

The history of huchen, *Hucho hucho* (L.), in Poland – distribution, restoration and conservation

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Abstract. The huchen, *Hucho hucho* (L.), became extinct in its autochthonous locations in the upper parts of the Czarna Orawa and Czadecznka systems in the early 1950s as a result of increased anthropogenic stress. It began to be introduced into the Dunajec River system in 1966. The quantity of stocking material released into the Dunajec and its tributaries during the first ten years was small, ranging from 8 to 30 thousand fry per year. In subsequent years, the production of stocking material at the Łopuszna Fish Farm increased gradually, and in recent years it has been from 0.6 to 0.99 million fry per year. The stocking material produced in 1955-2012 included approximately 15.2 million fry and 4.6 million fall fingerlings. Increased stocking material production made it possible to stock more rivers in the 1972-1995 period including the Nysa Kłodzka, San, Soła, Skawa, Raba, Bóbr, and Gwda. Of the nine rivers into which it was introduced, the huchen only adapted successfully in the Poprad, Dunajec, and San, where it now occurs along a total of approximately 400-450 km. Only these rivers are regularly stocked because of their favorable environmental conditions. In Poland huchen was saved (*ex situ*) through active protection by translocating it outside of its

natural distribution range, artificial breeding, and the regular stocking of selected montane rivers. The restoration of huchen in the Czarna Orawa began in 2002, but success was moderate. To preserve this species in Polish waters, the spawning stock kept by the PAA at Łopuszna should be financed regularly by the Ministry of Environment, and systematic monitoring, licensing, and limiting of the size of recreational catches should be introduced.

Keywords: huchen, occurrence, farming, stocking, restoration, conservation, Poland

Introduction

Two species of the genus *Hucho* occur in Europe (Kottelat and Freyhof 2007). The *Hucho hucho* (L.), known as the Danube salmon or huchen, which inhabits the Danube River system, and the eastern species *Hucho taimen* (Pallas) that occurs in the upper Volga system and the Pechora. For several decades, the status of the species in the Danube system has been regarded as critical and threatened with extinction (Holčík 1977, 1995, 1996, Witkowski 1994, 1996, 2003). At present, it occurs in less than 40% of its original distribution range (Holčík 1990), and the critical situation of *H. hucho* was confirmed at three hucho symposiums (Randik 1976, Harsányi 1994, Witkowski et al. 2012). The situations of *H. taimen* and *Parahucho perryi* (Brevoort) are similar; their

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main distribution ranges include Siberia from the Ob to the Yana River and the Far East in the Amur River and rivers flowing into the Okhotsk Sea. These species are seriously endangered (Rand 2013).

The objective of this paper is to present data on the threats, present status, protection, and the progress of a restoration project that aims at conserving huchen in autochthonous sites and in secondary locations outside of its natural distribution range and into which it has been introduced in Poland. This paper is based on our earlier publications (Witkowski and Kowalewski 1980, 1988, 1989, 1994, Witkowski 1990, 1994, 1996, 2003, 2012, Witkowski et al. 2007, 2012, Kotusz et al. 2010), and presents a summary of issues regarding huchen in Poland.

Historical distribution, introduction and translocation

Huchen occurred in two regions within the post-war boundaries of Poland: the Beskid Śląski Mountains and Orawa. These areas are drained by the small rivers of the Czadeczka (Slovak: Čerňanka) and Czarna Orawa, which are part of the Danube system. Only small parts of their catchment areas are located in Poland – Czadeczka – 23.4 km² and Czarna Orawa – 358.4 km² (Fig. 1), and because of their small sizes and quantities of water, except when there is spring thaw water, the main rivers and their tributaries only provide periodic habitats for the species.

The huchen spawners that appeared in the Czadeczka in the spring were migrants from the Vah and Kysuca rivers, because the small stream offered adequate spawning grounds and habitats for juvenile stages. The large, spawning huchen, which appeared only in the spring, were not monitored, and this led to rampant poaching in the region and to the decimation of these fish the moment they appeared on the Polish side of the border. A few huchen migrated annually to the Czadeczka, but practically none returned to Slovak territory. The water quality of the Kysuca in what was then Czechoslovakia (Kulmatycki 1931) also contributed to the

disappearance of the species from the upper section of the Czadeczka. A biological barrier caused by the large pollution loads released from paper mills and cellulose factories prevented this species from migrating to the upper reaches of the river system. Thus, the combination of poaching and water pollution completely eradicated huchen in the Czadeczka as early as in the 1950s, probably between 1952 and 1955 (Kotusz et al. 2010).

Huchen occurred on the Polish side in the upper reaches of the Czarna Orawa sporadically and only during high water when it could overcome the dam at the Borowiański mill located close to the border about 2 km downstream from Jabłonka (Ivaška 1951). Since the destruction of the dam in 1927, larger numbers of huchen are noted in the Czarna Orawa spawning grounds located between Jabłonka Orawska and Podwilk and in the mouths of the Lipnica, Syhleć, and Zubrzyca, its largest tributaries (Kulmatycki 1931, Holčík et al. 1965). Although there are no earlier published records of the occurrence of this species in the region, it is likely that it could have visited the upper sections of the Czarna Orawa even earlier, and where, also during many

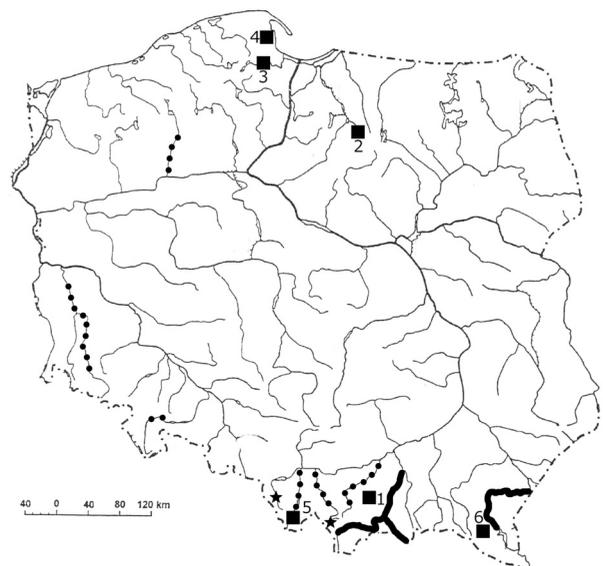


Figure 1. Occurrence of huchen (*Hucho hucho*) in Poland. The river section with unsuccessful introductions are indicated by dotted lines, river section with successful introductions are indicated by bold lines, an asterisk indicates autochthonous locations (non-existent). Huchen farms: 1 – Łopuszna, 2 – Czarci Jar, 3 – Rutki, 4 – Rumia, 5 – Zawoja, 6 – Wołkowyja.

years of poaching (Kulmatycki 1932), the fish migrating to these spawning grounds were decimated.

Before the Orava Reservoir was inundated (1951-1952), Balon's (1956) studies in the Bila Orava, Mutnianska, Orava, and Polhoranka rivers, which now feed the reservoir on the Slovak side, revealed uchen fry in the Polhoranka. According to Ivaška (1951), huchen spawning grounds were located in the stream. After the Orava Dam Reservoir was constructed on the Orava River in 1953, some huchen were cut off from the lower section of the river. In subsequent years, the species was recorded sporadically in both the reservoir and the upper part of the Czarna Orawa system. Holčík et al. (1965) report that the annual catch of huchen in the reservoir decreased gradually over three years from 112 kg in 1960 to 37 kg in 1962.

In view of the progressive decrease in abundance of huchen migrating to their spawning grounds in the Polish parts of the Orawa system, in 1955 the Kraków Branch of the Polish Angling Association (PAA) made an attempt to breed the species artificially "...to increase the abundance of this valuable fish species..." (Pałka 1955). On 3 and 4 May, the team, which included Dr. Kolder, Mr. Kwapień, and Dr. Pałka, caught six spawners in the Czarna Orawa near Podwilk – three males ranging in size from 44 to 71 cm and three females ranging in size from 71 to 90 cm total length, with body masses of 0.8-4.8, and 3.8-8.2 kg, respectively (Kolder 1964). The spawners were transported to the PAA Fish Farm at Łopuszna where, through artificial spawning on 10 May only one of the females yielded about 12,500 eggs; the remaining females had already spawned. The lack of incubation experience and biotechniques for rearing stocking material meant that only 300 fall fingerlings were obtained from 2,000 thousand fry, and 160 fish were released into the Czarna Orawa (Witkowski and Kowalewski 1980, Witkowski 1996). The next attempt to catch spawners in the Czarna Orawa was in 1963; these fish were probably the last huchen in the Polish part of the river, since the species was not observed there subsequently (Holčík et al. 1965, 1988, Skóra and Włodek 1989, Witkowski 1990, Przybylski et al. 2002). Since then, the Łopuszna fish

farm has been creating its own broodstock based on pond-reared individuals, and during the first ten years the quantity of stocking material was small ranging from 6,000 to 34,000 fry.

In the mid 1970s, when the spawning stock numbered from 60 to 70 fish, fry production started increasing rapidly. The spectacular progress (Fig. 2) began in 1975 when Mieczysław Kowalewski was employed at the Łopuszna fish farm. At the same time, another spawning stock was established at the PAA fish farm in Zawoja, and in 1987 it yielded 200,000 fry for the first time. In total, 1.61 million fry and 33,000 fall fingerlings (Witkowski and Kowalewski 1988) were produced in Poland in the 1955-1987 period.

Initially, the whole of the stocking material production from Łopuszna fish farm was used to stock the Czarna Orawa system. Overall, during four years in 1955 and from 1963 to 1965, 172,500 fry and 11,600 fingerlings were released there. During this period, according to an agreement signed on 17 December 1963 in Nowy Targ between the Kraków Branch of the PAA and the Slovak Angling Association (SAA), the Slovak side undertook, at their own expense, stocking in the Czarna Orawa system for a period of five years with 100,000 fry and 10,000 fingerlings. The coordinated stocking program yielded rather modest results. When sea trout and salmon were no longer able to reach Vistula River Carpathian tributaries because of the construction of the dam in Włocławek, it was decided to introduce huchen in the upper part of the Dunajec system beginning in the Poprad. This decision was also prompted by the fact that in the mid 1950s anglers had caught huchen in this river, and in 1956 the first huchen weighing about 9 kg was caught in the Dunajec at the mouth of the Białka Tatrzańska. The reason huchen occurred in the Dunajec stemmed from regular huchen fry stocking the SAA performed in the Poprad after World War II in the mid 1940s (Holčík 1977, Witkowski and Kowalewski 1980, 1989, Andreji and Stráňai 2013), and from there the fish rapidly spread into the main river. The first stocking of the Poprad is still being debated; according to data from the literature (Fauna Regni

Hungariae, T. III: 20-21, 1918), the first huchen were observed in the river as early as the beginning of the twentieth century. However, it is not impossible that the species was introduced there at the end of the nineteenth century, when, as Kulmatycki (1930a) wrote, "... the introduction and acclimatisation of various fish species were a part of fishery management...". This seems likely, since the sources of the Poprad and Wag where huchen occurs in autochthonous locations are separated by a small distance. In a later paper, Kulmatycki (1930b) retracted this information and attributed the record to a probable mistake during fish cataloging in the Hungarian National Museum.

Breeding and stocking

Since 1966, only rivers in the Carpathian part of the Vistula system have been stocked with huchen (Witkowski et al. 2011), but later stocking also began in the Sudetic tributaries of the Oder (Witkowski 1979, Błachuta et al. 1993). During the initial period, the numbers of fish released into the Dunajec were small ranging from 6,000 to 34,000. The greatest numbers of fry (85,000-300,000) were released in 1980-1987 (Witkowski and Kowalewski 1980, 1988, 1989). In addition to the spawning stock in Łopuszna, in the subsequent years of the 1970s and 1980s, attempts were made to breed huchen at other hatcheries in Rumia, Czarci Jar, at the PAA in Zawoja, and at the Inland Fisheries Institute (IFI) in Rutki. In 1972, 20,000 fertilized eggs (M. Bartusch, in litt.) were imported from Slovakia to stock the breeding ponds in Rumia. Because of the earlier breeding failures, about 220 juvenile fish weighing about 60 g each were transferred to the Czarci Jar fish farm, where huchen had been bred since 1974 (Krasowski K., in litt.). The stock at Czarci Jar was liquidated in 1985, and 30 females were transferred to Łopuszna, which contributed to the genetic diversity of that stock. Another stock existed in the 1985-1995 period in Zawoja (E. Pyka, in litt.). Since the effects of breeding were not satisfactory at most other hatcheries, attempts at maintaining broodstocks were

soon abandoned. To augment the results of artificial breeding, eggs were obtained nearly annually from huchen females caught in the Dunajec and its tributaries during so-called grayling campaigns. Biotechniques for producing stocking material were continually improved (Witkowski and Kokurewicz 1981, Kokurewicz and Witkowski 1988, Madziar et al. 1993, Przybył et al. 1993). Notably, the Department of Salmonid Fish Culture at Rutki of the IFI developed technology for breeding huchen under conditions at typical trout farms by resolving an array of problems, including limiting post-spawning mortality of the spawners, feeding fry and fingerlings with granulated feed, obtaining spawners in a complete breeding cycle, and feeding them with artificial feed with the addition of small quantities of fresh and frozen fish (Goryczko 1993). The spawner stock in Rutki, which had originating in Łopuszna, existed in the 1985-1996 period. After its liquidation, the adult female fish were sold to owners of private fishing grounds, while the males were sold to a trout farm in Tarnowo. Selects were used to stock the Dunajec and Poprad (Goryczko in litt.). Developing huchen breeding methods resulted in increased stocking material production only in the mid 1980s. In 1955-2012, production for stocking open waters and for further breeding was approximately 15.2 million fry and 4.5 million fingerling huchen (Table 1).

Huchen soon became established in the Dunajec system thanks to regular stocking. Several factors contributed to this, the most important of which was improved water quality and the great abundance of rheophilic cyprinid species (Pasternak and Skóra 1982, Starmach 1984), which are the huchen's main prey (Nagy 1976, Witkowski and Kowalewski 1982, 1984). The Soła, another river in the Vistula system, was stocked with 2,700 fry and 26,500 fall fingerling huchen were released in the 1970-1984 period. The introduction of huchen into the San started in 1977 and by 2012 – 929,000 fry, 55,000 fingerlings, and 20,500 older fish had been released. The huchen adapted quickly to local conditions, and the first natural spawning was observed in the San system in the Hoczewka River in 1986.

In the 1978-1991 period, huchen was introduced into the Raba and Skawa rivers, and 40,800 fry and

Table 1Stocking Polish rivers with huchen, *Hucho hucho* (L.), in 1955-2010. Selects are fish aged 1+ to 5+ and older spawners

River	Years	Feeding fry	Summer and fall fingerlings	Selects
Czarna Orawa	1955, 1963-1965	172,500	11,623	-
Czarna Orawa	2002-2012	90 000	410,000	
Poprad and Dunajec	1966-2012	13,658,580	4,078,820	2010 kg and 31,329 fish
San	1977-2012	929,000	55,000	20,500 fish
Soła	1970-1984	2,700	26,570	-
Skawa	1978-1991	5,800	400	-
Raba	1984-1987	35,000	400	-
Nysa Kłodzka	1968	-	2,000	-
Bóbr	1987-1996	125,000	30,000	-
Gwda	1991-1995	190,000	9,500	521 fish
Total	1955-2012	15,208,580	4,624,313	2010 kg and 52,350 fish

800 fall fingerlings were released there. Huchen was first introduced into the Oder system in 1968 when 2,000 summer fingerlings were released into the Nysa Kłodzka River. This unintentional stocking was done by a breeding facility in Hynčice near Broumov (Czech Angling Association), which is fed by the waters of the Ścinawka, a left-bank tributary of the Nysa Kłodzka. In 1975, huchen fingerlings stocked in a pond were washed into the river after passes failed (Witkowski 1979). Two years later anglers caught “brown trout” measuring 35 cm in the Nysa Kłodzka. In 1987-1988, 125,000 fry and in 1994-1996 30,000 fall fingerlings were released into the Bóbr River (Witkowski 1996); however, no long-term results were obtained from stocking these rivers. The failure of the huchen to thrive was attributed to considerable water pollution in the Nysa Kłodzka, and the very low abundance of cyprinid species in the Bóbr, Skawa, and Raba rivers. Several years later, below the original stocking site at Wleń-Lwówek, the greatest numbers of huchen were caught by anglers in the lower section of the Bóbr River from the mouth of the Kwisa to Brzeźnice. This section of the river had the richest fish fauna and the greatest abundance of rheophilic cyprinids (Błachuta et al. 1993), and it is likely that even today single huchen could be encountered there, which would indicate the existence of a small reproducing population (Fig. 1).

In 1991-1995, an attempt was made to introduce huchen into the Gwda, a moraine river system, that is a tributary of the Warta in the Oder drainage area in northwest Poland, and which is of a character that differs from that of Carpathian rivers. Not long before huchen introduction, the anadromous salmonids *Salmo salar* L. and *Salmo trutta trutta* L. (Kaj 1958) migrated into the river to spawn. *S. trutta fario*, *Salvelinus fontinalis* (Mitchill), *Salvelinus alpinus* (L.), *Oncorhynchus mykiss* Walbaum, and *Thymallus thymallus* (L.) also occurred in the Gwda River. In all, 190,000 fry, 2,500 feeding fry, 7,000 fall and spring fingerlings, and 521 spawners were released into the river system. Natural spawning was first observed in 1994 in the Płytnica River. In 1995-1997, about 30 adult huchen measuring more than 70 cm (TL) were caught in the Gwda (Andrzejewski 2000). After the experiment finished, stocking was abandoned, and in the absence of monitoring, the introduced huchen were soon caught, but a small population probably still inhabits the river (Fig. 1).

Present state and occurrence in Poland

Huchen is included in the IUCN category EXP (extinct in Poland) since it has not occurred in its autochthonous locations for many years (Witkowski

et al. 2009). It disappeared first in the mid 1950s from the Czadeczka system. The conditions in the upper part of the system were unfavorable for the species, which could not reach the river from Slovakia because of the biological barrier. The environmental conditions also deteriorated with summer water deficits and considerable water pollution that led to the impoverishment of the ichthyofauna and macrobenthos (Kotusz et al. 2010).

About ten years later, huchen also disappeared from the upper part of the Czarna Orawa system, and by 1963 the species was no longer recorded there. The restoration program was launched in 2002, and over the span of eleven years the Nowy Sącz Branch of the PAA released 90,000 fry and 400,000 summer fingerlings in the Czarna Orawa and its tributaries. During the first few years of stocking, no fingerlings or adults were observed in the river. Not until spring 2011 did Slovak ichthyologists observe a few individuals weighing 2-3 kg (Dr. M. Zontag, SAA – Ružemberok, in litt.) at the outlet of the river to the Orava Reservoir, which could indicate that the restoration is providing the first results and may still prove successful (Witkowski et al. 2012). In spite of this, huchen remains endangered in this river, and is now included in the critically endangered (CR) category.

Huchen, which was on the brink of extinction in the 1950s and 1960s in its autochthonous range of occurrence, could be saved as a component of Polish ichthyofauna through its introduction into several rivers of the Vistula drainage basin. Of the nine rivers into which it was introduced, it adapted successfully only in the Poprad, Dunajec, and San, where it occurs along a total stretch of river 450 km in length (Fig. 1). These rivers still have abundant populations, and are regularly stocked despite the fact that natural spawning has been observed repeatedly. The huchen introduced outside its natural distribution range in Poland is included in the extinct in the wild (EW) category.

Regretfully, the methods presented for saving huchen as a component of Polish ichthyofauna have been criticized by some ichthyologists as an introduction of a non-native species (Dębowski and Mikołajczyk 2007).

Expected trends and perspectives of the Danube salmon in Poland

Huchen is the only fish species in Poland which, though once on the brink of extinction, has been saved successfully. Legal protection of the sturgeon (*Acipenser sturio*/*A. oxyrinchus*) and attempts at saving the last salmon population with a native genotype failed. Huchen has been saved with active protection through translocation outside its natural distribution range, artificial breeding, and regular stocking of several of the largest montane rivers in Poland (Goryczko 1993). At present, the only fish farm in Poland still producing huchen stocking material is that at Łopuszna, which produces approximately 0.6 to 1 million fry per year (Fig. 2). This meets the stocking demands of Polish montane rivers. The only broodstock in Poland, with 120 adult individuals and about 1,000 successors, guarantees the further preservation of the species in Polish waters. Nevertheless, it is necessary to establish another such stock which, in case of catastrophic events, could take over the role and ensure the future of the species in Poland.

To date, breeding has made it possible to conserve a safe level of genetic variation of the species protected *ex situ*, which is proved by the lack of inbred symptoms among the offspring of the farm-bred spawners, and by the existence of relatively abundant populations in the Poprad, Dunajec, and San that are resistant to anthropogenic stress. Maintaining two spawning stocks should be financed

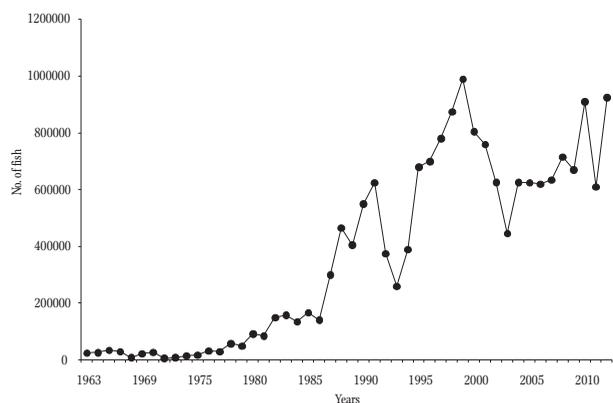


Figure 2. Production of huchen (*Hucho hucho*) fry at the Łopuszna fish farm.

regularly by the Ministry of the Environment, while the PAA should introduce a regular system for monitoring, licensing, and limiting of the size of angling catches of huchen. This should ensure the continued presence of the species in Poland.

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