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RESEARCH ARTICLE

## First records of *Anema nodulosum*, *A. tumidulum*, and *Pyrenocarpon thelostomum* (Lichinales, Lichinaceae) in Ukraine and a contribution to *Collematetia cristati* communities

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**Abstract.** Three new for Ukraine species, *Anema tumidulum*, *A. nodulosum*, and *Pyrenocarpon thelostomum* (Lichinales, Lichinaceae), are reported. They were found in the Dnister Canyon, on the S and W exposed cliff surfaces where water tracks formed 'a black zone' of the *Collematetia cristati* class. Other species forming these communities are *Anema decipiens*, *Psorotichia schaereri*, *Peccania coralloides*, *Thallinocarpon nigritellum*, *Thyrea confusa*, and *Verrucaria nigrescens* s. l. The analyzed dataset included three relevés from the Dnister cliff, as well as 14 relevés from literature sources: seven relevés of *Peccania coralloidis-Thyreetum pulvinatae* recorded from Poland, and seven relevés of *Thyrea nigritella-Anema moedingense* comm. from the Czech Republic. These data were analyzed in JUICE software. All analyzed relevés were separated in two clusters. Three relevés from Dnister Canyon fell into the same cluster with *Thyrea nigritella – Anema moelingensis* comm. provided by Wirth in 1972. We consider these communities as a new association *Thallinocarpo nigritelli-Anemum tumidulae*. Diagnostic species of the association are *Thallinocarpon nigritellum*, *Anema tumidulum*, *Staurothele frustulenta*, and *Anema nodulosum*. The lectotype of *Peccania coralloidis-Thyreetum pulvinatae* has been proposed, with diagnostic species *Enchylium polycarpon*, *Leproplaca cirrochroa*, *Placidium rufescens*, *Placynthium nigrum*, *Toninia candida*, and *Synalissa symphorea*. These associations belong to the *Peccanion coralloidis* alliance and differ by their ecological preferences. The association *Peccania coralloidis-Thyreetum pulvinatae* represents the nomenclatural type of the alliance and includes communities on the vertical exposed limestone surfaces in water tracks. The *Thallinocarpo nigritelli-Anemum tumidulae* association occupies similar habitats but in the xeric geollitoral zone along river banks. The alliance *Peccanion coralloidis* and order *Collematetia cristati* are reported from Ukraine for the first time.

**Keywords:** cliff, Dnister Canyon, lichen communities, limestone, *Peccanion coralloidis*, syntaxonomy, water tracks

### Introduction

The limestone outcrops on the Dnister Canyon (on the Dnister / Dniester River within Ternopil, Khmelnytskyi, Ivano-Frankivsk, and Chernivtsi administrative regions (*oblasts*) in the western part of Ukraine) represent specific communities of vascular plants, bryophytes, lichens, and algae

forming rare tufa habitats (Didukh et al., 2018). In particular, the cliff surface is covered by lichens with cyanobacterial photobionts. It looks like a wide 'black zone' in the upper geollitoral zone. These communities belong to a poorly studied class *Collematetia cristati* (Nowak, 1960; Wirth, 1972; Egea, Llimona, 1984; Bültman et al., 2015). Such communities are very difficult to study because

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they consist of species of *Lichinales* that are difficult to identify. Previously, we reported the class *Collematetea cristati* Wirth 1980 in monographs on habitat classification (Kuzemko et al., 2018; Didukh et al., 2020) based on physiognomic observation made only by the first author, since no relevé from Ukraine was available at the time of publication of the monographs. Fortunately, we observed the lichen communities of the *Collematetea cristati* on the Dnister cliffs in 2021. This observation allowed us to provide information on the new records of lichens for Ukraine, as well as their ecological and coenotic peculiarities, in the present article.

## Materials and Methods

The data were collected on the Dnister cliffs of the Dnister Canyon at the border between Khmelnytskyi and Chernivtsi administrative regions on 5 June 2021 (Fig. 1A). The lichen communities have been sampled using the Braun-Blanquet approach (Braun-Blanquet, 1932; Khodosovtsev et al., 2011, 2019, 2022). Lichens were identified by standard methods (Smith et al., 2009). Three relevés from the Dnister cliffs were analyzed with JUICE software (Tichý, 2002) together with the 14 relevés from literature: seven relevés of *Peccanio coralloidis-Thyreetum pulvinatae* Nowak 1960 (Nowak, 1960) from Poland and seven relevés of *Thyrea nigrifella-Anema moedlingense* comm. (Wirth, 1972) from the Czech Republic. Our analysis was made using PC-Ord v.5 (Grandin, 2006) with the Sørensen (Bray-Curtis) coefficient as a distance measure and flexible beta at -0.25 as the group linkage method. The original Braun-Blanquet scale (Nowak, 1960; Wirth, 1972) was used for Table 1. Nomenclature of lichens mainly follows Kondratyuk et al. (2021). Diagnostic species of the classes and suborder units follows European Vegetation Classification (<https://floraveg.eu/vegetation/>). The lichen specimens are deposited at the Herbarium of the Kherson State University (KHER).



**Fig. 1.** Class *Collematetea cristati* on cliffs of the Dnister Canyon. A: black zone on the cliff, B: habitat of *Thallinocarpo nigrifelli-Anemum tumidulae*, C: dominant species *Thyrea confusa* (scale 10 cm)

## Results

### New lichen records for Ukraine

Ten lichen species were registered in three relevés from the Dnister cliffs (Table 1). Three new for Ukraine species of lichens were identified.

#### *Anema nodulosum* (Nyl.) Forssell (Fig. 2C).

Thallus disc-form, squamulose, peltate, 2–3(–4) mm in diameter, black, covered by white-bluish pruina; lobes closely adjacent, 0.3–0.5 mm length. Apothecia immersed in squamules, compressed, 0.2–0.4 mm in diameter; disk brown, urceolate to flat, surrounded by black thalline margin, proper margin not visible.

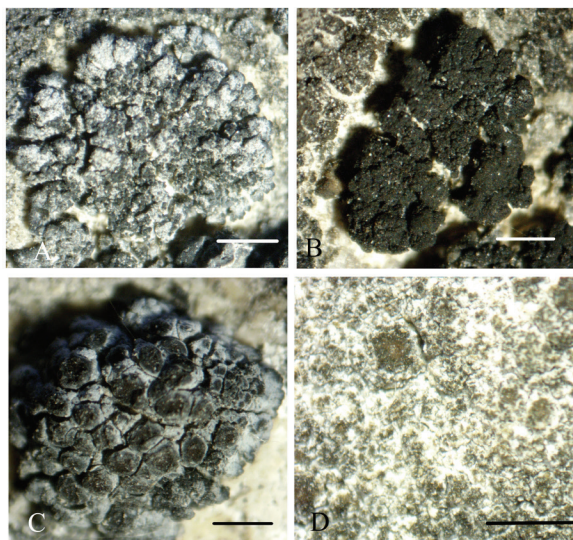
Thallus homoiomerous with loose net of hyphae and cyanobacterial cells in section. Epithecium orange-brown, up to 10  $\mu\text{m}$  high; hymenium hyaline, 70–120  $\mu\text{m}$  wide, I + (bluish);

Table 1. Phytocoenotic table of the *Peccanio coralloidis-Thyreetum pulvinatae* and *Thallinocarpo nigritelli-Anemum tumidulae* associations

Relevé number in the table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Original number	N2	N1	N7	N3	N6	N4	N5	W1	W2	W5	W4	W3	W6	W7	M2	M1	M3	
Plot size, m <sup>2</sup>	0.1	0.1	0.1	0.05	0.1	0.1	0.05	0.098	0.035	0.048	0.06	0.024	0.024	0.012	0.1	0.1	0.01	
Inclination, °	80	90	90	90	90	90	90	30	35	30	50	0	40	75	90	90	90	
Total cover, %	90	60	70	60	80	60	50	85	90	85	84	85	85	80	90	90	10	
Aspect	S	S	S	S	E	WS	S	S	S	S	S	S	S	S	W	S	S	
Species richness	10	7	18	12	17	14	15	7	6	6	7	7	10	8	8	6	4	
<b>D.s. association <i>Peccanio coralloidis-Thyreetum pulvinatae</i> Nowak 1960</b>																		
<i>Enchylum polycarpon</i> (Hoffm.) Otálora, P.M. Jørg. & Wedin	+		+	r	+	+	2											
<i>Placidium rufescens</i> (Ach.) Massal.	+		2	2	+	r	+				+							
<i>Leproplaca cirrochroa</i> (Ach.) Arup, Frödén & Söchting	+	+	+	+	+	+											+	
<i>Toninia candida</i> (F. Weber) Th. Fr.	+		2	+	r	+	+											
<i>Placynthium nigrum</i> (Huds.) S.O. Gray			+	r	r	r	r											
<i>Synalissa ramulosa</i> (Bernh.) Fr.		+	r		+	+	+											
<b>D.s. association <i>Thallinocarpo nigritelli-Anemum tumidulae</i> (Wirth 1972)</b>																		
<i>Thallinocarpon nigritellum</i> (Lettau) P.M. Jørg.								2	2	2	+	r	+	r	r	+	+	
<i>Anema tumidulum</i> Henssen ex P.M. Jørg., M. Schultz & Guttová								2	2	2	3	2	2		+	2	r	
? <i>Porocyphus coccodes</i> Flot. ex Körb.								3	4	3	3	3	3	3				
<i>Staurothele frustulenta</i> Vainio								2	2	+	+	+	+	+				
<i>Anema nodulosum</i> (Nyl.) Forssell														2	+			
<b>D.s. alliance <i>Peccanion coralloidis</i> Moreno et Egea ex Egea in Bültmann et al. 2015</b>																		
<i>Peccania coralloides</i> (A. Massal.) A. Massal.	+	+	2	2	3	2	2							r		r		
<i>Psorotichia schaeereri</i> (A. Massal.) Arnold s. l. (incl. <i>P. cf. caesiella</i> sensu Nowak 1960)	+		r		+	+									2	3		
<i>Anema decipiens</i> (A. Massal.) Forssell	+	r	r												+		r	
<b>D.s. class <i>Collematetea cristati</i> (and subordinated units)</b>																		
<i>Thyrea confusa</i> Henssen	3	3	+	+	2			2	+	3	3	2	3	3	2	3	r	
<i>Dermatocarpon miniatum</i> (L.) Mann.			r	+	r	r		r	r	r	r	r	2					
<i>Lathagrium cristatum</i> (L.) Otálora, P.M. Jørg. & Wedin			r			+	r							2				
<i>Lathagrium fuscovirens</i> (With.) Otálora, P.M. Jørg. & Wedin	r			r	r	2									r			

Relevé number in the table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Original number	N2	N1	N7	N3	N6	N4	N5	W1	W2	W5	W4	W3	W6	W7	M2	M1	M3
Plot size, m <sup>2</sup>	0.1	0.1	0.1	0.05	0.1	0.1	0.05	0.098	0.035	0.048	0.06	0.024	0.024	0.012	0.1	0.1	0.01
Inclination, °	80	90	90	90	90	90	90	30	35	30	50	0	40	75	90	90	90
Total cover, %	90	60	70	60	80	60	50	85	90	85	84	85	85	80	90	90	10
Aspect	S	S	S	S	E	WS	S	S	S	S	S	S	S	S	W	S	S
Species richness	10	7	18	12	17	14	15	7	6	6	7	7	10	8	8	6	4
<b>D.s. class <i>Verrucarietia nigrescentis</i> Wirth 1980 (and subordinated unit)</b>																	
<i>Verrucaria nigrescens</i> Pers.		r	r	r	r		r								2	2	
<i>Variospora velana</i> (A. Massal.) Arup, Søchting & Frödén	+		+	1	1	1											
<i>Candelariella aurella</i> (Hoffm.) Zahlbr.			+		+		+										
<i>Protoparmeliopsis muralis</i> (Schreb.) M. Choisy			r				+										
<i>Polyozosia albescens</i> (Hoffm.) S.Y. Kondr., L. Lökös & Farkas			r	r	r												
<i>Pyrenodesmia chalybaea</i> (Fr.) A. Massal.	r		r				r										
<i>Circinaria hoffmanniana</i> (S. Ekman & Fröberg ex R. Sant.) A. Nordin								+				+	1				
<i>Polyozosia dispersa</i> (Pers.) S.Y. Kondr., L. Lökös & Farkas		+					+										
<i>Verrucaria polysticta</i> Borrer					+	+											
<i>Placopyrenium fuscillum</i> (Turner) Gueidan & Cl. Roux.					r		+										
<i>Phaeophyscia nigricans</i> (Flörke) Moberg			r				r										
<b>Other species</b>																	
<i>Enchylium tenax</i> (Sw.) Gray											r			+			

Header data. 1–7 – **Poland**: 1 – Dolina Będkowska, 280 m a.s.l. (Nowak, 1960: tab. 16, rel. 2 [in our table N2]; 2 – Rybna, 370 m a.s.l. (Nowak, 1960: tab. 16, rel. 1 [in our table N1]; 3 – Dolina Kluczwoły, 200 m a.s.l. (Nowak, 1960: tab. 16, rel. 7 [in our table N7]; 4 – Ojców, dolina Prądnika, 300 m a.s.l. (Nowak, 1960: tab. 16, rel. 3 [in our table N3]; 5 – Kobyłańska, 270 m a.s.l. (Nowak, 1960: tab. 16, rel. 6 [in our table N6]; 6 – Dolina Brzoskwinki, 350 m a.s.l. (Nowak, 1960: tab. 16, rel. 4 [in our table N4]; 7 – Przegonia Duchowna, wzgorze Kajasówka, 380 m a.s.l. (Nowak, 1960: tab. 16, rel. 5 [in our table N5]; 8–14 – **Czech Republic**: Moravia, Rokytná river, between Rokytná and Budkovice, NE from Moravský Krumlov, 260 m a.s.l., 49.065028 N, 16.333750 E, (Wirth, 1972: page 254, tab. 40, relevés 1–7 [in our table W1–W7]); 15–17 – **Ukraine**: Khmelnytskyi Region, Kamianets-Podilskyi District; 1 – in front of Makarivka village (Chernivtsi Region), left bank of the Dnister, cliff above river, 125 m a.s.l., 48.571670 N, 26.753513 E, described by A. Khodosovtsev and A. Kuzemko (M2), 05.07.2021; 16 – Yaruga village, left bank of the Dnister, cliff above river, 48.589511 N, 26.723571 E, 121 m a.s.l., described by A. Khodosovtsev and A. Kuzemko (M1), 05.07.2021; 17 – in front of Makarivka village (Chernivtsi Region), left bank of the Dnister, cliff above river, 125 m a.s.l., 48.589513 N, 26.723567 E, described by A. Khodosovtsev and A. Kuzemko (M2), 05.07.2021. Other species: *Bryum argenteum* – 13 (+) Hedw., *Synthrichia ruralis* (Hedw.) F. Weber & D. Mohr – 13 (+), *Schistidium apocarpon* (Hedw.) Bruch & Schimp – 13 (r); *Lecania erysibe* (Ach.) S.Y. Kondr., *Thelidium decipiens* (Hepp) Krempel. – 6 (r), *Placynthium subradiatum* (Nyl.) Arnold – 5 (r); *Verrucaria gyelnikii* Servit – 4 (r); *Bagliettoa calciseda* (DC.) Gueidan & Cl. Roux – 7 (r); *Pyrenocarpon thelostomum* (Ach. ex J.Harriman) Coppins & Aptroot – 17 (1). D.s. – diagnostic species



**Fig 2.** *Anema* and *Pyrenocarpon* species. A: *A. decipiens*; B: *A. tumidulum*; C: *A. nodulosum*; D: *P. thelostomum* (scale: A, C – 0.5 mm; B – 0.7 mm, D – 1.0 mm)

paraphyses simple with slightly swollen apical cells; hypothecium hyaline to yellowish, 100–160  $\mu\text{m}$  thick. Asci 8-spored, ascospores hyaline, one-celled, 9–15  $\times$  6–9  $\mu\text{m}$ . Photobiont chroococcoid, 8–15  $\mu\text{m}$  in diam., often in clusters and surrounded by gelatinous hyaline sheath in the centre and yellow-brown in exposed parts.

*Specimens examined.* Ukraine: Khmelnytskyi Region, Kamianets-Podilskyi District, left bank of the Dnister River, in front of Makarivka village (Chernivtsi Region), cliff above the river, 121 m a.s.l., W exposition, 48.571670 N, 26.753513 E, 05.07.2022, leg. A. Khodosovtsev (KHER15212, 15217).

***Anema tumidulum* Henssen ex P.M. Jørg., M. Schultz & Guttová (Fig. 2B).**

Thallus small, rosette or disc-form, peltate, 3–4 mm in diameter, black, without pruina; lobes small, lobes closely adjacent, 0.3–0.6 mm long; central part covered with small isidia-like outgrowths. Apothecia in Ukrainian specimens not found. In section, thallus is similar to *A. nodulosum*.

*Specimens examined.* Ukraine: Khmelnytskyi Region, Kamianets-Podilskyi District, left bank

of the Dnister River, in front of Makarivka village (Chernivtsi Region), cliff above river, 121 m a.s.l., W exposition, 48.571670 N, 26.753513 E, 05.07.2022, leg. A. Khodosovtsev (KHER15214, 15215).

***Pyrenocarpon thelostomum* (Ach. ex J. Harriman) Coppins & Aptroot (Fig. 2D).**

Thallus crustose, thin, dark brown to olive-black, cracked-areolate or indistinct. Areoles very small, 0.1–0.2 mm wide, flat, smooth. Apothecia immersed in conical to hemispherical thalline warts, 0.2–0.5 mm across (in section), at first punctiform, then with expanded, brownish disc surrounded by a distinct light brownish proper exciple and olivaceous thalline margin.

Thallus homeomerous, hyphae 3–5  $\mu\text{m}$  wide. Thalline exciple 50–100  $\mu\text{m}$  wide laterally. Proper exciple 25–50  $\mu\text{m}$  wide in upper part. Epithecium yellowish brown. Hymenium colourless, 120–150  $\mu\text{m}$  high, in K/I faintly blue. Paraphyses slender, branched and anastomosing, with slightly swollen apical cells, 3–5  $\mu\text{m}$  wide. Hypothecium colourless. Asci 8-spored, cylindrical or narrowly clavate, thin-walled, without internal amyloid structures. Ascospores simple, hyaline, ellipsoid, (10–)13–18(–20)  $\times$  5–10  $\mu\text{m}$ . Photobiont cyanobacterial, chroococcoid, cells 5–10  $\mu\text{m}$  wide, enclosed in yellowish to brown-yellowish gelatinous sheaths.

*Specimen examined.* Ukraine, Khmelnytskyi Region, Kamianets-Podilskyi District, near Yaruga village, cliffs, in fissures, shaded condition, S exposure, 120 m a.s.l., 48.589513 N, 26.723567 E, 05.07.2022, leg. A. Khodosovtsev (KHER15219).

**Lichen communities of *Collematetea cristati* Wirth 1980**

The black zone of *Collematetea cristati* class on the Dnister cliff has clearly visible continuous line 1–2.5 m wide and 10–20 m long or as dispersed small spots on rain-exposed water tracks (Fig. 1). It starts from 1.0–1.5 m above water level. *Anema decipiens* (A. Massal.) Forssell, *A. nodulosum*, *A. tumidulum*, *Psorotichia schaeereri* (A. Massal.) Arnold, *Peccania coralloides* (A. Massal.) A. Massal.,

*Thallinocarpon nigritellum* (Lettau) P.M. Jorg., *Thyrea confusa* Henssen, and *Verrucaria nigrescens* Pers. s. l. occupied S and W exposed cliff surfaces (Table 1, Fig. 1). The dominant species was foliose *Thyrea confusa* (with cover up to 40%). The high cover values were also registered for foliose *Thallinocarpon nigritellum* (up to 10%) and crustose *Psorotichia schaereri* (up to 10%). *Pyrenocarpon thelostomum* was collected on a shaded rain protected shelf in species-poor communities.

Two clusters were obtained after our analyses of the dataset in JUICE (Table 1). Three relevés from the Dnister cliffs nested in the same cluster with *Thyrea nigritella*-*Anema moelingensis* comm. from the Czech Republic. *Thallinocarpon nigritellum*, *Anema tumidulum* and *Anema nodulosum* are common species for the communities recorded both in the Czech Republic and in Ukraine. Two species, *Peccania coralloides* and *Thyrea confusa*, were common in relevés from the Czech Republic, Poland, and Ukraine.

## Discussion

### Genera *Anema* Nyl. ex Forssell and *Pyrenocarpon* Trevis. in Ukraine

According to the latest prodromus (an annotated checklist) of lichens of Ukraine (Kondratyuk et al., 2021), the genus *Anema* in Ukraine is represented by two species. The first of them, *Anema notarisii* (A. Massal.) Forssell (= *A. nummularium* (Dufour ex Durieu & Mont.) Nyl. ex Forsell), was reported from a few locations in the Autonomous Republic of Crimea (Kopachevskaya, 1986). In its habitus, it is similar to *A. nodulosum* presented here but differs by the absence of pruina on the thallus and by longer central holdfast. The second species, *Anema decipiens* (Fig. 2A), has been reported from Khmelnytskyi Region (Bielczyk et al., 2005). It is similar to *A. tumidulum*, also discussed here, but differs by its bluish pruina on the thallus, more delicate soredia-like granules on the surfaces, and rare presence of apothecia. Thus, at present four species of the genus *Anema* are known in Ukraine,

and three of them we recorded in one relevé on the Dnister cliff.

There are only two species in the genus *Pyrenocarpon*; one of them, *P. montinii* (A. Massal.) Trevis. (= *Psorotichia montinii* (A. Massal.) Forssell) was found on limestone pebbles in Ukraine recently (Khodosovtsev et al., 2018, 2019). The newly recorded species, *P. thelostomum*, differs from *P. montinii* by larger ascospores ( $10\text{--}22.5 \times 5\text{--}12 \mu\text{m}$  vs.  $6\text{--}13 \times 4\text{--}7 \mu\text{m}$  in *P. montinii*), larger ascomata (0.2–0.5 mm vs. 0.1–0.3 mm in *P. montinii*), and, ecologically, by its preference of more or less shaded habitats.

### Two associations in *Peccania coralloidis* Moreno et Gea ex Gea in Bültmann et al. 2015

The class *Collematetea cristati* includes few alliances. One of them is *Peccania coralloidis* (*Collematetalia cristati* Wirth 1980) with *Peccania coralloidis*-*Thyreetum pulvinatae* Nowak 1960 (Nowak, 1960) as the type association (Bültmann et al., 2015). The association has been described from vertical limestone surfaces on water tracks (Poland). The communities are transitional between *Verrucarietetea nigrescentis* Wirth 1980 and *Collematetetea cristati*. In our opinion, the most typical to *Peccania coralloidis*-*Thyreetum pulvinatae* is relevé 2 described by Nowak (Nowak, 1960: Table 16) because it includes the lowest number of diagnostic taxa from *Verrucarietetea nigrescentis*. This relevé does not include *Placynthium nigrum* (Huds.) S.O. Gray, which is diagnostic for *Placynthietum nigrum* (Klement, 1955). We propose this relevé as a lectotype (see below) of the association *Peccania coralloidis*-*Thyreetum pulvinatae* Nowak 1960. *Leproplaca cirrochroa* has high frequency in *Peccania coralloidis*-*Thyreetum pulvinatae*; however, the species is diagnostic for *Caloplacetum cirrochroa* Poelt 1952 ex Breuer 1971, together with *Polyozosia hagenii* (Pers.) S.Y. Kondr., L. Lőkös et Farkas, *P. albescens* (Hoffm.) S.Y. Kondr., L. Lőkös et Farkas, *P. crenulata* S.Y. Kondr., L. Lőkös et Farkas, *Verrucaria muralis* Ach s. l., and *Candelariella aurella* (Hoffm.) Zahlbr. (see the synoptic table in Breuer, 1971). This association does not include

cyanobacterial lichens. It requires additional study and neotypification (Roux et al., 2009). Hence, the diagnostic species of *Peccanion coralloidis-Thyreetum pulvinatae* are *Enchylium polycarpon* (Hoffm.) Otálora, P.M. Jørg. et Wedin, *Leproplaca cirrochroa*, *Placynthium nigrum*, *Placidium rufescens* (Ach.) Massal, *Toninia candida* (F. Weber) Th. Fr., and *Synalissa ramulosa* (Bernh.) Fr.

Seven relevés were named as *Thyrea nigrیتella-Anema moelingensis* comm. (Wirth, 1972). These communities cover wetter spots among conglomerates on the S exposed bank of the Rokytná River in the Czech Republic. Later, Wirth has corrected the species composition in the association. The species reported as *Anema moedlingense* Zahlbr. was redefined as *A. tumidulum*, and that was reflected in the community name "*Gonohymenia nigrیتella-Anema tumidulum-Soc*" (Wirth, 1995). Sterile *Porocyphus coccodes* Flot. ex Körb. was observed with high cover and frequency (Wirth, 1972). However, this species is very rare in the Czech Republic. It was only collected twice during the period from 1960 to 2010 (Vondrák et al., 2010). The locations from the Rokytná River have not been cited in that paper. The identity of *Porocyphus coccodes* is in need of checking both in herbarium specimens and in field. *Staurothele frustulenta* Vainio is another high frequency species in the *Thyrea nigrیتella-Anema moelingensis* comm. cluster; that species was absent in the relevés from Ukraine. However, the species was reported previously from the Dnister cliffs, but was not recorded in our relevés. Hence, we propose to validate *Thyrea nigrیتella-Anema moelingensis* comm. as a new association *Thallinocarpo nigrیتelli-Anemum tumidulae* (see below) within the alliance *Peccanion coralloidis*. Diagnostic species of the association should be *Thallinocarpon nigrیتellum*, *Anema tumidulum*, *Staurothele frustulenta*, and *Anema nodulosum*. According of Bültmann (2015), the alliance *Peccanion coralloidis* has 11 characteristic species (Bültmann et al., 2015), including *Anema decipiens*, *Psorotichia schaeereri*, and *Peccania coralloides*. Our studies have confirmed the diagnostic significance of these species for the mentioned alliance.

Two associations of *Peccanion coralloidis* differ by their ecological preferences. The type association *Peccanion coralloidis-Thyreetum pulvinatae* overgrows vertical exposed surfaces in water tracks in low elevations. The *Thallinocarpo nigrیتelli-Anemum tumidulae* occupy similar habitats, but are located in the xeric geolitoral zone along the river banks. The alliance *Peccanion coralloidis* and order *Collematetalia cristati* are reported from Ukraine for the first time here.

## Syntaxonomy

### *Peccanion coralloidis-Thyreetum pulvinatae* Nowak 1960

Lectotype, *hoc loco*: Nowak, 1960: table 16, relevé 2 [*Anema decipiens* (1.2), *Enchylium polycarpon* (1.3), *Lathagrium fuscovirens* (+), *Leproplaca cirrochroa* (1.2), *Peccania coralloides* (1.2), *Placidium rufescens* (1.2), *Psorotichia schaeereri* s. l. (1.2), *Pyrenodesmia chalybaea* (+), *Thyrea confusa* (3.2), *Toninia candida* (1.3), *Variospora velana* (+)]: Poland, Dolina Bętkowska, 280 m a.s.l., J. Novak, no date.

Diagnostic species: *Enchylium polycarpon*, *Leproplaca cirrochroa*, *Placidium rufescens*, *Placynthium nigrum*, *Toninia candida*, *Synalissa ramulosa*.

### *Thallinocarpo nigrیتelli-Anemum tumidulae* (Wirth 1972), *ass. nova, hoc loco*

Holotype: Wirth, 1972, page 254, table 40, relevé 1 [*Anema tumidulum* (as *A. moedlingense*) (2b), *Circinaria hoffmanniana* (+), *Dermatocarpon miniatum* (+), ?*Porocyphus coccodes* (3), *Staurothele frustulenta* (як *Staurothele catalepta*) (2m), *Thallinocarpon nigrیتellum* (2b), *Thyrea confusa* (2m)]: Czech Republic, Moravia, Rokytná River, between Rokytná and Budkovice, NE from Moravský Krumlov, 260 m a.s.l., 49.0650 N, 16.3337 E, V. Wirth, no data.

Diagnostic species: *Anema tumidulum*, *Anema nodulosum*, *Thallinocarpon nigrیتellum*, *Staurothele frustulenta*, and *Porocyphus coccodes*.

## Conclusions

*Anema tumidulum*, *A. nodulosum*, and *Pyrenocarpon thelostomum* are reported from the Dnister limestone cliffs (Ukraine) for the first time. A lectotype of the association *Peccanion coralloididis-Thyreetum pulvinatae* Nowak 1960 is proposed. The association *Thallinocarpo nigritelli-Anemum tumidulae* (Wirth 1972) is validated. These are rare associations known only from the Czech Republic and Ukraine up to now. The alliance *Peccanion coralloididis* and order *Collematetalia cristati* are reported from Ukraine for the first time.

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**Перші знахідки лишайників *Anema nodulosum*, *A. tumidulum* і *Pyrenocarpon thelostomum* (*Lichinales*, *Lichinaceae*) в Україні та доповнення до класу *Collematetea cristati***

**Реферат.** Наведена інформація щодо поширення та екологічних уподобань нових для України видів лишайників *Anema tumidulum*, *A. nodulosum* та *Pyrenocarpon thelostomum*, які є елементами угруповання класу *Collematetea cristati*. Нові для України представники роду *Anema* зростали на експонованих прямовисних вапнякових кліфах південної та східної експозицій у місцях тимчасових водостоків (чорна зона), що синтаксономічно відносять до класу *Collematetea cristati*. Ці види формують угруповання з *Anema decipiens*, *Psorotichia schaeferi*, *Peccania coralloides*, *Thallinocarpon nigritellum*, *Thyrea confusa* та *Verrucaria nigrescens* s. l. Аналізований масив фітосоціологічних даних включав три описи з України, а також 14 описів з літературних джерел: сім описів асоціації *Peccania coralloidis-*

*Thyreetum pulvinatae* Nowak 1960 з Польщі та сім описів угруповання *Thyrea nigritella* – *Anema moelingensis* comm. з Чеської Республіки. Аналіз був проведений у програмі JUICE за допомогою кластерного аналізу. Аналізовані описи розділилися за двома кластерами. Три описи з вапнякових кліфів Дністровського каньйону опинилися в одному кластері з угрупованнями *Thyrea nigritella* – *Anema moelingensis* comm. з Чеської Республіки. Ми розглядаємо такі угруповання як нову для науки асоціацію *Thallinocarpo nigritelli-Anemum tumidulae* (Wirth 1972). Діагностичними видами її є *Thallinocarpon nigritellum*, *Anema tumidulum*, *Staurothele frustulenta* та *Anema nodulosum*. Запроновано лектотип асоціації *Peccanion coralloidis-Thyreetum pulvinatae* Nowak 1960. Діагностичні види асоціації *Enchylium polycarpon*, *Leproplaca cirrochroa*, *Placidium rufescens*, *Placynthium nigrum*, *Toninia candida*, *Synalissa symphorea*. Дві асоціації союзу *Peccanion coralloidis* відрізняються екологічними уподобаннями. Типова асоціація союзу *Peccanion coralloidis-Thyreetum pulvinatae* трапляється на прямовисних експонованих вапнякових скелях на місцях тимчасових водостоків. Асоціація *Thallinocarpo nigritelli-Anemum tumidulae* займає подібні біотопи, але які розташовані в зоні ксеричної геоліторалі рівнинних річок. Союз *Peccanion coralloidis* та порядок *Collematetalia cristati* вперше наводяться для України.

**Ключові слова:** вапняки, Дністровський каньйон, кліфи, лишайникові угруповання, синтаксономія, тимчасові водостоки, *Peccanion coralloidis*