Typification, taxonomy and distribution of *Braunia squarrulosa* (Hedwigiaceae) in Mexico and Central America

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Abstract. Diagnosis and illustrations are given for *Braunia squarrulosa*. Relevant to the taxonomy of the species, three names needed lectotypification. A Schlechtendahl specimen at BM is the lectotype for *B. squarrulosa*. A collection by Ehrenberg (BM) is the lectotype for *B. sphaerocarpa*. The lectotype for *B. liebmanniana* is a Liebmann specimen located at BM. The last two names are retained as synonyms of *B. squarrulosa*. The worldwide distribution of the species is documented in Mexico, Guatemala, Honduras, Costa Rica and Panama.

Keywords. Taxonomy, nomenclature, lectotypes, Hedwigiaceae, *Braunia*.

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Among species of *Braunia* in Mexico and Central America, *B. squarrulosa* (Hampe) Müll. Hal. is easy to distinguish due to the short setae, globose to urceolate capsules and multicellular spores. The species was first collected by Schlechtendahl, and originally described as *Harrisonia squarrulosa* Hampe (Hampe 1838). Two more species were published from Mexico as *Neckera sphaerocarpa* Müll. Hal. and *N. liebmanniana* Müll. Hal. (Müller 1851) from collections by Ehrenberg (Mineral del Monte) and Liebmann (Pico de Orizaba), respectively. At that time, *Braunia* was established as a genus in the Hedwigiaceae (Bruch et al. 1846) and soon these species were transferred as *B. squarrulosa*, which included *N. sphaerocarpa* and *N. liebmanniana* as heterotypic synonyms. Later, Brotherus (1909) listed *B. liebmanniana* (Müll. Hal.) Besch. for Mexico, but mistakenly attributed *B. squarrulosa* to South Africa. Next, Crum (1951) treated *B. liebmanniana* and *B. sphaerocarpa* (Müll. Hal.) Müll. Hal. as synonyms of *B. squarrulosa*. Subsequently, the comprehensive work by Crum (1994) also recognized *B. squarrulosa* with the same two synonyms.

Preliminary systematic work on the Hedwigiaceae (De Luna 1992) provided a first cladistic analysis of the species of *Braunia* on a worldwide basis. Three terminal units were used to evaluate the position of *B. squarrulosa*, *B. sphaerocarpa* and *B. liebmanniana* among other species in the genus. Such evaluation revealed sister group relationships among terminals which are congruent with the usual taxonomic treatment of *B. sphaerocarpa* and *B. liebmanniana* as synonyms of *B. squarrulosa*. This paper reports nomenclatural and taxonomic findings after reëxamination of type specimens of *B. squarrulosa*, *B. sphaerocarpa and B. liebmanniana*. Necessary lectotypifications for these three names are documented. Furthermore, based on examination of collections from several herbaria, a description of *Braunia squarrulosa* is presented, with illustrations and a summary of the known distribution in Mexico and Central America.

Braunia squarrulosa (Hampe) Müll. Hal., Linnaea 42: 380. 1879; *Harrisonia squarrulosa* Hampe, Linnaea 12: 349. 1838; *Hedwigidium squarrulosum* (Hampe) Bruch & Schimp., Bryol.

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Eur. 3: 161. 1846; *Hedwigia squarrulosa* (Hampe) Mitt., J. Linn. Soc., Bot. 12: 407. 1869. Protologue. "Mexico, Inter muscos Mexicanos, terrestris?". Type: Mexico, *Schlechtendahl s.n.* Hampe Hb. (lectotype, designated here, BM!; isolectotypes, BM!, NY!).

Neckera sphaerocarpa Müll. Hal., Syn. Musc. Frond. 2: 105. 1851; *Braunia sphaerocarpa* (Müll. Hal.) Müll. Hal., Bull. Herb. Boiss. 5: 201. 1897. Protologue. "Mexico: C. Ehrenberg. E Guatemala copiose communicavit Kegel." Types: Mexico, Mineral del Monte, in arbor. *C. Ehrenberg s.n.* (Lectotype, designated here, BM!); Guatemala, communicavit *H. Kegel* (syntypes, BM!, JE!, NY!).

Neckera liebmanniana Müll. Hal., Syn. Musc. Frond. 2: 668. 1851; *Hedwigidium liebmannianum* (Müll. Hal.) Schimp., Syn. Musc. Eur. ed. 1, 239. 1860; *Hedwigia liebmanniana* (Müll. Hal.) Mitt., J. Linn. Soc., Bot. 12: 407. 1869; *Braunia liebmanniana* (Müll. Hal.) Besch., Mém. Soc. Sci. Nat. Cherbourg 16: 185. 1872; *Braunia liebmannii* Kindb., Enum. Bryin. Exot. 8. 1888, *nom. illeg.* Protologue. "Mexico. In monte Orizabensi: Liebmann." Type: Mexico, Orizaba, *Liebmann* (Lectotype, designated here, BM!; isolectotypes, BM!, NY!).

Nomenclatural notes. The original publication of *Harrisonia squarrulosa* (Hampe 1838) described: "Surculo adscendente ramoso; … foliis semiamplexicaulibus late oblongo-ovatis oblique acuminatis;… theca breviseta subrotunda obliqua laevi." This description cites a type from Mexico, but without further information on the collector or locality data. The description was repeated along with an illustration in *Icones Muscorum* (Hampe 1844). There, it was the first place with an explicit mention of the collector of the type specimen: "Inter muscos Mexicanus clarissimus ab Schlechtendahl liberaliter communicavit." I have seen five duplicates of the Schlechtendahl collection. The best specimen (BM-HB HAMPE, sheet 48), designated here as lectotype, consists of three pieces (**Fig. 1**). Each piece is composed of an elongate sympodium, with short terminal modules and few short branches (**Fig. 2**). One stem has two short setae (3–4 mm) although broken at the capsule neck. The specimen is

Figures 1, 2. Lectotype of *Braunia squarrulosa.* **1.** Contents of *Braunia* sheet number 48 at BM. At center is the specimen selected as lectotype. **2.** Detail of lectotype.

supplemented by a hand written description in Latin (**Fig. 1**), which matches the published original description of the species. Two other specimens at BM consist of very few stems individually glued on cards. These have no capsules, but there are several short setae. The two duplicates at NY (hb. Mitten and ex hb.

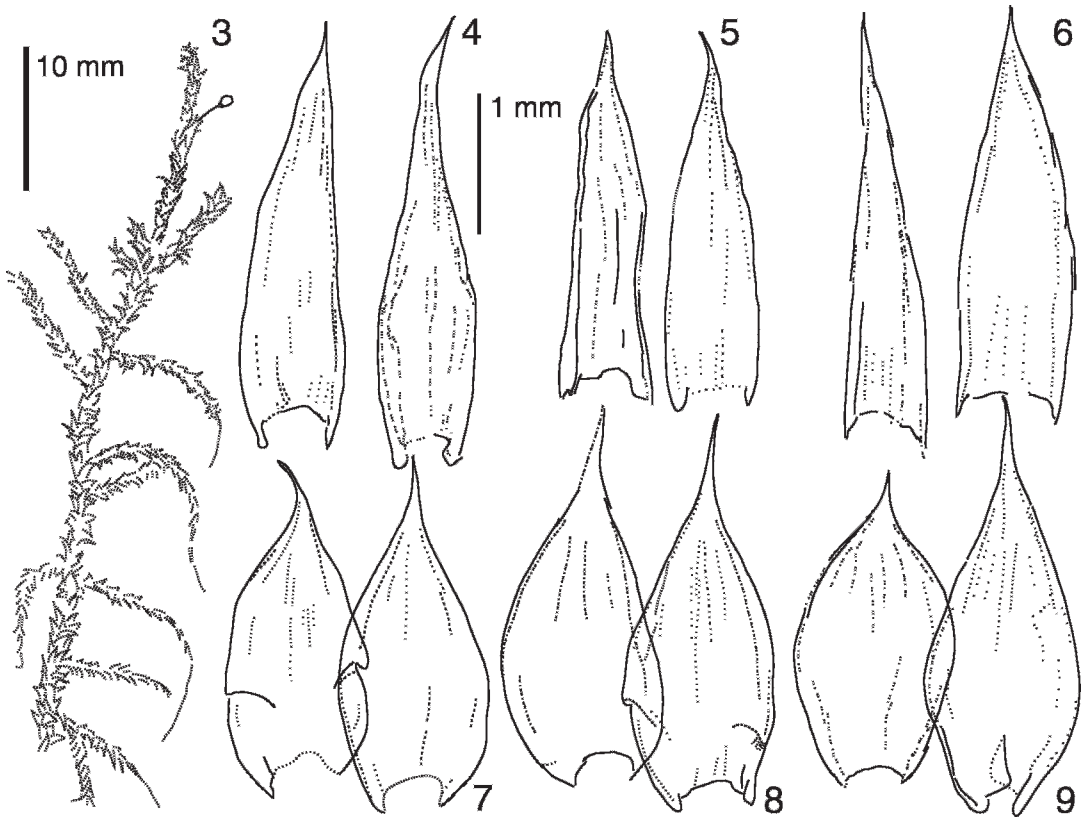
Bescherelle) each consist of a single stem glued on the herbarium sheet, without any remains of sporophytes.

When first published, two types were designated for *Neckera sphaerocarpa*: Ehrenberg (Mexico) and Kegel (Guatemala). The original description fits well features of both specimens: "monoica; latissime caspitosa robustissima…; folia ovato-acuminata…; theca breviter pedunculata maxime globosa, operculo depresso breviter oblique rostrato." The Ehrenberg specimen at BM is designated as lectotype. It consists of a very elongate sympodium composed of several short modules, and with a few short branches. Leaves are erect to patent, plicate, lanceolate, reflexed and aristate. Sporophytes in this specimen consist of a short seta (3 mm) and a globose capsule. The second specimen (Kegel) is represented by two duplicates at BM and two at JE. The specimen at BM HB. HOOK. consists of a very elongate sympodium (10 cm), with a very short seta (2.2 mm) and a globose capsule. The specimen at BM HB. WILSON consists of gametophytes, and only a short seta (3.5 mm). The two duplicates at JE are complete, with robust sympodia and at least three broad, urceolate capsules with short setae (3–4 mm).

The protologue of *Neckera liebmanniana* clearly designated a single specimen, Liebmann, from Mexico. I have seen two duplicates of the Liebmann specimen at BM and one at NY. All fit well the original description: "folia imbricata, … plicata acuminato ovata; … theca in ped. abbreviato siccitate dextrosum torto globosa;…" The best specimen, designated here as lectotype, is on sheet 21 (BM) and consists of an elongate sympodium, with sporophytes terminating each module. There are three short setae (3.5–4 mm), and the capsules are broadly urceolate. The spores are multicellular. The second specimen at BM also has a very elongate sympodium, branched distally, with a short seta (3 mm) and a globose capsule. The duplicate at NY (ex Kew) is only one stem without sporophytes. When Schimper (in Besch., Mém. Soc. Sci. Nat. Cherbourg 16: 185. 1872) transferred *N. liebmanianna* to *Braunia* he listed an additional specimen: "Mexico, In selva della Desierta Vieja, nov 1865, Bourgeau." I have seen two specimens at BM, *Bourgeau s.n.* (Desierta Vieja, Mexique, 1860, Hb. Bescherelle) and *Bourgeau 687* (Pedregal Valle de Mexico, 1865. Hb. Commission scientifique du Mexique), neither of which is *B. squarrulosa*. Both specimens have imbricate, ovate lanceolate leaves, and very long setae (11 mm). These two specimens are better identified as *B. secunda* (Hook.) Bruch & Schimp. There is also a specimen at NY, *Bourgeau s.n.* (Mexico, without locality information). It is a stem glued on paper, it has three elongate setae (11–12 mm) and narrowly elliptic capsules. This specimen is also *B. secunda*.

Description. Plants robust in dense mats; stems with sympodial branching, plagiotropic, (3–)5–7(–10) cm long, scarcely branched; branches arcuate, flexuose; flagelliform branches frequent; pseudoparaphylia foliose, with papillose cells. Leaves ovate or oblong-lanceolate, widest point below middle of leaf; acumen gradually differentiated, to ¼ length of leaf, acuminate to cuspidate, sometimes ending in a flexuose point, concolorous, 2.0–2.5 × 0.8–1.3 mm, concave, imbricate, erect-patent when dry, spreading squarrose when moist, strongly plicate; margins reflexed, sometimes recurved in lower ½, entire or papillose-crenulate; apical leaf cells 22–31 μm long, elliptic, narrow (4–7:1), sinuose, with few low marginal papillae; upper and median leaf cells 12–20 μm long, elliptic (3–5:1), walls nodulose, sinuose, papillae low, on side walls, overarching lumina. Autoicous. Archegonia distal on short vaginula (1.4–1.6 mm); perichaetial leaves oblong lanceolate, 2.4–2.6 mm long, slightly longer than vegetative leaves, acuminate, plicate; paraphyses biseriate at base, 2–3× longer than archegonia, immersed. Setae (3–)4–5(–8) mm long; capsule exserted; necks 0.3–0.4 mm long, sharply differentiated, broad; urns 1.2–1.6 mm long, urceolate to globose, mouth broad, nearly as wide as urn; capsule walls smooth, or wrinkled when dry; exothecial cells polygonal; stomata superficial; operculum base conical, short oblique-rostrate. Calyptrae cucullate, large, hairy. Spores multicellular, 35–42 μm in diameter.

Habitat. This species has been collected epiphytically (base of trees, on oak trunks, on bark of *Juniper*, on trunk of *Cupressus*), on fallen tree branches, forming carpets on very decayed logs, and on volcanic rocks (rarely on soil). It is very common in coniferous and broadleaf forests at middle elevations (1500–2900 m).



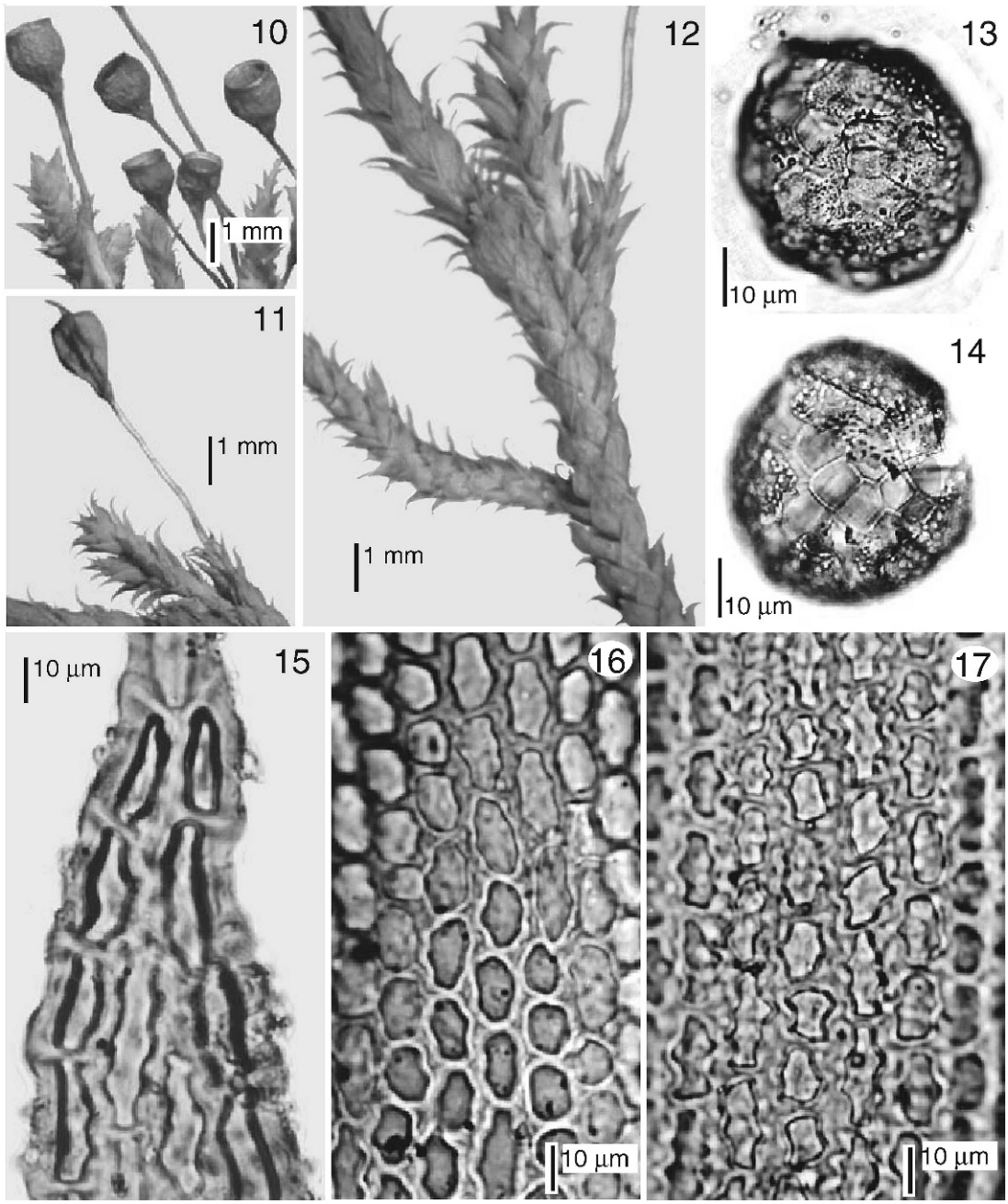
Figures 3–9. *Braunia squarrulosa*. **3.** Habit when dry. **4–6.** Perichaetial leaves. **7–9.** Vegetative leaves. 3 from *Dieterle 3192* (DUKE); 4, 7 from *Schlechtendahl s.n.* (lectotype of *B. squarrulosa*, BM); 5, 8 from *Ehrenberg s.n.* (lectotype of *B. sphaerocarpa*, BM); 6, 9 from *Liebmann s.n.* (lectotype of *B. liebmanniana*, BM).

Distribution. Since it was described, it was known from central and southern Mexico and Guatemala. Recently it was collected in Costa Rica, and for the first time *B. squarrulosa* is documented from Honduras and Panama.

Illustrations. Hampe (1844: 19, as *Harrisonia squarrulosa*); Bartram (1949: 235, fig. 106A–C); Crum (1994: 666, fig. g–i); **Figs. 1–17**.

Selected specimens examined. MEXICO. CHIAPAS: along route 190, *Hermann 26429* (BR, DUKE, NY); DISTRITO FEDERAL: Cima, *Pringle 10550* (BM, NY); DURANGO: near Puerto Buenos Aires, *Breedlove 69154* (DUKE); GUERRERO: about 40 km W of Chilpancingo, *Dieterle 3192* (DUKE); HIDALGO: Mineral del Monte, *Ehrenberg s.n.* (lectotype, BM); JALISCO: Sierra Madre W of Bolaños, *Rose #e* (NY); MÉXICO: Valle de Bravo, *Düll 55a* (JE); MICHOACÁN: Mil Cumbres, cerca de Puerto Garnica, *De Luna 1772* (DUKE, XAL); MORELOS: Tres Cumbres, Zempoala, *Düll 152* (JE); OAXACA: Sierra de Juárez, *Düll 66* (JE); SINALOA: about 6 mi W of Las Palmitas, *Norris et al 20444* (BR); VERACRUZ: Orizaba, *Liebmann s.n.* (lectotype BM, isolectotypes BM, NY); ZACATECAS: Gualterio, Mpio. Chalchihuites, *Cárdenas 1068* (MEXU, MICH, XAL). GUATEMALA. No locality, *Kegel*; *Kegel 3/48*, # *10004* (syntypes BM, JE, NY); HUEHUETENANGO: near Paquix, above Huehuetenango, *Sharp 4766* (DUKE). HONDURAS. LEMPIRA: Montaña de Celaque, Filo Seco, 13 km SW of Gracias, *Allen 12095* (DUKE, MO). COSTA RICA. SAN JOSÉ: Copey de Dota, *Griffin & Morales B 97* (BR, F, USJ). PANAMA. CHIRIQUÍ: E slope of volcán Chiriquí (Barú), WNW of Boquete, *Davidse & D'Arcy 10190 A* (G, MO).

Discussion. Plants of *Braunia squarrulosa* consist of a long chain of modules connecting subterminally, with short branches often becoming stoloniferous (**Fig. 3**). Sympodial stems are robust when epiphytic in shaded and moist environments, but become compact if growing at exposed habitats or on rocks (see. e.g. *Cárdenas 1068*, MICH). Consequently, there is variation in perichaetial and vegetative leaves of *B.*



Figures 10–17. Gametophytic and sporophytic features of *Braunia squarrulosa*. **10.** Capsules. **11.** Capsule with operculum. **12.** Stem. **13, 14.** Multicellular spores. **15.** Apical leaf cells. **16.** Upper leaf cells. **17.** Median leaf cells.

squarrulosa. Perichaetial leaves vary from oblong-lanceolate to very narrowly lanceolate (**Figs. 4–6**). Vegetative leaves most commonly are ovate to oblong-lanceolate, but the acumen varies from short cuspidate to slender acuminate and flexuouse (**Figs. 7–9**).

A short seta (3–6 mm), globose, smooth-walled capsules, plicate leaves wide-spreading to squarrose, and multicellular spores help in distinguishing this from all other species of *Braunia*. Many collections consist of dense mats with several capsules (see, e.g., *Hermann 26429*, DUKE). However, without sporophytes, variability in leaf shape and leaf cells among specimens in Mexico and Central America makes it difficult to distinguish it from *B. secunda*

and *Hedwigidium integrifolium*. In general, the leaves are more strongly plicate, the leaf base is broader, the acumen is slender, long cuspidate and the apical cells are narrower in *B. squarrulosa* than in the other two species. Also, the leaf margins are strongly revolute in *B. secunda* and *H. integrifolium*. These differences are more evident when comparing juvenile leaves in the three species.

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