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## Three new *Orientophila* species (Teloschistaceae, Ascomycota) from eastern Asia

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Three species, *Orientophila fauriei*, *O. jungakimae* and *O. yokjidoensis*, from South Korea are described as new, illustrated and compared with closely related taxa.

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### Introduction

Approximately 1100 species of lichens are known for South Korea; of these, c. 120 have been described as new to science, half of which during the past 10 years (Kondratyuk et al. 2015d), including 12 species of *Caloplaca* (Joshi et al. 2010, 2011, Kondratyuk et al. 2012, 2013a, 2013c, 2014a, 2015b, Arup et al. 2013a, Lumbsch et al. 2011). Additional species have been described from nearby regions in the Russian Far East (Kondratyuk et al. 2011, 2014b).

The taxonomy of the Teloschistaceae has undergone a radical change during recent years, including the creation of a large number of new genera, based mainly on molecular phylogeny (Arup et al. 2013a, Fedorenko et al. 2012, Gaya et al. 2012, Kondratyuk et al. 2013b, 2014a, 2014b, 2015a, 2015c, 2015d). Hence the number of genera in the Teloschistaceae has increased from 10 in the late 1990s (Kärnefelt 1989) to currently 75 (Arup et al. 2013a, Kondratyuk et al. 2013b, 2014a, 2014c, 2015a, 2015c, 2015d, Söchting et al. 2014a, b), and the family is divided in four subfamilies, Brownlielloideae, Caloplacoideae, Teloschistoideae and Xanthorioideae (Gaya et al. 2012, Arup et al. 2013b, Kondratyuk et al. 2015d).

Several new genera, i.e., *Orientophila* Arup, Söchting & Frödén, *Mikhtomia* S. Y. Kondr., Kärnefelt, Elix, A. Thell & J.-S. Hur, *Yoshimuria* S. Y. Kondr., Kärnefelt, Elix, A. Thell & J.-S. Hur, *Jasonhuria* S. Y. Kondr., L. Lökös & S.-O. Oh, *Loekoesia* S. Y. Kondr., S.-O. Oh & J.-S.

Hur were described from Eastern Asia, being segregated from *Caloplaca* (Kondratyuk et al. 2014a, 2015c, Arup et al. 2013a). These genera of the Teloschistaceae, as with *Nipponoparmelia* (Kurok.) K. H. Moon, Y. Ohmura & Kashiw. of the Parmeliaceae (Kondratyuk et al. 2013d), *Kashiwadia* S. Y. Kondr., L. Lőkös, & J.-S. Hur of the Physciaceae (Kondratyuk et al. 2014d), and *Ivanpisutia* S. Y. Kondr., L. Lőkös & J.-S. Hur of the Lecanoraceae (Kondratyuk et al. 2015b), are predominantly East Asian taxa, forming separate monophyletic branches in the phylogenetic trees of different families of the lichen-forming fungi.

In this study, three new species are described in *Orientophila* s. str., namely *O. fauriei*, *O. jungakimae*, and *O. yokjidoensis*.

## Materials & methods

A total of 1000 specimens, collected in 2014–2015 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 microscopic 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).

## Taxonomy

*Orientophila fauriei* S. Y. Kondr., L. Lőkös & J.-S. Hur, spec. nova (Fig. 1)  
Mycobank no.: MB 815691

Similar to *Caloplaca pelodella*, but differs in having a continuous to slightly cracked thallus, a well-developed pseudoprosoplectenchymatous cortical layer on the underside of the thalline margin, and smaller ascospores, as well as a weak K<sup>+</sup> bluish- or indigo-violet reaction of the uppermost lateral portion of the true exciple and the cortical layer of the thalline exciple.

Type: South Korea, Jeju-do, Seogwipo-si, Daejeong eup, along seashore at Sangmo-ri. 33°12'34.88"N, 126°17'30.81"E, alt. c. 5 m, on rock, growing together with *Caloplaca diffluens*. Coll.: Kondratyuk, S. Y. (212654), Lőkös, L., Oh, S.-O., Jayalal, U., Joshi, S., Park, J. S. & Hur, J.-S. 121849, 5.7.2012 (KoLRI 016828 – holotype).

Thallus to 5–10 mm wide but sometimes forming larger colonies, continuous, usually small and dispersed among other crustose lichens, possibly parasitic in part, grey to lead-grey or bluish-grey. Thallus thickness variable, to 100 µm; cortical layer 20–25 µm, mesodermatous paraplectenchymatous with distinct matrix, cell lumina rounded, 3–7 µm diam., algal zone 40–50 µm, with clustered algal cells; algal cells to 15(–17) µm diam. Prothallus usually distinct with very thin margin, to 0.3 mm wide, bluish or bluish-grey, concolorous with thallus.

Apothecia 0.3–0.6 mm diam., in section to 0.2 mm, lecanorine; in section zeorine or lecanorine, thalline margin to 60–80(–90) µm, cortical layer to 35(–45) µm, especially well developed on the underside, pseudoprosoplectenchymatous (*sensu* Kondratyuk & Kärnefelt 1997), hyphal lumina 2–3(–4) µm diam., with an epinecral layer 10–15 µm with dust particles, somewhat greyish; true exciple (20–)40–50 µm thick in the uppermost lateral portion, slightly pronounced,

outer layer yellowish-brown, concolorous with the epihymenium, 10–15 µm thick in lower lateral and basal portion, paraplectenchymatous; algal layer to 50 µm, between the exciple and lower cortex, sometimes the uppermost lateral portion decorticate; hymenium 60–70 µm high, epihymenium yellowish-brown; paraphyses more or less swollen towards the tips, 5–6 µm diam. in water, only 3(–4) µm diam. in K; subhymenium 60–100 µm thick, hyaline, sometimes with small oil droplets, to 1.5 µm diam.; asci 8-spored, sometimes with only 2–4 bipolar spores together with aborted spores; ascospores broadly ellipsoid to almost spherical, (10–)11–12 × (5–)6–7(–8) µm in water and (8–)9–12(–16) × 5.5–7(–8) µm in K, septum (3–)4–4.5(–6) µm wide in water and 4–6 µm wide in K.

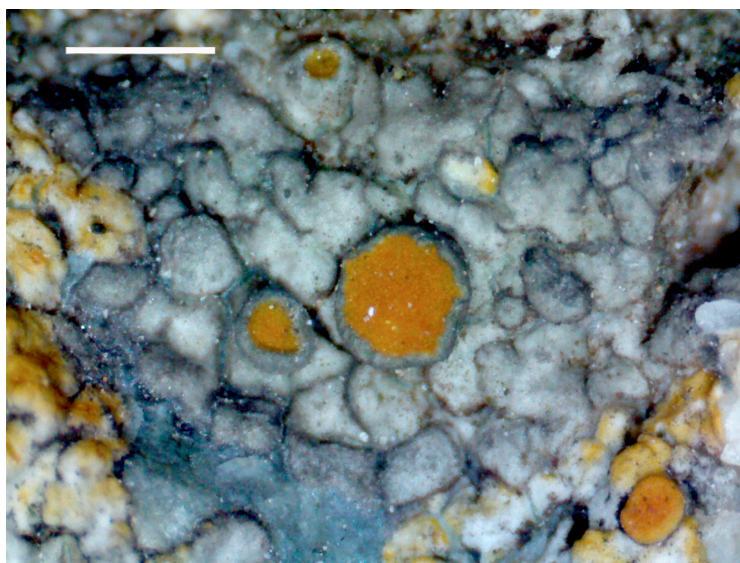
*Reactions:* Epihymenium K+ purple; cortical layer of the lateral portion of thalline exciple as well as the uppermost lateral portion of true exciple K+ bluish or indigo-violet.

*Ecology:* Abundant in the littoral zone on islands and along the coast of mainland South Korea, where it is associated with *Yoshimuria spodoplaca*, *Y. galbina*, *Caloplaca diffluens*, *Orientophila jungakimae*, and species of *Xanthoparmelia* and *Rusavskia*.

*Etymology:* The new species' name honours the French botanist Urbain Jean Faurie (1847–1915), whose collections of lichens, mosses and vascular plants from Eastern Asia are of considerable scientific importance.

*Distribution:* This new species is known only from the coastal zone of South Korea.

*Notes:* Two morphological characters of *Orientophila fauriei* resemble those of *Caloplaca cerina*, i.e. the continuous, slightly cracked, non-areolate, lead-grey or blue-grey thallus with a concolorous prothallus, and the lecanorine apothecia. However, *Orientophila fauriei* differs from *Caloplaca cerina* in having a well-developed pseudoprosoplectenchymatous cortical layer of the thalline exciple on the underside, bearing smaller ascospores and having a K+ bluish or indigo-violet reaction of the uppermost lateral portion of the true exciple and the lateral portion of the cortex of the thalline margin.



**Figure 1.** *Orientophila fauriei* (141089), general habit. Scale 2 mm (photo: S. Kondratyuk).



The thallus usually occurs as small patches dispersed among other crustose species such as *C. diffluens* and *Orientophila jungakimae*. However, *O. fauriei* has a propensity to overgrow the other species (Kondratyuk et al. 2013a, 2013c, 2015b). The thallus surface varies from smooth and continuous on even rock surfaces to irregular when growing on other lichens or over uneven rock surfaces.

Selected specimens examined (a number of localities of *Orientophila fauriei* were previously recorded as *Caloplaca* aff. *pelodella*, associated with *Caloplaca diffluens*, and *Yoshimuria galbina* etc. (see Kondratyuk et al. 2013b, 2013c, 2015b): around Singaemul Park near coast, Sinchang-ri, Hangyeong-myeon, Jeju-si, Jeju-do, 33°20'31.91"N, 126°10'13.00"E, on rock, with *Caloplaca diffluens*, *Pyrenopsis* & *Psorotichia* sp. Kondratyuk (212652), 5.7.2012, Lőkös et al. 121548 (KoLRI 016594); *ibid.*, with *Caloplaca diffluens*, 121567 (KoLRI 016613); Jeju-do, Jeju-si, Hallim-eup, along seashore at Gwideok-ri, 33°26'33.22"N, 126°16'59.97"E, on rock, with *Caloplaca diffluens*. Kondratyuk (212651), Lőkös et al. 121990 (KoLRI 016787); *ibid.*, with *Caloplaca diffluens*, 121982 (KoLRI 016779); Jeju-do, Jeju-si, Hangyeong-myeon, along seashore at Yongsu-ri, 33°19'13.56"N, 126°10'01.96"E, on *Vitex* bark, with *Caloplaca diffluens*, Kondratyuk (212653), 5.7.2012, Lőkös et al. 121997 (KoLRI 016796).

***Orientophila jungakimae*** S. Y. Kondr., S.-O. Oh & J.-S. Hur, spec. nova (Fig. 2)  
Mycobank no.: MB 815692

Similar to *O. subscopularis*, but differs in having longer, narrower lobes, a thinner, defoliating thallus, smaller apothecia, smaller ascospores and in often being overgrown by *O. fauriei* in the central parts.

Type: South Korea: Hauido, Hugwang-ri seaside, Haiu-myeon, Sinan-gun, Jeollanam-do, 34°37'55.05"N, 126°00'44.03"E, c. 6 m, on rock, growing together with *Orientophila fauriei*. 28.6.2013 S.-O. Oh, J. S. Park & J. J. Woo 130725 (KoLRI 019070 – holotype).

Thallus to 1 cm diam. and 140–170 µm thick, distinctly rosette-like, with very long and narrow lobes, verruculose in central parts, often exfoliated and overgrown by *Orientophila fauriei*, dull citrine-yellow to dull brownish-yellow, with dark, dull brownish apothecia in the centre. Lobes 1.5–2.5(–3) mm long and to 0.5 mm wide, in the centre, usually wider towards the tips to 0.8 mm; secondary lobules present, more frequent towards the tips, to 0.1(–0.15) mm wide, well separated and exposing the surface. Cortical layer 15–20(–35) µm, consisting of more or less rounded cells, cell lumina 3–5 µm diam., algae in clusters, photobiont layer to 60 µm, medulla 70–90 µm thick.

Apothecia 0.25–0.5(–0.7) mm diam., to 0.2 mm thick in section, lecanorine or biatorine, concolorous with thallus, dull yellow to dull brownish-yellow, usually slightly darker than the thallus, constricted at the base; thalline margin concolorous with the thallus, soon becoming crenulate or only apparent below; proper margin concolorous and barely distinguished from the disc, well-developed to 80 µm diam., slightly elevated; disc plane or slightly concave, rarely undulate, dull yellow with brownish tinge to dull brownish-yellow, zeorine; thalline exciple 100–120 µm thick, cortical layer 10–15 µm, thinner in the uppermost lateral portion; true exciple 50–80(–100) µm thick in the uppermost lateral portion, 15–20(–30) µm thick in the lower lateral and basal portions, more or less corresponding the *Blastenia*-type *sensu* Kondratyuk et al. (2014a), with radiating elongated cells; hymenium 50–60 µm high, hyaline; epihymenium slightly yellowish to greenish-brown, 10–15 µm thick, paraphyses distinctly swollen towards the tips, to 5–6 µm thick; subhymenium 40–70(–90) µm thick, hyaline, without oil droplets; asci 8-spored, ascospores often of variable size, rarely only four bipolar and four aborted ascospores present;

ascospores hyaline, broadly ellipsoid, very short to almost spherical, (6–)7–11(–12) × 5.5–7 µm in water and (7–)8–11(–13) × (5.5–)6–7(–8.5) µm in K, septa (2.5–)3–4.5(–6) µm wide in water and 4–6(–7) µm in K.

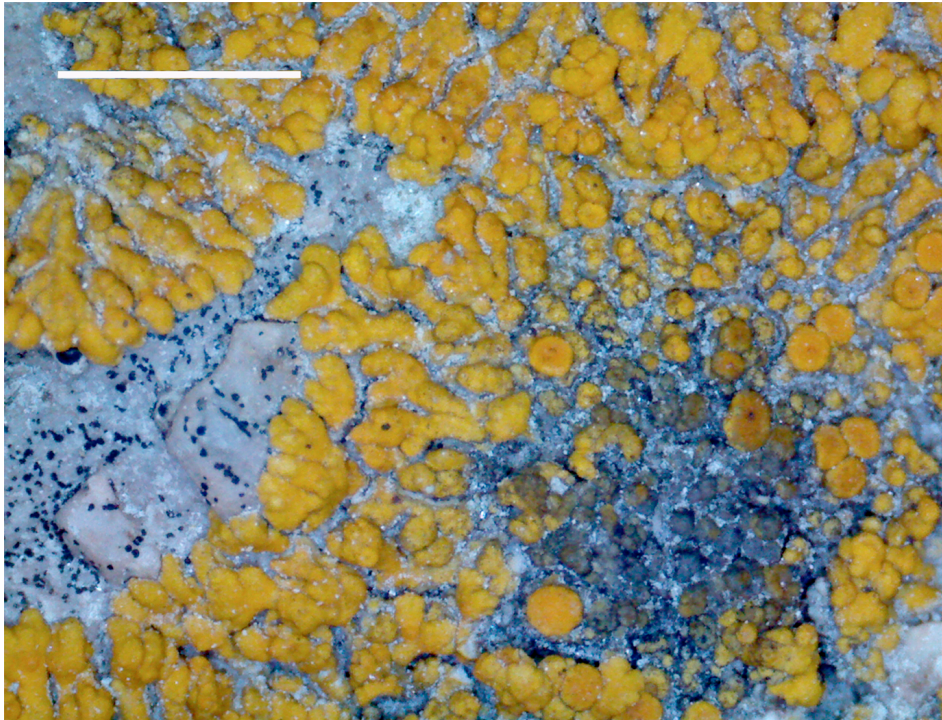
*Reactions:* Epihymenium and cortical layer of the thallus and thalline exciple K+ purple, cortical layer sometimes bluish-violet in the central part. Constituents: parietin (major), fallacinal, emodin, teloschistin and parietinic acid (small amounts).

*Ecology:* The new species grows on coastal rocks, often associated with *Orientophila fauriei* or species of *Caloplaca* and *Verrucaria*.

*Etymology:* This species is named after our colleague and good friend, Dr Jung A. Kim, Sunchon, South Korea, who kindly supplied us with the molecular data confirming that the new species belongs to the *Orientophila subscopularis* group.

*Distribution:* The species occurs in scattered localities in southern South Korea.

*Notes:* *Orientophila jungakimae* is similar to *O. subscopularis* but has longer and narrower lobes, 1.5–2.5(–3) mm vs. 0.8–1.5 mm long, a thinner thallus, to 170 µm vs. 200–400 µm thick, an often defoliating thallus commonly overgrown by *O. fauriei* in central part, whereas *O. subscopularis* has a thick thallus, forming large ‘pseudoareoles’. *O. jungakimae* also differs in having smaller apothecia (0.25–0.5 mm vs. 0.4–1 mm diam.), and smaller ascospores (6–)7–11(–12) × 5.5–7 µm vs. 12–15 × 5.5–6.5 µm.



**Figure 2.** *Orientophila jungakimae*, general habit, with parasitic thalli of *Caloplaca fauriei* in the center (holotype). Scale 2 mm (photo: S. Kondratyuk).

*O. jungakimae* is similar to *O. yokjidoensis* described below, but the former has longer and relatively narrower lobes, 1.5–2.5–3 mm long and 0.5–0.8 mm wide vs. 0.7–1 mm long and 0.4–1(–1.3) mm wide, small biatorine apothecia, 0.25–0.5 mm diam. vs. larger zeorine 0.4–1 mm diam. *O. yokjidoensis* also differs in having an indistinct true exciple in the basal portion, narrower tips to the paraphyses, and larger ascospores with broader septa. Interestingly, brown hyphae of a parasitic *Intralichen* sp. were observed in the hymenium of *Orientophila jungakimae*; spores located close to these hyphae were slightly narrower.

*Additional specimens examined:* Bokildo, 34°09'14.7"N, 126°37'33.2"E, 31.12.2004, on rock, J.-S. Hur 041682 (KoLRI 002478); Jungri beach, Jung-ri, Bogil Island, Bogil-myeon, Wando-gun, Jeollanam-do, 34°09'71.4"N, 126°35'52.7"E, on rock, with *Orientophila fauriei* & *Caloplaca* aff. *diffluens*, 6.2.2010, Joshi, Jeon & Jeong 100223 (KoLRI 011726); Saengil-do, Geumgok-ri coast, Saengil-myeon, Wando-gun, Jeollanam-do, 34°20'02.02"N, 126°57'51.02"E, on rock, 18.4.2012, Jayalal, Park & Ryu 120173 (KoLRI 014767); coast near Chorok village, Gwideok-ri, Hallim-eup, Jeju-si, Jeju-do, 33°26'33.3"N, 126°17'00.1"E, on rock, 4.7.2012, Kondratyuk, Lökös, Oh, Jayalal, Joshi, Park & Hur 121378 (KoLRI 016435); along seashore at Sangmo-ri, Daejeong eup, Deagwipo-si, Jeju-do, 33°12'34.88"N, 126°17'30.81"E, on rock, 5.7.2012, Kondratyuk, Lökös, Oh, Jayalal, Joshi, Park & Hur, 121845 (KoLRI 016824); along seashore at Yongsu-ri, Hangeong-myeon, Jeju-si, Jeju-do, 33°19'13.56"N, 126°10'01.96"E, on rock, 5.7.2012, Kondratyuk, Lökös, Oh, Jayalal, Joshi, Park & Hur, 122015 (KoLRI 016814); Hauido, Hugwang-ri seaside, Hai-myeon, Sinan-gun, Jeollanam-do, 34°37'55.05"N, 126°00'44.03"E, on rock, 28.06.2013, Oh, Park & Woo 130727 (KoLRI 019072); Sinuido, Hatae-gil seaside, Sinui-myeon, Sinan-gun, Jeollanam-do, 34°32'27.02"N, 126°02'11.01"E, on rock, with *Orientophila fauriei*, 28.6.2013, Oh, Park & Woo 130782 (KoLRI 018927); seashore of Mojini-mongdol, Sinyang-1-ri, Chuja-myeon, Chuja-do, Jeju-si, Jeju-do, 33°56'44.9"N, 126°20'03.01"E, Alt. c. 57 m, on rock. 21.6.2014, Kondratyuk (SK-07) 140913-1 (KoLRI 023436).

***Orientophila yokjidoensis*** S. Y. Kondr., S.-O. Oh & J.-S. Hur, spec. nova (Fig. 3)  
Mycobank no.: MB 815693

Similar to *O. subscopularis*, but differs in having shorter thalline lobes, a thinner thallus and smaller ascospores.

Type: South Korea: Yokji-do, Seosan-ri, Yokji-myeon, Tongyeong-si, Gyeongsangnam-do, 34°38'39.04"N, 128°14'04.05"E, c. 18 m, on rock. 10.5.2012 S.-O. Oh, U. Jayalal, J. S. Park & J. A. Ryu 120758 (KoLRI 015753 – holotype, BP, KW-L – isotypes).

Thallus to 2–3 cm wide, consisting of rather small, distinctly rosette-like individual thalli (2.5–)4–7 mm diam., with short, well-developed lobes, 1(–1.7) mm wide at the periphery, upper surface dull citrine-yellow to dull brownish-yellow, rarely entirely whitish, the central portion membranaceous, elsewhere warty and verruculose, with numerous dark, dull brownish apothecia, exfoliated in part. Lobes indistinct, 0.7–1(–1.7) mm long and (0.1–)0.2–0.5 mm wide towards the centre, broader towards the tips, (0.2–)0.4–1(–1.3) mm wide, closely attached to the substrate, sometimes with radial cracks to 0.1 mm wide; tips apically thin, usually raised. Warts and papillae-like formations (0.15–)0.2–0.3 mm diam.

Apothecia (0.25–)0.4–1 mm diam., 0.25–0.3 mm thick, lecanorine or zeorine, dull yellow to dull brownish-yellow and concolorous with thallus or dull yellow-brown and darker than the thallus, sessile, constricted at the base; thalline margin concolorous with the thallus, smooth to crenulate; proper margin barely distinguished; disc plane or slightly concave, rarely undulating,

from dull yellow with a brownish tinge to dull brownish-yellow, zeorine; thalline exciple 80–120(–150)  $\mu\text{m}$  thick, cortical layer 15–20  $\mu\text{m}$ , occasionally even thicker on the underside, of *textura globosa* type, rounded cells 5–7  $\mu\text{m}$  diam.; true exciple 20–30(–40)  $\mu\text{m}$  thick in the uppermost lateral portion and 15–20  $\mu\text{m}$  thick in lower lateral portion, indistinct or absent at the base; hymenium 50–60  $\mu\text{m}$  high, hyaline; epihymenium yellowish-brown; paraphyses swollen towards the tips, to 3(–4)  $\mu\text{m}$  diam.; subhymenium to 50  $\mu\text{m}$  thick, hyaline, without oil droplets; asci 8-spored, ascospores often of variable size, hyaline, broadly ellipsoid, slightly dilated at the septa, (7–)9–12(–13)  $\times$  (5–)5.5–7  $\mu\text{m}$  in water, 7–12(–13)  $\times$  (4.5–)5.5–7(–8)  $\mu\text{m}$  in K, septa (3.5–)4–6(–6.5)  $\mu\text{m}$  wide in water and (3.5–)4–7  $\mu\text{m}$  wide in K.

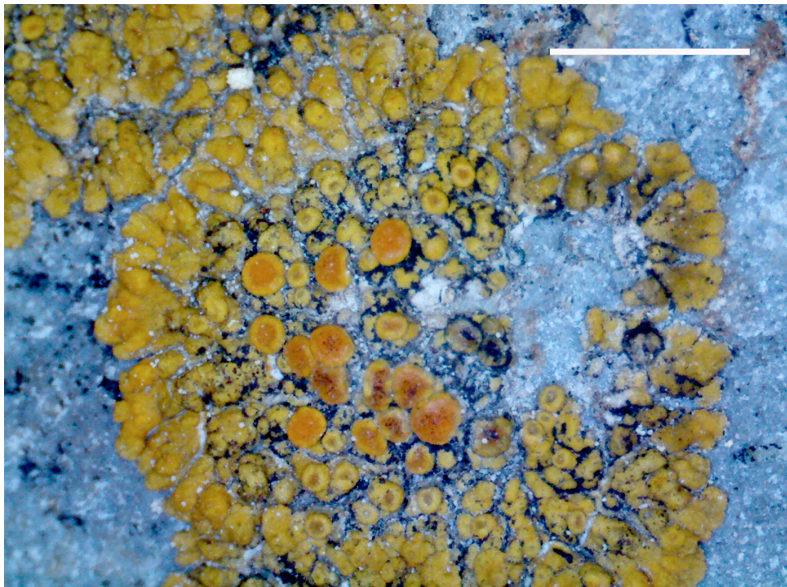
*Reactions:* Epihymenium and cortical layer of thallus and thalline exciple K+ purple, reaction very rapid. Constituents: parietin (major), fallacinal, emodin, teloschistin and parietinic acid (small amounts).

*Ecology:* *Orientophila yokjidoensis* occurs on coastal rocks, often associated with *O. fauriei* and other crustose species.

*Etymology:* The new species is named after Yokji-do Island, Gyeongsangnam-do Province of South Korea, Eastern Asia.

*Distribution:* *O. yokjidoensis* is known from scattered localities on islands in the southern part of South Korea. The majority of previous records of *O. subscopularis* from South Korea (see Kondratyuk et al. 2013c, 2015b, 2015e) belong to this taxon.

*Notes:* *O. yokjidoensis* is similar to *O. subscopularis*, with which it was found to be sympatric in several localities in South Korea. However, *O. yokjidoensis* differs in having shorter thalline lobes (up to 1 mm vs. 0.8–1.5 mm long), a thinner thallus which is often defoliated in the centre (*O. subscopularis* forms very large, thick ‘pseudoareoles’), and shorter ascospores (6–)7–11(–12)  $\times$  5.5–7  $\mu\text{m}$  vs. 12–15  $\times$  5.5–6.5  $\mu\text{m}$  (Arup et al. 2013a).



**Figure 3.** *Orientophila yokjidoensis* (holotype), general habit. Scale 2 mm (photo: S. Kondratyuk).

*O. jungakimae* is also similar to *O. jungakimae*, described above. In some specimens, namely 130180-1 (KoLRI 018524) and 130590 (KoLRI 018935), the thallus becomes colourless (whitish) and only the discs remain dull yellow or dull brownish-yellow; some of such specimens were previously incorrectly identified as *Yoshimuria galbina* (Kondratyuk et al. 2012).

*Orientophila yokjidoensis* is a host of the lichenicolous fungus, *Arthonia molendoi* (Heufl. ex Frauenf.) R. Sant. (specimen 140839 (KoLRI 023336)).

*Selected specimens examined:* Jungri beach, Jung-ri, Bogil Island, Bogil-myeon, Wando-gun, Jeollanam-do, 34°09.714'N, 126°35.527'E, on rock, with *Physcia stellaris* & *Buellia* sp. 6.2.2010, *Joshi, Jeon & Jeong* 100223-1 (KoLRI 011727); Jeob-do Island, Jindo Co, Jeonam Prov., 34°23.680'N, 126°18.251'E, on rock, 3.6.2011, *Wang & Ryu* 110508 (KoLRI 013552); along seashore at Sangmo-ri, Daejeong eup, Deagwipo-si, Jeju-do, 33°12'34.88"N, 126°17'30.81"E, on rock. 5.7.2012, *Kondratyuk, Lőkös, Oh, Jayalal, Joshi, Park & Hur* 121854 (KoLRI 016833); Imjado, Juman wharf, Bigeum-myeon, Sinan-gun, Jeollanam-do, 35°05'26.7"N, 126°09'27.0"E, on rock. 6.6.2013 *Oh, Park & Woo* 130180-1 (KoLRI 018524); Sinuido, Hatae-gil seaside, Sinui-myeon, Sinan-gun, Jeollanam-do, 34°32'27.02"N, 126°02'11.01"E, on rock, with *Physcia stellaris* & *Lecanora*. 28.6.2013 *Oh, Park & Woo* 130590 (KoLRI 018935); seashore of Mojini-mongdol, Sinyang-1-ri, Chuja-myeon, Chuja-do, Jeju-si, Jeju-do, 33°56'44.9"N, 126°20'03.01"E, alt. c. 57 m, on rock, with *Amandinea* cf. *punctata* & *Caloplaca* sp. 21.6.2014, *Lőkös* 140838 (KoLRI 023335); along western coast, seashore rocks at Muk-ri, Chuja-myeon, Chuja-do, Jeju-si, Jeju-do, 33°56'32.5"N, 126°18'55.72"E, on siliceous rock. 22.6.2014, *Kondratyuk* (SK-17) 141119 (KoLRI 023679).

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