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CHARA BALTICA (CHAROPHYCEAE, CHARALES) FROM THE BLACK SEA REGION AND TAXONOMIC IMPLICATIONS OF EXTRASTIPULODES

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Abstract

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Chara baltica (Hartm.) Bruz. was found in the bays of the northern part of the Black Sea as a result of our joint efforts for clarification of some charophyte species from the region. The species was reported new to Ukraine. This is the first reliable record of this species in the Black Sea Region and Russia. In the studied populations, *C. baltica* had a variable arrangement of stipulodes because of the presence of extrastipulodes as a common trait. The morphology of the specimens studied may suggest a possible explanation of old uncheckable regional records of *C. horrida* Wahlst., species known from the Baltic Sea only. The worldwide range of *C. baltica* was summarised with a map according to the published records, GBIF data and some checked specimens. It highlighted the records, which need to be confirmed. The presence of extrastipulodes in the specimen studied, as well as the indication and illustration of some species of charophytes, allowed to suggest several additions to the terminology of charophyte morphology useful for further studies. Their application was demonstrated with the specimens studied and the illustrations published elsewhere.

Keywords: Black Sea, *Chara baltica*, Characeae, charophytes, distribution, stipulodes.

INTRODUCTION

The charophytes are commonly easily recognisable group, but some groups of the species resemble a “nightmare” in species delineation. The subsection *Hartmania* of *Chara* is one of the best examples of this ongoing taxonomic problem (Urbaniak, 2010; Schneider et al., 2015; Arbeitsgruppe Characeen Deutschlands, 2016; Urbaniak & Kwiatkowski, 2019). The noticeable regional differences in the taxonomy of the group, especially in the case of old published records can be overcome with the study of collections or new sampling. The continuous efforts of the authors to clarify as far as possible some records of charophyte species from the Black Sea resulted in the first reliable record of *Chara baltica* (Hartm.) Bruz. for the region and highlighted some taxonomic aspects associated with the formation of extrastipulodes by different species of *Chara*.

MATERIALS AND METHODS

The specimens were collected during continuous monitoring of plant communities in the bays of the Black Sea in 2015–2016. The vouchers pressed and fixed in 4% formalin were deposited at the Komarov Botanical Institute (LE) of the Russian Academy of Sciences (St Petersburg, Russia). The collections of herbaria B, BCN, COI, H, L, LE, LISU, MA, W (the acronyms of the herbaria after Thiers (2020)) were studied in search of *Chara baltica* and *C. horrida* Wahlst. from the Black Sea and the neighbouring regions, as well as for the comparison with new collections of the species and clarification of their distribution. The photos of specimens stored at LE were taken using a Carl Zeiss Stereo Discovery V12 stereomicroscope equipped with an AxioCam MRs-5 digital camera. The map of records was made using SimpleMappr (http://www.simplemappr.net) based on cleaned GBIF records (GBIF.org, 2020), published data and some specimens, checked in the collections studied. It's impossible to include a complete bibliography of all records of *C. baltica*, therefore, we cited mostly relevant references having exact species localities and covering all distribution regions and records, omitting sources with repeating data.

RESULTS AND DISCUSSION

Chara baltica in the Black Sea

List of the specimens studied (Figs 1A–I, 2).

UKRAINE: 1. The Sea of Azov, Utlyutzkiy Liman, together with *Chara aspera* Willd., 24 August 1930, A.F. Zubovskiy (LE: A0000157); 2. The Sea of Azov, Kirillovskiy Bay [of] Utlyutzkiy Liman, near the northern coast of Fedotova Split at the meridian of Pereboynoe, stands, 13 July 1939, A.I. Proshkina (LE: A0000166); 3. Kherson Okrug (formerly Dneprovsky Uezd of Tavricheskaya Gubernia), Yagorlytskiy Bay of the Black Sea, between Kinburn Split and Island Dolgiy, 9 September 1926, A. Poretzky (LE: A0000167-A0000170). 4. The north-western part of the Black Sea, [Kherson Oblast], Tendrivska Bay [or Gulf of Tendra, the territory of the Black Sea Biosphere Reserve], in front of [split Bili] Kuchuhury, at a depth of 2.3 m, on silt, 2 August 1937, I.I. Pohrebniak (LE: A0000158); 5. Tendrivska Bay, near [split Bili] Kuchuhury, at a depth of 7 ft. [2.1 m], 2 August 1937, I.I. Pohrebniak (LE: A0000159); 6. Tendrivska Bay, near island Orlov, at a depth of 0.5 m, on silt and sand, 3 August 1937, I.I. Pohrebniak (LE: A0000160); 7–9. Kherson Oblast, Tendrivska Bay, the Black Sea Biosphere Reserve: 7. 46.186465° N, 31.98598667° E, at a depth of 1.3 m, on silty sand, 18 August 2015, D.D. Korolesova (LE: A0000161); 8. 46.22187167° N, 31.73646333° E, together with *Chara canescens* Loisel. (female plants) and *Lamprothamnium papulosum* (Wallr.) J.Groves, 19 August 2015, D.D. Korolesova (LE: A0000162); 9. 46.227278° N, 32.063738° E, at a depth of 1.1 m, on silty sand, together with *C. canescens* (female plants), 19 August 2015, D.D. Korolesova (LE: A0000163). RUSSIA: 10, 11. Krasnodar Krai, Taman Bay, settlement of Sennoy [Sennaya]: 10. at a depth of 0–0.5 m, 17 October 2015, D.F. Afanasyev (LE: A0000164); 11. at a depth of 1 m, on silty-sandy ground, 17 October 2015, D.F. Afanasyev (LE: A0000165).

The habit and morphological traits of the specimens studied are in a good agreement with descriptions and illustrations of *Chara baltica* from the Baltic Sea (Schubert & Blindow, 2003; Urbaniak & Gąbka, 2014; Arbeitsgruppe Characeen Deutschlands, 2016; Urbaniak & Kwiatkowski, 2019) as well as with specimens checked (LE) except for extrastipulodes (Fig. 2) rarely noted in descriptions although traceable at some illustrations (see below). The plants are mostly sterile, and only some of them from the Utlyutzkiy Liman are fertile; no ripe oospores are available.

Chara baltica is a species record new to Ukraine and first reliable record to Russia and the Black Sea. The earlier reported record from small water bodies in inland brackish minerotrophic fen in Pskov Region of Russia belongs to *C. papillosa* Kütz. (Efimov et al., 2016; LE!).

According to the specimens studied, we can conclude that *C. baltica* still grows in the North Black Sea Region, at least in the same bay. However, the recent apparent decline of charophyte abundance has been found (Korolesova, 2015). By the mid-1990s, the stands of *Chara* referred to *C. papillosa* (as *C. aculeolata* Kütz. sensu Hollerb. et Krass.) had high biomass values in the bays and limans of the North Black Sea Region. They formed dense cover at the depths of 0.9–2.1 m on silt and silty sand at nearshores of

Fig. 1. *Chara baltica* (A–I) and *C. papillosa* (J–O) from the north of the Black Sea Region (LE). A, B, J – apical parts of plants; C, D – whorls of branchlets; E–G, M, N – tylacanthous stem cortex with solitary (E–G) or clustered spine cell (M, N); H, O – nodal bulbils; I – conjoined gametangia (arrowhead – antheridium, double arrowhead – oogonium; a triangular shield of antheridium is visible below); K – whorl of stipulodes with triple extrastipulodes (arrowhead); L – triple extrastipulodes; M – stem cortex with clustered spine cells, up to four together (arrowhead). Scale: A –3 mm; B, D – 1 mm; E, F – 0.3 mm; G, H, K, M, N – 0.5 mm; J, O – 2 mm; L – 0.2 mm. All photos by R. Romanov

Tendrivska, Yahorlytska, Dzharylgatska, Karkinitska bays. The abrupt decrease of the area occupied with *Chara* stands was found by the end of 1990s. For example, it reduced from more than 100 km^2 to ca. 20 km^2 in Tendrivska Bay in 2015–2016. The actual average biomass of *Chara* stands was 485.28 ± 221.17 g m^{-2} (Korolesova, 2015, 2017; Korolesova, unpubl. data), being by one order of magnitude lower than in the 1960s (Pohrebniak & Ostrovchuk, 1973) and even in the early 1990s (Eryomenko & Minicheva, 1992; Tkachenko & Maslov, 2002). The charophytes decreased due to the decrease of river irrigation drain as well as under eutrophication. The recent recovery of charophyte abundance has

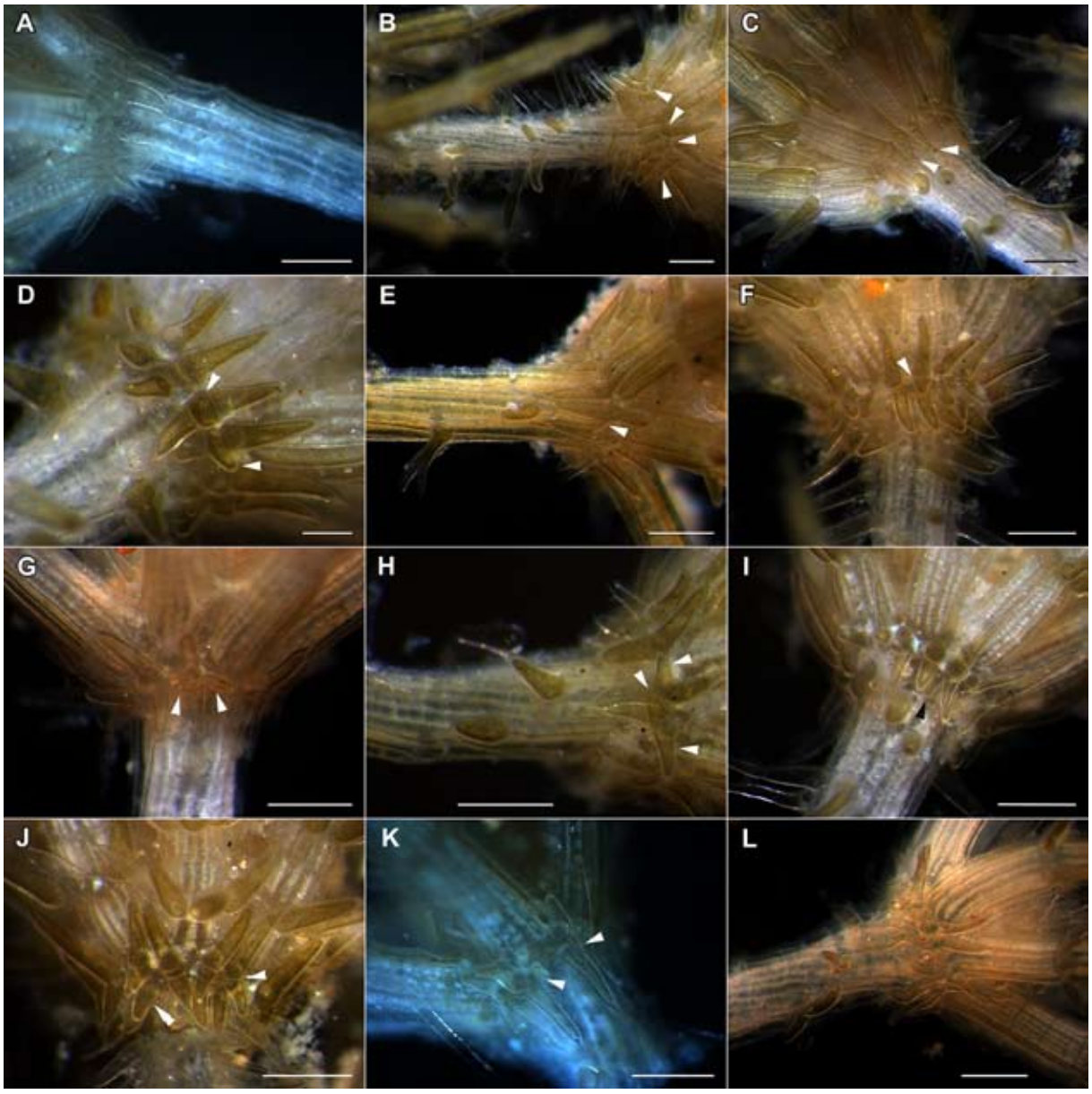

Fig. 2. Different patterns of stipulode whorl arrangement of *Chara baltica* from the North Black Sea Region (LE) A – diplostephanous whorl without extrastipulodes; B, C, F, I – diplo-triplostephanous whorls with conical or elongated central solitary extrastipulodes (arrowheads); D, E – triplostephanous whorl with papillate or conical central solitary extrastipulodes (arrowheads); G, H – diplo-triplostephanous whorls with conical lateral geminate extrastipulodes; J – diplo-triplostephanous whorl with vertical pair of extrastipulodes (left arrowhead) and conical central solitary extrastipulodes (right arrowhead); K – whorl with short lateral geminate (left arrowhead) and conical central solitary extrastipulodes (right arrowhead); L – flexuous stipulodes. Scale: D – 0.2 mm, others – 0.5 mm). All photos by R. Romanov

not been found despite the evident reduction in human impact in the bays of the North-West Black Sea Region. The plants from Dzharylgatska Bay posted at the Ukrainian Biodiversity Information Network as *Lamprothamnium papulosum* (Kalashnik, 2020) seem to belong to *C. baltica*, too.

We are expecting the recent occurrence of the species in Russia in the eastern part of Taman Bay near the settlements of Sennoy and Yubileiniy, and in Dinskoy Bay as well as along the southern coast of the Chushka Split, because the stands of charophytes similar by habit with *Chara baltica* are known from these areas at the depths of 0–3 m on sandy and silty bottom (Afanasyev, unpubl. data). The area where charophyte stands still occur is not precisely known, but it definitely doesn't exceed 50 km^2 and is currently undergoing intensive economic development. The decrease of natural habitat area, its fragmentation as a result of human activity, i.e. recreation, eutrophication and technogenic pollution, can be recognised as main threatening factors for *C. baltica* in Russia. Therefore, it is recommended to include this species into the Red Data Books of Ukraine, Russian Federation and Krasnodar Region.

According to the morphology of the specimens studied, i.e. presence of extrastipulodes, we can suggest some revision for existing records of *Chara horrida* in the Black Sea Region. *Chara horrida* can be referred to as a species of lagoon, known only from the Baltic Sea. Still, some old records outside of this region are known (Arbeitsgruppe Characeen Deutschlands, 2016), in particular one from water body associated with hot spring at the Római Baths in Budapest (Filarszky, 1893), which can be recognised as very improbable. Its recollection is impossible because of the severe transformation of the environment and disappearing of the water bodies (pers. comment by Attila Mesterhazy). Still, its voucher stored in HNHM can be restudied. Two localities are known from the Black Sea Region (Podlessky, 1935; Pohrebniak, 1955), i.e. Beikushskyi or Bejkús'kyi Liman (46°38′00″ N, 31°27′54″ E) and the Berezan Estuary, or Berezanskyi Liman (46°42′ N, 31°30′ E) at Mykolaiv Oblast of Ukraine.

The species concept of *Chara horrida* clarified after these records (Krause, 1997; Schubert & Blindow, 2004) seems to be not utterly coincident in details with manuals by W. Migula and A. Braun used by Podlessky (1935) for charophyte identification. Therefore, the species records published before the detailed description of *C. horrida* need to be checked, especially if they are extraordinary from the species distribution area. The morphology of the specimens studied by us allows suggesting that these unvouchered records (Podlessky, 1935; Pohrebniak, 1955) could be actually based on specimens of *C. baltica* or *C. papillosa* (Figs 1, 2). There are no new records of *C. baltica* and *C. horrida* from the region, but *C. papillosa* (as *C. intermedia* A. Braun ex A. Braun, Rabenh. et Stizenb.) is known there from the same habitats (Borisova et al., 2016). The similar situation can be noted for old unconfirmed record of *C. baltica* without exact locality in reed beds of the Danube Delta in Romania (Prodan, 1923; Ardelean et al., 1967, cit. in: Caraus, 2017). Notably, this species has not been found by V. Ionescu-Ţeculescu during their intensive research of charophytes in the Danube Delta. The search of Romanian specimens of *C. baltica* in the collection stored in W and elsewhere by the first author was not successful. Possibly this record was based on a specimen of *C. globata* Mig., a species occurring in coastal lakes of the region (Romanov, 2019).

The results of our study point towards checking of the collections from the Black Sea, the Sea of Azov and Lake Syvash, because *Chara papillosa* Kütz. (known from these regions as *C. aculeolata* sensu Hollerb. et Krass. or *C. intermedia*), i.e. species easily confusing with *C. baltica*, is the most frequently reported species in lagoons and bays of the regions listed (Gromov, 2012; Borisova et al., 2016). Therefore, restudy of the available specimens, and future field studies are essential for clarification of the past and actual distribution of *C. baltica* and *C. papillosa* in this region. Sometimes their delineation is tricky. Therefore, we illustrated *C. papillosa* from coastal water body of Tendrivska Bay collected at the same period (18 August 2016) at 46.1404° N, 32.23406° E by D.D. Korolesova (LE: A0000167; Fig. 1J–O). The key traits useful for species identification have been described elsewhere (Krause, 1997; Schubert & Blindow, 2003; Urbaniak & Gąbka, 2014; Mouronval et al., 2015; Arbeitsgruppe Characeen Deutschlands, 2016), but for our case, we can note usually clustered spine cells (up to four!) and somewhat encrustation for *C. papillosa* as the most important traits

for differentiation with mainly solitary spine cells and absence of incrustation of *C. baltica* (cf. Figs 1A–G and J–N). The extrastipulodes were found in plants of both species. The lateral geminate stipulodes have been found in *C. papillosa* from brackish fen in Pskov Oblast, too (Romanov & Zhakova, unpubl.).

Worldwide distribution

Chara baltica is mostly known from coastal regions of European countries bordering the Baltic Sea (except for Russia; Krause, 1997; Schubert & Blindow, 2003; Urbaniak, 2010; Torn et al., 2015; Urbaniak & Combik, 2013; Arbeitsgruppe Characeen Deutschlands, 2016; Urbaniak & Sakayama, 2017; Sinkevičienė et al., 2017; Urbaniak & Kwiatkowski, 2019) and the Atlantic Ocean (except for Iceland and Portugal; Braun & Nordstedt, 1883; Corillion, 1957; Compère, 1992; Stewart & Church, 1992; Langangen & Åsen, 1996; Roden, 1999; Langangen et al., 2001; NDFF, 2020; IrishLagoons.com, 2020) as well as from the Mediterranean: Spain (Corillion, 1962; Tomas, 1980; Margalef-Mir, cit. in: Aboal, 1986; Krause, 1997; Cirujano et al., 2007; Rodrigo & Alonso-Guillén, 2016), France (Mouronval et al., 2015), Italy (Becker, 2019; Romanov et al., 2019), Slovenia (Firbas & Al-Sabati, 1995), Albania (Zeneli & Kashta, 2016), Greece (without exact locality; Schneider et al., 2015), and North Africa (Corillion & Guerlesquin, 1971; Compère, 1986; Muller et al., 2017). The plants from the Mediterranean can belong to another species (Blindow & Erichsen, 2010). The records of *C. baltica* from Ireland have not been confirmed (IrishLagoons.com, 2020), but the occurrence of the species there seems to be possible.

Few records of *Chara baltica* outside of its main distribution area are known from the coastal brackish lake in Greenland (Langangen & Bennike, 1997), shallow semi-permanent ponds with clear water at the coast of Persian Gulf in Iran (Flor-Arnau, 2014), shallow brackish lakes associated with the River Ili and Lake Balkhash in Kazakhstan (without exact locality; Kostin, 1987) and pond in Central China (Ling, 1985; as *C. baltica* var. *borealis* Y.J. Ling). All records from Asia need to be confirmed. Chinese plants possibly better to designate as another species, e.g. *C. papillosa*. They need to be restudied, because their drawings and descriptions are insufficient for further clarification. Voucher or any other specimens of *C. baltica* from Kazakhstan are still not found during continuous efforts for revision of Kazakhstan charophytes by the first author.

The records of *Chara baltica* do exist for South America. Still, most of them, e.g. from Lake Titicaca, belong to *C. andina* (A.Braun) R.D. Wood, usually reported as *C. baltica* var. *andina* A. Braun (Blindow et al., 2018). Most probably a single record from Brazil is based on *Chara* from subsection *Willdenowia*, one of the most common species group in the region (Ribeiro et al., 2018) and sometimes having somewhat superfi-

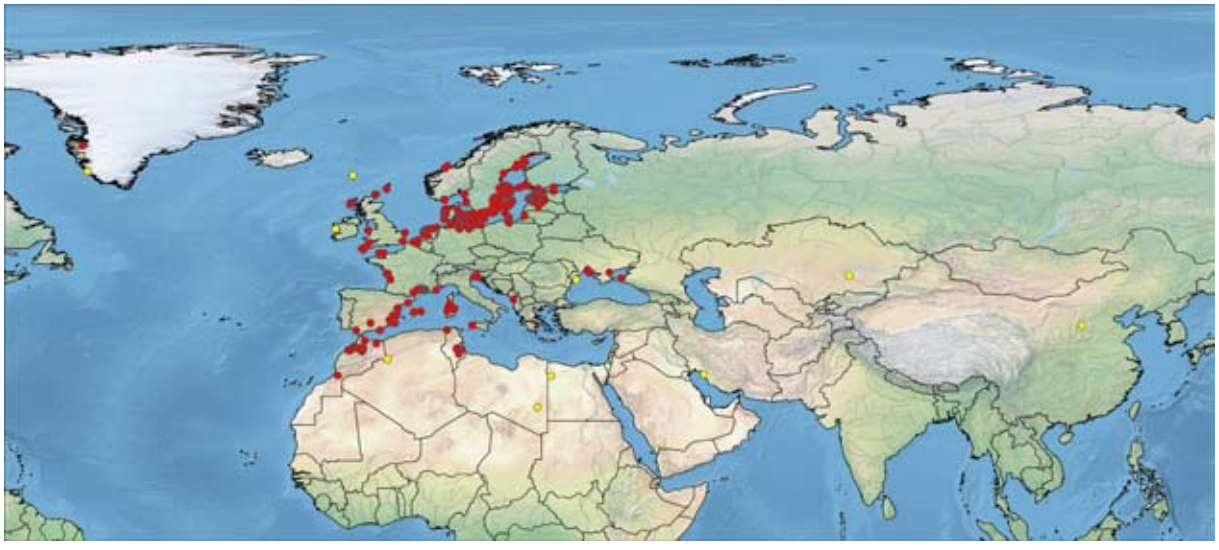

Fig. 3. Worldwide distribution of *Chara baltica* according to the records from GBIF, publications and studied specimens. Red dots – reliable records, yellow dots – records for future confirmation

cial similarity with *C. baltica* var. *liljebaldii* (Wallm.) Hasslow, the name applied for Brazilian specimen by Hasslow (1934). The restudy of its voucher is desirable. *Chara baltica* has been reported from Argentina (García, 1993). This record seems to belong to the taxon (possibly *C. andina*) different from *C. baltica*, because dimensions of its gametangia and oospores are smaller than known for the species from Europe (Arbeitsgruppe Characeen Deutschlands, 2016).

Therefore, worldwide distribution area of *Chara baltica* can be summarised with a map (Fig. 3) according to the references listed above, GBIF data (GBIF.org, 2020) and some checked specimens (LE, MA, W). It allowed achieving better visualisation of species records than known before (Corillion, 1957; Corillion & Guerlesquin, 1971; García, 1993; Arbeitsgruppe Characeen Deutschlands, 2016; Korsch, 2018) and suggesting several records outside of the main distribution area for further confirmation.

Taxonomic implications of extrastipulodes

The stipulode arrangement traits, i.e. common presence of extrastipulodes found in the plants of *C. baltica* and *C. papillosa* from the Black Sea Region, need to be discussed in the perspective of possible taxonomic implications and future morphological studies. For a long time, typical variants of stipulode arrangement have been recognised – haplostephanous *vs*. diplostephanous and unistipulate *vs*. bistipulate depending on the number of rows and number of stipulodes per branchlet (Wood & Imahori, 1965). The diplostephanous unistipulate branchlet seems to be unknown. Therefore, the diplostephanous bistipulate stipulodes mean the presence of four stipulodes, or in other words, two vertical pairs, each originating from own initial cell, per branchlet; and only three variants of stipulode arrangement can be suggested. Some deviations from this scheme do occur, e.g. when some or all stipulodes are absent in lower row, or both variants of stipulode number per branchlet present within the same plant or even in the same whorl (Wood & Imahori, 1965).

The formation of extrastipulodes by some charophyte species is the further complication of this scheme. We found some variants of their arrangement in the specimens listed above allowing suggesting some additions to terminology for charophyte morphology. The formation of extrastipulodes can be accommodated within the standard scheme for bistipulate stipulodes description as recognising of variants of diplo-triplostephanous and triplostephanous stipulodes. The first case means the presence of extrastipulodes not in all pairs of the main stipulodes. We suggest maintaining the term "bistipulate" for all these cases, because all extrastipulodes originated from the initial cell of the main stipulodes. The number of these initial cells and groups of stipulodes deriving from them, i.e. having a common origin, in any case, is two per branchlet.

Three types of diplo-triplostephanous and triplostephanous bistipulate stipulodes are available. 1. The stipulodes form a third row consisting of cells easily spotted between rows of the main stipulodes, i.e. one per vertical pair of the main stipulodes (Fig. 2B, C, F, I). The extrastipulodes can be rudimentary or elongate and acuminate. They can be called central solitary extrastipulodes. 2. The extrastipulodes are forming from both sides of each pair of stipulodes (Fig. 2G, H). In this case, they can be called lateral geminate extrastipulodes. 3. The combination of central solitary and lateral geminate extrastipulodes can occur in the same pair of the main stipulodes (Figs 1K, L, 2K). This case can be tentatively named triple extrastipulodes.

Besides this pattern, extrastipulodes can be formed as vertical pairs of cells between main stipulodes. The term "multistipulate stipulodes" can be suggested for this case. This pattern is recognisable in the photo of *C. horrida* (http://www.schattenblick.de/infopool/natur/botanik/nbom0056/2-nbom0056-chara_horrida_stipul_gustav_johansson_print.jpg). Also, it is complicated with the presence of single central stipulode at some vertical pairs of the main stipulodes. It should be noted that illustrated part has tylacanthous stem cortex; therefore, the plant does not fit the recent concept of *C. horrida*, described as having isostichous or slightly aulacanthous stem cortex (Schubert & Blindow, 2003; Arbeitsgruppe Characeen Deutschlands, 2016).

Chara horrida is the remarkable exclusion standing apart even from all these deviations. It produces so many stipulodes that their primary number, i.e. four per branchlet, is significantly increased. Stipulodes are described as huddled together without a special order (Krause, 1997) or arranged in more than two rows (Schubert & Blindow, 2003), or two compressed

rows (Arbeitsgruppe Characeen Deutschlands, 2016). Anyway, it has numerous extrastipulodes, but their arrangement pattern is tricky to describe, because available drawings are insufficient for this and available photos are few and are not enough to describe it correctly (cf. http://www.biopix.com/zoom.aspx?photoid=125522, http://www.schattenblick.de/infopool/natur/botanik/nbom0056.html, http://www.muutoslehti.fi/wp-content/uploads/2016/10/Chara_horrida_BothnianSea_Isokari_24082016_Metsahallitus_Heidi_Arponen_P8270207.jpg). Therefore, the details of stipulode arrangement in the case of *C. horrida* seem to be missing and will be a real challenge in the further studies of its fresh specimens.

Besides of *Chara horrida* having numerous extrastipulodes as a typical species trait as well as *C. baltica* and *C. papillosa* from the Black Sea Region studied by us, the formation of extrastipulodes can be traced for another species from four subsections. Except *C. horrida*, usually, they are somewhat or shorter than the main stipulodes, but rarely the extrastipulode is nearly equal with neighbouring stipulode in the lowest row. The whorl of stipulodes with additional row was illustrated for the subsection *Chara*, i.e. *C. tomentosa* L. from Central Europe (as *C. ceratophylla* Wallr., Migula, 1897: Fig. 14). Migula (1897) named them "dreifacher Stipularkranz" and noted that this stipulode arrangement is sometimes occurring, but could be incomplete and does not form in juvenile whorls. It has been occurring in different but not in all plants from the same locality (Migula, 1897: 390). We suggest naming this variant of stipulode arrangement as triplostephanous, with rudimentary central solitary extrastipulodes. They are shown at each pair of the main stipulodes (Migula, 1897: Fig. 14). Another variant has been illustrated for Polish plant *C. tomentosa* (Urbaniak & Gąbka, 2014: 22, Fig. 5.5). It can be assigned to diplostephanous stipulodes with the presence of central solitary elongate extrastipulode, because all stipulodes illustrated are visible. The extrastipulode is recognisable for sure in only one pair of the main stipulodes.

In section *Desvauxia*, the extrastipulodes were illustrated for *Chara canescens* from Great Britain (Guiry & Guiry, 2020: image 21317). This case can be named diplo-triplostephanous stipulodes with incomplete third row consisted of conical and elongate central solitary extrastipulodes, because nearly all stipulodes illustrated are visible in the photo. The extrastipulodes are recognisable for sure at least in several pairs of the main stipulodes.

In section *Grovesia*, *Chara leptosperma* A. Braun from Arizona has been illustrated and described as having extrastipulodes (Tindall, 1966: Fig. 38). This case can be tentatively assigned to diplostephanous stipulodes with the frequent presence of central solitary or geminate elongate or short extrastipulodes. *Chara strigosa* A. Braun can form extrastipulodes at least in some Asian populations (as *C. locuples* Hollerb., Hollerbach & Krassavina, 1983; Romanov et al., 2014); their arrangement needs to be studied in details. *Chara curta* Nolte ex Kütz. from North-East France has been illustrated with extrastipulodes (Bailly & Schaefer, 2010: 54, Fig. 5). This variant can be assigned to diplo-triplostephanous with incomplete third row consisted of elongated lateral geminate extrastipulodes, because nearly all stipulodes are visible in the photo (Bailly & Schaefer, 2010: 54, Fig. 5). The extrastipulodes are recognisable for sure at least in two pairs of the main stipulodes. Moreover, the presence of the third extrastipulode can be suggested, but can't be recognised for sure. Another placement of extrastipulodes for the same species has been found in the plants from Mediterranean France (as *C. aspera* var. *curta* (Nolte ex Kütz.) A. Braun ex Leonh.; Mouronval et al., 2015: 83, Fig. 6). The extrastipulodes are named "stipulodes surnumeraires", and they occur in some of the plants studied (Mouronval et al., 2015: 83). This case can be tentatively assigned to diplo-triplostephanous with incomplete third row consisted of conical central solitary extrastipulodes, because it is not visible in the photo for all stipulodes illustrated (Mouronval et al., 2015: p. 83, Fig. 6). The extrastipulodes are recognisable for sure at least in two pairs of the main stipulodes.

In subsection *Hartmania*, the extrastipulodes have been illustrated for *Chara papillosa* from Sweden (as *C. aculeolata* sensu auct. nonnul.; Olsen, 1944: Fig. 18a). This variant can be named diplo-triplostephanous stipulodes with few conical and elongate acuminate central solitary extrastipulodes. Another pattern with conical lateral geminate and central solitary extrastipulodes in the same pair of the main stipulodes was found for *C. papillosa* during this study (Fig. 1 K, L). The case of *C. subspinosa*

Rupr. from North-East France (as *C. rudis* A. Braun; Bailly & Schaefer, 2010: 44, Fig. 5) can be assigned to diplostephanous with single elongate central solitary extrastipulode, because all stipulodes illustrated are visible. The extrastipulode is recognisable for sure in only one pair of the main stipulodes. Finally, the presence of extrastipulodes in *C. baltica* from the Baltic Sea Region is known and illustrated (Schubert & Blindow, 2003: 56, Fig. 4.3.2; the former drawing erroneously had been referred to *C. baltica* var. *breviaculeata* Kütz.; Urbaniak & Gąbka, 2014: 43, Plate 2, left lower photo; Urbaniak & Kwiatkowski, 2019: Fig. 1). The first case possibly illustrates triplostephanous stipulodes with lateral geminate extrastipulodes and pairs of extrastipulodes between main stipulodes. The second case can be assigned to diplo-triplostephanous stipulodes with incomplete third row consisted of elongate central solitary extrastipulodes, because all stipulodes illustrated are visible in the photo (Urbaniak & Gąbka, 2014: 43, Plate 2, left lower photo), and extrastipulodes are recognisable for sure at least in two pairs of the main stipulodes.

This picture can be complicated with the formation of accessory short ecorticate branchlet with few nodes looking as apical part of a branchlet and originating below of the base of main branchlets, i.e. from typical stipulode place. It is known for *C. horrida* (Krause, 1997: Fig. 21D). It seems to be illustrated for *C. baltica*, too, with the photo taken from Scottish specimen (cf. Guiry & Guiry, 2020: image 26434).

Therefore, the cases of extrastipulode development should be included in the descriptions of charophyte specimens for further clarification of the significance of this trait for species delimitations as well as for outlining of possible differences between populations of the same species. Evidently, at the moment, we can't estimate the right scale and taxonomic implications of this phenomenon.

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CHARA BALTICA (CHAROPHYCEAE, CHARALES) IŠ JUODOSIOS JŪROS REGIONO IR TAKSONOMINĖ PERTEKLINIŲ PRIDĖTINIŲ PRIELAPIŲ REIKŠMĖ

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Santrauka

Chara baltica (Hartm.) Bruz. buvo rasta Juodosios jūros šiaurinės dalies įlankose, vykdant šio regiono maurabraginių rūšių tyrimus. Tai pirmas patikimas šios rūšies radavietės aptikimo įrašas Juodosios jūros regione, Ukrainoje ir Rusijoje. Tirtose populiacijose *C. baltica* turėjo skirtingą prielapių išsidėstymą, o pridėtiniai prielapiai yra įprastas maurabraginių požymis. Šiame darbe tirtų pavyzdžių morfologija yra svarbi identifikuojant kitą nepatikslintą rūšį, *C. horrida* Wahlst., kuri žinoma tik Baltijos jūros regione. Straipsnyje pateiktas apibendrintas *C. baltica* paplitimo pasaulyje žemėlapis, kuris sudarytas pagal paskelbtus įrašus, GBIF duomenis ir šiame darbe aprašytus pavyzdžius. Nustatyti pridėtiniai prielapiai ir jų iliustracijos sudaro pagrindą patikslinti maurabraginių morfologijos aprašymą, kas turės reikšmės tolesniuose tyrimuose.