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## General overview of *Tillandsia* subgenus *Tillandsia* in Peru: The three-pinnate species and the case of two endemic species

### Sinopsis de *Tillandsia* subgenus *Tillandsia* en el Perú: las especies tri-pinnadas y el caso de dos especies endémicas

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#### Abstract

A recent collection of a specimen with three-pinnate inflorescence was the inspiration to evaluate *Tillandsia* subgenus *Tillandsia* taxa with three pinnate inflorescences for the Peruvian flora. *Tillandsia extensa* characteristics are clarified, confirming its distribution for northeastern Peru, and recognizing a specimen, previously considered being the second record for this species, as *T. platyphylla*.

**Keywords:** Bromeliaceae, Peru, *Tillandsia* subg. *Tillandsia*, *T. extensa*, *T. platyphylla*, new records.

#### Resumen

La recolección reciente de un ejemplar de inflorescencia tri-pinnada motivó la evaluación de los taxones con inflorescencias tri-pinnadas de *Tillandsia* subgénero *Tillandsia* para la flora peruana. Se aclara las características de *T. extensa*, confirmándose su distribución para el noreste del Perú y reconociéndose un ejemplar, previamente considerado como el segundo registro de la especie, como *T. platyphylla*.

**Palabras clave:** Bromeliaceae, Perú, *Tillandsia* subg. *Tillandsia*, *T. extensa*, *T. platyphylla*, nuevos registros.

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#### Introduction

The largely American family Bromeliaceae combines large species richness, a high degree of endemism, and a wide ecological amplitude (Ibisch et al., 1996; Benzing, 2000; Kessler, 2002). The Bromeliaceae is among the most species rich families in the Peruvian flora, with over 450 species in 19 genera (Brako and Zarucchi, 1993; Luther, 2000, 2002, 2003; Ulloa Ulloa et al., 2004). Almost half of the Peruvian Bromeliaceae species are restricted in distribution to the country (León et al., 2006a,b), most of which are known from only one locality. Three main genera, *Pitcairnia*, *Puya* and *Tillandsia*, include over half the number of taxa of this family for the Peruvian flora.

The genus *Tillandsia* was recognized by Smith and Downson (1973) with seven subgenera (*Allardtia*, *Anoplophyllum*, *Diaphoranthema*, *Phytarrhiza*, *Pseudalcantarea*, *Tillandsia* and *Pseudocatopsis*) encompassing over 410 taxa, of which 255 in six subgenera were recorded for the Peruvian flora. Later studies, especially of Gardner (1986) have shown that the genus and its subgenera require new circumscription, and thus, for example, Spencer and Smith (1993) segregated all members of the subgenus *Pseudocatopsis* in the genus *Racinaea*. Additionally studies have also shown that the genus *Tillandsia* as circumscribed is polyphyletic (Barfuss et al., 2005).

The re-evaluation of the subgenus *Tillandsia* by Gardner (1986) included the examination and use of new floral characters, subdividing subgenus *Tillandsia* in seven groups on the basis especially of sepal shape, filament length and shape, and anther insertion. Gardner (1986) also stressed the close association of this subgenus with a group of *Vriesea* species that later were transferred by Grant (1993) to *Tillandsia* subg. *Tillandsia*. Today, this subgenus includes over 160 taxa of the 117 earlier recognized by Smith and Downs (1977).

A recent collection made in northern Peru of a specimen with a three-pinnate inflorescence prompted the evaluation of the *Tillandsia mima* group, and a re-examination of Rauh's (1973) understanding of *T. extensa*. Because of changes in the

systematics of *Tillandsia* subgenus *Tillandsia*, we also present a general overview of this subgenus in Peru.

#### The subgenus *Tillandsia* and the Peruvian flora

This subgenus is recognized by its free, symmetrical sepals, broad petal blades and conspicuous, exerted stamens, exceeding the claw of the petals, and a style slender and longer than the ovary. Gardner (1986) included in this subgenus some species previously recognized within the subgenus *Allardtia*, and subdivided the subgenus in five groups, recognized mainly by filament length, shape, anther position and the open corolla throat.

Most Andean species are included in Gardner's Groups II and III. A few, particularly for Peru, *T. carnosae*, *T. ecarinata*, *T. extensa*, *T. ferreyrae*, *T. platyphylla* and *T. teres* were considered "incertae sedis", because she did not have fresh material to confirm their characters. For the case of *Tillandsia ferreyrae*, and *T. teres* cultivated specimens and photographs of floral and habit features are available (e.g. <http://fcbs.org/pictures/Tillandsia.htm>), showing unequal filament length, petal apices slightly recurved and open throat, and for these reasons we include them within Gardner's Group II. This group includes part of what Rauh considered as the "mima group", a group of species with lax, mostly 3-pinnate inflorescences, and spikes with secund flowers.

The Peruvian flora comprises 28 taxa belonging in this subgenus; while another additional four species recorded in neighboring countries should be expected in the flora (Table 1). Sixteen taxa are considered restricted to Peru; all of which, with the exception of four, are known from northeastern Peru, mostly from the Marañón river basin that runs along the departments of Amazonas, Ancash-Huánuco, Cajamarca, and La Libertad. Most species are found in rocky slopes growing in crevices, rarely as epiphytes. Those endemic taxa are scarcely collected, 14 of them are known of less than 5 localities, and for those known from one locality all are found in xeric ecoregions, Desert Shrubland and Dry Forest or subxeric conditions in the Mesoandean mesic ecoregion (Table 1), demonstrating the need to emphasize the

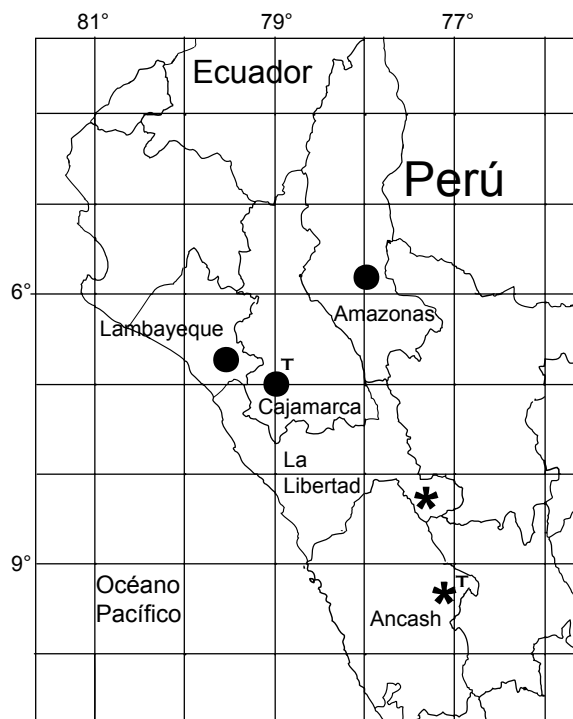
study of these mostly non-humid areas and the conservation status of their biota (León et al., 2006a).

### *Tillandsia extensa* and the three-pinnate inflorescence species of *Tillandsia*

Three-pinnate inflorescences are known in the subgenus *Tillandsia*, which in Peru occur in six taxa, *T. extensa*, *T. ferreyrae*, *T. hildae*, *T. mima* var. *chiletensis*, *T. platyphylla* and *T. propagulifera* (Tables 1 and 2). Although all these species have distichously arranged flowers, however, with the exception of *T. ferreyrae*, these flowers are twisted secund pendent. All three-pinnate taxa (Table 2) are characterized by having a red rachis that usually the color extends to branches and basal bracts of the spikes. These taxa are known from northern Peru on both sides of the Andes, growing as epiphytes or saxicolous in dry forest and other xeric environments in the Mesoandean and Desert shrubland areas.

*Tillandsia extensa* was described by Mez (1906) based on a specimen collected by Augusto Weberbauer (3986, holotype: B- 10 0243333-36; isotype: MOL-7489) on July 1903 in Masín, a locality in the Department of Ancash, at 2500 m, in the Puccha valley, a tributary of the upper Marañón river on the eastern Andean slopes (Figure 1, 2A). This saxicolous species is characterized by its 3-4-pinnate, paniculate, red inflorescences, with spikes 40 cm long, red floral bracts, erect or sub erect, not imbricate, pedicellate flowers and sepals 3 mm connate. The type collection was the only reference material for this species, until Rauh (1973) reported its rediscovery based on his collection (Rauh 24168 HEID n.v., US) made in northwestern Peru, in the Saña basin between 600 and 700 m elevation. Based on these two isolated and disjunct records, this species was evaluated by León et al. (2006b) as "Data Deficient".

http://sisbib.ummsm.edu.pe/BVRevistas/biologia/biologiaNEW.htm



**Figure 1.** Distribution of *Tillandsia extensa* (stars) and *T. platyphylla* (circles) showing type localities labeled with a "T" in the upper right.

Rauh (1973) reported his finding after sending a duplicate of his collection and photographs to Lyman B. Smith at US for verification. Rauh initially thought his specimen (Rauh 24168) to be a new species, and in his correspondence to Smith he proposed to name it after him. As noted by Rauh (1973), his collection was characterized by its 2-3 pinnate, paniculate inflorescences, with red axis, spikes 25 cm long, flowering bracts green at their base, and margins and apices red, sessile flowers and connate sepals 2-2,2 cm long. Smith appeared to have had for comparison only a photograph of the type at B, and this photograph shows a portion of the inflorescence broadly resembling Rauh's collection inflorescence. Rauh' specimen 24168 was therefore identified as a second collection of *T. extensa* by Smith (1977).

A more recent collection made in August of 2002 in the Marañón valley was also a plant with a three-pinnate red inflorescence. This specimen (*A. Sagástegui* and *M. Zapata* 17093 HUT, USM) was made in the Dpto. La Libertad, Prov. Patate, between: Huayllillas and Puente Chacas (08°12,1' S, 77°19,8' W), at 2400 m, growing on rocky steep slopes, and with a shrubland vegetation with columnar cacti, *Furcraea andina* Trel., *Arnaldoa weberbaueri* (Muschl.) Ferreyra, and a dominant endemic shrub, *Gochnatia patazina* Cabrera. This recent specimen has paniculate, 2 m long inflorescences (Fig. 2 B), proximal and medial spikes pedunculate, and slightly overlapping red floral bracts. Comparison of characters of those three-pinnate species in Peru (Table 2) and examination of herbaria specimens revealed that this specimen belong in *T. extensa* as originally described. This specimen also represents the second record for the species, within the Marañón basin, nearly 130 km apart from the original locality (Figure 1). It is probable that other populations might be found in similar habitat conditions along the basin. The presence of this and other endemic species within the reported area supports the conservation importance of the basin (e.g. Linares-Palomino, 2006).

Rauh's 24168 collection (Fig. 2 C-D) is a saxicolous plant with rosulate leaves, 60 cm long, 2 cm wide. Scape cylindrical, compact, grayish, approximately 70 cm long; lower bracts imbricate, narrowly triangulate, acuminate. Inflorescence 1,6 m long, lax, 3-pinnate, axis red; spikes curved, descending, 25 cm long; floral bracts green, apices and margins red, oblong, acuminate, 2 cm long x 0,8 cm wide, imbricate by 1/2 of its total length; flowers erect, sessile, ca. 3 cm long, sepals light green, ecarinate, oblong, obtuse or acuminate, 2-2,2 cm long, petals dark violet, stamens exserted, filaments of different size, style exserted. In Table 2, a comparison of this material with Peruvian three-pinnate species reveals that although its leaves are narrower it shares many features of *Tillandsia platyphylla* Mez, and here is recognized as such.

*Tillandsia platyphylla* was also described by Mez (1906) of a Weberbauer collection (Weberbauer 3888, holotype: B 10 0243491—3, available on-line, see Röper, 2000) made in July 1904, in northwestern Peru, in the Dept. Cajamarca, between San Miguel and San Pablo, at 1700 m, growing among rocks, probably in the Jequetepeque basin (Fig. 1). This species was recorded by Smith and Downs (1973) from an additional locality, based on a Rauh collection (24572, HEID n.v., US) which was made in 1970, in northeastern Peru, Dept. of Amazonas, Prov. Bongará, near Ingenio (approx. 05°57' S, 78° W), at 800

Thus, this species is known from both sides of the Peruvian northern Andes.

*Rauh 24168* represents the second record in the western range of *T. platyphylla*. Cultivated material exists (<http://fcbs.org/pictures/Tillandsia.htm>) probably originating from Rauh's original collection, and a photograph of its flower supports its inclusion within Gardner's II group. As is the case for species from dry Andean slopes, little is known about the sizes and conservation status of its populations (León et al. 2006a). León et al. (2006b) listed this species as "Data Deficient"; and although Rauh's record dates from the 1970's it provides, however, a glimpse that this long-lived species might have a wider distribution.

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We thank Graciela Vilcapoma of Herbario Weberbauer (MOL) for giving us information and access to Weberbauer's collection. Asunción Cano and María Isabel La Torre helped us with *Tillandsia* material at USM. Thanks to Debbie Bell, Vicki Funk, Linda Hollenberg, Greg McKee, Dan Nicholson and Harold Robinson of US for their help in discussing various taxonomic matters, historical accounts and for providing access to the US collection. We also thank Kenneth Young for comments on an earlier version of the manuscript. Jason Grant and Harry Luther provided insightful comments, suggestions and a thoroughly review of the manuscript.

**Table 1.** Taxa of *Tillandsia* subg. *Tillandsia* in Peru. Asterisk (\*) indicates Group 2 sensu Gardner (1986). For endemism, number of localities appears between parentheses. Department abbreviations, AM=Amazonas, AN=Ancash, CA=Cajamarca, CU=Cusco, HU=Huánuco, JU=Junín, LL=La Libertad, LA=Lambayeque, LO=Loreto, MD=Madre de Dios, PI=Piura, SM=San Martín, TU=Tumbes. Ecoregions are those recognized by León et al. (2007): DCT=Tropical Coastal desert, DST, Subtropical Coastal Desert, MA=Mesoandean, MDE=Desert shrubland, BHA=Amazonian Forest, BMHM= High Montane Humid Forest, BMHP= Premontane Humid Forest, BS=Dry Forest.

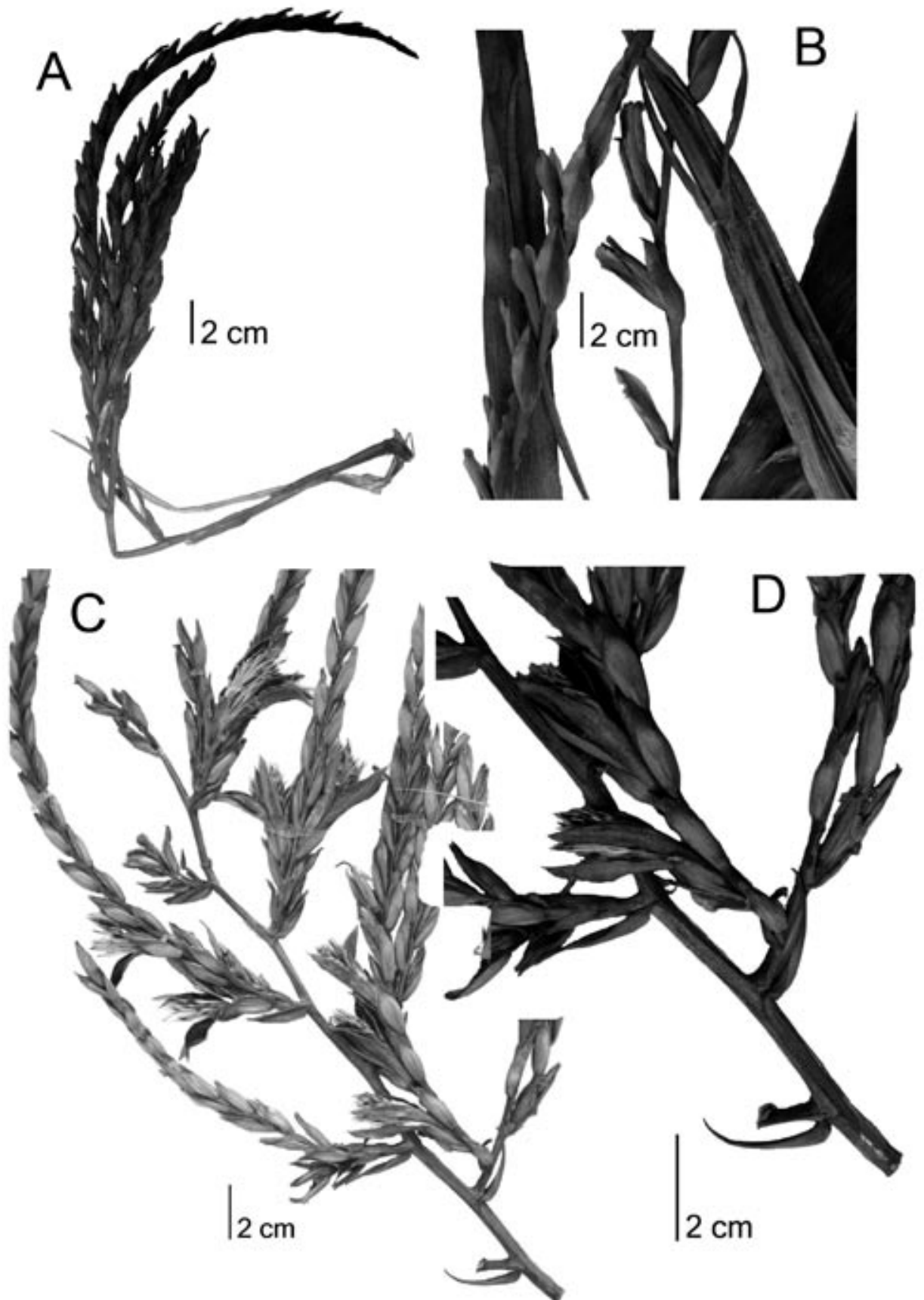
Name	Endemism	Habit	Departmental distribution	Ecoregion	Altitudinal range
<i>T. carnos</i> var. <i>brevistipitata</i> Rauh	Endemic (1)	Saxicolous	AM	BS	1200 m
<i>T. carnos</i> L. B. Sm. var. <i>carnos</i>	Not Endemic	Saxicolous	AM	BMHM	2000–2400
<i>T. carnos</i> var. <i>longispicata</i> Rauh	Endemic (1)	Saxicolous	AM	BS	500 m
<i>T. cereicola</i> Mez	Endemic (>5)	Saxicolous/Epiphyte	AM, AN, CA, LL	MDE, MA, BS	700–2200 m
<i>T. curvospica</i> (Rauh) J.R. Grant	Endemic (1)	Epiphyte	AM	BS	1200 m
<i>T. disticha</i> Kunth	Not Endemic	Epiphyte	LL, LA, PI, TU	DCT, DST, MDE	540–2100 m
<i>T. ecarinata</i> L.B. Sm.	Endemic (2)	Saxicolous	AM, PI	BS	300–700 m
<i>T. extensa</i> Mez*	Endemic (2)	Saxicolous	AN, LL	MA	2400–2500 m
<i>T. ferreyrae</i> L.B. Sm.*	Endemic (5)	Saxicolous	AM	BS	1900–2000 m
<i>T. flagellata</i> L.B. Sm.	Not Endemic	Epiphyte	Expected	MDE, BS	500–1950 m
<i>T. harmsiana</i> L.B. Sm.	Endemic (5)	Saxicolous/Epiphyte	AM, CA, LL, LA	MA, BS	2300–3000 m
<i>T. hildae</i> Rauh*	Endemic (1)	Saxicolous	CA	BS	1000–1100 m
<i>T. hitchcockiana</i> L.B. Sm.	Not Endemic	Epiphyte	PI	MDE	1200–1900 m
<i>T. incurva</i> Griseb.	Not Endemic	Epiphyte	Expected	MA	sd
<i>T. juncea</i> (Ruiz and Pav.) Poir.	Not Endemic	Epiphyte	CU, HU, SM	BMHM	300–1100
<i>T. mima</i> L.B. Sm. var. <i>chiletensis</i> Rauh*	Endemic (1)	Saxicolous	CA	MDE	800 m
<i>T. olmosana</i> (L.B. Sm.) J.R. Grant	Not Endemic	Epiphyte	LA	MA	sd
<i>T. paraensis</i> Mez*	Not Endemic	Epiphyte	AM, CU, LO, MD, SM	BHA	100–1117 m
<i>T. patula</i> Mez	Not Endemic	Saxicolous/Epiphyte	JU	MA	2100–2500 m
<i>T. pereziana</i> var. <i>canescens</i> André	Not Endemic	Epiphyte	AM	BMHP	2050 m
<i>T. peruviana</i> J.R. Grant	Not Endemic	Saxicolous	CA	BS	1500–2000 m
<i>T. platyphylla</i> Mez*	Endemic (2)	Saxicolous	AM, CA	BS, MDE	600–1700 m
<i>T. polystachia</i> (L.) L.	Not Endemic	Epiphyte	Expected	BHA, BMHP	200–1800 m
<i>T. porphyrocraspeda</i> J.R. Grant	Not Endemic	Epiphyte	CA	MDE	1800 m
<i>T. propagulifera</i> Rauh*	Endemic (2)	Epiphyte	AM, CA	BS	1300–1400 m
<i>T. rauhii</i> L.B. Sm. var. <i>rauhii</i>	Endemic (2)	Saxicolous	CA, LA	DST	700–800 m
<i>T. rauhii</i> L.B. Sm. var. <i>longispica</i> Rauh	Endemic (3)	Saxicolous	CA, LA, PI	DST	700–800 m
<i>T. spiraliflora</i> Rauh	Endemic (2)	Saxicolous	AM, CA	BS	1700 m
<i>T. teres</i> L.B. Sm.*	Endemic (1)	Saxicolous	CA	MDE	750–800 m
<i>T. tillandsioides</i> (L.B. Sm.) J.R. Grant	Not Endemic	Epiphyte	PI	MA	sd
<i>T. variabilis</i> Schltdl.	Not Endemic	Epiphyte	Expected	BHA, BMHP	sd
<i>T. werneriana</i> J.R. Grant	Not Endemic	Epiphyte	CA	BS	700 m

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**Table 2.** Comparison of Rauh 24168 with tri-pinnate inflorescence taxa of Peruvian *Tillandsia* subgenus *Tillandsia*.

	<i>Tillandsia extensa</i>	<i>Tillandsia minima</i> var. <i>chilensis</i>	<i>Tillandsia propugulifera</i>	<i>Tillandsia platyphylla</i>	<i>Tillandsia ferreyrae</i>	<i>Tillandsia</i> (Rauh 24168)
Plant size	2,2 m	1,2 m	3 m	1-1,6 m	1,5-3 m	1,6 m
Leaf size length	65-70 cm	70 cm	60-65 cm	80 cm	120 cm	80 cm
Sheath width	6-8 cm	5-6 cm	6,5 cm	15 cm	10-20 cm	6-7 cm
Scales	Whitish	Castaneous	Cinereous	Whitish	Whitish	Whitish
Inflorescence	Lax, 3-4 pinnate, flowers secund, spreading. Buds absent.	Lax, 2-3 pinnate, flowers secund, spreading. Buds present	Lax, 2-3 pinnate, flowers secund, spreading. Buds present.	Dense, 3 pinnate, flowers secund, slightly adpressed. Buds absent.	Dense, 2-3 pinnate, flowers distichous, adpressed. Buds absent.	Dense, 3 pinnate, flowers secund, slightly adpressed. Buds absent.
Spike length	30-50 cm	50-80 cm	80 cm	8-15 cm	20 cm	25 cm
proximal last segments	pedunculate $\geq$ 4 cm	pedunculate $\geq$ 4 cm	pedunculate $\geq$ 4cm	short pedunculate $\leq$ 2 cm	short pedunculate	short pedunculate $\leq$ 2 cm
Floral bracts	¼ imbricate, partially covering axis	Not imbricate, not covering axis	Not imbricate, not covering axis	½ imbricate, covering axis	2/3 imbricate, covering axis	1/4 imbricate, covering axis
size	2-3 cm	1,5-2 cm	2 cm	2-2,3 cm	3 cm	2 cm
shape	Elliptic, acuminate, ecarinate, equal or 2/3 length of sepals	Oblong, ecarinate, near ½ length of sepals	Oblong, acuminate, equal than sepals	Elliptic, obtuse, ecarinate, equal or 2/3 length of sepals	Oblong, obtuse, ecarinate, equal than sepals	Elliptic, obtuse, ecarinate, 2/3 length of sepals
color	Red, margins whitish	?	Green, apex light violet	Green, apex and margins red or maroon	Green, reddish center, margins whitish	Green, apex and margins red
Rachis	Red, glabrous, angled	Reddish, glabrous, angled	Greenish, glabrous, angled	Reddish, glabrous, angled	Reddish	Reddish, glabrous, angled
Flower	Erect	Pendulous	Erect	Erect	?	Erect
Pedicel	0,5 cm	?	< 0,5 cm	sessile	< 0,5 cm	sessile
Sepals	Oblong, apex obtuse or apiculate, 2,5-3 cm long	Narrowly obovate, broadly acute; 2,4 cm long	Elliptic, apiculate, 1,8-2 cm long	Elliptic, apex obtuse, 2,5 cm long	Elliptic, obtuse, 3 cm long	Elliptic, apex obtuse, 3 cm long
Petals	Dark violet	violet	violet	Dark violet	Dark violet	Blue-violet



**Figure 2.** A. Type material of *Tillandsia extensa* (Weberbauer 3296 MOL-7489), B. Segment of inflorescence (Sagástegui and Zapata 17093)

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