



## The fish fauna of the Ciuc Depression (Harghita County, Transylvania, Romania)

### A Csíki-medence halfaunája (Hargita megye, Erdély, Románia)

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**Kulcsszavak:** halfaunisztikai felmérés, őshonos fajok, Olt folyó, halastavak, invazív fajok  
**Keywords:** ichthyofaunistic survey, native species, Olt River, fishponds, invasive species

#### Abstract

An ichthyofaunistic evaluation was made in the Ciuc Depression with the help of the available data from the literature and our latest survey, conducted in the summer of 2012. Summarizing the data from the literature and the latest survey we found that in the natural watercourses of the Ciuc Depression 33 fish species were present, belonging to 10 families. If we compare the fish fauna lists from 2008-2012 and 1894-1999 we find that between 2008-2012 we identified 13 species more, but we did not find three species (*Rhodeus amarus*, *Carassius carassius*, *Silurus glanis*) that are mentioned in the previous data from the natural water bodies. The disappearance of that three species is due to the increased habitat loss, the water pollution and the presence of invasive species. The 20 fish species from the officially registered ponds of the Depression should be attached to the complete fish fauna list of the Ciuc Depression. Among these species are invasive, introduced and native species, but there is a new category of fish species, the ones which are native to the country, but not to the Ciuc Depression, and are introduced in these artificial habitats (e.g. *Abramis brama*, which is not native to this bioregion). Continuous monitoring of the fish fauna is needed in the Depression to track the changes in the fish fauna composition.

#### Kivonat

Halfaunisztikai kiértékelést végeztünk a Csíki-medencében a létező irodalmi adatok és a 2012 nyarán végzett legutolsó felmérések alapján. Összegezve az irodalmi és a legfrissebb terepi adatokat azt találtuk, hogy a Csíki-medence természetes vízfolyásaiban 10 halcsaláddhoz tartozó 33 halfaj volt jelen. Ha összehasonlítjuk a 2008-2012 közötti és az 1894-1999 közötti halfauna listákat azt találjuk, hogy 2008-2012 között 13 halfajjal többet sikerült kimutatni, viszont az előző időintervallum alatt jelzett halfajok közül 3 már nem volt jelen (*Rhodeus amarus*, *Carassius carassius*, *Silurus glanis*). Eltűnésük az élőhelyek eltűnésének, a vizek szennyezésének és az invazív fajok megjelenésének tudható be. A medence hivatalosan nyilvántartott halastavaiban 20 halfaj van jelen, melyek a medence halfauna listáját egészítik ki. A halastavakban megjelennek olyan fajok, melyek bár őshonosak az ország területére nézve, a Csíki-medencébe csak tudatos emberi betelepítés következtében jelenhettek meg (pl. *Abramis brama*, mely nem jellemző erre a biogeográfiai régióra). Folyamatos halfauna monitorizálás szükséges a medencében, hogy nyomon lehessen követni a halfauna összetételében bekövetkező változásokat.

#### Introduction

The Olt River takes its source in the Hășmaș Mountains (Eastern Carpathian Mountains) 1416 m above the sea level and takes its first 86 kilometers in the middle of the Ciuc Depression (Kristó 2002). We have little information about the fish fauna of the Depression before the 21<sup>st</sup> century. The first data are from Vitos (1894) from the end of the 19<sup>th</sup> century

when 12 fish species were described, data collected mostly from fishermen. About 70 years later Bănărescu (1964) released the fish fauna volume of the country where 15 species were mentioned from the Depression. At the end of the 1970- 80's the floodplain of the Depression was entirely drained and the course of the Olt River regulated totally, as well as all the streams that entered the floodplain, which negatively influenced the fish fauna of the wetlands (Demeter 2002). Bănăduc (1999) made an ichthyological survey on the Olt River which included three sampling stations in the Ciuc Depression resulting only 6 species. Standard ichthyological surveys started in 2008 when three major streams of the Depression were examined with a repeated method, resulting 14 species (Imecs & Újvári 2009). Later in 2010 Imecs et al. (2011) examined the floodplain of the Olt River in the Ciuc Depression searching for weatherfish (*Misgurnus fossilis*), which resulted totally 17 fish species. One year later Imecs & Újvári (2013) examined 10 major streams of the Depression and described 15 fish species. The lack of a summarized and transparent ichthyofaunistical evaluation encouraged us to collect all the relevant data from the literature to evaluate the fish fauna of the Ciuc Depression. The existing data were completed with our recent survey on the fish fauna of the Lower Ciuc Depression (the Southern part of the Depression) which was conducted in the summer of 2012.

## Materials and methods

### The study area

The Ciuc Depression is located in the middle part of the Eastern Carpathian Mountains with approximately 60 km length and 30 km width. The region is a distinct inter-Carpathian Depression with separate tectonic and geomorphologic units (Kristó 2002). The Ciuc Depression is situated between the Izvorul Mureşului Passage (950 m) and the Tuşnad Defile (650 m) with a 650-700 m average height above sea level. The Depression is divided into three subunits: the Upper Ciuc Depression (with narrow floodplain and small streams), the Middle Ciuc Depression (where the floodplain widens and the streams become bigger) and the Lower Ciuc Depression (with a wide floodplain and a generally regulated water system including the Olt River, bigger streams, drainage channel system and even a few ponds) (Jánosi 2002). The streams which flow down from the East (Ciuc Mountains) and the West (Harghita Mountains) arrive in the Olt River making a distinctive water system in the Ciuc Depression (Kristó 2002).

### Data collection

We collected all the ichthyofaunistical data from the available literature (Vitos 1894 Bănărescu 1964, Bănăduc 1999, Imecs & Újvári 2009, Imecs et al. 2011, Imecs & Újvári 2013) and completed them with the results of the survey from 2012 summer. Between 6-10 August 2012 we conducted a survey on the fish fauna of the Lower Ciuc Depression. Fish were captured by electro-fishing (SAMUS-725MP) (Pricope et al. 2004) from 30 sampling stations mainly on the floodplain. This means 11 stations from the Olt River, 6 stations from 6 drainage channel and 13 stations from 12 streams. The size of a sampling station varied between 30 and 100 m: 30 m in the streams, 100 m in the Olt River and up to 100 m in the channels. In the channels we sampled a maximum of 100 m because of the weatherfish (*Misgurnus fossilis*) which has a stationary behavior (only 10% of the population moves longer than 100 m) (Meyer & Hinrichs 2000) and manifest a 'vertical escape behavior' (if disturbed an individual escapes vertically to the nearest hiding place, which increases the chance of catching) (Meyer & Hinrichs 2000, Pekárik et al. 2008). If the species was not present we sampled a maximum of 100 m section and if it was present we sampled a minimum 30 m section. Fish were identified based on external morphological characteristics (Bănărescu 1964, Gyurkó 1972, Pintér 1989, 2002). The nomenclature was

adjusted after Kottelat & Freyhof (2007) and Harka (2011). After a few minutes fish were recovered and released without injury at a slower section of the waters bodies (Keresztessy 2007). Sampling stations were recorded with a GARMIN GPS and all the data and observations were recorded on data sheets. The same sampling methods were used in the surveys between 2008-2012 and we recorded the new species caught with fishing rod by local fishermen too (Imecs & Újvári 2009, Imecs et al. 2011, Imecs & Újvári 2013).

## Results

### Sampling stations

We do not possess information about the occurrence of the fish species described by Vitos (1894), but the data from Bănărescu (1964) and Bănăduc (1999) are very precisely shown on maps so we could edit a map with these sampling stations (Fig. 1). Between 2008-2012 we collected data from 122 sampling station (Imecs & Újvári 2009, Imecs et al. 2011, Imecs & Újvári 2013, current study) (Fig. 1). In the Ciuc Depression there are two major fish ponds, which are managed by the Hunters and Anglers Association – Miercurea Ciuc: the Frumoasa Dam Lake (which is built on the Frumoasa Stream) and the Ciuc Backwater Fishponds (which were formed from the old course of the Olt River, near Miercurea Ciuc, before the river regulation). The Association delivered us the latest fish database of these fishponds. There are several smaller private fishponds in the region, but their fish introductions and lists of fish species present is not registered anywhere.

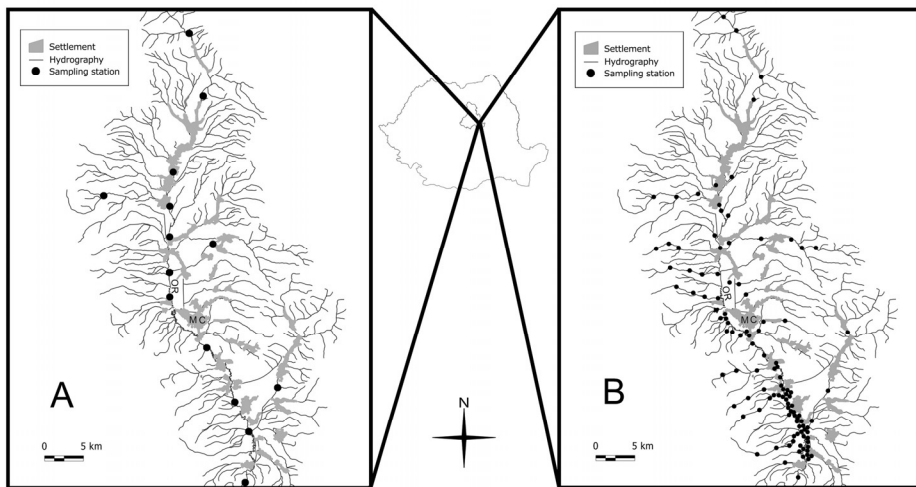


Fig. 1. A: Sampling stations of Bănărescu (1964) and Bănăduc (1999) in the Ciuc Depression (M C –Miercurea Ciuc city, OR – Olt River); B: Sampling stations between 2008-2012 in the Ciuc Depression (Imecs & Újvári 2009, Imecs et al. 2011, Imecs & Újvári 2013, current study) (M C –Miercurea Ciuc city, OR – Olt River)

### The fish fauna of the natural waters

Our newest survey, conducted between 6-10 August 2012 in the Lower Ciuc Depression, resulted in 19 fish species. To the fish species list we added 6 new species, which were captured only with fishing rod (*Scardinius erythrophthalmus*, *Aspius aspius*, *Alburnus alburnus*, *Barbus barbus*, *Cyprinus carpio* and *Gymnocephalus cernua*) (Table 1). Summarizing the data from the literature and the latest survey we found that in the natural watercourses of the Ciuc Depression 33 fish species were present, belonging to 10 families (Table 1). If we compare the fish fauna lists from 2008-2012 and 1894-1999 we find that

between 2008-2012 we identified 13 species more. On the other hand, we did not find three species that are mentioned in the previous data from the natural water bodies (Table 2). This result is due to the fact that in the last years the number of sampling stations increased (Fig. 1) and not to the appearance of new native species through natural paths in the Ciuc Depression.

Table 1. Fish species from the Ciuc Depression described from 1894 to date  
(X\* - fish species caught by fishermen)

| Species                            | Current study | Imecs & Újvári 2013 | Imecs et al. 2011 | Imecs & Újvári 2009 | Bănăduc 1999 | Bănărescu 1964 | Vitos 1894 |
|------------------------------------|---------------|---------------------|-------------------|---------------------|--------------|----------------|------------|
| <i>Eudontomyzon danfordi</i>       | X             | X                   | X                 | X                   | -            | -              | -          |
| <i>Salmo trutta</i>                | X             | X                   | -                 | X                   | -            | X              | X          |
| <i>Oncorhynchus mykiss</i>         | -             | -                   | -                 | X                   | -            | -              | -          |
| <i>Salvelinus fontinalis</i>       | -             | X                   | -                 | -                   | -            | -              | -          |
| <i>Esox lucius</i>                 | -             | -                   | X                 | -                   | -            | X              | X          |
| <i>Rutilus rutilus</i>             | X             | -                   | X                 | -                   | -            | X              | -          |
| <i>Scardinius erythrophthalmus</i> | X*            | -                   | -                 | -                   | -            | -              | -          |
| <i>Leuciscus leuciscus</i>         | X             | -                   | -                 | -                   | -            | -              | -          |
| <i>Squalius cephalus</i>           | X             | X                   | X                 | X                   | X            | X              | -          |
| <i>Phoxinus phoxinus</i>           | X             | X                   | X                 | X                   | X            | X              | -          |
| <i>Aspius aspius</i>               | X*            | -                   | -                 | -                   | -            | -              | -          |
| <i>Leucaspius delineatus</i>       | X             | -                   | -                 | -                   | -            | -              | -          |
| <i>Alburnus alburnus</i>           | X*            | -                   | -                 | -                   | X            | X              | -          |
| <i>Alburnoides bipunctatus</i>     | X             | X                   | X                 | X                   | -            | X              | -          |
| <i>Chondrostoma nasus</i>          | X             | -                   | -                 | -                   | -            | X              | X          |
| <i>Barbus barbus</i>               | X*            | -                   | -                 | -                   | -            | X              | X          |
| <i>Barbus petenyi</i>              | X             | X                   | X                 | X                   | X            | X              | X          |
| <i>Gobio gobio</i>                 | X             | X                   | X                 | X                   | X            | X              | -          |
| <i>Pseudorasbora parva</i>         | X             | -                   | X                 | -                   | -            | -              | -          |
| <i>Rhodeus amarus</i>              | -             | -                   | -                 | -                   | -            | X              | -          |
| <i>Carassius carassius</i>         | -             | -                   | -                 | -                   | -            | -              | X          |
| <i>Carassius gibelio</i>           | X             | X                   | X                 | -                   | -            | -              | X          |
| <i>Cyprinus carpio</i>             | X*            | -                   | -                 | -                   | -            | -              | X          |
| <i>Barbatula barbatula</i>         | X             | X                   | X                 | X                   | X            | X              | -          |
| <i>Misgurnus fossilis</i>          | X             | X                   | X                 | X                   | -            | -              | X          |
| <i>Cobitis elongatoides</i>        | X             | X                   | X                 | X                   | -            | -              | -          |
| <i>Sabanejewia balcanica</i>       | X             | X                   | X                 | X                   | -            | -              | -          |
| <i>Silurus glanis</i>              | -             | -                   | -                 | -                   | -            | -              | X          |
| <i>Lota lota</i>                   | -             | X                   | -                 | X                   | -            | X              | X          |
| <i>Lepomis gibbosus</i>            | -             | -                   | X                 | -                   | -            | -              | -          |
| <i>Perca fluviatilis</i>           | X             | -                   | X                 | -                   | -            | -              | -          |
| <i>Gymnocephalus cernua</i>        | X*            | -                   | -                 | -                   | -            | -              | -          |
| <i>Cottus gobio</i>                | X             | X                   | X                 | X                   | -            | X              | X          |
| Total                              | 25            | 15                  | 17                | 14                  | 6            | 15             | 12         |

### The fish fauna of the fishponds

From the database delivered by the Hunters and Anglers Association – Miercurea Ciuc we found that 20 fish species are present in the registered ponds, both native (13) and introduced (7) (Table 3). Among the introduced species there are accidentally introduced species, such as the *Pseudorasbora parva*, which is an invasive species. Some of these are

species of which presence was not indicated in the existing literature from the Ciuc Depression (Table 3). Except for the *Silurus glanis*, which was indicated at the end of the 19<sup>th</sup> century (Vitos 1894) from the natural water bodies (Table 1), but since no one indicated its presence. These species are mentioned in a separate category (new native species), because without the human intervention, they probably would not be able to appear in the Ciuc Depression water system (Table 3). The smaller private ponds, the species introduction in the natural water bodies by fishermen or the escapes of fish from ponds cannot be monitored or controlled.

Table 2. Fish species and their origin in the Ciuc Depression described between 2008-2012 and between 1894-1999 (X\* - fish species caught by fishermen)

| Species                            | 2008-2012 | 1894-1999 | Invasive | Native | Introduced | Natura 2000 |
|------------------------------------|-----------|-----------|----------|--------|------------|-------------|
| <i>Eudontomyzon danfordi</i>       | X         | -         | -        | X      | -          | X           |
| <i>Salmo trutta</i>                | X         | X         | -        | X      | -          | -           |
| <i>Oncorhynchus mykiss</i>         | X         | -         | -        | -      | X          | -           |
| <i>Salvelinus fontinalis</i>       | X         | -         | -        | -      | X          | -           |
| <i>Esox lucius</i>                 | X         | X         | -        | X      | -          | -           |
| <i>Rutilus rutilus</i>             | X         | X         | -        | X      | -          | -           |
| <i>Scardinius erythrophthalmus</i> | X*        | -         | -        | X      | -          | -           |
| <i>Leuciscus leuciscus</i>         | X         | -         | -        | X      | -          | -           |
| <i>Squalius cephalus</i>           | X         | X         | -        | X      | -          | -           |
| <i>Phoxinus phoxinus</i>           | X         | X         | -        | X      | -          | -           |
| <i>Aspius aspius</i>               | X*        | -         | -        | X      | -          | X           |
| <i>Leucaspis delineatus</i>        | X         | -         | -        | X      | -          | -           |
| <i>Alburnus alburnus</i>           | X         | X         | -        | X      | -          | -           |
| <i>Alburnoides bipunctatus</i>     | X         | X         | -        | X      | -          | -           |
| <i>Chondrostoma nasus</i>          | X         | X         | -        | X      | -          | -           |
| <i>Barbus barbus</i>               | X*        | X         | -        | X      | -          | -           |
| <i>Barbus petenyi</i>              | X         | X         | -        | X      | -          | X           |
| <i>Gobio gobio</i>                 | X         | X         | -        | X      | -          | -           |
| <i>Pseudorasbora parva</i>         | X         | -         | X        | -      | X          | -           |
| <i>Rhodeus amarus</i>              | -         | X         | -        | X      | -          | X           |
| <i>Carassius carassius</i>         | -         | X         | -        | X      | -          | -           |
| <i>Carassius gibelio</i>           | X         | X         | X        | -      | X          | -           |
| <i>Cyprinus carpio</i>             | X*        | X         | -        | -      | X          | -           |
| <i>Barbatula barbatula</i>         | X         | X         | -        | X      | -          | -           |
| <i>Misgurnus fossilis</i>          | X         | X         | -        | X      | -          | X           |
| <i>Cobitis elongatoides</i>        | X         | -         | -        | X      | -          | X           |
| <i>Sabanejewia balcanica</i>       | X         | -         | -        | X      | -          | X           |
| <i>Silurus glanis</i>              | -         | X         | -        | X      | -          | -           |
| <i>Lota lota</i>                   | X         | X         | -        | X      | -          | -           |
| <i>Lepomis gibbosus</i>            | X         | -         | X        | -      | X          | -           |
| <i>Perca fluviatilis</i>           | X         | -         | -        | X      | -          | -           |
| <i>Gymnocephalus cernua</i>        | X*        | -         | -        | X      | -          | -           |
| <i>Cottus gobio</i>                | X         | X         | -        | X      | -          | X           |
| Total                              | 30        | 20        | 3        | 27     | 6          | 8           |

Table 3. Fish species from fish ponds managed by the Hunters and Anglers Association – Miercurea Ciuc

| Species                            | Frumoasa Dam Lake | Ciuc Backwater Fishponds | Invasive | Native | Introduced | New native species |
|------------------------------------|-------------------|--------------------------|----------|--------|------------|--------------------|
| <i>Salmo trutta</i>                | -                 | X                        | -        | X      | -          | -                  |
| <i>Salmo trutta (lacustris)</i>    | X                 | -                        | -        | -      | X          | X                  |
| <i>Oncorhynchus mykiss</i>         | -                 | X                        | -        | -      | X          | -                  |
| <i>Esox lucius</i>                 | X                 | X                        | -        | X      | -          | -                  |
| <i>Rutilus rutilus</i>             | X                 | X                        | -        | X      | -          | -                  |
| <i>Ctenopharyngodon idella</i>     | X                 | X                        | -        | -      | X          | -                  |
| <i>Scardinius erythrophthalmus</i> | -                 | X                        | -        | X      | -          | -                  |
| <i>Squalius cephalus</i>           | X                 | X                        | -        | X      | -          | -                  |
| <i>Phoxinus phoxinus</i>           | X                 | -                        | -        | X      | -          | -                  |
| <i>Alburnus alburnus</i>           | -                 | X                        | -        | X      | -          | -                  |
| <i>Abramis brama</i>               | X                 | X                        | -        | X      | -          | X                  |
| <i>Tinca tinca</i>                 | -                 | X                        | -        | X      | -          | X                  |
| <i>Pseudorasbora parva</i>         | X                 | X                        | X        | -      | X          | -                  |
| <i>Carassius gibelio</i>           | X                 | X                        | X        | -      | X          | -                  |
| <i>Cyprinus carpio</i>             | X                 | X                        | -        | X      | -          | X                  |
| <i>Hypophthalmichthys molitrix</i> | -                 | X                        | -        | -      | X          | -                  |
| <i>Silurus glanis</i>              | -                 | X                        | -        | X      | -          | X                  |
| <i>Lepomis gibbosus</i>            | -                 | X                        | X        | -      | X          | -                  |
| <i>Perca fluviatilis</i>           | X                 | X                        | -        | X      | -          | -                  |
| <i>Sander lucioperca</i>           | X                 | X                        | -        | X      | -          | X                  |
| Total                              | 12                | 18                       | 3        | 13     | 7          | 6                  |

### Discussion

The majority of the sampling stations were in the Lower Ciuc Depression, because the floodplain on this section is expanded, with a lot of drainage channel, some backwaters and small ponds. The northern part of the Depression, the Upper Ciuc Depression, is much narrower and it is dominated by small streams, examination of which could not result the appearance of new fish species for the fish fauna list, unlike the southern side of the region, the Lower Ciuc Depression (Fig. 1). In the last decade three invasive species appeared in the Depression (*Pseudorasbora parva*, *Carassius gibelio*, *Lepomis gibbosus*), but they were present only in a few sampling stations (Table 2). The *Pseudorasbora parva*, which is native in Asia, was accidentally introduced into Romania in the 1960's among the fingerling of Chinese carps, imported from China (Bănărescu 1964). *Lepomis gibbosus*, native to North America, has been recorded in Romania since 1929 after Bănărescu (1964) and since 1918 after Băcescu (1942). *Carassius gibelio*, which originates from the Amur basin, was indicated first from 1912 (Pojoga 1959), Bănărescu (1964) put the date of introduction around 1920, but Vitos described it already in 1894, along the related species *Carassius carassius*. The *Carassius gibelio* once introduced, became invasive and gradually has replaced the native *Carassius carassius* in the whole country (Gavriloaie 2007). Probably the same scenario took place in the Ciuc Depression too, because after Vitos (1894) nobody described the presence of this species (Table 1), although it may be still present in very small patches and small population size. Another explanation for the disappearance of *Carassius carassius* might be the draining of the Olt River floodplain. The presence of *Rhodeus amarus* is linked to the

presence of freshwater *Unio* and *Anodonta* mussels, which are very sensitive to water pollution. The eggs of *Rhodeus amarus* are laid in the gill cavity of mussels (Bănărescu & Bănăduc 2007). One possible cause of its disappearance could be the massive water pollution of the last decades (Demeter 2002), which resulted probably the disappearance of the mussel species, thereby the disappearance of *Rhodeus amarus* too (Table 1). Its population restoring will occur along with the reappearance of the freshwater mussels.

The third species, *Silurus glanis*, once present in the natural water system of the Ciuc Depression (Vitos 1894) but disappeared probably due to overfishing and habitat loss during reconstruction of the floodplain and the regulation of the watercourses (Demeter 2002) (Table 1). Its natural restoring demands habitat reconstruction and rehabilitation mostly in the Lower Ciuc Depression. *Misgurnus fossilis*, which is one of the most threatened fishes in the world (Hartvich et al. 2010), was described by Vitos (1894) and even earlier by Orbán (1868), an ethnographer, who mentions it as the most abundant fish species of the marshy floodplain of the Ciuc Depression, which was an important food source for the local population (in fact the Hungarian name of this region – Csík – probably comes from Hungarian name of the species – réti csík). From the 20<sup>th</sup> century we have no reliable information on the presence of this species, but local people know the species well (Table 1). After the floodplain was totally rebuilt and drained, we recorded this species (Table 1) from man-made drainage channels. The artificial drainage channels and the regulated river and stream sections are also important watercourses, despite their artificial origin, because they have connections between each other, so fish species have their free movements among water bodies. In contrast, fishponds or dams are managed under controlled conditions, preventing the escape of fish with economic value. We detected the presence of introduced fish species with economic value (*Oncorhynchus mykiss*, *Salvelinus fontinalis* or *Cyprinus carpio*) in the natural water bodies. These fish probably escaped from ponds, and surely were not consciously introduced. Eight species of high conservation value were recorded (Natura 2000 species) (Bănărescu & Bănăduc 2007), of which the *Rhodeus amarus* could not be found after 1964 (Bănărescu 1964) (Table 1). Efficient ichthyological survey series from the last years (Imecs & Újvári 2009, Imecs et al. 2011, Imecs & Újvári 2013, present study) completed the existing literature concerning the fish fauna (Vitos 1894 Bănărescu 1964, Bănăduc 1999) of the natural water bodies in the Ciuc Depression. A total of 33 fish species were described until now: 27 native species, 6 introduced species of which 3 are invasive (Table 2) Comparing the old literature (1894-1999) and our data (2008-2012) we detected the lack of 3 species from the old literature and we completed the list with 13 new species from the natural water system of the Ciuc Depression (Table 2). Continuous monitoring of the fish fauna is needed in the Depression to track the changes in the fish fauna composition, detecting its causes and preventing the spread of other introduced or even invasive species in the natural water system of the Ciuc Depression. At present a set of measures is necessary for the efficient conservation of the ichthyofauna, like the reconstruction of the floodplain, canalization of villages, removal of the obstructions from the waterbeds, planting of trees along the rivers and so on. The major threats, among others, are: logging, pollution and non-adequate flood protection measures.

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