Tiscia (Szeged) Vol. XIII, pp. 163—168 (1978)

EFFECT OF THE ANTHROPOGENEOUS POLLUTION ON THE TISZA AND ITS TRIBUTARIES

I. KISS, M. MARIÁN and I. HORVÁTH

Department of Botany, Attila József University,
Szeged, Hungary
(Received September 15, 1977)

Abstract

In the watershed area of the Tisza there is first of all performed an agricultural activity polluting the water. The limnological character of the river is formed in a negative character by the chemical substances washed into, the considerable content of matter in suspension and bacteria.

The situation of dead arms is unfavourable, in many cases catastrophic. Our natural values are on the brink of ruin because of the proliferation of the phytophagous fish in the dead arms.

The Tisza is touched by the effect of industrial pollution mainly by means of the tributaries.

Not more than about 5 to 6 per cent of the urbanization sewage waters get into the rivers in a cleared state. According to the water quality investigations performed by means of biological methods, in the last decade the water of the Tisza only deteriorated in the lowest stretch. According to the bacteriological investigations, on the other hand, in the Lower Tisza Region, the hygienic quality of water bacame worse by 1 to 2 categories of late years.

The pollution of river waters can considerably be reduced by keeping in operation some water purification equipments.

This paper is reporting on some data from among the investigations of the Tisza-Research Working Committee. Apart from the authors whose names are given in the title, there were co-operating in the compilation: I. BANCSI, Mrs. I. BANCSI, K. BÁBA, GY. CZISMAZIA, MÁRIA CSOKNYA, Mrs. L. DOBLER, Á. FARKAS, J. HAMAR, Á. HARKA, MÁRIA HEGEDŰS, Mrs. Z. KEMENES, K. KISS, A. SZABÓ, A. VÁNCSA, P. VÉGVÁRI.

Introduction

The effect of the interventions influencing the life of rivers most obviously manifests itself where the natural course of the river was transformed by man (canalizition barrages, etc.) or where several industrial and agricultural establishments were set up beside the water. The same holds good considerably in respect of the Tisza and still more in that of its tributaries.

In the watershed area of the Tisza first of all an *agricultural* activity is going on, polluting the water in most part of the year and along the whole stretch of the rivers. The water deterioration manifests itself both in chemical and in biological relations.

The food content of the water is increased by the chemical substances (fertilizers, insecticides, pesticides) of agricultural origin which were washed into the water. The high floating-matter and bacterial content originating from these determines the limnological character of the Tisza.

Between the flood and summer low-water periods of the river there is a considerable difference. At flood, the conveyed float prevents a richer plankton from coming into being. Thus only the quantity and activity of the bacterial planktons is considerable.

At low water, the plankton activity increases; in the stretches before the river barrages the measurement of the primary production refers to a water of eutrophic and even sometimes hypertrophic state. The water of the river is rich in inorganic food materials (nitrogen, phosphorus). In this way, if the floating matter settles down, the phytoplankton always achieves the maximum growth, corresponding to the temperature.

After creating river barrages, the original state characteristic of the river changes: the clearing ability of the water decreases, the danger of eutrophisation increases. As a result of storage, a large quantity of float can be deposited. The salt content of water may increase what is unfavourable for irrigation. At making reservoirs, a meticulous care is, therefore, to be taken in removing the land-vegetation and — by preventing stagnant waters from coming into being — in avoiding the formation of marshlands.

The effect of tributaries is considerable. Their pollution is increasing, in the low-water periods they are in a eutrophic state. For instance, we refer to the change in the degree of trophity of the Sajó water between the years 1965 to 1976.

In the Sajó some phytoseston communities referring to a eutrophicated river state are to be found.

The seasonal change in all the values of a million order— particularly in some sections of the bed stretch below Miskolc — can be characterized by a curve of the course of double maxima: the winter minimum is followed by a spring maximum and then by a very strong autumn maximum.

For characterizing the change in time, the comparison carried out on the basis of average values is the most suitable. In the year 1976, in the bed stretch before the mouth, the effect of the double-mouth of Hernád manifested itself most definitely. Accepting as a limit the value $1 \cdot 10^6$ individual/litre, the Sajó can generally be characterized by the trophity below the eutrophic level. This only rises above the eutrophic level in the reaches before the mouth.

On the basis of the maximum values of the phytoseston, in the years 1974—1975—1976, it exceeded the eutrophic level in the whole bed stretch considerably. It is remarkable that below the double mouth of the Hernád the minima are also significantly greater than in other stretches.

It is unambiguously indicated by the changes in the longitudinal section that the trophity of the Sajó increases in the bed stretch below Miskolc and is sudden in the stretch before the mouth.

The increase in trophity is, of course, harmful to the water quality of the Tisza, as well. The trophity of the Sajó is, therefore, to be reduced by moderating the amount of the allochthonous materials.

From among the biological pollutions, the phytophagous fishes are to be emphasized particularly. The so-called phytophagous fish species introduced into the fisheries of our contry in the last decade are today already regular catches of the fishers in Szeged. 10 per cent of the fishes caught in 1976 is given by *Hypophthalamichtis molitrix,* 0.5 per cent by *Chtenopharingodon idella. Hypophthalamichtis nobilis* was caught but rearly. These may have been individuals escaping from the fisheries, resp. in case of *Hypophthalmichthys molitrix*, and *(Ctenopharyngodonidella)*, descend-

ants of the individuals strayed away and acclimatized. It is to be accepted as a fact that the latter two species spawn in the Tisza, resp. in its dead arms.

Their harmful effect has not manifested itself, as yet, in the flowing Tisza, all the more in the Tisza dead arms. The situation of the ox-bow lakes of the Tisza is, from this point of view, unfavourable, often catastrophic. The floating and the river-side vegetations of the Dead Arm at Tiszafüred and of the Dead Arm at Körtélyes, belonging to the Region-Conservation District Mártély-Sasér were fully exterminated in 1976 by the Ctenopharingodon idella having got there in a major quantity.

The dead arms drawn in this way into the hatching of fish become ruined fast while the production achieved with a small investment is only temporary. But the vegetation, belonging to the characteristic landscape and destroyed, cannot be reconstructed at all or only with a long and expensive work. The region-conservation districts, nature conservation areas should therefore be protected from the invasion of these fish species.

The effect of the industrial pollution is considerable in the tributaries, as well. The Kurca is an example for this.

The Kurca, flowing into the Tisza below Mindszent and being, in its present state, of dead-arm character, is a reservoir of inland and irrigation waters. The quality of its water at the main site of water removal (at Magyartés) in is any case suitable for irrigation (its dissolved salt content is 200—350 mg/l, the value of Na p. c. is between 23.8—44.8). Above the town Szentes the water quality is strongly deteriorated. (The dissolved salt is 580—950 mg/l, Na p. c. 44.7—57.2). This deterioration manifests itself below the town still more intensively. (Its dissolved salt content is 670—1000 mg/l, Na p. c. 67—75.4). At Szegvár, the water of the Kurca can already be used for irrigating only in case of a water improvement by dilution.

The quality of irrigating water grows, therefore, weaker as going down the Kurca. The high degree deterioration follows, first of all, as a result of the thermal waters. At present, about 24.000 l/sec water of fifteen thermal wells is getting into the main channel Kurca. Its damaging effect presents itself primarily as a result of the high Na^+ percentage and the dissolved salt content. There may incidentally occur some heat pollution, as well. (The water of high temperature is harmful to the aquatic zoobenthos not only owing to its degree of temperature but also inducing anoxia in the water by reducing the solubility of gas).

The main damaging effect presents itself in the high dissolved salt content of the thermal water. The fresh-water living world of the surface water courses which take up the thermal waters is strongly damaged by the increase in salt content. By this the fish even becomes unfit to eat. Daily 54.1 t salt content gets into the taking-in water course. This salt of discouraging amount will increase after the thermal well-boring, projected for the next future.

Today it is no more sufficient, only to observe and register the environmental pollution of the Kurca — and through it that of the Tisza — but a concrete intervention is also needed.

The pollution of the Tisza water by *urbanization* was increased strongly by the acceleration of the urbanizational processes taking place in the recent years. Therefore, and taking also into consideration that about 95 per cent of the sewage-waters of urbanization gets into the Tisza without being cleared, the evaluation of the water of the river according to water quality is very important. For rendering perceptible the quantity of extraneous materials getting into the Tisza, it is to be mentioned that at Szeged, only from the town, 40 to 43 thousand cc.m sewage water gets into the river a day.

The results of the biological and bacteriological investigations are not quite identical.

According to the biological investigations, the water quality of the Tisza changed in the recent years (1974—1976) hardly.

The halobity of the river was only examined by measuring the electrical conductivity, as well as the quantity of the eight main ions dissolved in the water. With this method, it could only be registered that the river leaving our country has been characterized by the Ca—Mg, resp. HCO_3—SO_4 ions for a period of more ten years.

By comparing the values of the competent saprobity index, it could be established that the pollution of the river from Csongrád down to Tiszasziget has not increased since 1974. At Szentes, first class water quality was found in all three years. Below Csongrád, too, the water is generally clean, that is to say, the Kőrös flowing into the Tisza there brings clean water. At Mindszent, the results of the saprobiological investigations do not reflect the deterioration of water quality which can easily be demonstrated from the bacteriological examinations. Getting to the border of the country, the Tisza leaves the country already with the pollution of the town Szeged and becoming united with the Maros, without changing its category but, at any rate, with a verifyable deterioration of the water quality.

Toxicity has not been investigated with test method. Zooplankton count was performed in 1975—1976. It is proved by the result of this that from Csongrád to Tiszasziget the zooplankton stock of the river was not damaged.

The examinations concerning the trophity of the river were completed, in addition to determining all the algae i/l, with the quantitative determination of chlorophyl, the total bacterial count, and from foodstoffs, with the quantitative determination of phosphorus and nitrogen. On the basis of surveying the results, the changes having affected our river since the river barrages at Tiszalök, Kisköre, resp. Óbecse had been built can be recognized unambiguously. In 1974, the highest total algal count was found in October (5 million i/l). In 1975, similarly in October, under approximately identical hydrological conditions, the algal count increased to 19 million i/l. In 1976, the highest value, 39 million i/l, could already be measured in August.

The trophity of the river legs still far behind the data of the eutrophic-polytrophic stagnant water. But the lineal rise taking place in the recent years calls the attention to that the possibility of loading the river with organic materials and changing the hydrological conditions is limited.

According to the bacteriological investigations, on the other hand, the quality of the Tisza water considerably deteriorated in the years 1974 to 1976.

The conditions of water quality in county Csongrád developed as follows:

In 1974, from Csongrád to Tápé, the water was of category II (a little polluted). In the reaches below the town Szeged (Tiszasziget, border of the country) it belonged to category III (polluted) what may probably have been caused by the uncleaned sewage water led into it here.

The water quality of the Maros was of category II in this year.

In 1975, the hygienic water quality of the Tisza generally deteriorated one class: it belonged to category III. The cause of this may supposedly have been the Kisköre Water Barrage. Its beginning to operate altered the microbiological conditions of the river.

The Maros belongs to category III.

In 1976, the Tisza till the area of the town Szeged and the water of the Maros are of category III. From Szeged down to the border of the country it is of category IV

(strongly polluted). The deterioration of the water quality of this stretch has probably been induced by the Törökbecse (Novi Bečej) river barrage which — reducing the speed of water considerably — has an unfavourable effect on the biological equilibrium of the Tisza.

The incidence of pathogenic bacteria has also increased in the water of the Tisza. In 1976, in the longitudinal section of county Csongrád — expressed in the percentage of the average positivity — it was 55.8 per cent. On the basis of the MSZVH—OVH — National Water Office sectoral standard-project, the percentage given surpasses the allowed percentage of incidence.

The consequences of the anthropogeneous pollution can be observed on the most various organisms of the zoobenthos of rivers. The organisms living in water are, of course, exposed to this effect in a higher degree than those living on the dry land.

The algal vegetation often designates water pollution with the phenomenon of algal bloom ("efflorescence of the Tisza"). The water of the Dead Arm at Mártély was already stained several times by the algal blooms of the Euglenophyte species and the efflorescence of *Eudorina elegans,* endangering also the recreation area.

Investigating the extreme resistance of *Eudorina elegans,* the following may be established.

This alga is a highly tolerant species. Its water bloom was observed in strongly polluted waters, and in those of polysaprobic and α-mesoapprobic characters. *Eurodina elegans* is, according to PASCHER (1927), of β-mesosaprobic, andaccording to HUBER—PESTALOZZI (1961) of oligosaprobic character. We were moved by these extreme values to investigate, in part experimentally, the tolerancee-conditions of *Eudorina elegans.*

During the algal bloom of the Dead Arm at Mártély in 1973, the plankton samples in the habitat water remained undamaged for the longest time. The fermenting dung water used as a polysaprobic nutritive medium exerted a damaging effect on the organisms but in different degrees and at various dates. In the nutrient solution of 12,000 mg/l total salt content, as well as in the saltyalkaline (sodic) water the destruction followed similarly at different dates. The initial signs of desorganization manifested themselves at some organisms but in the third week. In the salt solution diluted in 1 to 2 ratio with the water of the dead arm, the damages often appeared still later. Dung water added to the litre of the saltysodic water in a quantity of 10 ml played the part of a nutritive solution in which the *Endorina* thalluses were rather only deformed and its cells have sometimes not or but later preished. In this case, the polluting dung water exerted almost a "protective effect" on the single colonies. It could generally be observed that in tolerating the great concentration, alcalinity or pollution the single colonies are not quite idenical, and even sometimes they considerably differ from one another.

In respect of these great extremities, *Eudorina elegans* may be named an eurytopic organism.

The decline of almost catastrophic extent in the stock of *Palingenia longicauda,* taking place in the last decade, was caused — apart from the large floods in the time of swarming — by the water pollution and the dropping of water speed the siltation owing to the construction of water barrages. And the decrease in the may-fly population brought about the rapid diminution in the amount of *Acipenser ruthenus*, the main food of sturgeon having been the Ephemera species.

It was demonstrated by our benthos investigations that in the mouth district of sewage drains in the Tisza a considerable decay follows in respect

of the invertebrate bottom-dwelling animals which have a very important part in the self-purification of the river.

In the river stretch above Szeged, kept still in evidence as a natural biotope, the individual number of Anelida, Mollusca, Ephemeroptera, Diptera: Chironomidae, calculated for one square metre, is 5300/sq.m. From this, the individual number of Mollusca is 1300/sq.m.

From Mollusca, the snail species *Lithoglyphus naticoides* and the shell species *Dreissena polymorpha, Pisidium amnicum, Unio crassus* are dominant.

In the samples taken in 1—300 m after the sewage drains, the species and individual numbers of the above taxonomic categories fall to 640—2600/sq.m. The quota of Mollusca has increased but the shells important in the water filtration disappeared.

The benthos can be protected from this decay to a certain extent if the sewage water, even the purified one, is led into the middle of the river.

The disturbing human influence exerted on the terrestrial ecosystem often befalls the living world of the flood-plain by the means of dams. An example for this is the road-building on the top of the dam from the bridge at Algyő up to the Tisza Dead Arm at Atka. The bitumen of low melting point used for surfacing the road became flowing under the influence of the glare of the sun and hundreds of the tiny mammals got stuck in it and perished. In a km long stretch, we have counted on average 500 to 550 individuals from the following species: *Microtus arvalis, Mus musculus, Apodemus sylvaticus, Apodemus agrarius, Micromys minutus, Sorex araneus.*

As a result of the pollution followed on the dam, therefore, in the animal life that was enriched in the fringe-coenosis of the flood-plain, the biological equilibrium was lost what may have far-reaching further harmful consequences in the course of the whole food-chain.

The pollution of river waters, reservoirs can considerably be decreased with *water-purification plants.*

The sewage filtering lake system of the Tisza Integrated Chemical Works consists of six lakes of 1.5 m depth. Their total surface is 18 ha. Water remains in the lakes about 50 days long. 4,500 cc.m/day mechanically and biologically purified sewage water pour into them. The quality of the purified sewage water generally reaches the standard prescriptions. The value of KOI_{Cr} is 60—100 mg/litre. The dissolved salt content is medium high: 500—800 mg/litre. The total mineral N-content is 2—10 mg/litre. The total P-content changes between 1—3 mg/litre.

It is to be established that the more or less decomposed organic materials, the mineralized vegetable nutritive matters can be decomposed on in the post-purifying lakes or extracted from the water in case if in the lakes a fixed plant stand comes into being and is kept at an optimum level, by being treated and thinned adequately. The extent of repurification is increased by the rich animal stock of lakes. A part of these (Insecta) fly out of the water, another part get into the body of fishes bred in the lakes as fish-food. The amount of organic matters getting into the Tisza will be decreased with these, as well.

On the basis of the experiences so far, we propose to bring about similar repurifying lake systems.