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Ecological impacts of the Gabčíkovo River Barrage System with special reference to *Umbra krameri* WALBAUM, 1792, in the Szigetköz floodplain

(Pisces: Umbridae)

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Abstract

Prior to the installation of the Gabčíkovo power plant, before 1992, *U. krameri* WALBAUM was a common species in the Szigetköz floodplain. The present paper describes the impact of this power plant on the fish community of the Szigetköz floodplain with special reference to the European mudminnow.

Keywords: Umbridae, *Umbra krameri*, Hungary, Szigetköz, Gabčíkovo River Barrage System.

Zusammenfassung

Vor der Errichtung des Kraftwerks Gabčíkovo im Jahr 1992 war *Umbra krameri* WALBAUM eine im Bereich des Szigetköz häufig anzutreffende Art. Die vorliegende Arbeit beschreibt die Auswirkungen dieses Kraftwerksbaues auf die Fischgemeinschaft des Gebiets unter besonderer Berücksichtigung des Europäischen Hundsflusses.

The natural system of the Szigetköz

In the Little Hungarian Plain, the Danube runs on the Hungarian-Slovak border, depositing the largest stream alluvial cone in Europe. On the Hungarian side this is known as the Szigetköz, which is the area between the main Danube and the Mosoni-Danube. In this sector, the river gradient has been one of the factors affecting to a considerable extent the specific composition of individual groups of organisms. The change of the gradient was also responsible for the development of quite a vast floodplain with braided hydrosystem (HOLCIK & al. 1981). In the upper river section beginning at Devin and extending to the village of Palkovicovo (r.km. 1810), the gradient of the main river bed is 25 - 35 cm.km⁻¹. It decreases in the lower section, between Palkovicovo and Gönyű to 12 - 15 cm.km⁻¹ (GÖSCHEI 1979).

Depending on the geomorphological and hydrological features of the waters in the Szigetköz, the species composition of the fish assemblages of the particular habitats can be clearly distinguished (GUTI 1993). On the basis of geomorphology, functional units of fluvial biotopes (AMOROS & al. 1987) can be differentiated: constantly flowing eupota-

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mic channels; temporarily flowing parapotamic arms, which have a permanent connection with the river through their lower mouth; temporarily disconnected plesiopotamic branches; completely disconnected paleopotamic waters, which have lost their direct connection with the river.

The braided hydrosystem of the Szigetköz played a prominent part in the regulation processes of fish communities. For instance, in the spawning season numerous fishes of the main stream migrated instinctively against the current, sometimes covering a distance of 100 - 200 km, before they found a suitable habitat for reproduction. Due to the Alpine character flood regime of the Danube, the low region of the Szigetköz area was flooded during the early summer inundations, where migrating fishes could spread out. The slow flowing large branch-systems functioned not only as ideal spawning and nursery habitats for the fish species of the Middle Danube, but they are also places where these fishes sought refuge during winter, strong floods or periods of high pollution. Furthermore, the lentic waters of the branches were particularly favourable to the intensive production of plankton, and a large part of the planktonic production which had drifted into the main channel provided an important food source for fish (GUTI 1993).

The habitats of the European mudminnow (*U. krameri*) in the Szigetköz

The European mudminnow is a vulnerable species in Hungary (GUTI 1995). There are only a reduced number of localities in the flood plains of the Danube, which are characterized by *U. krameri*. In many places its habitats are becoming rare as river flows are being controlled and flood plains drained. It may become an endangered species if the unfavourable factors continue to be effective.

Prior to the installation of the Gabčíkovo power plant, before 1992, *U. krameri* was a common species in the Szigetköz floodplain. Its population dynamics has not been investigated, but ichthyological surveys have documented its occurrence in many waters in the flood protected area. There are no proving specimens in the main channel of the Danube and in the active floodplain, nor in the Mosoni-Danube, but in the lentic biotopes of the Mosoni-Danube its presence is not impossible.

Before 1992, the typical habitats of the mudminnow were the paleopotamic waters (e.g. Gazfűi-Danube arm, Lipót oxbow) and some artificial canals (e.g. Lipót-Hédervári canal) in the flood protected area. The water cover of these arms and canals depended on the water level of the Danube. In May and June, at the time of higher discharge of the river, a considerable quantity of water infiltrated to the paleopotamic beds which became flowing in many sections. At the end of summer and the beginning of autumn, in the droughty period, the biotopes became shallow and stagnant.

In the habitats of mudminnow the depth of the water was 20 - 300 cm, the current velocity was not significant, the turbidity was low, the substrate was silty, there were organic debris and dead branches on the bottom. The more frequent species of the aquatic vegetation were *Ceratophyllum demersum* L., *Potamogeton pectinatus* L., *P. perfoliatus* L., *Nymphaea alba* L., *Nuphar lutea* (L.), *Nymphoides peltata* (GMELIN), *Salvinia natans* L., *Hippuris vulgaris* L., and the characteristic species on the banks were the *Typha latifolia* L., *Phragmites communis* TRINIUS, and *Salix* spp. In the fish fauna there were 16

species. Besides *U. krameri*: *Esox lucius* L., *Rutilus rutilus* (L.), *Scardinius erythrophthalmus* (L.), *Alburnus alburnus* (L.), *Blicca bjoerkna* (L.), *Tinca tinca* (L.), *Rhodeus sericeus amarus* (BLOCH), *Carassius carassius* L., *Carassius auratus* L., *Cyprinus carpio* L., *Misgurnus fossilis* (L.), *Cobitis taenia* L., *Lepomis gibbosus* (L.), *Perca fluviatilis* L., and *Proterorhinus marmoratus* (PALLAS).

The Gabčíkovo River Barrage System

In 1977, the original project of the Gabčíkovo-Nagymaros Barrage System was intended to serve four purposes: electricity production, navigation improvement, flood protection, and regional development. The Gabčíkovo power plant is situated in a 27 km long, 300 - 700 m wide by-pass canal and it was designed to operate in peak mode. Expect for the peak hours of electricity consumption, the Danube would have been stopped, with practically no water coming through the power plant into the tail race canal. The ecological aspects of the conception were not evaluated in the treaty.

The original barrage system was never completed. During the construction of the barrages the international negotiations concerning operation of the Gabčíkovo power plant did not result in a mutually accepted solution. Hungary suspended the preparatory works at Dunakiliti, which had been aimed at the diversion of the Danube in 1989, but Slovakia constructed unilaterally the "C" variant of the Gabčíkovo River Barrage System, with a power plant running in continuous mode. It incorporates a new dam which cuts across the floodplain approximately 1.5 km from the Slovak-Hungarian border and connecting the right bank of the reservoir with a new 11 km long dike on the left bank of the river, joining the upper end of the original by-pass canal.

At the end of October 1992, the Danube was diverted to the Gabčíkovo by-pass canal, and fish populations which assembled in their winter habitats in the Szigetköz could not always follow the recession of the water. During the first three weeks of the diversion, the estimated quantity of fish that perished in the Szigetköz branch system amounted to at least 100 ton. As the side arms gradually dried out, fish remaining in the crowded muddy pools became easy preys for water birds and wild-boars and an accessible catch for the occasional poachers. In the second half of the winter the shallow pools froze solid because of the long lasting cold, which considerably diminished the overwintering chances of the fish. According to moderate estimations, 50 ton of fish during the winter 1992 - 1993 died for reasons mentioned above. In 1993 and 1994 the missing interconnection between the Danube and the side arms in the Szigetköz floodplain, as well as the extreme low water level, made a large-scale spawning of fishes impossible; therefore the natural recruitment of the fish populations decreased considerably.

After October 1992, when the Danube was diverted to the Gabčíkovo Barrage, most of the habitats of the *U. krameri* were completely dry during a long period. The artificial water replenishment of the empty beds started in the flood protected area in April 1993. The hydrology of the paleopotamic arms changed significantly. The Gazfűi-Danube arm had a permanent $5 \text{ m}^3 \cdot \text{s}^{-1}$ water supply without seasonal fluctuation. The ichthyological surveys did not prove the presence of the mudminnow in its previous habitats in 1993, but in 1994 its occurrence was documented several times in the lentic biotopes of the Gazfűi-Danube arm. There were 14 fish species in the samples: *Umbra krameri*, *Esox*

lucius, *Rutilus rutilus*, *Scardinius erythrophthalmus*, *Alburnus alburnus*, *Aspius aspius* (L.), *Blicca bjoerkna*, *Tinca tinca*, *Rhodeus sericeus amarus*, *Carassius carassius*, *Carassius auratus*, *Misgurnus fossilis*, *Lepomis gibbosus*, and *Perca fluviatilis*. In the Lipót oxbow, there was no fish at the beginning of 1993. At the time of the implementation of the artificial water replenishment, in the second half of 1993, only two fish species were observed: *Carassius auratus* and *Cyprinus carpio*. In 1994 the number of species increased. The additional species were: *Alburnus alburnus*, *Rutilus rutilus*, *Scardinius erythrophthalmus*, *Leuciscus leuciscus* (L.), *Rhodeus sericeus amarus*, *Perca fluviatilis*, and *Lepomis gibbosus*. The occurrence of the *Aspius aspius* and *Leuciscus leuciscus* was not typical in the paleopotamic habitats. The individuals of these rheophilic species probably drifted from the water replenishment canals.

The reconstruction of the paleopotamic biotopes and their fish assemblages in the Szigetköz floodplain is an important duty of nature conservation. The Hungarian Scientific Research Fund (contr. no. F-5341) and the Fishery Management Fund of the Ministry of Agriculture have supported the study of natural fish recruitment and the programme of fishery restoration in the Szigetköz. The *U. krameri* population would be an indicator of the interventions aimed at the habitat reconstruction and a new research programme could provide possibilities for investigation.

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