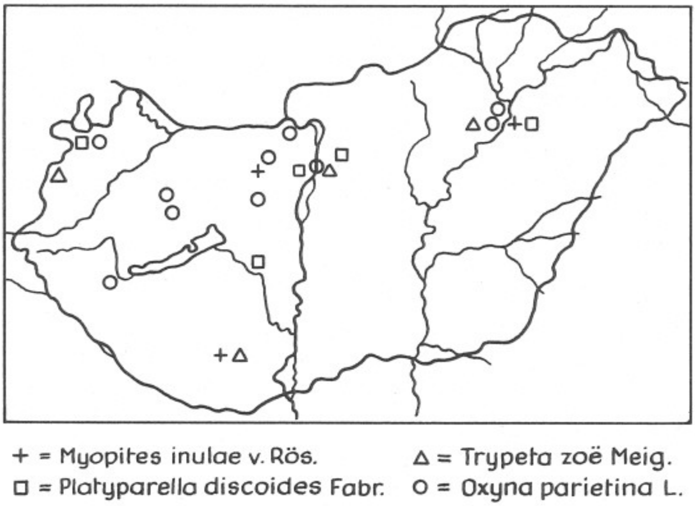


Fig. 2. Habitats of *Myopites inulae* v. Rös. *Pulatyparella discoidea* Fabr. *Trypeta zoo* Meig. and *Oxyna parietina* L. in this country.

25. *Camaromya bullans* Wied.

It can be found in the southern part of Europe and in South-America. In this country it is not common, occurring mainly in the Plain. Food plant of its larva is *Xanthium spinosum.*

Habitat: Tiszatarján, June 4th, 1966; June 8th, 1968.

26. *Tephritis nigricauda* Lw.

It can be found in the whole of Europe, in North-Africa, and largely in Asia. In Hungary it is not common. In the Tisza-valley only a single specimen was found. Its larvae develop in the capitula of *Achillea millefolium, A. ptarmica* and *Matricaria inodora.*

Habitat: Hejő-bank, July 18th, 1967.

27. *Tephritis dioscurea* Lw.

It is living in Central and Southern Europe, as well as in Kamchatka. In Hungary it can be found in a lot of places but it is not frequent. I have failed in collecting it but the Museum of Natural Sciences has a specimen from the Tisza-valley in its collection. Its larva develops in the capitula of *Achillea millefolium, Chrysanthemum* and *Crepis* species.

Habitat: Bustyháza, at the bank of the Tisza, June 5th, 1960 (Zsirkó).

28. *Tephritis formosa* Lw.

It is living in Central and Southern Europe. In this country it was collected but in a few places, mainly in hilly and mountainous countries. Its larva develops in the bloom of *Sonchus oleraceus*. In the Tisza-valley it has been found but in a single specimen; this, however, is a new datum for the flying time of the species because, so far, we hadn't any data from the month September.

Habitat: Tiszatarján, September 23rd, 1968.

29. *Tephritis ruralis* Lw.

It can be found in the whole of Europe. In Hungary it was found in many places, as well, but it is here not common. Its larva lives in the capitulum of *Hieracium pilosella*.

Habitats: Bustyháza, at the bank of Tisza, June 5th, 1960 (past. Zsirkó); Tiszatarján, June 14th, 1968.

30. *Tephritis pulchra* Lw.

It is living in Central Europe and in the environment of the Mediterranean. In Hungary it has been collected mainly in the Plain, being anyway not frequent. Its larva develops in the bloom of the *Scorzonera* species. In the Tisza-valley, it could be grown from the capitulum of *Scorzonera cana*.

Habitat: Tiszatarján, June, 1968.

31. *Tephritis cometa* Lw.

It is living in Europe, Asia Minor, as well as in Central Asia. In Hungary it is a common species everywhere, mainly in the plain regions. Its larva has been grown from *Arnica montana* and *Aster bellidiastrum*. It is frequent also in the Tisza-valley. It is interesting, however, that in 1968 it could not be found in spite of being collected intensively, and it could not be grown, either.

In connection with the dates April 30 and May 16 it is to be noticed that these are meaning new data concerning the beginning of the flying period of the species. So far, the earliest specimens were namely found but from the end of May.

Habitats: Hejő-bank, May 22nd, 1962; May 16th, 1963; Oszlár, June 12th, 1963; Oszlár, at the backwater of the Tisza, Aapril 30th, 1962; Tiszatarján, June 10th, August 23rd, 1962.

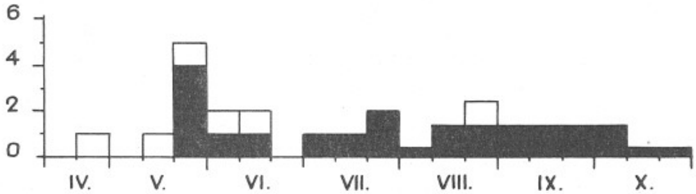


Fig. 3. Flping period of *Tephritis cometa* Lw. in this country.
On the horizontal axis the months are given, in decadal distribution.
On the vertical axis the number of collections is given on the basis of the evaluable data. The data from the Tisza-valley are left light.

32. *Trupanea amoena* Frfld.

It is a species common in the great part of the Palearcticum and in South-Asia. In this country it is frequent mainly in the plains; in the Tisza-valley, however, there was found but a single specimen of it. Its larva develops in the blooms of several plants. From time to time it causes losses in growing the lettuce seeds (*Lactuca sativa* L.).

Habitat: Tiszatarján, September 3rd, 1968.

33. *Trupanea stellata* Fuess.

It is a species wide-spread in a large part of the Palearcticum. In Hungary it is common everywhere, first of all in the plains. It has several food plants. In the Tisza-valley, I have grown it from the bloom of *Inula britannica*.

Habitats: Szolnok, July 29th, 1955 (past. Balás); Tiszatarján, August, 1968.

34. *Acanthiophilus helianthi* Rossi

It is common in the whole Palearcticum. In hungary, it is the most frequent *Trypetida species,* observed everywhere. It is a notorious parasite of the *Centaurea* seed production in this country. It hàs several food plants. In the Tisza-valley it could be grown from the bloom of *Cirsium arvense.*

Habitats: Tiszafüred, August 2nd, 1968; Tiszaladány, August 25th, 1964; Tiszatarján, July 11th, September 3rd, September 16th, September 30th, 1968.

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TISCIA (SZEGED) 5. 1969.

ZÖNOLOGISCHE UNTERSUCHUNGEN DER AN DER FLUSS-BETTKANTE DER TISZA AND IHRER NEBENFLÜSSE LEBENDEN SCHNECKEN

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Zielsetzung und Methodik der Untersuchungen

Im Rahmen des Tiszaforschungs-Programms (während der Jahre von 1956—1967) habe ich die Flussufer und Flussbettkanten der Tisza und ihrer acht Nebenflüsse untersucht (s. Beilage 1).

Über die Mollusken des Tisza-Tales hat bisher — Czogler, Rotarides und Horváth — wertvolle Mitteilungen bezüglich der im Fluss und in den Inundationsräumen lebenden Arten gemacht.

Mit den zönologischen Untersuchungen beabsichtigte ich die Ansiedlungsmöglichkeiten, die Struktur und die Sukzession der an den Flussufern lebenden Schneckenzönosen zu studieren. Die aus dem Inundationsraum mitgeteilten Zönosen wurden vergleichshalber in die Arbeit mitaufgenommen. Mit diesen Sammlungen trachtete ich den Unterschied zu ermitteln, der zwischen dem Inundationsraum und den Flussufern besteht. Die vorliegende Arbeit enthält auch die Ergebnisse meiner bisher erschienenen einschlägigen Untersuchungen.

In den oben genannten Forschungsjahren habe ich Sammlungen auf einer 565 km langen Strecke des Flusses — vom 163. bis zum 728. Flusskm — angestellt. Aus der Tisza und ihren Nebenflüssen habe ich Material von insgesamt 1140 Fundorten eingeholt; 10 Untersuchungspunkte bilden einen Sammelplatz, d.h. die Zahl der Sammelstellen beträgt 114. Die Sammelstellen hatte ich alle 10—50 Flusskm an verschiedenen Abschnitten festgesetz (Beilage 1.). Die angegebenen 1140 Sammelpunkte erfüllen die Forderungen einer repräsentativen, statistischen Probenentnahme, um so mehr, als die Schneckenzönosen das Tisza-Tal nicht fortwährend bevölkern. Die Sammelstellen der Nebenfülsse wurden 1—3 km vor ihrer Einmündung in die Tisza bezeichnet, wo die rückstauende Wirkung der Tisza bei normalem Wasserstand schon nicht zur Geltung kommt.

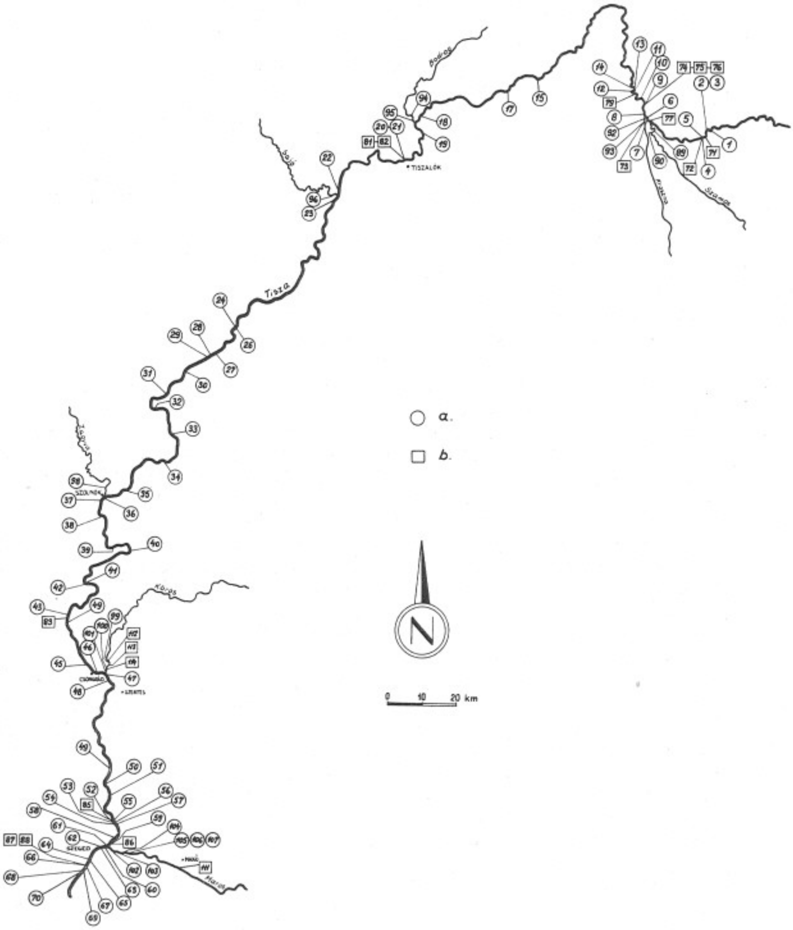
Die Sammlungen erfolgten an Quadraten von 25×25 cm^2 und unter Berücksichtigung der ökologischen Faktoren: ich habe die Daten bzgl. der Vegetation, Bodenbeschaffenheit, klimatischen Exposition und des Neigungswinkels registriert. Für die Revidierung der phytozönologischen Daten spreche ich Herrn Dr. Gy. Bodrogközy auf diesem Wege meinen Dank aus.

Bei der Benennung der Zönosetypen habe ich mich an die von Balogh empfohlenen Prinzipien gehalten. Die Aanalyse der zönologischen Kategorien geschieht mit den von mir konzipierten Modifikationen.

Den Vergleich der Zönosen habe ich mit Hilfe der Identitätsberechnungen nach Jaccard, Rekonnen und Kulczynski unternommen. Das Anwendungsgebiet dieser Methoden ist neu. Die mit diesen Methoden erhaltenen Verhältniszahlen habe ich (unter Berücksichtigung der territorialen Lokalisation der Zönosen) zur Ermittlung der Sukzession der Zönosen herangezogen.

Die die gefundenen Arten und ihre Lokalisation determinierenden Faktoren

Es gelang mir, aus dem Tisza-Tal 45 Arten mit insgesamt 3332 Individuen nachzuweisen (s. Beilage 3). Die Artenzahl dürfte mit den künftigen Inundationsraum-Untersuchungen noch zunehmen. Lebende Schnecken kamen nur aus 25% der untersuchten 1140 Quadrate zum Vorschein. Diese Ziffer spiegelt die störenden Faktoren, welche die Niederlassung der Tiere beeinträchtigen, es sind dies: der jeweilige Wasserstand des Flusses, und die zeitliche Dauer der Hochwässer im Winter,



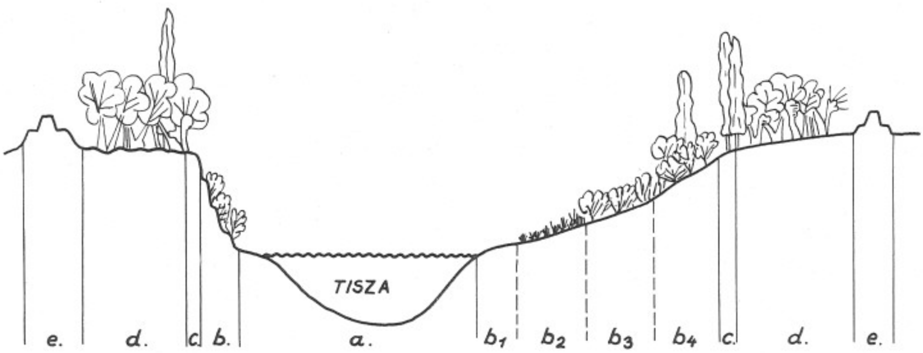
Beilage 1. Verteilung der Sammelstellen im Gebiete der Tisza und ihrer Nebenflüsse.
a: Zahl der Sammelplätze am rechten und linken Flussufer.
b: Sammlung von Inundationsraum.

Frühjahr und Sommer (so habe ich z.B. nach drei aufeinanderfolgenden Überschemmungen 1965 und 1966 entlang der Kőrös und in der Umgebung von Csongrád anlässlich der Untersuchung von je 5 km Strecken kein einziges lebendes Exemplar gefunden). Entlang der Tisza wechseln grossenteils Erosions- und Entwicklungs-Uferstrecken einander ab, lebende Schnecken kamen nur an den neutralen Abschnitten zur Beobachtung. Innerhalb der neuralen Uferstrecken sind die Steilhänge zur Ansiedlung der Schnecken nicht geeignet, weil die Niederschlagsgewässer sie herabspülen können.

Die Schnecken sind feuchtigkeitsliebende Tiere. Hinsichtlich der Bodenfeuchtigkeit sind (nach den Untersuchungen von Andó) die milden Hänge von 5—30°C am günstigsten. Wegen der Klimatischen Exposition nimmt die Verdunstung besonders an den südlichen Abhängen zu. Beeinflusst wird die Niederlassung der Tiere auch durch die Vegetation infolge ihrer Schattenwirkung. In bewachsenen Distrikten ist auch die Verdunstung gemässigt. (Die Einflüsse dieser Faktoren auf die Schnecken haben wir in einer gemeinsamen Arbeit mit Andó geklärt.)

Es war festzustellen, dass Schnecken nur auf Infusionslösz-, Lehm- oder gemischten Lösz-Lehm-Sandboden anzutreffen sind; der Sand übt eine mechanische Reizwirkung auf die Tiere aus.

Vorhandensein und Qualität der Vegetation sind nicht nur wegen der Schattenwirkung, sondern auch in alimentarer Hinsicht wicktig. An den vegetationslosen ,aber beschatteten, neutralen Uferstrecken kamen — unabhängig von der klimatischen Exposition — lebende Schnecken nicht vor. Schneckenzönosen bzw. Schnecken fand ich erst von dem



Beilage: 2. b_1, b_3: *Bidention*-Zone; b_4, c: *Salicion*-Zone; b, b_1, b_4 c: Ufer, b, b_3, b_4: Flussbett-Ufer; c: Flussbettkante; d: Inundationsraum.

nicht der ständigen Verschlammung seitens des Flusses ausgesetzten Bidentiongürtel an (Beilage 2). Die Entfernung der Bidentionzone vom Wasser ist an den einzelnen Uferstrecken verschieden. Die an Beilage 2 dargestellte Vegetationsgliederung hängt ab von der Breite, vom Neigungswinkel, vom Zustand und vom Boden der betreffenden Uferstrecke.

Die Aufzählung der die Ansiedlung der Schnekken beeinträchtigenden Faktoren mach verständlich, dass von den 45 gefundenen Arten an den Ufern nur 18 vorkamen. Die Umwelt des Inundationsraumes schaftt ausgeglichenere Bedingungen. Von den Inundationsräumen kamen auch trotz der geringeren Zahl an Untersuchungen ein grosser Teil der Arten (28 Arten) zum Vorschein (Beilage 3).

Die gefundenen Schnecken sind nach ihren Ansprüchen in drei Gruppen unterteilt. In die Gruppe „feuchtigkeitsliebende Ubiquisten" habe ich die Arten mit verschiedenen Feuchtigkeitsansprüchen, aber weit verbreitetem Vorkommen gereiht. In die Gruppe der „anderen feuchtigkeitsliebenden" kamen Schnecken, die infolge ihres hohen Feuchtigkeitsanspruches in Ungarn in Wäldern und Gebirgsgegenden vorkommen. Die "wärmeliebenden" bilden ebenfalls eine heterogene Gruppe. Diese beinhaltet wärmebeanspruchende und wärmetolerierende Arten. Auf Grund dieser Gruppierung sind 84% der Arten feuchtigkeitsliebend, was auf das feuchtere Klima des Tisza-Tales — gegenüber der Ungarischen Tiefebene (Alföld) — hindeutet; 56% der feuchtigkeitsliebenden Arten sind weit verbreitete Ubiquisten.

Ein Vergleich der an den Flussufern lebenden Arten mit den im Inundationsraum lebenden lässt feststellen, dass an den Ufern vorwiegend Ubiquisten mit hauptsächlich gemischten Nahrungsanspüchen: Detritus, Algen und Bakterien fressende Arten leben. In den Inundationsräumen sind Schnecken anzutreffen, die sich mit Pflanzen und Detritus ernähren.

Ein grosser Teil der Arten sind nicht ständige Bewohner des Tisza-Tales, im besonderen gilt dies für die in der Gruppe "andere feuchtigkeitsliebende" zusammengefassten Arten. Deise, sowie auch ein beträchtlicher Teil der Ubiquisten werden vom Wasser angeschwemmt. Viele der vom Wasser transportierten "anderweitigen feuchtigkeitsliebenden" gelangen bis nach Tokaj hinunter. Ein Teil der erörterten Arten lässt sich entlang der Tisza saisonal, der andere aber auch dauernd nieder. An der Flusstrecke unterhalb von Tokaj kommt die Wärmewirkung besser zur Geltung. An desen Strecke begegnete ich vereinzelt Arten mit hohen Feuchtigkeitsansprüchen (wie z.B. die unterhalb von Szeged gefundene, wahrscheinlich von der Maros beförderte *Isognomostoma isognomostona).*

Von den dauernd sesshaften Arten sind *Monachoides vicina, Perforatella bidens* und *Helix lutescens* hervorzuheben. Diese sind auch in der Fauna ausserhalb des Inundationsraumes an der Oberen Tisza anzutreffen.

Aus den an den verschiedenen Tisza-Abschnitten ständig auffindbaren Arten geht die Grundfauna hervor. Die Benennung "Grundfauna" ist das Ergebnis statistischer Untersuchungen. In Wirklichkeit verändert sich die Fauna ständig in Zeit und Raum, teils infolge der verringernden Wirkung der Überschwemmungen, teils wegen der in letzter Zeit häufigen anthropogenen Einflüsse. Der Grundfauna habe ich die folgenden Arten zugeordnet: *Carychium minimum, Succinea oblonga, Succinea putris, Succinea pfeifferi, Cochlicopa lubrica, Pupilla muscorum, Vallonia pulchella, Vallonia costata, Vitrea crystallina, Perpolita hammonis, Zonitoides nitidus, Agriolimax agrestis, Agriolimax laevis, Fruti-*

Nr.	A r t	Gesammelt		
		Am Ufer der Nebenflusse	Am Ufer der Tisza	In Inundationsraum der Tisza
1.	Carychium minimum O.F. Müller	+		+
2.	Succinea oblonga Draparnaud	+	+	+
3.	Succinea oblonga var. elongata A. Braun	+	+	+
4.	Succinea putris L.	+	+	+
5.	Succinea preifferi Rossmassler	+	+	+
6.	Cochlicopa lubrica O.F. Müller	+	+	+
7.	Vertigo antivertigo Draparnaud			+
8.	Pupilla muscorum L.		+	
9.	Pupilla sterri carpathica Kim.		+	
10.	Vallonia pulchella O.F. Müller	+	+	+
11.	Vallonia enniensis Gredler	+		
12.	Vallonia costata O.F. Müller		+	+
13.	Imparietula tridens O.F. Müller			+
14.	Puctum pygmaeum Draparnaud	+		
15.	Vitrea inopinata Ulicny	+		
16.	Vitrea crystallina O.F. Müller	+		+
17.	Vitrea contracta Westerlund	+		+
18.	Vitrea jetschini Kimakovitz		+	
19.	Oxychilus glaber Studer			+
20.	Perpolita hammonis Ström.	+	+	+
21.	Zonitoides nitidus O.F. Müller	+	+	+
22.	Vitrina pellucida O.F. Müller			+
23.	Limax maximus L.	+	+	
24.	Limax cinereoniger Wolf.	+		
25.	Limax flavus L.	+		
26.	Limax tenellus Nilson	+		
27.	Agriolimax agrestis L.	+	+	
28.	Agriolimax laevis O.F. Müller	+	+	
29.	Arion circumscriptus Johnston	+		
30.	Fruticicola fruticum O.F. Müller	+		+
31.	Helicella obvia Hartmann			+
32.	Monacha carthusiana A. Schmidt	+		
33.	Monachoides rubiginosa A. Schmidt	+	+	+
34.	Monachoides transsylvanica Westl.			+
35.	Monachoides incarnata O.F. Müller	+		
36.	Monachoides vicina Chemnitz	+	+	+
37.	Helicigona banatica Rossmassler			+
38.	Perforatella bidens Chemnitz	+		+
39.	Perforatella dibothryon Kim.			+
40.	Euomphalia strigella Draparnaud	+		
41.	Isognomostoma isognomostoma Gmelin			+
42.	Cepaea vindobonensis C. Pfeiffer	+		+
43.	Cepaea hortensis L.	+		
44.	Helix lutescens Rossmassler	+		+
45.	Helix pomatia L.		+	
	Zusammen	31	18	28

cicola fruticum, Helicella obvia, Monacha carthusiana, Monachoides rubiginosa, Monachoides vicina, Perforatella bidens, Cepaea vindobonesis, Helix pomatia, Helix lutescens. Diese 22 Anten sind grösstenteils Ubiquisten, was den weiter oben angeführten mannigfachen ansiedlungshemmenden Wirkungen entspricht. Ihr kontinuierliches Vorhandensein an den verschiedenen Flussstrecken beweist ,dass sie die konstant dominanten Arten der Zönosen bilden. Ein kleinerer Teil dieser Arten kommt an den Ufern unterhalb von Tokaj vor, so die *Succinea oblonga, Succina pfeifferi, Cochlicopa lubrica, Vallonia pulchella, Zonitoides nitidus, Agriolimax agrestis, Agriolimax laevis,* und *Monachoides rubiginosa.* Stellenweise kommen auch *Succinea putris* und *Perpolita hammonis* zum Vorschein. Die *Succinea oblonga* var. *elongata* kam am Oberen Flusslauf zur Beobachtung, *Succinea oblonga* lebt eher an den unteren Strecken.

Ein Teil der in der Artenliste an Beilage 3 zu findenden Arten bedeutet für das Tisza-Tal — und einige auch für Ungarn — neue Verbreitungsdaten. Auf Grund ihrer Anstprüche und ihrer bisherigen Verbreitung war das Aufscheinen von *Carychium minimum, Punctum pygmaeum, Vitrea crystallina, Perpolita hammonis, Vitrina pellucida, Limax flavus* und *Fructicicola fructicum* an mehreren Stellen zu erwarten. (Auch Horváth hat diese Arten angegeben.)

Von den vorübergehend sich niederlassenden Arten ist das Auftauchen von *Pupilla sterri carpathyca, Vitrea inopinata, Vitrea contracta, Limax cinereoniger, Limax tenellus, Monachoides incarnata, Monachoides transsylvanica* und *Cepaea hortensis* interessant; ihr Erscheinen im Tisza-Tal ist gleichzeitig ein Novum.

Eine neue Art innerhalb der Landesgrenzen Ungarns ist die am hohen Inundationsraum bei Remete aus einem angebauten Pappelbestand zum Vorschein gekommene *Perforatella dibothyron* (1 Exemplar von 6:8). Noch interessanter ist das Vorkommen der 11 verschieden grossen *Helicigona banatica*-Exemplare bei Bagiszeg, welche Art bislang nur aus den Östlichen und Südlichen Karpathen bekannt war. Ihre Grössenverhältnise zeigen, dass sie im Inudationsraum zur Vermehrung gelangt.

Allgemeine Charakterisierung der Zönosen

Von den an Beilage 1, aufgeführten Sammelplätzen stammen 26 aus den Einmündungsgebeiten der Nebenflüsse und 88 von der Tisza. (An der Beilage 1, sind die Sammlungen von Inundationsraum und von den Flussufern mit besonderen Bezeichnungen versehen.)

Bei der Analyse der Zönosen benutze ich die Daten der Individuenzahlen, die daraus berechnete Zahl der jugendlichen Individuen, die Dominanz, Konstanz, Gesamt-Artenzahl und die daraus berechnete juvenile Gesamtindividuenzahl...

In der vorliegenden Arbeit sind die in der Beilage 1, mit den Ziffern 19, 24, 25, 26, 31, 39, 83, 91, und 94 bezeichneten Zönosen nicht enthalten, sei sind in den im Literaturverzeichnis angeführten Arbeiten bereits mitgeteilt worden, bei der Systematisierung der Zönosen aber habe ich sie auch mitverwertet.

Die Hausgrössen-Analyse der Arten der Zönosen zeigt, das die Gestaltung der Charakteristika durch die kontinuierliche Vermehrung vom Frühjahr bis zum Herbst gesichert ist. In früheren Arbeiten konnte ich nachweisen, dass die Zahl der jungen Individuen in der Herausbildung des Konstanz-Dominanz-Grades entscheidend mitspielt und berücksichtige deshalb das prozentuelle Verhältnis der juvenilen Individuen bei der Auswahl der konstanten und dominanten Arten der Zönosen, wie auch bei der Feststellung ihrer Entwicklung und Degradation.

Trotz der im Anschluss an die seit 11 Jahren allsommerlich durchgeführten sehr zahlreichen orientierenden Sammlungen folgenden zönologischen Aufnahmen scheint die Zahl der von den Ufern zum Vorschein gekommenen 31 Zonosen (die Beschreibng von 23 dieser Gemeinschaften ist neu) relatív gering.

Nachdem ich den Einfluss der ökologischen Faktoren auf die Niederlassungsmöglichkeiten der Zönosen entlang der ganzen Tisza aufgenommen habe, besteht das Charakteristikum der Ufer der untersuchten Flüsse meinen Erfahrungen nach gerade in ihrer Armut an Arten und Zönosen infolge der mannigfaltigen Störungen. Unterstützt wird diese Feststellung durch die Befunde bei den kontrollweise untersuchten 15 Sammelstellen am Inundationsraum, wo die Zahl der Arten auch trotz der lokalen Untersuchungen um 10 grösser ist als an den Ufern entlang des ganzen Flusslaufes.

Ufer und Flussbettkanten sind nach den Untersuchungen von Timár und Ujvárosi phytologisch deutlich in eine *Bidention*- und eine *Salicion*zone getrennt (Beilage 2). Die in den genannten phytologischen Zonen befindlichen Schneckengemeinschaften divergieren nur in territorialer Beziehung, wiesen aber — was Struktr, Artenzahl und Entwicklungsumstände anbelangt — nur geringfügige Unterschiede auf. (Das Nachlassen des Feuchtigkeitsgehaltes an den Flussbettkanten infolge der Entfernung vom Wasser und des Neigungswinkels wird ausgeglichen durch die — gegenüber der *Bidention*zone — reicheren Nährflanzenbestände und deren Schattenwirkung.)

Im weiteren vergleiche ich nach den komparationsweise mitgeteilten Synusien der Sammelplätze an den Inundationsräumen die Struktur der an den Ufern und im Inundationsraum zur Entstehung gelangten Zönosen.

Von Inundationsraum-Sammelstellen sind drei ruderale und die übrigen natürliche Zönosen. De ruderalen Zönosen sind: an der 71. Sammelstelle in einem Akazienhain ein *Cochlicopa lubrica*-Synusium mit *Vitrina pellucida* und *Perpolita hammonis* als Subdominanten, an der 87. Sammelstelle an einem Hochwasser-Schutzdamm ein *Vallonia pulchella-Succinea oblonga*-Synusium und an der 77. Sammelstelle in einem 10-jährigen Bestand aus kandischen Pappeln in *Rubus*- und *Urtica*-Bodenvegetation ein Synusium aus *Monachoides rubiginosa-Succinea putris-Succinea oblonga*. Kolorierende Elemente sind *Fruticicola fruticum*, *Perforatella bidens* und *Perforatella dibothryon*. Interessant an dieser ruderalenZönose ist die Anwesenheit mehrerer hochfeuchtigkeitsbedürftiger Arten.

Drei Sammelplätze stammen von einer Inundationswiese. Zwei davon (81 und 82) sind unbeschattet, während der dritte (82) ein beschattetes, feuchtes Territorium darstellt. Ihre Synusien sind der Reihe nach mit *Zonitoides nitidus-Cochlicopa lubrica-Succinea oblonga-Vallonia pulchella* und *Succinea oblonga*-Arten characterisierbar.

Aus einem *Salicetum albae*-Wald kamen die Zönosen der Fundorte 80, 83 und 85 zum Vorschein, es sind der Reihe nach: *Zonitoides nitidus-Cochlicopa lubrica, Succinea oblonga, Vallonia pulchella-Succinea oblonga*-Synusien. (Die Sammelstellen 80 und 83 habe ich in vorangegangenen Arbeiten bereits beschrieben.)
Aus *Salicetum triandrae*-Strauchweidenbeständen habe ich die durch *Succinea putris, Succinea oblonga, Zonitoides nitidus-Cochlicopa lubrica*-Arten charakterisierten Synusien 74, 84 und 88 gesammelt.

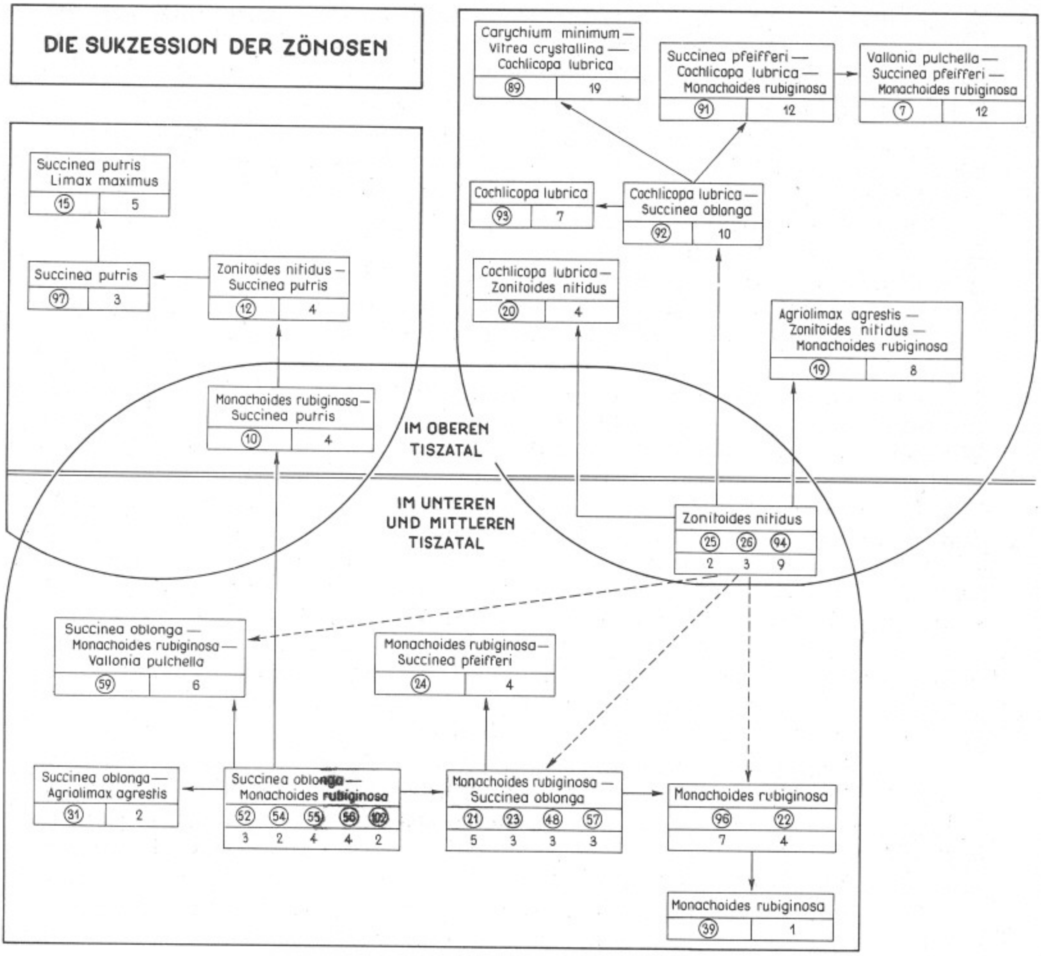
Was die kolorierenden Elemente und die Artenzahl anberifft, sind die Sammlungen aus den entwickelteren Waldungen des Tisza-Tales am interessantesten. Die Vegetation der Fundorte 72, 73 und 75 bilden Weiden-Pappeln-Erlen-Wälder mit Brombeerstruchern als Bodengewächsen, ein *Salicetum fragilis*-Wald und ein Eichen-Eschen-Ulmenwald mit *Rubus*-Bodenvegetation. Die *Cochlicopa lubrica-Monachoides rubiginosa*-Zönose der 72. Sammelstelle enthält als subkonstante Arten *Vitrea crystallina, Fruticicola fruticum* und *Cepae vindobonensis*. Die *Succinea putris-Monachoides rubiginosa*-Zönose des Fundortes 73 besteht aus 17 Arten. Neben zwei seltenen *Vitrea*-Arten weist sie auch 2 Exemplare von *Monachoides transsylvanica* auf. Am 75. Sammelplatz befindet sich ein *Monachoides vicina-Helicigona banatica* Synusium. In den beiden letzteren Zönose sind juvenile Individuen mit 50—52% — also im höchsten Prozentsatz — vertreten.

Vom Inundationsraum der Maros habe ich zwei ruderale Zönosen eingeholt, und zwar am 109. Sammelplatz aus einer Pappel-Eschen-Pflanzung ein *Cochlicopa lubrica-Succinea oblonga-Monachoides rubiginosa*-Synusium und am 110. Sammelplatz aus einer *Acer*-Pflanzung eine *Monachoides rubiginosa*-Zönose.

Die Synusientypen der Ufer enthält Beilage 4. (An den Sammelstellen 3 und 95 fand ich ruderale Zönosen vor.)

Beim Vergleich der von den Flussufern (Beilage 4) und den Inundationsräumen zum Vorschein gekommenen Zönosen zeigt sich, dass die von der gleichen Tisza-Strecke stammenden Zönosen aus dem Inundationsraum die von den Uferpartien an Arten- und Individuenzahl übersteigen. Dies ist verständlich, weil die Inundationswälder reicher an Nahrung, mikroklimatisch ausgeglichener und vom Wasser weniger gestört sind als die Flussufer.

Die Zahlencharakteristika der Charakterarten in den Zönosen vom Inundationsraum sind nicht um ein mehrfaches grösser als die Zahlencharakteristiken der subkonstanten, subdominanten Arten, im Falle der Uferzönosen aber ja. Obwohl die Ernährungsverhältnisse im Inundationsraum vielfältigere sind, finden sich hier doch mehrere Arten mit ähnlichem Ernährungstyp und annähernd gleichen Feuchtigkeitsansprüchen als an den Flussufern. An den Inundationsräumen der Oberen Tisza spreche ich die Zunahme der Artenzahl in den Zönosen den Wirkungen



Beilage 4

der Nebenflüsse zu. Die von ihnen verbreiteten feuchtigkeitsbeanspruchenden Arten nehmen in der Regel mit mittleren Charakteristiken am Aufbau der Zönosen teil.

An gleichen Flussabschnitten weichen auch die Charakteristiken der Charakterarten der Uferzonen und der Inundationsräume voneinander ab, selbst auch dann, wenn an beiden Stellen von den gleichen Arten die Rede ist.

Am Oberen Tisza-Lauf liegen die Inundationsräume im Verhältnis zum Flussniveau höher als an den unteren Flusstrecken und werden daher von den Hochwässern kürzere Zeit behelligt. Infolge dieser günstigen Situation verfügen die Zönosen der Inundationsräume in der Oberen Tisza-Region über eine reichere Individenzahl — meistens aber

Beilage 5

Sammelstellen (Nr. 3., 7., 10., 12., 15., 20., 21., 22., 23., 48., 52., 54) von den Ufern der Tisza (siehe: Beilage 2-3.)

A r t	3.				7.				10.				12.				15.				20.			
	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%
L.	1	100	5,00	10	21	25	22,10	90	10	-	26,10	60	9	11	45,00	50	1	100	20,00	10	-	-	-	-
Drap.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	20,00	10	-	-	-	-
var. elongata A. Braun	4	-	20,00	30	4	-	4,21	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
i Rossm.	-	-	-	-	2	50	2,10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ca C. F. Müll.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	28,56	20
rpathica Kim.	-	-	-	-	1	-	1,05	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
O. F. Müll.	1	-	5,00	10	2	-	2,10	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
a O. F. Müll.	-	-	-	-	34	5	35,70	90	-	-	-	-	-	-	-	-	-	-	-	-	1	-	14,28	10
Kim.	-	-	-	-	3	33	3,15	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
onis Ström.	-	-	-	-	4	50	4,21	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
s O. F. Müll.	-	-	-	-	9	22	9,45	50	13	84	33,93	60	9	42	45,00	60	1	-	20,00	10	3	-	42,84	20
L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100	20,00	10	-	-	-	-
stis L.	-	-	-	-	5	40	5,25	30	1	100	2,61	10	1	-	5,00	10	-	-	-	-	-	-	-	-
iginosa A. Schmidt	-	-	-	-	17	12	17,85	70	12	41	37,32	80	1	-	5,00	10	1	-	20,00	10	1	-	14,28	10
ina Rossm.	-	-	-	-	2	100	2,10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.	14	7,14	70,00	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zusammen	20	10	100	-	95	21	100	-	36	47	99,96	-	20	15	100	-	5	40	100	-	7	-	100	-

A r t	21.				22.				23.				48.				52.				54.			
	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%
L.	-	-	-	-	1	-	1,92	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drap.	-	-	-	-	3	33	5,75	20	15		17,40	80	5	-	29,41	30	31	-	64,68	100	26	-	73,89	100
var. elongata A. Braun	6	-	30,00	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
i Rossm.	-	-	-	-	-	-	-	-	-	-	-	-	3	-	17,62	20	-	-	-	-	-	-	-	-
ca O. F. Müll.	4	-	10,00	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
a O. F. Müll.	1	-	5,00	10	4	25	7,68	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
onis Ström.	-	-	-	-	1	-	1,92	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
s O. F. Müll.	5	-	25,00	30	2	-	3,84	20	14	7	16,24	80	-	-	-	-	-	-	-	-	-	-	-	-
L.	-	-	-	-	2	100	3,84	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
stis L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2,08	10	-	-	-	-
iginosa A. Schmidt	4	-	20,00	30	39	71	80,80	100	57	35	66,12	100	9	44	52,94	40	16	-	33,34	90	10	-	26,11	70
Zusammen	20	-	100	-	52	61	100	-	86	24	99,76	-	17	23	99,97	-	48	-	100	-	36	-	100	-

Beilage 5

Sammelstellen (Nr. 3., 7., 10., 12., 15., 20., 21., 22., 23., 48., 52., 54) von den Ufern der Tisza (siehe: Beilage 2-3.)

Nr.	Art	3.				7.				10.				12.				15.			
		S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%
1.	Succinea putris L.	1	100	5,00	10	21	25	22,10	90	10	-	26,10	60	9	11	45,00	50	1	100	20,00	10
2.	Succinea oblonga Drap.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	20,00	10
3.	Succinea oblonga var. elongata A. Braun	4	-	20,00	30	4	-	4,21	30	-	-	-	-	-	-	-	-	-	-	-	-
4.	Succinea pfeifferi Rossm.	-	-	-	-	2	50	2,10	10	-	-	-	-	-	-	-	-	-	-	-	-
5.	Cochlicopa lubrica C. F. Müll.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	Pupilla sterri carpathica Kim.	-	-	-	-	1	-	1,05	10	-	-	-	-	-	-	-	-	-	-	-	-
7.	Vallonia costata O. F. Müll.	1	-	5,00	10	2	-	2,10	20	-	-	-	-	-	-	-	-	-	-	-	-
8.	Vallonia pulchella O. F. Müll.	-	-	-	-	34	5	35,70	90	-	-	-	-	-	-	-	-	-	-	-	-
9.	Vitrea jetschini Kim.	-	-	-	-	3	33	3,15	20	-	-	-	-	-	-	-	-	-	-	-	-
10.	Perpolita hammonis Ström.	-	-	-	-	4	50	4,21	40	-	-	-	-	-	-	-	-	-	-	-	-
11.	Zonitoides nitidus O. F. Müll.	-	-	-	-	9	22	9,45	50	13	84	33,93	60	9	42	45,00	60	1	-	20,00	10
12.	Limax maximus L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100	20,00	10
13.	Agriolimax agrestis L.	-	-	-	-	5	40	5,25	30	1	100	2,61	10	1	-	5,00	10	-	-	-	-
14.	Monachoides rubiginosa A. Schmidt	-	-	-	-	17	12	17,85	70	12	41	37,32	80	1	-	5,00	10	1	-	20,00	10
15.	Monachoides vicina Rossm.	-	-	-	-	2	100	2,10	10	-	-	-	-	-	-	-	-	-	-	-	-
16.	Helix pomatia L.	14	7,14	70,00	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Zusammen	20	10	100	-	95	21	100	-	36	47	99,96	-	20	15	100	-	5	40	100	-

Nr.	Art	21.				22.				23.				48.				52.			
1.	Succinea putris L.	-	-	-	-	1	-	1,92	10	-	-	-	-	-	-	-	-	-	-	-	-
2.	Succinea oblonga Drap.	-	-	-	-	3	33	5,75	20	15		17,40	80	5	-	29,41	30	31	-	64,68	100
3.	Succinea oblonga var. elongata A. Braun	6	-	30,00	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	Succinea pfeifferi Rossm.	-	-	-	-	-	-	-	-	-	-	-	-	3	-	17,62	20	-	-	-	-
5.	Cochlicopa lubrica O. F. Müll.	4	-	10,00	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	Vallonia pulchella O. F. Müll.	1	-	5,00	10	4	25	7,68	30	-	-	-	-	-	-	-	-	-	-	-	-
7.	Perpolita hammonis Ström.	-	-	-	-	1	-	1,92	10	-	-	-	-	-	-	-	-	-	-	-	-
8.	Zonitoides nitidus O. F. Müll.	5	-	25,00	30	2	-	3,84	20	14	7	16,24	80	-	-	-	-	-	-	-	-
9.	Limax maximus L.	-	-	-	-	2	100	3,84	20	-	-	-	-	-	-	-	-	-	-	-	-
10.	Agriolimax agrestis L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2,08	10
11.	Monachoides rubiginosa A. Schmidt	4	-	20,00	30	39	71	80,80	100	57	35	66,12	100	9	44	52,94	40	16	-	33,34	90
	Zusammen	20	-	100	-	52	61	100	-	86	24	99,76	-	17	23	99,97	-	48	-	100	-

Beilage 6

Sammelstellen (Nr. 55., 56., 57., 59.), von den Ufern der Tisza (siehe: Beilage 2-3.)

Nr.	Art	55.				56.				57.				59.			
		S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%	S	juv. %	D%	C%
1.	Succinea oblonga Drap.	12	-	58,16	70	35	40	53,19	100	4	50	36,36	30	28	-	45,92	70
2.	Succinea putris L.	-	-	-	-	1	-	1,51	10	-	-	-	-	-	-	-	-
3.	Succinea pfeifferi Rossm.	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1,55	10
4.	Vallonia pulchella O. F. Müll.	-	-	-	-	-	-	-	-	-	-	-	-	13	-	19,89	90
5.	Zonitoides nitidus O. F. Müll.	1	-	4,76	10	4	-	6,04	20	1	-	9,09	10	2	-	2,06	20
6.	Agriolimax agrestis L.	3	-	13,28	30	-	-	-	-	-	-	-	-	1	100	1,53	10
7.	Monachoides rubiginosa A. Schmidt	5	-	23,80	40	26	-	46,81	90	6	-	54,54	40	19	-	29,07	90
	Zusammen	21	-	100	-	66	21	100	-	11	18	99,99	-	64	1	100	-

auch über eine höhere Artenzahl — als die Zönosen der Flussufer mit ihrer hier ebenfalls hohen Artenzahl. Die ruderalen Zönosen des Inundationsraumes weichen weniger von den anderen Zönosen des Inundationsraumes ab als die an den Ufern befindlichen.

Aus dem Vergleich erhellt, dass die Zönosen des Inundationsraumes sich von denen der Flussufer durch die abweichenden Umstände ihrer Siedlungsstellen unterscheiden.

Die Zönosen aus dem Inundationsraum habe ich aus verschiedenen Vegetationen eingeholt. Die Unterschiedlichkeiten der Flanzenzönosen kommen im allgemeinen den Unterschiedlichkeiten der Schneckenzönosen gleich. Die von den Ufern der Tisza und ihrer Nebenflüsse stammenden Schneckenzönosen kamen meistens aus den verschiedenen Bodenvegetationstypen der Weidenbestände zum Vorschein.

An den Ufern und Flussbettkanten der Tisza leben Zönosen mit nideriger Artenzahl (1—5 Arten), (Sammelplätze 10, 12, 15, 21, 22, 23, 24, 25, 26, 31, 39, 48, 52, 54, 55, 56, 57 und 59). An den Ufern der Nebenfülsse fand ich an der Unteren und Mittleren Strecke aus 2—9 Arten aufgebeute Zönosen, während am Oberen Flusslauf — oberhalb von Tokaj solche mit 4—19 Arten vertreten waren (Sammelplätze 94, 95, 96, 97, 102 bzw. 89, 91, 92 und 93). Ähnlich wie die Artenzahl gestaltet sich auch die Individuenzahl. An der Oberen Tisza kann sie bis zu 120 erreichen. Am Uteren und Mittleren Flusslauf ist in feuchten Umgebungen — z.B. am Ufer nach der Einmündung des Sajó — ein Anstieg auf 86 möglich, im allgemeinen werden aber 50 nicht überschritten. An den Ufern der Nebenfülsse der mittleren unteren Strecke bewegt sich die Individuenzahl zwischen 5 und 52 und an der oberen zwischen 27 und 974. In den feuchteren Umgebungen, so vor allem an der Oberen Tisza, nimmt die Zahl der juvenilen Individuen zu. Individuenzahl, Artenzahl und juvenlie Individuenzahl steigen von der Einmündung des Sajó in die Tisza ab aufwärts an.

Die Zalh der zönosebestimmenden, konstant-dominanten Arten beträgt an den Ufern der Tisza und ihrer Nebenfülsse an den mittleren und unteren Abschnitten 1 oder 2. Bei den artenreicheren Zönosen der Nebenflüsse steigt die Zahl der kondominanten, konkonstanten Arten an. Die konstant-dominanten Arten gehen aus den Mitgliedern der Grundfauna hervor, d.h. aus den in mehreren Zönosen häufig vorkommenden Arten mit hoher Charakteristik. Solche sind: *Succinea oblonga, Succinea putris, Succinea pfeifferei, Cochlicopa lubrica, Vallonia pulchella, Zonitoides nitidus* und *Monachoides rubiginosa*. Die beiden *Agriolimax*-Arten werden selten zu Leitarten der Zönose.

Bei den uferlichen Zönosen zeigt sich — ähnlich der Arten- und Individuenzahl, sowie des juvenilen Individuenprozentsatzes — eine territoriale Separation auch in den durch die Arten charakterisierten Synusientypen. Im Bereich der Unteren und Mittleren Tisza — etwa bis Tiszalök — sind *Succinea oblonga* und *Monachoides rubiginosa* die leitenden Arten der Synusien. Stellenweise erscheint die mit *Zonitoides nitidus* und *Succinea oblonga* vikariierende Art: die *Succinea pfeifferi*. Am oberen Flusslauf der Tisza übernimmt *Succinea putris* die Rolle der *Succinea oblonga*. An diesen Strecken können auf Grund ihrer Häufigkeit *Succinea putris* — *Monachoides rubiginosa* und *Cochlicopa lubrica* unter den konstanten Arten hervorgehoben werden. *Cochlicopa lubrica* kann durch die *Vallonia pulchella* vertreten sein. In anderen Fällen können auch *Carychium minimum* und *Vitrea crystallina* zu Leitarten werden. Die letzteren Arten werden auf den feuchten detritusreichen Gebieten konstant. Die Synusien des Oberen Tiszalaufes sind durch ihren Artenreichtum und auch durch die grössere Zahl von Characterarten gekennzeichnet.

Während meiner Sammlungen kamen aus den verschieden intensiv beschatteten Quadraten unterschiedliche Individuenzahlen zur Beobachtung. An den Flussufern sind Schnecken meistens an den Stengeln und Wurzeln von Pflanzen anzutreffen. Die in den Quadraten häufig wiederkehrenden Individuenzahlen waren 2—4—5—8.

Die Sukzession der Zönosen

Die an den Flussbettkanten und Flussufern anzutreffenden Zönosen sind territorial hinsichtlich ihrer Arten- und Individuenzahl sowie der prozentuellen Beteiligung juveniler Individuen und der Synusiumtypen verschieden. Diese Abweichung entspricht lokalisationsmässig der unteren, mittleren und oberen Strecke der Tisza.

Die Jaccard-, Rekonnen- und Kulczynski-schen Identitätsziffern zeigen laut Literaturangaben die allgemeine Versorgtheit der Zönosen an. Die Identitätsziffern habe ich unter Berücksichtigung sämtlicher an den Zönosen beteiligter Arten errechnet. Die Berechnung der intersynusialen Identitätsziffern habe ich entsprechend der bei den Zönosen beobachteten territorialen Separation durchgeführt. Auch die so erhaltenen Zahlen bilden drei verschieden grosse Gruppen. Am einheitlichsten und höchsten sind die Identitätsziffern am unteren Flusslauf, wo die Artenidentität zwischen 40 und 75%, die die Dominanz identität zwischen 42 und 98% und die Konstanzidentität zwischen 0,50 und 1,4 schwankt (Sammelstellen 52—59). Zwischen den Zönosen des mittleren (Sammelstellen 21—48) und des oberen Tisza-Abschnittes (Sammelstellen 3—20) ergeben sich davon abweichende Werte. Im mittleren Flusslauf der Tisza resultierten Jaccard-sche Zahlen von 50—66%, Rekonnen-Zahlen von 40—45% und Kulczynski-sche Zahlen von 0,50 bis 0,68. Am oberen Fluss-Gebiet sind Artenidentitätsziffern zwischen 33—50%, Dominanzidentitäten zwischen 41—53% und Konstanzidentitäten zwischen 0,10 und 0,35 am häufigsten. Dei Charakterstiken der ruderalen Zönosen an den Fundorten 31, 39 und 3 verschlechtern die Identitätswerte stark.

Ich habe die Zönosen der einzelnen Areale auch miteinander verglichen (was etwa 1400 Berechnungsoperationen bedeutet). Auf Grund der Identitätsziffern lassen sich die Beziehungen der territorial unterschiedlichen Zönosen zueinander feststellen. Bei der Ermittlung des gegenseitigen Verhältnisses der Zönosen habe ich nur die 50% überschreitenden Arten- und Dominanzidentitäts- sowie die 1,0 nahekommenden oder übersteigenden Konstanzidentitätsziffern berücksichtigt. Die in Anbetracht der Territorialität so in Beziehung zueinander getretenen Zönosen veranschaulicht Beilage 4. An der Beilage sind das Obere, Mittlere und Untere Tisza-Gelände durch eine doppelte Linie getrennt. Im Oberen Tisza-Gebiet sind die Zönosen der Tisza- und der Nebenflussufer gesondert angeführt. In Rechtecken sind die Synusientypen und mit eingekreisten Ziffern die Sammelplatznummern angegeben. Die nicht eingekreisten Zahlen bedeuten die Artenzahl der Synusien. Die Zusammenstellung spiegelt auf Grund der Identitätsziffern das Anwachsen der Artenzahl der Zönosen von der unteren Flusstrecke aufwärts. (Der Artenzuwachs an den Ufern der Nebenflüsse im Oberen Flusslauf ist ein intensiverer.) Beilage 4 ist auch zu entnehmen, wie die Leitarten der Zönosen in Richtung des feuchteren Oberen Tiszagebietes wechseln. Diese Veränderung wird angesichts des Klimatischen Atlasses von Ungarn verständlich. Das trockenste Gebiet der Tisza ist der mittlere Flusslauf unter- und oberhalb von Szolnok. Auf dieser Strecke sind vorwiegend die durch *Monachoides rubiginosa* charakterisierten Synusien anzutreffen. In den stellenweise feuchteren Gegenden können auch *Succinea pfeifferi* oder *Zonitoides nitidus* zu Charakterarten werden. An der unteren Flusstrecke sind die feuchtesten Areale bei den Sammelstellen 56 und 59 zu finden. Über die höchste Konstanz und Dominanz verfügt hier die feuchtigkeitsliebende *Succinea oblonga*. An den trockneren, weniger beschatteten Stellen ist das Trockenerwerden durch die zunehmende Charakteristik der *Monachoides rubiginosa* angezeigt. Den Prozess der Trocknung bringt an Beilage 4 dere von dem *Succinea oblonga-Monachoides rubiginosa-Vallonia pulchella*-Synusien-Typ zum Synusium-Typ der Sammelplätze 96, 22 und 39 mit *Monachoides rubiginosa* führende Weg zum Ausdruck. Die ruderale Zönose am Sammelplatz 31 kam infolge Abwertung eines feuchteren Areals (Waldrodung) zur Entstehung. Das Reicherwerden der Umgebung an Pflanzenbeständen drückt die Gestaltung der Zönosen an den Fundorten 10—12—97 und 15 aus. Von Tokaj aufwärts in nördlicher Richtung macht sich der Einfluss der immer feuchter werdenden Umgebung auch an den Zönosen der Ufer der Nebenfülsse bemerkbar. Die Zahl der Arten an der nördlichst — an der Szamos — gelegenen Sammelstelle 89 steigt auf 19.

Einen ungewissen Übergangsplatz nehmen auf Grund der Identitätsziffern die Fundorte 25, 26 und 94 ein, deren *Zonitoides nitidus*-Synusien einen Übergang zu den mit gestrichelten Pfeilen markierten Zönosentypen zeigen. Ich halte für wahrscheinlich, dass diese artenärmere Zönose auch aus mehreren Zönosen zustandekommen kann und einen post-degradativen, mit der Besserung der Umstände eintretenden Zustand spiegelt.

An Beilage 4 zeigen die zwischen den Synusien auf Grund der Territorialitäts- und Identitätsziffern umrissenen Beziehungen die Sukzession der Schnekkengemeinschaften an. Diese Sukzession verläuft — horizontal — in einer annähernd gleichen Vegetations-Association, sie ist induziert durch klimatische Ursachen (seihe Klimatischer Atlas Ungarns).

Die in der Sukzession teilnehmenden Synusien habe ich folgendermassen klassifiziert: Die Synusien entlang des Mittleren und Unteren Tisza-Tales (Sammelstellen 21—24, 52—59, 31, 39, 48 und 102) bilden auf Grund ihrer in zönologischer Affinität stehenden Arten und der weitgehenden Übereinstimmung ihrer Identitätsziffern ein *Succinea* *oblonga-Monachoides rubiginosa* — Malako-Sozion und die Synusien der Sammelstellen 10—12—97—15 ein *Succinea putris-Monachoides rubiginosa*-Sozion. Die im Oberen und Mittleren Tisza-Gebiet gefundenen Synusien (der Sammelplätze 7, 19, 20, 25, 26, 89, 91—94) beurteile ich als in ein *Cochlicopa lubrica-Succinea putris-Zonitoides nitidus-Monachoides rubiginosa*-Sozion gehörig. Die namengebenden Arten dieser Sozione stehen miteinander in zönologischer Affinität und kommen im ganzen Gebiet der drei Sozione vor, weshalb ich die drei Sozione zu einer *Succinea oblonga-(Succinea putris)-Cochlicopa lubrica-Monachoides rubiginosa*- Malako-Assozion-Kategorie vereint habe. Die angeführten Sozione stehen in Sukzessions-Beziehung zueinander. Bei der Benennung deuten die Klammern die *Succinea oblonga* vikariierende Art an.

Zusammenfassung

In den *Bidention*- und *Salicetum*-Vegetationszonen der Uferhänge und Flussbettkanten leben — territorial separiert, hinsichtlich ihrer Zönosen aber identifizierbare — Schneckenarten. Die Gestaltung der Schneckengemeinschaften untersteht dem Einfluss des Bodens, der klimatischen Exposition, der Vegetation und ihrer Schattenwirkung, den Wasserspiegelschwankungen, sowie dem Aufbau-, Korrosions- oder neutralen Gepräge der Ufergelände. Die Schneckenzönosen der Uferzonen und Flussbettkanten füllen daher den Raum nicht einheitlich und zusammenhänged aus, sondern finden sich an den einzelnen Uferstrecken mosaikartig, isoliert. — Infolge der die Ansiedlung hemmenden Faktoren ist die Gebietszone zwischen dem Wasser und der Flussbettkante der Tisza gekennzeichnet durch eine grosse Ärmlichkeit an Lebewesen und so auch an Schnecken.

Es sind 22, vornehmlich ubiquistische Arten zum Vorschein gekommen, de ich in Anbetracht ihrer Häufigkeit als Grundfauna bezeichne.

Entlang der ganzen Tisza ist an den Ufern und Flussbettkanten in den verschiedenen Bodenvegatationstypen der Weidenbestände ein in dreifacher Sukzessionsbeziehung stehendes Sozion des *Succinea oblonga-(Succinea putris)-Cochlicopa lubrica-Monachoides rubiginosa*-Malako-Assozions anzutreffen. Die horizontale Sukzession der Schneckenzönosen ist durch die verschiedenen klimatischen Abweichungen entlang der Tisza bedingt. Territorial ist die Sukzession auf Grund der Arten- und Individuenzahlen, des Individuenprozentsatzes der Juvenilen und der Identitätsziffern der Zönosen gut separierbar (Beilage 4).

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INVESTIGATION OF BROWN RATS (RATTUS NORVEGICUS NORVEGICUS BERKENHOUT 1769) LIVING IN THE TISZA DAMS, WITH A VIEW TO FLOOD PREVENTION

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The dams along the Tisza are strongly damaged by the gnawing of small mammals. My present investigations have been carried out on a dam sector close to Szeged, strongly damaged by the activity of these mammalia. In the course of my work, recommended by the town council of Szeged and directed by the National Office of Water Conservancy, I have obtained valuable assistance from the above mentioned organizations. I wish to express my thanks here to water specialists Mihály Bokor and Dr. István Vágás for their kind help afforded to me during my investigation.

Site, time, method of the investigation

The investigation was carried out on the dam between the segments 11+943—12+243, at the left bank of the Tisza. Apart from them, it comprised also the 20—20 m strips, on both sides along the dam, as well as the field at the inundation side of the dam till the line of a ditch running behind the old protective willow wood (Salix) and, on the protected side, the area of Works No. 2 of the Granaries of County Csongrád. My work was carried out from August 15 till October 15 1967. The small mammals living in the sector investigated were collected with traps. I have worked with 100 traps set in the form of a 1,5$\times$1,5 m square net. 50 p.c. of the traps were baited with parsley roots, the other 50 p.c. with greasy meat a little stewed. In the mole-holes of the dams I have set five traps. The 100 traps mentioned were the common flat mousetraps, got in the trade, with the so-called beating system. From the great number of brown rats living in the dam I have collected some also by air-gun, watching the brown rat specimens living in the dam with field-glass and naked eyes, as well. For investigating the mammalian holes in the dam, I have opened 11 research ditches together, exploiting in each case 2—6 cubic metres of earth. (Tools used were: pick, spade, shovel and a bit brace.)

General characteristic of the area

In the time of the investigation the weather was rainless, dry. The material of dam is solid, yellow clay, picked with difficulty.

The vegetation of the dam sector consists of gramineae of law growth. On the two sides of the dam I have found mammalian populations differring from each other both in quantity and in quality. On its inundation side, the dominant ones are: *Microtus arvalis* Pall., *Crocidura leucodon* Herm. being subdominant; then *Mus musculus spicilegus* Petényi, *Rattus norvegicus norvegicus* Berkenhout. On the protected side, there occurred mainly specimens of *Rattus norvegicus norvegicus* Berkenhout. According to my estimations, the specimen number of brown rats living here may surpass even 1000. On the protected side there are living two more species: *Citellus citellus* L., *Talpa europaea* L. but only in very low number. Apart from the dominant and subdominant species of the inundation side, I could ascertain the occurrence of six species more. These are as follows: *Sorex araneus* L., *Citellus citellus* L., *Erinaceus europaeus roumanicus* Bar-Ham., *Apodemus sylvaticus* L., *Apodemus flavicollis* Melch., *Talpa europaea* L.

As observed, problems of flood control are raised in the dam sectors where some mammalian species bred rapidly. This breeding causes the regression of other species. At present, on the protected side of dam, the problem of flood control was caused by the rapid breeding of brown rats. Their multiplication can be explained by the optimum of ecological factors. (Granaries at the foot of dam, a dam higly suitable for building holes, absence of natural enemies.)

Analysis of activity of the brown rats living in the dam

In this country — as I am informed — this was the first case that we could observe a major damaging activity of brown rats in the inundation dam of the Tisza at Szeged. In the future, we have to take

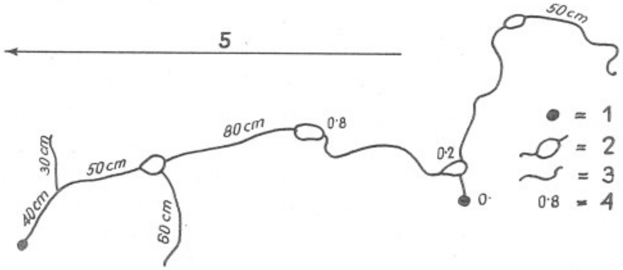

Fig. 1. Ground-plan of the burrows of brown rats in the inundation side of the dam.
5 Longitudinal axis of the dam
1 entrance opening
2 nest
3 hole
4 0,8 m depth points

this activity into account in an increased degree as this small mammalian species keeps spreading along the Tisza. This spread is in close connection with the great change that is at present carried out in the Tisza basin. (Barrages, campings, etc.)

The brown rat builds its hole scratching in the dam. The size, site and depth of these holes have a decisive influence on the resistence of dam during inundation. From the point of view of flood control it is therefore important to know the exact location and size facts of the holes scratched into the dam. On the surface of dam, the openings of holes can well be observed. On the inundation side, 91 percent of the entrance openings can be found in the upper one-third part of the dam. This is to be explained with the quick, immediate gushing out effect of the inundation waves. On this side I have noticed as many as 25 dwelling openings. On the opposite side, however, I could count 1800 rat's hole. From them about 1000 were in the 0—2 m strip of the foot (foundation) of dam, about 300 between 2—6 metres. In the strip close to the top of dam (6—8 m) there were about 500 openings.

The diameter of entrance holes is 7—9 cm. Their environment is covered with dredged earth and dirt. Among the holes run the much used small paths of rats. This path net converges into 1—1 major path, some of them leading partly to the inundation area, partly to the granaries.

The brown rats move in the daytime but in low number, in the twilight, however, they show themselves in masses. Then they go on the paths to the granaries for food. In the morning twilight I have also observed a movement of opposite direction of rats as they consume the sapful plants, the crop of blackberry in the holes of inundation area and at the riverside.

In the dam side at the inundation area I have opened three research ditches. Here opened the holes in three metres distance from the top of the dam, being only 0,8—1 m deep. One hole-dwelling divides into branches in an area of 2—3 sq.m, and two of them were not connected with each other. The direction of holes is parallel with the longitudinal

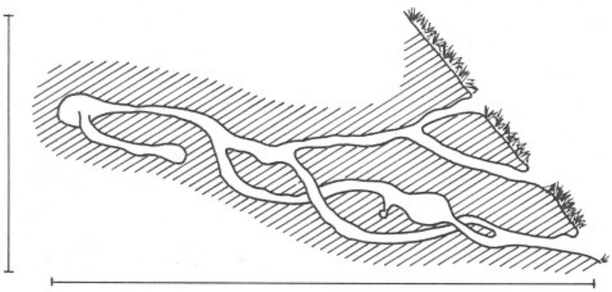

Fig. 2. Drawing of the burrows of brown rats in the foot zone of the protected side of the dam.
Surface of the slope
Nests full of crumbs

axis of the dam. The diametre of the net holes is 20—25 cm, they have a mildly flattenned spherical form. They are lined with dry gramineae, in two of them I have also found corn-cobs.

The brown rat holes in the inundation side are not at all so dangerous from the point of view of flood prevention as those in the protected side, as they do not go deep. Their presence can, of course, not be tolerated here, either, because the wide holes can get eroded at inundations.

In the protected side of the dam I have opened a ditch system in eight places. Here did the brown rats damages first of all only at the foundation of dam (0—2 m) and at the edge of the top of dam (6—8 m), while in the middle zone (2—6 m) I have found but a low number of holes. The rats' holes here have one main entrance, and one side entrance or two, covered with clumps of grass.

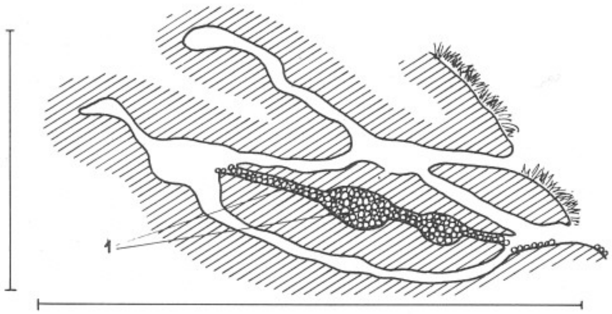

Fig. 3. Burrows of brown rats, the nests, holes filled up with crumled soil being indicated.

The holes in the zone of the dam foot (0—2 m) were all leading in a smaller or greater angle upwards in the body of dam. As explored, they were running 2—2,5 metres long into the body of dam (at right angles to the longitudinal axis), never going deeper than 1,2—1,4 m below the surface. Cp. Fig. 2.

I have explored here also two holes where beside the nests used there were some ancient nest holes, too, filled up with crumbled earth, dirt, etc. nearly fully. I have found also a hole system filled up. It seems so that the dredged earth material of great quantity of the new holes is scratched through into the old, deserted nests. From the point of view of the flood control this activity is very harmful. The number of holes filled up with crumbs is higher and higher in every year, and, besides the holes used, also these filled up holes contribute to the disintegration of the dam body, although it is apparently solid. From the surface conditions we cannot, and may not, ascertain, therefore, the degree of damage caused by the mammalian activity.

In the middle zone of the dam side (2—6 m) I could explore only short and not deep holes (0,8—1 m deep). Cp. Fig. 4. As I observed, these were holes of collective use, so-called escape paths. The brown rats, if they meet quickly some danger far from their own holes, are fleeing here. I have observed baglike escape places of wide entrance (15 cm diameters) like these in the parts of the inundation area with clearings, along the rats' ways, as well.

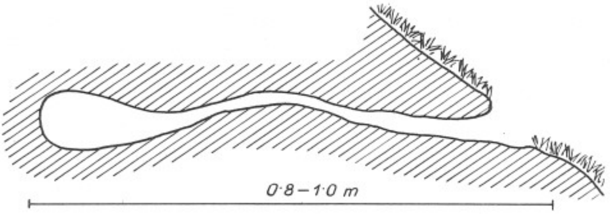

Fig. 4. Darwing of the so-called escaping places of collective use.

At the edge of the top of dam, the number of rat's holes is higher, again. They reach to 1 m depth in an area of 2 sq.m or so. Every hole consists of 2—3 nests and a path net connecting them.

The brown rats ,collected in the time of investigation in the dam with traps and air-gun, were all male ones. Female ones were caught between the double plank walls of the granary, as many as three specimens. In spring an summer also the female rats must live in the holes in dam, as shown by the large nests with the remains of food rings. At the nests encircled with food like these I have observed pass-out labyrinths of very narrow diameter in two cases. These pathways must be the result of hole-making activity of cub-rats as in these narrow holes the old rats could not pass.

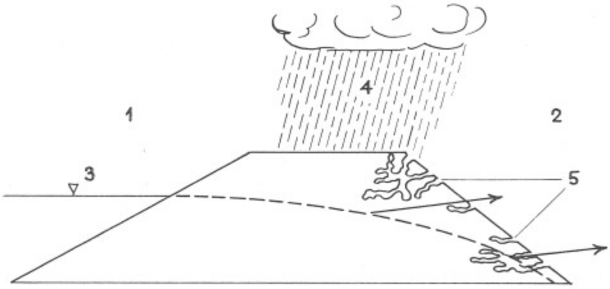

Fig. 5. The modifying effect of the burrows of brown rats upon the oozing curve.
1 Inundation side
2 Protected side
3 Flood level
4 Precipitation

The network of the holes of brown rats discussed above causes the destruction of dams in case of inundations. The shape of the oozing curve of the river water pressing the dam lastingly in case of an inundation wave is well known. Cp. Fig. 5.

This curve may not reach to the surface of dam anywhere because otherwise a bursting of the dam can occur. (Therefore the theoretical curve maximum is calculated with plus one metre safety height.) The holes of brown rats draw up this oozing curve, in case of inundation, prolongating it till the surface of the dam, particularly in the strip along the foot of the dam at the protected side, and then after oozing there may follow bursting or soil slip.

Another possibility, similarly dangerous from the point of view of flood control, may occur if an inundation wave is accompanied by a lasting raining. The holes, nests in the top of the dam and at its edge become drenched from rainwater. The oozing precipitation gets to the layer of the oozing curve and "drawing it upper" makes it straight, what again means "cutting it out". Cp Fig. 5.

The dwelling nests, holes and deserted cavities full of crumbs disrupt the resistance of dam. According to the law of communicating vessels, the water of large inundation waves endeavours to get a way upwards in the body of dam, too. An undamaged dam counterbalances this force of uprush well with its mass but it can do that only in a low degree if there are holes, loose parts inside the dam, as a result of causes mentioned above, there can be developed so-called internal springs in the dam body. In the history of flood prevention, the cause of several unexplicable dam burstings may have been the activity of small mammals that escaped notice.

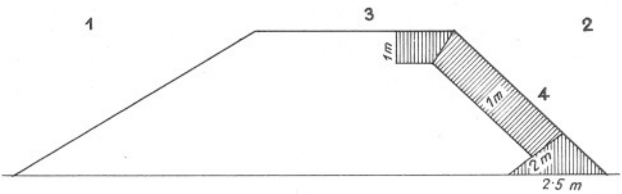

Fig. 6. Renovation of the damaged layer of dam.
1 Inundation side
2 Protected side
3 Top of the dam
4 "Infected" layer

Also the joint result of the activities of moles and brown rats can be dangerous. The moles escaping from the inundation area in time of floods make a great number of holes in the dam in a short time. (Mole progression!) One or more mole holes can reach to the parts of dams that are made loose by brown rats, in them oozing, water course can begin in case of high flood and, even if the dam did not get soaked through, a qucik bursting can occur, widening in a few moments.

The part of dam where my present investigations were carried out (11+943—12+243) is demanding urgent renovation. On the protected side of the dam, the soil stratum "infected" by the holes of brown rats is to be removed and replaced with earth material compact enough. Cp. Fig. 6.

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