TAXON: *Tillandsia polystachia (L.) L.* SCORE: *9.0* RATING: *High Risk*

Taxon: Tillandsia polystachia (L.) L. **Family:** Bromeliaceae

Common Name(s): air plant **Synonym(s):** Platystachys polystachia (L.) Beer
Renealmia polystachia L.
Tillandsia angustifolia Sw.
Tillandsia distachya Baker

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 16 Jun 2023

WRA Score: 9.0 **Designation:** H(Hawai'i) **Rating:** High Risk

Keywords: Epiphyte, Naturalized, Ornamental, Self-fertile, Wind-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y = -3, n = 0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	0 = low, 1 = intermediate, 2 = high (see Appendix 2)	High
202	Quality of climate match data	0 = low, 1 = intermediate, 2 = high (see Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y = 1, n = 0	y
204	Native or naturalized in regions with tropical or subtropical climates	y = 1, n = 0	y
205	Does the species have a history of repeated introductions outside its natural range?	y= -2, ? = -1, n = 0	n
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n = question 205	y
302	Garden/amenity/disturbance weed	y = 1*multiplier (see Appendix 2), n = 0	y
303	Agricultural/forestry/horticultural weed		
304	Environmental weed		
305	Congeneric weed	y = 1*multiplier (see Appendix 2), n = 0	y
401	Produces spines, thorns or burrs	y = 1, n = 0	n
402	Allelopathic		
403	Parasitic	y = 1, n = 0	n
404	Unpalatable to grazing animals		
405	Toxic to animals	y = 1, n = 0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y = 1, n = 0	n
408	Creates a fire hazard in natural ecosystems	y = 1, n = 0	n
409	Is a shade tolerant plant at some stage of its life cycle	y = 1, n = 0	y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)		

Qsn #	Question	Answer Option	Answer
411	Climbing or smothering growth habit	y = 1, n = 0	y
412	Forms dense thickets	y = 1, n = 0	n
501	Aquatic	y = 5, n = 0	n
502	Grass	y = 1, n = 0	n
503	Nitrogen fixing woody plant	y = 1, n = 0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y = 1, n = 0	n
601	Evidence of substantial reproductive failure in native habitat	y = 1, n = 0	n
602	Produces viable seed	y = 1, n = -1	y
603	Hybridizes naturally	y = 1, n = -1	y
604	Self-compatible or apomictic	y = 1, n = -1	y
605	Requires specialist pollinators	y = -1, n = 0	n
606	Reproduction by vegetative fragmentation		
607	Minimum generative time (years)		
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y = 1, n = -1	n
702	Propagules dispersed intentionally by people	y = 1, n = -1	y
703	Propagules likely to disperse as a produce contaminant	y = 1, n = -1	n
704	Propagules adapted to wind dispersal	y = 1, n = -1	y
705	Propagules water dispersed	y = 1, n = -1	n
706	Propagules bird dispersed	y = 1, n = -1	n
707	Propagules dispersed by other animals (externally)	y = 1, n = -1	n
708	Propagules survive passage through the gut	y = 1, n = -1	n
801	Prolific seed production (>1000/m2)		
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). Flora Neotropica, 14(2), 663-1492	[No evidence] "Epiphytic, from near sea level to 1800 m alt, Florida, West Indies and Mexico to Brazil and Bolivia."

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. (2023). Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. (2023). Personal Communication	NA

201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**High**
	Source(s)	**Notes**
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). Flora Neotropica, 14(2), 663-1492	"Distribution. Epiphytic, from near sea level to 1800 m alt, Florida, West Indies and Mexico to Brazil and Bolivia."
	KewScience. (2023). Plants of the World Online - Tillandsia polystachia. http://powo.science.kew.org. [Accessed 15 Jun 2023]	"Native to: Bahamas, Belize, Bolivia, Brazil North, Brazil Northeast, Brazil South, Brazil Southeast, Brazil West-Central, Colombia, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Leeward Is., Mexico Central, Mexico Gulf, Mexico Northeast, Mexico Northwest, Mexico Southeast, Mexico Southwest, Nicaragua, Puerto Rico, Venezuela, Windward Is."

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	KewScience. (2023). Plants of the World Online - Tillandsia polystachia. http://powo.science.kew.org. [Accessed 15 Jun 2023]	"Native to: Bahamas, Belize, Bolivia, Brazil North, Brazil Northeast, Brazil South, Brazil Southeast, Brazil West-Central, Colombia, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Leeward Is., Mexico Central, Mexico Gulf, Mexico Northeast, Mexico Northwest, Mexico Southeast, Mexico Southwest, Nicaragua, Puerto Rico, Venezuela, Windward Is."

203	**Broad climate suitability (environmental versatility)**	**y**
	Source(s)	**Notes**
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). Flora Neotropica, 14(2), 663-1492	[Broad elevation range] "Epiphytic, from near sea level to 1800 m alt, Florida, West Indies and Mexico to Brazil and Bolivia."

204	**Native or naturalized in regions with tropical or subtropical climates**	**y**
	Source(s)	**Notes**
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). Flora Neotropica, 14(2), 663-1492	"Epiphytic, from near sea level to 1800 m alt, Florida, West Indies and Mexico to Brazil and Bolivia."

Qsn #	Question	Answer
	Gallaher, T.J., Brock, K., Kennedy, B.H., Imada, C.T., Imada, K., & Walvoord, N. (2023). Plants of Hawai'i. http://www.plantsofhawaii.org.. [Accessed 15 Jun 2023]	"Kaua'i Naturalized O'ahu Naturalized"
	Frohlich, D. & Lau, A. (2010). New plant records from O'ahu for 2008. Bishop Museum Occasional Papers 107: 3-18	"This species has been observed in several neighborhoods establishing on various surfaces including trees, fences, rock walls, and gravel beds. It may form very dense coverings on branches and trunks, making photosynthesis for the "host" tree impossible anywhere but at the very tips of major branches. This species shows good potential for becoming a problematic species in Hawai'i. Material examined. O'AHU: Lower Pauoa Valley, off Booth Rd, in yard (UTM 620780, 2358473), blanketing main branches on a 20 ft tall cypress, no flowers noted, seeds with long, silky coma, occasional to locally abundant in the neighborhood and producing copious seeds, 14 Aug 2008, D. Frohlich & A. Lau 2008081401."

205	**Does the species have a history of repeated introductions outside its natural range?**	**n**
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. (2010). New plant records from O'ahu for 2008. Bishop Museum Occasional Papers 107: 3-18	"It has likely been in cultivation on O'ahu for a number of years, and is somewhat rare in cultivation in general."
	Murphy, M. (2023). Plant Pono Specialist. BIISC Early Detection Technician. personal communication. 22 May	[Hawaii Island] "We get complaints from residents who took some home from the arboretum, and now their trees are covered with thousands of them."

301	**Naturalized beyond native range**	**y**
	Source(s)	**Notes**
	Murphy, M. (2023). Plant Pono Specialist. BIISC Early Detection Technician. personal communication. 22 May	"Habitat: Densely blanketing trees in the Hilo Arboretum and Keaau Shipman Park. Branches break because of excess weight. Some individuals are growing directly on the powerline. Host trees: Cassia sp, palms, Tabebuia, etc"
	Frohlich, D. & Lau, A. (2010). New plant records from O'ahu for 2008. Bishop Museum Occasional Papers 107: 3-18	[Oahu] "Native from Florida south to Brazil and Bolivia, this usually epiphytic plant is known to grow from near sea level to 1800 m elevation. It has likely been in cultivation on O'ahu for a number of years, and is somewhat rare in cultivation in general. It can be recognized by its many narrowly triangular, usually flat leaves in a dense, spreading rosette that are usually yellow-green, flushing red when exposed to sun. The inflorescence is 30 cm long and can be pinnately or subdigitately compound. The petals are tubular-erect, 3 cm long, and violet, with the stamens and stigma exserted. The fruit is a capsule containing many small, wind-dispersed seeds (Smith & Downs 1977). This species has been observed in several neighborhoods establishing on various surfaces including trees, fences, rock walls, and gravel beds. It may form very dense coverings on branches and trunks, making photosynthesis for the "host" tree impossible anywhere but at the very tips of major branches. This species shows good potential for becoming a problematic species in Hawai'i. Material examined. O'AHU: Lower Pauoa Valley, off Booth Rd, in yard (UTM 620780, 2358473), blanketing main branches on a 20 ft tall cypress, no flowers noted, seeds with long, silky coma, occasional to locally abundant in the neighborhood and producing copious seeds, 14 Aug 2008, D. Frohlich & A. Lau 2008081401."
	Gallaher, T.J., Brock, K., Kennedy, B.H., Imada, C.T., Imada, K., & Walvoord, N. (2023). Plants of Hawai'i. http://www.plantsofhawaii.org.. [Accessed 16 Jun 2023]	Kaua'i Naturalized O'ahu Naturalized

302	**Garden/amenity/disturbance weed**	**y**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. (2010). New plant records from O‘ahu for 2008. Bishop Museum Occasional Papers 107: 3 -18	[Impacting landscaping trees] "This species has been observed in several neighborhoods establishing on various surfaces including trees, fences, rock walls, and gravel beds. It may form very dense coverings on branches and trunks, making photosynthesis for the “host” tree impossible anywhere but at the very tips of major branches. This species shows good potential for becoming a problematic species in Hawai‘i."
	Murphy, M. (2023). Plant Pono Specialist. BIISC Early Detection Technician. personal communication. 22 May	[Weedy and impacting landscaping and arboretum trees] "Habitat: Densely blanketing trees in the Hilo Arboretum and Keaau Shipman Park. Branches break because of excess weight. Some individuals are growing directly on the powerline. Host trees: Cassia sp, palms, Tabebuia, etc We get complaints from residents who took some home from the arboretum, and now their trees are covered with thousands of them. One woman wrote us asking if BIISC could do anything about the 'sky weeds'. I think that's a fitting common name. They make so many wind-dispersed seeds. It's insane to watch their migration around Hilo and Keaau."

303	Agricultural/forestry/horticultural weed	
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. (2010). New plant records from O‘ahu for 2008. Bishop Museum Occasional Papers 107: 3 -18	[Impacting trees in landscaping. Potential to become an agricultural weed if it establishes on fruit or other economically important trees] "This species has been observed in several neighborhoods establishing on various surfaces including trees, fences, rock walls, and gravel beds. It may form very dense coverings on branches and trunks, making photosynthesis for the “host” tree impossible anywhere but at the very tips of major branches. This species shows good potential for becoming a problematic species in Hawai‘i."
	Murphy, M. (2023). Plant Pono Specialist. BIISC Early Detection Technician. personal communication. 22 May	[Weedy and impacting landscaping and arboretum trees. Could become an agricultural weed if it establishes on fruit or other economically important trees] "Habitat: Densely blanketing trees in the Hilo Arboretum and Keaau Shipman Park. Branches break because of excess weight. Some individuals are growing directly on the powerline. Host trees: Cassia sp, palms, Tabebuia, etc We get complaints from residents who took some home from the arboretum, and now their trees are covered with thousands of them. One woman wrote us asking if BIISC could do anything about the 'sky weeds'. I think that's a fitting common name. They make so many wind-dispersed seeds. It's insane to watch their migration around Hilo and Keaau."

304	Environmental weed	
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. (2010). New plant records from O‘ahu for 2008. Bishop Museum Occasional Papers 107: 3 -18	[Impacting trees in landscaping. Potential to become an environmental weed if it establishes in native forest communities] "This species has been observed in several neighborhoods establishing on various surfaces including trees, fences, rock walls, and gravel beds. It may form very dense coverings on branches and trunks, making photosynthesis for the “host” tree impossible anywhere but at the very tips of major branches. This species shows good potential for becoming a problematic species in Hawai‘i."

Qsn #	Question	Answer
	Murphy, M. (2023). Plant Pono Specialist. BIISC Early Detection Technician. personal communication. 22 May	[Weedy and impacting landscaping and arboretum trees. This species could become an environmental weed if it establishes on trees in native forest communities] "Habitat: Densely blanketing trees in the Hilo Arboretum and Keaau Shipman Park. Branches break because of excess weight. Some individuals are growing directly on the powerline. Host trees: Cassia sp, palms, Tabebuia, etc We get complaints from residents who took some home from the arboretum, and now their trees are covered with thousands of them. One woman wrote us asking if BIISC could do anything about the 'sky weeds'. I think that's a fitting common name. They make so many wind-dispersed seeds. It's insane to watch their migration around Hilo and Keaau."

305	Congeneric weed	y
	Source(s)	**Notes**
	Johnson, J. D.; Halliwell, R. S. (1973) Compounds for the control of ball moss. Plant Disease Reporter 57(1): 81-83	"In field trials in south-west Texas in 1970-71, good control of Tillandsia recurvata on the evergreen Quercus virginiana was obtained by spring with Cu(OH)2 (Kocide 101) at 4-8 lb/100 gal water."
	Cardenas, C. H. (1971) Observations on Tillandsia recurvata and its control by means of herbicides. Revista de la Facultad de Agronomia, Universidad Central de Venezuela 6(2): 43-72	"In parts of Venezuela the epiphyte Tillandsia recurvata is sufficiently abundant to kill whole trees or their main branches. Its mode of propagation is described. In the laboratory detached plants were readily killed by submergence in various herbicidal solutions."
	Caldiz, D. O., Beltrano, J., Fernandez, L. V., & Andía, I. (1993). Survey of Tillandsia recurvata L.: preference, abundance and its significance for natural forests. Forest Ecology and Management, 57(1-4), 161-168	"The ball moss (Tillandsia recurvata L.) is an epiphytic weed that causes a deleterious effect upon its host when abundance is high." ... "The ball moss (Tillandsia recurvata L.) is an atmospheric epiphyte (Pittendrigh, 1948) which can be found along the American continent, from the southern USA to the middle part of Argentina. The importance of this species has increased in recent years because of its deleterious effects on forest and ornamental trees and bushes (Claver et al., 1983). Benzing (1980) called this effect 'nutritional piracy' and stated that it can be observed only under specific conditions. Other authors considered T. recurvata as an epiphytic weed (Petetin and Molinari, 1977; Claver et al., 1983) that competes for light, or produces some growth inhibitor that determines leaf abscission."
	Bartoli, C. G., Beltrano, J., Fernandez, L. V., & Caldiz, D. O. (1993). Control of the epiphytic weeds Tillandsia recurvata and Tillandsia aëranthos with different herbicides. Forest Ecology and Management, 59(3-4), 289-294	"The population of the epiphytic weeds Tillandsia recurvata and Tillandsia aëranthos on forestry and ornamental trees in different areas of Argentina has increased, causing deleterious effects on their hosts. As a result, an experiment was performed to control these epiphytes with different herbicides. During October 1988/June 1989, in the La Plata woods (34°55′S) the following treatments were applied to ten different host species which were actively growing: Atrazine 10 g 1−1; Dichlobenil 5 g 1−1; Simazine 5 g 1−1 of formulated product and their combination. All the selected herbicides, alone or in combination, controlled the epiphytes without causing phytotoxicity to the host plant, owing to the different absorption systems of the epiphytes and the hosts. This is a new approach to control these epiphytic weeds and an important tool for preserving natural forests which are very susceptible to the invasion of epiphytes."

Qsn #	Question	Answer
	Claver, F. K., Alaniz, J. R., & Caldíz, D. O. (1983). Tillandsia spp.: epiphytic weeds of trees and bushes. Forest Ecology and Management, 6(4), 367-372	"This paper comments on the increase of population of two species: Tillandsia recurvata (L.) Linne and Tillandsia aëranthos (Loisel) L.B. Smith (Bromeliaceae) in the La Plata area of Argentina. These small, oligotrophic, herbaceous plants were observed on many species of trees and bushes growing in the arboretum of the Faculty of Agronomy and in parks of the city. Such woody species are present in other areas of the country and would be susceptible to attack in the future. Both species grow initially on the branches of the trees and later colonise the whole host, causing abscission of the leaves and the death of the tree. Consistent with this finding, these epiphytes are considered specialised weeds of the host plant and preliminary results of this study demonstrate the presence of a natural inhibitor in crude extracts of the plants. At present, work is in progress to study its effect upon leaf abscission and the colonisation strategy related to damage upon host trees."

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Acevedo-Rodríguez, P. & Strong, M.T. (2005). Monocotyledons and Gymnosperms of Puerto Rico and the Virgin Islands. Contributions from the United States National Herbarium 52: 1-415	[No evidence] "Epiphytic or sometimes lithophytic, acaulescent, rather variable herb, solitary or in clusters. Leaves numerous, in a fasciculate rosette, densely pale-appressed-lepidote throughout, about 20-65 cm long; sheaths conspicuous, ovateelliptic, ca. 5-9 × 2-6 cm, dark brown; blades deltate-attenuate, gradually tapering into a filiform apex, arching to recurving, the margins involute. Scape erect or ascending, the sterile base shorter than the leaves; scape bracteoles foliaceous, reducing toward the apex, with erect, densely imbricate sheaths and elongate spreadingrecurved blades, green, red or purplish. Inflorescence variable, usually subcylindric or narrowly fusiform and exceeding the leaves, rarely simple to more commonly congested and subdigitate, or with a polystichously and densely branched axis to 45 cm long with short internodes; primary fertile bracteoles longer or shorter than the branches, short- or long-acuminate, reduced towards apex of the inflorescence (more commonly the lower primary fertile bracteoles are subfoliaceous with sheaths infolding the bases of the branches and involute-filiform blades much longer than the branches, the upper ovatelanceolate, short- or long-acuminate, and shorter than the branches); branches erect, ascending or spreading, straight or curved, linear, about 3-14 cm long, complanate, densely-flowered; bracts erect, appressed, rigid, imbricate, ovate-oblong, broadly acute or obtuse, mucronulate, 1.5-2 cm long, longer than the sepals, much longer than the internodes, coriaceous, smooth, glabrous or obscurely lepidote, carinate. Flowers subsessile, erect; sepals linear-elliptic to ovate-oblong, about 1.2-1.5 cm long, acute or mostly obtuse, coriaceous, even, glabrous, carinate; petals erect, tubular, ligulate, about 3 cm long, blue or violet; stamens and pistil exserted. Capsule cylindricalellipsoid, pointed, 2.5-4 cm long."

402	Allelopathic	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Valencia-Díaz, S., Flores-Palacios, A., Rodruíguez-López, V., & Jimenez-Aparicio, A. R. (2012). Effects of Tillandsia recurvata extracts on the seed germination of Tillandsia spp. Allelopathy Journal, 29(1): 125-135	[Unknown. No evidence, but allelopathic chemicals documented in other species] "Abstract: Epiphytes associate intraspecifically, but it is unclear whether the dominant species exerts a negative effect on its competitors through allelopathy. Tillandsia recurvata is the dominant epiphyte in the tropical dry forest of central Mexico. It has phytotoxic properties, therefore inhibits the seed germination of other epiphytic bromeliads, which may effect its associations. Nearest neighbor (NN) distance from each bromeliad was measured and the bromeliad associations were characterized as intra or interspecific. Leachates and organic extracts from T. recurvata were used in seed germination trials of Tillandsia. All species have a conspecific as their NN, but interespecific associations indicate that T. recurvata was less frequent NN for all Tillandsia. T. recurvata leachates and organic extracts inhibited the germination of all Tillandsia species. This research demonstrates the inhibitory potential of T. recurvata on its competitors; however its association patterns were not explained. Other ecological factors may account for its dominance and associations."

403	Parasitic	n
	Source(s)	Notes
	Acevedo-Rodríguez, P. & Strong, M.T. (2005). Monocotyledons and Gymnosperms of Puerto Rico and the Virgin Islands. Contributions from the United States National Herbarium 52: 1-415	"Epiphytic or sometimes lithophytic, acaulescent, rather variable herb, solitary or in clusters."

404	Unpalatable to grazing animals	
	Source(s)	Notes
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). Flora Neotropica, 14(2), 663-1492	"Epiphytic, from near sea level to 1800 m alt, Florida, West Indies and Mexico to Brazil and Bolivia." [Unknown, but epiphytic habit may keep plants out of reach of most browsing animals]
	Smith, J.G. (1900). Fodder and Forage Plants: Exclusive of the Grasses. Government Printing Office, Washington, D.C.	[Tillandsia usneoides palatable to cattle] "An epiphyte belonging to the Pineapple family, abundant in Florida and the Gulf States, where it is a characteristic feature of the forests with its long stems hanging in festoons from the tree trunks and branches. Cattle eat it, and it adds considerable value to the woodland pastures."

405	Toxic to animals	n
	Source(s)	Notes
	Air Plant Design Studio. (2023). Air Plants + Pets: Are Air Plants Toxic? https://www.air-plants.com/blogs/air-plant-encyclopedia/air-plants-pets-are-air-plants-toxic. [Accessed 16 Jun 2023]	"Tillandsia, aka air plants, are non toxic to dogs and cats. So if your cat is a little too fond of nibbling on your air plants leaves, don't worry!"
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence
	Wagstaff, D.J. (2008). International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Air Plant Design Studio. (2023). Top 5 Most Common Air Plant Issues. https://www.air-plants.com/blogs/tillandsia-info-care/most-common-issues. [Accessed 16 Jun 2023]	"While air plants don't have soil which rules out a lot of pests and issues that pests can cause, they can sometimes be susceptible to them. The most common pests that plague air plants are mealy bug, and scale. If an air plant is infested with mealy bug it will have a waxy cotton like substance on its leaves. Mealy bugs cause damage to the soft leaves of Tillandsia and Bromeliads by attacking the leaves to get to the "sap" inside."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	Plant Addicts. (2023). Are Air Plants Poisonous? https://plantaddicts.com/are-air-plants-poisonous/. [Accessed 16 Jun 2023]	"Air Plants are one of the easiest houseplants to grow and use to decorate indoor and outdoor spaces. As part of the Bromeliad family, Air Plants are considered completely non-toxic and safe to grow around humans and pets. The only parts of an Air Plant that may cause injury are the edges or pointed tips of the leaves. All Air Plants should be handled as little as possible, but the larger varieties could cause pokes and cuts if not handled gently and with some degree of caution. As with any other houseplant, if large amounts of the leaves are ingested, they could cause stomach and intestinal upset. "
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence
	Wagstaff, D.J. (2008). International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	Acevedo-Rodríguez, P. & Strong, M.T. (2005). Monocotyledons and Gymnosperms of Puerto Rico and the Virgin Islands. Contributions from the United States National Herbarium 52: 1-415	"Variable, from dry scrub forest at sea level to moist and wet forests about 800 m." [[No evidence. Unlikely to increase fire risk due to epiphytic habit, although may add to fuel load if forest burns]

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	**Notes**
	The National Gardening Association. (2023). Air Plant (Tillandsia polystachia). https://garden.org/plants/view/203494/Air-Plant-Tillandsia-polystachia/. [Accessed 16 Jun 2023]	"Sun Requirements: Full Sun to Partial Shade"
	Earth & Jungle. (2023). Air Plant - Tillandsia polystachia (One Plant) | Little Prince To Go. https://www.earthandjungle.com/product/fSPav63g/air-plant-tillandsia-polystachia-one-pla. [Accessed 16 Jun 2023]	Sun Exposure Part Shade Full Shade Part Sun Full Sun

Qsn #	Question	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	
	Source(s)	Notes
	Acevedo-Rodríguez, P. & Strong, M.T. (2005). Monocotyledons and Gymnosperms of Puerto Rico and the Virgin Islands. Contributions from the United States National Herbarium 52: 1-415	[NA] "Epiphytic or sometimes lithophytic, acaulescent, rather variable herb, solitary or in clusters."

411	Climbing or smothering growth habit	y
	Source(s)	Notes
	Frohlich, D. & Lau, A. (2010). New plant records from O‘ahu for 2008. Bishop Museum Occasional Papers 107: 3-18	[Observed to "smother" trees by rampant growth that may impede photosynthesis] "This species has been observed in several neighborhoods establishing on various surfaces including trees, fences, rock walls, and gravel beds. It may form very dense coverings on branches and trunks, making photosynthesis for the “host” tree impossible anywhere but at the very tips of major branches. This species shows good potential for becoming a problematic species in Hawai‘i."

412	Forms dense thickets	n
	Source(s)	Notes
	Acevedo-Rodríguez, P. & Strong, M.T. (2005). Monocotyledons and Gymnosperms of Puerto Rico and the Virgin Islands. Contributions from the United States National Herbarium 52: 1-415	"Epiphytic or sometimes lithophytic, acaulescent, rather variable herb, solitary or in clusters."
	Frohlich, D. & Lau, A. (2010). New plant records from O‘ahu for 2008. Bishop Museum Occasional Papers 107: 3-18	["Smothers" branches with dense growth. See 4.11] "It may form very dense coverings on branches and trunks, making photosynthesis for the “host” tree impossible anywhere but at the very tips of major branches. This species shows good potential for becoming a problematic species in Hawai‘i."

501	Aquatic	n
	Source(s)	Notes
	Acevedo-Rodríguez, P. & Strong, M.T. (2005). Monocotyledons and Gymnosperms of Puerto Rico and the Virgin Islands. Contributions from the United States National Herbarium 52: 1-415	"Epiphytic or sometimes lithophytic, acaulescent, rather variable herb, solitary or in clusters."

502	Grass	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2023). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 15 Jun 2023]	Genus: Tillandsia Family: Bromeliaceae Subfamily: Tillandsioideae Tribe: Tillandsieae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes

Qsn #	Question	Answer
	USDA, Agricultural Research Service, National Plant Germplasm System. (2023). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 15 Jun 2023]	Genus: Tillandsia Family: Bromeliaceae Subfamily: Tillandsioideae Tribe: Tillandsieae

504	**Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)**	**n**
	Source(s)	**Notes**
	Acevedo-Rodríguez, P. & Strong, M.T. (2005). Monocotyledons and Gymnosperms of Puerto Rico and the Virgin Islands. Contributions from the United States National Herbarium 52: 1-415	"Epiphytic or sometimes lithophytic, acaulescent, rather variable herb, solitary or in clusters."

601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	Acevedo-Rodríguez, P. & Strong, M.T. (2005). Monocotyledons and Gymnosperms of Puerto Rico and the Virgin Islands. Contributions from the United States National Herbarium 52: 1-415	"Very common and widespread, probably in all municipalities; recorded from Aguadilla, Arecibo, Cayey, Coamo, Comerío, Fajardo, Florida, Jayuya, Loíza, Manatí, Maricao, Mayagüez, Mona Island, Ponce, Salinas, Utuado, Vega Alta, and Yauco."

602	**Produces viable seed**	**y**
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. (2010). New plant records from O'ahu for 2008. Bishop Museum Occasional Papers 107: 3-18	"seeds with long, silky coma, occasional to locally abundant in the neighborhood and producing copious seeds"
	Chilpa-Galván, N., Márquez-Guzmán, J., Zotz, G., Echevarría-Machado, I., Andrade, J. L., Espadas-Manrique, C., & Reyes-García, C. (2018). Seed traits favouring dispersal and establishment of six epiphytic Tillandsia (Bromeliaceae) species. Seed Science Research, 28(4), 349-359	"There were large differences in germinability among species, from germination close to 90% in T. brachycaulos and T. yucatana, to values <50% in T. polystachia and T. recurvata. The causes behind these differences in germinability are unknown, as seed viability and dormancy would have to be further evaluated."

603	**Hybridizes naturally**	**y**
	Source(s)	**Notes**
	Ramírez‐Rosas, K., Aguirre‐Jaimes, A., Ramírez‐Morillo, I. M., & García‐Franco, J. G. (2020). Floral biology and potential hybridization of three sympatric epiphytic bromeliads in Veracruz, Mexico. Plant Species Biology, 35(3), 197-209	"The present results also indicated that seeds from any pollination treatment (intra- and interspecific) were viable, including the agamospermous seeds of T. juncea and T. polystachia. In particular, hybrid seeds of T. polystachia and T. juncea attained ca. 50% germination, indicating the absence of major postzygotic barriers when these species are the pollen recipient. Moreover, T. variabilis showed no significant postzygotic barriers when it was the recipient of T. polystachia pollen, whereas the opposite trend was observed when T. variabilis was crossed with T. juncea, with less than 10% seed set recorded."

604	**Self-compatible or apomictic**	**y**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Ramírez‐Rosas, K., Aguirre‐Jaimes, A., Ramírez‐Morillo, I. M., & García‐Franco, J. G. (2020). Floral biology and potential hybridization of three sympatric epiphytic bromeliads in Veracruz, Mexico. Plant Species Biology, 35 (3), 197-209	[Selfing results in reduced seed set] "The three species developed fruit in all intraspecific crosses. In general, fruit set following self-pollination and geitonogamy was higher than that from agamospermy (Table 2b). In particular, T. polystachia showed similarly low fruit set in response to agamospermy, self-pollination (both spontaneous and manual) and geitonogamy. Spontaneous selfing in T. juncea and T. variabilis resulted in higher fruit set than that recorded in the other pollination treatments in these species."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Ramírez‐Rosas, K., Aguirre‐Jaimes, A., Ramírez‐Morillo, I. M., & García‐Franco, J. G. (2020). Floral biology and potential hybridization of three sympatric epiphytic bromeliads in Veracruz, Mexico. Plant Species Biology, 35 (3), 197-209	[Pollinators not required] "Few bromeliad species display self-incompatibility mechanisms (Ramírez-Morillo et al., 2009; Wendt et al., 2001), and self-compatibility is common in Tillandsia (Cascante-Marín et al., 2006; Gardner, 1984). Self-compatibility and autogamy are advantageous where cross-pollination is infrequent owing to scarcity or absence of pollinators (Bawa, Perry, & Beach, 1985; Matallana et al., 2010). Gardner (1986) observed that 75% of the 40 Tillandsia species studied were self-compatible and suggested that autogamy occurs as a consequence of contact between the pistil and anthers during flower development. The present spontaneous selfing treatment produced high percentages of fruit and seed set in the studied bromeliad species. The stamen and pistil lengths are similar, and the synchrony in stigma receptivity and anther dehiscence will permit selfing to occur. However, the frequency of autogamy differed among the bromeliad species."

606	Reproduction by vegetative fragmentation	
	Source(s)	**Notes**
	The National Gardening Association. (2023). Air Plant (Tillandsia polystachia). https://garden.org/plants/view/203494/Air-Plant-Tillandsia-polystachia/. [Accessed 16 Jun 2023]	"Propagation: Other methods: Offsets" [Unknown if offsets can detach and form new plants]

607	Minimum generative time (years)	
	Source(s)	**Notes**
	Benzing, D. H. (2000). Bromeliaceae: Profile of an Adaptive Radiation. Cambridge University Press. Cambridge, UK	[Unknown for Tillandsia polystachia] "Many dry-growing tillandsias (e.g., T. stricta, T. recurvifolia, T. streptophylla, T. bulbosa, T. caput-medusae) require on average 4-6 years to flower from seed in cultivation, and for the exceptionally slow growing types (e.g., T. xiphioides, T. xerographica) this number probably more closely approaches a full decade (Dimmitt 1984, 1990, unpublished data)."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. (2010). New plant records from O‘ahu for 2008. Bishop Museum Occasional Papers 107: 3 -18	"The fruit is a capsule containing many small, wind-dispersed seeds (Smith & Downs 1977)."

702	Propagules dispersed intentionally by people	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. (2010). New plant records from O'ahu for 2008. Bishop Museum Occasional Papers 107: 3 -18	"Tillandsia polystachia (L.) L. New state record Native from Florida south to Brazil and Bolivia, this usually epiphytic plant is known to grow from near sea level to 1800 m elevation. It has likely been in cultivation on O'ahu for a number of years, and is somewhat rare in cultivation in general."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. (2010). New plant records from O'ahu for 2008. Bishop Museum Occasional Papers 107: 3 -18	"The fruit is a capsule containing many small, wind-dispersed seeds (Smith & Downs 1977)."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	[No evidence] "Major Pathway/s: Ornamental Dispersed by: Humans"

704	Propagules adapted to wind dispersal	y
	Source(s)	**Notes**
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). Flora Neotropica, 14(2), 663-1492	"Fruit capsular, septicidal; seeds with a plumose appendage at base or apex or both." [Generic description]
	Chilpa-Galván, N., Márquez-Guzmán, J., Zotz, G., Echevarría-Machado, I., Andrade, J. L., Espadas-Manrique, C., & Reyes-García, C. (2018). Seed traits favouring dispersal and establishment of six epiphytic Tillandsia (Bromeliaceae) species. Seed Science Research, 28(4), 349-359	"There are a number of studies describing the gross range of morpho-anatomical variability in epiphytic Tillandsia species, but the interspecific variation in seed traits remain largely unexplored, although these play an important role in determining dispersal and establishment success. In order to evaluate interspecific variation in seed morphology, anatomy and germination, we sampled six Tillandsia species from the Yucatan peninsula, Mexico, distributed along a precipitation gradient. We studied morpho-anatomical traits (seed length, seed mass, ratio of coma to seed, ratio of embryo to endosperm), seed terminal velocity in still air, and performed histochemical analyses and germination trials under controlled conditions. Tillandsia recurvata differs from the other five species in the structure of the plumose coma; it was the only species lacking an endosperm and showed distinct seedling development. Among the species, bigger seeds were related to longer comas, and had higher germinability. Overall, seed terminal velocity was invariably slow, compared with reports of other anemochorous species, suggesting a high dispersal potential. Taxonomical and ecological implications of our results are discussed."

705	Propagules water dispersed	n
	Source(s)	**Notes**
	Acevedo-Rodríguez, P. & Strong, M.T. (2005). Monocotyledons and Gymnosperms of Puerto Rico and the Virgin Islands. Contributions from the United States National Herbarium 52: 1-415	[A wind-dispersed epiphyte] "Epiphytic or sometimes lithophytic, acaulescent, rather variable herb, solitary or in clusters."

706	Propagules bird dispersed	n
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. (2010). New plant records from O'ahu for 2008. Bishop Museum Occasional Papers 107: 3 -18	"The fruit is a capsule containing many small, wind-dispersed seeds (Smith & Downs 1977)."

Qsn #	Question	Answer
	Benzing, D. H. (2000). Bromeliaceae: Profile of an Adaptive Radiation. Cambridge University Press. Cambridge, UK	"Tillandsioideae disperse among arboreal and lithic substrates via small, wind-transported seeds structured according to a single aerodynamic design"

707	Propagules dispersed by other animals (externally)	n
	Source(s)	**Notes**
	Benzing, D. H. (2000). Bromeliaceae: Profile of an Adaptive Radiation. Cambridge University Press. Cambridge, UK	"Tillandsioideae disperse among arboreal and lithic substrates via small, wind-transported seeds structured according to a single aerodynamic design"

708	Propagules survive passage through the gut	n
	Source(s)	**Notes**
	Benzing, D. H. (2000). Bromeliaceae: Profile of an Adaptive Radiation. Cambridge University Press. Cambridge, UK	"Tillandsioideae disperse among arboreal and lithic substrates via small, wind-transported seeds structured according to a single aerodynamic design"

801	Prolific seed production (>1000/m2)	
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. (2010). New plant records from O'ahu for 2008. Bishop Museum Occasional Papers 107: 3 -18	"Tillandsioideae disperse among arboreal and lithic substrates via small, wind-transported seeds structured according to a single aerodynamic design" [Numbers unspecified]

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	**Notes**
	Chilpa-Galván, N., Márquez-Guzmán, J., Zotz, G., Echevarría-Machado, I., Andrade, J. L., Espadas-Manrique, C., & Reyes-García, C. (2018). Seed traits favouring dispersal and establishment of six epiphytic Tillandsia (Bromeliaceae) species. Seed Science Research, 28(4), 349-359	"Dormancy has not been reported in Tillandsia; generally, seeds show rapid germination, often with high germinability under controlled conditions in an interval of 5–15 days after watering (Bader et al., 2009; Cascante-Marin et al., 2009; Montes-Recinas et al., 2012; Valencia-Díaz et al., 2010), unless they are severely stressed (Bader et al., 2009). In general, epiphyte seeds do not seem to form seed banks, but germinate immediately after dispersal at the end of the unfavourable season (reviewed in Mondragón et al., 2015)."
	SER, INSR, RBGK, (2023). Seed Information Database (SID). https://ser-sid.org/. [Accessed 16 Jun 2023]	"Storage Behaviour Orthodox Conditions 90 % viability following drying to mc's in equilibrium with 15 % RH and freezing for 83 days at -20C at RBG Kew, WP"

803	Well controlled by herbicides	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Bartoli, C. G., Beltrano, J., Fernandez, L. V., & Caldiz, D. O. (1993). Control of the epiphytic weeds Tillandsia recurvata and Tillandsia aëranthos with different herbicides. Forest Ecology and Management, 59(3-4), 289-294	[Herbicides used to control other species may be effective] "The population of the epiphytic weeds Tillandsia recurvata and Tillandsia aëranthos on forestry and ornamental trees in different areas of Argentina has increased, causing deleterious effects on their hosts. As a result, an experiment was performed to control these epiphytes with different herbicides. During October 1988/June 1989, in the La Plata woods (34°55′S) the following treatments were applied to ten different host species which were actively growing: Atrazine 10 g 1−1; Dichlobenil 5 g 1−1; Simazine 5 g 1−1 of formulated product and their combination. All the selected herbicides, alone or in combination, controlled the epiphytes without causing phytotoxicity to the host plant, owing to the different absorption systems of the epiphytes and the hosts. This is a new approach to control these epiphytic weeds and an important tool for preserving natural forests which are very susceptible to the invasion of epiphytes."
	Arny, N.P. (1996). Spanish Moss and Ball Moss. FOR52. University of Florida IFAS Extension, Gainesville, FL http://edis.ifas.ufl.edu. [Accessed 16 Jun 2023]	[Unknown. Chemical control of Tillandsia usneoides is effective] "Chemical control of Tillandsia is possible. As of 1996, the following materials are licensed for control of Spanish moss and/or ball moss: TC Tribasic Copper Sulphate, Blue Shield, Basic Copper 53, Micro Flo Basic Copper 53, Micro Flo Copper 3 FL. It should be noted that there is evidence that copper-based herbicides and fungicides may cause damage to tender growth on oak trees. As with all herbicides, when using these materials read and follow label directions carefully."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes
	WRA Specialist. (2023). Personal Communication	Unknown. Possibly may resprout after damage to offsets

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. (2023). Personal Communication	Unknown

Summary of Risk Traits:

Tillandsia polystachia, commonly known as air plant, is a species of epiphytic bromeliad. Epiphytic plants are those that grow attached to other plants or objects without deriving nutrients from them. It is native to the forests of Central and South America. It typically grows on tree branches or rocks, using its roots primarily for anchorage rather than nutrient absorption. This species has been cultivated as an ornamental in the Hawaiian Islands, and spreads by wind-dispersed seeds. On the islands of Oahu and Hawaii, it is reported to form dense cover on branches and trunks of supporting trees in landscaping, possibly depriving them of light. Similar negative impacts could presumably occur if it became established on economically important trees or trees in native ecosystems.

High Risk / Undesirable Traits
• Broad elevation range in tropical environments
• Naturalized on Kauai, Oahu, and Hawaii (Hawaiian Islands
• A landscaping weed, established on and negatively impacting landscaping trees
• A potential agricultural and environmental weed with the ability to establish on and deprive trees of light and possibly other nutrients
• Other Tillandsia species are invasive weeds
• Shade-tolerant
• Smothering habit, forming dense growth on branches and trunks that may impede photosynthesis
• Reproduces by wind-dispersed seeds
• Hybridizes with other species
• Self-fertile
• Seeds dispersed by wind and through intentional cultivation

Low Risk Traits
• Unarmed (no spines, thorns, or burrs)
• Non-toxic
• Herbicides used to control other invasive Tillandsia species may be effective