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Taxonomy and conservation problems of the native salmonids (Pisces: Salmonidae) in the Danube river system: a review

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Abstract. Five species of salmonids (Salmonidae *sensu* Reshetnikov, 1980) are recognized in the Danube River basin. The anadromous *Salmo labrax* Pallas, 1811, known from the lower course of the Danube proper is now very rare. Its lake derivative *Salmo labrax* (morph *lacustris*) still lives in some Austrian lakes. Its present status was described as disastrous, as it disappeared in some lakes and in other ones it was replaced by intentionally introduced lake trout of different origin. Another species of lake trout, the deepwater *Salmo schiefermuelleri* Bloch, 1784, endemic to some Austrian lakes seems to be completely extinct. Its proper taxonomic status is not clear yet. It is suggested that this taxon represented those specimens of the adult *Salmo labrax* lake form, which left out spawning for one or two years. The upper and middle Danube and its mountain and foothill tributaries are inhabited by the brook trout *Salmo labrax* (morph *fario*). Genus *Salvelinus* is represented by *Salvelinus umbla* (Linnaeus, 1758), and the deepwater species *Salvelinus profundus* Schillinger, 1901. From three forms of the former, the fast growing and predatory *Wildfangsaibling* and the zooplankton feeder *Normalsaibling* became probably extinct and only the deepwater *Tiefseesaibling* still survives in one lake. Also *Salvelinus profundus*, known from two Austrian lakes, is now probably extinct. Conservation status of the Danubian huchen *Hucho hucho* (Linnaeus, 1758) may be evaluated as critically endangered. Its range reduction recorded since 1945 seems to be halted in some countries, but in other it is decreasing and its populations are maintained mostly by extensive stocking.

Taxonomy, conservation, Pisces, Salmonidae, *Salmo labrax*, *Salmo schiefermuelleri*, *Salvelinus salvelinus*, *Salvelinus profundus*, *Hucho hucho*, Danube river basin, Palaearctic region

INTRODUCTION

The purpose of this paper is to initiate and/or promote research on the status of native salmonids inhabiting the Danube River basin, including their ecology and conservation and in most of them even their taxonomy and nomenclature. Danube basin is noted for both the highest total number and the highest ratio of endemic fish species in Europe (Berg 1932, Lindberg 1972). The Danube basin is also known as the Quaternary refuge of its freshwater fauna which, after the retreat of the ice sheat, expanded into other European river basins (Lindberg 1972). It is therefore astonishing, that relatively little is known about most Danubian native salmonids. This criticism deals both with their taxonomy and ecology, including their population density and in some respect even the fish catch statistics. It seems that most European ichthyologists were, and still are, interested in fishes from remote, exotic countries and not in those inhabiting rivers within reach of their hands. This is reason why the following data, although they were excerpted from all available information, give only an indistinct and in some respect confused picture on the present status of given species. In addition it seems, that most now belong to the endangered, and some species even among the extinct freshwater fishes of our Old continent.

To Dr. Jaroslav Hrbáček, Scholar, Teacher and Personage at the occassion of his 80th birthday.

Genus *Salmo* Linnaeus, 1758

Until now most authors suppose that European rivers are inhabited, besides forms of unknown systematic status, by three species of the genus *Salmo*, i.e. the Atlantic salmon *Salmo salar* Linnaeus, 1758 and the brown trout *Salmo trutta* Linnaeus, 1758, and by the marble trout *Salmo marmoratus* Cuvier, 1817. The brown trout forms three ecological forms, the sea trout –*S.trutta* (morph *trutta*), the brook trout – *S. trutta* (morph *fario*), and the lake trout – *Salmo trutta* (morph *lacustris*). This nomenclature implies close relationships of the migratory, stream resident and the lake resident forms respectively. However, it has been documented, that all three ecological forms inhabiting one river basin represent one gene pool and/or they are much more closely related each other, than to any of those from another river basin (Ferguson et al. 1995 and references therein). Moreover, recent data coming from population genetic analyses of various trout populations using both nuclear-gene (biochemical), nested clade and mtDNA markers throughout all over the Europe (e.g. Bernatchez et al. 1992, Riffel et al. 1995, Apostolidis et al. 1996 a, b, Bernatchez & Osinov 1995, Giuffra et al. 1995, Osinov & Bernatchez 1996, Bernatchez 2001) suggest that actual biological diversity of the brown trout might be far greater than it is recognised by the current taxonomy with its nomenclatorial limits (Kottelat 1997). This situation resembles that found recently in the another salmonid genus *Oncorhynchus* Suckley, 1861(Behnke 1992).

In other words, recent data coming from using the karyotype pattern (Phillips & Ráb 1997) and the mtDNA and biochemical analysis of various stocks (Kottelat 1996, and literature herein) indicate the more complex species composition of European trouts. This postulate is now verified by the thorough analysis of the allozymes and mtDNA of the "brown trout" stocks from many localities covering various European and also Central Asian river basins, made by Osinov & Bernatchez (1996). Within five phylogenetic groups distinguished earlier (Bernatchez et al.1992, Giuffra et al.1994, Bernatchez & Osinov 1995, Bernatchez 1995, 2001) there are two large ones: the "Atlantic" group and the "Danubian" group, the last one involving "brown trout" stocks inhabiting streams and lakes belonging to the basins of the Black, Caspian and Aral seas. The migratory trouts of the Black Sea and the lower Danube have been described as a distinct species *Salmo labrax* Pallas, 1814, later on considered to be subspecies of *Salmo trutta* by Berg (1916). Afterwards Balon (1968, 1969) refused even the subspecific status of the Black Sea trout and the migratory trout from its watershed he considered to be a morph – *Salmo trutta* m. *labrax* – only. However, observations by Dorofeeva (1967, 1977, 1985), Osinov (1984, 1989), Bernatchez & Osinov (1995), Largiader & Scholl (1995), Togan et al.(1995) and Osinov & Bernatchez (1996) revealed some osteological, karyological, biochemical and molecular differences among particular subspecies of *Salmo trutta*, suggesting to attribute them specific status. This is particularly true for the Black Sea trout populations and Kottelat (1997) tentatively recognizes it as a distinct species, in spite that the recent list of the salmonids inhabiting the territory of Russia, only *Salmo salar* and *Salmo trutta* are still recognised, the latter with four subspecies – *S. t. caspius* Kessler, 1870, *S. t. ciscaucasicus* Dorofeeva, 1967, *S. t. labrax* Pallas, 1814, and *S. t. ezenami* Berg, 1948 (Dorofeeva & Savvaitova 1998) In this paper I follow the opinion of Kottelat (l. c.) and consider the Black Sea trout to be a valid species.

Salmo labrax Pallas, 1814

The main anatomical characters distinguishing this species from its closest relative Atlantic trout *Salmo trutta* Linnaeus, 1758, occurring in the watershed of the Atlantic Ocean is the higher number of gill rakers, the high caudal peduncle depth (Berg 1948, Pavlov et al. 1994) and the structure and dentition of some skull bones (Dorofeeva 1967). Also, as revealed just recently, there is a set of distinct genetic markers suggesting that it represents one gene pool (Ráb pers. comm.).

The Black Sea trout is a migratory species, living as adult in the littoral of the Black Sea and ascending rivers for spawning. The following details on its ecology and life history are taken from the papers by Berg (1948), Bănărescu (1964), Svetovidov (1964), Elanidze et al. (1970), Marinov (1978), Pavlov (1980), Elanidze (1983), and Pavlov et al. (1994). Spawning migration begins in February, it peaks in April and May and terminates in July. The spawning proper is in October, peaks in November and lasted till the end of January. Juveniles stay 2–4 years in the brooks where they hatched and only then move downstream to their feeding grounds in the sea. Characteristic feature of this species is strong predominance of females: in some rivers the migratory and resident trouts form one stock, where migrants are represented by females which mate with males belonging to the resident brook form (m. *fario*). In this case part of hatched juveniles does not transform to smolts and stay in a stream. Smoltification is determined by sex, as only females leave the river while males remain there. Sexual maturation sets in at the age of 3–5 years and 350–900 mm of the total length (*Tl*). The diet of juveniles is composed of invertebrates only, but smolts start to eat also fish. The major food of adults in the sea is fish, mostly anchovy [*Thryssa* (*syn*. *Engraulis*) *encrasicholus* (Linnaeus, 1758)]. The main distribution of this trout are eastern shores of the Black Sea and the Azov Sea but it is known also from the shores of Crimea, Ukraine, Romania, Bulgaria and Turkey. It ascended the rivers of Crimea and Caucasus and also the rivers Dnieper (formerly up to Kremenchug, some 500 km from the river mouth), Don (up to Pavlovsk) and Kuban' with its tributary Laba (some 300 km upstream). In the Danube River it was known from Silistra and Orechovo, 350 and 700 km upstream from its delta, respectively, and in the delta lakes Razelm and Yalpukh. In comparison with eastern stock the western one was always less abundant and only single specimens weighing mostly 3–4 kg were taken. Maximum recorded size of this species was 1100 mm and 24 kg. At present the population of this species generally dropped dramatically and only few specimens are sometimes taken. In the main fishing grounds along the Georgian shores, where formerly 9 tons were taken annually, the fishery for this species had to be completely stopped. However, I must say that the exact status of the trout in the lower Danube is not known, in spite that the local fishermen known this trout perfectly. Only few and generally small-sized specimens are occasionally caught there (Bănărescu 1964, Pavlov 1980) and Balon (1968, 1969) considered them to be resident, non-migratory trouts washed downstream from the Danube river basin. According to Suciu (pers.comm.) the Romanian trout catch in the Danube delta is about 100 individuals annually and their length and weight varies from 400 to 520 mm *Tl* and 100–1800 g, respectively. Trouts found in the middle Danube have a similar colouration as the sea trouts and lake trouts, i.e. only black spots are scattered on their dorsum and flanks (Holčík 1969). The status of the sea trout from the Black Sea was evaluated by Lelek (1987) as endangered and by Pavlov et al. (1994) as vulnerable. However, the situation in the Danube basin is more critical, so the actual conservation status of this species at the western range of its area may be evaluated as critically endangered. The reasons of its decline are not properly known but it is certainly the combination of overfishing and the deteriorated environmental conditions, including pollution, construction works, and damming of streams where this species spawns. A list of conservation measures proposed by Lelek (1987) includes environmental protection, fishing restrictions, establishing of hatcheries and also intensive research focused on the population ecology of this species. Russian authors (Pavlov et al.1994) recommend also the the exclusive use of the local brown trout stock in hatcheries.

Most Alpine and pre-Alpine lakes in Austria are inhabited by the lake form – the lake trout *Salmo labrax* (m. *lacustris*). This form resembles the sea trout in form and also colouration, however it is much larger as it grows up to 31 kg. Its ecology is similar to that of both the sea trout and brown trout, but details are not well known. Sexual maturity is reached and first spawning performed only when fish attains 500 mm in the *Tl*, i.e. as 4 (3+) and 5 (4+) years old males and

females, respectively. In late autumn the lake trout migrates into lake tributaries, sometimes even into the outlets to spawn and afterwards it returns to the lake. In rare occasions the spawning was also observed in the lake itself, but usually close to the mouth of tributaries. In some localities the spawning with the resident brook trout was observed, but hybrids are said to display lower growth rate and they attain much smaller size than the lake trout (Hochleithner 1989). Two forms of the lake trout were recognized in particular lakes. They differs in the size, colour and the diet as well. Small, light-coloured and sexually immature fish called *Schwebforelle*, *Silberforelle*, *Silberlachs* or *Jugendform* inhabits upper layers of the water column, dwells close to shores and feeds on the airborn insects or small fishes. Large, dark and adult specimens called *Grundforelle* inhabit pelagial and are confined to depths up to 40 m below surface. They are typical predators preying on fish. Present conservation status of the lake trout in Austrian lakes was described as disastrous by Hochleithner (1989). This author made an attempt to assess its actual situation and tried to check populations inhabiting particular Austrian lakes. However, his data are based on reports of various persons, they lack quantitative figures dealing with population abundance and fish catch statistics. Due to this the following review is only a very rough and somewhat subjective simplification. From 14 lakes of the Danube basin the lake trout catches and recorded individual maximum or mean weights decreased in six (43%), seems to remain the same in four (28%) and improved in one (7%) lake. In three lakes, however, (Fuschlsee, Traunsee and Hallstättersee; 21%), the lake trout is now extinct. Individual weight of the lake trout catches from these lakes, recorded mostly till the first half of this century, attained up to 31 kg. As noted by Einsele (1959) 20 kg specimens were not rare. At present, however, the catches of individuals over 10 kg are very rare and the mean weight recorded during last years varied mostly from 6–8 kg. Both Hochleithner (l. c.) and Jagdsch (pers. comm.) claimed that reason of the decline of the lake trout is a combination of overfishing and environmental changes, including alteration or damage of the spawning grounds by construction works, and weirs and dams which have cut access to spawning grounds, and pollution and eutrofication which kill the fertilised eggs and hatching alevins, as well as the food resources for juveniles. Both Hochleithner and Jagdsch also stressed the wrong management which contributed to the decreasing trend of the lake trout stock in the Alpine and pre-Alpine lakes. With the aim to improve the population density of this species, foreign, (mainly Danish strains) of the sea trout (i.e. *Salmo trutta* [m. *trutta*]) reported to be the lake trout, were imported to Austria and stocked into the lakes. The imported trouts are accused to hybridise with the true, native, lake trouts. Their hybrids are noted, for both their lower growth rate and individual weight, but no data were introduced to support this assertion.

This, however, does not indicate the introgression of the imported trout of the Atlantic origin. Largiader & Scholl (1995) found that indigeneous genetic variation in the brown trout populations is still predominant in the Danube basin in Switzerland despite stocking. The low impact of foreign brown trout strains was also found also elsewhere as documented by Arias et al. (1995) in Spain, Beaudou et al. (1994, 1995), Poteaux et al. (1998) in France and by Ráb (pers. comm.) in former Czechoslovakia. The same seems to be valid for the genus *Salvelinus* (Kummer & Jungwirth 1999).

According to Jagdsch (pers. comm.) the present managing practice in Austria improved. Stocking activity is now based on the native lake trout progeny, and the Grundlsee and the Attersee lakes provide the original brood stocks for hatcheries. According to the Red List of endangered fishes in Austria the situation seemed to have improved during past decade. While in 1983 the lake trout was listed among endangered fish species (Hacker 1983) in 1989 it had moved to the vulnerable category (Herzig-Straschil 1994). In Switzerland, the lake trout now occurs in only one lake of 6 lakes of the Danube basin populated by fish and the species is evaluated as critically endangered (Pedroli et al.1991).

There is one more species of the genus *Salmo* described from the Alpian lakes. It is *Salmo schiefermuelleri* Bloch, 1784, known under vernacular name *Mayforelle*, sometimes also *Silberforelle*. This is a mysterious fish, whose vernacular name is derived from the observation that it might be seen close to the lake surface only in spring, while during most of the year it dwells in greater depths. This form was known to inhabit the lakes Attersee, Traunsee and Fuschlersee (Heckel & Kner 1854). It was reported to grow to the same large size as the deep-water lake trout or *Grundforelle*, i.e. 20–30 kg. According to Heckel (1851) and Heckel & Kner (1858), the difference between the deep-water *Grundforelle* and the *Mayforelle* is in the head shape, coloration, more deciduous scales, white eggs which would be of the same size as the millet seeds (while in the *Grundforelle* they are of the size of the pea seeds) and hardships to keep it alive. Systematic status of this trout is not solved yet. Haempel (1930) thought that the *Mayforelle* is only a sterile form of the lake trout. Berg (1932, 1948) considered it as a synonym of the Danubian basin lake trout – *Salmo trutta labrax* according to his nomenclature – while Balon (1968) supposed it to be the infraspecies i.e. ecological form of the species *Salmo trutta*. According to Kottelat (1997) *Salmo schieffermuelleri* is a valid species. With respect to data by Heckel & Kner (1858) and Haempel (1930) dealing with small eggs and/or its reproductive sterility, I suppose that the *Mayforelle* are those specimens of the adult lake trout (*Grundforelle*) which left out spawning for one or two years. Such a situation is known in various species of fishes including coregonids and salmonids occurring in northern regions or in deep lakes (Kennedy 1953, Grainger 1953, Gullestad 1973, Holčík et al. 1988). The exact taxonomy of this trout remains to be solved. However, the original stock seems to be extinct (Balon 1968, Kottelat 1997).

Genus *Salvelinus* Richardson, 1836

The systematics and nomenclature of the charrs, genus *Salvelinus* are even more obscure than those of the trouts. As pointed out by Kottelat (1997), here the main problem is the existence of a number of various stocks, which are variously called, and even were described as species, subspecies, forms, ecomorphs, etc. Moreover, possible transition of charrs originating from sympatric speciation from one form to other in the ontogeny, and, in some cases reproductively isolated and morphologically, ecologically and genetically different forms (Alekseyev et al. 1999, Dynes et al. 1999) complicate the situation and taxonomic status of particular stocks. Berg (1932) recognized 25 valid species in Europe, afterwards he (Berg 1948) lumped them into two. One is *Salvelinus alpinus* (Linnaeus, 1758) occurring in the lakes of Finland, Sveden (lake Vättern), southern Norway, in Alpine lakes (lakes in the watersheds of the rivers Danube, Rhine, Rhône), lakes on the British Isles, Orkney and Shetland islands, in Iceland, Kola peninsula, Karelia and in the lakes Onega and Ladoga. The second charr species is *Salvelinus lepechini* (Gmelin, 1780) inhabiting some lakes in Finland, Sweden (lakes Mälaren and Vennern) and southern Norway. Ladiges & Vogt (1979) recognised only one species, *Salvelinus alpinus* (Linnaeus, 1758) with 24 subspecies. According to Kottelat (1997) who extensively reviewed all available data, there are 23 valid species in Europe: 7 in England, Wales and Scotland, 6 in Ireland, 3 in Iceland, 2 in the Alps and 4 different species in Scandinavia, in the Onega and Ladoga lakes, in the Shetland, Orkney and Faroe islands, respectively. In the Danube river watershed Kottelat (l.c.) distinguishes *Salvelinus umbla* and *Salvelinus profundus*. The name *Salvelinus umbla* has nomenclatorial priority over the name *S. salvelinus* and *S. alpinus salvelinus* (Linnaeus, (1758) (Kottelat 1997), which was traditionally used just for charrs of lakes in Alps.

Salvelinus umbla (Linnaeus, 1758)

The Alpine charr, was described from various Alpine and pre-Alpine lakes, among them also Mondsee, Traunsee, Königssee and lakes of the Salzkammergut region in Austria, all in the watershed of the Danube river. Three different forms were known to inhabit them: (1) the dwarf deep-water *Tiefseesaibling* (also known under the names *Schwarzreuter* and/or *Hungersaibling*) attaining 170–250 mm in *Tl*, inhabiting the deep parts of the lakes and feeding on zooplankton, (2) the *Normalsaibling* feeding on zooplankton and zoobenthos, and (3) the *Wildfangsaibling* which is the largest (attaining 650–750 mm in *Tl* and 3–5 kg in weight), predatory and occurs in two forms, the yellow and white one (Buresch 1925, Haempel 1924, 1930, Berg 1932, Ladiges & Vogt 1965). Heckel & Kner (1858) and Schindler (1940) supposed that the *Normalsaibling* and the *Wildfangsaibling* are only different age classes of the same species. Kottelat (1997) suggests that in these lakes were at least two species, the deep-water and the "normal" one, which were morphologically distinct, and with different parental ancestry and descent. There is no doubt that the deep-water *Tiefseesaibling* belongs to different species *Salvelinus profundus* as it will be shown below. Morphology and ecology of these forms in Alpine lakes of the Danube basin are not properly known and the more or less complete information for the "normal" form are those by Dörfel (1974) from the Lake Constance (Bodensee; the Rhine River Basin). He found that it dwells in depth not exceeding 60 m. The diet is composed of the chironomid pupae (75%), copepods (15%) and chironomid larvae (10%). Spawning periods in first half of December and sexual maturation sets at age 3 years. Sexual dimorphism is well developed and in addition to more bright colouration, males display also a kype of their lower jaw. Maximum size was 278–441 mm *Tl* at 5 years. Fecundity of this form varied from 900 to 2000 eggs. Concerning the present status of this charr species in Austria, the following information are mostly from Wanzenböck (pers.comm.) and Jagdsch (pers.comm.). Indigenous populations in Austria still exist in 16 lakes. In two additional lakes (Irrsee in Upper Austria, Zellersee in the Salzburg county) the Alpine charr became extinct in the 1960ies following eutrophication and in the medieval time because of mining, respectively. A restocking program of the Zellersee was established in 1985. In the lakes Grundlsee, Altausser-See and also in the Attersee, this charr is still the commercially most important species together with whitefish (*Coregonus* spp.). In other lakes as in Mondsee and Wolfgangsee, the stocks of charr are much smaller and a following general pattern is observed: increasing eutrophication is accompanied with decreasing density of the charr, the dominant position of which is replaced by the whitefish. This phenomenon when salmonids are replaced by coregonids is well known also from other oligotrophic lakes in Eurasia and North America (see e.g., Colby et al.1977, Reshetnikov 1980, Holčík et al.1989). Wanzenböck suggests that competition between char and whitefish played also an important role, since alternating trends in the stock developments are obvious: overfishing of charrs led to increase in whitefish stock and *vice versa*. Both authors point out that the most serious problem might be the mixing of stocks from different lakes leading to the genetic erosion of different forms adapted to the specific conditions of particular lakes. Stocking material sometimes does not come from nearby lakes but also outside Austria, even from Scandinavia and Canada (Jagdsch 1987). With re-oligotrophication of many other lakes (e.g., Mondsee) signs of improvement of the charr stock have become obvious in recent years. In many small lakes in the high Alps, the charr have been introduced since the Middle Ages in habitats in which the fish can just survive, forming dwarf forms. But because these are not primary habitats for the species, its disappearance from some of these lakes cannot be regarded as the sign of danger. According to Wanzenböck the situation of native charrs in Austria is generally not bad, but Jagdsch (pers. comm.) estimates the char catch much lower than 1 $kg.ha^{-1}$. According to Maitland (1995) who sampled information by questionnaire in December 1993, 15 Austrian lakes still have indigenous

charr population, 13 lakes have indigenous plus introduced stocks from elsewhere and there are 150 lakes with introduced charr. This species is still economically important and the Austrian charr catch in 1993 was 30 000 specimens taken by anglers and 35 metric tons, fished commercially. Nevertheless, this species is regarded as endangered (see also Hacker 1983 and Herzig-Straschil 1994).

Salvelinus profundus Schillinger, 1901

It is another mysterious salmonid species reported from the Alpine lakes. It was formally named by Schillinger (1901) as *Salmo salvelinus* var. *profundus* from the lakes Constance and Ammersee. The proper and taxonomically correct description, however, has never been published. In spite of this already Berg (1932), then Behnke (1972, 1980), Cavender (1980) and at present Kottelat (1997) consider it to be a valid species. Its characteristic features are blunt and steeply downward bent snout, almost inferior mouth, large eyes and large teeth. This species has a lower number of gill rakers (l9–27, M=22.3) than the "*Normalsaibling*" (25–31, 0=27.7) and also its structure is different (Dörfel 1974, Behnke 1980, Cavender 1980). Its colouration is similar to that of the whitefish, without any spots, and it does not change in the period of spawning. There is no sexual dimorphism. Its ecology was studied by Brenner (1980) in Atterssee. He found that it dwells in depths from 40 to 130 m, both sexes became sexually mature in the third year of life, the main spawning period is between July and the beginning of November. However, sexually mature specimens of both sexes were caught, and monthly fertilisation tests were positive throughout the year, demonstrating that this charr reproduces all year round. The main spawning grounds in Attersee were at depths between 40 and 60 m and consisted of gravel with grains of 1.5–2.5 cm in diameter. The egg number of females 145–205 mm in *Tl* varied from 220–260 and decreased with increasing female size. The food of this charr consisted mainly of crustacean zooplankton, but fish eggs and remainders of fish were also found in its intestines. The growth of females and males appeared to be the same and the largest specimens were 6 years old and 160–190 mm *Tl*. It is of interest that 55 years ago the growth rate of this charr in the same lake was better, as 4 years old specimens reached 250 mm in *Tl* (Buresch 1925). It is worthwile to mention also that Brenner (1980) found in Attersee only this deep-water form but other two forms had disappeared, reportedly due to overfishing. The same situation probably also happened in other Alpine lakes. From other sources we know, that this deep-water charr may be found at depths around 100 m together with a whitefish (*Coregonus* spp.). When taken on the surface it becomes flatulent. Its maximum size is 150–175 mm. The female is able to spawn at the size of 100 mm *Tl*. Spawning period is in December and January. Data gathered by Dörfel (1974) from the Bodensee (Rhine basin) are similar and convincingly show morphological and ecological differences between the "normal" and a deep-water form allowing to admit the species status also to the latter. As Kottelat (l.c.) noted, it should urgently be investigated if the deepwater populations (of which several seem extinct) from various Alpine lakes are conspecific or not. It is of interest that in Transbaikalian lake Davatchan the deepwater dwarf charr occurs, resembling *S.profundus* in many characters. As pointed out by (Alekseyev et al. 1999) this form represents an interesting example of parallel evolution in deepwater mountain lakes.

Genus *Hucho* (Linnaeus, 1758)

Hucho hucho (Linnaeus, 1758)

The present distribution of this species is only a part of the earlier one. Historical records show that the huchen was quite common in almost all rivers of the Danubian watershed and this species inhabited almost 12 000 km of rivers in Europe. However, after 1945 the situation changed and by

the end of 1980s it disappeared from 39%, became rare in 28% and is now common in only about 33% of its former distribution. The present situation in those countries we have information from, is as follows. In Switzerland huchen occurred in the Inn River in the Engadin valley, but now is extinct as during past 50 years was not recorded there (Pedroli et al.1991). In Germany the huchen still occurs in the Danube and Iller in the vicinity of Ulm, but is rare and maintained by continuous stocking (Berg et al. 1989, Harsányi & Aschenbrenner 1994, Rösch pers.comm.). Jungwirth (pers.comm.) reported, that in Austria the huchen status is better than 10–15 years ago. In the rivers Drau, Mur and Pielach there is about 150 km of sections with very good huchen status and natural reproduction. There is also extensive stocking of 1, 2 and 3 years old juveniles amounting annually to 10,000–20,000, 5,000–10,000 and 1,000 specimens, respectively. This production is used to stocking of the rivers Danube, Mur, Drau, Pielach as well as the Inn and the Enns. Huchen catch statistics are not available. Jungwirth only mentioned, that in the rivers Drau and Mur annual catches are 50–60 and 30 large huchens, respectively. In Slovenia the rivers Mura (=Mur), Drava (=Drau), Sava, Savinja, Krka and Kolpa were known as the good huchen rivers. At present the huchen is extinct in the Mura and in other rivers the sections inhabited by the species are remarkably shorter than before. Also the population density of the huchen significantly decreased. In the Krka river, for instance, 60–65 mating huchens in the Soteska spawning ground could be counted in the past but today the number of spawners dropped to 5–6. Povź & Sket (1990) evaluate its status in the water bodies of Slovenia as endangered and vulnerable. The huchen stock in the rivers is maintained by stocking (Povź & Sket 1990, Skalin 1994). We have no information on the situation in other countries of the former Yugoslavia, but it is hardly better than elsewhere. From Romania we have reports by Miron (1994) and Bănărescu (pers.comm.). According to the first author, there were formerly 16 rivers in Romania with the huchen stock. At present their number dropped to three, i.e. 18.8% of the former number. During 1961–1979, 13 other rivers were stocked with huchen but acclimatization (probably also naturalisation) appeared only in 6 (46%), the negative one in 4 (31%) and there are no data for other three rivers (23%). According to Bănărescu the huchen in Romania underwent a numerical decline, but is not in danger of extinction. The huchen is also present in some man-made lakes as is the Bicaz Lake (on Bistricza River) its spawning however, is limited to tributary streams. An extensive stocking program was adopted, but its success depends on the water quality of the rivers and especially on hydraulic engineering, as the program for damming Romanian rivers seems to expands significantly. In Slovakia, the range of this species has considerably decreased too (Holčík 1990, Holčík et al. 1988). Some fifty years ago the huchen inhabited more than 1000 km of rivers in Slovakia. At present the huchen disappeared from 48% of the length of all streams in which it occurred in the past, it is rare in 12% and common in 40% of the total length of the streams. Analysis of historical records indicates that the population density of the huchen was formerly relatively high, supporting catches of up to 20 huchen of 3–30 kg in weight within a day at the same place. Recent observations in Slovakian rivers indicate that in spite of some protective measures like the legal restrictions, involving the bag and size limits and the closed season along with stocking, establishment of a reserve, the huchen in Slovakia is steadily decreasing. As it follows from the statistical data the catches of huchen shows a decreasing trend in numbers: the mean catch in periods 1954–1969, 1970–1978, 1979–1989 and in 1990–1995 was 154, 112, 92 and 54 specimens of the huchen, respectively. The increasing mean individual weight in these periods shows the reverse trend as it rose from 5.35 kg to 5.94, 6.67 and 7.3 kg, respectively. This indicates, that the population of huchen in the rivers of Slovakia becomes older. In other words both the natural reproduction of the huchen and its stocking are not sufficient enough to compensate its mortality. Recently Holčík (1997) suggested that if the observed decreasing trend continues, in 2017 the last huchen will be taken in Slovakia. Status of the huchen

in Poland was recently reported by Witkowski & Kowalewski (1994). Here the natural occurrence of the huchen was limited to two streams only, the Czarna Orawa and Czadeczka, belonging to the Danube river basin. Its density there was rather low as both represented the upper range of its natural occurrence. At the beginning of the 50's the huchen disappeared from the Czadeczka stream because of the pollution and after the construction of the Orava dam in the territory of Slovakia and subsequent construction of weirs in the Czarna Orawa river the occurrence of the huchen in the Czarna Orawa was reduced to 8–10 km only. Although the Polish stocking of the Dunajec, Poprad, Skawa, Sola and Raba rivers was successful and despite the occurrence of the huchen in about 300 km of streams, the general decrease of this valuable species in the Danube basin could not be reversed. Generally, the present occurrence of the huchen is no longer continuous in many places, as it was in the past, and these are often but isolated localities. As in other salmonids reasons for the decline is the denaturalization of the huchen habitat caused by industrial development and, later, by intensive large-scale agriculture. Destructive factors include the canalisation of rivers, construction of dams, the release of industrial waste waters and municipal sewage, eutrophication, deforestation and expansion of arable land. Overfishing, including poaching, is only a secondary factor, as fishing for the huchen requires some experience and special equipment. This factor had more effect before World War II, when legal restrictions were very loose, allowing anglers to catch unlimited bags of partly immature fish, and the fishing season lasted 9 months. Considering all these facts the present status of this valuable fish has to be evaluated as critically endangered.

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