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Article

First record of *Palaeastacus* (Decapoda: Erymidae) in the Upper Jurassic of Russia (Yaroslavl Oblast)

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With 4 figures and 1 table

Abstract: The first erymid lobster finding of the genus *Palaeastacus* Bell, 1850 in the Jurassic of Russia, represented by an almost complete chela of first pereiopod, is described. It comes from the Tithonian (= Volgian Regional Stage, Upper Jurassic) beds of the Cheryomukha River Basin, Yaroslavl Oblast. Previously, Upper Jurassic *Palaeastacus* were considered to be confined exclusively to lithographic limestones of Germany. The new record significantly expands the paleobiogeography of *Palaeastacus*. The morphological features of the discussed chela allow to identify it as *Palaeastacus* aff. *solitarius* Oppel, 1862. A historical compilation of all known decapod findings in the Jurassic deposits of Russia is presented.

Keywords: Crustacea; Decapoda; Erymidae; *Palaeastacus*; Jurassic; Tithonian; Russia; Yaroslavl Oblast

1 Introduction

Erymid lobsters (Crustacea, Decapoda, Erymidae) were an important component of the crustacean faunas in the Mesozoic seas of the European territory, especially during the Jurassic. These lobsters reached their greatest diversity during the Late Jurassic (Devillez & Charbonnier 2021). Among them, genera such as *Eryma* Meyer, 1840, *Enoploclytia* M'Coy, 1849, *Palaeastacus* Bell, 1850, *Pustulina* Quenstedt, 1857 and *Stenodactylina* Beurlen, 1928 are widespread.

The genus *Palaeastacus* Bell, 1850 occurs from the Lower Jurassic to the Upper Cretaceous of North America, Europe, Australia and Antarctica (Schweitzer & Feldmann 2024). However, all previously known Upper Jurassic remains of *Palaeastacus* are exclusively confined to lithographic limestones of Germany (Devillez & Charbonnier 2021). Members of this genus are represented there by three species, *P. fuciformis* (Schlotheim, 1822), *P. rothgaengerae* (Schweigert & Röper, 2001) and *P. solitaries* Oppel, 1862.

This study reports for the first time the discovery of *Palaeastacus* remains (chela of the first pair of pereiopods) in the Upper Jurassic of Russia.

2 History of the study of Jurassic decapods in Russia

Despite the long history of study and the wide distribution of Jurassic marine deposits in Russia, especially in Central Part, Volga Region and the North Caucasus, there are relatively few records in the literature about decapod records (Table 1).

The first report of Jurassic crustaceans in Russia was noted in Rouillier (1845: 47) and is represented by scant information about fragments of P1 chelae from the "river crayfish" (*Astacus* sp.) in the Jurassic near the Dorogomilovo and Khoroshevo villages (now districts of Moscow).

Later, Vosinsky (1848) described a new species of "crayfish", *Glyphaea Bronni*, from the Volgian Stage (= Tithonian, *Virgatites virgatus* Zone) near Khoro-

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Table 1. Reliably known remains of decapods in the Jurassic deposits of Russia.

Taxonomy	Species	Stratigraphy & locality	References
Anomura: Munidopsidae	*Gastrosacus wetzleri* Meyer, 1851	Upper Jurassic (Oxfordian) of the North Caucasus	Mychko et al. 2025
Brachyura: Goniodromitidae	*Goniodromites aliquantulus* Schweitzer, Feldmann & Lazăr, 2007	Upper Jurassic (Oxfordian) of the North Caucasus	Mychko et al. 2025
Astacidea: Erymidae	*Eryma quadriverrucatum* Trautschold, 1866	Middle Jurassic (Callovian) of Ryazan Oblast	Dadykin & Shmakov 2023
	E. ornatum (Quenstedt, 1858)		
	E. aff. *E. ventrosum* (Meyer, 1835)		
	Eryma sp.		
	Stenodactylina insignis (Oppel, 1862)		
	Stenodactylina (?) sp.		
Pleocyemata: Glypheidea	*Glypheopsis* sp.		
	Glypheopsis cf. *G. etalloni* (Oppel, 1861)		
	Glypheidae indet.		
Pleocyemata: Mecochiridae	*Eumorphia* sp.		
Dendrobranchiata: Aristeidae	*Archeosolenocera* sp.		
Dendrobranchiata: Penaeoidea	Penaeoidea indet.		
Anomura: Paguroidea	Paguroidea gen. et sp. indet.	Upper Jurassic (Volgian, = Tithonian) of Moscow	Mironenko 2020
Pleocyemata: Mecochiridae	*Mecochirus* sp.	Middle Jurassic (Callovian) of Saratov Oblast	Tesakova 2008
Brachyura: Longodromitidae	*Abyssophthalmus* (?) *dzhafarberdensis* (Ilyin, 2005)	Upper Jurassic – Lower Cretaceous (Upper Tithonian – Lower Berriasian) of Crimea	Ilyin 2005
Polychelida: Polychelidae	*Tauricheles crymensis* (Levitsky, 1974)	Lower – Middle Jurassic (Toarcian – Aalenian) of Crimea	Levitsky 1974; Audo et al. 2017
Pleocyemata: Eryonoidea	*Proeryon hartmanni* (Meyer, 1836)	Lower Jurassic of the Vilyui River Basin (Yakutia)	Chernyshev 1930; Audo et al. 2020
	Coleia sibirica (Chernyshev, 1930)		Chernyshev 1930
Astacidea: Erymidae	*Eryma quadriverrucata* Trautschold, 1866	Middle – Upper Jurassic (Callovian – Oxfordian) of the Ryazan Oblast	Gerasimov 1955; Charbonnier et al. 2013; Devillez & Charbonnier 2019, 2021
	Eryma quadriverrucata Trautschold, 1866 (= *E. mosquensis* Lahusen, 1894)	Upper Jurassic (Volgian, = Tithonian) of Moscow	
	E. lerasi (Étallon, 1861) (= *E. gracilimana* Lahusen, 1894)		
	Eryma sp. (= *Glypheopsis vosinskyi* Lahusen, 1894)		

Table 1. cont.

Taxonomy	Species	Stratigraphy & locality	References
Decapoda	Decapoda ind. (= *Prosopon* ? sp. I)	Upper Jurassic (Volgian, = Tithonian) of Yaroslavl Oblast	Gerasimov 1955
Decapoda	Decapoda ind. (= *Prosopon* ? sp. II)		
Pleocyemata: Glypheidea	*Glyphaea* sp. indeterm.	Jurassic of Volonga River in Northern Timan	Lahusen 1894
Pleocyemata: Mecochiridae	*Eumorphia socialis* (Meyer, 1841) (= *Mecochirus socialis* Münst. [sic!])	"Brown Jurassic" with *Ammonites ornatus* from Kaluga Oblast	Eichwald 1868

shevo village. Unfortunately, this material, represented by carapace and fragments of P1 chelae, is apparently lost.

Eichwald (1865–1868) described six different species of decapods from Russia in the second volume of "Lethaea Rossica …", two of which can be considered Jurassic in age. In particular, *Prosopon rostratum* Mey. from the "White Jurassic" of Kharkov Province (now – Kharkov Oblast, Ukraine), *Meyeria vectensis* Bell, to which Eichwald referred the Vosinsky's material and included findings from the Cretaceous of Ulyanovsk, *Mecochirus socialis* Münst. [sic!] from the "Brown Jurassic" with *Ammonites ornatus* from Kaluga Province (now – Kaluga Oblast, Russia).

Later, Trautschold (1866) described and illustrated a new species, *Eryma quadriverrucata*, based on a carapace from the same locality as the material described by Vosinsky (1848). Trautschold noted a number of differences that allow *E. quadriverrucata* to be distinguished from other *Eryma* species.

At the end of the 19th century, a generalizing work by Lahusen (1894) was published, covering the information available at that time on the Jurassic decapods of Russia. In this compilation he described a number of new species. In particular, Lahusen (1894) described a new species, *Eryma karitzkyi* Lahusen, 1894, from the Callovian of Ukraine. He provided descriptions of *E. quadriverrucata* Trautschold, 1866 from the Callovian – lower Oxfordian of Ryazan region. The new species *Eryma gracilimana* Lahusen, 1894 was established based on appendages' fragments from the Volgian near Moscow. Lahusen also described the new species *E. mosquensis* based on P1 chelae from Khoroshevo, cited in the work of Vosinsky (1848: pl. 9, figs. 2–4), and Vosinsky's carapace (1848, pl. 9, figs. 1, 5) described as another species – *Glyphaea Vosinskyi* Lahusen, 1894. In addition, Lahusen (1894) also described *Glyphaea* sp. indeterm. based on an appendage fragment discovered by Chernyshev in Jurassic deposits along the Volonga River in Northern Timan.

Only after almost 60 years some of these finds and species were revised by Gerasimov (1955) and new ones were described. In his work, decapods of the Jurassic of Central Russia are presented, in particular, the following list is given:

- *E. quadriverrucata* Trautschold, 1866 (carapace and appendages; upper Callovian and lower Oxfordian of the Ryazan Oblast)
- *E. mosquensis* Lahusen, 1894 (carapace, appendages, P1 chelae, abdominal fragments; Volgian (=Tithonian) of Moscow)
- *E. gracilimana* Lahusen, 1894 (fragmentary appendages; Volgian of Moscow)
- *E.* sp. (fragmentary carapace; Volgian of Moscow Oblast, Voskresensky District)
- *E.* aff. *quadriverrucata* Trautschold, 1866 (fragmentary remains of carapace, abdomen and appendages; Oxfordian on the Moskva River)
- *E.* ? sp. I (chelae casts; Volgian Stage of the vicinity of Moscow)
- *E.* ? sp. II (dactylus fragment; Volgian of Moscow Oblast)
- *Glypheopsis vosinskyi* Lahusen, 1894 (carapace, abdomen and appendages; Volgian of Moscow and Moscow Oblast)
- *Prosopon* ? sp. I (propodus; Volgian of the Cheremukha River, Yaroslavl Oblast)
- *Prosopon* ? sp. II (propodus; Volgian near Koprino village, Yaroslavl Oblast)

These same definitions are also cited in later works by Gerasimov et al. (1995; 1996). Thus, in Gerasimov et al. (1995: table 6, figs. 1–3) an image of *E. quadriverrucata* from the middle Callovian of Ryazan

Oblast is given. And in another work (Gerasimov et al. 1996), already for the Volgian of Central Russia, the taxa *E. mosquensis, E. gracilimana* and *G. vosinskyi* are cited.

These latter species were later revised (Charbonnier et al. 2013; Devillez & Charbonnier 2019, 2021): *E. mosquensis* became a junior subjective synonym of *Eryma quadriverrucatum, E. gracilimana* – junior subjective synonym of *E. lerasi* (Étallon, 1861), and *Eryma karitzkyi* – junior subjective synonym of *Eryma mandelslohi* (Meyer, 1840). According to these researchers (Devillez & Charbonnier 2021: 49), the Tithonian *Glypheopsis vosinskyi* has more features characteristic for *Eryma*.

It is worth noting that Jurassic decapods of Russia are known not only from the European part, but also from Siberia. Chernyshev (1930) described Eryonoidea representatives found in the Lower Jurassic of the Vilyui River Basin (Yakutia). In this research, he described two new species, *Proeryon viluensis* and *Coleia sibirica*. Recently, Audo et al. (2020) synonymized the first species with *Proeryon hartmanni* (Meyer, 1836).

Levitsky (1974) described lobster-like Polycheli-dae, *Palaeopolycheles crymensis*, from the Jurassic of Crimea. An imprint of the dorsal surface of the carapace was found in the Tauride Formation (= Tauride Flysch Group) in the Yaman ravine (Prokhladnoye, Crimea) (Levitsky 1974). Currently this species assigned to the genus *Tauricheles* Audo, Charbonnier & Krobicki, 2017. Also from Central Crimea, Ilyin (2005) described the crab *Abyssophthalmus* (?) *dzhafarberdensis* (Ilyin 2005) (= *Nodoproposon dzhafarberdensis* according to Ilyin), which comes from the upper Tithonian – lower Berriasian.

There are also reports of crustacean remains found in the Callovian of Saratov Oblast (Dubki locality), identified as *Mecochirus* sp. (Tesakova 2008).

The only record of Jurassic Anomura from Central Russia comes from Volgian (= Tithonian) deposits, represented by the remains of a hermit crab (Paguroidea gen. et sp. indet.) of poor preservation inside an ammonite shell (Mironenko 2020).

A review of known decapods in the Jurassic of Central Russia was presented by Shmakov (2016). Later, Dadykin & Shmakov (2023) studied a rich decapod assemblage from the Middle Jurassic (Callovian) of central European Russia (Ryazan Oblast), represented by the following taxa: *Eryma quadriverrucatum* Trautschold, 1866; *E. ornatum* (Quenstedt, 1858); *E.* aff. *E. ventrosum* (Meyer, 1835); *Eryma* sp.; *Stenodactylina insignis* (Oppel, 1862); *Stenodactylina* (?) sp.; *Glypheopsis* sp. *Glypheopsis* cf. *G. etalloni* (Oppel, 1861); *Eumorphia* sp.; *Archeosolenocera* sp.; Penaeoidea indet.; Glypheidae indet.

Mychko et al. (2025) reported the first decapods (anomuran *Gastrosacus wetzleri* Meyer, 1851 and dromiacean crab *Goniodromites aliquantulus* Schweitzer, Feldmann & Lazăr, 2007) in the Upper Jurassic (Oxfordian) of the North Caucasus.

3 Localities and geological setting

Jurassic deposits of the Yaroslavl Oblast are widespread in the central and southern parts of the region and are represented by the Middle and Upper Series. They are located with erosion and angular unconformity on the underlying Triassic and Carboniferous rocks, and are covered by Cretaceous, Quaternary and, less often, Neogene formations. The total thickness of the Jurassic ranges from 20–30 m to 140 m (Zastrozhnova et al. 2015).

The Upper Jurassic is represented here by all three stages, Oxfordian, Kimmeridgian and Tithonian (= Volgian Regional Stage). In the Cheryomukha River Basin (Rybinsky District of Yaroslavl Oblast) (Fig. 1) deposits of the Upper Volgian Substage are widespread in the middle (from Ivanovskoye village) and upper reaches (to Demidovo and Ilyinskoye villages) (Fig. 1C). In each outcrop, only a small part of the Upper Volgian sequence is exposed. In the recent years, about ten new sections have been discovered, from which a composite section has been compiled with an almost complete zonal and infrazonal sequence from the Fulgens Zone to the Singularis Zone. Some of them (sections of the terminal part of the Upper Volgian Substage) were described earlier (Kiselev 2003; Rogov et al. 2011; Kiselev & Rogov 2012).

Below is a stratigraphic subdivision of the Upper Volgian Substage section located on the left bank of Cheryomukha River (Fig. 1D), published in the work of Kiselev et al. (2018). In this section, the Upper Volgian layers directly overly the black clays of the Lower Kimmeridgian or the phosphatized sandstones of the Virgatus Zone. Here, from bottom to top, the following sequence of layers is described (Fig. 1G):

- Layer 1. Medium-grained sand, overfilled with concretions of phosphatized, medium-grained, black sandstone (Fig. 1F). At the base of the layer

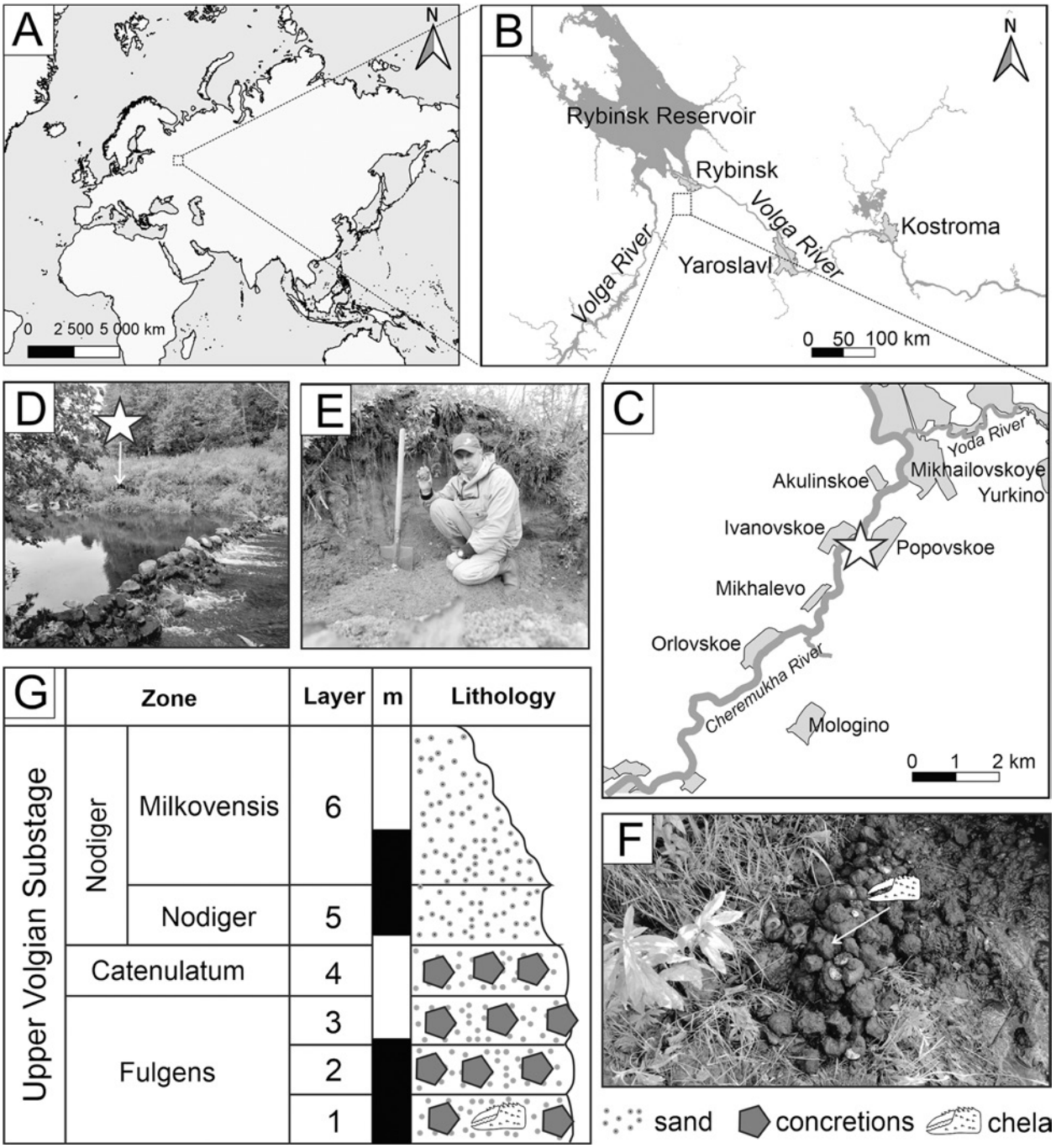

Fig. 1. Locality of *Palaeastacus* aff. *solitarius* Oppel, 1862 in Yaroslavl Oblast, Russia. **A** – schematic map of the Eastern Hemisphere; **B** – schematic map of areas in the vicinity of Yaroslavl and Rybinsk (Yaroslavl Oblast, Russia); **C** – the middle reaches of the Cheryomukha River south of Rybinsk, the star marks the locality; **D** – photo of the Cheryomukha River, the star marks the locality; **E** – geological outcrop and the author of the find M. Shekhanov; **F** – concretions with fossils from the locality; **G** – geological section of the locality, according Kiselev et al. (2018); photos D, E and F by M. Shekhanov.

there is a horizon of concretions in which *Virgatites rarecostatus* Rogov and *Dorsoplanites* spp., ammonites typical of the Virgatus Zone, are found. Higher, at the top of the layer, *Kachpurites cheremkhensis* Mitta et al., *Craspedites* spp. were found in concretions. Thickness up to 0.15–0.2 m.

- Layer 2. Clayey sand, bluish-grey, in places the upper part is cut off by moraine. At the base there is a horizon of concretions of phosphatized sandstone, mainly without fossils, in the upper part there are ammonites, among which *Kachpurites subfulgens* (Nikitin), *Craspedites* (*C.*) *okensis* (Orbigny), *Craspedites* (*C.*) sp. Thickness 0.25–0.3 m.
- Layer 3. Medium-grained sand, filled with concretions of black phosphatized sandstone with *Kachpurites involutus* Rogov, *Craspedites* (*C.*) *okensis* (Orbigny), *C.* (*C.*) *subditus* (Trautschold), *C.* (*C.*) cf. *subditoides* (Nikitin). Thickness 0.05–0.1 m.
- Layer 4. Medium-grained sand, grey, with concretions of black phosphatized sandstone containing ammonites *Garniericeras catenulatum* (Fischer), *Craspedites* (*C.*) *okensis* (Orbigny), *C.* (*C.*) *subditus* (Trautschold), *Craspedites* (*C.*) spp. Thickness up to 0.1 m. The layer is cut off in places by moraine.
- Layer 5. Clayey sand, dark grey, intensively bioturbated in the 0.2 m interval at the top, with reddish spots and smears. In the 0.1–0.15 m interval below the top, fragments of *Craspedites* (*Trautscholdiceras*) *nodiger* (Eichwald), *C.* (*T.*) cf. *parakachpuricus* Gerassimov were found. Thickness 0.7 m.
- Layer 6. Red sand. In the upper part of the layer, in the interval of 0.2 m thickness, fragments of *Craspedites* (*Trautscholdiceras*) *milkovensis* (Stremoukhov) were found. Visible thickness is 1.5 m.

The chela described in this paper comes from Layer 1 and was discovered by Mikhail Shekhanov (Fig. 1E) in 2016. It was discovered in concretions that are widespread in this layer. These concretions are rounded to irregular in shape and have diameters of about 10–20 cm. They contain a variety of fossils: belemnite rostra and their phragmocones, gastropod and bivalve shells, crustacean carapace fragments, sponge spicules, serpulid tubes, and numerous ammonites of various species. The ammonites are distinguished by the unique preservation of the phragmocone and the nacreous layer; they have repeatedly become the object of study for various paleontologists (Drushchitz et al. 1985; Mironenko 2015, 2017; Zatoń & Mironenko 2015).

All faunal remains in the concretions are chaotically mixed, often small shells, spicules and serpulids are found inside the body-chambers of ammonites, their surface is covered with layers of apatite. The study of apatite formed on the surface of gastropod egg capsules in the body-chambers of *Craspedites* ammonites showed that very rapid bacterial phosphatization took place, occurring under conditions of local oxygen deficiency with a large amount of organic matter (Zatoń & Mironenko 2015). All these facts support the hypothesis that the concretions were formed as a result of storms, when benthos was buried together with the remains of previously dead pelagic fauna in local depressions in the relief, which were immediately covered by sediment (Kiselev & Rogov 2012). The decomposition of organic matter from dead benthos (mollusks, serpulids, sponges, and possibly algae) led to the formation of large volumes of phosphate, which quickly cemented the buried accumulation (Mironenko 2017).

4 Systematic paleontology

I follow the classification by Devillez & Charbonnier (2022) and morphological terminology by Devillez & Charbonnier (2019, 2021, 2022).

Class Malacostraca Latreille, 1802
Order Decapoda Latreille, 1802
Infraorder Astacidea Latreille, 1802
Superfamily Erymoidea Van Straelen, 1925
Family Erymidae Van Straelen, 1925
Subfamily Eryminae Van Straelen, 1925
Genus *Palaeastacus* Bell, 1850

Type species: *Astacus sussexiensis* Mantell, 1824 (Cenomanian–Turonian of United Kingdom), by subsequent designation of Glaessner (1929).

Other species included (after Devillez et al. 2017; Garassino et al. 2021; Devillez & Charbonnier 2019, 2021, 2022; with additions, in stratigraphic order): *P. meyeri* (Garassino, 1996) (Sinemurian of Italy); *P. numismalis* (Oppel, 1853) (Pliensbachian of Germany); *P. argoviensis* Förster & Rieber, 1982 (Aalenian of Switzerland); *P. edwardsi* Étallon, 1861 (Callovian of France); *P. foersteri* (Feldmann, 1979) (Callovian of USA); *P. rothgaengerae* Schweigert & Röper, 2001 (Kimmeridgian of Germany); *P. soli-*

taries Oppel, 1862 (Kimmeridgian of Germany); *P. fuciformis* (Schlotheim, 1822) (Tithonian of Germany); *P. loryi* (Van Straelen, 1923) (Valanginian of France); *P. terraereginae* (Etheridge, 1914) (Barremian–Aptian of Antarctica, Argentina, Australia); *P. uranusiensis* Devillez & Charbonnier, 2019 (= ex. *P. foersteri* Taylor, 1979; Barremian of Antarctica); *P. tenuidigitatus* (Woods, 1957) (Aptian of Australia); *P. haidaensis* Garassino et al., 2021 (Albian of Canada); *P. walkeri* (Whitfield, 1883) (Albian of USA); *P. kimzeyi* Rathbun, 1935 (Campanian of USA).

Diagnosis: See Devillez & Charbonnier (2019).

Stratigraphic range: Lower Jurassic (Sinemurian) – Upper Cretaceous (Campanian).

Palaeastacus aff. *solitarius* Oppel, 1862
Figs. 2a–c, 3

Material: Incomplete chela of the first pair of pereiopods, no. MWO 1/88 №13050, Museum of the World Ocean (Kaliningrad, Russia).

Description: Relatively large and slightly incomplete P1 chela; propodus relatively short, thick, subrectangular, slightly spherical; inner margin straight, outer margin curved at index base; most part of index broken off, but its imprint shows that it was as long as dactylus; index, like dactylus, quite wide, but shorter than propodus; dactylar bulge relatively small, but noticeable; ornamentation of chela varied; propodus base covered with small spiny tubercles, located in checkerboard pattern; closer to dactylar bulge, these spines absent, but not present on index outer margin; rest part of chela, including spines areas, covered small pits of varying sizes; occlusal margins not preserved.

Measurements (in mm): propodus length along inner margin – 15, propodus length of from outer margin to index base – 13 mm; dactylus length – 16; chela width – 11.7; index base width – 5.6; propodus thickness > 8.

Remarks: The discussed chela has a morphology typical of *Palaeastacus*. Therefore, the generic affiliation does not raise any questions (see Devillez & Charbonnier 2021: 27). However, it is extremely difficult to determine it to the species, since the taxonomy of erymids, like most decapods, is based on the morphology of the carapace. It differs from the type species *P. sussexiensis* by the absence of spines on the outer margin of the dactylus and by the more prominent dactylar bulge. The discussed chela is quite similar to the chelae of the Jurassic *P. argoviensis* and *P. edwardsi*. However, the tubercles of the Yaroslavl' chela are smaller in size and concentrated closer to the outer margin of the propodus, while in *P. argoviensis* and *P. edwardsi* they are located over the entire dorsal surface of the propodus. It differs from *P. rothgaengerae* by the absence of hooked spines on the chela, and a longer propodus, dactylus and index. The only Tithonian species, *P. fuciformis*, is known from complete specimens from the Solnhofen Lithographic Limestones in Germany. Specimens of *P. fucifoirmis* are much smaller than the specimen described here and they have more spiny inner margins.

Nevertheless, among the known erymids P1 chelae, there were some very similar to the specimen from Yaroslavl Oblast. A very similar P1 chela was described by Oppel (1862) as *Palaeastacus solitarius* (Fig. 4). This taxon comes from the Upper Kimmeridgian Nusplingen Plattenkalk (Germany) and is known only by the holotype.

Schweigert et al. (2000) noted the similarity between the holotype of *Pustulina suevica* Quenstedt, 1857 and the P1 chela of the holotypes of *Eryma fraasi* Oppel, 1861 and *Palaeastacus solitarius* Oppel, 1862 from the same locality (Nusplingen Plattenkalk) and proposed to consider *Palaeastacus solitarius* Oppel, 1862 as a junior subjective synonym of *Pustulina suevica* Quenstedt, 1857. This opinion was supported in further studies (Devillez & Charbonnier 2021: 55).

However, in true *Pustulina* the ornamentation of the propodus consists of very coarse, densely spaced pustules, and especially a prominent node in the position where the dactylus inserts. This node is definitely missing in the holotype of *P. solitarius* and the pustules are irregular and wider spaced (pers. comm. Dr. Günter Schweigert). Apparently, *Palaeastacus solitarius* Oppel, 1862 should still belong to *Palaeastacus*, not to *Pustulina*, and is therefore included here in the list of species of the genus.

Moreover, the ornamentation of *P. solitarius* is quite similar to the ornamentation of the specimen from Russia, but with some minor differences. In particular, the pustules on the propodus of *P. solitarius* are located almost evenly, while in the specimen under discussion they are mainly closer to the outer margin. However, it is important to note that both of these

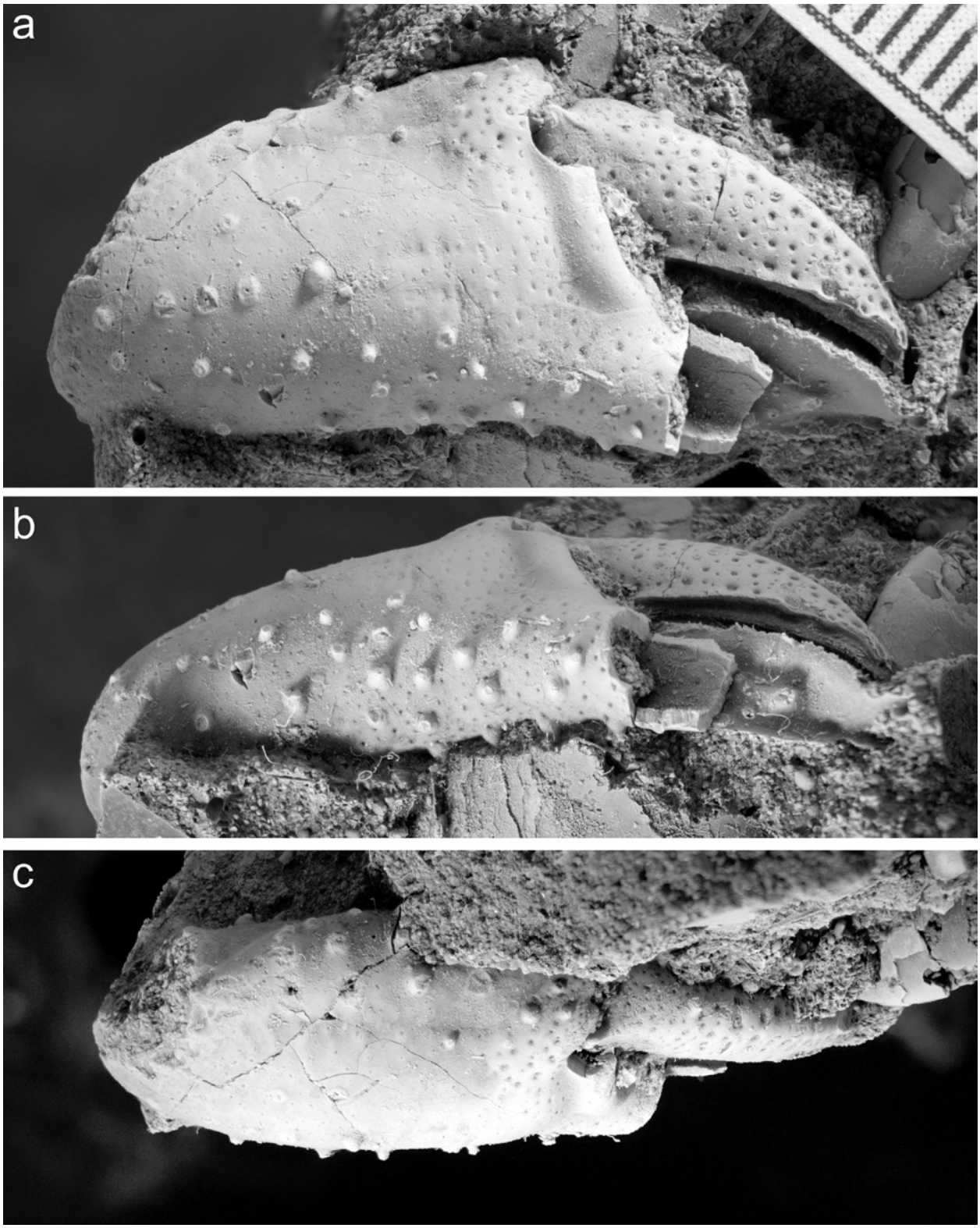

Fig. 2. Incomplete P1 chela of *Palaeastacus* aff. *solitarius* Oppel, 1862 from the Volgian (=Tithonian, Upper Jurassic) of Yaroslavl Oblast, Russia; no. MWO 1/88 №13050, Museum of the World Ocean (Kaliningrad, Russia): **a** – view from dorsal side, **b** – view from outer margin, **c** – view from inner margin; photos by the author.

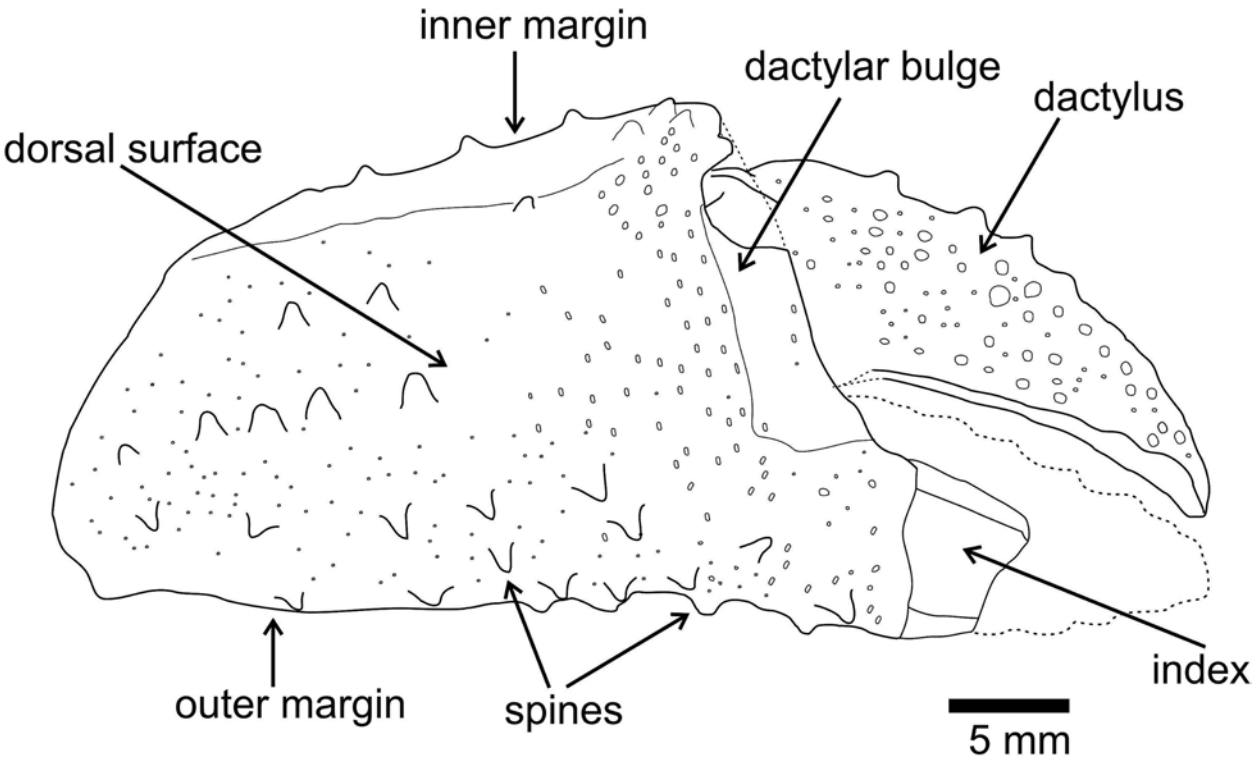

Fig. 3. Interpretative line drawing of the P1 chela of *Palaeastacus* aff. *solitarius* Oppel, 1862 from Yaroslavl Oblast; drawing by the author.

specimens come from different geographical regions and are of different geological ages. Nevertheless, I consider the chela from Yaroslavl Oblast to be close to the Plattenkalk species and propose to consider it *Palaeastacus* aff. *solitarius* Oppel, 1862.

5 Discussion

The P1 chela from the Upper Jurassic of Yaroslavl Oblast described in this study obviously belongs to the genus *Palaeastacus* Bell, 1850 and is quite similar in ornamentation to the chela of *Palaeastacus solitarius* Oppel, 1862 from the Kimmeridgian of Germany. I conditionally classify it as the latter species. I note that it is proposed to again consider the species *P. solitarius* as a representative of *Palaeastacus* Bell, 1850, and not *Pustulina* Quenstedt, 1857, as researchers previously believed (Schweigert et al. 2000; Devillez & Charbonnier 2021).

Remains of *Palaeastacus* were previously unknown in Russia, both in the Jurassic and Cretaceous. Therefore, this paper presents the first record of this genus in this geographic region, expanding the paleobiogeographic distribution of *Palaeastacus* to the East of Europe.

It is worth noting that the described *Palaeastacus* chela is not the first record of decapods from this locality. Previously, Gerasimov (1955) had described a propodus from the Volgian along the Cheryomukha River, which he identified as *Prosopon*? sp. I. Its fragmentary preservation hardly allows it to be confidently assigned to any taxon, but it is unlikely that it belongs to a crab. Similar propodi are characteristic, for example, for ghost shrimps, such as Callianassidae. From the personal commentary of Dr. Dmitry Kiselev it follows that crustacean remains are quite common in these deposits. It is obvious that the Upper Jurassic along the Cheryomukha River in the Yaroslavl Oblast have great potential for finding further decapod remains.

Not less important is that Late Jurassic representatives of *Palaeastacus* were previously known exclusively from lithographic limestones of Germany (Devillez & Charbonnier 2021). The *Palaeastacus* aff. *solitarius* Oppel, 1862 record of the Yaroslavl Oblast comes from completely different lithologies, represented by sands and clayey sands with concre-

Fig. 4. Incomplete P1 chela and its imprint of *Palaeastacus solitarius* Oppel, 1862, holotype, from the upper Kimmeridgian (Upper Jurassic) of Nusplingen, Germany; Staatliches Museum für Naturkunde (Stuttgart, Germany), SMNS 3682-4; scale bar – 1 cm; photo by Dr. G. Schweigert.

tions. The formation of these concretions was accompanied by very rapid phosphatization in an apparently oxygen-depleted environment (Zatoń & Mironenko 2015). Storms were frequent in that depositional setting (Kiselev & Rogov 2012). These conditions differ significantly from those experienced by the *Palaeastacus* inhabitants in the Late Jurassic of Central Europe.

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