*Vestnik zoologii*, **49**(4): 317–324, 2015
DOI 10.1515/vzoo-2015-0034

DE GRUYTER
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UDC 567.58:782.1(477)

# A NEW EXTINCT SPECIES OF PIKEPERCH *SANDER SVETOVIDOVI* (TELEOSTEI, PERCIDAE) FROM THE LATE MIOCENE OF SOUTHERN UKRAINE

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**A New Extinct Species of Pikeperch, *Sander svetovidovi* (Teleostei, Percidae), from the Late Miocene of Southern Ukraine. Kovalchuk O. M. —** A new species of pikeperch from the Upper Miocene strata of Ukraine (Egorovka 2 locality, MN 12) is described in the paper. Extinct species *Sander svetovidovi* sp. n. differs from the Miocene and recent taxa of the genus *Sander* by the configuration of the quadrate bone, form and sizes of the lateral condyle and also presence of additional double crista on the anterior inferior edge of quadratum.

K e y w o r d s: *Sander*, Percidae, new species, Egorovka 2, Late Miocene, Ukraine.

**Новый вымерший вид судака, *Sander svetovidovi* (Teleostei, Percidae), из позднего миоцена юга Украины. Ковальчук А. Н. —** Описан новый вид судака из отложений верхнего миоцена юга Украины (местонахождение Егоровка 2, MN 12). Вымерший вид *Sander svetovidovi* sp. n. отличается от миоценовых и современных рыб рода *Sander* конфигурацией квадратной кости, формой и размерами латерального мыщелка, а также наличием дополнительного двойного гребня на переднем нижнем крае quadratum.

К л ю ч е в ы е  с л о в а: *Sander*, Percidae, новый вид, Егоровка 2, поздний миоцен, Украина.

## Introduction

Formation of the fish fauna is a complex dynamic process depending on many interfacial and complementary factors. Elucidation of ways of formation of the extant freshwater fish variety in the Southeastern Europe will not help only to understand the causes of its mosaic, set its genetic relationship with ichthyocomplexes of other regions, but also give a valuable material for theoretical generalizations in the context of its further development. Achieving of this goal is not possible without a comprehensive analysis of paleontological material. Determination of the Late Miocene and Pliocene freshwater fish species composition on numerous bone remnants is an important and challenging task.

The perch family (Percidae) comprises 204 extant species, belonging to 10 genera, which are confined to freshwater, in the temperate and subarctic regions of Eurasia and North America (Nelson, 2006). Representatives of the six genera (*Gymnocephalus* Bloch, 1793; *Perca* Linnaeus, 1758; *Percarina* Nordmann, 1840; *Romanichthys* Dumitrescu, Bănărescu et Stoica, 1957; *Sander* Oken, 1817; *Zingel* Cloquet, 1817) are spread in Europe (FishBase, 2014), and almost all of them (except *Romanichthys*) are known in water bodies of Ukraine (Movchan, 2011). The earliest members of Percidae (*Vixperca corrochani* de la Pena Zarzuelo, 1991) were found in the Lutetian strata (42.8–42.2 Ma, Middle Eocene) of Sante Clara de Avedillo (Zamora Province) in Spain (Pena Zarzuelo de la, 1991).

Percids are hardy species tolerating a wide range of environmental conditions. High production, growth and survival of percids require appropriate food such as zooplankton, littoral invertebrates and prey fish, at the correct stage in the life cycle. Perch species are very successful animals within the limits of tolerable environmental conditions (Craig, 2000). The generalised form of the percids makes them radially adaptive. Up to the Miocene the Percidae probably played a major role in the fish fauna in Europe. But the appearance of cyprinids at this time may have prevented diversification of the percids (Craig, 2000). Nevertheless, perch fishes along with minnows, catfishes and pikes form the core of the Late Miocene freshwater fish fauna of Southern Ukraine (Kovalchuk, 2015).

The present paper is devoted to description of a new extinct pikeperch species, with remarks on distribution and early evolutionary stages of fishes of the genus *Sander* in the Eastern Europe.

**Study site**

Multilayered locality of the fossil vertebrates has been discovered by M. V. Sinitsa in 2007 near the Egorovka village, Odesa region, Ukraine (fig. 1). The faunal list of Egorovka locality comprises fishes, amphibians, reptiles, birds and small mammals. Geological section and Late Miocene small mammal fauna from two heterochronous levels were described in detail previously (Sinitsa, 2008; Sinitsa, 2010; Rosina, Sinitsa, 2014). Lower bonyferous level (Egorovka 1) is composed of light-gray clays and lacustrine loams. Upper level (Egorovka 2) is a clay gravestone with lenses of gray loams (Sinitsa, 2008). Freshwater fish bones come from these strata and can be dated by the late Maeotian according to the study of mammals (Kovalchuk, 2011). These remnants are belonged to 18 species, 13 genera, 4 families, namely Cyprinidae, Siluridae, Esocidae and Percidae (Kovalchuk, 2015).

**Material and methods**

The material under study is represented by disarticulated bones. These items are housed in the Paleontological Museum of the National Museum of Natural History (NMNH-P), National Academy of


Fig. 1. Type locality Egorovka 2, Odesa Region (Ukraine).

Sciences of Ukraine (collection No. 41). Determination of remnants is provided by author using diagnostic features. Recent fish bones, deposited in the NMNH-P, Zoological Museum (NMNH NAS of Ukraine), as well as fossil fish remnants from the Late Miocene and Pliocene localities of Ukraine and Kazakhstan were used for comparison. Ichthyologic systematics in the paper follows Nelson (2006) and Movchan (2011), correlation of the Eastern Paratethys stages with European Mammal Neogene Zones — Topachevsky et al. (1997, 1998), Nesin and Nadachowski (2001). The specimens were measured with aid of a digital caliper with 0.01 mm precision. The following measurements were taken: LAS — length of articular surface, WAS — width of articular surface, WPP — width of processus praeopercularis, DCL — diameter of condylus lateralis, R — range, M — mean. Bone terminology follows Sytchevskaya (1989) and Lepiksaar (1994). Anatomical scheme of the quadrate bone of pikeperch is presented on the fig. 2.

The perch family is represented in the Late Miocene of Southeastern Europe at least 6 species and three genera (*Perca*, *Sander*, and extinct *Leobergia* Schtylko, 1934). Pikeperch remnants from the Egorovka locality were found to be different from other species of the genus *Sander* in a number of characters and described here as new species under the principles of the International Codex of Zoological Nomenclature (International Code..., 2003).

Genus *Sander* Oken, 1817 consists of 5 extant taxa (FishBase, 2014), including two species (*Sander lucioperca* Linnaeus, 1758 and *Sander volgensis* Gmelin, 1789) from the water bodies of Ukraine (Movchan, 2011). The earliest representatives of the genus (*Sander* sp.) have been appeared in the fossil record in the Middle Miocene (15.9 Ma) of Canada — Kleinfelder Farm near Rockglen, Saskatchewan (Divay, Murray, 2011; Divay, Murray, 2013). Extinct pikeperch species (*Sander martinii* (Rückert-Ülkumen, 1994), *Sander teneri* Murray, Cumbaa, Harrington, Smith et Rybczynski, 2009) were described from the

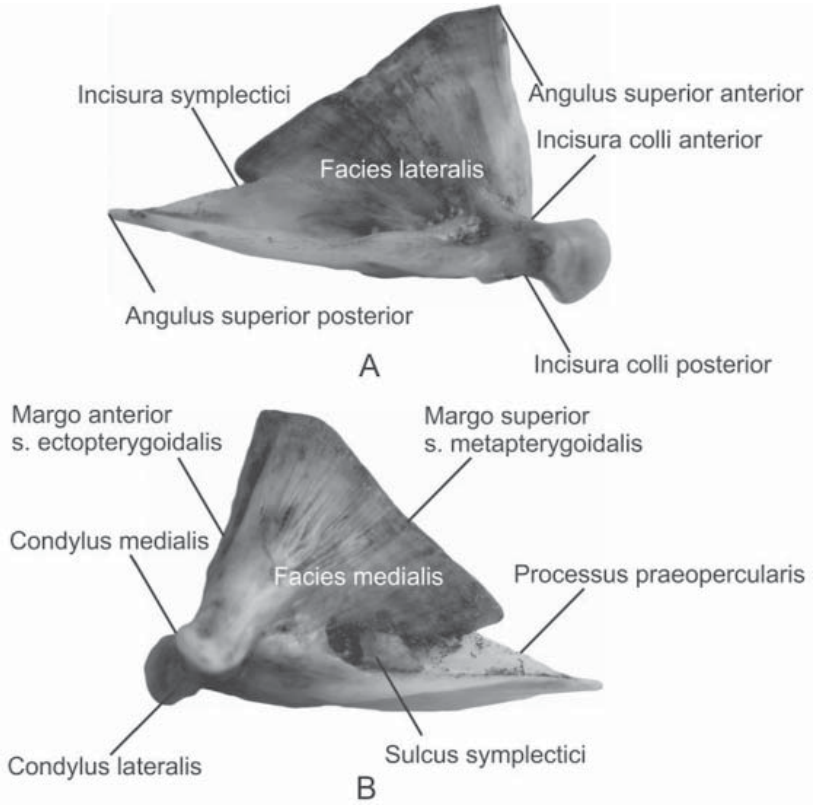


Fig. 2. Quadrate bone of the recent *Sander lucioperca* (Linnaeus, 1758): A — lateral surface; B — medial surface.

Late Miocene and Pliocene strata of Asia and North America (Rückert-Ülkumen, 1994; Murray et al., 2009). The remnants of *Sander* sp. were known from the Early Pliocene (5.3–4.0 Ma) of Lozenets (Kamenov, Kojumdshieva, 1983; Böhme, Ilg, 2003). *Sander* cf. *lucioperca* has been identified in materials from the Pliocene localities Sofia Tuchlovarna Fabrica in Bulgaria (Sytchevskaya, 1980) and also from Priozernoe in the Republic of Moldova (Kovalchuk et al., 2014). It should be noted, that near five (extinct and recent) taxa of the genus *Sander* are known the Late Miocene and Pliocene of Southern Ukraine (Tarashchuk, 1962, 1965, 1967; Kovalchuk, 2013; Kovalchuk, Nesterovsky, 2013).

**Family PERCIDAE** Cuvier, 1816
***Sander*** Oken, 1817 (= ***Stizostedion*** Rafinesque, 1820)
***Sander svetovidovi*** Kovalchuk, **sp. n.**

2011 *Sander* cf. *lucioperca* — Kovalchuk, p. 134, fig. 2 (6).

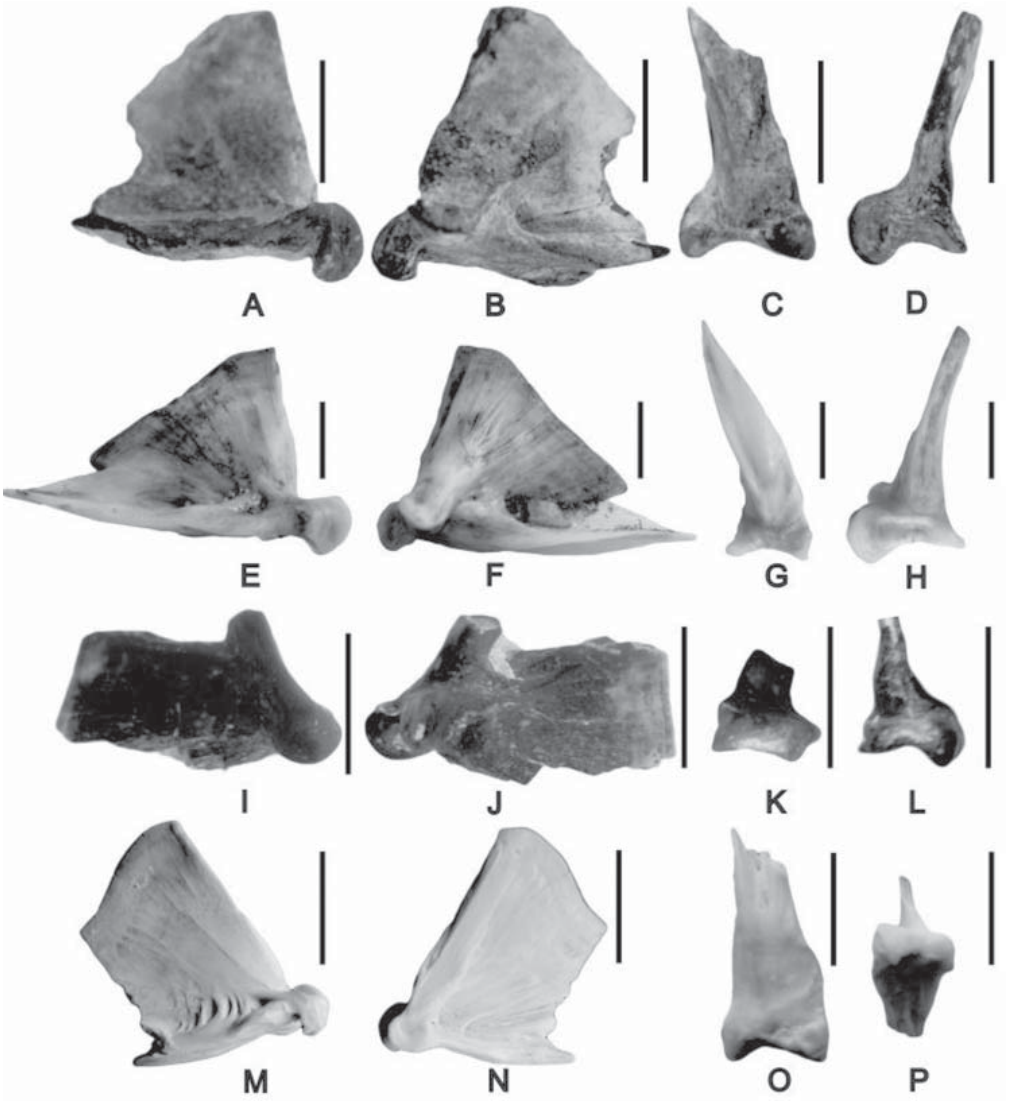


Fig. 3. Quadrate bone of some extinct and extant percid fishes: A–D — *Sander svetovidovi* sp. n., holotype (NMNH-P 41/4527); E–H — *Sander lucioperca*, extant (NMNH-P 1/191); I–L — *Leobergia zaissanica*, Zaissan, Kazakhstan (NMNH-P 52/45); M–P — *Perca fluviatilis*, extant (NMNH-P 1/176).

Type specimen. The holotype (fig. 3, A–D) is a near-complete right quadrate bone (quadratum), NMNH-P 41/4527. It is deposited in the Department of Vertebrate Paleozoology and Paleontological Museum, National Museum of Natural History, National Academy of Sciences of Ukraine (Kyiv).

Type locality. Egorovka 2, Odesa Region, Southern Ukraine.

Geological age. Late Miocene, Maeotian, MN 12.

Additional material. Fragment of the left quadrate bone (NMNHU-P 29/1716), Popovo 3, Zaporizhya Region, Southern Ukraine.

Diagnosis. The new *Sander* species is characterized by the large articular angle between the axis and the plane of the quadrate bone, middle-sized oval lateral condyle (condylus lateralis) and also presence of additional double crista on the anterior inferior edge of quadratum.

Description. Quadrate bone is flat and triangular (fig. 3, A–D). Its lower top forms the joint in a double oblique arthrodial block. The angle between the articular axis of the bone and the plane is 75°. The superior edge of the quadratum is somewhat thickened. There is a clearly visible double crest on the posterior edge of the quadrate bone. It is begun from the articular block and terminated by the elongated spicular process (processus praeopercularis). The inferior anterior angle has thickened edge with an additional low crista. Front notch at the neck of quadrate bone (incisura colli anterior) is small and rounded. There is no invagination at the condylus lateralis. Lateral condyle is oval and middle-sized, with rounded edges. It is separated from the rear edge of the quadrate bone by the clear shallow groove. Measurements of the type species and some other extinct and recent percid fishes are presented at the table 1. The length of the articular surface facet is 9.7 mm, width of the articular surface — 4.1 mm; width of processus praeopercularis — 6.0 mm; diameter of condylus lateralis — 4.5 mm. Recovered fish body length is near 52–60 cm.

Comparison. A new species, as compared with *Sander lucioperca*, is characterized by the larger tilt angle of the quadrate bone (fig. 3, C–D, G–H), fits into the limits of variability of the *Leobergia zaissanica* (68–80°; fig. 3, K–L) and less than in the *Perca fluviatilis* (90°; fig. 3, O–P). There is an additional crest on posterior edge of the quadratum in all studied specimens, and distinct only in the genus *Sander* (including a new species). New species and *Sander lucioperca* are comparable in the presence of expanded anterior inferior angle. Additional double crest is clearly visible in the *Sander svetovidovi* sp. n. (fig. 3, C), less developed in the extant *Sander lucioperca* (fig. 3, G), and absent in representatives of the genera *Perca* (fig. 3, K) and *Leobergia* (fig. 3, O). Most of the studied specimens are characterized by the weak incisura colli anterior (except *Sander lucioperca*). There is a specific invagination at the lateral condyle of *Sander lucioperca* (fig. 3, E) and *Leobergia zaissanica* (fig. 3, I), however it is absent in the *Sander svetovidovi* sp. n. (fig. 3, A). Representatives of the new species (as compared to other studied percids) are characterized by an intermediate position under the development of condylus lateralis between the *Sander lucioperca* (on the one hand), and also *Perca* and *Leobergia* (on the other). Lateral condyle is rounded in majority of Percidae. However, it is triangular in the *Sander lucioperca* (fig. 3, E–F) and oval in the new species (fig. 3, A–B). Besides, condylus lateralis is separated from the plane of the quadrate bone only in the *Sander svetovidovi* sp. n. Described remnants of the new species are comparable in size to those in the extant *Sander lucioperca*, somewhat bigger than those in the *Leobergia zaissanica* and twice bigger than quadratum of the extant *Perca fluviatilis* (table 1).

Etymology. In honour of the Russian ichthyologist A. N. Svetovidov for his contributions to the knowledge of recent and fossil percid fishes.

Distribution. Late Miocene of Southern Ukraine, late Sarmatian — Maeotian, MN 11-12.

**Table 1. Measurements of quadrate bone of the *Sander svetovidovi* sp. n. and some extinct and recent percid fishes**

| Locality | n | Angle, ° | | LAS, mm | | WAS, mm | | WPP, mm | | DCL, mm | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R | M | R | M | R | M | R | M | R | M |
| *Sander svetovidovi* sp. n. | | | | | | | | | | | |
| Egorovka 2 | 1 | – | 75 | – | 9.7 | – | 4.1 | – | 6.0 | – | 4.5 |
| Popovo 3 | 1 | – | 74 | – | 9.7 | – | 4.2 | – | 5.7 | – | 4.6 |
| *Sander lucioperca* (Linnaeus, 1758) | | | | | | | | | | | |
| Vasylivka 1 | 1 | – | 67 | – | 8.9 | – | 3.9 | – | 6.6 | – | 4.1 |
| Lobkovo | 1 | – | 70 | – | 8.3 | – | 3.7 | – | 6.3 | – | 3.9 |
| Kotlovina | 1 | – | 67 | – | 5.5 | – | 3.5 | – | 3.7 | – | 3.2 |
| Recent | 25 | 65–72 | 68 | 5.2–8.0 | 7.1 | 2.6–3.9 | 3.3 | 2.4–3.6 | 3.3 | 1.9–3.5 | 2.8 |
| *Leobergia zaissanica* (Lebedev, 1959) | | | | | | | | | | | |
| Zaissan | 8 | 68–80 | 77 | 5.1–9.1 | 7.0 | 2.4–5.4 | 3.6 | 3.1–4.2 | 3.7 | 2.5–2.8 | 3.7 |
| Vasylivka 1 | 2 | 76; 78 | – | 6.4; 6.8 | – | 6.7; 8.4 | – | 3.5; 3.9 | – | 2.6; 2.8 | – |
| *Perca fluviatilis* (Linnaeus, 1758) | | | | | | | | | | | |
| Recent | 11 | 85–90 | 87 | 3.5–5.2 | 4.3 | 2.5–3.5 | 3.0 | 2.1–2.9 | 2.6 | 2.2–2.9 | 2.6 |
| *Perca* sp. | | | | | | | | | | | |
| Popovo 3 | 1 | – | 85 | – | 3.6 | – | 2.7 | – | 2.8 | – | 2.3 |

## Conclusions

Description of the new extinct *Sander* species from the Late Miocene of Southern Ukraine adds to our knowledge on the evolutionary history and early developmental stages of percids in the Eastern Europe. These fossils appear to be useful subjects for discussing European paleobiogeography and freshwater environmental continuity. It is safe to say, that in the Late Miocene fishes of the genus *Sander* had have extensive and continuous area from the Western Siberia to eastern North America (Kudersky, 1966). A general morphological similarity of the new species to extant *Sander lucioperca* may indicate the presence of phylogenetic relationship between them.

New findings of the *Sander* remnants in the Upper Miocene strata of Southern Ukraine allow us to detail and review some of the possible evolutionary scenarios of development of the pikeperches during the late Neogene (Haponski, Stepien, 2013). *Sander* and *Leobergia* cannot be regarded as chronotaxa, which is indicated by clear morphological differences between them, as well as their joint presence in the Late Miocene of Southern Europe.

I am thankful to M. V. Sinitsa (National Museum of Natural History of the NAS of Ukraine) for the kindly providing possibility to study the fossil fish remnants from the Egorovka locality.

### References

Böhme, M., Ilg, A. 2003. *Database of Vertebrates: fossil Fishes, Amphibians, Reptiles and Birds (fosFARbase) localities and taxa from the Triassic to the Neogene*. www.wahre-staerke.com.

Craig, J. F. 2000. *Percid fishes: systematics, ecology and exploitation*. Blackwell Science Ltd., Malden, [i-xvi]+1–352.

Divay, J. D., Murray, A. M. 2011. First evidence of percids (Teleostei: Perciformes) in the Miocene of North America. *Canadian Journal of Earth Sciences*, **48**, 1419–1424.

Divay, J. D., Murray, A. M. 2013. A mid-Miocene ichthyofauna from the Wood Mountain Formation, Saskatchewan, Canada. *Journal of Vertebrate Paleontology*, **33**, 1269–1291.

Froese, R., Pauly, D., eds. 2014. *FishBase*. www.fishbase.org.

Haponski, A. E., Stepien, C. A. 2013. Phylogenetic and biogeographical relationships of the Sander pikeperches (Percidae: Perciformes): patterns across North America and Eurasia. *Biological Journal of the Linnean Society*, **110** (1), 156–179.

International Code of Zoological Nomenclature. 2003. Fourth edition. By the International Comission of Zoological Nomenclature. Biblioteka ofitsijnykh vydan', Kyiv, XLIII+1–175 [In Ukrainian].

Kamenov, B., Kojumdshieva, E. 1983. Stratigraphy of the Neogene in the Sofia Basin. *Palaeontology, Stratigraphy and Lithology* (Bulg. Acad. Sci.), **18**, 69–84.

Kovalchuk, A. N. 2011. Freshwater fish community in the lake deposits of the Late Miocene locality Egorovka (Odessa region), *Zbirnyk prats Zoologichnogo muzeyu*, **42**, 128–136 [In Russian].

Kovalchuk, A. N. 2015. *Late Miocene carp fishes (Cyprinidae) of Southern Ukraine*. Universytets'ka knyga, Sumy, 1–156 [in Russian].

Kovalchuk, O. M. 2013. History of the fossil carp fishes (Teleostei, Cyprinidae) in Ukraine. *Acta Zoologica Cracoviensia*, **56 (**1), 41–51.

Kovalchuk, O. M., Nesterovsky, V. A. 2013. Rests of bony fishes from the Pontian sediments of Crimea in the Geological Museum of Kyiv National University named after T. Shevchenko. *Naukovi zapyski Derzhavnogo pryrodoznavchogo muzeyu*, **29**, 214–218 [in Ukrainian].

Kovalchuk, O. M., Zakharov, D. S., Marareskul, V. A., Obadă, T. F. 2014. Early Pliocene fishes from Priozernoe locality (Republic of Moldova). *Acta Zoologica Cracoviensia*, **57** (1-2), 43–55.

Kudersky, L. A. 1966. Modern area of fishes of the genus *Lucioperca* and history of its forming. *Trudy Karel'skogo otdeleniya GosNIORH*, **4** (1), 187–214 [In Russian].

Lepiksaar, J. 1994. *Introduction to osteology of fishes for paleozoologists*. Göteborg, 1–75.

Movchan, Yu. V. 2011. *Fishes of Ukraine*. Zolovi vorota, Kyiv, 1–444 [In Ukrainian].

Murray, A. M., Cumbaa, S. L., Harington, C. R. et al. 2009. Early Pliocene fish remains from Arctic Canada support a pre-Pleistocene dispersal of percids (Teleostei: Percidae). *Canadian Journal of Earth Sciences*, **46**, 557–570.

Nelson, J. S. 2006. *Fishes of the World*. John Wiley & Sons Inc., New Jersey, 1–602.

Nesin, V. A., Nadachowski, A. 2001. Late Miocene and Pliocene small mammal faunas (Insectivora, Lagomorpha, Rodentia) of Southeastern Europe. *Acta Zoologica Cracoviensia*, **44** (2), 107–135.

Pena Zarzuelo, A. de la. 1991. La ictiofauna del Eoceno Medio del Yacimiento de Santa Clara (Zamora, Cuenca del Duero, España). *Colloquios de Paleontologia*, **43**, 9–33.

Rosina, V. V., Sinitsa, M. V. 2014. Bats (Chiroptera, Mammalia) from the Turolian of the Ukraine: phylogenetic and biostratigraphic considerations. *Neues Jahrbuch für Geologie und Paläontologie Abhandlungen*, **272** (2), 147–166.

Rückert-Ülkumen, N. 1994. Erstnachweis der Teleostei-Genera Lucioperca, Serranus und Lates in Sarmatischen Ablagerungen von Thrakien, Türkei. *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie*, **34**, 187–198.

Schtylko, B. A. 1934. Neogene freshwater fish fauna of Western Siberia. *Trudy VGRO NKTP SSSR*, **359**, 1–93 [In Russian].

Sinitsa, M. V. 2008. Maeotian small mammals from the Egorovka locality. *In*: Gozhik, P. F., ed. *Biostratigraphic fundamentals of creating the stratigraphic schemes of the Phanerozoic of Ukraine*: *Proceedings of the Institute of Geological Sciences of the NAS of Ukraine*. Kyiv, 285–289 [In Russian].

Sinitsa, M. V. 2010. Cricetids (Mammalia, Rodentia) from the Upper Miocene of Egorovka locality. *Vestnik Zoologii*, **44** (3), 209–225 [In Russian].

Sytchevskaya, E. K. 1980. *Fossil teleost fishes of the USSR*. Nauka, Moscow, 1–210 [In Russian].

Sytchevskaya, E. K. 1989. Freshwater Neogene Ichthyofauna of Mongolia. *Trudy Sovmestnoy Sovetsko-Mongolskoy Paleontologicheskoy Ekspeditsii*, No. 39. Nauka, Moscow, 1–144 [in Russian].

Tarashchuk, V. I. 1962. Materials on the study of freshwater fishes from the Neogene and Anthropogene sediments of Ukraine. *Zbirnyk prats Zoologichnogo muzeyu AN URSR*, **31**, 3–27 [In Ukrainian].

Tarashchuk, V. I. 1965. Ectothermic vertebrates from the Pliocene sediments of Zaporozhye region. *In*: Pidoplichko, I. G., ed. *Prirodnaya obstanovka i fauny proshlogo*. Is. 2. Naukova Dumka, Kiev, 74–101 [in Russian].

Tarashchuk, V. I. 1967. Fossil pikeperches of Ukraine. *Voprosy ikhtiologii*, **7**(1), 33–45 [In Russian].

Topachevsky, V. A., Nesin, V. A., Topachevsky, I. V. 1997. An essay of the small mammal fauna history (Insectivora, Lagomorpha, Rodentia) in Ukraine during Middle Sarmat-Aktshagyl Period. *Vestnik Zoologii*, **5-6**, 3–14 [In Russian].

Topachevsky, V. A., Nesin, V. A., Topachevsky, I. V. 1998. Biozonal microtheriological scheme (stratigraphic distribution of small mammals — Insectivora, Lagomorpha, Rodentia) of the Neogene of the northern part of the Eastern Paratethys. *Vestnik Zoologii*, 1–2, 76–87 [In Russian].

Received 23 January 2015
Accepted 24 March 2015