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ON THE IDENTITY OF HUCHO HUCHO AND HUCHO TAIMEN (PISCES, SALMONIDAE)

О ТОЖДЕСТВЕННОСТИ HUCHO HUCHO И HUCHO TAIMEN (PISCES, SALMONIDAE)

Karol HENSEL[1] and Juraj HOLČÍK[2]

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[1]Department of Systematic and Ecological Zoology, Faculty of Sciences, Comenius University, Bratislava

[2]Laboratory of Fishery Research and Hydrobiology, Bratislava

Abstract

On comparative analysis of various data dealing with morphology and ecology of *Hucho hucho* (Linnaeus, 1758) and *Hucho taimen* (Pallas, 1773) the authors found no substantial differences between both species. They confirm the opinion of some previous authors that these species are conspecific, forming only two subspecies of the species *Hucho hucho* (Linnaeus, 1758). The differences between them are in coloration only.

Introduction

The mainland of Eurasia northwards of 40 °N is inhabited by two species of the genus *Hucho, i.e.* by *Hucho hucho* (Linnaeus, 1758) and by *Hucho taimen* (Pallas, 1773) which are strictly allopatric. Even Berg (1916, 1948) pointed out that both species are very close and the differences between them are only in the number of gill rakers and the shape of vomer. However, he still held both species to be valid. On the other hand Bajkov (1924), followed by Vladykov (1963) and Behnke (1968), suggested conspecific status. Šapošnikova (1968), who thouroughly studied some osteological characters and also the external morphology of both species, is also of the opinion that the existing differences are negligible and that both forms are at the most only two subspecies of one species. Recently Gricenko (1978) came to the conclusion that there are no principal differences between *H. hucho* and *H. taimen*, and he rejects even the existence of subspecies. Hensel & Pivnička (1980) after comparison of counts and measurements of *H. hucho* from the Danube River basin and *H. taimen* from the Mongolian sources of the Yenisei River, did not find any substantial differences, and they are again of the opinion that both species are conspecific.

To solve this problem definitively we have decided to gather and analyse all available information dealing with both the morphology and the ecology of both species.

Material and Methods

Counts and measurements, along with the data on ecology of *H. taimen*, were taken from the papers of Varpachovskij (1899), Isačenko (1912), Berezovskij (1924), Borisov (1928), Lindberg & Duľ-

kejt (1929), Syč-Averinceva (1933), Berg (1948), Nikoľskij (1956), Podlesnyj (1958), Karantonis & al. (1956), Kirillov (1962, 1972, 1976), Bukirev (1967), Šapošnikova (1968), Luk'ančikov (1967), Mišarin & Šutilo (1971), and Kalašnikov (1978) and those dealing with *H. hucho* were excerpted from data introduced by Heckel & Kner (1858), Siebold (1863), Vladykov (1931), Kulmatycki (1931), Berg (op. cit.), Svetina (1962), Banarescu (1964), Balon (1968), Šapošnikova (op. cit.), Frank (1971) and Blahák (1972). Beside this we have had in our hands 23 specimens of *H. hucho* measuring 315—963 mm of fork length *(Fl),* caught in the rivers Váh, Orava and Turiec (northern and central Slovakia) and 71 specimens of *H. taimen* 270—1170 mm in *Fl,* taken in the Šišchid River (one of the sources of the Jenisej River, Mongolia) previously investigated by Hensel & Pivnička (1980). Whenever possible the comparison of particular populations was made using the calculation of the coefficient of difference (*C. D.*). Osteological characters were studied in the skulls of 6 specimens of *H. hucho* and 3 specimens of *H. taimen,* some of which were cleared and stained (the smallest specimens of *H. hucho*).

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Results and Discussion

External morphology: Basic information summarizing all hitherto known data dealing with counts of *H. hucho* and *H. taimen* are shown in Tab. 1. As can be seen there are no substantial differences between the two species in this respect. This is especially true for the number of gill rakers, which was used by Berg (1916, 1948) as the basic criterion for distinguishing *H. hucho* from *H. taimen.* It has to be mentioned, however, that there are some methodical problems here. Namely, apart of the normally-developed gill rakers there are also rudimental ones which

Tab. I. Principal counts of *H. hucho* and *H. taimen.* (Summarized data of various authors including our figures)

Character	*Hucho hucho*	*Hucho taimen*
Ramified rays in D	8—12	8—14
Ramified rays in A	7—10	7—11
Lateral line scales	115—156	107—194
Transversal scale rows	175—233	131—288
Scales above l.l.	28—38	25—33
Scales below l.l.	24—35	26—39
Gill rakers[1]	10—14 (19)	9—16 (18)
Branchiostegal rays	10—11	10—13
Vertebrae	67—68	60—72
Pyloric caeca	200[2]	160—283

[1] figure in bracket indicates the number with rudimentary gill rakers
[2] the only information given by Berg (1948)

have the form of small tubercles. Most authors did not show whether their formula of gill rakers also includes rudimentary or only the normal ones. Šapošnikova (1968) writes that only a few specimens of huchens also have rudimentary gill rakers. We are, however, of a different opinion, as in 23 specimens of *H. hucho* investigated by us all have also the rudimentary gill rakers and in 16 specimens of *H. taimen* from the Šišchid River only 2, *i.e.* only 12 %, did not posses this structure. In specimens of *H. hucho* and *H. taimen* investigated by us the number of rudimentary gill rakers varied from 1 to 5, and it was identical in average (2.22 and 2.13 respectively). The number of normally developed gill rakers in the same specimens (including further 55 specimens of *H. taimen* from the same river) ranged from 10 to 14 (11.8 in average) in *H. hucho* and since 9 to 13 (10.6 in average) in *H. taimen*, *i.e.*, it was only slightly higher in the former species. The only difference found is that in *H. hucho* there is a statistically significant positive correlation between the size of fish and the number of normally developed gill rakers ($r = 0.434$, $P < 0.05$, *d.f.* 21), but in *H. taimen* this correlation is negative but statistically insignificant ($r = -0.089$, *d.f.* 69). However, these differences are negligible and cannot be used as a valid specific character, partly because the situation in other *H. taimen* populations is unknown in this respect.

Some differences between the scale formulae in *H. hucho* and *H. taimen* are due difficulties in counting them. The scales of the huchens are very small and frequently irregularly arranged, particularly along the lateral line. Moreover, the unpored scales intersticed between the pored lateral line scales (= *"eingeschaltete Schuppen"* of Kulmatycki 1931) increase in number with increasing fish size, as found by that author, and therefore the number of scale rows counted with may vary also in the same population, depending on size of fish investigated. Besides this the true lateral line scales are deeply embedded into the skin (Kulmatycki op. cit., Holčík 1982a) and may easily be overlooked. There are also different methods of counting the scales in huchens (usually not mentioned by particular authors) which are then responsible for differences which may be found. This is evidently the case of the Berg's (1948) number of scales above and below the lateral line of *H. hucho* (18—20 and 20—24 respectively) which is very low in comparison with data introduced for this species by Vladykov (1931), Kulmatycki (1931), Balon (1968), Blahák (1972), and also found by us, and therefore his data are not included in our Tab. 1.

Wider range of most counts in *H. taimen* cannot be considered to be its specific character but it is evidently due to the fact that this form is better known than *H. hucho*.*)

Šapošnikova (op. cit.) noted some differences in a few measurements such as the length of lower jaw, length of nose and the horizontal diameter of the eye. However, these characters also failed to distinguish *H. hucho* from *H. taimen*, as is shown in Tab. 3 and 4. Moreover, some of the differences found may be biased due to the nature of material in-

*) If the number of specimens studied by particular authors is summarized, then it follows that the data for *H. taimen* were from about 600 specimens but for *H. hucho* from about 60 only!

Tab. 2. Coefficient of difference in the counts among some populations of huchens

Character	Váh River versus						
	Višera	Šišchid	Angara	Frolicha	Anabar	Oleniok	Lena
Ramified rays in D	0.41	0.37	0.04	0.67	0.37	0.30	0.18
Ramified rays in A	0.03	0.41	0.48	0.67	0.50	0.63	0.45
Transversal rows of scales	0.82	0.28	0.51	0.10	—	—	—
Scales above l.l.	—	0.20	—	—	—	—	—
Scales below l.l.	—	0.17	—	—	—	—	—
Gill rakers (normal)	0.15	0.62	0.41	0.06	0.09	0.46	0.38
Gill rakers (all)	—	0.58	—	—	—	—	—
	Šišchid River versus						
	Váh	Višera	Angara	Frolicha	Anabar	Oleniok	Lena
Ramified rays in D	0.37	0.88	0.70	0.23	0.76	0.08	0.22
Ramified rays in A	0.41	0.42	0.17	0.23	0.83	0.27	0.11
Transversal of scales	0.28	0.87	0.16	0.18	—	—	—
Scales above l.l.	0.20	—	—	—	—	—	—
Scales below l.l.	0.17	—	—	—	—	—	—
Gill rakers (normal)	0.26	0.44	0.10	0.81	0.73	0.99	0.92
Gill rakers	0.58	—	—	—	—	—	—

vestigated and/or due to the methods of measuring. It is necessary to point out the paper of Hensel & Pivnička (1980), who used the same method on a sample of huchen and one of taimen, and found only one statistically significant difference, *i.e.* the slightly greater depth of D in *H. hucho* (*C. D.* = 1.39). It is true that the real differences between particular populations cannot be excluded, but we have not found any regular clinal gradation in particular characters.

As seen on Tabs. 2, 3 and 4 the calculation of *C. D.* does not reveal any substantial differences between the two species, which is especially true for the counts.

Osteology: According to Šapošnikova (op. cit.) the principal differences between *H. hucho* and *H. taimen* are in the shape of supraethmoid (called by her mesethmoid) which should be more narrow, and with three distinct lobes on its caudal part in the former, but wide and

Tab. 3. Coefficient of difference in the measurements between the pouplation of the huchen from the Váh River (*H. hucho*) and those from other rivers

Character	Váh River versus								
	Viseul	Višera	Jenisej	Šišchid	Angara	Frolicha	Anabar	Oleniok	Lena
Head length	0.48	**1.33**	**0.97**	0.04	1.00	1.20	**1.38**	0.16	**1.32**
Predorsal distance	—	0.83	0.07	0.25	0.64	0.52	—	0.43	0.23
Preventral distance	—	0.36	0.22	0.27	0.35	0.10	—	0.29	0.31
Preanal distance	—	0.06	0.30	0.29	0.14	0.20	—	0.23	0.19
Postdorsal distance	—	1.19	—	0.37	—	—	—	**1.52**	0.63
Body depth	0.71	0.24	0.12	0.47	0.25	0.37	—	0.73	0.63
Caudal peduncle length	**6.68**	0.70	0.41	0.21	1.08	0.73	—	0.64	1.17
Minimum body depth	0.09	0.92	0.88	0.67	0.94	**1.49**	**3.06**	**3.59**	**2.18**
P—V distance	0.36	0.33	0.21	0.23	0.91	0.09	0.58	0.44	0.71
V—A distance	**1.77**	0.10	0.51	0.23	**1.47**	0.04	—	0.45	0.20
A—C distance	—	—	—	0.38	—	—	—	—	—
Adip. — C distance	—	—	—	0.36	—	—	—	—	—
Length of D	0.29	0.19	0.27	0.07	0.17	0.43	—	0.16	0.08
Length of A	0.13	0.89	0.85	0.87	0.63	**1.28**	—	0.74	0.73
Length of C (longest ray)	—	0.84	0.42	0.74	0.03	0.17	—	—	—
Length of C (shortest ray)	—	**1.75**	**1.74**	0.10	**1.70**	**3.16**	—	—	—
Length of P	0.67	—	0.10	0.55	**1.35**	0.56	—	—	—
Length of V	1.00	—	0.49	0.30	**1.30**	**1.35**	—	—	—
Depth of D	**1.89**	1.25	0.93	**1.39**	**1.78**	0.29	0.71	0.02	0.67
Depth of A	0.98	0.12	0.19	0.37	0.85	0.08	0.71	0.91	0.05
Preorbital distance	0.95	0.40	0.42	0.52	0.76	—	—	0.92	0.63
Diameter of eye	0.39	0.54	0.98	0.09	0.73	0.15	0.14	1.16	0.06
Postorbital distance	—	0.03	0.68	0.61	0.21	—	0.16	0.15	0.47
Head depth	—	0.09	0.28	0.04	0.26	0.20	—	0.60	0.02
Interorbital distance	—	—	0.64	0.48	0.40	0.67	**2.16**	1.04	0.18
Maxilla length	0.08	0.37	0.32	0.59	0.82	0.29	—	0.25	0.22
Maxilla depth	0.59	0.21	0.51	0.34	0.14	0.51	—	0.43	0.52
Lower jaw length	0.03	0.57	0.44	0.45	0.75	0.65	—	0.16	0.11

Note: Heavy ciphers = statistically significant values

Tab. 4. Coefficient of difference in the measurements between the population of the huchen from the Shishkhid River (*H. taimen*) and those from other rivers

Character	Šišchid River versus								
	Váh	Viseul	Višera	Jenisej	Angara	Frolicha	Anabar	Oleniok	Lena
Head length	0.04	0.45	**1.20**	0.87	0.89	1.08	1.20	0.09	1.20
Predorsal distance	0.25	—	0.92	0.27	0.78	0.67	—	0.60	0.38
Preventral distance	0.27	—	0.49	0.03	0.60	0.35	—	0.48	0.52
Preanal distance	0.29	—	0.27	0.07	0.95	0.18	—	0.11	0.23
Postdorsal distance	0.37	—	0.78	—	—	—	—	1.03	0.36
Body depth	0.47	0.34	0.80	0.43	0.31	0.05	—	**1.50**	**1.45**
Caudal peduncle length	0.21	**5.69**	0.77	0.51	1.12	0.82	—	0.75	1.20
Minimum body depth	0.67	0.46	0.47	0.49	0.07	0.83	**2.09**	**2.65**	**1.44**
P—V distance	0.23	0.87	0.19	0.07	0.81	0.35	0.43	0.21	0.57
V—A distance	0.23	**2.02**	0.28	0.25	**1.19**	0.23	—	0.59	0.38
A—C distance	0.38	—	—	—	—	—	—	—	—
Adip. — C distance	0.36	—	—	—	—	—	—	—	—
Length of D	0.07	0.52	0.16	0.27	0.14	0.48	—	0.13	0.03
Length of A	0.87	1.04	0.25	0.30	0.13	0.48	—	0.03	0.06
Length of C (longest ray)	0.74	—	**1.62**	0.19	0.69	0.46	—	—	—
Length of C (shortest ray)	0.10	—	**1.82**	**1.81**	**1.76**	**3.30**	—	—	—
Length of P	0.55	**1.30**	—	0.49	1.94	1.16	—	—	—
Length of V	0.30	0.75	—	0.32	1.11	1.09	—	—	—
Depth of D	**1.39**	0.19	0.05	0.17	0.11	1.17	0.94	**1.69**	0.54
Depth of A	0.37	0.59	0.15	0.40	0.42	0.30	1.07	1.27	0.22
Preorbital distance	0.52	0.28	0.10	0.06	0.22	—	—	0.53	0.40
Diameter of eye	0.09	0.15	0.39	0.93	0.54	0.21	0.01	1.06	0.13
Postorbital distance	0.61	—	0.47	0.13	0.43	—	0.80	0.83	0.05
Head depth	0.04	—	0.12	0.07	0.21	0.23	—	0.53	0.04
Interorbital distance	0.48	—	—	0.20	0.10	0.25	**1.48**	0.49	0.19
Maxilla length	0.59	0.55	0.16	0.29	0.30	0.05	—	0,78	0.53
Maxilla depth	0.34	0.26	0.14	0.20	0.07	0.16	—	0.16	0.20
Lower jaw length	0.45	0.60	0.19	0.16	0.32	0.24	—	—	0.20

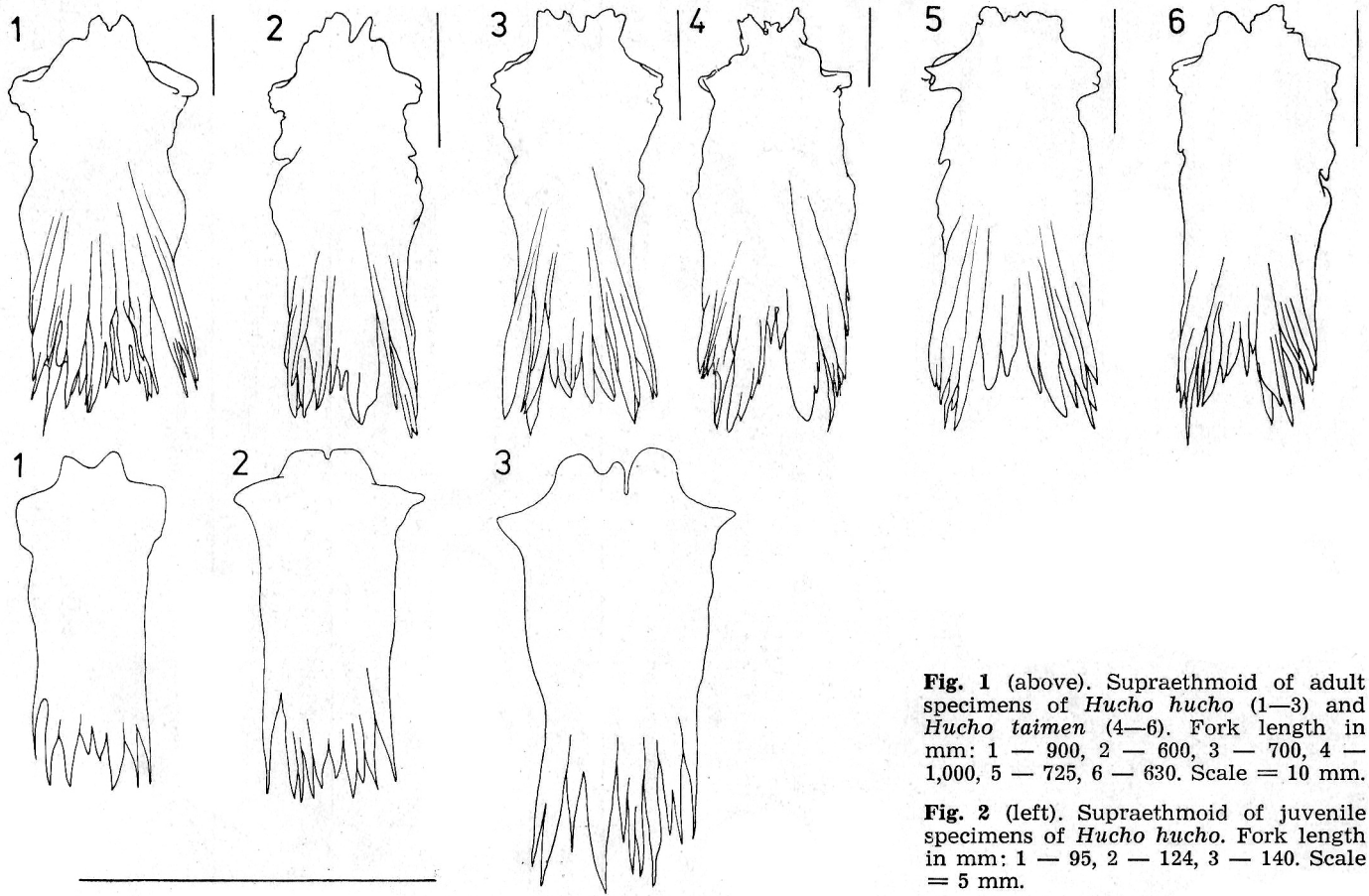

Fig. 1 (above). Supraethmoid of adult specimens of *Hucho hucho* (1—3) and *Hucho taimen* (4—6). Fork length in mm: 1 — 900, 2 — 600, 3 — 700, 4 — 1,000, 5 — 725, 6 — 630. Scale = 10 mm.

Fig. 2 (left). Supraethmoid of juvenile specimens of *Hucho hucho*. Fork length in mm: 1 — 95, 2 — 124, 3 — 140. Scale = 5 mm.

with two lateral lobes in the latter. At the same time this bone in *H. hucho* should be covered by frontalia while in *H. taimen* the supraethmoid penetrates into the "fissure" of the frontal bones. Moreover the facefront of the latters should be straight (on the level of praefrontal bones) in *H. hucho* but rounded in *H. taimen.*

However, our observations dealing with the shape of these bones do not confirm the statement of Šapošnikova. As may be shown (Fig. 1) the variability of supraethmoids is considerable and there are practically no differences between the two species. In *H. hucho* from 6 specimens studied, none possesses the central lobe. On the contrary, the caudal part of this bone is frayed into many processes, the posterior edge of which lies on the line, or the lateral processes may be protracted. The latter type has been found both in adult (large) and in juvenile (small) specimens (Fig. 2). *H. taimen* also has the same shape of supraethmoid, but here in all specimens examined the lateral processes are protracted. One can also see that there are no differences in the width of this bone, which is the same in both species. The caudal part of supraethmoid in both species is wedged between the frontal bones. Of 9 specimens studied none had the caudal part of supraethmoid covered by frontalia. We were unable to confirm any difference in the shape of the frontal bones: straight and rounded facefront of frontalia at the level of praefrontalia was found both in *H. hucho* and in *H. taimen* as well. One can conclude therefore that the osteological differences between *H. hucho* and *H. taimen* are minute only, and do not justify specific status.

Tab. 5. Chromosomal pattern of ***H. hucho*** and ***H. taimen*** (modified according to Ráb & Liehman 1982)

Species	Region (river)	2n	Chromosome types	NF
H. hucho	Yugoslavia[1] (?)	82	12 M, SM + 29 A—T	106
	Yugoslavia[2] (Sava R.)	82	13 M + 3 SM + 6 ST + 19 A—T	126
	Slovakia[2] (Turiec R.)	82	13 M + 2 SM + 6 ST + 20 A—T	124
H. taimen	USSR[3] (?)	84	9 M, SM + 33 A—T	102
	[4]		15—16 M, SM 6 ST 26 A—T	124

[1]) Sofradžija (1979);
[2]) Ráb & Liehman (1982);
[3]) Dorofejeva (1977);
[4]) number assumed by Ráb & Liehman (op. cit.)

Karyotype pattern: The karyotype of *H. hucho* was studied by Sofradžija (1979) and by Ráb & Liehman (1982) and that of *H. taimen* by Dorofejeva (1977). As can be seen (Tab. 5) the differences are only minute. Considering the possible error in the *H. taimen*

chromosome counting*) and also inter-population differences (*e.g.* in *H. hucho* as seen on Tab. 5) the chromosome formula in *H. hucho* and *H. taimen* is substantially similar "if not even identical" as emphasized by Ráb & Liehman (op. cit.)

Coloration: As follows from the data of various authors (Ivaška 1951, Nikoľskij 1956, Bukirev 1967, Mišarin & Šutilo 1971, Kirillov 1972, Gricenko in litt. 2. 9. 1978) the coloration seems to be the only character which can be used to separate both species, but only when alive. The caudal and lower part of body in *H. taimen* during the spawning season (but frequently also outside it) is coherently bright raspberry red, or orange red, or it is arranged in the form of big red spots, thus reminding one of the situation in *Brachymystax lenok* (Berg 1948). In *H. hucho* the red pigment is spread on the body flanks and back and very rarely also on the belly, here, however, in the form of few big red spots. The anal and caudal fins of *H. taimen* are red but in *H. hucho* these fins are brownish. Some populations from the Ural Mountain rivers seem to be transitional in this respect, as the red pigment is dispersed

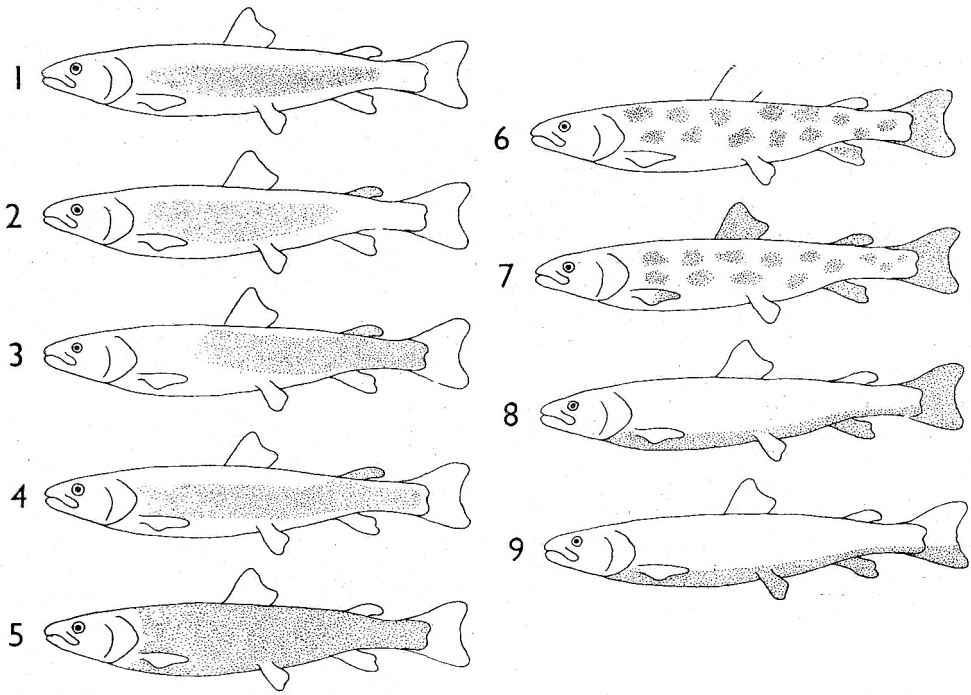

Fig. 3. Distribution of the red pigment on the body of *Hucho hucho* (1—4) and *Hucho taimen* (5—9). 1 — Váh R.; 2 — Turiec R.; 3 — Pielach R.; 4 — Orava R.; 5 — rivers of the Ural Mountains; 6 — Baikal Lake and Angara R.; 7 & 8 — Lena R.; 9 — Amur R. (According to various sources compiled by Gricenko & Holčík).

*) Dorofejeva (in litt., Jan. 1981) analyzed embryonic material (blastulae), and due to this the chromosome formula and karyotype structure were determined only approximatively.

both on the body flanks and the belly, but the caudal and anal fins are without it. The principal types of coloration found are shown in Fig. 3.

The coloration of juvenile specimens of both forms is the same. The number of parr marks in *H. hucho* varies from 7 to 12 (Bastl & Kirka 1959) while in *H. taimen* there are 7—10 of these transversal dark bands (Mišarin & Šutilo 1971). Also the age of fish at which these marks disappear is the same, *i.e.*, about 2 years as follows from Ivaška (1951) and Mišarin & Šutilo (op. cit.).

Ecology: The first spawning of both forms is roughly at the age of 3 years in males and 4 years in females, after attaining the weight of about 1 kg by the former and 2 kg by the latter. As the sexual maturation in fish depends on climatic and geographic conditions, the first spawning of northern populations of both forms is delayed in comparison with the southern ones. For instance, *H. hucho* from the Orava and Turiec rivers (about 49 °N) usually spawns in April and May, while the population of huchen living in the Drava river (about 47 °N) begins to reproduce already at the end of February and March (Munda 1935, Jungwirth 1977). Similarly the populations of *H. taimen* from the Amur river, rivers of the Altai Mountains and the Ural spawn as early as in April and May (Sabanejev 1911, Nikoľskij 1956), while those inhabiting the northern rivers like the Lena, Viljuj, Aldan, Angara and Frolicha breeds only since May to July (Pirožnikov 1955, Kirillov 1962, 1972, Mišarin & Šutilo 1971, Olifer 1977). Due to this the age of sexual maturation in *H. taimen* is generally higher than in *H. hucho,* although the size of the first spawning fish is identical (Tab. 6).

H. taimen is said to spawn only once in two or three years (Sabanejev 1911, Mišarin & Šutilo op. cit., Sigunov 1972) while in *H. hucho* this phenomenon was not recorded, and in the Slovakian huchen hatcheries the same fishes are stripped every year. However, here too the climatic and geographic conditions may be responsible, as is known from other salmonoids (Kennedy 1953, Rešetnikov 1980).

The place of spawning in both forms is identical. They reproduce in mountain brooks and small rivers or in such sections of rivers where the temperature and hydrological regime is similar to those of the former (Kirillov 1972). Both species frequently spawn in small and shallow brooks with a water depth of 0.3—1.2 m (Ivaška op. cit., Pravdin 1949, Bukirev op. cit., Vokač 1959). The arrival of both species to the spawning places is correlated with the departure of the snow water (Sigunov 1972, Pravdin op. cit., Wu 1979, Olifer 1977, Jungwirth 1977) which may be even in February in the South but as late as in July in the populations in the North (Komárek 1955, Vlasova 1959, Munda 1935, Kirillov op. cit., Pirožnikov 1955, Mišarin & Šutilo op. cit., Olifer op. cit., Bukirev op. cit., Nikoľskij op. cit., Sabanejev op. cit.). The water temperature at spawning in *H. hucho* and *H. taimen* is the same and varies from 5 to 10 °C on average (Novák 1932, Mišarin & Šutilo op. cit., Kulmatycki 1931, Vlasova 1959, Jungwirth 1977, Olifer op. cit., Wu op. cit.).

There are some differences in the maximum size attained. As recently shown by Holčík (1982b), the huchens are among the biggest freshwater fishes and are the largest of the salmonoids. The highest record

Tab. 6. Age, standard length (*Sl*, in mm) and body weight (*w*, in kg) of *H. hucho* and *H. taimen* females at the time of first spawning (according to Holčík & al. 1981)

Locality	Age	*Sl*	*w*	Authority
		Hucho hucho		
Sava R. basin	—	627	3	Munda 1925, 1926
Ammer R.	—	—	1.5	Seez 1939
Drava R.	4	627	3	Krauss 1933
Danube R. basin	4	—	—	Siebold 1863
Turiec & Orava rivers	5	582	3	Ivaška 1951
Drava R.	4	—	2	Vokač 1959
Danube R. basin	—	564	1.7	Svetina 1970
		Hucho taimen		
Amur R.	4	368	—	Nikoľskij 1956
Lena R.	7	451	1.5	Karantonis & al. 1956
Jenisej R.	—	442	2.5	Podlesnyj 1958
Viljuj R.	6	552	2	Kirillov 1962
Kama R.	7	—	—	Bukirev 1967
Chatanga R.	8	552	3	Luk'jančikov 1967
Angara R.	7	644	2	Mišarin & Šutilo 1971
Angara R.	6	552	2.1	Olifer 1977
Yakutian rivers	7	598	1.5	Kirillov 1972
Anabar	7	568	1.9	Kirillov 1976
Vitim	7	644	3.2	Kalašnikov 1978

Note: For the sake of comparison total length in *H. hucho* and fork length in *H. taimen* were recalculated for standard length each using formulae $Sl = -4.749 + 0.903\ Tl$ and $Sl = 0.098 + 0.920\ Fl$ respectively, as derived from 174 huchens from Slovakian rivers measuring 42—940 mm of standard length

for *H. hucho* is 60 kg (Danube at Tulln — Anonymous 1897) and for *H. taimen* it is 105 kg [Kotuj River (Chatanga River basin) — Sigunov 1972]. However, these differences can be due to the "space factor" as in the large rivers the fishes attain larger size and also due to Bergmann's rule, the existence of which in the poikilotherm vertebrates was confirmed by Lindsey (1966). However, with regard to the most frequent body size in catches, there are no differences between *H. hucho* and *H. taimen*, as in both it varies between 3 and 10 kilograms (*e.g.* Munda 1925, Teplov 1951, Pirožnikov 1955, Nikoľskij 1956, Luk'jančikov 1967, Mišarin & Šutilo 1971, recent statistics of the Slovak Angler's Union). It is of interest that the average size of the taimen from praehistoric settlements of man in Siberia was also practically the same as follows from data of Cepkin (1980).

The length-weight relationship of the nominate form and *H. taimen* seems to be without any substantial differences, as it follows from comparison of the length-weight equations calculated from the representative material 527 specimens of *H. hucho* published by Munda (1925) and the average of data calculated from the figures given by various Soviet authors. It is $\log w = -5.47791 + 3.14420 \log Sl$ (with 95 % confidence

limits for "*b*" 3.06786 and 3.17160) for *H. hucho* and $\log w = -5.19619 + 3.00738 \log Sl$ (with confidence limits 3.04588 and 3.14888) for *H. taimen*. The slower growth in weight with increasing length of *H. taimen* is negligible, as follows from Tab. 7 where the weight for particular lengths is derived from the above-introduced equations.

Tab. 7. Body weights for particular standard length (*Sl*, in mm) in *H. hucho* and *H. taimen*

Sl	*Hucho hucho*		*Hucho taimen*	
	Weight in kilograms			
	Mean	Ranges	Mean	Ranges
200	0.08	0.06—0.11	0.09	0.06—0.11
400	0.72	0.53—0.98	0.73	0.54—0.99
600	2.56	1.83—3.56	2.56	1.84—3.56
800	6.27	4.43—8.87	6.25	4.43—8.82
1000	12.58	8.79—18.00	12.47	8.74—17.80
1200	22.21	15.38—32.09	21.94	15.23—31.61
1400	35.93	24.68—52.32	35.36	24.35—51.36
1600	54.50	37.17—79.91	53.48	36.57—78.20
1800	78.70	53.35—116.10	77.02	52.36—113.31
2000	109.33	73.71—162.17	106.75	72.17—157.89

Growth rate of both forms is very similar (Tab. 8) and, as it follows from the von Bertalanffy curve (Fig. 4) derived from the data of this table, it is slightly lower for *H. taimen* in the period of its first 20 years, but higher afterwards, thus exceeding the growth of *H. hucho* of higher age. However, these differences cannot be considered to be specific to *H. taimen*, and they can be explained by the environmental conditions, *i.e.*, by the lower water temperature of Siberian rivers on the one hand (first

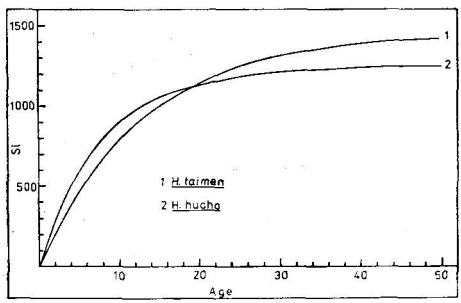

Fig. 4. The von Bertalanffy growth curve for *Hucho hucho* and *Hucho taimen*. Standard length (Sl) in mm, age in years. 1 — $l_t = 1447\ (1\text{-}e^{-0.08\ (t-0.27)})$; 2 — $l_t = 1251\ (1\text{-}e^{-0.13\ (t-0.52)})$.

20 years of life), but by the better feeding possibilities on the other. *H. hucho* living in highly industrial countries of Central and Eastern Europe is now displaced into the short sections of the mountain and foothill streams with a low density of feeding organisms available, but *H. taimen* still lives in the long sections of the huge Siberian rivers, with a large amount of food available.

Tab. 8. Comparison of the growth rate of *H. hucho* and *H. taimen* (*Sl*, in mm) in the period of first 15 years of life. Data of various authors were combined (according to Holčík & al. 1981)

Age	*Hucho hucho*					*Hucho taimen*					*t*	*C.D.*
	Sl	*s*	$s_{\bar{x}}$	*c.v.*	*n*	*Sl*	*s*	$s_{\bar{x}}$	*c.v.*	*n*		
1	193.00	78.22	20.20	40.53	15	173.25	70.43	20.33	40.65	12	0.68	0.13
2	325.93	51.35	13.26	15.75	15	259.73	61.33	15.84	23.61	15	3.21**	0.59
3	442.53	55.40	14.30	12.52	15	344.44	65.20	15.37	18.93	18	4.60***	0.81
4	545.07	61.44	15.86	11.27	15	412.79	63.39	14.54	15.36	19	6.12***	1.06
5	621.69	84.17	23.34	13.54	14	510.71	86.53	18.88	16.94	21	3.99***	0.65
6	703.20	109.20	32.93	14.33	11	583.55	49.91	11.16	8.55	20	4.20***	0.75
7	790.78	88.67	29.56	11.21	9	655.28	64.09	15.11	9.78	18	4.56***	0.89
8	846.71	73.77	27.88	8.71	7	765.56	114.47	26.98	14.95	18	1.73	0.43
9	892.80	79.23	35.43	8.87	5	809.50	103.33	25.83	12.76	16	1.65	0.46
10	955.20	106.32	47.55	11.13	5	844.92	126.66	35.13	14.99	13	1.72	0.47
11	955.67	55.43	32.00	5.80	3	877.75	141.58	40.87	16.13	12	0.91	0.40
12	975.00	71.39	41.22	7.32	3	949.11	89.29	29.76	9.41	9	0.45	0.16
13	1009.67	60.18	34.74	5.96	3	1014.22	107.37	35.79	10.59	9	0.07	0.03
14	1074.50	95.46	87.50	8.88	2	1022.00	109.16	48.82	10.82	5	0.59	0.26
15	1181.00	111.72	79.00	9.46	2	1030.20	141.12	63.11	13.70	5	1.33	0.74

** = $P < 0.01$, *** = $P < 0.001$

Conclusions

Comparative analysis of various data dealing with morphology and ecology of *Hucho hucho* and *Hucho taimen* did not reveal any substantial differences between these species. The only character in which *H. hucho* differs from *H. taimen* is the arrangement of the red pigment. Some differences found, *e.g.*, in the age of sexual maturation, the body size and growth rate are only negligible, and are caused by differences in environmental conditions. Therefore the point of view of some previous authors on the conspecific status of *H. hucho* and *H. taimen* is fully confirmed. and both species have to be lumped together into one species, whose name, according to the Priority Law, is *Hucho hucho* (Linnaeus, 1758). At the same time we are of the opinion that the differences in the coloration and interrupted area of distribution justify the taxonomical separation of both forms and they can be considered as two subspecies, *i.e.*, *Hucho hucho hucho* and *Hucho hucho taimen* respectively. The key for the identification of both subspecies is as follows:

A. Caudal and anal fins usually red; the belly and a lower part of caudal peduncle raspberry red or orange red, in some populations the red pigment is concentrated into big red spots. From the Kama and Pečora rivers up to the Jana and Amur river basins.

. . . . . *Hucho hucho taimen* (Pallas, 1773)

B. Caudal and anal fins brownish; body flanks red, belly whitish (very rarely with a few big red spots). Danube River basin.

. . . . . *Hucho hucho hucho* (Linnaeus, 1758)

Резюме

Сравнительный анализ данных по морфологии и экологии дунайского лосося и тайменя не выявил никаких существенных различий между этими видами. Единственным признаком, по которому дунайский лосось и таймень различаются — это распределение красного пигмента на теле и плавниках. Некоторые другие различия, например, возраст полового созревания, максимальные размеры и интенсивность роста совсем незначительные и их можно игнорировать, потому что они зависят от влияния факторов внешней среды. Этим подтверждается точка зрения некоторых предыдущих авторов о тождественности обоих видов. По закону приоритета этот вид должен нести название *Hucho hucho* (Linnaeus, 1758). Но все же мы считаем, что различия в окраске, а также в аллопатрическом распространении дунайского лосося и тайменя дают право на их таксономическое разделение и обе формы можно считать подвидами, т. е. *Hucho hucho hucho* и *Hucho hucho taimen*. Ключ для определения подвидов:

А. Хвостовой и анальный плавники обычно красные; брюхо и нижная половина хвостового стебля малиново-красные или оранжевые, у рыб некоторых популяций красный пигмент в форме больших красных пятен. От р. Кама и Печора на западе вплоть до бассейнов рек Яна и Амур на востоке.

. . . . . *Hucho hucho taimen* (Pallas, 1773)

В. Хвостовой и анальный плавники коричневые; бока тела красные, брюхо белое (изредка с несколькими большими красными пятнами). Бассейн р. Дунай.

. . . . . *Hucho hucho hucho* (Linnaeus, 1758)

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Critical revision by
Ing. *J. Libosvárský*, CSc.

Authors' addresses:

RNDr. Karol HENSEL, CSc.,

Dept. of Systematic and Ecological Zoology, Faculty of Sciences, Comenius University, Moskovská 2, 814 52 Bratislava, ČSSR;

RNDr. Jural HOLČÍK, CSc.,

Laboratory of Fishery Research and Hydrobiology, Drieňová 3, 826 24 Bratislava, ČSSR.