

New taxa and nomenclatural notes on the flora of the Marojejy massif, Madagascar. V. Cunoniaceae: *Weinmannia*

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ABSTRACT

Sixteen species of *Weinmannia* (Cunoniaceae) are recognized in a treatment of taxa known from the Marojejy massif in northeastern Madagascar. Following the key, descriptions of new species and notes on the circumscription of some previously published species are provided along with information on geographical distribution and citation of collections from Marojejy. Six of these (*Weinmannia lowryana*, *W. integrifolia*, *W. marojejyensis*, *W. pauciflora*, *W. rakotomalzana*, and *W. venosa*) are described as new and one new combination (*W. arguta*) is made. The species present at Marojejy are a broad sample of the diversity among Malagasy *Weinmannia* and contain members of both sections *Inspersa* and *Spicata*, as well as five of the seven species-groups that occur in Madagascar.

KEY WORDS

Madagascar,
Cunoniaceae,
Weinmannia,
Marojejy.

RÉSUMÉ

Nouveaux taxons et notes nomenclaturales pour la flore du massif de Marojejy, Madagascar. V. Cunoniaceae : Weinmannia.

Seize espèces de *Weinmannia* (Cunoniaceae) sont reconnues dans le traitement des taxons de ce genre connus du massif du Marojejy (NE Madagascar). Une clé de détermination, les descriptions des espèces et des notes sur la délimitation de certaines espèces publiées antérieurement sont fournies, ainsi que la distribution géographique et la liste des spécimens provenant du Marojejy. Six de ces espèces (*Weinmannia lowryana*, *W. integrifolia*, *W. marojejyensis*, *W. pauciflora*, *W. rakotomalzana*, and *W. venosa*) sont nouvelles et une nouvelle combinaison (*W. arguta*) est établie. Les espèces présentes au Marojejy fournissent un bon exemple de la diversité au sein des *Weinmannia* malgaches ; on y trouve des représentants des deux sections *Inspersa* and *Spicata*, ainsi que cinq des sept groupes d'espèces qui existent à Madagascar.

MOTS CLÉS

Madagascar,
Cunoniaceae,
Weinmannia,
Marojejy.

INTRODUCTION

Marojejy is an isolated mountain massif in northeastern Madagascar in Antsiranana province. With its tallest peak rising to 2,137 m, the area is home to a diverse flora of upland species. The main massif, its satellite peaks, and some of the surrounding lowlands were protected as Réserve Intégrale No. 12 on 31 December 1927 and the status of the reserve was recently changed to that of a National Park on 19 May 1998.

Numerous species have been described from Marojejy (e.g. HUMBERT 1955) and the area has been widely recognized as a center of plant endemism, particularly for Montane species. Henri HUMBERT collected extensively in the region from 1948 to 1950 and the collections made by him and his colleagues provided the basis for a book on the massif (HUMBERT 1955) and the description of additional species in subsequent publications by various authors.

Marojejy was relatively unknown botanically prior to HUMBERT's efforts. With the exception of brief visits by several botanists in the 1960s and 1970s, little collecting took place there until 1988, when several groups began efforts to survey the massif. This recent collecting at Marojejy continues to yield new taxa (MILLER & PIPOLY 1993; MILLER 1998; MILLER & RANDRIANASOLO 1998; RAZAFIMANDIMBISON & MILLER 1999; MILLER 2000).

Weinmannia L. is the only genus of Cunoniaceae present in Madagascar. HUMBERT (1955) did not cover *Weinmannia* in his account of the plants from Marojejy, but BERNARDI (1965) recognized 20 species in the Flore de Madagascar et des Comores, and he described one additional species afterwards (BERNARDI 1969), bringing the total known from Madagascar to 21 species. Recent review of new collections from Madagascar indicates that there are probably 15-20 additional new species that BERNARDI did not recognize or for which he had no material.

Weinmannia is one of the largest woody plant genera at Marojejy, with sixteen species known from the area, six of which are newly described here. Additional collections may represent other species new to science or new to Marojejy, but are inadequate for description. In addition to high species richness, the Marojejy reserve protects a broad taxonomic diversity of *Weinmannia*, including members of both sections *Inspersa* and *Spicata* and five of the seven species-groups that occur in Madagascar (BRADFORD 2001).

For the present study, species were assigned to species-groups based on qualitative variation in inflorescence and floral features, within which collections were considered to belong to the same species if they shared a pattern of quantitative character variation that did not overlap with other species. Patterns of character variation at the species level were judged subjectively from available herbarium specimens.

The key to the species currently known from the Marojejy massif, presented below, emphasizes inflorescence features in early couplets following the terminology of BRADFORD (1998, 2001). The classification of Marojejy *Weinmannia* species follows BRADFORD (2001), and the species-group to which each species belongs is labeled to facilitate discussion of distinguishing features and possible relationships. Descriptions emphasize species level characters, rather than features common to *Weinmannia* or to sections *Spicata* and *Inspersa* (for more general features see BRADFORD 2001). The key and descriptions apply best to mature foliage near the crown of the tree and may not be accurate for juvenile or understory foliage. In general, understory leaves are larger and more often compound than canopy leaves. The term Inflorescence Module (IM) refers to various forms of compound racemes, pseudoracemes or spikes. Terminology for indumentum follows HEWSON (1988), with short trichomes (which define the puberulous state) being about 0.5 mm long or less.

Key to the species of *Weinmannia* at Marojejy

1. Pedicels distinct, easily visible and slender; seeds with surfaces more or less evenly covered with trichomes (sect. *Inspersa*) 2
- 1'. Pedicels lacking, very short, or thick as if an extension of the receptacle; seeds usually comose, sometimes more or less covered with trichomes throughout (sect. *Spicata*) 5

2. Inflorescence Modules (IMs, i.e. compound racemes or spikes) equal in size at different nodes, unbranched, terminating in a bud; flowers at maturity positioned away from the floral bract; floral bract subtending a single flower *W. lowryana*
- 2'. IMs unequal in size at different nodes, larger basally than distally, branched or not, terminating in a raceme or in a bud; flowers at maturity positioned near the floral bract; floral bract subtending a group of flowers or a solitary flower 3
3. Floral bracts each subtending a group of flowers, IM usually well-branched *W. venusta*
- 3'. Floral bracts each subtending a solitary flower or occasionally a group of flowers, IM unbranched or weakly branched 4
4. Leaves usually 3-foliolate, leaflets c. 1 cm long *W. hepaticarum*
- 4'. Leaves usually 5-foliolate or more, leaflets usually greater than 1 cm long *W. rutenbergii*
5. Floral bracts subtending multiple flowers (but not usually in the axil of a bract at maturity); nectary disc sometimes easily broken into segments 6
- 5'. Floral bracts subtending solitary flowers (but not usually in the axil of a bract at maturity); floral nectary usually entire and membranous 7
6. Leaves with 5 or more small leaflets, usually less than 2 cm long *W. marojejyensis*
- 6'. Leaves with up to 5 larger leaflets, usually greater than 2 cm long *W. rakotomalazana*
7. Leaves unifoliolate, never compound 8
- 7'. Leaves compound, occasional some unifoliolate leaves present 11
8. Plant a sparsely-branched, erect shrub; ovaries glabrous *W. humbertiana*
- 8'. Plant a densely-branched tree or shrub; ovaries pubescent 9
9. Leaves entire or nearly so, margin serrate only along apical portion *W. integrifolia*
- 9'. Leaves serrate along most of margin 10
10. Flowers densely packed along axis of spike so that rachis is not easily visible *W. bojeriana*
- 10'. Flowers sparse along axis of spike, rachis easily visible *W. pauciflora*
11. Leaves mostly 3-foliolate 12
- 11'. Leaves mostly 5-foliolate or more 15
12. Leaves 2.5-4 cm long, glabrous *W. humblottii* var. *anceps*
- 12'. Leaves greater than 4 cm long (usually 6-12 cm), glabrous or pubescent 13
13. Leaflets serrulate, apex obtuse *W. venosa*
- 13'. Leaflets serrate, apex acute 14
14. Secondary veins decurrent along midvein, bifurcating c. 1/2 to 2/3 the distance to the margin, making a c. 45° angle with the midvein, vein branching to 4 orders *W. stenostachya*
- 14'. Secondary veins not decurrent along midvein, bifurcating c. 2/3 to 3/4 the distance to the margin, making a c. 65-80° angle with the midvein, vein branching to 5 orders *W. arguta*
15. Leaves usually with more than 9 leaflets *W. sanguisugarum*
- 15'. Leaves with less than 9 leaflets 16
16. Leaflets mostly elliptic, apex acute, margin toothed throughout; ovaries glabrous *W. decora*
- 16'. Leaflets obovate, apex obtuse, margin of lower half not toothed; ovaries pubescent *W. humblottii* var. *anceps*

Weinmannia arguta (Bernardi) J.C. Bradford, **comb. et stat. nov.** (species-group G).

Weinmannia hildebrandtii var. *arguta* Bernardi, Flore de Madagascar et des Comores, fam. 93: 30 (1965). — Type: *Service Forestier (Capuron) 8848*, massif du Beanjada, nord de la presqu'île Masoala, vers 1000 m, 15°16'S, 50°00'E (holo-, P!).

COLLECTIONS EXAMINED FROM MAROJEJY. — MADAGASCAR, *Prov. Antsiranana: Bradford & Rafamanantanantsoa 689, 690*, forest between camps 2 and 3¹,

1130 m, 14°26'S, 49°44'30"E (MO, P, TAN); *Deroin & Badré 11*, rive gauche de la Manantenina, versant sud du Beondroka, 730 m, 14°25'S, 49°50'E (MO, P); *Miller & Randrianasolo 4659*, along trail to the summit of Marojejy Est, N of Mandena, premontane forest, lichen forest and exposed wind-swept ridges below the 3rd camp, 900-1300 m, 14°26'S, 49°46'E (MO, P, TAN).

Other collections, not from Marojejy: *Cours 4747*, itinéraire de Didy à Brickaville (MO, P); *Humbert & Capuron 24145*, Mt. Anjenabe, aux environs d'Antongondriha, 1000 m, 14°17'S, 49°46'E (MO, P).

1. It should be noted that while the numbered camps of HUMBERT have been considered well-established localities within the reserve, recent collectors have established a series of numbered camps that may not correspond exactly with those of HUMBERT.

Known from Marojejy, surrounding peaks, and uplands north of the Masoala Peninsula.

Specimens from the northern mountains, including the type locality, are fairly uniform and readily assigned to *W. arguta*, whereas those from further south that may be conspecific with *W. arguta* differ somewhat. Further study will be needed to resolve their taxonomic status.

This species differs qualitatively from *W. hildebrandtii* in the number of flowers per floral bract (see BRADFORD 2001, fig. 4). *Weinmannia arguta* has a bract subtending each single flower, whereas they subtend about four flowers in *W. hildebrandtii*. BERNARDI (1965) confused *W. arguta* with *W. stenostachya*, similarity in leaf size and shape has also led to their confusion in the herbarium, but their venation is distinct and easily discriminates between the two species. In *W. stenostachya*, the secondary veins are decurrent along the midvein, they bifurcate c. 1/2 to 2/3 the distance to the margin, and make a c. 45° angle with the midvein; veinlets branch to 4 orders. By contrast, in *W. arguta*, the secondary veins are not decurrent along the midvein, they bifurcate c. 2/3 to 3/4 the distance to the margin, and make a c. 65–80° angle with the midvein; veinlets branch to 5 orders.

Miller & Randrianasolo 4659 differs from other collections of *W. arguta* in having obovate, somewhat pubescent leaflets, and in possibly larger flowers (although the specimen is in bud). However, its 3-foliolate leaves with secondary veins nearly perpendicular to the midvein, and dense, visible tertiary venation matches other specimens of *W. arguta*.

Weinmannia bojeriana Tul. (species-group G)

Ann. Sci. Nat. 4 ser. 8: 155 (1857). — Type: *Bojer s.n.*, Analamazoatra, 18°58'S, 48°25'E (holo-, P!).

COLLECTION EXAMINED FROM MAROJEJY. — MADAGASCAR, *Prov. Antsiranana: Rasoavimbahoaka et al. 22*, aux environs du sommet de l'Est, 1300–1500 m, 14°29'S, 49°38'E (MO).

This species is widespread in the eastern uplands, but the only specimen examined from Marojejy has more pubescent leaves, shorter petioles, and more prominent venation than is typical in *W. bojeriana*. Still, it is placed here based on

its unifoliolate, medium-sized, serrate leaves and spikes congested with fruits. A collection from Mt. Beondroka (*Humbert 23489*) cited by BERNARDI (1965) under *W. bojeriana* was not seen. Some sterile specimens inadequate for positive identification may represent additional collections of this species.

Weinmannia decora Tul. (species-group G)

Ann. Sci. Nat., ser. 4, 8: 154 (1857). — Type: *Bernier 324*, Vohémar, 13°22'S, 50°00'E (holo-, P!; iso-, P!).

COLLECTIONS EXAMINED FROM MAROJEJY. — MADAGASCAR, *Prov. Antsiranana: Bradford & Rafamantanantsoa 673*, near trail to “Camp 3”, 1040 m, 14°26'S, 49°45'42"E (MO, P, TAN); *Bradford & Rafamantanantsoa 688*, forest between camps 2 and 3, 1100 m, 14°26'S, 49°44'30"E (MO, P, TAN); *Bradford & Rafamantanantsoa 694*, forest between camps 2 and 3, 1230 m, 14°26'S, 49°44'30"E (MOP, TAN); *Humbert & Saboureau 31823*, partie occidentale du Massif de Marojejy (nord-est), de la vallée de l'Ambatoharanana au bassin supérieur de l'Antsahaberoka, 1700–1800 m, 14°32'S, 49°36'E (MO, P).

A species widespread in eastern and northern uplands. Only *Humbert & Saboureau 31823* specimen is typical of the species. The material collected by BRADFORD is similar in the number of leaflets, venation pattern, and tooth shape, but differs from the typical *W. decora* in its shorter, broader leaflets. It is nevertheless placed here because the only fertile collection (*Bradford 673*) has glabrous ovaries, which are uncommon in sect. *Spicata*.

Weinmannia hepaticarum Bernardi (species-group C)

Bot. Jahrb. Syst. 83: 147 (1964). — Type: *Humbert 23545*, Madagascar, *Prov. Antsiranana*, vallée de la Lokoho, Mt. Beondroka, au nord de Maroambihy, sylvie à lichens sur gneiss et quartzite, 1000–1450 m, 14°26'S, 49°48'E (holo-, P).

This species is known only from the type collection. BERNARDI (1965) cited a second collection, which is now referred to a new species,

W. lowryana J.C. Bradford (see below). Therefore, the emended description of *W. hepaticarum* in BERNARDI, which is based on material of both species, is inaccurate. *Weinmannia hepaticarum* may be a highly reduced form of *W. rutenbergii*.

***Weinmannia humbertiana* Bernardi** (species-group G)

Bot. Jahrb. Syst. 83: 139 (1964). — Type: *Humbert & Cours 23814*, sommet oriental du Massif de Marojejy (nord-est), 1850-2137 m, 14°25'S, 49°43'E (holo-, P).

COLLECTIONS EXAMINED FROM MAROJEJY. — MADAGASCAR, Prov. Antsiranana: *Bradford & Rafamantanantsoa 695*, forest between camps 2 and 3, 1200 m, 14°26'S, 49°44'30"E (MO, P, TAN); *Bradford & Rafamantanantsoa 703*, forest and shrubby thickets above "Camp 3" trail leading to summit, 1740 m, 14°26'12"S, 49°44'30"E (MO, TAN); *Humbert 22505*, pentes orientales du massif du Marojejy (Nord-Est), c. 1400-1500 m, (P); *Humbert 23532* (paratype), Mt. Beondroka au nord de Maroambihy, 1000-1450 m (MO, P); *Humbert & Cours 23814* (type); *Miller & Lowry 4106*, along the trail to the summit of Marojejy Est, NW of Mandena, wind swept ridges below the third camp, 1200-1300 m, 14°26'S, 49°15'E (MO, P, TAN); *Miller & Lowry 4137*, along the trail to the summit of Marojejy Est, 1300-1600 m, 14°26'S, 49°14'E (MO, TAN); *Rasoavimbahoaka et al. 26*, environs d'Andohan'Antsahaberôkakely et Marojejybe, 1672 m, 14°25'45"S, 49°39'30"-49°42'15"E (MO).

This species is currently known only from the Marojejy region.

***Weinmannia humblottii* var. *anceps* Bernardi** (species-group G)

Flore de Madagascar et des Comores, fam. 93: 41 (1965). — Type: *Perrier de la Bâthie 6421*, Analamazaotra, 18°58'S, 48°25'E (holo-, P!; iso-, P!).

COLLECTIONS EXAMINED FROM MAROJEJY. — MADAGASCAR, Prov. Antsiranana: *Bradford & Rafamantanantsoa 697*, forest between camps 2 and 3, 1200 m, 14°26'S, 49°44'30"E (MO, TAN); *Bradford & Rafamantanantsoa 707 & 708*, south of and below summit of Marojejy, 2000 m, 14°27'S, 49°44'E (MO, P, TAN); *Bradford & Rafamantanantsoa 724*, along tributary of Manantenina river, 19 km NW of

Manantenina, 725 m, 14°26'S, 49°45'42"E (MO, P, TAN); *Guillaumet 4047*, R.N. Marojejy, 2000 m (MO, TAN).

This species is common at high elevations in several areas, including Marojejy, Anjanaharibe-Sud, Manongarivo, the mountains north of the Masoala peninsula, and along the eastern escarpment.

Most Marojejy collections of this species are from high elevations and have small, 3-foliolate leaves. *Bradford 724* is the record from the lowest elevation in the area, and it has larger, 5-7-foliolate leaves, which match the type of the variety better than the high elevation material. All these collections have glabrous, obovate, basally decurrent leaflets with basally entire margins.

***Weinmannia lowryana* J.C. Bradford, sp. nov.** (species-group D)

Arbor parva. Folia imparipinnata, 3-5-foliolata, rhachidi leviter alata, foliolis lateralibus obovatis, 2.2-2.4 cm longis, 0.5-1.2 cm latis, apicem obtusis, basim attenuatis. Inflorescentia racemosa, c. 4 cm longa, bracteis c. 1 mm longis, subtendens florem singularis. Flores pedicelli c. 1 mm longi, gracilibus. Ovarium dense puberulum. Semina non visi.

TYPUS. — *Humbert 23057*, Madagascar, Prov. Antsiranana, contreforts occidentaux du massif de Marojejy (nord-est) près du col de Doanyanala (limite des bassins de la Lokoho et de l'Andraronga), forêt ombrophile sur latérite de gneiss près des torrents, 800-1200 m, 25 jan.-25 fév. 1949 (holo-, P!; iso-, G, K, MA, MO!, NY, WAG).

Small tree; branching every one to five nodes, not dichotomously; internodes 1-5 cm long; young stems with dense, short, appressed to spreading, straight to curved, glossy trichomes; lateral branches with a short internode c. 1-2.5 mm long, then internodes of c. 1 cm or longer. Axillary buds enclosed by a pair of c. 2 mm long stipules, puberulous medially, fused basally, quickly caducous; medial stipules orbicular to obovate, 3-6 mm long and wide, trichomes restricted to midline, about 0.5 mm long, appressed. Leaves decussate, imparipinnate, nearly glabrous, 3-5-foliolate, rachis weakly alate, up to 1.5 mm wide,

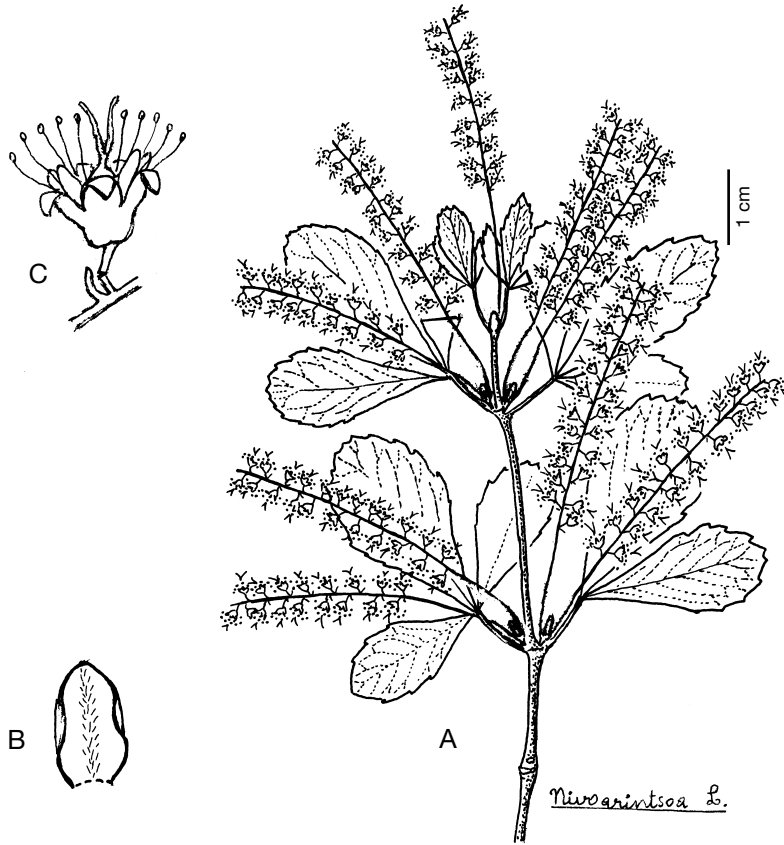


Fig. 1. — *Weinmannia lowryana* J.C. Bradford: **A**, fertile branch; **B**, stipules; **C**, flower. From Humbert 23057 (P).

whole leaf 2.5–4 cm long, petiole 4–8 mm long, leaflets obovate with attenuate bases, terminal leaflets 1.8–3.5 cm long, 0.8–1.6 cm wide, lateral leaflets 1.2–2.4 cm long, 0.5–1.2 cm wide; margins serrate in apical half to third of leaf only, teeth blunt, sinus shallow, glandular; 10–12 secondary veins per leaflet, semicraspedodromous, with veins terminating at the sinus.

Flower-bearing axes racemose, about 4 cm long; racemes borne in pairs from sparsely puberulous peduncles, each c. 1 mm long, with a vegetative bud between each raceme (i.e. forming dyads), dyads borne axillary near the distal end of stems, or racemes borne from leaf axils along the main stem. Floral bracts c. 1 mm long, sparsely puberulous, subtending a single flower that may be 2–4 mm from the bract, pedicel c. 1 mm long, sparsely puberulous.

Flowers bisexual, calyx and corolla of 5, free lobes; sepals triangular, 1 mm long, glabrous; petals elliptic, c. 1 mm long; androecium of 10 stamens, diplostemonous, filaments thin, c. 2.5 mm long, anthers c. 0.4 mm long; nectary thin, entire or divided into 5 segments opposite the petals; ovary densely puberulous, styles c. 2–2.5 mm long. Fruits unknown. — Fig. 1.

This species, which is known only from the type collection, was cited by BERNARDI (1965) under *W. hepaticarum* but was not used to prepare the original description (BERNARDI 1964). *Weinmannia lowryana* is considered distinct from *W. hepaticarum* based on the presence of a terminal bud versus a terminal raceme in the IM (see key above and BRADFORD 2001, fig. 3), flowers sparse on the axis versus congested, and leaves

larger with sparser venation and smoother texture. Illustrations reportedly of *W. hepaticarum* in BERNARDI (1965, fig. IX) are actually composed of the two species: 6a. is of *W. hepaticarum* whereas 6b. is of *W. lowryana*. This species is named in honor of Porter P. LOWRY II who collected many *Weinmannia* specimens at Marojejy.

***Weinmannia integrifolia* J.C. Bradford, sp. nov.**
(species-group G)

Arbor 5-17 m alta. Folia unifoliolata, glabra, elliptica ad obovata, 3.5-9.5 cm longa, 1.3-4 cm lata, apicium obtusis, basim acutis, margine integra vel serrata ad apicium. Inflorescentia spicata, 6-10 cm longa, bracteis c. 1 mm longis, subtendens florem sessilis, singularis. Ovarium dense puberulum. Semina comosa.

TYPUS. — *Rasoavimbahoaka et al. 4*, Madagascar, Prov. Antsiranana, Réserve Naturelle Intégrale 12, Marojejy, au Nord d'Andapa, aux environs du sommet de l'Est, 1300-1500 m, 14°29'S, 49°38'E, 21-22 Jan. 1994 (holo-, MO; iso-, P, TAN).

Tree, 5-17 m tall, branching every one to several nodes, sometimes dichotomously, internodes 1-5 cm long, lateral branches with a short internode, c. 1 mm long, then internodes of c. 1 cm or longer, the stems gray, cylindrical, young growth glabrous. Axillary buds stipulate, stipules, c. 3 mm long, fused basally and somewhat persistent; medial stipules elliptic, nearly glabrous, with scant, c. 0.2 mm long appressed trichomes along midsection, caducous, colleters c. 0.3 mm long, black. Leaves decussate, unifoliolate, elliptic to obovate, 3.5-9.5 cm long, 1.3-4 cm wide, apex obtuse to rarely acute, base acute and decurrent, surfaces glabrous, petiole indistinct, margin entire to serrulate along the apical one-fourth only, teeth blunt, sinus shallow, lateral veins (14)-18-24, semicraspedodromous, with veins terminating at the sinus (where they occur).

Flower-bearing axes spicate, spikes 6-10 cm long, usually borne in pairs from glabrous peduncles, each c. 1 mm long, with a vegetative bud between each spike (i.e. forming dyads), dyads usually borne axillary or sometimes terminally near the distal end of stems. Floral bracts keel

shaped, puberulous, c. 1 mm long, subtending solitary flowers that spread apically in a line away from the bract, flowers inserted up to 1-3 mm from their bract.

Flowers bisexual, 4-5-merous, diplostemonous; calyx fused basally, sepal lobes triangular, 0.75-1 mm long, sparsely puberulous, margins membranous, weakly ciliate or glabrous; petals white, elliptic, c. 1.5 mm long; stamens 8-10, filaments c. 4 mm long, glabrous, anthers 0.5 mm long; nectary disc thin, entire, easily broken into rectangular costae, c. 0.3 mm tall; ovary ovate, c. 1.25 mm tall, c. 1 mm wide, densely puberulous, locules with several (c. 12) ovules, styles c. 2 mm long. Capsules 4-5 mm long (style to receptacle), calyx persistent, placenta remaining upright between separate carpels, endocarp and exocarp separating in old fruits, seeds elliptic, 1-1.25 mm long, 0.4-0.5 mm wide with longitudinal striations, comose with kinky, c. 0.25-1 mm long, shiny, translucent trichomes. — Fig. 2.

PARATYPES. — MADAGASCAR, *Prov. Antsiranana: Bradford & Rafamantanantsoa 700*, forest and shrubby thickets above "Camp 3", trail leading to summit, 1360 m, 14°26'12"S, 49°44'30"E (MO, P, TAN); *Bradford & Rafamantanantsoa 713, 714*, forest above "Camp 3" along trail to summit, 1330 m, 14°26'12"S, 49°44'30"E (MO, P, TAN); *Bradford & Rafamantanantsoa 718*, forest above "Camp 3" along trail to summit, 1440 m, 14°26'12"S, 49°44'30"E (MO, P, TAN); *Rakotomalaza, Messer & Ravelonarivo 897*, along tributary at head of Andranomifototra river, Campment 4, 1625 m, 14°26'24"S, 49°44'30"E (MO, P, TAN); *Ralimanana 106*, Toamasina: Maroantsetra, Ambatolaidama, 7 km au NE d'Ankovona, vers 1000 m, 15°18'30"S, 49°59'E (MO).

This species is known from Marojejy and the mountains north of the Masoala Peninsula.

With unifoliolate, entire (or nearly so) leaves, *W. integrifolia* is most similar to *W. mammea* Bernardi (Bot. Jahrb. Syst. 83: 141, 1964). It differs by having smaller leaves and shorter petioles. In *W. integrifolia*, leaves are usually between 4 and 8 cm long and have a 0.5-1.5 cm long petioles. By contrast, the type of *W. mammea* (other specimens referred to this species in BERNARDI 1965 are doubtfully conspecific) has 10-15 cm long leaves, with c. 3 cm long petioles.

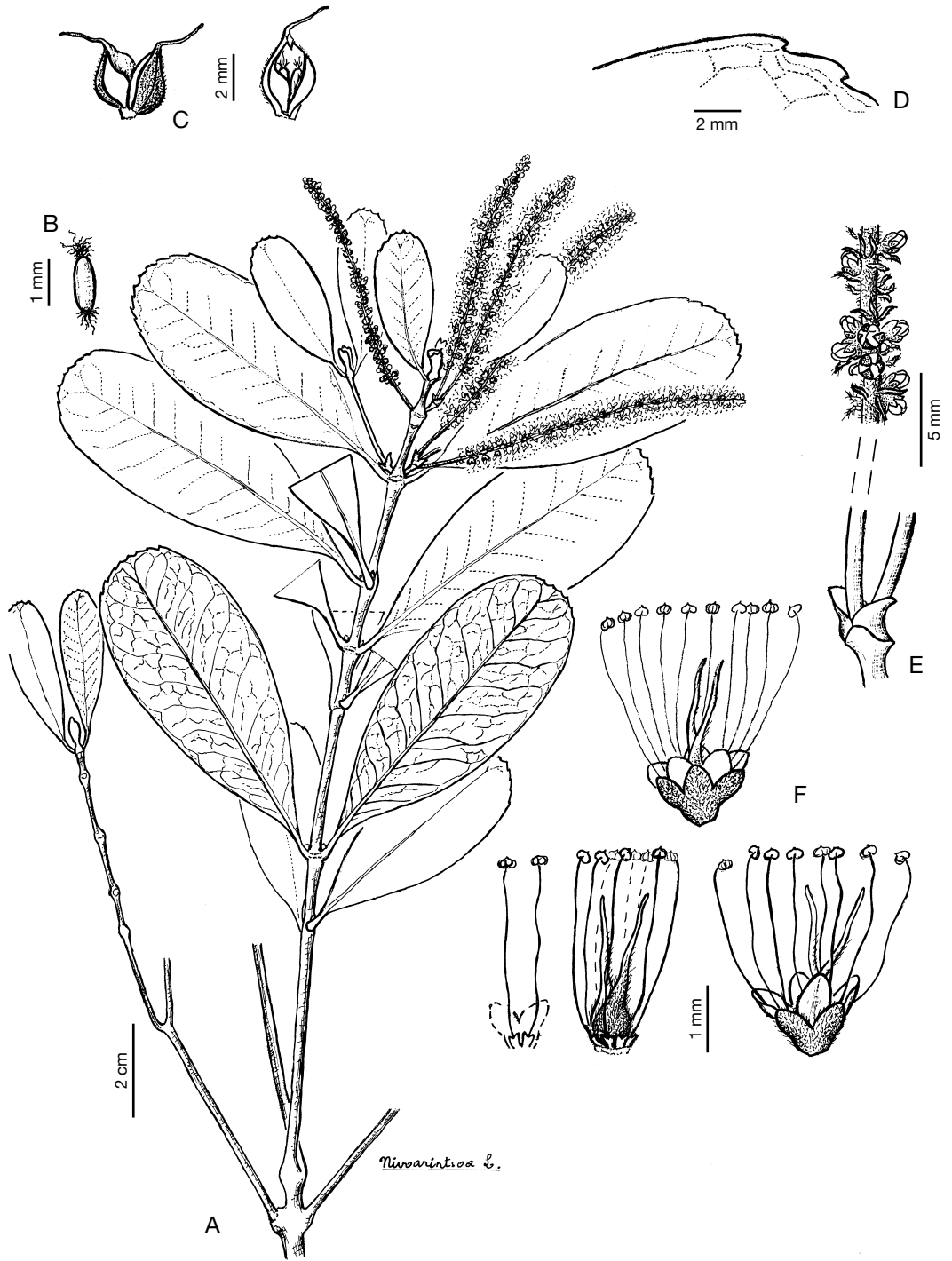


Fig. 2. — *Weinmannia integrifolia* J.C. Bradford: **A**, fertile branch; **B**, seed; **C**, entire capsule showing septal dehiscence (left), and ventral view of individual carpel and seeds inside (right); **D**, leaf edge showing transition from entire to serrulate margin towards apex; **E**, close-up of a portion of spike; **F**, flowers. From *Rasoavimbahoaka et al.* 4 (TAN).

Weinmannia marojejensis J.S. Mill. & J.C. Bradford, **sp. nov.** (species-group F)

Arbor 5-18 m alta. Folia imparipinnata, 7-13 foliolata, rhachidi teri ad leviter alata, foliolis lateralibus sessilibus, oblongis ad ellipticis, 6-20 mm longis, 4-8 mm lata, apicem acutis ad obtusis, basium obliquis, margine integra vel serrata ad apicem. Inflorescentia spicata, (5-)7-9 cm longa, bracteis 1.5-3 mm longis, subtensens 3-4 flores sessilia. Ovarium puberulum. Semina non visi.

TYPUS. — *Miller & Lowry 4044*, Madagascar, Prov. Antsiranana, Réserve Naturelle de Marojejy, along the trail to the summit of Marojejy Est, NW of Mandena, wet, evergreen forest between the second and third camps, 1100-1200 m, 14°26'S, 49°15-16'E, 13 Feb. 1989 (holo-, MO; iso-, BR, K, P, TAN, WAG).

Broad-crowned tree 5-18 m tall, branching every one to few nodes, occasionally dichotomously, internodes 1-3 cm long, lateral branches with a short internode c. 1 mm long, then internodes of c. 1 cm or longer, stems gray-brown, cylindrical, young growth densely pubescent, trichomes 0.5-1 mm long, yellow-brown to red-brown. Axillary buds enclosed by stipules, c. 2 mm long, with dense, appressed pubescence, lateral stipules barely fused basally, usually caducous on young branches; medial stipules caducous, puberulous, orbicular, 2.5-4 mm wide, colleters 0.2-0.3(-0.5) mm long, glossy-black. Leaves decussate, imparipinnate, (3-)7-13(-23)-foliolate, rachis (25-)35-45 mm long, terete to slightly alate, up to 1 mm wide, sparsely to densely puberulous with an abaxial tuft of trichomes in the axil of each leaflet, lamina glabrous above, lustrous, with sparse, short trichomes below, these denser along the margin and midvein, lateral leaflets sessile, oblong to elliptic, 6-20 mm long, 4-8 mm wide, apex acute to obtuse, base oblique, distally acute, basally obtuse to rounded, terminal leaflet usually slightly larger than the laterals, 12-21 mm long, base acute to attenuate, margin entire or serrulate for the apical one-half, teeth blunt, sinus shallow, lateral veins 6-8(-9), semicraspedodromous, with veins terminating at the sinus.

Flower-bearing axes spicate, spikes (5-)7-9 cm long, usually borne in pairs from densely puberulous peduncles, each 20-80 mm long, with a vegetative bud between each spike (i.e. forming

dyads), dyads borne axillary near the distal end of stems, or spikes borne from leaf axils along the main stem. Floral bracts obovate, c. 1.5-3 mm long, c. 1-1.5 mm wide, subtending a group of (1-)3-4 flowers that spread apically in a line away from the bract, more flowers per bract basally than apically, flowers inserted from to 1-15 mm from their bract.

Flowers bisexual, pentamerous; sepals ovate, 1-1.4 mm long, densely puberulous except along the membranous margins, but these weakly ciliate; petals white, oblong to slightly obovate, 1.5-2 mm long; stamens 10, filaments 2.5-3 mm long, glabrous, anthers 0.4-0.5 mm long; floral nectary composed of nearly separate segments, 0.5-0.7 mm tall; ovary ovoid, 1 mm tall, densely puberulous, trichomes glossy-orange, styles 1 mm long. Capsules 2-2.5 mm long, calyx persistent, placenta remaining upright between separate carpels, endocarp and exocarp separating in old fruits, seeds unknown. — Fig. 3.

PARATYPES. — MADAGASCAR, *Prov. Antsiranana: Bradford & Rafamantanantsoa 668*, near trail to "Camp 3" along a ridge, 990 m, 14°26'S, 49°45'42"E (MO, P, TAN); *Bradford & Rafamantanantsoa 674*, near trail to "Camp 3" along a ridge, 1060 m, 14°26'S, 49°45'42"E (MO, P, TAN); *Bradford & Rafamantanantsoa 692*, forest between camps 2 and 3, 1130 m, 14°26'S, 49°44'30"E (MO, P, TAN); *Bradford & Rafamantanantsoa 712*, forest above "Camp 3", 1300 m, 14°26'12"S, 49°44'30"E (MO, P, TAN); *Miller 4085*, along the trail to the summit of Marojejy Est, NW of Mandena, wind swept ridges below the third camp, 1200-1300 m, 14°26'S, 49°15'E (MO, P, TAN); *Rakotomalaza, Messer & Ravelonariivo 837*, Marojejy, sur la crête, le long de la piste C, 1150-1300 m, 14°26'S, 49°44'30"E (MO, P, TAN).

This species is known only from Marojejy. With spicate inflorescences, bracts subtending c. 4 flowers, and pubescent, usually 7-13-foliate leaves, *W. marojejensis* is one of the most distinctive *Weinmannia* species in Madagascar. Only *W. sanguisugarum* typically has as many leaflets, but these are glabrous, and bracts subtend a single flower in this species. All of the possibly related taxa in species-group F (*W. hildebrandtii*, *W. icacifolia*, and *W. rakotomalazana*) are 1-5-foliate.

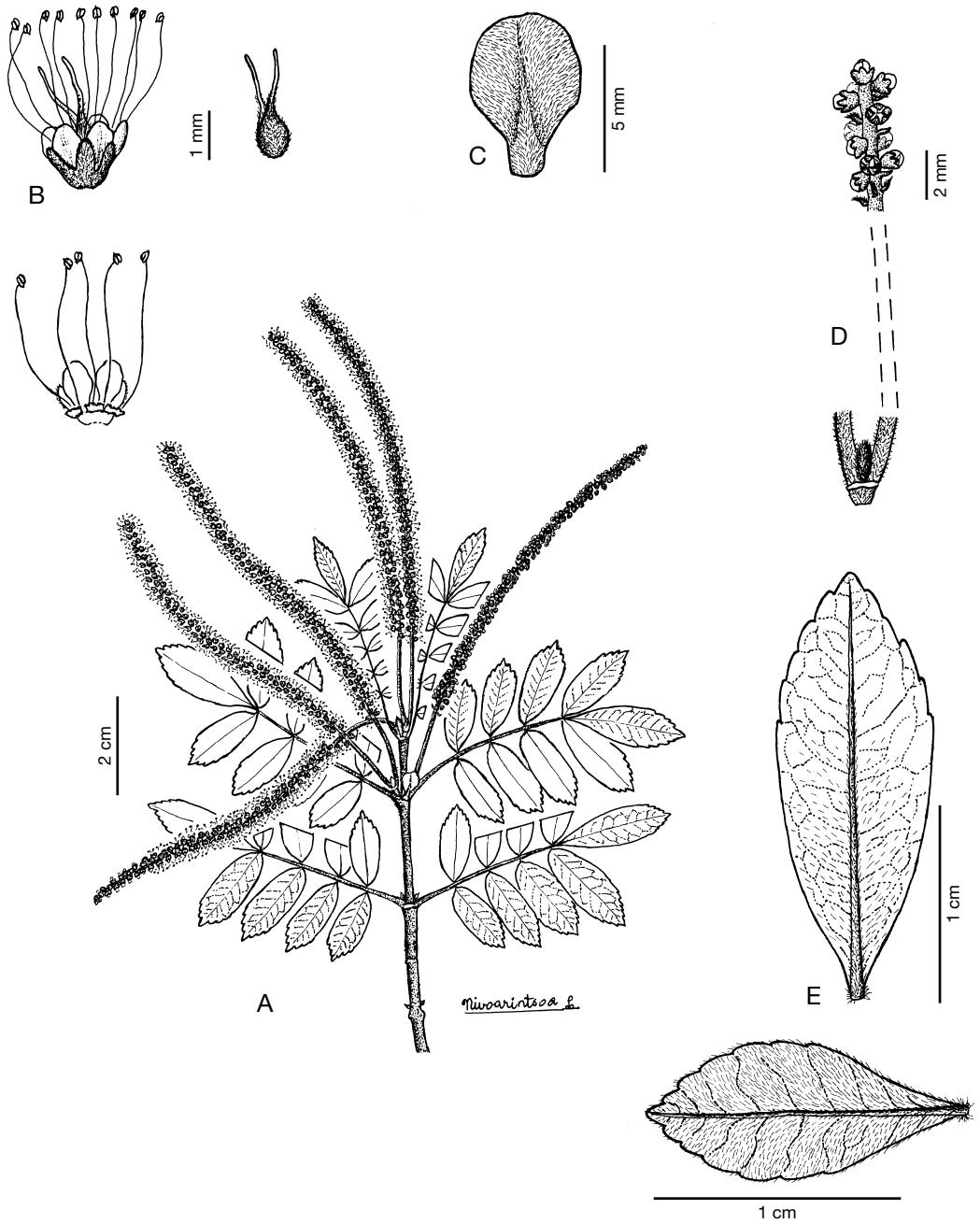


Fig. 3. — *Weinmannia marojejyensis* J.S. Mill. & J.C. Bradford: A, fertile branch; B, flowers; C, stipule; D, portion of spike; E, close-up of leaflets. From Miller & Lowry 4044 (TAN).

***Weinmannia pauciflora* J.C. Bradford, sp. nov.**
(species-group G)

Frutex vel arbor ad 5 m alta. Folia unifoliolata, glabra, elliptica ad obovata, 2.5-8 cm longa, 1-4 cm lata, apicium obtusis ad acutis, basim decurrenti, margine serrata. Inflorescentia spicata, 7-10 cm longa, bracteis 1-1.5 mm long, subtendens florem sessilis, singularis. Ovarium puberulum. Semina comosa.

TYPUS. — *Bradford & Rafamantanantsoa 702*, Madagascar, Prov. Antsiranana, Réserve Naturelle Intégrale de Marojejy, near tributary of Manantenina river, 10 km NW of Manantenina, forest and shrubby thickets above “Camp 3”, along ridges with forest varying from tall trees to stunted shrubbery depending upon elevation and exposure, forest about 4-5 m tall along trail leading to summit, 1690 m, 14°26'12”S, 49°44'30”E, 5 Nov. 1996 (holo-, MO; iso-, P, TAN).

Small tree or shrub, 1-5 m tall, branching every few to several nodes, rarely dichotomously; internodes 0.5-6 cm long, glabrous; lateral branches with a short internode, c. 2 mm long, then internodes of c. 1 cm or longer. Axillary buds enclosed by basally fused stipules, c. 3 mm long, that usually persist on young branches; medial stipules elliptic to obovate, 4-13 mm long, 2-6 mm wide, glabrous to puberulous along midsection. Leaves decussate, pinnate, unifoliolate or rarely trifoliolate, coriaceous, glabrous or with isolated short trichomes along midvein; mature leaves elliptic to obovate, 2.5-8 cm long, 1-4 cm wide (leaves borne from trunk shoots up to 18 cm long, 11 cm wide), apex acute to obtuse, base decurrent, petiole usually less than 0.5 cm long; margins serrate, teeth blunt, sinus shallow, glandular, 15-20 secondary veins per leaf, semicraspedodromous, with veins terminating at the sinus.

Flower-bearing axes spicate, spikes slender, 7-10 cm long, axis glabrous or sparsely puberulous; spikes usually borne in pairs from glabrous to puberulous peduncles, each c. 1 mm long with a vegetative bud between each spike (i.e. forming dyads), or spikes borne from leaf axils along the main stem; dyads borne axillary or medially near the distal end of stems. Flowers solitary in the axils of keel-shaped, glabrous to sparsely puberulous bracts, each 1-1.5 mm long, flowers borne up to 2 mm from a bract, relatively sparse on axis, only c. 70 flowers per spike.

Flowers pentamerous, sepals basally fused, apically blunt, 1.5-2 mm long, glabrous, or ciliate along membranous margins; petals obovate, 2.5 mm long; androecium of 10 stamens, filaments thin, 3.5-4.5 mm long; floral nectary disc thin, or composed of 10, more or less, square segments about 0.5 mm long; ovary bicarpellate, c. 1-1.5 mm long, densely puberulous, trichomes glossy-orange; ovules numerous; styles c. 1.5 mm long. Capsules c. 4 mm long, 3 mm wide, calyx persistent, placenta remaining upright between separate carpels; endocarp and exocarp separating in old fruits; seed body elliptic, 1.5 mm long, 0.7 mm wide, with longitudinal striations, comose, translucent trichomes about 0.5 mm long. — Fig. 4.

PARATYPES. — MADAGASCAR, *Prov. Antsiranana: Bradford & Rafamantanantsoa 704*, forest and shrubby thickets above “Camp 3”, trail leading to summit, 1750 m, 14°26'12”S, 49°44'30”E (MO, P, TAN); *Bradford & Rafamantanantsoa 706, 709*, South of and below summit of Marojejy, 2000 m, 14°27'S, 49°44'E (MO, P, TAN); *Miller & Lowry 4156*, along the trail to the summit of Marojejy Est, 1900-2133 m, 14°26'S, 49°13-14'E (MO, P, TAN).

This species is known only from Marojejy. The presence of spicate inflorescences with bracts subtending a single flower places *W. pauciflora* in species-group G. Unifoliolate leaves are also found in *W. bojeriana*, but *W. pauciflora* is distinguished by its sparse versus congested flower-bearing axes, and its usually smaller leaves. Serrate leaf margins distinguish *W. pauciflora* from *W. mammea* and *W. integrifolia*, which are also in species-group G and have unifoliolate leaves.

***Weinmannia rakotomalazana* J.C. Bradford, sp. nov.** (species-group F)

Arbor 3 m alta. Folia imparipinnata, 3-5-foliolata, rhachidi non alata, foliolis lateralibus ellipticis, 2.5-3 cm longis, 0.9-1.3 cm latis, apicium acutis, basim acutis, margine serrulata, pagine inferiore pubescentia. Inflorescentia spicata, ad 8 cm longa, bracteis c. 1.5 mm longis, subtendens 1-4 flores sessilia. Ovarium puberulum. Semina non visi.

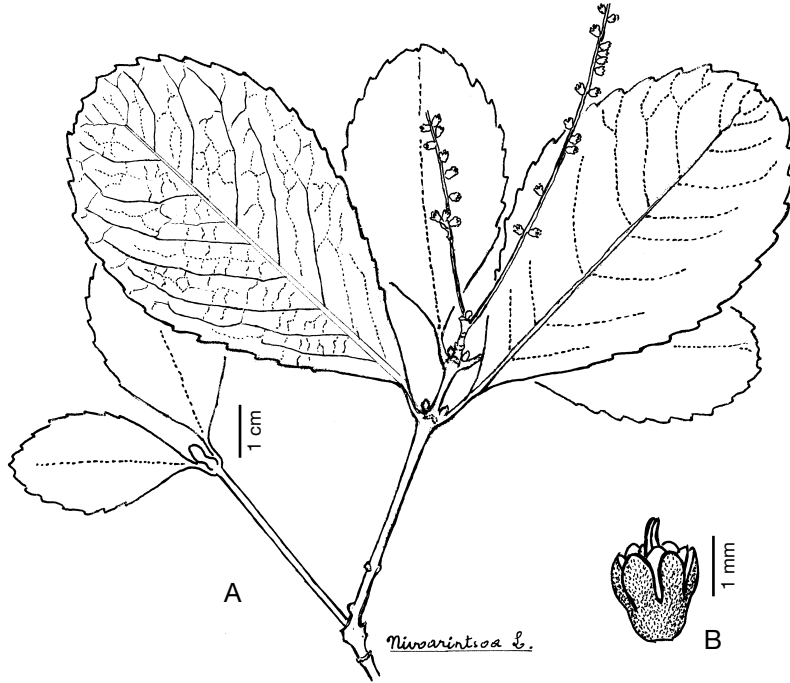


Fig. 4. — *Weinmannia pauciflora* J.C. Bradford: **A**, fertile branch; **B**, flower. From Bradford & Rafamantanantsoa 702 (TAN).

TYPUS. — Bradford & Rafamantanantsoa 676, Madagascar, Prov. Antsiranana, Réserve Naturelle Intégrale de Marojejy, near tributary of Manantenina River, 10 km NW of Manantenina, near trail to “Camp 3” along a ridge, 1160 m, 14°26’S, 49°45’42”E, 3 Nov. 1996 (holo-, MO; iso-, P, TAN).

Tree, branching every few to several nodes, not dichotomously, internodes 1–3 cm long; young stems densely covered by slender, soft, orange trichomes, c. 1 mm long; lateral branches with a short internode c. 2 mm long, then internodes of c. 1 cm or longer. Axillary buds enclosed by basally fused stipules, c. 3 mm long, usually persistent on young branches; medial stipules elliptic to obovate above the slender point of attachment, up to 10 mm long, 6 mm wide, medially pubescent with appressed trichomes, sparsely pubescent otherwise. Leaves decussate, imparipinnate, (3-)5-foliate, rachis not winged, coriaceous, leaves 5–6 cm long, rachis segments 1.2–1.5 cm long, leaflets elliptic, 2.5–3 cm long, 0.9–1.3 cm wide, apex acute, terminal leaflets c. 0.5 cm longer than lateral ones, mature leaves nearly glabrous above, surface

sparsely pubescent on lamina below, more densely pubescent along midveins, immature leaves dark (at least when dried) with conspicuous, orange trichomes, c. 1 mm long, especially along the rachis, midveins and also on both lamina surfaces, margins serrulate, 20–24 secondary veins per leaflet, semicraspedodromous, with veins terminating at the sinus.

Flower-bearing axes spicate, spikes up to 8 cm long in bud, at least 9 cm long in fruit, densely puberulous (trichome length c. 0.5 mm or less); spikes usually borne in pairs from puberulous peduncles, each 1–2 mm long, with a vegetative bud between each spike (i.e. forming dyads), or rarely the peduncle bearing a terminal spike with lateral vegetative buds, or spikes borne from leaf axils along the main stem; dyads borne axillary near the distal end of stems. Floral bracts keel-shaped, puberulous, c. 1.5 mm long, subtending a group of 1–4 flowers that spread apically in a line away from the bract, more flowers per bract basally than apically, flowers inserted up to 3–4 mm from their bract.

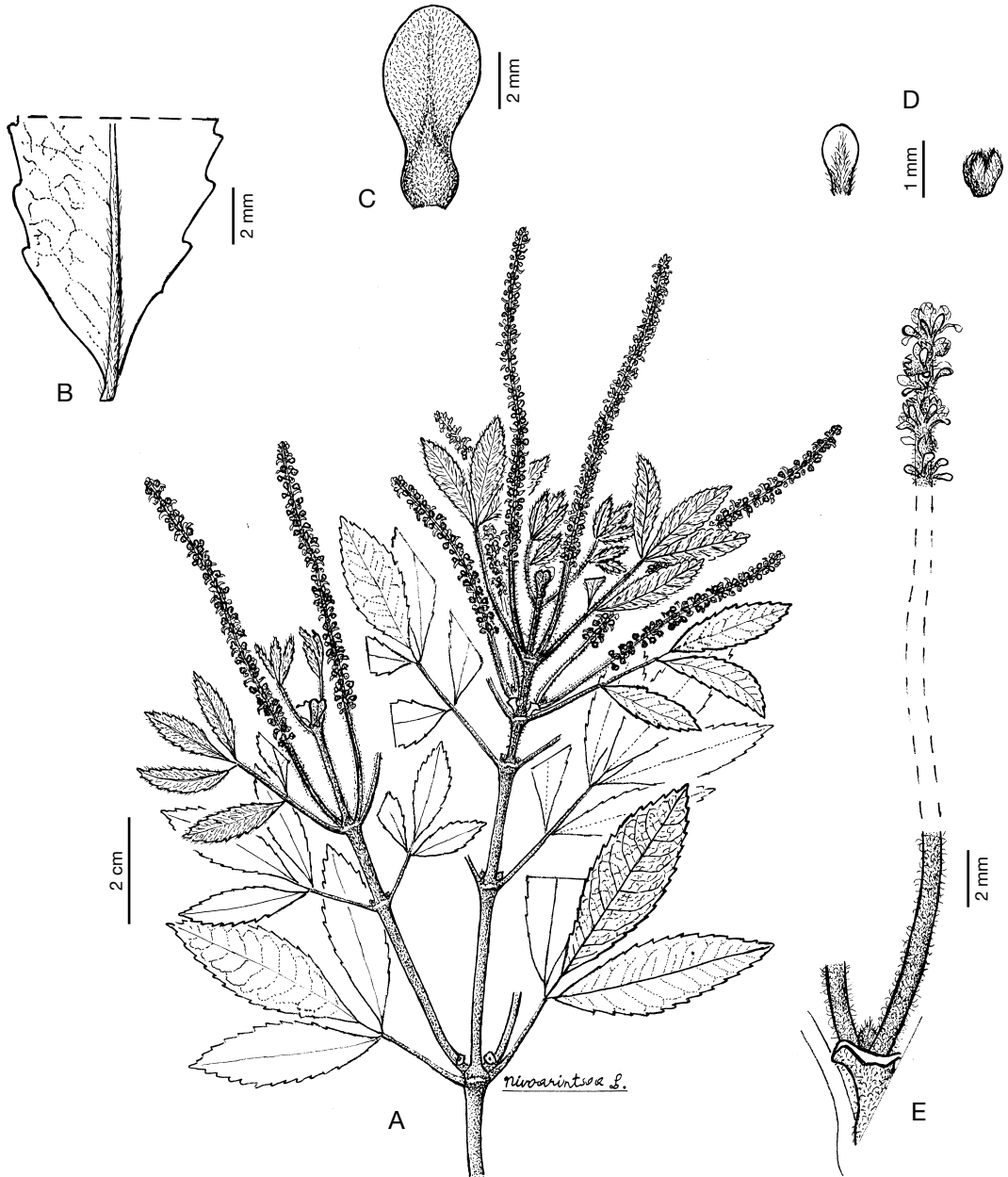


Fig. 5. — *Weinmannia rakotomalazana* J.C. Bradford: **A**, fertile branch; **B**, base of lateral leaflet; **C**, stipule; **D**, floral bract (left) and floral bud (right); **E**, portion of spike. From Bradford & Rafamantanantsoa 676 (TAN).

Flowers known only in bud, perianth pentamerous, calyx puberulous, androecium of 10 stamens, filaments thin, nectary disc thin, with c. 5 costae that break apart easily, ovary puberulous,

ovules numerous. Calyx persistent in fruit, placenta remaining upright between separate carpels, endocarp and exocarp separating in old fruits, seeds unknown. — Fig. 5.

This species is known only from the type collection made at Marojejy, and was found in stunted, wet, montane forest along a ridge.

Based on the structure of the spike, *Weinmannia rakotomalazana* may be closely related to *W. hildebrandtii*, *W. icacifolia* and *W. marojejyensis*. These four species have bracts subtending 1-4 flowers that dissociate from the bract during elongation of the axis (species-group F). *Weinmannia rakotomalazana* is similar to *W. marojejyensis* in having compound leaves and persistent pubescence on young stems and buds. It differs most obviously from *W. marojejyensis*, however, by having fewer and larger leaflets (usually 5-foliolate versus 7-13-foliolate), and from *W. hildebrandtii* and *W. icacifolia* by having more numerous and usually smaller leaflets (1 or 3-foliolate in these species). This species is named in honor of P.J. RAKOTOMALAZA, one of the Malagasy botanists whose efforts have contributed so greatly to our knowledge of the flora of Marojejy.

***Weinmannia rutenbergii* Engl.** (species-group C)

Abh. Bremen 7: 16 (1880).

COLLECTIONS EXAMINED FROM MAROJEJY. — MADAGASCAR, *Prov. Antsiranana*: *Bradford & Rafamantanantsoa* 683, above second camp at edge of escarpment and through forest above (not along trail to third camp), 930 m, 14°26'S, 49°45'42"E (MO, TAN); *Bradford & Rafamantanantsoa* 696, forest between camps 2 and 3, 1200 m, 14°26'S, 49°44'30"E (MO, TAN); *Bradford & Rafamantanantsoa* 698, 699, forest between camps 2 and 3, 1200 m, 14°26'S, 49°44'30"E (MO, P, TAN); *Bradford & Rafamantanantsoa* 701, forest and shrubby thickets above "Camp 3", trail leading to summit, 1520 m, 14°26'12"S, 49°44'30"E (MO, P, TAN); *Bradford & Rafamantanantsoa* 710, North of and below summit of Marojejy, 2000 m, 14°27'S, 49°44'E (MO, P, TAN); *Humbert* 23663, pentes orientales du massif de Marojejy (nord-est), 1750 m (MO, P); *Miller & Lowry* 4083, along the trail to the summit of Marojejy Est, NW of Mandena; wind swept ridges below the third camp, 1200-1300 m, 14°26'S, 49°15'E (MO, P, TAN); *Miller & Lowry* 4131, along the trail to the summit of Marojejy Est, 1300-1600 m, 14°26'S, 49°14'E (MO, P, TAN); *Rasoavimbahoaka et al.* 129, environs d'Andohan'Antsahaberôkakely et Marojejybe,

1672 m, 14°25'45"S, 49°39'30"-49°42'15"E (MO); *Rasoavimbahoaka* 530, sommet de Marojejy, 2312 m, 14°26'50"S, 49°43'57"E (MO).

Weinmannia rutenbergii is a very common species or species complex that is widespread in Madagascar, occurring from sea level to near the summit of Marojejy. Most montane forms are shrubby with small leaves, whereas lowland forms can be large, canopy trees with much larger leaves. High within and between population morphological variation makes this a difficult species or species complex to understand. Ecologically, *W. rutenbergii* populations do well in open, disturbed areas, including roadsides and repeatedly burned sites. The ability of the species to colonize areas exhibiting a tremendous range of edaphic and climatic conditions may partially account for the observed morphological plasticity.

***Weinmannia sanguisugarum* Bernardi** (species-group G)

Candollea 24: 85 (1969). — Type: *Bernardi* 11999, Montagne d'Ambre, 1100-1200 m (holo-, G; iso-, P!).

COLLECTION EXAMINED FROM MAROJEJY. — MADAGASCAR, *Prov. Antsiranana*: *Bradford & Rafamantanantsoa* 715, 11 km NW of Manantenina, forest above "Camp 3", along trail to summit, 1340 m, 14°26'12"S, 49°44'30"E (MO, TAN).

The only record of this species at Marojejy is a sterile collection, but the foliage, with several pairs of small leaflets per blade, is distinctive (BERNARDI 1969). It was found in a single population with many nearby conspecifics. Other collections of *W. sanguisugarum* are from high elevations on the massif Montagne d'Ambre in far northern Madagascar (*S. Malcomber et al.* 2363 and *Bernardi* 11999), and in the south on the massif de l'Andringitra (*Humbert* 3823).

***Weinmannia stenostachya* Baker** (species-group G)

Kew Bull. 1895: 103 (1895). — Type: *Baron* 6406, northern Madagascar (holo-, K!; iso-, P!).

COLLECTIONS EXAMINED FROM MAROJEJY. — MADAGASCAR, *Prov. Antsiranana: Deroin & Badré 74*, rive gauche de la Manantenina, versant sud du Beondroka, 1130 m, 14°26'S, 49°48'E (MO, P); *Miller & Randrianasolo 4456*, western slopes and summit of Mt. Beondroka, 830-1210 m (MO, P, TAN).

This species is widespread in the northern, eastern and southern uplands. See discussion under *W. arguta* about the distinguishing features of *W. stenostachya*.

***Weinmannia venosa* J.C. Bradford, sp. nov.**
(species-group G)

Frutex vel arbor 2-12 m alta. Folia plerumque 3-foliolata, glabra, rhachidi non alata, foliolis lateralibus ellipticis, 1-4.5 cm longis, 0.8-2 cm latis, apiceum obtusis, basin acutis, margine serrulata. Inflorescentia spicata, 4.5-7 cm longa, bracteis c. 1 mm longis, subtendens florem sessilis, singularis. Ovarium puberulum. Semina comose.

TYPUS. — *Rakotomalaza, Ravelonarivo & Messmer 959*, Madagascar. *Prov. Antsiranana, Réserve Naturelle Intégrale de Marojejy*, versant ouest et sud-ouest du sommet de Marojejy, ouest et sud du campement 5, 1875 m, 14°27'S, 49°44'E, 18-19 Nov. 1996 (holo-, MO; iso-, TAN).

Tree or shrub, 2-12 m tall, branching every 1- few nodes, occasionally dichotomously, internodes 0.7-5.5 cm long, lateral branches with short internodes, c. 1-2 mm long, then internodes of c. 1 cm or longer, the stems gray, cylindrical, the young growth with dense, orange pubescence. Axillary buds stipulate, stipules c. 2 mm long, 2.5 mm wide, unfused, pubescent, caducous; medial stipules caducous, inner surface glabrous, outer surface pubescent, elliptic to ovate, 4-7 mm long, colletors 0.3-0.7 mm long, red-black. Leaves decussate, imparipinnate, (1-)3-5(-7)-foliolate, 2.5-8.5 cm long, petiole 0.3-1.5 cm long, rachis not winged, both lamina surfaces glabrous in mature leaves except for pubescent midribs, young leaves sparsely pubescent on abaxial lamina; lateral leaflets elliptic, 1-4.5 cm long, 0.8-2 cm wide, the apex obtuse, the base concave distally, convex basally, terminal leaflets slightly larger than the laterals, 1.6-6 cm long, 1.3-3 cm

wide, elliptic to obovate, decurrent at the base for 3-7 mm, apex obtuse, margin serrulate throughout, teeth blunt, sinus shallow, with a small dark gland, lateral veins 15-22 per leaflet, semicraspedodromous, veins terminating at the sinus.

Flower-bearing axes spicate, spikes 4.5-7 cm long, axis puberulous, usually borne in pairs from a short peduncle, 0.7-1.5 mm long, with a vegetative bud between each spike (i.e. forming dyads), dyads borne axillary and sometimes terminally near the distal end of stems, or spikes occasionally borne from leaf axils along the main stem. Floral bracts curled, ligulate, c. 1 mm long, subtending solitary flowers that spread apically in a line, flowers inserted up to 3 mm from their bract.

Flowers bisexual or female?, pentamerous, diplostemonous, sepal lobes triangular, 1-1.25 mm long, sparsely puberulous, petals green?, elliptic, 1.2-1.4 mm long, 1 mm wide, sparsely puberulous, stamens 10, filaments 2.5-3 mm long (1 mm, female flower?), floral nectary thin, c. 0.5 mm tall, ovary ovoid, 1 mm tall, densely puberulous, ovules numerous, c. 16 per locule, styles 1.8-2 mm long. Capsules 4-5 mm long, calyx persistent, endocarp and exocarp separating in old fruits, seeds elliptic to slightly reniform, 1.25 mm long, 0.6-0.7 mm wide, comose, trichomes c. 0.5-1 mm long. — Fig. 6.

PARATYPES. — MADAGASCAR, *Prov. Antsiranana: Bradford & Rafamantanantsoa 719, 722*, near source of Andranomifototra river, NE of summit of Marojejy, near "Camp 4" and forested slopes north of the camp, 1520-1600 m, 14°26'24"S, 49°44'30"E (MO, P, TAN); *Humbert, Capuron & Cours 24726*, massif de l'Anjanaharibe (pentes et sommet nord) à l'ouest d'Andapa (haute Andramonta, bassin de la Lokoho: nord-est), 1600-1800 m (MO, P). — *Prov. Toliara: Rakotomalaza 517*, Fort-Dauphin, Eminiminy, RNI #11 Andohahela, parcelle #1, campement 4, sur la crête, 1500-1650 m, 24°34'S, 46°44'E (MO, P).

Weinmannia venosa is known from two disjunct populations at Marojejy and Andohahela more than 1500 km apart, and possibly from a third population at Andringitra (*Guillaumet 3388*).

The leaves of *W. venosa* resemble those of *W. hildebrandtii*; both have prominent venation, but they differ most obviously by the number of

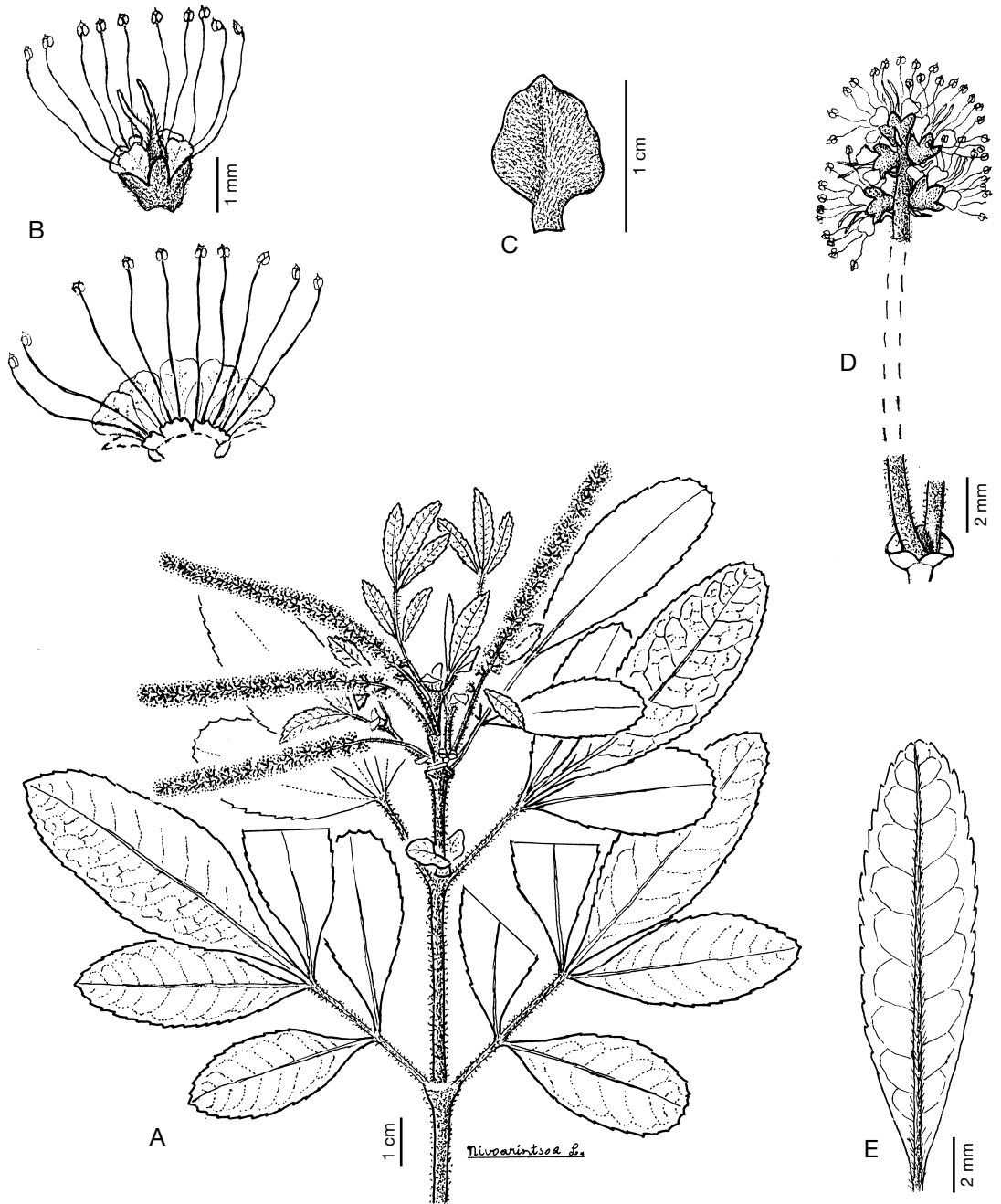


Fig. 6. — *Weinmannia venosa* J.C. Bradford: A, fertile branch; B, flowers; C, stipule; D, portion of spike; E, close-up of terminal leaflet. From Rakotomalaza, Ravelonarivo & Messmer 959 (TAN).

flowers subtended by a bract (one in *W. venosa* versus c. four in *W. hildebrandtii*). With its spicate inflorescence, pubescent ovaries and comose seeds, *W. venosa* is similar to *W. humblottii*, *W. sanguisugarum* and *W. arguta*. However, *Weinmannia venosa* has fewer leaflets (usually 3) than *W. sanguisugarum* (c. 15). *W. venosa* has elliptic to obtuse leaflets that are apically obtuse, whereas leaflets of *W. arguta* are elliptic to ovate and apically acute. In *W. venosa*, the leaves are generally larger than in *W. humblottii*, and the venation in *W. venosa* is more prominent than in *W. humblottii*. *Weinmannia venosa* does not have a slightly laminar rachis, which is a common feature in *W. humblottii*.

Bradford 722 appears to have diminutive male organs, whereas *Rakotomalaza 959* from the same population has bisexual flowers. Wart-like bumps on the leaves of *Bradford 722* suggest that the plant is diseased, which may have affected floral development. Unisexual flowers are not known in Malagasy species of *Weinmannia*, but do occur elsewhere in the genus.

***Weinmannia venusta* Bernardi (species-group B)**

Bot. Jahrb. Syst. 83: 156 (1961). — Type: *Humbert & Capuron 21944*, Madagascar, Prov. Antsiranana, environs d'Andapa, bassin de la Lokoho, 400-600 m (holo-, P; iso-, TEF).

Weinmannia venusta is known from one collection from Marojejy and a few others from the surrounding area. It likely occurs at relatively low elevations, probably from near sea level upwards to a few hundred meters.

The original description of *Weinmannia venusta* (BERNARDI 1964) is based on a single specimen from Marojejy. Collections of *W. venusta* not cited by BERNARDI (1964, 1965) are: *S.F. 17231*, *S.F. 17610*, and *S.F. 27632*. BERNARDI (1965) later included numerous other specimens under the name *W. venusta*, some of which should be considered distinct and represent an undescribed species with an unusual, highly clustered arrangement of flowers along decussate-branching inflorescence axes (see *Bradford 654b*, *Bradford 655*, *Bradford 659*,

Raharimalala 295, *R.N. 111*, *R.N. 2853*, *S.F. 5464*, and *S.F. 24061*). This apparently related species occurs at low elevations along the east coast, south of the range of *W. venusta*. In BERNARDI (1965), figure X: 2 & 5b shows the normal leaf and fruit form of the undescribed species, not of *W. venusta*.

Poorly known species and collections with uncertain affinities

An as yet unidentified species is represented by four collections (*Bradford & Rafamantanantsoa 677*, *681*, *684* and *716*), ranging from 800-1340 m in elevation. All specimens are sterile except *Bradford 681*, which has parts of old infructescences that place it in species-group G. *Bradford 716* was made from the site from which the only record of *W. sanguisugarum* was collected and consisted of a large population of conspecifics, c. 5 m tall, along the edges of a regenerating gap above the third camp.

Bradford & Rafamantanantsoa 723 may be conspecific with *Bradford 681*, but differs in having deeply serrated leaves. It was collected at 1520-1600 m along a creek near the fourth camp.

Bradford & Rafamantanantsoa 705 was collected at 1800 m and is somewhat similar to collections identified as *W. stenostachya*, but differs by having smaller leaves. The collections cited as *W. stenostachya* are from lower elevations and *Bradford 705* may simply be a high elevation form of this.

Another pair of sterile collections, *Bradford & Rafamantanantsoa 679* and *687*, made near the escarpment above camp 2 (c. 750 m), may represent another undescribed species. The leaves are usually 7-foliolate, with a glabrous lamina, leaflets that are entire except near the apex, and a rachis that is slender, barely winged, and pubescent.

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