

Lecania fructigena Zahlbr., a coastal saxicolous lichen, new for Europe, with notes on related species

Pieter P. G. van den BOOM and A. Maarten BRAND

Abstract: *Lecania fructigena* has been found in western Europe. This species, previously known only from western North America and north-western Mexico, is described and compared with related species. It is easily overlooked for *L. aipospila*. *Lecania sampaiana* is a synonym of *L. aipospila*.

Key words: *Lecania*, *Lecania aipospila*, *Lecania atrynoides*, new records, supralittoral zone, western Europe

Introduction

During a study of the genus *Lecania* from south-western USA and north-western Mexico, by the first author, it was clear that *Lecania fructigena* is a common species on the Pacific coast. The results of this study were recently published (van den Boom & Ryan 2004) as part of the *Lichen Flora of the Greater Sonoran Desert Region*. Meanwhile, as part of his studies on lichens from western Europe, the second author has recently made extensive collections, including much *Lecania* material, during several fieldtrips to western France (Brittany). As a result of the revision of coastal *Lecania* species in Europe based on fresh material, *Lecania aipospila* and *L. fructigena* have been found in several localities in this most western part of France. *Lecania fructigena* is recorded here for the first time outside the western Pacific coast, and is new to Europe. It is easily mistaken for *L. aipospila* and both species are discussed below. Other *Lecania* species occurring in coastal areas in western Europe which could be confused with *L. fructigena* or *L. aipospila* are also discussed. *Lecania*

sampaiana appears to be synonymous with *L. aipospila*. A key for coastal *Lecania* species and similar species in western Europe is also provided.

Material and Methods

Specimens were studied from the following herbaria: ASU, COL, GZU, PO, SANT, SBBG and the private herbaria of P. P. G. van den Boom and A. M. Brand. Additional comparative material of *L. atrynoides* Knowles has also been examined (see below). Observations of thallus and apothecial anatomy were undertaken using standard microscopic techniques. Ascospores and conidia measurements were made in water at magnifications of $\times 400$ or $\times 1000$. Chemical constituents were identified using standard methods of thin-layer chromatography (TLC), according to Culberson & Ammann (1979) or Culberson & Johnson (1982).

Additional comparative specimens of Lecania atrynoides examined. **France:** *Manche:* near Nez de Jobourg, between Baie Ecalgrain and Anse du Cul Rond, W exposed coastal granite, supralittoral zone, 1997, M. Brand s.n. (hb Brand). *Finistère:* Crozon Peninsula, Cap de la Chèvre, Pointe de Lost Marc'h, N-point, on pillow lava, low cliff above beach, $4^{\circ}33.2'W-48^{\circ}12.7'N$, 1997, M. Brand s.n. (hb Brand). *Morbihan:* 0.7 km SE of Locmaria, Port-Maria, supralittoral zone, on vertical NW exposed mica schist, $3^{\circ}25.6'W-47^{\circ}37.4'N$, 1999, M. Brand s.n. (hb Brand); Pas-de-Calais, Cap Gris-Nez, seashore, on W exposed sandstone outcrop, $1^{\circ}35'E-50^{\circ}52.3'N$, 2004, P. van den Boom 33682 (hb. v.d. Boom).—**Spain:** *Asturias:* Oviedo, Luarca, N exposed coastal schistose rocks, 1985, P. van den Boom 3143 (hb v.d. Boom).

Pieter P. G. van den Boom: Arafura 16, 5691 JA, Son, the Netherlands.

A. Maarten Brand: Klipperwerf 5, 2317 DX, Leiden, the Netherlands.

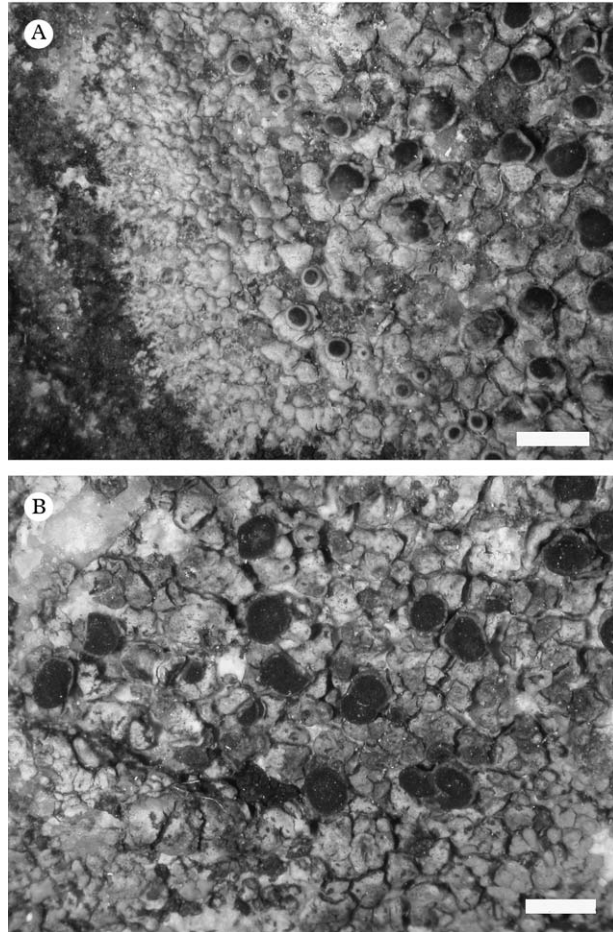


FIG. 1. *Lecania aipospila* (Brand 35001, U.K.). A, thallus margin with some young apothecia; B, centre of thallus with mature apothecia. Scales: A & B=1 mm.

The Species

Lecania aipospila (Wahlenb.) Th. Fries

Lich. Scand. I. (1871).—*Parmelia aipospila* Wahlenb., *Meth. lich. suppl.* 36 (1803); type: Norway, Finnmark, Hammerferst, 1802, *Wahlenberg* (UPS—syntype).

Lecania sampaiana de Lesd., *Bull. Soc. Bot. France* 68: 204 (1921); type: Portugal, Povoia de Varzin, Villa de Conde, rochas maritimas, 1920, *G. Sampaio* 2348L (PO—lectotype, selected here).

(Fig. 1)

Thallus pale to dark grey, sometimes brownish or purplish to indigo-black coloured, areolate and verrucose, warty to

often with knobbly papillae, weakly effigurate at the margin, upper surface matt to somewhat shining, upper cortex paraplectenchymatous; prothallus dark brownish black.

Apothecia somewhat immersed to sessile; disc dark brownish black; margin entire, up to 0.1 mm wide, excipulum paraplectenchymatous, \pm concolorous with the thallus; *hymenium* 65–90 μ m high; *epihymenium* reddish to dark brown; *ascospores* (0–)1-septate, 10–14(–16) \times 4–5.5 μ m, oblong to ellipsoid.

Pycnidia numerous, immersed, 75–250 μ m diam., brown-black near ostiole;

conidia filiform, slightly to strongly curved, c. 18–24 × 0.8 µm.

For a full description, see Mayrhofer (1988) and James & Purvis (1992).

Chemistry. Thallus K –, C –, KC –, P –; two unidentified triterpenes detected by TLC.

Distribution and ecology. *Lecania aipospila* is known from the supralittoral zone on exposed coastal areas in western Europe, ranging from north-western Portugal to Finnmark (Norway). Previously *L. aipospila* was considered to occur in the British Isles, France, Norway and Sweden (James & Purvis 1992). In Santesson *et al.* (2004) it is also reported from Finland (northernmost and southernmost areas). The present study extends its distribution to Spain and Portugal. Outside Europe, *L. aipospila* is known only from the west coast of North America (van den Boom & Ryan 2004).

Lecania aipospila was found in the lower supralittoral zone, often with, *Caloplaca marina*, *Lecanora actophila*, *L. helicopsis* and *Verrucaria maura*. Further associated species (in France, Brittany) are: *Anaptychia runcinata*, *Caloplaca thallincola*, *Catillaria chalybeia*, *Halecania ralfsii*, *Lecanora praepostera*, *Opegrapha calcarea*, *Pertusaria gallica*, *Ramalina siliquosa*, *Rinodina gennarii*, *R. luridescens*, *Toninia aromatica*, *Verrucaria latericola* and *Xanthoria parietina*.

Notes. Although *L. aipospila* generally forms warts and coarse, knobby papillae, we have seen several specimens with thalli where the warts are not well developed. Specimens with this character probably tend to occur in more southern habitats of France, Spain and Portugal. This may be the reason why *L. aipospila* is confused with species such as *L. rabenhorstii* in coastal regions of these countries. In this form there are several more species with which it can be confused, such as *Lecanora helicopsis* (Wahlenb.) Ach. and *Halecania ralfsii* (Salway) M. Mayrh. However, the latter species has a P+ red thallus (argopsin) and

ascospores with a well-developed perispore and the former species has *Lecanora*-type asci and predominantly simple ascospores. Both species occur in similar habitats.

The type specimen of *L. sampaiana* has been studied and it appears to be a form of *L. aipospila* lacking the characteristic knobby papillae. Only weakly developed papillae have been observed.

Selected specimens studied. **British Isles:** *England:* V. C. 1, West Cornwall: 9 km N of Penzance, Zennor Head, middle part, schistose coastal rocks in supralittoral zone, 1996, *M. Brand* 35090 (hb. Brand).—**France:** *Finistère:* cap Sizun, Park de Brézellec, N exposed sheltered coastal rocks, 1978, *M. Brand* 7570 (hb. Brand); Pointe du Raz, on S exposed cliff in intergrading yellow and grey zones, 1978, *M. Brand* 7663 (hb. Brand); *ibid.*, 1997, *M. Brand* 36882 (hb. Brand); 10 km W of Douarnenez, Pointe du Millier, N exposed coastal granite, 1997, *M. Brand* 36811 (hb. Brand).—**Spain:** *Galicia:* La Coruña, Illa de Salvora, Volta do Roque, coastal granite, 17 vi 1996, *G. Paz Bermudez* (SANT-Lich 9642); *ibid.*, Rio de Ribadeo, Punta das Peues Banles (LV), 16 x 1993, *G. Paz Bermudez* (SANT-Lich 9866).—**Portugal:** *Minho:* Povoia de Varzim, Vila do Conde, Leca de Palmeira, rocas marítimas, 1920, *Sampaio* 137 (PO); *ibid.* Penedo da beira mer, 1920, *Sampaio*, 2341L (PO).

Lecania fructigena Zahlbr., in Hasse

Bryologist 17: 61 (1914); type: USA, California, Catalina Island, at the 'Isthus' on serpentine cliffs exposed to ocean spray, s.d. (SMS—holotype).

(Fig. 2)

Thallus greyish, light yellowish brown, pale to dark brownish, weakly areolate, usually divided into secondary verrucae; verrucae ± bullate, dispersed, becoming crowded, papillate to ± subsquamulose, roundish to ellipsoid, often irregularly, constricted at base; upper surface matt to somewhat shining; upper cortex paraplectenchymatous; prothallus brown to black.

Apothecia broadly sessile to almost sub-stipitate 0.5–1.0(–1.4) mm diam.; disc ± plane to slightly concave, red-brown to dark brown; thalline *exciple* entire to more often flexuous or crenulate, 0.1–0.2 mm wide; paraplectenchymatous, ± concolorous with thallus; *hymenium* 40–70 µm high; *epihymenium* reddish brown to dark brown;

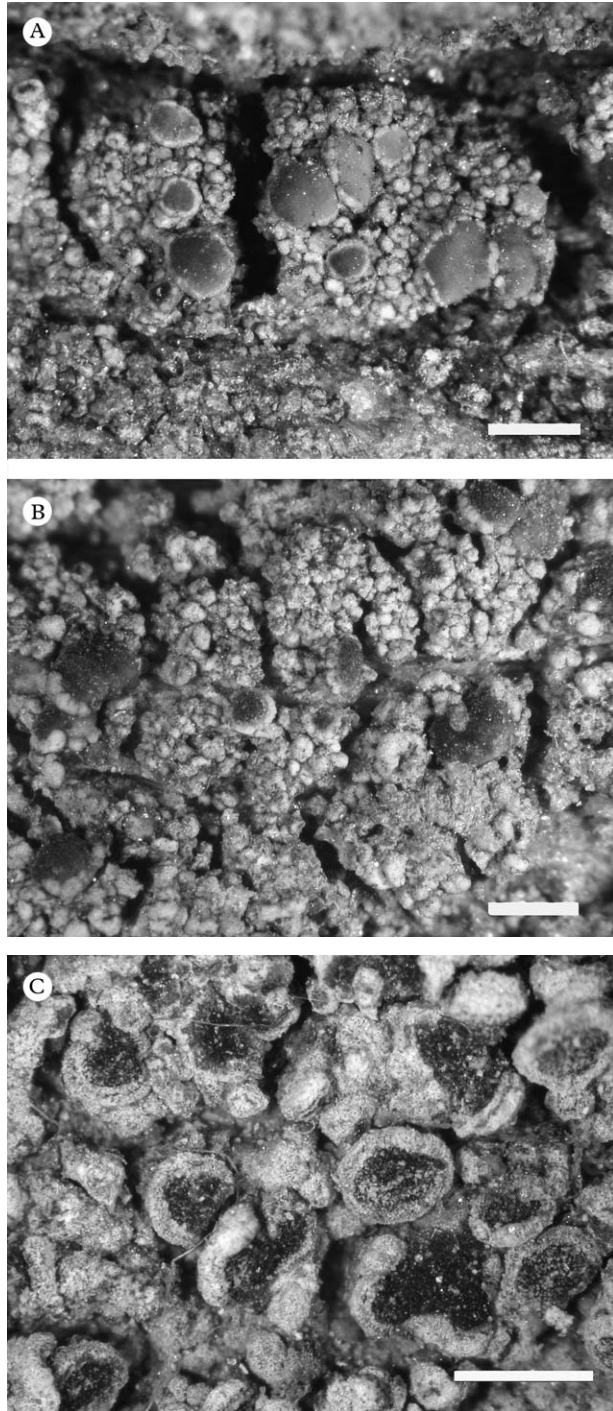


FIG. 2. *Lecania fructigena*. A & B, apothecia from different habitats (*Brand 45765*, France). A, red-brown apothecia; B, dark brown apothecia; C, well-developed apothecia with a few papillae (*Brand 38153*, France). Scales: A–C=1 mm.

ascospores (0–)1-septate, 10–15(–18) × (3–)4–5(–5.5) µm, oblong to ellipsoid.

Pycnidia numerous, immersed, 75–150 µm diam., brown near ostiole; *conidia* filiform, slightly to strongly curved, *c.* 14–24 × 0.8 µm.

A full description of *L. fructigena* with notes on ecology and distribution, can be found in van den Boom & Ryan (2004), based on material from coastal localities of the Sonoran area (SW USA and NW Mexico).

Chemistry. Thallus K –, C –, KC –, P –; no substances detected by TLC.

Distribution and ecology. *Lecania fructigena* was previously known only from the Pacific west coast of North America from Monterey to Mexico (Baja California), often found in spray zones and only on acidic rocks. In continental Europe it is distributed along the Atlantic coast from the most north-western point in Spain (Galicia) to Cap Gris-Nez in France, with a single locality in north-western Netherlands, as the northern limit. In Europe, it has a wider ecological amplitude than in North America, ranging from acidic rocks (cliffs) in the supralittoral zone to natural rocks as well as artificial habitats, mainly on old walls (e.g. churches) in coastal areas somewhat inland. In addition, one specimen was collected on limestone. In Europe, accompanying species with *L. fructigena*, in natural coastal rock communities (Brittany, France) are: *Bacidia viridifarinosa*, *Caloplaca marina*, *C. microthallina*, *Diplotomma alboatrum*, *Solenopsis vulturien-sis*, *Verrucaria maura* and *Xanthoria parietina*. Accompanying species on walls of churches or chapels in France are: *Belonia nidarosien-sis*, *Caloplaca litorea*, *Candelariella vitellina*, *Catillaria chalybeia*, *Diploschistes actinos-tomus*, *Dirina massiliensis* f. *sorediata*, *Lecan-actis grumulosa*, *Lecanora campestris*, *L. sulphurea*, *Opegrapha calcarea*, *O. gyrocarpa*, *O. subelevata*, *Ramalina baltica*, *R. cuspidata*, *R. lacera*, *R. siliquosa*, *Roccella* sp., *Solenop-sora vulturien-sis* and *Tephromela atra*.

Selected specimens examined. **The Netherlands:** *Friesland:* SW of Leeuwarden, Jowerd, tuff-stone of wall of church, 2000, *M. Brand* 40960 (hb. Brand); *ibid.*, 2001, *P. van den Boom* 28088 (hb. v.d. Boom).—**France:** *Pas de Calais:* 2 km S of Cap Gris-Nez, sandstone boulders and outcrops along beach, IFBL E22.15, *c.* 10 m, 2004, *P. van den Boom* 33682 (hb. v. d. Boom). *Finistère:* 11 km S of Quimperlé, Le Pouldu, E of village, coastal vertical rock-face in sheltered cove, 1999, *M. Brand* 38412 (hb. Brand); Crozon Peninsula, Roscanvel, N-side of Anse de Fraternité, on SW sloping soft limestone, 17 vii 1997, *M. Brand* (hb. Brand). *Côtes d'Armor:* 10 km E of St. Brieux, Morieux, coastal area N of St. Maurice, on coastal rocks (granodiorite), 1997, *M. Brand* 36288 (hb. M. Brand). *Manche:* Granville, N of old town, near stairs to beach, schistose outcrops on N-slope of cliff, 1997, *M. Brand* 36254 (hb. Brand). *Morbihan:* Presqu'île de Rhuys, St. Gildas church, N exposed granite, 1999, *M. Brand* 38153 (hb. Brand, hb. v. d. Boom). *Loire Atlantique:* Pornic, Prigny-les-Sables, free standing chapel, N side of schistose and limestone wall, 2002, *M. Brand* 45783 (hb. Brand).—**Spain:** *Galicia:* La Coruña, Cabo Laxe, parte baixa do faro, 10 ix 1997, *G. Paz-Bermúdez* (SANT-Lich 10288).

Discussion

Lecania fructigena is easily mistaken for *L. aipospila* especially if the warts or papillae are not well developed. Both species have a very variable habitus with a thallus that may be reduced and rather thin to thick papillate. If well developed, the thallus of *L. fructigena* varies from scattered bullate-areolate to sub-squamulose or thick compact papillate, ± determinate, not effigurate, 0.2–0.8 mm thick, tightly attached, and greyish to more often brownish coloured. Although the thal-lus has an isidiate-like appearance, speci-mens with true isidia have not been observed. *Lecania fructigena* possesses sessile to almost stipitate apothecia and numerous pycnidia. The appearance of the apothecia can be very different, varying from those with small, thin, entire and thalline margins to those with relatively wide, sometimes thick, flexuous to crenulate margins. In *L. aipospila*, at least initially, the thallus is made up of rather scattered areoles, some-what rounded at the edge, becoming more angular and more or less weakly convex. If well developed, the thallus of *L. aipospila* is generally stouter, warty to knobbly papil-late, with a weakly effigurate margin, less

crowded papillae and the colour of the thallus is pale to dark greyish. The margin of the apothecia is mostly entire. The dark brownish black prothallus of *L. aipospila* has been found in nearly all specimens studied, whereas in *L. fructigena* we have never found a prothallus in the European material. The ascospores of *L. aipospila* are generally shorter than in *L. fructigena*, with a length/width ratio <2.3 (in *L. fructigena* >2.3). The two species also differ in their chemistry. Two unidentified triterpenes are known in *L. aipospila*. These thalline compounds are easily extracted in acetone, forming thin and long crystals, not or slightly lightened in polarized light. Sometimes these crystals are also visible in water (after boiling) or with lactophenol. In *L. fructigena*, no chemical compounds have been detected.

We have now seen material of *L. fructigena* and *L. aipospila* from the same localities in Brittany, France, but have never seen or collected both species at the same site. Along the English Channel *L. fructigena* occurs abundantly at Cap Gris-Nez (northern France), however *L. aipospila* has never been found there. *Lecania aipospila* and *L. fructigena* occur on the west coast of North America but the former species has a more northern distribution in contrast to the more southern distribution of the latter. In North America, as in Europe, the two species have never been found at the same localities (van den Boom & Ryan 2004).

Some forms of *L. fructigena* can also easily be confused with *L. inundata* and *L. atrynoides*. *Lecania inundata* has a weakly

areolate, nodular, small papillate and pale grey-brown thallus with a different cortex (phenocortex) consisting of an often yellow-tinged layer of dying fungal and algal cells, pale to dark brown discs and smaller pycnidia which are mostly lacking. It usually occurs on calcareous substrata, including man-made materials. *Lecania atrynoides* has a less developed thallus, but this can be knobby and the areoles sometimes pillow-like vaulted, never plane, with a greyish to pale brown colour and dull appearance, sometimes comparable to that in *L. aipospila* or *L. fructigena*. Some specimens of *L. atrynoides* have a rimose-areolate thin thallus which is difficult to distinguish from some forms of *L. aipospila*. However in *L. atrynoides*, the paraplectenchymatous cells of the thalline exciple are not developed, the hymenium is somewhat higher, and the paraphyses are smaller, with less swollen apices. As in *L. fructigena*, all chemical spot-tests are negative in *L. atrynoides* and no compounds are detected by TLC. *Lecania atrynoides* is known mainly from siliceous rocks in the xeric-supralittoral zone. In northern France it was found in the same communities as *L. fructigena*. More rarely it occurs in the lower supralittoral zone, especially in sheltered situations, in association with *L. aipospila* or *L. fructigena*. *Lecania atrynoides* has a rather similar, but somewhat more northern, distribution in western Europe, ranging to southern Sweden; it is also known to occur as far east as Italy (Toscana) (Mayrhofer 1988; van den Boom 1992).

Key to coastal species of *Lecania* in western Europe

- 1 Thallus rimose-areolate to areolate, \pm even to slightly granular-verrucose; not effigurate; apothecia adpressed to sessile; without lichen substances **L. atrynoides**
 Thallus weakly areolate, with nodules, small or knobby papillate, warted to subsquamulose; sometimes effigurate; apothecia sessile to substipitate; \pm two unknown triterpenes 2
- 2(1) Thallus weakly areolate with \pm scattered to crowded nodules, not paraplectenchymatous, not effigurate; apothecia sessile; sometimes occurring in coastal habitats **L. inundata**
 Thallus bullate-areolate to subsquamulose, knobby papillate to warted, paraplectenchymatous, sometimes weakly effigurate; apothecia sessile to substipitate

- occurring in coastal habitats (supralittoral zone) 3
- 3(2) Thallus initially weakly areolate, warted to knobby papillate, usually pale to dark grey, slightly effigurate; often with a dark brown-black prothallus; with two unknown triterpenes **L. aipospila**
- Thallus initially warted, bullate areolate to subsquamulose, greyish to brown, not effigurate; prothallus not seen in European material; without lichen substances **L. fructigena**

We are grateful to Graciela Paz Bermudaz for sending us some specimens including the type material of *L. sampaiana*, Paul Diederich, for preparing the photographs and Harrie Sipman for TLC of some selected specimens. Two referees are thanked for valuable comments on an earlier version of the manuscript.

REFERENCES

- Bouly de Lesdain, M. (1921) Notes on lichénologiques XVIII. *Bulletin de la Société Botanique de France* **63**: 203–207.
- Coppins, B. J. (2002) *Checklist of Lichens of Great Britain and Ireland*. London: British Lichen Society.
- Culberson, C. F. & Ammann, K. (1979) Standard-methode zur Dünnschichtchromatographie von Flechtensubstanzen. *Herzogia* **5**: 1–24.
- Culberson, C. F. & Johnson, A. (1982) Substitution of methyl tert.-butyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. *Journal of Chromatography* **238**: 483–487.
- Fries, Th. M. (1871) *Lichenographia Scandinavia* I. Uppsala.
- Hasse, H. E. (1914) Additions to the lichen flora of southern California. No. 9. *Bryologist* **17**: 61.
- James, P. W. & Purvis, O. W. (1992) *Lecania* Massal. (1853). In *The Lichen Flora of Great Britain and Ireland* (O. W. Purvis, B. J. Coppins, D. L. Hawksworth, P. W. James & D. M. Moore, eds): 285–292. London: Natural History Museum Publications.
- Mayrhofer, M. (1988) Studien über die saxicolen Arten der Flechtengattung *Lecania* in Europa II. *Lecania* s. str. *Bibliotheca Lichenologica* **28**: 1–133.
- Santesson, R., Moberg, R., Nordin, A., Tønsberg, T. & Vitikainen, O. (2004) *Lichen-forming and lichenicolous fungi of Fennoscandia*. Uppsala: Museum of Evolution.
- van den Boom, P. P. G. (1992) The saxicolous species of the lichen genus *Lecania* in the Netherlands, Belgium and Luxemburg. *Nova Hedwigia* **54**: 229–254.
- van den Boom, P. P. G. & Ryan, B. D. (2004) *Lecania* Massal. (1853). In *Lichen Flora of the Greater Sonoran Desert Region*. Volume 2 (T. H. Nash, B. D. Ryan, P. Diederich, C. Gries & F. Bungartz, eds): 143–171. Tempe: Lichens Unlimited.

Accepted for publication 12 April 2005