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Article

Middle Oxfordian – Lower Kimmeridgian ostracod zones from the Mikhalenino section (Kostroma region) and their comparison with synchronous strata of the Eastern and Western Europe

Ekaterina M. Tesakova, Stephan M. Demidov, Alexander V. Guzhov, Mikhail A. Rogov, Dmitry N. Kiselev

With 3 figures, 2 plates and 1 table

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Abstract: The study focuses on Oxfordian-Kimmeridgian ostracods from the Mikhalenino section (Kostroma region, Russia). In the Upper Oxfordian - Lower Kimmeridgian (Densiplicatum – Bauhini ammonite Zones) we distinguished ostracod zones: *Sabacythere attalicata – Eucytherura costaeirregularis* (Densiplicatum Zone), *Eucyterura – Tethysia* (Tenuiserratum to Bauhini Zone). In the lower Kimmeridgian, Kitchini ammonite Zone (Subkitchini Subzone), we identified ostracod zones *Schuleridea triebeli*, *Neurocythere jakovlevae – Klentnicella rodewaldensis* and *Galliaecytheridea fragilis*. A comparison has been made between the beds with the ostracod fauna from the Mikhalenino section and coeval strata from Western and Eastern Europe. In addition, a new species, *Neurocythere jakovlevae* Kolpenskaya in Tesakova et al., sp. nov., was described from the Lower Kimmeridgian, Kitchini Zone, Subkitchini Subzone.

Key words: stratigraphy, Oxfordian, Kimmeridgian, ostracods, Kostroma region (Russia).

Introduction

The Mikhalenino section (Fig. 1) is one of the continuous and easily accessible sections of the Middle Oxfordian – Lower Kimmeridgian on the Russian Platform. This section, which has been the object of detailed studies during the last few years, is located some 20 km north of another famous locality, Makariev, which is a reference section for the Oxfordian on the Russian Platform. Its ammonite record consists of a mixture of Boreal, Sub-boreal and Sub-mediterranean forms (Rogov & Kiselev 2007; Glowniak et al. 2010) providing a good background for improving the interregional ammonite-based correlation of the Middle Oxfordian – Lower Kimmeridgian. The very rich gastropod fauna has been analyzed recently in this section (Guzhov 2004), and trends were compared with those of ostracods (Guzhov et al. 2009). The Mikhalenino section is also known as a source of unique fossil squids with mineralized soft tissues (Rogov & Ippolitov 2008). This section is composed of alternating silt and clay beds with marly and phosphorite concretions, supposed stromatolite buildups and a remarkable black shale band marking the base of the Upper Oxfordian. Rich autochthonous ostracod assemblages, characterized by occurrence of the

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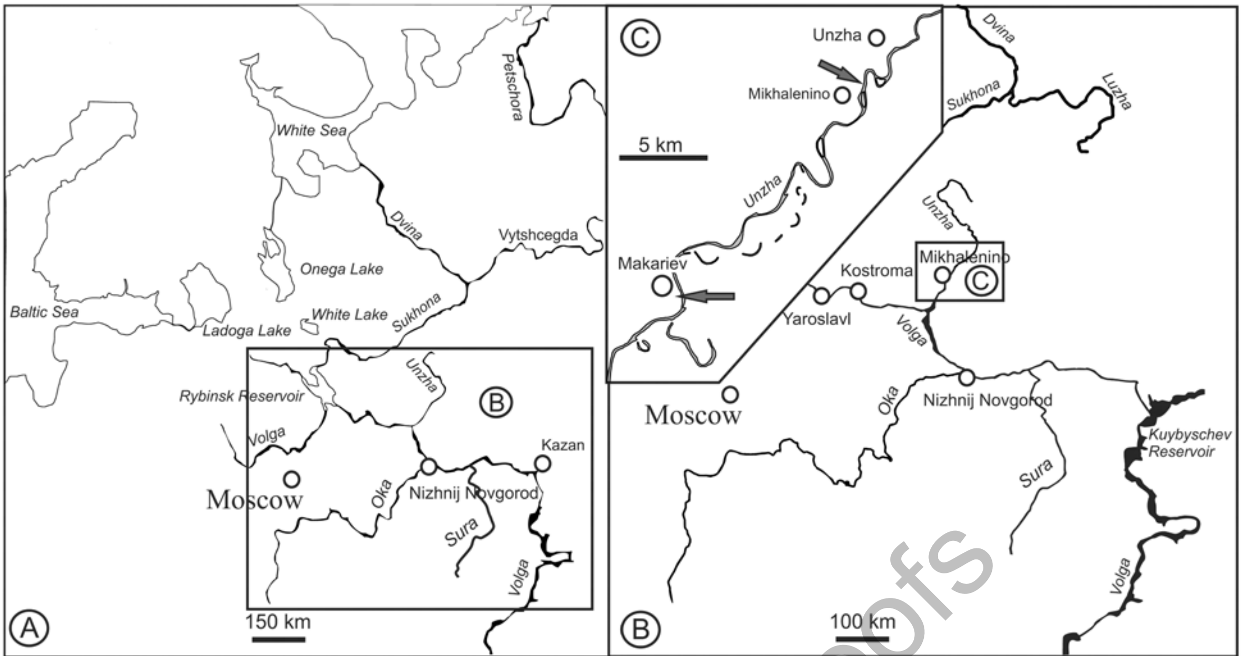


Fig. 1. Location map of the Mikhalenino and Makariev sections.

well-preserved both adults and juveniles, recognized throughout the entire succession (Fig. 2).

2. Materials and methods

A total of 45 samples have been collected. Sampling levels were based on ammonite findings (Głowniak et al. 2010), and were aimed at sampling at the lower and upper parts of each bed. Additionally, we analyzed Foraminifera distribution (Ustinova 2009).

Sediment samples of 0.5 kg were boiled with soda and washed over a 0.1 mm mesh size sieve. Dried samples were split into two fractions: >0.315 and >0.1<0.315 mm. Ostracods were picked from both fractions In total, more than 2 550 well preserved ostracod specimens, including both adult and larval stages, have been collected. The total species diversity reaches ca. 50 taxa, of which 31 species, subspecies and varieties were determined, and the remainder were left in open nomenclature (plates I, II). The distribution of the most common species and their abundance is shown in Fig. 2. Studied collection is stored in the Department of Palaeontology (Moscow State University, Moscow) at number 351.

3. Results

The detailed analysis of the ostracod distribution throughout the section, including FAD and LAD of species as well as changes in dominant taxa allowed us to recognize 16 assemblages reflecting variable ostracod habitats (Fig. 2). They are partially composed

Fig. 2. Stratigraphic range chart of ostracods in the Mikhalenino section and its ostracod-based subdivision. 1 – silty clays; 2 – clays; 3 – bituminous oil clays; 4 – calcareous concretions; 5 – glauconitic concentrations; 6 – phosphorites; 7 – pyrite nodules; 8 – shells of ammonites; 9 – dominant species from family Cytheruridae; 10 – dominant species from families Schulerideidae, Cytherideidae or Neurocytheridae; 11 – the presence of species from families Schulerideidae, Cytherideidae or Neurocytheridae; 12 – number of specimen in the sample.

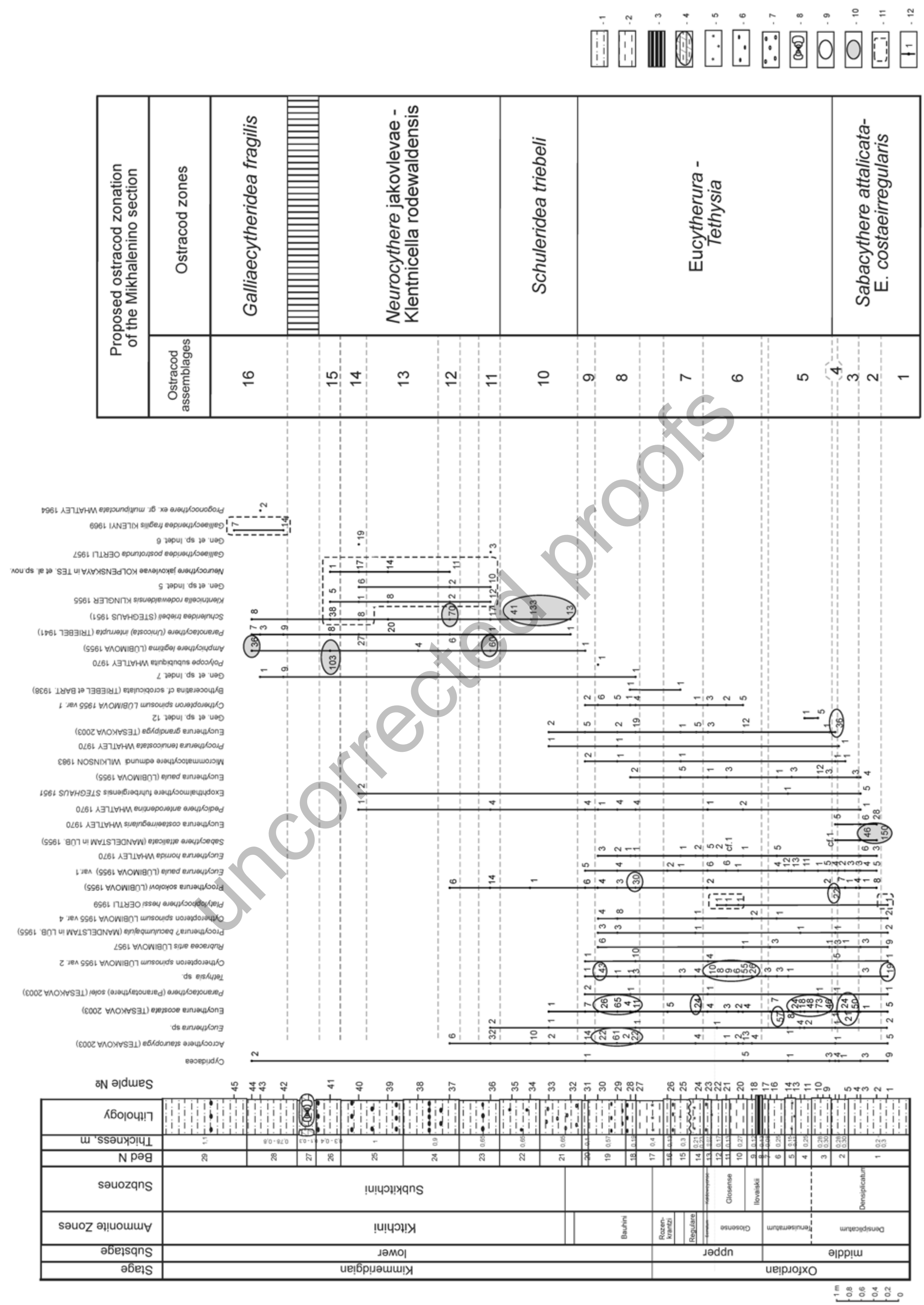

Proposed ostracod zonation of the Mikhalenino section
Ostracod zones
Ostracod assemblages
Galliaecytheridea fragilis
Neurocythere jakovlevae - Klentnicella rodewaldensis
Schuleridea triebeli
Eucytherura - Tethysia
Sabacythere attalicata - E. costaeirregularis
Stage
Substage
Ammonite Zones
Subzones
Bed N
Thickness, m
Lithology
Sample №
Kimmeridgian
Oxfordian
lower
upper
middle
Kitchini
Subkitchini
Bauhini
Regulare
Glosense
Ilovaiskii
Tenuiserratum
Densiplicatum

Fig. 2.

from recurrent faunulas, possibly reflecting sea-level oscillations. For example, couplets 1 and 6, 5 and 8 or 11 and 15 are represented by nearly same taxa.

The most significant turnover in the ostracod fauna occurred during the Early Kimmeridgian, and thus the studied section has been subdivided into two major parts. The lower part encompasses the Middle Oxfordian – lowermost Kimmeridgian (Bauhini ammonite Zone) and the upper part corresponds to the Lower Kimmeridgian (Kitchini ammonite Zone). The ostracod assemblages in these parts of the section are distinguished by prevailing development of the different families (Fig. 2; Tab. 1).

The lower part of the studied section (ostracod zones *Sabacythere attalicata – Eucytherura costaeirregularis* and *Eucytherura – Tethysia*, corresponding to Densiplicatum – Bauhini ammonite Zones) is characterized by the prevalence of small-sized genera of Cytheruridae.

Noteworthy that the species *Platylophocythere hessi*, widely distributed in Western Europe, occurs in two intervals of the Mikhalenino section, while *S. attalicata* (Mandelstam in Lübimova 1955), closely related to *S. caledonia* Whatley (Upper Callovian-Lower Oxfordian of Scotland), is abundant at the level between these records. It is possible that these three intervals correspond to periodical ostracod immigration events from Western Europe, which were connected with the high sea level stand. The same interval of the section also contains some immigrant ammonite species of the Sub-Mediterranean and Sub-Boreal origin.

The uppermost part of the Mikhalenino section, corresponding to the Kitchini ammonite Zone (Subkitchini Subzone), is marked by the predominance of large ostracods belonging to the families Schulerideidae, Cytherideidae and Neurocytheridae. Based on their distribution, the following ostracod zones were identified within the Subkitchini ammonite subzone: *Schuleridea triebeli*, *Neurocythere jakovlevae – Klentnicella rodewaldensis* and *Galliaecytheridea fragilis*.

The majority of species from this part of the section are of Western European origin, which indicates a broad connection of the Middle Russian Sea with Western Europe, influenced by the Early Kimmeridgian transgression.

4. Discussion

The ostracod record in Central Russia and in the Volga area sections (Fig. 3) is similar to that in the Mikhalenino section. The Oxfordian of these areas is characterized by small-sized Cytheruridae as well. In Central Russia, *Sabacythere attalicata* and *S. rubra* (Mandelstam in Lübimova 1955) are the most important ostracod species of the Lower Oxfordian and lowermost Middle Oxfordian, corresponding to beds with *Sabacythere attalicata – Renicytherura costaeirregularis* (Tesakova 2003). In the Lower to lowermost Middle Oxfordian (up to Popilaniense ammonite subzone) of the Volga area, beds with *S. nikiforovae* Kolpenskaya nom. nud. have been recognized (Kolpenskaya 1999). The unpublished species *S. nikiforovae* is the junior synonymous of *S. attalicata*. So, the *S. attalicata – E. costaeirregularis* ostracod zone, recognized in the lower part of the Mikhalenino section, is correspond to the beds with *S. nikiforovae* and *Sabacythere attalicata – Renicytherura costaeirregularis*. In the Volga area (i.e. in the Makariev section) *Neurocythere*, *Schuleridea*, *Amphycythere*, *Klentnicella* appear in the Lower Kimmeridgian, and beds with *N. jakovlevae* Kolpenskaya nom. nud. – *K. rodewaldensis*, distinguished in the Lower Kimmeridgian of this region (Kolpenskaya 1999), correspond to ostracod zone *Neurocythere jakovlevae – Klentnicella rodewaldensis*.

On the other hand, ostracod distribution ranges in the Oxfordian-Kimmeridgian of Western Europe are significantly different from those of the European Russia. Ostracods of Western Europe are much more abundant and include also marine ostracods from the families Bairdiidae, Cytherellidae, Polycopidae, Bythocytheridae, Cyprididae, Cytherettidae, Cytheridae, Progonocytheridae etc., as well as brackish Limnocytheridae, Darwinulidae and Ilyocyprididae. Moreover, in Western Europe large-sized ostracods are abundant and most typical throughout the entire studied interval. Cytheruridae also occur in the Oxfordian and Kimmeridgian of this area but never play a dominant role. They are mainly represented by species of the genera *Cytheropteron* and *Paranotacythere* (different at the species level from those occurring in Russia), while the genus *Eucytherura*, which is very common in European Russia, is poorly represented in Western Europe.

European ostracod-based stratigraphical units are characterized by different minuteness in different countries, and their direct correlation encounters some problems. Nevertheless, some common trends can be recognized: in Sub-boreal Europe, i.e. in England (Kilenyi 1978; Kilenyi & Neale 1978; Wilkinson 1983), Scandinavia (Christensen 1988), NW Germany

Ostracod zones	*Sabacythere attalicata – Eucytherura costaeirregularis*	*Eucytherura – Tethysia*	*Schuleridea triebeli*	*Neurocythere jakovlevae – Klentnicella rodewaldensis*	*Galliaecytheridea fragilis*
	The stratigraphic unit is recognized by the distribution of *Sabacythere attalicata* and *Eucytherura costaeirregularis*	The stratigraphic unit is based on the dominance of the index taxa.	The stratigraphic unit is recognized by the dominance of the index species and the absence of the genera *Klentnicella, Neurocythere* et *Galliaecytheridea*	The stratigraphic unit is recognized by the range of the index species. Lower and upper parts of this unit are dominated by *Schuleridea triebeli* and *Amphicythere legitima*.	The stratigraphic unit is recognized by stratigraphic range of the index species. In the middle part of the zone *Amphicythere legitima* is dominate.
Stratotype	Mikhalenino section, beds 1-2 (dark grey clays), visible thickness 1,2 m.	Mikhalenino section, beds 3-20 (dark grey and silty clays, sometimes enriched by glauconite and phosphorite nodules). Thickness 4 m.	Mikhalenino section, beds 21-22 (dark grey silty clays with phosphorite nodules and pyrite concretions). Thickness 1,4 m.	Makariev-South section, (dark grey clays). Thickness 8 m. (Nikolaeva et al., 1999, p. 125).	Mikhalenino section, bed 28 and lower part of the bed 29 (dark grey silty clays). Thickness 1 m.
Typical families	Neurocytheridae, Cytheruridae	Cytheruridae, Neurocytheridae	Schulerideidae	Neurocytheridae, Cytheruridae, Cytherideidae, Schulerideidae	Cytherideidae
Typical genera	*Sabacythere*, *Eucytherura*	*Acrocythere*, *Eucytherura*, *Tethysia*, *Platylophocythere*	*Schuleridea*	*Neurocythere*, *Klentnicella*, *Amphicythere*, *Schuleridea*, *Paranotacythere* (*Unicosta*)	*Galliaecytheridea*, *Amphicythere*
Typical species	*Sabacythere attalicata*, *Eucytherura costaeirregularis*	*Acrocythere stauropyga*, *Eucytherura paula* var. 1, *E. horrida*, *Tethysia* sp., *Platylophocythere hessi*	*Schuleridea triebeli*	*Neurocythere jakovlevae*, *Klentnicella rodewaldensis*, *Amphicythere legitima*, *Schuleridea triebeli*, *Paranotacythere* (*Unicosta*) *interrupta*	*Galliaecytheridea fragilis*, *Amphicythere legitima*
Auxiliary families	Cytheruridae, Pontocyprididae	Pontocyprididae, Bythocytheridae	Cytheruridae	Cytheruridae	Schulerideidae, Pontocyprididae, Progonocytheridae, Cytheruridae
Auxiliary genera	*Acrocythere*, *Procytherura*, *Eucytherura*, *Paranotacythere* (*Paranotaythere*), *Rubracea*, *Cytheropteron*, *Tethysia*, *Pedicythere*, *Exophthalmocythere*, *Micrommatocythere*, *Pontocyprella*?	*Procytherura*, *Exophthalmocythere*, *Rubracea*, *Cytheropteron*, *Pedicythere*, *Pontocyprella*?, *Micrommatocythere*, *Paranotacythere* (*Paranotacythere*)	*Acrocythere*, *Eucytherura*, *Procytherura*, *Paranotacythere* (*Unicosta*)	*Procytherura*, *Pedicythere*, *Exophthalmocythere*	*Paranotacythere* (*Unicosta*), *Schuleridea*, *Progonocythere*, Cypridacea
Auxiliary species	*Acrocythere stauropyga*, *Procytherura sokolovi*, *P. tenuicostata*, *P.*? *baculumbajula*, *Eucytherura paula* var. 1, *E. paula*, *E. grandipyga*, *E. horrida*, *E. acostata*, *E.* sp., *Paranotacythere* (*Paranotaythere*) *solei*, *Cytheropteron spinosum* LÜBIMOVA var. 2, *C. spinosum* LÜBIMOVA var. 4, *Rubracea artis*, Cypridacea, *Tethysia* sp., *Pedicythere anterodentina*, *Exophthalmocythere fuhrbergiensis*, *Micrommatocythere edmundi*	badly preserved species from the family Cypridacea, *Eucytherura acostata*, *E. paula*, *E. grandipyga*, *E.* sp., *Paranotacythere* (*Paranotaythere*) *solei*, *Rubracea artis*, *Cytheropteron spinosum* LÜBIMOVA var. 1, *C. spinosum* LÜBIMOVA var. 2, *C. spinosum* LÜBIMOVA var. 4, *Procytherura sokolovi*, *P. tenuicostata*, *P.*? *baculumbajula*, *Pedicythere anterodentina, Exophthalmocythere fuhrbergiensis*, *Micrommatocythere edmundi*, *Bythoceratina* cf. *scrobiculata*, *Polycope sububiquita*, Gen. et sp. Indet. 7, Gen. et sp. Indet. 12	*Acrocythere stauropyga*, *Eucytherura* sp., *E. acostata*, *E. grandipyga*, *Procytherura tenuicostata*, *Procytherura sokolovi*, *Paranotacythere* (*Unicosta*) *interrupta*	*Paranotacythere* (*Unicosta*) *stauropyga*, *Procytherura sokolovi*, *Pedicythere anterodentina*, *Exophthalmocythere fuhrbergiensis*, Gen. et sp. Indet. 5, Gen. et sp. Indet. 6	*Paranotacythere* (*Unicosta*) *interrupta*, *Schuleridea triebeli*, *Progonocythere* ex gr. *multipunctata*, Cypridacea, Gen. et sp. Indet. 7
Correlation	Mariae, Cordatum and Densiplicatum ammonite Zones	ammonite zones Tenuiserratum – Bauhini (Middle Oxfordian – lowermost Kimmeridgian)	lower part of the Subkitchini ammonite Subzone	middle part of the Subkitchini ammonite Subzone	middle part of the Subkitchini ammonite Subzone (*bayi* (?) and *subkitchini* horizons)

(Schudack 1994), Poland (Bielecka et al. 1988; Kubiatowicz 1983), and Moscow area (Tesakova 2003), the Lower and Middle Oxfordian are characterized by *Neurocythere cruciata oxfordiana* (Lutze 1960), but in the Kostroma region this subspecies did not cross the Lower/Middle Oxfordian boundary (Tesakova 2003). *Galliaecytheridea* appeared in Western Europe during the Late Oxfordian and became widely distributed in the Kimmeridgian and Volgian, while in the Kostroma region and the Volga area it appeared in the Early Kimmeridgian and culminated during the Volgian.

5. Systematic paleontology

Order Podocopida Sars 1865
Suborder Cytherocopina Gründel 1967
Superfamily Progonocytheracea Sylvester-Bradley 1948
Family Neurocytheridae Gründel 1975
Genus *Neurocythere* Whatley 1970
Neurocythere jakovlevae Kolpenskaya in Tesakova et al., sp. nov.
Plate 2, Fig. 6, 8
1999 *Nophrecythere* sp.: Nikolaeva et al., pl. 33, Fig. 1.

Etymology: In honour of the micropaleontologist S.P. Yakovleva.

Holotype: Specimen no. – N9-O-119, VNIGRI, S.-Petersburg. Russian Platform, Kostroma Region, Unzha River, section Makariev Yuzhnyi (Fig. 1), outcrop 10, sample 742; Makariev beds, Lower Kimmeridgian (Nikolaeva et al. 1999, pl. 33, fig. 1).

Description: The shell is medium-sized, rounded rectangular, inequivalve. The left valve is larger than the right one, and overlaps it along the dorsal, antero- and posterodorsal edges. The shell's maximal length is at its mid-height, the maximal height is at the anterior hinge, and maximal thickness is at the posteroventral part. The dorsal edge is straight in right valves and concave in left valves because of high hinge ears. The ventral margin is slightly concave, parallel to the dorsal one, and slightly converges posteriorly in juvenile forms. The anterior margin is high, evenly arcuately rounded; the posterior edge is insignificantly lower than the anterior one, triangular, shows stronger dorsal truncation. The valve surface bears fine band-like ridges. The first one runs from the large eye tubercle along the anterior edge of the valve, continues along the ventral margin and reaches the posterior margin. This ridge is convex behind the adductor. Below, the second crest-like ridge runs along the ventral margin. The third ridge stretches along the dorsal margin, it is more pronounced in right valves, on left valves it is only observed in the anterior part near the eye tubercle. At the posterodorsal angle it deflects vertically down and continues into the longitudinal median ridge that runs horizontally in posterior part of the valve. Interrupted near the adductor, the median ridge deviates diagonally down into the anterior part of the valve. The median ridge reaches the anterior margin of the valve and crosses the anterior rib. The surface between ridges, except at the posterior margin, the zone between ventral ridges and along the anterior margin, is reticulate; fossae are rounded. The reticulation-free surface bears indistinct large angular fossae with thin muri. The hinge of the right valve is represented by two large indented teeth separated by the indented groove.

Measurements, mm:	L	H	T
holotype 9-O-119 (left valve)	0.54	0.33	0.14
spec. 9-O-120 (right valve)	0.51	0.28	0.12
spec. 9-O-121 (right valve)	0.56	0.26	0.12

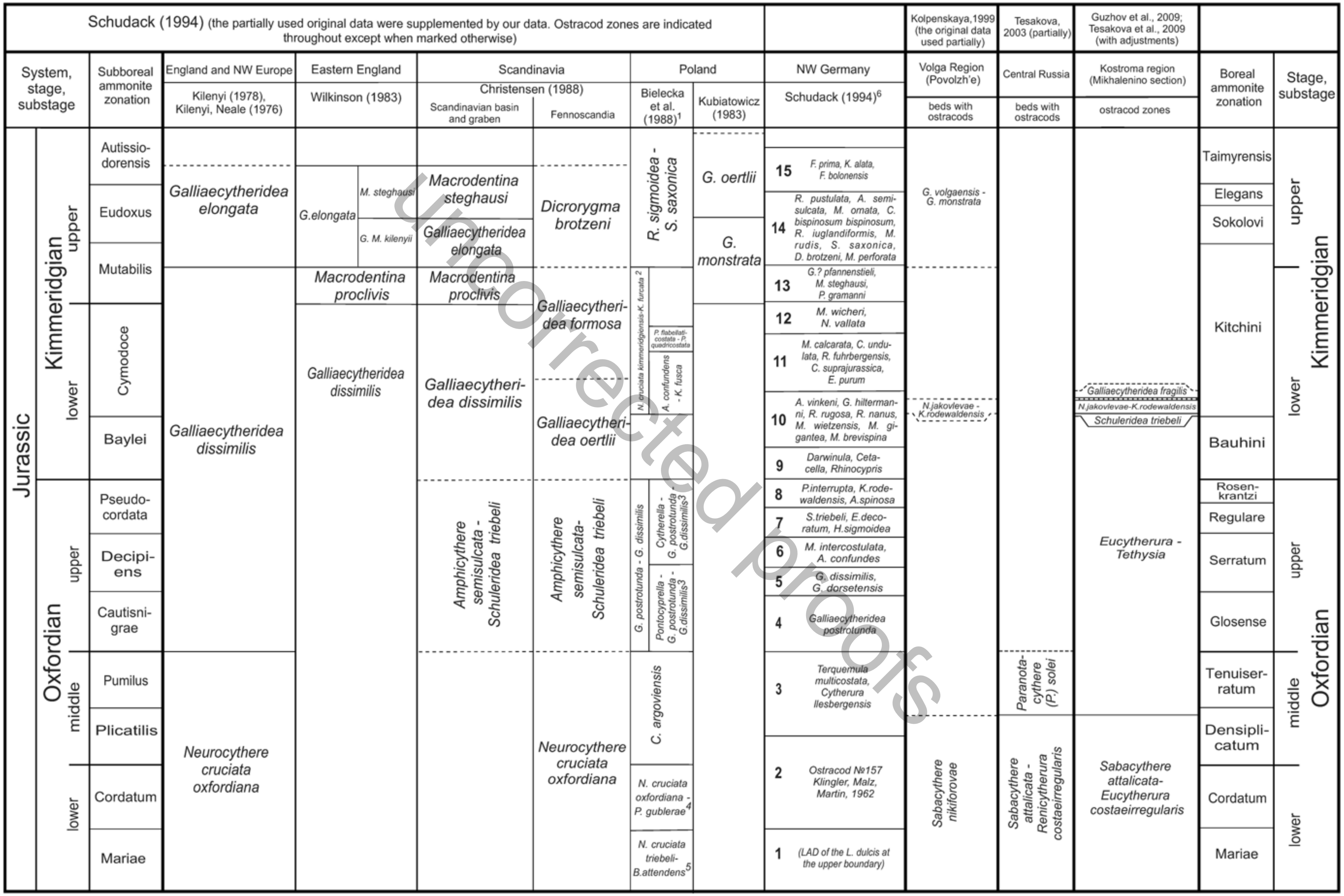
Comparison: The new species is most similar to *Neurocythere cruciata oxfordiana* (Lutze 1960) from Oxfordian of England (Wilkinson & Whatley 2009, p. 278, pl. 8, fig. 1-4), Germany (Lutze 1960, p. 425, pl. 35, fig. 5), Poland (Bielecka et al. 1988, p. 366, pl. 164, fig. 6) and Dnieper-Donets Depression (Ukraine) (Pyatkova & Permyakova 1987, p. 147, pl. 61, fig. 5), and also from Upper Callovian (Lamberti Zone) of the Moscow and Ryazan Regions in Central Russia (Tesakova 2003, p. 195, pl. 13, fig. 4-5, 7-12) in valve outline, position of ribs and reticulation pattern. The new species is distinct by the interrupted median ridge and rounded fossae.

Comments: This species has been created and described in the unpublished manuscript by Kolpenskaya.

Distribution: Kostroma Region, sections Makariev Yuzhnyi and Mikhalenino, Unzha River. Lower Kimmeridgian,

Fig. 3. Correlation chart of the Subboreal European ostracod zonation for the Oxfordian and Kimmeridgean. 1 – newly introduced units defined by FAD of index-taxa; 2 – acme-units named after dominant species; 3 – concurrent-range units; 4 – partial-range units named after most characteristic species; 5 – units named after LAD of index-taxa; 6 – with a few exceptions, zonal named are proposed herein (originally defined by numbers instead of fossils names) by FAD of index-species.

Fig. 3.


Schudack (1994) (the partially used original data were supplemented by our data. Ostracod zones are indicated throughout except when marked otherwise)
Kolpenskaya,1999 (the original data used partially)
Tesakova, 2003 (partially)
Guzhov et al., 2009; Tesakova et al., 2009 (with adjustments)
System, stage, substage
Subboreal ammonite zonation
England and NW Europe
Kilenyi (1978), Kilenyi, Neale (1976)
Eastern England
Wilkinson (1983)
Scandinavia
Christensen (1988)
Scandinavian basin and graben
Fennoscandia
Poland
Bielecka et al. (1988)1
Kubiatowicz (1983)
NW Germany
Schudack (1994)6
Volga Region (Povolzh'e)
beds with ostracods
Central Russia
beds with ostracods
Kostroma region (Mikhalenino section)
ostracod zones
Boreal ammonite zonation
Stage, substage
Jurassic
Kimmeridgian
upper
lower
Oxfordian
upper
middle
lower
Autissiodorensis
Eudoxus
Mutabilis
Cymodoce
Baylei
Pseudocordata
Decipiens
Cautisnigrae
Pumilus
Plicatilis
Cordatum
Mariae
Galliaecytheridea elongata
Galliaecytheridea dissimilis
Neurocythere cruciata oxfordiana
G.elongata
M. steghausi
G. M. kilenyii
Macrodentina proclivis
Galliaecytheridea dissimilis
Macrodentina steghausi
Galliaecytheridea elongata
Macrodentina proclivis
Galliaecytheridea dissimilis
Amphicythere semisulcata - Schuleridea triebeli
Dicrorygma brotzeni
Galliaecytheridea formosa
Galliaecytheridea oertlii
Amphicythere semisulcata- Schuleridea triebeli
Neurocythere cruciata oxfordiana
R. sigmoidea - S. saxonica
N. cruciata kimmeridgiensis-K. furcata 2
P. flabellaticostata - P. quadricostata
A. confundens - K. fusca
G. postrotunda - G. dissimilis
Cytherella - G. postrotunda - G.dissimilis3
Pontocyprella - G. postrotunda - G.dissimilis3
C. argoviensis
N. cruciata oxfordiana - P. gublerae4
N. cruciata triebeli- B.attendens5
G. oertlii
G. monstrata
15 F. prima, K. alata, F. bolonensis
14 R. pustulata, A. semisulcata, M. ornata, C. bispinosum bispinosum, R. iuglandiformis, M. rudis, S. saxonica, D. brotzeni, M. perforata
13 G.? pfannenstieli, M. steghausi, P. gramanni
12 M. wicheri, N. vallata
11 M. calcarata, C. undulata, R. fuhrbergensis, C. suprajurassica, E. purum
10 A. vinkeni, G. hiltermanni, R. rugosa, R. nanus, M. wietzensis, M. gigantea, M. brevispina
9 Darwinula, Cetacella, Rhinocypris
8 P.interrupta, K.rodewaldensis, A.spinosa
7 S.triebeli, E.decoratum, H.sigmoidea
6 M. intercostulata, A. confundes
5 G. dissimilis, G. dorsetensis
4 Galliaecytheridea postrotunda
3 Terquemula multicostata, Cytherura ilesbergensis
2 Ostracod №157 Klingler, Malz, Martin, 1962
1 (LAD of the L. dulcis at the upper boundary)
G. volgaensis - G. monstrata
N.jakovlevae - K.rodewaldensis
Sabacythere nikiforovae
Paranotacythere (P.) solei
Sabacythere attalicata - Renicytherura costaeirregularis
Galliaecytheridea fragilis
N.jakovlevae-K.rodewaldensis
Schuleridea triebeli
Eucytherura - Tethysia
Sabacythere attalicata- Eucytherura costaeirregularis
Taimyrensis
Elegans
Sokolovi
Kitchini
Bauhini
Rosenkrantzi
Regulare
Serratum
Glosense
Tenuiserratum
Densiplicatum
Cordatum
Mariae
upper
lower
Kimmeridgian
upper
middle
lower
Oxfordian

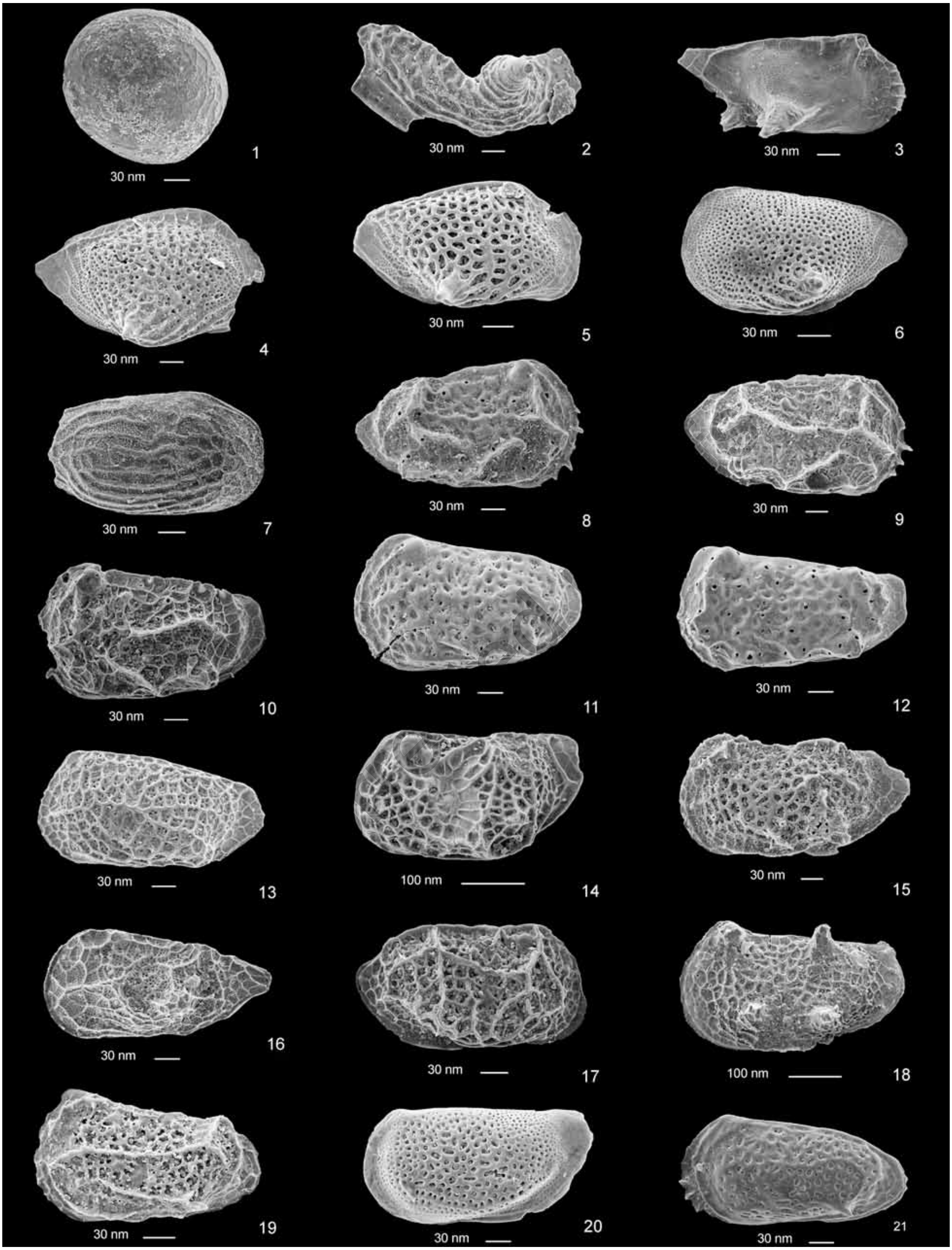

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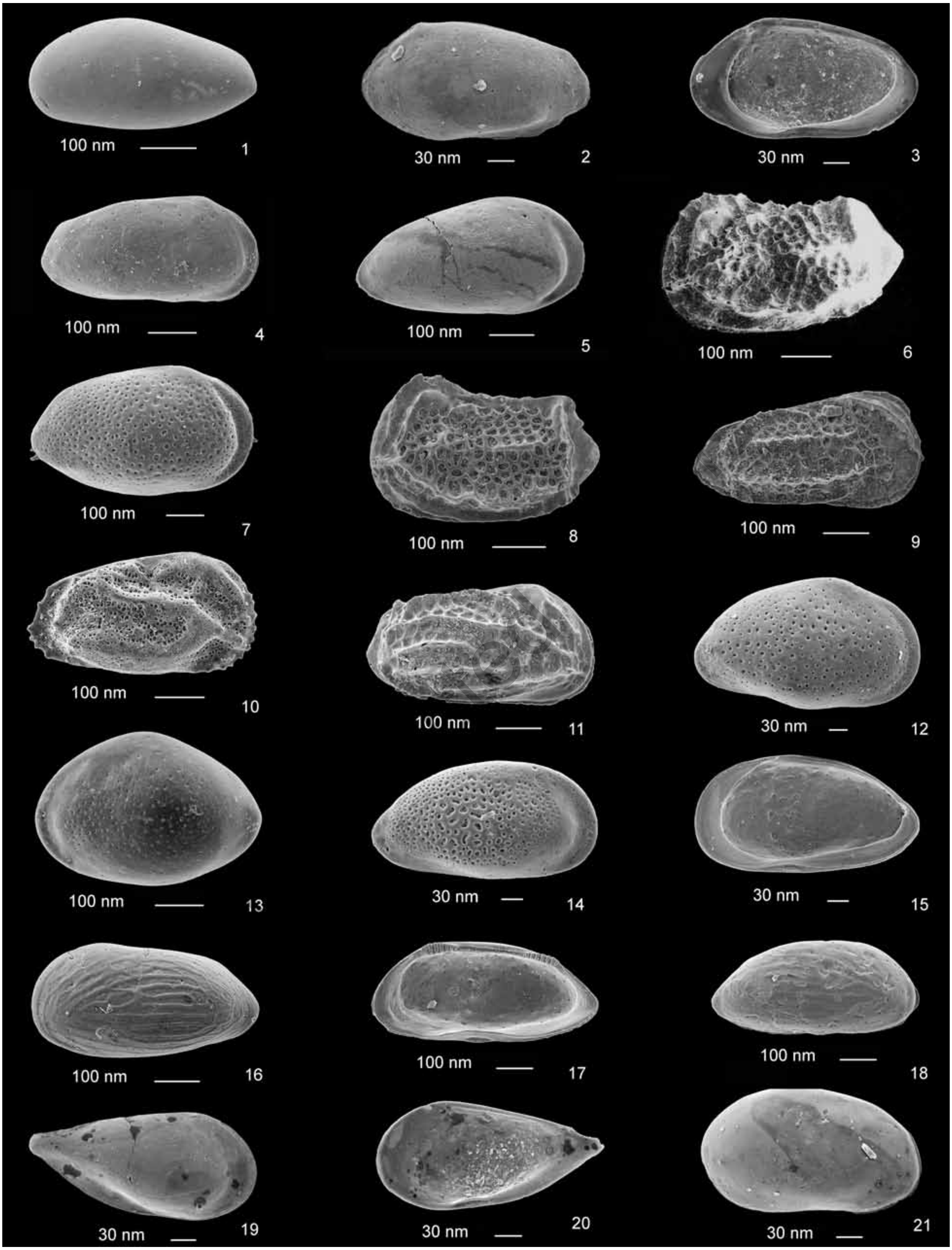
Plate 1.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20
30 nm
21

Plate 2.

Kitchini Zone, Subkitchini Subzone, *N. jakovlevae – K. rodewaldensis* ostracod zone.
Material originates from Kostroma Region, Unzha River basin. Six valves of moderate preservation from Lower Kimmeridgian of the section Makariev Yuzhnyi. 43 well and moderately preserved valves from Lower Kimmeridgian, Kitchini Zone, Subkitchini Subzone, section Mikhalenino.

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Plate 1. All specimens are from Mikhalenino section. **Fig. 1.** *Polycope sububiquita* Whatley: MSU-351 Mich-2/75, car. lat., Lower Kimmeridgian, Bauhini Ammonite Zone, sample 30; **Fig. 2**. *Bythoceratina* cf. *scrobiculata* (Triebel & Bartenstein): MSU-351 Mich-1/106, LV, Lower Kimmeridgian, Bauhini Ammonite Zone, sample 28; **Fig. 3.** *Pedicythere anterodentina* Whatley: MSU-351 Mich-2/34, RV, Middle Oxfordian, Densiplicatum Ammonite Zone, sample 3; **Fig. 4.** *Cytheropteron spinosum* Lübimova var. 1: MSU-351 Mich-2/76, RV, Lower Kimmeridgian, Bauhini Ammonite Zone, sample 30; **Fig. 5.** *Cytheropteron spinosum* Lübimova var. 4: MSU-351 Mich-2/78, RV, Lower Kimmeridgian, Bauhini Ammonite Zone, sample 30; **Fig. 6.** *Cytheropteron spinosum* Lübimova var. 2: MSU-351 Mich-3/13, LV, Upper Oxfordian, Serratum Ammonite Zone, sample 23; **Fig. 7.** *Procytherura tenuicostata* Whatley: MSU-351 Mich-1/6, RV, Lower Kimmeridgian, Kitchini Ammonite Zone, sample 33; **Fig. 8.** *Eucytherura costaeirregularis* Whatley: MSU-351 Mich-2/56, RV, Middle Oxfordian, Densiplicatum Ammonite Zone, sample 2; **Fig. 9.** *Eucytherura paula* (Lübimova): MSU-351 Mich-2/30, RV, Middle Oxfordian, Densiplicatum Ammonite Zone, sample 3; **Fig. 10.** *Eucytherura paula* (Lübimova) var.1: MSU-351 Mich-3/49, LV, Middle Oxfordian, Plicatilis Ammonite Zone, sample 10; **Fig. 11.** *Eucytherura grandipyga* (Tesakova): MSU-351 Mich-2/7, LV, Middle Oxfordian, Plicatilis Ammonite Zone, sample 8; **Fig. 12.** *Eucytherura acostata* (Tesakova): MSU-351 Mich-2/4, LV, Middle Oxfordian, Plicatilis Ammonite Zone, sample 10; **Fig. 13.** *Eucytherura* sp.: MSU-351 Mich-3/2, LV, Middle Oxfordian, Tenuiserratum Ammonite Zone, sample 14; **Fig. 14.** *Paranotacythere* (*Unicosta*) *interrupta* (Triebel): MSU-351 Mich-1/83, LV, Lower Kimmeridgian, Kitchini Ammonite Zone, sample 40; **Fig. 15.** *Eucytherura horrida* Whatley: MSU-351 Mich-2/13, LV, Middle Oxfordian, Densiplicatum Ammonite Zone, sample 3; **Fig. 16**. *Paranotacythere* (*Paranotacythere*) *solei* (Tesakova): MSU-351 Mich-2/1, LV, Middle Oxfordian, Plicatilis Ammonite Zone, sample 10; **Fig. 17.** *Acrocythere stauropyga* (Tesakova): MSU-351 Mich-1/14, RV, Lower Kimmeridgian, Kitchini Ammonite Zone, sample 34; **Fig. 18.** *Exophthalmocythere fuhrbergiensis* Steghaus: MSU-351 Mich-1/80, LV, Lower Kimmeridgian, Kitchini Ammonite Zone, sample 40; **Fig. 19.** *Tethysia* sp.: MSU-351 Mich-2/73, LV, Lower Kimmeridgian, Bauhini Ammonite Zone, sample 30; **Fig. 20.** *Micrommatocythere edmundi* Wilkinson: MSU-351 Mich-3/39, LV, Middle Oxfordian, Densiplicatum Ammonite Zone, sample 5; **Fig. 21.** *Procytherura*? *baculumbajula* (Mandelstam in Lübimova): MSU-351 Mich-3/26, LV, Lower Kimmeridgian, Bauhini Ammonite Zone, sample 29.

Plate 2. All specimens are from Mikhalenino section, except Fig. 6. **Fig. 1.** *Rubracea artis* Lübimova: MSU-351 Mich-2/12, LV, Middle Oxfordian, Plicatilis Ammonite Zone, sample 8; **Fig. 2, 3.** *Procytherura sokolovi* (Lübimova), Middle Oxfordian: 2 - MSU-351 Mich-3/40, LV, Densiplicatum Ammonite Zone, sample 5; 3 - MSU-351 Mich-2/45, RV inside, Densiplicatum Ammonite Zone, sample 2; **Fig. 4.** *Galliaecytheridea postrotunda* Oertli: MSU-351 Mich-1/48, RV, Lower Kimmeridgian, Kitchini Ammonite Zone, sample 36; **Fig**. **5.** *Galliaecytheridea fragilis* Kileniy: MSU-351 Mich-1/88, RV, Lower Kimmeridgian, Kitchini Ammonite Zone, sample 42; **Fig. 6, 8.** *Neurocythere jakovlevae* Kolpenskaya in Tesakova et al. sp. nov., Lower Kimmeridgian: 6 – Holotype VNIGRI N9-O-119, LV, Unzha River, section Makariev Yuzhnyi, outcrop 10, sample 742; 8 – MSU-351 Mich-1/58, LV, Kitchini Ammonite Zone, sample 39; **Fig. 7.** *Amphicythere legitima* (Lübimova): MSU-351 Mich-1/43, RV, Lower Kimmeridgian, Kitchini Ammonite Zone, sample 36; **Fig. 9.** *Platylophocythere hessi* Oertl: MSU-351 Mich-1/100, RV, Middle Oxfordian, Densiplicatum Ammonite Zone, sample 1; **Fig. 10.** *Klentnicella rodewaldensis* (Klingler): MSU-351 Mich-1/28, RV, Lower Kimmeridgian, Kitchini Ammonite Zone, sample 36; **Fig. 11.** *Sabacythere attalicata* (Mandelstam in Lübimova): MSU-351 Mich-2/35, RV, Middle Oxfordian, Densiplicatum Ammonite Zone, sample 3; **Fig. 12, 13.** *Schuleridea triebeli* (Steghaus), Lower Kimmeridgian, Kitchini Ammonite Zone: 12 – MSU-351 Mich-1/20, RV, male, larva, sample 34; 13 – MSU-351 Mich-1/2, LV, female, sample 32; **Fig. 14, 15.** Gen. et sp. Indet. 5, Lower Kimmeridgian, Kitchini Ammonite Zone: 14 – MSU-351 Mich-1/78, RV, sample 40; 15 – MSU-351 Mich-1/77, RV, sample 40; **Fig. 16-18.** Gen. et sp. Indet. 6, Lower Kimmeridgian, Kitchini Ammonite Zone, sample 40: 16 – MSU-351 Mich-1/71, LV; 17 – MSU-351 Mich-1/66, RV; 18 – MSU-351 Mich-1/67, RV.; **Fig. 19, 20.** Gen. et sp. Indet. 7, Lower Kimmeridgian, Kitchini Ammonite Zone, sample 42: 19 – MSU-351 Mich-1/93, RV; 20 – MSU-351 Mich-1/95, RV; **Fig. 21.** Gen. et sp. Indet. 12: MSU-351 Mich-2/2, RV, Middle Oxfordian, Plicatilis Ammonite Zone, sample 10.

References

Bielecka, W., Styk, O. & Blaszyk, J. (1988): Class Ostracoda Latreille, 1806. – In: Malinowska, L. (Ed.): Atlas of Guide and Characteristic Fossils, Part 2b, Mesozoic, Jurassic, 165-179; Warsaw (Wydawnictwa Geologiczne).

Christensen, O.B. (1988): Ostracod Zones and Dispersion of Mesozoic Fossils in the Scandinavian North sea Area. – In: Hanai, T., Ikeya, N. & Ishizaki, K. (Eds.): Evolutionary biology of ostracoda – its fundamentals and applications, 1269-1281; Tokyo (Elsevier).

Głowniak, E., Kiselev, D.N., Rogov, M.A., Wierzbowski, A. & Wright, J.K. (2010): The Middle Oxfordian to lowermost Kimmeridgian ammonite succession at Mikhalenino (Kostroma district) of Russian Platform, and its stratigraphical and palaeobiogeographical imnplications. – Volumina Jurassica, **8**: 8-45.

Guzhov, A.V. (2004): Jurassic gastropods of European Russia (orders Cerithiiformes, Bucciniformes and Epitoniiformes). – Paleontological Journal, **38**, suppl. **5**: 457-562.

Guzhov, A.V., Tesakova, E.M., Demidov, S.M., Rogov, M.A. & Kiselev, D.N. (2009): Peculiarities of the distribution of gastropods and ostracods in the Oxfordian-Kimmeridgian deposits of the Mikhalenino section (Kostroma region). □ Abstracts of the IX International conference «New ideas in Earth sciences». Moscow, April 14-17 2009. Vol.**1**: 46-47. [in Russian]

Kilenyi, T.I. (1978): The Jurassic Part III; Callovian – Portlandian. – In: Bate, R.H. & Robinson, E. (Eds.): A stratigraphical index of British Ostracoda, 259-298; Liverpool (Seel House Press).

Kilenyi, T.I. & Neale, J.W. (1978): The Purbeck / Wealden. – In: Bate, R.H. & Robinson, E. (Eds.): A stratigraphical index of British Ostracoda, 299-325; Liverpool (Seel House Press).

Kolpenskaya, N.N. (1999): Jurassic. – In: Sokolov, B.S. (Ed.): Practical manual on microfauna of the USSR. V. **7**. Mesozoic ostracods, 125-129; Saint-Petersburg (VSEGEI). [in Russian]

Kubiatowicz, W. (1983): Upper Jurassic and Neocomian Ostracodes from Central Poland. – Acta Geologica Polonica, **33/1-4**: 1-83.

Lutze, G.F. (1960): Zur Stratigraphie und Paläontologie des Callovien und Oxfordien in Nordwest-Deutschland. – Geologisches Jahrbuch, **77**: 391-532.

Nikolaeva, I.A., Kolpenskaya, N.N. & Lübimova, P.S. (1999): Superfamily Progonocytheracea Sylvester-Bradley, 1948. – In: Sokolov, B.S. (Ed.): Practical manual on microfauna of the USSR. V. **7**. Mesozoic ostracods, 62-67; Saint-Petersburg (VSEGEI) [in Russian].

Pyatkova, D.M. & Permyakova, M.N. (1978): Jurassic foraminifers and ostracodes of Ukraine. – 288 pp.; Kiev: (Naukova dumka) [in Russian].

Rogov, M.A. & Ippolitov, A.P. (2008): First records of coleoids with soft tissue remains from the Oxfordian of the Russian Plate. – In: Alekseev A.S. (Ed.): Paleostrat-2008. Annual meeting of paleontological section of Moscow Society of Naturalists and Moscow Branch of Russian Paleontological Society (Moscow, January 28-29, 2008). Abstracts. Moscow: 47-48 [in Russian].

Rogov, M.A. & Kiselev, D.N. (2007): The Kimmeridgian of Russia and adjacent areas, its subdivision and correlation. Field trip guidebook. – 35 pp.; Moscow (Geological Institute of RAS).

Schudack, U. (1994): Revision, Dokumentation und Stratigraphie der Ostracoden des nordwestdeutschen Oberjura und Unter-Berriasium. – Berliner geowiss. Abh. Reihe E. **11**: 1-193.

Tesakova, E.M. (2003): Callovian and Oxfordian Ostracodes from the Central region of the Russian Plate. – Paleontological Journal, **37**, suppl. **2**: 107-227.

Tesakova, E.M., Demidov, S.M., Guzhov, A.V., Rogov, M.A. & Kiselev, D.N. (2009): Oxfordian-Kimmerigian ostracods from Mikhalenino section (Kostroma region, Russia). – Abstracts of the 16th International Symposium on Ostracoda "Biostratigraphy and applied ecology". University of Brasília – Brazil. July 26-30, 2009; Brasilia: 32.

Ustinova, M.A. (2009): Foraminiferal ranges in the Oxfordian-Kimmeridgian deposits of the Mikhalenino section (Kostroma region). – In: Zakharov, V.A. (Ed.): Jurassic System of Russia: problems of stratigraphy and paleogeography. 3-rd all-Russian meeting: scientific materials, 246-248; Saratov (Nauka) [In Russian].

Wilkinson, I.P. (1983): Kimmeridge Clay Ostracoda of the North Wootton Borehole, Norfolk, England. – Journal of Micropalaeontology, **2**: 17-29.

Wilkinson, I.P. & Whatley, R.C. (2009): Upper Jurassic (Callovian–Portlandian). – In: Whittaker, J.E. & Hart, M.B. (Eds.): Ostracods in British Stratigraphy, 241-287; London (The Geological Society for the Micropalaeontological Society).

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Addresses of the authors:

Ekaterina M. Tesakova, Stephan M., Demidov, Geological Faculty, Moscow State University, Moscow, Russia;
e-mail: ostracon@rambler.ru

Alexander V. Guzhov, Paleontological Institute RAS, Moscow, Russia;
e-mail: avguzhov.paleo@mail.ru

Mikhail A. Rogov, Geological Institute RAS, Moscow, Russia;
e-mail: rogov_m@rambler.ru

Dmitry N. Kiselev, Yaroslavl' State Pedagogical University, Yaroslavl', Russia;
e-mail: dnkiselev@mail.ru