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Discovery, distribution, and conservation of mudminnow *Umbra krameri* WALBAUM, 1792, in Slovenia

(Pisces: Umbridae)

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Abstract

The European mudminnow, *Umbra krameri* WALBAUM, was first found in Slovenia in the oxbow lake Kapitany lap on the left bank of the Mura River at Hotiza (NE Slovenia) in 1980. Meanwhile mudminnow findings in 13 localities are known. The present knowledge on the distribution of *U. krameri* in Slowenia is summarized with special respect to the biotic and abiotic characteristics of the habitats of the European mudminnow. Additionally experiences in trials of protecting *U. krameri* (i.e. introduction, habitat-revitalization) are described.

Key words: Umbridae, *Umbra krameri*, Slovenia, distribution, protection.

Zusammenfassung

Der Europäische Hundsfisch, *Umbra krameri* WALBAUM, wurde in Slowenien erstmals 1980 im Kapitany lap, am linken Ufer der Mur bei Hotiza (NO Slowenien) gefunden. Mittlerweile liegen Nachweise aus 13 Fundorten vor. Hier wird der heutige Wissensstand über die Verbreitung von *U. krameri* in Slowenien zusammengefaßt und dabei besonders auf die biotischen und abiotischen Charakteristika der Lebensräume dieser Art Bezug genommen. Darüber hinaus werden Erfahrungen bei der Umsetzung von Artenschutzmaßnahmen (Einbürgerung, Habitat-Revitalisierung) beschrieben.

Introduction

HECKEL & KNER (1858) for the first time mentioned the habitats of *U. krameri* in the Mura river near Czakaturn (Podturen is the recent name of this town) on the Slovenian - Croatian border. The only recent information on the potential presence of the mudminnow in Slovenia is to be mentioned by SKET (1967) and by the Inventory of the Natural and Cultural Heritage of Slovenia (1976). Treats to the survival of the mudminnow in Europe were dealt with by LELEK (1987). In the Red List of Fresh Water Fish in Slovenia (Povž 1989) the mudminnow is now assigned to the category of rare fishes.

Its habitats, i.e. oxbows, are eliminated in a natural way, as they are being more and more densely overgrown with vegetation. Another negative factor is river regulation. River branches are eliminated so that the function of river floods is restricted or even completely prevented. A third factor is that these habitats are situated on agricultural land intensively treated with fertilizers, herbicides, and pesticides, which are washed off into the oxbows. Besides, numerous oxbows situated in agricultural areas serve as gar-

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bage dumps. According to Pečina & Čepička (1979), the mudminnow's existence in oxbows is threatened by pumpkinseed *Lepomis gibbosus* (L.), which feeds on its brood.

Material and methods

Study area

The distribution of mudminnow was investigated in the Mura river basin, Slovenia (Povž, 1987). In the Mura oxbows the fish were caught in the area between the outflow of the River Ščavnica and the Slovenian - Hungarian border. The oxbows of the Mura river are at different distances from the main river. None of the oxbows sampled is permanently connected with the river, except when the water-level is exceptionally high. The fish were caught by means of electro-fishing.

Biology and physio-chemical characteristics of oxbows and a gravel pit

Oxygen content, oxygen saturation, and water temperature were measured in three oxbows inhabited by *U. krameri* in the summer of 1989. In 1990, physio-chemical and biological characteristics of two oxbows (Beloviči and Podkev) were examined. Due to scarce fundings, water samples were taken only twice for chemical analysis: on February 2, 1990, and on November 25, 1990. The following parameters were analyzed: turbidity, pH, carbonate and total hardness, chemical consumption of oxygen (COD), oxygen content, oxygen saturation, and water temperature. A single water sample was taken from the gravel pit on November 25, 1990. A bottom sampler was used to obtain samples for qualitative analysis of bottom fauna and aquatic flora of the sampling sites. Collected vegetation was later determined in the laboratory.

Results and discussion

Distribution

Umbra krameri was caught for the first time in Slovenia in 1980 in the oxbow Kapitany lap near Petišovci, on the left bank of the Mura River. It has been completely separated from the Mura River for several decades. It is up to 2 m deep and has an area of 100 m^2. The bottom is covered with mud, and the oxbow is overgrown with plants. In 1982, the species was found in two other oxbows, Gyula marof and Szent kiraly, on the left bank of the Mura River as well. In 1983 to 1989 we caugth *U. krameri* in another 9 oxbows and in one channel (Fig. 1).

The actual extent of its distribution area and how far it reaches from our territory towards the east could only be solved through systematic ichthyofaunistic investigations such as currently under way in Slovenia.

Its habitats are not interconnected and are confined to a relatively small area in Slovenia. Though common, the mudminnow is a potentially seriously endangered species due to the nature of these habitats.

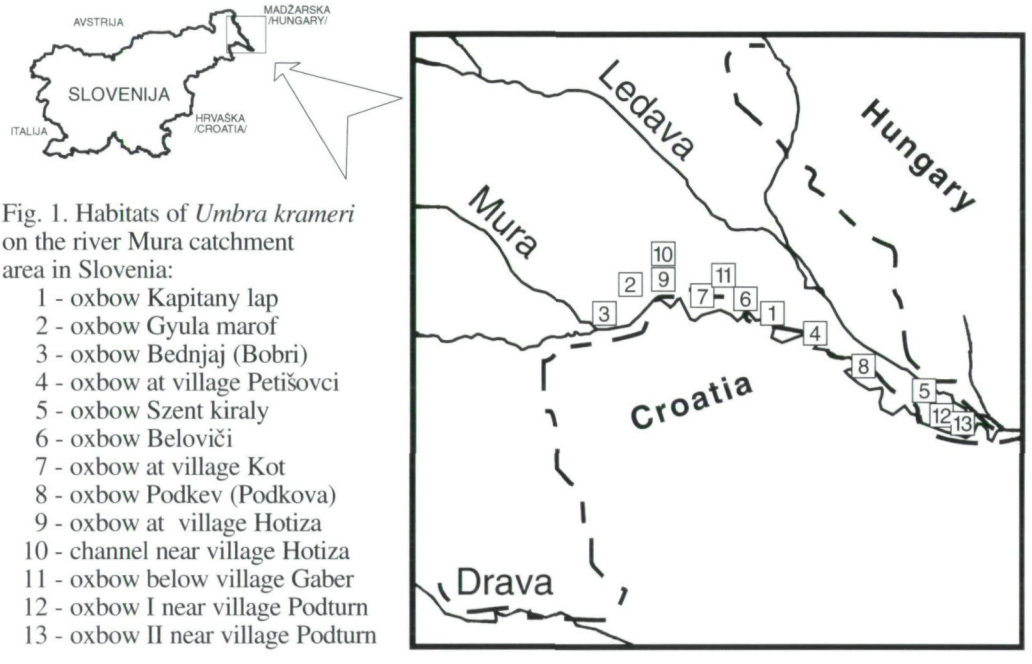

Fig. 1. Habitats of *Umbra krameri* on the river Mura catchment area in Slovenia:
1 - oxbow Kapitany lap
2 - oxbow Gyula marof
3 - oxbow Bednjaj (Bobri)
4 - oxbow at village Petišovci
5 - oxbow Szent kiraly
6 - oxbow Beloviči
7 - oxbow at village Kot
8 - oxbow Podkev (Podkova)
9 - oxbow at village Hotiza
10 - channel near village Hotiza
11 - oxbow below village Gaber
12 - oxbow I near village Podturn
13 - oxbow II near village Podturn

Physio-chemical and biological characteristics of oxbows and gravel pit

The results of measurements performed in summer 1989 show that oxygen content and saturation are very low at that time (Table 1). In autumn, oxygen content is normal, while in winter it is even higher. Very high chemical consumtion of oxygen and low oxygen content in summer may be ascribed to rapid decomposition of plant remains. During the winter, the consumption is almost three times lower, since decomposition and thus oxygen consumption proceed more slowly. Total water hardness ranges between 11.2 to 12.7 German degrees, pH values of water range from 7.0 to 7.8.

Bottom fauna and aquatic flora

In a single sample from late autumn, 19 different animal organisms were found in Beloviči oxbow, 14 in Podkev, and only 5 in the gravel pit (Table 2). The oxbow flora is very rich and divers. In Beloviči oxbow 14 algal taxa were identified and 13 higher aquatic plants, in Podkev oxbow 9 algal taxa and 6 different macrophytes were found (Table 3).

Ichthyofauna of oxbows

In 12 oxbows and one channel we found 18 different fish species from 8 families. Three fish species are introduced. KUX & LIBOSVARSKY (1957) found only 9 different native fish species co-occurring with mudminnows.

Table 1: Physio-chemical characteristics of oxbows Beloviči and Podkev, and the gravel pit in which *U. krameri* was released, measured on February 2, and November 25, 1990 (localities 1 - 3), and temperature, oxygen content and saturation with O_2 (%) in three oxbows inhabited by *U. krameri* on June 17, 1989 (localities 4 - 6).

No.locality date	T °C	Turbidity	pH	Total Hardness	KPK	O_2	Saturation O_2 (%)
1. Beloviči oxbow							
22.2.1990	12.3		7.9	12.0	44.6	12.3	112
25.11.1990	12.2	Brown-50	7.9	11.2	146.0	8.4	80
2. Podkev oxbow							
22.2.1990	8.2		7.8	12.7	52.0	9.3	76
25.11.1990	13.1	Brown-40	7.0	12.5	135.0	7.6	70
3. Gravel pit near Čarda							
25.11.1990	13.0	Clear	7.6	15.5	140.0	8.3	81
4. Kapitany lap oxbow							
17.6.1989	14.6	-	-	-	-	2.3	23
5. Oxbow 1 near Podturen							
17.6.1989	14.1	-	-	-	-	2.6	30
6. Oxbow 2 near Podturen							
17.6.1989	16.0	-	-	-	-	1.6	10

An interesting observation, made by accident, deserves to be mentioned. Until 1988, ichthyological investigation in oxbows has been always conducted during summer months. At that time catching a specimen of *U. krameri* was the exception rather than the rule. In 1989, however, fish were caught in oxbows Beloviči, Podkev, Kapitany lap and others for the first time in winter. Numerous specimens were captured in a small area. For example, more than hundred specimens were easily caught in an hour. We may assume that in summer they withdraw from warm surface water towards the oxbow bottom, where the water is cool.

Threat and conservation measures

Major factors which are threatening *U. krameri* may be summarized as follows:

1. Vanishing of the oxbows in a natural way and river regulation.

2. Pollution by pesticides, herbicides, and artificial fertilizers.

A most important conservation measure enforced in Slovenia in 1993 is the "Provision of the protection of threatened animal species" (Official Journal of the Republic of Slovenia No. 57/1993). By this decree it is prohibited to catch *U. krameri* or destroy its habitats. Preservation of river flooding and meandering would be another optimum protective measure. We also considered the possibility to prevent agening of already filled-in oxbows, of raising the species in controlled conditions or finding a substitute habitat.

The following pilot experiments were made to find solutions for the protection of the species:

Table 2: Qualitative biologic analysis of bottom fauna of oxbows Beloviči and Podkev, and of gravel-pit near Čarda area (+ species is present).

Species	oxbows		gravel-pit
	Beloviči	Podkev	near Čarda
Gastropoda			
Lymnea sp.	+	+	-
Gyraulus sp.	+	+	-
Lamelibranchiata			
Pisidium sp.	+	+	-
Oligochaeta			
Nais sp.	+	+	-
Tubifex sp.	-	+	+
Hirudinea			
Hemiclepis marginata	-	+	-
Erpobdella octoculata	+	-	-
Helobdella stagnalis	+	-	-
Crustacea			
Phyllopoda	+	+	+
Ostracoda	+	+	+
Isopoda (*Asellus* sp.)	+	+	-
Ephemeroptera			
Baetis sp. (larva)	+	-	+
Cloeon sp. (larva)	+	+	-
Caenis sp. (larva)	-	+	-
Odonata			
Calopterix splendens (larva)	+	-	-
Heteroptera			
Corixa sp. (larva)	+	-	-
Ilyocoris cimicoides	+	-	-
Neuroptera			
Sialis sp. (larva)	-	+	-
Coleoptera			
Helophorus griseus (imago)	+	-	-
Diptera			
Chironomidae (larva)	+	+	+
Bezzia sp. (larva)	+	-	-
Amphibia			
Triturus sp. (larva)	+	-	-
tadpoles	+	+	-

1. Introduction of *U. krameri* in a substitute biotope - a gravel pit

(1) A gravel pit of about 300 m^2 in size, located near the oxbow Beloviči, which is inhabitede by *U. krameri*, was selected as a substitute habitat. Its physio-chemical (Table 1) and biological characteristics (Table 2, 3) were analyzed in 1990. No significant differences were found between parameters of the two oxbows and the gravel pit, with the exception of water hardness, where values were considerable different. The effect of hardness on *U. krameri*, however, is not known at present.

The water in the gravel pit was clearer than in the oxbows, which may be attributed to minimal decomposition of vegetational remnants. There were no macrophytes in the gravel pit except some individual stands of *Typha* sp. in one part. Among the algae, diatom species were the most abundant (Table 3). Its bottom was stony, without mud.

Table 3: Qualitative biologic analysis of aquatic flora of oxbows Beloviči and Podkev, and of gravel-pit near Čarda area (+ species is present).

Species	oxbows		gravel-pit
	Beloviči	Podkev	near Čarda
Algae			
Cymbella sp.	+	-	+
Pinnularia sp.	+	+	+
Synedra ulna	+	+	+
Eunotia sp.	+	+	-
Diatoma vulgare	+	+	+
Asterionella formosa	+	-	-
Navicula cuspidata	+	+	-
Achnanthes lanceolata	+	-	-
Tabellaria sp.	+	+	+
Gyrosigma acuminatum	+	-	-
Cymatopleura sp.	+	+	+
Melosira varians	+	+	+
Cocconeis sp.	+	+	+
Pinnularia interrupta	+	-	-
Higher aquatic plants			
Salvinia natans	+	-	-
Utricularia sp.	+	-	-
Lemna trisulca	+	-	-
Lemna sp.	+	+	-
Spirodella polyrrhiza	+	-	-
Stratoides aloides	+	-	-
Nuphar luteum	+	-	-
Ranunculus sp.	+	-	-
Riccia fluitans	+	-	-
Elodea canadensis	+	-	-
Typha sp.	+	+	+
Hippuris sp.	+	+	-
Myriophyllum sp.	+	+	-
Hydrocharis morsus ranae	-	+	-
Potamogeton crispum	-	+	-

Despite these considerable differences we decided to introduce *U. krameri* in the gravel pit in 1991. On March 20, 1991, 22 males and 21 females were captured with electrofishing gear in the nearby Beloviči oxbow. Big females, full of eggs, were selected for the purpose. Water temperature in the oxbow was 15.5 °C and 13.5 °C in the gravel pit. The fish were recaptured in the gravel pit in November 1991. At that time, the water was slightly brown in colour. Ten specimens of *U. krameri* were caught (23 %), all of them in one part of the gravel pit, where the bottom was covered with a thick layer of decaying leaves. The next control captures were carried out on April 14 and September 20, 1992. No *U. krameri* were caught.

Results of the analysis of physio-chemical parameters, bottom fauna and flora in oxbows and in the gravel pit suggest that, at present, gravel pits are not the most adequate substitute habitats for *U. krameri*. Other abandoned, older and more overgrown gravel pits, containing more mud, should be examined in detail, and physio-chemical properties of water analyzed. Introduced fish would have to be tagged.

Table 4: Ichthyofauna of 12 oxbows and one channel in Slovenia and in the waters in Slovakia. 1 - Kapitany lap; 2 - Gyula marof; 3 - Bednjaj; 4 - at village Petišovci; 5 - Szent kiraly; 6 - Beloviči; 7 - at village Kot; 8 - Podkev (Podkova); 9 - at village Hotiza; 10 - channel near village Hotiza; 11 - below village Gaber; 12 - near village Podturn - I; 13 - near village Podturn - II; R = reference (KUX & LIBOSVARSKY 1957).

	1	2	3	4	5	6	7	8	9	10	11	12	13	R
Umbridae														
Umbra krameri	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cyprinidae														
Aspius aspius	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Rutilus rutilus	-	+	+	+	+	+	+	+	+	-	-	-	+	+
Scardinius erythrophthalmus	-	+	+	+	+	+	+	+	+	-	-	-	-	+
Tinca tinca	-	+	+	+	+	+	+	+	+	-	-	-	+	+
Alburnus alburnus	-	+	+	-	+	-	-	-	-	-	-	-	-	+
Blicca bjoerkna	-	+	+	+	-	-	-	-	-	-	-	-	-	+
Abramis brama	-	+	+	+	+	-	-	-	-	-	-	-	-	-
Rodeus s. amarus	-	-	+	-	+	-	-	-	-	-	-	-	-	-
Carassius carassius	+	-	+	+	+	+	+	+	+	+	+	+	+	+
Carassius auratus gibelio	-	-	-	+	-	-	-	-	-	-	-	-	+	-
Leuciscus cephalus	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Cobitidae														
Cobiti taenia	-	+	-	+	-	-	-	-	-	-	-	-	-	+
Misgurnus fossilis	-	-	-	-	+	+	-	+	+	-	-	-	+	+
Ictaluridae														
Ictalurus nebulosus	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Siluridae														
Silurus glanis	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Esocidae														
Esox lucius	-	+	+	+	+	+	+	+	+	-	-	+	+	-
Percidae														
Perca fluviatiis	-	+	+	-	+	-	-	+	+	-	-	-	+	-
Centrarchidae														
Lepomis gibbosus	-	+	+	+	+	-	+	-	+	-	-	-	+	-
Total number of fish species	2	13	13	12	12	7	7	8	9	3	2	4	9	9

The observations mentioned lead to the conclusion that the only adequate substitute habitats of *U. krameri* are the existing oxbows in Slovenia and in other parts of its distribution area.

2. Re-vitalization of oxbow

Until now, there has been only one such re-vitalization case. It has been carried out by hunters in order to improve the oxbow habitat for ducks. Part of the Beloviči oxbow was deepened and after a short time, a considerable population increase of *U. krameri* was observed. In the previous years only individual, very big specimens were caught in this oxbow. Since it has been deepened many fish of different size have been captured (Povž 1990). Re-vitalization of oxbows seems to be the most adequate and efficient protective

measure. A comprehensive re-vitalization plan should be made, based on a list of ox-bows and a survey of their physio-chemical, biological, and geomorphological features. Austrian re-vitalization schemes could serve as an example (Gepp & al. 1985). If the number of habitats of *U. krameri* is increased, the species will be less endangered.

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