

## A synopsis and key for the lichen genus *Caloplaca* (Teloschistaceae) on Kangaroo Island, with the description of two new species

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### Abstract

An identification key and short diagnoses are presented for the thirty-two species of the lichen genus *Caloplaca* Th.Fr. recorded from Kangaroo Island, South Australia. In addition, two new saxicolous species, *C. aggregata* Kantvilas & S.Y.Kondr. occurring on limestone and *C. sergeyana* Kantvilas from siliceous rocks, are described.

**Key Words:** biodiversity, lichens, new taxa, identification, South Australia.

### Introduction

The lichen genus *Caloplaca* Th.Fr. is a highly prominent component of the southern Australian, maritime lichen flora, especially in lower rainfall areas. It is responsible for the orange, red and yellow banding of coastal rocks, but it is also found away from the littoral zone on bark, wood, calcareous and siliceous rocks, and consolidated soil in open forest, woodland and heathland, as well as in areas disturbed or modified by man. The thallus of *Caloplaca* can be highly variable, ranging from subfruticose to placodioid, squamulose, crustose or areolate; in some species the thallus is endosubstratic and hardly evident. Nevertheless, the genus is easily recognised, being characterised by apothecial ascomata, *Teloschistes*-type asci and hyaline, usually polaribilocular ascospores, where the two spore locules are separated by a thick septum pierced by a central channel (Kantvilas & Kondratyuk 2013). In addition, most species contain orange or yellowish, K<sup>+</sup> purple anthraquinone pigments in their thallus and/or apothecia.

For decades, the identification of species of *Caloplaca* in Australia was a near-impossible task. The diversity of taxa was clearly very high, but published taxonomic accounts, almost invariably based on Northern Hemisphere floras, clearly did not include many, if any, of the species present. It has been only in the last two decades that the diversity of Australian *Caloplaca* species has been elucidated, almost entirely through the efforts of the Ukrainian lichenologist, Sergey Kondratyuk. Together with several collaborators (chiefly Ingvar Kärnefelt, Sweden), Kondratyuk described more than 75 species based on Australian types (Kantvilas & Kondratyuk 2013; Kärnefelt & Kondratyuk 2004; Kondratyuk et al. 2007a, 2007b, 2009a, 2009b, 2010, 2011, 2013a; Lumbsch et al. 2011), with this work culminating in a key to the more than 120 species recorded for Australia (Kondratyuk et al. 2012).

Meanwhile, phylogenetic studies using DNA sequence data indicated that the genus is heterogeneous (Gaya et al. 2012; Søchting & Lutzoni 2003), leading to the erection of dozens of smaller, more natural genera (Arup et al. 2013; Kondratyuk et al. 2013b, 2014a, 2014b, 2015), many with representatives in Australia. This new classification has not been without controversy, as well as proving unwieldy to most taxonomists working with traditional morphological and anatomical characters. Consequently, it has not been generally taken up (e.g. see Gaya et al. 2015; McCarthy 2016). Furthermore, because of its easy recognition, *Caloplaca* in the broad sense is likely to continue to be applied in Australia for the foreseeable future.

Despite the large number of species based on Australian types, the numerous papers on the topic, and large numbers of specimens held in Australian herbaria, identification of Australian collections has remained problematic. Almost any detailed investigation that requires identification to species rank encounters inconsistencies between published descriptions, designated type specimens, herbarium reference material and the key of Kondratyuk et al. (2012). This has certainly been this author's experience in the course of compiling a catalogue of Kangaroo Island lichens, where *Caloplaca* has been one of the largest genera encountered. Thirty-two species have been recorded for the island, but their identification has been a major challenge. In this paper, I summarise the results of my attempts to resolve the Kangaroo Island *Caloplaca* flora through extensive fieldwork and collecting, study of my own collections, type specimens, herbarium reference material and the literature. The paper offers a synopsis of the taxa based on their salient features, as well as an identification key. Two further new species, one of which honours the work of Sergey Kondratyuk, are also described.

## Material and methods

**Specimens.** The study is based principally on the collections of *Caloplaca* from Kangaroo Island, compiled by the author between 2008 and 2015 and housed in the Tasmanian Herbarium (HO), supplemented by specimens from other collectors. Other critical resources employed include an extensive comparison with type material (held in various herbaria as cited), reference herbarium specimens, published accounts of species, and correspondence and duplicate specimen exchange with Dr S. Kondratyuk, the architect of current Australian *Caloplaca* taxonomy, in Kiev.

The importance of study of type specimens cannot be overestimated in this instance. The recent history of *Caloplaca* studies in Australia has been a chequered one. There are large holdings of specimens in Australian herbaria, especially CANB, HO and MEL, which were studied and annotated by Kondratyuk. However, these annotations often represent snapshots in time as species concepts for Australian taxa evolved. Hence there may be inconsistencies in the names that have been employed, and the taxa they have been applied to. Likewise, there are inconsistencies between some published descriptions and the specimens cited in their compilation.

**Methodology.** Observations of specimens were conducted in the field and, subsequently, in the laboratory using low-power and high-power microscopy. Thin sections of the apothecia, cut by hand for the observation of apothecial structure and anatomy, were examined in a range of mounting media, including water, 10% KOH (K) and lactophenol cotton blue (LCB). It is generally acknowledged that *Caloplaca* ascospores may swell, depending on the mounting medium. Because spore and septum dimensions are critical in the delineation of taxa, all measurements were undertaken *exclusively* in sections hydrated in water and then mounted in LCB. Likewise, observations of paraphyses and oil vacuoles were undertaken in LCB. That all measurements are standardised in this way is critical, because unless the mounting medium is specifically stated, ascospore dimensions cannot be compared with confidence.

**Characters in *Caloplaca*.** Most recently described Australian taxa are accompanied by extensive morphological and anatomical descriptions (see the numerous papers by Kondratyuk as listed in the bibliography). I have distilled my own observations down to a limited number of salient features that, in my opinion, adequately delimit the taxa:

- morphology and colour of the thallus, including presence of vegetative diaspores
- insertion of the apothecia (viz. immersed, adnate, basally constricted etc.) and their colour
- the apothecial margin (biatorine, zeorine or lecanorine), observed in thin section; zeorine is applied where a two-layered margin is clearly present, the



Fig. 1. *Caloplaca aggregata* (holotype) habit; note the tightly clustered apothecia. Scale = 1 mm.

inner or “proper” one lacking algal cells, and the outer one with algal cells

- presence of oil droplets in the hymenium and/or in the tissue immediately below (termed the sub-hymenium)
- structure of the paraphyses, particularly the presence of oil vacuoles in the filaments proper or in the apical cells
- dimensions of ascospores and the ascospore septum, based on 25–50 observations.

Thallus chemistry is important where xanthonones or depsides may be present in addition to other, more typical “*Caloplaca* substances” such as parietin. These additional metabolites are noted, but the other compounds are not, as their identification requires specialist skills. They are rarely critical in delineating taxa studied, although they tend to support morphological and anatomical characters.

**Presentation of data.** Although in some cases, large numbers of specimens of various provenance have been examined, I have limited the descriptive data presented solely to Kangaroo Island specimens. Significant deviations from the type collection are noted where appropriate. Whereas all available collections were studied anatomically and morphologically, only a selection of these (up to a maximum of three per taxon) is cited; a complete list of Kangaroo Island specimens of *Caloplaca* (and other genera) will be given in a later publication. Descriptions are condensed along the lines given above and measurements are presented as a simple range. Only in the case of the new taxa are more comprehensive descriptions provided, and ascospore dimensions, based on 50 observations, are presented in the format: 5<sup>th</sup> percentile–average–95<sup>th</sup> percentile, with outlying values in brackets. The published protologues of species sometimes indicate that type specimens are present in certain herbaria where they could not to be located. Consequently, I have limited citation of types to specimens that I have actually seen myself.

**Key to the species of *Caloplaca* recorded from Kangaroo Island**

1. Growing on wood or bark
  2. Orange or yellow, K+ purple anthraquinone pigments entirely lacking; apothecia black ..... *C. kalbiorum*
  - 2: Orange or yellow, K+ purple pigments present in the apothecia and sometimes also in the thallus
    3. Thallus sorediate, isidiate or composed of isidia-like granules
      4. Thallus pale greyish, continuous or endophloeodal; soredia orange-yellow, occurring in roundish, excavate, crater-like soralia to 0.5 mm wide ..... *C. wilsonii*
      - 4: Thallus with at least some yellowish or orange tones, subsquamulose, granular or entirely sorediate, if endophloeodal or  $\pm$  absent then soredia dispersed or clumped in irregular, superficial soralia
        5. Thallus subsquamulose, orange to brownish orange ..... *C. erythrosticka*
        - 5: Thallus granular, isidioid or  $\pm$  entirely sorediate, some tone of yellowish
          6. Apothecia biatorine, sometimes with yellow-orange thalline tissue concolorous with the disc developing at the base ..... *C. tibellii*
          - 6: Apothecia at first biatorine, soon lecanorine to zeorine, with a whitish or pale grey-green thalline margin
            7. Thallus composed of minute, scattered, isidioid granules; apothecia to 1 mm wide, biatorine to zeorine; disc yellow to orange-yellow ..... *C. gilfillaniorum*
            - 7: Thallus composed of minute granules that become sorediate; apothecia to 1 (–2) mm wide, usually soon lecanorine; disc orange to orange-pink ..... *C. kaernefeltii*
      3. Thallus rimose-areolate, squamulose, lobate or absent, never sorediate, isidiate or granular
        8. Apothecia mostly becoming lecanorine to zeorine, developing a greyish, somewhat incomplete thalline margin that contrasts with the yellow or orange disc
          9. Apothecia to 1.2 mm wide, superficial; disc brownish orange; hymenium densely inspersed with oil droplets ..... *C. bastowii*
          - 9: Apothecia to 0.5 mm wide, often rather immersed when young; disc yellow to orange; hymenium not inspersed with oil droplets ..... *C. maccarthyi*
        - 8: Apothecia persistently biatorine, with the proper margin  $\pm$  concolorous with the disc
          10. Thallus commonly pale glaucous grey to beige-brown, containing lichexanthone; apothecia strictly biatorine and entirely lacking algal cells (observe in section), to 1.5 mm wide, with margin usually flexuose and lobed ..... *C. dahlíi*
          - 10: Thallus endophloeodal and inconspicuous, lacking lichexanthone; apothecia biatorine but usually with algal cells at the base (evident in section), to 0.5 mm wide, with margin neither flexuose nor lobed
            11. Apothecia bright yellow; ascospores  $7.5\text{--}11 \times 4\text{--}6 \mu\text{m}$  ..... *C. subluteoalba*
            - 11: Apothecia orange; ascospores  $10\text{--}13 \times 5\text{--}7 \mu\text{m}$  ..... *C. cliffwetmorei*
  - 1: Growing on rock or soil
    12. Thallus sorediate
      13. Thallus dull rusty brownish orange; soredia concolorous with the thallus or greenish yellow; growing on siliceous substrata ..... *C. ferdinandmuelleri*
      - 13: Thallus greyish to yellow or orange; soredia bright yellow or orange-yellow; growing on calcareous or nutrient-enriched substrata
        14. Thallus pale greyish yellow, composed of small squamules c. 1 mm thick with plicate, effigurate margins; soredia arising from the underside of the margins, eventually spreading across the upper surface ..... *C. kantvilasii*
        - 14: Thallus bright yellow to orange-yellow, composed of thin, adnate areoles; soredia arising from the eroding upper surface and margins of the areoles ..... *C. cranfieldii*
    - 12: Thallus not sorediate
      15. Thallus well-developed and comprising the dominant and conspicuous part of the lichen, entirely or in part a shade of yellow, orange or reddish, K+ purple (anthraquinones present), with or without  $\pm$  concolorous apothecia
        16. Thallus subfoliose to placodoid, with radiating, plicate marginal lobes 0.3–0.8 mm wide ..... *C. tomareeana*
        - 16: Thallus crustose, rimose-areolate or squamulose, lacking conspicuous marginal lobes
          17. Thallus bright yellow, at first rimose-areolate, becoming papillate to  $\pm$  subfruticose ..... *C. sublobulata*
          - 17: Thallus a shade of orange, red or pink, rimose-areolate,  $\pm$  smooth to bullate but never papillate
            18. Thallus comprised of dispersed or imbricate squamules, sometimes with effigurate margins, rusty brownish orange; ascospores  $12\text{--}18 \times 6\text{--}9 \mu\text{m}$  ..... *C. rexfilsonii*
            - 18: Thallus crustose, a shade of yellow, yellow-orange or orange-red, sometimes mottled; ascospores  $7\text{--}14 \times 4\text{--}7 \mu\text{m}$ 
              19. Apothecia initially immersed and rather aspicilioid, remaining so or becoming adnate at maturity
                20. Thallus vivid orange-red, containing gyrophoric acid; apothecia adnate at maturity with the margin and disc concolorous with the thallus ..... *C. brownlieae*
                - 20: Thallus greyish pink to pale orange-pink, lacking gyrophoric acid; apothecia remaining immersed and aspicilioid, with a pink-red disc and thin, pale,  $\pm$  orange margin ..... *C. montisfracti*
          - 19: Apothecia basally constricted from the earliest stages



21. Thallus mottled yellowish or orange with shades of pale grey or greenish grey, sometimes in concentric zones ..... *C. jackelixii*
- 21: Thallus ± uniformly yellowish, orange or reddish, never mottled
22. Thallus centrally bullate and wrinkled, minutely effigurate-lobed at the margin, lacking a prothallus ..... *C. eos*
- 22: Thallus ± smoothly rimose-areolate throughout, lacking an effigurate margin; prothallus effuse, wispy, concolorous with the thallus or a little paler, usually evident at the thallus margin or between the areoles ..... *C. gallowayi*
- 15: Thallus pale yellowish grey, greyish brown to greenish brown or inconspicuous, K– (lacking anthraquinones), sometimes comprised of scattered, orange or yellowish, K+ purple areoles, but these are inconspicuous relative to the apothecia; yellow, orange or reddish tones conveyed solely or predominantly by the apothecia
23. Thallus dull greenish, brownish or brownish grey, usually forming a conspicuous background that contrasts with the brightly coloured apothecia
24. Apothecia dull rusty orange-brown, sometimes becoming zeorine to lecanorine, with a pale grey thalline margin; hymenium and hypothecium densely inspersed with oil droplets; containing lichexanthone ..... *C. kilcundaensis*
- 24: Apothecia orange-yellow, persistently biatorine; hymenium and hypothecium not inspersed; lichexanthone absent ..... *C. sergeyana*
- 23: Thallus absent, inconspicuous, or a shade of whitish, pale grey or pale yellow-orange that blends into the substratum; overall appearance dominated by apothecia
25. At least some apothecia developing a zeorine, usually incomplete and/or mainly basal thalline margin that is paler than and contrasts with the yellow or orange disc
26. Apothecia 0.1–0.3 mm wide; disc yellow-orange; growing on nutrient enriched substrata ..... *C. holocarpa*
- 26: Apothecia 0.4–1 mm wide; disc bright orange to orange-pink, sometimes with a whitish pruina; growing exclusively on limestone ..... *C. johnwhinrayi*
- 25: All apothecia persistently biatorine, or at least with any thalline margin concolorous with the disc
27. Growing on siliceous rocks
28. Apothecia rusty brownish orange; thallus reduced and consisting of scattered, rusty brownish areoles ..... *C. lateritia*
- 28: Apothecia yellow; thallus not apparent ..... *C. piscatorica*
- 27: Confined exclusively to limestone
29. Apothecia tightly clustered and producing ± pulvinate clumps that obscure a thallus of scattered areoles ..... *C. aggregata*
- 29: Apothecia scattered; thallus not apparent
30. Ascospores 14–18 × 6–9 µm; hymenium inspersed with oil droplets; paraphyses with occasional oil vacuoles; apothecia brownish orange ..... *C. jerramungupensis*
- 30: Ascospores 9–13 × 3.5–7 µm; hymenium not inspersed; oil vacuoles lacking; apothecia yellow or orange
31. Apothecia yellow; ascospores 8–11 × 3.5–5 µm ..... *C. yorkensis*
- 31: Apothecia orange-yellow to orange or reddish orange; ascospores 9–13 × 5–7 µm ..... *C. mereschkowskiana*

### New species

#### *Caloplaca aggregata* Kantvilas & S.Y.Kondr., *sp. nov.*

*Habitu plus minusve pulvinato, thallo inconspicuo, areolato, apotheciis aggregatis tecto, hymenio subhymenioque guttulis inspersibus, et ascosporis parvis, 9–14 µm longis, 4.5–6 µm latis designata.*

**Typus:** SOUTH AUSTRALIA, Kangaroo Island: Windmill Bay, 35°51'S 138°07'E, 20 m alt., on outcropping limestone in coastal pasture, 17 Sep. 2012, G. Kantvilas 476/12 (holo.: HO 5567239; iso.: KW-L).

**Mycobank no.:** MB817744.

*Thallus* crustose, areolate, forming irregular, undelimited, rather pulvinate patches to 30 mm wide, dominated almost entirely by clustered apothecia; individual areoles yellow-orange, 0.2–0.5 mm wide, to 200 µm thick, scattered or contiguous, soon obscured by apothecia, with a cortex 20–30 µm thick, consisting of short-celled, anticlinal hyphae 5–10 µm thick; photobiont cells ± globose, 6–24 µm wide. *Apothecia* 0.3–1 mm wide, very numerous, becoming tightly clustered,

roundish to distorted-rhomboid due to mutual pressure, sessile to basally constricted, at first zeorine but, with maturity, the thalline margin becoming increasingly incomplete, crenulate and basal, at length ± biatorine; disc somewhat deeper orange than the thallus, at first plane, becoming convex in the oldest apothecia, matt, epruinose; proper margin concolorous with the disc, rather glossy, entire or a little flexuose, persistent but increasingly less conspicuous in older apothecia, in section 40–60 µm thick at the sides and at least in part inspersed with golden-yellow crystals that turn crimson and partially dissolve in KOH, composed of radiating, ± parallel, anastomosing hyphae 5–7 µm thick with lumina 2–4 µm wide at the sides, ± paraplectenchymatous towards the base. *Subhymenium* hyaline, ± wedge-shaped and c. 90–150 µm thick centrally but thinner at the sides, very heavily inspersed with oil droplets that frequently coalesce to form irregular oil bodies 10–20 µm wide. *Hymenium* 60–70 µm thick, hyaline, inspersed with oil droplets, overlain by a dense



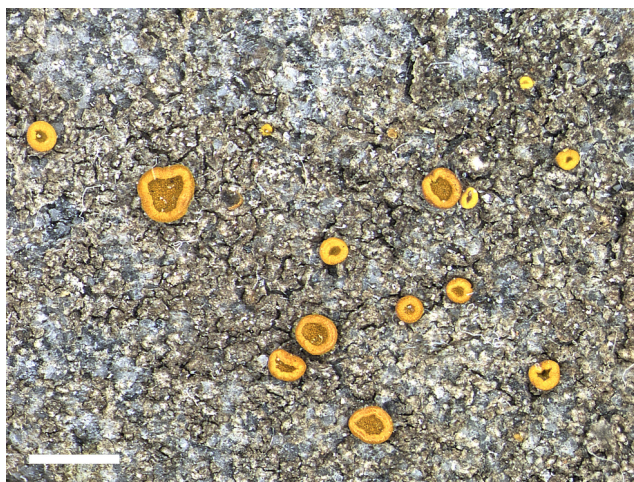


Fig. 2. *Caloplaca sergeyana* (holotype) habit. Scale = 1 mm.

band of golden-yellow crystals as in the apothecial margin, rather poorly differentiated from the subhymenium; paraphyses slender, 1.5–2  $\mu\text{m}$  thick, lacking oil vacuoles, sparsely branched, expanding to 3.5–6  $\mu\text{m}$  at the apices; asci 8-spored, 40–55  $\times$  12–16  $\mu\text{m}$ . *Ascospores* polaribilocular, ellipsoid, (9–) 10–11.3–13.5 (–14)  $\times$  (4.5–) 5–5.4–6  $\mu\text{m}$ ; septum (1.5–) 2–2.5–3  $\mu\text{m}$ . *Pycnidia* not found. *Chemistry*: not analysed. **Fig. 1.**

**Etymology.** The species epithet alludes to the densely clustered apothecia.

**Remarks.** The pulvinate habit of this species, with its densely clustered apothecia that essentially obscure the thallus, in combination with a very densely inspersed hymenium and subhymenium and relatively small ascospores are extremely distinctive, and I am unaware of any other similar species. Amongst the complement of Australian species of *Caloplaca*, *C. aggregata* is best compared to the other major limestone-inhabiting species with which it may occur. Both *C. mereschkowskiana* and *C. yorkensis* lack a conspicuous thallus, do not have an inspersed hymenium or subhymenium, and the latter differs further by having lemon-yellow apothecia. *Caloplaca jerramungupensis* has an inspersed hymenium, but has paraphyses with oil vacuoles and markedly larger ascospores. None of the species mentioned has clustered apothecia. The distinctiveness of *C. aggregata* is also supported by preliminary molecular data (S. Kondratyuk, pers. comm.).

**Distribution and ecology.** The new species is known only from the type collection, from outcrops of limestone in a coastal sheep paddock on the Dudley Peninsula, Kangaroo Island. Since it was first collected in 2012, this and similar sites have been searched for additional material without success. The new species forms isolated “islands” within an expanse of *Lecanora sphaerospora* Müll.Arg., one of the dominant calcicolous lichens known from the island. Other lichens present in this species-rich habitat include *Buellia albula* (Nyl.) Müll. Arg., *B. xantholeuca* Bungartz & U.Grube, *Caloplaca*

*johnwhinrayi*, *C. kantvilasii*, *C. mereschkowskiana*, *C. yorkensis* and *Lecania turicensis* (Hepp) Müll.Arg.

There is a further collection (J.B. Cleland, AD-C 59907) from the Rocky River area which shares with *C. aggregata* the limestone habitat and the clustered apothecia. However, as no well-developed ascospores could be located and the subhymenium is not markedly inspersed (possibly an artefact of the age of the specimen), its identity cannot be confirmed.

***Caloplaca sergeyana* Kantvilas, sp. nov.**

*Caloplacae dahliae* Elix, S.Y.Kondr. & Kärnefelt similis et item apotheciis vere biatorinis, aurantiaco-flavis, ascosporis 11–17  $\mu\text{m}$  longis, 5–8.5  $\mu\text{m}$  latis, septo 3–7  $\mu\text{m}$  crasso sed thallo saxicola, furfuraceo, lichexanthonicum destituto differt.

**Typus:** SOUTH AUSTRALIA, Kangaroo Island: Creek Bay Farm, 35°50'S 138°06'E, 85 m alt., on rocks in malle woodland, 12 Sep. 2013, G. Kantvilas 378/13 (holo.: HO 571447; iso.: KW-L).

**Mycobank no.:** MB817745.

**Thallus** crustose, very uneven and scurfy and following the texture of the coarse substratum, forming irregular, undelimited patches to 30–40 mm wide, dull greenish grey to brownish grey, in places to 250  $\mu\text{m}$  thick but generally much thinner; photobiont cells  $\pm$  globose, 5–15  $\mu\text{m}$  wide. *Apothecia* 0.5–0.8 (–1) mm wide, scattered, orange to orange-yellow, strictly biatorine, sessile, basally constricted; disc at first concave, then plane to undulate, matt, epruinose; proper margin initially  $\pm$  inrolled, rather glossy, with age sometimes a little flexuose, persistent and elevated above the level of the disc, in section cupular, 60–80  $\mu\text{m}$  thick at the sides, (60–) 70–120  $\mu\text{m}$  thick centrally, hyaline within but with an outer layer c. 10  $\mu\text{m}$  thick of dense, golden-yellow crystals that turn crimson and dissolve in KOH, composed of radiating,  $\pm$  parallel, anastomosing hyphae 3–5  $\mu\text{m}$  thick with lumina 2–3  $\mu\text{m}$  wide, never containing any photobiont cells. *Subhymenium* hyaline except for a yellowish band in the lowermost part, 30–40  $\mu\text{m}$  thick, not inspersed. *Hymenium* 70–80  $\mu\text{m}$  thick, hyaline, not inspersed, overlain by a dense band of golden-yellow crystals as in the apothecial margin; paraphyses slender, 1.5–2  $\mu\text{m}$  thick, lacking oil vacuoles, becoming more richly branched in the uppermost part, with apices mostly slightly expanded to 3–4 (–5)  $\mu\text{m}$ ; asci mostly 8-spored, 40–55  $\times$  15–20  $\mu\text{m}$ . *Ascospores* polaribilocular, broadly ellipsoid, (11–) 11.5–14.1–16 (–17)  $\times$  (5–) 6–7.1–8 (–8.5)  $\mu\text{m}$ ; septum 3–5.3–7 (–9)  $\mu\text{m}$ . *Pycnidia* not found. *Chemistry*: parietin only. **Fig. 2.**

**Etymology.** This species is named after my friend and colleague, Dr Sergey Kondratyuk, of Kiev, Ukraine, in acknowledgement of his enormous contributions to the taxonomy of the genus *Caloplaca* in Australia.

**Remarks.** At first sight, this species recalls the common epiphytic species, *C. dahliae*, and both taxa share orange to orange-yellow apothecia that are strictly biatorine, with





Fig. 3. *Caloplaca gallowayi* habitat. This species is usually the dominant contributor to the orange-red zonation of the littoral zone.

absolutely no photobiont cells included within or enveloping the apothecial margin. Ascospore and septum dimensions, and the morphology and anatomy of the paraphyses and apothecial margin are essentially the same in these two species. However, in addition to their different substrate ecologies, the two species differ in that *C. sergeyana* has a scurfy, poorly developed thallus that lacks lichexanthone, whereas *C. dahlia* has a conspicuous, well developed thallus containing copious concentrations of this substance. Also somewhat similar is *C. kilcundaensis*, which has a pale brownish grey thallus containing lichexanthone, but differs by having apothecia with a rusty orange-brown disc and a pale grey thalline margin, and a densely inspersed hymenium and subhymenium.

**Distribution and ecology.** The new species is known only from the type collection, from boulders of a coarse sandstone in mallee woodland on the Dudley Peninsula, Kangaroo Island. This habitat was relatively depauperate with respect to lichens owing to the shaded conditions and the effect of litter fall that had smothered many of the rocks. Other lichens recorded on these rocks included: *Candelariella vitellina* (Hoffm.) Müll. Arg., *Megalania subtasmanica* Kantvilas, *Caloplaca holocarpa* (Hoffm.) A.E.Wade, *C. ferdinandmuelleri* S.Y.Kondr. & Kärnefelt, *Xanthoparmelia mougeotina* (Nyl.) D.J.Galloway, *X. subprolixa* (Nyl. ex Kremp.) O.Blanco et al., *X. xanthomelaena* (Müll.Arg.) Hale, *Lecidella sublapicida* (C.Knight) Hertel and *Lecanora mobergiana* Lumbsch & Elix

### Synopsis of the other species

#### *Caloplaca bastowii* S.Y.Kondr. & Kärnefelt

Biblioth. Lichenol. 99: 260 (2009); *Franwilsia bastowii* (S.Y.Kondr. & Kärnefelt) S.Y.Kondr., Kärnefelt, A.Thell, Elix, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 56: 111 (2014). — **Type:** Australia, Victoria: Gippsland Plain, Mornington, 38°13'S 145°01'E, 9 Feb. 1901, R.A. Bastow (holo.: MEL!).

Thallus crustose, bullate and wrinkled, pale grey to brownish grey; apothecia lecanorine, to 1.2 mm wide, basally constricted; margin whitish grey; disc brownish orange; hymenium and subhymenium densely inspersed with oil droplets; paraphyses lacking oil vacuoles, with apices not markedly enlarged; ascospores 9–13 × 4–6 µm; septum 2–4 µm.

On bark in coastal heathland.

*Specimen examined.* Point Ellen, 36°00'S 137°11'E, 3 m alt., 2013, G. Kantvilas 221/13 (AD, HO, KW).

#### *Caloplaca brownlieae* S.Y. Kondr., Elix & Kärnefelt

in Lumbsch et al., Phytotaxa 18: 28 (2011); *Neobrownliella brownlieae* (S.Y.Kondr., Elix & Kärnefelt) S.Y.Kondr., Elix, Kärnefelt & Thell, Acta Bot. Hungarica 57: 340 (2014). — **Type:** Australia, New South Wales: above Lake Eucumbene, on granite boulder, April 1969, Brownlie (holo.: MEL!).

Thallus crustose, rimose-areolate, very tightly adnate (like a splash of paint), vivid orange-red, containing gyrophoric acid; apothecia biatorine, to 0.6 mm wide, at first immersed, then adnate; margin and disc con-

colourous with the thallus; hymenium not inspersed; subhymenium with very occasional oil droplets; paraphyses lacking oil vacuoles but with apical cells enlarged to 4 µm; ascospores 10–12.5 × 4–7 µm; septum 2.5–5 µm.

On siliceous rocks in dry sclerophyll woodland. This species was for a short time synonymised with *Caloplaca aequata* (Hue) Zahlbr. and included in the genus *Brownliella* by Kondratyuk et al. (2013b).

*Selected specimens examined.* Ironstone Hills near Harry Bates' cottage, 35°43'S 137°58'E, 90 m alt., 2011, *G. Kantvilas* 313/11 (AD, HO); Creek Bay Farm, 35°50'S 138°06'E, 85 m alt., 2013, *G. Kantvilas* 372/13 (AD, HO); Latham Conservation Park, 35°38'S 137°14'E, 160 m alt., 2015, *G. Kantvilas* 290/15 & *B. de Villiers* (HO).

#### *Caloplaca cliffwetmorei* S.Y.Kondr. & Kärnefelt

Biblioth. Lichenol. 100: 236 (2009). — **Type:** Australia, Tasmania: Flinders Island, Yellow Beach, c. 80 m from its western end, on living and dead branches of a huge *Acacia longifolia* var. *sophorae* tree at the head of the beach, 8 July 1978, *J.S. Whinray* 1229 (holo.: MEL!; iso.: HO!).

Thallus crustose, inconspicuous, endophloeodal; apothecia biatorine, sometimes with an incipient thalline margin at the base, to 0.5 mm wide, sessile, typically very numerous; proper margin and disc orange; hymenium and subhymenium not inspersed; paraphyses with occasional oil vacuoles 5–7 µm wide occurring in chains, but with apices not enlarged; ascospores 10–13 × 5–7 µm; septum 3–5 µm.

On bark in coastal heathland.

*Specimen examined.* Ravine des Casoars, at the coast, 35°48'S 136°35'E, 5 m alt., 2012, *G. Kantvilas* 446/12 (AD, HO, KW).

#### *Caloplaca cranfieldii* S.Y.Kondr. & Kärnefelt

Biblioth. Lichenol. 95: 352 (2007); *Flavoplaca cranfieldii* (S.Y.Kondr. & Kärnefelt) Arup, Frödén & Söchting, Nordic J. Bot. 31: 45 (2013). — **Type:** Australia, Western Australia: 2.7 km S of Lynton Station ruin, 28°12'44"S 114°20'09"E, on ironstone/sandstone, often in shade of *Acacia ligulata* in pasture, 6 Jan. 2004, *S. Kondratyuk* 20423, *I. Kärnefelt* & *R.J. Cranfield* (holo.: PERTH; iso.: CANB!, HO!, MEL!).

Thallus composed of rather dispersed, adnate areoles, yellow to orange-yellow, becoming coarsely sorediate-blastidiate at the margins and on the upper surface; apothecia lecanorine (but with algal cells mainly towards the base of the margin), to 0.5 mm wide, basally constricted; margin and disc concolorous with the thallus; hymenium and subhymenium lightly inspersed with oil droplets; paraphyses lacking oil vacuoles but with apical cells enlarged to 4 µm; ascospores 8–15 × 4.5–6.5 µm; septum 3–5 µm.

On nutrient-enriched rocks, especially in the vicinity of animal pasture, bird rookeries or bird perch-sites; also on limestone in such sites and in coastal heathland.

*Selected specimens examined.* Stokes Bay, 35°37'S 137°13'E, 50 m alt., 2012, *G. Kantvilas* 520/12 & *B. de Villiers* (AD, HO, KW); northern end of Antechamber Bay, 35°46'S 138°04'E, 5 m alt., 2013, *G. Kantvilas* 269/13

(HO); Western River Cove, E of beach, 35°41'S 136°58'E, 20 m alt., 2015, *G. Kantvilas* 412/15 (AD, HO, KW).

#### *Caloplaca dahliei* Elix, S.Y.Kondr. & Kärnefelt

Biblioth. Lichenol. 99: 267 (2009); *Eilifdahlia dahliei* (Elix, S.Y.Kondr. & Kärnefelt) S.Y.Kondr., Kärnefelt, Elix, A.Thell, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 56: 110 (2014). — **Type:** Australia, New South Wales: Jimberoo State Forest, Mountain Creek, 11 km NNE of Rankins Springs, 33°45'S 146°19'E, 340 m alt., on dead *Callitris* on *Callitris*-dominated rocky ridge, 13 June 1990, *J.A. Elix* 25276 (holo.: CANB!; iso.: MEL!).

Thallus crustose, indistinct or pale glaucous grey to beige-brown, containing lichexanthone; apothecia biatorine, to 1.5 mm wide, basally constricted; margin bright orange, orange-yellow or reddish orange, entire or lobed to markedly flexuose; disc concolorous, sometimes slightly pruinose; hymenium and subhymenium not inspersed; paraphyses lacking oil vacuoles, with apices sometimes slightly expanded to c. 3 µm; ascospores 12–17 × 5–9 µm; septum 4–7.5 µm. **Fig. 5A.**

On bark; very common and widely distributed. This is by far the most common epiphytic species of *Caloplaca* on the island.

*Selected specimens examined.* Red Banks, 35°45'S 137°43'E, 2008, *G. Kantvilas* 326/08 (AD, HO); Beyeria Conservation Park, 35°47'S 137°36'E, 50 m alt., 2010, *G. Kantvilas* 211/10 (AD, HO); Brown Beach, 35°48'S 137°50'E, 10 m alt., 2012, *G. Kantvilas* 417/12 & *B. de Villiers* (AD, HO).

#### *Caloplaca eos* S.Y.Kondr. & Kärnefelt

Biblioth. Lichenol. 95: 355 (2007); *Sirenophila eos* (S.Y.Kondr. & Kärnefelt) Arup, Frödén & Söchting, Nordic J. Bot. 31: 63 (2013). — **Type:** Australia, New South Wales: S of Anna Bay, Tomaree National Park, 32°47'16"S 152°04'48"E, on rock (rhyolite outcrops) along the coast, 24 Jan. 2004, *I. Kärnefelt* 20044701, *R.B. Filson* & *S. Kondratyuk* 20475 (holo.: CANB!; iso.: MEL!).

Thallus crustose, areolate, rather bullate and wrinkled centrally, minutely effigurate-lobed at the margins, yellow-orange to orange-red, lacking any prothallus; apothecia biatorine, becoming ± zeorine, to 0.7 mm wide, basally constricted; thalline margin mostly incomplete and basal; proper margin and disc concolorous with the thallus or more intensely orange-red; hymenium not inspersed; subhymenium inspersed with abundant oil droplets; paraphyses very rarely with occasional oil vacuoles to c. 5 µm wide, and with apices not or only slightly enlarged to 3.5–4 µm; ascospores 10–13 × 5–7 µm; septum 3.5–5.5 µm.

On siliceous coastal rocks. Together with *C. gallo-wayi* and *C. sublobulata*, this species is one of the main contributors to the orange, red and yellow coloration of the littoral zone.

*Selected specimens examined.* Windmill Bay, 35°51'S 138°07'E, 2 m alt., 2013, *G. Kantvilas* 237/13 & *B. de Villiers* (HO); northern end of Antechamber Bay, 35°47'S 138°04'E, 1 m alt., 2011, *G. Kantvilas* 389/11 (AD, HO, KW); Point Ellen, 36°00'S 137°11'E, 2 m alt., 2012, *G. Kantvilas* 463/12 & *B. de Villiers* (AD, HO, KW).



***Caloplaca erythrosticta* (Taylor) Zahlbr.**

Cat. Lich. Univ. 7: 116 (1930); *Lecanora erythrosticta* Taylor, J. Bot. (Hooker) 6: 161 (1847). — **Type:** Australia, Western Australia: Swan River, on bark, *J. Drummond* (holo.: FH; iso.: BM!).

Thallus subsquamulose-areolate; areoles contiguous or dispersed,  $\pm$  effigurate, brownish orange, sorediate; soredia coarsely granular, concolorous with the thallus, mostly laminal and arising in erose, rather crater-like soralia, soon spreading across the thallus; apothecia (not seen in KI material) zeorine, mostly to 0.6 mm wide, basally constricted; thalline margin brownish orange, crenulate, chiefly basal, sometimes incomplete; proper margin and disc a deeper tone than the thallus, orange-red; hymenium and subhymenium not interspersed; paraphyses lacking oil vacuoles, with apices sometimes swollen to 3–4.5  $\mu$ m; ascospores 11–15  $\times$  5–6.5  $\mu$ m; septum 3.5–6  $\mu$ m.

On wood. The single, small specimen from KI is sterile, but the sorediate subsquamulose areoles match the type specimen, numerous herbarium specimens (chiefly from Western Australia) determined by S. Kondratyuk and the description of Kondratyuk et al. (2004). The descriptive notes on apothecia and ascospores are based on these specimens.

*Specimen examined.* [Rocky River area], 1940, *J.B. Cleland* (AD 59909, HO).

***Caloplaca ferdinandmuelleri* S.Y.Kondr. & Kärnefelt**

Biblioth. Lichenol. 100: 241 (2009); *Filsoniana ferdinandmuelleri* (S.Y.Kondr. & Kärnefelt) S.Y.Kondr., Kärnefelt, A.Thell, Elix, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 55: 271 (2013). — **Type:** Australia, Victoria: Melbourne, Royal Botanic Gardens, near “Temple of the Winds” and “Plant Craft Cottage”, among “grey plants” and succulents, on volcanic rocks, 14 Feb. 2004, *S. Kondratyuk* 204133 (holo.: CANB; iso.: MEL).

Thallus subsquamulose; squamules contiguous to rather dispersed,  $\pm$  effigurate, dull brownish orange, sorediate at the margins and on the upper surface; soredia coarsely granular, concolorous with the thallus or in part greenish or yellowish; apothecia biatorine, becoming zeorine, to 0.7 mm wide, basally constricted; thalline margin incomplete; proper margin and disc concolorous with the thallus; hymenium and subhymenium not interspersed; paraphyses lacking oil vacuoles but with apices mostly swollen to 5  $\mu$ m; ascospores 9–13  $\times$  5–7  $\mu$ m; septum 2–4.5  $\mu$ m.

On siliceous rocks in mallee woodland; elsewhere this species has also been recorded from soil. Neither type specimen could be located. The Kangaroo Island specimen has few, rather juvenile apothecia, which may explain why its ascospores are rather smaller than those cited for the type and seen in other specimens [(11–) 13–17 (–18)  $\times$  6–8 (–10)  $\mu$ m: Kondratyuk et al. 2009b]. The morphology of the KI specimen matches other herbarium specimens very well. This species is probably the sorediate counterpart of *C. rexfilsonii*.

*Specimen examined.* Creek Bay Farm, 35°50'S 138°06'E, 85 m alt., 2013, *G. Kantvilas* 370/13 (AD, HO).

***Caloplaca gallowayi* S.Y.Kondr., Kärnefelt & Filson**

Biblioth. Lichenol. 95: 358 (2007); *Sirenophila gallowayi* (S.Y.Kondr., Kärnefelt & Filson) Søchting, Arup & Frödén, Nordic J. Bot. 31: 63 (2013). — **Type:** Australia, Tasmania: W of Wynyard, Boat Harbour Beach, on coastal rocks, locally abundant, 40°55'57"S 145°37'07"E, 29 Jan. 1999, *I. Kärnefelt* 997501 (holo.: CANB!; iso.: HO!, MEL!).

Thallus crustose, rimose-areolate, orange-red, often with a patchy, effuse, pale orange-red prothallus visible at the margins or between areoles; apothecia biatorine, sometimes becoming  $\pm$  zeorine, to 0.5 mm wide, basally constricted, typically very abundant and crowded; thalline margin mostly incomplete and basal; proper margin and disc concolorous with the thallus; hymenium not interspersed; subhymenium interspersed with abundant oil droplets; paraphyses mostly slender, with oil vacuoles uncommon and apices sometimes expanded to 3.5  $\mu$ m; ascospores 9–14  $\times$  4–7  $\mu$ m; septum 3.5–5.5  $\mu$ m. **Fig. 3.**

This is the most common and conspicuous species in the littoral zone, responsible for the vivid reddish banding on siliceous coastal rocks. It may also extend slightly inland.

*Selected specimens examined.* Emu Bay, 35°35'S 137°31'E, 1957, *H.B.S. Womersley* (AD); Cape St Albans, 35°48'S 138°08'E, 40 m alt., *G. Kantvilas* 362/11 (AD, HO, KW); Stokes Bay, 35°37'S 137°13'E, 50 m alt., 2012, *G. Kantvilas* 512/12 & *B. de Villiers* (AD, HO, KW).

***Caloplaca gilfillaniorum* Kantvilas & S.Y.Kondr.**

J. Adelaide Bot. Gard. 26: 10 (2013); *Kaernefia gilfillaniorum* (Kantvilas & S.Y.Kondr.) S.Y.Kondr., A.Thell, Elix, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 55: 272 (2013). — **Type:** Australia, South Australia: Kangaroo Island, Creek Bay Farm (“Carew”), 35°51'S 138°06'E, 100 m alt., on dead old mallee root in rough pasture, 25 Sep. 2011, *G. Kantvilas* 417/11 (holo.: HO!; iso.: AD!, KW-L!).

Thallus composed of scattered, minute, isidioid granules to 0.1 mm wide, greyish green to greenish yellow or yellow; apothecia biatorine, soon becoming zeorine, to 1 mm wide, basally constricted; thalline margin pale greyish green; proper margin and disc yellow to orange-yellow; hymenium not interspersed; subhymenium with occasional oil droplets; paraphyses slender, with oil vacuoles uncommon, to 5  $\mu$ m wide, and with apices sometimes expanded to 5  $\mu$ m; ascospores 12–17  $\times$  6–8.5  $\mu$ m; septum 3–7  $\mu$ m.

In dry, exposed habitats on wood in pasture, mallee woodland and dry sclerophyll forest. With further observations and collections of this species and its relative, *C. kaernefeltii*, I have grown increasingly uneasy about their distinctiveness, at least on Kangaroo Island, where the main points of difference (the sorediate thallus, broader, more orange apothecial disc and entire, lecanorine apothecial margin of the latter) are becoming



Fig. 4. *Caloplaca jackelixii* habit, showing the mottled orange, yellow and greyish thallus. Scale = 2 mm. Photo: B. de Villiers.

increasingly blurred. I am somewhat reassured that molecular studies by Kondratyuk et al. (2013) maintain their separation. However, it is possible that all Kangaroo Island collections of this complex are conspecific but distinct from the type specimen of *C. kaernefeltii*, which is from Western Australia. In that specimen, the subhymenium is not interspersed, oil vacuoles are frequent, and no ascospores are longer than 13  $\mu\text{m}$ .

*Specimens examined.* Creek Bay Farm, 35°50'S 138°06'E, 70 m alt., 2013, *G. Kantvilas* 225/13 (HO); Grassdale Lagoon, 36°00'S 136°53'E, 20 m alt., 2015, *G. Kantvilas* 333/15 & B. de Villiers (AD, HO, LD).

#### *Caloplaca holocarpa* (Hoffm.) A.E.Wade

Lichenologist 3: 11 (1965); *Athallia holocarpa* (Hoffm.) Arup, Frödén & Söchting, Nordic J. Bot. 31: 36 (2013); *Verrucaria oblitterata* var. *holocarpa* Hoffm., Deutschl. Fl., Zweiter Teil (Erlangen): 179 (1796). — **Type:** Germany: Herrenhausi, *Ehrhart*, Plantae Cryptogamae nr. 284 (lecto.: GOET, fide Arup 2009).

Thallus crustose, inconspicuous, dull greyish; apothecia biatorine, sometimes becoming zeorine, 0.1–0.3 mm wide, basally constricted, crowded together and dominating the thallus; thalline margin incomplete, basal; proper margin and disc yellow-orange; hymenium and subhymenium not interspersed; paraphyses lacking oil vacuoles, with apices becoming  $\pm$  moniliform and expanded to 3–5  $\mu\text{m}$ ; ascospores 9–14  $\times$  5–8  $\mu\text{m}$ ; septum 3–4  $\mu\text{m}$ .

On nutrient-enriched rocks.

*Specimen examined.* Creek Bay Farm, 35°50'S 138°06'E, 85 m alt., 2013, *G. Kantvilas* 376/13 (HO, KW).

#### *Caloplaca jackelixii* S.Y.Kondr., Kärnefelt & A.Thell

Biblioth. Lichenol. 100: 251 (2009); *Sirenophila jackelixii* (S.Y.Kondr., Kärnefelt & A.Thell) Söchting, Arup & Frödén, Nordic J. Bot. 31: 63 (2013). — **Type:** Australia, Tasmania: far south-eastern Bass Strait, Cygnet Island, near Swan Island, c. 11 m WSW of the summit, 40°43'S 148°04'E, 1 m alt., on quartzite, 10 Apr. 1980, *J.S. Whinray* 1549 (holo.: MEL!).

Thallus crustose, deeply rimose-areolate, mottled with yellowish, orange, pale grey and greenish grey tones, sometimes in  $\pm$  concentric zones; apothecia at first biatorine, soon zeorine, to 0.9 mm wide, basally constricted, usually very numerous; thalline margin greyish, at first basal but soon enveloping the entire apothecium; disc bright orange-yellow to orange-red; proper margin concolorous with the disc or a little paler; hymenium and subhymenium not interspersed, or with occasional oil droplets in the latter; paraphyses usually with scattered oil vacuoles to 7  $\mu\text{m}$  wide, and apices sometimes expanded to 3  $\mu\text{m}$ ; ascospores 9–13  $\times$  5–6.5  $\mu\text{m}$ ; septum 3–4  $\mu\text{m}$ . **Fig. 4.**

On siliceous coastal rocks, intermixed with other species of *Caloplaca*, but seemingly preferring more sheltered sites such as overhangs or the lee side of boulders. Whereas the thick, zoned or mottled thallus makes this species readily recognisable, anatomically it is variable and rather enigmatic. Kondratyuk et al. (2009b) emphasise the presence of conspicuous oil vacuoles in chains, but my observations suggest these are at best occasional in the type specimen, rather uncommon in collections from Kangaroo Island, but abundant in some



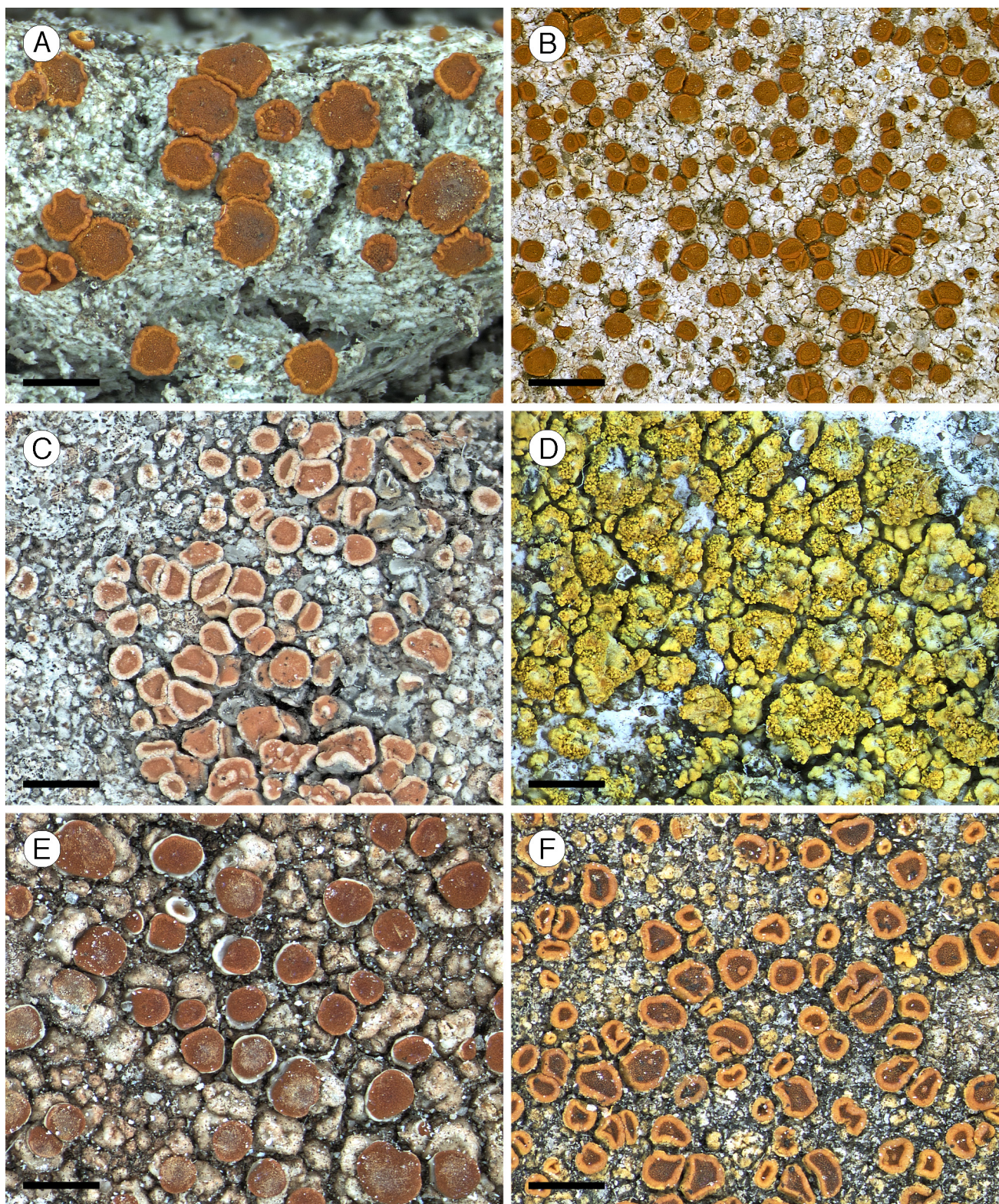


Fig. 5. Habit of *Caloplaca* species of Kangaroo Island. A *C. dahlii*; B *C. jerramungupensis*; C *C. johnwhinrayi*; D *C. kantvilasii*; E *C. kilcundaensis*; F *C. lateritia*. Scale = 1 mm.

Tasmanian collections. The presence of scattered oil droplets in the hypothecium is likewise variable.

*Specimens examined.* Cape St Albans, 35°48'S 138°07'E,

40 m alt., 2015, G. Kantvilas 399/15 (AD, HO, KW); shoreline of Eastern Cove, c. 2.5 km NE of American River, 35°46'S 137°47'E, 3 m alt., 2015, G. Kantvilas 491/15 (AD, HO, KW).



***Caloplaca jerramungupensis* S.Y.Kondr., Kärnefelt & Elix**

Biblioth. Lichenol. 99: 270 (2009); *Xanthocarpia jerramungupensis* (S.Y.Kondr., Kärnefelt & Elix) S.Y.Kondr., Kärnefelt, A.Thell, Elix, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 55: 273 (2013). — **Type:** Australia, Western Australia: Shire of Jerramungup, Fitzgerald River, 21 km E of Jerramungup, 33°49'44"S 119°15'44"E, on sandy soil in scrub with *Melaleuca uncinata*, *Eucalyptus astringens* and *Allocasuarina campestris* and granite outcrops, 10 Jan. 2004, S. Kondratyuk 20444, E.I. Kärnefelt & R.J. Cranfield (holo.: PERTH; iso.: CANB!).

Thallus crustose, inconspicuous, faintly rimose, pale yellowish grey to yellowish brown (K–); apothecia biatorine, rarely becoming zeorine, to 0.7 mm wide, basally constricted, usually crowded together, rather angular and dominating the thallus; thalline margin mostly basal, only very rarely completely enveloping the apothecium; proper margin and disc brownish orange; hymenium and subhymenium interspersed with oil droplets; paraphyses with occasional oil vacuoles to 7 µm wide in the uppermost parts, with apices typically expanded to 5 µm wide and ± moniliform; ascospores 14–18 × 6–9 µm; septum 1–4 µm. **Fig. 5B.**

On limestone outcrops in coastal heathland or in rough pasture near the coast. This species was first described (from Western Australia) from soil, but most herbarium specimens seen (from a range of geographical locations) are from calcareous rocks.

*Selected specimens examined.* Cape St Albans, 35°48'S 138°08'E, 40 m alt., 2011, G. Kantvilas 359/11 (AD, HO, KW); Ravine des Casoars, at the coast, 35°48'S 136°35'E, 5 m alt., 2012, G. Kantvilas 454/12A (HO, KW); near Pelican Lagoon, summit of hill above the Tiger Simpson memorial, 35°50'S 137°49'E, 60 m alt., 2013, G. Kantvilas 287/13 (HO).

***Caloplaca johnwhinrayi* S.Y.Kondr. & Kärnefelt**

Biblioth. Lichenol. 100: 253 (2009). — **Type:** Australia, Tasmania: Bass Strait, Furneaux Group, West Sister Island, c. one-third of the way from W end of Southern Bay, c. 75 m inland, on S side of limestone bank, growing on small rocks and outcrops, together with *C. kantvilasii* and *C. jerramungupensis*, 15 Dec. 1966, J.S. Whinray (holo.: MEL!).

Thallus crustose, inconspicuous, scurfy-verruculose, greyish white; apothecia initially biatorine, usually soon zeorine, 0.4–1 mm wide, markedly basally constricted, crowded and dominating the thallus; thalline margin whitish, scabrid or coarsely pruinose; proper margin pale orange; disc pinkish orange, sometimes with a thin, whitish pruina; hymenium not interspersed; subhymenium interspersed with sparse oil droplets; paraphyses with scattered oil vacuoles to 7 µm wide, mostly occurring in pairs or short chains, and with apices mostly not expanded; ascospores 12–15 × 4.5–7 µm; septum 3–6 µm. **Fig. 5C.**

On limestone in coastal heathland and rough pasture.

*Specimens examined.* Stokes Bay, 35°37'S 137°13'E, 50 m alt., 2012, G. Kantvilas 518/12 & B. de Villiers

(AD, HO, KW); Windmill Bay 35°51'S 138°07'E, 20 m alt., 2012, G. Kantvilas 475/12 (AD, HO, KW); Cape Willoughby, 35°51'S 138°08'E, 10 m alt., 2013, G. Kantvilas 242/13 & B. de Villiers (HO).

***Caloplaca kaernefeltii* S.Y.Kondr., Elix & A.Thell**

Biblioth. Lichenol. 100: 254 (2009); *Kaernefia kaernefeltii* (S.Y.Kondr., Elix & A.Thell) S.Y.Kondr., A.Thell, Elix, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 55: 273 (2013). — **Type:** Australia, Western Australia: at edge of Lake Chittering, 31°25'01"S 116°05'39"E, on *Melaleuca raphiophylla* and *Eucalyptus rudis*, 3 Jan. 2004, S. Kondratyuk 20407, I. Kärnefelt & R.J. Cranfield (holo.: PERTH; iso.: CANB!, MEL!, HO!).

Thallus composed of dispersed greyish green to orange-yellow granules that become ± sorediate; apothecia lecanorine, sometimes biatorine to zeorine, to 1 (–2) mm wide, basally constricted; thalline margin whitish, scabrid; proper margin and disc orange to orange-pink; hymenium and subhymenium not interspersed; paraphyses with scattered oil vacuoles to 6 µm wide, and with apices sometimes expanded to 3.5 µm; ascospores 11.5–16 × 5.5–8 µm; septum 3.5–6 µm.

On soft, moist bark in swampy woodland. Distinguishing this species from its relative, *C. gilfillaniorum*, is discussed above under that species, including the possibility that Kangaroo Island collections are distinct from the Type collection.

*Specimens examined.* Chapman River, 35°48'S 138°04'E, 2 m alt., 2011, G. Kantvilas 371/11 & B. de Villiers (HO, KW); Ravine des Casoars, 35°48'S 136°35'E, 15 m alt., 2012, G. Kantvilas 483/12 & B. de Villiers (AD, HO); the old Cannery, American River, c. 1 km SW of Ballast Head, 35°46'S 137°48'E, 3 m alt., 2013, G. Kantvilas 348/13 & B. de Villiers (AD, HO).

***Caloplaca kalbiorum* S.Y.Kondr. & Kärnefelt**

Biblioth. Lichenol. 96: 158 (2007); *Marchantiana kalbiorum* (S.Y.Kondr. & Kärnefelt) S.Y.Kondr., Kärnefelt, Elix, A.Thell, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 56: 111 (2014); *Streimanniella kalbiorum* (S.Y.Kondr. & Kärnefelt) S.Y.Kondr., Kärnefelt, A.Thell, Elix, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 57: 340 (2015). — **Type:** Australia, Western Australia: c. 5 km SE of Katanning, on roadside *Casuarina*, 250 m, 33°40'S 117°38'E, 16 Aug. 1994, K. & A. Kalb 33828 (holo.: PERTH).

Thallus crustose, rimose-areolate, glaucous grey, sorediate, containing lichexanthone; soralia scattered, ± erose, to 0.3 mm wide, bluish grey; apothecia biatorine, to 0.6 mm wide, basally constricted, scattered, black, lacking anthraquinone pigments but with the outermost parts with a blue-green, N+ crimson pigment; hymenium not interspersed; subhymenium densely interspersed with oil droplets; paraphyses slender, lacking oil vacuoles, with apices sometimes expanded to 3.5 µm; ascospores 10–15 × 5–8 µm; septum 4–6 µm.

On the bark of an old *Leucopogon* shrub at the edge of an abandoned paddock. With its black apothecia that lack any of the orange or yellow pigments characteristic for the genus, this species is unique in the *Caloplaca*

flora of KI. Superficially it looks like a species of *Buellia*, from which it is instantly distinguished by its hyaline, polaribilocular ascospores and *Teloschistes*-type asci.

*Specimen examined.* Hanson Bay Track, c. 1 km S of Grassdale Homestead, 36°00'S 136°52'E, 5 m alt., 2015, G. Kantvilas 368/15 & B. de Villiers (AD, HO).

### ***Caloplaca kantvilasii* S.Y.Kondr. & Kärnefelt**

Biblioth. Lichenol. 95: 363 (2007); *Flavoplaca kantvilasii* (S.Y.Kondr. & Kärnefelt) Arup, Frödén & Söchting, Nordic J. Bot. 31: 45 (2013). — **Type:** Australia, Western Australia: Cape Burney, Greenough River Mouth, 28°42'2"S 114°38'10"E, on sandy limestone, 5 Jan. 2004, S. Kondratyuk 20418a, I. Kärnefelt & R.J. Cranfield (holo.: PERTH; iso.: CANB, MEL!).

Thallus subsquamulose, pale greyish to greenish yellow; individual squamules c. 1 mm thick, scattered, or crowded and separated by deep cracks, convex, plicate or effigurate, developing greenish yellow to yellow soredia from the underside of the margins, eventually disintegrating into soredia; apothecia lecanorine to zeorine, to 0.7 mm wide, nestled amongst the soredia; thalline margin greyish yellow, sorediate; disc and proper margin bright orange; hymenium and subhymenium interspersed with scattered oil droplets, the former rather sparingly; paraphyses lacking oil vacuoles but with apices becoming rather moniliform and expanded to c. 5 µm; ascospores 8–15 × 4–6 µm; septum 2–5 µm. **Fig. 5D.**

On limestone outcrops in coastal pasture and heathland. Fertile specimens are uncommon, and apothecia on most specimens studied belong to other species growing in very close association.

*Selected specimens examined.* Windmill Bay, 35°51'S 138°07'E, 20 m alt., 2012, G. Kantvilas 472/12 (HO, KW); North Cape area, 3 km N of Cape Rouge, 35°35'S 137°38'E, 10 m alt., 2013, G. Kantvilas 251/13 (AD, HO, KW); near Pelican Lagoon, summit of hill above the Tiger Simpson memorial, 35°50'S 137°49'E, 60 m alt., 2013, G. Kantvilas 288/13 (HO, KW).

### ***Caloplaca kilcundaensis* S.Y.Kondr. & Kärnefelt**

Biblioth. Lichenol. 100: 256 (2009); *Franwilsia kilcundaensis* (S.Y.Kondr. & Kärnefelt) S.Y.Kondr., Kärnefelt, Elix, A.Thell, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 56: 111 (2014). — **Type:** Australia, Victoria: Kilcunda, South Gippsland, on sandstone rocks along the shore, 38°33'9"S 145°28'43"E, 12 Feb. 2004, I. Kärnefelt 20047101 & S. Kondratyuk (holo.: CANB!; iso.: MEL!, HO!).

Thallus crustose, rimose-areolate, sometimes verruculose, pale brown to brownish grey, containing lich-exanthone; apothecia biatorine, sometimes becoming zeorine to lecanorine, to 1.2 mm wide, basally constricted; thalline margin pale grey; proper margin and disc rusty orange-brown, the former often excluded as the disc becomes markedly convex; hymenium and subhymenium densely interspersed with oil droplets; paraphyses lacking oil vacuoles, with apices sometimes

expanded to 3.5–4 µm; ascospores 11–18 × 5–7 µm; septum 1–3 µm. **Fig. 5E.**

On coastal rocks, mostly in habitats subject to nutrient enrichment from birds.

*Selected specimens examined.* Point Ellen, 36°00'S 137°11'E, 4 m alt., 2007, R.W. Rogers 15515 (BRI, HO); northern end of Antechamber Bay, 35°47'S 138°04'E, 5 m alt., 2011, G. Kantvilas 395/11 (AD, HO, KW); Stokes Bay, 35°37'S 137°13'E, 50 m alt., 2012, G. Kantvilas 519/12 & B. de Villiers (HO, KW).

### ***Caloplaca lateritia* (Taylor) Zahlbr.**

Cat. Lich. Univ. 7: 154 (1930); *Lecidea lateritia* Taylor, J. Bot. (Hooker) 6: 149 (1847). — **Type:** Australia, Western Australia: Swan River, J. Drummond (holo.: FH!).

Thallus crustose, composed of discrete, rather scattered, sometimes inconspicuous, brownish orange areoles to c. 0.5 (–1) mm wide; apothecia biatorine, sometimes becoming zeorine, to 0.8 (–1) mm wide, basally constricted, scattered or crowded and then rather angular; thalline margin developing from the base, usually incomplete, crenulate when well developed; proper margin and disc rusty brownish orange, ± concolorous with the thallus; hymenium not interspersed; subhymenium usually interspersed with small oil droplets; paraphyses lacking oil vacuoles, becoming branched, ± moniliform and to 3.5 µm thick at the apices; ascospores 12–20 × 5.5–9.5 µm; septum 2.5–5 µm. **Fig. 5F.**

Widespread on siliceous rocks along the coast and in rough pasture, heathland and dry sclerophyll forest. This is a very variable species with respect to the size of the apothecia, the anatomy of the apothecial margin, and degree of interspersed of the subhymenium. The type specimen has somewhat larger apothecia than seen on KI (to 1.2 µm), zeorine apothecia with a ± complete, crenulate, thalline margin, and a non-interspersed subhymenium, but all specimens studied have the same distinctive ellipsoid ascospores with a relatively wide septum, and I am confident that they are conspecific.

Another related species (also mentioned by Kondratyuk et al. 2012) is *C. scarlatina* Zahlbr., described from New Zealand. However, this species has a more continuous, rimose-areolate thallus, and rather broader, squatter ascospores, 12–14 × 7–9 µm, with the septum 4–5 µm thick (isotype in CHR examined). Also related is *C. rexifilsonii* (see below) which has the same apothecial anatomy and ascospore dimensions as *C. lateritia*, but differs by its squamulose thallus. It is possible that *C. lateritia* and *C. rexifilsonii* represent extremes of a morphological continuum and should be synonymised, although I had little difficulty assigning the specimens studied to one or other taxon.

*Selected specimens examined.* c. 2 km SW of Cape St Albans, 35°49'S 138°07'E, 60 m alt., 2011, G. Kantvilas 353/11 (HO, KW); c. 3.5 km NE of Stokes Bay, 35°37'S 137°13'E, 50 m alt., 2012, G. Kantvilas 537/12 (HO, KW); Billygoat Falls, 35°42'S 136°55'E, 200 m alt., 2012, G. Kantvilas 759/12 & B. de Villiers (HO, KW).



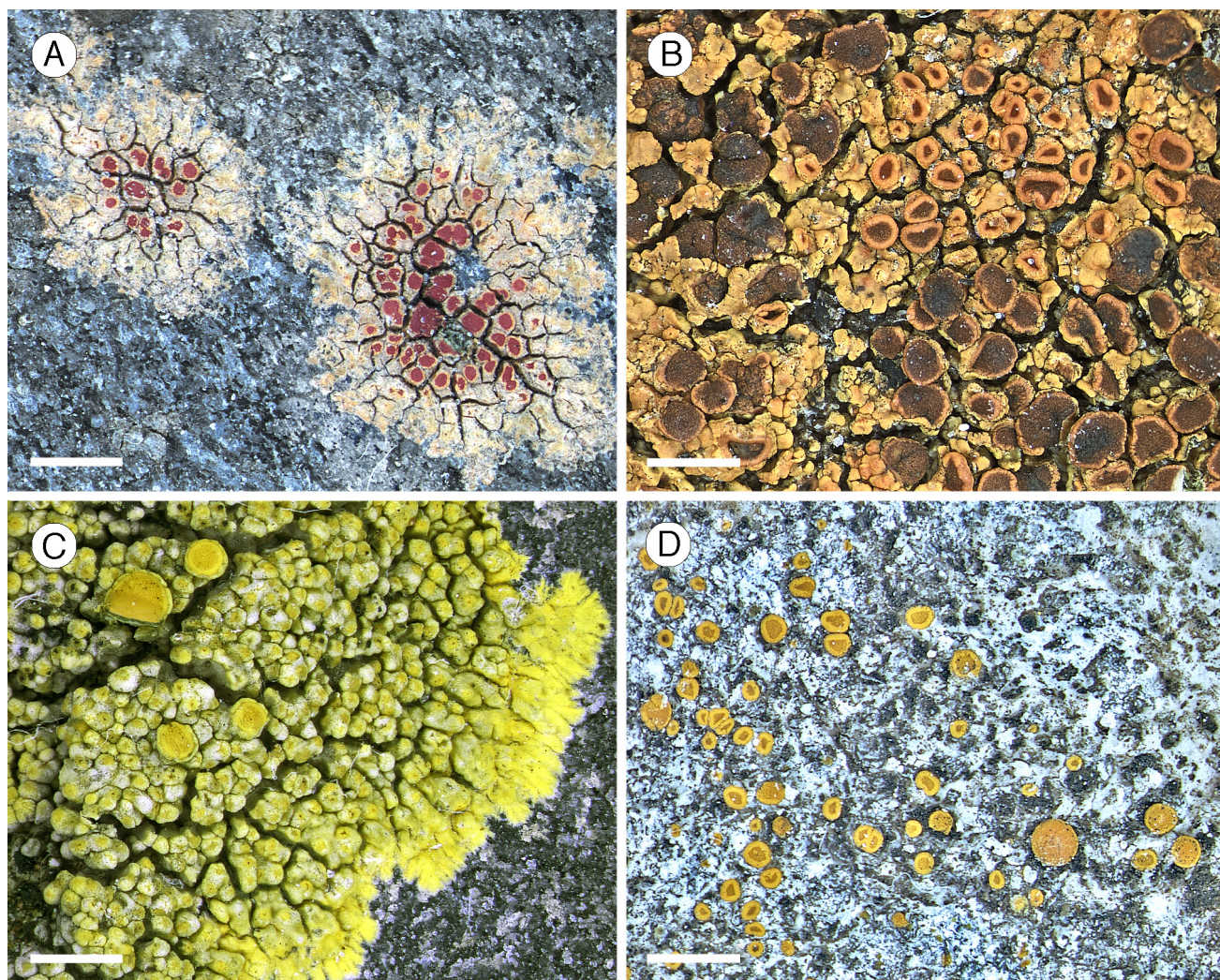


Fig. 6. Habit of *Caloplaca* species of Kangaroo Island. A *C. montisfracti*; B *C. rexfilsonii*; C *C. sublobulata*; D *C. yorkensis*. Scale = 1 mm.

***Caloplaca maccarthyi* S.Y.Kondr., Kärnefelt & Elix**

Biblioth. Lichenol. 100: 258 (2009); *Sirenophila maccarthyi* (S.Y.Kondr., Kärnefelt & Elix) Arup, Frödén & Søchting, Nordic J. Bot. 31: 63 (2013). — **Type:** Australia, Victoria: Port Welshpool, 22 km E of Foster, on trees near the shore, 38°42'00"S 146°28'01"E, 12 Nov. 1997, I. Kärnefelt 977801 (holo.: CANB!; iso.: HO!, MEL!).

Thallus crustose, rather scurfy, grey to green-grey; apothecia soon becoming lecanorine to zeorine, to 0.5 mm wide, semi-immersed to sessile; thalline margin greyish; proper margin and disc yellow, sometimes discoloured pale orange-brown; hymenium and subhymenium not interspersed; paraphyses usually with scattered oil vacuoles to 6 µm wide, sometimes forming chains, and with apices not markedly expanded; ascospores 10–15 × 5–8 µm; septum 4–6 µm.

On the bark and wood of shrubs in heathland and mallee.

*Selected specimens examined.* Cape St Albans, 35°48'S 138°07'E, 90 m alt., 2011, G. Kantvilas 357/11 (HO, KW); northern end of Antechamber Bay, 35°46'S 138°04'E, 5 m alt., 2013, G. Kantvilas 274/13 (HO); Red House Bay,

35°49'S 138°06'E, 15 m alt., 2013, G. Kantvilas 321/13 (HO).

***Caloplaca mereschkowskiana* S.Y.Kondr. & Kärnefelt**

in Lumbsch et al., Phytotaxa 18: 33 (2011); *Flavoplaca mereschkowskiana* (S.Y.Kondr. & Kärnefelt) Arup, Frödén & Søchting, Nordic J. Bot. 31: 46 (2013). — **Type:** Australia, Western Australia: N of Northampton, road to Horrocks, Bower River Rd, on calcareous rock, 28°24'S 114°27'E, Jan. 2004, I. Kärnefelt 20041503, S. Kondratyuk & R.J. Cranfield (holo.: PERTH; iso.: CANB!).

Thallus crustose, scurfy, pale greyish, more commonly inconspicuous to absent; apothecia biatorine, to 0.6 mm wide, basally constricted, dominating the thallus, rarely with an incipient thalline margin developing at the base; disc orange-yellow to orange or reddish orange; proper margin concolorous, rarely becoming excluded; hymenium not interspersed; subhymenium mostly not interspersed; paraphyses lacking oil vacuoles, with apices only slightly expanded to c. 3 µm; ascospores 9–13 × 5–7 µm; septum 1.5–3 µm.





Fig. 7. *Caloplaca tomareeana* habit. Scale = 5 mm.

On limestone outcrops in coastal heathland and rough pasture.

*Specimens examined.* Windmill Bay, 35°51'S 138°07'E, 20 m alt., 2012, G. Kantvilas 474/12 (AD, HO, KW); near Pelican Lagoon, summit of hill above the Tiger Simpson memorial, 35°50'S 137°49'E, 60 m alt., 2013, G. Kantvilas 289/13 (HO).

***Caloplaca montisfracti* S.Y.Kondr. & Kärnefelt**

Biblioth. Lichenol. 95: 370 (2007); *Brownliella montisfracti* (S.Y.Kondr. & Kärnefelt) S.Y.Kondr., Kärnefelt, A.Thell, Elix, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 55: 271 (2013); *Neobrownliella montisfracti* (S.Y.Kondr. & Kärnefelt) S.Y.Kondr., Elix, Kärnefelt & A.Thell, Elix, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 57: 340 (2015). — **Type:** Australia, Western Australia: N of Northampton, road to Port Gregory, on sandstone-ironstone rocks, 28°12'41"S 114°20'9"E, 6 Jan. 2004, I. Kärnefelt 20041703, S. Kondratyuk & R.J. Cranfield (holo.: PERTH; iso.: CANB!).

Thallus crustose, rimose-areolate, very tightly adnate, greyish pink to pale orange-pink, forming discrete round spots to 10 mm wide; apothecia ± aspicilioid, immersed, to 0.3 mm wide, crowded together and rather angular; disc pinkish red; margin thin, pale orange; hymenium and subhymenium not interspersed; paraphyses lacking oil vacuoles, with apices to 3 µm wide, not significantly expanded; ascospores 7–11 × 4.5–6 µm; septum 1.5–3 µm. **Fig. 6A.**

In rather sheltered underhangs on siliceous rocks in rough pasture.

*Specimen examined.* c. 2 km SW of Cape St Albans, 35°49'S 138°07'E, 60 m alt., 2011, G. Kantvilas 355/11 (AD, HO, KW).

***Caloplaca piscatorica* Kantvilas & S.Y.Kondr.**

J. Adelaide Bot. Gard. 26: 12 (2013). — **Type:** Australia, South Australia: Kangaroo Island, northern end of Antechamber Bay, 35°47'S 138°04'E, 0 m alt., on seashore rocks in underhangs and crevices, 18 Sep. 2012, G. Kantvilas 510/12 (holo.: HO!; iso.: AD!, KW!).

Thallus crustose, not apparent to absent; apothecia biatorine, to 0.6 mm wide, basally constricted; proper margin and disc bright lemon-yellow; hymenium and subhymenium not interspersed; paraphyses lacking oil vacuoles, with apices sometimes enlarged to 3–4 µm; ascospores 7.5–11 × 4–5 µm; septum 0.5–2.5 µm.

On siliceous sea-shore rocks, mostly in sheltered microhabitats.

*Specimens examined.* Northern end of Antechamber Bay, 35°47'S 138°04'E, 2011, G. Kantvilas 489/11 (HO, LD, KW); Ravine des Casoars, c. 0.5 km inland from coast, 35°48'S 136°35'E, 15 m alt., 2012, G. Kantvilas 481/12 & B. de Villiers (AD, HO, KW).

***Caloplaca rexfilsonii* S.Y.Kondr. & Kärnefelt**

Biblioth. Lichenol. 95: 371 (2007); *Filsoniana rexfilsonii* (S.Y.Kondr., Kärnefelt & Filson) S.Y.Kondr., Kärnefelt, A.Thell, Elix, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 55: 272 (2013). — **Type:** Australia, New South Wales: Kiama, Coronation Park, 34°40'39"S 115°51'18"E, on rock outcrops along the coast, 27 Jan. 2004, S. Kondratyuk 20480 (holo.: CANB!, iso.: BM!, HO!, MEL!).

Thallus squamulose, rusty brownish orange; squamules dispersed or, more commonly, imbricate, sometimes with ± effigurate margins; apothecia at first biatorine, usually soon becoming zeorine, to 1.2 mm wide, sessile to basally constricted; thalline margin cre-



nulate, sometimes incomplete; disc dark rusty brownish orange; proper margin concolorous with the disc or slightly paler; hymenium not inspersed; subhymenium sometimes inspersed with a few oil droplets; paraphyses lacking oil vacuoles, with apices usually becoming  $\pm$  moniliform and expanded to 3.5  $\mu\text{m}$ ; ascospores 12–18  $\times$  6–9  $\mu\text{m}$ ; septum 2–6  $\mu\text{m}$ . **Fig. 6B.**

On siliceous rocks near the coast; also collected from consolidated soil in a gap in mallee woodland where it grew together with *Psora decipiens* and species of *Endocarpon*. This species appears to be closely related to *C. lateritia* and may possibly represent a form of that species with a very well-developed thallus. When growing on rocks, the two species frequently co-occur and have identical apothecial anatomy and ascospores.

*Selected specimens examined.* Northern end of Antechamber Bay, 35°47'S 138°04'E, 5 m alt., 2013, *G. Kantvilas* 266/13 (AD, HO); Cape St Albans, 35°48'S 138°07'E, 40 m alt., 2015, *G. Kantvilas* 396/15 (HO, KW); Lashmar Conservation Park, c. 2 km S of Cape Coutts, 35°47'S 138°04'E, 50 m alt., 2015, *G. Kantvilas* 428/15 & *B. de Villiers* (HO).

#### *Caloplaca sublobulata* (Nyl.) Zahlbr.

Cat. Lich. Univ. 7: 267 (1931); *Gondwania sublobulata* (Nyl.) S.Y.Kondr., Kärnefelt, Elix, A.Thell, J.Kim, M.-H. Jeong, N.N.Yu, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 56: 164 (2014). — **Type:** [Argentina] Fuegia, Staten Island, 1882, *Spegazzini* (holo.: H-Nyl 30655).

Thallus crustose, rimose-areolate, soon becoming rather papillate to subfruticose, bright yellow, typically surrounded by a yellow, spidery to effigurate prothallus; apothecia biatorine to zeorine, to 1.1 mm wide, basally constricted; proper margin and disc concolorous with the thallus; hymenium not inspersed; subhymenium usually inspersed with small oil droplets; paraphyses lacking oil vacuoles, with apices expanded to 4  $\mu\text{m}$ ; ascospores 10–14  $\times$  5–7  $\mu\text{m}$ ; septum 2.5–4  $\mu\text{m}$ . **Fig. 6C.**

On siliceous coastal rocks, often in the vicinity of bird roosting sites, typically forming mosaics with the orange to orange-red species, *C. eos*, *C. gallowayi* and *C. jackelii*. This name is based on a South American type and has been widely applied across the Southern Hemisphere (Søchting & Øvstedal 1992), including South Australia (Santesson 1944). Published descriptions cite somewhat larger ascospores; for example, 14–16  $\times$  7–8  $\mu\text{m}$  (Søchting & Øvstedal 1992), 13–15 (–18)  $\times$  5–6 (–7)  $\mu\text{m}$  (Galloway 2007) and 12–17  $\times$  6.5–8.5  $\mu\text{m}$  (Santesson 1944). However, this discrepancy could be due to KI specimens having few well-developed asci containing mature ascospores, despite being seemingly well-fertile. In the event that not all Southern Hemisphere populations are deemed to be conspecific, two names based on Australasian types could be available: *C. conranii* S.Y.Kondr. & Kärnefelt, described from Victoria (holotype in CANB examined), and *C. circumlutosa* Zahlbr., described from New Zealand (isolectotype in CHR examined).

*Selected specimens examined.* Windmill Bay, 35°51'S 138°07'E, 2 m alt., 2012, *G. Kantvilas* 495/12 (AD, HO, KW); the old Cannery, American River, c. 1 km SW of Ballast Head, 35°46'S 137°48'E, 0.5 m alt., 2013, *G. Kantvilas* 340/13 & *B. de Villiers* (HO, KW); Cape St Albans, 35°48'S 138°07'E, 2 m alt., 2013, *G. Kantvilas* 213/13 & *B. de Villiers* (AD, HO, KW).

#### *Caloplaca subluteoalba* S.Y.Kondr. & Kärnefelt

Biblioth. Lichenol. 100: 269 (2009); *Cerothallia subluteoalba* (S.Y.Kondr. & Kärnefelt) Arup, Frödén & Søchting, Nordic J. Bot. 31: 40 (2013). — **Type:** Australia, Victoria: Port Fairy, western part of the shore, 38°23'34"S 142°13'41"E, 29 km W of Warnambool, on shrubs above the shore, 14 Nov. 1997, *I. Kärnefelt* 978206 (holo.: CANB!; iso.: HO!, MEL!).

Thallus crustose, scurfy and inconspicuous, or endophloeodal; apothecia biatorine, sometimes with an incipient thalline margin at the base, to 0.5 mm wide, sessile; proper margin and disc bright yellow; hymenium not inspersed; subhymenium inspersed with occasional oil droplets; paraphyses lacking oil vacuoles but with the uppermost cells sometimes expanded to 4  $\mu\text{m}$ ; ascospores 7.5–11  $\times$  4–6  $\mu\text{m}$ ; septum 0.5–2  $\mu\text{m}$ .

On bark and wood in coastal heathland.

*Specimens examined.* W of Windmill Bay, 35°51'S 138°07'E, 40 m alt., 2012, *G. Kantvilas* 498/12A & 500/12 (HO, KW).

#### *Caloplaca tibellii* S.Y.Kondr. & Kärnefelt

Biblioth. Lichenol. 100: 269 (2009). — **Type:** Australia, Western Australia: Porongorups National Park, 21 km ESE of Mount Barker, 0.2 km E of Hayward Peak, 34°41'S 117°53'E, 520 m [alt.], on decaying bark of *Eucalyptus*, 13 Oct. 1983, *L. Tibell* 14157; distributed through *Lich. Sel. Exsicc. Upsalienses* 2 as *Caloplaca citrina* (holo.: CANB!; iso.: BM!).

Thallus inconspicuous, endophloeodal, detected as scattered, granular clusters of bright lemon-yellow soredia; apothecia biatorine, to 0.6 mm wide, basally constricted; disc yellow-orange; proper margin concolorous, sometimes becoming excluded; hymenium not inspersed; subhymenium sometimes inspersed with minute oil droplets; paraphyses with scattered oil vacuoles to 5–8  $\mu\text{m}$  wide occurring in chains or pairs, and with apices sometimes expanded to 3.5–4  $\mu\text{m}$ ; ascospores 8–15  $\times$  4–7  $\mu\text{m}$ ; septum 3–6.5  $\mu\text{m}$ .

On bark in heathland. Kondratyuk et al. (2009b) cite somewhat larger ascospores, 13–16  $\times$  5–7 (–9)  $\mu\text{m}$  with the septum 5–7 (–9)  $\mu\text{m}$  thick, but these dimensions were not confirmed by examination of the type collection, nor specimens from Kangaroo Island.

*Specimens examined.* West Bay, 35°53'S 136°33'E, 40 m alt., 1994, *H.T. Lumbsch* 10920e, *A. Dickhäuser* & *H. Streimann* (CANB, HO); W of Windmill Bay, 35°51'S 138°07'E, 40 m alt., 2012, *G. Kantvilas* 498/12B (HO).

#### *Caloplaca tomareeana* S.Y.Kondr. & Kärnefelt

Biblioth. Lichenol. 95: 379 (2007); *Sirenophila tomareeana* (S.Y.Kondr. & Kärnefelt) Arup, Frödén & Søchting, Nordic J. Bot. 31: 64 (2013); *Tarasginia tomareeana*

(S.Y.Kondr. & Kärnefelt) S.Y.Kondr., Kärnefelt, A.Thell, Elix, J.Kim, A.S.Kondr. & J.-S.Hur, Acta Bot. Hungarica 57: 340 (2015). — **Type:** Australia, New South Wales: S of Anna Bay, Tomaree National Park, 32°47'16"S 152°04'48"E, on rock (rhyolite) outcrops along the coast, 24 Jan. 2004, S. Kondratyuk 20474, R.B. Filson & I. Kärnefelt (holo.: CANB!; iso.: MEL!).

Thallus subfoliose-placodioid, bullate-areolate centrally, with radiating, plicate, convex to plane, marginal lobes 0.3–0.8 mm wide, greenish yellow to yellowish orange; apothecia zeorine to lecanorine, to 1.2 mm wide, basally constricted; proper margin and disc orange to orange-red; hymenium not interspersed; subhymenium interspersed with minute oil droplets; paraphyses lacking oil vacuoles, with apices to 3.5 µm wide but generally not expanded; ascospores 9–14 × 5–6 µm; septum 3.5–7 µm. **Fig. 7.**

On hard, siliceous coastal rocks, especially on granite. Kondratyuk et al. (2007) also described another placodioid species, *C. whinrayi* S.Y.Kondr. & Kärnefelt, which they claimed differs from *C. tomareeana* chiefly by having thinner, plane rather than convex marginal lobes. However, Arup et al. (2013) suggested that these two taxa are conspecific, based on their having identical ITS sequences. More recently, in a molecular analysis, Kondratyuk et al. (2015) referred two Kangaroo Island collections to *Tarasginia whinrayi* (≡ *C. whinrayi*), but given that no new material of *C. tomareeana* was included in that analysis, and the single sequence of that species was nested within *C. whinrayi*, the controversy remains unresolved. My observations of herbarium collections and populations in the field suggest that a single, morphologically variable species is involved.

*Selected specimens examined.* Point Ellen, 36°00'S 137°10'E, 10 m, 2007, R.W. Rogers 15518A (BRI, HO); W of Windmill Bay, 35°51'S 138°07'E, 40 m alt., 2012, G. Kantvilas 506/12A (AD, HO); Cape St Albans, 35°48'S 138°07'E, 2 m alt., 2013, G. Kantvilas 211/13 & B. de Villiers (AD, HO).

### *Caloplaca wilsonii* S.Y.Kondr. & Kärnefelt

Biblioth. Lichenol. 100: 271 (2009). *Blastenia circum-polaris* Søchting, Frödén & Arup, Nordic J. Bot. 31: 67 (2013). — **Type:** Australia, Victoria: Mt Macedon, 1886, F.R.M. Wilson 716 (lecto.: NSW!; isolecto.: HO!).

Thallus crustose, pale greyish, very thin to endophloeodal, detected by the scattered, roundish, crater-like, yellow or orange-yellow soralia 0.2–0.3–(0.5) mm wide; apothecia (not seen in KI material) biatorine, to 0.5 mm wide, basally constricted; disc orange to orange-brown, sometimes a little yellowish-pruinose; proper margin yellow-orange to orange; hymenium and subhymenium not interspersed; paraphyses lacking oil vacuoles, with apices not markedly expanded; ascospores 10–15 × 5–7 µm; septum 3–5.5 µm.

On eucalypt bark in dry sclerophyll forest. Descriptive notes on apothecia and ascospores given above are based on Tasmanian collections held in HO.

*Specimen examined.* Billygoat Falls, 35°42'S 136°55'E, 200 m alt., 2012, G. Kantvilas 775/12 (HO).

### *Caloplaca yorkensis* S.Y.Kondr. & Kärnefelt

in Lumbsch et al., Phytotaxa 18: 34 (2011); *Cerothallia yorkensis* (S.Y.Kondr. & Kärnefelt) Arup, Frödén & Søchting, Nordic J. Bot. 31: 40 (2013). — **Type:** Australia, South Australia: Yorke Peninsula, Coodowie, 5 km E of Edithburgh along the coast, 35°03'S 137°44'E, on calcareous rocks, Jan. 1999, I. Kärnefelt 995207 (holo.: CANB).

Thallus crustose, inconspicuous, endolithic or absent, rarely composed of brownish grey areoles; apothecia biatorine, to 0.5 mm wide, basally constricted; disc yellow, sometimes discoloured greyish; proper margin yellow; hymenium not interspersed; subhymenium interspersed with oil droplets; paraphyses lacking oil vacuoles, slender, with apices sometimes expanded to 2.5–3 µm; ascospores 8–11 × 3.5–5 µm; septum 0.5–3 µm. **Fig. 6D.**

On limestone in coastal heathland, typically in close association with *C. mereschkowskiana* and *C. jerramungupensis*, both of which are distinguished macroscopically by their more orange apothecia.

*Selected specimens examined.* Point Ellen, 36°00'S 137°11'E, 5 m alt., 2012, G. Kantvilas 458/12 & B. de Villiers (AD, HO, KW); Windmill Bay 35°51'S 138°07'E, 20 m alt., 2012, G. Kantvilas 473/12 (AD, HO, KW); Ravine des Casoars, at the coast, 35°48'S 136°35'E, 5 m alt., 2012, G. Kantvilas 454/12 (HO, KW).

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