A taxonomic revision of *Zamia montana* and *Zamia oligodonta*, with notes on their conservation status

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Abstract

The taxonomy of *Zamia montana* and *Z. oligodonta*, two poorly understood species occurring at high elevations in the Western Cordillera of Colombia, is discussed. *Zamia oligodonta* was recently synonymized under *Z. montana*, but information derived from recent field studies is provided showing the two species are quite distinct. A treatment of both species is presented, including discussion of the major morphological differences between them and also between other South American species with prominently-veined leaflets. The conservation status of both species is evaluated.

Key words: Antioquia, Cycadales, Risaralda, Zamiaceae

Introduction

*Zamia montana* Braun (1875: 376) was described in 1875 by German botanist Alexander Braun from material collected by German plant collector Gustav Wallis in Colombia (then 'New Grenada') in 1873 and cultivated by James Veitch & Son nursery in London. Braun received dried materials of *Z. montana* from Wallis which he returned to Wallis with the exception of a single leaflet (Eichler 1881). This leaflet, which could have been considered the holotype for the species, was likely destroyed in the bombing of the Berlin herbarium in 1943. However, an illustration of this leaflet was sent in 1881 by then Director of the Berlin Herbarium August Eichler to William Thiselton Dyer at Kew and is still extant (Fig. 1).

While under the employment of The Veitch Nurseries in England, German plant collector Guillermo Kalbreyer recollected *Zamia montana* in 1880 in an area called 'Paramillo', believed to be the highest point of a mule trail in Murri, within the present day municipality of Frontino, Antioquia (Bernal et al. 1989). Harry James Veitch requested and received only dried material of the cycads collected by Kalbreyer in Colombia [*Z. montana* and *Z. wallisii* Braun (1875: 376)] as in his opinion the demand for material of these species did not justify the expense of introducing live material (Veitch 1880). Veitch sent this material to German Botanist Hermann Wendland at the Herrenhausen herbarium who, then, forwarded some of this material to William Thiselton-Dyer at Kew (Thiselton-Dyer 1882).

In 1882, live plants of *Z. montana* were imported from Antioquia by English plant dealers Shuttleworth, Carder & Co. Edward Shuttleworth sent vegetative material and live plants to William Thiselton-Dyer at Kew, who then prepared a description of the species for inclusion in the Gardeners’ Chronicle by combining the notes and material from Wallis, Kalbreyer and Shuttleworth Carder, & Co. into his description (Thiselton-Dyer 1882), reproduced below:

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Stem tuberous, 4–5 feet high, ¾ foot thick (probably in very old plants); leaves forming an erect terminal tuft, 4–5 feet long; petioles at the base fusco-tomentose flattened above and ¾ inch in diameter; beset throughout with minute scattered prickles, leaflets numerous (eight to ten pairs), the lower more distant, 1 foot or more long, 2–4 inches wide, chartaceous, oblanceolate to linear-oblanceolate, slightly unsymmetrical, narrowing into a very short petiolar, apex abruptly acuminate, with usually one prominent and a few obscure teeth; nerves twenty to thirty-five, marked by strong furrows above, scarcely prominent except in dried specimens below. Inflorescence unknown. New Grenada. Moderately shady places in the upper mountain region, 7000–8000 feet.
From the description and the historic collections extant at the Kew herbarium, it was clear that *Z. montana* was unusual in that it occurred at a very high elevation for a Neotropical cycad, and was distinctive in having leaflets with multiple prominent veins (hereafter referred to as prominently-veined leaflets), a character which is rare in the Cycadales and shared with only a about a fifth of all *Zamia* Linnaeus (1763: 1659) species. However, after these historic collections, *Z. montana* remained an enigmatic species for over 100 years, until it was rediscovered in 1983 in premontane rainforest in the Frontino Municipality of Antioquia by Colombian botanists Rodrigo Bernal and Gloria Galeano who retraced Kalbreyer’s itinerary while studying Colombian palms (Bernal et al. 1989). Consequently, the region was identified as a center of high biodiversity and attracted researchers who made five collections of *Z. montana* between 1986 and 1991.

Despite these few more recent collections, the species remained enigmatic, as it was never studied in great detail, and only a couple of photographs of the species have ever been published (Galeano et al. 2005). Unfortunately, soon after these recent collections were made, the region where *Z. montana* was known to occur became inaccessible to botanists for over 20 years due to the violence related to Colombia’s armed conflict. As ongoing deforestation in the region was extensive at the time of these collections, it was believed that the species might be extinct in the wild (Stevenson 2004).

In 2003, *Zamia oligodonta* Calderón-Sáenz & Stevenson (2003: 486), an additional prominently-veined species native to premontane rainforests from the Western Cordillera of Colombia, was described. The authors distinguished the new species from *Z. montana* by stating that *Z. montana* had an arborescent habit compared to the subterranean stem of *Z. oligodonta*, and that *Z. montana* did not have the acuminate leaflets or the thick sub-apical teeth of *Z. oligodonta*.

Lindstrom (2009), based on comparative examination of herbarium specimens, placed *Z. oligodonta* under synonymy of *Z. montana*, suggesting that the former was a juvenile form of the latter and that the diagnostic characters provided by Calderón-Sáenz & Stevenson to distinguish *Z. oligodonta* (i.e. subterranean stem and differences in leaflet morphology) were simply differences due to ontogenetic changes in morphology of the same species.

New evidence obtained from recent visits to wild populations of *Zamia* in premontane forests of Risaralda and Antioquia confirms that there are major morphological differences between the populations from both regions, and that both *Z. oligodonta* and *Z. montana* should both be recognized as distinct species. Below we attempt to shed some light on both species and elucidate their differences.

**Taxonomy**

**Comparison between *Z. montana* and *Z. oligodonta*:—** *Zamia montana* and *Z. oligodonta* both occur on the Pacific slope of the Western Cordillera of Colombia at what can be considered very high elevations for cycads. *Zamia montana* is endemic to Antioquia, where it occurs in premontane and lower montane rainforests at 1750–2080 m, the highest elevation known for a Neotropical cycad. *Zamia oligodonta* is endemic to Risaralda, where it occurs in premontane rainforest at 1500–1800 m. The two species occur approximately 160 linear km away from each other.

The two species can easily be distinguished based on vegetative characters alone. *Zamia montana* is a large arborescent species, with trunks up to 1.5 m tall and 20 cm in diameter bearing up to 10 individual leaves, whereas *Z. oligodonta* has stems that are typically subterranean but occasionally arborescent to 40 cm tall and 11 cm in diameter and bear a maximum of 3 leaves. The leaflets of *Z. montana* are oblanceolate, strongly coriaceous and appearing rigid, with the veins only slightly protruding on the abaxial surface and margins that are strongly revolute throughout most of the leaflet, whereas the leaflets of *Z. oligodonta* are narrowly elliptic to elliptic, papyraceous to subcoriaceous and appearing undulate, with veins strongly protruding on the abaxial surface and margins that are revolute only on the proximal third. The leaflets of *Z. oligodonta*, to 50 × 14 cm, attain much larger dimensions than those of *Z. montana*, which can be up to 41 × 10.5 cm.

The ovulate strobili of both species are quite distinct, with those of *Z. montana* being beige-yellow tomentose when juvenile, cylindrical in shape with megasporophylls arranged in up to 10 orthostichies of 7–9 sporophylls each, whereas those of *Z. oligodonta* are brown tomentose when juvenile, ellipsoid in shape with megasporophylls arranged in 6–7 orthostichies of 3–5 sporophylls each.

**Comparison of South American zamias with prominently-veined leaflets:**—Both *Z. montana* and *Z. oligodonta* have prominently-veined leaflets, a character shared with approximately a fifth of all *Zamia* species.
All species from Central and North America with prominently-veined leaflets have leaflet margins that are conspicuously toothed, with teeth often occurring in the proximal half, whereas most South American species, with the exception of Z. disodon D.W.Stev. & Sabato (Stevenson 2001: 38) and Z. urep Wallnöfer (1996: 1056) have leaflets with entire margins or with occasional crenate teeth on the distal end of leaflets. A key to South American species of Zamia with prominently-veined leaflets is provided below.

**Key to South American species with prominently-veined leaflets:**

1. Presence of distinct petiolule on each leaflet..........................................................Z. wallisii  
- No distinct petiolule present on leaflets ....................................................................2.  
2. Leaflets with margins serrate below distal half...........................................................3.  
- Leaflets with margins entire or with occasional teeth on distal end...........................4.  
3. Leaflets membranaceous .........................................................................................5.  
- Leaflets chartaceous to subchoriacous ....................................................................Z. disodon  
4. Leaflet length to width ratio above 5:1 ...................................................................6.  
- Leaflet length to width ratio below 5:1 ....................................................................5.  
5. Leaflets pale yellow green on both surfaces, glabrous, veins not protuberant...........Z. gentry  
- Leaflets dark green adaxially, pale green abaxially, veins protuberant abaxially with scattered red-brown trichomes .......Z. roezlii Linden (1873: 10)  
6. Petoioles densely covered with prickles (10+ per linear cm. of petiole) which are often branched...........Z. amplifolia Master ex Masters (1878: 810)  
- Petoioles sparsely armed with prickles (8 or less per linear cm. of petiole) which are typically unbranched..............................Z. montana  
7. Leaflets oblanceolate with strongly revolute margins to distal quarter, coriaceous and not appearing undulate, veins only slightly protruding on abaxial side, stems arborescent, Antioquia .........................................................Z. montana  
- Leaflets narrowly elliptic to elliptic, with margins revolute only in proximal half and straight in distal half, chartaceous to subchoriacous, appearing undulate in fresh material, veins strongly protruding on adaxial side, stems typically subterranean, Risaralda ........................................Z. oligodonta

**Zamia montana** Braun (1875: 376). Figs. 1,2,3.

Neotype (designated by Stevenson 2001: 57)—COLOMBIA. Antioquia: Municipio de Frontino, km 17 of road Nutibara–Murri, 1750 m, 24 September 1987, Zarucchi et al. 5724 (neotype NY!, isoneotypes COL!, HUA!, MO!).

_Aulacophyllum montanum_ (A.Braun) Regel (1876: 141).


**Illustrations:**—Galeano et al. (2005), Stevenson (2001, 2004).

**Etymology:**—The specific epithet references the premontane to lower montane habitat of this species, which occurs at the highest elevation of any Neotropical cycad.

**Description:**—_Stems_ arborescent, to 150 × 20 cm, solitary or occasionally branching, erect or decumbent. _Leaves_ 1–10, to 307 cm long, _petiole_ to 170 cm, sparsely armed with prickles to 2 mm long, _rachis_ to 137 cm long, unarmed or sparsely armed with prickles in the proximal third, _Rachis_ to 131 cm, unarmed or sparsely armed with prickles in the proximal third, carrying up to 30 opposite to suboppositely arranged leaflets. _Leaflets_ oblanceolate, narrowly cuneate basally, acuminate apically, coriaceous, veins forming grooves on adaxial surface, only slightly protruding on abaxial surface, margins strongly revolute except at acuminate tip, entire but sometimes uneven and slightly sinuous (repend) at distal end. Middle leaflets 19.5–41 × 5.9–10.5 cm, spaced 6-10 cm apart, apical leaflets 24.6–27.7 × 6.4–9.6 cm, basal leaflets 28.5–35.5 × 5.9–8.5 cm. _Eophylls_ unknown. _Pollen_ strobili 1–3 per stem apex, to 13.5 × 3.5 cm, beige-yellow tomentose, peduncle 2.5–3.5 cm long, strobilar axis villous, microsporophylls arranged in 16–20 orthostichies of 20–28 sporophylls each, at 13 × 6 mm, sterile apex encompassing approximately 1/3 of total length of...
sporopyll, microsporangia 0.8–1.0 mm, present on both abaxial and adaxial surfaces. On adaxial surface, aggregated in single group of 10–15 sporangia limited to the distal end of fertile region, on abaxial surface, aggregated in single group of 15–20 sporangia covering entire fertile region. *Ovulate strobili* 1 per stem apex, erect, cylindrical, beige-yellow tomentose when juvenile (mature color not seen), to $33 \times 16$ cm, sterile apex obtuse, to 5 cm long, peduncle obscured by cataphylls to $4 \times 4$ cm. *Megasporophylls* arranged in up to 10 orthostichies of 7–9 sporophylls each, bullae truncate with hexagonal to oblong-hexagonal distal face 3–4 × 3–4 cm, terminal facet moderately protruding, distinct, shallowly indented. *Seeds* unknown.

**FIGURE 2.** *Zamia montana* in habitat in Antioquia, Colombia. A–B. Leaves on juvenile plants. C. Base of petiole showing sparse prickles. D. Leaf of adult-sized plant. E. Adult plant with decumbent stem 1.1 meters long. F. Middle leaflet from adult plant.
**Distinguishing features:**—*Zamia montana* is readily distinguished by its obovate leaflets with acuminate tips which are prominently-veined, the sparse prickles on its petiole, and its arborescent habit. It differs from other species with prominently-veined leaflets in that the veins are only slightly protuberant on the abaxial side of the leaflet, whereas in the other species the veins are strongly protruding.

**FIGURE 3.** *Zamia montana* in habitat in Antioquia, Colombia. A. Newly emerging leaf. B. Herbivory by *Eumaeus* sp. Larvae. C. Arborescent trunk with 30 cm ruler for scale. D. Juvenile seed strobilus approximately 33 x 16 cm. Photograph by Marco Tulio Betancur. E. Juvenile pollen strobili, longest one approximately 12 cm long. Photograph by Julio Betancur.

**Distribution and habitat:**—*Zamia montana* is endemic to the department of Antioquia, where it occurs in premontane and lower montane rain forests (sensu Holdridge 1967) on the Western Cordillera at elevations between 1750 to 2080 m. Rainfall averages 2400–2500 mm per year and is bimodal, with rainfall peaks occurring in October–November and April–May, and the driest months being December–March and July–August. The mean annual temperature is 19.2 °C, with temperature ranging from 11.9° to 25.7° C (climate data derived from GIS analysis using...
Zamia montana Regel (1876) transferred several species of Zamia (K), mounted illustration of, into the genus et al.

COLOMBIA [Nueva Granada]:
is currently known from only a single very fragmented population

Solanum quitoense

Soils are rich in organic matter with high content of aluminum and low content of calcium, magnesium, and potassium (Restrepo et al. 1989) and pH ranging from 4.24 to 5.86 (Luteyn & Sylva 1999).

Reproductive phenology:—Very little is known about the reproductive phenology of this species. Immature and near-mature pollen strobili have been collected in mid-April, and an immature but near full-sized ovulate strobilus was observed in July of 2014 (Fig. 3d).

Ecology:—Larvae of a butterfly species of the genus Eumaeus Hübnner were observed feeding on new leaves of Z. montana (Fig. 3b). The pollinators of this species have not yet been observed.

Conservation status:—Zamia montana is currently known from only a single very fragmented population comprised of four subpopulations in forest fragments separated by areas cleared for pasture. There are an estimated total of 100 adult plants in an extent of occurrence of approximately 3 sq. km. These populations occur in small forest fragments surrounded by pasture, totaling an area of occupancy of less than 0.2 sq. km. Other forest fragments were visible in nearby mountains where additional populations may occur, but these have yet to be surveyed.

This species is likely one of the most threatened species in the genus. Believed to be possibly extinct (Stevenson 2004) until our re-discovery of extant populations in 2014, the situation of remnant populations is dire. Several collection sites from the late 1980’s and early 1990’s were revisited and are now completely deforested. A single population was located with a few subpopulations occurring in small forest fragments that were scheduled for clearing by local inhabitants within a year. Recently cleared forests were surveyed where Zamia montana plants had been cut down only a few days prior to our visit. Even areas surrounding rivers and creeks, normally protected to preserve water quality, were totally deforested.

In three days of searching, no regeneration was observed, likely because most plants seen had been previously chopped down in previous habitat clearing attempts. These plants had regenerated new shoots, but likely most had not grown enough to produce strobili and reproduce. Only four out of approximately 80 plants surveyed were found that were intact, and a single fertile plant with a seed strobilus was observed (Fig. 3d).

The main threat to the species is habitat destruction by deforestation, primarily for the creation of cattle pasture and general colonization activities, and also for the cultivation of diverse crops such as lulo (Solanum quitoense Lamark [1794: 16]).

Zamia montana is not known to occur in any protected area, and the establishment of such areas is critical to the survival to the species as well as the establishment of an ex situ conservation program (also see Galeano et al. 2005). The species should remain classified as Critically Endangered based on IUCN Criteria A3ac, B1ab(i–v)+2ab(i–v). The category suggested here is the same recommended by Galeano et al. (2005), even though the criteria are slightly different. Specific locality information has been purposefully withheld from this paper to minimize the risk of illegal harvesting of this critically endangered species.

Historical notes:—Regel (1876) transferred several species of Zamia, including Z. montana, into the genus Aulacophyllum Regel (1876: 140) based on distinct adaxial grooves on the leaflets (i.e strongly nerved leaflets) and the production of simultaneous rather than sequential leaf production. However, the group included species without strongly nerved leaflets such as Aulacophyllum ortgiesii Regel (1876: 141), a synonym of Z. chigua Seemann (1854: 201), and the distinction between simultaneous and sequential leaf production is not clear. Leaf production in Zamia appears to be sequential, even if in some species it may be very closely spaced as to appear almost simultaneous. Bentham & Hooker (1880) placed Aulacophyllum back into synonymy under Zamia, and all subsequent authors have followed this treatment.

Stevenson (2001) designated a 1987 collection by James L. Zarucchi as the neotype for the species as the holotype collection of Z. montana was believed to have been destroyed in the bombing of the Berlin herbarium during the Second World War.

Schuster (1932) cited a specimen labeled as “Z. kalbreyeri U. Dammer” in the Berlin herbarium under his treatment of Z. montana, but the species name was never validly published and therefore has no taxonomic status. This specimen was also likely destroyed with the bombing of the Berlin herbarium.

Additional specimens examined:—COLOMBIA [Nueva Granada]: Eichler s.n. (K!), mounted illustration of holotype material (original material likely destroyed) collected by Gustav Wallis and cultivated by James Veitch, 26 March 1881. Antioquia: Paramillo, 26 July 1880, Kalbreyer 1928 (K!); 1882, Shuttleworth s.n. (K!); Municipio de Frontino, 2080 m, 16 February 1991, Callejas et al. 10656 (HUA!);1800–1950 m, 5 July 2014, Roldán et al. 4725 (HUA!);1880–1920 m, 20 November 1986, Sánchez et al. 700 (CUVC!, MEDEL!);1900 m, 23 November 1986, Sánchez et al. 816 (MEDEL!);1750 m, 14 April 1987, Sánchez et al. 1185 (COL!, MEDEL!);14 April 1987, Sánchez et al. 1186 (MEDEL!).

Type:—Colombia, cultivated by E. Calderón Sáenz, originally collected in Risaralda, Calderón-Sáenz 174 (holotype FMB!).

Literature:—Calderón-Sáenz & Stevenson (2003), Lindstrom (2009, as synonym of Z. montana).

Illustrations / figures:—Calderón-Sáenz & Stevenson (2003), Galeano et al. (2005).

Etymology:—The specific epithet is derived from the greek roots oligo (few) and odonto (=teeth), in allusion to the presence of a few teeth in the apical region of each leaflet.

FIGURE 4. Zamia oligodonta in habitat in Risaralda, Colombia. A. Eophyll leaflets. B. Leaf of juvenile plant. C. Petiole base showing sparse prickles. D. Slightly arborescent ovulate plant with 30 cm. ruler for scale. E. Adult sized plant with completely subterranean stem and two leaves, each approximately 2.7 m long. F. Middle leaflet from adult plant.
Description:—Stems typically subterranean, rarely arborescent, to 40 × 11 cm, erect or decumbent, typically solitary but occasionally branched. Cataphylls chartaceous, narrowly triangular, grey-tomentose with glabrous dark brown margin, to 7 cm long, and 2.5 cm wide at base. Leaves pinnately compound, 1–3 per stem apex, held straight to slightly arching, to 290 cm long. Petiole to 162 cm long, sparsely armed with prickles to 4 mm long, base swollen and glabrous, to 6 cm wide. Rachis to 131 cm, unarmed or sparsely armed with prickles in the proximal third, carrying 2 to 26 opposite to suboppositely arranged leaflets. Leaflets narrowly elliptic to elliptic, straight to very slightly falcate, cuneate basally, acuminate to caudate apically, chartaceous to subcoriaceous, more or less flat and appearing undulate, veins forming grooves on adaxial surface, strongly protruding on abaxial surface, margins revolute on proximal third,
transitioning to straight on distal half, entire but often uneven and slightly sinuous at the distal end and appearing as if broadly toothed. Middle leaflets 20–50 cm × 6.6–14 cm, spaced 8–14 cm apart and sometimes slightly imbricate, apical leaflets 26.5–39 × 10.4–12.4 cm, basal leaflets 35.5–47.5 × 8.0–12 cm. New leaf flushes carry leaflets that are white tomentose at first, quickly becoming glabrous and light yellow-green in color, maturing acropetally to a bronze color before turning a glossy bright green at maturity. *Eophylls* carrying 2 narrowly elliptic leaflets 20.0–23.7 × 6.7–8.4 cm, petioles 40–50 cm long, rachis 0.4–0.5 cm long. *Pollen strobili* 1–3 per stem apex, to 7–11 × 2.0–2.7 cm, emerging yellow-green tomentose, maturing to yellow-beige tomentose, narrowly ovoid-cylindrical, apex obtuse to acute, peduncle to 3.6 × 1.4 cm, similar in color to rest of strobilus. *Microsporophylls* arranged in 18–28 fertile sporophylls each, 5.0–5.2 × 3.0–3.2 mm, sterile apex encompassing 1/3 of total length of sporophyll, microsporangia 8–13, 0.7–1.0 mm, limited to the abaxial surface and arranged in two separate groups arranged along sporophyll margin. *Ovulate strobili* 1 per stem apex, erect, ellipsoid, emerging reddish-brown tomentose and transitioning to brown and light tan at maturity, to 17 × 11 cm, sterile apices obtuse or pungent, 1–2 cm long, peduncles obscured by cataphylls 2–3 × 2–3 cm. similar in color to sporophylls. *Megasporophylls* arranged in 6–7 orthostichies of 3–5 sporophylls each, bullae truncate with hexagonal to oblong-hexagonal distal face 2.5–3.5 × 5.0–6.0 cm and 7–10 mm thick, terminal facet broad, slightly protruding, and indented. Seeds ovoid-pyramidal, 3.5–4.2 × 2.2–2.8 cm, sarcotesta ripening from pink to orange, 10–20 mm thick.

**Distinguishing features:**—Although the specific epithet of the species refers to the presence of a few teeth in the apical region of each leaflet, the leaflet margins of this species can be considered mostly entire but in some cases are unevenly sinuous (repand) at the distal end. This unevenness in some cases (such as in the holotype) is strongly marked, giving the leaflets the appearance of having broad teeth at the distal end. However, the irregularity of the distal margin is quite variable, with some margins being completely entire and others only slightly sinuous. Moreover, the margins cannot be considered truly serrate such as in the case of *Z. disodon*, *Z. urep*, and species of the *Z. skinneri* Dietrich (1851: 146) species complex in which every individual vein terminates in a distinct tooth. The repand distal margins are not a consistent character in *Z. oligodonta* and are also present in some leaflets of *Z. montana* so they cannot be considered a good diagnostic character.

*Zamia oligodonta* is readily distinguished by its broad narrowly elliptic to elliptic leaflets which are prominently-veined, undulate, and with long acuminate to caudate tips, its (mostly) subterranean stem carrying few (up to 3) leaves, and sparse prickles on its petioles.

**Distribution and habitat:**—*Zamia oligodonta* is endemic to the department of Risaralda, where it occurs in premontane rain forests (sensu Holdridge 1967) on the Western Cordillera at elevations between 1500 to 1800 m. Rainfall averages 2600–2700 mm per year and is bimodal, with rainfall peaks occurring in October–November and April–May, and the driest months being January–March and July–August. The mean annual temperature is 18.8 °C, with temperature ranging from 13.6° to 24.3° C (climate data derived from GIS analysis using Worldclim 1.4 [release 3] climate layers as described by Hijmans et al. 2005).

**Reproductive phenology:**—Very little is known about the reproductive phenology of this species. New and developing ovulate strobili as well as new and juvenile pollen strobili were observed in late March of 2014, mature seeds have been reported in October. All previously observed pollen strobili were completely rotten by early July, and based on their stage of development observed in March, pollen release likely occurred between April and May.

**Ecology:**—No herbivory or pollinators have been observed on this species.

**Conservation status:**—*Zamia oligodonta* is known from only five subpopulations with an estimated total 1,000 adult plants total within a total extent of occurrence of 30 km². The area of occupancy for the species, calculated by adding the areas with the known altitudinal range for the species within its extent of occurrence, is estimated to be 5 km².

In all five populations recruitment appears to be healthy, with plants of different ages observed. Fertile seed strobili at different stages of maturity have been observed in two populations, indicating that reproduction is occurring normally. One of the populations is within a protected area in Risaralda.

The region where *Z. oligodonta* is native appears to still have a considerable amount of forest cover left. As the species was recently described (Calderón–Sáenz & Stevenson 2003), little is known about its population demographic dynamics, although deforested areas of otherwise suitable habitat suggest that the species is declining. The main threat to this species appears to be habitat destruction for the creation of cattle pastures as well as agricultural production, primarily of coffee and sugar cane.

The species was previously classified as Data Deficient in the Red List of Colombian cycads (Galeano et al. 2005), but we now have enough field data to recommend its classification as Endangered based on IUCN Criteria.
B1ab(i–v)+2ab(i–v); C1. Specific locality information has been purposefully withheld from this paper to minimize the risk of illegal harvesting of this threatened species.

**Historical notes:**—The original description for *Z. oligodonta* was based on a few plants cultivated by Eduardo Calderón Sáenz. *In situ* observations carried out during this study confirmed that wild plants attained much larger dimensions than the cultivated plants upon which the original description was based.

**Additional specimens examined:**—COLOMBIA. Cultivated by E. Calderón Sáenz, originally collected in Risaralda, Calderón Sáenz 175 (JAUM!), 182 (COL!), 183 (FMB!, NY!). Live plants cultivated by E. Calderón Sáenz also studied. **Risaralda:** 1750–1800 m, 9 July 2014, Roldán et al. 4276 (HUA!).

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