

Six New Species of *Neurolepis* (Poaceae: Bambusoideae: Bambuseae) from Ecuador and Peru

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ABSTRACT. Six new species, *Neurolepis asymmetrica*, *N. fimbriiligulata*, *N. laegaardii*, *N. nana*, *N. rigida*, and *N. villosa*, are described and illustrated. Two subspecies are recognized within *N. fimbriiligulata*: *N. fimbriiligulata* subsp. *peruviana* and subsp. *fimbriiligulata*. All taxa except for *N. fimbriiligulata* subsp. *peruviana* are endemic to Ecuador; *N. fimbriiligulata* subsp. *peruviana* is known only from Peru. These species were all formerly included within a broadly defined *N. aristata* (Munro) Pilger because of the presence of an awn on glumes I and II. A table comparing the six new taxa in Ecuador and *N. aristata* is provided.

Revision of the high Andean bamboo genus *Neurolepis* Meissner for the Flora of Ecuador has revealed the existence of six new species, which are here described and illustrated. All six, as well as *N. acuminatissima* (Munro) Pilger, *N. stuebelii* (Pilger) Pilger, and *N. weberbaueri* Pilger, were previously included within a very broadly circumscribed *N. aristata* (Munro) Pilger based on the presence of a well-developed awn on glumes I and II (Soderstrom, 1969), but discontinuities in variation and distribution among these six taxa are sufficient to warrant recognition at the species level. *Neurolepis acuminatissima*, *N. stuebelii*, and *N. weberbaueri* are now recognized as species distinct from *N. aristata* (Clark, unpublished data). A total of 12 described species of *Neurolepis*, including the six described herein and *N. stuebelii* and *N. weberbaueri*, is now known from Ecuador. With the exception of *N. fimbriiligulata* and *N. laegaardii*, the other species are each restricted to one cordillera or the other in Ecuador. Among the new taxa, *N. asymmetrica*, *N. nana*, and *N. rigida* occur in the Eastern Cordillera, whereas *N. villosa* is found only in the Western Cordillera. *Neurolepis fimbriiligulata* is principally from the Western Cordillera, with one population on the western slope of the Eastern Cordillera, and conversely, *N. laegaardii* is primarily from the Eastern Cordillera, with one population in the Western Cordillera.

The lack of vegetative branching of the aerial culms is characteristic of *Neurolepis* (McClure,

1973; Davidse & Clark, 1996). Rhizome bracts intergrade into culm leaves acropetally along each culm, making it difficult to distinguish between the two. Culm leaves usually exhibit blades, but successive culm leaves each produce a longer blade, which adds to the difficulty of characterizing the culm leaves; therefore descriptions of the culm leaves, usually an important and even diagnostic source of characters in other bamboo genera, are brief. The transition from culm leaves to foliage leaves is usually rather abrupt in *Neurolepis*. Foliage leaf morphology is very useful in distinguishing among species of *Neurolepis*. The juncture of the sheath and blade, including the sheath summit, the inner ligule, and the blade base, is critical for species identification, and should always be collected. Because the development of the pseudopetiole is so variable among the species of *Neurolepis*, the length of the pseudopetiole is excluded from the length of the blade in the descriptions.

Terminology to describe the inflorescences follows Troll (1964), Soderstrom and Londoño (1988), and Weberling (1992). The synflorescence was measured from the lowermost primary paracladium (or paracladia) to the apex of the main axis (rachis); a measurement for the peduncle is given separately, where data are available. Variation in the development of spikelets, particularly the awns of glumes I and II, is correlated with position in the synflorescence. Spikelets terminating the main axis and the primary and secondary paracladia are often slightly larger and exhibit the greatest awn development, whereas those spikelets terminating tertiary or higher order paracladia are often smaller and show markedly less awn development. Measurements were taken from the most and least developed functional spikelets to provide a full range of variation.

Measurements for the descriptions and comparisons in Table 1 were taken from virtually all specimens cited in this paper, including holo- and isotypes. When possible, two leaves were measured per specimen, but frequently only one complete leaf was available. Usually two spikelets per flowering specimen were measured.

Neurolepis asymmetrica L. G. Clark, sp. nov.

TYPE: Ecuador. Loja: páramo at road Yanagana-Cerro Toledo, 3150 m, 26 Feb. 1985 (fl), S. Lægaard 53681 (holotype, QCA; isotypes, AAU, LOJA, QCNE). Figure 1A-C.

Culmi synflorescentiis inclusis 2–2.5 m alti, 0.8–1.5 m alti sine synflorescentiis, simplices, erecti. Vaginae foliorum valde involutae, glabrae, apex marginis superpositi prolongatus, scariosus, involvens; laminae foliorum (27–)35–65(–85) cm longae, (1.5–)2–3.3 cm latae, ratio long./lat. = 17–28(–43), lineari-lanceolatae, erectae, glabrae, costa valde excentrica; pseudopetiolus variabilis, (1.5–2.5–)9–17.5 cm longus. Synflorescentiae (21–)30–47 cm longae, 7–10 cm latae; rhachis glabra; paracladia primaria basalia (8–)11–21 cm longa. Spiculae 3.6–4.4 mm longae; gluma I variabilis, 1.3–1.6 vel 3–4.1 mm longa, 0.25–1-plo longior quam lemma, squamiformis vel mucronata vel aristata, enervis vel 1-nervis; gluma II 3–4.4 mm longa, 0.6–1.1-plo longior quam lemma, subulata vel aristata, 1-vel 3-nervis; gluma III 2.4–3.5 mm longa, 0.6–1-plo longior quam lemma, mucronata vel subulata, 3-nervis; gluma IV 2.6–3.3 mm longa, 0.66–0.9-plo longior quam lemma, mucronata, 3-nervis; lemma 3.2–3.7 mm longum, mucronatum, 5-nervis; palea 3–3.7 mm longa.

Culms 0.5–0.7 cm diam., 0.8–1.5 m tall without synflorescences, 2–2.5 m tall with synflorescences, unbranched, erect. *Internodes* not observed. *Culm leaves* bladeless, mucronate, glabrous sheaths with the nerves raised toward the apex, the apicalmost ones sometimes developing a blade to 4 mm long. *Foliage leaves* with sheaths persistent, involute, abaxially glabrous, striate, nerves slightly raised, the overlapping margin scarious, glabrous or ciliate near the apex, the summit prolonged on the overlapping side into a scarious flange, this confluent with the inner ligule and also wrapping around the pseudopetiole; blades (27–)35–65(–85) cm long, (1.5–)2–3.3 cm wide, L:W = 17–28(–43), linear-lanceolate, erect, stiff, deciduous, adaxially glabrous, not tessellate, abaxially glabrous, $\pm$ weakly tessellate, the midrib eccentric, adaxially flush, prominent, ca. 2 mm wide, forming the bottom of a groove near the base, also slightly grooved along the lower $\frac{1}{3}$ and then flat above, visible for nearly the full length, abaxially raised, prominent, ca. 1 mm wide, forming a keel along the lower $\frac{1}{3}$ – $\frac{1}{2}$, less prominent above but still visible for nearly the full length, wider part of the blade (1.4–)1.9–2.6 times as wide as the narrower part, the apex tapering, the base attenuate, the margins 0.3–0.4 mm wide, cartilaginous, glabrous; pseudopetiole variable, (1.5–2.5–)9–17.5 cm long on most leaves, 0.5–1 cm long on the flag leaves, glabrous, terete; outer ligule a mere rim to 0.5 mm long, glabrous; inner ligule 6–8 mm long, rounded, abaxially hispidulous. *Synflorescence* (21–)30–47 cm long from the lowermost branch, 7–10 cm wide, paniculate, pyramidal to

ovate-pyramidal when mature, exerted from the subtending leaf when mature; peduncle variable, 7–21 cm long, terete, glabrous; rachis glabrous, ridged and grooved longitudinally; cincinni numerous, the basal ones with 4 orders of branching; paracladia angular, glabrous or scabrous along the ridges, basally adaxially pulvinate, the primary paracladia somewhat spreading to ascending, the basalmost ones (8–)11–21 cm long, the basalmost one subtended by an asymmetrical scar with a bract 0.5 mm long, other primary paracladia each subtended by a similar scar until close to the apex, secondary and higher order paracladia ascending to somewhat spreading; pedicels 1–3 mm long. *Spikelets* 3.6–4.4 mm long, slightly laterally compressed but the fertile floret slightly dorsally compressed; glumes I and II abaxially scabrous-pubescent or scabrous along the midnerve only, adaxially pubescent on the upper $\frac{1}{2}$; glume I variable, 1.3–1.6 to 3–4.1 mm long, 0.25–1 times the spikelet body, scalelike to mucronate to awned, when awned the body 1.5–2.5 mm long, the awn 1.4–1.6 mm long and scabrous, enervate or 1-nerved; glume II 3–4.4 mm long, 0.6–1.1 times the spikelet body, subulate to awned, the body 2–2.5 mm long, triangular, the awn 1–2.4 mm long, 1- or 3-nerved; glumes III and IV rounded-triangular, navicular, adaxially pubescent near the apex, 3-nerved; glume III 2.4–3.5 mm long, 0.6–1 times the spikelet body, mucronate or subulate, abaxially scabrous-pubescent at the apex; glume IV 2.6–3.3 mm long, 0.66–0.9 times the spikelet body, mucronate, abaxially glabrous or scabrous at the apex; lemma 3.2–3.7 mm long, mucronate, rounded-triangular, navicular, adaxially pubescent just below the apex, abaxially glabrous or scabrous near the apex, 5-nerved; palea 3–3.7 mm long, bimucronulate, adaxially pubescent just at the apex, abaxially glabrous or scabrous near the apex, sulcate only at the tips, 2- or 4-nerved. *Lodicules* 3, glabrous; the anterior pair ca. 9 mm long; the posterior one ca. 0.7 mm long. *Stamens* 3; anthers 1.5–2 mm long. *Fruit* unknown.

Phenology. Various flowering dates and lack of information on extent of blooming make it impossible to determine flowering behavior in this species at present.

Distribution. Eastern Cordillera of Loja, Ecuador; páramo, sometimes on ridges or in bogs; 3000–3400 m.

This species is characterized by having culms 0.8–1.5 m tall (without synflorescences); involute foliage leaf sheaths with the summit prolonged into a scarious flange on the overlapping side; pseudopetiolate blades (27–)35–65(–85) cm long and

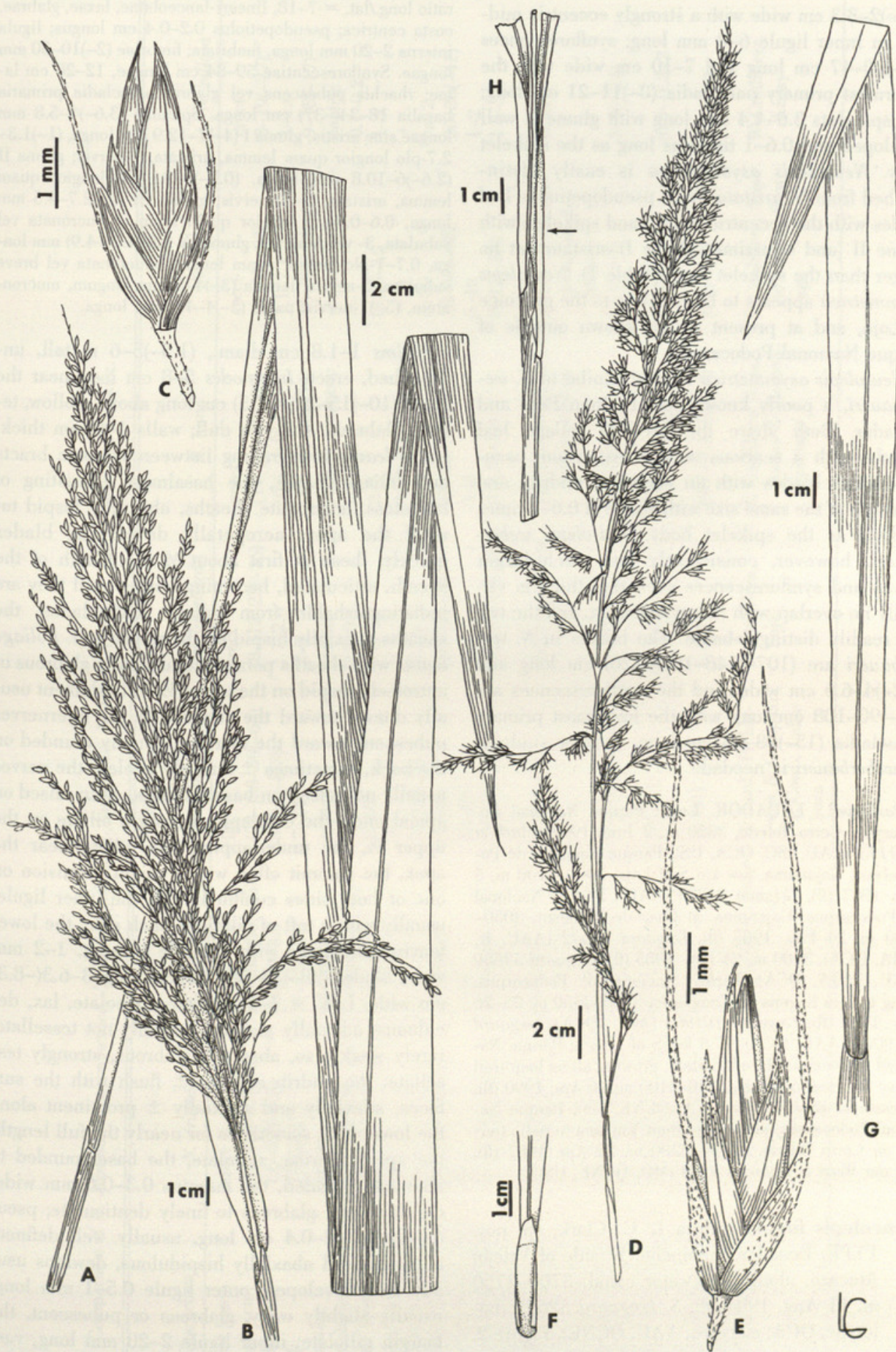


Figure 1. *Neurolepis asymmetrica* L. G. Clark and *N. rigida* L. G. Clark. A–C. *N. asymmetrica* (A, C based on Lægård 53681; B based on Lægård 101904B). —A. Leaf. —B. Synflorescence. —C. Spikelet. D–H. *N. rigida* (D–E, H based on Øllgaard 38709; F, G based on Øllgaard 38222). —D. Synflorescence. —E. Spikelet. —F. Ligular area of the leaf, adaxial view. —G. Leaf, abaxial view. —H. Ligular area of two leaves, showing a distinct pseudopetiole (arrow).

(1.5–)2–3.3 cm wide with a strongly eccentric midrib; an inner ligule 6–8 mm long; synflorescences (21–)30–47 cm long and 7–10 cm wide with the lowermost primary paracladia (8–)11–21 cm long; and spikelets 3.6–4.4 mm long with glume II well developed and 0.6–1 times as long as the spikelet body. *Neurolepis asymmetrica* is easily distinguished from *N. aristata* by its pseudopetiolate leaf blades with the eccentric midrib and spikelets with glume II (and sometimes glume I) aristate but no longer than the spikelet body (Table 1). *Neurolepis asymmetrica* appears to be endemic to the province of Loja, and at present is not known outside of Parque Nacional Podocarpus.

Neurolepis asymmetrica is most similar to *N. weberbaueri*, a poorly known species from Peru and Ecuador. Both share the involute foliage leaf sheaths with a scarious summit extension, pseudopetiolate blades with an eccentric midrib, and spikelets of the same size with glume II 0.6–1 times as long as the spikelet body. *Neurolepis weberbaueri*, however, consistently has much larger leaves and synflorescences such that there is virtually no overlap with *N. asymmetrica*, and the two are readily distinguishable. The blades in *N. weberbaueri* are (107–)148–180(–220) cm long and (3.2–)4–6.6 cm wide, and the synflorescences are (75–)90–108 cm long with the lowermost primary paracladia (15–)28–35 cm long. Further study of *N. weberbaueri* is needed.

Paratypes. ECUADOR. **Loja:** Parque Nacional Podocarpus, Cerro Toledo, 3350 m, 2 June 1992, Clark et al. 1113 (AAU, ISC, QCA, US); Parque Nacional de Podocarpus, Cajanuma, few km S of Loja, 3000–3100 m, 5 Mar. 1987 (fl), Grignon 84296 (AAU); Parque Nacional de Podocarpus, Cajanuma, at Casa de Predesur, 3050–3300 m, 24 Feb. 1985 (fl), Lægaard 53642 (AAU, K, LOJA, QCA), 3400 m, 24 Feb. 1985 (fl), Lægaard 53650 (AAU, LOJA, QCA); Parque Nacional de Podocarpus, along trail to Laguna de Compadre, 3200–3350 m, 25–26 Mar. 1992 (fl), Lægaard 101904 (AAU, QCA), Lægaard 101904B (AAU, QCA); 17.3 km S of Loja at Parque Nacional Podocarpus Headquarters, growing along loop trail above the Headquarters, 2830–3100 m, 26 Apr. 1990 (fl), Peterson et al. 8928 (K, QCA, QCNE, US); Parque Nacional Podocarpus, along road from Yangana to radio towers on Cerro Toledo, (2900–)3200 m, 29 Apr. 1987 (fl), van der Werff & Palacios 9163 (MO, QCNE, US).

***Neurolepis fimbriligulata* L. G. Clark, sp. nov.**

TYPE: Ecuador. Pichincha: W side of Volcán Atacazo, along drinkwater canal, 3700–3750 m, 11 Aug. 1984 (fl), S. Lægaard 52632 (holotype, QCA; isotypes, AAU, QCNE). Figure 2.

Culmi (1.5–)3–6 m alti, simplices, erecti. Vaginae foliorum glabrae vel hispidae versus apicem; laminae foliorum (28–)33–59(–63) cm longae, 3–6.3(–8.3) cm latae,

ratio long./lat. = 7–18, lineari-lanceolatae, laxae, glabrae, costa centrica; pseudopetiolus 0.2–0.4 cm longus; ligula interna 2–20 mm longa, fimbriata; fimbriae (2–)10–50 mm longae. Synflorescentiae 59–84 cm longae, 12–20 cm latae; rhachis pubescens vel glabra; paracladia primaria basalia 18–34(–37) cm longa. Spiculae (3.6–)4–5.8 mm longae sine aristis; gluma I (4–)7–12.9 mm longa, (1–)1.3–2.7-plo longior quam lemma, aristata, 1-nervis; gluma II (2.6–)6–10.8 mm longa, (0.7–)1–2.1-plo longior quam lemma, aristata, 1(–3)-nervis; gluma III (2–)2.7–4.5 mm longa, 0.6–0.9-plo longior quam lemma, mucronata vel subulata, 3- vel 5-nervis; gluma IV 2.5–4.2(–4.9) mm longa, 0.7–1-plo longior quam lemma, mucronata vel breve subulata, 5-nervis; lemma (3–)4–5 mm longum, mucronatum, (5–)7-nervis; palea (3–)4–4.8 mm longa.

Culms 1–1.8 cm diam., (1.5–)3–6 m tall, unbranched, erect. **Internodes** 5–8 cm long near the base, (10–)15–21(–27.5) cm long above, hollow, terete, glabrous, shiny or dull; walls 1–2 mm thick. **Culm leaves** intergrading between rhizome bracts and foliage leaves, the basalmost consisting of bladeless, mucronate sheaths, abaxially hispid toward the apex, acropetally developing blades quickly, these at first about ½ the length of the sheath, articulated, becoming longer until they are indistinguishable from foliage leaf blades, the sheaths abaxially hispid on the upper half. **Foliage leaves** with sheaths persistent, abaxially glabrous or antrorsely hispid on the upper ½–¾ (indument usually denser toward the summit) or the internerves pubescent toward the margins, usually rounded on the back, sometimes ± strongly keeled, the nerves usually not raised on basal sheaths, often raised on apical ones, the overlapping margin ciliate on the upper ½, the underlapping one ciliate near the apex, the summit often with a slight extension on one or both sides confluent with the inner ligule, usually with a tuft of cilia one each side, the lower leaves sometimes with a girdle present, 1–2 mm wide; blades (28–)33–59(–63) cm long, 3–6.3(–8.3) cm wide, L:W = 7–18, linear-lanceolate, lax, deciduous, adaxially glabrous, usually not tessellate, rarely weakly so, abaxially glabrous, strongly tessellate, the midrib centric, ± flush with the surfaces, adaxially and abaxially ± prominent along the lower half, sometimes for nearly the full length, the apex tapering, subulate, the base rounded to attenuate-rounded, the margins 0.3–0.6 mm wide, cartilaginous, glabrous to finely denticulate; pseudopetiole 0.2–0.4 cm long, usually well defined, adaxially and abaxially hispidulous, dewlaps usually well developed; outer ligule 0.5–1 mm long, usually slightly wavy, glabrous or pubescent, the margin ciliate; inner ligule 2–20 mm long, vascularized, apically divided into well-developed fimbriae (2–)10–50 mm long, these basally flattened, apically fine and curly or flattened and straight for

Table 1. Comparison of *N. aristata*, *N. asymmetrica*, *N. fimbriiligulata*, *N. laegaardii*, *N. nana*, *N. rigida*, and *N. villosa* in Ecuador.

Characters	<i>N. aristata</i>	<i>N. asymmetrica</i>	<i>N. fimbriiligulata</i> subsp. <i>fimbriiligulata</i>	<i>N. laegaardii</i>	<i>N. nana</i>	<i>N. rigida</i>	<i>N. villosa</i>
Foliage leaf blade	erect	erect	lax	erect	erect	erect	erect
Blade length (cm)	(13-)18-37(-50)	(27-)35-65(-85)	(28-)33-59(-63)	(8-)12-23(-26)	(11-)16-29(-39)	24-51(-63)	8-19(-27)
Blade width (cm)	1.6-3.2(-4.5)	(1.5-)2-3.3	3-6.3(-8.3)	1.7-2.6	(0.6-)0.8-1.4	1.1-2.1	1-1.6
Blade L:W	7-15(-17)	17-28(-43)	7-14	5-9	(10-)13-30(-50)	16-32(-44)	9-15(-17)
Midrib position	centric	eccentric	centric	centric	slightly eccentric	eccentric	centric
Pseudopetiole length (cm)	0.2-0.4(-0.6)	(1.5-2.5-)9-17.5	0.2-0.4	0.2-0.4	0.2-0.3	—	0.1-0.2
Inner ligule length (mm)	(1-)2-3	6-8	2-10	1-2	2-5	(3-)5-15	1-3
Fimbriae on inner ligule	—	—	+	+	+ in one population	+ or -	+
Fimbriae length (mm)	—	—	(2-)10-30	5-10	3-9	5-30	ca. 2
Synflorescence length (cm)	(19-)28-59(-75)	(21-)30-47	59-84	(16-)21-56	18-30(-37)	33-50(-68)	20-36(-41)
Synflorescence width (cm)	2-7	7-10	12-20	2-5	1-2	5-10	1-2
Basal primary paracladia length (cm)	(4-)6-15(-19)	(8-)11-21	18-34(-37)	(1.5-)3-14(-19)	2.5-5(-11)	9-17(-26)	1.5-3
Rachis indument	densely hirsute	glabrous	pubescent	finely pubescent	glabrous or pilose in one population	hirsute or hirsute-pilose or glabrous	villose
Spikelet length (mm) (excluding awns)	3.2-4.5(-5.1)	3.6-4.4	(4-)4.5-5.8	(3-)3.5-5	3.6-5.2(-6)	(3-)3.5-5	3-4(-4.4)
Ratio of glume I to spikelet length	(1-)1.3-2.6	0.25-1	1.3-2.7	2-3(-4)	(0.7-)1.1-1.7(-2)	1-2(-2.7)	(0.8-)1.2-2
Ratio of glume II to spikelet length	(0.8-)1-2.2(-3)	0.6-1.1	(0.7-)1-2.1	1.7-3	(0.7-)1.1-1.7(-2)	1-2(-2.7)	1-1.6(-2)
Distribution in Ecuador	E Cordillera, Azuay to Sucumbíos	E. Cordillera, Loja	W Cord., Pichincha & Cotopaxi; E Cord., Imbabura	E Cordillera, Loja	E Cordillera, Loja, Azuay & Morona-Santiago	E Cordillera, Napo to Morona-Santiago	W Cordillera, Azuay



Figure 2. *Neurolepis fimbriatigulata* L. G. Clark. A–F. *N. fimbriatigulata* subsp. *fimbriatigulata*. —A. Portion of synflorescence showing one primary paracladium. —B. Spikelet. —C. Two leaves. —D. Inner ligule, abaxial view. —E. Habit. —F. Synflorescence. —G. *N. fimbriatigulata* subsp. *peruviana*, inner ligule, side view. (A based on McClure 21425; B based on Lægård 55677; C based on Lægård 53257; D based on Young 172; E, F based on photo of plants from Pichincha; G based on Wurdack 1680.)

the full length but narrowing toward the apex. *Synflorescence* 59–84 cm long from the lowermost branch, 12–20 cm wide, paniculate, pyramidal, usually exerted from the subtending leaf when mature; peduncle variable in length, often 10–14 cm long, terete, glabrous or hirsute; rachis pubescent or rarely glabrous, grooved above each primary paracladium, thus ridged and grooved longitudinally; cincinni numerous, the basal ones with 3–4 orders of branching; paracladia angular, pubescent but hairs sparse in places, basally adaxially pulvinate, the pulvini well developed, yellow to brown, the primary paracladia appressed to the rachis when young, eventually spreading, the basalmost ones 18–34(–37) cm long, subtended by a usually ciliate scar, this disappearing in the apicalmost paracladia, secondary and higher order paracladia appressed to somewhat spreading; pedicels 0.5–2 mm long, angular, pubescent. *Spikelets* (3.6–)4–5.8 mm long excluding the awns, (3.7–6–)7.2–12.5 mm long including the awns, terete to slightly dorsally compressed; glumes I and II with the body adaxially pubescent, abaxially scabrous-pubescent, triangular, attenuate, the awn scabrous; glume I (4–)7–12.9 mm long including the awn, (1–)1.3–2.7 times as long as the spikelet body, the body (1.2–)2–4 mm long, 1-nerved, the awn (2.7–)4.8–9.6 mm long; glume II (2.6–)6–10.8 mm long including the awn, (0.7–)1–2.1 times as long as the spikelet body, the body 1.6–3.5 mm long, 1(–3)-nerved, the awn (2–)3.5–8 mm long; glumes III and IV rounded-triangular, slightly navicular, adaxially pubescent toward the apex, abaxially pubescent toward the apex; glume III (2–)2.7–4.5 mm long, 0.6–0.9 times as long as the spikelet body, mucronate to subulate, 3- or 5-nerved, the tip (0.4–)1–1.2 mm long; glume IV 2.5–4.2(–4.9) mm long, 0.7–1 times as long as the spikelet body, mucronate to short subulate, 5-nerved, the tip to 0.5 mm long; lemma (3–)4–5 mm long, mucronate, rounded-triangular, navicular, adaxially pubescent at the apex, abaxially with some scattered short hairs near the apex, (5–)7-nerved; palea (3–)4–4.8 mm long, bimucronulate, adaxially pubescent just at apex, abaxially with a few scattered hairs at the apex, sulcate only at the tips, 2- or 4-nerved. *Lodicules* 3, all strongly vascularized on the lower ½ to ¾, apically sparsely ciliate; the anterior pair 1.3–1.7 mm long; the posterior one 0.8–1.5 mm long. *Ovary* glabrous. *Stamens* 3; anthers 2.8–3.2 mm long. *Fruit* unknown.

Phenology. The 1980 flowering of the Imbabura population (Young 172) was apparently gregarious, but a flowering collection of the same pop-

ulation from 1976 (Øllgaard & Balslev 8556) indicates that sporadic or continuous flowering may also occur. No data on extent of flowering in the other populations are available.

Distribution. Western Cordillera of Ecuador (Pichincha and Cotopaxi) with one population in the Eastern Cordillera (Imbabura), and in northern Peru; high montane forest, *Polylepis* forest, and remnants/secondary scrub of these forests; 3100–3850 m.

This species is named for its well-developed, fimbriate inner ligules. It is also characterized by the culms (1.5–)3–6 m tall; lax foliage leaf blades (28–)33–59(–63) cm long, 3–6.3(–8.3) cm wide, and L:W = 7–18; synflorescence 12–20 cm wide with the basal primary paracladia 18–34(–37) cm long; and spikelets with the body (3.6–)4–5.8 mm long. The combination of size, long fimbriate inner ligules, lax foliage leaf blades, and the wide inflorescence distinguish *N. fimbriligulata* from the other species with long awns on glumes I and II (Table 1).

The geographic disjunction between the Peruvian populations of this species and the Ecuadorian ones is striking, and certain features (in particular the leaf sheaths, relative width of the leaf blades, length and curliness of the fimbriae, and pubescence of the rachis and lemma) differ between these two groups of populations. I have elected to recognize two subspecies, but when the Peruvian taxon is better known, it may prove to represent a separate species.

A. *Neurolepis fimbriligulata* subsp. *fimbriligulata*

Foliage leaves with sheaths rounded on the back; blades with L:W = 7–14, the midrib ± prominent on the lower half; inner ligule 2–10 mm long, the fimbriae (2–)10–30 mm long, flattened at base, fine and curly at apex. *Synflorescence* with the rachis pubescent. *Spikelets* (4–)4.5–5.8 mm long excluding the awns; glume I 1.3–2.7 times as long as the spikelet body; lemma abaxially scabrous-pubescent toward the apex. Figure 2A–F.

Paratypes. ECUADOR. **Cotopaxi:** at Isinlivi, 3500 m, 2 July 1985, Løgaard 54618 (AAU, QCA); about 19 mi. above Macuchi on the road from Pichilingue to Latacunga, 15 Oct. 1945 (fl), McClure 21425 (US). **Imbabura:** Páramo de Mariano Acosta, Km 26 Yahuarcocha–Mariano Acosta, 3570 m, 8 Feb. 1992 (fl), Løgaard 101198 (AAU, QCA); road Ibarra–Mariano Acosta, E of the pass, 3500–3600 m, 9 Aug. 1976 (fl), Øllgaard & Balslev 8556 (AAU, F); Pimampiro Canton, Ibarra–Mariano Acosta, Loma Yarpacunga, 3400 m, 3 Mar. 1992 (fl), Palacios & Tipaz 9910 (QCNE); 22 km from Yuracruz on the road to Mariano Acosta, 3600 m, 9 June 1980 (fl), Young 172 (AAU,

QCA, US). **Pichincha**: forêt des pentes occid. du Pichincha, 29 Nov. 1930 (fl), *Benoist* 3342 (P); Malchinguï to Pomasqui, 3000–3600 m, 13 Aug. 1923 (fl), *Hitchcock* 20863 (US); Volcán Atacazo, W slope, 17 km from San Juan, 3850 m, 25 Aug. 1980, *Holm-Nielsen & Asanza* 25097 (AAU, QCA); along drinkwater canal on W side of Volcán Atacazo, 3750–3800 m, 24 Nov. 1985 (fl), *Lægaard* 55677 (AAU); along drinkwater canal on W side of Atacazo, ca. 5 km S of Campamento, 3750 m, 28 Oct. 1984 (fl), *Lægaard* 53257 (AAU); N side of Volcán Pichincha above Hacienda Yanacocha, 3800 m, 4 June 1985, *Lægaard* 54464 (AAU, QCA), 54470 (AAU), 54471 (AAU, QCA), 54472 (AAU, QCA), 54473 (AAU, QCA), 54483 (AAU, QCA).

B. *Neurolepis fimbriuligulata* subsp. *peruviana*

L. G. Clark, subsp. nov. TYPE: Peru. Amazonas: Prov. Chachapoyas, S side of Molinopampa–Diosan pass, 3100 m, 8 Aug. 1962 (fl), *Wurdack* 1636 (holotype, US—10 sheets; isotype, USM—1 sheet). Figure 2G.

Vaginae foliorum plus minusve valde carinatae; laminae ratio long./lat. = 13–18, costa plus minusve prominens pro fere longitudine laminarum; ligula interna 5–20 mm longa; fimbriae 20–50 mm longae, complanatae, rectae, angustatae ad apicem. Synflorescentiae rhachidi glabrae. Spiculae 3.6–4 mm longae sine aristis; glume I 1–1.6-plo longior quam lemma; lemma abaxialiter glabrum.

Foliage leaves with sheaths $\pm$ strongly keeled; blades with L:W = 13–18, the midrib $\pm$ prominent for nearly the entire length; inner ligule 5–20 mm long, the fimbriae 20–50 mm long, flattened, straight, narrowed toward the apex. *Synflorescence* with the rachis glabrous. *Spikelets* 3.6–4 mm long excluding the awns; glume I 1–1.6 times as long as the spikelet body; lemma abaxially glabrous.

Paratypes. PERU. Locality unknown, 1909–1914 (fl), *Weberbauer* 7159 (F). **Amazonas**: Prov. Chachapoyas, upper slopes and summit of Cerro Yama-uma above Taulia, 12–15 km SSE (145°) of Molinopampa, 3200–3400 m, 11 Aug. 1962 (fl), *Wurdack* 1680 (F, K, US, USM).

***Neurolepis laegaardii* L. G. Clark, sp. nov.**

TYPE: Ecuador. Loja: Parque Nacional Podocarpus, Cerro Toledo, 3350 m, 2 June 1992 (fl), *L. Clark, S. Lægaard & M. J. Stern* 1112 (holotype, QCA; isotypes, AAU, ISC, MO, QCNE, US). Figure 3A–D.

Culmi 0.15–0.8 m alti, simplices, erecti. Vaginae foliorum glabrae; laminae (8–)12–23(–26) cm longae, 1.7–2.6 cm latae, ratio long./lat. = 5–9, ovati-vel linearilanceolatae, erectae, adaxialiter glabrae in dimidio inferiore, scabrae-hispidae in dimidio superiore, abaxialiter glabrae, costa centrica; ligula interna 1–2 mm longa, fimbriata; fimbriae 5–10 mm longae. Synflorescentiae (16–)21–56 cm longae, 2–5 cm latae; rhachis subtiliter pubescens; paracladia primaria basalia variabilia, (1.5–)3–14(–19) cm longa. Spiculae (3–) 3.5–5 mm longae sine aristis; gluma I (7.4–)9.6–18(–24) mm longa, 2–3(–4)-plo

longior quam lemma, aristata, 1-nervis; gluma II (8.2–)10.2–13 mm longa, 1.7–3-plo longior quam lemma, aristata, 1(–3)-nervis; glumae III et IV (1.8–)3.2–4.1 mm longae, (0.6–)0.7–0.9-plo longior quam lemma; gluma III subulata vel aristata, 3-nervis; gluma IV mucronata, 5-nervis; lemma (2.8–)3.6–4.5 mm longum, mucronulatum, (5–)7-nervis; palea (2.9–)3.6–4.2 mm longa.

Culms 0.3–0.6 cm diam., 0.15–0.8 m tall, unbranched, erect. *Internodes* 3–6(–12) cm long, hollow, terete; walls ca. 1 mm thick. *Culm leaves* with sheaths glabrous, the nerves not raised, the internerves appearing papillose, the margins ciliate, often densely so; blades small, mucronate. *Foliage leaves* often appearing crowded toward apex of culm; sheaths persistent, abaxially glabrous, the nerves not raised, the internerves appearing finely papillose under the dissecting microscope, the overlapping margin ciliate for the upper $\frac{1}{2}$, densely so at the summit, the underlapping margin densely ciliate at least at the apex, the summit lacking any extensions; girdle absent; blades (8–)12–23(–26) cm long, 1.7–2.6 cm wide, L:W = 5–9, ovate-to linear-lanceolate, erect, stiff, deciduous, adaxially glabrous and weakly tessellate on the lower half, on the upper half the nerves scabrous-hispid with antrorse hairs and not tessellate, abaxially glabrous, not tessellate, the midrib centric, flush with the surfaces, adaxially and abaxially prominent along the lower half, the apex tapering, short subulate, the base rounded, often slightly clasping, the margins ca. 0.5 mm wide, cartilaginous, glabrous; pseudopetiole 0.2–0.4 mm long, $\pm$ well defined, abaxially glabrous, dewlaps often present, but well developed only on the largest leaves; outer ligule ca. 0.5 mm long, glabrous, wavy to erose; inner ligule 1–2 mm long, vascularized, the margin fimbriate with nerves extending into the fimbriae, fimbriae 5–10 mm long, flattened at the base. *Synflorescence* (16–)21–56 cm long from the lowermost branch, 2–5 cm wide, paniculate, narrowly pyramidal, exerted from the subtending leaf when mature; peduncle 3–10 cm long, finely striate, terete, mostly glabrous but with some vertical stripes of scattered pubescence; rachis finely pubescent, becoming ciliate on the ridges above the middle, grooved above each primary paracladium, thus grooved and ridged longitudinally; cincinnos numerous, the basal ones with 4 orders of branching; paracladia angular, pubescent, at least weakly basally adaxially pulvinate, the primary paracladia appressed, eventually spreading, the basalmost ones variable, (1.5–)3–14(–19) cm long, subtended by an asymmetrical scar, often a bract present also, this 3–4 mm long, papery, hispid in parts, the next primary paracladium subtended by a similar but smaller bract, sec-

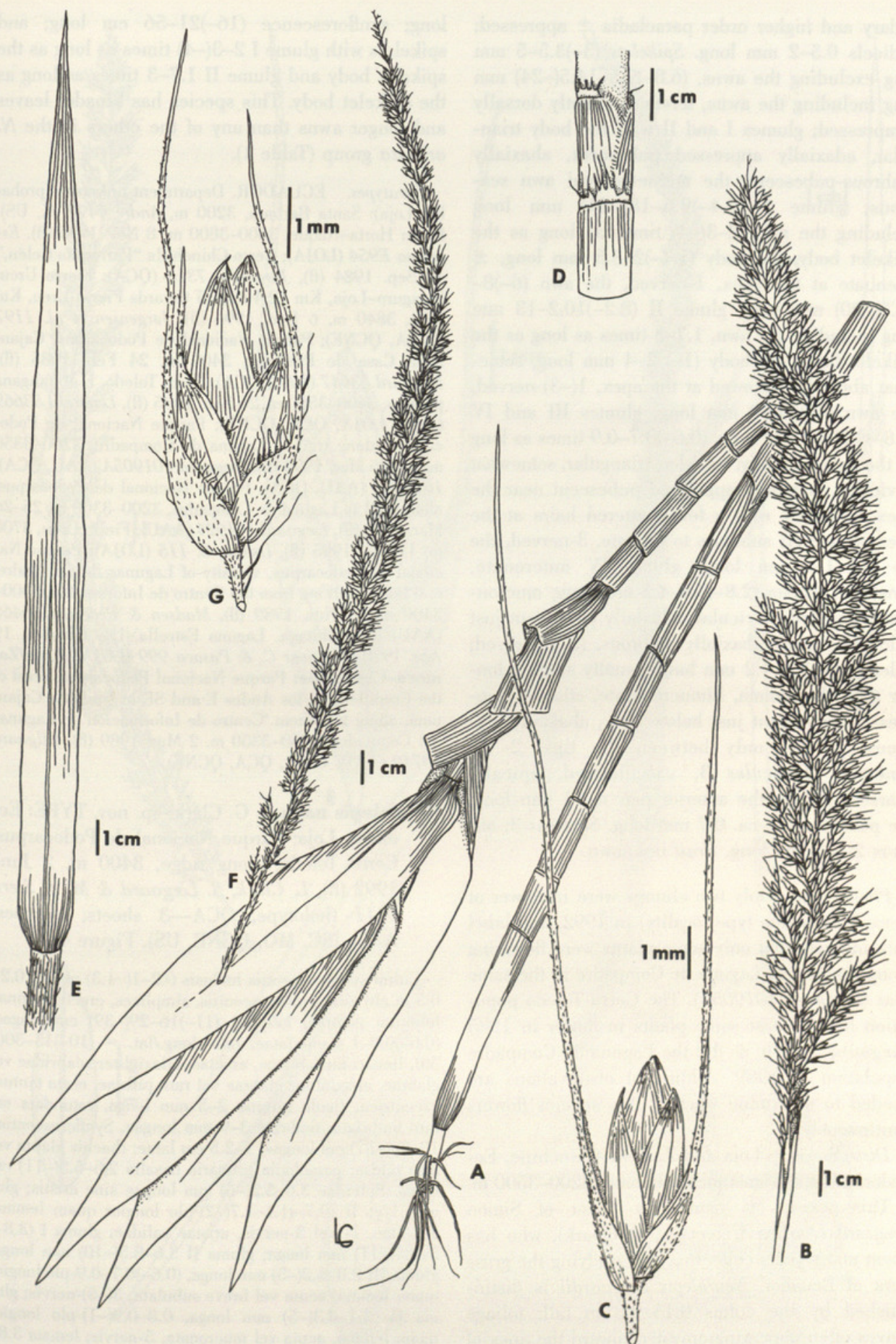


Figure 3. *Neurolepis laegaardii* L. G. Clark and *N. villosa* L. G. Clark. A–D. *N. laegaardii* (A, C based on Clark *et al.* 1112; B based on Øllgaard 90749; D based on Lægaard 53669). —A. Culm with leaves. —B. Synflorescence. —C. Spikelet. —D. Detail of inner ligule, abaxial view. E–G. *N. villosa* (E, G based on Lægaard 52884; F based on Lægaard 52848). —E. Leaf, abaxial view. —F. Synflorescence. —G. Spikelet.

ondary and higher order paracladia $\pm$ appressed; pedicels 0.5–2 mm long. *Spikelets* (3–)3.5–5 mm long excluding the awns, (6.8–)9.5–14.5(–24) mm long including the awns, terete to slightly dorsally compressed; glumes I and II with the body triangular, adaxially appressed pubescent, abaxially scabrous-pubescent, the midnerve and awn scabrous; glume I (7.4–)9.6–18(–24) mm long including the awn, 2–3(–4) times as long as the spikelet body, the body (1.4–)2–3.5 mm long, $\pm$ attenuate at the apex, 1-nerved, the awn (6–)8–14.5(–20) mm long; glume II (8.2–)10.2–13 mm long including the awn, 1.7–3 times as long as the spikelet body, the body (1–)2–4 mm long, somewhat abruptly narrowed at the apex, 1(–3)-nerved, the awn (4–)5.8–9 mm long; glumes III and IV (1.8–)3.2–4.1 mm long, (0.6–)0.7–0.9 times as long as the spikelet body, rounded-triangular, somewhat navicular, adaxially appressed pubescent near the apex, abaxially with a few scattered hairs at the apex; glume III subulate to aristate, 3-nerved, the tip 0.5–1.3 mm long; glume IV mucronate, 5-nerved; lemma (2.8–)3.6–4.5 mm long, mucronulate, rounded, navicular, adaxially pubescent just below the apex, abaxially glabrous, (5–)7-nerved; palea (2.9–)3.6–4.2 mm long, usually slightly longer than the lemma, bimucronulate, adaxially appressed pubescent just below apex, abaxially glabrous, sulcate only between the tips, 2- or 4-nerved. *Lodicules* 3, vascularized, apically sparsely ciliate; the anterior pair ca. 1 mm long; the posterior one ca. 0.7 mm long. *Stamens* 3; anthers 2–2.5 mm long. *Fruit* unknown.

Phenology. Only two clumps were in flower at Cerro Toledo (the type locality) in 1992, and label data indicate that only some plants were flowering along the trail to Laguna de Compadre in the same year (*Lægaard 101905A*). The Cerro Toledo population had at least some plants in flower in 1985 (*Lægaard 53669*), as did the Laguna de Compadre population in 1989. Additional observations are needed to determine whether this species flowers continuously.

Distribution. Loja and Zamora-Chinchipe, Ecuador; páramo, sometimes dominant; 3200–3500 m.

This species is named in honor of Simon Lægaard (Aarhus University, Denmark), who has spent many years collecting and studying the grass flora of Ecuador. *Neurolepis laegaardii* is distinguished by the culms 0.15–0.8 m tall; foliage leaves often appearing crowded toward the apex of the culm; erect foliage leaf blades (8–)12–23(–26) cm long, 1.7–2.6 cm wide, and L:W = 5–9; fimbriate inner ligules with the fimbriae 5–10 mm

long; synflorescence (16–)21–56 cm long; and spikelets with glume I 2–3(–4) times as long as the spikelet body and glume II 1.7–3 times as long as the spikelet body. This species has broader leaves and longer awns than any of the others in the *N. aristata* group (Table 1).

Paratypes. ECUADOR. Department unknown (probably Loja): Santa Barbara, 3200 m, *André 4499* (K, US). **Loja:** Horta-Naque, 3500–3800 m, 8 Nov. 1946 (fl), *Espinosa E954* (LOJA); Cerro Chinchilla “Parroquia Celén,” 19 Sep. 1984 (fl), *Jaramillo 7313* (QCA); Fierro Urcu, Saraguro–Loja, Km 12.4 turnoff towards Fierro Urcu, Km 23.8, 3840 m, 6 Dec. 1994 (fl), *Jørgensen et al. 1197* (LOJA, QCNE); Parque Nacional de Podocarpus, Cajanuma, Casa de Predesur, 3400 m, 24 Feb. 1985 (fl), *Lægaard 53647* (AAU, QCA); Cerro Toledo, E of Yangana páramo, 3400–3500 m, 26 Feb. 1985 (fl), *Lægaard 53669* (AAU, LOJA, QCA, QCNE); Parque Nacional de Podocarpus, along trail to Laguna de Compadre, 3200–3350 m, 25–26 Mar. 1992 (fl), *Lægaard 101905A* (AAU, QCA), *101905B* (AAU, QCA); Parque Nacional de Podocarpus, along trail to Laguna de Compadre, 3200–3300 m, 25–26 Mar. 1992 (fl), *Lægaard 101924* (AAU); Fierro Urcu, 3700 m, 11 Jan. 1995 (fl), *Lozano C. 115* (LOJA); Parque Nacional de Podocarpus, vicinity of Lagunas de Compadre, c. 6 hours walking from the Centro de Información, 3000–3400 m, 21 Nov. 1989 (fl), *Madsen & Pedersen 86465* (AAU); Rumishitana, Laguna Estrella, Las Escobas, 19 Apr. 1978 (fl), *Vivar C. & Pasaca 999* (LOJA). **Loja/Zamora-Chinchipe:** Parque Nacional Podocarpus, crest of the Cordillera de los Andes E and SE of Nudo de Cajanuma, along trail from ‘Centro de Información’ to Lagunas del Compadre, 3250–3350 m, 2 Mar. 1989 (fl), *Øllgaard 90749* (AAU, LOJA, QCA, QCNE).

Neurolepis nana L. G. Clark, sp. nov. TYPE: Ecuador. Loja: Parque Nacional de Podocarpus, Cerro Toledo, along ridge, 3400 m, 2 June 1992 (fl), *L. Clark, S. Lægaard & M. J. Stern 1111* (holotype, QCA—3 sheets; isotypes, AAU, ISC, MO, QCNE, US). Figure 4.

Culmi synflorescentiis inclusis 0.2–1(–1.3) m alti, 0.2–0.5 m alti sine synflorescentiis, simplices, erecti. Vaginae foliorum glabrae; laminae (11–)16–29(–39) cm longae, (0.6–)0.8–1.4 cm latae, ratio long./lat. = (10–)13–30(–50), lineari-lanceolatae, erectae, adaxialiter scabridae vel glabrae, abaxialiter glabrae vel raro pilosae, costa tantum excentrica; ligula interna 2–5 mm longa, rotundata vel raro fimbriata; fimbriae 3–9 mm longae. Synflorescentiae 18–30(–37) cm longae, 1–2.5 cm latae; rhachis glabra vel raro pilosa; paracladia primaria basalia 2.5–5.5(–11) cm longa. Spiculae 3.6–5.2(–6) mm longae sine aristis; glumae I et II (0.7–)1.1–1.7(–2)-plo longior quam lemma, aristatae, 1- vel 3-nervis, aristae validae; gluma I (3.8–)5–8.3(–11) mm longa; gluma II 3.6–8.5(–10) mm longa; gluma III 2.8–4.2(–5) mm longa, (0.6–)0.7–0.9-plo longior quam lemma, acuta vel breve subulata, 3(–5)-nervis; gluma IV 3.1–4.3(–5) mm longa, 0.8–0.9(–1)-plo longior quam lemma, acuta vel mucronata, 5-nervis; lemma 3.8–4.9(–5.4) mm longum, acutum vel mucronatum, 5(–7)-nervis; palea 3.5–4.5(–5) mm longa.

Culms 2–4 mm diam., 0.2–1(–1.3) m tall, 0.2–



Figure 4. *Neurolepis nana* L. G. Clark (A, C, F, G based on Clark *et al.* 1111; B based on Clark *et al.* 1082; D based on Læggaard 53815; E based on Madsen *et al.* 75650). —A. Plant with rhizomes and leaves, Loja population. —B. Leaf, Azuay population. —C. Synflorescence, Loja population. —D. Synflorescence, Azuay population. —E. Spikelet. —F. Caryopsis, showing hilum. —G. Caryopsis, showing embryo.

0.5 m tall without inflorescences, unbranched, erect. *Internodes* 1–6.5 cm long, terete, glabrous. *Culm leaves* intergrading between rhizome bracts and foliage leaves, the basalmost consisting of bladeless, mucronate, glabrous sheaths with nerves evident but not raised, the more apical ones developing blades, the sheaths with nerves slightly raised and fairly prominent, the internerves appearing papillose, the margins scarious, the blades to 1.8 cm long, deciduous. *Foliage leaves* with sheaths persistent, keeled at least toward the apex, the midrib prominent near the apex, abaxially glabrous, the nerves raised, the internerves appearing papillose under the microscope, the margins scarious, the summit with a small extension on each side confluent with the inner ligule, or the overlapping margin sparsely ciliate and the internerves on that side pubescent toward the keel and summit, or the internerves pubescent to pilose for the upper $\frac{1}{2}$ – $\frac{2}{3}$; blades (11–)16–29(–39) cm long, (0.6–)0.8–1.4 cm wide, L:W = (10–)13–30(–50), linear-lanceolate, erect, stiff, deciduous, adaxially scabrid or glabrous, not tessellate, abaxially glabrous or $\pm$ densely pilose in one population, tessellate, the midrib slightly eccentric, sometimes this only noticeable toward the apex, adaxially flush with the surface, ca. 1 mm wide at the base, prominent on the basal half, becoming indistinguishable from the other nerves toward the apex, abaxially raised, not as wide but prominent or at least distinguishable for the full length, the apex tapering, subulate, the base attenuate or rounded-attenuate, the margins 0.5–0.7 mm wide, cartilaginous, glabrous or denticulate; pseudopetiole 0.2–0.3 cm long, well defined, glabrous, dewlaps absent; outer ligule 0.1–0.4 mm long, glabrous or ciliate; inner ligule 2–5 mm long, chartaceous, glabrous, vascularized, usually rounded to asymmetrical, irregularly fimbriate in one population, the fimbriae 3–9 mm long. *Synflorescence* 18–30(–37) cm long from the lowermost branch, 1–2.5 cm wide, paniculate, linear, exerted from the subtending leaf when mature; peduncle variable, (5–)11–30(–44) cm long, terete to slightly flattened, glabrous, striate; rachis glabrous or pilose in one population, grooved above each primary paracladium, thus grooved and ridged longitudinally; cincinni numerous, the basal ones with 3 orders of branching; paracladia angular, glabrous or pilose in one population, usually not pulvinate, rarely with moderately developed basal adaxial pulvini, the primary paracladia usually appressed to ascending, occasionally somewhat spreading, the basalmost ones 2.5–5.5(–11) cm long, subtended by an asymmetrical scar, often a bract present also, this 1–3 mm long, glabrous,

somewhat more apical primary paracladia often subtended by a scar, secondary and higher order paracladia usually appressed but sometimes slightly spreading; pedicels 1–4 mm long, angular, glabrous or pubescent in one population. *Spikelets* 3.6–5.2(–6) mm long excluding the awns, 4.9–8.5(–10.8) mm long including the awns, slightly laterally compressed; glumes I and II (0.7–)1.1–1.7(–2) times as long as the spikelet body, the body attenuate, adaxially pubescent, abaxially scabrous, slightly less so near the margins, 1- or 3-nerved, the awn stout, scabrous; glume I (3.8–)5–8.3(–11) mm long including the awn, the body (1.5–)2–4.5 mm long, the awn (1.7–)2.3–5.5(–6.7) mm long; glume II 3.6–8.5(–10) mm long including the awn, the body 2–4 mm long, the awn 1.6–5(–7) mm long; glumes III and IV with the body rounded-triangular, navicular, adaxially pubescent toward the apex; glume III 2.8–4.2(–5) mm long, (0.6–)0.7–0.9 times as long as the spikelet body, acute to short subulate, abaxially scabrous on the upper $\frac{1}{3}$, 3(–5)-nerved, the tip (when present) to 0.5 mm long; glume IV 3.1–4.3(–5) mm long, 0.8–0.9(–1) times as long as the spikelet body, acute to mucronate, abaxially scabrous on the upper $\frac{1}{3}$ to glabrous, 3- or 5-nerved; lemma 3.8–4.9(–5.4) mm long, acute to mucronate, rounded-triangular, navicular, adaxially pubescent just below the apex, abaxially scabrous near the apex to glabrous, 5(–7)-nerved; palea 3.5–4.5(–5) mm long, bimucronulate, adaxially pubescent just at apex, abaxially scabrous near the apex to glabrous, sulcate only at the tips, 2(–4)-nerved. *Lodicules* 3, vascularized on the lower $\frac{1}{2}$, apically glabrous; the anterior pair 1–2 mm long, asymmetrical; the posterior one 1–1.5 mm long, symmetrical. *Stamens* 3; anthers 2.2–2.5 mm long. *Fruit* a caryopsis (only one seen), 3.1 mm long, 1 mm wide, brown; persistent beak 0.2 mm long; hilum linear, reddish; embryo small, ca. 0.5 mm long.

Phenology. Flowering collections from 1976, 1984, 1985, 1988, and 1992 do not indicate any regular cycle of flowering in the various populations, and little information on extent of flowering is available. In 1992, both the Cerro Toledo population in Loja (Clark *et al.* 1111) and the Gualaico-Limón population in Azuay (Clark *et al.* 1088) were mostly vegetative, suggesting that this species flowers sporadically or continuously.

Distribution. Eastern Cordillera of Ecuador in the provinces of Azuay, Loja, and Morona-Santiago; páramo; 3150–3600 m.

Neurolepis nana is one of the most diminutive members of this genus. It is characterized by the culms 0.2–0.5 m tall; blades (11–)16–29(–39) cm

long, (0.6)–0.8–1.4 cm wide, and L:W = (10)–13–30(–50) with a slightly eccentric midrib; linear synflorescences 18–30(–37) cm long and 1–2.5 cm wide; and spikelets with glumes I and II abaxially scabrous with stout awns. This species is very similar to *N. villosa*, but the two are distinguished by the more rounded foliage leaf blade bases, villous leaf sheaths and rachis, smaller spikelets, and more delicate awns on glumes I and II of the latter (Table 1). In addition, *N. nana* is restricted to the Eastern Cordillera whereas *N. villosa* is endemic to the Western Cordillera. *Neurolepis nana* is also close to *N. rigida*, and the two are sympatric in Azuay. They are distinguished by the larger leaf blades and larger, more open and narrowly pyramidal synflorescences of *N. rigida* (Table 1).

The Azuay populations of *N. nana* differ from the Loja populations in having narrower foliage leaf blades (Fig. 4B), more open synflorescences (Fig. 4D), and glume IV, the lemma, and the palea abaxially glabrous or nearly so. In addition, the population of *N. nana* on the road from Gualaceo to Limón has an irregularly fimbriate inner ligule. The other population in Azuay, along the Sigsig–Chiguinda road, has nonfimbriate inner ligules but the foliage leaf sheaths are pilose on the upper $\frac{1}{3}$ – $\frac{1}{2}$, leaf blades are abaxially pilose, and the rachis is pilose.

Paratypes. ECUADOR. **Azuay:** at pass on road from Gualaceo to Limón (Gral. L. Plaza Gutierrez), 3420 m, 30 May 1992 (fl), *Clark et al. 1088* (AAU, ISC, MO, QCA, US); road Gualaceo–Sucuá, just W of pass, 3450 m, 23 Oct. 1984 (fl), *Lægaard 53215* (AAU); road Sigsig–Gualaquiza, in pass, 3300 m, 4 Mar. 1985 (fl), *Lægaard 53814* (AAU, QCA), *53815* (AAU, QCA); uppermost W slopes of the Cord. Oriental, 0.5–2 km N of (above) the pass on the Gualaceo–Limón road, 3500–3600 m, 4 Feb. 1988 (fl), *Molau & Eriksen 2917* (AAU, GB, QCA, QCNE). **Azuay/Morona-Santiago:** at pass on road between Sigsig and Chiguinda, 3300 m, 29 May 1992 (fl), *Clark et al. 1082* (AAU, ISC, MO, QCA, US). **Loja:** Horta–Naque, 3600–3800 m, 9 Nov. 1946 (fl), *Espinosa E-989* (LOJA, US); carretera Yangana–Toledo, 3420 m, 28 Dec. 1988 (fl), *Jaramillo 10596* (AAU, QCA); Parque Nacional de Podocarpus, Cajanuma, Casa de Predesur, 3050 m, 22 Feb. 1985, *Lægaard 53620* (LOJA); Parque Nacional de Podocarpus, Cajanuma, at Casa de Predesur, 3400 m, 24 Feb. 1985 (fl), *Lægaard 53654* (AAU, LOJA, QCA); Cerro Toledo, E of Yangana Páramo, 3400–3500 m, 26 Feb. 1985 (fl), *Lægaard 53671* (AAU, LOJA, QCA, QCNE), *53676* (AAU, K, LOJA, QCA, QCNE); páramo at road Yangana–Cerro Toledo, 3150 m, 26 Feb. 1985 (fl), *Lægaard 53679* (AAU); Parque Nacional de Podocarpus, along trail to Laguna de Compadre, 3200–3350 m, 25–26 Mar. 1992 (fl), *Lægaard 101921* (AAU, QCA), *101934* (AAU, QCA); sendero Amaluza–Palanda, cerca de la Laguna Arrebatadas, 3350 m, 4 Apr. 1985 (fl), *Larsen & Eriksen 18* (AAU, GB, QCA); Parque Nacional de Podocarpus, Cerro Toledo, 3350 m, 1 Dec. 1988 (fl), *Madsen et al. 75650* (AAU, LOJA, QCA, QCNE); muletrack Amaluza–Palanda, west-

ern slope, near the pass (at Laguna Areviatadas Pilares), 3350–3450 m, 22 Sep. 1976 (fl), *Øllgaard & Balslev 9701* (AAU, F), *9710* (AAU); Parque Nacional Podocarpus, Sep. 1991, *Vivar C. & Merino 3832* (LOJA); Amaluza, Laguna Chuquiragua, 1 Dec. 1983 (fl), *Vivar C. & Merino 1985* (LOJA). **Morona-Santiago:** road Sigsig–Gualaquiza, E of the pass, 3300 m, 31 Aug. 1985 (fl), *Lægaard 52818* (AAU); road Gualaceo–Limón, from the pass towards Limón, 3200–3400 m, 8 Feb. 1989 (fl), *van der Werff & Palacios 10477* (MO, QCNE).

***Neurolepis rigida* L. G. Clark, sp. nov. TYPE:** Ecuador. Napo: Llanganati, páramo SE of Chosa Aucacocha, between Aucacocha and Pan de Azucar, 3800–3900 m, 15 May 1982 (fl), *B. Øllgaard, L. Holm-Nielsen, B. Boysen Larsen, L. P. Kvist, A. R. Jensen & S. Wiium-Andersen 38498* (holotype, QCA; isotypes, AAU, F). Figure 1D–H.

Culmi synflorescentiis inclusis 1–2.5 m alti, 0.5–1 m alti sine synflorescentiis, simplices, erecti. Vaginae foliorum glabrae vel pubescentes; laminae 24–51(–63) cm longae, 1.1–2.1 cm latae, ratio long./lat. = 16–32(–44), lanceolatae, erectae, rigidae, adaxialiter glabrae, abaxialiter glabrae vel raro pilosae, costa tantum vel valde excentrica; ligula interna (3)–5–15 mm longa, rotundata vel irregularis vel erosa, efimbriata vel fimbriata; fimbriae 5–30 mm longae. Synflorescentiae 33–50(–68) cm longae, 5–10 cm latae; rhachis hirsuta vel hirsuti-pilosa vel raro glabra; paracladia primaria basalia 9–17(–26) cm longa. Spiculae (3)–3.5–5 mm longae sine aristis; glumae I et II 1–2(–2.7)-plo longior quam lemma, aristatae, abaxialiter scabrae, aristae plus minusve valde, scabrae; gluma I 6–8.5(–11) mm longa; gluma II 5.6–9.5(–13) mm longa; gluma III (2.4)–3–3.9(–5) mm longa, 0.66–1-plo longior quam lemma, mucronata vel breve subulata, 3-nervis; gluma IV (2.2)–2.8–4.5 mm longa, (0.68)–0.8–1-plo longior quam lemma, mucronata, 3-nervis; lemma (2.9)–3.5–5 mm longum, mucronatum, 5(–7)-nervis; palea (2.8)–3.5–4.5 mm longa.

Culms 0.4–0.8 cm diam., 1–2.5 m tall, 0.5–1 m tall without synflorescences, unbranched, erect. **Internodes** not observed. **Culm leaves** intergrading between rhizome bracts and foliage leaves, the basalmost consisting of bladeless, mucronate, glabrous sheaths with nerves slightly raised, the more apical ones with scarious margins, terminating in a mucro or a small blade up to 1.4 cm long. **Foliage leaves** with sheaths persistent, keeled toward the apex, abaxially glabrous or the internerves pubescent, in some pubescent only toward the apex, the margins scarious, the summit extended on each side for 4–11 mm and adnate to the inner ligule, the summit extensions glabrous or pubescent; blades 24–51(–63) cm long, 1.1–2.1 cm wide, L:W = 16–32(–44), lanceolate, erect, stiff, deciduous, adaxially glabrous, not tessellate, abaxially glabrous, rarely with scattered long weak hairs, tessellate, the midrib slightly to markedly eccentric, adaxially flush with

the surface, 1(–1.5) mm wide at the base, prominent on the lower $\frac{1}{3}$ – $\frac{1}{2}$, abaxially 0.5–1 mm wide, projecting, forming a keel near the base, visible but not so prominent toward the apex, the apex tapering, subulate, the base attenuate, not pseudopetiolate although sometimes appearing slightly constricted for 1–3 cm above the juncture with the sheath, the margins 0.3–0.6 mm wide, cartilaginous, glabrous or denticulate; outer ligule 0.1–0.3 mm long, glabrous; inner ligule (3–)5–15 mm long, chartaceous, pubescent, vascularized, rounded to irregular or erose, in some fimbriate, the fimbriae 5–30 mm long, flattened. *Synflorescence* 33–50(–68) cm long from the lowermost branch, 5–10 cm wide, paniculate, narrowly pyramidal, exerted from the subtending leaf when mature; peduncle variable, (10–19–)30–66 cm long, terete, glabrous; rachis hirsute or hirsute-pilose, rarely glabrous, grooved above each primary paracladium, thus ridged and grooved longitudinally; cincinni numerous, the basal ones with 4 orders of branching; paracladia angular, hirsute, basally adaxially pulvinate, the primary paracladia somewhat spreading to spreading, the basalmost ones 9–17(–26) cm long, subtended by an asymmetrical scar and also often a glabrous bract to 3 mm long, at least the more basal secondary paracladia on all primary paracladia spreading to ascending, tertiary and higher order paracladia somewhat spreading to appressed; pedicels 0.5–2 mm long, angular, scabrous-pubescent or the ridges ciliate. *Spikelets* (3–)3.5–5 mm long excluding the awns, (5.3–)6–9.5(–13) mm long including the awns, $\pm$ terete, the fertile floret usually slightly dorsally compressed; glumes I and II 1–2(–2.7) times the spikelet body, the body triangular, attenuate, adaxially pubescent, abaxially scabrous, slightly less so toward the base, the awn $\pm$ stout, scabrous for the full length; glume I 6–8.5(–11) mm long including the awn, the body 2.5–3 mm long, the awn 3.5–6.2(–8.5) mm long, 1-nerved; glume II 5.6–9.5(–13) mm long including the awn, the body 2–3 mm long, the awn 2.8–7(–10) mm long, 1(–3)-nerved; glumes III and IV triangular to rounded-triangular, $\pm$ navicular, adaxially pubescent toward the apex, 3-nerved; glume III (2.4–)3–3.9(–5) mm long, 0.66–1 times the spikelet body, mucronate or less commonly short subulate, abaxially scabrous or pubescent on the upper $\frac{1}{2}$ – $\frac{3}{4}$, rarely nearly glabrous, the tip (when present) to 0.4 mm long; glume IV (2.2–)2.8–4.5 mm long, (0.68–)0.8–1 times the spikelet body, mucronate, abaxially scabrous toward the apex or rarely glabrous; lemma (2.9–)3.5–5 mm long, mucronate, rounded-triangular, navicular, adaxially pubescent just below the apex, abaxially scabrous

or pubescent toward the apex, in some glabrous, 5(–7)-nerved; palea (2.8–)3.5–4.5 mm long, bimucronulate, adaxially pubescent just at the apex, abaxially scabrid or pubescent just at the apex or glabrous in some, sulcate only at the tips, 2-nerved. *Lodicules* 3, strongly vascularized on the lower $\frac{1}{2}$, apically glabrous, all 1.2–1.3 mm long. *Stamens* 3; anthers 1.5–3 mm long. *Fruit* unknown.

Phenology. All known collections of this species are flowering; different populations were in bloom during the 1980s, but no data on extent of flowering are available. The Azuay/Morona-Santiago population was mostly vegetative (Clark *et al.* 1083) suggesting that this species may be a continuous bloomer.

Distribution. Eastern Cordillera of Ecuador from Napo to Azuay/Morona-Santiago; páramo or upper montane forest; 3200–3900 m.

This species is named for its stiff foliage leaf blades, but *N. rigida* is also characterized by having non-pseudopetiolate leaf blades 24–51(–63) cm long and 1.1–2.1 cm wide with a slightly to markedly eccentric midrib and fairly prominent, cartilaginous margins 0.3–0.6 mm wide; an inner ligule (3–)5–15 mm long; synflorescence 33–50(–68) cm long and 5–10 cm wide with the primary paracladia spreading, the basalmost ones 9–17(–26) cm long; and glumes I and II awned and 1–2(–2.7) times the spikelet length with the awns relatively stout and scabrous for their full length. This species somewhat resembles *N. stuebelii* especially in the form of the synflorescence, but *N. stuebelii* has synflorescences (46–)70–96 cm long with the basalmost primary paracladia (9–15–)25–44 cm long, and vegetatively *N. stuebelii* has less rigid foliage leaf blades 97–157 cm long and 2.5–4.6 cm wide with thin, barely differentiated margins. *Neurolepis rigida* is closest to *N. nana*, but differs from that species in having larger, non-pseudopetiolate leaf blades, and longer, wider, and more open synflorescences (Table 1).

Paratypes. ECUADOR. **Azuay:** along road Gualaceo-Limón, 3100–3500 m, 25 ago. 1989 (fl), van der Werff & Gudiño 11441 (MO, QCNE); swampy ground in Hoyada de Galápagos, between Huararancha and Loma de Galápagos, 3140–3505 m, 9 Jul. 1943 (fl), Steyermark 53485 (F), 53486 (F). **Azuay/Morona-Santiago:** at pass on road between Sigsig and Chiguinda, Páramos de Matanga, 3300 m, 29 May 1992 (fl), Clark *et al.* 1083 (AAU, ISC, QCA, US). **Chimborazo:** Riobamba Canton, Parque Nacional Sangay, Páramo de Pinilligüe, entre Alao y La Tranca, 3300–3700 m, 18 ago. 1990 (fl), Cerón *et al.* 11845 (QCNE); W of pass: Alao-Huamboya, 3750–3800 m, 11 Oct. 1985 (fl), Løgaard 55426 (AAU); road ca. 10 km NE of Alao, at Cuspipacha, 3550–3600 m, 6 May 1982 (fl), Øllgaard 38054 (AAU, QCA); from campsite

above Rfo Alao (8.5 km E of Guardiania Alao by road), NNE to pass (via old route to Huamboya), 3350–3550 m, 20 May 1990 (fl), *Peterson et al.* 9188 (QCA, QCNE, US); Parque Nacional Sangay, Changalay Chico, Rfo Ramos Tambo, junto al rfo, 3340 m, 18 Jul. 1991 (fl), *Valencia et al.* 591 (QCA). **Chimborazo/Morona-Santiago:** trail Alao-Huamboya, around the pass, between Cuspipacha and alt. 3700 m on E slope, 3550–3950 m, 7 May 1982 (fl), *Øllgaard et al.* 38222 (AAU, QCA). **Morona-Santiago (near the border with Azuay):** road in construction Sigsig-Gualaquiza, Cord. Matanga, 3200 m, 10 Apr. 1968 (fl), *Harling et al.* 8160 (GB); road Sigsig-Gualaquiza, E of pass, 3300 m, 31 Aug. 1984 (fl), *Lægaard* 52820 (AAU). **Napo:** Llanganati, N-facing slope towards the Rfo Golpe, just N of Chosa Aucacocha, 3600 m, 16 May 1982 (fl), *Øllgaard et al.* 38709 (AAU). **Tungurahua:** Cord. de los Llanganates, at Rfo Verde Grande at base of Cerro Hermoso, 2 km WSW of the summit, 3800 m, 11 Nov. 1980 (fl), *Holm-Nielsen & Jaramillo* 28411 (AAU, QCA).

***Neurolepis villosa* L. G. Clark, sp. nov. TYPE:**
Ecuador. Azuay: Páramo de Las Cajas W of Cuenca, 4000–4150 m, 2 Sep. 1984 (fl), S. *Lægaard* 52884 (holotype, QCA; isotypes, AAU, QCNE). Figure 3E–G.

Culmi 0.3–1.2 m alti, simplices, erecti. Vaginae foliorum villosae vel raro glabrae; laminae 8–19(–27) cm longae, 1–1.6 cm latae, ratio long./lat. = 9–15(–17), linearilanceolatae, erectae, adaxialiter villosae in dimidio inferne, sparsim villosae vel glabrae in dimidio superne, abaxialiter glabrae vel sparsim villosae, interdum villosae non nisi ad basim, costa centrica; ligula interna 1–3 mm longa, ciliata vel fimbriata; fimbriae usque ad 2 mm longae. Synflorescentiae 20–36(–41) cm longae, 1–2 cm latae; rhachis dense villosa; paracladia primaria basalia 1.5–3 cm longa. Spiculae 3–4(–4.4) mm longae sine aristis; gluma I (3.5–)4.3–8 mm longa, (0.8–)1.2–2-plo longior quam lemma, aristata, 1-nervis; gluma II 4–7.4 mm longa, 1–1.6(–2)-plo longior quam lemma, aristata, 1-nervis; gluma III (2–)2.5–4.2 mm longa, 0.7–1-plo longior quam lemma, mucronata vel subulata, 1- vel 3-nervis; gluma IV 2.5–4 mm longa, 0.75–0.9(–1)-plo longior quam lemma, mucronata vel raro breve subulata, 3- vel 5-nervis; lemma 2.5–3.9 mm longum, mucronatum, (3–)5-nervis; palea 2.5–4 mm longa.

Culms 0.2–0.4 cm diam., 0.3–1.2 m tall, unbranched, erect. **Internodes** 1.7–3 cm long, hollow, terete, glabrous, striate, dull; walls ca. 1 mm thick. **Culm leaves** with sheaths striate, appressed hirsute at the base, the internerves appearing papillose, the margins ciliate toward the apex; blades ca. 2 mm long, mucronate. **Foliage leaves** with sheaths persistent, striate, abaxially appearing papillose over the entire surface, villose but irregularly so or rarely nearly glabrous, often villose or more densely villose toward the apex and margins, but sometimes more villose in the middle portion, the hairs ca. 2 mm long, whitish opaque, the nerves $\pm$ raised, the overlapping margin glabrous to ciliate, the underlapping margin glabrous, the summit on each side

with a small extension confluent with the inner ligule, this usually villose or ciliate at least on the overlapping side; girdle absent; blades 8–19(–27) cm long, 1–1.6 cm wide, L:W = 9–15(–17), linear-lanceolate, erect, stiff, deciduous, adaxially villose on the lower half, this especially dense near the midrib, sometimes also the upper half sparsely villose, not tessellate, rarely weakly so, abaxially glabrous or sparsely villose, sometimes villose only near the base, strongly tessellate, the midrib centric, flush with both surfaces, adaxially and abaxially $\pm$ conspicuous along the lower half, the apex tapering, subulate, the base slightly rounded, the margins 0.3–0.4 mm wide, cartilaginous, denticulate; pseudopetiole 1–2 mm long, $\pm$ well defined, dewlaps not well developed; outer ligule 0.3–0.5 mm long, ciliolate or glabrous, irregular, wavy; inner ligule with the basal undivided portion 1–3 mm long, vascularized, the margin ciliate to shortly fimbriate, the fimbriae to 2 mm long. **Synflorescence** 20–36(–41) cm long from the lowermost branch, 1–2 cm wide, paniculate, narrowly pyramidal, exerted from the subtending leaf when mature; peduncle variable, 12–30 cm long, terete, villose; rachis densely villose, less densely so near the apex, grooved above each primary paracladium, thus ridged and grooved longitudinally; cincinni numerous, the basal ones with 3 orders of branching; paracladia angular, villose, the secondary and tertiary ones less densely so, basally adaxially pulvinate, the pulvini well developed, yellow, the primary paracladia appressed when young, eventually somewhat spreading, the basalmost ones 1.5–3 cm long, subtended by an asymmetrical scar, secondary and higher order paracladia appressed; pedicels 0.5–1.5 mm long. **Spikelets** 3–4(–4.4) mm long excluding the awns, (3–)4–6.5(–7.6) mm long including the awns, terete to slightly dorsally compressed; glumes I and II with the body triangular, $\pm$ abruptly narrowed at the apex, awned, adaxially appressed-pubescent on the upper $\frac{1}{2}$, abaxially scabrous-pubescent with a few longer hairs present along midnerve and margins, 1-nerved, the awn scabrous; glume I (3.5–)4.3–8 mm long including the awn, (0.8–)1.2–2 times as long as the spikelet body, the body 1.2–2 mm long, the awn (1.2–)2.5–6.8 mm long; glume II 4–7.4 mm long including the awn, 1–1.6(–2) times as long as the spikelet body, the body 1.5–2.5 mm long, the awn (1.9–)2.5–5.9 mm long; glumes III and IV rounded-triangular, slightly navicular, adaxially appressed-pubescent toward the apex, abaxially with a few hairs toward the apex, the margins ciliate toward the apex, the awn scabrous; glume III (2–)2.5–4.2 mm long, 0.7–1 times as long as the spikelet body, mu-

cronate to subulate, 1- or 3-nerved, the tip to 1.2(–1.7) mm long; glume IV 2.5–4 mm long, 0.75–0.9(–1) times as long as the spikelet body, mucronate to rarely short subulate, 3- or 5-nerved, the tip to 0.5 mm long; lemma 2.5–3.9 mm long, mucronate, rounded-triangular, navicular, adaxially appressed-pubescent at the apex, abaxially with a few hairs toward the apex, (3–)5-nerved; palea 2.5–4 mm long, bimucronulate, adaxially pubescent at the apex, abaxially scabrous near apex, sulcate only at the tips, 2-nerved. *Lodicules* 3, all strongly vascularized on the lower $\frac{2}{3}$, apically glabrous; the anterior pair ca. 1 mm long; the posterior one ca. 0.9 mm long. *Stamens* 3; anthers 1.2–2 mm long. *Fruit* unknown.

Phenology. All of the known flowering collections are from 1983 to 1985, but no notes on extent of flowering are available, so flowering behavior for this species cannot be determined.

Distribution. Endemic to the Western Cordillera of Ecuador in the province of Azuay; páramo and open areas in *Polylepis* forest; 3750–4150 m.

Neurolepis villosa is distinguished by its short pseudopetioles 0.1–0.2 cm long, inner ligule 1–3 mm long with cilia or short fimbriae to 2 mm long, narrow synflorescence 20–36(–41) cm long and 1–2 cm wide with the basal primary paracladia 1–3 cm long, as well as by the villose pubescence on the foliage leaf sheaths, adaxial surface of the leaf blades, the peduncle and rachis, and glumes I and II (Table 1). This species is most similar to *N. nana* (see discussion of that species).

Paratypes. ECUADOR. **Azuay:** Laguna Toreadora, Las Cajas, 3900 m, 9–10 Sep. 1983 (fl), *Larsen & Eriksen* 45029 (AAU, QCA); Parque de Recreación Cajas, 4000–4100 m, 31 Aug. 1984 (fl), *Jaramillo* 7177 (QCA); Parque de Recreación Cajas, 4000–4100 m, 2 Sep. 1984 (fl), *Jaramillo* 7189 (GB, QCA); Páramo de las Cajas W of Cuenca, 4000–4150 m, 2 Sep. 1984 (fl), *Lægaard* 52848 (AAU,

QCA, QCNE); Páramo de Soldados, SW of Cuenca, 3750–3850 m, 3 Mar. 1985 (fl), *Lægaard* 53799 (AAU, QCA); Páramo de Las Cajas, in the pass, 4100 m, 27 Aug. 1985 (fl), *Lægaard* 55061 (AAU); Páramo de Las Cajas, in the pass, 4200 m, 27 Aug. 1985 (fl), *Lægaard* 55067 (AAU, QCNE); Area Nacional de Recreación “Cajas,” 19–23 Aug. 1985 (fl), *Ramsay et al.* 136 (K); Totorococha–Mazan valley, Area Nacional de Recreación Cajas, 3750 m, 12 Sep. 1987 (fl), *Ramsay et al.* 482 (QCA, QCNE); in vicinity of Toreador, between Molleturo and Quinoas, 3810–3930 m, 15 June 1943, *Steyermark* 53186 (F, US).

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