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BIOMETRIC ANALYSIS OF FISH REMAINS FROM PALAEOLAKE BOLTYSH (UKRAINE)

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Biometric Analysis of Fish Remains from Palaeolake Boltysh (Ukraine). Dubikovska, A. & Koval-chuk, O. — The results of the study of the meristic and morphometric characters of complete and fragmentary skeletons of *Notogoneus gracilis* (Gonorynchidae) and *Boltyshia brevicauda* (Umbridae) recovered from Paleocene–Eocene lacustrine deposits of the Boltysh impact structure are presented in the paper. Some of the specimens previously assigned to *Thaumaturus avitus* were re-identified as *Boltyshia brevicauda*. The meristic characters of the specimens considered are stable in both species and refer to those in the respective type series. A previously unknown caudal fin formula (I 6–6 I) is observed in several specimens of *Boltyshia brevicauda*. The latter species is characterised by more variable meristic characters compared to *Notogoneus gracilis*.
Key words: *Notogoneus*, *Boltyshia*, meristic traits, metric traits, squamation.

Introduction

The Boltysh (Bovtyshka) impact structure was formed 65.59 ± 0.64 Ma (roughly at the Cretaceous–Paleogene boundary) in the central part of the modern territory of Ukraine (Gilmour et al., 2013, 2014; Dykan et al., 2018; Pickersgill et al., 2021). Considering the meteoric origin of the crater and the features of the lake that existed within its borders for a long time (Gurov et al., 2006; Ebinghaus et al., 2017; Dykan & Dykan, 2020), Boltysh represents a unique locality yielding numerous remains of Paleocene–Eocene vertebrates, mostly of endemic taxa (Sytchevskaya, 1976, 1986; Gaudant, 2012; Skutschas & Gubin, 2012; Dykan et al., 2018; Dubikovska & Kovalchuk, 2022).

The species composition of bony fishes from palaeolake Boltysh is generally well known. A series of imprints obtained from boreholes was assigned to a number of taxa (Amiinae gen. et sp. indet., *Notogoneus gracilis* Sytchevskaya, 1986, *Thaumaturus avitus* Sytchevskaya, 1986, *Boltyshia brevicauda* Sytchevskaya et Daniltshenko, 1975, *Boltyshia truncata* Sytchevskaya, 1976, *Tretoperca vestita* Sytchevskaya, 1986) representing five families: Amiidae, Gonorynchidae, Thaumaturidae, Umbridae, and Percichthyidae (Dykan et al., 2018). These fishes inhabited a lake that had occasional water exchange with the Tethys Ocean (Dykan et al., 2018; Dykan & Dykan, 2020). Their remains are likely to have been transported at some distance prior to burial in an oxygen-free environment.

A number of fish specimens from Boltysh are stored in the collection of the Department of Palaeontology of the National Museum of Natural History, National Academy of Sciences of Ukraine (Kyiv). This is valuable material as it includes both complete and near-complete fish skeletons with imprints of internal organs. Preliminary species identification of the specimens from this sample was carried out at the macromorphological level. The data on meristic and morphometric characters for most fish species from the Boltysh locality are rather limited or incomplete, while those provided by Sytchevskaya (1976, 1986) in most cases represent the relative values of particular morphometric characters, expressed in percentages (e. g., the ratio of orbital diameter to head length). It is rather problematic to use such data without having information about the linear values of the respective measurements because the original linear values can't be derived from ratios themselves. Some meristic characters mentioned in diagnoses (e. g., the number of dorsal and ventral fin rays, the number of precaudal vertebrae in *Thaumaturus* and *Boltyshia*) are the same or strongly overlap, and in this case the use of morphometric characters allows additionally clarifying the species identification for some problematic specimens. The study of a series of specimens is also important for the estimation of the range of intraspecific variability since the accuracy of results strongly depends on the sample size, as well as for further clarification of patterns of morphological disparity between discrete faunas.

The aim of this paper is to present a revised list of taxonomic composition of fish remains recovered from Boltysh and to carry out a biometric analysis of a series of fish remains belonging to the species *Notogoneus gracilis* and *Boltyshia brevicauda* endemic to Palaeolake Boltysh, comparing them with the respective data of the type series.

Material and Methods

The studied sample consists of 91 fish imprints, some of which represent complete specimens while others are fragmentary, obtained from a depth of 307.0–434.5 m. These specimens were recovered during core drilling within the Boltysh impact structure in the vicinity of the village of Bovtyshka in Kirovohrad Oblast, central Ukraine. Fragmentary specimens (including various combinations of body parts with fins, heads, or tails) are much more numerous, while only *Boltyshia brevicauda* is represented by 10 complete skeletons, which provided comprehensive results for this species compared to other taxa from the sample. Original data (Sytchevskaya, 1986) were used to identify the species affiliation of the specimens, and all available characters were subjected to morphometric and meristic analysis. In order to minimize error in meristic variables, counts were carried out twice: once from the anterior and once from the posterior end of the body, following the methodologies of Barton and Wilson (1999) and of Frey et al. (2016). Morphometric measurements follow Sytchevskaya's (1976, 1986) methods; they were taken in three repetitions with digital calipers, with an accuracy of 0.01 mm.

The following parameters were measured in the specimens from Boltysh: standard length; preorbital length; orbital diameter; postorbital length; head length; head depth; length of the lower jaw; maximum and minimum body depth; predorsal, preventral, preanal, pectoroventral and ventroanal length; dorsal and anal fin base length, and caudal peduncle length. Calculations were carried out in MS Excel 2010. Photographs of the specimens were taken with a Canon PowerShot SX530 HS camera; microphotographs of scales were made using a ZOOM MICROmed trinocular microscope, equipped with a SL-CMOS/CCD microscope camera and Tsview 7 modular software. Abbreviations used: HL —head length; NMNHU-P Pi — Department of Palae-

ontology, National Museum of Natural History, National Academy of Sciences of Ukraine (collection Pisces); PIN — Borissiak Palaeontological Institute, Russian Academy of Sciences; SD — standard deviation; SL — standard length; TL —total length.

Results

Species composition

An updated species list of fish specimens recovered from the Boltysh locality (with the information on the depth from which the respective samples were collected as well as borehole numbers) is presented in the Appendix.

The Boltysh assemblage is taxonomically similar to those known from Paleocene and Eocene localities elsewhere in Europe: Menat and Montmartre in France, Messel, Eckfeld and Geiseltal in Germany, and Kučlín in the Czech Republic (Voigt, 1934; Jerzmańska, 1977; Gaudant, 1979, 1981; Cavagnetto & Gaudant, 2000; Böhme & Ilg, 2003; Gaudant, 2012). *Boltyshia brevicauda* and *Notogoneus gracilis* are the most abundant taxa in the Boltysh assemblage (figs 1, 2), being represented by specimens in different states of preservation; other taxa are relatively rare. The smallest number of imprints obtained from Boltysh represent an undetermined amiine fish, *Boltyshia truncata*, and *Tretoperca vestita*. The preservation of two other imprints is extremely poor and thus they remain undetermined.

Dykan et al. (2018) pointed out the presence of ten complete and fragmentary specimens identified as *Thaumaturus avitus* in the NMNHU-P collection. During our study, these imprints were revised and reassigned to *Boltyshia brevicauda*, based on both meristic and morphometric parameters.

Meristic characters

The meristic characters of the specimens in the sample are quite stable and species-specific (see Sytchevskaya, 1986 for more details). The meristic characters collected include the number of precaudal and caudal vertebrae as well as the number of rays in paired and unpaired fins (table 1).

The total number of vertebrae in the specimens considered refers to those in the type series of *Notogoneus gracilis* and *Boltyshia brevicauda* (Sytchevskaya, 1986). It is impossible to accurately count the number of precaudal vertebrae in *N. gracilis* due to poor preservation of the specimens, which prevents the unambiguous identification of the first caudal centrum.

Fig. 1. *Notogoneus gracilis* Sytchevskaya, 1986, NMNHU-P Pi 291. Scale bar 5 mm.

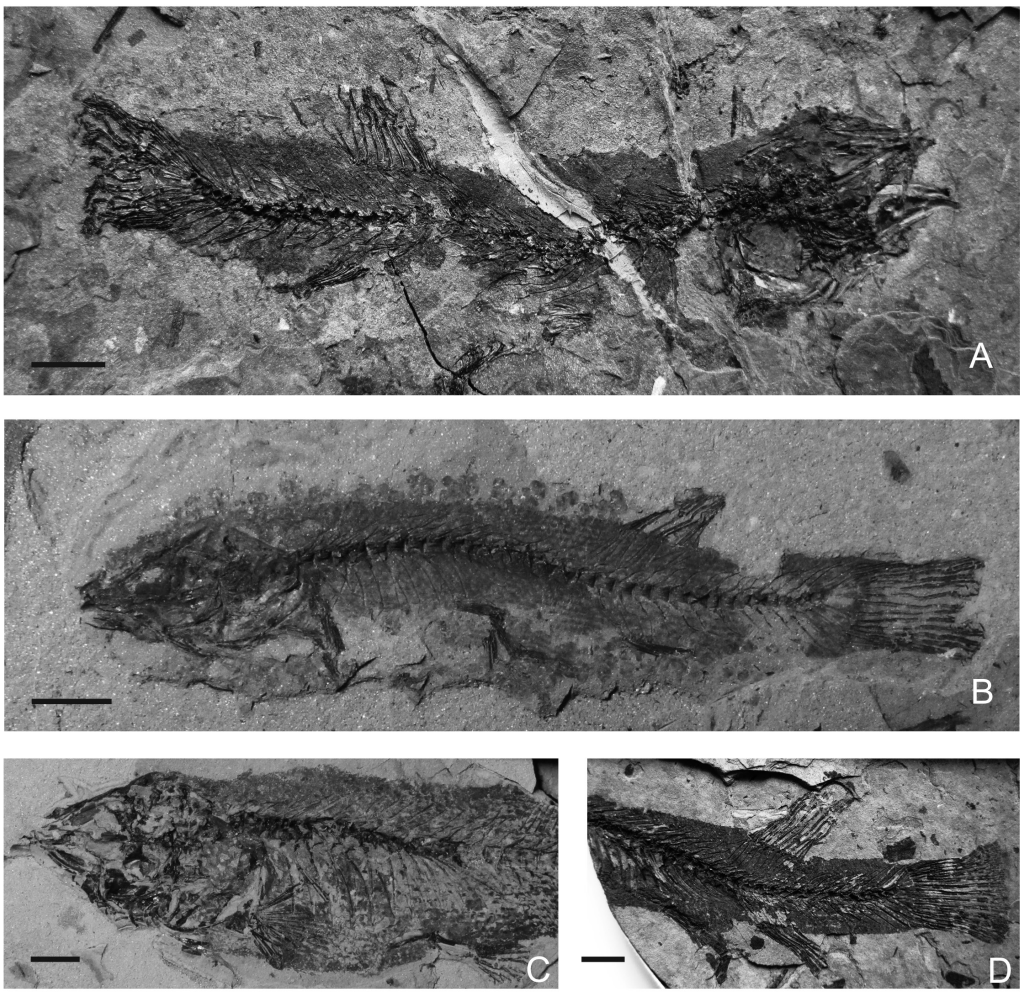

Fig. 2. Imprints of *Boltyshia brevicauda* Sytchevskaya and Daniltshenko, 1975: A — NMNHU-P Pi 307; B — NMNHU-P Pi 333; C — NMNHU-P Pi 342; D — NMNHU-P Pi 299. Scale bars equal 5 mm.

The numbers of dorsal and ventral fin rays in the imprints of *Notogoneus gracilis* and *Boltyshia brevicauda* fall within the ranges of those seen in their respective type series. The same was observed with regards to the number of anal fin rays of *B. brevicauda*, while this character in *N. gracilis* coincides with only one of the values within the interval determined in Sytchevskaya (1986).

The number of pectoral fin rays in specimens of the two studied species is identical to those from their respective type series. The caudal fin formula of *Notogoneus gracilis* is also equal to that originally established for this species (Sytchevskaya, 1986). The caudal fin formula of *Boltyshia brevicauda* appears to be the most variable species-specific character: the most frequent formula in the sample is I 7–6 I (7 specimens), although it does not correspond to the formula indicated for the species in Sytchevskaya (1976, 1986). Three specimens of *B. brevicauda* from the NMNHU-P (Pi 320, Pi 333, and Pi 344) have a previously unknown caudal fin formula of I 6-6 I.

The most stable (i. e., least variable) meristic characters in *Notogoneus gracilis* are the number of rays in dorsal, ventral, and caudal fins (II 9, I 6, and I 8–9 I, respectively). All meristic characters of *Boltyshia brevicauda* are characterised by a certain range of variability (table 1).

Table 1. Meristic characters of selected fish specimens from the Boltysh locality

Characters	*Notogoneus gracilis* Sytchevskaya, 1986		*Boltyshia brevicauda* Sytchevskaya and Daniltschenko, 1975		*Boltyshia truncata* Sytchevskaya, 1976	*Thaumaturus avitus* Sytchevskaya, 1986
	NMNHU-P	PIN 3119*	NMNHU-P	PIN 3119*	PIN 3119*	PIN 3119*
Total number of vertebrae	45–47	45–47	33–36	33–36	29	36–39
Abdominal vertebrae	?	33	18–20	18–20	15	18
Dorsal fin rays	II 9	II 9	11–13	11–13	II 11	12
Anal fin rays	II 6	II 6–7	8–12	8–12	I 9	16–17
Pectoral fin rays	10–11	10–11	15–20	15–20	19	11
Ventral fin rays	I 6	I 6	8–10	8–10	9	7–8
Caudal fin rays	I 8-9 I	I 8-9 I	I 7-6 I**	I 6–8-7–8 I	15	I 8-8 I

* Data presented after Sytchevskaya (1986). ** Other variants of the caudal fin-rays formula for this sample are the following: I 6–7 I; I 6–6 I.

Morphometric characters

Morphometric characters of fishes are more variable than meristic ones because they change during ontogeny and under the influence of environmental factors (Elder & Smith, 1988; Micklich & Klappert, 2004; Frey et al., 2016). Values of the 16 morphometric characters were analysed, mean values and standard deviations were calculated along with the ratio of head measurements and standard length wherever possible. This is the first time that most of these morphometric data are presented for the studied species.

The state of preservation of the specimens assigned to *Notogoneus gracilis* does not make it possible to estimate the ratio of individual measurements to standard length. In addition, it was not possible to measure their preventral and ventroanal length. Several characters (e. g., length of the lower jaw, predorsal and preanal length, dorsal and anal fin base length, caudal

Table 2. Measurements of the studied specimens of *Notogoneus gracilis* Sytchevskaya, 1986 compared to the type series

Characters	NMNHU-P				PIN 3119 (Sytchevskaya, 1986)		
	% SL	% HL	Range, mm	Mean ± SD	% SL	% HL	Range, mm
Standard length	–	–	–	–	–	–	20.0–170.0
Preorbital length	–	28.96–47.20	3.77–12.65	8.21 ± 6.28	–	27.8–30.6	–
Orbital diameter	–	20.49–23.50	2.36–5.49	3.57 ± 1.35	–	21.7–25.5	–
Postorbital length	–	27.24–45.47	5.55–7.30	6.39 ± 0.78	–	43.8–50.4	–
Head length	–	–	13.02–26.80	19.91 ± 9.74	24.5–26.4	–	–
Head depth	–	43.96–53.99	7.03–11.78	9.41 ± 3.36	–	30.2–42.5	–
Lower jaw length	–	26.19	3.41	–	–	24.3–27.2	–
Maximum body depth	–	–	5.52–11.92	8.77 ± 3.20	14.6–15.9	–	–
Minimum body depth	–	–	2.39–7.64	3.94 ± 1.96	7.8–8.5	–	–
Predorsal length	–	–	57.49	–	58.5–60.6	–	–
Preventral length	–	–	–	–	56.4–59.5	–	–
Preanal length	–	–	57.49	–	81.9–83.1	–	–
Pectoventral length	–	–	17.17–17.35	17.26 ± 0.13	31.0–31.4	–	–
Ventroanal length	–	–	–	–	24.5–27.0	–	–
Dorsal fin base length	–	–	4.00	–	6.9–10.6	–	–
Anal fin base length	–	–	1.83	–	5.7–6.4	–	–
Caudal peduncle length	–	–	4.07	–	12.3–12.7	–	–
Caudal peduncle depth	–	–	2.74–4.36	3.55 ± 1.15	7.6–8.5	–	–

peduncle length) can only be estimated in some specimens. However, it was possible to measure other parameters, in particular preorbital length, orbital diameter, postorbital length, head depth, as well as the ratio of the length of the lower jaw to the head length (table 2). All of the obtained data complement and expand the ranges established based on the study of the type series, except for the length of the lower jaw (Sytchevskaya, 1986).

The least variable characters in the studied sample of *Notogoneus gracilis* are postorbital and pectoroventral length (SD < 1), orbital diameter, minimum body depth, and caudal peduncle height (SD < 2). In *Boltyshia brevicauda* (table 3), the least variable morphometric parameters are preorbital length, orbital diameter, minimum body depth, dorsal and anal fin base length (SD < 2). Information about these is presented for the first time here, because these characters are missing from the original description of the species. The expansion of the ranges of relative body parameters can be explained by the presence of individuals representing different ecomorphs *sensu* Sytchevskaya (1976, 1986) in the studied sample.

Squamation

Cycloid scales of *Boltyshia brevicauda* (fig. 3, A, B) are thin, densely placed, and cover the entire body, head, and proximal parts of the caudal fin rays. Their basal edge is uneven and sinuous. The focus is located in the center or shifted towards the basal edge. Thin scle-

Table 3. Measurements of the studied specimens of *Boltyshia brevicauda* Sytchevskaya and Daniltschenko, 1975 compared to the type series

Characters	NMNHU-P				PIN 3119 (Sytchevskaya, 1986)			
					TL up to 260 mm		TL 250–320 mm	
	% SL	% HL	Range, mm	Mean ± SD	% SL	% HL	% SL	% HL
Standard length	–	–	24.33–70.84	49.37 ± 16.45	–	–	–	–
Preorbital length	–	19.21–48.83	1.67–12.33	5.05 ± 2.99	–	26.0–33.0	–	25.8–27.8
Orbital diameter	–	10.54–32.73	1.42–6.99	3.77 ± 1.54	–	16.0–23.0	–	24.2–26.6
Postorbital length	–	30.66–54.85	2.48–13.82	7.56 ± 2.91	–	48.0–55.0	–	46.4–51.5
Head length	26.00–34.68	–	6.62–27.99	16.91 ± 6.13	28.0–33.0	–	26.3–32.6	–
Head depth	–	57.06–78.05	3.91–17.68	11.14 ± 3.88	–	58.0–65.0	–	66.6–82.7
Lower jaw length	–	24.65–68.21	1.91–15.64	8.30 ± 3.81	–	39.0–48.0	–	39.6–42.2
Maximum body depth	16.49–27.93	–	2.97–20.91	10.09 ± 5.47	16.0–24.0	–	16.5–24.0	–
Minimum body depth	10.73–15.96	–	2.77–10.47	7.27 ± 2.27	–	–	–	–
Predorsal length	61.65–74.20	–	14.27–52.58	33.75 ± 21.20	62.0–70.0	–	65.3–67.2	–
Preventral length	50.88–58.96	–	11.34–51.56	29.72 ± 12.10	52.0–58.0	–	50.9–60.0	–
Preanal length	69.23–82.04	–	17.80–57.60	37.58 ± 12.94	70.0–75.0	–	67.1–74.9	–
Pectoventral length	17.10–23.86	–	3.96–18.45	11.51 ± 4.65	18.0–23.0	–	18.7–22.7	–
Ventroanal length	16.60–23.95	–	4.34–17.11	11.02 ± 3.67	16.0–22.0	–	16.5–19.2	–
Dorsal fin base length	7.44–14.08	–	1.68–8.60	5.78 ± 2.10	–	–	–	–
Anal fin base length	5.46–9.76	–	1.95–7.19	4.57 ± 1.33	–	–	–	–
Caudal peduncle depth	2.74–16.17	–	1.84–10.88	7.27 ± 2.60	–	–	–	–
Caudal peduncle length	18.58–35.97	–	4.52–18.34	13.15 ± 2.73	20.0–25.0	–	24.0–27.5	–

rites converge near the basal edge and widely diverge in the apical part. The arrangement of the scales is tile-like, individual scales overlapping to some extent, with their lateral edges forming parallel lines on dorsal and ventral sides of the body, as well as near the caudal fin in some individuals. Small ctenoid scales of *Notogoneus gracilis* (fig. 3, C) bear three to five cteni on their rounded apical edge.

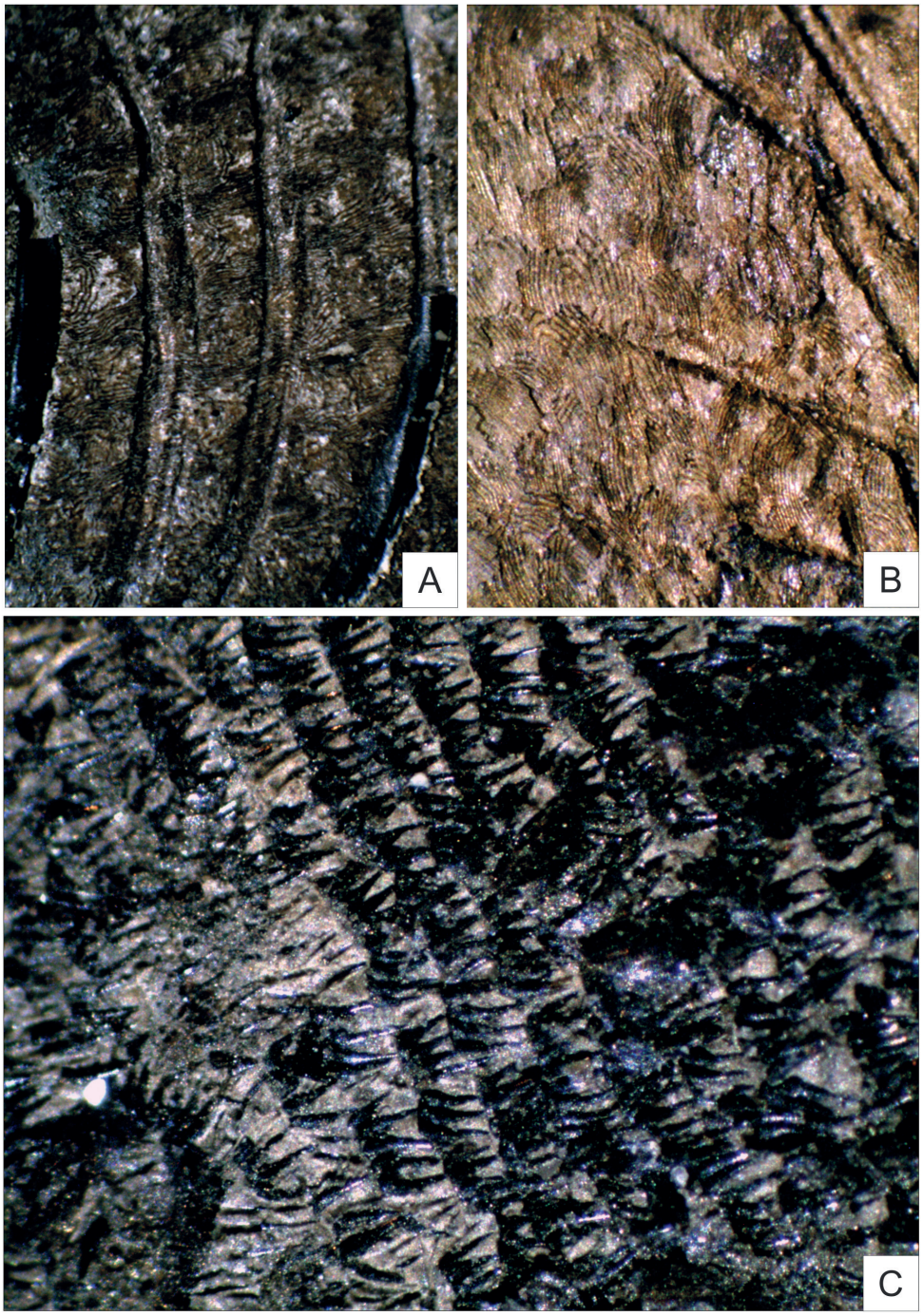

Fig. 3. Squamation of *Boltyshia brevicauda* (A, B) and *Notogoneus gracilis* (C). Not to scale.

Discussion

The study of intraspecific variation in fossil species requires the presence of large and well-preserved samples with a clear stratigraphic context in order to minimize sampling bias and avoid taxon oversplitting (e. g., Bookstein et al., 1978; Behrensmeyer, 1982; Smith et al., 1988; Frey et al., 2016).

Although the series of fish imprints from Boltysh in the NMNHU-P collection is less numerous than the material analysed by Sytchevskaya (1986), its study largely contributes to the understanding of the morphological variation of these endemic fish taxa, including the clarification of species-specific and diagnostically important parameters. The absolute values of the morphometric characters, presented here for the first time, additionally allow the determination of their variability among the several complete imprints in the studied sample representing each species. All ranges of values that could be determined for both species considered were compared to those of the type series. This material also allows more precise species identification and comparison with fish remains originating from other deposits of the same age.

Notogoneus gracilis is characterised by several stable meristic characters, in particular the number of dorsal, ventral and caudal fin rays, and the number of precaudal vertebrae (n = 33); however, it is impossible to confirm the latter due to poor preservation of most imprints in the studied sample. A total of 26 specimens in the NMNHU-P collection were identified as *Notogoneus gracilis*; they differ from the other species of this genus by morphology and biometric parameters (e. g., Divay et al., 2020; Grande et al., 2022).

In *Boltyshia brevicauda*, all meristic traits are variable among the examined specimens, although our counts fall within the previously defined ranges (Sytchevskaya, 1976, 1986). The most variable fin formula in this species is that of the caudal fin. Some meristic characters of *B. brevicauda* — the number of dorsal, ventral and caudal fin rays, the number of precaudal vertebrae — are similar to or overlap with those of *Thaumaturus avitus*, which may cause difficulties during the identification of incomplete fish imprints. Because of this, a special attention should be taken for the correct differentiation of the genera *Thaumaturus* and *Boltyshia* when using the number of anal and pectoral fin rays, the structure of the caudal fin skeleton, or the morphology and placement of scales.

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Appendix 1. The list of fish specimens recovered from the Boltysh locality (complete imprints are indicated with an asterisk)

• **Amiinae gen. et sp. indet.**: 1 specimen in the NMNHU-P collection — Pi 277, borehole no. 9848, depth 272.9–275.9 m (Dykan et al., 2018).

• ***Notogoneus gracilis* Sytchevskaya, 1986**: 26 specimens in the NMNHU-P collection — Pi 291 (n = 5), borehole no. 9836, depth 355.5–359.7 m; Pi 292 (n = 5), borehole no. 9836, depth 355.5–359.7 m; Pi 293 (n=1), borehole no. 9862, depth 364.0–368.0 m; Pi 295 (n=3), borehole no. 9862, depth 364.0–368.0 m; Pi 302 (n = 2), borehole no. 9840, depth 359.0–364.2 m; Pi 309 (n = 3), borehole no. 9836, depth 355.5–359.7 m; Pi 310 (n = 2), borehole no. 9836, depth 355.5–364.2 m; Pi 312 (n = 3), borehole no. 9840, depth 359.0–364.2 m; Pi 313 (n = 1), borehole no. 9862, depth unknown; Pi 332 (n = 1), borehole no. 9862, depth 364.0–368.0 m. In addition, there are 270 specimens in the PIN collection — 3119/730–1051, borehole no. 10438, depth 390.4 m (Sytchevskaya, 1986).

• ***Thaumaturus avitus* Sytchevskaya, 1986**: 7 specimens — PIN 3119/710–718, borehole no. 10371, depth 230.4 m (Sytchevskaya, 1986).

• ***Boltyshia brevicauda* Sytchevskaya and Daniltshenko, 1975**: 62 specimens in the NMNHU-P collection — Pi 278 (n = 1), borehole no. 9856, depth 393.0–397.0 m; Pi 279 (n = 3), borehole no. 9840, depth 376.0–378.0 m; Pi 280 (n = 1), borehole no. 9840, depth 307.0–308.9 m; Pi 281 (n = 1), borehole no. 9853, depth 397.5–401.8 m; Pi 282* (n = 1), borehole no. 9855, depth 419.2–422.1 m; Pi 283 (n = 1), borehole no. 9840, depth 359.0–364.2 m; Pi 284 (n = 1), borehole no. 9862, depth 391.7–395.7 m; Pi 285 (n = 1), borehole no. 9840, depth 369.8–384.5 m; Pi 286 (n = 1), borehole no. 9850, depth 402.2–406.9 m; Pi 287 (n = 2), borehole no. 9854, depth 431.0–434.5 m; Pi 288 (n = 1), borehole no. 9845, depth 400.0–403.6 m; Pi 289 (n = 2), borehole and depth unknown; Pi 290 (n = 1), borehole no. 9840, depth 307.0–308.9 m; Pi 294 (n = 5), borehole no. 9843, depth 400.0–403.6 m; Pi 296* (n = 1), borehole no. 9840, depth 376.0–378.0 m; Pi 297 (n = 1), borehole no. 9854, depth 431.1–434.5 m; Pi 298 (n = 1), borehole no. 9851, depth 394.1–398.0 m; Pi 299 (n = 1), borehole no. 9840, depth 398.0–401.5 m; Pi 300 (n = 1), borehole no. 9850, depth 402.2–406.9 m; Pi 301 (n = 1), borehole no. 9854, depth 401.8–403.0 m; Pi 303* (n = 1), borehole no. 9855, depth 419.2–422.1 m; Pi 304 (n = 1), borehole no. 9850, depth 402.2–406.9 m; Pi 305 (n = 1), borehole and depth unknown; Pi 306 (n = 1), borehole no. 9840, depth 367.1–369.8 m; Pi 307* (n = 1), borehole no. 9840, depth 382.0–384.5 m; Pi 308 (n = 1), borehole no. 9840, depth 307.0–308.9 m; Pi 309 (n = 1), borehole no. 9836, depth 355.5–359.7 m; Pi 310 (n = 1), borehole no. 9836, depth 355.5–364.2 m; Pi 311 (n = 1), borehole no. 9840, depth unknown; Pi 312 (n = 2), borehole no. 9840, depth 359.0–364.2 m; Pi 316 (n = 1), borehole no. 9840, depth 393.5–395.0 m; Pi 317 (n = 2), borehole and depth unknown; Pi 318 (n = 1), borehole no. 9840, depth 402.0–404.8 m; Pi 319 (n = 5), borehole no. 9840, depth 376.0–378.0 m; Pi 320* (n = 1), borehole no. 9851, depth 394.1–395.0 m; Pi 321 (n = 1), borehole no. 9840, depth 376.0–378.0 m; Pi 322* (n = 1), borehole no. 9851, depth 394.1–398.0 m; Pi 333* (n = 1), borehole no. 9855, depth 422.1–426.0 m; Pi 334 (n = 1), borehole no. 9854, depth 431.1–434.5 m; Pi 337 (n = 1), borehole no. 9854, depth 431.1–434.5 m; Pi 342 (n = 1), borehole and depth unknown; Pi 343* (n = 1), borehole and depth unknown; Pi 344* (n = 1), borehole and depth unknown; Pi 345 (n = 1), borehole and depth unknown; Pi 346* (n = 1), borehole and depth unknown; Pi 347 (n = 1), borehole and depth unknown; Pi 348 (n = 1), borehole and depth unknown; Pi 349 (n = 1), borehole and depth unknown. There are 705 specimens in the PIN collection — 3119/1–705, borehole no. 9842, depth 399.0 m (Sytchevskaya, 1976, 1986).

• ***Boltyshia truncata* Sytchevskaya, 1976**: 1 specimen — PIN 3119/27, borehole no. 9870, depth 410.0 m (Sytchevskaya, 1976, 1986: 1 specimen — PIN 3119/720, borehole no. 10327, depth 325.0 m (Sytchevskaya, 1986).

• **Teleostei indet.**: 2 specimens — NMNHU-P Pi 282, borehole no. 9855, depth 419.2–422.1 m; Pi 288, borehole no. 9845, depth 400.0–403.6 m.