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Aspidiotus bornmuelleri Lindinger, 1911, rev. comb. (Hemiptera: Coccomorpha: Diaspididae), a neglected endemic species from Macaronesia, with comments on the genus *Cryptophyllaspis,* and further notes on the scale insect fauna of Canary Islands, Spain

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Abstract

Cryptophyllaspis bornmuelleri (Lindinger) (Hemiptera: Diaspididae), an endemic plant-galling species from the Canary Islands, has been re-collected in Tenerife. The galls induced by this species on *Globularia salicina* leaves and the diaspidid adult female are redescribed and illustrated. Detailed study of the species has resulted in the combination *Aspidiotus bornmuelleri* Lindinger being revived, with *C. bornmuelleri* sunk as a junior synonym. Its taxonomic history, and comments on the genus *Cryptophyllaspis* and the other species pertaining to it, are reported. Further data on the scale insect fauna of Canary Islands are also presented.

Key words: *Globularia salicina,* galls, redescription, *Voraspis nerii, Icerya seychellarum*, *Bambusaspis miliaris*

Introduction

Lindinger was the first coccidologist to attempt a systematic study of the scale insect fauna of the Canary Islands and Madeira. Between 1908 and 1912, he described several new scale insect species, of which 13 are endemic, mostly linked to endemic plants of the Macaronesian area (Table 1).

Some of the endemic diaspidids described by Lindinger were redescribed years later and in some cases transferred to other genera, namely *Aonidiella lauretorum* (Lindinger, 1911), *Diaspidiotus laurinus* (Lindinger, 1912), *Aonidiella taorensis* (Lindinger, 1911), *A. tinerfensis* (Lindinger, 1911), *Cryptaspidiotus aonidioides* Lindinger, 1911 and *Diaspis barrancorum* Lindinger, 1911 (McKenzie 1938; Ferris 1943; Balachowsky 1948; 1950; 1951; 1954). *Cryptaspidiotus barbusano* (Lindinger, 1908) was re-collected in May 2003 in the Jardín Botánico Canario Viera y Clavijo, Tafira Alta, Las Palmas de Gran Canaria, and its peculiar scale cover was described in detail by Porcelli *et al.* (2012). Other species, namely *Aspidiotus gymnosporiae* Lindinger, 1911, *A. tafiranus* Lindinger, 1912 and *A. bornmuelleri* Lindinger, 1911 (see the Taxonomy section below for a discussion on the generic assignment) are known only from the original descriptions and have not been collected since.

A visit to the Jardín de Aclimatación de la Orotava in Puerto de la Cruz (Tenerife) in October, 2016, lead to the collection of small, conical galls on the leaves of *Globularia salicina* Lam. (Plantaginaceae), an endemic bush of Macaronesia (Plate 1a, b, c). Inside each gall there were some specimens of a diaspidid (mostly adult females and crawlers). According to the host plant and the gall description by Rübsaamen (1902) and Lindinger (1911), we suspected the species could be *A. bornmuelleri*, and this was confirmed later by the study of slide-mounted specimens.

The finding of this endemic species more than one hundred years after its original discovery and description enabled us to describe both the gall induced on the leaves by the diaspidid and the position of the diaspidid inside

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the gall. Moreover, the adult female is redescribed and illustrated, based on the recently collected specimens, as the original description needs to be updated to match modern standards.

Material and methods

Two small twigs, each bearing about 25 galled leaves, were collected on October 30, 2016, at the Jardín de Aclimatación de la Orotava, 28°24'39" N, 16°32'7" W, and preserved in 70% alcohol. In the laboratory, the galls were carefully opened with a scalpel to verify the developmental stages and count the number of specimens inside each gall. Some galled leaves were preserved in 70% alcohol for further observations. The specimens were slide mounted according to the procedures of Ben-Dov and Hodgson (1997). Moreover, a number of females were slide-mounted unstained, after bleaching at 50°C in NaOH/Sodium lauryl sulphate and clearing in Essig's Aphid Fluid. Pictures and drawings were made using bright field and phase contrast illuminations at magnifications of up to x1,200. The microscope was tested positively to discriminate details down to 1 µm.

Specimen depositories: specimens were deposited at the Scientific Museums of the University of Padova (Italy): Department of Agronomy, Food, Natural Resources, Animals and Environment–Entomology, Padova, Italy (DAFNAE); and The Scale Insect Collection, University of Bari Aldo Moro, Department of Soil, Plant and Food Sciences sez. Entomologia e Zoologia, Bari, Italy (DiSSPA).

Results and discussion

The genus *Cryptophyllaspis* Cockerell, 1897 and its species

In 1897, Cockerell erected *Cryptophyllaspis* as a subgenus of *Aspidiotus*, with *A. occultus* Green, 1896 as the type species. Cockerell (1897) gave the following explanation for the erection of the new subgenus: "*A form discovered by Green in Ceylon, living in leaf-gall of* Grewia". In 1899, Cockerell himself changed the status of *Cryptophyllaspis* from subgeneric to generic rank without any explanation. Fernald (1903) accepted the generic status of *Cryptophyllaspis* and considered it to be close to *Aspidiotus*.

Subsequently, a few other gall-forming diaspidids were included in the genus *Cryptophyllaspis*, namely *C. ruebsaameni* Cockerell, 1902; *C. liquidambaris* Kotinsky, 1903; *C. elongata* (Green, 1905), and *C. bornmuelleri,* the last two having been described previously in the genus *Aspidiotus.* Of these, *C. liquidambaris* is a North American species, *C. occulta, C. elongata* and *C. ruebsaameni* are Oriental (from Sri Lanka and Papua New Guinea respectively), while *C. bornmuelleri* is a Macaronesian species.

The inclusion of these species in *Cryptophyllaspis* was controversial. Lindinger (1911) did not recognise the genus *Cryptophyllaspis* [as suggested by Rübsaamen (1902)] for the new species *bornmuelleri* and described it in the genus *Aspidiotus*. Ferris (1938, 1941) observed that the ability to be a gall-maker could hardly be taken as a basis for distinguishing a genus and that the validity of genus *Cryptophyllaspis* could be determined only by a study of the species then included in it. As a consequence, *C. liquidambaris* was transferred to the genus *Diaspidiotus* (Ferris 1938a) and *C. occulta* and *C. elongata* were placed in *Aspidiotus* (Ferris 1941). Borchsenius (1966) simply accepted the genus *Cryptophyllaspis* and included four species: *C. occulta*, *C. elongata*, *C. ruebsaameni* and *C. bornmuelleri.* This situation did not change until the work of Williams and Watson (1988) and Normark *et al.* (2014). The history and present systematic position of the four *Cryptophyllaspis* species are discussed below.

Cryptophyllaspis occulta (Green, 1896)

This minuscule species forms minute rounded galls on the upper leaf surfaces of *Grewia orientalis* L. (Malvaceae). It is known only from the original record in Sri Lanka. According to Green (1896), the scales settle on the leaf underside, and the adult female becomes completely enclosed in the leaf tissue. Green placed this species in *Aspidiotus*, but Cockerell (1897) referred to it as *Aspidiotus (Cryptophyllaspis) occultus.* Leonardi (1897) transferred it to *Hemiberlesia* and Cockerell (1899) placed it in *Cryptophyllaspis*. Ferris (1938) presented a

drawing of *C. occulta* based on specimens from the type material; three years later, the same author in his in-depth study on the genus *Aspidiotus* considered it to be an *Aspidiotus* species (Ferris, 1941). Borchsenius (1966) maintained the species in *Cryptophyllaspis.*

Cryptophyllaspis elongata (Green, 1905)

Green (1905) stated that this species forms pit galls on the upper surface of the leaves of *Grewia*; the opening of each gall is closed by the scale cover; and that the female cover consists principally of a delicate film lining the cavity of the gall. The species is known only from the original record in Sri Lanka. Green described it as *Aspidiotus (Cryptophyllaspis) occultus elongatus,* i.e., a subspecies of *A. (Cryptophyllaspis) occultus*. Sanders (1906) elevated it to species rank in the genus *Cryptophyllaspis*. Ferris (1941) considered it to be an *Aspidiotus,* but later Borchsenius (1966) transferred the species back into *Cryptophyllaspis.* Munting (1971) presented the first reliable drawing of the pygidium of this species as *Cryptophyllaspis elongatus*.

Hemiberlesia ruebsaameni (Cockerell, 1902)

This species, recorded only from Papua New Guinea (Bismarck Archipelago), forms small cylindrical galls, each about 2 mm long, in clusters on the leaves of *Codiaeum* sp. (Euphorbiaceae). It was originally described by Cockerell (1902) in the genus *Cryptophyllaspis.* Williams and Watson (1988: 17) studied a few original slide-mounted specimens, described as "*in poor condition*", and concluded that "*The species seems to be a component of* Abgrallaspis *or a genus close to it*", but they took no formal action to transfer it to a different genus. Despite this, the species was moved to *Abgrallaspis* by Ben-Dov and German (2003).

Recently, Normark *et al.* (2014) made the genus *Abgrallaspis* a junior synonym of *Hemiberlesia*. As a consequence of this action, in the same paper Normark *et al.* transferred twelve *Abgrallaspis* species to the genus *Hemiberlesia* with the following explanation: "*thought to be congeneric with it*". *Abgrallaspis ruebsaameni* was included among them, and is presently treated as *H. ruebsaameni* in García Morales *et al.* (2016).

Aspidiotus bornmuelleri Lindinger, 1911

Taxonomy

Cryptophyllaspis bornmulleri Rubsaamen 1902: 62, *nomen nudum*.
Aspidiotus bornmulleri Lindinger 1911: 9, accepted valid name.
Cryptophyllaspis bornmuelleri (Lindinger, 1911): Borchsenius 1966: 272, emendation of the species name and change of combination; Carnero Hernandez & Perez Guerra, 1986: 35; Danzig & Pellizzari, 1998: 224; García Morales *et al.* 2016.
Aspidiotus bornmuelleri Lindinger, 1911: revived combination (present paper).

Taxonomic history of the species. Rübsaamen (1902) was sent this species by Bornmueller, who collected it in Madeira (Funchal) on *Globularia salicina* Lam. (Plantaginaceae) on May 30, 1901. Rübsaamen briefly described the leaf galls as follows: "*Conical galls 2-3 mm high. The gall opening differs from galls induced by mites on other plants because of the absence of hairs. The gall maker is a scale insect and surely a species of* Cryptophyllaspis *that I name* bornmulleri *in honour of its discoverer. The description of the adult scale insect will follow in another paper in a short time*". In fact, Rübsaamen never did describe the new species, and *Cryptophyllaspis bornmulleri* Rübsaamen is a *nomen nudum*.

A few years later Lindinger (1911) gave the first valid description and illustration of the scale insect (adult female and nymphs) based on specimens sent to him by Rübsaamen. According to Lindinger's description (1911), the male galls are thin and 1/3 longer than those of the female, which are wider and cylindrical. According to Lindinger, only one male is present in each male gall, whereas two individuals are most frequently present in each female gall. Moreover, Lindinger described the covers as "*female scale white, flat, elongate; exuviae subcentral, length and width undetermined because the adult lives inside the gall and its cover could not be kept intact during the extraction from the dry gall. Male cover linear, white, 1.1 mm long, 0.36 mm wide, with apical exuvia*".

At the end of the morphological description, Lindinger (1911) added the following information: "*Tenerife, Barranco de San Andrés, many specimens on leaf galls, leg. Bornmueller, 30.05.1901: adult females in second instar exuviae, adult female with eggs with embryos, empty male covers, second instar males".* Lindinger adds the following about the galls and gall makers: *"Bornmueller included the observation on the host plant distribution at n. 3040 of Plant exsiccata, Canarias, "with coccids" (sp. nov.). Rübsaamen… described the gall in Marcellia (1902)… He* (referring to Rübsaamen) *does not mention the place of the record*".

After the gall description (in some parts unclear), Lindinger added "*The adult specimens sent to me by Rübsaamen for the description as* C. bornmuelleri *agree with the specimens coming from the Herbarium of Hamburg and Berlin* (also confirmed in Weidner and Wagner, 1968)*, so that they could come from the same place*". Moreover: "*I maintain the same species name chosen by Rübsaamen… but I refuse to accept the genus* Cryptophyllaspis *because it does not have any foundation*". In fact, the new species was described as *Aspidiotus bornmuelleri* Lindinger, 1911.

In the same paper, Lindinger presented a photograph of a *Globularia* twig (dry herbarium specimen) with many conical galls on the leaves. It is clear that Lindinger described the species from dry material collected years before by Bornmueller, preserved in an herbarium and sent to him by Rübsaamen.

One year later, in his book (1912), Lindinger redescribed the *A. bornmuelleri* galls as "*galls nipple-shaped (mainly males) or cylindrical (mainly females) with a rounded apex and large opening. Cover oval whitish, more or less flat*".

Later, Borchsenius (1966) transferred this species to the genus *Cryptophyllaspis,* a combination accepted until this day.

Distribution. *Aspidiotus bornmuelleri* is an endemic species of Macaronesia, recorded so far only from Funchal, Madeira (Rübsaamen 1902) and the Canary Islands (type locality: Barranco de San Andrés, Tenerife) (Lindinger 1911). In 1931, Lindinger published a list of other localities in Tenerife where the species was recorded, without collection dates (Vuelta Blanca, Barranco de la Goleta, Los Núñez, Los Frailes, Lomo de Llerena). Considering that Lindinger stayed on the island from 1914 to 1919 (Williams 1986), these collection data must be prior to the latter date.

Aspidiotus bornmuelleri is strictly linked to its host plant *Globularia salicina* (Plantaginaceae), an endemic shrub common on hillsides in Madeira, and present in Deserta Grande but considered rare in Porto Santo. In the archipelago of Canarias, *G. salicina* is common on southern slopes in Tenerife and in the northern coastal region of La Gomera, uncommon in Gran Canaria, but is also recorded in El Hierro and in the north-eastern area of La Palma (Bramwell and Bramwell 2001).

Gall description and developmental stages. *Aspidiotus bornmuelleri* galls are present on both the upper and lower leaf surfaces, with the gall opening in the opposite surface. Fully-developed galls are sub-conical, with a tapering apex, about 3 mm long; the gall opening is circular-elliptical and has a diameter of about 1.5 mm. The gall is green but the gall apex and the leaf tissue around the gall opening turn yellow and then dark brown in fully-developed galls (Plate 1a, b, d, e). No shape difference was observed among galls induced by females or by males. The crawler, once settled, initially induces a shallow depression, with the first instar at the centre. In some cases, up to 4 crawlers may settle in the same shallow depression. Observations on the gall aperture mostly showed either a thin, white, round to oval scale cover with an eccentric, ochreous, oval first-instar exuviae, closing the gall opening (Plate 1f) and/or the white exit flaps of a male cover. Inside the gall, the female grows and assumes a shape similar to the gall cavity (Plate 1h, i); its prosoma is turned towards the gall apex and its pygidium towards the gall opening. A very thin white waxy film lines the gall cavity where the female has settled.

At the time of the collection (October 30th, 2016), the fully-developed galls usually contained one adult female and in the same gall also one elongate, bivalved empty male cover with the exit flaps towards the gall opening and, thus, visible through the gall opening (Plate 1g). Although the above arrangement (1 female and 1 male per gall) was most common, the following combinations were also noted: a) two adult females and one elongate empty male cover; b) one adult female and two elongate empty male covers; c) only one adult female; d) only one empty male cover; e) one second-instar female; and f) one male pupa or prepupa inside the elongate male cover. In addition, occasionally one or two live crawlers were observed near the female genital opening. The females are ovoviviparous: in two cases, live crawlers with broken egg-chorion were observed partially emerged from the female vulva. The absence of perivulvar pores in adult females supports the likelihood of ovoviviparity.

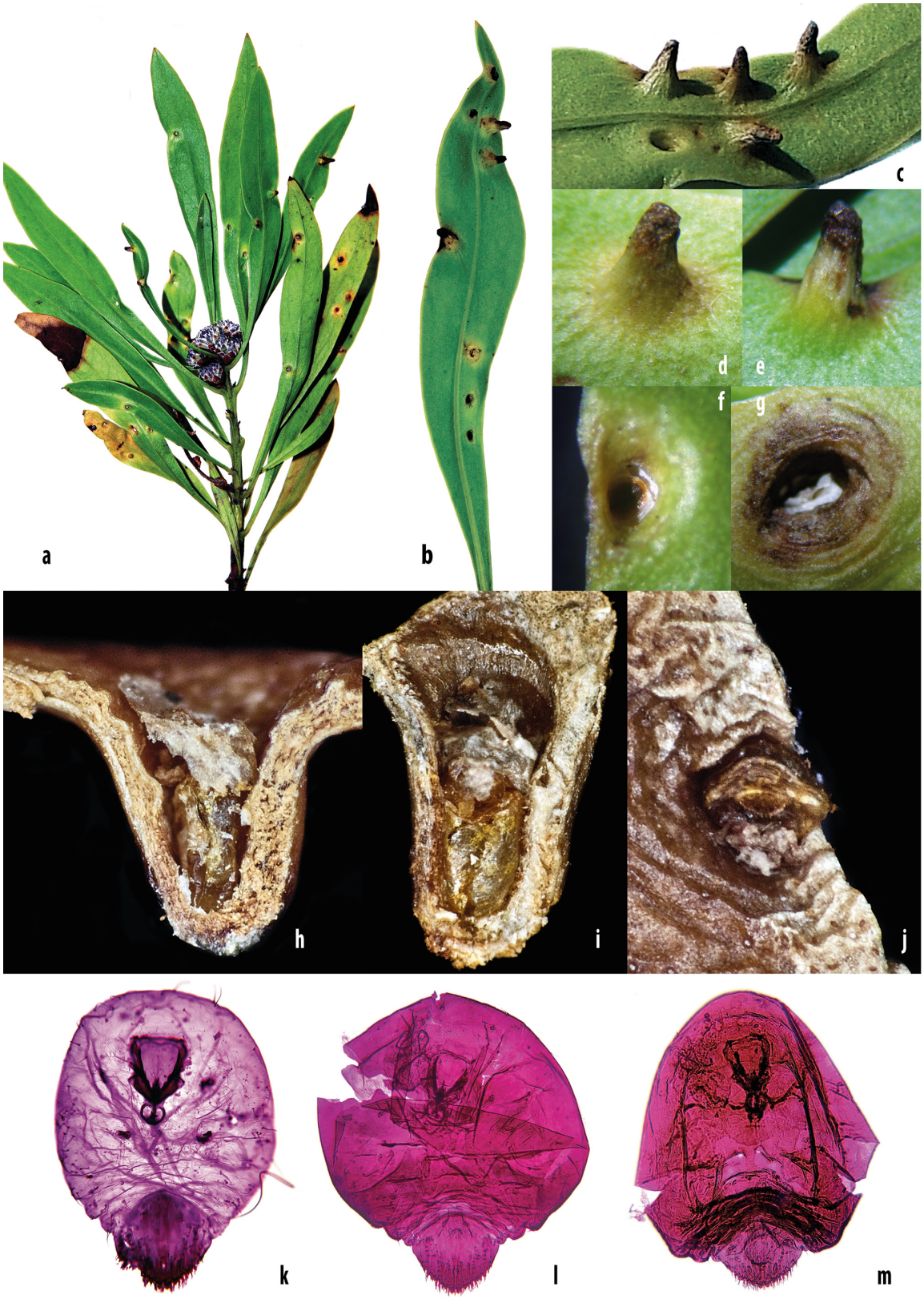

FIGURE 1. a) Twig of *Globularia salicina* with galled leaves; b) galls of *Aspidiotus bornmuelleri* Lindinger on upper and lower leaf surfaces; c) group of *A. bornmuelleri* galls; d and e) "old" galls with blackish tips: inside these galls the diaspidid had already completed its development; f) cover of the adult female, and g) exit flaps of the male cover from the gall opening; h and i) longitudinal section of leaf galls to show position and shape of the adult female inside the gall; j) adult female in (h) viewed from the gall opening: the pygidium is toward the observer; k to m) slide-mounted females: k) teneral, l) mature, and m) post-reproductive females.

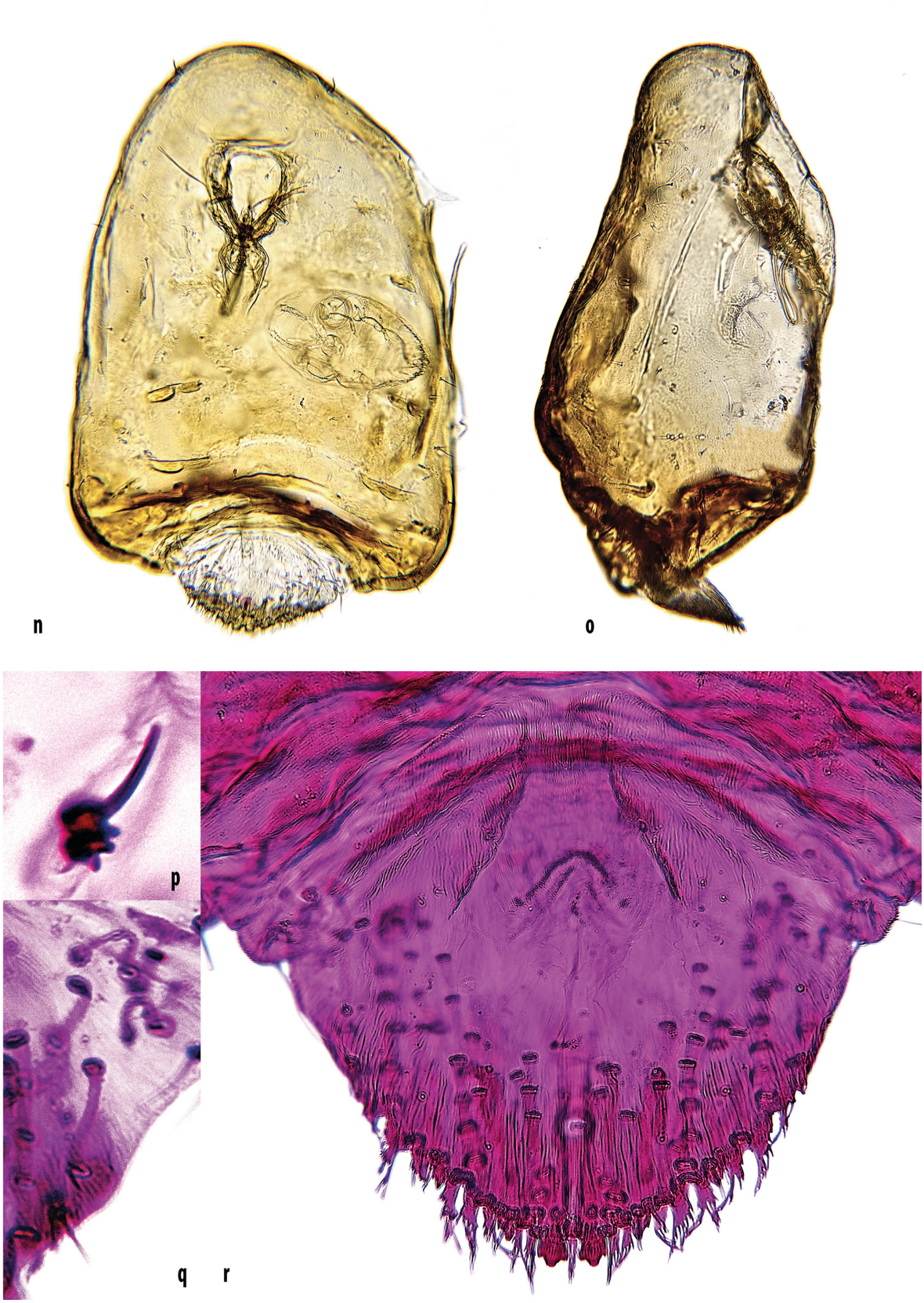

FIGURE 2. n) Reproductive female of *Aspidiotus bornmuelleri* Lindinger viewed from venter, with an embryo inside its body; o) body of a reproductive female viewed from the side. Available gall volume determines the shape of the female's body: note the swelling of the prosoma and position of the pygidium; p) adult female antenna; q) pre-pygidial marginal and submarginal ducts; r) pygidium.

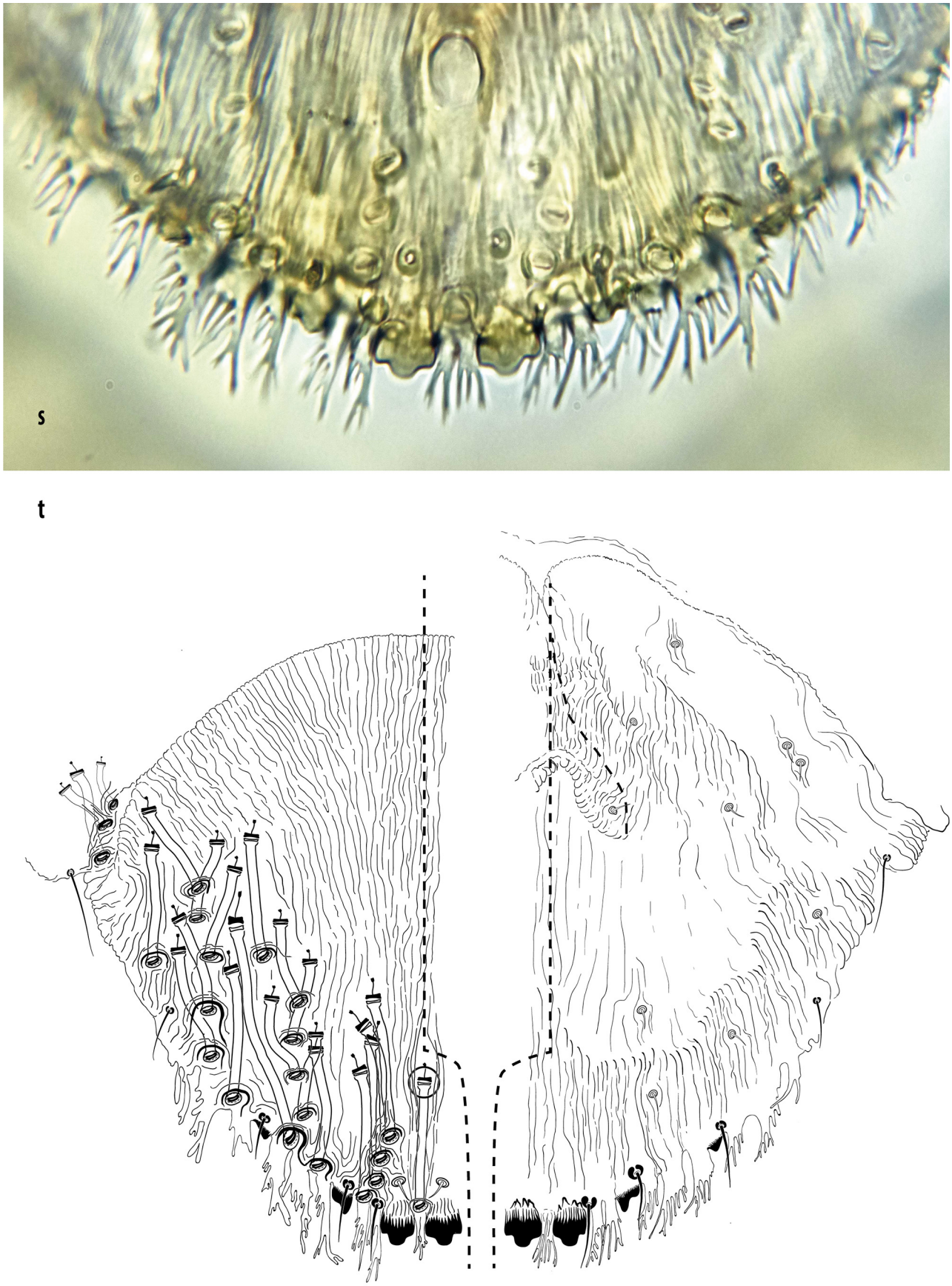

FIGURE 3. s) *Aspidiotus bornmuelleri* Lindinger, margin of adult female pygidium viewed from dorsum; t) taxonomic illustration of pygidium of the adult female *A. bornmuelleri*; left: dorsum, right: venter.

Redescription of the adult female (Plate 3). Redescription based on 10 adult females, collected at Canary Islands, Tenerife, Puerto de la Cruz, on *Globularia salicina*, leg. G. Pellizzari, 30.x.2016; slide numbers: 1882/3; 1882/3A; 1882/8; 1882/9; 1882/10.

In life, body of adult female yellow-ochreous. Slide-mounted young female cordate, prosoma membranous, pygidium lightly sclerotized; body relatively thick/ deep in comparison with other diaspidid species. Reproductive female with body sub-conical, head blunt, maximum diameter at posterior end of prosoma. Prosoma and pre-pygidial abdominal segments sclerotized and partly retracted into prosoma; pygidium fully exposed (Plate 1k, l, m; Plate 2n, o). Dorsal body setae long, distributed along body margin and submargin; antennae each with 1 chaetic seta (rarely 2) and 2 or 3 pegs (spurs) on basal segment (Plate 2p). Spiracular pores absent. Pre-pygidial macropores short, numbering 2 or 3 situated on dorsal margins of abdominal segments II, III and IV. Pygidium (Plate 2q; plate 3) dorsally sclerotized; anal opening broadly oval, situated fully 3 anal diameters from base of median lobes. Lobes numbering 3 pairs: median lobes each with subparallel margins, 1 medial notch and subequal lateral notch; second lobes each smaller than a median lobe, with 1 lateral notch; third lobes smallest, each subtriangular, spinose and usually with a weak lateral notch.

Plates well developed, distinctly longer than lobes; plate formula (following Miller and Davidson 2005): 2, 3, 2/3, space between median lobes containing 2 conspicuous apically fringed plates. Plates between median and second, and second and third pairs of lobes, heavily fringed or branched; plates lateral to third pair of lobes variable, usually branched or fimbriate on external margins. Marginal spines numbering 5 on each side of pygidium. Dorsal macroducts on each side distributed as follows: segment VIII: single marginal macroduct between median lobes extending forwards as far as anal opening; VII: marginal and submarginal macroducts numbering 3 or 4; VI: macroducts numbering 5–7 situated between margin and median area; V: macroducts numbering 4 or 5 situated between margin and median area; IV: with 0 or 1 submarginal macroduct.

Venter of pygidium sclerotized on margin of abdominal segment III; with marginal spines numbering 4 on each side of pygidium; also 8 small setae, each with an evident socket, present on each side of pygidium, in submarginal, median and vulvar areas. Perivulvar pores absent.

Based on this study, and after having considered the detailed diagnosis of the genus *Aspidiotus* by Ferris (1941), we re-transfer *Cryptophyllaspis bornmuelleri* back into the genus *Aspidiotus*.

New records for the Canary Islands

Diaspididae

Voraspis nerii (Newstead, 1895)

Specimens of *V. nerii* were collected from *Nerium oleander* L. (Apocynaceae) in Gran Canaria, Reserva Natural Especial Dunas de Maspalomas, on May 28, 2003. This species was known only in North Africa (Algeria, Morocco, Tunisia), penetrating along the wadis into Central Sahara, following the distribution of its host plant, the wild *N. oleander* (Balachowsky 1954). The finding of this interesting autochthonous species in the Canary Islands expands its known distributional range and confirms the hypothesis by Balachowsky (1946) on the affinity of its autochthonous scale insect fauna with that of Africa.

Asterolecaniidae

Bambusaspis miliaris (Boisduval, 1869)

Bambusaspis miliaris was collected together with *B. bambusae* (Boisduval, 1869), already known from Tenerife (Soria *et al.* 1998; Matile-Ferrero and Oromí 2001), on an ornamental *Bambusa* sp. plant at Puerto de la Cruz (Tenerife) on 30.x.2016. Both species are now cosmopolitan and are frequently found in greenhouses (Ülgentürk *et al.* 2014). They are mostly associated with bamboo species (Poaceae), and are rarely recorded on plants from other families. The small, flat *B. miliaris* females were settled on both surfaces of the leaves, whereas the *B. bambusae* specimens were found on the green culms.

Monophlebidae

***Icerya seychellarum* (Westwood, 1855)**

This is a cosmopolitan and highly polyphagous species. Heavily infested leaves of an undetermined plant were collected in Puerto de la Cruz (Tenerife) on 30.x.2016. In the Macaronesian area, *I. seychellarum* has been recorded previously on the island of Madeira (Franco *et al.* 2011).

TABLE 1. List of the endemic scale insects recorded from the Canary Islands.

Family	Species	Distribution	Host plant
Pseudococcidae	*Pseudococcus aridorum* Lindinger, 1911	Tenerife	*Argyranthemum frutescens*, *Cytisus prolifer* var. *palmensis*, *Trifolium panoramitanum*
	Phenacoccus guanchorum Gavrilov-Zimin & Danzig, 2015	Tenerife	*Erica arborea*
	Fonscolombia menieri (Matile-Ferrero & Balachowsky, 1972)	Tenerife	*Euphorbia canariensis*
Cryptococcidae	*Pseudochermes williamsi* Kozár & Konczné Benedicty, 2008	Tenerife	*Coffea arabica*
Monophlebidae	*Palaeococcus tabaybae* Lindinger, 1919	Tenerife	*Euphorbia regis-jubae*
Diaspididae	*Aonidia campylanthi* (Lindinger, 1911)	Tenerife	*Campylanthus salsoloides*
	Aonidiella atlantorum Matile-Ferrero & Balachowsky, 1972	Tenerife	*Euphorbia canariensis*
	Aonidiella lauretorum (Lindinger, 1911)	Tenerife, Gran Canaria, La Palma	*Gymnosporia cassinoides, Ilex canariensis, I. platyphylla, Oreodaphne foetens, Picconia excelsa, Smilax canariensis, Hedera helix canariensis, Apollonias canariensis, Visnea mocanera*
	Aonidiella taorensis (Lindinger, 1911)	Tenerife, Gran Canaria	*Euphorbia aphylla, E. regis-jubae*
	Aonidiella tinerfensis (Lindinger, 1911)	Tenerife, Gran Canaria	*Dracaena draco*
	Aspidiotus gymnosporiae Lindinger, 1911	Tenerife, La Palma	*Gymnosporia cassinoides*
	Aspidiotus tafiranus Lindinger, 1912	Gran Canaria	*Olea europaea*
	Cryptaspidiotus aonidioides Lindinger, 1911	Tenerife, La Palma	*Apollonias canariensis, Laurus canariensis*
	Cryptaspidiotus barbusano (Lindinger, 1908)	Gomera, Tenerife, Gran Canaria, La Palma	*Apollonias canariensis*
	Cryptophyllaspis bornmuelleri (Lindinger, 1911)	Tenerife	*Globularia salicina*
	Diaspidiotus arroyoi (Balachowsky, 1968)	Tenerife	*Spartocytisus nubigenus*
	Diaspidiotus laurinus (Lindinger, 1912)	Tenerife	*Cytisus supranubius, Laurus novocanariensis, Ocotea foetens, Tetraena fontanesii*
	Diaspis barrancorum Lindinger, 1911	Tenerife, Gran Canaria	*Euphorbia regis-jubae*

Concluding remarks on the scale insect fauna of the Canary Islands

According to Matile-Ferrero & Oromí (2001) and García Morales *et al.* (2017), 107 scale insect species have been recorded from the Canary Islands (mostly on Gran Canaria and Tenerife). Some omitted or more recent records add 7 further species, namely *Bambusaspis bambusae* (Boisduval), *Puto barberi* (Cockerell), *Phenacoccus guanchorum* Gavrilov-Zimin & Danzig, *Phenacoccus solenopsis* Tinsley, *Peliococcus globulariae* (Goux), *Mirococcus inermis* (Hall) and *Paracoccus burnerae* (Brain) (Soria *et al.* 1998; Malumphy 2010; Gavrilov-Zimin and Danzig 2015; Masten Milek and Pellizzari 2016). Together with the new records given above, the number of scale insect species so far recorded from the Canary Islands is now 117, in the following families: Asterolecaniidae (3 species), Coccidae (20), Cryptococcidae (1), Dactylopiidae (1), Diaspididae (60), Eriococcidae (2), Monophlebidae (3), Ortheziidae (2), Pseudococcidae (21), Putoidae (2) and Rhizoecidae (2).

There are 18 endemic scale insect species in the Canaries (Table 1), representing 15% of the recorded scale insect fauna; but, if we exclude the alien introduced species, the percentage of endemic species exceeds 32%. This high number confirms the importance the Macaronesian islands as a centre of biodiversity. For instance, the Anaga Rural Park (28°33'48" N, 16°12'04" E), a remote protected area located in north-east Tenerife, was declared a Biosphere Reserve by the UNESCO in 2015, and is considered to have the largest number of endemic species in Europe. In the laurisilva forest of Anaga the diaspidid *Cryptaspidiotus barbusano,* one of the endemic species described by Lindinger, is still present: demes of this species were observed on November 1, 2016 by one of the authors.

Unfortunately, more than 50% of the scale insect species recorded in the Canaries (at least 60 of a total of 117) are alien invasive cosmopolitan species, introduced by man in the past or in recent times. Incidental introductions are still continuing: to the already known alien scale insects of the Canary Islands, we have added two more species: *Bambusaspis miliaris* and *Icerya seychellarum*.

In Tenerife, the destruction of natural habitats by human activities led to the rarefaction or disappearance of some species that now are possibly only confined to the natural reserves or inaccessible wild places in the mountains. In this context, the Botanical Gardens play an important role in preserving not only the endemic plants but also the endemic insects closely linked to them. The re-collection of the endemic *Aonidiella tinerfensis* from *Dracaena draco* (Porcelli, pers. obs.) and *Cryptaspidiotus barbusano* in the Jardín Botánico Canario Viera y Clavijo, Las Palmas, Gran Canaria (Porcelli *et al.* 2012), and the recent collection of *Aspidiotus bornmuelleri* in the "Jardín de Aclimatación de la Orotava" in Puerto de la Cruz (Tenerife) supports this assumption.

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