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CURRENT DISTRIBUTION OF THE EUROPEAN GRAYLING, *THYMALLUS THYMALLUS*, AND HUCHEN, *HUCHO HUCHO*, IN THE TRANSCARPATIAN REGION OF UKRAINE

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Current Distribution of the European Grayling, *Thymallus thymallus*, and Huchen, *Hucho hucho*, in the Transcarpatian Region of Ukraine. Didenko, A. V., Talabishka, E. M., Velykopolskiy, I. I., Kurtyak, F. F., Kucheruk, A. I. — The distribution of the European grayling and huchen have been studies using several sources of data including ichthyological surveys, analysis of anglers' and poachers' catches, interviewing of local fisheries inspectors, forestry inspectors, and some local people, etc. As the results show, the European grayling is very widespread in the Transcarpathian region inhabiting all major rivers and their major tributaries in piedmont areas. The range of the huchen is narrower and includes the Tisza, Rika, Tereblya, Shopurka, and Teresva River with its tributaries such as the Luzhanka, Brusturyanka, and Mokryanka Rivers. Nevertheless, the huchen is quite widespread in the Transcarpathian region and maintains self-sustaining populations.
Key words: salmonids, Danube salmon, Tisza River, poaching, recreational fishing.

Introduction

The European grayling, *Thymallus thymallus* (Linnaeus, 1758), and huchen or Danube salmon, *Hucho hucho* (Linnaeus, 1758), are two Salmoniformes species, which are listed in the Red Book of Ukraine as vulnerable and endangered, respectively (Red Book, 2009). Both species are also listed in appendix III of the Bern Convention, while huchen is also listed as endangered (B2ab (ii, iii)) in the IUCN Red List (Freyhof, Kottelat, 2008). As for neighboring countries, the European grayling is listed as near threathened in Slovakia, vulnerable in Poland and Romania, while the huchen has the status of critically endangered in Romania and endangered in Hungary and Slovakia (Koščo, 2014).

The European grayling plays an important role in the recreational and sport fishery in salmonid waters in many European countries, including other Carpathian countries such as Slovakia (Novomeská, Kovác, 2015), Poland (Kaczkowski, Grabowska, 2015), Czech Republic (Horký, 2015), and Romania (Curtean-Bănăduc, Bănăduc, 2016). In addition, this species is harvested by commercial fishermen in such countries as Germany (Schubert, 2015) and France (AND International, 2009). Despite the endangered status of the huchen, sport fishing targeting this species is practiced with certain limitations in some European countries including Austria, Germany, Bosnia and Herzegovina, Croatia, Czech Republic, Poland, Serbia, Slovakia, and Slovenia (Krajč et al., 2012; Šubjak, 2013; Witkowski et al., 2013 a).

Within Ukraine, the European grayling occurs in the Tisza basin and mountain zones of the Dniester and its tributaries, while the huchen is also reported for the Tisza River and some of its tributaries as well as in the Prut basin (Movchan, 2011). In the first half of the XX century, these species had an important commercial value in the Transcarpathian Region (Vladykov, 1926; Vladykov, 1931); however, their abundances and distribution areas have drastically declined since then.

The European grayling in the Transcarpathian Region was recorded previously by Koščo et al. (2004) in the Black Tisza, Teresva, Latorica, Uzh, Ublya, and Ulichka. These authors noted a wide distribution of this species; however, it was not abundant. It was also earlier recorded by Harka and Bănărescu (1999) in the Black Tisza at Yasinya and its presence was established in the Tisza River. More recently, the European grayling was recorded in the Shypit (Kruzhylina, Didenko, 2011), Tereblya and Chorna Rivers (Mruk et al., 2012); Teresva, Tereblya and its tributaries — Krasna and Chorna Rivers (Khandozhivska et al., 2014). Previously, this species was common and abundant in the upper reaches of the Tisza, Borzhava, Latorica, and Uzh and upper and middle reaches of the Teresva, Tereblya, and Rika (Vlasova, 1956).

The occurrences of the huchen in the Upper Tisza as well as in the Teresva and Tereblya were earlier reported by Vásárhelyi (1960), in the middle and lower reaches of the Teresva, Tereblya, and Rika upstream to the height of 500–600 m and in the Tisza downstream to the height of 115 m above sea level (Vlasova, 1959). Historically, the huchen occurred in the Tereblya upstream to the reaches, where the Tereblya reservoir was built in 1955, however, this species disappeared from there by 1959 (Vlasova, 1968). It also inhabited middle and lower reaches of the Black and White Tisza, lower reaches of the Shopurka and Apshytsya Rivers (Vlasova, 1956).

However, there is no much information on the current distribution of the European grayling and huchen in Ukraine and the available data are incomplete and fragmentary. Therefore, the aim of this study was to gather and generalize these data and provide information that could be used for the management and conservation of these species in the Transcarpathian Region.

Material and methods

Information on the distribution of the European grayling and huchen in the Transcarpathian Region were collected using several sources of data.

- Ichthyological surveys conducted conjointly with the Transcarpathian Fish Protection Inspection in selected Transcarpathian rivers (Tisza, Teresva, Tereblya, Rika, Uzh, Latorica, Luzhanka, Shopurka, Lyutyanka, Shypit, Chorna, Vycha) during different months of 2008, 2009, 2012 within the frameworks of the development of the biological justification for the artificial propagation of the Danube salmon, brown trout, and European grayling populations in river systems of the Carpathian region. Fish were sampled with the aid of gill nets (mesh size of 25, 30, 36, 40 mm, length 30 m, height 1.8 m), which were used as set nets by blocking backwaters from the main channel or as drift nets, i. e. left free to drift with the current for approximately 200 m to 1000 m. In addition, hook and line gears (spinning rod and fly-fishing), a triangular fishing dip net (1 cm mesh size, mouth size of 40 x 40 x 40 cm), and visual observations were used. All fish caught were counted, measured (standard length) to the nearest 1 cm and weighed to the nearest 0.1 g, if possible, and released.
- A survey of recreational anglers conducted in the field in 2011 by inspectors of the Transcarpathian Fish Protection Inspection, which included interviewing of anglers, filling a specially designed questionnaire and measuring their catches. In total, 175 questionnaires were filled.
- A search through offence reports filled by inspectors of the Transcarpathian Fish Protection Inspection in the field for the period of 2008-2011 in connection with the violation of recreational fishing rules (poaching). These reports contain information on the date, rivers and precise locations, where fish were caught, as well as the fishing gears used to catch them. In total, 222 offence reports were analyzed.
- Interviewing inspectors of the Transcarpathian Fish Protection Inspection, forestry inspectors, and some local people living and fishing in the Transcarpathian Region.
- Individual surveys carried out by authorsin 2009–2016 using fishing rods and visual observations.
- Recent literature data and collections of the National Zoological Museum of Ukraine.

Results

European grayling

European grayling were sampled during ichthyological surveys at 10 locations in the Teresva (4.6 % of total fish catch by number); five locations each in the Lyutyanka (25.8 %) and Pesya (23.0 %); three locations each in the Uzh (3.4 %); two locations each in the Shypit (12.1 %) and Luzhanka and one location each in the Shopurka (3.4 %), Rika (14.0 %), Black Tisza (25,0 %) and Vycha (3.8 %) (fig. 1).

Mean lengths and weights of the European grayling in selected rivers were 18.7 cm and 80.2 g in the Lyutyanka, 13.2 cm and 30.9 g in the Shypit, 22.1 cm and 119.9 g in the Pesya.

Fig. 1. Distribution of the European grayling, *Thymallus thymallus*, in the Transcarpatian Region of Ukraine:potential distribution — information obtained from interviewing inspectors of the Transcarpathian Fish Protection Inspection, forestry inspectors, and local people; places of catches — sites, where European grayling were actually caught and/or recorded during scientific surveys, in recreational or poacher's fishing gears.

European grayling in angler's catches were recorded in 39 questionnaires (17.6 % of all questionnaires) at five locations in the Teresva, eight locations in the Rika, five locations in the Shypit, two locations each in the Tereblya, Mokryanka and Shopurka, and one location each in the Uzh, Borzhava, Brusturyanka, Kosivs'ka (Kisva), Lyutyanka, Krasna (Krasnoshurka), Vycha, Pesya and Bron'ka rivers. The mean length of fish caught by anglers was 23.8 cm (from 12 to 33 cm).

European grayling in poachers' catches were recorded in 13 offence reports in the Teresva and Rika (three offence reports each), Latorica (two reports), and one report each in the Tereblya, Brusturyanka, Shopurka, Uzh and Repinka. Gears used to catch the grayling included electrofishing (four reports), screen net (one report), fishing dip net (one report), lift net (two reports), concussion (two reports), hook and line gears (three reports). On average, the grayling composed 0.66 % of the total catches of fish caught by poachers in number.

European grayling were recorded in catches together with the following fish species:

Eudontomyzon danfordi Regan, 1911; *H. hucho* (Linnaeus, 1758); *Salmo trutta fario* Linnaeus, 1758; *Oncorhynchus mykiss* (Walbaum, 1792); *Squalius cephalus* (Linnaeus, 1758); *Barbus barbus* (Linnaeus, 1758); *Barbus carpathicus* Kotlik, Tsigenopoulos, Ráb and Berrebi, 2002; *Chondrostoma nasus* (Linnaeus, 1758); *Barbatula barbatula* (Linnaeus, 1758); *Phoxinus phoxinus* (Linnaeus, 1758); *Gobio carpathicus* Vladykov, 1925; *Leuciscus leuciscus* (Linnaeus, 1758); *Idus idus* (Linnaeus, 1758); *Telestes souffia* (Risso, 1827); *Alburnoides bipunctatus* (Bloch, 1782); *Alburnus alburnus* (Linnaeus, 1758); *Lota lota* (Linnaeus, 1758); *Cottus gobio* Linnaeus, 1758; *Cottus poecilopus* Heckel, 1837.

H u c h e n

Huchen were sampled during ichthyological surveys at 21 locations of the Tisza River, eight locations in the Teresva River, one location in the Luzhanka River (fig. 2):

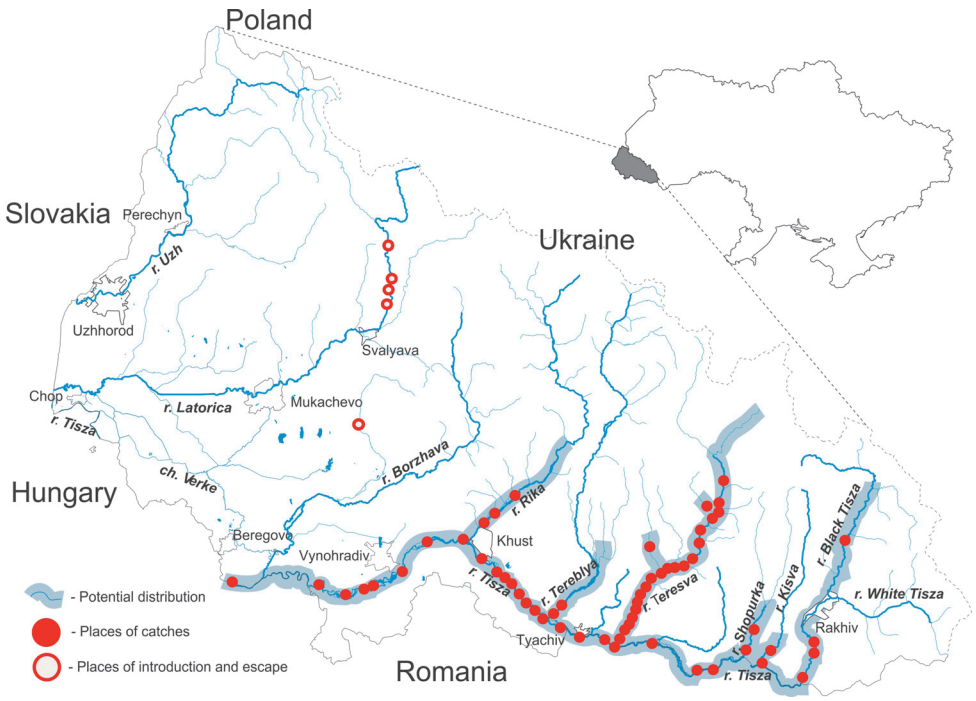

Fig. 2. Distribution of the huchen, *Hucho hucho*, in the Transcarpatian Region of Ukraine: potential distribution — information obtained from interviewing inspectors of the Transcarpathian Fish Protection Inspection, forestry inspectors, and local people; places of catches — sites, where huchen were actually caught and/or recorded during scientific surveys, in recreational or poacher's fishing gears, places of introduction — sites were huchen were released intentionally or escaped accidentally.

- Tisza — Vynogradiv District: between vil. Vilok and Nove Selo, in front of vil. Pyiterfolvo, vil. Drotyntsi, near Vynogradiv, near vil. Veryatsya; Khust District — downstream of the motorway bridge to vil. Kryva, within the city of Khust, in front of vil. Mod'orosh, vil. Steblivka, vil. Sokyryntsya, town Vyshkovo, vil. Yablunivka; Tiachiv District: near the town of Bushtyno, Tyachiv, vil. Bedevlya, vil. Hrushovo, vil. Solotvyno; Rakhiv District: near vil. Bila Tserkva, vil. Velykyi Bychkiv.
- Teresva River — mouth reach near vil. Teresva, between vil. Kryva and vil. Ternovo, between vil. Dobryans'ke and downstream of the motorway bridge to vil. Neresnytsya, near vil. Hanychy, vil. Kalyny, town Dubove, between the town of Dubove and vil. Krasna, between vil. Krasna and town Ust'-Chorna.
- Luzhanka River — near vil. Novoselytsya.

Wintering grounds of the huchen were recorded by the Transcarpathian Fish Protection Inspection in the following rivers:

- Tisza River: from the border tower opposite to Tyachiv to 200 m downstream; from the motorway bridge across the Tisza (vil. Vyshkovo) to 100 m upstream and 150 m downstream; from the motorway bridge across the Tisza (vil. Velyatyn) to 100 m upstream and 100 m downstream; 100 m upstream from the railway bridge across the Tisza (Stare Selo) to 100 m downstream from the motorway bridge (Tekovo bridge) near Vynogradiv; from the railway bridge near vil. Veryatsya to 200 m upstream; between vil. Tekovo and Sasovo; from vil. Nove Selo opposite to Fanchikovo.
- Teresva River: between vil. Krasna and vil. Dubove; under the pedestrian bridge between vil. Dubove and Kalyny; between vil. Kalyny and vil. Hanychy; 1 km downstream from the motorway bridge near vil. Neresnytsya; between vil. Vil'khivtsi and vil. Ternovo; between vil. Ternovo and vil. Kryva and opposite to vil. Kryva; 50 m downstream from the motorway bridge in vil. Teresva.

- Brusturyanka River: between the Brusturyans'ke State Forest Hunting Enterprise and vil. Lopukhiv.

Wintering grounds in the Tisza River are characterized by depths of 5–7 m. Mainly juvenile and relatively small specimens of the huchen seem to winter in the Teresva River, while the majority of them spend the winter in the Tisza River. E. g., huchen with lengths of up to 40 cm were recorded in poachers' and anglers' catches in the late fall and winter months (November–February) in the Teresva near vil. Hanychi and Neresnytsya.

According to local people, anglers, forestry workers, and official data of the Transcarpathian Fish Protection Inspection, huchen spawning runs were observed in the spring in the Rika River near vil. Lypcha; Teresva River and its tributaries: Luzhanka, Krasna, Mokryanka, Brusturyanka; Shopurka River near Velykyi Bychkiv; Tisza near vil. Luh and vil. Dilove.

Huchen were recorded in anglers' catches (9 questionnaires) at three locations in the Teresva River and one location each in the Tereblya and Shopurka Rivers. The mean length of the recorded fish was 39.2 cm, while individual lenghts varied from 35 to 62 cm. Several huchen were recorded in poachers' catches (5 offence reports) at two locations of the Tisza and three locations of the Teresva. Gears used to catch this species were gill nets, lift nets, fishing rods. Pitchforks are used by poachers to catch huchen on their spawning grounds in shallow waters. On average, huchen composed 0.14 % of the total catches of fish caught by poachers in number.

Huchen were recorded in catches together with the following fish species:
T. thymallus (Linnaeus, 1758); *S. cephalus* (Linnaeus, 1758); *B. barbus* (Linnaeus, 1758); *B. carpathicus* Kotlik, Tsigenopoulos, Ráb et Berrebi, 2002; *Chondrostoma nasus* (Linnaeus, 1758); *C. gobio* Linnaeus, 1758; *B. barbatula* (Linnaeus, 1758); *P. phoxinus* (Linnaeus, 1758); *Gobio carpathicus* Vladykov, 1925; *Romanogobio uranoscopus* (Agassiz, 1828); *L. leuciscus*(Linnaeus, 1758); *I. idus* (Linnaeus, 1758); *T. souffia* (Risso, 1827); *A. alburnus* (Linnaeus, 1758); *A. bipunctatus*(Bloch, 1782); *Rutilus rutilus* (Linnaeus, 1758); *Aspius aspius* (Linnaeus, 1758); *Abramis brama* (Linnaeus, 1758); *Blicca bjoerkna* (Linnaeus, 1758); *Ballerus ballerus* (Linnaeus, 1758); *Ballerus sapa* (Pallas, 1814); *Vimba vimba* (Linnaeus, 1758); *Esox lucius* Linnaeus, 1758; *Lota lota* (Linnaeus, 1758); *Zingel zingel* (Linnaeus, 1766); *Zingel streber* (Siebold, 1863); *Gymnocephalus schraetser* (Linnaeus, 1758); *Perca fluviatilits* Linnaeus, 1758; *Sander lucioperca* (Linnaeus, 1758).

In addition, huchen were artificially stocked in the Latorica River at locations from vil. Nelypino to vil. Pidpolozzia, despite the fact that this species did not occur here historically. The release of young-of-the-year huchen was done twice in 29.09.2011 — 440 fish and 9.11.2012 — 330 fish. Grown up huchen were observed at these locations during following years. However, lower reaches of the Latorica River are not very suitable for this species because of their lowland type. An accidental escape of huchen occurred in the Irshava River, when a fish farm pond containing them was destroyed by a flood in 2010.

Discussion

In general, the occurrences of the European grayling and huchen in the Transcarpathian Region mentioned in scientific publications published since 1999 by other authors (Harka, Bănărescu, 1999; Koščo et al., 2004; Mruk et al., 2012) have been confirmed and new occurrences were detected.

As the obtained data show, the European grayling is very widespread in the Transcarpathian region inhabiting all major rivers and their major tributaries in piedmont areas. Its range includes:

- Tisza from Khust to the mouths of the White (Bila) Tisza and Black (Chorna) Tisza, as well as reaches near the mouths of the Rika, Tereblya, and Teresva;
- Black Tisza upstream to the mouth of the Srednitsa as well as its tributaries: Lazeshchina upstream to the mouth of Foresok;

- White Tisza upstream to the mouth of the Stogovets;
- Uzh from Uzhgorod to vil. Volosyanka as well as its tributaries: Ublya and Ulichka upstream to the state border with Slovakia; Uzh upstream to the mouth of Stuzhytsya; Lyutyanka upstream to vil. Lyuta and somewhat further; Tur'ya including the Shypit upstream to the trout hatchery and the Turychka (Turytsya) upstream to vil. Turychky;
- Rika from Khust to vil. Pryslip as well as its tributaries: Repinka upstream to vil. Verkhnii Studenyi, Holyatynka upstream to vil. Novoselytsya, and some other streams;
- Tereblya from vil. Tereblya to the mouths of the Sloboda River (and up to 5 km upstream along this river) as well as its tributaries: Mala Uhol'ka (approximately 7 km upstream) and Velyka Uhol'ka (approximately 8 km upstream), Ozeryanka upstream to the mouth of the Pesya Rika then the Pesya Rika upstream to the mouth of the Chorna, Rostoka (approximately 5 km upstream), and mouth reaches of some other small streams entering the Tereblya and its large tributaries;
- Teresva from vil. Kryva to the confluence of the Brusturyanka and Mokryanka rivers as well as its tributaries: Luzhanka upstream to vil. Shyrokyi Luh, Tereshul upstream to vil. Tarasivka, Krasna (Krasnoshurka) upstream to the mouth of the Polunna, Brusturyanka upstream to the mouth of the Plais'ka, Turbat upstream to the confluence with the Turbatsyl, Mokryanka upstream to vil. Mala Ozeryanka;
- Shopurka upstream to the confluence of the Mala Shopurka (Kraynya) (approximately 11 km upstream) and Serednya rivers (approximately 9 km upstream);
- Kisva (Kosivs'ka) upstream to the end of vil. Kosivs'ka Polyana;
- Borzhava from vil. Pryborzhavs'ke upstream to the mouth of the Hrabovets' as well as its tributaries: Bron'ka approximately 9 km upstream, Krasny approximately 4 km upstream, Kushnitsa upstream to vil. Lysycheve;
- Latorica from vil. Pasika upstream to vil. Nyzhni Vorota as well as its tributaries: Vyznytsya from Mukachevo upstream to the bridge to vil. Hertsivtsi, Pynya upstream to the confluence of the Mala Pynya and Velyka Pynya (upstream to vil. Rodnykivka), Vycha upstream to vil. Skotars'ke; Zhdenivka upstream to vil. Pashkivtsi.

It is necessary to note that the range of the European grayling is not limited to the above-mentioned rivers and streams and can also include some other smaller tributaries flowing into them. This species mainly inhabits the so-called "grayling zone" (e. g., from Rakhiv to Khust along the Tisza River), which is characterized by stony and pebbly bottom, maximum water velocity of 1.1–1.5 m/s, water temperature no higher than 16° C, and oxygen content of 9–10 mg/L (Harka, Bănărescu, 1999). The grayling zone is located further downstream of the trout zone, where rivers become wider with a gentle slope with riffles and rapids being separated by pools and runs (Huet, 1959). However, the European grayling was also often observed in the trout zone (e. g., the Black Tisza above Rakhiv according to Harka and Bănărescu (1999)), where this species co-occurred with the brown trout. The co-occurrences of these two species were also observed in the Shypit, Vycha, Bron'ka, and Pesya upstream to the mouth of the Chorna at typical trout zones. The grayling normally has broader environmental requirements than the brown trout (Woolland, 1986).This fish occurred more frequently in pools, below natural and artificial barrages, where it can be observed visually. The European grayling co-occurred with other rheophilic species listed in the Results that is typical for European "grayling" rivers (Amirowicz, Kukuła, 2005; Lasne et al., 2007; Pekárik et al., 2012).

According to the Fish Protection Inspection and recreational fishermen, very high abundance of European grayling was observed in the Rika. However, this population is currently in danger and a part of it can be reduced or disappear due to the alteration of their habitat and loss of river connectivity after construction of the Nyzhnii Bystryi small hydropower plant in 2014. A similar situation is observed on the Shypit, where two dams (Turyans'ka small hydropower plant) were built in 2012 and 2014. As some studies show, the construction of a small hydropower plant in the "grayling zone" of a river can result in

a 61 % decrease in the population biomass of the European grayling (Ovidio et al., 2004). The range of the huchen in the Transcarpathian region is narrower than that of the European grayling and includes:

- Tisza from the Hungarian border upstream to vil. Chorna Tysa;
- Rika upstream to the town of Nyzhnii Bystryi (dam of the Nyzhnii Bystryi small hydropower plant);
- Tereblya upstream to vil. Dulovo;
- Teresva upstream to the confluence of the Brusturyanka and Mokryanka rivers as well as its tributaries: Luzhanka upstream to vil. Shyrokyi Luh and mouth of the Tereshul, Brusturyanka upstream to vil. Lopukhiv, Mokryanka upstream to vil. Rus'ka Mokra;
- Shopurka upstream to vil. Kobylets'ka Polyana;
- Kisva (Kosivs'ka) upstream to vil. Kosivs'ka Polyana.

Despite the fact that the huchen is not a very abundant species, nevertheless, it is quite widespread in the Transcarpathian region and maintains self-sustaining populations. The highest abundances of huchen seem to occur in the Tisza and Teresva rivers, where they were observed in catches most frequently and at a larger number of locations compared to other rivers. These two rivers still have a natural flow regime not disrupted by hydropower dams as well as deep areas suitable for fish wintering. Therefore, huchen inhabiting Tisza and Teresva can perform spawning migrations far upstream, where they can find the most suitable conditions for the development of their eggs and juveniles.

Huchen normally inhabit the so-called "nase zone" (e. g., Tisza River from Khust to the state border with Hungary), which exhibits a gradual transition between mountain and lowland reaches, where river bed is covered by small stones, water velocity of 0.7–1.1 m/s, water temperature no higher than 20° C, and oxygen content of 8–9 mg/L (Harka, Bănărescu, 1999). However, these fish were also observed in the "grayling zone", where both species co-occurred, especially during spring spawning period and summer. As huchen are relatively big fish, they require wider open spaces and larger depths than European grayling and such habitats can be found in lower reaches of the Teresva and piedmont-lowland reaches of the Tisza (Vlasova, 1959). Huchen were recorded in catches together with typical rheophilic species inhabiting the "nase zone" and "grayling zone" as well as with some limnophilic and eurytopic species (e.g., bream, roach, perch, pike). Such a situation is also observed in Austrian rivers, where huchen occur (Schmutz et al., 2002). The co-occurrence of huchen with limnophilic and eurytopic species was observed only in the lowland reaches of the Tisza River (from the Hungarian border to vil. Sokyrnytsya).

The huchen population inhabiting the Rika River was significantly affected by the construction of the Nyzhnii Bystryi small hydropower plant, which blocked the access of this fish to spawning grounds located in the upper reaches of this river. Some specimens of this species might remain upstream of the dam of this hydropower plant, where depths suitable for wintering can be found, however, no reliable data on them are available.

Due to its widespread distribution in the Transcarpathian Region, the European grayling is a relatively frequent object in poachers' catches in piedmont rivers. This species is also often harvested by poachers in other neighboring countries, e. g., in Romania, where they also sometimes use electricity from vehicle accumulators and other rechargeable devices as well as some chemicals and such activities may cause a decline in the number of this fish there (Curtean-Bănăduc, Bănăduc, 2016).

Despite the fact that the European grayling is listed in the Red Book of Ukraine that implies a strict prohibition on catching them, this species is a common object of recreational and sport fishing in many rivers of the Transcarpathian region composing up to 8.0% of the total recreational catch (Velykopolskiy, Didenko, 2011). This is because the European grayling is very abundant and dominant species at some locations where local people traditionally fished them. Moreover, this fish is one of the target species for fly-fishing, which is increasingly gaining popularity in Ukraine. Fly-fishermen create their clubs and organize

official fly-fishing competitions such as the "Cup of Ukraine" and "Cup of Carpathians", which are held on piedmont rivers and are targeted at fishes inhabiting them, including the European grayling. Such a situation is due to the fact that almost one third of the Transcarpathian fish fauna is listed in the Red Book of Ukraine including species, which are typical for this region and are abundant here. As for mountain and piedmont rivers and streams, the majority of their fish species are officially protected, especially those, which represent an interest for sport fishing; however, it is very hard to avoid them by anglers that results in the involuntary violation of environmental legislation.

The same also concerns the huchen, which is a valuable object of sport fishing in many European countries (Krajč, 2012; Šubjak, 2013; Witkowski et al., 2013 a) and is an object for angling in the Transcarpathian region despite its endangered status. Additionally, this species was intentionally introduced into some new rivers (e. g. in Poland),where it was absent historically but is of great interest for sport fishers, who contributed to such introductions (Witkowski et al., 2013 a; Witkowski et al., 2013 b).

A rising interest in fly-fishing implies more angling pressure and might require artificial replenishment of the stocks of salmonids in the Transcarpathian region. Such activities are a common practice in other Carpathian countries (Witkowski et al., 2013 a; Novomeská, Kovác, 2015), where the stocking of rivers with fish, which represent an interest for sport fishing, is financed and managed by anglers through fishing associations. However, in Ukraine, it may be very difficult to obtain special permissions to catch brood fish of protected species officially and keep them at hatcheries. Moreover, there is a lack of money and often absence of interest to rear fish for stocking natural water bodies, especially the officially endangered species, which are prohibited for catching. Nevertheless, there are some enthusiasts in the region, including some fly-fishing clubs, which try to do it and usually illegally. Taking into account a rising interest in ecotourism and fly-fishing in Ukraine, it would be advisable to adopt legal practices of other Carpathian countries in organizing licensed recreational and sport fishing targeted at the European grayling and huchen as well as other local species and in managing their stocks that might bring out these activities of the shadows and enhance the tourism potential of the Transcarpathian Region. E. g., the huchen draws anglers from the world over to such countries as Slovenia, Montenegro, and Slovakia, and businesses have been established to cater to the needs of these fishers by offering guided fishing tours (Witkowski et al., 2013 a).

Currently, there is no possibility to perform a quantitative assessment of European grayling and huchen stocks in Transcarpathian rivers, which would significantly increase our knowledge on their real state and which is required for their effective management. Firstly, sampling methods suitable for fish abundance estimation in mountain rivers imply the use of electrofishing devices (EN 14962 : 2006; Bonar et al., 2009), which are prohibited by law in Ukraine. Secondly, a significant part of the Tisza River is a frontier zone, where the access for researchers is restricted. Moreover, fish stock assessment in this part of the Tisza River would require joint participation of fisheries specialists from neighboring countries.

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