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FISHES OF THE GENUS *AMEIURUS* (ICTALURIDAE, SILURIFORMES) IN THE TRANSCARPATHIAN WATER BODIES

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Fishes of the Genus *Ameiurus* (Ictaluridae, Siluriformes) in the Transcarpathian Water Bodies. Movchan, Yu. V., Talabishka, E. M., Velikopolskiy, I. J. — Morphometric standards of two species of the genus *Ameiurus* Rafinesque, 1820 are analyzed. The differences in external morphology between *A. melas* and *A. nebulosus* and the boundaries of current distribution of these fishes in the waters of Transcarpathia are determined.

Key words: Brown bullhead, Black bullhead, Transcarpathia, river basins, morphological features, distribution.

Рыбы рода *Ameiurus* (Ictaluridae, Siluriformes) в водоёмах Закарпатья. Мовчан Ю. В., Талабишка Е. М., Великопольский И. И. — Проанализированы морфометрические стандарты двух видов рода *Ameiurus* Rafinesque, 1820. Установлены внешнеморфологические различия между *A. melas* и *A. nebulosus* и приведены современные границы распространения этих рыб в водоёмах Закарпатья.

Ключевые слова: американский сомик, чёрный американский сомик, Закарпатье, бассейны рек, морфологические особенности, распространение.

Introduction

The brown bullhead (*Ameiurus nebulosus* Lesueur, 1819) and black bullhead (*A. melas* Rafinesque, 1820) are the representatives of the genus *Ameiurus*, and these species have already become a part of local ichthyofauna in the Transcarpathian Region of Ukraine. These species originate from the freshwater bodies of North America. Brown bullhead is distributed from Canada to Florida and occurs in the Mississippi basin, whereas the black bullhead is distributed in the water bodies of the east part of America, from the south of Canada to the north of Mexico (Scott, Crossman, 1973; Kottelat, Freyhof, 2007; etc.). Both species are widely introduced to the freshwater bodies at least in 18–25 countries of North and South America, Europe, and Asia.

In 1871 *A. nebulosus* was recorded in Europe for the first time in France, and later in 1880 and 1885 there was a large introduction of this fish to Germany (Vivier, 1951; Schindler, 1953; Spillmann, 1961; etc.). In 1884 when the regular overseas traffic between America and Europe had been established this fish was introduced in Belgium (Kendall, 1910). It is believed, that in Hungary for the first time this species appeared in 1902 (Pintér, 1989, cited after Wilhelm, 1998). Acclimatization of *A. nebulosus* in the Danube is known since 1926 (Balon, 1964), and since 1934 in Romania (Antonescu, 1938). Holčik (1972) revealed the presence of *A. nebulosus* during his study of morphological features of the bullheads in Czechoslovakia. Similar results were given for the Transcarpathian water bodies (Movchan, 1988).

The first record of *A. melas* in Europe was from France in 1871 (Boët, 2001). In Italy it was found in 1904 (Tortonese, 1970), in the Netherlands in 1936 (Pintér, 1989) and 1941 (Wheeler, 1978), in Poland in 1953 (Nowak et al., 2010), in Hungary in 1980 (Harka, Pintér, 1990), in Romania in 1997 (Wilhelm, 1998), in Slovakia in 1999 (Koščo et al., 2000), and also it is already known from the water bodies of Portugal (Gante, Santos, 2002), Spain (Elvira, 1984) and many other countries.

The bullheads recorded at that time in the water bodies of France, Italy and Romania, are suggested to be misidentified as *A. nebulosus*, but in fact it was *A. melas* (Spillmann, 1967; Tortonese, 1967, Bănărescu, 1968; etc.). Also it was noted, that most of bullheads introduced into Europe, belong to *A. nebulosus*, but also *A. melas, Ictalurus punctatus* (Rafinesque, 1818) and, possibly, *A. natalis* (Lesueur, 1819) were introduced (Wheeler, 1978). The latter author rejects the idea that *A. melas* exclusively occurs in Europe, and he agrees that in Europe both *A. nebulosus* and *A. melas* occur. Electrophoretics study of hemoglobin shows the mix of features for these three species of bullheads: *A. nebulosus, A. melas*, and *A. natalis* (Raunich et al., 1966), but still remains the question of the correspondence of this data to the morphological features of these species. The possibility of hybridization of *A. nebulosus* and *A. melas* under natural conditions of their homeland is not excluded (Scott, Crossman, 1973).

A. nebulosus was recorded in the water bodies of Transcarpathia for the first time in 1954, and in eight years it was spread in the Latoritsa basin (from the state border with Slovakia to Svalyava), Uzh (from the state border to Kamianytsa village) Borzhava (in all tributaries up to the dam in the village Velyki Komiaty) and Tisza (caught near Khust) and in floodplain lakes, channels and reservoirs of these rivers basins (Kukhta, 1964). Vlasova (1956) claims that in the rivers of Transcarpathia (Latoritsa, Uzh) this species was recorded for the first time in 1955. Turyanin (1982) also believes that in this species was firstly discovered in the rivers of Transcarpathia in 1955, it came from the lake of Balaton (Hungary) as *A. nebulosus melas*. From 1956 to 1966 fishermen's catch in the lower part of streams of Transcarpathian Rivers consisted exclusively of these fish. We have revised large collections of *A. nebulosus* specimens caught in water bodies of Volyn and Transcarpathia at the Zoological Museum NMNH NAS (Movchan et al., 2003) and Zoological Museum of Uzhhorod State University, for the period up to 1986. This species is known to be introduced in Orekhovske lake (western Belarus) in 1935, and then transported into the lakes Luky and Lutsymyr of Volyn (Ivlev, Protasov, 1948; Makushok, 1951; Zhukov, 1965; etc.); although it is possibly known here since 1928 (Bilko, Pavlov, 1965). Of 901 specimens of the genus *Ameiurus* in the collections no specimens belong to *A. melas* and it may show this species was absent there at that time.

In Transcarpathia, *A. melas* was recorded for the first time, in a floodplain lake in Tisza basin near Solomonovo vil. at the border with Slovakia in 2002 (Koščo et al., 2004), i. e., c. 50 years after the advent of *A. nebulosus*, and according to our data, now it is widespread in the water bodies of this region and has become a part of local ichthyofauna. Five water bodies near Uzhhorod were inhabited by *A. nebulosus*, and two by both *A. melas* and *A. nebulosus*. Unfortunately, the authors did not provided either any details about the number of specimens caught in these lakes, or their sizes, morphometric features, etc., although they noticed the difficulty in identification of both species (Markovych, Kutsokon, 2012). In our opinion, the presence of *A. melas* in the water bodies near Uzhhorod needs a reasonable confirmation.

These species are unevenly studied *A. nebulosus* is well known, particularly in the waters of Transcarpathia (Movchan, 1988), whereas the data on *A. melas* in the water bodies of Tisza basin in Ukraine are scarce.

Material and methods

Studies were conducted in 2007–2012 (some data in 2005) in the water bodies of Transcarpathian Region of Ukraine. This work is based on the material collected in the river basins and watercourse areas of Tisza, Borzhava, Latoritsa and Uzh: channels, floodplain lakes and ponds aiming finding fishes of the genus *Ameiurus*. All specimens were fixed and then studied in the laboratory. For the biometric study of morphological features of *A. melas,* 26 specimens (13 ♀ and 13 ♂) caught in the pond near the Mala Dobron vil. (Ukraine, Transcarpathian Region, Uzhgorod District, in June 2011, 48°26′42″ N, 22°24′21″ E) were taken. The pond is connected with Latoritsa River by a channel. Spring floods allows free migration of fish from the river to stagnant water bodies or conversely. To clarify the diagnosis of species, its morphological standards of *A. melas* were compared with those of *A. nebulosus*. 26 specimens of *A. nebulosus* (13 ♀ and 13 ♂) with length parameters appropriate to *A. melas* were collected in the oxbows of Latoritsa (Ukraine, Transcarpathian Region, Uzhgorod District, vic. of Chop, "Syren" gorge, 20–21.08.1976). Measurements of morphological parameters and its biometric processing were conducted according to commonly accepted methods of ichthyologic studies (Pravdin, 1966; etc.).

Results and discussion

Both species are similar (fig. 1), but considerably differ by colouration and morphometric characters. *A. melas* is usually uniformly black, without spots, gradually changing into light gray from dorsal to ventral side, with sharper transition observed ventrally of the lateral line: there are tiny black grains of pigment on a gray background (on brownish background for *A. nebulosus*). Base of the rays of the anal fin light colored and noticeably thicker than the rest of the anal fin area. The membrane between ramified rays of fins is dark, usually black, and contrasts with the lighter rays. Specimens of *A. nebulosus* with large, unexpressed transverse spots of irregular shape on the body sides often occur. The body and upper part of head are usually dark brown, olive, sometimes almost black in this species. Ventrally, on the level of

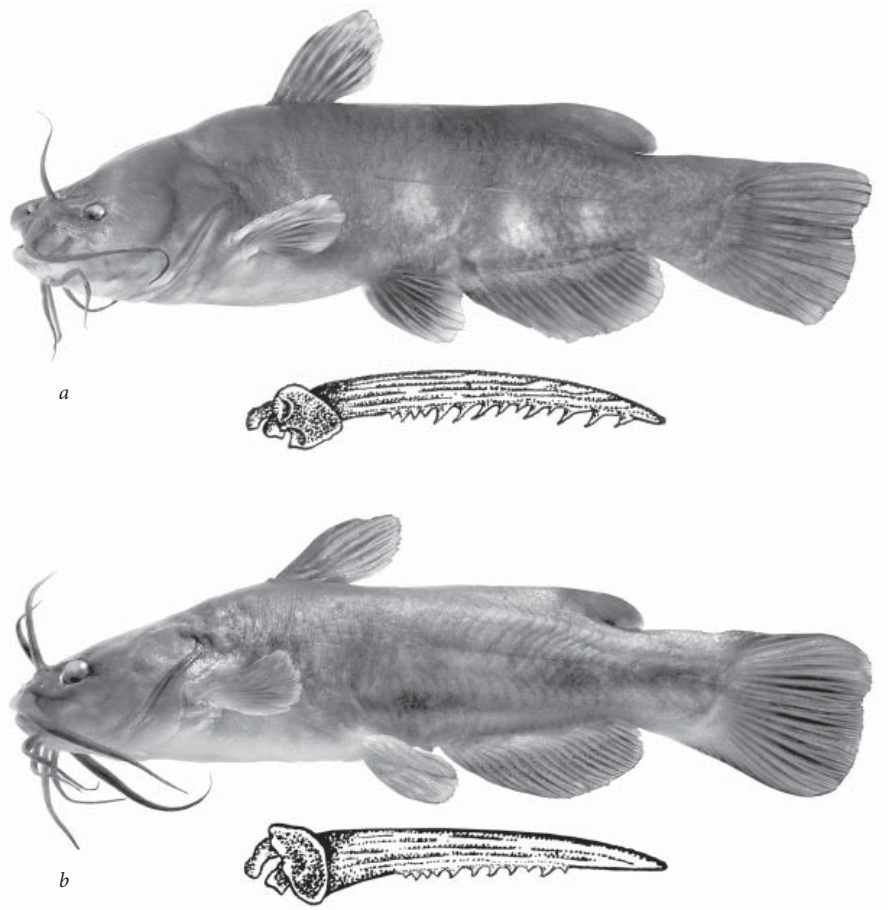

Fig. 1. Fishes of the Genus *Ameiurus*: *a — A. nebulosus, b — A. melas* (photo by O. Yu. Zhaporozhets).

Рис. 1. Рыбы рода *Ameiurus*: *a — A. nebulosus, b — A. melas* (фото О. Ю. Запорожец).

the pectoral fins the color becomes brighter, yellowish-brown or almost yellow and gradually becomes the pale yellow or dirty white on the abdomen. Colouration of fins is monotonous, as the colouration of the body, but with dominance of light tones. It should be noted that the color of these fishes strongly depends on their age and environmental conditions. *A. melas* specimens 3–5 cm long are almost entirely black, except light-gray abdomen, and the young specimens of *A. nebulosus* often have yellowish, pinkish or violet color and poorly expressed spots on the body. In the shallow water bodies with sandy, sandy-clayey or clayey bottom both species become lighter, especially where the vegetation is absent.

Both species have distinctive bare, massive and thick body, almost rounded in frontal part and more slender, laterally compressed behind the dorsal fin. Head and snout in both species are relatively long and wide with rounded apex. Paired nostrils on each side of the head widely separated, each with a pair of long, a bit flattened antennas at base. The second pair of long antennae located at the corners of the transverse terminal mouth. Third and fourth pairs of antennae are located on the bottom surface of the head, slightly behind the mandible, the inner antennae are shorter. The lateral line is complete, almost straight line runs through the middle of the body sides.

All fins are usually rounded apically, dorsal and pectoral fins have sharp osseous spikes, in the pectoral fins it usually more massive, wide and rounded. 70 % specimens of *A. melas* with a few small denticles on the inner surface of the pectoral fin spike, denticles are located on the second third of the ray and do not reach its base, 30 % specimens have

Table 1. Compare of morphological features of *A. melas* and *A. nebulosus*

Таблица 1. Сравнительная характеристика морфологических признаков *A. melas* и *A. nebulosus*

Feature	*A. melas* (n = 26)			*A. nebulosus* (n = 26)			M_{diff}
	M	m	lim	M	m	lim	
D	5.96	0.04	5–6	6.08	0.06	6–7	1.71
A	19.81	0.19	18–22	20.11	0.21	18–22	1.07
P	7.92*	0.09	7–9	8.23	0.11	7–9	2.21
sp. br.	17.03**	0.15	15–19	13.92	0.13	13–15	15.55
l, cm	12.93	0.20	11.5–15.4	12.96	0.20	11.4–15.8	0.28
: *l*, %							
H	26.30	0.33	22.2–29.8	23.05	0.14	20.2–25.9	9.03
h	11.60	0.11	10.3–12.8	11.30	0.09	10.4–12.3	0.97
iH	19.30	0.24	16.7–21.3	19.70	0.20	18.0–21.9	1.29
aD	40.30	0.25	38.2–43.3	37.90	0.21	35.5–40.7	7.27
pD	57.00	0.37	53.8–61.0	56.17	0.32	52.1–59.3	1.69
aV	51.90	0.57	47.6–64.2	49.97	0.20	45.7–50.0	3.22
aA	64.30	0.75	49.6–70.5	60.40	0.31	56.7–64.0	4.81
PV	27.60	0.31	24.0–30.1	24.20	0.27	20.8–26.1	8.29
VA	14.60	0.35	11.2–18.4	14.63	0.27	11.7–17.4	0.07
pl	16.60	0.19	14.6–18.2	18.90	0.16	16.7–19.6	9.20
lD	8.50	0.13	6.5–9.5	8.66	0.11	7.0–9.5	0.94
hD	18.90	0.32	14.7–21.4	18.78	0.29	15.1–20.3	0.31
lA	22.10	0.28	18.9–24.5	22.10	0.23	20.3–24.5	0.00
hA	13.20	0.30	10.0–17.4	15.51	0.28	12.3–18.1	5.50
lP	15.80	0.27	13.3–18.3	16.55	0.27	13.7–18.6	1.97
lV	13.80	0.15	12.2–15.8	15.47	0.26	12.9–16.8	5.67
lC ***	20.70	0.37	17.6–23.6	16.40	0.26	13.9–17.9	9.56
c, cm	29.10	0.17	27.6–31.0	27.05	0.17	26.2–29.8	8.54
: *c*, %							
hc	64.90	0.63	59.2–70.5	65.80	0.81	60.0–72.7	0.87
hc_1	47.30	0.46	42.6–52.7	46.65	0.63	38.5–51.5	0.83
r	39.40	0.36	35.5–43.6	41.69	0.32	38.5–45.4	13.94
o	11.30	0.22	9.1–13.2	13.21	0.25	10.9–15.1	5.79
po	51.90	0.60	45.4–60.4	49.24	0.21	45.4–52.9	4.15
io	53.30	0.57	47.2–58.8	51.43	0.56	45.0–57.1	2.34
Cir_1	47.70	1.18	38.0–62.0	50.05	0.78	42.5–57.6	1.99
cir_2	90.00	1.26	79.1–104.8	86.55	1.41	71.8–107.7	1.83
cir_3	46.50	1.15	35.3–59.3	44.79	0.76	33.3–53.8	1.24
cir_4	57.30	1.38	36.5–66.8	56.61	0.92	46.1–66.7	0.42

* Fish from the oxbow lake — the former river bed of Latoritsa near Velyki Geyivtsi vil. (18.07.2012).
** *n* = 37.
*** Length of the upper blade of *C*.

Note. M — differentiation coefficient, *n* — number of specimens, *M* — mean value of the feature, *m* — the average error, *lim*—measurement limits. Designation of features: number of ramified fin rays: dorsal — *D*, anal — *A*, pectoral — *P*, the number of gill rakers — *sp. br.*; fins: ventral — *V*, caudal — *C*; standard body length — *l*, cm, ratio (percentage, %) of the following characters to *l*: maximal body height — *H*, minimal body height — *h*, maximal thickness of the body — *iH*, intervals: antedorsal — *aD*, postdorsal — *pD*, anteventral — *aV*, anteanal — *aA,* between fins *P* and *V* — *PV*, between fins *V* and *A* —*VA*, length of caudal peduncle — *pl*, length of base *D* — *lD*, height *D* — *hD*, length of the base *A* — *lA*, height *A* — *hA*, length *P* — *lP*, length *V* — *lV*, length of the upper lobe *C* — *lC*, length head *c*, cm; ratio (percentage, %) of the following characters to *c*: maximal height of head — *hc*, height of head through the middle of the eye — *hc1*, snout length — *r*, the horizontal diameter of the eye — *o*, postocular interval — *po*, width of the forehead — *io*, length of antennae near upper nostril — cir_1 , on the upper jaw — cir_2, inner antennae on chin — cir_3, external antennae on chin — cir_4.

well developed denticles. These 30 % of black bullhead differs from brown bullhead by the distribution of the denticles on the spike. The whole inner surface of the spikes of *A. nebulosus* is always covered with numerous, well serrated and sharp denticles (fig. 1). The paired fins, especially abdominal, of *A. melas* are by touch slightly thicker than fins of *A. nebulosus*.

Comparison of morphological characters of these species shows that specimens of *A. melas* have much more gill rakers, and it corresponds to the literature data (Kottelat, Freyhof, 2007; Nowak et al., 2010). Also specimens of *A. melas* have relatively more expressed characters such as maximal body height, antedorsal, anteventral, anteanal, PV, length of caudal fin and length of the head, whereas specimens of *A. nebulosus* have generally longer caudal peduncle, height of anal, and length of abdominal fins. Specimens of *A. nebulosus* have longer snout and larger eye diameter, whereas specimens of *A. melas* have longer postocular interval (table 1). It should be noted that the number of rays in the anal fin do not differ between these species, making this character ineffective for identification, although according to the literature this character is useful for the studied species (Nowak et al., 2010).

From the data given above we can conclude that in spite of the great morphological similarity in features, this two species significantly differs by the some features that give us the opportunity to define them as follows:

1 (2). Gill rakers: 13–15. The first ray of the pectoral fin (on the inner side) forming the solid spike usually covered with numerous sharp denticles on the inner side (strongly serrated). Base of the anal fin without significant thickening. Leathery membrane between rays of the anal and caudal fins is the same colour as the rays. Transverse blurred spots on the body of irregular shape. ..... Brown bullhead — *A. nebulosus*

2 (1). Gill rakers: 15–19. The first ray of the pectoral fin (on the inner side) forming the solid spike usually covered with a few sharp denticles on the middle part. Base of the anal fin with significant thickening, noticeably lighter coloured compared to the color of the fin. Leathery membrane between rays of the anal and caudal fins black and noticeably darker than rays of the fins. Spots on the body absent. .... Black bullhead — *A. melas*

A. melas is widespread in the floodplain water bodies downstream of Latoritsa River and in some lakes, ponds and reservoirs located within the water intake of that river. It occurs also in the slowly flowing or stagnant waters in the channel system located between Latoritsa and Borzhava and in the floodplain water bodies of Borzhava. In channels with fast-flowing water, these fishes have not been found. In the basin of Tisza, this species is almost ubiquitous in Vynohradiv and Khust Districts, in the network of small flood water bodies and meliorative channels that stretch along the river. It also avoids a significant flow of the Tisza, but at the same time gradually moves higher along its course, which suggests that this fish uses mainstream of rivers (usually with a significant currency) only for the further distribution into the water bodies with relatively weak flow or stagnant ones. *A. melas* was not found in the basins of the Tisza River tributaries such as Teresva, Tereblya and Rika, although the appearance of this species is possible in small private ponds because of uncontrolled migrations between different farms in the lowlands. In the Uzh River basin, this species been found yet, but its appearance is expecting due to the existing optimal conditions for this species in the lakes near Uzhhorod, where, according to our data, only *A. nebulosus* was found so far (fig. 2). Invasion of *A. melas* is only the matter of time, because basins of Uzh and Latoritsa are connected by the system of channels.

We should note some data about the speed and way of distribution of *A. melas*. For the first time it was recorded in Transcarpathia in 2004 at the border with Slovakia. In 2007 we caught this species in the lake connected with Latoritsa near Svalyava, more than in 65 km from the first location, and it shows the ability to travel long distances in order to expand the inhabited area. Now this species has been found in the same water bodies, where *A. nebulosus* was found before (fig. 2). It gives us the opportunity to assume that both species use the same pathways in this region; perhaps the seasonal floods have a key role in their distribution.

There is an interesting fact which is requires further confirm. We think that the distribution of *A. melas* in the water bodies of the region is related to fading of *A. nebulosus*, as

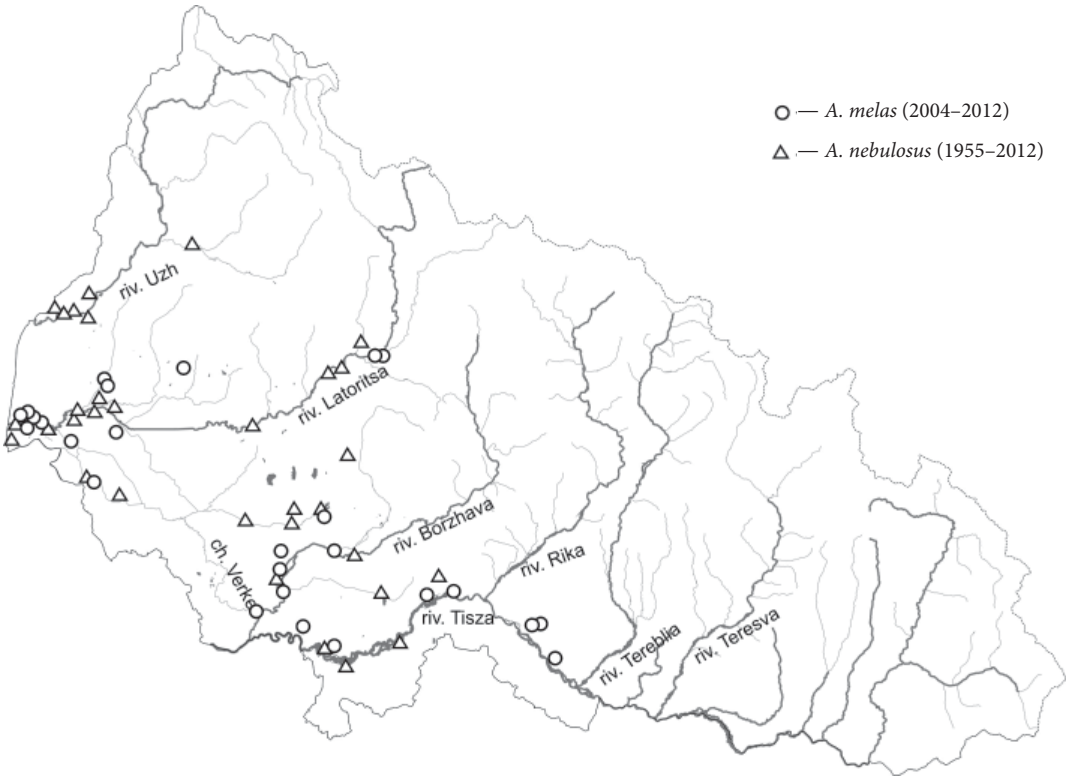

Fig. 2. Present distribution of species of the genus *Ameiurus* in Transcarpathia waters.

Рис. 2. Современное распространение видов рода *Ameiurus* в водоёмах Закарпатья.

the following data evidenced. In 2004 in the lake near the village Solomonovo *A. melas* was found for the first time, and it occurred together with *A. nebulosus*, nowadays only *A. melas* occurs there. In the oxbows of Latoritsa River, near Velyki Geyivtsi village, 41 specimens of the genus *Ameiurus*, 40 specimens of *A. melas*, and only one of *A. nebulosus* were caught. In the lake near Mala Dobron village, in 2011 2–3 specimens of *A. nebulosus* per several dozens of *A. melas* were caught, but in 2012 only specimens of *A. melas* were found. *A. melas* became dominant over *A. nebulosus* in the lakes near Svalyava town back in 2007, and in 2012 of 62 caught bullheads no specimens of *A. nebulosus* were found. In the water bodies of the Latoritsa floodplain, *A. melas* is also gradually replacing *A. nebulosus*, but in the mainstream of Latoritsa *A. nebulosus* are still catching by the amateur fishers from time to time. In the water bodies inhabited by *A. melas*, adult specimens of *A. nebulosus* were found dead. It could be due to parasites of *A. melas*, for which the local population of *A. nebulosus* lost its resistance. Death causes of adult specimens of *A. nebulosus* require special studies.

Conclusions

A. nebulosus is a typical bottom fish, very steady and unpretentious to the quality of water and environment, this species is the omnivore and the active rival not only for the industrial, but also to all fishes of the local ichthyofauna. The negative impact of this species into the local ichthyofauna was repeatedly mentioned previously (Ivlev, Protasov, 1948; Markevych, Korotkiy, 1954; Nosal, Simonova, 1958; Kukhta, 1964; Turyanin, 1982; Movchan, 1988; etc.). However, behavior of *A. melas* is actually does not differ from that of *A. nebulosus*. That is why the study of the distributional dynamics of the new invasive species in a local area, in particular in the water bodies of Transcarpathia, can be an

important source of information for predicting and determining behavior and the impact of new, usually dangerous species for the local ichthyofauna. Both species of bullheads have been already naturalized and become the part of the local ichthyofauna. Their expansion in Tisza took place subsequently after almost 50 years, and now there is a new destabilization (deterioration and redistribution) in some ichthyocenoses under the influence of dangerous and aggressive *A. nebulosus* and *A. melas*. *A. nebulosus* gradually became a "victim" of *A. melas*. Therefore more accurate studies of these invasive species, their negative impact on the ichthyofauna of Transcarpathia and methods for reducing their populations are needed.

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