RESULTS AND TASKS OF THE FIFTEEN YEARS OLD TISZA RESEARCH

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The organized Tisza research was set in action in 1957 by Academician DR. GÁBOR KOLOSVÁRY, Professor of General and Systematic Zoology at the Attila József University, Szeged. Academician Kolosváry was not only organizer and leader of these investigations but also their active research worker until his death in 1970.

In the first years, the members of the Tisza Research Association organized expeditions and investigated the whole Tisza region in Hungary. As a result of that work, a good survey has been achieved about the natural history of the Tisza and of its immediate environment.

It would be difficult to give a brief but complete survey of the results of thi 15-year research work. We would like only to characterize, by means of a few examples, how complex and many-sided research work has been carried out by the members of the Tisza Research Association.

A map of the Middle and Lower Region of the Tisza was drawn by researchers dealing with water chemistry, Protophytes, and Protozoa floating in the water. The degree of water pollution and its influence on the unicellular organisms that determine the "self-purification" of a river were established. It is shown by these investigations that the micro-organisms of the Tisza are still able, at present, to „work up" the pollutions, that is to say, it is still a clear river. It was, anyhow, ascertained, as well, that in some places, intermittently, the pollution grows to dangerous proportions. We must take care, therefore, of the satisfactory waste-water purification, otherwise we cannot avoid the fate of the countries, where a great part of the rivers became a stinking sullage-pipe.

The increasing pollution of the environment, particularly that of air, was proved by the investigation of the distribution of lichens living in the inundation area of the Tisza. It can be established that approaching the great cities and industrial establishments we find fewer and fewer lichens as they are killed by the polluted air.

It is worht mentioning that much work has been devoted and money spent to clean the dams, built of stone, from lichens, although there wouldn't grow any lichens there if the stones were rubbed with tired oil.

In the course of the Tisza research, there was elaborated a grass-cover composition for serving the biological protection of dams. It was established what grass species were the most suitable for composing the grass cover of the dams of different soil and water-movement for making it the most resistant to the water-movement. The use of grass-covers was justified by the great inundation of the Tisza in 1970.

It is also important to record the soil-marking plants, indicating in the inundation area the stagnant waters left behind at the feet of dams that induce the danger of their thorough soaking.

The investigation of fish food and fish life is one of the most important topics of Tisza research, carried out in collaboration with the research workers of the Research Institute for Pisciculture at Szarvas. They elaborate the result of fishing, dealing with the causes of the decrease in the "fish population" of the Tisza. By means of marking the fish, they can follow the fish migration.

The researchers have dealt for years with preparing the introduction of fish into the water-basin formed out above the river barrage at Kisköre — at present, in process of construction — and they have dealt also with the prospective development of the quantity of natural fish food. The river-basin will play an important part, among other things, in increasing the stock of fish in the Tisza, as well.

The backwaters along the Tisza are very important places of fish-breeding in the Great Hungarian Plain. The Association is dealing, therefore, with exploring the causes of fish perdition occuring in the backwaters from time to time. They have elaborated a procedure for preventing the mass poisoning of fish as a result of the hydrogen sulphide production induced by the changes in the weather.

It is generally known that the application of plant-protecting agents means more and more a world-wide problem in respect of water pollution.

The importance of the so-called biological protection is emphasized, therefore, more and more. Opposite to the insect, mouse and other rodent parasites of the agricultural areas along the Tisza, the avifauna of the woods in the inundation areas along the whole Hungarian Plain has a considerable — although, unfortunately, more and more decreasing — part. That has got the Association of Tisza Research to deal also with the problem of the artificial bird-introduction and the practical implementation of that, as well.

The investigation of the bank swallows along the Tisza has led to results connected with public hygiene.

The nest-groups of this sociable bird species were studied along an about 600 km region. It was established that the more times 10,000 birds nesting in the steep river walls played a part in the promotion of the undisturbed holidays along the Tisza. A large part of the food of bank swallows consists namely of gnats.

In respect of flood-prevention, there is important also the investigation carried out in connection with the elimination of the dammage induced by some small mammals — mouse, field-vole, rat, mole — deteriorating the dams. Examining systematically their way of life, their ducts, one tries to elaborate a process that decreases their number and, in that way, also the damages in dams.

One of the indispensable starting-points of the biological research is to know the climate of the area investigated. Therefore were established two meteorological stations by the Committee of Tisza Research, in the vicinity of the two intended water-basins at Kisköre. The data of these can be used not only for the present investigations but in the future, as well, representing, in this way, a considerable value as comparative material.

An important part of the task of the Tisza Reserch Association is the preservation of nature, endeavouring to preserve in an unchanged form the areas along the Tisza that are valuable in respect of the investigation or of holidays. Also this contributed to the fact that in the recent past the approximately 30 km Tisza region between Mártély and Sasér was declared a nature conservation area.

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In the autumn of 1971, the Committee of Tisza Reasearch elaborated the long-range (15 years) research plan of the Association. On the basis of that, the Tisza research became more and more concentrated on two areas, taking into consideration the social demands, as well.

One of these areas is the Tisza region between Tiszafüred and Kisköre where river barrage "Tisza II" is in process of construction. The second one is the nature conservation area between Sasér and Mártély. The research work carried out in these areas will be completed during the 15-year plan with a third area, as well: the environment of Csongrád. According to that plan, namely, the river barrage "Tisza III" will be built there.

The Association of Tisza Research is striving for carrying on a complex research work with the participation of meteorologists, water-chemists, botanists and zoologists as well as of practical specialists. This complex research work is referred to by the title of the research topics, as well:

"Natural geographic, hydrobiological, zoo- and phyto-ecological investigations,

(1) in the area of river barrage "Tisza II",
(2) in the area of the nature conservation district Sasér—Mártély,
(3) in the area of Csongrád."

(1) In the area of river barrage Tisza II

The artificial lake of a surface 200 sq. to be formed above the water barrage is a remaking of nature in such a degree that is a case without parallel in Hungary. As it is to be expected, it will influence in a considerable degree the natural geographic conditions of the adjacent areas — first of all the so-called local climate —, the plant associations and their organic matter production, too, as well as the animal kingdom. It will be an important task to profit of the opportunity provided by this enormous "field experiment" as well as possible for analysing the regularities of the connections between the living being and its environment and for promoting the solution of practical programmes (increase in fish output, formation of holiday centres, etc.).

As a result of the investigations started three years ago, the fact-finding investigation of the present state has already taken place, both in hydrobiologic and in botanical or zoological respects. These mean a comparative basis for comparing the changes to be as a result of remaking the nature. In two stations, also a continuous meteorological observation has begun.

In the course of investigations, in the future, we will start from the conception:

(a) of character and degree of the effect exerted by the artificial lake as a water eco-system upon the local climatland other natural geographic conditions,
(b) of character and degree of the effect exerted by it upon the adjacent terestrial eco-systems, and
(c) of the formation of the biological equilibrium of the water-basin as an artificial eco-system.

Corresponding to this triple programme, the following investigations are outlined by the Association of Tisza Research:

(a) Continuous meteorological observations at minimum two states. Microclimatic investigations in the water and terrestrial biotops marked out for that purpose. (Minimum one water and three terrestrial biotops).

(b) Synecological investigations in the natural plant associations of meadows and pasture lands (stand structure, production, etc.), at least in three biotops. Zoo-ecological and population-dynamic investigations touching every major taxonomic category, at least in three biotops.
(c) Water-chemical investigations (water pollution, bacteriology), at least in one water biotop.

Investigation of phyto- and zooplankton and of benthos. Investigation of the food-chain from planktons till fish.
Apart from the results at the level of basic research, the investigations endeavour to give help connected with the following problems, as well:

Nature conservation,
Flood-prevention,
Biological protection,
Construction of holiday centres,
As good agricultural exploitation as possible of the adjacent areas,
Augmentation of fish production.

(2) In the area of the nature conservation disrict between Sasér and Mártély

In the course of the formation of river barrages in the Tisza, the natural primary environment is more and more transformed. The transformation of these parts that are nice even as landscapes is meaning a heavy loss in nature conservation. It is therefore an important task to reconstruct the nature conservation area between Sasér and Mártély as prescribed by the order of the National Office of Nature Conservation. The Association of Tisza Research endeavours to promote also this nature conservation reconstruction with investigations scheduled for this area.

The research work between Mártély and Sasér, started in 1971, is justified also by that it is approaching Szeged, the centre of the Association of Tisza Research (where about 50 per cent of the investigators are working), making possible even continuous investigations by means of frequent visits to the scene.

The research work intended in this area is justified, *in tertio*, also by that here, in the early 1950s, a detailed plant geographic survey was carried out. That — as a basis for comparison — enables us to estimate the doubtless considerable anthropogenic effect exerted in the last two decades. From that it can be established, too, what the primary aim of human intervention is to be in the future, for carrying out the reconstruction of the region in as short a time as possible.

It follows from the programme outlined, as well, that the investigations in this area must be performed not only in the living Tisza but in the inundation areas, as well, and moreover in the backwaters of the Tisza that are aesthetically beautiful and for the people pleasant, too (e.g., the importance of establishing holiday centres in the vicinity of Szeged).

The research programme of the Association of Tisza Research in this area is the following:

(1) Water-chemical, phyto-zooplankton and benthos investigations in the backwaters as natural biotops.
Investigations of the food-chain for increasing fish production.
Self-purification of the backwaters.

(2) Syn-ecological investigation of the meadows, grass-lands and woods, as well as that of comparative production.
(3) Zoo-economical and population-dynamical investigations with special regard to the reconstruction of the bird-populations.
(4) Local and microclimatic investigations of the meadows, grass-lands and woods in the inundation areas. (Taking into consideration also the requirements connected with the allocation of recreation areas).
(5) Comparative water-chemical and production-biological investigations in the living Tisza.

(3) In the area of Csongrád

The aim of the investigations is:

(a) A precise summing up investigation of the present natural geographic and biological state in the place of the intended river barrage at Csongrád.
(b) Starting from the phytogeographic surveying in the 1950s, an analysis of the changes that took place since then.
(c) Connected with the formation of the river barrage planned, calling the attention to the areas that mean a considerable value in respect of the protection of nature.

These aims approximately agree with the investigations planned in the area of Kisköre, therefore, also the research tasks are similar to those outlined in item 1.

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The Conference of Tisza Research, arranged yearly, every spring, plays an important part in coordinating the activity of the Association of Tisza Research that consists of 35 to 40 research workers, lecturers, and practical specialists. In this Conference, the members of the Association are reporting on the results of their research work, elaborating the plans for the next year. This considerably promotes the research work to be a collective cooperation, even if it is not carried out by the participants at the same time.

The most important results achieved in the course of the Tisza research are published by the Committee of Tisza Research, in the scientific review "Tiscia" appearing yearly, subsidized by the Hungarian Academy of Sciences. There have appeared, so far, six volumes of the Tiscia that have excited a great interest, even in international relations. That is shown, for instance, by that the Committee of Tisza Research receives more than 100 scientific publications appearing abroad in exchange for this publication.

The papers published possibly in another scientific publication in connection with the Tisza research are epitomized by the Committee of Tisza Research in the series "Tisciale Hungarica", established in the recent past. In this way, an easy survey of the most important scientific publications relating to the Tisza research could be provided, independently of where they were published.

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THE GREAT FLOOD IN THE TISZA BASIN IN 1970

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Abstract

In May and June 1970 an extraordinary flood passed through the Tisza and all the left-side tributaries of the Tisza. The highest flood levels recorded so far were overstepped at least in half metre order and in the tributaries in metre order and even in the order of more metres by the flood level. The inundation devastated in some regions, as known; causing catastrophic disasters.

The paper is establishing that the extraordinary hydrome teorological situtaions and the orographic data of the watershed area can be considered as a primary effect exerting the flood situation.

The series of current waves that developed in 1970 were characterized by that the water-movement of the rivers of the water system and the common order of the inundation periods differed from the regular ones accustomed to under average circumstances.

The movement of water in the Tisza is generally characterized by three flood waves a year.

1970 all that happened in another way. Until the end of April, five flood waves passed through the Tisza from the winter precipitation and thaw waters. The effect of that was still more increased by the influence of flood waves coming from further extraordinary rainfalls between May 11th and 14th and between May 22nd and 24th and later, in the course of June, by the influence of a last considerable flood wave.

In the first third of 1970, in the water system of the Tisza a fundamental hydrological situation came about the water loading of which could only disastrously increased in the months May and June. The climate of the watershed area was controlled, owing to a very strong atmospheric circulation, by regional cyclones. The clash of cold and warm fronts, air bodies of considerably different temperature, ensured favourable conditions for exerting in a short time precipitation of large water output.

Also the mutual effects of the surface formations of the watershed area may be connected close to the flood-inducing atmospheric processes. As a result of the ground relief, there fell sporadically a precipitation amount exceeding 100 mm in the water system of the Upper Tisza, Szamos, Kraszna, Tur, Batár, Lápos and Visó, between May 12th and 14th 1970.

It could be established that in the period May-June 15.5 cubic km precipitation amount fell on the watershed area belonging to the segment of the Tisza at Szeged of which, according to the recordings, 6.9 cubic km flowed through the segment at Szeged. That means that the ratio of flowing through was 44 per cent, considerably higher than the about 20 per cent average value of several years.

In May and June of 1970 an unprecedented flood descended down the Tisza and all its left-hand tributaries. The previously recorded highest flood-levels were exceeded by this inundation by in general at least half a metre, while in the upper reaches of the tributaries the waters rose a metre, and in some places several metres, higher than ever before. The outflow, accumulation and encounters of the large masses of water ridiculed all previous customary "regularities". In certain regions the inundation caused catastrophic damage. The inhabitants of many other settlements were kept in terror. The population of the country, however, urged themselves to heroic resistance, united against the dangers of this natural catastrophe, and spurred themselves on to effective action.

The natural causes which led to the flood situation in the river-system are now accurately known. The primary causes were the extreme hydrometeorological conditions, and also the orographic (i.e. the surface-relief) characteristics of the catchment area. Although the orographic factor is geographically accurately known, a completely reliable forecast can still not be given at present with regard to the occurrence in time and the qualitative and quantitative changes of the hydrometeorological factor. Calculations can be carried out on the basis of our experience, only as regards the frequency, and hence the probability of such occurrences, but the concrete time of their appearance can not be precisely determined.

The series of flood-waves in 1970 (and also the higher floods during the preceding one hundred years too) were generally characterized by the fact that the movement of the rivers of the system and the periods of the flooding differed from those corresponding to average conditions. According to the hydrographic regularities in the river-system, the water-movement of the Tisza is characterized by a possible three flood-waves:

Spring flooding: this results from the melting of the winter's snow or from the spring rains following this, and it takes place along the whole length of the river.

Summer flooding: this is known as the green-flooding, and follows the rains of May and June; it is usually no longer considerable in the Middle—Tisza and in most cases does not even reach the Lower-Tisza.

Autumn flooding: this is a rarer flooding, normally confined to the Upper-Tisza, and is due to the soft rainfalls resulting from the Mediterranean effect.

The simultaneity of the flooding of the tributaries of the Tisza is a fairly rare phenomenon. Although the flood-waves in several tributaries may begin simultaneously as a result of a common reason, due to the difference in their flow-times they are not discharged into the Tisza at the same time, and hence do not usually cause a maximum load there.

This regular water-movement, however, may often be considerably modified, since the precipitation on the water-catchment area is a phenomenon connected primarily with the period and not with a definite season. (Andó 1964) From the point of view of precipitation, the periods of the year can be divided by and large into two characteristic groups:

(i) a shorter, wet period (May-August), and
(ii) a longer, dry period (August-May).

There is no close connection between this time division and the periods when the rivers flood. The early spring flood and the high water-level of the rivers do not result from the amount of precipitation in the spring, but from the melting of the snow which has accumulated during the drier period. If the melting proceeds rapidly and further precipitation falls, the water-supply of the rivers may increase suddenly, and this may give rise to situations of the danger of flooding, either in certain areas or over the entire water-catchment region.

The early summer flood is a result of the precipitation period. In the knowledge of the annual precipitation-distribution of the river-system, the occurrence of flooding at the beginning of the summer can be taken for the most part as certain. At such time, however, the amount of water in the rivers varies considerably as a result, of the occurrence of precipitation and its evaporation. It frequently happens that the average water-supply of the rivers at the time of the early summer floods is less than in the period when the snow melts. Naturally, the extreme situation may also arise, when a considerable water-supply builds up on the catchment area and the rapidly descending waters produce catastrophic floods. This was the case with the flood situation which developed in May and June of 1970. In these months the weather was generally cool for the season, but the weather in the preceding months also differed from the usual.

The snow-cover had already developed on the river-system by the end of December 1969. However, on the action of the sub-tropical, moist air-masses which moved in at the beginning of January 1970 this almost completely melted. The high temperature of the air and the frequent rainfall led to complete melting in the river-system up to a height of about 600 m above sea-level. This melting resulted in the previously essentially frost-free surface soil becoming saturated with the melt-water; thus, the state of affairs had already developed in January that the water-capacity of the soil had been reduced to a minimum. From the middle of February until the first week of March the weather was again cold. The upper layer of soil earlier saturated with water became appreciably frozen, and so its water-permeability too decreased practically to zero. In higher regions relatively thick sheets of ice also formed on certain subsidiary catchment areas, and all this increased and accelerated the surface movement of the later precipitation to a considerable extent.

After the first week of March the rapid exchange and extreme variability of the air-masses produced unsettled weather in the Carpathian basin, and this led to a more rainy state than the average. From the struggle of the polar and the sub-tropical air-masses a more abundant precipitation can mostly be attributed to the sub-tropical air-masses. The spring floods too were caused in almost all cases by the precipitation and melting accompanying a sub-tropical air-mass. With the exception of North-west Transdanubia, the monthly precipitation totals throughout Hungary exceeded the many years' average. In many parts of the country a precipitation surplus of 100—200% developed, and in a considerable area it was even 200—300%. This was accompanied by serious problems regarding the inland waters. In the first half of March the precipitation fell for the most part in the form of snow, but in the second half of the month too snow-storms were observed, and of course heavy rainfalls were not rare either. In the main, air-masses of varying temperature, originating from the seas of the temperate zone, came into prominence, and these acted on the river-system as warm- and cold-fronts. As a result of this relatively rainy situation, together with the melting, the snow-cover of the Carpathian basin was appreciably depleted. By March 20 the melting-limit was already about 1700 m, and it subsequently never fell below 1200 m. At the end of March a (considerable amount, 50—80 mm, of rain fell on the) Upper-Tisza catchment area and caused a considerable mass of the snow-cover to melt. As a consequence of this, the Tisza flood-water at Tokaj on April 2 had already attained 751 cm.

The air-temperature in April was somewhat lower than usual. The monthly amount of precipitation was once more above the many years' average. In the wetter regions the precipitation surplus was again between 100 and 200%. Stormy weather too was frequent. Hail fell on the Great Hungarian Plain, and snow on the hilly districts. The catchment area came in turn under the effects of moderate air-masses and others originating from the Arctic Ocean. The effects of the many cold-fronts and the related cooling too increased the surface water-supply, since the extent of evaporation was lower than usual. The April temperature remained 0.4—0.5 °C below the average, and in May this difference became 2 °C even. These values alone indicate that cold air-masses predominated in the Carpathian basin.

During the first four months of 1970 in the Tisza river-system a hydrological situation arose, the water-load of which was increased to catastrophic proportions in May and June; these months normally belong among the rainier ones, anyway, but for the most part they turned out to be extremely wet. The precipitation which had fallen in the winter and spring had practically completely saturated the soil. At the same time, the snow still remaining was undergoing rapid melting. Because of the

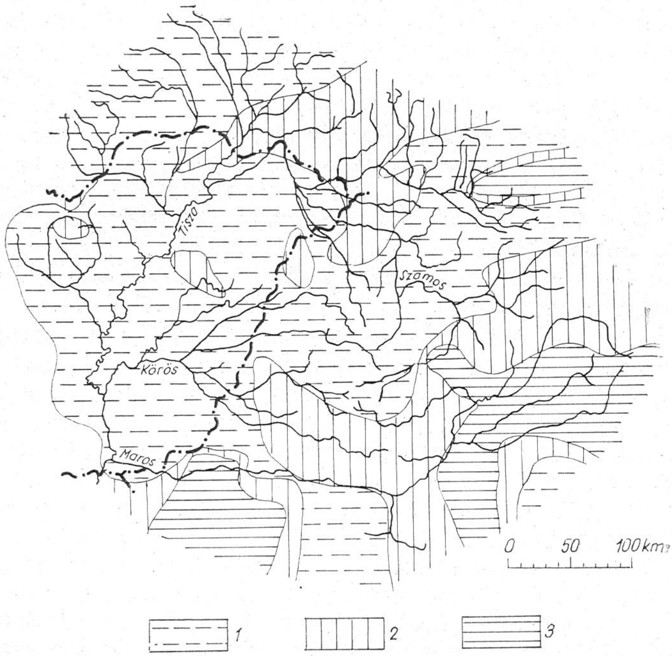

Fig. 1. Precipitation distribution, May 1—5, 1970 (pentad I).

extremely high moisture content of the air, evaporation was severely restricted, and indeed the evaporated water at best merely increased the cloud-formation. The beds of the water-courses were filled with the winter-spring ice-waters and they were restricted in their outflow. In this state, five very serious flood-waves descended down the Tisza up to the end of April, and as a result the May outflows were greeted by full beds. And, after all this, in May the precipitation was even higher than before.

As a consequence of the very strong atmospheric circulation, the weather of the catchment area in May was determined by regional cyclones. Cold- and warm-fronts, and the encounter of air-masses of very different temperatures, produced a condition favourable for the occurrence of a considerable precipitation in a short time.

The regional formation of precipitation in the river-system during May 1970 can be assessed on the basis of the effects of three types of air-mass:

1. Moderately cool air-masses originating from seas of the temperate zone gave rise to frontal rains following each other from the N. W.
2. Cold air-masses of polar origin, with strong turbulence, discharged locally extensive precipitations onto certain parts of the catchment area.

3. Warm air-masses (sub-tropical fronts) with centres of low air-pressure provided regionally-varying amounts of precipitation.

The atmospheric events in May, which resulted in catastrophic consequences, may be divided into pentads to give the following picture:

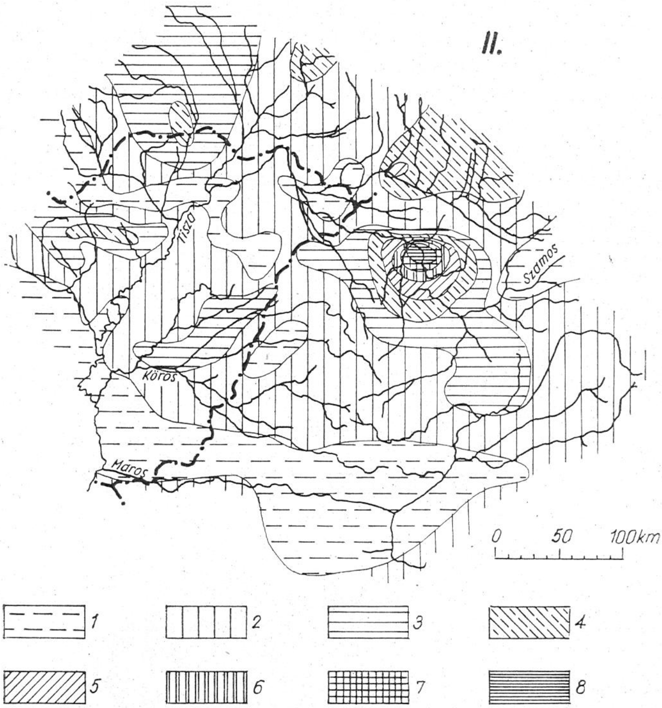

Fig. 2. Precipitation distribution, May 6—10, 1970 (pentad II).

Pentad I, May 1—5:

Precipitation was produced in the river-system by a complex front, and then a cold air-wave. Snow fell again in the hilly districts. The snow-cover was 20 cm at a height of 800 m above sea-level, and 100 cm above 2000 m. Relatively rainy and cool weather dominated over the catchment area, similar to that in Western Europe, but in contrast Eastern Europa experienced tropical heat, the temperature in Moscow reaching +27 °C (Fig. 1).

Pentad II, May 6—10:

Warm air from Eastern Europe streamed towards the Tisza catchment area as a result of the tropical air-masses, and so melting began everywhere. The maximum value of the air-temperature was 8—10 °C higher than the many years' average. Thus, in the mountainous areas of Rumania melting even continued at night. Variable precipitation and regional storms were produced in the catchment area. The catchment areas of the Upper Tisza, the Szamos and the Kraszna received a considerable precipitation of some 70—80 mm. In a period of only 10 days, therefore, a precipitation approximately equivalent to the many years' average for the whole month fell on this north-eastern regional catchment area (Fig. 2).

Pentad III, May 11—15:

At 6 p.m. on May 11, with the break-through of a cold-front, a polar air-mass advanced towards the catchment area. A deep cyclone system developed over the northern part of the catchment area, with an air-pressure below 740 mm Hg. With this advection two moist air-masses met above the river-system. The very high water vapour content of the air (12—20 g/m^3) resulted in an abundant precipitation. The movement of the cyclone was restricted by the North-Eastern and Eastern Carpathians, the air-mass was forced to ascend, and this led to a strong increase of the cloud-formation (cloud-level 7,500 m) and of the precipitation-intensity. With the retarding action of the relief, on May 12—13 a new, polar, cold air-mass caught up with the cyclone slowly moving in the north-east of the catchment area, and as a result a 100—120 mm precipitation fell within a short space of time. (In Beszterce-Naszód, Máramaros and Maros counties, almost 2.5 km^3 of water fell on about 50,000 km^2 in 72 hours.) During the 48 hours from 8 a.m. on May 11 to 8 a.m. on May 13, 72 mm of rain fell on Nagybánya, 99 mm on Beszterce, and 105 mm on Maroshévíz. Measurements and estimations suggested (that even 150 mm may have fallen locally.) It may be presumed that if the range of the Carpathians had not been there, such an extensive precipitation would not have occurred. For instance, the 70—80 km-wide

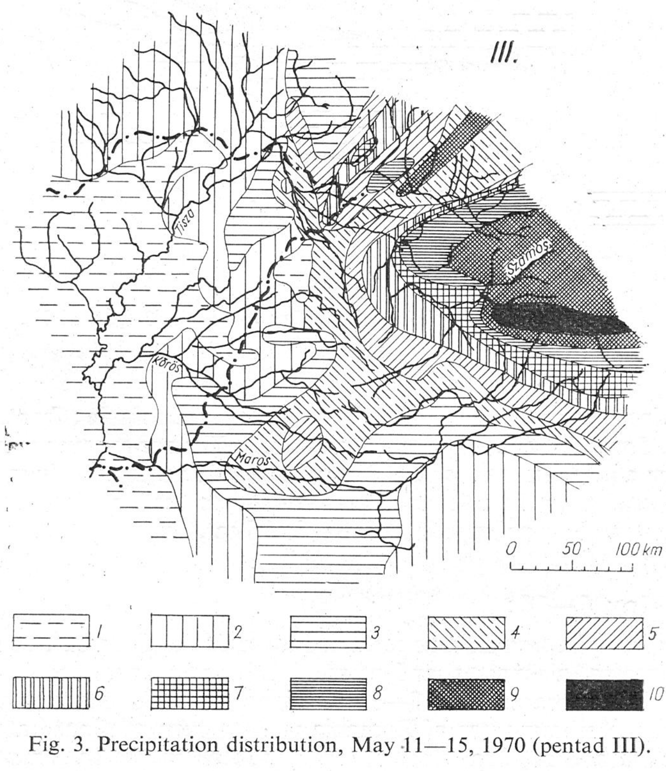

Fig. 3. Precipitation distribution, May 11—15, 1970 (pentad III).

1. 0—10 mm
2. 10—20 mm
3. 20—30 mm
4. 30—40 mm
5. 40—50 mm
6. 50—60 mm
7. 60—70 mm
8. 70—80 mm
9. 80—90 mm
10. 90— mm

front, moving at some 40 km/hour, resulted in only2 hours' rain-showers and hail on the Great Hungarian Plain. At the same time, on the upper catchment areas of the Szamos and the Maros the slackening and rising cold-front collided with the sub-tropical air-pocket stagnating there, and as is well known this led to the catastrophic rainfalls (Fig. 3).

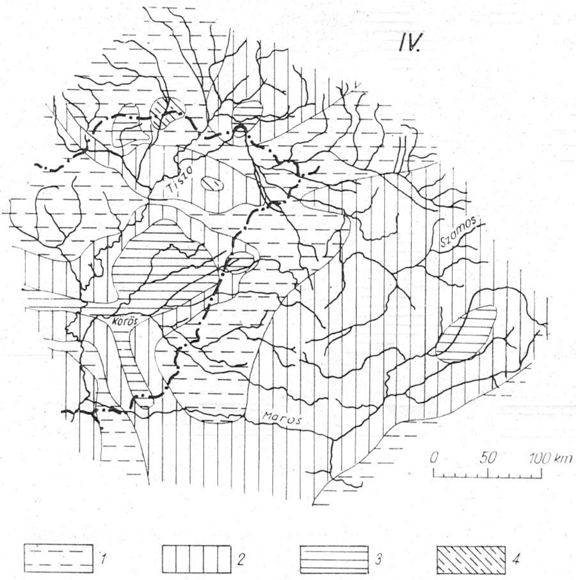

Fig. 4. Precipitation distribution, May 16—20, 1970 (pentad IV).

Pentad IV, May 16—20:

Following this large inundation, a relatively quieter period developed as regards precipitation, although the atmospheric instability was fairly considerable. In the first part of the pentad, even cooler and rainier air-masses were predominant, whereas in the second part warm, dry air-masses took over (Fig. 4).

Pentad V, May 21—25:

This period, beginning with a rise in temperature and local downpours, led mainly in the Maros valley to surface outflow which together with the melt-waters produced a new, considerable flood-wave. A 20—60 mm precipitation fell on the S.E. parts of the river-system on May 23 and 24. In the period June 1—3 the water flowing down the Maros, which had fallen in pentad V, met the mass of the N.E. waters which had fallen in pentad III, and this gave rise to the highest water-level of 961 cm at Szeged (Fig. 5).

Pentad VI, May 26—31:

The weather was relatively clear, although a few more significant downpours did further increase the already considerable flood-waves of the catchment area (Fig. 6).

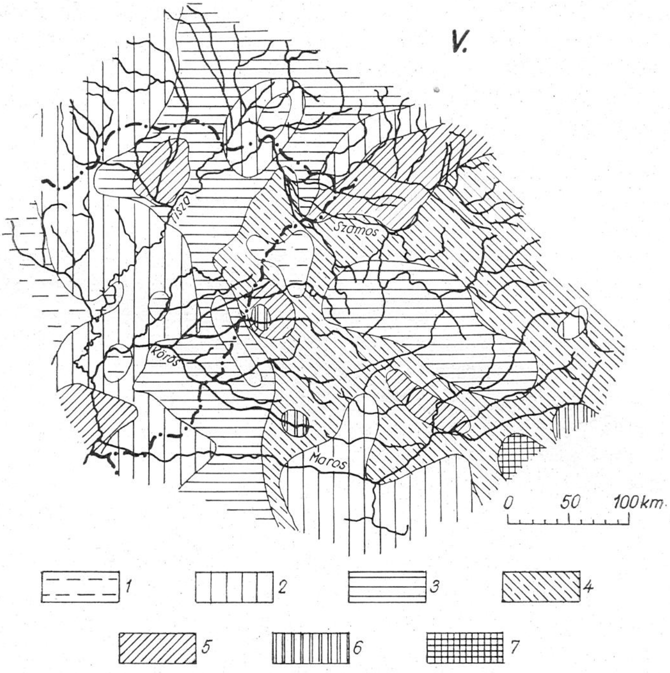

Fig. 5. Precipitation distribution, May 21—25, 1970 (pentad V).

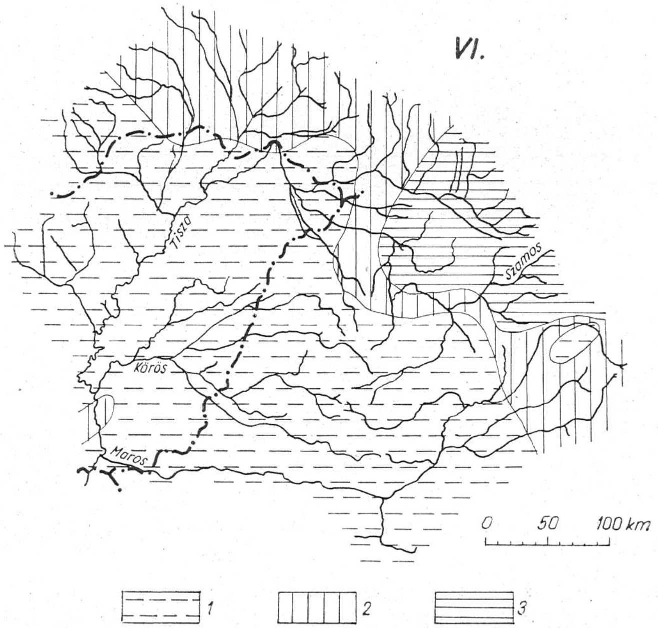

Fig. 6. Precipitation distribution, May 26—31, 1970 (pentad VI).

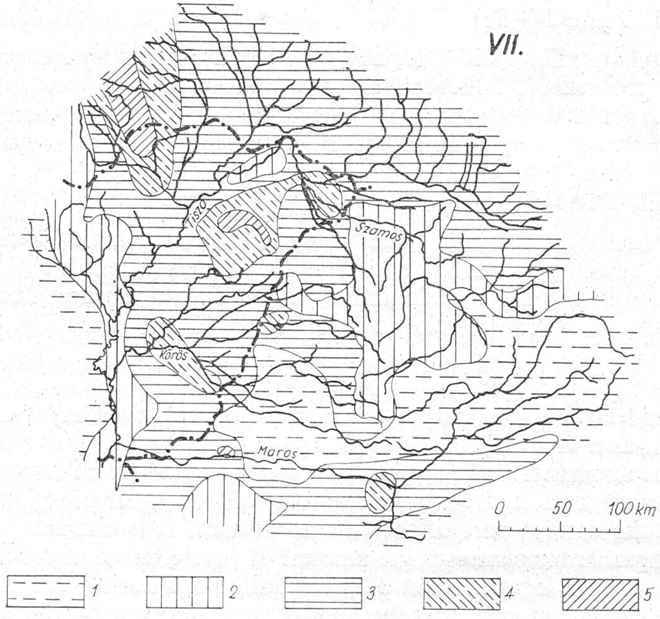

Fig. 7. Precipitation distribution, June 1—5, 1970 (pentad VII).

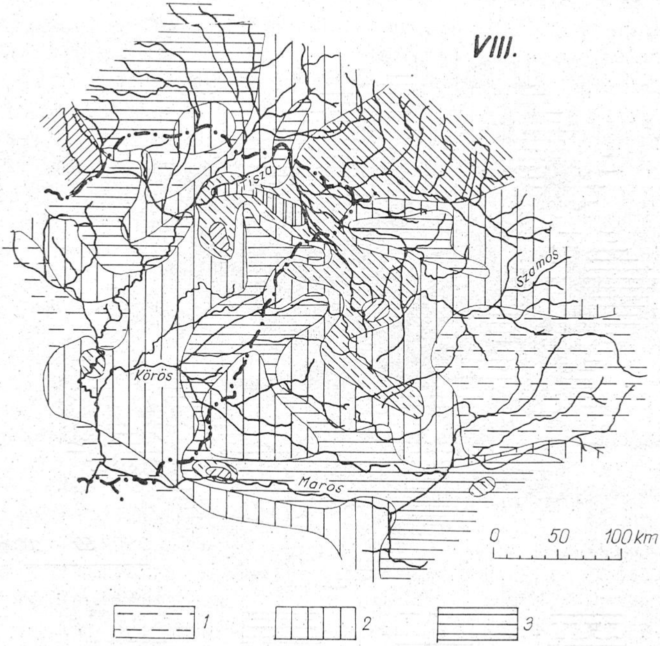

Fig. 8. Precipitation distribution, June 6—10, 1970 (pentad VIII).

Pentad VII, June 1—5:

The cold-front effects still held, and the daily average temperatures were relatively low for the season. Although the precipitation activity was in the form of scattered showers and thunder-storms, never-theless it further increased disquietingly. A cyclone moving in from the N.E. settled on the river-system (Fig. 7).

Pentad VIII, June 6—10:

The catchment area again came under an unstable atmospheric effect. The succession of sub-tropical, arctic and Atlantic air-masses produced variable weather and caused locally high precipitation, violent downpours and storms (in places hail) on the catchment area (mainly on that of the Körös rivers Fig. 8).

Pentad IX, June 11—15:

The humid air-mass in the first part of the pentad, together with a very high temperature, was a favourable condition for the local formation of thunder-storms. This state was disturbed in the second part of the pentad by cold air with a strong wind from Scandinavia, and this gave rise to a cold-warm air mixed zone above the Ukraine and the eastern part of the catchment area. It is characteristic that with the very changeable temperatures the amount of precipitation also developed in an extreme way. Such a large amount of precipitation fell during this time, primarily on the Körös catchment area, that the flood-wave there exceeded all previous levels, while on the Maros and the N.E. waters the state of danger produced in pentad III in May seemed to be repeated (Fig. 9).

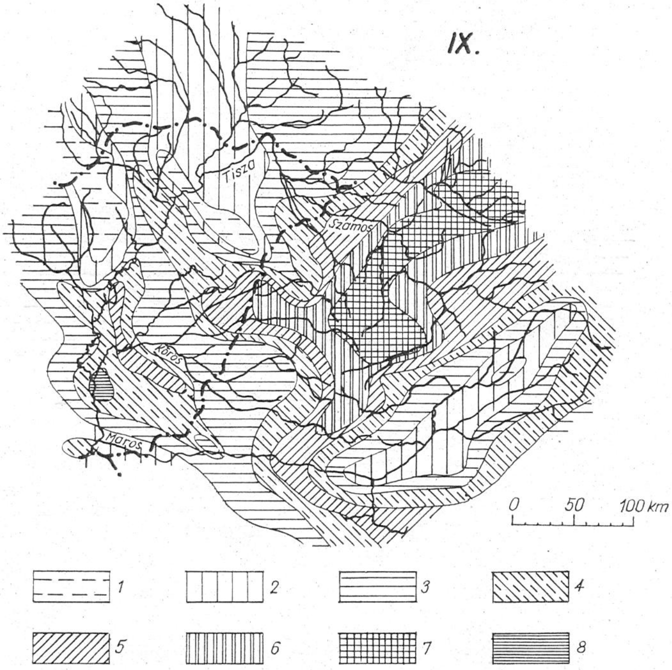

Fig. 9. Precipitation distribution, June 11—15, 1970 (pentad IX).

As has been seen already, the direct causes of the precipitation were known, but these may not provide a completely satisfactory explanation. The main cause of the period of haphazard but heavy precipitation in the first half of 1970 can be deduced from the climatic situation which developed in the northern hemisphere. While it was extremely cold in N. Europe, at the same time it was an exteremely warm winter in N. Africa. The two air-masses of such different temperatures gave rise to an extremely active mixed zone between the 40th and 50th parallels. The tropical air-masses often penetrated even to the Baltic. The struggle between the cold and warm air was repeated almost daily in the temperate zone, and polar and tropical days alternated with high frequency. Although it is not a common phenomenon that the polar air-mass comes into direct contact with a tropical air-mass (it usually transforms to an intermediate sub-polar and a sub-tropical air-mass), this now occurred above Europe, and completely changed the normal circulation.

The interactions of the surface-forms of the catchment area can also be closely related with the above-listed atmospheric processes giving rise to the flood.

As is well known, the atmospheric advections extending to the whole of the basin did not in general exhibit uniform precipitation distribution. In the main, heavy and rapid precipitation activities were confined only to smaller areas. One of the reasons for this is to be found in the surface-relief. Thus, the situation, form and height of the hills, the steepness of their slopes, the flora covering the surface, etc., are always the most important factors of the orographic precipitation formation. For example, on the occurrence of N.W., W. or S. W. winds, those ridges of the Máramaros snow-capped mountains which extend in the N-S direction act as „precipitation traps". The situation is similar to this with the northern slope-exposure of the Sziget mountains in Transylvania. The heaviest rainfalls generally occur here when the centre of the accompanying air-pressure minima and the intensified Atlantic cyclone activity is situated over the Polish Plain and the Ukraine. At such time the rapid increase of the air-flow on the exposed side of the mountain may give rise to intense precipitation. In addition to these areas, similar orographic conditions occur in many other places too in the river-system. In such cases the surface size and height of the relief may play an important role in the formation of local and heavy precipitation. The "memorable" rains which fell in the period May 12—14, 1970 are also closely connected with the orographic conditions. As a result of the relief (exposure, upwards flow on the slope, etc.), in places more than 100 mm precipitation fell on the river-system of the Upper Tisza, the Batár, the Túr, the Szamos, the Kraszna, the Lápos and the Visó.

Table 1. *Annual total (mm) of the precipitation increase for a rise of 100 m, calculated on the basis of the 40 years' average*

Western slope of the Bihar range	45 mm
Western slope of the Avas range	71 mm
Western slope of the Kőhát range	42 mm
Western slope of the Lápos range	33 mm
Western slope of the Bükk range	50 mm
Western slope of the Radnai snow-capped mountains	33 mm
Western slope of the Kelemen snow-capped mountains	50 mm
Western slope of the foothills of the Southern Carpathians (Bánáti range)	100 mm

The amount of precipitation varies in the mountains with the increase of the relief above sea-level. The values calculated on the basis of the average annual precipitation (40 years' average) on exposed western slopes of the individual mountainous districts of the river-system show that certain mountains are in a favourable geographical position in the paths of the air-currents delivering the precipitation (Table 1).

The surface water-course density too may be taken into consideration as a factor producing the flood-state.

According to the water-course densities, the catchment area of the Tisza is asymmetrical. Primarily the left-hand tributaries have a large effect on the supplementing of the Tisza water-supply, and on the conditions for the development of flood-states. It may be stated as a fact that the relief of the left-side river-system, the density of the river-network, and the regional precipitation distribution are the main factors controlling the flow of the Tisza (Fig. 10).

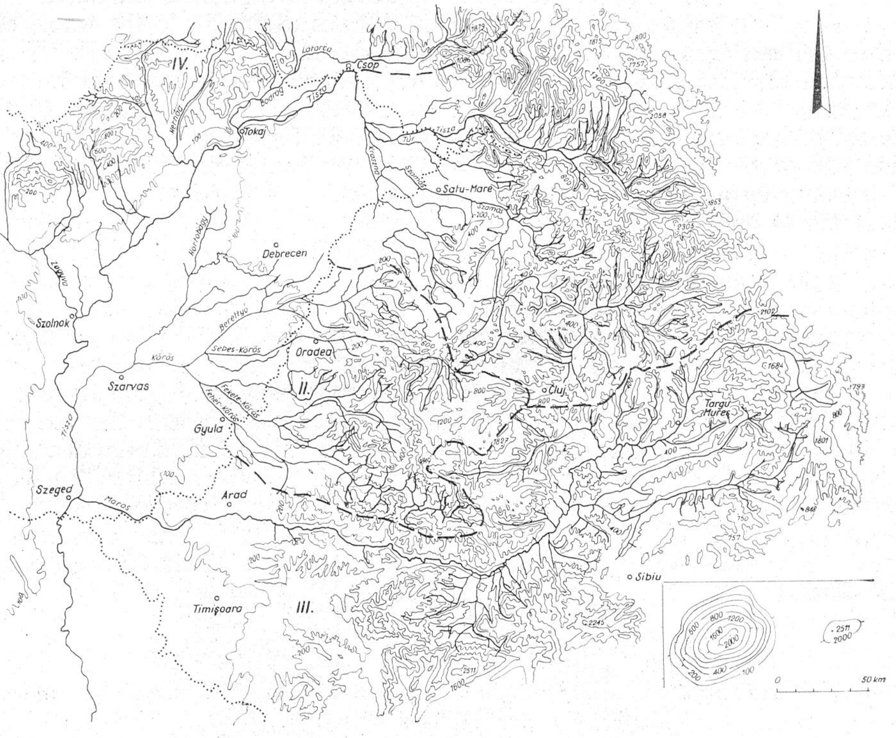

Fig. 10. Surface relief of the river-system.

I. N. E. catchment area of the Tisza (Upper Tisza, Szamos, Kraszna, Túr, Batár, etc.)

II. Cachtment area of the Körös rivers

III. Catchment area of the Maros

IV. Other, right-bank Tisza catchment areas (Bodrog, Sajó, Zagyva, etc.)

In general, the tributaries of the Tisza can be divided into two groups on the basis of the surface-relief. The first group comprises those rivers which possess considerable mountainous district catchment areas, arrive via very rainy valley-sections to the Tisza basin on the Great Hungarian Plain, and here, after a relatively short section on the Plain, reach their erosion-basin, the Tisza. The courses of these tributaries are typified by their torrent nature. The water-supplies of the rivers may be characterized as a function of the development with time of the prevailing amount of precipitation. The following tributaries can be classified in this type: the Beszterce, the Szamos, the Almás, the Lápos, the Túr, the Kraszna, the Sebes Körös and the Fekete Körös. The other group contains those tributaries which, after their mountain origin, thread down with numerous mountain-basins. They reach the region of the Great Plain via valley-sections where comparatively less rain falls. Their courses are generally not typified by a torrent nature, but that does hold here too in certain valley-sections. The water-supplies of the rivers are obtained from the soil-water too, in addition to the precipitation factors, by means of the tapping of alluvial and detrital cones. In such types of rivers, flood-wave courses protracted in both time and extent are possible. The primary example here is the Maros, although the first May flood-wave in 1970 had a similar torrent-type nature.

The natures of the surface-formations, the surface-relief and the precipitation factors can all exert a significant influence on the density of the river water-network, which again and again is an important factor in the regional development, of the flood (MORARIN and SAVU 1954). The density of the river-network is the greatest in the region of the Radnai and Máramarosi snow-capped mountains, the volcanic range of the Avas, the Gutin and the Cibles, the Borgói, Kelemen, Gyergyói, Csíki Görgényi and Baróti snow-capped mountains, the Fogarasi, Almási and Ruszka snow-capped mountains, and the Southern Carpathians, and, from the Transylvanian Sziget mountains, on the regions of the Bihar, the Gyulai, the Királyerdő and the Érchegység mountains. (The water-network is particularly dense on the left-hand catchment area of the Fekete Körös, where at times it even exceeds 1.0 km/km^2.)

A medium density of 0.3—0.6 km/km^2 can be observed on the table-land of the Szamos, in the Transylvanian basin, on the regions of the Mezőség and Szilágyság, and also on the alluvial cones of the rivers coming out of the mountains. The surface water-network is very rare (0.06—0.03 km/km^2) in the Great Hungarian Plain.

The density value of the water-network assumes a characteristic picture in the catchment areas. Thus, for example, the western part of the Transylvanian Sziget mountains and the N. E. Carpathians can be assigned as one such belt, which comprises the catchment areas of the Upper Tisza, the Visó, the Iza, the Batár, the Túr, the Szamos, the Sebes Körös and the Fekete Körös. The relief of the ground here is of favourable exposure for the air current bringing the precipitation, and a "luw" zone develops, where the torrential possibilities of the course of the river are considerable.

The other zone is on the catchment region of the Kis Szamos, the Nagy Szamos, the Fehér Körös, the Maros, the Aranyos and the Küküllők. The density of the surface water-network here is 0.5—0.6 km/km^2, and the precipitation conditions of the catchment area are more moderate than the above.

The density of the surface water-network is influenced to a large extent by the variable stone composition of the surface, the individual tectonic structures, the extents of the drought factors and the precipitation, the form of the water catchment area, its spatial situation, the degrees of soil and plant cover, and not least by the activity of society in reshaping nature (Fig. 11).

The amounts of rain-water which fell in May and June, 1970 are summarized in Table 2. The Table indicates quite sharply the individual periods and partial catchment areas in which more concentrated amounts of water were set in motion. On the partial catchment areas of the north-east tributaries of the Tisza (the catchment areas of the Upper Tisza, the Szamos, the Kraszna, the Túr and the Batár, completely up to the Vásárosnamény section of the Tisza), after preparatory rains of gradually increasing amounts the outstanding value of 1.6 km³ arose in pentad III. On the other hand, the amounts of water in pentad V, and particularly pentad IX, were also considerable. In May and at the beginning of June, the water-load on the catchment area of the Körös was almost uniform, but relatively quite high. Clearly,

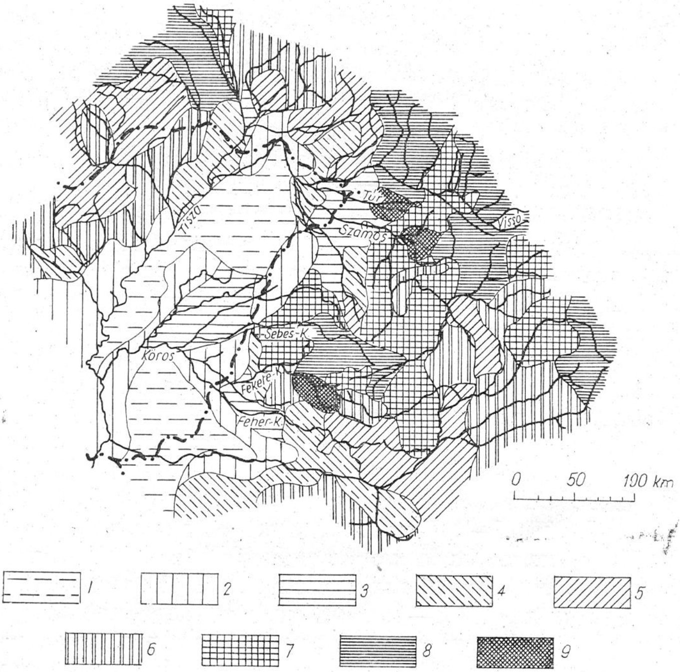

Fig. 11. Water-course density in the river-system of the Tisza.

1. 0.0—0.1 km/km$_2$
2. 0.1—0.2 km/km$_2$
3. 0.2—0.3 km/km$_2$
4. 0.3—0.4 km/km$_2$
5. 0.4—0.5 km/km$_2$
6. 0.5—0.6 km/km$_2$
7. 0.6—0.7 km/km$_2$
8. 0.7—0.8 km/km$_2$
9. 0.8—0.9 km/km$_2$

this could be increased only to a catastrophic level by the further extreme amounts of water in pentad IX, if it is considered that the consequences of the previous water-load had still not disappeared during the short time available. The load of the catchment area of the Maros was in general evened out, more so than the loads of the Upper Tisza and the Szamos, but during the whole period of the flood it was very intense. The waters of pentads III and V initiated the two large flood-waves on the Maros. The waters of pentads VII and VIII, and especially of pentad IX, ensured the relatively more uniform, but overall extremely heavy water-load of the Maros in June, and this determined the lastingness of the June flood-wave at Szeged, and, together with the accumulating waters of the Körös rivers, the prolonged height of the Tisza too (Table 2).

Table 3 shows the average precipitation totals which fell in the individual pentads, from a knowledge of the partial catchment areas (the N.E. waters meeting up

Table 2. *1970. precipitation (in km^3)*

Pentad		N. E. waters	Körös	Maros	Other	Total
May	1—5	0.1	0.1	0.3	0.2	0.7
	6—10	0.6	0.3	0.2	0.6	1.7
	11—15	1.6	0.3	0.9	0.2	3.0
	16—20	0.2	0.3	0.3	0.2	1.0
	21—25	0.8	0.3	0.8	0.3	2.2
	26—31	0.4	0.1	0.2	0.2	0.9
June	1—5	0.5	0.4	0.4	0.4	1.7
	6—10	0.3	0.3	0.5	0.3	1.4
	11—15	0.9	0.7	0.9	0.4	2.9
Total		5.4	2.8	4.5	2.8	15.5

Note: N. E. waters = waters uniting up to the Vásárosnamény section of the Tisza (Tisza, Szamos, Kraszna, Túr, Batár, etc.).

to the Vásárosnamény section: 32,000 km^2; the Körös rivers: 26,600 km^2; the Maros: 29,800 km^2; and other Tisza tributaries together: 50,000 km^2; in all up to the Szeged section, i.e. to the Yugoslav frontier: 138,400 km^2). These data are also suitable for comparison, although the outstanding values may scarcely be demonstrated (Table 3).

The next questions is what proportion of the waters resulting from the precipitation made its way down the rivers. In the determination of this the rate of flow and the mass of the water in the Szeged section of the Tisza must be taken into account. During the flood-defence work (starting from May 27), the rates of flow of the water were measured directly (by the measurement of the flow-rate at many points of the bed-section, and by the multiplication of the rates by the reference surfaces, and then the summation of the partial flow-rates NÉMETH 1954). The other flow-rates (between May 19 and 26) could be determined by calculation from a consideration of the measured and calculated flow-rates at places outside Szeged. The flow-rates of the period preceding the flood were obtained, in the knowledge of the water-levels which were systematically read off daily, from the so-called ,,flow-rate (curve", which expresses the flow-rates) as a function of the water-level. It should be noted that the flow-rate curve would not have been usable in the May-June periods of the flood, since it would not have been possible to apply it to the high water-levels which

Table 3. *1970 average precipitations (in mm)*

Pentad		N. E. waters	Körös	Maros	Other	Overall average
May	1—5	3.1	3.7	10.0	4.0	5.1
	6—10	18.8	11.2	6.7	12.1	12.3
	11—15	50.0	11.2	30.0	4.0	21.6
	16—20	6.3	11.2	10.0	4.0	7.3
	21—25	25.0	11.2	26.7	6.1	16.0
	26—31	12.5	3.7	6.7	4.0	6.5
June	1—5	15.6	15.0	13.4	8.1	12.3
	6—10	9.4	11.2	16.7	6.1	10.1
	11—15	28.2	26.2	30.0	8.1	21.0
Total		168.9	104.6	150.2	56.5	112.2

Note: N. E. waters = waters uniting up to the Vásárosnamény section of the Tisza (Tisza, Szamos, Kraszna, Túr, Batár, etc.).

occurred, while in addition, because of the various water-accumulation effects, the relation between the flow-rate and the water-level was not clear-cut during the flood. The actual relation resulted in a spe-cially involved variation of the flood loop-curve (Fig. 12).

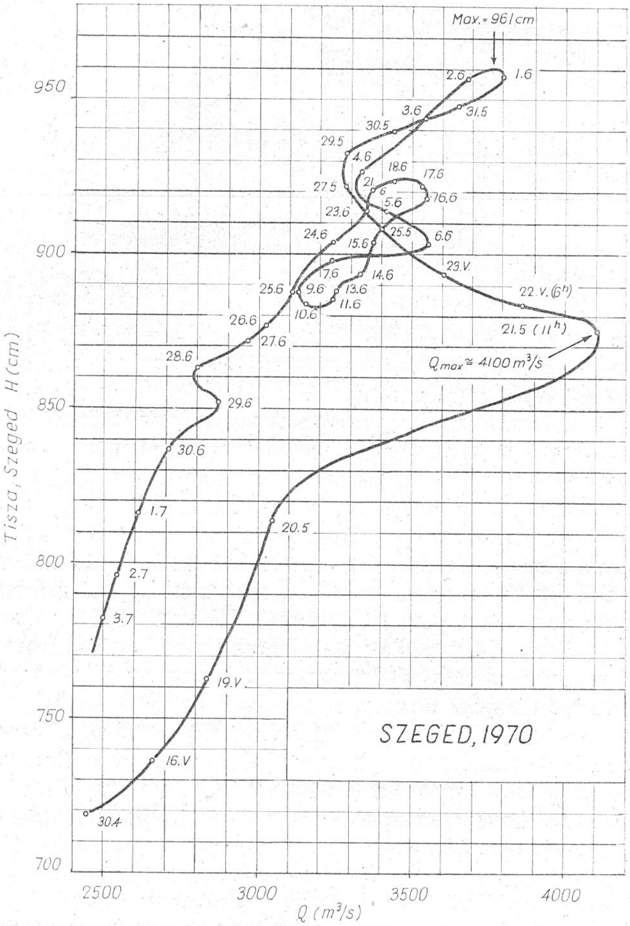

Fig. 12. Relation between the water-level and the flow-rate at Szeged in 1970. (Flood loop-curve)

The series of times of the flow-rates for the Szeged section (Fig. 13), however, does not always show the desired amount of the outflow, since the water would also have flowed in the Tisza (but much less) if by chance it had not rained in May and June. Thus we had to distinguish the outflow waters of the period before May 1 from those of the following period, in the series of times of the flow-rates. This was done by extending in an arc the receding branches of the April flood-wave of the Tisza completely to the beginning of the July flood-wave following the great flood, in accordance with the 4—6 weeks more advanced receding tendency observed on the upper water-gauges compared with that at Szeged (Fig. 13). The Tisza at Szeged during the summer otherwise maintained a flow-rate of 900—1,000 m³/s. Since that flood-wave which passed Szeged on April 23 reached its maximum at Tokaj on April 2, and at Vásárosnamény on March 30, it was possible to determine relatively accurately the subsiding tendency of the April flood-wave assumed for Szeged (Fig. 13).

The area measurable between the receding line of the waters originating before May 1 and the flow-rate — time line of the waters which actually flowed (the time data are in sec) gives the amount of the waters originating after May 1. This was found to be 6.9 km³. If this is compared with the amount of precipitation, 15.5 km³, it can be seen that 44% of the latter had flowed past Szeged up to July 18, 1970. This outflow fraction was substantially higher than the many years' fraction, ca. 18—20%, for the whole of the catchment area region, and confirmed the strong limitations on the infiltration and evaporation, especially during May.

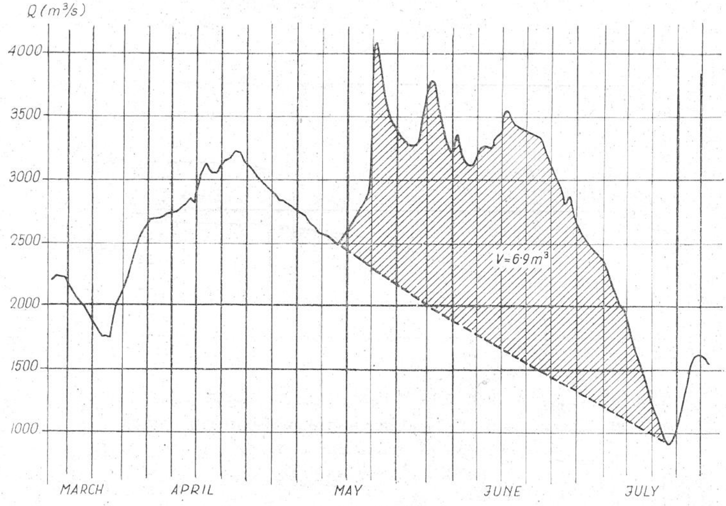

Fig. 13. Series of times of flow-rates, and flow-rates and amounts of precipitation after May 1 at Szeged.

In addition, we also determined the changes with time of the amounts of the outflow waters for the Szeged section and the precipitation amounts there, and thus the change with time of the outflow fraction (Fig. 14). The times of the fall of the precipitation had to be converted for the Szeged section. The actual outflow rates of the flood-water and the extension in time of the moving flood-waves were taken into consideration, and the relevant amounts of water during this were found for those days on which these should have in theory passed the Szeged section (without infiltration and evaporation losses). In the knowledge of the actual amount of water which flowed past on that day, the outflow fraction too could be determined. The water amounts mentioned were expressed by their values amassed (integrated) from May 1 (Fig. 14).

Thus, it can be seen that the observed movements of the flood-waves in the Tisza river-system in 1970 not only developed in a complex way, but, as a result of the extreme amounts of water and the congesting effects of the individual tributaries on each other, also severely tried the technical structures and technical strengths of the Hungarian flood-defence.

The Tisza and its tributaries were confined between embankments in the last decades of the 19th century, on the basis of the ideas and plans of ISTVÁN SZÉCHÉNYI and PÁL VÁSÁRHELYI, which had been developed in the first half of that century. Since their construction these embankments had been reinforced many times. Hence, about a quarter of the territory of Hungary had been freed from the periodically recurring overflows of the flooding rivers. The development of modern industry, agriculture, the traffic system, and even human settlements would not have been

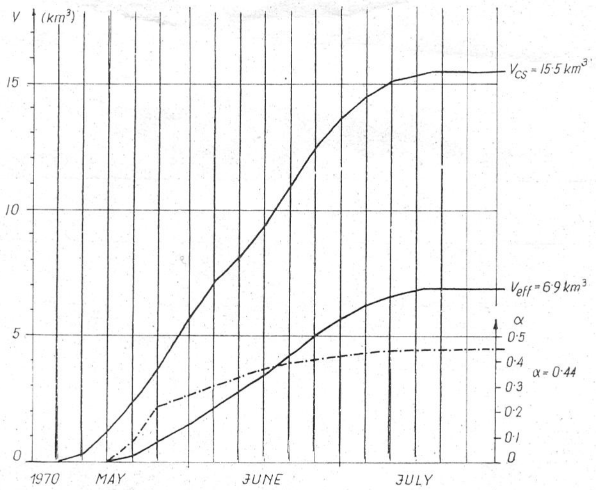

Fig. 14. Precipitation and outflow values reduced to Szeged.

Vcs = summed water content of the precipitation

Veff = amount of water due to precipitation passing Szeged after May 1

$\alpha = \frac{\text{Veff}}{\text{Vcs}}$ = outflow fraction for Szeged

possible on a large part of Hungary without the removal of the threat of flooding in the Tisza valley (BOGDÁNFY 1904). However, the embankments raised the levels of the previous highest floods, and are still raising them today. This is particularly the case for the lowest-lying Lower Tisza region (downstream from the mouth of the Körös), and Szeged is most characteristic for this (see Table 4). The flood-waves of the tributaries can pile up on each other here, and even the high water-levels of the Danube can exhibit their effects here. The regulation of the Körös and the Maros, on the other hand, greatly accelerated their flows. By this means it could be attained that the first wave of the flood-waters flows out of the Lower Tisza sooner, and before the peak of the flood-wave of the Upper Tisza reaches this section. However, it did not prove possible by means of flood-defence and river-regulation to prevent the situation when the later, renewed flood-waves of the tributaries mentioned meet, although rarely, with the flood-waves passing down the Tisza (IVÁNYI 1948). (Table 4).

In 1970 two large flood-waves set out from the waters of the N. E. tributaries of the Tisza: the first attained its maximum level of 912 cm at Vásárosnamény on May 15, 12 cm higher than the previous maximum, while the second reached 830 cm on June 14. Two flood-waves set out on the Körös in June. The first of these was still

Table 4. *Annual maximum water-levels of the Tisza observed on the Szeged water-gauge, in descending order of magnitude (1892—1970). (Based on the compilation of* DR. I. ZSUFFA*)*

Serial number	Water-level (cm)	Date	Serial number	Water-level (cm)	Date
1	961	2 Jun 1970	41	626	4 Mar 1969
2	923	15 Apr 1932	42	614	2 Apr 1917
3	916	12 May 1919	43	604	19 Apr 1898
4	884	12 Apr 1895	44	604	4 Jun 1957
5	870	11 Apr 1924	45	603	20 Mar 1931
6	855	12 May 1941	46	602	31 Mar 1947
7	847	11 Apr 1940	47	599	15 Apr 1968
8	820	22 Apr 1962	48	595	16 May 1908
9	802	20 Jul 1913	49	594	6 May 1935
10	799	5 Mar 1966	50	587	29 Mar 1963
11	791	31 Dec 1915	51	582	27 Feb 1960
12	791	1 Jan 1916	52	579	1 Jun 1939
13	790	26 Mar 1967	53	568	27 Jun 1894
14	780	7 Mar 1942	54	563	13 Apr 1911
15	778	3 Apr 1914	55	555	4 Apr 1945
16	774	8 Apr 1922	56	552	7 Apr 1896
17	764	17 Apr 1964	57	550	14 Jun 1906
18	759	12 Jan 1926	58	550	23 May 1951
19	758	24 Apr 1907	59	542	23 Apr 1928
20	753	4 Oct 1912	60	526	24 Mar 1934
21	748	22 Jul 1965	61	525	23 Feb 1900
22	730	17 Apr 1897			23 May 1900
23	730	7 Mar 1958	62	525	11 Apr 1946
24	726	17 Jun 1893	63	522	24 Dec 1950
25	714	29 Jan 1948	64	511	28 Apr 1905
26	708	26 Jan 1920	65	508	16 Júl 1903
27	706	17 Jan 1953	66	496	12 May 1910
28	703	2 Apr 1937	67	496	29 Nov 1930
29	689	7 May 1956	68	495	30 Jul 1949
30	681	31 Dec 1925	69	488	18 Mar 1927
31	680	28 Mar 1901	70	472	14 Apr 1936
32	668	1 Jul 1902	71	460	5 Jun 1899
33	660	17 Jul 1933	72	458	9 May 1929
34	657	3 Mar 1955	73	454	13 Mar 1954
35	654	2 May 1944	74	450	18 Feb 1904
36	648	23 Apr 1952	75	436	30 Jan 1959
37	642	7 Apr 1909	76	394	1 Jan 1961
38	638	16 May 1938	77	366	7 Apr 1943
39	637	19 Mar 1923	78	349	31 Dec 1918
40	630	12 Apr 1892	79	325	29 Apr 1921

only partial; it caused higher-water-levels on the Fehér Körös, only filled out the Hármas Körös rather, and could no longer be distinctly detected in the Tisza. The second Körös flood-wave, however, attained a new peak at Gyoma on June 14 of 918 cm (45 cm above the previous record), and its effect at Szeged (together with the flood-waves of the Maros) could be observed on June 18 during the second maximum of 924 cm. This was 1 cm more than the previous record water-level of 923 cm at

Szeged in 1932. On the Maros, two larger flood-waves set out in May and two more in June (practically). The first Maros flood-wave set a record of 928 cm at Gyulafehérvár on May 15 (the previous highest water-level there was 561 cm)!. At 10 p.m. on May 20 this Maros attained a level of 624 cm at Makó (the previous highest water-level there was 580 cm!). The effect of the Maros flood-wave was felt at Szeged in the evening of May 21. The record flow-rate of 4,000 m^3/s was observed. The second Maros flood-wave reached its maximum at Gyulafehérvár in the morning ofs-May 25 (550 cm). This caused a peak-level of 544 cm at Makó between 6 p.m. on May 31 and 8 a.m. on June 1, while at Szeged it was this flood-wave which, combining with the peak-waters arriving from the Upper Tisza, gave rise to a period (between 2 p.m. on June 1 and 4 a.m. on June 2) when the water-level was in general 960 cm, attaining its maximum of 961 cm at 1 a.m. on June 2. Since the first Tisza flood-wave itself would have arrived at Szeged on June 3, the peak of the second Maros flood-wave avoided a precise meeting with it, preceding it by only one day, but naturally even so the two flood-waves strongly enhanced each other's effect. The first great flood-wave meeting at Szeged therefore occurred during the 1970 flood, between the Tisza flood-wave which originated in the north-east in pentad III and the second Maros flood-wave of pentad V. The second flood-wave meeting, which produced water-levels not much lower than those of the first meeting and in excess of the previous record levels, took place in the period June 17—19; at this time the almost confluent third and fourth flood-waves of the Maros in the Makó section resulted in a prolonged peak-level period, and at the same time the effect of the large flood-wave of the Körös in pentad IX made itself felt in the water-level of the Tisza at Szeged. (The peak-level at Szeged was 924 cm on June 18.) The second Tisza flood-wave did not meet with this, all the more so because it originated with the third Körös and the fourth Maros flood-waves (Fig. 15., 16).

The meetings of the flood-waves are also illustrated graphically (Fig. 17). The diagrams include the most important tributaries, the days on which the peaks were reached, and the descent times. The meetings of the flood-waves of the tributaries and the main river can be well followed from the identity or the closeness of the peak-level dates (Busacker Saaly 1969). (Fig. 17).

When the outflow durations of the 1970 flood-waves are taken as basis (although these durations are far from constant, and indeed because of the water-retention of the wave-areas with the increase of the amount of the outflow water are never reduced more considerably), it can be established that if the flood-wave setting out in the N.E. tributaries of the Tisza is followed 10—12 days later by a flood-wave on the Maros, and 13—17 days later by one on the Körös, and if the amount of water in these flood-waves is extreme, then we are faced with the most dangerous state of build-up the waters as regards not only Szeged, but also the whole Lower Tisza region too.

Naturally the defence-works of Szeged and the Tisza are able, perhaps with difficulty, but with appropriate defence preparedness and efforts to cope with waters 1—1.5 m higher even than those of 1970. It is also true, however, that the water-levels in 1970 are not the highest which may conceivably happen, in spite of the fact that as regards the meetings the most dangerous state of rainfall on the Tisza, the Maros and the Körös at suitably delayed times, together with extreme flow-rates and water-levels, has never before occurred with complete precision. The averting of the flooding of the Tisza and its river-system was a great historic act, but as a result of our natural endowments there will always be periods when the flood-defence will again call for heroic deeds to protect the country and the people.

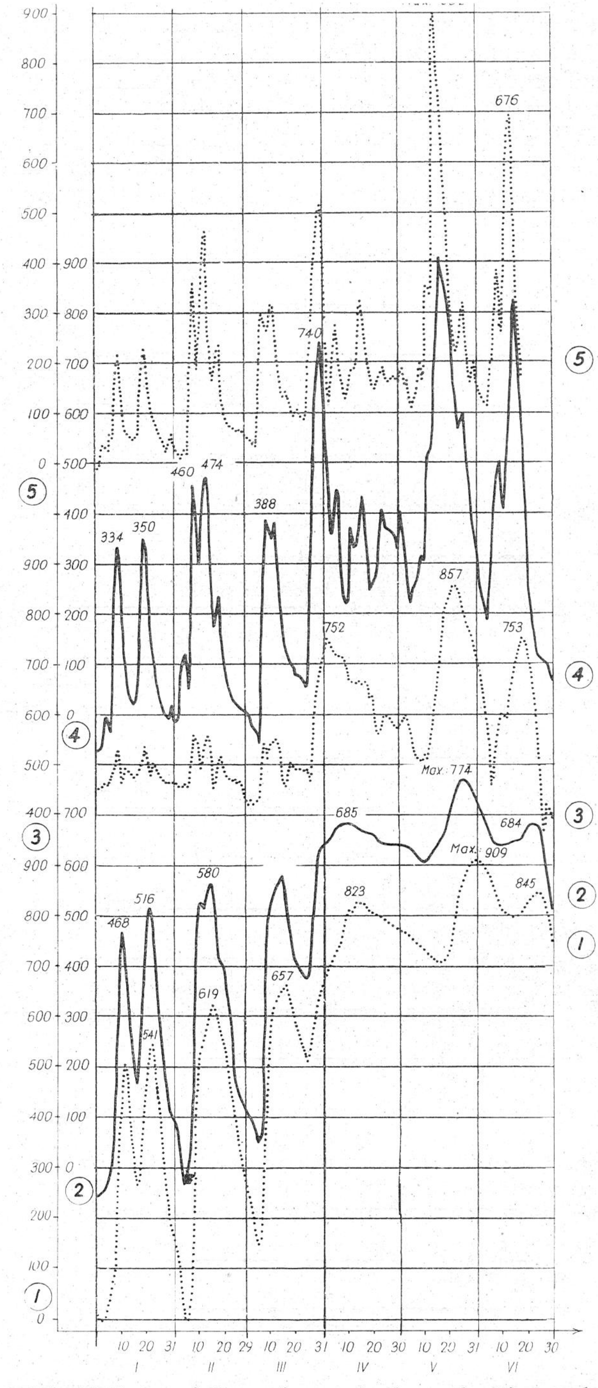

Fig. 15. Series of times of water-levels on the Tisza and its tributaries in the first half of 1970. LNV = highest water. *1.* Szolnok, *2.* Tiszafüred, *3.* Tokaj, *4.* Vásárosnamény, *5.* Csenger

If a study is made of which are the most dangerous periods with regard to the development of the extreme floods of the Tisza, we can primarily again point only to the remarkable differences from the regularities of the Tisza and its river-system which can be observed during the larger floods. From the times of the peak water-levels observed in the individual years (Table 4), it is not possible to make clear-cut conclusions as to a function between the maximum water-level and the season. The monthly distribution of the maximum yearly levels of the Tisza on the Szeged water-gauge for

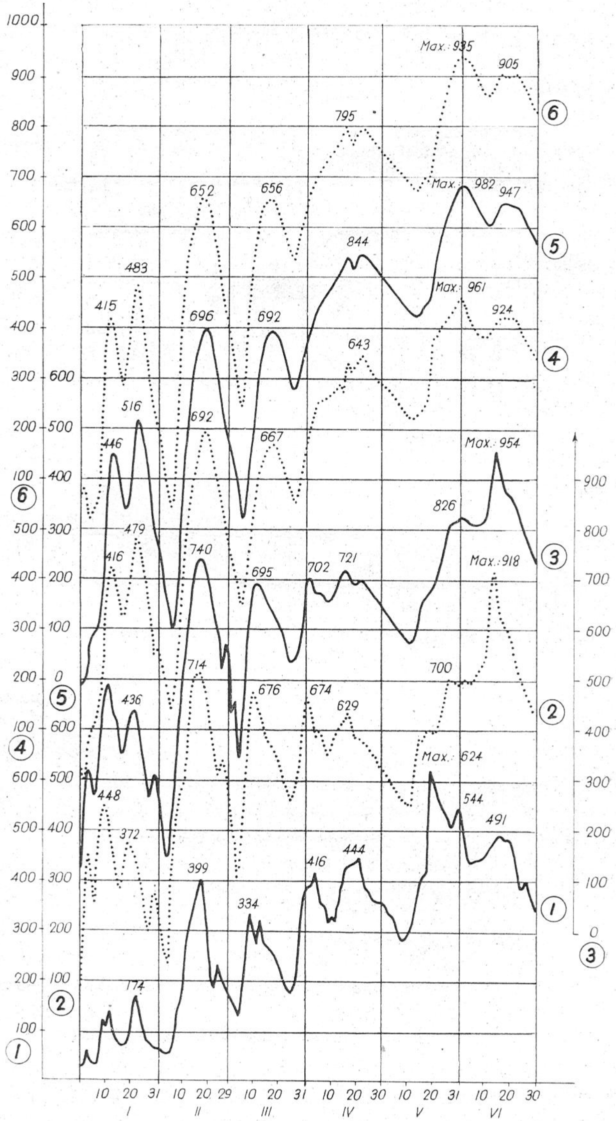

Fig. 16. Series of times of water-levels on the Tisza and its tributaries in the first half of 1970. LNV = highest water.
1. Makó, *2.* Gyoma, *3.* Szarvas, *4.* Szeged, *5.* Mindszent, *6.* Csongrád

the last 80 years is as follows: in January: 7 times; in February: 3 times; in March: 14 times; in April: 26 times; in May: 11 times; in June: 7 times; in July: 6 times; in October: once; in November: once; and in December: 4 times. If the highest annual maxima are taken, however, it emerges that the majority of these were in April, and to a lesser extent in March, while all the levels above 850 cm occurred between May 2 and June 1. Since 450—700 cm maxima also occurred frequently in these

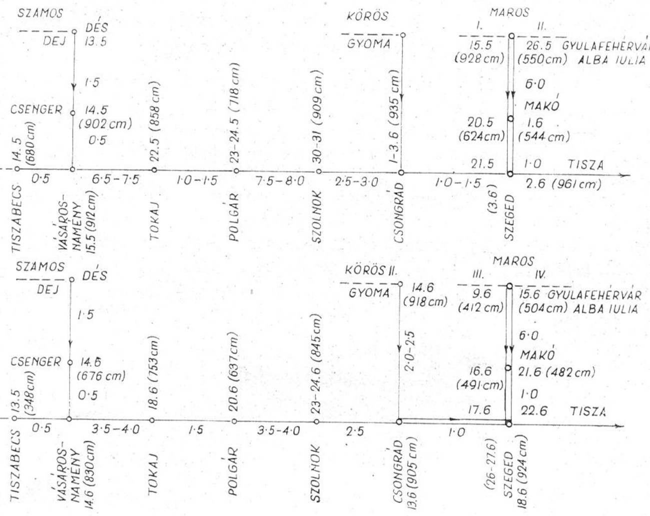

Fig. 17. Graphical diagram of the Tisza valley flood-wave descent in May and June. (The dates are the days of the peak levels; the cm values in bracketsar e the maximum water-levels; and the numbers on the graph-edges are the times of descent of the peak flood-waves, expressed in days.)

months, only one important conclusion can be made: if a very high water-level (maybe even higher than ever before) will occur in the Tisza at Szeged, then this can be expected with a higher probability in May and June than before May. The advanced season in itself does not mean a high flood-wave, but this is to be expected with the greatest certainty in the advanced season (presumably in the „special" situation in May-June which complements the effect of long and prolonged winter precipitation.

*

The great flood of the Tisza in 1970 was an instructive series of events which also provided incentives for the various sciences. It was possible to become reacquainted from new angles with this perhaps most loved of our rivers, which is certainly not easy for us to know as regards its entire behaviour, its calms and its caprices. However, the flood-level plaque erected in the main square of Szeged to commemorate the peak of the flood-wave no longer announces a catastrophe which has taken place, but instead a possibility of danger which was averted by technical skill and heroism. The Tisza was thus prevented from repossessing the Great Hungarian Plain, and Szeged was successfully savedfrom the threat of a repetition in 1970 of the flood disaster in 1879.

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DATA ON THE KNOWLEDGE OF ZOOFLAGELLATA OF THE RIVER TISZA

J. HAMAR

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Abstract

The present paper is raporting on the occurrence of the species *Bodo* and of *Collodictyon tricilliatum* CARTER from among the Zooflagellata to be found in the river Tisza.

Introduction

The most frequent ones of the Zooflagellata living in the Tisza are the species *Bodo* that are to be found almost in every biotop. 15 *Bodo* species were demonstrated by SZABADOS (1957, 1963, 1965) while 6 ones of the species reported on by the author are new for the Tisza.

Collodictyon triciliatum CARTER is new for the Tisza, as well.

About the occurrence of the genus Bodo

As the majority of Zooflagellata, a considerable part of the species *Bodo* are cosmopolites. Generally independently of climate and geographical distribution, they appear almost in every season even in the most extreme places where there is to be found some water, respectively organic matter.

They live and multiply like coprozoical organisms in faecal matter, some species of them can be found like cysts in the human and animal intestinal tracts, and getting out of the organism they prove viable. *Bodo caudatus*, *Bodo edax* are the species to be observed in large numbers in the faecal matter (HOARE 1927, WALKER 1911 in WATSON 1946, WENYON 1926).

The species *Bodo putrinus*, *Bodo edax*, *Bodo celer*, *Bodo saltans* are considerable representatives of the rich microfauna in the livestock manure (VARGA 1953, SZABADOS 1948).

After that it seems to be natural that they can be found in various stages of the decomposition of organic matters, of course with a different species and individual number, indicating anyway their surroundings well. They can therefore be used well in the saprobiological qualification (KOLKWITZ—MARSSON 1908, LIEBMANN 1951, SLÁDECEK 1963, etc.). They are not so characteristic of the first phase of decomposition (hypersaprobiological zone SRÁMEK—HUSEK (1956), coprozoical zone „a"; bacterium community FJERDINGSTAD (1964) as of the second phase (a-polysaprobical zone SRÁMEK—HUSEK (1956), coprozoical zone „b": *Bodo community* FJERDINGSTAD (1964) .

In the strongly polluted (polysaprobical) waters the species *Bodo putrinus, Bodo minimus, Bodo edax, Bodo caudatus, Bodo rostratus, Bodo celer* appear in large numbers. In another -third- phase of decomposition — called α-mesosaprobical zone — the species *Bodo globosus, Bodo saltans, Bodo mutabilis, Bodo compressus* are characteristic.

In rivers, brooks the organic matters of allochtonous or autochtonous origin can always be found to a certain degree, making possible the presence of the Bodo species. On this basis, the separation of three types seems to be necessary in case of the rivers (e.g. Zagyva, Tisza).

1. Waters polluted not at all, or but in a low degree, where the great masses of the decomposing organic matters are of autochtonous origin. In the plankton of these we can find the organisms indicating pure water — β-mesosaprobical ones —, in case of the Tisza we find *Bodo spora, Bodo variabilis, Bodo moroffi*, respectively more rarely the organisms indicating a water a little more polluted — α-mesosaprobical ones —, like *Bodo globosus, Bodo mutabilis*; in its periphyton *Bodo triangularis, Bodo globosus, Bodo mutabilis, Bodo saltans*, and *Bodo caudatus* are the most frequent ones (ERTL 1970).

2. In case of local pollutions a larger amount of waste-water gets into the river. That makes its effect feel for a shorter or longer time, depending upon the capacity of the river. At Szolnok, below the inrush of the waste-water from the sugar-works, *Bodo putrinus* and *Bodo caudatus*, indicating the strongly decomposing organic matter, can be found in large numbers while in the community of the *Sphaerotilus natans* KÜTZ. flakes, developed as a results of the waste-water of the paper-mill, *Bodo putrinus, Bodo globosus* and *Bodo minimus* are present. The river is polluted by these flakes that are often washed away to great distances.

3. In case of waste-water waves or of standing, strong pollutions, the self-purification of the river is frequently not enough for decomposing the organic matters and, therefore, the river changes into a sewer (HAMAR 1970—71). In its plankton *Bodo putrinus* and *Bodo saltans* appear. In the benthical community of the polluted river — in the α-polysaprobical zone — in the *Euglena* community *Bodo globosus* and *Bodo minimus* appear in the *Beggiatoa* community of the β-polysaprobical zone *Bodo minimus* can be observed (FJERDINGSTAD 1964).

There are known some species that could be found so far only in pure waters, like *Bodo designis* SKUJA, *Bodo stigmatophorus* SKUJA, *Bodo fusiformis* LEMM. (SKUJA 1946—48, 1956, LEMMERMANN 1914).

Bodo curvifilus GRIES. is a sea species (GRASSÉ 1952).

Bodo perforans HOLL. is an ectoparasite of *Chilomonas paramecium* EHR. (HOLLANDE 1938).

It is proved by the investigation of some samples taken from various places of Earth that from among the Protozoa of soil the Zooflagellata, more intimately the species *Bodo (saltans, celer, edax)* are the most frequent ones (VARGA 1933, 1953, 1956, ROSA 1957, 1961, 1963).

Bodo celer KLEBS (Fig. 3. 4)

A little bent, oval cells, of size 8—10×4—5.5 μ, below widely rounded, ahead ending in a blunt point from which a flagellum of 1.5—2-fold body-length protrudes. The central nucleus, one contractile vacuole can be found at the anterior end of the body. Its motion is rotaring or bounding here and there.

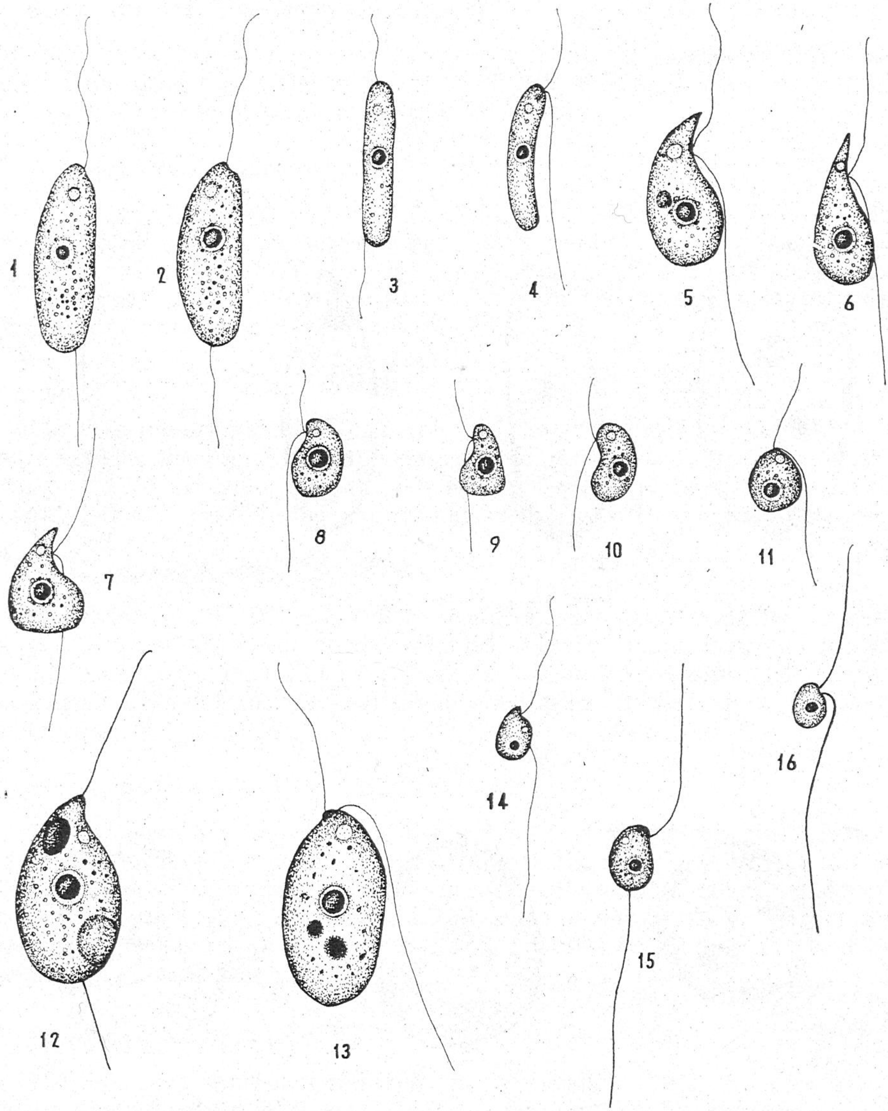

Fig. 1. 1—2, *Bodo mutabilis,* 3—4, *Bodo varians,* 5—7, *Bodo uncinatus,* 8—10, *Bodo minimus,* 11, *Bodo moroffi,* 12—13, *Bodo compressus,* 14—16, *Bodo spora*

Bodo compressus LEMM. (Fig. 1.: 12—13)

The cells are oval, flattened, of size 10—17.5×6—10μ. Its anterior part ends in a short, bent point from where flagella of obout 1.5-fold body-length take their origin. There are a central nucleus, one contractile vacuole in various parts of the body. The kinetonucleus can rarely be seen even unstained immediately under the anterior part. There are always to be found in the cell food vacuoles of different sizes. In movement the cell lies on its pressed left side and advances wobbling.

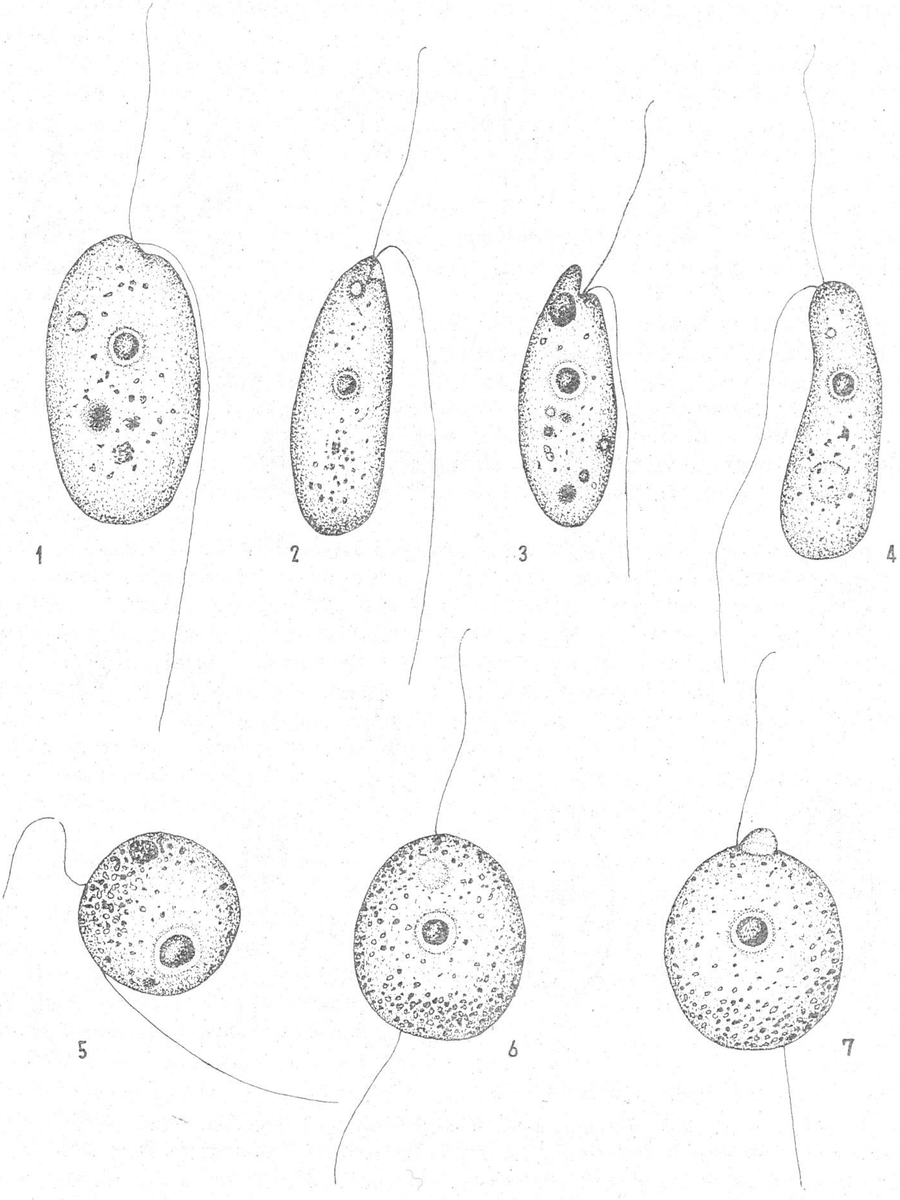

Fig. 2. 1, *Bodo repens*, 2—3, *Bodo saltans*, 4, *Bodo celer*, 5—7, *Bodo globosus*.

Bodo globosus Stein (Fig. 2.: 5—7)

The cell are spherical, rarely deformed, of 3—13μ diameter. The two flagella are of the same length, monstly the double of the body-length. Central nucleus, one contractile vacuole may be found in different parts of the body, rarely protruding. The plasma contains small granules. Its motion is wobbling, without rotation.

Bodo moroffi VALKANOV (Fig. 1.: 11)

The cells are spherical, with 3—7μ diameter. The central nucleus, one contractile vacuole take place below the origin of the flagellum. The flagella are of 1.5-fold body-length. Their motion is slow, steady.

Bodo minimus KLEBS (Fig. 1.: 8—10)

The cells are bean-shaped, of 4—5×2—2.5μ size. The flagella take their origin from the recess beneath the anterior part, the swimming flagellum being of body-length, the trailing flagellum somewhat longer. The central nucleus, one contractile vacuole can be found in the anterior part of the body. The plasma is finely granulated. It has a slow, bowing-crawling motion.

Bodo mutabilis KLEBS (Fig. 1.: 1—2)

The cells are cylindrical, behind rounded, ahear ending in a blunt point. One side is straight, the other one bent in various degree. The cells are of 8—14×3—5μ size. The flagella are about 1.5-fold body-length. The central nucleus, one contractile vacuole can be observed in the anterior half of the body. It is of swimming motion.

Bodo repens KLEBS (Fig. 2.: 1)

The shape of cells is from oval to ovoid one, their size being 10—15×5—7μ The cell is ahead flattened, behind rounded. The swimming flagellum is shorter than the body-length, the trailing flagellum is of double body-length. The nucleus and one contractile vacuole may be found in the anterior half of the body. It is of bowing-crawling motion.

Bodo saltans EHR. (Fig. 2.: 2—3)

The oval cells are 16—21μ long, the anterior part ending in a blunt point. The flagella take their origin from the recess beneath the anterior part that can be of different depth. The central nucleus, one contractile vacuole can be found in the anterior half of the body. The plasma is granulated in various degree. The swimming flagellum is of body-length while the trailing flagellum is 1.5—2 times longer than the body. Its motion is wobbling.

Bodo spora SKUJA (Fig. 1.: 14—16)

The cells oval, somewhat romboid, mildly metabolic, of 3—3.5×3μ size. The flagella come from the mild recess beneath the anterior part. The swimming flagellum is of 2—3, the trailing flagellum of 3—4-fold body-lenght. The central nucleus, one contractile vacuole can be found in the anterior part. Its motion is uniformly advancing.

Bodo uncinatus (KENT) KLEBS (Fig. 1.: 5—7)

The egg-shaped cells are a little metabolic, 8—10 μ long. Their posterior part is rounded, the anterior part is laterally declining and anding in a point, under these take place the flagella. The swimming flagellum is of body-length, the trailing flagellum is a double body-length. The central nucleus, one contractile vacuole can be found in the anterior part. Its motion is quick, jumping.

Bodo variabilis (Stokes) Lemm. (Fig. 1.: 3—4).

The cells are cylindrical, at their ands rounded, straight or weakly bent, having a size of $11 \times 2\ \mu$. The swimming flagellum is of a half, the trailing flagellum of 1.5—2-fold body-lenght. The central nucleus, one contractile vacuole are in the anterior half of the body. The plasma is a finely granular. It is a bowing motion.

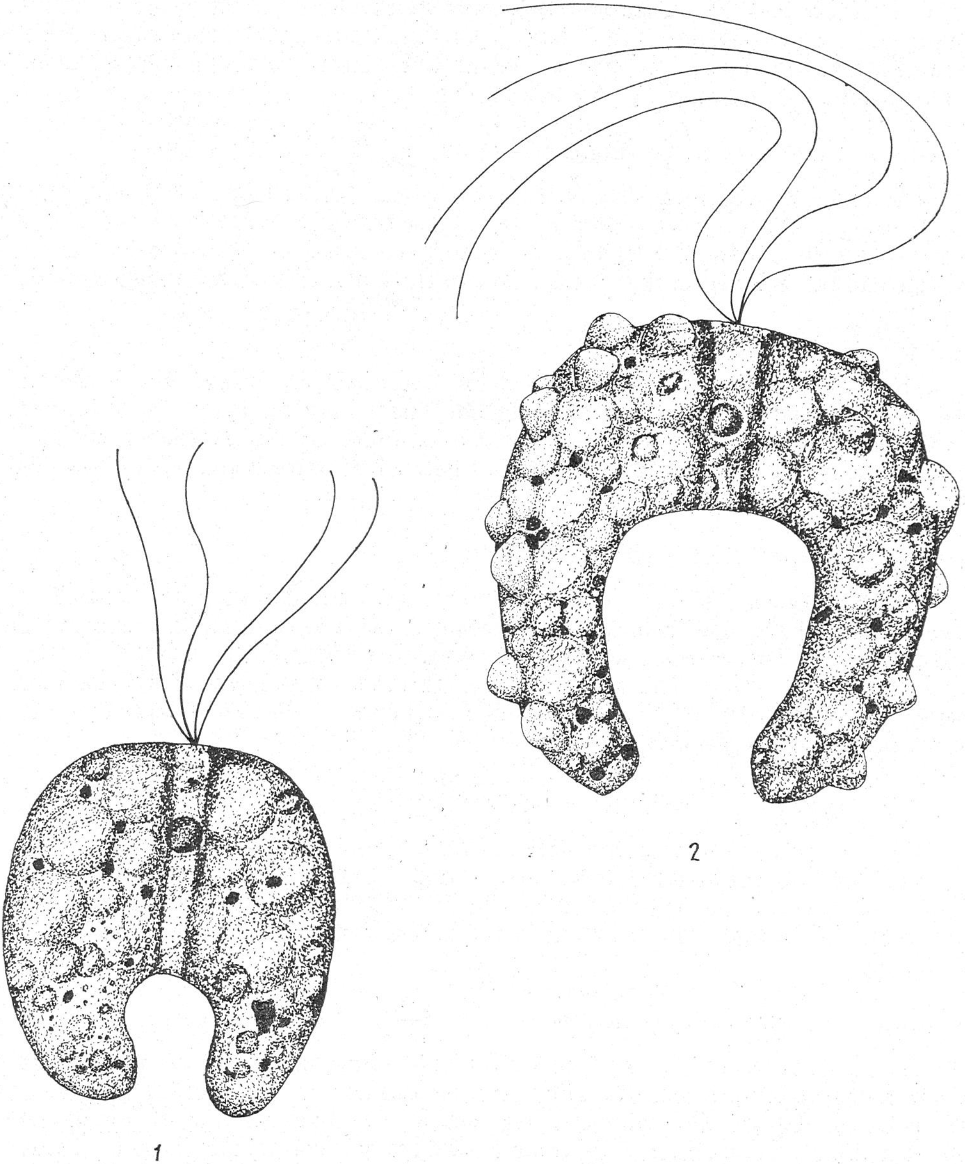

Fig. 3. 1—2, *Collodictyon triciliatum*

Data on the distribution of Collodictyon triciliatum Carter

The characterization of the species described by CARTER is completed by FRANCÉ (1904). Then its morphological peculiarities, the way of its multiplication is reported on in details by BELAR 1921).

According to FRANCÉ it is to be found in rather smaller muddy pools, in ditches along the way, in smaller eutrophic waters in larger numbers and in the company of *Trachaelomonas*-es as their consumer. GRASSÉ (1952) mentions it as a phagocyte, consuming smaller unicellular animals, e.g. Ciliata. The author found it in the Tisza, under the influance of the paper-mill waste water in large numbers, in a little polluted (α-mesosaprobical) water, as well as in the overflowing water of the oxidation tank, in the company of the species *Euglena, Uronema marinum*, in an α—β mesosaprobical water.

PASCHER (1927) and SKUJA (1956) regard it as Phytomonadina that is a member of the colourless and phagotrophic family. GRASSÉ (1952) classes it among the Zooflagellata of uncertain sistematic place while LEMMERMANN (1914) and STARMACH (1968) are reporting on it among the Zooflagellata.

Collodictyon triciliatum CARTER (Fig. 3.: 1—2)

The oval-shaped cell is strongly metabolic, ahead rounded, behind supplied with 1—3 processes, of 20—60 μ length. Four anterior flagella of equal length, with 2—4 blepharoplast. The plasma is often filled in by the central nucleus, 1—3 contractile vacuoles, and several food vacuoles. Its motion is rotating. It is phagocyte, taking its food by means of the longitudinal furrow observed on its side.

I acknowledge with thanks the kind help of my dear colleague T. GAÁL and that of O. ARATÓ

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DIE FLECHTENVEGETATION DER ESCHENBAUMSTÄMME LÄNGS DER THEISS

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Auf den Überschwemmungsgebieten der Theiß in Ungarn und in Jugoslavien habe ich zwischen 1926 und 1970 die Flechtenvegetation der Baumarten der Eichen-Eschen-Ulmenwälder *(Fraxino pannonicae—Ulmetum)* untersucht. Es hat sich erwiesen, daß die Flechtenvegetation der Eschenbaumstämme *(Fraxinus angustifolia, F. pennsylvanica)* die reichste ist.

Im Laufe meiner Untersuchungen habe ich mir die folgenden aufgaben gestellt:

1) Sammlung und Bestimmung der an den Eschenbaumstämmen vorkommenden Flechtentaxen;
2) Die Untersuchung der Flechtenbesiedlung der jügeren (glatten), bzw. rissigen (älteren) Baumstammniveaus, die Feststellung ihrer syngenetischen und ökogenetischen Verhältnisse;
3) Die Beobachtung der Veränderungen der Epiphytenflechten-vegetation der Stämme in Spiegel des regionalen Vorkommens;
4) Die Ermessung und zönologische Bewertung der an den Stämmen vorkommenden Epiphytenflechtenzönosen.

Ergebnisse

a) Auf den erwähnten Überschwemmungsgebieten der Theiß kommen zu 14 Familien gehörende 68 Flechtenspezies und deren zahlreiche Varianten vor. Die Anzahl der Fundortangaben ist: 274.

b) Die Borke der Stämme ist an den unteren und mittleren Niveaus, ungefähr bis zum 150 cm Höhe, von rissiger, rauher Oberfläche und verhältbismäßig glatt am oberen Niveau, ungefähr über der Höhe von 150 cm. Es zeigt sich ein Unterschied auch zwischen den in pH Werten ausdrückten Reactionen der Rinden der zwei Niveaus, insofern das pH der bodenständigen Zone ungefähr einen Wert 5,16, das der mittleren Zone 5,20 und das obersten Zone 5,39 zeigt.

In Hinsicht dessWasserhaushalts sind die Stämme mesophilen Typus. Die stark beschatteten Stämme haben eine dünne, die nur ein wenig beleuchteten Stämme eine reichere und die gut beleuchteten eine üppige Flechtenvegetation. Für Bestimmung der Feuchtigkeitsverhältnisse habe ich Piche'sche Evaporimeter angewandt.

An den oberen, jüngeren, glattrindigen Oberflächen der Stämme sind die Krustenflechten *Polyblastiopsis fallaciosa, Arthonia dispersa, A. punctiformis* und *A. radiata* die Pioniere dann die zu den Genera *Lecanora* und *Lecidea* und ihnen folgend zu den *Rinodina* und *Caloplaca* Gattungen gehörene Arten erscheinen.

An den rissigen Mittelteilen treten auch schon die Laubflechtenarten der Genera *Candelaria, Parmelia, Xanthoria* und *Physcia* auf und erscheinen selbst einige Strauchflechten, wie z. B. *Evernia prunastri, Pseudevernia furfuracea* und einige *Ramalina species*. Der Lauf der Sukzession kann also an den Stämmen von oben nach unten schreitend selbst in einem identischen Zeitpunkt gefolgt werden.

c) Der Lauf der Theiß von der sowiet-ungarischen Grenze bis zur Mündung kann in drei Strecken getrennt werden. Die prozentuale Verteilung der an den Eschenbaumstämmen längs der drei Strecken vorkommenden und nach Lebensformen gruppierten Flechtenarten ist in der unterstehenden Tabelle dargestellt:

Lebensformen	Obere	Mittlere	Untere
	Strecke		
Krustenflechten	16	17	20%
Laubflechten	77	70	69%
Strauchflechten	7	13	11%
Zusammen:	100	100	100%

Die hohe Zahl der Vorkommnisse in der mittleren Strecke ist auffällig und läßt eine Folgerung darauf, daß die zu allen drei Lebensformen gehörigen Flechten ihre entsprechendsten Niederlassungsumstände und ihr mikroklimatisches Optimum in dieser Strecke finden.

d) An den Eschenbaumstämmen der untersuchten Flutgebiete kommen die folgenden Flechtenzönosen vor:

1. *Arthonietum dispersae* Gallé (Häufig)
2. *Lecanoretum carpineae continentale* (Gallé) Barkm. (Häufig)
3. *Physcietum ascendentis* typicum Frey. et Ochsn. (Häufig)
   var. *parmeliosum glabrae* Barkm. (Häufig genug)
   var. *physciosum griseae* Barkm. (Häufig)
4. *Xanthorietum candelariae* Barkm. (Häufig genug)
5. *Parmelietum acetabuli* Ochsn. (Kommt sporadisch vor)
6. *Parmelia caperata* synusium. (Selten)
7. *Parmelietum furfuraceae* Hilitz.
   var. *protococcetosum viridis* Barkm. (Selten)

An den *Fraxinus* Stämmen längs der Theiß kommen also 7 Epiphytenflechtenzönosen vor. Von diesen haben 6 Assoziations-, 2 Varietäts- und 1 Synusiumswerte. Die Zönosen sind von dem mesophilen, bzw. wenig xerophilen Typus, sie sind photophil, größtenteils mit mäßig acidophilen und ein wenig stickstofftoleraten Charakterarten.

DATA ON THE CHIRONOMUS FAUNA OF THE FLOOD AREA OF THE TISZA AT TISZAFÜRED—KISKÖRE

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(Received June 30th 1971)

Abstract

The author is establishing on the basis of his investigations that in the area that is water-covered after the water-basin being constructed the *Chironomus* species characteristic of the stagnant waters have kept on surviving in masses at present, too. In this way, the development of the rich benthofauna of the lake is guaranteed. It can, however, be checked by the anaerobic decomposition of the vegetation that has remained in the flood area and got under water, by the formation of hydrogen sulphide in large quantitites.

Introduction

It is well-known that the environmental changes react upon the quantity and species composition of the living beings. The Tisza region between Tiszafüred and Kisköre gets the character of a lake after the water barrage being constructed, and that changes its natural history, too.

It is important both from scientific and from practical points of view to know the present state because we are able, in this way, partly to study the process of development of the natural history of an artificial lake of such a large extent and partly to draw a conclusion concerning the predominating species and the factors determining the species composition of the natural history of the new lake. The practice expects an answer to the question, what quantity, and from commercial respect what quality, of fish can be assured by the new lake of 14,800 ha size, and how can be achieved in fish-catching an as favourable ratio as possible of "noble" fish opposite to "rubbish" fish.

In 1970 I began investigating the *Chironomus* species of the indicated areas taking into consideration the research tasks outlined.

Materials and Methods

As the inundation period had been prolongated long owing to the extraordinary weather, I could carry out my observations and collection in the indicated areas in the parts marked out of the grassland at Cserőköz, the meadow at Tiszanána and the meadow at Sarud (Fig. 1) only between 21st and 23rd October.

I took mud-samples by means of Ekman's mud-gripper from the barrow pits in which there was water in the time of collecting, rewqshing them through a sieve set on the spot. I fixed the nymphs found in the samples in 80 per cent alcohol. From the vegetation of the collecting stations I have collected imagos by singling, and by applying a net, fixing these similarly in 80 p. c. alcohol.

Results, conclusions

In the course of elaborating the material collected, I have determined the following species:

Tanypodinae:

Ablabesmyia monilis L.

Chironominae:

Chironomus anthracinus Z.,
Chironomus aprilinus Mg.,
Chironomus thummi K.,
Chironomus winthemi Goetgh.,
Endochironomus tendens F. (nymph)
Stictochironomus sp. (nymph)
Tanytarsus sp. (imago).

At elaborating the material collected it was immediately striking that the species enumerated (except *Stictochironomus* sp.) correspond to the species of the rice-fields, irrigation canals, drain-canals and back-waters investigated systematically for eight years in the vicinity of Szarvas (Szitó 1968). The species recorded on, similarly to those in the areas at Szarvas, are of predominating character as to the number of individuals, as well. I caught with net in the collecting area of the Tisza with the highest individual number the imagos of *Chironomus thummi* K. and *Ch. anthracinus* Z., both having large bodies.

It follows from the high number of individuals that the species mentioned are standing members of the fauna of smaller or larger back-waters, stagnant waters in the Tisza region investigated.

Owing to the high-degree similarity of the species of two areas lying so far from each other, we can say for certain that we shall find several species characteristic of standing waters by means of still more exhausting collections to be carried out in the area of the to-be reservoir in the summer months. The *Chironomus* species that will populate the lake to be constructed and the present flood area after being covered with water are, therefore, living in that area at present, too. Because of the slow filling in of the lake, in the first fey years the shallow lake may mean very favourable conditions for the multiplication of the species to be found here. The living and deceased vegetation to the lake will be an abundant source of food for the mining and mud-dwelling nymphs.

As long as in this immense area, in the first years of damming up the lake, the water vegetation of the previous flood area grows above the water surface, these places will assure a favourable possibility for the multiplication of the various *Chironomus* species, and we may reckon with a very rich mud-fauna. On the other hand, as the depth of water grows in the course of damming, the vegetation rising above the water surface will be limited more and more to the riverside regions, and the occurrence of the *Chironomus* nymphs, too, can be expected in large numbers first of all in these places.

After restocking the lake, the consumption of the bottom fauna by fish will, of course, contribute to decrease their number. That will, however, not be a decisive factor in the decrease of nymph number; this factor will be the lack of being covered with vegetation.

The appraisal of the food supply of the zooplankton in the lake must precede the blueprint of fish-breeding in the water-basin. That is important first of all for the carp-breeding, so much the more because the subordinate part of the *Chironomidic* nymphs in the feeding of carp is confirmed by the most recent investigations (MEGYERI 1969).

On the other hand, the development and importance of the mud-fauna depends on the so-called redox-level. In May 1970, G. UHERKOVICH raised the question in his address delivered at the Conference of the Tisza research that the decomposition of the great quantity of organic matter getting under water-covering may bring about unfavourable conditions for the animal kingdom of the lake. On the basis of Berczik's investigations (1962), he is setting out the fact that in places where the hydrogen-sulphide (H_2S) level is on the surface of mud or above it the mud-dwelling nymphs of the *Chironomus* are missing: either they have perished owing to being poisoned or, feeling the danger of perdition, they have escaped into higher regions.

If in the new water-basin the hydrogen-sulphide (H_2S) level is over the mud surface owing to the large quantity of organic matter then — until its decrease and sinking under the mud surface — we cannot speak of a mud-fauna. As there will be an intensive fish-breeding in the lake, it is necessary to carry out thorough investigations from this point of view before the beginning of that.

Summary

From knowing the *Chironomus* fauna of the areas getting under water-covering we can conclude the species composition to be expected in the water-basin. As a result of the standing-water character of the lake, first of all the predominance of the backwater species, resp. that of those with wide ecological valancy is to be expected.

An intensive fish-breeding is only possible on the basis of the knowledge of the biochemical conditions subsisting in the lake.

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EXPERIMENTAL INVESTIGATION OF THE RESPIRATION OF NYMPHS OF PALINGENIA LONGICAUDA OLIV. (EPHEMEROPTERA)

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(Received on December 30th 1970.)

Abstract

The oxygen consumption of the nymphs of *Palingenia longicauda* OLIV. is influenced by temperature and light, as depended upon their age. The oxygen requirement calculated according to the body weight is higher in case of younger nymphs than in that of older ones. The older nymphs, however, increase their oxygen requirement in a high degree before their transformation. After a transitory inhibition, the oxygen uptake is stimulated by light similarly as by temperature.

The investigations of respiration have a very great importance in understanding the ecology of the insects living in water. That is shown also by the rather comprehensive literature already treating of this problem. The mayflies have, however, been pushed fairly into the background in this respect. Our experimental animal, *Palingenia longicauda* OLIV. belongs to this group, as well. Its limited geographical distribution, the long development of its nymphs, its peculiar ecological conditions, and the very short life of the imago are raising several problems to be responded. For understanding these we can get a great help by recognizing their respiration. Taking into consideration the entirely special demands of this organism, we may reckon upon drawing a conclusion by means of them concerning the physical state, pollution of water. That is to say, the nymphs of *Palingenia longicauda* OLIV. as bio-indicators may characterize the pure state of natural waters. With regard to that, we investigated seasonally (September—October) the respiration of the nymphs of this organism, as induced by various factors (light, temperature).

Materials and Methods

The nymphs of different age, development and weight of *Palingenia longicauda* OLIV. were collected partly from the reaches of the Tisza, partly from those of the Maros at Szeged (between September 11th and October 30th 1970). They were investigated partly immediately, partly after a laboratory observation for a longer or shorter time.

The oxygen consumption of animals has been determined by Warburg's manometric process. There was put one animal of known weight in each 5 ml fluid of the manometer vessels, and 0,2 ml 20 p. c. KOH was measured to it for fixing the carbon dioxide produced at the respiration. The vibration speed was 77/sec. Our experimental results have been established from the data of 24 parallel measurements.

At our experiments we have endeavoured to ensure that they should reflect the natural states, standing very close to them. Therefore examining the oxygen consumption of the animals put in distilled water, we have measured, as a control, also the respiration of some animals in filtered Tisza water (for that purpose we had taken water from a site where there was no sewerage in a distance of 100—150 m). At evaluating the factors having influence on the intensity of respiration, there have always served the quantities of the oxygen consumption calculated for 1 gr live weight (Q_{02}) as a basis for comparison.

Results and their discussion

It is a known fact that the intensity of respiration is influenced by external and internal factors and that among them the latter ones are of higher importance. For being able to understand their essence, we may not separate the two ones from each other. That was taken into consideration as we have reported on the effect of some physical factors modifying the intensity of respiration.

First we wanted to clarify, of what degree the difference is between the respirations in natural water (river water) and in distilled water, and in which degree the water influx could be regulated, resp. tolerated by the nymphs investigated in an ionless milieu. It has appeared in the course of the comparison of the two parallel investigations that the values measured in distilled water were in any case higher (Table 1), showing that a major change in the osmotic relations could not be tolerated by the nymphs. The organism hasn't any regulative system for impeding the influx of pure (ionless) water. A fast permeation of water is overstraining the energy system of organism, increasing for a while its metabolism, its oxygen requirement but leading at last to the destruction of the organism.

Table 1. *Oxygen consumption of the nymphs of Palingenia longicauda* OLIV. *of different weights*

Body weight of nymphs in mg	Q_{O_2}	
	Filtered river water	Distilled water
230	2.79	3.52
280	2.07	3.24
620	1.90	2.09
630	1.82	2.49

As known, the nymphs of *Palingenia longicauda* OLIV. live in dark ducts made by themselves. It may be supposed that they are adapted to the ecological conditions like these to a great extent, and their photosensitivity changed, as well, considerably. As photosensitivity can be concluded from the behaviour in the dark and by daylight — in the present case from the change in the intensity of respiration — we have measured the oxygen consumption of nymphs first in the dark and then by daylight. For studying the effect of daylight, we have illuminated the nymphs with a light of 90 lux.

It is obvious from the data of the Table that, at measuring the oxygen consumption, we have also taken into consideration to have animals in the vessels with a proportionately growing weight. It turned out that the values of the oxygen consumption for an hour of the nymphs were growing till a ceratin weight group and then, after a strong decrease, they begin increasing again. The phenomenon may be connected with the different age of life of the nymphs. This conection is in case of *Palingenia longicauda* OLIV. of linear character.

It is shown by several ecological investigations that there is a connection between the development of animals, food, etc. and the oxygen consumption (EDWARDS 1937, FOX et al. 1937, ALLEN W. KNIGHT and ARDEN R. GAUTIN 1966, ERIKSEN

Table 2. *Values of the oxygen consumption (20 °C) of the nymphs of Palingenia longicauda* OLIV. *of different weight in the dark and by light (90 lux)*

Body weight of nymphs in mg	Values measured in the dark		Values measured by light	
	O_2 consumption in 1 hour in ml	Q_{O_2}	O_2 consumption in 1 hour in ml	Q_{O_2}
155	—	—	48.2	3.41
200—300	44.3	1.70	62.8	2.57
300—400	68.7	1.94	62.7	1.96
400—500	131.2	2.70	64.8	1.40
500—600	85.7	1.67	71.1	1.30
600—700	115.0	1.82	90.3	1.68
700—800	—	—	132.0	1.85

1968, REICHLE 1968, THEODORE et al. 1968). Genetic determination, development and sexual maturity have, anyway, some importance, too. It can be seen from our results, as well, that the metabolism of younger animals is more active than that of older ones, and that before sexual maturity, resp. during it, the respiration of nymphs is rocketing.

As a result of light, the Q_{0_2}-values change in inverse ratio to the decrease in weight of nymphs, that is to say they decrease but that is valid only till about 600 mg body weight. Above that weight group, the Q_{0_2} increases again, and the data obtained don't show any major difference from those measured in the dark.

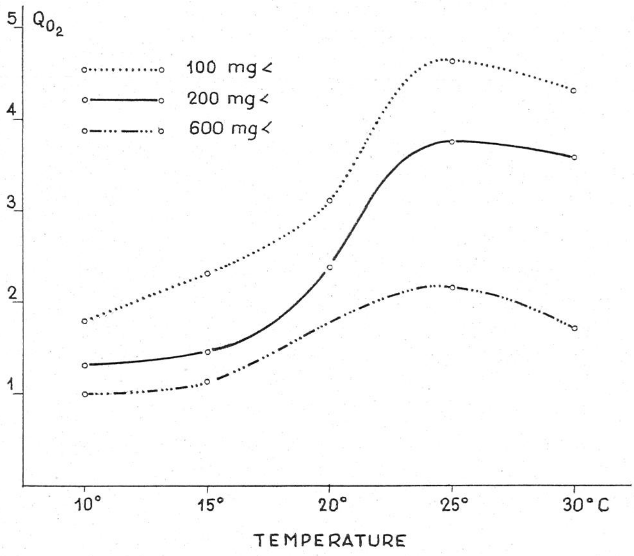

Fig. 1. Oxygen consumption of the nymphs of *Palingenia longicauda* OLIV., taken as a function of temperature.

It can be established by comparing the values of Table 2, that the O_2 consumption of the nymphs of *Palingenia longicauda* OLIV. is inhibited by the light in the ratio of the increase in body weight till the state of sexual maturity; then, however, just the other way round, the light is exerting a stimulatory effect.

It is known that the animals don't respond to the light in the same way. There is elicited some light reaction at animals adapted to the daylight and another at those accustomed to the dark. Thus, for instance, at the *Tetrahymena pyriformis* GL. accustomed to the normal light the respiration is stimulated by being illuminated (Biczók 1968). We can draw the conclusion from similar results (Edwards 1937, Istenič 1963), as well as from our own measurement, that the nymph of *Palingenia longicauda* Oliv. has for a long time adapted itself well to living in the dark. In the

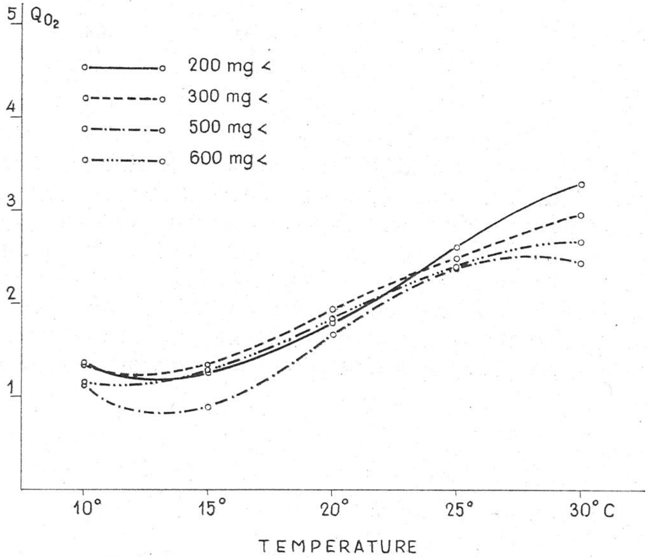

Fig. 2. Thermo- and photo-induced (90 lux) oxygen consumption of the nymphs of *Palingenia longicauda* Oliv. of different weight.

final period of their development, however, there comes into prominence a light reaction that may obviously be characteristic of the imagos living in natural light. Here it must be noticed, too, that the motion of nymphs is more and more increasing in that time, and there may be observed a striving from the concealed course of life after a less or not at all concealed course.

Apart from the light, we have taken into consideration the effect of heat, as well. As kown, the metabolism of an organism is increased by temperature (Edwards 1937, Fox et al. 1937, Berg et al. 1962, Istenič 1963). That is, of course, valid only till certain temperature value above which heat has already a damaging, devastating effect.

In case of the nymphs of *Palingenia longicauda* Oliv. the change in metabolism caused by the increasing temperature can be determined from the values of the graph of oxygen consumption recorded in Fig. 1. As was to be expected, the connection is of direct proportion, the oxygen consumption growing in the ratio of raising the temperature. That increase goes on till about 30 °C. After that a slow decrease can be observed.

It seemed to be interesting to investigate the common effect of two factors, namely that of an increase in light and temperature (Fig. 2). Also the curves showing the results have a single maximum, and it is at 25 °C.

The difference of the two graphs (Figs. 1 and 2) is decided. It may be recognized well that in case of a common effect of both factors the values of oxygen consumption are always higher as if the factors had exerted separate effects. In addition, the maximum presents itself about 5 °C earlier.

Summary

Values of oxygen consumption of the nymphs of *Palingenia longicauda* OLIV. have been investigated under standing and changing temperature and light conditions. We have established that the metabolism of younger nymphs, under identical conditions, is more active than that of older ones, except the last nymph state where we have observed an increased oxygen consumption before the formation of imago.

The oxygen uptake was initially inhibited, later on stimulated by light. The temperature was of stimulating effect on any nymphs. Above 30 °C, metabolism was decreasing owing to the photo-lesion.

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INVESTIGATION OF COMPOSITION OF THE FISH POPULATION IN BACKWATERS BELONGING TO THE AREA OF WATER-BASIN II OF THE TISZA

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Abstract

It is planned in our country that a water-basin connected with the river barrage at Kisköre will be formed in the Tisza from 1973. The inundation, touching a living-water sector of about 41 river-kms, makes several dead channels (backwaters) cease to continue. Taking into consideration the biological effects of the transformation, it is necessary to investigate the present states. That is important also for preparing the fishing plans of the area. In this paper the backwater results of this investigations are published. In the course of the work, the author has examined 4010 fish-baskets and 6928 fish exemplars, representing 22 species. Five of them are of outstanding significance as they were giving 70.83 per cent of the exemplars investigated. Further eight species appeared to be frequent, four species to be common, and five ones to be rare.

Introduction

Commissioned by the Station for Piscicultural Research at Szarvas, in June 1970 we began dealing with investigating the Tisza sector belonging to the area of water-basin II of the Tisza. Our work had begun in the living part of the Tisza; we were feeling, however, already in the first months that we can only imagine even approximately the original fish population of the water-basin if our work includes the backwaters, as well. We had chiefly two reasons for deciding so:

1. The ichthyological research works of the Tisza back-waters have produced so far but few results, we have hardly any literature in this relation.

2. After evaluating the catching data of the "May 1" Fishing Co-operative for 1968 and 1969, it manifested itself that 54.1 per cent of the marketable fish amount came from the back-waters. This fact proves the fishing and biological importance of the backwaters, and justifies in itself the amplification of the matter of research.

Place and time of investigations

The backwaters investigated take place in a geographically well-separate unit of the Middle Tisza Region, along the right and left banks of the river. On the side from the Nagykunság the Backwater of Örvény and the Backwater of Füred (under its local name: the Little Tisza at Füred) are lying while on the open flood-area side from Heves-Borsod the Small-Backwater and Large-Backwater take place.

The structural-morphological largeform of the area is a river inundation plain, the form-group of its relief being a low inundation area. Its surface formations are the present river deposits: silt, clay, and sand. In its configurations of the terrain, the alluvial cones from the Holocene and the backwaters, meanders are predominating. The anthropogenic forms of the surface are the outer and inner flood dams and dykes fringing the area, water conduits and railway-embankments.

There are characteristics of the climate: the frequent foehn character of the atmospheric motion, the comparatively few clouds (50 p.c.), plenty of sunshine (2000 hrs/year), manifestation of a comparatively dry character (annual precipitation: 550 mm, annual water-evaporation: 525 mm, annual water deficiency: 150 mm), a daily and annual fluctuation of temperature on a rather wide scale. The unrelieved surface is connected with the uniformity of climate, being deficient in micro- and mezzoclimates (BULLA 1962).

The water-systematic axis of the area of investigation is the Tisza. The water-level of backwaters is in correlation with the water currents in the Tisza. From the two annual inundations that are characteristic of the Tisza that following the thawing of the snow in Spring in the decisive one for the water supply of backwaters. The river, flooding at that time, fills in and refreshes the stagnant water of mortlakes. The second inundation wave, appearing at the precipitation maximum in the early summer, has only an importance if owing to a late thawing of the snow the two inundations are composed and, in that case, the area is covered by continuous water for long months (e.g. in 1970). The inundation that seldom presents itself in the Upper Tisza Region, owing to a Submediterranean influence, has no importance for the water supply of backwaters. At the time of the periods of little water, reflecting a continental effect (late summer, early autumn) also the water of backwaters decreases considerably. While in the Large-Backwater and in that of Füred there remains a considerable water quantity at that time, too, the Small-Backwater and that of Örvény frequently becomes a marsh if the inundation failed to come about that year, resp. they may even dry up if they don't get the water supply for several years.

The time of our investigations was determined by the possibilities of fishing. The fisher helping our work laid the fish-baskets, corresponding to the water level of the river either in the Tisza or in the backwaters. In 1971 there was low water in the Tisza frequently and for a long time what was more favourable to angling and the fish-baskets were used by the fisher in the backwater. In this way, the data of a comparatively long period are available for us. Our work was done between May 18th and September 10 1971, on 84 occasions altogether.

Method of investigation

In the backwaters, the predominating, and even nearly single, method of fishing is that performed with fish-baskets. In the period of our work, we haven't find any other method at all. The method of our work was determined by that.

We took part, together with the fishers, in taking up the fish-baskets at early dawn, and determined the fish that got out of the fish-baskets (STOHL-WOYNÁROVICH 1950, BERINKEY 1966, WOYNÁROVICH 1969). recording the data. At the Cyprinidae that can only be separated with difficulty we have applied Vásárhelyi's method (1956) of determination with throat teeth. (ossapharyngea inferiora). Our work was extended to the fish caught by the sport anglers, as well. In this way, we got hold of some data that could not be obtained with fish-baskets.

Materials, results of investigations

In the course of the work we examined 4010 fish-baskets altogether in which 5597 fish exemplars were found. In addition, we have determined 1331 exemplars with the help of sport anglers. That means together with the previous ones 6928 exemplars. Our conclusions have been drawn on the basis of the elaboration of that fish quantity.

1. Qualitative composition of the fish population of backwaters:
In the course of the work, the 6928 fish exemplars were determined. A great part of the species, 14 species, belong to the family Cyprinidae, 4 species are representing the family Percidae, while one species each is from the families Siluridae, Ictaluridae, Esocidae *and* Centrarchidae.

Details are as follows:

Esocidae
1. *Esox lucius* L.

Cyprinidae
2. *Rutilus rutilus* L.
3. *Scardinius erythrophthalmus* L.
4. *Aspius aspius* L.
5. *Alburnus mento* AG.
6. *Alburnus alburnus* L.
7. *Blicca bjoerkna* L.
8. *Abramis brama* L.
9. *Abramis sapa* PALL.
10. *Abramis ballerus* L.
11. *Tinca tinca* L.
12. *Pelecus cultratus* L.
13. *Cyprinus carpio* L.
14. *Carassius carassius* L.
15. *Carassius auratus gibelio* BL.

Ictaluridae
16. *Ictalurus nebulosus* Le *Suer*

Siluridae
17. *Silurus glanis* L.

Centrarchidae
18. *Lepomis gibbosus* L.

Percidae
19. *Perca fluviatilis* L.
20. *Acerina cernua* L.
21. *Acerina schraetzer* L.
22. *Stizostedion lucioperca* L.

We should like to notice that the enumeration published here is no fauna register because it is sure that it does not contain every species. The reason of that is that (a) the fish-basket is only a selective instrument for catching fish, species of small individuals could not be get out of it; (b) these data are not a result of an observation for several years; this observation period is too short for constructing a fauna register; (c) the works went on only in four backwaters. Yet we felt necessary to construct this enumeration for giving — after being completed properly — a basis for comparison to later investigations a few years after the change in the present water-geographical situation.

The species belonging to the six families were found in the four backwaters in different distributions. Most species (19) were demonstrated from the Backwater of Füred. We succeeded in demonstrating 15 species from the Backwater of Örvény, and 14—14 ones from the Small-Backwater and Large-Backwater.

18 of the 22 species found in the backwaters are already mentioned by Vutskits, following OTTÓ HERMAN and others, but he does not deal with the quantitative distribution of the species recorded on by him. From among the known species, *Tinca tinca* L. does not occur in his work and, of course, there can't occur the species

naturalized since then, either, like *Carassius auratus gibelio* BL., *Ictalurus nebulosus* LE SUER, and *Lepomis gibbosus* L. (VUTSKITS 1904).

In every backwater lives *Cyprinus carpio* L. that prefers the waters of muddy bed, flowing slow.

Tinca tinca L. occurs similarly in all the four backwaters. From none of the places investigated was missing *Abramis brama* L., either. The presence of *Carassius carassius* L. in similar degree isn't any surprise, as well, as this species that tolerates well the shallow muddy pools is very frequent in the backwaters. It is, even on the basis of our investigations, more frequent in tha backwaters than in the river itself.

Rutilus rutilus L. is of frequent occurrence because it prefers particularly the waters grown by vegetation.

Scardinius erythrophthalmus L. is everywhere present. The rapid breeding in mass if this species in the backwaters is particularly characteristic of the area investigated.

Ictalurus nebulosus LE SUER — although its distribution isn't known exactly even to-day — is a frequent prey in each of the areas investigated. As it tolerates well the muddy places that are poor in oxygen, its rapid breeding is the backwaters seems not to be checked at all.

The species of backwaters supplying the most fish to the market is *Esox lucius* L. As its favourable food, Cyprianidae, live in large numbers in the backwaters investigated, it develops well, occurring in a high individual number.

Perca fluviatilis L., although occurring in every area investigated, has properly multiplied only in the backwaters abounding in water.

Stizostedion lucioperca L., avoiding the rapid reaches of a river, but looking for biotops of deeper water, subsists in the backwaters well. But we met it in large numbers only in the Large-Backwater.

Taking into consideration, how worthless economically *Lepomis gibbosus* L. is, it is regrettable that it has pullulated in every backwater. It multiplies in high degree in the easily warmed backwater (*e.g.*, in the Small-Backwater.) It is often fished in the river, too, but its occurrence in the backwaters is more considerable.

The 11 species mentioned seem to be fond of the ecological conditions in the backwaters as they are present in all the four backwaters. In addition to them, however, we must reckon on the occurrence of other species, as well. There belongs to them *Abramis ballerus* L. that was not found in the Small-Backwater and Örvény-Backwater, both poor in water, but is present everywhere in the slowly moving waters abounding in water. *Blicca bjoerkna* L. was now present only in two backwaters. It is to be attributed only to the size of the two *Alburnus* species that they could not be found in the waters investigated only by means of fish-baskets; we consider as probable also their presence in other backwaters. The occurrence of *Carassius auratus gibelio* BL., forming its population only of females, is increasing even under the conditions of backwaters. It is proved by its individuals fished in the Small- and Large-Backwaters that they are propagated by their multiplication in the way of gynogenesis (Deckert 1969) in wider and wider limits in the backwaters, too. *Acerina cernua.* L. can be fished both in the backwaters and in the water of river. Its frequent occurrence in the backwaters — even if not only in large numbers — can be regarded to be proved.

Further 5 species are less characteristic of these areas. The occurrence of *Aspius aspius* L. in the backwater is recorded by the literature, too (Deckert 1969) but here it was found but with few exemplars. *Silurus glanis* L., *Pelecus cultratus* L., and *Abramis sapa* Pall. are rather species from river water. *Acerina schraetzer* L. is rare in other water, as well. The individuals of these species must have remained behind in the backwaters at the separation after the inundations.

2. Quantitative composition of the fish population in the backwaters investigated:

In respect of the quantitative occurrence the backwaters are showing a colourful picture in spite of the presence of many identical species. That is, to be sure, ecologically reasoned. Fish is highly responsive to any change in the biocoenosis, and its multiplication, development depend decisively upon the conditions of life. That is complicated in case of a backwater by that the fish living there do react not only to the change in the biocoenosis of the backwater but, owing to the periodical connection with the living Tisza, to the changes in the Tisza, as well. The backwaters investigated differ from one another in respect of theirecological peculiarities. It may be explained by that from the point of view of quantitative occurrence the identity is much rarer. Considering that, we had better analyse shortly the backwaters investigated one by one (Table 1a, b, c, d).

As one of the aims of the work is to serve as a basis for comparison to later investigations, we have elaborated the frequency of the occurrence of the single species not with marking but numerically. We hope to get a picture more exact in this way.

a. Small-Backwater:

Three of the fourteen species, caught by means of fish-baskets from the backwater containing less and shallower water, are predominating: *Lepomis gibbosus* L. (33.16 per cent), *Scardinius erythrophthalmus* L. (23.35 p.c.), and *Carassius carassius* L. (12.87 p.c.). These are giving approximately 70 per cent of all the fish caught. *Ictalurus nebulosus* Le Suer (7.38 per cent), *Rutilus rutilus* L. (6.27 p.c.), *Esox lucius* (530 p.c.), and *Perca fluviatilis* L. (4.04 p.c.) are the further species to be called frequent in that area. The other seven species don't achieve even 8 p.c. what refers to unfavourable conditions being for them in that area. The exemplars of *Abramis brama* L. coming from that area have shown the marks of scragginess.

b. Large-Backwater:

The conditions of life found in a deeper water of larger surface resulted in a somewhat differring quantitative composition. Beside *Scardinius eryphrophthalmus* L. (21.6 per cent) and *Carassius carassius* L. (16.06 p.c.) that tolerate the backwater conditions like these, as well, *Lepomis gibbosus* L. (1.78 p.c.) went strongly back while *Rutilus rutilus* L. (17.96 p.c.) and *Esox lucius* L. (21.17 p.c.) found better conditions in the backwater of richer vegetation. That the essential conditions are of different character as compared to the former ones, it is shown by *Stizostedion lucioperca* L. (6.78 per cent) whose occurrence to a greater extent — considering its individual weight, toois important economically, as well. This fact is proved also by the frequent occurrence of further four species: *Ictalurus nebulosus* Le Suer (3.19 p.c.), *Carassius auratus gibelio* Bl. (2.49 p.c.), *Abramis ballerus* L. (2.43 p.c.), and *Cyprinus carpio* L. (2.16 p.c.). The occurrence of *Carassius auratus gibelio* Bl. in a such a proportion is considerable even faunistically.

c. Backwater of Örvény:

It is a typical „pond" of carp-pike-tench. These species markedly multiplied in the backwater refreshed by the inundation and since then becoming slowly drier.

Besides the occurrence in large numbers of *Carassius carassius* L. (45.71 per cent) and *Esox lucius* L. (14.94 p.c.) the presence in high proportion of *Tinca tinca* L. (10.30 p.c.) may be emphasized, in agreement with some literary data that notice the enormous multiplication of the tench, too, in some places (DECKERT 1969). Apart from these three species — that come to 71 per cent of the fish caught from the backwater — *Ictalurus nebulosus* LE SUER (6.86 p.c.), *Scardinius erythrophthalmus* L. (6.5 p.c.), *Lepomis gibbosus* L. (5.02 p.c.), *Cyprinus carpio* L. (4.11 p.c.), and *Rutilus rutilus* L. (3.90 p.c.) are worth mentioning.

d. Backwater of Füred:

Investigating the data of this backwater, it is to be mentioned that we have so far taken into consideration only the results of the sport anglers. We can get a real picture after completing these in the following with an investigation by means of fish-baskets, as well. *Alburnus alburnus* L. (39.00 p.c.), *Alburnus mento* AG (6.60 p.c.), and *Pelecus cultratus* L. (5.4 p.c.) could not be found elsewhere at all or not in this ratio. This can be attributed in case of the two *Alburnus* species to the method of catching while the occurrence of *Pelecus* in such a high degree cannot be generalized and only be considered as a consequence of the transitional state after the great flood of 1970. In respect of other species, also the backwater of Füred shows the feature of other backwaters.

After evaluating the summarized data, we may confirm the generalizations contained in the above analysation. The species, in respect of their occurrence and quantity, can be put in four groups (Table 1, total fish).sWe have considered as occurring in large numbers the fish achieving 10.00 per cent. In the other categories, apart from their number, we took into consideration the demands of fish, as well.

A. There live in large numbers in the area investigated:

Scardinius erythrophthalmus L. (19 p.c.), *Carassius carassius* L. (16 p.c.), *Lepomis gibbosus* L. (15.63 p.c.), *Rutilus rutilus* L. (10.20 p.c.), and *Esox lucius* L. (10 p.c.). Those together are giving 70.83 per cent of the 6928 fish exemplars examined hat proves their backwater character. Taking into consideration not only the number but also the weight of the individuals, we find a prevalence of pike whose exemplars weighing more than 1 kg are not at all seldom in these waters. The carp, owing to its wantlessness, develops in "poorer waters", as well. That is the explanation for its much larger backwater distribution than that of the carp.

The roach and white-fish are not to be underrated as food for the fish of prey; like fishing products, however, they are worthless. The common sunfish is noxious in the backwaters, too, because of its voracious roe-eating.

B. There are frequent in the area investigated:

Alburnus alburnus L. (7.03 per cent), *Ictalurus nebulosus* LE SUER (4.3 p.c.), *Perca fluviatilis* L. (2.7. p.c.), *Tinca tinca* L. (2.22 p.c.), *Stizostedion lucioperca* L. (2.21 p.c.), *Cyprinus carpio* L. (1.73 p.c.), *Acerina cernua* L. (1.7. p.c.), and *Abramis brama* L. (1.6 p.c.). Although being frequent, they live only sporadically in large masses. The carp is to be mentioned because of its importance. Its multiplication in large numbers cannot be recorded on, unfortunately, anywhere in the backwaters. This directs our attention to the vital importance of the acclimatization of carps.

C. There are common in the area investigated:

Alburnus mento Ag. (1.2 per cent), *Abramis ballerus* L. (0.91 p.c.), *Carassius auratus gibelio* Bl. (0.81 p.c.), and *Blicca bjoerkna* L. (0.72 p.c.).

D. There are rare in the area investigated:

Pelecus cultratus L. (1.00 p.c.), *Acerina schraetzer* L. (0.9 p.c.), *Abramis sapa* Pall. (0.06 p.c.), *Aspius aspius* L. (0.04 p.c.), and *Silurus glanis* (0.04 p.c.).

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ROLLE DER THEISS UND IHRER NEBENFLÜSSE IM ZUG DER VÖGEL DER OSTKARPATEN

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SZIJJ (1954) ist im Laufe der Untersuchung der Kreuzschnabelinvasion zu dem Ergebnis gekommen, daß in Ungarn mehrerlei Bewegungen möglich sind:

1. Im Laufe der großen europäischen Invasionen überfluten die Kreuzschnäbel *(Loxia curvirostra)* das Land gleichmäßig. Diese kommen von Norden und Nord-Osten — dem Ergebnis der Beringung nach wird das Karpatenbecken selbst von dänischen Kreuzschnäbeln besucht (TISCHLER 1934). Diese Vögel kommen gewöhnlich im Herbst an und ziehen im Frühling fort.

2. Unabhängig von den allgemeinen europäischen Invasionen erscheinen die Kreuzschnäbel in Ungarn auch im Juni und bleiben bis zum Dezember. Diese kommen wahrscheinlich von den nördlichen Karpaten.

3. Es kommt zunächst im westlichen Teil von Pannonien vor, daß sie im Juli—August ankommen und am Ende des Herbstes wegziehen. Vom Zeitpunkt und Ort der Bewegung aus ist darauf zu schließen, daß diese aus den Alpen umherstreifende Vogelschwärme sind.

Als ich diese Theorie durchdachte, warf sich in mir die Frage auf, aus was für einer Invasion die Kreuzschnäbel, — die hier genötigt sind unter für sie ungünstigen Umständen zu leben und sich zu bewegen, — stammen mögen, ob der Brutbestand der südlichen und östlichen Karpaten im Winter durch die Täler der Flüsse nicht auf die Tiefebene bis zur Theiß herabzieht; und ob das Vorkommen anderer Gebirgsarten in der Tiefebene kein Bild über diesen vertikalen Zug abgibt.

In diesem Fall ist die Auswahl der Arten nicht leicht, weil z.B. auch der Tannenhäher *(Nucifraga caryocatactes)* in den siebenbürgischen Gebirgen brütet; dennoch scheinen seine Bewegungen zu zeigen, daß der größte Teil von ihnen von Nord-Osten — oft selbst aus Sibirien — kommt. Es kann höchstens so viel festgestellt werden, daß die Bewegungen in Uungarn und Rumänien gleichzeitig stattfinden. Ein anderes Beispiel ist der Rabe *(Corvus corax)*, der sich zwar sehr wahrscheinlich auch von Siebenbürgen verbreitet hat aber auch in den Wäldchen der Theiß und ihrer Nebenflüsse brütet. Ein drittes Beispiel ist die Bergstelze *(Motacilla cinerea)*, die im Winter das Land gleichmäßig überflutet und längs der offenen und zugefrorenen Wässer herumstöbert. Es kann nicht entschieden werden, ob die die Tiefebene besuchenden Exemplare von den Bergen der Mátra und Bükk, usw. oder von den siebenbürgischen Gebirgen ankommen.

Bei den Kreuzschnäbeln liegt es aber auf der Hand, das Thema von solchem Gesichtspunkt aus zu betrachten. Das Bild auf der Tiefebene wird durch die Angaben von Debrecen getrübt, denn der dortige Großwald (Nagyerdő) liegt viel zu nahe den nordöstlichen Karpaten. Die Kreuzschnäbel wurden hier zwischen 1924—31 von NAGY (1935) systematisch beobachtet. In den Jahren 1924, 1926 und 1928 sind sie im Herbst angekommen, hauptsächlich im November, und noch im Laufe dessWinters verschwunden. In 1925 und 1931 kamen sie früh im Herbst; in 1929 und 1930 erschienen sie im Juni und sind im Dezember geschieden. In 1927 hatten sie wahrscheinlich zwei voneinander unabhängige Bewegungen: die eine im Juni, die andere zwischen 22. Juli und 14. Dezember.

KOVÁCS (1966) nach haben Schwärme von jungen Exemplaren am 17. Juli 1963 bei Debrecen die Blattläuse der Pflaumenbäume gesammelt. BERETZK (1964) hat zwischen 23. und 25. Juli 1963 bei Tiszadob ein Männchen geschossen, ein Weibchen beobachtet und auch die verlorenen Zapfen gefunden. STERBETZ (Brief) hat am 28. Oktober 1968 in Hortobágy—Máta fünf Vögel beobachtet.

Sie wurden bei der Untersuchung der Kőrös- und Maroslinien, im Laufe der großen europäischen Invasion in 1930, am 1. August in Kőrösladány von ALMÁSY beobachtet (SCHENK 1931). BODNÁR hatte im Sommer 1909 und 1918 in Hódmezővásárhely je ein Exemplar gesehen (STERBETZ) — wohl zu merken, daß 1909 das Jahr einer Sommerinvasion war (GRESCHIK 1909), welche Invasion sich auf Siebenbürgen, die nördlichen Karpaten und Transdanubien erstreckte. STERBETZ hat zwischen 9. und 14. Juli 1963 kleinere Schwärme über der Theißinsel Sasér täglich beobachtet. BERETZK (1942) hat in der Umgebung von Szeged am 13. November und am 8. Dezember 1941 an voneinander weit liegenden Stellen 4—5, bzw. 3 von diesen Vögeln beobachtet (in den Wäldern Alsótanya, Felsőtanya-Fajka). Er sah im Juli auch am Széchenyiplatz zu Szeged einen kleineren Schwarm; aber die Angaben des Jahres sind leider vorlorengegangen. Ebendort haben auch SZIJJ (1954) am 13. Januar 1951 und BERETZK am 2. Februar 1962 je ein exemplar gesehen.

Das so erhaltene Bild ist also nicht einheitlich, denn Kreuzschnäbel waren auf der Tiefebene selbst in den Jahren der großen Invasionen beobachtet. Die in der Umgebung von Hódmezővásárhely und Szeged ausgeführten Beobachtungen lassen uns jedenfalls ahnen, daß diese Vögel den mehrmaligen isolierten Vorkommen zufolge aus den östlichen Karpaten stammen, während die Ergebnisse der in der Umgebung von Debrecen ausgeführten Forschungen in die Linie der vom Nordosten ankommenden Invasionen fallen, obwohl selbst eine Rolle der Theiß- und Szamostäler nicht völlig ausgeschlossen werden kann.

Der Mauerläufer *(Tichodroma muraria)* ließ sich in Debrecen nur dreimal beobachten, allemal auf dem Gebäude der Universität, so am 17. November 1943 (1, SÓVÁGÓ 1944) und in den ersten Tagen von Oktober 1951 zweimal (ZILAHI—SEBESS 1957).

Von der Umgebung von Békéscsaba haben wir zwei Angaben: Kispereg, am 19. Oktober 1925 (1, CSATH 1929) und Csorvás, am 10. Januar 1954 (1, FESTETICS 1955). Das letztere Exemplar versteckte sich unter dem Traufdach eines Dorfhauses. Ebenso wurde einer am Anfang von September 1946 in Deszk, einer in der Dorfgemeinde beim Fluß Maros, erlegt (BERETZK 1950). In Hódmezővásárhely hat BODNÁR diesen Vogel, der dort seinem Wissen nach früher häufiger vorkam, im Februar 1911 und Januar 1913 beobachtet (STERBETZ, in litt.). PÉCZELY (1957) hat den Vogel am 16. Oktober 1955 auf einem Kirchturm neuerlich gesehen.

In Szeged hat BERETZK (1950) den Vogel am Domplatz im September 1945 mehrere Tage lang und zwischen 8. und 12. März 1946 täglich gesehen.

Es wird von diesen Angaben gezeigt, daß die Felsen und die Mauern von Hochgebäuden zeitweilig selbst durch kleine Dorfhäuser ersetzt werden können. In solcher

Weise vermag dieser Vogel auf die Tiefebene mehr und mehr herunterzudringen. Es wird auch von der frühen Angabe von Deszk gezeigt, daß diese Vögel im Laufe ihres vertikalen Zugs aus Siebenbürgen auf die ungarische Tiefebene kommen, um hier mit Hilfe der Umstände beim Marosufer zu überwintern. Dies ist eben was bei den Kreuzschnäbeln nicht ohne Zweifel festgesetzt werden konnte.

Es kann noch das Beispiel der Tannenmeise *(Parus ater)* erwähnt werden, obzwar dieser, ebenso wie das Goldhähnchen *(Regulus regulus)*, weitverbreitet überall herumstreift. NAGY (1936) schreibt nicht ausdrücklich darüber, daß er im Großwald (Nagyerdő) vorgekommen wäre; man kann aber von seinen dahingeworfenen Worten, wonach sie in der Tiefebene hauptsächlich die Tannengruppen suchen, ahnen, daß der Verfasser seine Erfahrung in dem in der Nähe seiner Wohnung liegenden Nagyerdő erworben hatte. STERBETZ hat am 28. Oktober 1968 in Hortobágy—Máta ein Exemplar gefunden.

In Hódmezővásárhely wird er von PÉCZELY (1957) erwähnt, der am 8. und am 29. Oktober 1955 je einen beobachtet hatte. In der Umgebung (Körtvélyes, Barcirét, Sasér) hat STERBETZ am 4. April 1960 einen, am 7. November und am 16. Dezember 1961 drei, bzw. zwei, am 4. November 1962 einen gesehen.

In Biharugra hat er einen am 29. September 1951 beobachtet. Nach KÁRPÁTI (1958) überwinterte der Vogel zwischen 1956 und 1958 im Flutgebietswald auf einer 40 km Strecke oberhalb der Marosmündung. Laut der freundlichen Mitteilung von BERETZK bewegten sich 3—4 Exemplare in Szeged am 6. Februar 1941 am Széchenyiplatz; am 13. und am 14. März 1941 mehrere Exemplare an den Tannen des Parks und der Straßen; einige am 9. Oktober 1948 an den Tannen des Széchenyiplatzes.

Nach Vergleich dieser Angaben mögen wir sehen, daß die aus dem östlichen Teil des Landes stammenden Angaben früher sind, als diejenigen von dem Gebiet von Hódmezővásárhely und Szeged. Die Tannenmeise kommt in den Flutgebietswäldern beider Flüsse (Maros und Theiß) vor. Wir können mit der erforderlichen Wahrscheinlichkeit annehmen, daß diese größtenteils, wenn auch nicht alle, aus Siebenbürgen gezogen sind — was im Falle des Regulus nicht einmal mit Vorbehalt behauptet werden könnte.

Vorsichtig soll man auch mit BODNÁRS Angaben in Hinsicht des Wasseramsel *(Cinclus cinclus)* umgehen, da er diese derzeit nicht veröffentlicht hatte; in seinen hinterlassenen Aufzeichnungen (STERBETZ) kommt es aber vor, daß er sie in Hódmezővásárhely im März 1907 und Februar 1908 beobachtet habe.

Abgesehen von der Frage des vertikalen Zuges, rufen wir zoogeographische Angaben zu Hilfe unserer Theorie: die Türkentaube und der Blutspecht sind ohne zweifel längs der Flüsse von der Tiefebene und nicht vom Süden nach Siebenbürgen eingedrungen. Ein Beispiel für die Verbreitung aus der entgegengesetzten Richtung ist der Rabe, der sich aus den siebenbürgischen Gebirgen in die Wäldchen der Flüsse eingebürgert hat. Besteht die Wechselwirkung die Probe im Falle der sich verbreitenden Arten, so haben die Flüsse ihre Rolle wahrscheinlich auch hinsichtlich des vertikalen Zuges.

Schon in der Einleitung haben wir auf drei Arten verwiesen, die wir für die Aufklärung unseres Themas nicht für geeignet gefunden hatten, da die Möglichkeit der Fehlerquellen viel zu groß ist, um auf die Richtung ihrer Bewegung ausdrücklich oder annähernd schließen zu können. Aber wir könnten noch zahlreiche Arten aufzählen, die die Tiefebene aus verschiedenen Richtungen besuchen konnten, z.B. das Wintervorkommen des Uhus *(Bubo bubo)* in Biharugra und Gyoma (PÁTKAI, 1960) oder das des Rauchfußkauzes *(Aegolius funereus)* in Debrecen (SIROKI 1957), usw.

Mit meinen bescheidenen Zeilen möchte ich eingehendere Forschungen dieser

Richtung ermutigen, damit die obigen sporadischen Beiträge mit den Ergebnissen einer systematischen Winterbeobachtung vertauscht werden können, denn nur diese vermögen zu entscheiden ob es von den siebenbürgischen Gebirgen einen vertikalen Zug auf die Tiefebene gibt. Sie werden auch entscheiden, was für eine Wirkung dies auf die Ausbildung des Winteraspekts der Theiß und ihrer Nebenflüsse ausübt und was der Rhythmus und die Aktivität dieser speziellen Bewegung seien.

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COMPARATIVE DATA OF THE NUTRITION OF GREBES (PODICIPIDAE) AT THE TISZA

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Abstract

The paper is investigating the nutrition of the grebe species *(Podiceps cristatus, Podiceps ruficollis, P. nigricollis, P. griseigena* collected in the environment of the Tisza, with a comparative method. The material placed at our disposal for being compared was collected at the delta and the Hungarian reaches of the Danube, at fish-ponds and other natural or „cultivated" waters. There were investigated together 113 gastric contents. The results have proved a general dominance of insect foodstuffs. The maximum size of the gastric fish remains was 10 cm at the freat cresrted grebe, 8 cm at the red-necked grebe. In case of the black-necked grebe and the small grebe there couldn't be found any fish foodstuff. At the Tisza, all the three species — except the black-necked grebe — fed on the grubs of the *Palingenia longicauda* that meant a local speciality.

Introduction

About the nutrition of the European grebe species a comprehensive knowledge can be found in the literary summary of NIETHAMMER—BAUER—GLUTZ's Manual (1966). From Hungarian territory, however, there have not been published, so far, any Podiceps-bromatologic investigations. The gastric-content material of the Hungarian Ornithological Institute and BOTOND J. KISS's collection from the delta of the Danube have now rendered possible for us to evaluate the food composition of the grebe species originating from the Tisza (Szeged—Hódmezővásárhely), comparing them with those collected from the Danube, fish-ponds, and other waters. This method, in addition to determining the different foodstuffs, may also give answer to the problem if the environment of the Tisza promises, in case of grebes, any bromatologic peculiarities.

Materials and Methods

The gastric-contents were investigated prepared dry, with a binocular microscope. It appeared from their elaboration that the exaggerated separation of the collecting stations hasen't much practical importance. The Tables were, therefore, made according to the categories Tisza, Danube, the delta of Danube, fish-ponds, as well as other waters. The foodstuffs proved were classified according so the frequency of their occurrence.

Results

1. Freat crested grebe — *Podiceps cristatus* (L.) 1758.

78 individuals of these were investigated, 23 of them originating from the Tisza, 25 from the delta of the Danube, 6 from the Hungarian Danube reaches, 21 from fish-ponds, and 3 from other waters. The data of the collections are as follows:

Tisza: Mártély 20 March 1970; 30 March; 30 March; 30 March; 1 April; 2 April; 2 April; 5 April; 20 April; 20 May; 31 March 1972; Körtvélyes, 20 March 1970; 30 March; 1 April; 1 April 1971; 10 April; 10 May; Holm Atka, 10 March 1970; 10 March; 20 March; 10 April 1971; 19 April; meadow at Barc, 5 April 1970.

The distribution of the gastric-content foodstuffs of the 23 individuals collected from the Tisza is as follows:

Kind of foodstuff	Cases of occurrence	Piece
Chitin-remains	10	fragments
Fish-bone	7	fragments
Frog-bone	3	fragments
Grub of *Palingenia longicauda*	2	2
Alburnus alburnus	1	1
Aspro zingel	1	1
Cyprinidae sp.	1	1
Bone and hair of small mammals	1	fragments
Grub of *Odonata* sp.	1	fragments
Dytiscus marginalis	1	1
Ochthebius sp.	1	1
Hydrophilidae sp.	1	fragments
Grub of *Chironomus* sp.	1	1

The material investigated, originating from the delta of the Danube: Chilia, 18 March 1969; 30 March; 30 March; St. Gheorge, 18 February 1968; 21 February; 5 January 1969; 5 February; 5 February; 5 February; Canal Crasnicol, 12 Ferbuary 1968; Tulcea, 29 March 1969; 29 March; 29 March; 30 March; Mineri, 30 March 1969; 31 March; 16 April; 17 April; 17 April; 1 May; Murighiol, 14 April 1970; 14 April; Letea, 28 March 1968; Jurilovca, 19 March 1969; delta of the Danube, without date, from Hungary: Szigetszentmiklós, 18 June 1950; 18 July; 1 August; Magyaróvár, 5 July 1960; Ásvány, 1 July 1962; Majosháza, 21 September 1947.

Sorts of foodstuffs from the gastric-content of 31 individuals from the Danube, resp. the delta of the Danube:

Kind of foodstuff	Cases of occurrence	Piece
Fish-bone	9	fragments
Chitin-remains	8	fragments
Cyprinidae sp.	5	5
Hair and bone of small mammals	4	fragments
Alburnus alburnus	3	3
Dytiscus marginalis	2	2
Hydrophilidae sp.	2	2
Helophorus sp.	2	2
Carassius vulgaris	1	1
Rutilus rutilus	1	1
Frog-bone	1	fragments
Berosus sp.	1	1
Reed-grass remains	1	fragments

Collections at fish-ponds: Szeged-Fehértó, 25 March 1963; Biharugra, 6 May 1957; 12 April 1958; 24 July; Hortobágy, 11 May 1947; 11 May; 8 August 1950; 14 August: 1 September; Rétszilas, 1 April 1948; 18 April; 18 April; 18 April; 3 August 1951; 3 July 1952; 25 April 1954; 15 June 1955; 10 May 1957; Varászló, 5 July 1955; Dombóvár, May 1955; Mórichely, 11 April 1954.

Gastric-content of 21 individuals from fish-ponds:

Kinds of foodstuff	Cases of occurrence	Piece
Chitin-remains	14	fragments
Fish-bone	3	fragments
Cyprinus carpio	2	2
Grub of *Odonata* sp.	2	2
Helophorus sp.	1	2
Rhodeus s. amarus	1	1
Seeds of *Zea mays*	1	fragments

Other water collections: Rice-field canals at Mezőtúr, 5 April 1965; Lake Velence at Dinnyés, 16 March 1947; Albertirsa, 24 October 1952.

The foodstuffs found in three stomachs are:

Kinds of foodstuff	Cases of occurrence	Piece
Chitin-remains	3	fragments
Berosus sp.	1	1
Hair and bone of small mammals	1	fragments

2. Small grebe — *Podiceps ruficollis* (PALL.) 1764.

There were investigated 14 individuals, 5 of these are from the Tisza, 2 from the Hungarian Danube, 4 from fish-ponds, 3 from other waters.

Tisza: Szeged, 1 June 1952; Holm Atka, 1 August 1970; meadow at Barc, 2 November 1969; Körtvélyes, 10 April 1970; Mártély, 1 October 1970.

The gastric-contents of the 5 individuals from the Tisza are:

Kinds of foodstuff	Cases of occurrence	Piece
Grub of *Palingenia longicauda*	3	detritic mass
Helophorus sp.	2	3
Chitin-remains	2	detritic mass
Seeds of *Polygonum* sp.	2	160
Ochthebius sp.	1	1
Berosus sp.	1	1
Grub of *Odonata* sp.	1	fragments

Collections from the Danube: Baja, 21 October 1954; Gyimrót, 12 September 1961.

In two gastric-contents from the Danube we found, on one occasion each, some chitin in fragmentary state and remains of *Sigara* sp. and *Hydrophilidae* sp.

Collections from fish-ponds: Szeged—Fehértó, 1 November 1965; Biharugra, 27 July 1958; Varászló, 25 March 1953; 29 July.

The foodstuffs proved from four stomachs are:

Kinds of foodstuff	Cases of occurrence	Piece
Chitin-remains	3	fragment
Hydrophilidae sp.	2	7
Ochthebius sp.	1	6
Hydraena sp.	1	1
Spercherus sp.	1	3
Seed of *Carex* sp.	1	1
Seed of *Poligonum*	1	1

Material from other water-sides: Dorog, 18 September 1958; Békéscsaba, 14 April 1952; Pálosszentkút, 31 August 1952.

Food distribution of the three gatsric-contents:

Kinds of foodstuff	Cases of occurrence	Piece
Chitin-remains	2	fragments
Grubs of *Odonata* sp.	1	6

3. Black-necked grebe — *Podiceps nigricollis* (CH. L.) BREHM 1831.

There were 13 gastric-contents at our disposal: from the Tisza 4, from the Hungarian Danube 1, from the fish-ponds 5, from other waters 3.

Data about the Tisza: Mártély, 2 May 1970; 2 May; 1 July; 31 March 1971.

Gastric contents of the four individuals from the Tisza:

Kinds of foodstuff	Cases of occurrence	Piece
Sigara sp.	2	7
Grubs of *Chironomus* sp.	1	128
Hydrophilidae sp.	1	fragments
Chitin-remains	1	fragments
Bone and hair of small mammals	1	fragments

We have found in the gastro-intestinal organs of the signle individual, originating from the Danube, shot on 13 May 1951 in Gyimrót, a large mass of *Chara* spores and two exemplars of *Planorbis spirorbis*.

Collections from the fish-ponds: Biharugra, 17 July 1951; 25 April 1960; 12 June 1966; 27 April 1967; Varászló, 19 September 1954.

Contents of the five stomachs:

Kinds of foodstuff	Cases of occurrence	Piece
Chitin-remains	3	fragments
Grub of *Odonata* sp.	1	1
Spercherus sp.	1	1
Hydrobius sp.	1	fragments
Hydrophilidae sp.	1	fragments
Helophorus sp.	1	3
Chara spore	1	large amount

Collections originating from other waters: Lake Velence, Dinnyés, 24 March 1947; Békéscsaba, 16 April 1967; Pálosszentkút, 31 March 1951.

Contents of the three stomachs:

Kinds of foodstuff	Cases of occurrence	Piece
Grubs of *Chironomus* sp.	1	126
Enochrous bicolor	1	1
Chitin-remains	1	fragments
Frog-bone	1	fragments
Chara-spore	1	large amount

4. Red-necked grebe — *Podiceps griseigena* BODD. 1783.

There were investigated eight individuals of this comparatively rarer species: 2 of them originating from the Tisza, 1 from the delta of the Danube, 1 from the Hungarian Danube, 3 from fish-ponds, 1 from other waters.

Data of the individuals originating from the Tisza are: Körtvélyes, 2 June 1969; Holm of Atka, 5 July 1970.

Contents of the two stomachs:

Kinds of foodstuff	Cases of occurrence	Piece
Grub of *Palingenia longicauda*	1	fragments
Dytiscus marginalis	1	fragments
Frog-bone	1	fragments

Collection of an individual from the delta of the Danube: Chilia, 19 March 1963; another individual from the Hungarian Danube-region: Szigetcsép, August 1965.

The nutriment found in the individuals originating from the Danube:

Kinds of foodstuff	Cases of occurrence	Piece
Chitin-remains	2	plenty of fragments
Grubs of *Chironomus* sp.	1	4
Haliplus sp.	1	2
Hidrous piceus	1	1

Individuals from the fish-pounds: Hortobágy, 7 August 1950; 17 August; Biharugra, 29 August 1958.

Gastric-contents of the three individuals from the fish-ponds:

Kinds of foodstuff	Cases of occurrence	Piece
Frog-bone	2	fragments
Reed-grass	1	fragments
Chara-spore	1	in mass
Cyprinidae sp.	1	2
Hydrophilidae sp.	1	2

Our single individual from other waters is originating from the Dinnyés region of the Lake Velence. Date of collection: 23 September 1946. Gastric-content: the remains of 1 Cyprinidae sp., embedded in feathers.

Summary

The evaluation of the investigation is rendered more difficult by the fact that the remains of foodstuffs were found in an extremely fragmentary state. Another difficulty was raised in every case of the freat crested and red-necked grebes, in five cases of the small greves and in two cases of the black-necked greves by the large mass of feathers that is a well-known characteristic of greve stomachs. An exact determination of the fish-bones and insect remains ground to dust and embedded in feather balls was, therefore, mostly possible only in rough outlines.

All the four species are characterized by the general dominance of the insect foodstuff. In case of the small and black-necked species we have not found any fish.

Taking into consideration that about 30 per cent of our full material investigated came from the neighbourhood of fish-ponds, this notice may be reassuring even for practical fish-breeders. Fish-remains found in measurable state in case of freat crested grebes are: *Cyprinidae* sp. 6—7—8—8—10 cm. *Alburnus* sp. 5—8—8 cm. *Aspro zingel* 7 cm. *Rhodeus s. amarus* 3 cm. In case of the red-necked crebe: *Cyprinidae* sp. 5—5—8 cm.

At the investigated material from the Tisza, we are emphasizing, as a speciality, the repeated occurrence of the grubs of *Palingenia longicauda.* We have proved the presence of the grub of the Ephemera at 23 freat crested grebes on two occasion, at five small greves in three cases and in large numbers, at two red-necked grebes in one case, similarly in large numbers. The four black-necked grebes avoided this sort of foodstuffs.

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QUANTITATIVE UNTERSUCHUNG DER SINGVOGELPOPULATION (PASSERIFORMES) DES ÜBERSCHWEMMUNGSGEBIETES DER THEISS (TISZA)

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(Eingegangen am 25 April 1972)

Auszug

Auf dem in einem typischen Weide-Pappel Auenwald *(Salicetum albae-fragilis)* des Überschwemmungsgebietes des Flusses Theiß (Tisza) festgesetzten Versuchsgebiet haben i.J. 1971 quantitative ornithologische Untersuchungen stattgefunden. Die Rolle der auf einem stark gestörten Gebiet nistenden *Passeriformes*-Population wurde im Stoff-Energie Umlauf der Biozönose analysiert.

Die Untersuchungen wurden auf Grund der Gewichtsmasse (Biomassa) der *Passeriformes*-Population ausgeführt. Die forst- und landwirtschaftliche sowie biozönotische Rolle der einzelnen Arten und Artpopulationen ist auf der Wege trophischer Lebensformen abgemessen worden.

Das Ergebnis der Beobachtungen und Berechnungen erweist die wichtige Rolle der *Passeriformes*-Population.

Einleitung

Es ist allgemein bekannt, daß wir die biologischen Verhältnisse eines Gebietes nur dann wirklich kennen, wenn wir nicht nur die dort lebenden Arten ausnahmslos aufzählen sodern auch die Frage beantworten können, in welcher Menge diese Arten oder Artpopulationen auf dem untersuchten Gebiet leben und was für eine Rolle ihre Gesamtheit in der Lebensmittelkette spielt.

Unter den gegenwärtigen Umständen der ornithologischen Untersuchung der Theiß soll die Frage aufgeworfen werden, in welcher Menge die einzelnen Vogelarten auf den Überschwemmungsgebieten des Flusses leben, was für eine Rolle sie im Stoff-Energie Umlauf dieses Gebietes und der mit ihm zusammenhängenden Agrargebiete spielen, und endlich welche Bedeutung sie für den forst- und landwirtschaftlichen Nutzen und Schaden haben.

Von solchen Überlegungen geleitet haben wir einige Jahre lang im Wald des Überschwemmungsgebietes der Theißstrecke bei Vesszős eine quantitative Populationsaufnahme ausgeführt. Ebenda, aber auf einer Strecke viel größerer Ausdehnung wurden schon quantitative Untersuchungen durchgeführt (MARIÁN 1965). Während aber dann der Gegenstand der Untersuchung die Vogelpopulation im Winter war, haben wir jetzt die Rolle der horstenden Arten untersucht. In unserer gegenwärtigen Abhandlung wird ein Teil dieser Arbeit, der sich mit den — für die Wälder des Überschwemmungsgebietes charakteristischsten und dort in zahlenmäßiger Überlegenheit befindlichen — Singvögeln beschäftigende Abschnitt, demonstriert.

Für die Beobachtungen haben wir Angaben von A. BANKOVICS und GY. TRASER erhalten, wofür wir ihnen unseren Dank auch hiemit aussprechen.

In diesem Land ist eine die Vogelwelt der Überschwemmungsgebiete der Theiß in quantitativer Weise analysierende Abhandlung — außer der oben Erwähnten — noch nicht erschienen.

Es beschäftigen sich übrigens mit der Vogelwelt der Theiß nur wenige Abhandlungen. Es sollen hier die Werke von BERETZK (1966), KEVE—SAGE (1967), KÁRPÁTI (1958), LEGÁNY (1967, 1970), MARIÁN (1960, 1968), STERBETZ (1956) erwähnt werden.

Beschreibung des Gebietes und Methode der Untersuchung

Unsere Untersuchungen wurden in einem Wald des am rechtsseitigen Theißufer ungefähr 7 km nördlich von Szeged liegenden, Vesszős genannten Überschwemmungsgebietes ausgeführt (80 m über dem Meeresspiegel).

Hier haben wir ein Versuchsgebiet von ung. 2 Hektar Ausdehnung abgesteckt. (Drei, voneinander einige 100 m liegende rechteckige Gebiete mit einer 60×120, 20×120 und 50×120 m Ausdehnung). Das Überschwemmungsgebiet ist hier mit einem die Mittelstrecke der Theiß begleitenden, charakteristischen Weide-Pappel Auenwald *(Salicetum albae-fragilis)* bedeckt. Die dominante Baumart ist die Weide *(Salix alba)*, deren ungefähr 600 mittelaltrige und alte (hohle) Exemplare auf dem Gebiet stehen. Es sind noch viele Weißpappeln *(Populus alba)*, ungefähr 40—50 amerikanische Eschenbäume *(Fraxinus pennsylvanica)* und ein gut entwickelter Sommereichenbaum *(Quercus robur)* zu finden. Zum Unterholz gehören: ein stellenweise bürstendicker Eschenaufschlag und dicke Brombeersträuche *(Robus caesius)* und Unforme *(Amorpha fruticosa)*. Es gibt — unter dem ganz geschlossenen Baumkronen niveau — auch Stellen, wo das Unterholz ganz spärlich ist. Diese sind während des ganzen Jahres näßlich, feucht bleibende Winkel.

Unmittelbar am Rand des Flußbettes zieht sich ein ungefähr 25 m breites Weidegesträuch hin.

An der befreiten Seite des Dammes wird das Gebiet von den Äckern, bzw. von den für industrielle Zwecke benützten unangebauten Land mit einem schmalen, ungefähr 30 m breiten Pappelwaldstreifen abgesondert.

Wir haben dieses Gebiet nicht nur deshalb gewählt, weil seine Gegebenheiten dem allgemeinen Typ der Wälder der Überschwemmungsgebiete längs der Mittel-Theiß entsprechen, sondern auch weil seine anthropogene Trübung mittelmäßig war. Der letztere Gesichtspunkt ist wegen einer eventuellen Verallgemeinerung der Folgerungen wichtig. In dieser Beziehung hat aber schon im ersten Viertel d.J. 1971 eine Änderung stattgefunden: auf dem neben dem Gebiet befindlichen Damm hat eine große Umgestaltungsarbeit begonnen. Das Versuchsgebiet wurde durch die ausgedehnten Feldarbeiten motorischer Kraft, den Wegbau im Wald, den mit schweren Geländekraftfahrzeugen stattfindenden kontinuierlichen Transport im ganzen Jahr sehr stark gestört. So bezieht sich unsere Aufnahme — das soll hervorgehoben werden — auf eine durch den Menschen, bzw. die Technik maximal gestörte Population.

Die Beobachtungen wurden vom März bis zum Oktober 1971 ausgeführt. Unser Gebiet wurde in der Heckzeit im allgemeinen wöchentlich oder zweiwöchentlich durchgewandert.

Größe, Zusammensetzung der Population

Auf unserem versuchsgebiet haben im Jahre der Untersuchung 25 Singvogelarten gehorstet. Die Liste von diesen wurde auf Tabelle I angegeben.

Wir haben nicht die Absicht, eine faunistische Charakterisierung zu geben, deshalb unterlassen wir eine Aufzählung der auf unserem Gebiet von Zeit zu Zeit erscheinenden aber nicht hier horstenden Arten. Dies bedeutet aber keine Verschiebung in unserer Analyse. Im Stoff-Energie Umlauf gehört nämlich die Hauptrolle den eben ihrem Zahlenverhältnis zufolge überwiegenden, sich hier vermehrenden Arten.

Obwohl sich die Anzahl der Arten auf einigen Gebieten jährlich ändert, ist die überwiegende Mehrzahl der aufgezählten Arten für in großem Maße ortstreu und in jedem Jahr hier horstend anzusehen. Sie blieben ja auf ihrem Heckgebiet selbst unter den im Jahr der Untersuchung ausgebildeten ungünstigen Umständen.

Tabelle 1

Species	Trophische Gruppen	Individuum	Biomasse
		per 2 ha	
Oriolus oriolus	C	12	876
Coloeus monedula	C	21	4746
Garrulus glandarius	D	7	1155
Parus maior	D	36	720
Parus coeruleus	C	18	198
Aegithalos condatus	C	9	81
Certhia brachydactyla	C	15	105
Troglodytes troglodytes	C	9	72
Turdus merula	D	24	2112
Phoenicurus phoenicurus	C	28	364
Luscinia megarhynchos	C	6	108
Locustella fluviatilis	C	6	125
Hippolais icterina	C	6	84
Hippolais pallida	C	6	84
Sylvia atricapilla	D	12	216
Sylvia borin	C	6	114
Sylvia communis	C	7	98
Sylvia corruca	C	6	72
Muscicapa striata	C	14	266
Lanius collurio	C	8	256
Sturnus vulgaris	C	91	7007
Passer montanus	D	108	2484
Chloris chloris	H	14	364
Carduelis carduelis	D	7	91
Fringilla coelebs	D	5	105
Summa		481	21 904

Tropische Verteilung und wirtschaftliche Rolle der Population

Turĉek hat zweifellos recht als er feststellt, daß die Rolle der Vogelpopulation eines Gebietes im Stoff-Energie Umlauf nicht der Vogelzahl nach, sondern auf Grund ihrer Gewichtsmasse beurteilt werden kann. Denn „nicht die Vogelzahl, sondern ihre Gewichtsmasse hat im Stoff-Energie Umlauf der Assoziation teil." (Turĉek 1957).

Die Gewichtsmasse (biomassa, Balogh 1958) der Vogelpopulation erhalten wir durch Multiplizierung des post mortem abgewogenen Gewichts der einzelnen Arten mit der aus der Populationsaufnahme gewonnenen Individuenzahl. Wir berechnen das Durchschnittsgewicht der Arten auf Grund der Angaben des Bandes-Fauna Hungariae Aves (Székessy 1958), mit Zugrundelegung des summierten Mittelwertes der Gewichte der Vogelmännchen und Vogelweibchen.

Auf dem Versuchsgebiet in der Heckzeit bzw. während der Zeit des Aufwachsens der Jungen lebten 481 Vögel in 1971, mit minimaler Rechnung (d.h. wenn wir nur mit einmaliger Brut und mit der niedrigsten Nachkommenzahl rechnen). Die Summe ihrer Biomasse (falls die Nachkommen mit ihrem entwickelten Gewicht gerechnet sind) ist 21,9 kg. Das heißt, es fallen einem Wald 1 ha im Überschwemmungsgebiet von ähnlicher ökologischen Gegebenheit und ähnlicher Trübung ausgerundet 240 Vögel mit einem Gewicht von 11 kg zu.

Das Gesamtgewicht der Vogelpopulation gibt Information über die Produktivität der ganzen Biozönose. Wollen wir aber den Wert der Vogelpopulation in wirtschaftlicher Hinsicht untersuchen, so sollen wir sie weiter zerlegen. So gelangen wir zur trophischen Gruppierung.

Auch die Vögel, wie alle Tierarten, kommen auf dem Wege der Ernährung und der Nahrungsaufnahme in die engste Verbindung mit der Biozönose. Auf dem Wege der Ernährung spielt sich der Stoff-Energie Umlauf ab. Es ist deshalb vernünftig, die Vogelpopulation auf dem Wege der Ernährung zu analysieren.

Die Vögel können ihren Ernährungslebensformen nach in drei trophische Gruppen eingeteilt werden (TURĈEK 1957):

1. Pflanzenfresser (Herbivores, H.)
2. Gemischtefresser (Diversivores, D.)
3. Fleischfresser (Carnivores, C.).

Es ist natürlich, daß die Arten, bzw. Artpopulationen in den einzelnen trophischen Gruppen nicht ständig sind. Die Goldamsel ist z.B. in einem großen Teil der Vegetationsperiode des Jahres ein Insektenfresser, als aber die Frucht des Maulbeerbaums und des Holunders reif wird, ernährt sie sich hauptsächlich damit. Beim Gruppieren ist also der Hauptgesichtspunkt, was für eine Nahrung eine Art überwiegend frißt. (Tabelle 2).

Tabelle 2

Trophische Gruppen	Zahl der Vögel		Biomasse	
	Individuum	%	g	%
Herbivores	14	3	364	2
Diversivores	199	41	6 883	31
Carnivores	268	56	14 657	67
Summa	481	100	21 904	100

Es fällt in Gruppe H (Herbivores) nur eine Art, der Grünfink, mit einer nur 364 g Gewichtsmasse (2%) und mit 14 Individuen. Er ist zwar körnerfressend, aber er ernährt sich auch mit Insekten und nährt auch seine Jungen zunächst einmal mit Insekten. Der herbeigeführte Schaden kompensiert sich im großen und ganzen mit seinem Nutzen. Bei seiner gegenwärtigen Populationsgröße kann er — selbst im nationalen Verhältnis — in land — und forstwirtschaftlicher Hinsicht als gleichgültig angesehen werden. Im Fall einer großen Vermehrung jedoch — wie es in den 1970-er Jahren in Ostdeutschland stattfand — mag sein Schaden dem des Hausspatzen gleichkommen.

In Gruppe D *(Diversivores)* fällt eine 6883 g Gewichtsmasse (31%). Es können hier nur 7 Arten mit 199 Individuen eingereiht werden.

Die Nützlichkeit ihrer Mehrzahl kann von niemand in Abredegestellt werden. Selbst der Häher und der Fledsperling, die für schädlich betrachtet werden können, sind in gewisser Hinsicht nützlich. Denken wir daran, daß z.B. der Letztere den amerikanischen Bärenspinner *(Hyphantria cunea)* zerstört und seine Jungen mit Insekten ernährt.

Die Gruppe der Gemischtefresser ist von Gesichtspunkt des Menschen die wichtigste. Die dazu gehörenden Arten, ihrer hochgradigen Plastizität zufolge, passen sich an die anthropogenen Änderungen in erhöhtem Maße an und sind eben deshalb bedeutenden wirtschaftlichen Wertes.

Sie richten sich gut nach den Ernährungsmöglichkeiten in jeder Jahreszeit. Die Amsel ernährt sich zum Beispiel im Frühling und im Sommer hauptsächlich mit Insekten, im Herbst und im Winter besonders mit verschiedenen Beeren.

Es fällt in Gruppe C (Carnivores) der größte Teil der Singvögel unseres Gebietes: eine 14.657 g Gewichtsmasse (67%), die aus 268 Individuen, bzw. 17 Arten gegeben ist.

Es ist charakteristisch für die Gruppe der Fleischfresser, daß sie sich aus einer großen Anzahl der Individuen zusammensetzt, das Gewicht der einzelnen Individuen aber klein ist. Ihre wirtschaftliche Rolle ist — nachdem ihrem gesteigerten Stoffwechsel zufolge ihre Konsumtion hoch ist — immerhin sehr bedeutend.

Alle die in die Gruppe der Fleischfresser eingeteilten Arten unseres Versuchsgebietes sind Insektenfresser. Infolge ihren verschiedenen Lebensweisen suchen sie ihre Ernährung an den verschiedensten Stellen, so sind sie auf allen Niveaus des Waldes im Überschwemmungsgebiet tätig. Man braucht nur auf einige Arten hinzuweisen: der Zaunkönig vernichtet die Insekten auf dem dickesten Strauchniveau, der Gartenbaumläufer tut dies auf dem Niveau der Baumstämme und der dicken Äste, die Grasmücken (Sylviidae) auf dem Baumkronenniveau.

Die Rolle der einzelnen Arten und Artpopulationen klärt sich noch besser auf, wenn die Gewichtmasse der trophischen Gruppen weiterzerteilt wird: in die Gruppen der sich im Walde und außer dem Walde Ernährenden. (Auch hier kann zwischen den zwei Gruppen keine scharfe Grenze gezogen werden. Es handelt sich mehr um Vogel gruppen, die den überwiegenden Teil der Ernährung im Walde bzw. außer dem Walde suchen.) In dieser Hinsicht werden wir von Tabelle III informiert.

Die 364 g Gewichtsmasse der Gruppe der Herbivores ernährt sich außer dem Walde. Die Rolle des hier eingeteilten Grünfinks ist oben schon besprochen worden.

Der größere Teil (4203 g: 61%) der Gewichtsmasse der Gruppe Diversivores verläßt densWald für ihre Ernährung nicht. Die hier aufgezählten Arten sind nicht nur wegen ihrer Insektenkonsumtion wichtig für die Forstwirtschaft, sondern sie sind auch bedeutende Sukzessionsfaktoren. Die Amsel und die Mönchgrasmücke verbreiten sehr viele Gesträuche, als sie die Beerenfrucht konsumieren. Selbst der Eichelhäher, der mit der Verwüstung der Waldsaaten und der Vernichtung der Jungen der Singvögel ein Schädling ist, hat eine solche Bedeutung: er verbreitet die Eichel.

Die 2680 g Gewichtsmasse (39%) der Gemischtefresser gehört zum Wald im Überschwemmungsgebiet größtenteils nur in topischer Beziehung. Diese Arten benützen den Wald für Schlafstätte oder Schlupfwinkel. Ihre Ernährung wickelt sich meistens auf den umliegenden Gebieten ab.

Die im Wald des Überschwemmungsgebiets horstende Stieglitzpopulation ist ein Zerstörer der kleinkörnigen Unkrautsamen auf den benachbarten Agrargebieten. Ihr Wert ist aus landwirtschaftlichem Gesichtspunk beachtlich. Der Fink ist ein wichtiger Zerstörer der Unkrautsamen und Insekten auf den Äckern, Feldern und in den Obstgärten.

Tabelle 3

Trophische Gruppen	Ernärung innerhalb des Waldes				Ernärung ausserhalb des Waldes				Summe			
	Individuum		Biomasse		Individuum		Biomasse		Individuum		Biomasse	
		%	g	%		%	g	%		%	g	%
Herbivores					14		364	2	14	3	364	2
Diversivores	79	40	4203	61	120	60	2 680	39	199	41	6 883	31
Carnivores	156	59	2904	20	112	41	11 753	80	268	56	14 657	67
Summa	235	49	7107	32	246	51	14 797	68	481	100	21 904	100

Nur ein kleinerer Teil der Gewichtsmasse der Gruppe Carnivores (2904 g: 20%) ernährt sich im Walde. 17 Arten entfalten hier ihre insektenzerstörende Tätigkeit, auf deren Wert wir oben schon hingezeigt hatten. Hier möchte ich nur auf die Feststellung Turčeks hinweisen, die vom Gesichtspunkt des Waldbestands im Überschwemmungsgebiete aus betrachtet wichtig zu sein scheint. Dementsprechend, früh im Frühling zerstören die Meisen eine sehr große Menge der Insekten (hauptsächlich die Larven der Rüsselkäfer) auf den Blütenkätzchen der Pappeln und Weiden (Turček 1957).

Die 11 753 g Gewichtsmasse (80%) dieser Gruppe ernährt sich außer dem Walde. Diese Gewichtsmasse ist nur von den Individuen zweier Arten (Dohle und Star) gebildet. Ihr Körpergewicht ist jedoch viel größer als das der früher besprochenen Insektenfresser von kleinem Körper. Außerdem bewohnen sie die hohlen Weiden in kleineren oder größeren Kolonien, ihre Population ist deshalb groß. Ihr Wert zeigt sich in der Säuberung der umliegenden Äcker und Weiden von den Insekten und kleinen Nagetieren.

Zusammenfassung

Zusammenfassend das bisher Gesagte vermögen wir festzustellen, daß die auf dem Versuchsgebiet horstenden, zur Population Passeriformes gehörenden Arten von forst- und Landwirtschaftlichem, sowie zönologischem Gesichtspunkt aus betrachtet von großer Bedeutung sind. Unsere Feststellung wird auch dadurch unterstrichen, daß wir unsere Ergebnisse nicht durch Abschätzung, sondern durch den realen Verhältnissen nahe kommende, auf Grund der Gewichtsmasse der Artpopulationen ausgeführte Berechnungen erzielt haben.

Es soll auch darauf hingewiesen werden, daß eben die Mitglieder der untersuchten Population die größte Ortstreue der Biozönose des Waldes im Überschwemmungsgebiet zeigen.

Es folgt aus den Obigen, daß die Erhaltung und Verteidigung der auf dem Überschwemmungsgebiet der Theiß und anderer Flüsse nicht nur im Interesse des Naturschutzes sondern auch in demjenigen der Volkswirtschaft wichtig ist. Und dies kann nur mit solcher Verwaltung der Wälder im Überschwemmungsgebiet realisiert werden, die eine Horstungsmöglichkeit für die dort brütenden Vogelarten gibt.

Den gegenwärtigen Plänen gemäß werden die längs der Flüsse befindlichen Weide-Pappel Auenwälder überall im Lande mit Edel-Pappeln ersetzt. In den schnell wachsenden, neuen Wäldern hört das Strauchniveau auf zu bestehen; die Löcher werden verschwinden. Die Horstungsmöglichkeiten der Vögel fallen auf das Minimum.

Wir schlagen vor:

1. Die Überprüfung des erwähnten Planes.
2. Mit Rücksicht auf die Gesichtspunkte der biologischen Verteidigung und des Naturschutzes so viel alte Weide-Pappel Auenwälder unbeschadet zu lassen, wie es möglich ist.
3. Wo der Wald auf dem Überschwemmungsgebiet abgeholzt wird, 25% der alten, hohlen Weiden zu erhalten.
4. Eine große Menge künstlicher Vogelhöhlen in die neuen Edelpappelwälder hinauszustellen.

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ZUR ÖKOLOGIE DES SPROSSERS (LUSCINIA LUSCINIA L.) IN DER THEISS-AUEN BEI TISZATELEK, NACH SEINER ANKUNFT IM FRÜHLING

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Auszug

Der Sprosser kommt in NO-Ungarn, am oberem Lauf der Theiss und bei dem Fluss Bodrog, regelmässig und wo die Auwälder noch geblieben sind, in verhältnissmässig grosser Zahl vor. Sein Lebensraum beschränkt sich auf die Flussauen, ist also ziemlich eng begränzt. Nach FARKAS (1952) musste sein Verbreitungsgebiet vor der Kultivierung des Gebietes, d.h. der Trockenlegung der Überschwämmungsgelände und der Moore sowie der Regelung der Theiss und ihrer Nebenflüsse, bedeutend grösser gewesen sein. Zuletzt sind aber nur noch die Flussauen als Lebensräume für den Sprosser geblieben. Gleichzeitig hatte die Nachtigall die trocken gelegten Gebiete stufenweise besiedelt und war auch in die Flussauen eingedrungen, wo sie, zwar nur in geringer Anzahl, gemeinsam mit dem Sprosser vorkommt.

Zwischen 1968—1972 habe ich Ende April — Anfang Mai, also bei Ankommen der Sprosser, regelmässig einige Tage in der Umgebung von Tiszatelek (Kétérköz) verbracht, wo ich mich vor allem mit der Ökologie des Sprossers beschäftigt habe.

Zum Biotop

Schon die verschiedenen Trivialnamen des Sprossers (Auennachtigall, Wassernachtigall usw.) deuten auf seine Vorliebe für die dunstigen, üppigen Auwälder der Flüsse. An der Theiss lebt er vor allem im Hochwald mit reichem Unterwuchs. Den Bestand des Waldes bilden hauptsächlich Weiden und Pappeln, im allgemeinen vermischt, es kommen aber gelegentlich auch reine Weidenbestände vor. Eine der dominante Arten des Unterwuchses ist der Holunder, daneben finden sich verschiedene Sträucher, sowie Weiden- und Pappelsprösslinge. Die Dichte des Unterwuchses ist stark verschieden, grössere Dickichten wächseln mit leichten Beständen. Die Sprosser schienen zwischen den beiden Typen keinen Unterschied zu machen, und besiedeln beide fast gleichartig. Sie schlagen, im Gegenteil zu der Nachtigall, im allgemeinen hoch in den Kronen der Bäume, suchen aber bei einer Störung sofort die Sträucher unter sich steif fliegend auf. Ich habe auch Männchen gefunden die vom Hochwald regelmässig in das benachbarte Weidendickicht herauskamen, um dort in einem grösseren Gebüsch zu schlagen. Die Brennessel, die FARKAS (1952) für das Sprosserbiotop der oberen Theiss so kennzeichnend nennt, ist zu dieser Jahreszeit noch ganz niedrig, schütter, praktisch also ganz unbedeutend. Regelmässig habe ich Sprosser auch in auf Holzschläge aufgewachsenen Weidenbuschbestand gefunden. Die einzelnen Büsche standen hier in Gruppen, waren aber nie so hoch wie normale Weidenbäume. In der bei der Theiss leider immer häufiger werdende gepflanzten, unterwuchslosen Pappelbeständen fehlt der Sprosser dagegen völlig.

Nach ihrer Ankunft haben die Sprosser besonders jene Waldabschnitte gern, wo grössere Haufen von geschnittenen Ästen am Boden liegen. In Ungarn kommen die Männchen erst in den letzten Apriltagen oder den ersten Maitagen an. Die Weibchen folgen ihnen einige Tage später nach. Gleich nach der Ankunft habe ich oft Männchen in diesen Haufen gefunden. Gefangene Exemplare waren meist stark abgemagert. Die Vögel verhielten sich ganz still, wenn man aber ihren Lockruf nachahmte, reagierten sie gewöhnlich mit einem tiefen „Tack—Tack" oder gaben selbst Lockrufe. Sie sassen zwischen den Zweigen mit leicht aufgepolstertem Gefieder, von dem langen Zug offensichtlich erschöpft. Einen Haufen hatte immer nur ein Vogel in Besitz genommen. Wenn man sich an sie näherte, benahmen sie sich verschiedenartig. Einige, die wahrscheinlich schon seit Tagen angekommen waren, flogen dicht über dem Boden zu einem anderen Haufen. Andere hinwieder, vermutlich Frischankömmlinge, kamen aus dem Haufen trotzt heftiger Fusstritte nicht hervor. Erstere konnte man mit andauernden Lockrufen manchmal auch zum Schlagen bringen, der aber keineswegs so stark war wie der normale Sprosserschlag.

Nach einigen Tagen, besonders bei günstigem warmen Wetter, besetzen die erstarkten Männchen die Reviere, und damit beginnt der eigentliche Sprosserschlag in den Auwäldern. Die Reisighaufen suchen die frischangekommene Vögel wahrscheinlich aus Schutz- und Ernährungsgründen auf. Das Insektenleben ist dort nähmlich bei den so oft regnerischen und nasskalten Frühlingstagen reicher als sonst im Walde herum, und bietet reichliche Nahrung für einen sich dort aufhaltenden Sprosser.

Ein sehr bedeutender öklologischer Faktor, der den Brutverlauf des Sprossers aber auch anderer in den Auwäldern nistenden Singvögel wesentlich beeinflussen kann ist die Überflutung der Theiss. Die im Vorfrühling eintreffenden kleinere oder grössere Flutwellen sind, da sie noch vor ihrer Ankunft abziehen, für den Sprosser indifferent. Wenn aber eine grössere Überflutung erst während der Brutzeit erfolgt, gehen alle am Boden oder im Unterwuchs befindlichen Nester zugrunde. Im Jahre 1970 z.B. herrschte von Mai ab praktisch während der ganzen Brutzeit Hochwasser im Überschwemmungsgebiet, es konnte im ganzen Gebiet bei den niedrig nistenden Aıten keine erfolgreiche Brut erfolgen. Die Wirkung dieses Brutausfalls konnte man im Frühling 1971 sowohl beim Bestand des Sprosser, als auch bei der Nachtigall oder der Gartengrasmücke deutlich registrieren.

Mitbewohner

Wenn die Arten die für das Biotop des Sprossers in Ungarn kennzeichend sind behandelt werden, soll die Nachtigall die das Biotop mit dem Sprosser auch im engsten Sinne teilt, am erster Stelle stehen. Oft habe ich versucht in dem von mir gut gekannten Gebiet die einzelnen Reviere von Sprosser und Nachtigall ökologisch zu trennen, es ist mir aber nie zufriedenstellend gelungen. Der Sprosser ist in den Auwäldern der oberen Theiss in Mehrzahl gegenüber der Nachtigall, in dem von mir untersuchten Gebiet etwa wie 8:1. Letztere sind in einzelnen Paaren zwischen die Sprosser sozusagen verkeilt. Es fiel mir nur auf, dass die Nachtigallen meistens am Rande des Waldes ihr Revier hatten, für die Sprosser schien die Wahl, Rande oder

Mitte des übrigens nicht breiten Waldes, gleichgültig zu sein. Die Reviere der beiden Arten sind voneinander nicht streng getrennt. Die Männchen von Nachtigall und Sprosser schlagen nicht selten unweit voneinander, nur die vertikalen Unterschiede der schlagenden Vögel sind, wie schon erwähnt, bedeutend. Das Zusammenleben beider Arten hat auch die Folge, dass unter dem Sprosser oft sogenannte Zwischaller vorkommen, d.h. Männchen, die in ihrem Schlag auch Touren von der Nachtigall übernehmen.

Von anderen, als Nahrungskonkurrent in Frage kommenden Erdsängern ist *Erithacus rubecula* recht selten, auch *Turdus philomelos* und. T. merula kommen nur vereinzelt vor. Von den sich im Laub ernährenden Arten sind *Oriolus oriolus*, *Sylvia atricapilla*, *S. borin*, und *S. curruca* häufig, dagegen sind *Phylloscopus collybita*, *P. sibilatrix*, *Muscicapa striata* und *Hippolais icterina* seltener. Am Rande des Waldes, aber auch in Weidendickichten in dessen Nähe der Sprosser schon brütet, ist *Sylvia nisoria* überall recht häufig, im demselben Biotop kommen auch *Sylvia communis*, *Locustella fluviatilis* und *Lanius collurio* vor.

Zur Ergänzung eine Liste von anderen im Auwald bei Tiszatelek (Kétérköz) nistenden Arten: *Anas platyrhyncha*, *Milvus migrans*, *Falco tinnunculus*, *Perdix perdix*, *Phasianus colchicus*, *Actitis hypoleucos* (?) (wurde oft in der Brutzeit beobachtet), *Columba palumbus*, *Streptopelia turtur*, *S. decaocto* (wurde auch fern von menschlichen Siedlungen brütend gefunden), *Cuculus canorus*, *Asio otus*, *Coracias garrulus*, *Upupa epops*, *Jynx torquilla*, *Picus viridis*, *Picus canus*, *Dendrocopos major*, *Riparia riparia* (kleine Kolonie am Theiss-Ufer), *Corvus cornix*, *Garrulus glandarius*, *Parus major*, *P. coeruleus*, *Aegithalos caudatus*, *Remiz pendulinus*, *Phoenicurus phoenicurus*, *Acrocephalus arundinaceus*, *Phylloscopus trochilus* (?) (noch Durchzügler?), *Anthus trivialis*, *Sturnus vulgaris*, *Passer montanus*, *Chloris chloris*, *Carduelis carduelis* (im Nähe menschlicher Siedlungen), *Fringilla coelebs*, *Emberiza citrinella.*

Folgende Arten wurden ausser dem Damm gefunden, oder sie wurden nur zufällig im Gebiet beobachtet: *Ardea cinerea*, *Egretta garzetta*, *Nycticorax nycticorax*, *Botaurus stellaris*, *Ciconia ciconia*, *Pernis apivorus*, *Buteo buteo*, *Falco subbuteo*, *Vanellus vanellus*, *Tringa nebularia*, *Larus ridibundus*, *Caprimulgus europaeus*, *Alcedo atthis*, *Merops apiaster*, *Galerida cristata*, *Alauda arvensis*, *Hirundo rustica*, *Delichon urbica*, *Corvus frugilegus*, *Coloeus monedula*, *Pica pica*, *Saxicola rubetra*, *Acrocephalus palustris*, *Muscicapa hypoleuca*, *Muscicapa albicollis*, *Motacilla alba*, *Lanius minor*, *Passer domesticus*, *Coccothraustes coccothraustes*, *Emberiza calandra.*

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NEUERE BEITRÄGE ZUR KENNTNIS DER GROSS-SCHMETTERLINGE DES THEISS-TALES, MIT BESONDERER RÜCKSICHT AUF DIE UMGEBUNG VON TISZAFÜRED

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Gymnasium, Sellye
(Eingegangen am 31. Dezember 1970)

Ich habe im Jahr 1964 begonnen, die Tagfalter des Theiß-Tales zu untersuchen. Im Laufe dieser Untersuchungen habe ich 76 Tagfalterarten nachgewiesen. Die Ergebnisse meiner Untersuchungen wurden früher veröffentlicht (UHERKOVICH 1967, 1968). Die Forschung nach den weiteren Mitgliedern der Groß-Schmetterlings-Fauna war ein ebenso vernachlässigtes Gebiet wie die Erkenntnis der Tagfalter. Obwohl KOVÁCS (1953, 1956) und ZILAHI—SEBESS (1961) auch große Nachfalter veröffentlichen — hauptsächlich aus dem Raum von Szeged, Szikra, Tiszaderzs, Tiszacsege und Tiszaluc —, ist die Anzahl der von ihnen mitgeteilten Angaben viel zu klein im Vergleich mit der Größe des Gebiets.

Ich habe meine Forschungen in Hinsicht der übrigen Großschmetterlinge (Heterocera) schon in 1964 begonnen. Die Zahl der Angaben aus den Jahren zwischen 1964 und 1968 ist klein, sie stammen größtenteils aus 1969 und 1970, als isch in der Umgebung von Tiszafüred und Szeged eine größere Sammlung durchgeführt hatte. Ich erhielt einige neuere Angaben auch über andere Fundstellen, die ich früher besucht hatte (UHERKOVICH 1968). Ich habe bisher nicht einmal die Tagfalter der Umgebung von Tiszafüred und Algyő mitgeteilt, so habe ich auch diese Fundortangaben in meine Abhandlung aufgenommen um die Angaben meiner — auf das Gebiet bezüglichen — Publikation so vollständig wie möglich zu ergänzen.

Neue Fundortangaben

Der größere Teil des Stoffes stammt von der Umgebung von Tiszafüred. Von dieser Stelle habe ich früher keine Angaben mitgeteilt. Ich habe hier bei 3 Gelegenheiten, in drei verschiedenen Jahreszeiten gesammelt. Bei Tagessammlungen habe ich die früher geeignet erwiesene Methode der Zählung der Individuen angewandt (UHERKOVICH 1972). Meine Nachsammlungen habe ich mit einer 125 Watt Quecksilberdampflampe aus geführt und die Lampe auf die Krone des Schutzdamms aufgestellt.

In der Umgebung von Szeged habe ich für die Sammlung der Nacht-Groß-schmetterlinge gleichfalls eine Quecksilberdampflampe angewandt. Ich habe ferner auch die in die Stadt einfliegenden und sich auf die Stadtlampen normalen Lichtes setzenden Makrolepidopteren gesammelt.

Die anderen Beiträge stammen aus Tagessammlungen. Einige Angaben habe ich von anderen Sammlern erhalten, bzw. sind sie ein Ergebnis gemeinsammer Sammlungen. Diese habe ich bei den einzelnen Fundorts beiträgen vermerkt: (G.) DÁNIEL GÁL, (U.—V.) ÁKOS UHERKOVICH—LÁSZLÓ VARJAS, (V.) LÁSZLÓ VARJAS.

Bei der Aufzählung habe ich der Familien-Reihenfolge von GOZMÁNY (1965) gefolgt. Weil über die Unterartsverhältnisse der mitgeteilten Arten nur noch sehr wenige Publikationen erschienen sind, unterlasse ich eine bis zur Unterart ausgeführte eingehende Darlegung.

Aufzählung der gesammelten Arten:

Cossus cossus L. — Szeged, Theißufer, 20. VII. 1969.
Zeuzera pyrina L. — Szeged, 17. VII. 1969; Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969; Dombrád, 21. VII. 1965.
Zygaena filipendulae L. — Tiszafüred, 11. VIII. 1969; Dombrád, 18. VII. 1965.
Synanthedon tipuliformis CL. — Szeged, 31. V. 1964, 14. V. 1966.
Aegeria apiformis CL. — Szeged, V. 1967. (V.)
Canephora unicolor HUFN. — Szeged-Rókus, 30. V. 1965.
Sterrha aversata L. — Szeged, 7. VIII. 1970.
S. rufaria HUFN. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 12. VI. 1968.
S. muricata HUFN. — Tiszafüred, 9., 11. VIII. 1969.
S. degeneraria HBN. — Tiszafüred, 11. VIII. 1969.
S. serpentata HUFN. — Tiszafüred, 11. VIII. 1969.
Scopula incanata L. — Szikra, Tőserdő, 8. VIII. 1967. (U.—V.)
S. rubiginata HUFN. — Tiszafüred, 9., 11. VIII. 1969.
S. corrivalaria KRESTSCHM. — Tiszafüred, 9. VIII. 1969.
S. immutata L. — Tiszafüred, 9., 11. VIII. 1969.
Calothysanis amata L. — Szeged, 1965—1968; Szikra, Tőserdő, 8. VIII. 1967. (U.—V.) Tiszaug, 8. VIII. 1967; Tiszafüred, 9., 11. VIII. 1969; Dombrád, 12. VIII. 1967; Tuzsér, 11. VIII. 1967.
Lythria purpurata L. — Szeged, Theißufer, 24. VI. 1966.
L. purpuraria L. — Szeged, Theißufer, 20. VII. 1969; Szeged-Rókus, 6. IV. 1965; Újszeged, 7. IV. 1965; Szikra, Tőserdő, 8. VIII. 1967; Dombrád, 12. VIII. 1967; Tuzsér, 11. VIII. 1967.
Minoa murinata SCOP. — Szikra, Tőserdő, 15. V. 1966. (U.—V.)
Lithostege asinata HUFN. — Szikra, Tőserdő, 15. V. 1966. (U.—V.)
Mysticoptera sexalata RETZ. — Tiszafüred, 11. VIII. 1969.
Nycterosea obstipata F. — Szeged, 7. VIII. 1970.
Xanthorrhoe ferrugata L. — Tiszafüred, 9., 11. VIII. 1969. 3. V. 1970; Dombrád, 12. VIII. 1967.
X. fluctuata L. — Szeged, VIII. 1967; Tiszafüred, 2., 3. V. 1970.
Euphya bilineata L. — Szikra, Tőserdő, 8. VIII. 1967. (U.—V.)
Mesoleuca albicillata L. — Szeged, 16. V. 1966; Tiszafüred, 11. VIII. 1969.
Epirrhoe alternata MÜLL. — Tiszafüred, 9., 11. VIII. 1969, 3. V. 1970.
Pelurga comitata L. — Szeged, 15. VIII. 1966; Tiszafüred, 9., 11. VIII. 1969; Dombrád, 7., 8. VIII. 1966.
Cataclysme riguata HBN. — Szikra, Tőserdő, 15. V. 1966. (U.—V.)
Eupothecia assimilata DBL. — Dombrád, 8. VIII. 1966.
E. denotata HBN. — Tiszafüred, 9. VIII. 1969.
E. subnotata HBN. — Tiszafüred, 11. VIII. 1969; Dombrád, 6., 7. VIII. 1966.
E. tripunctaria HS. — Tiszafüred, 11. VIII. 1969.

E. linariata F. — Tiszafüred, 11. VIII. 1969.
Anticollix sparsata TR. — Tiszafüred, 11. VIII. 1969.
Chlorissa viridata L. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 11. VIII. 1969.
Euchloris smargdaria F. — Tiszafüred, 11. VIII. 1969.
Cabera exanthemata SCOP. — Tuzsér, 11. VIII. 1967.
Ennomos autumnaria WERNB. — Tiszafüred, 11. VIII. 1969.
Angerona prunaria L. — Tiszafüred, 9., 11. VIII. 1969.
Lomaspilis marginata L. — Tiszafüred, 9., 11. VIII. 1969.
Epione repandaria HUFN. — Tiszafüred, 9. VIII. 1969.
Therapis flavicaria SCHIFF. — Szikra, Tőserdő, 15. V. 1966. (U.—V.)
Pseudopanthera macularia L. — Szikra, Tőserdő, 15. V. 1966. (U.—V.)
Eilicrinia cordiaria HBN. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 11. VIII. 1969.
Macaria alternaria HBN. — Szeged, 6., 15., 18. VIII. 1967; Tiszafüred, 9., 11. VIII. 1969.
Chiasmia clathrata L. — Szeged, 18. VIII. 1967; Szeged, Theißufer, 20. VII. 1969; Szikra, Tőserdő, 15. V. 1966. (U.—V.); Tiszafüred, 9., 11. VIII. 1969; Dombrád, 13. VIII. 1967.
Ch. glareria BRAHM. — Szeged, VII. 1967.
Narraga tessularia METZN. — Tiszafüred, 9., 11. VIII. 1969.
Tephrina arenacearia SCHIFF. — Szeged, 17. VII. 1969; Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969.
Lycia hirtaria CL. — Tiszafüred, 2. V. 1970.
Ectropis bistortata GOEZE — Tiszafüred, 2. V. 1970.
Ascotis selenaria SCHIFF. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969.
Serraca punctinalis SCOP. — Tiszafüred, 9., 11. VIII. 1969.
Ematurga atomaria L. — Szikra, Tőserdő, 15. V. 1966 (U—V.); Tiszaug, 8. VIII. 1967; Tiszafüred, 3 V. 1970; Dombrád, 28. VII. 1965; Tuzsér, 11. VIII. 1967.
Euxoa aquilina SCHIFF. — Szeged, Theißufer, 20. VII. 1969.
Agrotis segetum SCHIFF. — Szeged, 8. VIII. 1968, 7. VIII. 1970; Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969; Dombrád, 13. VIII. 1967
A exclamationis L. — Szeged, 7. VIII. 1970; Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969; Dombrád, 12. VIII. 1967.
A. ipsilon HUFN. — Szeged, 8. VIII. 1968; 7. VIII. 1970.
Ochropleura plecta L. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969.
Triphaena pronuba L. — Tiszafüred, 9., 11. VIII. 1969.
T. janthina SCHIFF. — Tiszafüred, 11 VIII 1969
Peridroma saucia HBN — Szeged, 8 VIII 1968; Szeged, Theißufer, 20 VII. 1969.
Amathes c-nigrum L. — Szeged, 6. VIII. 1967; Szeged, Theißufer, 20. VII. 1969; Szikra, Tőserdő, 8. VIII. 1967. (U.—V.); Tiszafüred, 9., 11. VIII. 1969; Gáva, 12. VIII. 1967.
Discestra trifolii ROTT. — Szeged, 6. VIII. 1967; Szeged, Theißufer, 20. VII. 1969; Tiszafüred, p., 11. VIII. 1969.
D. dianthii TAUSCH. — Tiszafüred, 9. VIII. 1969.
Hyssia gozmanyi KOV. — Tiszafüred, 9. VIII. 1969.
Mamestra brassicae L. — Szeged, 6. VIII. 1967; Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969.

M. oleracea L. — Szeged, 18. VIII. 1967; 7. VIII. 1970; Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969.
M. suasa SCHIFF. — Szeged, 13. VIII. 1966; Tiszafüred, 9. VIII. 1969.
Hadena cucubali SCHIFF. — Tiszafüred, 11. VIII. 1969.
H. lepida ESP. — Tiszafüred, 11. VIII. 1969.
H. bicruris HUFN. — Szeged, 12. V. 1966.
H. luteago SCHIFF. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9. VIII. 1969.
Mythimna turca L. — Tiszafüred, 9., 11. VIII. 1969.
M. ferrago F. — Szeged, 18. VIII. 1967; Tiszafüred, 11. VIII. 1969.
M. albipuncta F. — Szeged, 1965—1968.
M. vitellina HBN. — Szeged, 14. VIII. 1966; Tiszafüred, 9., 11. VIII. 1969.
M. pallens L. — Tiszafüred, 9., 11. VIII. 1969.
M. obsoleta HBN. — Szeged, 6. VIII. 1965; Tiszafüred, 9., 11. VIII. 1969.
Xylomiges conspicillaris L. — Tiszafüred, 3. V. 1970.
Orthosia incerta HUFN. — Tiszafüred, 3. V. 1970.
Cucullia umbratica L — Tiszafüred, 9., 11. VIII. 1969.
Pyrois tragopogonis CL. — Tiszafüred, 9. VIII. 1969.
Dypterygia scabriuscula L. — Tiszafüred, 9., 11. VIII. 1969.
Euplexia lucipara L. — Tiszafüred, 9 VIII. 1969.
Oligia strigilis L. — Tiszafüred, 9., 11. VIII. 1969.
Trachea atriplicis L. — Tiszafüred, 9., 11. VIII. 1969.
Telesilla amethystina HBN. — Szeged, Theißufer, 20 VII. 1969.
Athetis palustris HBN. — Tiszafüred, 9., 11. VIII. 1969.
Charanyca trigrammica L. — Szeged, V. 1966.
Cosmia trapezina L. — Szeged, Theißufer, 20. VII. 1969.
Caradrina morpheus HUFN. — Tiszafüred, 9., 11. VIII. 1969.
Archanara sparganii ESP. — Tiszafüred, 9. VIII. 1969.
Hapalotis venustula HBN. — Tiszafüred, 9. VIII. 1969.
Heliothis maritima GRASL. — Szeged, 20 VII. 1969; Tiszafüred, 9 VIII 1969
H. viriplaca HUFN — Szikra, Tőserdő, 8. VIII. 1967. (U.—V.)
Pyrrhia umbra HUFN. — Tiszafüred, 9., 11. VIII. 1969.
Axylia putris L. — Szeged, 17. VIII. 1966; Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969.
Unca olivana SCHIFF. — Szikra, Tőserdő, 15. V. 1966. (U.—V.); Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969.
U. candidula SCHIFF. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9. VIII. 1969.
Emmelia trabealis SCOP. — Szeged, 5. VIII. 1967; Szeged, Theißufer, 20. VII. 1969; Szikra, Tőserdő, 8. VIII. 1967. (U.—V.); Tiszaug, 8. VIII. 1967; Dombrád, 13. VIII. 1967.
Trache lucida HUFN. — Szeged, VIII. 1967; Dombrád, 21. VII. 1965.
Earias chlorana L. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9 VIII 1969
Autographa confusa STEPH — Szeged, 13 VIII 1966; Szeged, Theißufer, 20 VII 1969; Tiszafüred, 11 VIII 1969; Tuzsér, 11 VIII 1967
A gamma L. — Szeged, 15 V. 1966; Szeged, Theißufer, 20. VII. 1969; Szikra, Tőserdő, 8. VIII. 1967. (U.—V.); Tiszaug, 8. VIII. 1967; Tiszavasvári, 20. VII. 1964. (G.); Tiszafüred, 9., 11. VIII. 1969; Dombrád, 13. VIII. 1967; Tuzsér, 11. VIII. 1967.
Plusia chrysitis L. — Szeged, 13. VIII. 1966; Szeged, Theiäufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969; Tuzsér, 11. VIII. 1967.
Abrostola triplasia L. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969; Dombrád, 7. VIII. 1966.

Catocala nupta L. — Tiszafüred, 11. VIII. 1969.
C. elocata ESP. — Szeged, VIII. 1966.
Ophiusa algira L. — Szeged, 5. VIII. 1966; 8. VIII. 1968.
Ectypa glyphica L. — Szikra, Tőserdő, 8. VIII. 1967. (U.—V.); Tiszafüred, 11. VIII. 1969, 3. V. 1970; Tuzsér, 11. VIII. 1967.
Lygephila pastinum TR. — Tiszafüred, 9. VIII. 1969.
Acontia luctuosa SCHIFF. — Szeged, Theißufer, 20. VII. 1969; Szikra, Tőserdő, 8. VIII. 1967; (U.—V.); Tiszaug, 8. VIII. 1967; Tiszafüred, 9. VIII. 1969.
Rivula sericealis SCOP. — Tiszafüred, 11. VIII. 1969.
Simplicia rectalis EV. — Szeged, Theißufer, 20. VII. 1969
Zanclognatha tarsicrinalis KNOCH — Tiszafüred, 9 VIII 1969
Z griseális SCHIFF — Tiszafüred, 9 , 11 VIII 1969
Trisateles emortualis SCHIFF. — Tiszafüred, 9. VIII. 1969.
Lymantria dispar L. — Szikra, Tőserdő, 8. VIII. 1967. (U.—V.); Tiszafüred, 9. VIII. 1969; Tuzsér, 11. VIII. 1967.
Euproctis chrysorrhoea L. — Szeged, Theißufer, 20. VII. 1969.
Stilpnotia salicis L. — Tiszafüred, 9., 11. VIII. 1969; Dombrád, 12. VIII. 1967; Tuzsér, 11. VIII. 1967.
Pelosia muscerda HUFN. — Tiszafüred, 9., 11. VIII. 1969.
Phragmatobia fuliginosa L. — Szeged, 8. VIII. 1968; Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969; Dombrád, 21. VII. 1965; Tuzsér, 11. VIII. 1967.
Spilosoma menthastri ESP. — Szeged, 9. V. 1966, 5. VIII. 1967; Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969.
Spilarctia lutea HUFN. — Tiszafüred, 9., 11. VIII. 1969.
Hyphantria cunea DRURY — Tiszavasvári, 20. VII. 1964. (G.); Szeged, 19. V. 1966; Tiszafüred, 11. VIII. 1969, 3. V. 1970.
Arctia caja L. — Szeged, 5. VIII. 1966; Dombrád, 11. VIII. 1967.
Cerura bifida HBN. — Szeged, 9. V. 1966; Tiszafüred, 9., 11. VIII. 1969.
C. furcula CL. — Tiszafüred, 3. V. 1970.
Gluphisia crenata ESP. — Dombrád, 24. VII. 1965.
Notodonta ziczac L. — Szikra, Tőserdő, 8. VIII. 1967. (larvae, U.—V.); Tiszafüred, 9. VIII. 1969.
N. phoebe SIEB. — Szeged, Theißufer, 20. VII. 1969.
Pheosia tremula CL. — Tiszafüred, 9. VIII. 1969.
Spatalia argentina SCHIFF. — Szeged, Theißufer, 20. VIII. 1969.
Pygaera anachoreta F. — Tiszafüred, 3. V. 1970.
Habrosyne pyritoides HUFN. — Tiszafüred, 9 , 11. VIII. 1969.
Thyatira batis L. — Tiszafüred, 9., 11. VIII. 1969.
Tethea or F. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969.
T. ocularis L. — Szeged, Theißufer, 20. VII. 1969; Tiszafüred, 9., 11. VIII. 1969.
Saturnia pyri SCHIFF. — Szeged, V. 1966; Tiszavasvári, 14. V. 1964. (G.)
Acherontia atropos L. — Szeged 21. IX. 1964.
Herse convolvuli L. — Tiszafüred 11. VIII. 1969
Amorpha populi L. — Tiszafüred, 9. VIII. 1969; Tiszavasvári, 20. VII. 1964. (G.)
Celerio euphorbiae L. — Szikra, Tőserdő, 13. IX. 1965. (larvae); Tiszafüred, 9., 11. VIII. 1969.
Mimas tiliae L. — Tiszafüred, 9., 11. VIII. 1969.
Macroglossum stellatarum L. — Szeged, 20. V. 1966; Dombrád, 13. VIII. 1967; Tuzsér, 11. VIII. 1967.

Pergesa elpenor L. — Tiszafüred, 9., 11. VIII. 1969.
P. porcellus L. — Tiszafüred, 9., 11. VIII. 1969.
Gastropacha populifolia Esp. — Tiszafüred, 9., 11. VIII. 1969.
G. quercifolia L. — Tiszafüred, 9. VIII. 1969.
Odenestis pruni L. — Tiszafüred, 11. VIII. 1969.
Thymelicus lineola O. — Tiszafüred, 12. VI. 1968.
Ochlodes venata faunus Trti. — Algyő, 13. VIII. 1968; Tiszafüred 12. VI. 1968, 10. VIII. 1969.
Carcharodus alceae Esp. — Algyő, 13. VIII. 1968; Tiszafüred, 10., 11. VIII. 1969.
Erynnis tages L. — Tiszafüred, 10. VIII. 1969, 3. V. 1970.
Pyrgus malvae L. — Tiszafüred, 11. VIII. 1969, 3. V. 1970.
Leptidea sinapis L. — Tiszafüred, 12. VI. 1968, 11. VIII. 1969.
Gonopteryx rhamni L. — Tiszafüred, 3. V. 1970.
Colias croceus Fourc. — Algyő, 13. VIII. 1968.
C. hyale L. — Algyő, 13. VIII. 1968; Tiszafüred, 3. V. 1970.
Antocharis cardamines L. — Tiszafüred, 3. V. 1970.
Pontia daplidice L. — Algyő, 13. VIII. 1968; Tiszafüred, 12. VI. 1968, 10. VIII. 1969.
Pieria brassicae L. — Tiszafüred, 10., 11. VIII. 1969.
P. rapae L. — Algyő, 13. VIII. 1968; Tiszafüred, 12. VI. 1968, 10., 11. VIII. 1969, 3. V. 1970.
P. napi L. — Algyő, 13. VIII. 1968; Tiszafüred, 12. VI. 1968, 10., 11. VIII. 1969. 3. V. 1970.
Papilio machaon L. — Algyő, 13. VIII. 1968; Tiszafüred, 11. VIII. 1969.
Thersamonia thersamon Esp. — Algyő, 13. VIII. 1968.
Th. dispar rutilus Wrbg. — Algyő, 13. VIII. 1968; Tiszafüred, 12. VI. 1968, 11. VIII. 1969.
Loweia tityrus Poda — Tiszafüred, 12. VI. 1968, 3. V. 1970.
Lycaena phlaeas L. — Tiszafüred, 12. VI. 1968, 3. V. 1970.
Thecla betulae L. — Tiszafüred, 11. VIII. 1969.
Everes argiades Pall. — Algyő, 13. VIII. 1968; Tiszafüred, 12. VI. 1968, 10., 11. VIII. 1969, 3. V. 1970.
Celastrina argiolus L. — Algyő, 13. VIII. 1968; Tiszafüred, 12. VI. 1968, 10. VIII. 1969.
Glaucopsyche alexis Poda — Tiszafüred, 12. VI. 1968.
Plebejus argus aegon Schiff. — Tiszafüred, 10., 11. VIII. 1969.
Polyommatus icarus Rott. — Algyő, 13. VIII. 1968; Tiszafüred, 12. VI. 1968, 10., 11. VIII. 1969.
Lysandra bellargus Rott. — Algyő, 13. VIII. 1968.
Issoria lathonia L. — Tiszafüred, 12. VI. 1968, 3. V. 1970.
Clossiana dia L. — Tiszafüred, 12. VI. 1968, 10., 11. VIII. 1969, 3. V. 1970.
Melitaea phoebe Schiff. — Tiszafüred, 11. VIII. 1969.
Araschnia levana L. — Tiszafüred, 12. VI. 1968.
Polygonia c-album L. — Tiszafüred, 12. VI. 1968, 10. VIII. 1970.
Nymphalis io L. — Tiszafüred, 12. VI. 1968.
Vanessa atalanta L. — Tiszafüred, 12. VI. 1968, 10. VIII. 1969, 3. V. 1970.
V. cardui L. — Tiszafüred, 12. VI 1968, 11 VIII 1969, 3. V. 1970.
Apatura ilia Schiff. — Algyő, 13. VIII. 1968; Tiszafüred, 12. VI. 1968.
Coenonympha pamphilus L. — Algyő, 13. VIII. 1968; Tiszafüred, 12. VI. 1968, 10., 11. VIII. 1969.
Maniola janira L. — Algyő, 12. VI. 1968; Tiszafüred, 12. VI. 1968, 10., 11. VIII. 1969.

Ökologische und zönologische Analyse der Groß-Schmetterlinge der Umgebung von Tiszafüred

Tagfalter (Diurna)

Die Anzahl der nachgewiesenen Arten ist 35. Die für das Inundationsgebiet (Wellenraum innerhalb der Schutzdämme) charakteristische Art ist die Theistalform der *Apatura ilia* SCHIFF. von zweien Generationen und die *Thekla betulae* L. Die Vorige ist charakteristisch für die heimischen Flußtäler, die Letzteren in der ungarischen Tiefebene hauptsächlich für die Auewälder des Überschwemmungsgebiets, anderswo kommen sie nur selten vor. Die zwei charakteristischen Arten des Schutzdammes sind die *Clossiana dia* L. und *Glaucopsyche alexis* PODA. Die Letztere ist auf der Ungarischen Tiefebene selten, längs der Theiß kommt sie stellenweise vor (UHERKOVICH 1967, 1968).

Im Frühling dominieren an den Schutzdämmen die allgemein verbreiteten mit keinem bestimmten Biotop verbundenen Arten (UHERKOVICH 1971). Am 3. Mai 1970 habe ich zwei Aufnahmen ausgeführt um die relativen Dominanzwerte festzusetzen:

1. Tiszaörvény (Flußkilometer 426—428)

	%		%
Erynnis tages	28,6	*Antocharis cardamines*	7,1
Clossiana dia	23,8	*Issoria lathonia*	4,8
Pieris rapae	16,6	weitere vier Arten	9,6
Pieris napi	9,5		

2. Zwischen Tiszafüred und Tiszaörvény (zwischen den Flußkilometern 436—439), in einer ein wenig nässeren Stelle von üppigerer Vegetation habe ich die folgende Dominanzreihenfolge festgestellt:

	%		%
Loweia tityrus	40,6	*Lycaena phlaeas*	8,1
Pieris rapae	24,3	*Clossiana dia*	5,4
Erynnis tages	10,6	weitere fünf Arten	11,0

Am 12. Juni 1968 habe ich die Häufigkeitswerte der Tagfalter des Schutzdamms in einer ungefähr drei Km Strecke nördlich von Tiszafüred untersucht:

	%		%
Pieris rapae	30,4	*Pieris napi*	3,2
Coenonympha pamphilus	26,4	*Loweia tityrus*	3,2
Pontia daplidice	11,2	*Glaucopsyche alexis*	2,4
Polyommatus icarus	4,8	*Clossiana dia*	2,4
Issoria lathonia	4,0	*Maniola janira*	2,4
Everes argiades	4,0	weitere fünf Arten	5,6

Dem späteren Zeitpunkt zufolge ist die Zahl der Arten höher. Die charakteristischen Arten des 2. Aspekts sind noch zu finden (vgl.: Anfang Mai!), aber diese werden mit den durchschnittlich Mitte Mai entschlüpfenden *Lycaeniden* und *Satyriden* ergäntz. Dies ist das charakteristische Bild des 3. Aspekts (UHERKOVICH 1971).

Gleichzeitig habe ich auch in dem zwischen Tiszafüred und Poroszló liegenden sehr breiten Inundationsgebiet quantitave Untersuchungen ausgeführt. Meine Aufnahmen wurden an den Rändern und auf den Lichtungen der angelegten Flutgebietswälder erzeugt. Die dominanten Bäume des Waldes in meinen Sammelorten waren: *Populus canadensis*, *Salix alba*, *S. fragilis*, *Quercus robur*, *Fraxinus angustifolia;* und die häufigsten Sträucher waren: *Amorpha fruticosa*, *Salix triandra*.

Für den 3. Aspekt dieser Schmetterlingassoziation ist die Anwesenheit von viel mehreren silvicolen und meso-hygrophilen Arten charakteristisch; zur selben Zeit ist die Anzahl der xerophilen und ruderalen Arten sehr niedrig:

	%		%
Pieris rapae	42,2	*Apatura ilia*	3,0
P. napi	26,5	*Ochlodes venata*	2,4
Celastrina argiolus	9,1	*Vanessa atalanta*	1,8
Polygonia c-album	4,8	weitere acht Arten	6,6
Maniola janira	3,6		

Die Sammlung am 10—11. VIII. 1969 geschah in der Zeit des 4. (Sommer) Aspekts. Im Überschwemmungsgebiet dominierte dann *Pieris napi*, die Subdominanten waren *Plebejus argus*, *Polyommatus icarus* and *Pieris rapae*. Dann und dort habe ich auch die zwei *Thecla betulae* L. von Tiszafüred gesammelt, am Rande des Flutgebietspopulation *Amorpha fruticosa*.

Zur selben Zeit habe ich an den Schutzdämmen 19 Arten in den folgenden Quantitäten nachgewiesen:

	%		%
Coenonympha pamphilus	27,8	*Clossiana dia*	4,6
Plebejus argus	16,7	*Leptidea sinapia*	4,6
Pieris napi	13,0	*Everes argiades*	4,6
Pieris rapae	7,4	weitere elf Arten	15,8
Polyommatus icarus	5,5		

Die Artenzusammensetzung der Tagfalter der Schutzdämme erinnert uns an die Verhältnisse in der Umgebung von Dombrád und Tiszakarád. Die Pflanzengesellschaft ist identisch: die Assoziation *Arrhenateretum elatioris*, deren Fazies *Rumexes*. Der Grund der Ähnlichkeit ist nicht nur die identische Pflanzengesellschaft, sondern auch die ähnlichen bodenkundlichen Umstände (UHERKOVICH 1967).

Die Schmetterlingassoziation des Inundationsgebiets zeigt gewissermassen eine Mittelstellung zwischen den Schmetterlinggesellschaften der in der Umgebung von Szeged befindlichen, völlig ungestalteten, angebaut aussehenden Ufergeländen und denjenigen der in der Umgebung von Dombrád—Tiszakarád befindlichen, verhältnismässig weniger umgestalteten Inundationsgeländen üppiger Vegetation.

Nachtfalter (Heterocera)

In 1969 und 1970 habe ich in Tiszafüred vier Abende lang mit Hilfe von einer 125 Watt Quecksilberdampflampe Nacht-Grossschmetterlinge gesammelt.

Am 2. und am 3. Mai 1970 habe ich bei sehr ungünstigem Wetter in der Nähe des Dammwärterhauses gesammelt. Dem in den vorigen Tagen stattgefundenen sehr starken kalten Frontdurchgang, sowie dem Hochwasserstand der Theiß zufolge flogen nur sehr wenige Schmetterlinge auf die Lampe. Wegen der späten Ankunft des Frühlings flogen dann noch auch einige Spätwinter-Frühfrühlingsarten (*Lycia hirtaria* CL., *Orthosia incerta* HUFN.), es erschienen schon aber gleichzeitig auch einige Frühlingsarten.

Am 9. und am 11. August 1969 habe ich unter günstigeren Wettersumständen, bei einem niedrigeren Wasserstand, an derselben Stelle gesammelt. Während einer insgesamt fünfundhalbstündigen Beleuchtung habe ich mehr als 1000 Exemplare von 104 Arten eingesammelt.

Der ökologisch-zoogeographischen Analyse gemäß leben auf dem Gebiet zunächst mehrere Arten von sibirischer und einige von aralo-kaspischer Verbreitung neben den euryöken paläarktischen Arten. Die Vorigen sind die Charakterarten des östlichen Teils der ungarischen Tiefebene (Theiß-Kőrösgegend: Tisio-Crisicum; vgl.: VARGA 1960, 1964, KOVÁCS 1965, GOZMÁNY 1970).

In größter Anzahl leben hier — wie auch auf anderen Gebieten — die euryöken und hypereuryöken Arten. Die Assoziationen bekommen ein charakteristisches Gepräge von den arundiphilen und hygrophilen Komponenten eurosibirischer Verbreitung (*Archanara sparganii* ESP., *Scopula corrivalaria* KRETSCHM., bzw. *Mythimna obsoleta* HBN., *Unca olivana* SCHIFF., *Scopula immutata* L.). Die Wälder des Überschwemmungsgebiets ermöglichen teils das Leben einiger (alnetalen) Moorwald-Auenwaldarten (z.B. *Pelosia muscerda* HUFN.), teils auch das Leben mehrerer, an Pappeln und Weiden lebenden Arten. Es fehlen aber auf dem Gebiet die altoherbosen und nemoralen Konponenten: die Lebensmöglichkeiten der Letzteren bestehen nur in sehr geringem Maße auf dem immer wieder unter Wasser geratenen Überschwemmungsgelände, es würden ihnen übrigens die klimatischen Umstände geeignet sein. Es fehlen gleichfalls auch die mediterranen-pontomediterranen Arten, was gleichzeitig auch ein faunogenetischer Beweis ist: die mediterranen Elemente nehmen in der Ausbildung der Tisio-Crisicum-Fauna nur in geringem Maße teil; das Auftreten der Komponenten von Sodasteppen ist viel bedeutender (*Dicestra dianthii* TAUSCH., *Narraga tessularia* METZN.).

Auf Grund der Zusammenfassung der Sammlungen von 9. und 11. August 1969 war die Dominanz-Reihenfolge (mit der Anzahl der gesammelten Exemplare in Klammern):

Amathes c-nigrum	(579)	*Athetis palustris*	(17)
Axylia putris	(107)	*Phragmatobia fuliginosa*	(16)
Chiasmia clathrata	(67)	*Spilarctia lutea*	(15)
Ochropleura plecta	(58)	*Mamestra brassicae*	(15)
Habrosyne pyritoides	(38)	*Tephrina arenacearia*	(13)
Narraga tessularia	(30)	*Plusia chrysitis*	(13)
Agrotis exclamationis	(24)	*Agrotis segetum*	(13)
Mythimna turca	(22)	*Discestra trifolii*	(11)
Mamestra oleracea	(19)	*Unca olivana*	(11)
Ascotis selenaria	(18)	*Emmelia trabealis*	(11)
Mythimna pallens	(17)	*Spilosoma menthastri*	(11)

weitere 82 Arten in 1—10 Exemplaren.

Die Lebensmöglichkeiten der auf dem Inundationsgelände — dem Staugebiet des zukünftigen Wasserspeichers — lebenden Arten werden mit der Überschwemmung natürlich aufhören. Nach der Auffüllung des Wasserspeichers, parallel mit dem Anfang des neuen vegetativ-sukzessiven Prozesses mögen sich die neuen Schmetterlingzönosen ausgestalten. Die Lebensbedingungen der arundiphilen und hygrophilen Arten bilden sich in den zustandegekommenen neuen Röhrichten, bzw. an den Schutzdämmen neulich ausbilden. In den Schmetterlinggesellschaften der Schutzdämme werden die mesophilen Arten wahrscheinlich in größerem Verhältnis teilnehmen. Die Lebensbedingungen der Komponenten von den Sodasteppen ändern sich mit der Ausbildung des Wasserspeichers nicht, denn sie entwickeln sich außerhalb des Flutgebiets, auf alkalischen Flecken.

Die Grossschmetterlings fauna in der Umgebung von Szeged

Die Tagfalter des Gebiets habe ich schon bearbeitet (UHERKOVICH 1967, 1968). Zwischen 1964 und 1970 habe ich mehrmals Nacht-Großschmetterlinge gesammelt. Die neuen faunistischen Ergebnisse werden im entsprechenden Teil meiner Abhandlung mitgeteilt. Die zoogeographisch-ökologische Verteilung der Groß-Schmetterlinge ist mit derjenigen der Arten von Tiszafüred nicht identisch. Die für Moor- und Flutgebietsbiotope charakteristischen Arten leben auch hier in kleinerer Zahl (z.B. *Telesilla amethystina* HBN.), es gibt aber mehrere xerophile und ruderale Arten. Die mediterranen Wanderarten kommen ebenfalls vor (*Ophiusa algira* L., *Nycterosea obstipata* F.). In Verbindung mit der *Ophiusa algira* habe ich eine interessante phänologische Beobachtung angestellt. GOZMÁNY (1970) Meinung nach kommt diese Art in unserem Land mit einer Generation, V—VI. Flugzeit vor. In enem Biotop (Villány-Gebirge) habe ich sie wirklich im Juni gefangen in Szeged aber fanden sich alle drei Exemplare von ihnen (alle Weibchen in gutem Zustand) in August (vgl.: „Neue Fundortangaben"). Die Exemplare von Szeged wanderten hierher wahrscheinlich nicht von heimischen Vegetationstellen (Süd-Transdanubien), sondern von südlicher liegenden Gebieten, wo die Art eventuell zwei Geschlechtsfolgen hat.

Ich habe meine Sammlungen in der Umgebung von Szeged anf dem Stadtgebiet ausgeführt (an Hoflampen normalen Lichts, bzw. an den Lampen der Straßenbeleuchtung), teils auf dem rechten Theißufer, auf der Stelle meiner ordentlichen Tagessammlungen (UHERKOVICH 1968). Am 20. Juli 1969 habe ich mit einer Quecksilberdampflampe bei Flußkilometer 168 gesammelt. Die Lampe und das Leintuch standen auf der Dammkrone, das Licht wurde auf das Inundationsgelände gerichtet. In dieser Stelle werden die unangebauten Gebiete im Flußsaum mit einem abgeschnittenen *Salix alba*-Wald bedeckt. Zwischen diesem und dem *Salicetum triandrae* Weidengebüsch am Ufer gibt es ein Ackerfeld. Im Wald gibt es stellenweise Erdgruben, in denen eine Sumpfvegetation gedeiht. Das Wetter war während der Sammlung sehr günstig. Das Ergebnis war gleichwohl sehr gering: ich habe in zwei Stunden nicht mehr als 40 Arten gesammelt.

Die Artenzusammensetzung ist sehr gleichförmig. Es dominieren die euryöken Kulturtoleranten und kulturfolgenden Arten. Außerdem leben auf dem Gebiet auch einige Laubwaldarten (*Cosmia trapezina* L., *Spatalia argentina* SCHIFF.), bzw. Sumpf- und hygrophile Arten (*Telesilla amethystina* HBN., *Unca olivana* SCHIFF.); ferner mehrere, auf Wiesen allgemein verbreitete Arten.

Die Dominanzreihenfolge der Sammlung vom 20. Juli 1969 war die folgende (Exemplarzahl in Klammern):

Discestra trifolii	(18)	*Phragmatobia fuliginosa*	(6)
Acontia luctuosa	(13)	*Eiliscrinia cordiaria*	(5)
Tephrina arenacearia	(12)	*Autographa confusa*	(5)
Autographa gamma	(11)	*Earias chlorana*	(5)
Spilosoma menthastri	(9)		

weitere 31 Arten in 1—4 Exemplaren.

Zusammenfassung

Zwischen 1964 und 1970 habe ich aus dem Theißtal 152 Heteroceren nachgewiesen. Die Anzahl der auf diese Arten bezüglichen Fundortangaben übersteigt 250. Ein bedeutender Teil der Fundortangaben ist — mangels bisheriger Forschungen — neu für das Gebiet. Ich habe auch die neuen, bisher nicht veröffentlichten Fundorte von 37 Tagfaltern *(Diurna)* aufgezählt.

Es wurde festgestellt, daß die Fauna der Groß-Schmetterlinge von ökologisch-zoogeographischem Standpunkt aus betrachtet abwechslungsreich genug ist. Es leben auf den Inundationsgebieten der Theiß viele hygrophile und Sumpfarten, die Anzahl der Xerophyten ist — wie es voraussichtlich war — nur gering. In der Ausbildung der Fauna nehmen außer den allgemein verbreiteten palaearktischen (polycentrischen) Arten eher sibirische und einige turanische (aralo-kaspische) Elemente teil. Die Anzahl der mediterranen Elemente ist gering, auch diese gedeihen mehr auf den südlichen Gebieten, unter der Wirkung des nahen Sandgebiets (Praematricum) zwischen der Donau und Theiß. Die Umgestaltung des Gebiets zu einem Kulturgebiet befördert die Vermehrung der kulturtoleranten Arten breiter ökologischer Valenz.

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FROM THE LIFE OF THE ASSOCIATION
TISZA RESEARCH CONFERENCE '72

Compiled by
GY. BODROGKÖZY

The Committee of Tisza Research held its Tisza Research Conference for this year at the headquarters of the Szeged Committee of the Hungarian Academy of Sciences, on April 22nd 1972. Dr. I. HORVÁTH, President of the Committee, in his opening address commemorated the fifteenth anniversery of the Tisza Research, delivering also a short exposition of the history of these researches that goes back till the part played by MARSIGLI in the year 1700. His first comprehensive work was publishing several data about the natural history of the Tisza. The organized researches started in 1957, under the guidance of G. KOLOSVÁRY. At present, there are already functioning separete work teams and their actvity takes a more and more complicated form. The researches are at present concentrated on two areas: the river barrage at Kisköre and the nature conservation area at Mártély. The five work teams consist altogether of thirty-five research workers and there were published so far 250 scientific papers and the six volumes of the Tiscia.

After the opening address, the registered and received lectures were delivered:

ANDÓ, M.:

Micromorphological problems of the inundation and flood areas of the South Tisza basin (Abstract).

The lecture is analysing the development of surface in the South Tisza basin in the Holocene, the surface-shaping activity of the river, the accumulation of deposits.

The Tisza basin is, in fact, the depression hollowed out in the Pleistocene layers at the beginning of the Holocene and filled in by the Tisza gradually until the present day. The Tisza of the Holocene eroded and filled upan area of 5 to 10 km breadth with its meanders and wandering beds. The Holocene surface formed in this way is, to be sure, still lower than the adjacent area that consists of Pleistocene layers. In some places, this difference in altitude can hardly be noticed; in other places, however, it brought about a one-two m bench. The Pleistocene layers were removed here by the Holocene erosion about 15 m deep.

In the surface face of the river basin mainly the geomorphological formations from before the anti-inundation work are dominant. These form-combinations are bearing the marks of the erosive and accumulative activity of the river. Owing to the Tisza-regulation, as a result of the large-scale accumulation — particularly in the inundation area — the single morphological formations have undergone a transformation, during their silting up some so-called secondary microformations were formed in their place. These recent formations, that are nothing else but the deposits of the flooding river overflowing into the inundation area, may take various forms.

In developing these formations a considerable part may be played by the density of the vegetation covering the surface, the stand of plants, the extent and earlier relief of the inundation area, the hydrodynamical mechanism of the river water, etc.

Summing up, there have been formed, owing to the recent development of surface, so-called overflown areas, manifested universally in the aggradation of the whole inundation area. For the time being, as a result of the sediment-laying work, the environment in the inundation area is situated two to three m higher than the protected flood plain environment.

Contributions to the discussion:

MARIÁN, M.: He calls the attention to that the papers published in the „Tiscia" will be available, in the future, in Hungarian language, as well, in the library of the Committee of Tisza Research. He is proposing to place there a copy of M. ANDÓ's lecture already now for making it easy of access.

BODROGKÖZY, GY.: He establishes that the results of the lecture delivered are supplying a great want in the field of the Tisza Research, rendering help to the investigations in hydrobiology, zoology, and botany. It would be desirable that the colleagues do really use it.

HAMAR, J.:

The Zooflagellates of the Middle Tisza Region.

(In the press, to be published in the "Tiscia", Vol. 1973).

Contributions to the discussion:

GÁL, D.: Pathogenic Protozoa have been found by him, too, in refuse waters. These have got into the river mainly with faecal matters (e.g., *Entamoeba coli*). The *Trichomonas* has got into the refuse water similarly by urine. To be sure, it could not be proved to be present in the Tisza, only in the refuse water.

HORVÁTH, I.: He regards as a merit of the lecturer to have investigated just this group that can only be studied with difficulty but by means of which we may obtain a more complete picture about the natural history of the Tisza.

Lecturer's answer: He has found the *Trichomonas* in the sullage-pipe of a pig-farm. He hasn't any data, if this species occurred in the vagina of sow. In the Tisza, on the other hand, he has found Zooflagellates in every sample, only in lower species and individual number. The pollution is marked very well in spots. They occur mainly in the waste-waters of sugar-works and paper-mills in higher individual number. In the backwaters mainly the periphyta are of non-planktonic character.

FERENCZ, MAGDOLNA and CSOKNYA, MÁRIA:

Comparative zoobenthos investigations in the Tisza and Maros.

(Published in the "Tiscia", Vol. 1972)

Contributions to the discussion:

HAMAR, J.: He asks if mollusc species were found by the lecturers in the refuse waters.

MARIÁN, M.: He is setting high value on the statements in connection with the migration of Palingenia and asks if the samples are from the inrush of sewage-water or from the refuse water itself.

BODROGKÖZY, GY.: The material of the lecture is meaning a powerful help for recognizing the food-chain, resp. the biorhythm of the rivers while endeavouring to give an answer to several „why"-s. He is emphasizing that the graphs applied have rendered a service for making the material easier to survey. He regards as interesting that the fluctuation of water level is so important.

The lecturers were giving answers to the questions.

HARKA, Á.:

Data to the stock of fish of the Tisza-reaches at Tiszafüred.

(Published in the "Tiscia", Vol. 1972)

Contributions to the discussion:

HAMAR, J.: Whether or not it is to be supposed that the Ctenopharyngodon idella in the river-basin pullulates in the future as the species cannot be given access to the river.

BERETZK, P.: He asks if there are any regular fish-introduction and angling in those reaches.

BODROGKÖZY, GY.: He asks if the quantitative changes can be evaluated with suitable reliability and for how long a period these statements are valid.

SZITÓ, A.: The importance of ichthyology for science and people's economy is incontestable. But the stock of fish gives a reliable picture only after the lapse of some years. Particularly the problems connected with the fish migration are unsolved. The fact is that the fish population continuously shrink, nevertheless there are not any new fish introductions. It would be desirable to change this wrong outlook as soon as possible. The scientific research must get a decisive part in making a decision on the degree of fishing and fish introduction. The natural conditions of the multiplication of the fish species amur are not given in Hungary, as yet.

Lecturer's answer: He has used for his investigations the data about netting and sport-angling, as well. At present, in the river, a tendency of the multiplication of the less valuable fish species is general. The decrease of spawning-grounds results generally in the numerical reduction of fish masses. The more and more increasing water pollution is a harmful factor, as well. In the new reservoir to be formed, the decrease of some species and the multiplication of others may be expected. The reservation of the biological equilibrium at the various interventions is, therefore, to be taken into consideration in an increased degree.

TÓTH, L.:

Fish-stock investigations in the backwater at Tiszafüred.
(Published in the "Tiscia", Vol. 1972)

Contributions to the discussion:

HAMAR, J.: He asks if there is a difference between the backwaters of different limnologic properties and the fish species; if there is a fish introduction, apart from the backwater at Tiszafüred, into other backwaters, as well, resp. if there get fish there from the Tisza.

MARIÁN, M.: The work of ichthyologists is supplying a great want, their responsability is great, first of all the research of the living Tisza-water in this direction is important. He regards as *important* the co-operation in this field with the Hatchery and Research Institute for Pisciculture at Szarvas. He is proposing, in addition to the quantitative investigations, the weight investigations, as well. To-day there is indispensable already, in this connection, also to carry out a marking investigation in regard of the major species. The preservation of nature has, as well, several fishing connections (e.g., the extinction of silures).

BODROGKÖZY, GY.: The elaboration of the backwater vegetation in the affected area and the publication of the material of that work took place. The next step would be the biocoenological exploration of these backwaters. The ichthyological investigations are facing a considerable task in the framework of that. It is namely to be supposed that, owing to the various plant combinations in the backwaters of different ages, there are to be found some differences in respect of the fish species combinations, as well. He would be interested, too, in carrying out an investigation in respect of replanting the backwaters with shoals of fish, after becoming completely dry from time to time.

Lecturer's answer: A connection between the single backwater types and their fish species combinations has so far not been investigated with exact measurements, there are only some results of comprehensive view at our disposal. The common sunfish lives, for instance, only in the backwaters, and the Lucioperca only in major mortlakes with a rich flora. A stocking took place only in a single backwater for sport-anglers (pike, carp). In case of high water, there is a change of fish fauna between the river and backwaters. Some weight investigations, resp. fish markings will start before long. He holds for desirable a comparative ichthyological investigation of the backwaters of different age and state.

GALLÉ, L.:

Changes in the cryptogamic vegetation of the circular dam in Szeged since 1938.

The circular dam of Szeged, covered with brick in an eight km long sector, has perceptibly changed since the first paper of the author referring hereto and published in 1938, as a result of the crumbling of the coverring material, of being grown in great profusion by various mosses, and the tensive effect of the root system of several floriferous plants.

On the brick surface, in its present state, there are living one filiform alga, 29 crustaceous lichens, seven foliaceous lichens, together 36 lichen species, and five foliose mosses.

The lichen coenoses are as follows:

1. *Verrucarietum nigrescentis* (KAISER) GALLÉ 1960
2. *Caloplacetum murorum* (DE RIETZ) KAISER 1926
   Caloplacetum murorum caloplacetosum arenariae (WILLMANNS) GALLÉ 1970
   varietas (a) *Lenanorosum crenulatae* GALLÉ 1970
   (b) *Lecanorosum albescentis* GALLÉ 1970
   (c) *Candellariellosum vitellinae* GALLÉ 1970
3. *Caloplacetum citrinae* (GALLÉ) BESCHEL 1950

The number of character species taking part in the building up of lichen coenoses increased eight during the time passed. Among them, there are to be found particularly well-developed thalluses of *Lecidea fuscoatra* f. *tegularis* and *Squamaria albomarginata*.

I have performed growth measurings on the most permanent lichen species that are the most characteristic of brick surface. As a result of these measurements, on the basis of about 250 metric data, it can be established that the annual increase of the thalluses of the single lichen species changes between 0,9 and 4,5 mm. The approximate age of the species, measured rough reckoned from the annual growth, is between 5 to 50 years.

On the brick surface, besides algae and lichens, there are living five foliaceous moss species, as well: *Tortula muralis, Grimmia pulvinata, Funaria hygrometrica, Bryum murale,* and *Bryum argenteum.*

The development of the micro-vegetation is influenced by the pollution of the town air only in the neighbourhood of the Rókus railway station. Here are the covering values of the single species lower, the development of apothecium rarer and there are to be found many sterile asci in them.

The cryptogamic and phanerogamic plant species promote a slow crumbling process of the brick surface. The organs of flood prevention protect the dam against them with scratching and burning.

Contributions to the discussion:

HORVÁTH, I.: He asks the cause of the increase in species number of the lichen coenoses.

HAMAR, J.: He asks if also other establishments of water conservancy are damaged by the lichen thalluses and if there exists a substratum offering resistance to them.

BODROGKÖZY, GY.: He considers the lecturer's lichen coenological and synecological investigations to be considerable even on a world scale. Research works on a similar topic have been carried on for such a long period but by a few investigators. He asks what differences in the phytomass production were induced by the humid and arid vegetation periods during the investigations lasting for more decades.

Lecturer's answer: An increase in lichen species takes place only under optimum ecological conditions. The presence of phanerogamic plants is, for instance, unfavourable to the increase in lichen vegetation. The deleterious after-effect of lichens is a fact established as they multiply first of all on decaying brick surfaces. Under the flood level, on the other hand, there develops never any lichen vegetation.

BODROGKÖZY, GY. and HORVÁTH, I.:

Effect of hydrological factors on the zonation conditions of the uliginous vegetation in the area at Sarud.

Contributions to the discussion:

MARIÁN, M.: The reported results of the investigations are important for the other researchers working under the condition of the inundation area, as well.

BÁBA, K.: The knowledge of plant associations indicating the hydrographic conditions and the use of their data are important also for him, as a zoologist. He would be pleased to cooperate.

Lecturer's answer: It is an old wish that the modern biocoenological investigations, at least to some extent, should be realized. He regards, therefore, as desirable to establish in the future a closer cooperation between the single special fields of research.

SZITÓ, A.:

A quantitative and qualitative investigation of the Chironomidae grubs in the Tisza region between Tiszafüred and Kisköre. (Published in the "Tiscia", Vol. 1972)

Contributions to the discussion:

GÁL, D. He asks from what water depth the lecturer's samples were obtained and if the Chironomidae grubs are migrating in case of a change in water depth. He is proposing vertical investigations for the further research series.

BÁBA, K.: He asks how the quantitative conditions of the grubs change at the middle of the river bed. The species and individual number of Molluscs is namely higher in the neighbourhood of banks.

Lecturer's answer: The samples were retained from the Tisza aut of a depth of 2,5 to 3,5 m. The water-course in the sampling place is so slow that it is tolerated even by species of stagnant water. He has not observed the migration of grubs. They tide over the fluctuation of water level by creeping into the silt. In the backwaters, the quantity of the Chironomidae grubs depends generally upon food. It is, anyway, influenced by the conditions of vegetation, as well.

Lectures delivered in the afternoon:

GALLÉ, L.: Investigations on the Formicoidea populations of the Tisza-dams, with particular regard to the region at Tiszafüred. (Published in the "Tiscia", Vol. 1972)

Contributions to the discussion:

BODROGKÖZY, GY.: He is delighted to learn that the lecturer carried on his investigations in a biocoenological framework. By that, the lecture furnished a new proof in respect of the synecological interconnections of the single biocoenoses. In the time when he carried out the investigation of these dam-grass coenoses, he found a close connection between the race combination of the single coenoses and the climatic conditions. He thinks to be desirable that the lecturer — in the course of his subsequent research — includes the climatic factors, as well, into his investigations.

HORVÁTH, I.: He speaks highly of the lecturer's mathematico-statistical method of evaluation.

Lecturer's answer: The alimentary activity of the single Formacoidea species is influenced, apart from the temperature, by the degree of humidity, as well. He carried on some activity investigations like this in the area at Vesszős, on the Tisza-dams. He regards desirable a closer cooperation with botanists. The knowledge of the vegetation and microclimatic conditions would namely mean a great help to him in clarifying the living conditions of the single Formicoidea populations,

BÁBA, K.:

The snail coenoses of the willow groves in the Middle Tisza region.

I carried out zoocoenological samplings in the area of river barrage II, in the Middle Tisza region, in the years 1959—62, 1964, 1969 and 1970. The sampling took place in the area of Kisköre, Tiszaszöllős, Tiszaug, Tiszaörvény, Óhalászi and Poroszló, on the sides of the river bed, in the inundation areas, and in backwaters. The vegetation of the biotops investigated may be divided into willowies and cultivated woods. From 20 biotops, 650 individuals of 16 species came to light. The species number of the coenoses is 2 to 5 on the sides of the river bed, 3 to 10 in the inundation areas. The individual number is low. The most part of the species found (13 species) are hygrophytic ubiquists. The colouring elements, found in this region only rarely nowadays, are: *Vertigo antivertigo* (DRAP), *Succinea putris* (L.), *Nasovitraea hammonis* (STRÖM), *Euconulus fulvus* (O. F. MÜLL.), *Bradybaena fruticum* (O. F. MÜLL.).

There are five species that can generally become character species alone or together with other species. These are: *Cochlicopa lubrica* (O. F. MÜLL.), *Succinea oblonga* (DRAP), *Succinea pfeifferi* (ROSM.), *Zonitoides nitidus* (O. F. MÜLL.), *NMonachoides rubiginosa* (A. SMIDT). *Succines pfeifferi* and *Zoinotides nitidus* are character species differentiated opposite to the Lower and Upper Tisza regions, not only on the sides of the river bed (BÁBA, 1969) but also in the inundation areas.

In the various associations of willow groves, and in the facies of these, I have separated the following synusium types:

(a) In the *Salicetum albae-fragilis* Issle-association:

1. *Succines oblonga*
2. *Succinea oblonga-Monachoides rubiginosa* (fac.: *Amorpha fruticosa*)
3. *Succinea oblonga* (fac.: *Nymphaetum*)
4. *Succinea pfeifferi-Monachoides rubiginosa-Zonitoides nitidus* (fac.: *Phragmitetum caricetosum*)
5. *Zonitoides nitidus* (*Salicetum albae* SIMON, consociation)

(b) In the *Salicetum triandrea* Malcuit association:

1. *Zonitoides nitidus* — *Succinea pfeifferi*
2. *Monachoides rubiginosa* — *Succinea pfeifferi* (in thin-grown places).

(c) In poplar — willow groves of various origins:

1. *Zonitoides nitidus* — *Cochlicopa lubrica* (in thin-grown places)
2. *Zonitoides nitidus* (in a dense bramble undergrowth)
3. *Succinea pfeifferi*
4. *Zonitoides nitidus* — *Monachoides rubiginosa* — *Cochlicopa lubrica* (fac.: *Amorpha*)
5. *Cochlicopa lubrica* (fac.: Phragmites).

(d) Cultivated woods:

1. *Zonitoides nitidus* (oaken)
2. *Zonitoides nitidus* — *Monachoides rubiginosa* (American ash grove)

It may be established that in case of a change in environmental factors, if they become one-sided, if the plants put forth stems, if monoculture follows or a facies-forming plant species gets the preponderance (consociation), then the species number decreases. The number of character species decreases to one. In rather shadeless places, the *Cochlicopa lubrica, Monachoides rubiginosa,* in shadier, moister places the *Zonitoides nitidus, Succinea pfeifferi* become character species of the synusia.

Contributions to the discussion:

GALLÉ, L., Jr. asks if any montanic species were found by the lecturer in the willow groves, respectively if they survive in the consocions.

BODROGKÖZY, GY.: is drawing the attention to that the narrow *Populus* forests attract the thermophilous species. Here gets the underwood more sunshine, and the montanic species demanding a cool climate are rather connected with the dams. He asks, as well, in which plants of the area investigated any traces of gnawing were observed.

HORVÁTH, I. thinks important to clear up the role of Molluscs in the food chain.

GALLÉ, L., Sr. established that he often saw lichens gnawn by snails.

HAMAR, J. asks what the mosaic character determines if plant and water cooperate.

Lecturer's answer: In the Middle Tisza region the montanic elements are only accessory. In the Upper Tisza region, however, they are characteristic ones, too. The surprise of the montanic elements is not excluded by cultivation. The Molluscs are no food specialists. The species in the inundation area are mainly detritophages, resp. feeding on mixed food. The vegetation is of microclimate-inducing effect. Where the microclimate is favourable, there often live 900—1000/qu. major individuals. They may have an important part in the food circulation. Water chemistry has a fundamental role in the distribution of species.

MARIÁN, M. and PUSKÁS, L.:

Quantitative investigations on the Passeriformes stock in the inundation area of the Tisza.

(Published in the "Tiscia", Vol. 1973)

Contributions to the discussion:

BERETZK, P.: Lecturer's investigations needed much work from which conclusions could be drawn in respect of the whole inundation area of the Tisza. It is of great value that he established the number of nesting birds. After a while, in the inundation area the possibility of nesting will come to an end, the change is worth being observed.

BÁBA, K.: From the single species, the small- and large-statured birds, belonging to the Carnivores group, are represented in an approximately similar individual number. He asks if their food is different.

CSIZMAZIA, GY. asks if the investigation has covered the quantitative connections of food.

HAMAR, J.: The biomass indicates a more or less instantaneous state. In a longer period, the population dynamics changes. The birds exert an effect even on the life of waters. He asks what an influence river barrage Tisza II. will have on the birds.

GALLÉ, L. Jr.: He is appreciating the pioneering character of the work. He regards striking the very high individual number of tree-sparrows as compared with their past number and asks whether there is a connection between the overpopulation of the fall webworm and the increase in the individual number of sparrows.

HORVÁTH, I. asks what an anthropogenic effect was experienced by the lecturer.

MARIÁN, M. 's answer: At the quantitative reckonings, he always took for basis the average weight of the developed individuals. Three carnivorous species take their food from different places. He did not carry out any food investigations as he worked with the living material. The stock was taken in the hatching period, in the time of maximum life functions. The birds are area-bound only at nesting. The river barrage at Kisköre may be a water-fowl's paradise but the warblers can settle down there only later on. The multiplication of the stock of sparrows may have been induced by the overpopulation of the fall webworm. The anthropogenic effect is of high degree. The unfavourable effect of the huge mass of dust raised by the vehicles of transport makes itself felt in an indirect way.

CSIZMAZIA, GY.:

Methods of taking up the mammal stocks in the inundation area of the Tisza.

(Published in the "Tiscia", Vol. 1972)

Contributions to the discussion:

GÁL, D. is sceptical about the living of wild cat in the neighbourhood of Sasér.

BERETZK, P., however, is stating it positively.

MARIÁN, M. is appreciating the lecture mainly from methodical point of view. The conclusi on of the food of mammals from their droppings is logical.

HORVÁTH, I. is giving his special thanks for the report on the new methodical methods.

Lecturer's answer: The wild cat lives in Sasér and even it multiplies. One can make the attempt to clear up the number of females after their cry.

Declarations:

BODROGKÖZY, GY.: In the Tiscia of this year 24 papers will be published. For Volume 1974, the papers are to be presented until May 1st 1973. Also the Abstract of the lectures delivered here will also be published in the "Tiscia".

President's concluding words.

HORVÁTH, I.: He is establishing that the Conference has been characterized by good lectures and keen inteiest. There are given more and more lectures connected with the matter-energy circulation and that meets the fundamental requirements. The research programme of the biosphere is namely important in the long-range planning and the encouragement of that is getting along in a good way. After desiring further good work, he is closing the conference.

Ismét lehet jelentkezni a Magyar Telekom országos gyakornoki programjára

A Magyar Telekom gyakornoki programjának 2011 szeptemberében induló félévére április 15-ig lehet jelentkezni a vállalat honlapján. Az előző, februárban indult gyakornoki félévre 1.000 hallgató jelentkezett, közülük 50 diákot vettek fel a programra. Velük együtt közel 100 gyakornok dolgozik jelenleg a vállalat különböző területein.

A Magyar Telekom – az országban az elsők között – 15 éve indította el gyakornoki programját azzal a céllal, hogy használható gyakorlati tudást adjon a főiskolai, egyetemi hallgatóknak. A képzés lehetőséget nyújt arra, hogy a diákok Magyarország vezető távközlési cégénél végezhessék el a kötelező szakmai gyakorlatukat, gazdagíthassák elméleti és gyakorlati tudásukat, és elindíthassák karrierjüket a Telekomnál.

A program sikerét bizonyítja, hogy a 2011 februárjában induló gyakornoki félévre 1000 hallgató jelentkezett, közülük 50 diák kezdhette el a programot. Velük együtt közel 100 gyakornok dolgozik jelenleg a vállalat különböző területein. „Célunk, hogy friss tudással gazdagítsuk a céget. A mentori rendszernek és a gyakori személyes konzultációknak köszönhetően különösen nagy figyelmet tudunk fordítani a hallgatók személyes fejlődésére. Büszkén mondhatom, hogy a Magyar Telekom a legjobb hely arra, hogy a fiatalok megmutathassák, mire képesek" – mondta el *Somorjai Éva*, a Magyar Telekom humán erőforrás vezérigazgató-helyettese.

A Magyar Telekom 2011 szeptemberében induló gyakornoki félévére április 15-ig lehet jelentkezni a karrier.telekom.hu oldalon. Az 5 hónapos programra olyan, aktív hallgatói jogviszonnyal rendelkező, felsőoktatásban tanuló diákok jelentkezhetnek, akik főiskolai szintű diplomát adó (BSc vagy BA), valamint egyetemi szintű diplomát adó (MSc és MA) képzésen vesznek részt. További feltétel a legalább középszintű angolnyelv-tudás is. A gyakornokokkal részmunkaidős, határozott idejű munkaszerződést köt a vállalat, 2 hónapos próbaidővel. A hallgatók számára a program heti 20 órás elfoglaltságot jelent. A gyakornokok havi bruttó 75 ezer forintot kapnak, amely a próbaidő letelte után széles körű béren kívüli juttatási csomaggal bővül.

A program első három hete az adott szakterületen való érdemi és tartalmas munkavégzésre készít fel. Ezt követően a gyakornokok konkrét, projektszerű feladatokban vesznek részt a vállalat különböző területein. Minden gyakornoknak van egy mentora, aki azon túl, hogy segít a beilleszkedésben, rendszeres visszajelzést ad a gyakornok munkájáról. Ezzel a módszerrel a Magyar Telekom igyekszik nagyvállalati, összetett tudását és tapasztalatát megosztani a diákokkal.

A Magyar Telekom támogatta.

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