



## A revision of *Welfia* (Arecaceae)

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### Abstract

A taxonomic revision of the neotropical palm genus *Welfia* based on morphological data and morphometric methods was carried out. One hundred and five herbarium specimens were scored for one qualitative variable and 19 quantitative variables. Based on the qualitative variable, fruit shape, two species are recognized. One (*W. regia*) is widely distributed in Central America and northwestern South America from Nicaragua to Colombia and Ecuador; the second, described here (*W. alfredii*) is restricted to a small area of central Peru. Nomenclature, descriptions, and distribution maps are provided for each species, and images of the type specimen of the new species are also provided.

**Key words:** Neotropics, geonomoid palms, Palmae

### Introduction

In establishing the genus *Welfia*, Wendland (1869: 242) wrote that he knew of two species, *W. georgii* from Costa Rica and *W. regia* from Colombia. Neither species was described nor specimens cited. André (1871) gave a description and illustration of *W. regia* and also described *W. georgii* (in the form of a quotation from a letter from Wendland). Hence two species are validly published and usually recognized: *W. regia* Wendland ex André (1871: 93) and *W. georgii* Wendland in André (1871: 94). A third species, *W. microcarpa* Burret (1930: 129) was added later, but this is poorly known and was placed as a synonym of *W. georgii* by Wessels Boer (1968).

*Welfia* is a member of the geonomoid group of palms, formally named the Geonomateae Luerssen (1882: 342) (Dransfield *et al.* 2008). The geonomoids are characterized by their flowers sunken in pits along the rachillae, with each pit covered before anthesis by a proximal lip. Although there have been disagreements over generic boundaries within the group (e.g., Moore 1966; Wessels Boer 1968), these are now mostly resolved (Dransfield *et al.* 2008). The group comprises six genera and 103 species: *Asterogyne* Wendland ex Hooker (1883: 914; 5 species, Stauffer *et al.* 2003), *Calyptrogyne* Wendland (1859: 72; 18 species, Henderson 2005), *Calyptronoma* Grisebach (1864: 518; 3 species, Zona 1995), *Geonoma* Willdenow (1805: 174; 68 species, Henderson 2011), *Pholidostachys* Wendland ex Hooker (1883: 915; 7 species, Henderson 2012), and *Welfia* (2 species, this revision). Roncal *et al.* (2010) placed *Welfia* and *Pholidostachys* as sister genera, and these two as sister to the remaining four genera (*Asterogyne*, *Calyptronoma*, *Calyptrogyne*, and *Geonoma*).

*Welfia* has always been considered as a small and uncomplicated genus, comprising two (e.g., Wessels Boer 1968) or one (e.g., Henderson *et al.* 1995) species. However, the most recent monographer (Wessels Boer 1968) used only eight specimens on which to base his revision, all from either Costa Rica or Colombia and none from Nicaragua, Panama, Ecuador, or Peru, where the genus also occurs. In the present revision, 105 specimens were examined from throughout the range of the genus. *Welfia*, as revised here, comprises two species.

## Materials and Methods

### Data matrix construction

One hundred and five specimens from the following herbaria were examined and scored: AAU, BH, BM, COL, F, FTG, HOXA, K, MO, NY, and US (herbarium abbreviations from Thiers, continuously updated). Specimens from AAU and FTG were not examined, but images used from institutional websites. Sometimes, more than one duplicate of a collection was used in scoring. Morphological attributes that could be scored or measured from specimens were divided into qualitative (binary or multistate) or quantitative (continuous, meristic) variables. A search was made for qualitative variables in which two or more states of the variable were present among the specimens and could be scored unequivocally. This search was based on a survey of specimens. A dissecting microscope was used to survey floral variables. One qualitative variable was found and scored (Appendix I).

A search was made for quantitative variables that could be taken from specimen labels (where, in case of ranges, median values were used) or measured from specimens. Variables were counted or measured with a ruler, digital calipers, or protractor. Nineteen quantitative variables were found and scored (Appendix II). Three are from stems, five from leaves, and eleven from reproductive structures. Fifteen are continuous and four are meristic.

A data matrix was constructed with specimens as rows and variables as columns (<http://sciweb.nybg.org/Science2/res/Henderson/Welfia.xls.zip>). Additional columns recorded a specimen identification number, collector, collector's number, herbarium, country, latitude, longitude, and elevation. Latitude and longitude were taken from the specimen label, when available. On specimens lacking coordinates, these were estimated from the collection locality using either maps or electronic gazetteers.

For each of the 105 specimens in the matrix, three spatial variables and 19 morphological variables were recorded, giving a potential total of 2,200 data points. However, approximately 65% of these potential data is missing in the matrix. *Welfia* has particularly high levels of missing data compared to other genera (e.g., 40% missing data in *Geonoma*; Henderson 2011) because the plants are so large that available collections are usually fragmentary. Because of this, data for most quantitative variables were taken from specimen labels, and these are recorded with varying degrees of accuracy.

### Taxonomic treatment

A detailed description of *Welfia* was recently given by Dransfield et al. (2008) and is not repeated here. Only a description based on variables from the matrix is given in the Taxonomic Treatment section. However, this is preceded by a discussion of morphology of the genus.

For each species, complete synonymy is given. Most types of names of *Welfia* were examined for this study and these are followed by a "!". Those which were not examined are followed by "*n.v.*". Excluded Names are listed in Appendix III. Images of types of the new taxon deposited at NY are available at the website [http://www.nybg.org/bsci/herbarium\\_imaging/](http://www.nybg.org/bsci/herbarium_imaging/). A numerical list of taxa and a list of specimens examined, ordered by collector, are given in Appendix IV.

## Results

### Morphology

The genus description given below in the Taxonomic Treatment section is based on the list of characters and quantitative variables used in this study (Appendices I and II). In the following discussion, morphology is treated in more detail, and the morphology of several attributes of *Welfia* not used in delimiting species is discussed.

Stems are always solitary. Stem height ranges from 4.4–22.5 m and diameter from 10.0–25.0 cm. Leaf number ranges from 7–26 per stem, with a mean of 15.

Leaves consist of sheaths, petioles, rachises, and pinnae. Sheaths are open and do not form crownshafts, and are usually rather fibrous along the margins. They are large and woody and range from 23.0–165.0 cm in length. Petioles are not well-developed. They range in length from 5.0–83.0 cm, but the higher figure given here may include part of the sheath. In general, petioles are rather short in *Welfia* and there may be some confusion between the sheath and petiole, leading collectors to over-estimate petiole length. Rachises are well-developed and elongate, ranging in length from 279.0–570.0 cm. Leaves are pinnate and never undivided. There are 33–90, regularly arranged, lanceolate pinnae per side of the rachis.

Inflorescences of *Welfia* are infrafoliar. They can be branched to one or two orders and are pendulous at anthesis. Rachillae number ranges from 7–16 and these are rather long and thick, ranging from 46.5–110.0 cm long and 12.2–31.9 mm wide. Flower pits are covered by proximal lips before anthesis. Flowers are arranged in triads, at least on the proximal parts of the rachillae. Commonly distal parts of the rachillae bear staminate flowers only. Staminate flowers have three, free, narrow sepals; three, valvate petals that are slightly connate at the bases; and 33–46 stamens. The filaments are connate for most of their length into a tube, but are free at the apices. Pistillate flowers have similar sepals and petals to those of staminate flowers. There is a staminodial tube with lobed apices, and these lobes are exerted at anthesis and spread in a star-shaped fashion. There is an elongate style with three, spreading stigmas. Inflorescences of all species appear to be protandrous, judged from specimens.

Fruits are either globose, not or scarcely dorsiventrally compressed, scarcely ridged laterally and blunt apically, and with a contracted base; or almond-shaped, dorsiventrally compressed, ridged laterally especially toward the apex, pointed apically, without a contracted base. Eophylls are bifid.

## Taxonomic Treatment

*Welfia* Wendland (1869: 242). Type:—*Welfia regia* Wendland ex André

**Plants** 13.9(6.0–25.0) m tall. **Stems** 9.8(4.4–22.5) m tall, 17.1(10.0–25.0) cm in diameter. **Leaves** 15(7–26) per stem; sheaths 93.2(23.0–165.0) cm long; petioles 36.7(5.0–83.0) cm long; rachises 446.7(279.0–570.0) cm long; pinnae 73(33–90) per side of rachis. **Inflorescences** prophylls 99.2(83.0–113.0) cm long; peduncular bracts 88.8(65.0–105.0) cm long, inserted 2.4(1.5–4.5) cm above the prophyll; peduncles 17.3(8.0–30.0) cm long, 44.9(27.6–59.1) mm diameter; rachillae 10(7–16), 71.3(46.5–110.0) cm long, 22.2(12.2–31.9) mm diameter; stamens 40(33–46); **fruits** globose, not or scarcely dorsiventrally compressed, scarcely ridged laterally and blunt apically, with a contracted base, or almond-shaped, dorsiventrally compressed, ridged laterally especially toward the apex, pointed apically, without a contracted base, 34.2(28.6–40.8) mm long, 15.8(10.8–28.0) mm diameter.

## Key to the species of *Welfia*

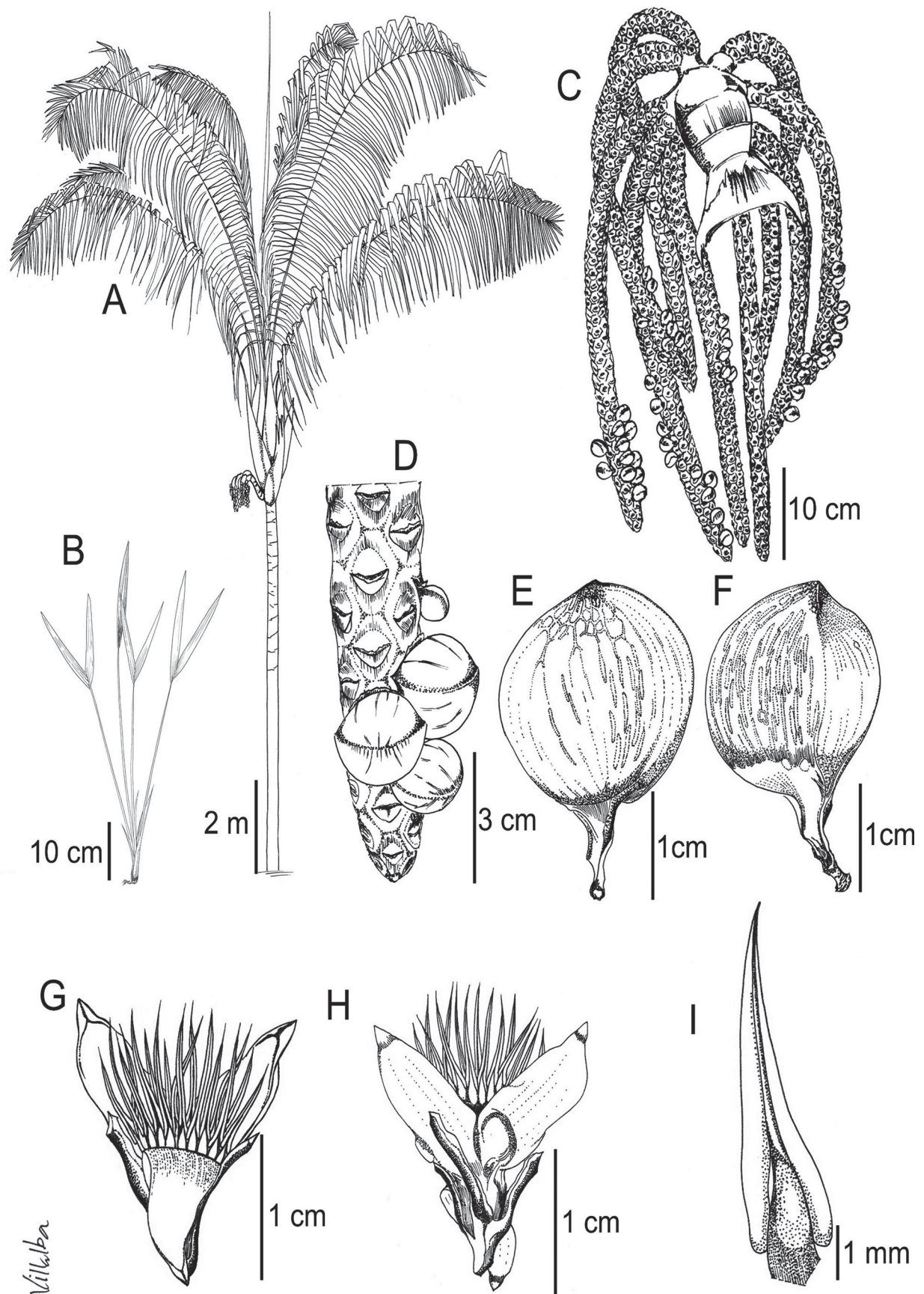
- 1 Fruits globose, not or scarcely dorsiventrally compressed, scarcely ridged laterally and blunt apically, with a contracted base, 25.9(24.8–28.0) mm diameter; central Peru ..... *W. alfredii*
- Fruits almond-shaped, dorsiventrally compressed, ridged laterally especially toward the apex, pointed apically, without a contracted base, 15.2(10.8–18.2) mm diameter; Honduras, Nicaragua, Costa Rica, Panama, western Colombia, western Ecuador ..... *W. regia*

### 1. *Welfia alfredii* Henderson & Villalba, *sp. nov.* (Figs. 1 & 2)

It differs from *Welfia regia* in its fruits which are globose, not or scarcely dorsiventrally compressed, and scarcely ridged laterally.

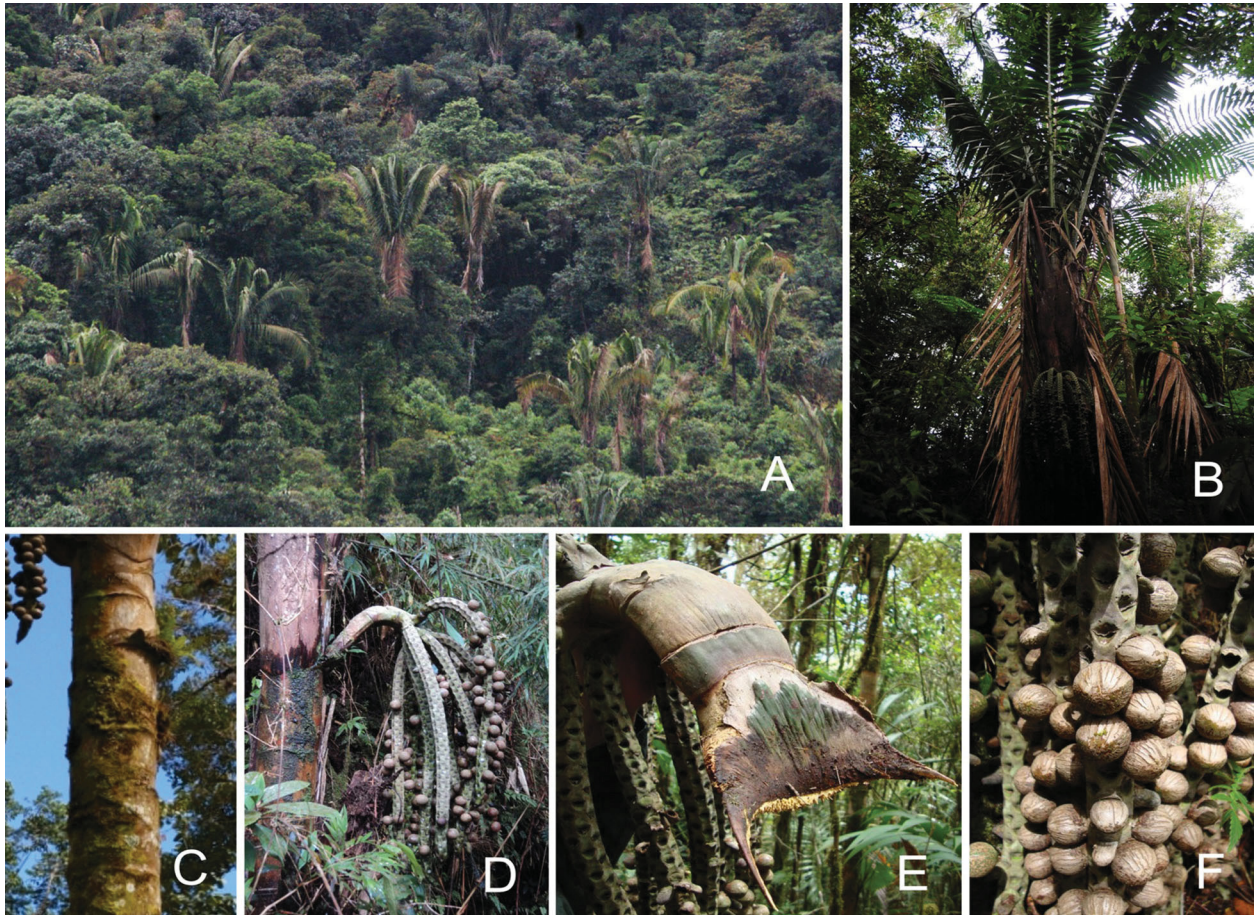
Type:—PERU. Pasco: 18 km NE of Villa Rica on carretera marginal, 1550 m, 8 September 1998, *A. Henderson, E. Ferreira & M. Arakaki 3001* (holotype USM!, isotype NY!).





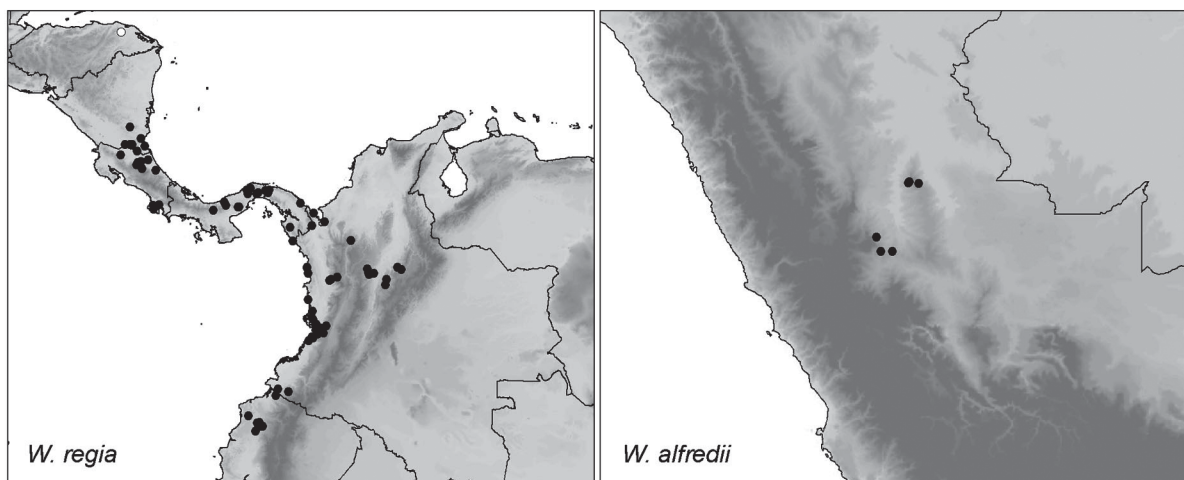
**FIGURE 1.** *Welfia alfredii* A. Habit. B. Seedling. C–D. Infructescence. E. Fruit in frontal view. F. Fruit in dorsiventral view. G. Staminate flower in frontal view. H. Staminate flower dorsal view. I. Stamen. (drawings by I. Villalba; C–F from Vásquez 35870, G, H, I from Valenzuela 19375).





**FIGURE 2.** *Welfia alfredii*. A Habitat in montane forest at Bosque de Protección Pui–Pui. B. Habit. C. Stem with leaf scars. D. Inflorescence. E. Peduncle. F. Fruits. (Images by I. Villalba, L. Valenzuela and R. Vásquez).

**Plants** 14.7(9.0–19.0) m tall. **Stems** 7.5(5.0–12.0) m tall, 17.7(14.0–20.0) cm in diameter. **Leaves** 8(7–9) per stem; sheaths 74.1(64.0–90.0) cm long; petioles 35.1(34.4–36.0) cm long; rachises 463.5(360.0–570.0) cm long; pinnae 76(65–85) per side of rachis. **Inflorescences** prophylls 83.0 cm long; peduncular bracts 65.0 cm long; peduncles 22.2(18.0–24.5) cm long; rachillae 12(8–16), 72.1(55.0–100.0) cm long, 25.4(19.4–28.1) mm diameter; stamens 45(44–46); **fruits** globose, not or scarcely dorsiventrally compressed, scarcely ridged laterally and blunt apically, with a contracted base, 34.3(33.1–35.9) mm long, 25.9(24.8–28.0) mm diameter.



**FIGURE 3.** Distribution maps of *Welfia regia* and *W. alfredii*.

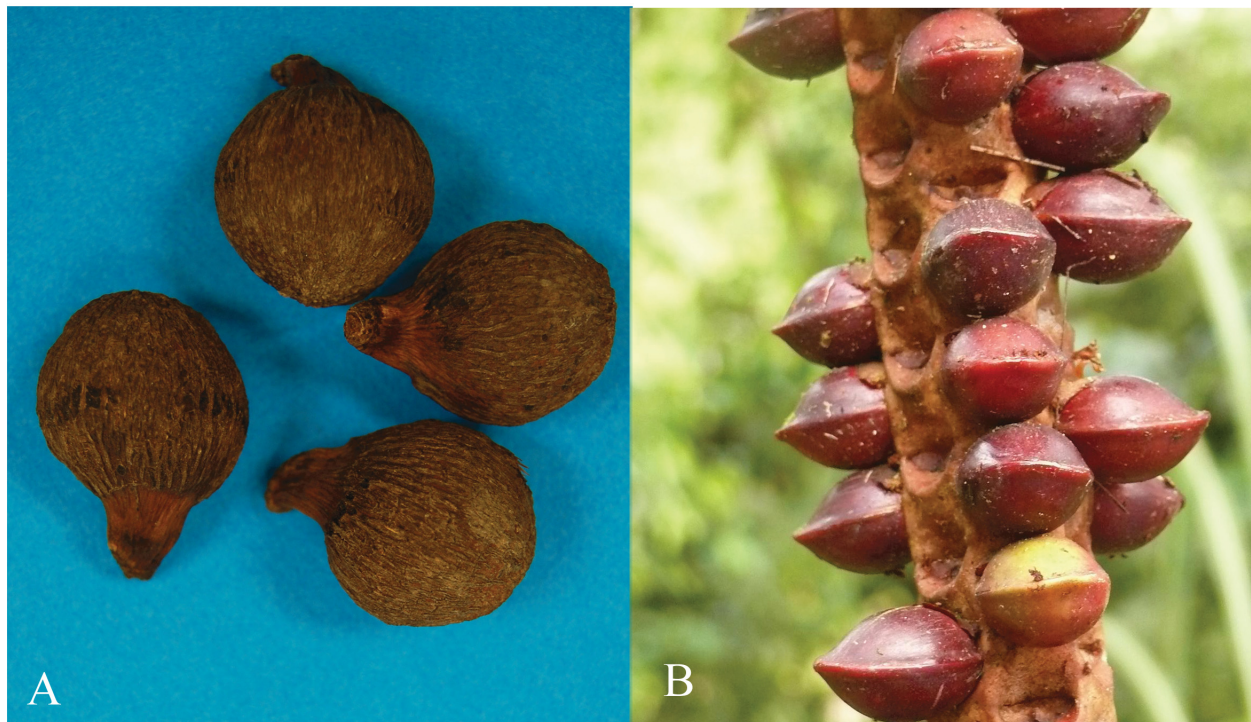


**Distribution and habitat.** From 9°25'–10°40'S and 74°35'–75°19'W in central Peru (Huánuco, Pasco, Ucayali) on the Cordillera Oriental, Cordillera El Sira, and the eastern flank of the Cordillera Yanachaga at 1502(1391–1725) m elevation in montane rainforest or cloud forest (Fig. 3).

On Yanachaga *Welfia alfredii* is found growing in wet pre-montane forest and prefers slightly clayey sandy soils, where it forms gregarious populations. It occurs in a forest dominated by large trees of *Croton matourensis* (Euphorbiaceae) and also other palms such as *Socratea exorrhiza*, *Dictyocaryum lamarckianum*, and *Euterpe luminosa*. The undergrowth is sparse, with Melastomataceae shrubs, ferns (*Cyathea* sp.), palm shrubs as *Geonoma longepedunculata* and juveniles of *S. exorrhiza* and *W. alfredii*.

**Taxonomic notes.** Only eight specimens of *Welfia alfredii* were examined in this study. It was first collected by Gentry (*Gentry 63540*) in 1988. A second collection (*Rainer 11231188*) was made in the same year, and briefly described by Rainer (1995) as *Welfia* sp. The third collection, the type, was made by Henderson (*Henderson et al. 3001*) in 1998. All three collectors realized that these Peruvian plants were somehow different (Gentry, unpublished report to USAID; Rainer 1995; Henderson *et al.* 1995) but did not pursue the problem. The most recent specimens collected come from the Parque Nacional Yanachaga Chemillén.

The most obvious difference between *Welfia alfredii* and *W. regia* is the shape of the fruits (Fig. 4). Only three of the specimens examined have mature fruits (*Graham 6031*, *Vásquez 35870*, *Valenzuela 19375*). Label data from *Rainer 11231188* describes fresh fruits as “globose, 4–5 cm diameter”. Quantitatively, *Welfia alfredii* differs significantly from *W. regia* in five variables (lower leaf number, higher number of rachillae, greater rachillae width, higher stamen number, larger fruit diameter)(*t*-test, *P* < 0.05). The new species is also geographically separate from *W. regia*, and the nearest populations of the two are more than 1,100 km apart and on opposite sides of the Andes. Habitat also differs, with *W. regia* occurring in lowland to montane rainforests at 295(0–1300) m elevation and *W. alfredii* occurring in montane forests at 1502(1391–1725) m elevation.



**FIGURE 4.** A. Fruits of *Welfia alfredii* showing the globose shape and contracted base, without dorsiventral compression and lateral ridges (from *Graham 6031*). B. Fruits of *W. regia* showing the almond shape and non-contracted base, with dorsiventral compression and lateral ridges (image by G. Galeano, from Chocó, Colombia).

Dr. James Graham (pers. comm.) monitored several populations of *Welfia alfredii* in the Cordillera El Sira in Peru over the last few years. Here the palms occur from 1550 m to 1800 m elevation in cloud forest, growing with another large palm, *Dictyocaryum lamarckianum*. Stems remain acaulescent for a number of years. Even as aerial stems emerge, up to about 5 m tall, they remain covered with the woody leaf sheaths.



These sheaths persist on the stem until sexual maturity is reached, when they shed en masse. After the sheaths are shed, the stems can be seen to have irregular internodes and inflorescence scars. The abaxial surface of the prophyll is rounded and the adaxial surface is planar, with a woody ridge at its margins. Both surfaces are fissured; although not exactly accordion-like, they do split to expand the bracts until they fall. After the bracts fall the rachillae turn from yellow to greenish. Within a few weeks the floral pits begin to open to reveal the very fragrant staminate flowers. Flowers attract numerous insects, including bees, flies, and thrips. Fruits take from 18–20 months to mature. Seeds are extremely hard and dense. No predation was observed of seeds on the ground below the parent tree, and no dispersers were observed either from the tree or from the ground. Mature fruits are globose, but immature fruits become somewhat almond-shaped upon drying.

Luis Valenzuela (pers. comm.) also collected sterile individuals of the new species in the Cordillera El Sira (*Valenzuela et al.* 17649, 17505) at 1391 m, however he reported their presence up to an elevation of 1800 m. Another population of 12 individuals was evaluated by Villalba et al. in 2012 at the Cordillera of Yanachaga under the Jardín Botánico de Missouri and the TEAM Network logistics. Here, *Welfia alfredii* occurs at elevations of 1401–1451 m and grows with several other large palms: *Euterpe luminosa*, *Socratea exorrhiza* and *Dictyocaryum lamarckianum*.

*Welfia alfredii* is named after Alfred Henderson.

**2. *Welfia regia*** Wendland ex André (1871: 93). Type:—COLOMBIA. “Nouvelle-Grenade”, 1200 m, 1868, *G. Wallis s. n.* (holotype, BR, not localized). Lectotype (here designated):—André, 1871: Pl. LXII.

*Welfia georgii* Wendland in André (1871: 94). Type:—COSTA RICA. Heredia: “flum. Sarapiquí”, 1857, *H. Wendland s n.* (holotype HBG *n.v.*, isotype K!).

(Fig. 5)



**FIGURE 5.** *Welfia regia*. A. Habit (image by G. Galeano from Chocó, Colombia). B. Inflorescence (image by A. Henderson from Antioquia, Colombia).

**Plants** 13.8(6.0–25.0) m tall. **Stems** 10.4(4.4–22.5) m tall, 17.0(10.0–25.0) cm in diameter. **Leaves** 17(9–26) per stem; sheaths 100.8(23.0–165.0) cm long; petioles 37.3(5.0–83.0) cm long; rachises 440.6(279.0–540.0) cm long; pinnae 73(33–90) per side of rachis. **Inflorescences** prophylls 103.3(97.0–113.0) cm long; peduncular bracts 94.8(80.0–105.0) cm long, inserted 2.4(1.5–4.5) cm above the prophyll; peduncles 16.1(8.0–30.0) cm long, 44.9(27.6–59.1) mm diameter; rachillae 9(7–15), 71.2(46.5–110.0) cm long, 21.9(12.2–31.9) mm diameter; stamens 38(33–43); **fruits** almond-shaped, dorsiventrally compressed, ridged laterally especially toward the apex, pointed apically, without a contracted base, 34.2(28.6–40.8) mm long, 15.2(10.8–18.2) mm diameter.

**Distribution and habitat.** From 11°49'N–0°16'S and 73°40'–84°48'W in Nicaragua, Costa Rica, Panama, western Colombia, and western Ecuador at 314(0–1325) m elevation in lowland or montane rainforest (Fig. 3). *Welfia* is reported to occur in Honduras (probably based on *Welfia microcarpa*—see Excluded Names), but no specimens from there have been seen. However, Dr. Paul House (pers. comm.) reports that it occurs in Honduras on the Patuca River in the Patuca National Park (open circle on Fig. 3).

**Taxonomic notes.** Wendland, in a letter quoted by André (1871), stated that the Colombian *Welfia regia* differed from the Costa Rican *W. georgii* in its larger fruits. In the present study, no significant differences in fruit size between the two countries are found (Colombia fruits—34.2(28.6–40.8) mm long, 15.7(10.8–18.2) mm diameter; Costa Rica fruits—35.4(32.7–37.7) mm long, 14.8(14.0–16.1) mm diameter), and they are here regarded as belonging to the same species.

Of the two available names for this species, neither *Welfia regia* nor *W. georgii* have priority based on their original publication. Apparently the first publication in which one was placed in synonymy of the other was that of Henderson *et al.* (1995) who placed *W. georgii* as a synonym of *W. regia*. The correct name for the species is therefore *W. regia*.

A specimen of *Welfia regia* (*G. Wallis s. n.*) was cited by André (1871) and was said to be in Linden's herbarium and to come from “Nouvelle–Grenade, à 1,200 mètres d'altitude”. Linden's herbarium was dispersed (Stafleu & Cowan 1981), but the Wallis specimen is presumed to be the same specimen as the one seen by Burret (1930). However, Burret wrote that the specimen, consisting at least of fruits, came from “Colombia: Cauca–Tal” [Cauca valley], etwa 1650 m”. The differences in elevation are unexplained (all other specimens examined from Valle del Cauca in Colombia are from lower elevations—30–795 m), and the specimen has not been located and is presumed destroyed. The syntype, the plate in André is therefore designated as lectotype.

**Intraspecific variation.** *Welfia regia* is not continuously distributed but occurs in several separate populations. It is not clear if these populations are real or artifacts of uneven collecting. The northernmost population, in southeastern Nicaragua and northeastern Costa Rica occurs at low elevations of 172(50–750) m. A second population occurs in southwestern Costa Rica on the Osa Peninsula at 218(100–350) m elevation. There are no significant morphological differences between these two populations.

The population in central and western Panama occurs at slightly higher elevations, at 363(30–1000) m. There are no significant morphological differences between this and the southeastern Nicaragua and northeastern Costa Rican population except for plant height: Panamanian plants are significantly taller.

In Colombia plants occur all along the Pacific coast except for the most southerly part, but this is likely to be a collecting artifact. However, there are three outlying, Andean populations. A single specimen (*Alverson 78*) comes from an elevation of 550 m in the northern Cauca valley. Four specimens (*Cardenas 2478*, *Henao 298*, *Hernández 444*, *Ramirez 858*) are from the eastern slopes of the Cordillera Central at 772(525–1000) m elevation; and four specimens (*Fassett 25210*, *Jaramillo 135*, *Lozano 7188*, *Pesca 2*) are from the western slopes of the Cordillera Oriental at 1070(800–1300) m. Although there are few specimens of each population, plants from the Cordillera Central have thinner rachillae and smaller fruits than others. There is also a slight difference in fruit shape; the two Cordilleran populations have almond-shaped, dorsiventrally compressed fruits, as in other specimens, but they are not so markedly ridged laterally and are apically blunter. More specimens are needed to determine the taxonomic status of these Cordilleran populations.



The most southerly population in southern Colombian and Ecuador does not differ morphologically from other Colombian populations.

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## Appendix I. Qualitative Variables

### Characters

The abbreviation in parentheses at the end of the character is the column label in the Data Matrix (<http://sciweb.nybg.org/Science2/res/Henderson/Welfia.xls.zip>). The states of the characters here are scored as ‘(1)’ or ‘(2)’ and correspond with the states in the Data Matrix.

1. Fruits globose, not or scarcely dorsiventrally compressed, scarcely ridged laterally and blunt apically, with a contracted base (1); fruits almond-shaped, dorsiventrally compressed, ridged laterally especially toward the apex, pointed apically, without a contracted base (2). (fruit)

## Appendix II. Quantitative variables

Abbreviations in parentheses at the end of each variable are the column labels in the Data Matrix.

1. Plant height (m); data taken from specimen labels. (plheight)
2. Stem height (m); data taken from specimen labels. (stemheight)
3. Stem diameter (cm); data taken from specimen labels. (stemdiameter)
4. Number of leaves per stem; data taken from specimen labels. (leafnumber)
5. Sheath length (cm); data taken from specimen labels. The distinction between sheath and petiole is not clear. (sheath)
6. Petiole length (cm); data taken from specimen labels. (petiole)
7. Rachis length (cm); data taken from specimen labels. (rachislen)
8. Number of pinnae per side of rachis; data taken from specimen labels. (nodivisions)
9. Prophyll length (cm); data taken from specimen labels. (prophyll)
10. Peduncular bract length (cm) data taken from specimen labels. (pedbract)
11. Distance between peduncular bract and prophyll insertion (cm); data taken from specimens. (distance)
12. Peduncle length (cm); data taken from specimens. (pedunclelen)
13. Peduncle width (mm); data taken from specimens. (pedunclelen)
14. Number of rachillae; data taken from specimen labels or from specimens. (norachillae)
15. Rachilla length (cm); data taken from specimen labels or from specimens. (rachilllen)
16. Rachilla diameter (mm); data taken from specimens, measured at middle of rachilla. (rachillwid)
17. Number of stamens; data from specimens. (stamen)
18. Fruit length (mm); data taken from specimens. (fruitlen)
19. Fruit diameter (mm); data taken from specimens, narrowest side measured. (fruitdiam)

## Appendix III. Excluded Names

*Welfia microcarpa* Burret (1930: 129). Type: Honduras. No locality, no date, *unknown collector* (holotype, B, destroyed?).

Burret (1930) did not cite a specimen of *W. microcarpa*, for unknown reasons, but must have had at least some fruits at his disposal. He described the fruit as 3 cm long and 1.5 cm wide, and considered this smaller than those of other species in the genus. This size does, however, fit within the fruit size range recorded here, although at the lower end of the range. It seems unlikely that Burret would have made a mistake in his generic identification, and *Welfia* does occur in Honduras. However, no specimens from that country could be localized, and the name is thus considered an Excluded Name.



## Appendix IV. Numerical List of Taxa and Specimens Examined

### Numerical List of Taxa

1. *Welfia alfredii*
2. *Welfia regia*

### Specimens Examined

Specimens are arranged by collector (with first initial) in alphabetical order, followed by collector's number in increasing order, followed by species number in parentheses.

Acevedo, P. 73 (2)  
Aguilar, R. 2234 (2)  
Allen, P. 2112 (2), 2565 (2)  
Alverson, W. 78 (2)  
Balick, M. 1698 (2)  
Barfod, A. 60026 (2), 60050 (2)  
Bernal, R. 111 (2), 691 (2), 1528 (2), 3022 (2)  
Betancur, J. 4305 (2)  
Borchsenius, F. 262 (2), 279 (2)  
Boyle, B. 5584 (2)  
Burger, W. 4274 (2), 7261 (2)  
Calderón, M. 18 (2)  
Carballo, G. 103 (2)  
Cardenas, M. 2478 (2)  
Churchill, H. 5963 (2)  
Clark, J. 4605 (2)  
Cook, O. 94 (2), 636 (2)  
Croat, T. 15085 (2), 17319 (2), 44237 (2)  
Cuatrecasas, J. 13967 (2), 16314 (2), 16932 (2), 17365 (2)  
Davidse, G. 23538 (2)  
de Nevers, G. 5958 (2), 5974 (2), 8549 (2)  
Devia, W. 5095 (2)  
Dodson, C. 14605 (2)  
Dransfield, J. 4907 (2)  
Duke, J. 8025 (2), 15030 (2)  
Faber–Langendoen, D. 434 (2)  
Fassett, N. 25210 (2)  
Folsom, J. 9921 (2), 9931 (2)  
Fuchs, H. 22211 (2)  
Galeano, G. 391 (2), 7994 (2), 8104 (2),  
Gentry, A. 63540 (1), 7234 (2), 41012 (2), 41077 (2), 48267 (2), 53737 (2), 53770 (2), 68579 (2), 34889 (2)  
Gómez, L. 19509 (2)  
Gordon, B. 16 (2)  
Graham, J. 6031 (2)  
Guteniez, D. 8 (2)  
Hammel, B. 10703 (2)  
Henao, J. 298 (2)

Henderson, A. 711 (2), 3001 (1)  
Hernández, J. 444 (2)  
Holm, R. 928 (2)  
Jaramillo, R. 135 (2)  
Knudsen, J. 607 (2)  
Lozano, G. 7188 (2)  
McPherson, G. 19628 (2)  
Moore, H., 6557 (2), 6573 (2), 9457 (2), 10183 (2)  
Morales, J. 1501 (2)  
Mowbray, T. 1405 (2)  
Nee, M. 6595 (2)  
Pesca, A. 2 (2)  
Porter, D. 4742 (2)  
Rainer, H. 11231188 (1)  
Ramírez, J. 858 (2)  
Read, R. 8148 (2)  
Rueda, R. 7482 (2), 8711 (2), 9129 (2), 10222 (2), 10423 (2)  
Salick, J. 7904 (2), 8079 (2)  
Siefke, R. 11 (2)  
Stevens, W. 9029 (2)  
Sugden, A. 532 (2)  
Sytsma, K. 2034 (2)  
Thomsen, K. 110 (2), 1189 (2)  
Tomlinson, P. (2)  
Valenzuela, L. 17505 (1), 17649(1), 19375 (1)  
Vásquez, R. 35870 (1)  
Wendland, H. 74 (2)  
Whitefoord, C. 168 (2)  
Zuluaga, R. 623 (2)