

## THREE NEW GENERA OF THE RAMALINACEAE (LICHEN-FORMING ASCOMYCOTA) AND THE PHENOMENON OF PRESENCE OF ‘EXTRANEIOUS MYCOBIONT DNA’ IN LICHEN ASSOCIATIONS

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Three new genera *Coppinsidea*, *Vandenboomia* and *Wolseleyidea* are described and the genera *Ivanpisutia*, *Lecaniella* and *Myrionora* are resurrected on the basis of a phylogenetic analysis of multi-locus sequence data of the Ramalinaceae including the nuclear protein-coding marker *rpb2*, the internal transcribed spacer and a fragment of the small mitochondrial subunit. The genus *Hertelidea* was positioned within the *Ramalina* clade of the phylogenetic tree of the Ramalinaceae. *Bacidia sipmanii*, *Phyllopsora chlorophaea*, *P. castaneocincta* and *Ramalina subbreviscula* were recorded from South Korea for the first time here confirming by molecular data, too.

Forty-eight new combinations are proposed: *Bacidia alnetorum* (basionym: *Biatora alnetorum* S. Ekman et Tønsberg), *Biatora amazonica* (basionym: *Phyllopsora amazonica* Kistenich et Timdal), *Biatora cuyabensis* (basionym: *Lecidea cuyabensis* Malme), *Biatora halei* (basionym: *Pannaria halei* Tuck.), *Biatora kalbii* (basionym: *Phyllopsora kalbii* Brako), *Biatora subhispidula* (basionym: *Psoroma subhispidulum* Nyl.), *Coppinsidea alba* (basionym: *Catillaria alba* Coppins et Vězda), *Coppinsidea aphana* (basionym: *Lecidea aphana* Nyl.), *Coppinsidea croatica* (basionym: *Catillaria croatica* Zahlbr.), *Coppinsidea fuscoviridis* (basionym: *Bilimbia fuscoviridis* Anzi), *Coppinsidea pallens* (basionym: *Bilimbia pallens* Kullh.), *Coppinsidea ropalosporoides* (basionym: *Gyalidea ropalosporoides* S. Y. Kondr., L. Lókös et J.-S. Hur), *Coppinsidea scotinodes* (basionym: *Lecidea scotinodes* Nyl.), *Coppinsidea sphaerella* (basionym: *Lecidea sphaerella* Hedl.), *Ivanpisutia hypophaea* (basionym: *Biatora hypophaea* Printzen et Tønsberg), *Ivanpisutia ocelliformis* (basionym: *Lecidea ocelliformis* Nyl.), *Lecaniella belgica* (basionym: *Lecania belgica* van den Boom et Reese Naesb.), *Lecaniella cyrtellina* (basionym: *Lecanora cyrtellina* Nyl.), *Lecaniella dubitans* (basionym: *Lecidea dubitans* Nyl.), *Lecaniella erysibe* (basionym: *Lichen erysibe* Ach.), *Lecaniella hutchinsiae* (basionym: *Lecanora hutchinsiae* Nyl.), *Lecaniella naegelii*

(basionym: *Biatora naegelii* Hepp), *Lecaniella prasinoides* (basionym: *Lecania prasinoides* Elenkin), *Lecaniella sylvestris* (basionym: *Biatora sylvestris* Arnold), *Lecaniella tenera* (basionym: *Scoliciosporum tenerum* Lönnr.), *Mycobilimbia albohyalina* (basionym: *Lecidea anomala* f. *albohyalina* Nyl.), *Mycobilimbia cinchonarum* (basionym: *Triclinum cinchonarum* Fée), *Mycobilimbia concinna* (basionym: *Phyllopsora concinna* Kistenich et Timdal), *Mycobilimbia ramea* (basionym: *Bacidina ramea* S. Ekman), *Mycobilimbia siamensis* (basionym: *Phyllopsora siamensis* Kistenich et Timdal), *Myrionora australis* (basionym: *Biatora australis* Rodr. Flakus et Printzen), *Myrionora ementiens* (basionym: *Lecidea ementiens* Nyl.), *Myrionora flavopunctata* (basionym: *Lecanora flavopunctata* Tønsberg), *Myrionora globulosa* (basionym: *Lecidea globulosa* Flörke), *Myrionora hemipolia* (basionym: *Lecidea arceutina* f. *hemipolia* Nyl.), *Myrionora lignimollis* (basionym: *Biatora ligni-mollis* T. Sprib. et Printzen), *Myrionora malcolmii* (basionym: *Phyllopsora malcolmii* Vězda et Kalb), *Myrionora vacciniicola* (basionym: *Lecidea vacciniicola* Tønsberg), *Phyllopsora agonimioides* (basionym: *Coenogonium agonimioides* J. P. Halda, S.-O. Oh et J.-S. Hur), *Phyllopsora sunchonensis* (basionym: *Agonimia sunchonensis* S. Y. Kondr. et J.-S. Hur), *Vandenboomia chlorotiza* (basionym: *Lecidea chlorotiza* Nyl.), *Vandenboomia falcata* (basionym: *Lecania falcata* van den Boom, M. Brand, Coppins, Magain et Sérus.), *Wolseleyidea africana* (basionym: *Phyllopsora africana* Timdal et Krog), *Wolseleyidea byssiseda* (basionym: *Lecidea byssiseda* Nyl. ex Hue), *Wolseleyidea canoumbрина* (basionym: *Lecidea canoumbрина* Vain.), *Wolseleyidea furfurella* (basionym: *Phyllopsora furfurella* Kistenich et Timdal), *Wolseleyidea ochroxantha* (basionym: *Lecidea ochroxantha* Nyl.), and *Wolseleyidea swinscowii* (basionym: *Phyllopsora swinscowii* Timdal et Krog). The combination *Biatora longispora* (Degel.) Lendemer et Printzen is validated here. The new names *Biatora vezdana* for *Lecania furfuracea* Vězda and *Coppinsidea vainioana* for *Lecidea sphaeroidiza* Vain. are proposed. The phenomenon of presence of ‘extraneous mycobiont DNA’ in lichen association, i.e. DNA, belonging neither to mycobiont nor photobiont or to endophytic fungi is for the first time illustrated. So the presence of nrITS and mtSSU sequences of crustose lichen *Coppinsidea ropalosporoides* in thalli of crustose *Verrucaria margacea* and foliose *Kashiwadia orientalis*, as well as nrITS of *Phyllopsora* sp. KoLRI in *Agonimia pacifica* and *Biatora longispora*, or nrITS and mtSSU of *Biatora longispora* in thalli of *Agonimia pacifica*, *Oxneriopsis oxneri* and *Pyxine limbulata*, *Ivanpisutia oxneri* in thalli of *Rinodina xanthophaea*, etc. is documented. Scarce cases of presence of ‘extraneous mycobiont DNA’ in representatives of the Teloschistaceae, Physciaceae known from literature data are discussed, too.

Key words: *Agonimia*, *Bacidia*, *Biatora*, *Coppinsidea*, *Ivanpisutia*, *Lecania*, *Lecaniella*, *Mycobilimbia*, *Myrionora*, *Phyllopsora*, phylogeny, taxonomy, *Vandenboomia*, *Wolseleyidea*

## INTRODUCTION

*Gyalidea ropalosporoides* S. Y. Kondr., L. Lőkös et J.-S. Hur was originally described with hesitation concerning its generic position (Kondratyuk *et al.* 2016b). It was found within the present study that *Gyalidea ropalosporoides* belonged to the *Phyllopsora* s. l. subclade of the *Biatora* s. l. clade of the family Ramalinaceae.

*Phyllopsora loekoessii* S. Y. Kondr., E. Farkas, S.-O. Oh et J.-S. Hur and *Coenogonium agonimioides* J. P. Halda, S.-O. Oh et J.-S. Hur have been described (Kondratyuk *et al.* 2016a) when no molecular data were available for the cited material. Later when molecular data on *P. loekoessii* and *C. agonimioides* were obtained it was not possible to compare these data with other taxa of the gen-

era mentioned because data were available at that time only for a few species of the genera *Phyllopsora* and *Coenogonium*. After molecular data on the Ramalinaceae provided by Kistenich *et al.* (2018, 2019a, b) the further clarifying on the phylogenetic position of the Eastern Asian material became possible. Both species mentioned within our study was found to be positioned within the *Phyllopsora* s. l. subclade of the Ramalinaceae.

*Agonimia sunchonensis* S. Y. Kondr. et J.-S. Hur was described as a member of the genus *Agonimia* (Kondratyuk *et al.* 2018c), although the morphological characters of this sterile material made some hesitation if it belonged to the genera *Bacidia* or *Agonimia*. However, according to the phylogenetic analysis within the current study the Korean material previously recorded as *Agonimia sunchonensis* was found to be positioned within the *Phyllopsora* s. l. subclade of the Ramalinaceae, too.

The monotypic Eastern Asian genus *Ivanpisutia* S. Y. Kondr., L. Lőkös et J.-S. Hur was described without providing molecular data because the type collection was very small (Kondratyuk *et al.* 2015). The genus *Ivanpisutia* was listed as Lecanorales incertae sedis by Lücking *et al.* (2017a, b). Kistenich *et al.* (2018) made a note that in their phylogeny *Ivanpisutia* formed a strongly supported clade with *Biatora ocelliformis*. Unfortunately, nrITS sequence was cited only for one specimen of *Ivanpisutia oxneri* (Kistenich *et al.* 2018), and this taxon was not included in the final combined phylogenetic tree. In general the genus *Ivanpisutia* was considered as a synonym of the genus *Biatora* (Kistenich *et al.* 2018). Additionally, the morphological similarity of *Ivanpisutia oxneri* and *Biatora pacifica* Printzen, Tønsberg et G. Thor was pointed out by Printzen *et al.* (2016), while molecular data are still not available for the latter taxon.

Within this study data on nrITS and mtSSU sequences were obtained for the *Ivanpisutia oxneri* S. Y. Kondr., L. Lőkös et J.-S. Hur, the type species of the genus *Ivanpisutia*, and within combined phylogenetic analysis it was found that the genus *Ivanpisutia* including two more species is positioned as a separate monophyletic branch within the Ramalinaceae. Thus our data do not confirm the proposal of the cited authors (Kistenich *et al.* 2018) that the genus *Ivanpisutia* is synonymous with *Biatora*.

The aim of this paper was to present molecular data on all these members of the Ramalinaceae from the Eastern Asian region as well as to discuss their position. All representatives of the genera belonging to the *Biatora* group of the Ramalinaceae (sensu Kistenich *et al.* 2018) for which molecular data are hitherto available are included in the combined phylogenetic analysis, while other groups (representatives of the *Bacidia*, the *Ramalina* and the *Toninia* groups) are included only with the aim to illustrate the position of some biatoroid, lecanioid or ramalinoid Eastern Asian taxa for which molecular data are provided for the first time.

## MATERIAL AND METHODS

Numerous specimens of the Ramalinaceae from the Eastern Asian collections treated within the latest years (see Kondratyuk *et al.* 2016a, b, 2017, 2018b, 2019) as well as separate taxa from Europe were included in comparative molecular study. More than 400 Ramalinaceae specimens, collected in 2014–2018 and deposited in the Korean Lichen Research Institute, Sunchon National University, South Korea (KoLRI), as well as some duplicates in the Hungarian Natural History Museum (BP) and the Lichen Herbarium in the M. H. Kholodny Institute of Botany of National Academy of Sciences of Ukraine (KW-L) have been examined using standard microscopical techniques, and hand-sectioned under a dissecting microscope (Nikon SMZ 645; Nikon, Tokyo, Japan). Anatomical characters were observed using a Nikon Eclipse E200 microscope and a Zeiss Scope, complemented with a digital camera AxioCam ERc 5s. Sections of apothecia were tested with water, K and IKI (10% potassium iodide). Total DNA was extracted directly from the thalli according to Ekman (1999) and was purified with DNeasy Plant Mini Kit (Qiagen, Germany). The nuclear ribosomal RNA gene region including the internal transcribed spacers 1 and 2 and the 5.8S subunit (ITS) was amplified using the primers ITS1F (Gardes and Bruns 1993) and ITS4 (White *et al.* 1990), the 28S nrLSU using the primer LR5 (Vilgalys and Hester 1990), and the 12S mtSSU using the primers mtSSU1-mtSSU3R and mtSSU2R (Fedorenko *et al.* 2009, 2012). Methods of extractions of DNA, data on primers and phylogenetic analysis are provided in our previous paper (Kondratyuk *et al.* 2017a, 2018a, d).

The amplification was done using a Takara JP/TP600 PCR machine (Takara Bio Inc., Japan). One initial cycle of 5 min at 94 °C was followed by 30 cycles of the following steps: 30 seconds at 94 °C, 39 seconds at 57 °C and 1 min at 72 °C. Amplifications were ended with a final cycle at 72 °C for 10 min. Then the PCR products were sent to sequencing facilities of the Genotech Corporation, Daejeon, South Korea, for cleaning and sequencing. The sequencing was carried out using the fluorescent marker BigDye and an ABI 3730xl sequencing machine (Applied Biosystems, Carlsbad, CA, USA). The consensus sequence was aligned with all related species sequences retrieved from the GenBank database (Appendix).

## RESULTS

### *Phylogeny*

The 3-locus dataset (concatenated nrITS, mtSSU and rpb2 gene sequences) consisted of 156 taxa and resulted in a 2,599 bp long alignment (where the nrITS portion included 595 bp, the 12S mtSSU portion – 907 bp, and the rpb2

gene portion – 1,093 bp) with 2,346 parsimony-informative sites and 30.2% missing data (Appendix).

More than 225 taxa were included into the nrITS phylogeny, while only 176 specimens were left in the final phylogenetic tree (Fig. 1).

From the combined phylogenetic analysis of multi-locus sequence data of the Ramalinaceae including the nuclear protein-coding marker *rpb2*, the internal transcribed spacer and a fragment of the small mitochondrial small subunit, the following clades were included in our analysis: the *Ramalina* s. l., the *Lecania* s. l., the *Biatora* s. l. and the *Bacidia*–*Toninia* s. l. clades.

#### The *Ramalina* s. l. clade

After the combined phylogenetic analysis based on nrITS, mtSSU and *rpb2* gene sequences of the Ramalinaceae the *Ramalina* s. l. clade is represented in our case by the *Ramalina* s. l. branch, the *Cliostomum* branch and the single species *Hertelidea botryosa* (Fr.) Printzen et Kantvilas.

The *Ramalina* s. l. branch illustrates the position of South Korean material of *Ramalina subbreviscula* Asahina, which is recorded in South Korea for the first time. At the same time it should be mentioned that the type species *Ramalina fraxinea* (L.) Ach. is positioned in a somewhat separate subbranch within the *Ramalina* s. l. branch. It may suggest that the genus *Ramalina* Ach. is polyphyletic from molecular point of view, too. Within our analysis this genus has the highest level of support (Fig. 1). However, analysis of molecular data on various species groups of the genus *Ramalina* is outside of this paper.

The *Cliostomum* branch is represented in our analysis by three species *C. griffithii* (Sm.) Coppins, *C. corrugatum* (Ach.) Fr. and *C. haematommatis* (Keissl.) D. Hawksw., Earl.-Benn. et Coppins, which do not show the highest level of support in this case (Fig. 1).

The Northern Hemisphere species *Hertelidea botryosa* was found to be positioned in the *Ramalina* s. l. clade of the Ramalinaceae, while it was considered to be in 'out position' to the Stereocaulaceae in the original publication (Printzen and Kantvilas 2004).

#### The *Lecania* s. l. clade

According to the combined phylogenetic analysis based on nrITS, mtSSU and *rpb2* gene sequences of the Ramalinaceae, the *Lecania* s. l. clade includes two subclades, i.e.: the *Bilimbia*–*Coppinsidea*–*Thamnolecania*, and the *Lecania* s. l. subclades.

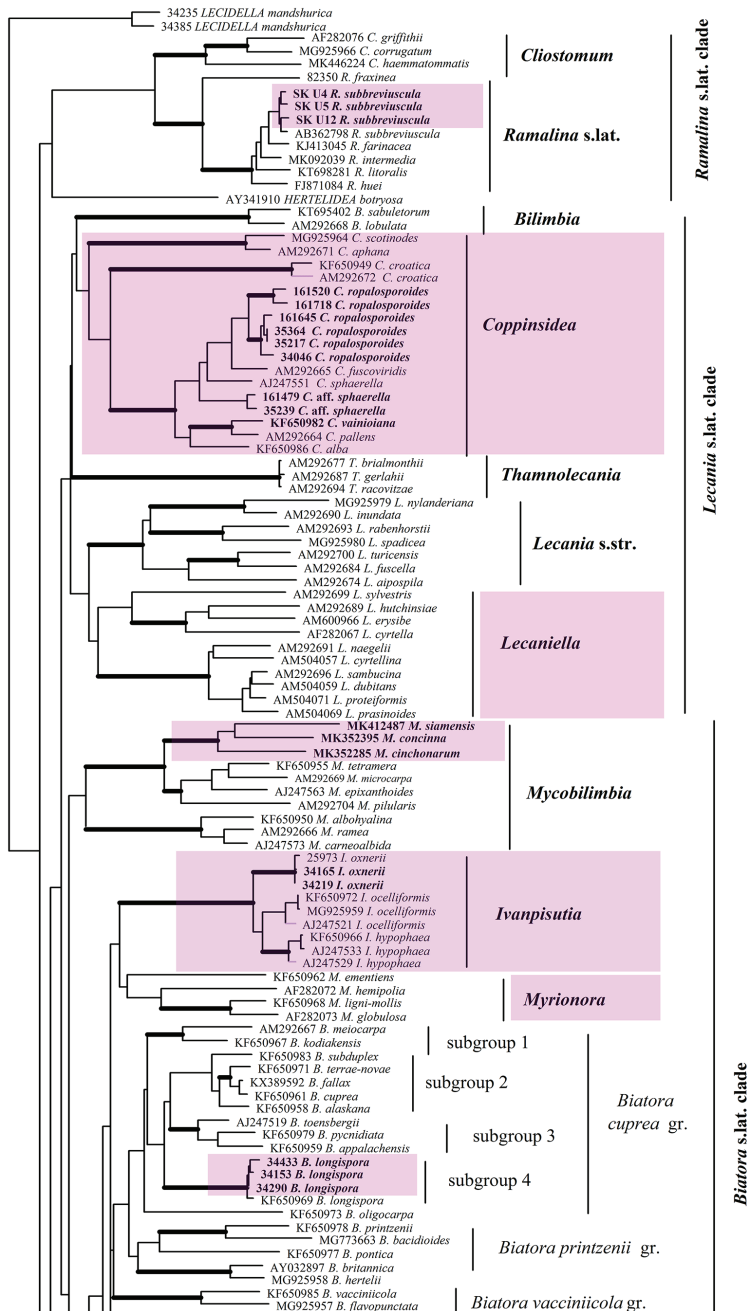


Fig. 1. Position of the genera *Coppinsidea*, *Vandenboomia*, *Wolseleyidea*, as well as *Lecaniella*, *Ivanpisia* and *Myrionora* in phylogenetic tree of the Ramalinaceae, based on combined multi-loci sequence dataset. Branches with the highest level of the bootstrap support are in bold

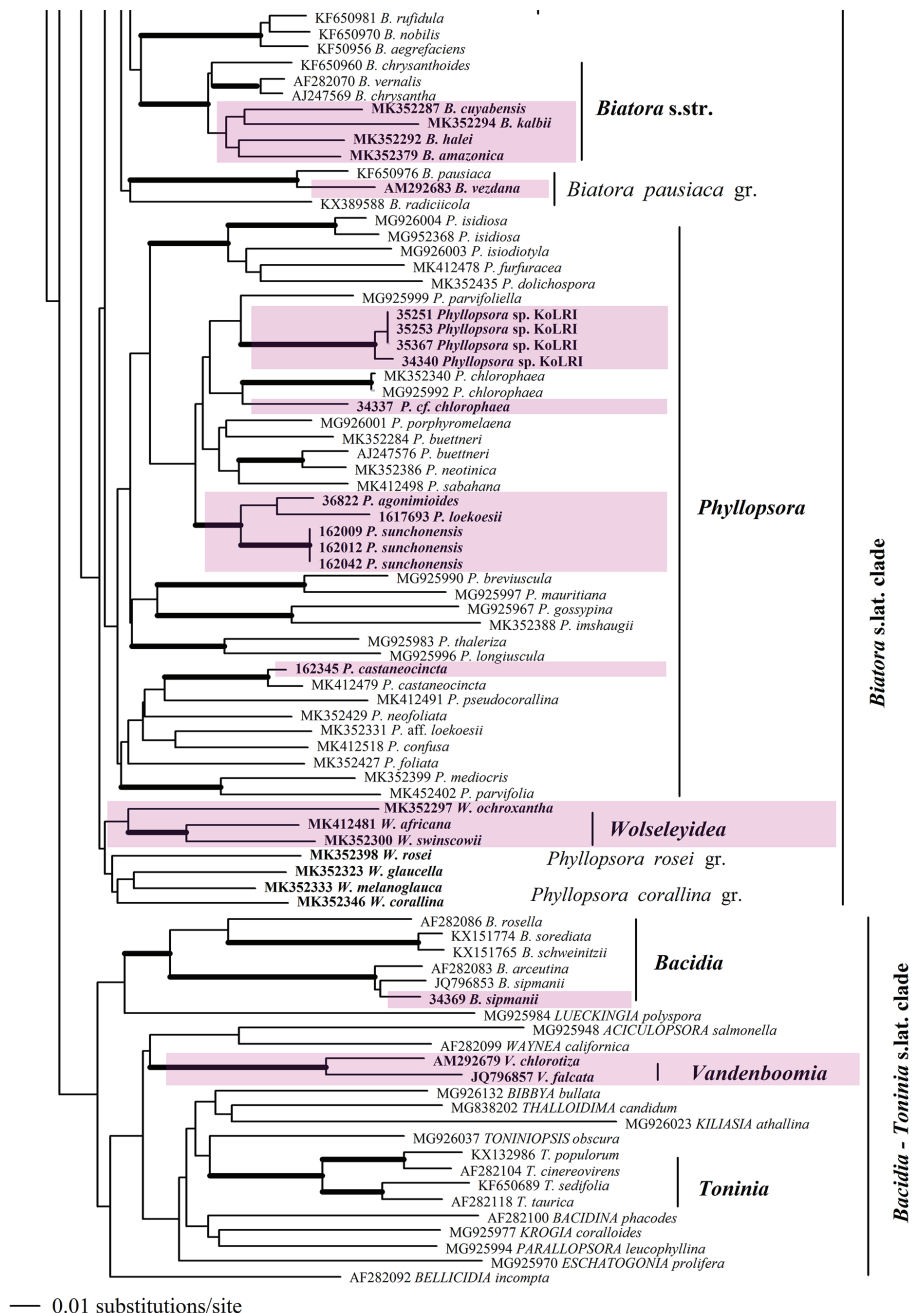


Fig. 1. (continued)

*Bilimbia*–*Coppinsidea*–*Thamnolecania* subclade

From the combined phylogenetic analysis based on nrITS, mtSSU and rpb2 gene sequences of the Ramalinaceae the *Bilimbia*–*Coppinsidea*–*Thamnolecania* subclade includes three branches, i.e. the *Bilimbia*, the *Coppinsidea* and the *Thamnolecania* branches.

The *Bilimbia* branch is represented only by two species *B. sabuletorum* (Schreb.) Arnold and *B. lobulata* (Sommerf.) Hafellner et Coppins. The *Coppinsidea* s. l. branch in fact includes the following subbranches, i.e.: the *Coppinsidea* s. str., the *Coppinsidea pallens*, the *Coppinsidea croatica* and the *Coppinsidea scotinodes* subbranches (Fig. 1).

The *Coppinsidea* s. str. (= the former *Lecidea sphaerella* group) subbranch is represented by four taxa, i.e.: *Coppinsidea fuscoviridis* (Anzi) S. Y. Kondr., E. Farkas et L. Lőkös, *C. ropalosporoides* (S. Y. Kondr., L. Lőkös et J.-S. Hur) S. Y. Kondr., E. Farkas et L. Lőkös, *C. sphaerella* (Hedl.) S. Y. Kondr., E. Farkas et L. Lőkös, and one more still not described species (*Coppinsidea* aff. *sphaerella* in Fig. 1) forming a robust monophyletic branch. Unfortunately, data on rpb2 gene of *C. fuscoviridis* are still missing.

Molecular data on *Coppinsidea ropalosporoides* are provided to the GenBank for the first time. *C. ropalosporoides* is presented by six specimens in the ITS phylogeny, four of them (i.e. 161718 (KoLRI 039936), 161520 (KoLRI 039738), 161645 (KoLRI 039863) and 151671 (KoLRI 035364)) were extracted from this lichen species, while two other specimens, i.e. 151524 (KoLRI 035217) and 150813 (KoLRI 034046) were extracted from the crustose lichen species *Verrucaria margacea* (Wahlenb.) Wahlenb. and the foliose lichen species *Kashiwadia orientalis* (Kashiw.) S. Y. Kondr., L. Lőkös et J.-S. Hur, respectively (see phenomenon of ‘extraneous mycobiont DNA’ below, too).

Furthermore, the *Coppinsidea pallens* subbranch (i.e. the former *Biatora pallens* group) is positioned within the *Coppinsidea* s. l. branch, too. It includes the following three taxa, i.e.: *Coppinsidea alba* (Coppins et Vězda) S. Y. Kondr., E. Farkas et L. Lőkös, *C. pallens* (Kullh.) S. Y. Kondr., E. Farkas et L. Lőkös, as well as *C. vainioana* S. Y. Kondr., E. Farkas et L. Lőkös. The inclusion of the three *Biatora* species into the *Coppinsidea* genus is rather preliminary. In our analysis this branch has rather low level of bootstrap support, while species of the former *Biatora pallens* have rather high level of support within this branch. We are considering these taxa within this new genus to emphasise that they represent a unique group of biatoroid species and the status of this group is in urgent need of further clarifying.

The *Coppinsidea* s. l. branch includes also the separate *C. croatica* and the *C. scotinodes* monophyletic subbranches, which are characterised by strong bootstrap support within various analyses, while they are positioned within the *Coppinsidea* s. l. branch with much weaker support. Their status is still



not clear with molecular data so far available (Fig. 1). The *Coppinsidea croatica* subbranch includes only one rather rare European-North American taxon *C. croatica* (Zahlbr.) S. Y. Kondr., E. Farkas et L. Lőkös, while the *Coppinsidea scotinodes* subbranch includes also *C. scotinodes* (Nyl.) S. Y. Kondr., E. Farkas et L. Lőkös, a rare European species (known from Sweden, Norway, United Kingdom, and Switzerland, while status of Ukrainian specimens is waiting for clarifying, see Svensson *et al.* 2017) and an Atlantic European endemic species *C. aphana* (Nyl.) S. Y. Kondr., E. Farkas et L. Lőkös. Unfortunately, data on mtSSU and rpb2 genes of *C. aphana* are still missing.

Thus *Coppinsidea* is accepted here as a polyphyletic genus, which includes the *Coppinsidea* s. str. (i.e. the *C. sphaerella* monophyletic branch), the *C. pallens*, the *C. croatica* and the *C. scotinodes* subbranches. Two latter subbranches form also monophyletic branches in the phylogenetic tree of the Ramalinaceae.

According to the combined phylogenetic analysis based on nrITS, mtSSU and rpb2 gene sequences of the Ramalinaceae as well as after simple nrITS or mtSSU phylogeny, the *Thamnolecania* branch includes three species of the genus *Thamnolecania* (Vain.) Gyeln., i.e.: the type species *T. brialmontii* (Vain.) Gyeln., as well as *T. gperlachei* (Vain.) Gyeln. and *T. racovitzae* (Vain.) S. Y. Kondr., L. Lőkös et J.-S. Hur.

#### *Lecania* s. l. subclade

The *Lecania* s. l. branch (in the *Lecania* s. l. subclade) is represented by members of the only the genera *Lecania* A. Massal. and *Lecaniella* Jatta from the combined phylogenetic analysis based on nrITS, mtSSU and rpb2 gene sequences of the Ramalinaceae (Fig. 1). However, we would like to emphasise that after our phylogenetic analysis the genus *Lecania* is not monophyletic in contrast to the conclusion of Kistenich *et al.* (2018) data. So the *Lecania* s. l. branch includes as *Lecania* s. str. subbranch, as well as the *Lecania erysibe* subbranch (as Group 1 in Fig. 1) and the *Lecania dubitans* subbranch (as Group 2 in Fig. 1). It should be emphasised that these three subbranches have rather higher level of support than the whole the *Lecania* s. l. branch.

The *Lecania* s. str. subbranch includes *L. fuscella* (Schaer.) A. Massal., the type species of the genus, *L. nylanderiana* A. Massal., *L. inundata* (Hepp ex Körb.) M. Mayrhofer, *L. turicensis* (Hepp) Müll. Arg., *L. aipospila* (Wahlenb. ex Ach.) Th. Fr., *L. rabenhorstii* (Hepp) Arnold and *L. spadicea* (Flot.) Zahlbr. From the mtSSU phylogeny two more species, i.e.: *L. fructigena* Zahlbr., and *L. leprosa* Reese Naesb. et Vondrák are members of this branch, too. Unfortunately, hitherto there are data only on mtSSU sequences of species mentioned, and data on rpb2 sequences of *Lecania fuscella* and *L. leprosa* are still missing. Sometimes this branch is positioned as separate branch in distant position from the

*Lecania* branch within the phylogenetic analysis of the Ramalinaceae if limited number of taxa is included in the analysis.

The *Lecaniella* branch includes two species groups, i.e. the *Lecaniella erysibe* group, which is represented by *Lecaniella erysibe* (Ach.) S. Y. Kondr., *Lecaniella belgica* (van den Boom et Reese Naesb.) S. Y. Kondr., *L. sylvestris* (Arnold) S. Y. Kondr., *L. hutchinsiae* (Nyl.) S. Y. Kondr., and *L. cyrtella* (Ach.) S. Y. Kondr., while the *Lecaniella dubitans* group is represented by *Lecaniella dubitans* (Nyl.) S. Y. Kondr., *L. naegelii* (Hepp) S. Y. Kondr., *L. cyrtellina* (Nyl.) S. Y. Kondr., *L. sambucina* (Körb.) Jatta, *L. proteiformis* (A. Massal.) Jatta, and *L. prasinoides* (Elenkin) S. Y. Kondr. However, there are two more separate groups of the *Lecaniella* species, i.e.: *Lecaniella erysibe* and the *Lecaniella dubitans* groups, which sometimes form separate clade with rather low level of support, while each of these groups have rather high (or the highest) level of bootstrap support. So conclusion that it is first confirmation the generic name *Lecaniella* Jatta should be resurrected for the *Lecaniella erysibe* group is done here (Fig. 1). Unfortunately, data on mtSSU sequences of *Lecaniella sylvestris* are still missing, as well as data on rpb2 gene of *L. belgica* are still not available.

In contrast to the combined phylogenetic analysis after the mtSSU phylogeny the *Lecaniella erysibe* and *L. dubitans* are positioned in the same robust monophyletic branch. This is why we prefer to include the second branch (i.e. the *Lecaniella dubitans* group) to the genus *Lecaniella*, too, until this hypothesis will be checked with additional data including new vouchers and new molecular markers.

It should be emphasised that two additional former *Lecania* species of the *L. chlorotiza* group, i.e.: *Lecania falcata* and *L. chlorotiza* are positioned within the *Toninia* s. l. clade (see under *Vandenboomia*, too). Additionally to this after molecular data hitherto available *Lecania glauca* Øvstedal et Søchting is positioned in 'out position' to all known members of the Ramalinaceae (not shown in Fig. 1). However, data on rpb2 gene of *Lecania glauca* are still missing.

Furthermore after mtSSU phylogeny *Lecania baeomma* (Nyl.) P. James et J. R. Laundon (for which hitherto only mtSSU data are available) is positioned in 'out position' to all *Lecania* and *Biatora* species and positioned in separate branch. However, it was not possible to check the position of this taxon after

\* Based on the specimen (AM292691) of Reese Naesborg *et al.* (2007), which is positioned within the *Lecania* clade, while another specimen (AF252101) of '*Lecaniella* *naegelii* (Ekman's data) is positioned within the *Toninia* clade in sister position to *Bacidina arnoldiana* (Körb.) V. Wirth et Vězda, too. Furthermore, after our mtSSU phylogeny of the Ramalinaceae this species (*Lecaniella naegelii*) similarly to Reese Naesborg *et al.* (2007) is positioned together with *Biatora vezdana* S. Y. Kondr. and *Lecaniella tenera* in separate branch closely related to the *Coppinsidea* clade. However, only data on mtSSU sequence of *Lecaniella tenera* and data on nrITS and mtSSU sequences of *Biatora vezdana* are so far available. So final decision about status of this species group can be done when complete data set including all molecular markers for taxa mentioned will be available.

combined phylogenetic analysis as far as data on other molecular markers are still missing for this taxon.

### The *Biatora* s. l. clade

The *Biatora* s. l. clade is represented by four separate subclades, i.e. the *Mycobilimbia*, the *Ivanpisutia*–*Myrionora*–*Biatora*, the *Phyllopsora* s. l. and the *Wolseleyidea* subclades.

### The *Mycobilimbia* subclade

The *Mycobilimbia* subclade is represented only by the species of the genus *Mycobilimbia*, if we accept that this genus is paraphyletic. There are two monophyletic branches within this subclade, the first one includes three species of the genus *Mycobilimbia* Rehm, the type species *Mycobilimbia obscurata* (Sommerf.) Rehm (the current name is *M. tetramera* (De Not.) Vitik., Ahti, Kuusinen, Lommi et T. Ulvinen ex Hafellner et Türk), *M. epixanthoides* (Nyl.) Vitik., Ahti, Kuusinen, Lommi et T. Ulvinen ex Hafellner et Türk and *M. pilularis* (Hepp ex Körb.) Hafellner et Türk, and, unexpectedly, three more species previously considered as members of the *Phyllopsora* genus (Kistenich *et al.* 2019a, b). However, as far as after combined phylogeny they are positioned within the *Mycobilimbia* branch, the following three species, i.e. *Mycobilimbia siamensis* (Kistenich et Timdal) S. Y. Kondr., *Mycobilimbia concinna* (Kistenich et Timdal) S. Y. Kondr., and *M. cinchonarum* (Fée) S. Y. Kondr. are combined to the *Mycobilimbia* genus here (see below).

The second monophyletic branch within the *Mycobilimbia* subclade (the former *Lecidea albohyalina* group) includes *Mycobilimbia albohyalina* (Nyl.) S. Y. Kondr. (the combination is proposed below), *Mycobilimbia ramea* (S. Ekman) S. Y. Kondr. (see below, too), and *Mycobilimbia carnealbida* (Müll. Arg.) S. Ekman et Printzen. Level of support of the whole *Mycobilimbia* subclade is rather low, while the two mentioned branches form monophyletic branches within this subclade (Fig. 1). Unfortunately, data on mtSSU gene of *M. ramea* are still missing.

Thus the genus *Mycobilimbia* is accepted here as polyphyletic similarly to the genus *Coppinsidea*.

### The *Ivanpisutia*–*Myrionora*–*Biatora* subclade

The *Ivanpisutia*–*Myrionora*–*Biatora* subclade includes the *Ivanpisutia* monophyletic branch with the *Myrionora* branch being in sister position to *Ivanpisutia*, as well as a number of monophyletic branches of the *Biatora* species including the *Biatora* s. str. branch of the *Biatora* s. l. clade.

The *Ivanpisutia* monophyletic branch. – In contrast to the phylogenetic tree of the Ramalinaceae provided by Kistenich *et al.* (2018) from our combined phylogenetic analysis based on concatenated nrITS, mtSSU and rpb2 sequences found to be separate the *Ivanpisutia* monophyletic branch in sister position to the *Biatora* s. l. branch. The *Ivanpisutia* branch includes three species, i.e. the type species *I. oxneri* S. Y. Kondr., L. Lőkös et J.-S. Hur (three specimens are included in the analysis (25973 after Kistenich *et al.* 2018) and two specimens from our data, i.e. 150932 (KoLRI 034165) and 150986 (KoLRI 034219)), as well as the North American species *I. hypophaea* (Printzen) S. Y. Kondr., and the widely distributed Northern Hemisphere species *I. ocelliformis* (Nyl.) S. Y. Kondr. It should be mentioned that both nrITS and mtSSU data on the 150986 specimen of *Ivanpisutia oxneri* were obtained during extraction of DNA from *Rinodina xanthophaea* (Nyl.) Zahlbr. (see phenomenon of ‘extraneous (= foreign) mycobiont DNA’ below). *Ivanpisutia hypophaea* and *I. ocelliformis* are represented by three voucher specimens each, while all 12 specimens of the nrITS sequences of the latter species submitted to the GenBank are the same (see also Appendix). According to Kistenich *et al.* (2018) sequences from two *Biatora ocelliformis* voucher specimens have had 100 level of bootstrap support, while *Ivanpisutia oxneri* was not included in the phylogenetic tree at all. Only in the Appendix *Ivanpisutia oxneri* was cited as voucher specimens for only one nrITS sequence. However, after the nrITS phylogeny including also our data, *I. oxneri*, *I. ocelliformis* and *I. hypophaea* form a separate branch at rather low level (MP = 55), while separate species have the highest level of support.

The *Myrionora* branch. – The former *Biatora globulosa* group branch is positioned in the sister position to the *Ivanpisutia* monophyletic branch from the combined phylogenetic analysis based on nrITS, mtSSU and rpb2 gene sequences of the Ramalinaceae. In this situation after combined analysis, the *Biatora globulosa* group includes four species, i.e. *B. globulosa*, *B. ligni-mollis*, *B. hemipolia*, and *B. ementiens*. All these species belong to the genus *Myrionora* R. C. Harris (see also Fig. 1), while such conclusion can be done with some hesitation, since only mtSSU sequence data of a single specimen of *M. albidula* (Willey) R. C. Harris, the type species of this genus, are still available. Thus, unfortunately, *M. albidula* could not be hitherto included in the combined phylogenetic analysis of the Ramalinaceae. Molecular data on the second, hitherto known member of this genus, i.e. *Myrionora pseudocyphellariae* (Etayo) S. Ekman et Palice are still absent, too (see Palice *et al.* 2013).

The suggestion of Kistenich *et al.* (2018) that *Myrionora albidula* is closely related (or is positioned together) with *Biatora ligni-mollis* is confirmed by our analysis. Furthermore we would like to add that *M. albidula* is positioned in the same branch with the South American (hitherto known from Argentina and Ecuador) species *M. australis* (Rodr. Flakus et Printzen) S. Y. Kondr., *M.*

*ligni-mollis* (T. Sprib. et Printzen) S. Y. Kondr., and *M. globulosa* (Flörke) S. Y. Kondr., as well as, with *Biatora beckhausii* and *Coppinsidea alba* after the mtSSU analysis. *M. ementiens* (Nyl.) S. Y. Kondr., and *M. hemipolia* (Nyl.) S. Y. Kondr. are included in this genus with some hesitation as far level of support of these taxa in the *Myrionora* branch is rather low. However, molecular data on *Biatora beckhausii* are somewhat different from all members of the Ramalinaceae and they are in need of confirmation on the basis of additional voucher specimens as well as molecular markers. On the other hand, *Coppinsidea alba* is a member of the *Coppinsidea* branch after the combined phylogenetic tree (Fig. 1).

The opinion of Kistenich *et al.* (2018) that the genus *Myrionora* is synonymous with *Biatora* cannot be accepted. The former *Biatora globulosa* group is positioned in a separate branch, which is in sister position to *Ivanpisutia* and in distant position from the *Biatora* s. str. subclade / branch. In addition, the level of support of the *Myrionora* branch is rather low (between MP = 90–94), while the highest level of support within this group found to be shown between *M. globulosa* and *M. ligni-mollis* (Fig. 1). Level of support of the *Ivanpisutia*–*Myrionora* subclade is rather low too (lower of MP = 89).

Unexpectedly three more species, i.e. *Myrionora flavopunctata* (Tønsberg) S. Y. Kondr., *M. vacciniicola* (Tønsberg) S. Y. Kondr., and *M. malcomii* (Vězda et Kalb) S. Y. Kondr. are positioned within the *Myrionora* branch too, when recently provided data on a number of *Phyllopsora* species (Kistenich *et al.* 2019b) are included into the phylogenetic analysis (see also discussion under the genera *Myrionora* and *Wolseleyidea* below). Two first taxa are members of the former *Biatora vacciniicola* group (see also below).

The *Biatora* s. l. branch is represented by the *Biatora* s. str. branch itself, which is characterised by not very high level of support, but with very low species diversity, as well as three more species groups, i.e. the *Biatora cuprea*, the *B. pausiaca*, and the *B. vacciniicola* groups having the highest or rather high level of bootstrap support additionally to the *Biatora* s. str. branch.

The *Biatora* s. str. branch includes only the type species *B. vernalis* (L.) Fr., *B. chrysantha* (Zahlbr.) Printzen, and *B. chrysanthoides* Printzen et Tønsberg, and in some analysis additionally to these two species of the *B. rufidula* group, i.e.: *B. rufidula* (Graewe) S. Ekman et Printzen, *B. nobilis* Printzen et Tønsberg, as well as *B. aegrefaciens* Printzen. The branch with two species, i.e. *B. vernalis* and *B. chrysanthoides*, as well as the *B. rufidula* group have the highest level of support, while level of support of these two branches is somewhat variable from analysis to analysis. However, if we will accept that the genus *Biatora* is paraphyletic, these two branches may be accepted as the *Biatora* s. str. genus.

Unexpectedly the *Biatora* s. str. branch included also five more species previously considered as members of the *Phyllopsora* genus (Kistenich *et al.* 2019a, b). However, as far after combined phylogeny they are positioned with-

in this branch, the following four species, i.e. *Biatora amazonica* (Kistenich et Timdal), *Biatora cuyabensis* (Malme), *B. halei* (Turk.) and *B. kalbii* (Brako) are combined to the *Biatora* genus here (see below).

In somewhat 'out position' to the *Biatora* s. str. branch the following groups are positioned after the combined phylogenetic analysis, i.e.: the *B. cuprea* group, the *B. printzenii* group, the *B. hertelii* group, as well as the *B. vacciniicola* and the *Biatora pausiaca* groups.

The large *Biatora cuprea* group is positioned in sister branch to the *Biatora* s. str. branch, and includes the following three subgroups: the *Biatora meiocarpa* subgroup (or group 1 in Fig. 1) including only two species, i.e.: *B. meiocarpa* (Nyl.) Arnold and *B. kodiakensis* Printzen et Tønsberg; it has rather high level of support (MP to 97); the *Biatora cuprea* subgroup (or group 2 in Fig. 1), including *B. cuprea* (Sommerf.) Fr., *B. alaskana* Printzen et Tønsberg, *B. fallax* Hepp, *B. longispora* (Degel.) Lendemer et Printzen, *B. subduplex* (Nyl.) Printzen, and *B. terrae-novae* Printzen et J. W. McCarthy, as well as the *Biatora toensbergii* subgroup (or group 3 in Fig. 1), including *B. appalachiensis* Printzen et Tønsberg, *B. pycnidiaata* Printzen et Tønsberg, and *B. toensbergii* Holien et Printzen. These three groups form sometimes robust monophyletic branches within the *Biatora cuprea* group, while the whole group has rather low level of support. The *Biatora cuprea* group is positioned in a sister position to the *Biatora* s. str. and it is the most diverse group of the biatoroid lichens at the moment. According to molecular data so far available for biatoroid lichens the *Biatora cuprea* group includes about 20 species at the moment.

The *Biatora printzenii* group is represented by three species (*B. printzenii* Tønsberg, *B. bacidioides* Printzen et Tønsberg, and *B. pontica* Printzen et Tønsberg), and the *Biatora hertelii* group includes two species (*B. hertelii* Printzen et Etayo and *B. britannica* Printzen, Lumbsch et Orange), as well as the single species *Biatora oligocarpa* Printzen et Tønsberg forms a separate branch between the *Biatora cuprea* group and the *Biatora* s. str. branch.

The *Biatora pausiaca* group, including so far only two species, i.e. *B. pausiaca* Printzen et Tønsberg and *B. raditicola* Printzen, Palice et J. P. Halda, is positioned in the outermost position to the *Biatora* s. l. branch of the *Biatora* s. l. clade (Fig. 1).

It should be mentioned that after the ITS phylogeny *Biatora vezdana* is a member of the *Lecania* clade, while after the mtSSU phylogeny it is positioned in the *Lecaniella naegelii* subclade, which includes *L. naegelii*, *L. tenera* and *B. vezdana*. Unfortunately, so far only mtSSU data are available for the *L. tenera*, as well as data on *L. naegelii* are somewhat contradictory (see above). So proposal on transferring of this species to the genus *Biatora* is done with some hesitation. However, position of this species (*B. vezdana*) should be checked additionally when data on rpb2 and other genes will be available for this species.

It should be especially emphasised that additionally to species groups forming the *Biatora* s. l. branch there are the following species groups of biatoroid lichens: the *B. beckhausii*, the *B. globulosa*, the former *B. ocelliformis* group (see under *Ivanpisutia*) and the *B. pallens*, which are positioned outside of the *Biatora* s. l. branch (see above, and they were characterised within the other clades/branches).

The *Biatora beckhausii* group is probably positioned outside the Ramalinaceae after molecular data so far available for this group. It includes *B. beckhausii* (Körb.) Tuck. and the Southern Hemisphere species *B. australis* Rodr. Flakus et Printzen. This group being in sister position to the *Lecania glauca* branch is hitherto positioned outside of all clades represented in our phylogenetic tree of the Ramalinaceae (not included in Fig. 1). However, it should be emphasised that data on rpb2 sequence of *Lecania glauca* Øvstedal et Søchting are still not available.

The former *Biatora botryosa* Fr. (now as *Hertelidea botryosa* (Fr.) Printzen et Kantvilas) is for the first time illustrated to be positioned in the *Ramalina* s. l. clade of the Ramalinaceae (Fig. 1). However, data on rpb2 gene is still not available for this species. Similarly to taxon mentioned above, the former *Biatora pallens* group including so far three species is positioned within the *Coppinsidea* branch of the *Bilimbia–Coppinsidea–Thamnolecania* subclade of the *Lecania* s. l. clade (see above), as well as the former *Biatora globulosa* group including hitherto four species is positioned in sister position to the *Ivanpisutia* branch (see under the *Myrionora* branch above). The former *Biatora ocelliformis* group is discussed under the *Ivanpisutia* branch, and they are not mentioned here.

Thus from totally more than seven species groups of biatoroid lichens five groups, i.e. the *Biatora beckhausii*, the former *B. globulosa*, the former *B. ocelliformis*, the former *B. pallens*, and the *B. pausiaca* are positioned outside the *Biatora* s. l. branch, and consequently generic status of these groups should be under special revision in future. Three of the groups mentioned above proposed to be placed in the *Coppinsidea*, *Ivanpisutia* and *Myrionora* genera consequently in this paper. At the same time only three groups, i.e. the *Biatora cuprea*, the *B. pausiaca*, and the *B. vacciniicola* groups are positioned within the *Biatora* s. l. subclade. It is why the general conclusion that the genus *Biatora* is still polyphyletic, is accepted here in contrast to the conclusion about the monophyletic nature of this genus suggested by Kistenich *et al.* (2018). From our combined analysis of the Ramalinaceae the former *Lecania furfuracea*, described by Vězda in 1999 (Vězda 1999), belongs to the *Biatora pausiaca* branch, too, on the basis of data provided by Reese Naesborg *et al.* (2007), thus the new name *Biatora vezdana* S. Y. Kondr. is proposed below for *Lecania furfuracea* Vězda (not *Biatora furfuracea* Anzi (1864), and not *B. furfuracea* Kremp. (1886)).

It should be mentioned that after separate nrITS and mtSSU or rpb2 analysis some species are not positioned within the same groups or subgroups,

which are shown in Figure 1. It depends also on length of sequences of separate (mtSSU or rpb2) genes. So position of separate species within this group as well as status of each group mentioned is still in urgent need of confirmation with multi-locus phylogeny. In case of the *Ivanpisutia* and *Coppinsidea* branches we have more or less clear situation with number of species and with name after molecular data hitherto available. However, status of *Biatora* species, which are positioned outside of the *Biatora* s. l. subclade is especially in urgent need of clarifying.

Unfortunately, the status of several biatoroid taxa is still unclear. On one side there are species, i.e. *Biatora efflorescens*, etc. for which only nrITS sequence data (or *Lecaniella tenera*, *Myrionora albidula*, etc. for which only mtSSU sequence data) are present. On the other hand, there are data in GenBank on species *Biatora pseudohelvola*, but we were not able to allocate if this species is legally described. Status of them will wait for the further molecular data.

Within our study nrITS and mtSSU data were obtained for 5–6 specimens of *Biatora longispora*, for the first time from Korean specimens. However, it should be mentioned that they were obtained from *Biatora longispora* specimens as well as from ‘sterile isidiate crust’ (KoLRI 034168) and *Agonimia pacifica* (KoLRI 034290) specimens.

#### The *Phyllopsora* s. l. subclade

After our phylogenetic analysis it is seen that the genus *Phyllopsora* is still polyphyletic in contrast to the conclusion of Kistenich *et al.* (2018). Thus, from the combined phylogenetic analysis based on nrITS, mtSSU and rpb2 gene sequences of the Ramalinaceae the *Phyllopsora* s. l. subclade includes four separate branches, i.e. the *P. isidiosa*, the *P. loekoesii*, the *P. breviuscula* and the *P. castaneocincta* groups.

The *Phyllopsora isidiosa* branch/group including four taxa, i.e. *P. isidiosa* Kistenich et Timdal, *P. isidiotyla* Kistenich et Timdal, *P. furfuracea* (Pers.) Zahlbr. and *P. dolichospora* Timdal et Krog is positioned as robust monophyletic branch within the *Phyllopsora* s. l. subclade.

The *Phyllopsora* s. str. branch, including only the type species of the genus *Phyllopsora* *P. breviuscula* (Nyl.) Müll. Arg., is consisting of three robust subbranches with two species each. So the *P. breviuscula* subbranch includes type species itself, as well as *P. mauritiana* (Taylor) Gotth. Schneid., while the *P. gossypina* subbranch consists of *P. gossypina* (Sw.) Kistenich, Timdal, Bendiksby et S. Ekman, and *P. imshaugii* Timdal (Fig. 1). Unfortunately, data on rpb2 gene sequences of *P. mauritiana* are still missing.

The *Phyllopsora longiuscula* group with two species, i.e. *P. longiuscula* (Nyl.) Zahlbr. and *P. thaleriza* (Stirt.) Gotth. Schneid. ex Brako found to be in



sister position to the *Phyllopsora* s. str. branch. Each of these three subbranches has rather high level of support, while the *Phyllopsora* s. l. clade does not have high level of bootstrap support.

The *Phyllopsora longiuscula* group includes also two more still undescribed *Phyllopsora* species known so far from Brazil (Kistenich *et al.* 2018, as *Phyllopsora* sp. 1 (26003) and *Phyllopsora* sp. 2 (26004)), if they are included in the analysis (Fig. 1, not shown).

The *Phyllopsora loekoesii* branch/group, including hitherto about nine species (see below, as well as Fig. 1), includes *P. loekoesii* S. Y. Kondr., E. Farkas, S.-O. Oh et J.-S. Hur, *P. agonimioides* (J. P. Halda, S.-O. Oh et J.-S. Hur) S. Y. Kondr., D. Liu et J.-S. Hur and *P. sunchonensis* (S. Y. Kondr. et J.-S. Hur) S. Y. Kondr., L. Lőkös et J.-S. Hur, all three recently described from South Korea (see below), as well as and six more or less widely distributed taxa *P. buettneri* (Müll. Arg.) Zahlbr., *P. chlorophaea* (Müll. Arg.) Zahlbr., *P. porphyromelaena* (Vain.) Zahlbr., *P. parvifoliella* (Nyl.) Müll. Arg., recently described *P. neotinica* Kistenich et Timdal and *P. sabahana* Kistenich et Timdal. Molecular data for *P. loekoesii*, *P. agonimioides* and *P. sunchonensis* were obtained and submitted to the GenBank within this study for the first time. As a result of the ITS phylogeny *Phyllopsora loekoesii* and *P. agonimioides* are extremely similar, while morphologically they are rather different, and they were described as representatives of different genera in the original paper (i.e. *Phyllopsora* Müll. Arg. and *Coenogonium* Ehrenb., Kondratyuk *et al.* 2016a), because these lichen species were collected in fertile stage. On the other hand, material of *Phyllopsora sunchonensis* was described as a member of the genus *Agonimia* Zahlbr., because it is still known only from sterile (sorediate) stage.

The *Phyllopsora loekoesii* branch includes also a South Korean *Phyllopsora* sp. (KoLRI), which was extracted in three cases from *Agonimia pacifica* (H. Harada) Diederich thalli (specimens KoLRI, see Appendix) and in one case from *Biatora longispora* (Degel.) Lendemer et Printzen specimen (KoLRI see Appendix) (see also phenomenon of 'extraneous (= foreign) mycobiont DNA' below).

Kistenich *et al.* (2019a, b) have mentioned that *Phyllopsora loekoesii* is close to *P. confusa*. However, as it is seen from Figure 1 from our combined phylogenetic analysis that material named as *Phyllopsora loekoesii* by Kistenich *et al.* (2019a, b) is very different from the Korean material and it is positioned within the *Phyllopsora castaneocincta* branch. Thus we made the conclusion that specimens from Nepal and Japan named by Kistenich *et al.* (2019a) as *Phyllopsora loekoesii* probably represent another species and for this material we used name as *Phyllopsora* aff. *loekoesii*. Status of this material is still waiting for further clarification.

The *Phyllopsora castaneocincta* branch includes seven species, i.e. *P. castaneocincta* (Hue) Kistenich et Timdal itself, *P. pseudocorallina* Kistenich et Tim-

dal, *P. neofoliata* Elix, *P. confusa* Swinscow et Krog, *P. foliata* (Stirt.) Zahlbr., *P. mediocris* Swinscow et Krog, *P. parvifolia* (Pers.) Müll. Arg. as well as one more still undescribed species, which we mentioned as *P. aff. loekoesii* above.

The *Phyllopsora loekoesii* and the *P. isidiosa* branches may belong to another, still not described genus/genera, which is/are very close to the genus *Phyllopsora* Müll. Arg. However, this hypothesis should be checked in future with larger number of vouchers selected, as well as data on more gene sequences.

In contrast to Kistenich *et al.* (2018) data *Phyllopsora chlorophaea* is positioned in somewhat 'out position' to the *Phyllopsora* s. str. branch, being a member of the *Phyllopsora loekoesii* branch (Fig. 1). This species is positioned with one Korean specimen 151104 (KoLRI 034337), which was selected as voucher for *Biatora longispora*, but appeared to be close to *P. chlorophaea* (see Fig. 1 and Appendix under *Phyllopsora cf. chlorophaea*). *Phyllopsora chlorophaea* and *P. castaneocincta* are reported from South Korea for the first time here, confirmed by molecular data.

### The *Wolseleyidea* subclade

From the combined phylogenetic analysis based on nrITS, mtSSU and rpb2 gene sequences of the Ramalinaceae the *Wolseleyidea* subclade is positioning in 'out position' to the *Ivanpisutia*–*Myrionora*–*Biatora* and the *Phyllopsora* s. l. subclades and is represented by the species of the genus *Wolseleyidea*, proposed below. It hitherto includes six species of the former *Phyllopsora swinscowii* group, i.e. *Wolseleyidea africana* (Timdal et Krog) S. Y. Kondr., E. Farkas et L. Lőkös, *W. byssiseda* (Nyl. ex Hue) S. Y. Kondr., E. Farkas et L. Lőkös, *W. canoumbrina* (Vain.) S. Y. Kondr., E. Farkas et L. Lőkös, *W. furfurella* (Kistenich et Timdal) S. Y. Kondr., E. Farkas et L. Lőkös, *W. ochroxantha* (Nyl.) S. Y. Kondr., E. Farkas et L. Lőkös, and *W. swinscowii* (Timdal et Krog) S. Y. Kondr., E. Farkas et L. Lőkös (see also description of the genus below).

Originally some species of the *Phyllopsora rosei* and the *Phyllopsora corallina* groups were planned to be included in the genus *Wolseleyidea*. However, they found to be positioned in separate monophyletic branches in intermediate position between the *Phyllopsora* and the *Biatora* clades of the phylogenetic tree of the Ramalinaceae if larger set of taxa of the genus *Phyllopsora* are included in the phylogeny. So the *Phyllopsora rosei* branch includes four taxa, i.e. *Phyllopsora rosei* Coppins et P. James itself, as well as *P. chodatunica* Elix, *P. hispaniolae* Timdal, and *P. nemoralis* Timdal et Krog. The *Phyllopsora corallina* group includes so far the following six species: *P. corallina* (Eschw.) Müll. Arg., *P. glaucella* (Vain.) Timdal, *P. melanoglauca* Zahlbr., *P. phaeobyssina* (Vain.) Timdal, *P. rappiana* (Brako) Elix, and *P. teretiuscula* Timdal (not shown in the Fig. 1). Status of these two groups (i.e.: *Phyllopsora rosei* and *P. corallina* groups) is pending accumulation data on additional vouchers and additional molecular markers.

### The *Bacidia*–*Toninia* s. l. clade

From the combined phylogenetic analysis based on nrITS, mtSSU and rpb2 gene sequences of the Ramalinaceae the *Bacidia*–*Toninia* s. l. clade consists of two separate subclades, i.e. the *Bacidia* and the *Toninia* s. l. subclades.

#### The *Bacidia* subclade

The *Bacidia* subclade is represented by the type species *Bacidia rosella* (Pers.) De Not., as well as *Bacidia sorediata* Lendemer et R. C. Harris, *B. schweinitzii* (Fr. ex Tuck.) A. Schneid. and *Bacidia sipmanii* M. Brand, Coppins, van den Boom et Sérus. *Bacidia sipmanii* hitherto known only from North Africa (Canary Islands) and the Asian Near East (Turkey) is recorded and confirmed by molecular data from South Korean material (151136 (KoLRI 034369)) for the first time here (Fig. 1, Appendix). It is shown that this species is positioned within the *Bacidia* branch of the *Bacidia*–*Toninia* s. l. clade of the Ramalinaceae.

Similarly to data of previous authors (Kistenich *et al.* 2018) *Lueckingia polyspora* is positioned in 'out position' to the *Bacidia* branch.

#### The *Toninia* s. l. subclade

The *Toninia* s. l. subclade includes members of the genera *Aciculopsora* Aptroot et Trest, *Bacidina* Vězda, *Bellicidia* Kistenich, Timdal, Bendiksby et S. Ekman, *Bibbya* J. H. Willis, *Kiliasia* Hafellner, *Krogia* Timdal, *Parallopsora* Kistenich, Timdal et Bendiksby, *Thalloidima* A. Massal., *Toninia* A. Massal., *Toniniopsis* Frey, *Waynea* Moberg, as well as the former '*Lecania*' *chlorotiza* group. Authors of the recently described *Lecania falcata* (Sérusiaux *et al.* 2012) pointed out that the former *Lecania chlorotiza* group is positioned in sister position to the species of the genus *Toninia*. However, they hesitated to make a final conclusion about status of this group as far data on other genera of the *Toninia* s. l. clade were very incomplete at that time. After providing numerous molecular data on the genera of the *Toninia* clade (they all were included in the combined phylogenetic analysis, see Fig. 1 and Appendix) it was found that the former *Lecania chlorotiza* group had the highest level of bootstrap support to form a separate branch within the *Toninia* s. l. subclade. It should be especially emphasised that after combined phylogenetic analysis as well as after separate mtSSU analysis two species of the former *Lecania chlorotiza* group, i.e.: *L. chlorotiza* (Nyl.) P. James and *Lecania falcata* van den Boom, M. Brand, Coppins, Magain et Sérus. are positioned within the *Toninia* s. l. clade. They are positioned in a robust monophyletic branch and therefore transferred to the new genus *Vandenboomia* described below.

## THE PHENOMENON OF PRESENCE OF 'EXTRANEOUS MYCOBIONT DNA' IN LICHEN ASSOCIATION

The presence of 'extraneous (= foreign) mycobiont DNA' in lichen association, which not belonging either to own (= expected) mycobiont or photobiont, or to endophytic fungi, is especially mentioned here. Previously similar situations were treated usually as contamination or as mistakes with voucher numbers. However, in case of *Phyllospora* taxa mentioned above, as well as *Biatora longispora* specimens these cases are especially illustrative.

So here we can clearly confirm the presence of nrITS and mtSSU sequences of *Biatora longispora* in thalli of *Agonimia pacifica*, *Oxneriopsis oxneri* and *Pyxine limbulata*; *Coppinsidea ropalosporoides* sequences in *Verrucaria margacea* and *Kashiwadia orientalis* thalli; *Coppinsidea* aff. *sphaerella* sequences in thalli of *Agonimia pacifica*; *Ivanpisutia oxneri* sequences in thalli of *Rinodina xanthophaea*; *Phyllospora* cf. *chlorophaea* sequences in the thalli of *Biatora longispora*, as well as nrITS of *Phyllospora* sp. KoLRI in thalli of *Agonimia pacifica*, and *Biatora longispora* (Appendix).

It is why we propose special term for this case as presence of 'extraneous (= foreign) mycobiont DNA' in lichen association and we think it plays an important role in formation of lichen association especially at early stage of formation of lichen thalli / at overgrowing one species by others. We believe that if we will especially analyse situation with 'extraneous mycobiont DNA' in lichen association in future, on one side we will have more illustrations (more cases) when 'extraneous mycobiont DNA' present in lichen association, as well as that a phenomenon of 'extraneous mycobiont DNA' in lichen association will help to understand better taxonomy of some lichen groups as *Phyllospora*, *Biatora*, etc.

The presence of DNA of 'an extraneous lichen species' in herbarium (= voucher) specimens was checked several times additionally after getting sequencing results, however in all cases listed below (see Appendix) presence of thalli or apothecia of 'an extraneous lichen species' was not confirmed. After morphological data the presence of this lichen cannot be confirmed. It is why we have to differentiate situation when DNA results were obtained directly from thallus of the same lichen from the situation when we cannot confirm morphological thallus of this lichen, while molecular data on such taxon were obtained. In general hypothesis about the existence of such phenomenon of 'extraneous (= foreign) mycobiont DNA' in lichen association show high level of risk to make wrong conclusion about DNA of newly described taxa when data on one voucher specimen is available. Maybe it is also an explanation of the curious situation of nrITS and mtSSU data of *Oxnerella safavidiorum* S. Y. Kondr., Zarei-Darki, L. Lókös et J.-S. Hur (see Kondratyuk *et al.* 2014a, Resl *et al.* 2016) and *Sedelnikovaea baicalensis* (Zahlbr.) S. Y. Kondr., M. H. Jeong et J.-S. Hur (see Kondratyuk *et al.* 2014b, 2019).

On the other hand, this phenomenon is also stimulating for the further revision of material cited in this paper as *Phyllopsora* sp. (KoLRI) or as *Biatora longispora* from both morphological and molecular point of view, with the aim to clarify the status of lichen specimens mentioned.

## NEW GENERA

*Coppinsidea* S. Y. Kondr., E. Farkas et L. Lőkös, *gen. nov.*

Mycobank no.: MB 832141.

*Similar to Thamnolecania, but differs in having crustose thallus, in having lecideine or biatorine and mostly rather convex to almost spherical apothecia, as well as in having Northern Hemisphere distribution.*

Type species: *Coppinsidea sphaerella* (Hedl.) S. Y. Kondr., E. Farkas et L. Lőkös

Thallus crustose, usually very thin to effuse, surface more or less smooth to irregularly cracked, rarely immersed, from whitish to pale grey or greyish-greenish.

Apothecia 0.3–1 mm in diam., at first flat, but soon becoming strongly convex, light red-brown, to dark brown, dark brownish black or black, K+ purplish or violaceous; true exciple thick at first, colourless or upper and outer parts pale orange or pinkish or upper parts dark grey-brown, K+ greenish grey, or dark green, a brownish, K+ purplish pigment sometimes additionally present, inner portions of exciple colourless to pale straw-yellow, as well as bluish black or black in inner portions, while outer layer (especially in lateral portion) hyaline or transparent to lightly brownish or violetish black, palisade with well-developed matrix and separate hyphae to 5–6  $\mu\text{m}$  wide, and hyphae lumina of 2(–3)  $\mu\text{m}$  seen. Hymenium colourless or pale yellow-brown in upper part in places or colourless below and pale reddish brown above with dark reddish brown epithecium, K+ purplish or violaceous, with some grey K+ greenish grey pigment, as well as hyaline, but sometimes with bluish portions vertically orientated; epihymenium indistinct, the same hyaline or bluish as hymenium. Hypothecium colourless or pale straw-yellow, K+ yellowish or somewhat brownish to reddish or violetish brown. Paraphyses 1.5–2  $\mu\text{m}$  wide, simple or occasionally branched, the apices only slightly widening to 2.5(–3)  $\mu\text{m}$  or to 4.5(–5)  $\mu\text{m}$  most surrounded by dense dark brown or grey pigment. Asci *Bacidia* type. Ascospores from 0- to 1(–3)- to (1–)3-septate to (0–)1–3(–4)-septate, ellipsoid to oblong-ellipsoid, fusiform-ellipsoid to fusiform, slightly widened in the middle with more or less attenuated, but

rounded ends, sometimes one of the middle cell is the widest and one end thinner (tail-like), slightly constricted at septum. Pycnidia not found.

Ecology: Growing on various calcareous rocks (schists, calcite, chalk, partly calcareous mica-schist of old walls, or calcareous sandstone), often on vertical, dry, more or less well-lit coastal and inland overhung cliff faces, as well as on siliceous rock in shaded woodlands.

Etymology: It is named after the well-known British lichenologist Brian J. Coppins (E, the UK) in acknowledgement of his numerous contributions to lichenology, as well as on occasion of his 70th years anniversary.

Species diversity and distribution: It includes several widely distributed species, i.e.: *Coppinsidea fuscoviridis*, *C. sphaerella*, and *C. croatica*, etc. as well as rather rare or scarcely distributed species, i.e.: *C. aphana*, *C. scotinodes*. There is one more taxon from South Korea (mentioned in the text and in Fig. 1 as *Coppinsidea* aff. *sphaerella*) is still waiting for legal description.

Taxonomic notes: The genus *Coppinsidea* is similar to Gyelnik's genus *Thamnolecania* (Vain.) Gyeln. in position in the *Lecania* s. l. clade of the combined phylogenetic tree of the Ramalinaceae, but differs in having crustose thallus (vs. fruticose thallus), in having lecideine or biatorine and mostly rather convex to almost spherical apothecia, as well as in having Northern Hemisphere distribution (vs. Antarctica).

The genus *Coppinsidea* is similar to the genera *Lecania* s. str. and *Lecaniella* of the *Lecania* s. l. clade of the Ramalinaceae, but differs in having lecideine or biatorine, mostly very convex to almost spherical and emarginated at over-mature apothecia.

The species *Coppinsidea croatica* as well as *C. scotinodes* and *C. aphana* differing from the other species in having darker K+ purplish or violaceous epihymenium are included in this genus with some hesitation. The species *Coppinsidea scotinodes* and *C. aphana* differing from the other species in having darker K+ purplish or violaceous epihymenium still differs in the absence of the abruptly swollen paraphyses apices with a dark brown cap, i.e. the typical *Catillaria* type paraphyses. However, they are included in the *Coppinsidea* clade to emphasise that they do not belong either to the *Lecania* or the *Catillaria* clades of the Ramalinaceae or Catillariaceae, while in future they will be placed in the separate genus.

### *Vandenboomia* S. Y. Kondr., *gen. nov.*

Mycobank no.: MB 832142.

*Similar to the genera Aciculopsora and Waynea in position in the combined phylogenetic tree of the Ramalinaceae, but differs in having bright pink or pale brown-*

ish apothecia, in having micro- and macroconidia, as well as in having so far restricted Atlantic distribution.

Type species: *Vandenboomia chlorotiza* (Nyl.) S. Y. Kondr.

Thallus scurfy to scurfy-leprose, bright to glaucous-green, more or less continuous, often wide-spreading.

Apothecia 0.1–0.3 mm in diam., occasional, semi-immersed to more or less sessile, more or less convex, rounded to more or less tuberculate, bright pink or more or less piebald-brownish, thalline exciple more or less excluded; hymenium 25–40  $\mu\text{m}$  tall; ascospores (9–)10–12(–18)  $\times$  2–3  $\mu\text{m}$ , 0- to 1-septate. Pycnidia: (a) minute to 50  $\mu\text{m}$  in diam., microconidia 7–10  $\times$  0.5  $\mu\text{m}$  curved or hooked; (b) 70–160  $\mu\text{m}$  in diam., pale gaping ostioles, macroconidia 3–6  $\times$  1–2  $\mu\text{m}$ , cylindrical.

Ecology: Growing on very shaded, more or less basic bark and inside hollow trees, especially *Ulmus*, *Fraxinus* and *Salix* in sheltered, wayside and woodland sites and by water; rare.

Etymology: It is named after the well-known Dutch lichenologist Pieter P. G. Van den Boom (JA Sou, the Netherland) in recognition of his numerous contributions to lichenology and especially in our recent knowledge on lecanoid lichens.

Species diversity and distribution: It includes two rather scarcely distributed taxa, i.e.: *V. chlorotiza* (Nyl.) S. Y. Kondr. in Atlantic Europe (England, France Denmark, Norway), and *V. falcata* (van den Boom, M. Brand, Coppins, Magain et Sérus.) S. Y. Kondr. from Atlantic North Africa (Spanish Canary Islands.).

Taxonomic notes: *Vandenboomia* is similar to the genera *Aciculopsora* Aptroot et Trest and *Waynea* Moberg of the 'in position' in the combined phylogenetic tree of the Ramalinaceae, but differs in having bright pink or pale brownish lecanorine apothecia, where thalline exciple can be excluded, in having micro- and macroconidia, as well as in having so far mainly Atlantic distribution (vs. tropical regions or Western North America, respectively).

***Wolseleyidea*** S. Y. Kondr., E. Farkas et L. Lőkös, *gen. nov.*

Mycobank no.: MB 832143.

*Similar to Phyllopsora, but differs in having well developed reddish brown prothallus, medium sized green granules often being isidiate, in having narrowly ellipsoid simple ascospores, and in having methyl 2,7-dichloropsoromate and methyl 2,7-dichloronorpsoromate, phyllopsorin, chlorophyllopsorin, vicanicin and norovicanicin.*

Type species: *Wolseleyidea swinscowii* (Timdal et Krog) S. Y. Kondr., E. Farkas et L. Lőkös

Thallus often consisting of medium sized green thalline granules often being isidiate. Prothallus reddish brown, usually well developed. Apothecia common, to 1(–1.5) mm in diam., medium brown to dark brown with an indistinct, concolorous, often pubescent margin, excipulum pale brown to colourless. Hypothecium colourless. Epithecium colourless. Ascospores narrowly ellipsoid, simple.

Chemistry: Medulla K–, C–, P+ orange; containing methyl 2,7-dichlorosporomate and methyl 2,7-dichloronorsporomate, phyllopsorin, chlorophyllopsorin, vicanicin and norvicanicin.

Ecology: It grows on bark mostly in montane rainforest and coastal forest.

Etymology: It is named after the known British lichenologist Patricia A. Wolseley (BM, the UK), who has contributed to recent revision of the genus *Phyllopsora* and other tropical lichen groups, as well as to her jubilee birthday anniversary.

Species diversity and distribution: Six species are confirmed to as members of the *Wolseleyidea* clade so far. Species are known from both Americas as well as from tropical regions of other continents.

Taxonomic notes: The genus *Wolseleyidea* is similar to *Phyllopsora*, but differs in having well developed reddish brown prothallus, in having simple ascospores and in its chemistry.

Similarities and phylogenetic position: Six species are member of this genus at the moment, i.e.: *Wolseleyidea africana* (Timdal et Krog) S. Y. Kondr., E. Farkas et L. Lőkös, *W. byssiseda* (Nyl. ex Hue) S. Y. Kondr., E. Farkas et L. Lőkös, *W. canoumbrina* (Vain.) S. Y. Kondr., E. Farkas et L. Lőkös, *W. furfurella* (Kistenich et Timdal) S. Y. Kondr., E. Farkas et L. Lőkös, *W. ochroxantha* (Nyl.) S. Y. Kondr., E. Farkas et L. Lőkös, and *W. swinscowii* (Timdal et Krog) S. Y. Kondr., E. Farkas et L. Lőkös.

Seven species shown in Figure 1 (three species of the genus *Wolseleyidea*, i.e.: *W. africana*, *W. ochroxantha*, and *W. swinscowii*, three species of the *Phyllopsora corallina* group, i.e.: *P. corallina*, *P. glaucella*, and *P. melanoglauca*, as well as *P. rosei* of the *Phyllopsora rosei* group) form a separate clade, which is positioned in 'out position' to both the *Ivanpisutia*–*Myrionora*–*Biatora* and the *Phyllopsora* s. l. subclades in combined phylogenetic tree of the Ramalinaceae.

As it was stressed above originally some species of the *Phyllopsora rosei* and the *Phyllopsora corallina* groups planned for including into the genus *Wolseleyidea* on the basis of results of combined phylogeny (see Fig. 1). However, they found to be positioned in separate monophyletic branches in intermediate position between the *Phyllopsora* and the *Biatora* clades of the phylo-



genetic tree of the Ramalinaceae if larger set of taxa of the genus *Phyllopsora* (i.e. data provided by Kistenich *et al.* 2019b) are included in the phylogeny, while six species of the genus *Wolseleyidea* listed above are forming monophyletic clade. It is why the members of the *Phyllopsora rosei* and the *Phyllopsora corallina* groups are hitherto excluded from the genus *Wolseleyidea*.

#### FURTHER ACCEPTED GENERA

***Ivanpisutia*** S. Y. Kondr., L. Lőkös et J.-S. Hur, in Kondratyuk *et al.*, Acta bot. hung. 57(1–2): 97 (2015). – Type: *Ivanpisutia oxneri* S. Y. Kondr., L. Lőkös et J.-S. Hur, in Kondratyuk *et al.*, Acta bot. hung. 57(1–2): 100 (2015). Syn.: *Biatora oxneri* (S. Y. Kondr., L. Lőkös et Hur) Printzen et Kistenich, in Kistenich *et al.*, Taxon 67(5): 891 (2018). – From combined phylogenetic analysis the *Ivanpisutia* robust monophyletic branch together with the *Myrionora* branch are positioned separately from the *Biatora* s. str. subclade. The genus hitherto includes three species, two of which are combined in this paper below. After molecular data one more, still undescribed taxon from East Asia probably belongs to this genus, too. From morphological point of view *Biatora pacifica* may belong to the genus *Ivanpisutia* as well.

***Lecaniella*** Jatta, Monogr. Lich. Ital. Merid., p. 142 (1889). – Type (designated by Hafellner in Beih. Nova Hedwigia 79: 289 (1984)): *Lecaniella cyrtella* (Ach.) Jatta. Syns: *Lecidea cyrtella* Ach., *Lecania cyrtella* (Ach.) Th. Fr. – Of 16 species included by Jatta to the genus *Lecaniella* three species names, i.e.: *Lecaniella cyrtella* (Ach.) Jatta, *Lecaniella proteiformis* (A. Massal.) Jatta, and *Lecaniella sambucina* (Körb.) Jatta, confirmed as members of the genus *Lecaniella* by the combined phylogenetic analysis of the Ramalinaceae. For the other nine species, i.e. *Lecaniella belgica*, *L. cyrtellina*, *L. dubitans*, *L. erysibe*, *L. hutchinsiae*, *L. naegelii*, *L. prasinoides*, *L. sylvestris*, and *L. tenera*, new combinations are proposed in this paper below. Interestingly, the three species mentioned above, i.e.: *L. naegelii*, *L. tenera* (and *Biatora vezdana*) are positioned within a separate strong monophyletic branch after mtSSU phylogeny. So may be these taxa in future will be segregated in a separate genus. Unfortunately, so far only mtSSU sequences are available for *L. tenera*.

***Myrionora*** R. C. Harris, in Harris *et al.*, Evansia 5(2): 27 (1988). – Type: *Myrionora albidula* (Willey) R. C. Harris, in Harris *et al.*, Evansia 5(2): 27 (1988). Syns: *Biatora albidula* Willey, in Tuckerman, Syn. N. Amer. Lich. (Boston) 2: 130 (1888); *Biatorella albidula* (Willey) Zahlbr., Catal. Lich. Univers. 5: 34 (1927) [1928]; *Scoliciosporum albidulum* (Willey) Etayo, in Etayo and Sancho, Bibl. Lichenol. 98: 223 (2008). – After recent morphological data the genus *Myrionora* included two species only, i.e. *M. albidula* and *M. pseudocyphellariae* (Etayo) S. Ekman et Palice. Only mtSSU sequences were hitherto available for the type

species of this genus, i.e. for *M. albidula*. According to the mtSSU phylogeny *M. albidula* is positioned in the robust branch together with *M. australis* (Rodr. Flakus et Printzen) S. Y. Kondr., and *M. ligni-mollis* (T. Sprib. et Printzen) S. Y. Kondr. Thus *M. albidula* cannot be included in the combined phylogenetic analysis. After our combined phylogenetic analysis the *Myrionora* branch is positioned together with the *Ivanpisutia* monophyletic branch separately from the *Biatora* s. str. subclade. This branch (as *Myrionora* = the *Biatora globulosa* branch) includes *M. ligni-mollis* and *M. globulosa* (Flörke) S. Y. Kondr., which has the highest level of bootstrap support, as well as two more taxa, i.e.: *M. ementiens* (Nyl.) S. Y. Kondr. and *M. hemipolia* (Nyl.) S. Y. Kondr. in one branch, and three species, i.e.: *M. flavopunctata* (Tønsberg) S. Y. Kondr., *M. malcolmii* (Vězda et Kalb) S. Y. Kondr., and *M. vacciniicola* (Tønsberg) S. Y. Kondr., which both show very low level of support. So these latter five species are included in the genus *Myrionora* with some hesitation. After morphological data it should be added that the genus *Myrionora* may include also the recently described Eastern Asian species *Biatora pseudosambuci* (S. Y. Kondr., L. Lőkös et J.-S. Hur) S. Y. Kondr., L. Lőkös et J.-S. Hur, as well as *Biatora loekoesianae* S. Y. Kondr. et J.-S. Hur (Kondratyuk *et al.* 2016a, b, 2018b). However, our first attempts to extract DNA from the mentioned species were so far unsuccessful. We have to wait for confirmation of this hypothesis by molecular data on both species. Thus status and species diversity of the genus *Myrionora* still are waiting for clarifying with data on more voucher specimens and for more molecular markers, too.

## NEW COMBINATIONS

***Bacidia alnetorum*** (S. Ekman et Tønsberg) S. Y. Kondr., *comb. nova* – MycoBank no.: MB 832144. – Basionym: *Biatora alnetorum* S. Ekman et Tønsberg, Mycokeys 48: 58 (2019).

***Biatora amazonica*** (Kistenich et Timdal) S. Y. Kondr., *comb. nova* – MycoBank no.: MB 832691. – Basionym: *Phyllopsora amazonica* Kistenich et Timdal ad int., in Kistenich et al., Lichenologist 51(4): 357 (2019).

***Biatora cuyabensis*** (Malme) S. Y. Kondr., *comb. nova* – MycoBank no.: MB 832146. – Basionym: *Lecidea cuyabensis* Malme, Ark. Bot. 28A(no. 7): 11, 48 (1936). = *Phyllopsora cuyabensis* (Malme) Zahlbr., Catal. Lich. Univers. 10: 377 (1939).

***Biatora halei*** (Tuck.) S. Y. Kondr., *comb. nova* – MycoBank no.: MB 832147. – Basionym: *Pannaria halei* Tuck., Amer. J. Sci. Arts, Ser. 2, 25: 424 (1858). = *Phyllopsora halei* (Tuck.) Zahlbr., Catal. Lich. Univers. 4: 398 (1926) [1927].

***Biatora kalbii*** (Brako) S. Y. Kondr., *comb. nova* – MycoBank no.: MB 832148. – Basionym: *Phyllopsora kalbii* Brako, Fl. Neotrop., Monogr.: 51 (1991).

*Biatora longispora* (Degel.) Lendemer et Printzen, *comb. nova* – MycoBank no.: MB 832145. – Basionym: *Lecidea helvola* var. *longispora* Degel., Ark. f. Bot. 30(1) A(3): 38 (1942). ≡ *Biatora longispora* (Degel.) Lendemer et Printzen, in Lendemer, Opusc. Phylolich. 1: 38 (2004) nom. inval., Arts 41.4, 41.5 (Melbourne).

*Biatora subhispidula* (Nyl.) S. Y. Kondr., *comb. nova* – MycoBank no.: MB 832397. – Basionym: *Psoroma subhispidulum* Nyl., Annls Sci. Nat., Bot., sér. 4, 11: 256 (1859). ≡ *Phyllopsora subhispidula* (Nyl.) Kalb et Elix, Bibl. Lichenol. 57: 293 (1995).

*Biatora vezdana* S. Y. Kondr., *nom. nov.* – MycoBank no.: MB 832149. – Basionym: *Lecania furfuracea* Vězda, Lichenes Rariores Exsiccati 39 (nos 381–390): 3, no. 386 (1999).

*Coppinsidea alba* (Coppins et Vězda) S. Y. Kondr., E. Farkas et L. Lőkös, *comb. nova* – MycoBank no.: MB 832150. – Basionym: *Catillaria alba* Coppins et Vězda, in Vězda, Lichenes Rariores Exsiccati, Fasc. 6 (nos 51–60) (Brno): 2 (1993). – Syn.: *Biatora veteranorum* Coppins et Sérus., in Sérusiaux et al., Bryologist 113(2): 337 (2010) (non *Biatora alba* (Schleich.) Hepp 1857).

*Coppinsidea aphana* (Nyl.) S. Y. Kondr., E. Farkas et L. Lőkös, *comb. nova* – MycoBank no.: MB 832151. – Basionym: *Lecidea aphana* Nyl., Flora, Regensburg 50: 327 (1867). ≡ *Catillaria aphana* (Nyl.) Coppins, Lichenologist 21(3): 219 (1989).

*Coppinsidea croatica* (Zahlbr.) S. Y. Kondr., E. Farkas et L. Lőkös, *comb. nova* – MycoBank no.: MB 832152. – Basionym: *Catillaria croatica* Zahlbr., Annls Mycol. 4(6): 487 (1906). ≡ *Lecania croatica* (Zahlbr.) Kotlov, Nov. sist. Niz. Rast. 37: 251 (2004).

*Coppinsidea fuscoviridis* (Anzi) S. Y. Kondr., E. Farkas et L. Lőkös, *comb. nova* – MycoBank no.: MB 832153. – Basionym: *Bilimbia fuscoviridis* Anzi, Comm. Soc. crittog. Ital. 2(fasc. 1): 16 (1864). ≡ *Lecidea fuscoviridis* (Anzi) Nyl., Flora, Regensburg 64: 456 (1881). ≡ *Bacidia fuscoviridis* (Anzi) Lettau, Hedwigia 52: 132 (1912).

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## CONCLUSIONS

Among numerous branches of the combined phylogenetic tree of the Ramalinaceae the *Coppinsidea*, the *Ivanpisutia*, the *Biatora* s. str., the *Vandenboomia* and the *Wolseleyidea* and some others show the highest level of bootstrap support, while the *Myrionora* branch, the *Phyllopsora* s. l. branch are characterised by low level of support. Status of many members of the genera *Biatora*, *Myrionora*, *Phyllopsora* as well as the *Phyllopsora rosei* and the *Phyllopsora corallina* groups is pending for accumulation of further data on both additional vouchers and molecular markers.

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## Appendix

List of specimens and GenBank number of sequences included in phylogenetic analysis (newly proposed combinations and names are given in bold)

Species name	Vouchers / reference	ITS	mtSSU	rpb2
<i>Aciculopsora salmonea</i>	Kistenich <i>et al.</i> 2018	MG925948	MG925842	
<b><i>Bacidia alnetorum</i></b>	Ekman and Tønsberg 2019 as <i>Biatora alnetorum</i>	MH818375		
<i>Bacidia rosella</i>	Ekman 2001	AF282086		
<i>Bacidia rosella</i>	Lumbsch <i>et al.</i> 2004		AY300877	
<i>Bacidia rosella</i>	Reese Naesborg <i>et al.</i> 2007			AM292755
<i>Bacidia sipmanii</i>	Sérusiaux <i>et al.</i> 2012	JQ796853	JQ796832	
<i>Bacidia sipmanii</i>	South Korea, Gangwon-do, 10.07.2015, Kondratyuk, S. (SK-96), Lókös, L., 151136 (KoLRI 034369)	34369		
<i>Bacidia sorediata</i>	Lendemer <i>et al.</i> 2016	KX151772		
<i>Bacidia sorediata</i>	Lendemer <i>et al.</i> 2016	KX151774		
<i>Bacidia sorediata</i>	Lendemer <i>et al.</i> 2016	KX151775		

Species name	Vouchers / reference	ITS	mtSSU	rpb2
<i>Bacidia schweinitzii</i>	Kistenich <i>et al.</i> 2018			MG926235
<i>Bacidina arnoldiana</i>	Mark <i>et al.</i> 2016	KX098343, KX098347		
<i>Bacidina arnoldiana</i>	Ekman 2001	AF282093		
<i>Bacidina arnoldiana</i>	Kistenich <i>et al.</i> 2018		MG925854	MG926238
<i>Bacidina neosquamulosa</i>	Sérusiaux <i>et al.</i> 2012	JQ796856, JQ796855	JQ796838, JQ796837	
<i>Bacidina phacodes</i>	Ekman 2001	AF282100		
<i>Bacidina phacodes</i>	Andersen and Ekman 2005		AY567725	
<i>Bacidina phacodes</i>	Miadlikowska <i>et al.</i> 2014		KJ766358	KJ766691
<i>Bacidina phacodes</i>	Kistenich <i>et al.</i> 2018			MG926049
<i>Bellicidia incompta</i>	Ekman 2001	AF282092		
<i>Bellicidia incompta</i>	Kistenich <i>et al.</i> 2018		MG925849	MG926233
<i>Biatora aegrefaciens</i>	Printzen (2017 unpubl.)	KF650956		KF662444
<i>Biatora alaskana</i>	Printzen (2017 unpubl.)	KF650958	KF662405, KF662404	KF662445
<i>Biatora amazonica</i>	Kistenich <i>et al.</i> 2019a, b	MK352365	MK352194	
<i>Biatora amazonica</i>	Kistenich <i>et al.</i> 2019a, b	MK352379	MK352208	
<i>Biatora appalachensis</i>	Printzen (unpubl.)	KF650959		
<i>Biatora appalachensis</i>	Theodosopoulos <i>et al.</i> 2019	MK092095		
<i>Biatora bacidioides</i>	Vondrák <i>et al.</i> 2018	MG773664, MG773663	MG773675	
<i>Biatora bacidioides</i>	Printzen (unpubl.)		KF662406	
<i>Biatora beckhausii</i>	Ekman 2001 (sub <i>Bacidia</i> )	AF282071		
<i>Biatora beckhausii</i>	Printzen (2017 unpubl.)		KF662407	
<i>Biatora beckhausii</i>	Kistenich <i>et al.</i> 2018	MG926053	MG925858	MG926243
<i>Biatora britannica</i>	Printzen <i>et al.</i> 2001	AY032897, NR_119480		
<i>Biatora chrysantha</i>	Printzen and Lumbsch 2001 (unpubl.)	AJ247569		
<i>Biatora chrysantha</i>	Printzen (2017 unpubl.)		KF662408	
<i>Biatora chrysanthoides</i>	Printzen (2017 unpubl.)	KF650960	KF662409	KF662446
<i>Biatora cuprea</i>	Printzen (2017 unpubl.)	KF650961	KF662410	KF662447
<b><i>Biatora cuyabensis</i></b>	Kistenich <i>et al.</i> 2019a, b	MK352287	MK352108	
<b><i>Biatora cuyabensis</i></b>	Kistenich <i>et al.</i> 2019a, b	MK352286	MK352107	
<i>Biatora efflorescens</i>	Vondrák <i>et al.</i> 2018	MG773665	MG773676	
<i>Biatora efflorescens</i>	Printzen and Lumbsch 2001 (unpubl.)	AJ247555, AJ247554		
<i>Biatora fallax</i>	Printzen <i>et al.</i> 2016	KX389593, KX389592		

Species name	Vouchers / reference	ITS	mtSSU	rpb2
<i>Biatora fallax</i>	Printzen (2017 unpubl.)		KF662412	
<i>Biatora hafellneri</i>	Printzen <i>et al.</i> 2016	KX389595		
<b><i>Biatora halei</i></b>	Kistenich <i>et al.</i> 2019a, b	MK352423	MK352257	
<b><i>Biatora halei</i></b>	Kistenich <i>et al.</i> 2019a, b	MK352336	MK352161	
<i>Biatora helvola</i>	Printzen and Lumbsch 2001 (unpubl.)	AJ247557		
<i>Biatora hertelii</i>	Printzen and Lumbsch 2001 (unpubl.)	AJ247539, AJ247537, AJ247536, AJ247535		
<i>Biatora hertelii</i>	Printzen (2017 unpubl.)		KF662416	KF662452
<i>Biatora hertelii</i>	Kistenich <i>et al.</i> 2018	MG925958		
<b><i>Biatora kalbii</i></b>	Kistenich <i>et al.</i> 2019a, b	MK352291	MK352112	
<b><i>Biatora kalbii</i></b>	Kistenich <i>et al.</i> 2019a, b	MK352293	MK352114	
<i>Biatora kodiakensis</i>	Printzen (2017 unpubl.)	KF650967	KF662417	KF662453
<i>Biatora longispora</i>	Printzen (2017 unpubl.)	KF650969	KF662419, KX389602	KF662454
<b><i>Biatora longispora</i></b>	South Korea, Gangwon-do, 10.07.2015, Kondratyuk, S. (SK-93), Lökös, L., 151045 (KoLRI 034278) (from fertile thallus of <i>Pyxine limbulata</i> )	34278		
<b><i>Biatora longispora</i></b>	South Korea, Gangwon-do, 10.07.2015 Kondratyuk S. (SK-97), Lökös, L., 151200 (KoLRI 034433)	34433	34433	
<b><i>Biatora longispora</i></b>	South Korea, Gangwon-do, 10.07.2015 Kondratyuk S. (SK-91), Lökös, L., 150920 (KoLRI 034153)	34153	34153	
<b><i>Biatora longispora</i></b>	South Korea, Gangwon-do, 10.07.2015 Kondratyuk S. (SK-94), Lökös, L., 151057 (KoLRI 034290) (from fertile thallus of <i>Agonimia pacifica</i> )	34290	34290	
<b><i>Biatora longispora</i></b>	South Korea, Gangwon-do, 10.07.2015 Kondratyuk S. (SK-91), Lökös, L., 150935 (KoLRI 034168) (from isidiate crust growing together with <i>B. longispora</i> )	34168	34168	
<b><i>Biatora longispora</i></b>	South Korea, 151109 (KoLRI 034342) (from <i>Oxneriopsis oxneri</i> )	34342		

Species name	Vouchers / reference	ITS	mtSSU	rpb2
<b><i>Biatora longispora</i></b>	South Korea, 151110 (KoLRI 034343) (from <i>Oxneriopsis oxneri</i> )	34343	34343	
<i>Biatora meiocarpa</i>	Reese Naesborg <i>et al.</i> 2007	AM292667	AM292710	AM292757
<i>Biatora meiocarpa</i> var. <i>tacomensis</i>	Printzen (2017 unpubl.)		KF662420	
<i>Biatora nobilis</i>	Printzen (2017 unpubl.)	KF650970	KF662421	KF662455
<i>Biatora oligocarpa</i>	Printzen (2017 unpubl.)	KF650973	KF662423	KF662458
<i>Biatora pausiaca</i>	Printzen (2017 unpubl.)	KF650976	KF662426	KF662459
<i>Biatora pontica</i>	Printzen (2017 unpubl.)	KF650977	KF662427	KF662460
<i>Biatora printzenii</i>	Printzen (2017 unpubl.)	KF650978	KF662428	KF662461
<i>Biatora pseudohelvola</i>	Printzen and Lumbsch 2000	AJ247558, AJ247572, AJ247571, AJ247570		
<i>Biatora pycnidiatra</i>	Printzen (2017 unpubl.)	KF650979	KF662429	KF662462
<i>Biatora radiciicola</i>	Printzen <i>et al.</i> 2016	KX389588	KX389606, KX389607	
<i>Biatora radiciicola</i>	Printzen (2017 unpubl.)			KF662463
<i>Biatora rufidula</i>	Printzen (2017 unpubl.)	KF650981	KF662430	KF662464
<i>Biatora rufidula</i>	Kistenich <i>et al.</i> 2018		MG926059	
<i>Biatora subduplex</i>	Printzen (20.11.2017 unpubl.)	KF650983	KJ766360, KF662431	KF662465
<i>Biatora subduplex</i>	Miadlikowska <i>et al.</i> 2014		KJ766360	
<i>Biatora subhispidula</i>	Kistenich <i>et al.</i> 2019a, b	MK352313	MK352134	
<i>Biatora subhispidula</i>	Kistenich <i>et al.</i> 2019a, b	MK352408	MK352241	
<i>Biatora terrae-novae</i>	Printzen <i>et al.</i> 2016	KX389589	KX389600	
<i>Biatora terrae-novae</i>	Printzen (2017 unpubl.)	KF650971	KF662422	KF662456
<i>Biatora toensbergii</i>	Printzen and Lumbsch 2000	AJ247519		
<i>Biatora toensbergii</i>	Printzen (2017 unpubl.)	KF650984	KF662432	KF662466
<i>Biatora vernalis</i>	Ekman 2001	AF282070		
<i>Biatora vernalis</i>	Reese Naesborg <i>et al.</i> 2007		AM292711	AM292758
<i>Biatora vernalis</i>	Arup <i>et al.</i> 2007		DQ838753	
<i>Biatora vernalis</i>	Bendiksby and Timdal 2013	KF360369	KF360418	
<b><i>Biatora vezdana</i></b>	Reese Naesborg <i>et al.</i> 2007 (sub <i>Lecania furfuracea</i> )	AM292683	AM292734	
<i>Bibbys bullata</i>	Kistenich <i>et al.</i> 2018	MG926132	MG925929	MG926287
<i>Bibbys vermifera</i>	Ekman 2001 (sub <i>Toninia</i> )	AF282128		
<i>Bibbys vermifera</i>	Kistenich <i>et al.</i> 2018		MG925852	MG926237

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<i>Bilimbia lobulata</i>	Reese Naesborg <i>et al.</i> 2007	AM292668	AM292712, AM292713	AM292759
<i>Bilimbia sabuletorum</i>	Reese Naesborg <i>et al.</i> 2007	AM292670	AM292717, AM292721	AM292761
<i>Bilimbia sabuletorum</i>	Tefler <i>et al.</i> 2015	KT695402		
<i>Bilimbia sabuletorum</i>	Miadlikowska <i>et al.</i> 2014		KJ766361	
<i>Catillaria modesta</i>	Reese Naesborg <i>et al.</i> 2007		AM292719	AM292762
<i>Cliostomum corrugatum</i>	Printzen (2017 unpubl.)			KF662436
<i>Cliostomum corrugatum</i>	Andersen and Ekman 2005		AY567722	
<i>Cliostomum corrugatum</i>	Kistenich <i>et al.</i> 2018	MG925966		
<i>Cliostomum griffithii</i>	Ekman 2001	AF282076		
<i>Cliostomum griffithii</i>	Sérusiaux <i>et al.</i> 2010a		GU138667	
<i>Cliostomum haematommatis</i>	Dietrich and Maliček 2019	MK446224	MK446223	
<i>Coppinsidea alba</i>	Printzen (2017 unpubl.) (as <i>Biatora veteranorum</i> )	KF650986, KF650975	KF662434	
<i>Coppinsidea alba</i>	Sérusiaux <i>et al.</i> 2010a, (as <i>Biatora veteranorum</i> )		GU138664	
<i>Coppinsidea alba</i>	Kistenich <i>et al.</i> 2018 (as <i>Biatora veteranorum</i> )	MG925961	MG925862	
<i>Coppinsidea aphana</i>	Reese Naesborg <i>et al.</i> 2007	AM292671		
<i>Coppinsidea croatica</i>	Printzen (2017 unpubl.)	KF650949	KF662397	KF662437
<i>Coppinsidea croatica</i>	Reese Naesborg <i>et al.</i> 2007	AM292672	AM292718	
<i>Coppinsidea fuscoviridis</i>	Reese Naesborg <i>et al.</i> 2007 as <i>Bacidia</i>	AM292665	AM292754	
<i>Coppinsidea pallens</i>	Reese Naesborg <i>et al.</i> 2007	AM292664	AM292709	
<i>Coppinsidea pallens</i>	Printzen (2017 unpubl.)		KF662425	
<i>Coppinsidea ropalosporoides</i>	South Korea, Ulleung-do, 09.07.2016, Kondratyuk, S., Lókös, L., 161520 (KoLRI 039738)	161520		
<i>Coppinsidea ropalosporoides</i>	South Korea, Ulleung-do, 09.07.2016, Kondratyuk, S., Lókös, L., 161718 (KoLRI 039936)	161718		
<i>Coppinsidea ropalosporoides</i>	South Korea, Ulleung-do, 09.07.2016, Kondratyuk, S., Lókös, L., 161645 (KoLRI 039863)	161645		
<i>Coppinsidea ropalosporoides</i>	South Korea, Halla Mts, 21.07.2015, Halda, J., 151671 (KoLRI 035364) (sub <i>Gyalidea</i> )	35364		



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<i>Coppinsidea ropalosporoides</i>	South Korea, Halla Mts, 20.07.2015, Halda, J., 151524 (KoLRI 035217) (from thalli of <i>Verrucaria margacea</i> )	35217		
<i>Coppinsidea ropalosporoides</i>	South Korea, Chungcheongbuk-do, 09.07.2015, Kondratyuk, S. (SK-88), Lőkös, L., 150813 (KoLRI 034046)? (from <i>Physcia orientalis</i> )	34046		
<i>Coppinsidea scotinodes</i>	Reese Naesborg <i>et al.</i> 2007	AM292673	AM292721, AM292720	AM292763
<i>Coppinsidea scotinodes</i>	Kistenich <i>et al.</i> 2018	MG925964	MG925864	
<i>Coppinsidea sphaerella</i>	Printzen (20.11.2017 unpubl.)	KF650952	KF662400	KF662440
<i>Coppinsidea sphaerella</i>	Reese Naesborg <i>et al.</i> 2007	AM292702, AM292701	AM292749	
<i>Coppinsidea aff. sphaerella</i>	South Korea, Halla Mts, 20.07.2015, Halda, J., 151546 (KoLRI 35329) (from thallus of <i>Agonimia tristicula</i> (SK as <i>A. pacifica</i> ))	35329	35329	
<i>Coppinsidea aff. sphaerella</i>	South Korea, Ulleung-do, 08.07.2016, Kondratyuk, S., Lőkös, L. 161479 (KoLRI 039697) (from thallus of <i>Bacidia</i> (black))	161479		
<i>Coppinsidea vainioana</i>	Printzen and Lumbsch 2000	AJ247551, AJ247552, AJ247553		
<i>Coppinsidea vainioana</i>	Printzen (20.11.2017 unpubl.)	KF650982		
<i>Eschatogonia prolifera</i>	Kistenich <i>et al.</i> 2018	MG925970	MG925871	MG926249
<i>Hertelidea botryosa</i>	Printzen and Kantvilas 2004	AY341910		
<i>Hertelidea botryosa</i>	Miadlikowska <i>et al.</i> 2014		KJ766403	
<i>Ivanpisutia hypophaea</i>	Printzen (2017 unpubl) (as <i>Biatora</i> )	KF650966		
<i>Ivanpisutia hypophaea</i>	Printzen and Lumbsch 2000 (as <i>Biatora</i> )	AJ247533 AJ247529		
<i>Ivanpisutia ocelliformis</i>	Printzen (2017 unpubl.)	KF650972		KF662457
<i>Ivanpisutia ocelliformis</i>	Kistenich <i>et al.</i> 2018	MG925959		MG926244
<i>Ivanpisutia oxneri</i>	Kistenich <i>et al.</i> 2018 (as <i>Biatora</i> )	MG925973		
<i>Ivanpisutia oxneri</i>	South Korea, Gangwon-do, 10.07.2015, Kondratyuk, S. (SK-91), Lőkös, L. 150932 (KoLRI 034165)	34165	34165	

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<i>Ivanpisutia oxneri</i>	South Korea, Gangwon-do, 10.07.2015, Kondratyuk, S. (SK-91), Lókös, L. 150986 (KoLRI 034219) (sub <i>Rinodina xanthophaea</i> , green isidious for DNA)	34219	34219	
<i>Kiliasia athallina</i>	Kistenich <i>et al.</i> 2018	MG926023		MG926284
<i>Krogia coralloides</i>	Kistenich <i>et al.</i> 2018	MG925977	MG925875	MG926251
<i>Lecania aipospila</i>	Reese Naesborg <i>et al.</i> 2007	AM292674	AM292723	AM292753
<i>Lecania aipospila</i>	Kistenich <i>et al.</i> 2018	MG925978	MG926252, MG925876	
<i>Lecania atrynoides</i>	Reese Naesborg <i>et al.</i> 2007	AM292675	AM292724	AM292764
<i>Lecania fructigena</i>	Miadlikowska <i>et al.</i> 2014		KJ766413	
<i>Lecania furfuracea</i>	Reese Naesborg <i>et al.</i> 2007	AM292683	AM292734	
<i>Lecania fuscella</i>	Reese Naesborg <i>et al.</i> 2007	AM292685, AM292684	AM292735	
<i>Lecania fuscella</i>	Kistenich <i>et al.</i> 2018		MG925877	
<i>Lecania glauca</i>	Reese Naesborg <i>et al.</i> 2007	AM292688	AM292738	
<i>Lecania inundata</i>	Reese Naesborg <i>et al.</i> 2007	AM292690	AM292740	AM292772
<i>Lecania leprosa</i>	Reese Naesborg <i>et al.</i> 2007	AM292698	AM292747	
<i>Lecania nylanderiana</i>	Reese Naesborg <i>et al.</i> 2007	AM292692	AM292742	AM292774
<i>Lecania nylanderiana</i>	Kistenich <i>et al.</i> 2018	MG925979, MG925878		
<i>Lecania rabenhorstii</i>	Reese Naesborg <i>et al.</i> 2007	AM292693	AM292743	AM292775
<i>Lecania spadicea</i>	Kistenich <i>et al.</i> 2018	MG925980		MG926253
<i>Lecania turicensis</i>	Reese Naesborg <i>et al.</i> 2007	AM292700	AM292748	AM292777
<i>Lecaniella belgica</i>	Reese Naesborg <i>et al.</i> 2007	AM292697	AM292746	
<i>Lecaniella cyrtella</i>	Ekman 2001	AF282067		
<i>Lecaniella cyrtella</i>	Reese Naesborg 2008	AM504055, AM504054		
<i>Lecaniella cyrtella</i>	Reese Naesborg <i>et al.</i> 2007	AM292680	AM292728	AM292767
<i>Lecaniella cyrtella</i>	Shaheen (2017 unpubl.)	MG554663		
<i>Lecaniella cyrtella</i>	Lumbsch <i>et al.</i> 2004		AY300891	
<i>Lecaniella cyrtella</i>	Andersen and Ekman 2005		AY567720	
<i>Lecaniella cyrtella</i>	Miadlikowska <i>et al.</i> 2014		KJ766412	KJ766933
<i>Lecaniella cyrtellina</i>	Reese Naesborg 2008	AM504057		
<i>Lecaniella cyrtellina</i>	Reese Naesborg <i>et al.</i> 2007	AM292681	AM292729, AM292730	AM292768
<i>Lecaniella dubitans</i>	Reese Naesborg 2008	AM504058, AM504059		

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<i>Lecaniella dubitans</i>	Reese Naesborg <i>et al.</i> 2007	AM292732	AM292731	
<i>Lecaniella erysibe</i>	Reese Naesborg 2008	AM600966, AM504061, AM504060		
<i>Lecaniella erysibe</i>	Reese Naesborg <i>et al.</i> 2007	AM292682	AM292733	
<i>Lecaniella hutchinsiae</i>	Reese Naesborg 2008	AM504081		
<i>Lecaniella hutchinsiae</i>	Reese Naesborg <i>et al.</i> 2007	AM292689	AM292739	AM292771
<i>Lecaniella naegelii</i>	Ekman 2001	AF282101		
<i>Lecaniella naegelii</i>	Reese Naesborg <i>et al.</i> 2007	AM292691	AM292741	AM292773
<i>Lecaniella naegelii</i>	Miadlikowska <i>et al.</i> 2014		KJ766414	
<i>Lecaniella prasinoides</i>	Reese Naesborg 2008	AM504070, AM504069, AM504068		
<i>Lecaniella proteiformis</i>	Reese Naesborg 2008	AM600968, AM504071		
<i>Lecaniella sambucina</i>	Reese Naesborg <i>et al.</i> 2007	AM292695, AM292696	AM292744, AM292745	
<i>Lecaniella sylvestris</i>	Reese Naesborg <i>et al.</i> 2007	AM292699		AM292776
<i>Lecaniella tenera</i>	Reese Naesborg <i>et al.</i> 2007 (as <i>Cliostomum tenerum</i> )		AM292733	
<i>Lueckingia polyspora</i>	Kistenich <i>et al.</i> 2018	MG925984	MG925882	
<i>Micarea doliiformis</i>	Sérusiaux <i>et al.</i> 2010a		GU138666	
<i>Micarea doliiformis</i>	Schmull <i>et al.</i> 2011	HQ650654		
<i>Mycobilimbia albohyalina</i>	Printzen (2017 unpubl.)	KF650950	KF662398	KF662438
<i>Mycobilimbia carneoalbida</i>	Printzen and Lumbsch 2000 (as <i>Biatora carneoalbida</i> )	AJ247565, AJ247573		
<i>Mycobilimbia carneoalbida</i>	Printzen <i>et al.</i> 2016		KX389596	
<i>Mycobilimbia concinna</i>	Kistenich <i>et al.</i> 2019a, b	MK352373	MK352202	
<i>Mycobilimbia concinna</i>	Kistenich <i>et al.</i> 2019a, b	MK352395	MK352224	
<i>Mycobilimbia cinchonarum</i>	Kistenich <i>et al.</i> 2019a, b	MK352285	MK352106	
<i>Mycobilimbia cinchonarum</i>	Kistenich <i>et al.</i> 2019a, b	MK352381	MK352210	
<i>Mycobilimbia epixanthoides</i>	Printzen (2017 unpubl.)	KF650953	KF662401	KF662441
<i>Mycobilimbia epixanthoides</i>	Vondrák <i>et al.</i> 2018	MG773670	MG773685	
<i>Mycobilimbia microcarpa</i>	Reese Naesborg <i>et al.</i> 2007	AM292669	AM292715, AM292714	AM292760
<i>Mycobilimbia pilularis</i>	Ekman 2001 (as <i>Biatora sphaeroides</i> )	AF282068		
<i>Mycobilimbia pilularis</i>	Printzen (2017 unpubl.)		KF662402	KF662442

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<i>Mycobilimbia pilularis</i>	Reese Naesborg <i>et al.</i> 2007	AM292704, AM292703		
<i>Mycobilimbia ramea</i>	Reese Naesborg <i>et al.</i> 2007	AM292666		AM292756
<i>Mycobilimbia siamensis</i>	Kistenich <i>et al.</i> 2019a	MK412477	MK412410	
<i>Mycobilimbia siamensis</i>	Kistenich <i>et al.</i> 2019a	MK412484	MK412418	
<i>Mycobilimbia tetramera</i>	Printzen and Lumbsch 2000	AJ247561		
<i>Mycobilimbia tetramera</i>	Printzen (2017 unpubl.)		KF662403	KF662443
<i>Mycobilimbia tetramera</i>	Miadlikowska <i>et al.</i> 2014		KJ766439	KJ766957
<i>Myrionora albidula</i>	Kistenich <i>et al.</i> 2018 (sub <i>Biatora</i> )		MG925886	
<i>Myrionora australis</i>	Printzen <i>et al.</i> 2016 (as <i>Biatora</i> )	KX389594	KX389597	
<i>Myrionora ementiens</i>	Printzen (2017 unpubl.) (as <i>Biatora</i> )	KF650962	KF662411	KF662448
<i>Myrionora flavopunctata</i>	Printzen (2017 unpubl.)	KF650963	KF662413	KF662449
<i>Myrionora flavopunctata</i>	Kistenich <i>et al.</i> 2018	MG925859, MG925957	MG925859	
<i>Myrionora globulosa</i>	Ekman 2001 (as <i>Biatora</i> )	AF282073		
<i>Myrionora globulosa</i>	Printzen (2017 unpubl.) (as <i>Biatora</i> )		KF662414	KF662450
<i>Myrionora hemipolia</i>	Ekman 2001 (as <i>Bacidia</i> <i>hemipolia</i> )	AF282072		
<i>Myrionora hemipolia</i>	Printzen (2017 unpubl.) (as <i>Biatora</i> )			KF662451
<i>Myrionora ligni-mollis</i>	Printzen (2017 unpubl.) (as <i>Biatora</i> )	KF650968	KF662418	
<i>Myrionora ligni-mollis</i>	Sérusiaux <i>et al.</i> 2010 (as <i>Biatora</i> )		GU138665	
<i>Myrionora malcolmii</i>	Kistenich <i>et al.</i> 2019a, b	MK352344	MK352170	
<i>Myrionora vacciniicola</i>	Printzen (2017 unpubl.)	KF650985	KF662433	KF662467
<i>Myrionora vacciniicola</i>	Kistenich <i>et al.</i> 2018	MG925960	MG925861	MG926245
<i>Parallopsora leucophyllina</i>	Kistenich <i>et al.</i> 2018	MG925994	MG925897	MG926265
<i>Phyllospora agonimioides</i>	South Korea, Jeju-do, Jeju-si, Seogwipo, Yeongcheon- dong, 33° 18' 00.79" N, 126° 34' 34.54" E, Alt.: 307 m a.s.l., on rock. 18.08.2015, J. Halda 152600 (KoLRI 036822)	36822		
<i>Phyllospora atrocarpa</i>	Kistenich <i>et al.</i> 2018		MG925889	
<i>Phyllospora breviuscula</i>	Kistenich <i>et al.</i> 2018	MG925990		MG926263
<i>Phyllospora breviuscula</i>	Kistenich <i>et al.</i> 2018	MG925991	MG925893, MG925892	

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<i>Phyllopsora borbonica</i> (→ <i>Sporacesta</i> )	Kistenich <i>et al.</i> 2018	MG925988	MG925890	MG926261
<i>Phyllopsora buettneri</i>	Printzen and Lumbsch 2000	AJ247576		
<i>Phyllopsora chlorophaea</i>	Kistenich <i>et al.</i> 2018	MG925992	MG925894	
<b><i>Phyllopsora cf. chlorophaea</i></b>	South Korea, Gangwon-do, 10.07.2015, Kondratyuk, S. (SK-94), Lőkös, L. 151104 (KoLRI 034337) (sub <i>Scoliciosporum chlorococcum</i> , but <i>Biatora longispora</i> for DNA)	34337		
<i>Phyllopsora confusa</i>	Kistenich <i>et al.</i> 2019a	MK412489	MK412426	
<i>Phyllopsora confusa</i>	Kistenich <i>et al.</i> 2019a	MK412503	MK412460	
<b><i>Phyllopsora corallina</i></b>	Stewart <i>et al.</i> 2018	MH887524		
<i>Phyllopsora corallina</i>	Kistenich <i>et al.</i> 2019a, b	MK352346	MK352173	
<i>Phyllopsora corallina</i>	Kistenich <i>et al.</i> 2019a, b	MK352380	MK352209	
<i>Phyllopsora glaucella</i>	Kistenich <i>et al.</i> 2019a, b	MK352323	MK352147	
<i>Phyllopsora glaucella</i>	Kistenich <i>et al.</i> 2019a, b	MK352356	MK352184	
<i>Phyllopsora gossypina</i>	Kistenich <i>et al.</i> 2018	MG925968, MG925967	MG925868, MG925867	MG926248, MG926247
<i>Phyllopsora lividocarpa</i>	Kistenich <i>et al.</i> 2018	MG925995	MG925898	
<i>Phyllopsora loekoesii</i>	South Korea, Gyeong-sangbuk-do, Ulleung-gun, Ulleung-eup, Ulleung-do, at a rockwall between Naesujeon and Soekpo waterfall, 37° 31' 19.51" N, 130° 54' 16.03" E, Alt. 415 m a.s.l., on siliceous rock. 09.07.2016, S. Y. Kondratiuk, L. Lőkös 161769_3 (KoLRI 039989), isotype	1617693		
<i>Phyllopsora aff. loekoesii</i>	Kistenich <i>et al.</i> 2019a, b	MK352331	MK352156	
<i>Phyllopsora aff. loekoesii</i>	Kistenich <i>et al.</i> 2019a, b	MK352439	MK352279	
<i>Phyllopsora longiuscula</i>	Kistenich <i>et al.</i> 2018	MG925996	MG925899	MG926266
<i>Phyllopsora mauritiana</i>	Kistenich <i>et al.</i> 2018	MG925997	MG925900	
<i>Phyllopsora melanoglauca</i>	Kistenich <i>et al.</i> 2019a, b	MK352333	MK352158	
<i>Phyllopsora melanoglauca</i>	Kistenich <i>et al.</i> 2019a, b	MK352374	MK352203	
<i>Phyllopsora parvifoliella</i>	Kistenich <i>et al.</i> 2018	MG925999	MG925902	MG926267
<i>Phyllopsora porphyromelaena</i>	Kistenich <i>et al.</i> 2018	MG926001	MG925904	
<i>Phyllopsora pyxinoides</i>	Ekman and Tønberg 2002	AF517920		
<i>Phyllopsora pyxinoides</i>	Lutzoni <i>et al.</i> 2004		AY584615	

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<i>Phyllopsora pyxinoides</i>	Hofstetter <i>et al.</i> 2007			DQ883748
<i>Phyllopsora rosei</i>	Kistenich <i>et al.</i> 2019a, b	MK352398	MK352228	
<i>Phyllopsora rosei</i>	Kistenich <i>et al.</i> 2019a, b	MK352436	MK352272	
<i>Phyllopsora soredata</i>	Kistenich <i>et al.</i> 2018	MG926002	MG925905	MG926269
<i>Phyllopsora</i> sp.	South Korea, Jeju-do, Jeju-si, Arail-dong, Mt Halla, (course of Gwaneum Temple) 3, 33° 24' 02.80" N, 126° 32' 25.28" E, Alt.: 868 m a.s.l., 20.07.2015, J. Halda 151558 (KoLRI 035251) [from fertile thallus of <i>Agonimia pacifica</i> ]	35251		
<i>Phyllopsora</i> sp.	South Korea, same locality, 20.07.2015, J. Halda 151560 (KoLRI 035253) [from fertile thallus of <i>Agonimia pacifica</i> ]	35253		
<i>Phyllopsora</i> sp.	South Korea, Jeju-do, Seogwipo-si, Mt Halla, (Yeongsil Trail) 7, 33° 21' 12.19" N, 126° 29' 51.54" E, Alt. 1,308 m a.s.l., 21.07.2015, J. Halda 151674 (KoLRI 035367) [from fertile thallus of <i>Agonimia pacifica</i> ]	35367		
<i>Phyllopsora</i> sp.	South Korea, Jeju-do, Seogwipo-si, Mt Halla, (Yeongsil Trail 4), 33° 21' 20.93" N, 126° 30' 01.14" E, Alt. 1,388 m a.s.l., 21.07.2015, J. Halda 151647 (KoLRI 035340) [from fertile thallus of <i>Biatora longispora</i> ]	35340		
<i>Phyllopsora suncheonensis</i>	South Korea, Gyeong-sangbuk-do, Ulleung-gun, Ulleung-eup, Dodong-ri, Dodong Port, 37° 28' 59.9" N, 130° 54' 40.7" E, 20 m a.s.l., 11.07.2016, S. Y. Kondratiuk, L. Lőkös 162009 (KoLRI 040247)	162009		
<i>Phyllopsora suncheonensis</i>	South Korea, same locality, 11.07.2016, S. Y. Kondratiuk, L. Lőkös 162012 (KoLRI 040250)	162012		
<i>Phyllopsora suncheonensis</i>	South Korea, same locality, 11.07.2016, S. Y. Kondratiuk, L. Lőkös 162042 (KoLRI 040280)	162042		

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<i>Phyllopsora</i> aff. <i>sunchonensis</i>	South Korea, 162345 (KoLRI 040583)	Bia162345 L		
<i>Phyllopsora thaleriza</i>	Kistenich <i>et al.</i> 2018	MG925983, MG925982	MG925881, MG925880	MG926256, MG926255
<i>Ramalina farinacea</i>	Lim <i>et al.</i> (2005 unpubl.) (Hur 040059)	DQ001298		
<i>Ramalina farinacea</i>	Hur (2007 unpubl.) (Hur HB070122a)	GU593041, GU593042		
<i>Ramalina fraxinea</i>	Catalá <i>et al.</i> 2016	KP282349, KP282325, KP282315		
<i>Ramalina fraxinea</i>	Kistenich <i>et al.</i> 2018		MG925918	MG926277
<i>Ramalina huei</i>	Sérusiaux <i>et al.</i> 2010b	GU827310		
<i>Ramalina intermedia</i>	Meese <i>et al.</i> 2019 (unpubl.)	MK092093		
<i>Ramalina litoralis</i>	Moon <i>et al.</i> 2016	KT698282, KT698283, KT698281		
<i>Ramalina subbreviscula</i>	Republic of Korea, Gyeong-sangbuk-do, Ulleung-gun, Dokdo-ri, Western Island, over stairs, 37° 14' 26.66" N, 131° 51' 51.50" E, 20 m a.s.l., on rock, 07.09.2017, B. G. Lee 170918 (KoLRI 045199), SK U04 KoLRI	SK U04		
<i>Ramalina subbreviscula</i>	Republic of Korea, Gyeong-sangbuk-do, Ulleung-gun, Dokdo-ri, Western Island, 37° 14' 27" N, 131° 51' 54" E, Alt. 100 m a.s.l., on rock, 07.09.2017, J.-J. Woo 171031 (KoLRI 045312), SK U05 KoLRI	SK U05		
<i>Ramalina subbreviscula</i>	Republic of Korea, Gyeong-sangbuk-do, Ulleung-gun, Dokdo-ri, Western Island, over stairs, 37° 14' 26.66" N, 131° 51' 51.50" E, 20 m a.s.l., on rock, 07.09.2017, B. G. Lee 170919 (KoLRI 045200), SK U12 KoLRI	SK U12		
<i>Ramalina subbreviscula</i>	Republic of Korea, Gyeong-sangbuk-do, Ulleung-gun, Dokdo-ri, Western Island, 37° 14' 27" N, 131° 51' 54" E, 100 m a.s.l., on rock, 07.09.2017, S.-O. Oh 171067 (KoLRI 045348), SK U16 KoLRI	SK U16		

Species name	Vouchers / reference	ITS	mtSSU	rpb2
<i>Ramalina subbreviscula</i>	Ohmura <i>et al.</i> 2008	AB362798		
<i>Thalloidima candidum</i>	Kistenich <i>et al.</i> 2018	MG838202		
<i>Thalloidima candidum</i>	Kistenich <i>et al.</i> 2018	MG926028	MG925932	MG926289, MG926290
<i>Thamnolecania brialmontii</i>	Reese Naesborg <i>et al.</i> 2007	AM292676, AM292677	AM292726	AM292765
<i>Thamnolecania brialmontii</i>	Ekman 2001	AF282066, DQ534467		
<i>Thamnolecania brialmontii</i>	Kistenich <i>et al.</i> 2018		MG925925	MG926283
<i>Toninia cinereovirens</i>	Ekman 2001	AF282104		
<i>Toninia cinereovirens</i>	Ekman <i>et al.</i> 2008	AY756365	AY567724	
<i>Toninia cinereovirens</i>	Reese Naesborg <i>et al.</i> 2007			AM292781
<i>Toninia populorum</i>	Mark <i>et al.</i> 2016 (sub <i>Arthrosporum</i> )	KX132986		
<i>Toninia populorum</i>	Ekman 2001 (sub <i>Arthrosporum</i> )	AF282106		
<i>Toninia populorum</i>	Kistenich <i>et al.</i> 2018	MG925950	MG925843	MG926228
<i>Toninia sedifolia</i>	Schmull <i>et al.</i> 2011	HQ650689		
<i>Toninia sedifolia</i>	Miadlikowska <i>et al.</i> 2006			DQ973073
<i>Toninia sedifolia</i>	Miadlikowska <i>et al.</i> 2014		KJ766503	KJ766946
<i>Toninia taurica</i>	Ekman 2001	AF282118		
<i>Toninia taurica</i>	Kistenich <i>et al.</i> 2018	MG838203, MG838174		
<i>Toniniopsis aromatica</i>	Ekman 2001	AF282126		
<i>Toniniopsis bagliettoana</i>	Ekman 2001	AF282123		
<i>Toniniopsis bagliettoana</i>	Kistenich <i>et al.</i> 2018		MG925847	MG926232
<i>Toniniopsis coelestina</i>	Ekman 2001	AF282127		
<i>Toniniopsis coelestina</i>	Kistenich <i>et al.</i> 2018		MG925933	MG926291
<i>Toniniopsis obscura</i>	Kistenich <i>et al.</i> 2018	MG926037	MG925943	MG926301
<b><i>Vandenboomia chlorotiza</i></b>	Reese Naesborg <i>et al.</i> 2007	AM292679	AM292727	AM292766
<b><i>Vandenboomia falcata</i></b>	Sérusiaux <i>et al.</i> 2012	JQ796857		
<i>Waynea californica</i>	Ekman 2001	AF282099		
<i>Waynea californica</i>	Kistenich <i>et al.</i> 2018		MG925947	MG926305
<b><i>Wolseleyidea africana</i></b>	Kistenich <i>et al.</i> 2019a	MK412480	MK412413	
<b><i>Wolseleyidea africana</i></b>	Kistenich <i>et al.</i> 2019a	MK412481	MK412414	
<b><i>Wolseleyidea byssiseda</i></b>	Kistenich <i>et al.</i> 2019a, b	MK352382	MK352211	
<b><i>Wolseleyidea byssiseda</i></b>	Kistenich <i>et al.</i> 2019a, b	MK352383	MK352212	



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Species name	Vouchers / reference	ITS	mtSSU	rpb2
<i>Wolseleyidea canoumbrina</i>	Kistenich <i>et al.</i> 2019a, b	MK352366	MK352195	
<i>Wolseleyidea furfurella</i>	Kistenich <i>et al.</i> 2019a, b	MK352361	MK352189	
<i>Wolseleyidea furfurella</i>	Kistenich <i>et al.</i> 2019a, b	MK352369	MK352198	
<i>Wolseleyidea ochroxantha</i>	Kistenich <i>et al.</i> 2019a, b	MK352297	MK352118	
<i>Wolseleyidea ochroxantha</i>	Kistenich <i>et al.</i> 2019a, b	MK352298	MK352119	
<i>Wolseleyidea swinscowii</i>	Kistenich <i>et al.</i> 2019a, b	MK352300	MK352121	
<i>Wolseleyidea swinscowii</i>	Kistenich <i>et al.</i> 2019a, b	MK352326	MK352151	

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