

Notes on the synonymy, variability and bionomy
of *Eपुरаеа (Eपुरаеа) biguttata* (Thunberg, 1784) and
E. (E.) unicolor (Olivier, 1790) (Coleoptera: Nitidulidae)

Замечания по синонимии, изменчивости и бионии
Eपुरаеа (Eपुरаеа) biguttata (Thunberg, 1784) и
E. (E.) unicolor (Olivier, 1790) (Coleoptera: Nitidulidae)

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KEY WORDS: synonymy, Coleoptera, Nitidulidae, *Eपुरаеа*, variability, rearing, bionomy.

КЛЮЧЕВЫЕ СЛОВА: синонимия, Coleoptera, Nitidulidae, *Eपुरаеа*, изменчивость, разведение, биония.

ABSTRACT. The distinction of “species” *Eपुरаеа (Eपुरаеа) biguttata* (Thunberg, 1784) and *E. (E.) unicolor* (Olivier, 1790) is estimated. On the base of examination of the vast collection material, rearing of *E. (E.) biguttata* and *E. (E.) unicolor* imagines on different types of substrates under laboratory conditions and field observations was shown that these “species” are a single species. Besides, it was shown a significant degree of variability of imagines making impossible to distinguish these “species” as well.

РЕЗЮМЕ. Оценены различия “видов” *Eपुरаеа (Eपुरаеа) biguttata* (Thunberg, 1784) и *E. (E.) unicolor* (Olivier, 1790). На основании изучения обширного коллекционного материала, разведения на разных типах субстратов в искусственных условиях и полевых наблюдений показано, что эти “виды” являются одним видом. Установлена значительная степень изменчивости имаго, также делающая невозможным разграничение этих “видов”.

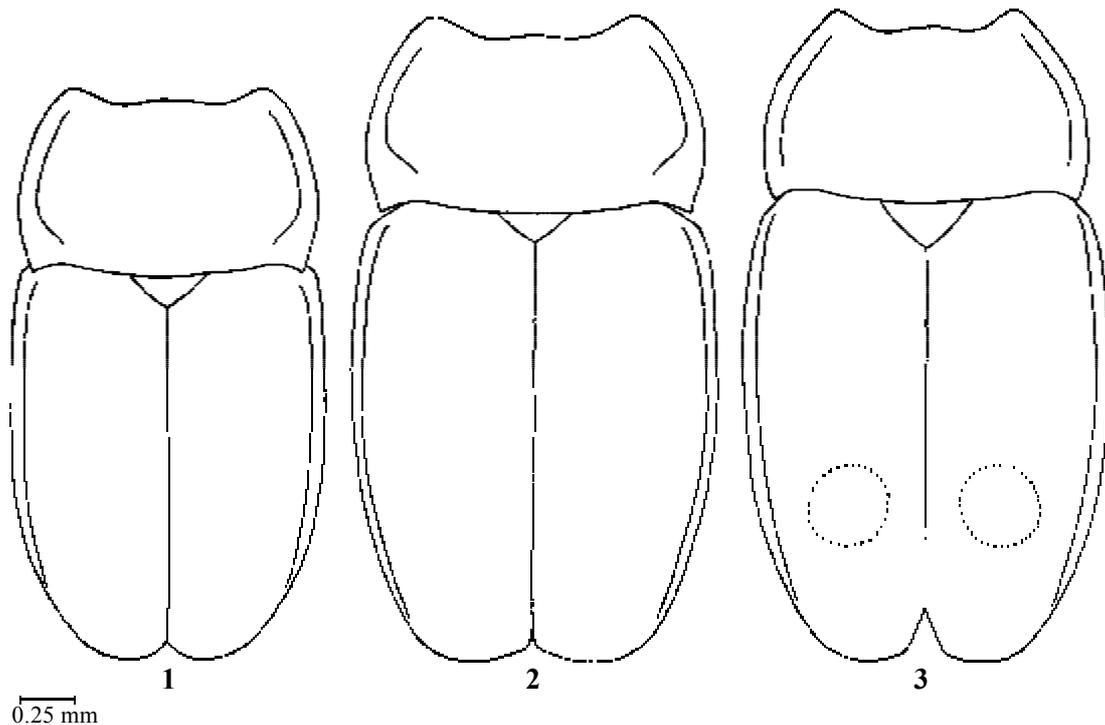
Introduction

E. Reitter [1894, 1919] and L. Ganglbauer [1899] treated under the name *E. (E.) obsoleta* Fabricius, 1792 a species which the later researchers and authors of the current publication consider as *E. (E.) biguttata*. A. Grouvelle [1913] regarded *E. (E.) obsoleta* as a synonym of *E. (E.) unicolor*, but he was also first who treated the name *E. (E.) biguttata* as a probable synonym of *E. (E.) unicolor*. In the Winkler’s [1926] catalogue the name *E. (E.) obsoleta* was also regarded as a synonym of *E. (E.) unicolor*. O. Sjöberg [1939] examined Thunberg’s type of *E. (E.) biguttata* from Uppsala

Universität Museum and considered it as a separate species. Such an approach was used by some later authors [Spornraft, 1967; Audisio, 1980, 1993; Kirejtshuk, 1992] who regarded these “species” *E. (E.) biguttata* and *E. (E.) unicolor* as distinctive. Thus, this paper presents an attempt to examine these 2 forms during the last 60 years regarded as 2 species. For this purpose a wide comparison of museum specimens, some observations in the field and laboratory experiments were carried out.

It was thought that the differences of two forms treated with names “*biguttata*” and “*unicolor*”, if they are not separate species, at least should be expressed some preferences in ecological requirements or appearance of these forms is associated with difference in circumstations of larval development.

Identification of the forms, interpreted as “*biguttata*” and “*unicolor*” is hard due to absence of the reliable diagnostic characters. According to A.G. Kirejtshuk [1992] the following characters can be used to diagnose these “species”: “Quite slender, with more convex pronotum and elytra, with clearly explanate sides. Pronotum less than twice narrower than in length. Body usually lighter, with dispersed dark pattern on elytra. Mesotibiae of males with weak subapical process at inner edge. Apex of female pygidium widely rounded. Aedeagus as for *biguttata*” for *E. (E.) unicolor* and “More robust, with more flattened pronotum and elytra, with gently sloping and slightly explanate sides. Pronotum about as twice wide as length. Usually dark, not rarely with lighted oval spots in posterior third of elytra. Mesotibiae of males sharply expanded before apex. Apex of female pygidium narrowly rounded” for *E. (E.) biguttata*, but he also emphasized that [Kirejtshuk, 1992:



Figs 1–3. General shape of males body of *E. (E.) biguttata* = *E. (E.) unicolor* (without head and abdomen apex) from Samara Region. 1–2 — reddish coloration of the body; 3 — dark brown coloration of the body.

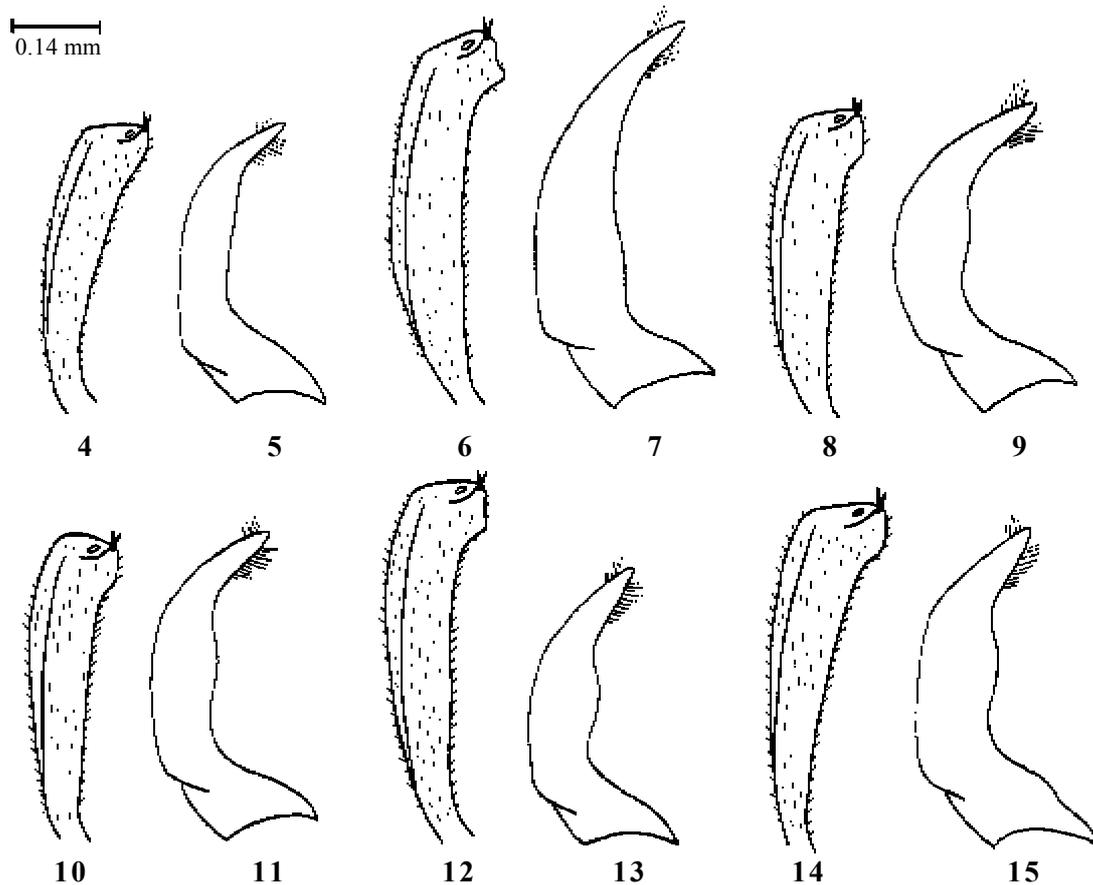
Рис. 1–3. Общая форма тела самцов *E. (E.) biguttata* = *E. (E.) unicolor* (без головы и вершины брюшка) из Самарской области. 1–2 — рыжеватая окраска тела; 3 — тёмно-коричневая окраска тела.

155]: “Probably, forms *E. biguttata* and *E. unicolor* more reasonably to consider as a single species, since specimens with the intermediate state of characters occur in nature...” P. Audisio [1993] used almost the same characters on the base of earlier publications [Reitter, 1894, 1913; Spornraft, 1967; Audisio, 1980] but he also drew some attention to the tegmen structure: “On the average, size smaller (length 2.3–3.2 mm) and body slightly more elongate. Male genitalia: ...in particular parameres narrower if viewed laterally, with simple inner margin.” for *E. (E.) unicolor* and “On the average, size larger (length 2.8–3.6 mm) and body slightly less elongate. Male genitalia: ...in particular parameres wider if viewed laterally, with distinct gibbosity on inner margin.” for *E. (E.) biguttata*. Thus, the main characters to be used for separation of these two “species” are: general shape of the body (especially proportions, convexity and the shape of pronotum and elytra apices), shape of male mesotibiae and peculiarities in the tegmen structure. All the rest characters mentioned in the above keys give some chances for discrimination of the forms under consideration.

Study of museum specimens

Examination of many hundreds specimens of both “species” deposited in the collections of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg and many other collections of the world showed

that all characters used in identification of *E. (E.) biguttata* and *E. (E.) unicolor* possess rather a great variability. This great variability was observed in size, shape of the body and pronotum, body coloration, expression of the secondary sexual characters and aedeagus structure. Specimens from Europe and Russia demonstrate transitions between the characters regarded as diagnostic for the mentioned forms and especially in the shape of male mesotibiae and peculiarities in the tegmen structure which were considered to belong tightly to either *E. (E.) biguttata* or to *E. (E.) unicolor* in accordance with the identification keys [Sjöberg, 1939; Spornraft, 1967; Audisio, 1980, 1993; Kirejtshuk, 1992]. Some variability was observed in general shape of the body, proportions, convexity and shape of pronotum and shape of elytral apices, some interesting cases were illustrated (Figs 1–3). The shape of the body varies from more slender and comparatively narrow to more robust and wider; the same situation noted in shape of the pronotum which additionally can have rather widely explanate sides. The shape of male mesotibiae and tegmen is also very variable and many series represent a mixture of *E. (E.) biguttata* and *E. (E.) unicolor* characters. Reddish and light brown males from “okr. Kalugi (env. Kaluga)”, “Raddevka na Amure (Raddevka at Amur River)” have the mesotibiae sharply expanded along its inner edge (characteristic of *E. (E.) biguttata*) and the tegmen with a simple inner margin (characteristic of *E. (E.) unicolor*). Male specimens from “Yarosl. (Yaroslavl)”, “D/HS, Lkr. Kassel



Figs 4–15. Male mesotibiae and tegmens: 4, 6, 8, 10, 12, 14 — mesotibia, ventral; 5, 7, 9, 11, 13, 15 — tegmen, lateral; 4–5, 12–15 — Samara Region; 6–7 — “Raddevka na Amure” (Raddevka at Amur River); 8–9 — “Primorsky krai”; 10–11 — “Petropolis”.

Рис. 4–15. Средние голени самцов и тегмены: 4, 6, 8, 10, 12, 14 — средняя голень, снизу; 5, 7, 9, 11, 13, 15 — тегмен сбоку; 4–5, 12–15 — Самарская область; 6–7 — “Радевка на Амуре”; 8–9 — “Приморский край”; 10–11 — “Петрополис”.

Reinhardswald”, “Petropolis”, “SPb”, “Boblovo” (Moscow Region), “Samara Region”, “Primorskykrai”, “Vladivostok” and many others show different combinations and degree of these characters expression in all above-mentioned structures which can be easily traced within rather a large series of the specimens. It should be noted that K. Spornraft [1967] found some differences in the shape of the penis trunk (visible in lateral view) of the “species” but his drawings probably referred to imagines of different size. Taking into consideration the body coloration it is possible to divide specimens of these “species” into three types of coloration: (1) specimens with dark brown or brown coloration of the body, often with the characteristic light sport in the distal third of each elytron; (2) intermediate specimens with light brown coloration of the body, not infrequently with the light sport in the distal third of each elytron; (3) specimens with reddish or light reddish coloration of the body, without sports on elytra.

Field and laboratory study

Some field observation carried out in Kemerovsk Region and Altaysky Kray in June 1998 as well as in

Primorsky Kray during 1989, 1999 and 2001 gave impression that the forms under consideration more or less regularly originated from different habitats. Particularly, “*E. (E.) biguttata*” usually occurred in open places (characteristic of surface of fruit bodies of *Fomes* spp. and localities with spores fallen from its hymenophores), while “*E. (E.) unicolor*” is more characteristic of under bark inhabitation.

In order to testify this impression some experiments with rearing of larvae were made in 2006 during the spring – summer in Samara Region. There have been taken adults from different substrates with part of peculiar substrate and put in reservoirs to obtain eggs, larvae and then adults of the next generation. In other cases mature larvae were taken from certain places in order to get adults from these larvae. As result, six series of specimens have been obtained from larvae appeared in laboratory, they are:

I. Over 20 brown adults collected: 06.V.2006. Russia, Samara Region, Volzhsky District, 4,5 km SSO Zelyonen’ky Village, ravine forest, on arboricolous fungi *Fomes fomentarius* and in its spore powder on fallen trunk of *Betula pendula* and were put on arboricolous fungi *Fomes fomentarius* for rearing under laboratory

conditions. Development had the following dynamics: 06–07.V.2006 — adults laid eggs; 08.V.2006 — emergence of first stage larvae; 13–14.V.2006 — emergence of mature larvae; 17.V.2006 — mature larvae went in soil for pupation; 24.V.2006 — emergence of first pupa; 27.V.2006 — emergence of numerous pupae; 03.VI.2006 — emergence of 4 adults and transferring them on yeast / banana / sugar / water mixture for feeding; 16.VI.2006 — mature adults were mounted. Results: 4 emerged adults were brown in coloration, and with more or less expressed other characters of “*E. (E.) biguttata*”.

II. 12 brown adults collected: 28.V.2006. Russia, Samara City, Krasnoglinsky District, 1,5 km OSO Krasnaya Glinka Town, bottom and slope of Kuznetsov Mountain, broad-leaved forest with some hazels, on yeast / banana / sugar / water mixture and were put on sawn trunks (length — 100 mm, diameter — 100–110 mm) of *Betula pendula* with almost completely detached bark for rearing under laboratory conditions. Development had the following dynamics: 30–31.V.2006 — adults laid eggs; 01.VI.2006 — emergence of first stage larvae; 07.VI.2006 — emergence of mature larvae; 12.VI.2006 — some mature larvae went in soil for pupation; 14–16.VI.2006 — numerous mature larvae went in soil for pupation; 16.VI.2006 — emergence of first pupa; 26.VI.2006 — emergence of numerous pupae; 24.VI.2006 — emergence of first adult; 24.VI–02.VII.2006 — emergence of 14 adults and transferring them on yeast / banana / sugar / water mixture for feeding; 06.VII.2006 — mature adults were mounted. Results: 14 emerged adults were from light brown to brown in coloration, and with smaller body size. Combination of their characters are similar to those of “*E. (E.) unicolor*” rather than to that of “*E. (E.) biguttata*”.

III. Mature larvae collected: 14.V.2006. Russia, Samara Region, Krasnoyarsky District, 3 km OSO Staraya Binaradka Village, broad-leaved forest, under bark of charred *Quercus robur* on fermented sap, mold fungi and were put on yeast / banana / sugar / water mixture for feeding. Development had the following dynamics: 17–20.V.2006 and later — larvae went in soil for pupation; 31.V.2006 — emergence of numerous pupae; 04–10.VI.2006 — emergence of 27 adults and transferring them on yeast / banana / sugar / water mixture for feeding; 22.VI.2006 — mature adults were mounted. Results: 27 emerged adults were from brown to reddish in coloration, and the characters more similar to those in other “*E. (E.) unicolor*”.

IV. Mature larvae collected: 04.VI.2006. Russia, Samara Region, Stavropol'sky District, 3 km WSW Vlast' Truda Village, pine-broad-leaved forest at second overflood-plain terrace of Volga River, on hymenophore of arboricolous fungus *Fomes fomentarius* on fallen trunk of *Tilia cordata*. Development had the following dynamics: 07.VI.2006 — larvae went in soil for pupation; 12.VI.2006 — emergence of first pupa; 14.VI.2006 — emergence of numerous pupae; 17, 20–22.VI.2006 — emergence of 14 adults and transferring them on yeast / banana / sugar / water mixture for feeding; 30.VI.2006 — mature adults were mounted. Results: of 14 emerged

adults 12 were dark brown in coloration and only 2 specimens were reddish in coloration, with characters in some as those in other “*E. (E.) unicolor*” while other specimens had certainly characters more similar to those in other “*E. (E.) biguttata*”.

V. A mature larva collected: 07.VI.2006. Russia, Samara Region, Volzhsky District, 1 km OSO Kurumoch Village, burnt pine-birch-aspen forest, on fermented sap of charred *Betula pendula*. Development had the following dynamics: 12.VI.2006 — larva went in soil for pupation; 17.VI.2006 — emergence of a pupa; 23.VI.2006 — emergence of an adult and transferring it on yeast / banana / sugar / water mixture for feeding; 30.VI.2006 — a mature adult was mounted. Results: an emerged adult was dark brown in coloration with the characters of “*E. (E.) biguttata*”.

VI. Mature larvae collected: 10.VI.2006. Russia, Samara Region, Stavropol'sky District, 3 km WSW Vlast' Truda Village, pine-broad-leaved forest at second overflood-plain terrace of Volga River, broken tree of *Acer platanoides*, on fermented sap covered with yeast. Development had the following dynamics: 12.VI.2006 — larvae went in soil for pupation; 16.VI.2006 — emergence of pupae; 23, 25.VI.2006 — emergence of 2 adults and transferring them on yeast / banana / sugar / water mixture for feeding; 30.VI.2006 — mature adults were mounted. Results: 2 emerged adults were dark brown in coloration with the characters of “*E. (E.) biguttata*”.

Totally 61 specimens of “*E. (E.) biguttata* – *E. (E.) unicolor*” were reared under laboratory conditions. Examination of them found out not strict dependence between the types of substrates and appearance, and characters expression of emerged adults. Thus, there are no reliable diagnostic characters to consider *E. (E.) biguttata* and *E. (E.) unicolor* as separate and independent species. The following synonymy should be recognized to *E. (E.) biguttata*:

Eपुरaea (Eपुरaea) biguttata (Thunberg, 1784)

- = *Silpha biguttata* Thunberg, 1784: 9
- = *Nitidula bipunctata* Heer, 1841: 398, non *Nitidula bipunctata* (Linnaeus, 1758): 359
- = *Nitidula unicolor* Olivier, 1790: 17
- = *Nitidula obsoleta* Fabricius, 1792: 256 (partim), non *Nitidula obsoleta* Illiger, 1798: 384 (partim), nec *Nitidula obsoleta* Herbst, 1793: 240
- = *Nitidula aestiva* Kugelann, 1792: 511; non *Nitidula aestiva* Fabricius, 1775: 77, nec *Eपुरaea aestiva* (Linnaeus, 1758): 574
- = *Eपुरaea subangulata* Motschulsky, 1860: 127
- = *Eपुरaea trapezicollis* Motschulsky, 1860: 127
- = *Eपुरaea heeri* Tournier, 1872: 439
- = *Eपुरaea pallax* Reitter, 1873: 33
- = *Eपुरaea maculata* Dalla Torre, 1879: 87
- = *Eपुरaea x-rubrum* J. Sahlberg, 1911: 42; Sjöberg, 1939: 117

Notes on bionomy

Some elements of the mature larva of *E. (E.) biguttata* but under the name *E. (E.) obsoleta* were precisely drawn by K.W. Verhoeff [1923]. A.G. Böving & J.G. Rozen [1962] used a larva of “*E. (E.) unicolor*” for elaboration of a key to larvae of Nitidulidae. However,

the drawing of this larva demonstrates that it looks like very different not only from the illustration by Verhoeff but also all Palaearctic larvae of the genus *Epuraea* Erichson, 1843. Therefore, it seems to be erroneously identified or labeled. Later, rather a detailed description of the mature larva of *E. (E.) biguttata* with some drawings was carried out by V.A. Potozkaja [1978]. In her publication larvae of both “*E. (E.) biguttata*” and “*E. (E.) unicolor*” species were included in a key to the genus *Epuraea*, but the characters used for identification of the latter “species” repeats those proposed by Böving & Rozen for “erroneous” “*E. (E.) unicolor*”.

Some observations on the larvae of *E. (E.) biguttata* and its rearing under the laboratory conditions yielded some valuable information on the larval trophics. Larvae were found to feed on wide spectrum of organic substrates which represented by hymenophore and spores of arboricolous fungus *Fomes fomentarius*, fermented sap of different trees (*Acer platanoides*, *Betula pendula*, *Quercus robur*) in some cases covered with yeasts, “under bark of charred *Quercus robur* on fermented sap, mold fungi” and yeast / banana / sugar / water mixture. Moreover, it was shown under laboratory conditions for the first time that larvae of considering species were successfully developing on sawn trunks of *Betula pendula* with almost completely detached bark. Under these circumstances larvae fed upper layer of the wood and inner layer of the bark which have not been preliminary transformed by some mold fungi or like that fungi.

Discussion

As it was shown above the forms “*E. (E.) biguttata*” and “*E. (E.) unicolor*” most likely to represent the extremes of variability of one species with a well expressed polymorphic nature. It demonstrates not only a great range of morphological variability but a high degree of the trophic plasticity at both stages of the life cycle. It is possible to suggest that such a degree of variability could be due to rather a high ability of this species to occur under various conditions (throughout Palaearctic) in the natural environments that probably somewhat reflects on its morphology.

ACKNOWLEDGEMENT. The authors thank to the colleagues provided them with the specimens for study. The specimens of the species considered in this paper were obtained from collections of almost all museums, although most numerous series are deposited in Muse-

um für Naturkunde an der Humboldt-Universität (F. Hieke and M. Uhlig), Zoologisk Museum in København Universitet (O. Martin), Naturhistoriska Riksmuseet, Stockholm (P. Lindskog, B. Viklund), Staatliches Museum für Naturkunde, Stuttgart (W. Schawaller), Museum für Naturkunde, Erfurt (M. Hartmann), Natural History Museum in London (M.V.L. Barclay, M.J.D. Brendell, P.M. Hammond), Zoologische Staatssammlung, München (O. Scherer, K. Spornraft). The study of the second author was supported by the Programme of the Presidium of the Russian Academy of Sciences “Origin and evolution of biosphere”.

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