Ann. Naturhist. Mus. Wien	97 B	470 - 477	Wien, November 1995

Distribution and status of *Umbra krameri* WALBAUM, 1792, in the drainage of Lake Balaton, Hungary

(Pisces: Umbridae)

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Abstract

The present contribution summarizes observations on the distribution of the mudminnow (*Umbra krameri*) within the drainage of Lake Balaton (rivulets and Kis-Balaton Water Reservoir). In the course of regular studies since 1987, *U. krameri* could only be detected in two rivulets. Reasons for the decline of this protected species are discussed and suggestions for conservation measures are presented.

Key words: Umbridae, *Umbra krameri*, Hungary, Balaton, Kis-Balaton, distribution, protection.

Zusammenfassung

Beobachtungen über die Verteilung des Europäischen Hundsfisches (*Umbra krameri*) im Einzugsgebiet des Balaton (Zubringer und das Kis-Balaton-Reservoir) werden zusammengefaßt. Im Laufe der seit 1987 regelmäßig durchgeführten Untersuchungen konnte *U. krameri* lediglich in zwei Bächen nachgewiesen werden. Gründe für den Rückgang dieser geschützten Art werden diskutiert und Vorschläge für Schutzmaßnahmen präsentiert.

Introduction

The European mudminnow (*Umbra krameri* WALBAUM), a threatened Pannonian endemic species, is known to occur in a restricted area of central and eastern Europe, which is confined to the drainage basins of the Danube (middle and lower stretch) and Tisza Rivers up to the River Dniester (BERINKEY 1966, LELEK 1980).

Written records (HANKÓ 1923, 1931, LUKÁCS 1941, UNGER 1916, VUTSKITS 1913) summarize the former distribution and the characteristic habitats of mudminnow in the Carpathian Basin. By now, these localities have mostly disappeared, and at present this species has a mosaic-like distribution in swampy areas of black, humic waters or in small rivulets connected with such areas. Ócsa bog was one of the last remnants of an ancient moorland situated between the rivers Danube and Tisza in Hungary. This bog was densely inhabited by pike (*Esox lucius* L.), mudminnow (*Umbra krameri*), Giebel (*Carassius auratus gibelio* (BLOCH)), catfish (*Ictalurus nebulosus* (LESUR)) and pumpkinseed (*Lepomis gibbosus* (L.)) (GUTI & al. 1991). Recently this bog, as many others, was dredged and dried out.

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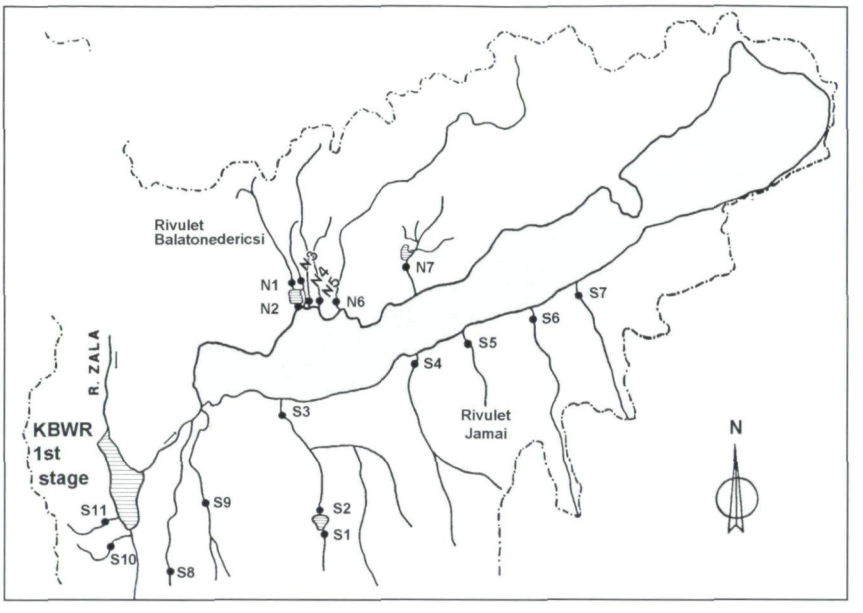

Fig. 1. Map of the area studied (1987 - 1993). N1 - N7: sampling stations in northern inflows, S1 - S11: sampling stations in southern inflows (only rivulets with *Umbra krameri* are named). The 1st stage of Kis-Balaton Water Reservoir (KBWR) has been functioning since 1985 (modified from BÍRÓ & PAULOVITS 1994).

Since 1987 regular studies of the fish fauna of rivers flowing into Lake Balaton and Kis-Balaton Water Reservoir (KBWR) were accomplished. The first stage of KBWR was constructed in 1985 and the second stage has currently been inundated since 1992. Recent results of ichthyological investigations and the description of the water bodies together with their limnological characteristics are presented in different papers (BÍRÓ 1994, BÍRÓ & PAULOVITS 1994). The aim of the present contribution is to summarize observations on the distribution of the European mudminnow within the drainage of Lake Balaton.

Acknowledgements

This study forms a part of the Biological Monitoring Programme financed by the Western Hungarian Water Authority (NYUDUVIZIG, Szombathely), Kis-Balaton Management (Keszthely) and the Nature Conservation Authority (Veszprém). Thanks are due to Dr. I. Varanka for his field work and to Mrs. B.M. Maroskövi and Mrs. B. Varanka for their laboratory assistance.

Study area and methods

Fish collections were made monthly with an a.c. electric shocker (max. capacity 400 V and 8 A) from a boat in northern and southern inflowing waters during 1988, and at 4 - 6 sites of the newly impounded Kis-Balaton Water Reservoir (KBWR 1st stage) during

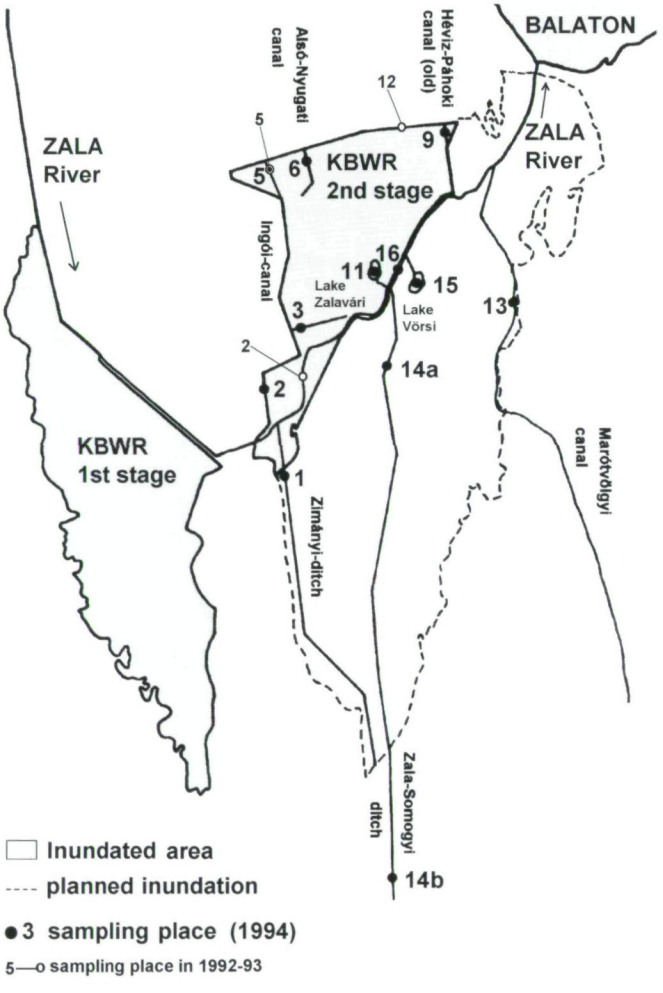

Figure 2. Location of the 1st and 2nd stages of Kis-Balaton Water Reservoir along River Zala with the indication of sampling sites in 1992 - 1993 and 1994, respectively.

1987 - 1993, respectively (BÍRÓ & PAULOVITS 1994) (Fig. 1). The same samplings were made at 16 sites of the partly impounded 2nd stage of Kis-Balaton Water Reservoir during 1992 - 1994 (Fig. 2). The latter studies form a part of a wide-scale biological monitoring programme aiming at the description of colonization process accompanying the impoundment. The fished areas varied according to the macrophyta coverage and the extension of open water. Fish specimens caught were taxonomically determined, their length and weight measured. Then standing stock and biomass of fish were calculated per unit area. All these figures should be handled with care because they are rough and preliminary.

The various localities can be characterized as follows (compare with Figs. 1 and 2).

Zimányi-ditch (site no. 1): A characteristic bog-water bordered with *Phragmites* stands and containing high amounts of organic material. Mean depth varies from 0.5 to 2 m. The sampled area covered 0.005 ha.

Table 1. List of fish species occurring in the KBWR. Protected species...*

Species	1991	1992	1993				1994								
	KBWR 1st stage	KBWR 2nd stage	2	5	11	12	1	2	3	9	11	13	14 a-b	15	16
European mudminnow - *Umbra krameri* WALBAUM*	-	+	+	+	+	+	+	+	-	+	+	-	+	+	-
Pike - *Esox lucius* L.	+	+	-	-	+	+	-	-	-	-	-	+	+	+	-
Roach - *Rutilus rutilus* (L.)	+	+	+	-	+	+	-	+	+	-	-	-	+	-	-
Amur - *Ctenopharyngodon idella* (VALENCIENNES)	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rudd - *Scardinius erythrophthalmus* (L.)	+	+	-	-	-	-	-	-	-	-	+	+	+	-	-
Chub - *Leuciscus cephalus* (L.)	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Ide - *Leuciscus idus* (L.)	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Asp - *Aspius aspius* (L.)	+	+	-	-	-	-	-	+	-	-	-	-	-	-	-
Bleak - *Alburnus alburnus* (L.)	+	+	-	-	-	+	-	+	-	-	-	-	-	-	-
White bream - *Blicca björkna* (L.)	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Bream - *Abramis brama* (L.)	+	+	-	-	-	-	-	+	+	-	-	-	+	-	-
Tench - *Tinca tinca* (L.)	+	+	-	-	+	+	-	-	-	-	-	-	-	-	-
Rasbora - *Pseudorasbora parva* (TEMMINCK & SCHLEGEL)	+	+	-	-	-	-	-	+	-	-	-	-	+	-	-
Bitterling - *Rhodeus sericeus amarus* (PALLAS)	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Crucial carp - *Carassius carassius* (L.)	+	+	+	+	+	+	-	+	-	-	+	+	-	+	-
"Giebel" - *C. auratus gibelio* (BLOCH)	+	+	+	+	+	+	+	+	+	-	+	-	+	+	-
Carp - *Cyprinus carpio* L.	+	+	-	-	-	-	-	+	-	-	-	-	-	-	+
Silver carp - *Hypopthalmichthys molitrix*	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Stone loach - *Noemacheilus barbatulus**	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Weatherfish - *Misgurnus fossilis**	+	+	-	+	-	-	-	-	-	-	-	+	+	+	-
Spined loach - *Cobitis taenia**	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-
Wels - *Silurus glanis*	+	+	-	-	-	-	-	-	-	-	-	-	+	-	-
Eel - *Anguilla anguilla*	+	+	-	-	-	+	-	+	+	-	-	+	-	+	+
Pumpkinseed - *Lepomis gibbosus*	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-
Pikeperch - *Stizostedion lucioperca*	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Wolga pikeperch - *Lucioperca volgensis*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Perch - *Perca fluviatilis*	+	+	-	-	-	+	-	-	-	-	-	-	+	-	-
Ruffe - *Gymnocephalus cernuus*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long-whiskered gudgeon - *Gobio uranoscopus**	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zobel - *Abramis sapa*	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Total:	27	22	4	4	6	12	2	11	4	1	4	5	12	6	3

Ingói-canal (site no. 2): This place has an extensive open water surface and contains high amounts of submersed and littoral macrophyta stands. The sampled area was 0.05 ha. Two other sampling places were connected with this canal. **Site no. 3** was in a side-arm (0.125 ha), and **site no. 5** was placed at the upper stretch of Ingói-canal (0.008 ha).

Hévíz-Páhoki-canal (site no. 9): A typical, standing bog-water (dark brown) with high submerse coverage. Mean depth varies from 1 to 2.5 m. Collections were made on 0.01 ha.

Lake Zalavári (site no. 11): An open water area bordered with *Phragmites* stands. It is connected to River Zala, and the excessive water flows to the river. The water of the canal is rather of bog-type, while that of the lake is similar to the river. Fishes were collected from 0.05 ha.

Marótvölgyi-canal (site no. 13): It is located at the eastern part of the planned KBWR 2nd stage and connected to River Zala. The area of collections covered 0.4 ha.

Zala-Somogyi-canal (sites no. 14a and no. 14b): This is also connected to River Zala and has a most diversified fish fauna. Sampled areas covered 0.5 and 0.1 ha, respectively.

Lake Vörsi (site no. 15): A small lake-type water connected to River Zala. Fish samples were take from 0.3 ha.

River Zala (site no. 16): At present it forms the southern border of KBWR 2nd stage. Fish collections were made on 0.08 ha.

Results

The distribution of *Umbra krameri* around Lake Balaton

Up to the present, no specimen of the mudminnow could be found directly in Lake Balaton, although the littoral zone has currently been studied intensively.

Figure 1 shows the distribution of the mudminnow in the rivulets along the northern and southern shorelines of the lake. Mudminnows could be detected only in two more or less humic rivulets. Rivulet Balatonedericsi at the north (site N2) flows through a wetland and Rivulet Jamai at the south (site S5) comes from a swampy area. Most of the other inflowing waters are of different types and are more or less polluted.

Fish fauna of Kis-Balaton Water Reservoir

The number of species found at 13 distinct sites varied from 1 to 11, respectively, and there were places containing no fish at all (no. 4 - 5, no. 10). At the area of KBWR (2nd stage) the presence of altogether 23 fish species have been registered. Among protected and endangered species, the European mudminnow and weatherfish were found in the 2nd stage of KBWR in 1993 - 1994. However, stone and spined loaches did also occur in 1992 (Table 1).

Figure 2 shows the map of KBWR 2nd stage and the places of regular collections. The reservoir is still in an unstable transitional stage. *Umbra krameri* occurred in 6 places among 10 studied sites in 1994 (Table 1).

In the Zimányi-ditch (no. 1), two species coexisted (mudminnow, Giebel). The Ingói-canal (no. 2) showed altering species richness during 1993 - 1994 (4 - 11 species). The species composition indicates periodic immigration and emigration, where dominant species were bream and Giebel. At the nearby side-arm of Ingói-canal (no. 3) a total of 4 species were observed. The Hévíz-Páhoki-canal (no. 9) exhibits the most preferred habitat for the mudminnow. Lake Zalavári (no. 11) has a characteristic spring and autumn fish fauna (4 - 6 species), however, fishes rarely occurred during summer. For the Marótvölgyi-canal (no. 13), the occurrence of 5 species was characteristic. The isolated bog-type Lake Vörsi (no. 15) was inhabited by 6 species with the dominance of *Carassius* species and the mudminnow. In the lower stretch of River Zala (no. 16) a total of 3 species only was observed.

Continuous observations showed the species assemblages to be highly variable in space and time. An overall decrease in fish diversity was registered at the area of KBWR.

Table 2. Numbers, sizes and estimated population size, and biomass values of European mudminnow in different sites of KBWR II. (1994) (numbers refer only for mudminnow where it occurred in different fish assemblages) in different sites of KBWR II. (1994). (figures refer only for mudminnow where it occurred in different fish assemblages); * = min.-max. values, ** = average values, N = number of individuals, SL = standard length, W = weight, TW = total weight, B = biomass.

Site of collection		N (ind.)	SL* (mm)	SL** (mm)	W* (g)	W** (g)	TW (kg)	N (ind/ha)	B (kg/ha)
1:	Zimányi ditch	2	77 - 84	81	10.5 - 14.5	13	0.02	400	5
2-5:	Ingói canal	1		63		5.3	0.01	20	0.1
9:	Héviz-Páhoki canal	66	30 - 88	60.3	0.6 - 14.5	6	0.3	6600	37.9
11:	Lake Zalavári	2	56 - 61	59	4 - 5.7	5	0.01	40	0.1
		6	41 - 74	59	1 - 8	4.5	0.02	20	0.09
14:	Zala-Somogyi ditch	4	64 - 76	71	5.8 - 11	8	0.03	8	0.06
15:	Lake Vörsi	32	53 - 89	73	4.1 - 19.1	10	0.3	107	1

Figure 3 shows the pooled size distribution and length-weight relationships of *Umbra* specimens in 1992, 1993, and 1994. Their length-frequencies were asymmetrical or bimodal, and the length-weight relationships indicated relatively fast weight gain (b = 2.18 - 3.52) as compared to the rate of growth in length.

The stock size and biomass estimates varied within wider scales according to time and nature of habitats (Table 2). In the Zimányi-ditch (site no. 1) altogether 3 species were found with 73 kg ha^{-1} biomass in 1992. In the Ingói-canal (sites no. 3 - 5), a total of 4 species occurred having an estimated biomass of 0.4 - 95.3 kg ha^{-1} in 1993. In the Hévíz-Páhoki-canal (site no. 9) 3 species formed a high biomass of 511 kg ha^{-1} in 1992. In Lake Zalavári (site no. 11), a total of 9 (1992) and 6 species (1993) occurred with a biomass of 13.6 and 222.9 kg ha^{-1}, respectively. The highest fish density (6600 ind. ha^{-1}) and biomass (37.9 kg ha^{-1}) was found in the Hévíz-Páhoki canal (no. 9), which contains standing black (humic) water. The other places are of flowing or standing waters of less humic contents.

Conservational measures

From the time series of qualitative and quantitative data obtained from 1988 up to the present (BÍRÓ & PAULOVITS 1994) it can be concluded that the colonization, transition, and stabilization of KBWR result in a continuous alteration and decrease of fish fauna both in diversity and biomass.

Because the construction of KBWR 2nd stage is to be continued, it is highly probable, that most of the unique habitats will soon disappear or significantly contract. In this respect the isolated bog-lakes (no. 1 and 5) as well as canals (e.g. no. 9) are mostly endangered. These processes have been indicated by an ever increasing expansion of *Carassius auratus gibelio* (even in the littoral zone of Lake Balaton) and step by step disappearance of protected species. Therefore strict conservational measures are urgently needed to preserve the above localities as well as the gene-pool of mudminnow together with other endangered fish species. This aim could be achieved by the separa-

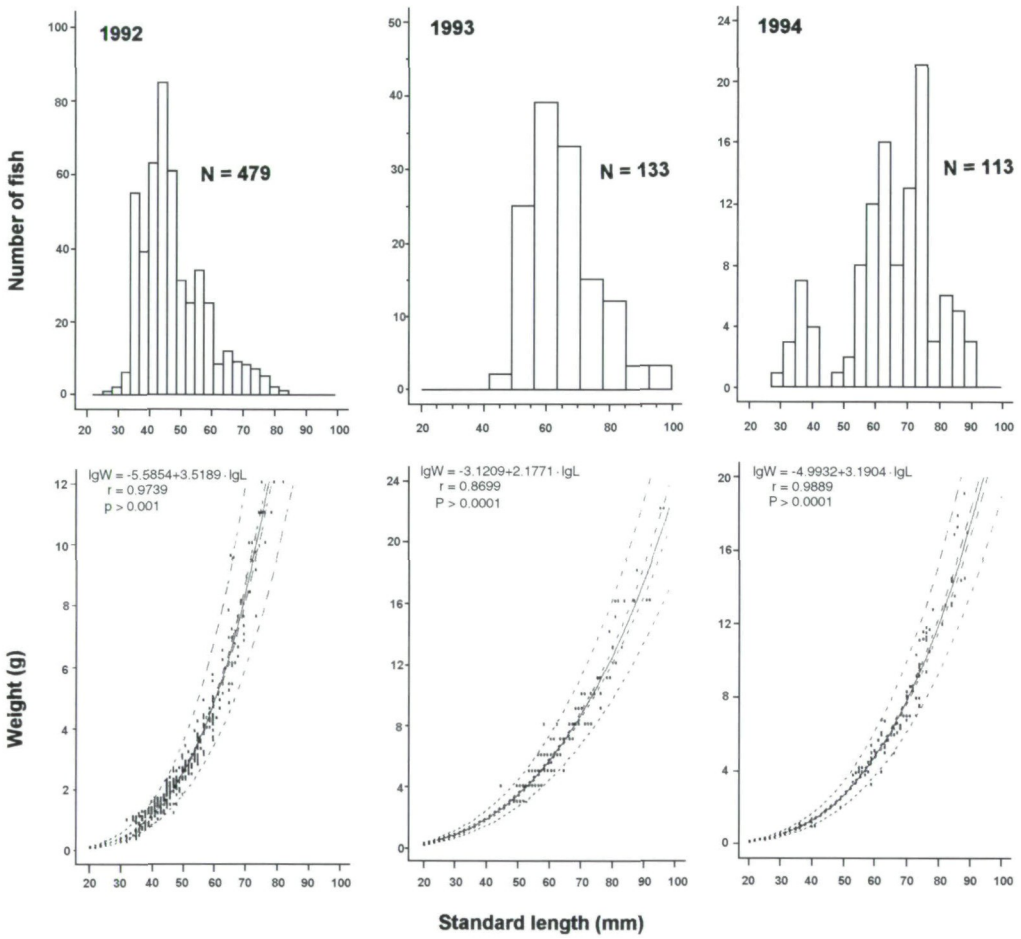

Figure 3. Size-distribution and length-weight relationships of *Umbra krameri* collected in 1992, 1993, and 1994 (all sampling stations are pooled). Dotted lines indicate 90 % and 95 % confidence limits.

tion of the above places from further inundation and preserving them in their original state. For this reason, future changes which might affect the hydrology and alter the vegetation must be avoided (LELEK 1980). Complete inundation of the planned territory (see Fig. 2) is to be continued during 1995. This will result in further emigration of mudminnow into nearby canals, as refugia.

Systematic stockings of mudminnow into adjacent rivulets and canals might help to develop self-sustaining populations of *Umbra krameri*, where this species disappeared or still occurs sporadically. The best guarantee for the maintenance of the populations is the preservation of a variety of suitable micro-habitats. Artificial propagation of mudminnow would further help in increasing its stocks. Another threat for these stocks are the effects of the yearly repeated massive fish and bird kills caused by high organic load, anoxic conditions, and bacterial infections.

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