

# *Lecanora (Aspicilia) masafuerensis* is a species of *Xenolecia* (Ascomycota, Lecideaceae)

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**Abstract.** The new combination *Xenolecia masafuerensis* is made for *Lecanora masafuerensis*, a lichen species known from only two localities on Isla Alejandro Selkirk in the Juan Fernández archipelago, Chile. The species is fully described and illustrated and shown to be morphologically and chemically distinct from the similar *X. spadicomma*, which is known only from Chile and the Falkland Islands. The typification of *X. masafuerensis* and its distribution on the islands are also discussed.

**Key words:** distribution, endemic species, Juan Fernandez islands, lichenized-fungi, typification

## Introduction

The genus *Xenolecia* was erected by Hertel (1984) for the single species *X. spadicomma* (Nyl.) Hertel (basonym *Lecidea spadicomma* Nyl.), which was known only from the type collection made by R.O. Cunningham from Isla Wellington in southern Chile in 1868 (Crombie 1876). Fryday & Thüs (2017) reported additional records of this species from Los Largos Region, Chile and from several localities on the Falkland Islands, and also reported a second species in the genus, *X. cataractarum* Fryday, from Campbell Island New Zealand. Here, a third species is added to the genus from the Juan Fernandez archipelago, Chile.

The Juan Fernández archipelago is located 650–830 km off the west coast of Chile at a latitude of ~33.5°S. It consists of three main islands; Robinson Crusoe Island (47.9 km<sup>2</sup>), Alejandro Selkirk Island (49.5 km<sup>2</sup>) and the much smaller Santa Clara Island (2.2 km<sup>2</sup>) (Fig. 1). The two larger islands were formerly known as Más a Tierra and Más Afuera, respectively, but their names were changed in 1966 to promote tourism. The islands have a rugged, mountainous terrain reaching over 1,250 m in altitude and experience a subtropical Mediterranean climate that is moderated by the cold Humboldt Current. Temperatures show little seasonal variation, daily mean temperatures ranging from 12.5°C in August to 19.0°C in February. Average annual precipitation is c 1,000 mm, but is strongly influenced by the El Niño–Southern Oscillation and can vary between ~300 mm/year to over 1,500 mm/

year (Wikipedia 2023). The archipelago became a national park in 1935 and was designated as a UNESCO Biosphere Reserve in 1977. It is recognized as one of the most ecologically vulnerable ecosystems in the world with a high level of endemism – the islands are sixty-one times richer in endemic plant species per square kilometer and thirteen times greater in endemic bird richness than the Galápagos. (Island Conservation 2023).

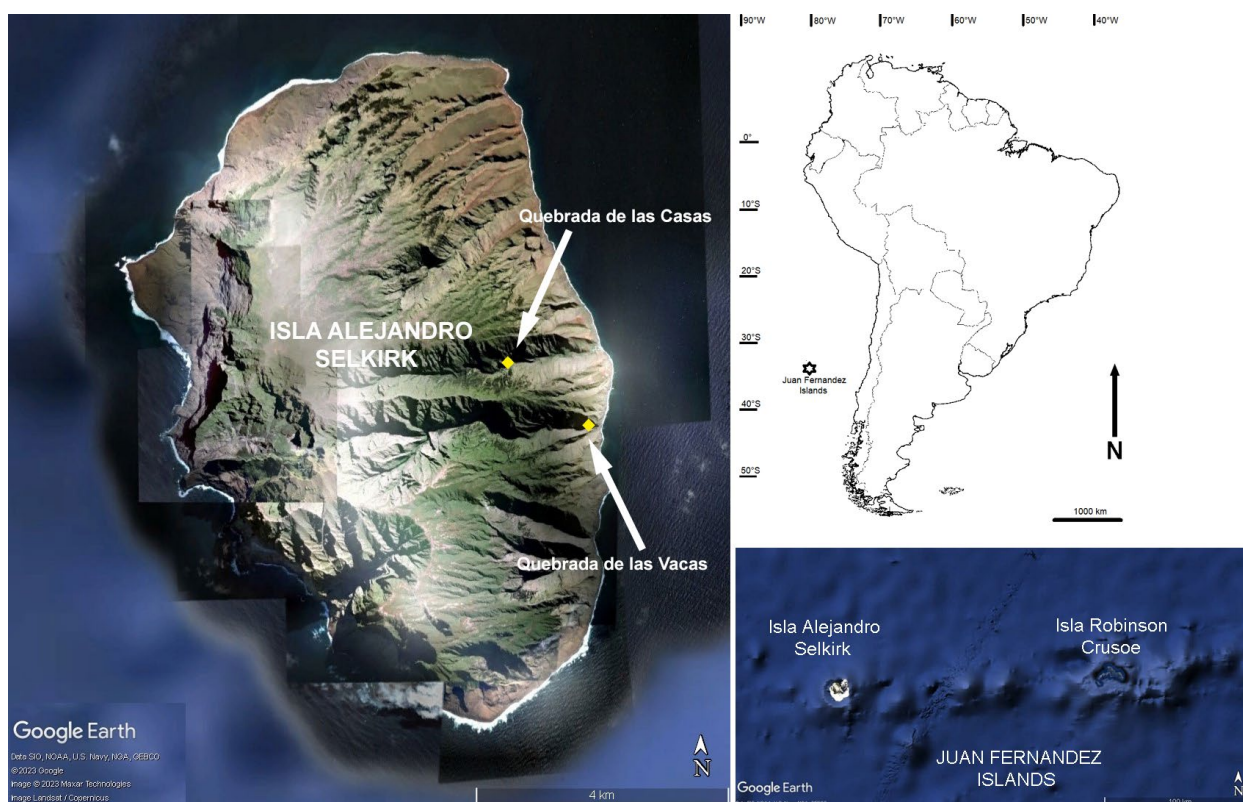
There have been three main expeditions to the Juan Fernandez archipelago that made significant lichen collections. The first was by Carl Skottsberg in 1917, whose lichen collections were identified and described by Zahlbruckner (1924), and the second by Henry Imshaug in 1965. Imshaug made ~1,600 lichen collections, which are preserved in the herbarium of Michigan State University (Fryday & Prather 2001), but never published the results of his investigations. Finally, Redón & Quilhot (1977) stayed over a month in 1975, but only some of their results were published. Although Skottsberg and Imshaug visited both of the main islands, Redón & Quilhot visited only Isla Robinson Crusoe and did not visit Isla Alejandro Selkirk. Both Skottsberg and Imshaug collected specimens of the lichen that is the subject of this paper.

## Materials and methods

Gross morphology was examined under a dissecting microscope and apothecial characteristics by light microscopy (compound microscope) on hand-cut sections mounted in water, 10% KOH (K), 50% HNO<sub>3</sub> (N) or Lugol's reagent (0.15% aqueous IKI). Thallus sections were investigated in water, K and Lugol's reagent. Ascospore measurements

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**Figure 1.** The Juan Fernandez islands; location, position of the two main islands and the two collection sites of *Xenolecia masafuerensis* (yellow diamonds).

are given as (minimum value–) mean  $\pm$  standard deviation (–maximum value). Thalline chemistry was investigated by thin-layer chromatography (solvent C) following the methods of Orange et al. (2001).

**Additional comparative specimens examined.**—*Xenolecia cataractarum*: NEW ZEALAND. Campbell Island, around waterfalls in *Dracophyllum* scrub on south slope of Mt. Honey, above Southeast Harbour, 21 January 1970, H.A. Imshaug 47396 (MSC0195380 – holotype).—*Xenolecia spadicomma* (selected): CHILE. [XII Región de Magallanes y de la Antártica Chilena, Isla Wellington], Eden Harbour, in the bed of a stream, April 1868, R.O. Cunningham (BM – holotype; BM, E – isotypes). FALKLAND ISLANDS. East Falkland: cliffs on rock dome at summit of Mt. Kent, 21F VC 2374 [51°42.550'S, 58°0.900'W], 1500 ft. [457.5 m], 1968, H.A. Imshaug 41549 (MSC0011041).

## Results

Specimens collected by Imshaug and named as *Lecanora masafuerensis*, along with an isotype of that taxon in NY and a high-resolution image of the holotype in W, were compared with each other and with specimens of *Xenolecia spadicomma*. This showed that Imshaug's collections were correctly identified and that *L. masafuerensis* and *X. spadicomma* were clearly congeneric and very similar to each other. However, close morphological investigation and chemical analysis revealed several differences that indicated that two distinct taxa were involved. Unfortunately, the most recent collections of *L. masafuerensis* were made in 1965 and so molecular analysis to confirm this was not a realistic possibility.

## Taxonomy

*Xenolecia masafuerensis* (Zahlbr.) Fryday, comb. nov.

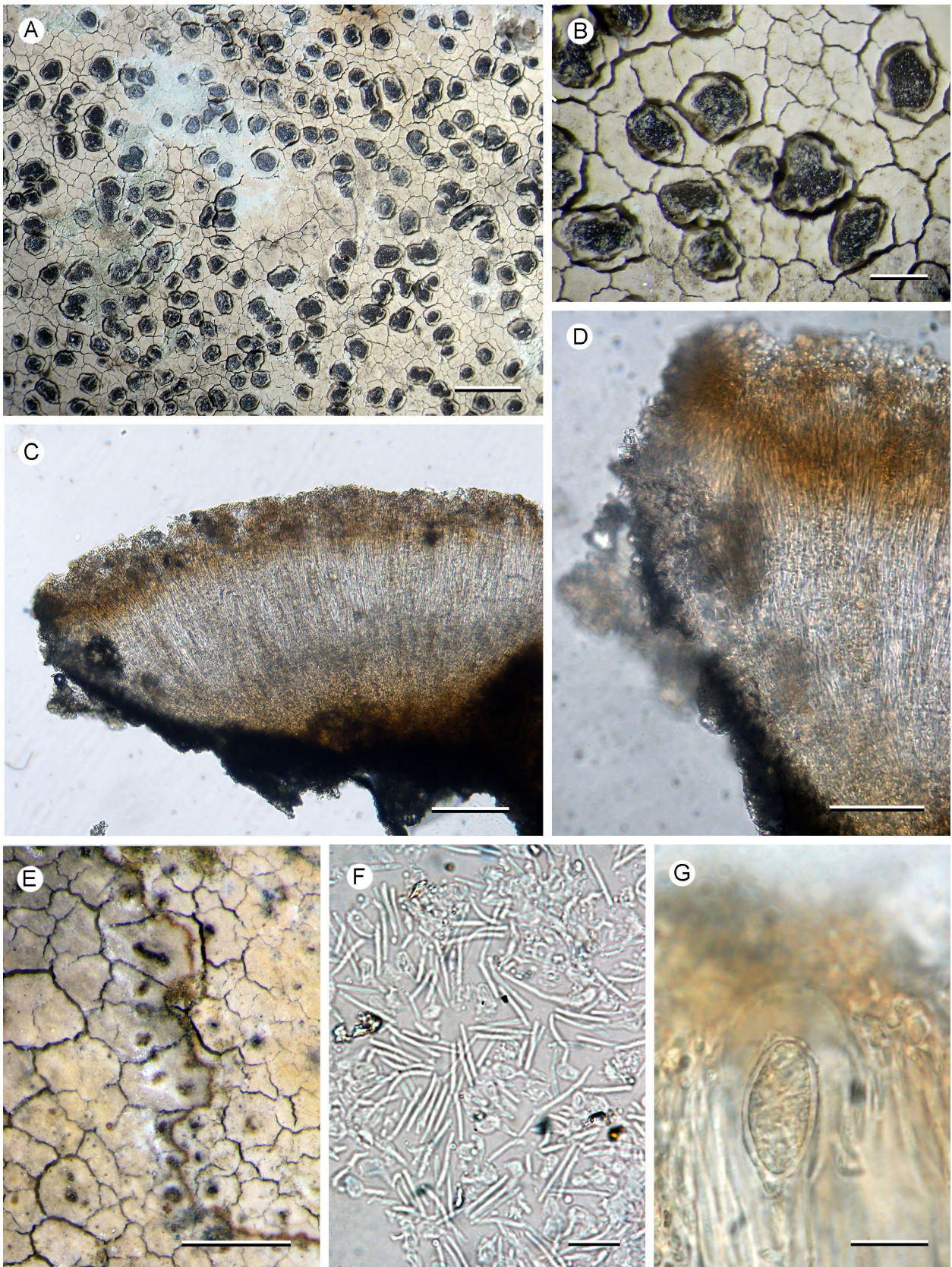
Fig. 2

Mycobank MB 849821

$\equiv$  *Lecanora (Aspicilia) masafuerensis* Zahlbr., in Skottsberg, Nat. Hist. Juan Fernandez Easter Isl. Vol. 2 (Bot.) 3(11): 378. 1924.

Type: Chile, Juan Fernández Islands, Más Afuera [Isla Alejandro Selkirk], Quebrada de las Casas, C. & I. Skottsberg s.n. (W0207554 – holotype, high resolution image seen; BM, GB, LD, NY!, UPS – isotypes).

**Description.** Thallus wide spreading, effuse, creamy-yellow to pale grey.  $\sim$ 0.3–0.5 mm thick, smooth cracked-areolate, areoles rhomboid, flat to slightly convex separated by fine cracks, 0.4–0.6 mm across. In section a thin hyaline cortical layer  $\sim$ 20–25  $\mu$ m thick above a thick photobiont layer  $\sim$ 200  $\mu$ m thick that is interrupted by narrow bands of medullary tissue 20–25  $\mu$ m wide; medulla to 250  $\mu$ m deep, hyaline above becoming rusty brown below, slightly I+ mauve (only apparent in section). Photobiont chlorococcoid, cells thin-walled  $\sim$ 8–15  $\mu$ m diam. Apothecia innate, lecideine, often separated from the thallus by a wide crack, disc dark-brown, mid-brown when wet, concave, 0.4–0.6 mm across, proper margin not apparent, but with a section of the thallus adhering to the disc forming a pseudothalline margin. In section: proper exciple cupular, dark brown  $\sim$ 10–25  $\mu$ m wide, but becoming thinner towards the surface and often visible only as a narrow band of hyaline, vertically aligned – hyphae  $\sim$ 5  $\mu$ m wide. Hymenium 175–200  $\mu$ m deep, upper



**Figure 2.** *Xenolecia masafuerensis* (Imshaug 36697 – topotype). A – thallus and apothecia; B – apothecia; C – section of apothecium; D – section of exciple; E – pycnidia; F – conidia; G – ascospore in ascus. Scale bars: A = 2 mm; B = 0.5 mm; C = 100  $\mu\text{m}$ ; D = 50  $\mu\text{m}$ ; E = 1 mm; F & G = 10  $\mu\text{m}$ .

25–50  $\mu\text{m}$  (epihymenium) with dilute brown pigment (K–, N+ yellow), merging imperceptibly into the hypothecium, which is hyaline above (~75–100  $\mu\text{m}$ ) gradually becoming golden brown below (lowest 75–100  $\mu\text{m}$ ), underlain by the

dark proper exciple (25  $\mu\text{m}$  thick); paraphyses sparingly branched and anastomosing, ~1–1.5  $\mu\text{m}$  thick, widening at the apex to 2.5–3  $\mu\text{m}$ , rarely with a brown pigmented cap. Asci *Porpidia*-type,  $\pm$ cylindrical ~80–100  $\times$  25–30  $\mu\text{m}$ ;

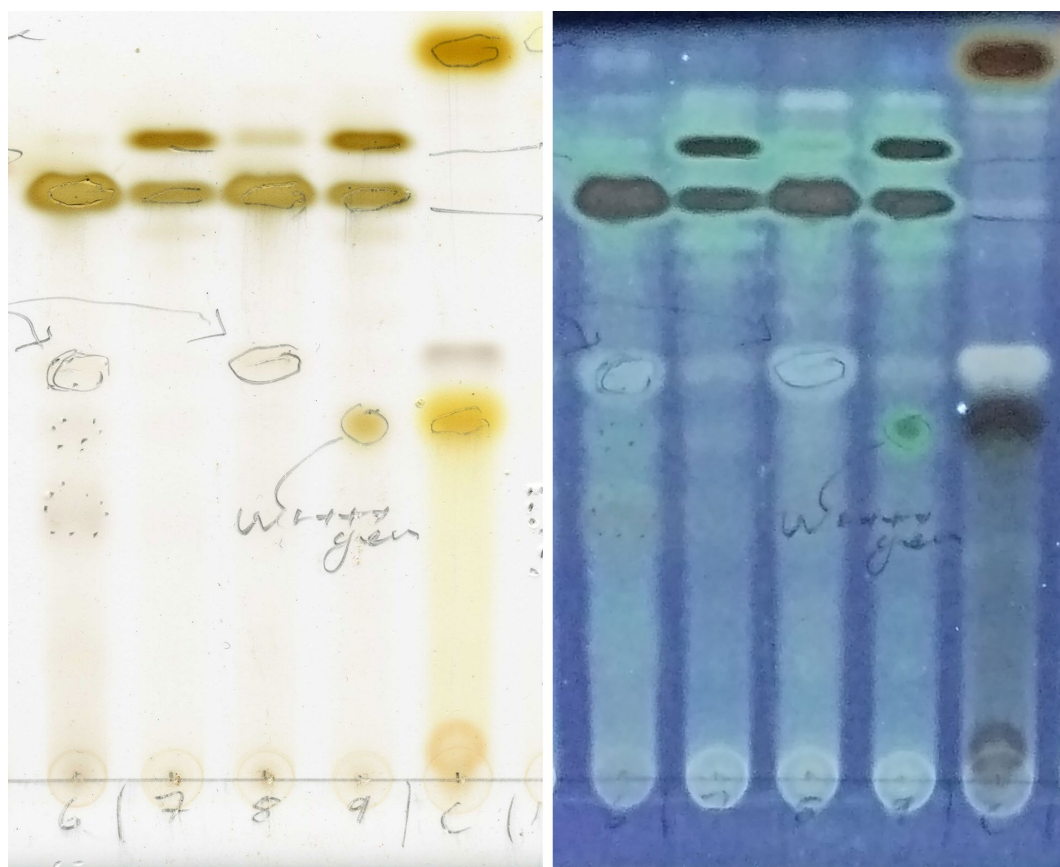
ascospores simple, hyaline,  $(14.5\text{--}18.9 \pm 3.6\text{--}22) \times (6.5\text{--}9.3 \pm 1.7\text{--}12) \mu\text{m}$ , l/b ratio  $(1.5\text{--}2.1 \pm 0.4\text{--}2.6)$ ;  $n=38$ , spore wall  $1\text{--}1.5 \mu\text{m}$  thick, perispore not apparent. Conidiomata pycnidia, frequent, especially along margins of adjacent thalli, pale brown, immersed,  $\sim 0.05 \text{ mm}$  diam.; conidia short filiform,  $10\text{--}15 \times 1 \mu\text{m}$ .

**Chemistry.** All spot tests negative; 2'-*O*-methylperlatolic acid, confluent acid,  $\pm$ ?anziaic acid by tlc (Fig. 3).

**Discussion.** The genus *Xenolecia* is characterized by having *Porpidia*-type asci, innate (aspidioid) apothecia with a brown disc and abundant pycnidia containing filiform conidia (Hertel 1984). All three described species occur in damp habitats subject to periodic inundation – most often on rocks in or beside streams (Fryday & Thüs 2017). Fryday et al. (2021) suggested that *L. masafuerensis* was probably a synonym of *X. spadicomma*, but closer examination has shown a number of differences: *X. masafuerensis* has smaller apothecia ( $0.5\text{--}2.2 \text{ mm}$  diam. in *X. spadicomma*) and ascospores (mean  $23.0 \times 10.7 \mu\text{m}$  in *X. spadicomma*) and a  $\pm$ hyaline hypothecium (dark brown in *X. spadicomma*) suggesting it was a distinct species. Labels on the Imshaug collections also indicated that the species contained an unknown substance giving crystals resembling those of cryptochlorophaeic acid in GE (1:3 glycerine: glacial acetic acid). Thin layer chromatography of *X. masafuerensis* revealed the presence of 2'-*O*-methylperlatolic and confluent acids as major

substances, with an additional substance giving a green spot at Rf 4 under UV light after charring in solvent C (possibly anziaic acid) also being detected in one specimen. This contrasts with *X. spadicomma*, which has only confluent acid as a major substance with 2'-*O*-methylperlatolic acid and 2'-*O*-methylmicrophyllinic acid as minor substances (Fig. 3). These results indicate that *X. masafuerensis* and *X. spadicomma* contain different chemosyndromes: the confluent acid chemosyndrome in *X. spadicomma*, and the 2'-*O*-methylperlatolic acid chemosyndrome in *X. masafuerensis* (Gowan 1989), providing further evidence that *X. masafuerensis* should be recognized as a distinct species. Both species are clearly distinguished from the third species in the genus, *X. cataractarum*, the thallus of which contains norstictic acid, giving a bright red reaction with K (needle-shaped crystals in section), the other two species being K–.

**Typification.** Zahlbruckner (1924) gives the type locality of *Lecanora masafuerensis* as “Chile: Masafuera, Quebrada de las Casas, bei 450 m, auf vulcanischem Gestein (C. & I. Skottsberg)”. There is a specimen in the Naturhistorisches Museum Wien (W), which is where Zahlbruckner was based, labeled “Typus” and “spec. orig.”, and is also annotated “Juan Fernandez, Masafuera, in Quebrada de las Casas, leg. C. & I. Skottsberg”, but no altitude or date of collection are given (Fig. 4). There are also collections of *Lecanora masafuerensis* collected by C. & I. Skottsberg from Quebrada de las Casas in several



**Figure 3.** Thin layer chromatography plate under natural (left) and UV light (right). In 6 *Porpidia cinereoatra* (McCarthy 3570): confluent acid; In 7, *Xenolecia masafuerensis* (Imshaug 36704); In 8, *X. spadicomma* (Imshaug 41549); In 9 *X. masafuerensis* (Imshaug 36872); In 10 control: norstictic acid, zeorin, atranorin.

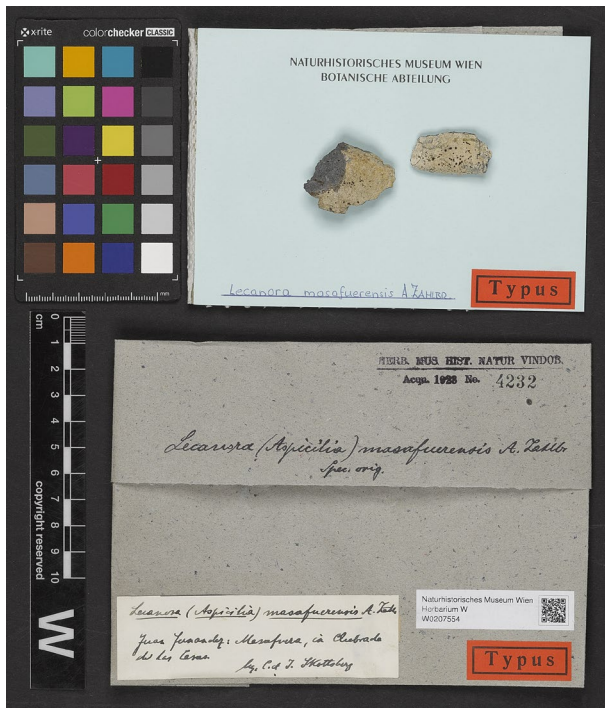


Figure 4. *Xenolecia masafuerensis*. Holotype (W; <https://w.jacq.org/W0207554>).

other herbaria (BM, GB, LD, NY, UPS (2)) that have labels similar to each other, but different to that of the collection in W. These labels are all headed “SVENSKA PACIFICEXPEDITION 1916–17” and appear to have been written by a different person than annotated the specimen in W (presumably Zahlbruckner) and spell the locality “Zuebrada de las Casas”. These labels also usually include a date of collection “10/3 1917” and are annotated “Det. A. Zahlbr.” (Fig. 5). Two, in GB and UPS, have the elevation given as 150 m but none have the elevation given as 450 m, which is that given in the protologue. The elevation given in the protologue is probably a transcription error as it is unlikely that the Skottsbergs reached that altitude on the Island (from his field books it is clear that Imshaug certainly didn’t get higher than ~200 m). These collections and the specimen in W are all from the same locality and it is safe to assume that they were all collected on the same date and, therefore, constitute a “single gathering” (ICNafp Art 8.2: footnote). Because the collection in W is housed in the herbarium where the describing author worked and is clearly labeled “Typus” and “spec. orig.” it should be regarded as the holotype, with the other collections being isotypes.

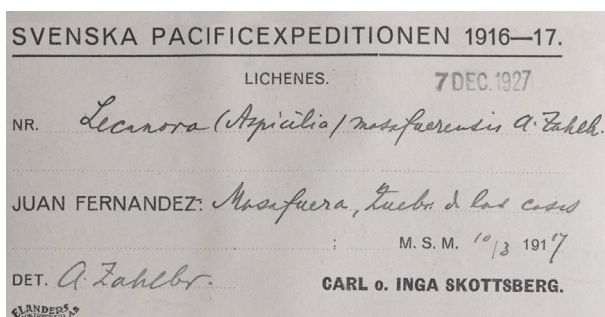


Figure 5. *Xenolecia masafuerensis*. Isotype label (BM).

**Imshaug collections.** Imshaug’s field books are preserved in MSC. For 27 November 1965, the day he landed on Más Afuera) he wrote:

Base camp elevation reads c. 400 ft., all other readings of 27 Nov, based on this. On this day went up Quebrada Casas to point where waterfalls prevented further travel. Collected from this point back to Base Camp.

In his account of the expedition Meyer (1966) writes that “A suitable camping site was found in Q. de las Casas along the stream about a quarter of a mile from the settlement.”, which would put the base camp at ~275 ft. (~85 m). At this altitude the Quebrada is relatively broad, whereas at 400 ft. (~120 m) a further ¼ mile (~400 m) inland up the Quebrada, it is narrow and there is no suitable place for a large group to camp. We must assume, therefore, that, as he implies, Imshaug had not recalibrated his altimeter on landing on Más Afuera and it is necessary to subtract ~125 ft. (~40 m) from his readings for that day.

All three collections of *X. masafuerensis* from Quebrada de las Casas (Fig. 1) were collected from Imshaug’s first collection site for that day, of which he writes:

At 650 ft. canyon very narrow and walls and base rocks covered with bryophytes. filmy ferns and *Gunnera*. Very few lichens except on large rocks in stream.

Imshaug then gives separate entries for collections at 600 ft, 550 ft. and 450 ft., but *X. masafuerensis* was not collected at these lower locations. This means that *X. masafuerensis* would have been collected between 475–525 ft. (145–195 m a.s.l.).

Two days later (29<sup>th</sup> November) Imshaug collected in Quebrada de las Vacas, (Fig. 1) ~1.5 km south of Quebrada de las Casas. In his field book he wrote:

At two waterfalls in valley (elev. 100 ft.). Valley is a narrow gorge. Collections mainly from large rocks at least partially inundated after rains.

*Xenolecia masafuerensis* was collected at this site, but although Imshaug then gives separate entries for collections up to 650 ft. (~200 m), there are no collections of *X. masafuerensis* from these higher locations.

**Distribution.** The two known localities of *Xenolecia masafuerensis* are ~1.5 km apart. In Quebrada de las Casas, *X. masafuerensis* was collected only above 145 m a.s.l., whereas in Quebrada de las Vacas it was collected only at ~30 m a.s.l. As these were the altitudes at which Imshaug started collecting, it is possible that *X. masafuerensis* was present at the other altitudes but was not collected. Also, it is possible that, because these were the first two sites where he collected on Juan Fernandez, *X. masafuerensis* may have been present elsewhere but not collected because he had already recorded it from the islands. However, Imshaug was a very thorough collector and made ~1,600 lichen collections on the archipelago (Fryday & Prather 2001), so it seems unlikely that he would not have recorded the species’ presence at other localities if it was there – especially when he visited the other main island of the group, Isla Robinson Crusoe (Más a Tierra). It is also perhaps significant that the species was not recorded by Redón & Quilhot (1977), because they did not visit Isla Alejandro Selkirk, their collections being confined to Isla Robinson Crusoe.

**Other specimens examined.** CHILE. Juan Fernandez, Más Afuera [Isla Alejandro Selkirk], Quebrada de las Casas, narrow section, [c.  $-33.765^{\circ}\text{S}$ ,  $-80.768^{\circ}\text{W}$ ], with abundant bryophytes, filmy ferns and *Gunnera*, 200 m, 27 Nov. 1965, H.A. Imshaug 36697 (MSC, UMCE), 36698 (MSC, HO), 36704 (MSC, LD, E, M); *ibid.*, Quebrada de las Vacas, near two waterfalls of stream in narrow section of canyon, [c.  $33.775^{\circ}\text{S}$ ,  $-80.758^{\circ}\text{W}$ ], 100 m, 29 Nov. 1965, H.A. Imshaug 36869 (MIN, MSC), 36972 (MSC, NY, UPS).

## Conclusion

Seventy percent of the vascular plants of Juan Fernández are endemic to the archipelago (Meyer 1966), so it is not surprising to find a lichen that also occurs nowhere else. *Xenolecia masafuerensis* was recorded by Skottsberg only at 150 m a.s.l. in Quebrada de las Casas and by Imshaug between 145 and 195 m a.s.l. at the same locality and at  $\sim 30$  m a.s.l. in the nearby Quebrada de las Vacas (Fig. 1). Both collectors made numerous collections of the species so it must have been quite frequent. It appears that *X. masafuerensis* is a narrow endemic known from only a small area of one island of the Juan Fernández archipelago where it appears to be quite frequent – or at least it was 60 years ago! The sites are remote and rarely visited so the species is probably not in any danger, but it would be good to know its current status and monitor any changes that may occur in the future.

## Acknowledgements

Jack Elix (Canberra) is thanked for assistance with identifying the TLC products. I also thank the curators and other personnel of the herbaria GB, UPS & W for responding positively to my requests for images of the specimens in their care, to the curators of NY for the loan of their isotype specimen and the curators of BM and W for permission to reproduce images of their collections. I also thank an anonymous reviewer for details of the visit by Redón & Quilhot to Robinson Crusoe Island, of which I was previously unaware.

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