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A New Species of Grayling *Thymallus svetovidovi* sp. nova (Thymallidae) from the Yenisei Basin and Its Position in the Genus *Thymallus*

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Abstract—The Upper Yenisei grayling *Thymallus svetovidovi* sp. nova that inhabits the headwaters of the Yenisei River in Mongolia is described. From the other representatives of the genus *Thymallus*, the species differs in the elements of body coloration, dorsal fin pattern, some morphometric characters, and genetic characteristics. Besides this species, most of the Yenisei basin is inhabited by Baikal grayling *T. baicalensis* Dyb., and its low reaches, by the Arctic grayling *T. arcticus* (Pall.).

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Previously, grayling that inhabits the upper reaches of the Yenisei River, namely its headwaters in Mongolia, was assigned to the nominative subspecies of the Arctic grayling *Thymallus arcticus* (Pall.) (Dulma, 1973; Pivnička and Hensel, 1978; Baasanzhav et al., 1983, 1985; Baasanzhav and Tsend-Ayush, 2001). Molecular genetic studies demonstrated that most of the Yenisei basin is populated by Baikal grayling *T. baicalensis* Dyb. rather than by the Arctic grayling; their sympatric dwelling and reproductive isolation were established in the lower course of the Yenisei River (Khantaiskoye Lake) (Weiss et al., 2007). The Upper Yenisei grayling genetically and phenotypically clearly differs from the aforementioned species, in connection with which it can be given an independent taxonomic status (Koskinen et al., 2002; Froufe et al., 2005; Weiss et al., 2007; Knizhin and Weiss, 2007). Sequences of the mitochondrial DNA of the Upper Yenisei, Upper Ob *T. nikolskyi* Kasch. and Mongolian *T. brevirostris* Kessl. graylings at the phylogenetic tree represent branches that differ at a low level (Froufe et al., 2005). This circumstance can be regarded as evidence of their common origin from a form that inhabited tertiary water bodies of Mongolia until the isolation of the Ob, Yenisei, and Kobdo basins in Central Asia. Pivnička and Hensel (1978) concluded that the grayling from the headwaters of the Yenisei River (Shishkid Gol River) in several characters is closely related to the Upper Ob *T. nikolskyi* and Mongolian *T. brevirostris* graylings. Nevertheless, the Upper Yenisei grayling has a set of diagnostic characters that make it possible to consider it an independent species whose description is the purpose of this paper.

MATERIAL AND METHODS

The paper is based on the sample of graylings caught from Aug. 28 to Sept. 1, 2007 in the Sharga Gol River (Shargyn Gol)— 99°41′10″ E, 51°31′32″ N— that is a northern tributary of the Shishkid Gol River[1] (Malyi Yenisei). The Sharga Gol River originates from the southern macroslope of the Bol'shoi Sayan Ridge, whose summits are a boundary that separates Russia and Mongolia to the northwest of Chovsgul Lake. The headwaters of the Shishkid Gol River are southward, at the slopes of the Ulan-Taiga Ridge. Its waters flow from the south to the north via lakes of Darkhat Depression, after which they turn to the west and fuse with the Belin and Busiin Gol rivers, forming the Kyzyl Khem River (Fig. 1).

Available to us were a total of 26 fixed in a 4% solution of formaldehyde adult fish L_{Sm} 349–396 mm. All fish were subjected to a complete morphological analysis according to Pravdin's scheme (1966) with consideration of recommendations and modifications for graylings (Svetovidov, 1936; Tugarina, 1981; Knizhin et al., 2004). Estimation of characters was made by one operator. For the comparative analysis, materials of the authors on the morphology of graylings from water bodies of Eurasia and North America were used. In describing external specific features of fish, besides morphometric characters, body coloration and the shape and dorsal fin pattern were considered. For clarifying the range, the collections of the Zoological Museum, RAS (St. Petersburg), Zoological Museum of

[1] Several variants of the name of this river are known: Shishged Gol, Shishkhid Gol, Shishked Gol, etc.

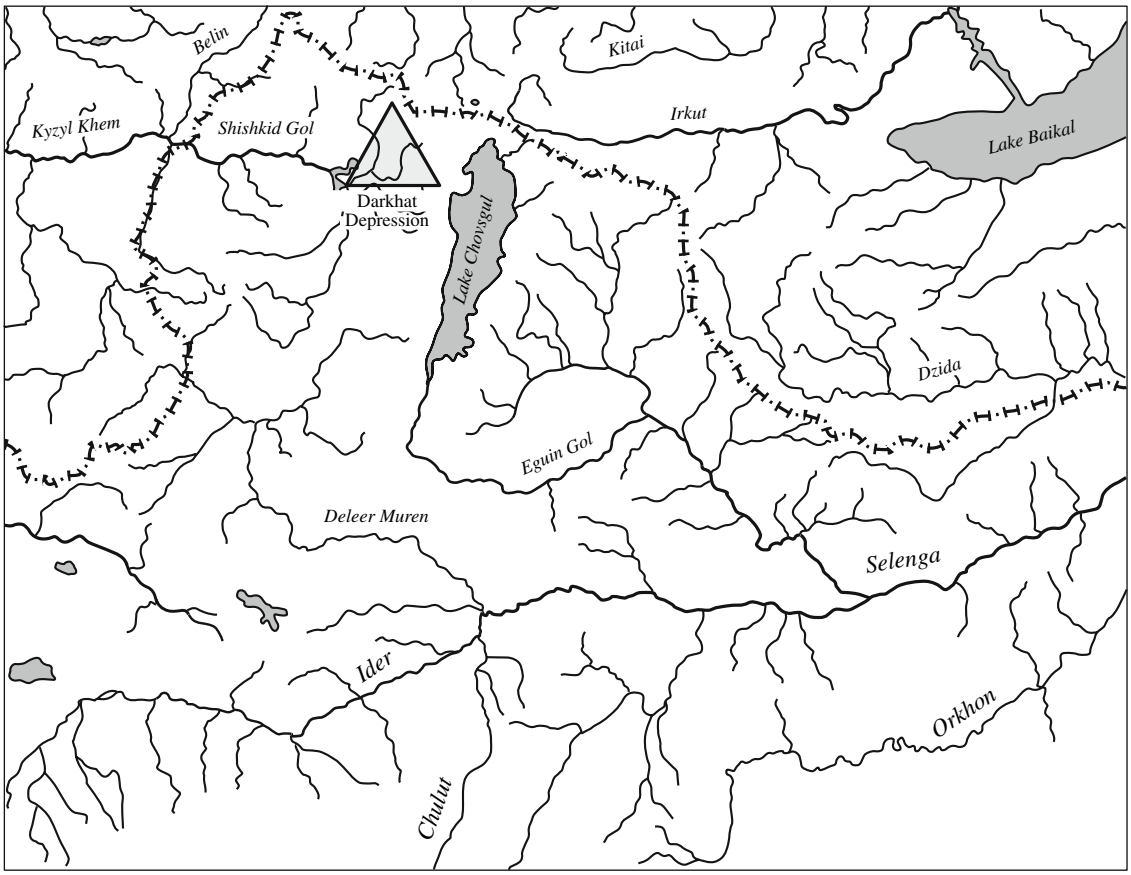

Fig. 1. Map–scheme of the study area. The site of fishing graylings *Thymallus* (the Sharga Gol River) is denoted by a triangle.

Moscow State University (ZMMU, Moscow), and Humboldt University Museum of Natural History (Berlin) were examined.

Statistical processing of data was performed using guides by Plokhinskii (1970) and Rokitskii (1973). Significance of differences and their value were determined according to *t*-test, taking the level of null hypothesis as $p \leq 0.001$, and according to CD coefficient (Mayr, 1969).

For deciding which is the taxonomic rank of the described species, the authors used the concept of the Linneaus species or linneon (sensu Berg, 1948) based on the phenetic and genetic criteria (Mina, 2007).

RESULTS AND DISCUSSION

Thymallus svetovidovi Knizhin et Weiss sp. nova—the Upper Yenisei grayling
(Fig. 2)

Thymallus arcticus (non Pallas, 1776)—Dulma, 1973: 50 (partim—lakes of Darkhat Depression); Baasanzhav et al., 1985: 56 (partim—Darkhat Depression, Lake Dod-Tsagan-Nur, Shishkhid Gol and Tengiz-Gol rivers); Baasandzav and Tsend-Ayush, 2001: 45 (partim—Darkhat Depression); Koskinen et al., 2002: 2061, Fig. 1 (the Shishkhid River); Froufe et al., 2005: 108, Fig. 3 (the Shishkhid River).

Thymallus arcticus arcticus (non Pallas, 1776)—Baasandzav et al., 1983: 127 (partim–Lake Dod-Tsagan-Nur).

Thymallus sp.1—Kottelat, 2006: 24, 94 (the Shishkhid River).

Thymallus sp.—Weiss et al., 2007: 374, Fig. 2 (the Shishkhid River).

Thymallus sp., the Upper Yenisei grayling—Knizhin and Weiss, 2007: 108 (the Shishkid Gol River).

Holotype. ZMMU No. R-21992, male L_{Sm} 374 mm, weight 695 g, age 9+, the Sharga Gol River; collector C. Ratschan; September 2007 (Fig. 2a).

Paratypes. ZMMU No. R-21993, two individuals, (1) L_{Sm} 396 mm, weight 870 g, and (2) L_{Sm} 357 mm, weight 640 g, collected together with the holotype. Zoological Museum of Irkutsk State University No. R-8, 23 individuals, L_{Sm} 349–395 mm, the Sharga Gol River; collector C. Ratschan; September 2007.

Diagnosis. ll 73–87, D_1 7–9, D_2 12–15, D 20–23, vert. 50–52, sb. 17–23, pc 19–28.

Body massive. Its maximum depth is 23.3–28.4% of L_{Sm}, on average, 25.6%. Head depth near the occiput

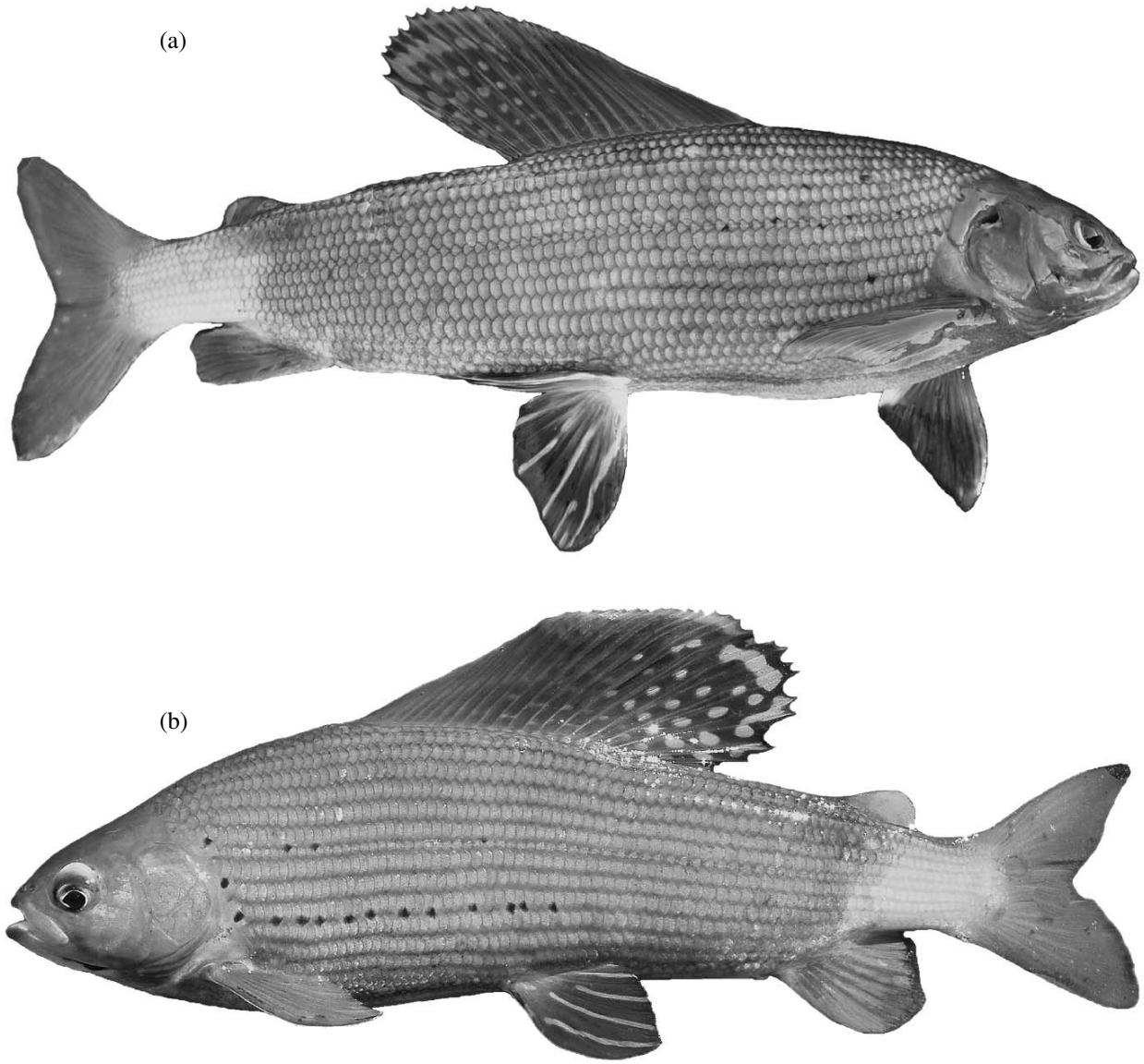

Fig. 2. The Upper Yenisei grayling *Thymallus svetovidovi* sp. n.: (a) holotype No. R-21992; (b) the species under water. Photograph taken by C. Ratschan.

15.6 to 18.2% of L_{Sm}, on average, 16.9%, forehead width 6.8–8.2 (6.6)%. Caudal peduncle length is 7.4 to 8.8% of L_{Sm}, on average, 8.2%, and its length is 13.4–15.8 (14.8)%. The end of the upper jaw does not extend beyond the midorbit. Weakly developed teeth are present at jaws and the head of the vomer. Articulation of lower jaw with the cranium is anteriorly the vertical of the posterior edge of the eye.

Scale cover dark gray with a turquoise shade. Caudal peduncle and caudal fin insertion of bright orange color. Posterior edge of dorsal fin in large males in folded state extends to adipose fin. Along its insertion, over interradial membranes, six to nine (on average, seven) bands consisting of red-crimson spots run. In the posterior part of dorsal fin, some of the spots located closer to the margin are vertically or horizontally extended, curved, and fused with spots of neighboring membranes forming a common tortuous drawing. Lower rows consist of separate smaller-sized spots of round, oval, or granular shape.

Description of the holotype (Fig. 2a). Morphometric characters of the holotype are given in Table 1. Body deep, massive. Scales large, densely sitting. Snout oval, mouth terminal. Upper jaw not extending beyond midorbit. Main body coloration is gray-black. Dorsum dark, monotonous. Abdomen white. From the throat to ventral fins, two weakly pronounced parallel brownish yellow stripes running. Branchiostegal rays with a yellowish shade. Beyond gill cover to insertion of the seventh unbranched ray of dorsal fin, eight small black

Table 1. Plastic and meristic characters of the Upper Yenisei grayling *Thymallus svetovidovi* sp. nova from the Sharga Gol River

Characters	Holotype	Paratypes (n = 25*)			
		M	*m*	σ	limits of variation
L_{Sm}, mm	374.0	369.8	2.63	13.39	349.5–396.3
Plastic characters In % of L_{Sm}					
l_1	94.9	94.5	0.09	0.46	93.3–95.2
l_2	77.6	77.2	0.18	0.89	75.5–78.9
ao	7.1	6.4	0.09	0.46	5.2–7.1
o	4.5	4.3	0.06	0.31	3.6–5.0
f	10.5	10.2	0.07	0.37	9.5–11.0
c	20.2	19.5	0.13	0.64	18.5–21.0
cH	16.9	16.9	0.11	0.58	15.6–18.2
ch	11.7	11.2	0.14	0.72	10.0–12.5
io	6.9	6.6	0.09	0.43	6.0–8.2
lmx	5.6	5.6	0.05	0.26	5.1–6.0
i/lmx	2.0	2.0	0.03	0.14	1.8–2.3
lmd	9.6	9.6	0.08	0.40	8.9–10.4
H	25.1	25.6	0.24	1.24	23.3–28.4
h	8.1	8.2	0.09	0.43	7.4–8.8
w	12.4	11.4	0.19	0.97	9.2–13.6
aD	35.0	35.0	0.22	1.11	33.0–37.0
pD	40.9	39.6	0.26	1.32	37.8–42.1
aA	69.1	71.5	0.34	1.75	67.9–74.5
aV	46.4	46.9	0.27	1.39	44.9–49.4
lp	15.5	14.8	0.12	0.61	13.4–15.8
PV	29.3	29.5	0.25	1.26	27.3–31.6
VA	24.5	26.2	0.33	1.66	23.2–30.3
lD	25.9	24.1	0.27	1.39	21.1–27.1
hD_1	11.7	11.3	0.18	0.92	9.1–12.9
hD_2	22.4	20.2	0.45	2.31	16.8–24.4
lA	9.7	9.5	0.14	0.73	8.6–10.9
hA	11.5	12.3	0.24	1.23	10.6–14.8
lP	17.9	17.6	0.19	0.96	15.5–19.9
lV	19.5	18.3	0.18	0.94	17.0–21.1
B % c					
ao	35.1	32.7	0.39	1.97	28.1–35.8
o	22.3	22.3	0.25	1.27	18.6–24.8
f	52.1	52.2	0.30	1.51	49.1–55.0
cH	83.8	87.1	0.56	2.86	81.4–92.1
ch	58.3	57.4	0.60	3.06	50.7–61.9
io	34.2	34.1	0.46	2.36	31.0–41.4
lmx	27.8	28.7	0.18	0.92	26.9–30.5
i/lmx	9.8	10.3	0.15	0.76	9.1–11.8
lmd	47.7	49.2	0.32	1.63	46.4–51.4

Table 1. (Contd.)

Characters	Holotype	Paratypes (n = 25*)			
		M	*m*	σ	limits of variation
Meristic characters					
ll	85	82.2	0.58	2.97	73–87
D_1	9	7.9	0.12	0.62	7–9
D_2	13	13.7	0.15	0.77	12–15
D	22	21.6	0.15	0.74	20–23
P	15	14.8	0.10	0.53	13–16
V	10	10.0	0.05	0.28	9–11
A_1	5	4.1	0.08	0.42	3–5
A_2	8	9.2	0.13	0.66	8–10
sb.	19	19.0	0.23	1.18	17–23
rb.	10	8.7	0.12	0.59	8–10
vert.	–	51.0	0.16	0.75	50–52
pc	–	23.9	0.58	2.80	19–28

Note: L_{Sm}, fork length; l, length to the end of scale cover; l_2, length of the body; ao, snout length; o, horizontal eye diameter; f, length of postorbital region of the head; c, head length; cH, head depth near the occiput; ch, head depth near the eye; io, forehead width; lmx, length of upper jaw; i/lmx, width of upper jaw; lmd, length of lower jaw; H, maximum body depth; h, minimal body depth; w, body thickness; aD, antedorsal distance; pD, postdorsal distance; aA, anteanal distance; aV, anteventral distance; lp, length of caudal peduncle; PV, pectoventral distance; VA, ventroanal distance; lD, length of dorsal fin insertion; hD_1, depth of the anterior part of dorsal fin; hD_2, depth of the posterior part of dorsal fin; lA, length of anal fin insertion; hA, depth of anal fin; lP, length of pectoral fin; lV, length of ventral fin; ll, number of perforated scales in lateral line; D_1, number of unbranched rays in dorsal fin; D_2, number of branched rays in dorsal fin; D, total number of rays in dorsal fin; P, number of branched rays in pectoral fin; V, number of branched rays in ventral fin; A_1, number of unbranched rays in anal fin; A_2, number of branched rays in anal fin; sb., number of gill rakers; rb., number of branchiostegal rays; vert., number of vertebrae without urostyle; pc, number of pyloric caeca; M, average value of the index; m, its error; σ, standard deviation. *, number of vertetebrae and pyloric caeca was counted in 23 individuals.

spots of different shape with a diameter of 1–3 mm are scattered. Above ventral fins, below lateral line, scales have a weak reddish shade. Caudal peduncle large, extending to adipose fin in a folded state. Its upper edge wide, oval. Dorsal fin pattern consists of several series of red-crimson spots of different shape. In its anterior part, poorly distinguishable spots are only near the insertion as three to four narrow horizontal stripes, while, in the posterior part, their number increases to seven. Closer to the middle of the fin, spots become rounded in the shape and well noticeable. Spots of the upper row are the largest, of an irregular shape, vertically and horizontally extended. Their margins extend to neighboring interradial membranes, sometimes fusing with the margin, forming a kind of a continuous wide tortuous stripe. Rows located lower are formed of oval spots of a smaller size with a narrow dull framing. Along rays of ventral fins, four stripes of red-claret color pass. Between the first and the second stripes there is an additional shortened stripe of the same color. Adipose fin large, of lilac color. Pectoral fins monotonous, yellowish gray.

Etymology. The species is named in honor of the famous researcher of graylings of Eurasia, Anatolii Nikolaevich Svetovidov.

Description of the species (compiled from type individuals of grayling from the Sharga Gol River). Morphometric characters are described in detail in Table 1. Some of them are listed in the diagnosis.

Besides specific features of morphology and coloration mentioned in the diagnosis, the species is characterized by still other characters. The interorbital space is two times smaller than the head length, and the postorbital region is slightly smaller than its half. Mouth terminal. Postdorsal distance is approximately by 10–15% larger than antedorsal. Posterior part of dorsal fin in individuals of both sexes is higher than the anterior part. The length of its insertion averages a quarter of L_{Sm}. Pectoral fins slightly shorter than ventral. The latter do not extend to the anterior edge of anal fin insertion. Caudal peduncle shortened and wide.

Upper part of the head and dorsum almost black. Clearly distinguishable black spot on lower jaw. Gill cover of a steel-blue color with a light turquoise shade. Lower jaw lighter than the upper jaw. Tongue light. Lower part of abdomen white. Two parallel stripes of dark brownish color with a yellowish shade running from the throat to the insertion of ventral fins. In most individuals along the sides of the body in its anterior part, small black spots (up to 23, on average, 5 with a diameter of 1 to 3 mm) are scattered. One or two such

spots sometimes present also on the posterior edge of gill cover. No black spots on the body of some fish. Above the insertion of ventral fins (not higher than the lateral line), scales have a weak reddish shade.

The general background of dorsal fin dark. A red-crimson margin runs along its upper edge. In the anterior part, it is narrow; by the middle of the fin, near its insertion, spots small, horizontally extended, situated as three to four rows. The upper anterior part of the fin is spot free. Nearer to median rays, spots become larger, and the number of their rows increases. Ventral fins of dark gray color with four to five red-claret stripes running along rays. Adipose fin relatively large, of dark lilac color with a claret shade. Pectoral fins yellowish gray. Anal fin yellow-orange near insertion, and its margins are yellowish red (Figs. 2a, 2b).

Comparative remarks. The study of mitochondrial DNA sequences variation demonstrated that the Upper Yenisei, Upper Ob *T. nikolskyi*, and Mongolian *T. brevirostris* graylings differing from each other at a relatively low level of divergence comprise close branches at the phylogenetic tree. In turn, they are considerably distant from branches that represent the Arctic *T. arcticus* and, to a smaller degree, Baikal *T. baicalensis* graylings (Koskinen et al., 2002; Froufe et al., 2005; Weiss et al., 2007).

The set of diagnostic characters that distinguish the new species of grayling *T. svetovidovi* sp. n. from other representatives of the genus *Thymallus* is rather wide, it includes body coloration, dorsal fin pattern, as well as some morphometric characters.

In the Upper Yenisei grayling, unlike Arctic grayling, there is a bright red spot above ventral fins, and caudal peduncle and caudal fin insertion are yellow-orange rather than red-claret, as in several known species and subspecies of the genus *Thymallus*. This specific feature in the body coloration of the Upper Yenisei grayling was also recorded by Pivnička and Hensel (1978) in graylings from the Shishkhid Gol River whose tributary is the Sharga Gol River. In addition, at dorsal fin of the new species, spots of the upper row have an uneven outline and, on fusing, form a tortuous stripe. On the contrary, in the Arctic grayling, spots of neighboring membranes do not connect with each other. Unlike other representatives of the genus (except Arctic grayling), in the Upper Yenisei grayling on dorsal fin there are more than five rows comprised of spots of different size and shape.

The new species of grayling considerably differs (coefficient of difference CD exceeds formally the subspecies level 1.28) from the sympatric part of the Yenisei basin Arctic grayling (including populations from rivers of the Arctic coast of Eurasia and North America) in five plastic (cH, ch, io, lmd, H, aD) and four meristic (D_1, V, vert., pc) characters. From the second sympatric species, Baikal grayling that inhabits the main part of the Angara-Yenisei basin and Lake Baikal with tributaries (Knizhin et al., 2006; Weiss et al., 2007), the Upper-Yenisei grayling differs at a formally subspecies level in eight plastic (cH, H, h, lp, lD, hD_2, lP, lV) and three meristic (ll, vert., pc) characters, and from the Kosogol grayling *T. baicalensis nigrescens* Dor.[2] from Lake Khubsugul in nine plastic (cH, H, h, pD, lp, lD, hD_2, lP, lV) and six meristic (ll, D_2, D, V, sb., vert.) characters. In the latter case, hiatus between five characters (H, pD, hD_2, lV, vet.) was revealed.

Unlike the Upper Ob and Mongolian graylings, in all individuals of the Upper Yenisey grayling, the depth of the posterior part of caudal fin is noticeably greater than the depth of its anterior part. In turn, Mongolian grayling differs from other taxa of the genus *Thymallus* in the fact that only in it the articulation of the lower jaw with the cranium is behind the vertical of the posterior edge of the eye, and teeth, besides jaws, are present on vomer and palate. Unlike the new species, in Mongolian and Upper Ob graylings, body coloration completely lacks red and yellow-orange shades. With respect to coefficient CD, the Upper-Yenisei grayling differs from the Upper-Ob grayling in seven plastic (o, cH, H, w, lP, hD_2, lV) and two meristic characters (D_2, D), and from the Mongolian grayling, in 12 plastic (cH, ch, lmd, H, h, pD, lp, PV, lD, hD_2, lP, lV) and four meristic (D_1, D_2, D, rb.) characters. As compared to Mongolian grayling, hiatus was revealed between three characters (pD, hD_2, lV) and with the Upper Ob grayling, for one character (hD_2).

Unlike Amur taxa, the new species lacks stripes of yellow-brown or black spots between rows of scales. In the Upper Yenisei grayling with the nominative subspecies of Amur grayling *T. g. grubii*, differences were recorded that exceeded the formal subspecies level in the number of rays in dorsal fin with hiatus between maximum body depth and head depth near occiput, and with yellow-spotted grayling *T. g. flavomaculatus*, in the total number of rays in dorsal fin with hiatus between antedorsal distance. From the Lower Amur grayling *T. tugarinae* Knizh. et al., the Upper Yenisei grayling is distinguished in the coefficient of CD in nine plastic (o, f, ch, io, H, h, aD, lp, lD) and two meristic characters (D, pc) with hiatus between antedorsal distance, and with the Burein grayling *T. burejensis* Ant. in ten plastic (f, cH, io, aD, lp, hD_2) and one meristic (D) characters.

Unlike the Upper Yenisei grayling and other species, the European grayling *T. thymallus* (L.) has an elongated snout, almost subterminal mouth, and dorsal fin pattern is composed of small and large spots, as well as of wide bands at terminal interradial membranes. In the Upper Yenisei and European graylings, differences that exceed the subspecies level were established for ten

[2] The data of the molecular genetic and morphological analyses make it possible to consider Kosogol grayling in the status of subspecies of Baikal grayling (Knizhin and Weiss, 2007).

plastic (f, cH, ch, io, lmd, H, h, hD_2, lP, lV) and two meristic (V, rb.) characters.

The Upper Yenisei and Burein graylings differ from all the known taxa of the genus *Thymallus* in, on average, greater length of pectoral fins and smaller number of branchiostegal rays, and, as compared to Mongolian grayling, in having relatively fewer vertebrae (without urostyle). The Upper Yenisei and Lower Amur graylings have relatively short postdorsal distance and caudal peduncle length. The Upper Yenisei and Baikal graylings, as compared to other taxa of the genus, are characterized, on average, by a greater value of antedorsal distance (Table 2).

Thus, the new species—*T. svetovidovi* sp. n., besides genetic characteristics, has a set of specific charaters that include a yellow-orange caudal peduncle and fin insertion, dorsal fin pattern, on average, great head depth near occiput, width of interorbital space, maximum and minimal body depth, as well as the depth of the posterior part of dorsal fin.

On the basis of some of the listed characters, it is possible to compile a key for the differentiation of the Upper Yenisei grayling from the sympatric with it in the Yenisei basin Baikal *T. baicalensis* and Arctic *T. arcticus* graylings, as well as from phylogenetically close to it taxa—Mongolian *T. brevirostris* and the Upper Ob *T. nikolskyi* graylings.

KEY TO GRAYLINGS *THYMALLUS* FROM THE UPPER OB AND THE ANGARA-YENISEI AND BAIKAL BASINS

1(2) Teeth present on the head and shaft of the vomer and also on palate. Articulation of lower jaw with cranium is behind the posterior edge of the eye

.....***Thymallus brevirostris*—Mongolian grayling.**

2(1) Teeth on vomer shaft and palatine lacking. Articulation of lower jaw and cranium is in front of the posterior edge of the eye.

3(6) On dorsal fin, no more than five rows of spots of different size and shape.

4(5) Dorsal fin pattern consists of four to five relatively uniform complete rows comprised of red-crimson spots of oval shape not connecting with each other and a narrow rim that passes along the upper margin of the fin. Depth of the upper part of dorsal fin in individuals of both sexes is the same as or smaller than its depth in the anterior part. Body coloration monotonous, silvery. Number of scales in lateral line 76–91 (81). Number of branched rays in dorsal fin 14–18 (15)….

……***Thymallus nikolskyi*—Upper Ob grayling.**

5(4) Dorsal fin pattern consists of three to four incomplete rows of spots concentrated in its posterior part. Some of the spots from the upper row fuse with the margin that runs along the upper part of the fin, forming wide and short stripes extending to the middle of rays. Depth of posterior part of fin in males is usually greater than the depth of its anterior part. Body coloration varies from the raven-black-gray to almost black, above ventral fins there is a pale crimson or large red spot. Number of scales in lateral line 80–110 (97). Number of branched rays in dorsal fin 10–15 (13) …….***Thymallus baicalensis*—Baikal grayling.**

6(3) At dorsal fin, more than five rows of spots.

7(8) Caudal peduncle and caudal fin insertion of red-claret color. Above ventral fins there is a large spot of irregular shape of the same color. Head depth near occiput 12.0–16.6 (14.0)%, antedorsal distance 28.2–34.3(31.1)% L_{Sm}…….....

.....***Thymallus arcticus*—Arctic grayling.**

8(7) Caudal peduncle and caudal fin insertion of yellow-orange color. Above ventral fins, scales can have light reddish shade. Head depth near occiput 15.6–18.2(17.0)%, and dorsal distance 33.0–37.0(35.0)% L_{Sm}. …***Thymallus svetovidovi* sp. n.—Upper-Yenisei grayling (Svetovidov grayling).**

Distribution. The range of the species requires clarification. It inhabits the upper course of the Yenisei River in Mongolia and possibly in Tuva. Two individuals from the Konui River (tributary of the Abakan River, upper reaches of the Yenisei in Khakassia),[3] studied by methods of molecular genetics, according to mitochondrial DNA, turned out to be close to graylings from the Shishkhid Gol (according to our unpublished data). With high probability one can expect finding local populations of the Upper Yenisei grayling at watersheds of the Yenisei with the Selenga (Lake Baikal basin) and Oka rivers (basin of the upper reaches of the Angara River).

We have at our disposal also the photograph of grayling from the upper course of the Borshoo Gol River (northwestern tributary of Lake Uvs Nur). Drawing on the dorsal fin of this individual is very close to that of the Upper Yenisei grayling. According to Golubtsov (IPEE RAS), the habitation of graylings in this tributary can be the result of introduction.

Biology. The biology of the species has almost not been studied. Brief evidence on graylings from the upper course of the Yenisei River in Mongolia (lakes Dod Tsagan Nur, Shishkhid Gol) is presented in the monograph by Baasanzhav et al. (1985). However, as was mentioned above, the authors of the listed paper did not separate taxonomically graylings of the upper course of the Selenga and the upper course of the Yenisei, taking them for a nominative subspecies of the Arctic grayling.

[3] Samples from graylings from the Konui River for performing molecular genetic analysis were obtained from S.S. Alekseev (IDB RAS).

Table 2. Some morphometric characters of species and subspecies of graylings *Thymallus* (above the line is the average value of the character; below the line, limits of its variation; *n*, number of fish in which plastic/meristic characters were assessed)

Characters	*T. tugarinae* *n* = 76/93	*T. grubii grubii* *n* = 122/138	*T. grubii flavomaculatus* *n* = 67/67	*T. burejensis* *n* = 33/34	*T. brevirostris* *n* = 57/61	*T. thymallus* *n* = 158/154	*T. nikolskyi* *n* = 40/40	*T. baicalensis* (black) *n* = 248/248	*T. baicalensis* (white) *n* = 41/41	*T. baicalensis nigrescens* *n* = 35/35	*T. arcticus* *n* = 167/236
L_{Sm}, mm	150–274	132–303	160–324	153–348	188–665	202–426	144–293	207–428	242–408	233–333	172–430
						In % of L_{Sm}					
cH	16.0 13.5–17.4	14.6 13.4–16.6	15.1 13.2–17.1	15.6 13.0–16.7	14.1 12.1–18.0	14.6 13.0–16.7	15.5 14.1–16.6	14.2 12.1–16.7	14.4 13.6–15.4	13.9 12.6–17.1	13.9 12.0–16.6
io	5.8 4.8–7.7	5.8 4.8–7.4	5.5 4.5–6.2	5.6 5.0–6.2	5.9 3.8–7.6	5.5 4.5–6.7	6.1 5.5–6.7	6.0 4.7–7.2	6.1 5.3–6.8	6.0 5.5–7.8	5.5 4.6–7.2
H	22.8 19.8–25.8	19.5 16.9–21.8	21.4 18.3–25.5	23.6 21.5–25.7	19.9 16.6–23.5	22.0 18.9–26.8	22.7 20.1–26.6	20.0 16.3–25.0	21.7 17.7–24.6	18.3 16.2–19.8	20.3 16.7–24.1
h	7.4 6.8–8.3	6.5 6.0–7.3	7.1 6.2–8.0	7.6 6.9–8.3	6.6 5.5–7.7	7.3 6.3–8.2	7.6 7.1–8.4	6.5 4.4–7.7	6.3 5.8–6.7	6.5 6.0–7.2	7.5 6.2–8.8
aD	28.6 26.2–31.9	31.4 27.7–34.5	29.3 27.1–30.9	31.6 29.8–33.5	33.9 30.6–37.1	33.8 31.1–37.3	33.6 30.8–35.7	34.9 32.0–39.0	35.3 33.1–37.6	34.1 31.5–36.3	31.1 28.2–34.3
pD	40.1 37.3–43.7	43.1 39.4–46.1	43.2 39.4–45.4	41.1 38.0–44.2	45.3 42.1–48.7	41.4 38.0–45.4	41.0 38.6–44.2	42.1 36.5–47.3	43.2 39.9–45.6	44.8 42.4–48.0	40.9 36.8–45.7
lp	17.1 14.0–19.5	17.5 15.7–19.6	17.8 15.6–19.7	16.5 15.0–18.3	17.1 14.4–20.0	15.9 13.8–18.9	17.1 14.9–19.0	17.0 14.3–19.3	16.8 15.4–18.3	17.4 15.5–19.2	16.0 14.0–18.8
hD_2	16.8 11.3–24.5	11.5 6.7–22.7	13.3 8.3–23.7	14.9 9.5–21.0	8.4 6.1–10.6	13.6 8.1–23.1	9.2 6.9–15.4	11.5 6.2–22.9	7.0 5.7–9.7	9.4 6.9–12.2	19.2 9.2–37.0
lP	16.5 14.9–18.3	15.3 13.9–17.1	15.7 13.6–17.5	17.8 14.8–19.0	14.7 12.5–16.3	15.1 12.0–17.3	16.2 14.3–17.6	15.8 13.3–17.9	13.7 12.8–14.8	15.6 13.6–17.0	16.1 13.6–19.6
						In % of c					
cH	83.6 76.1–91.5	74.4 66.8–81.3	79.3 69.6–89.0	82.3 68.1–89.9	67.9 57.7–83.5	76.3 65.3–88.4	80.6 73.0–89.1	73.4 65.9–85.2	74.4 67.1–80.0	70.8 63.5–87.7	74.2 62.9–87.5
io	30.4 26.3–38.9	29.8 26.1–35.5	29.1 23.6–32.9	29.4 26.4–33.6	28.6 16.7–34.0	29.0 24.1–34.9	31.9 28.5–36.2	31.1 26.1–36.1	31.7 27.4–35.2	30.7 28.3–39.8	29.4 23.1–36.6
						Meristic characters					
rb.	9.7 8–11	9.7 8–12	9.4 8–11	8.7 8–10	10.0 9–11	9.3 7–11	9.3 9–10	9.4 7–11	10.2 9–12	9.3 8–10	8.8 7–10
vert.	51.9 48–55	54.0 48–57	53.8 50–57	52.4 51–54	51.1 49–57	51.9 50–55	52.5 50–55	55.4 50–60	55.0 52–58	55.3 54–57	54.1 51–59

Note: Designations of characters are the same as in Table 1. *T. tugarinae*, the rivers Anyui (basin of the lower reaches of the Amur) and Khunmakta (northwestern Sakhalin); *T. grubii grubii*, the Ingoda River, Onon River (basin of the upper reaches of the Amur), and the Umalta-Makit River (upper course of the L. Bureya River); *T. grubii flavomaculatus*, rivers Anyui, Merek (basin of the lower course of the Amur River), Buta, Botchi, and Koppi (Tatar Strait); *T. burejensis*, the Umalta-Makit River (upper course of the L. Bureya River); *T. brevirostris*, lakes Kokh Nur, Khoton Nur, Khurgan Nur, Tolbo Nur, and the upper course of the Kobdo River (Central Asiatic basin, Mongolia); *T. thymallus*, the rivers Obr, Gurk, Mur, Gail, Inn, Socha, Linon, Ans, and the Rhine (basins of the Black and Adriatic seas); *T. nikolskyi*, the rivers Biya and Bashkaus and Lake Teletskoe (basin of the upper course of the Ob River); *T. baicalensis* (black grayling), Lake Baikal, Irkutsk Reservoir, the upper course of rivers Oka, Nizhnyaya Tunguska, and Fokina (Angara-Yenisei basin); *T. baicalensis* (white grayling), Lake Baikal and the Selenga River; *T. baicalensis nigrescens*, Lake Khubsugul (Mongolia); *T. arcticus*, lower reaches of the Lena and V. Khandyga rivers (Aldan-Lena), the rivers Anabar, Yana, Indigirka, Kolyma, Penzhina (basins of the East Siberian Sea and the Laptev Sea), Ulya, Urak, Raduga (basin of the Sea of Okhotsk), and the Big Hol River (basin of the Missouri River).

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REFERENCES

1. G. Baasanzhav and Ya. Tsend-Ayush, *Mongol orny zagas* (Ulaanbaatar: Ulanbaatar Khot, 2001).
2. G. Baasanzhav, Yu. Yu. Dgebuadze, A. N. Demin, et al., "Family Thymallidae," in *Fishes of the Mongolian People's Republic*, Ed. by M. I. Shatunovskii (Nauka, Moscow, 1983).
3. G. Baasanzhav, Yu. Yu. Dgebuadze, A. N. Demin, et al., "Family Thymallidae," in *Ecology and Commercial Importance of Fish of the Mongolian People's Republic*, Ed. by M. I. Shatunovskii (Nauka, Moscow, 1985).
4. L. S. Berg, *Fishes of the USSR and Adjacent Countries*, 4th ed. (Akad. Nauk SSSR, Moscow, 1948), Part 1 [in Russian].
5. A. Dulma, "Zur Fishfauna der Mongolei," Mitt. Zool. Mus. (Berlin) **49**, 49–67 (1973).
6. E. Froufe, I. Knizhin, and S. Weiss, "Phylogenetic Analysis of the Genus *Thymallus* (Grayling) Based on mtDNA Control Region and ATPase 6 Genes, with Inferences on Control Region Constrains and Broad-Scale Eurasian Phylogeography," Mol. Phylogen. Evol. **34**, 106–117 (2005).
7. I. B. Knizhin and S. J. Weiss, "Modern Concepts of the Diversity and Taxonomic Status of Graylings (Thymallidae) of Eurasia," in *Proceedings of the International Scientific and Practical Conference on Protection and Scientific Studies at Especially Protected Natural Territories of Far East and Siberia Dedicated to the 20th Anniversary of Organization of Bureinskii State Nature Reserve, 2007., settlement of. Chegdomyn* (Priamursk. Geograf. O-vo, Khabarovsk, 2007), pp. 103–112.
8. I. B. Knizhin, S. J. Weiss, A. L. Antonov, and E. Froufe, "Morphological and Genetic Diversity of Amur Graylings (*Thymallus*, Thymallidae)," Vopr. Ikhtiol. **44** (1), 59–76 (2004) [J. Ichthyol. **44** (1), 52–69 (2004)].
9. I. B. Knizhin, S. J. Weiss, and S. Sušnik, "Graylings of Baikal Lake Basin (*Thymallus*, Thymallidae): Diversity of Forms and Their Taxonomic Status," Vopr. Ikhtiol. **46** (4), 442–459 (2006) [J. Ichthyol. **46** (6), 418–435 (2006)].
10. M. T. Koskinen, I. Knizhin, C. R. Primmer, et al., "Mitochondrial and Nuclear DNA Phylogeography of *Thymallus* spp. (Grayling) Provides Evidence of Ice-Age Mediated Environmental Perturbations in the World's Oldest Body of Freshwater, Lake Baikal," Mol. Ecol. **11**, 2599–2611 (2002).
11. M. Kottelat, *Fishes of Mongolia. A Check-List of the Fishes Known to Occur in Mongolia with Comments on Systematics and Nomenclature. World Bank Rep. (NEMO)* (Wash., DC, 2006).
12. E. Mayr, *Principles of Systemic Zoology* (McGraw-Hill, New York, 1969).
13. M. V. Mina, "Species—Ideal, Real, and Distinguished According to Agreement," Sb. Tr. Zool. Muz. Mosk. Gos. Univ. **58**, 305–317 (2007).
14. K. Pivnička and K. Hensel, "Morphological Variation in the Genus *Thymallus* Cuvier, 1829 and Recognition of the Species and Subspecies," Acta Univ. Carolinae-Biologica 1975–1976 **4**, 37–67 (1978).
15. N. A. Plokhinskii, *Biometry* (Mosk. Gos. Univ., Moscow, 1970) [in Russian].
16. I. F. Pravdin, *Guide for Fish Study* (Pishch. Prom-st', Moscow, 1966) [in Russian].
17. P. F. Rokitskii, *Biological Statistics* (Vysheish. Shk., Minsk, 1973) [in Russian].
18. A. N. Svetovidov, "European-Asiatic Graylings (Genus *Thymallus* Cuvier)," Tr. Zool. Inst. Akad. Nauk SSSR **3**, 183–301 (1936).
19. P. Ya. Tugarina, *Graylings of Baikal* (Nauka, Novosibirsk, 1981) [in Russian].
20. S. Weiss, I. Knizhin, V. Romanov, and T. Kopun, "Secondary Contact Between Two Divergent Lineages of Grayling *Thymallus* in the Lower Enisey Basin and Its Taxonomic Implications," J. Fish. Biol. **71** (Suppl. C), 371–386 (2007).