Taxon: Tillandsia usneoides **Family:** Bromeliaceae

Common Name(s): Spanish moss **Synonym(s):** Renealmia usneoides L.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 20 Feb 2015

WRA Score: 12.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Naturalized Epiphyte, Ornamental, Spreads Vegetatively, Wind-Dispersed, Bird-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	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	n
303	Agricultural/forestry/horticultural weed		
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	n
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	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	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens	y=1, n=0	n
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	y
409	Is a shade tolerant plant at some stage of its life cycle		
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		
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
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	y
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)	y=1, n=-1	y
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m2)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
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**
	Garth, R.E. 1964. The ecology of the Spanish moss (Tillandsia usneoides), its growth and distribution. Ecology 45: 470-481	No evidence

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. 2015. 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**
	USDA, ARS, National Genetic Resources Program. 2015. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/. [Accessed 19 Feb 2015]	" Native: NORTHERN AMERICA (Check conservation status in U.S. & Canada in NatureServe Explorer database) Southeastern U.S.A.: United States - Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Virginia South-Central U.S.A.: United States - Texas Northern Mexico: Mexico - Coahuila, Durango, Nuevo Leon, San Luis Potosi, Tamaulipas Southern Mexico: Mexico - Aguascalientes, Campeche, Chiapas, Federal District, Guanajuato, Guerrero, Hidalgo, Jalisco, Mexico, Michoacan, Nayarit, Oaxaca, Puebla, Queretaro, Quintana Roo, Tabasco, Tlaxcala, Veracruz, Yucatan SOUTHERN AMERICA Caribbean: Bahamas; Cuba; Dominican Republic; Guadeloupe; Haiti; Jamaica; Martinique; Puerto Rico; St. Vincent and Grenadines; Trinidad and Tobago; Virgin Islands (U.S.) Mesoamerica: Costa Rica; El Salvador; Guatemala; Honduras; Nicaragua; Panama Northern South America: Guyana; Suriname; Venezuela Brazil: Brazil Western South America: Bolivia; Colombia; Ecuador; Peru Southern South America: Argentina; Chile; Paraguay; Uruguay"

202	**Quality of climate match data**	**High**

Qsn #	Question	Answer
	Source(s)	**Notes**
	USDA, ARS, National Genetic Resources Program. 2015. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/. [Accessed]	

203	Broad climate suitability (environmental versatility)	y
	Source(s)	**Notes**
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 19 Feb 2015]	[Broad elevation range and distribution in tropical climates, demonstrating environmental versatility] "Found in a very wide range of subtropical and tropical habitats (mangroves, scrub, rainforest, gallery forest, montane forest, cloud forest), from 0 to 3300 m above sea level. Often abundant in wet habitats: along ponds, streams, rivers, and in swamps." ... "Because of its very wide distribution, abundance and adaptation to a very broad range of habitats and climates, this bromeliad is not threatened and there are no specific conservation measures needed."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	**Notes**
	Billings, F. H. (1904). A study of Tillandsia usneoides. Botanical Gazette, 38(2): 99-121	"Tillandsia usneoides, popularly called "long moss," "black moss," or " Spanish moss," is the most widely distributed representative of the tropical and subtropical family Bromeliaceae. According to SCHIMPER (I) it extends from southern Virginia, its northern limit, as far southward as the Argentine Confederation."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. 2007. New plant records from O'ahu for 2006. Bishop Museum Occasional Papers 96: 8-13	"A species introduced to Hawaii around 1920, Spanish moss is cultivated in many home gardens throughout the state."
	Hosking, J. R., Conn, B. J., & Lepschi, B. J. (2003). Plant species first recognised as naturalised for New South Wales over the period 2000–2001. Cunninghamia, 8(2): 175-187	"Hanging epiphyte widely grown as an ornamental in NSW."
	Wagner, W. L. and Lorence, D. H. 2002-. Flora of the Marquesas Islands website. http://botany.si.edu/pacificislandbiodiversity/marquesasflora/index.htm. [Accessed 20 Feb 2015]	"Tillandsia usneoides (L.) L. Status: Cultivated Distribution: UP"
	Pacific Island Ecosystems at Risk (PIER), 2011. Tillandsia usneoides. http://www.hear.org/Pier/species/tillandsia_usneoides.htm. [Accessed 20 Feb 2015]	Cultivated on a number of Pacific Islands

301	Naturalized beyond native range	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Hosking, J. R., Conn, B. J., & Lepschi, B. J. (2003). Plant species first recognised as naturalised for New South Wales over the period 2000–2001. Cunninghamia, 8(2): 175-187	"NSW DISTRIBUTION / HABITATS: North Coast. Occurs in a rainforest remnant, growing on Araucaria cunninghamii and Grevillea robusta. Likely to naturalise in warmer coastal areas of NSW." ... "Naturalised in a remnant patch of rainforest, Rotary Park, in Lismore and reportedly naturalised at a number of other locations in Lismore (R. Joseph pers. comm. Nov 2000)." ... "The species is also recorded as naturalised in south-eastern Queensland (Moreton and Wide Bay pastoral districts) (Conran in George 1987, Henderson 2002) with the first naturalised specimen collected by E.C. Cunning at Maryborough in November 1965 (G. Batianoff pers. comm. Dec 2002)."
	Frohlich, D. & Lau, A. 2007. New plant records from O'ahu for 2006. Bishop Museum Occasional Papers 96: 8-13	"The following voucher was collected in a large garden, where the grounds manager says the 4 m long masses of Tillandsia usneoides volunteered in a large kamani tree. The species has also been noted dominating the mid-level branches of an 18 m tall tree in Nu'uanu. Material examined. O'AHU: Waimea Botanical Garden, naturalized, forming large draping masses on a Calophyllum inophyllum tree, mass about 4 m long of small, gray-green bromeliads, no flowers seen on collected material, 7 Dec 2006, A. Lau & D. Frohlich s.n. (BISH 725948)."

302	Garden/amenity/disturbance weed	n
	Source(s)	**Notes**
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

303	Agricultural/forestry/horticultural weed	
	Source(s)	**Notes**
	Floridata. 2012. Tillandsia usneoides. http://www.floridata.com/ref/t/till_usn.cfm. [Accessed 19 Feb 2015]	[Native to Florida, but a possible pest of pecan orchards] "Spanish moss is not a parasite. That is, it does not take nutrients or water from the host tree on which it lives. However, occasionally, Spanish moss can become so thick that it shades the leaves of its host, or, when heavy with rainwater, breaks a branch. Although a tree might be weakened, it would not likely be killed by Spanish moss. However, it is considered a pest in pecan orchards."

304	Environmental weed	n
	Source(s)	**Notes**
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

305	Congeneric weed	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	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."

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Standley, P.C. 1944. Flora of Panama. Part II. Fascicle III. Annals of the Missouri Botanical Garden 31(1): 1-157+159 -172	[No evidence] "Growing pendent from trees in slen- der branching strands up to 8 m. long. Roots absent. Stem less than 1 mm. thick, sympodial, the internodes 3-6 cm. long with only the extreme base covered by the leaves, curved. Leaves distichous, 5 cm. long, densely lepidote; sheaths elliptic, 8 mm. long; blades fili- form, less than 1 mm. thick. Scape lacking. Inflorescence reduced to a single flower. Floral bract shorter than the sepals, ovate, lepidote. Sepals nar- rowly ovate, acute, to 7 mm. long, thin, nerved, glabrous, equally short-connate. Petals narrow, 9-11 mm. long, pale green or blue. Stamens deeply included, ex- ceeding the pistil. Capsule cylindric, to 25 mm. long."

402	Allelopathic	
	Source(s)	**Notes**
	USDA NRCS. 2006. Plant Guide - Spanish Moss - Tillandsia usneoides. http://plants.usda.gov/plantguide/pdf/cs_tius.pdf. [Accessed 19 Feb 2015]	[Probably not allelopathic] "It is said to be excellent mulch for the garden."
	WRA Specialist. 2015. Personal Communication	Unknown

403	Parasitic	n
	Source(s)	**Notes**
	Billings, F. H. (1904). A study of Tillandsia usneoides. Botanical Gazette, 38(2): 99-121	[No evidence] "Although the beauty of the landscape is enhanced by its presence, its growth upon ornamental trees is regarded often with apprehension, a common impression being that it lives parasitically. A most casual examination, however, will reveal the fact that the moss is in no way connected with the tree, but merely wraps its dead, wiry stems loosely around the twigs in order to support itself." ... "A proof of the true epiphytism of the plant is its longcontinued and vigorous growth upon decorticated limbs of dead trees."

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 19 Feb 2015]	"Native American tribes used T. usneoides for livestock feed, as a binding agent in clay bricks and plaster, and for kindling."
	Smith, J.G. 1896. Fodder and Forage Plants: Exclusive of the Grasses. Government Printing Office, Washington, D.C.	[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**
	USDA NRCS. 2006. Plant Guide - Spanish Moss - Tillandsia usneoides. http://plants.usda.gov/plantguide/pdf/cs_tius.pdf. [Accessed 19 Feb 2015]	[No evidence] "Livestock: The plant is used as fodder for animals."
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence
	Cornell University. 2014. Plants Poisonous to Livestock and other Animals. http://www.ansci.cornell.edu/plants/index.html. [Accessed 19 Feb 2015]	No evidence

406	Host for recognized pests and pathogens	n
	Source(s)	**Notes**
	Missouri Botanical Garden. 2015. Tillandsia usneoides. http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=f427. [Accessed 20 Feb 2015]	"No serious insect or disease problems."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 19 Feb 2015]	"Known hazards: None recorded"
	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	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Wiley, S.S. 2015. Is Spanish Moss Flammable? http://homeguides.sfgate.com/spanish-moss-flammable-86996.html. [Accessed 20 Feb 2015]	"Spanish moss is considered highly flammable, to the point that institutions like Johns Hopkins School of Medicine in Maryland ban Spanish moss from their grounds. Newman University, in Kansas, bans Spanish moss from its residential housing, including it with items such as hay and straw as “highly flammable decorative materials.”"
	USDA NRCS. 2006. Plant Guide - Spanish Moss - Tillandsia usneoides. http://plants.usda.gov/plantguide/pdf/cs_tius.pdf. [Accessed 20 Feb 2015]	[May increase fire risk when growing in abundance on trees] "Dry Spanish moss was used for fire arrows. The moss was wrapped around the base of the shaft, lit on fire and then shot from the bow."

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	**Notes**
	Clay, H.F. & Hubbard, J.C. 1987. The Hawaii Garden: Tropical Exotics. University of Hawaii Press, Honolulu, HI	"Best growth is obtained in partly shaded areas protected from winds."
	Floridata. 2012. Tillandsia usneoides. http://www.floridata.com/ref/t/till_usn.cfm. [Accessed 19 Feb 2015]	"Light: Full sunlight to partial shade"
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Spanish-moss grows in full sun but seems to do better in partial shade with a humid environment."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	
	Source(s)	**Notes**
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 20 Feb 2015]	[Epiphytic] "The plants are suspended from hanging structures with no soil required at all."

411	Climbing or smothering growth habit	y
	Source(s)	**Notes**
	USDA NRCS. 2006. Plant Guide - Spanish Moss - Tillandsia usneoides. http://plants.usda.gov/plantguide/pdf/cs_tius.pdf. [Accessed 19 Feb 2015]	"Although Spanish moss does not take nutrients from the host tree, it should be thinned if it becomes too thick. This is because it may either shade the tree’s leaves or, when it is wet it can become very heavy and the branches may break under its weight."
	Standley, P.C. 1944. Flora of Panama. Part II. Fascicle III. Annals of the Missouri Botanical Garden 31(1): 1-157+159 -172	"Growing pendent from trees in slen- der branching strands up to 8 m. long. Roots absent."

412	Forms dense thickets	n
	Source(s)	**Notes**
	Smith, L.B. and Downs, R.J. 1977. Tillandsioideae (Bromeliaceae). Flora Neotropica 14(2): 663-1401+1403-1411+1413-1473+1475 1492	[Epiphytic] "Plant growing pendent from trees in branching strands up to 8 m long"

Qsn #	Question	Answer
501	**Aquatic**	**n**
	Source(s)	**Notes**
	Smith, L.B. and Downs, R.J. 1977. Tillandsioideae (Bromeliaceae). Flora Neotropica 14(2): 663-1401+1403-1411+1413-1473+1475 1492	[Epiphytic] "Plant growing pendent from trees in branching strands up to 8 m..."

502	Grass	n
	Source(s)	**Notes**
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	Bromeliaceae

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	Bromeliaceae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	"Tillandsia usneoides is distinctive by its pendent stems without roots."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 19 Feb 2015]	"Because of its very wide distribution, abundance and adaptation to a very broad range of habitats and climates, this bromeliad is not threatened and there are no specific conservation measures needed."

602	Produces viable seed	y
	Source(s)	**Notes**
	Floridata. 2012. Tillandsia usneoides. http://www.floridata.com/ref/t/till_usn.cfm. [Accessed 19 Feb 2015]	"Propagation: Spanish moss produces tiny seeds that sail on the wind and stick fast to tree branches. Birds and the wind carry fragments of the plant to new locations, probably the commonest means of propagation."

Qsn #	Question	Answer
	Garth, R.E. 1964. The ecology of the Spanish moss (Tillandsia usneoides), its growth and distribution. Ecology 45: 470-481	"The three-locular, septicidal capsule becomes evident near the end of June but does not open until the following December or January (Fig. 7). In January 1954 100 capsules, chosen at random, were examined. Eighty per cent of the capsules contained between 11 and 20 seeds each, with a mean of 13. The range of seeds per capsule was from 2 to 23, and the median was 16.5."

603	Hybridizes naturally	
	Source(s)	**Notes**
	Gonçalves, C. N., & de Azevêdo-Gonçalves, C. F. (2009). A new hybrid bromeliad from southernmost Brazil, Tillandsia× baptistana. Novon 19(3): 353-356	[Hybridization documented in genus Tillandsia, although this study discounts T. usneoides as a parent of the described hybrid] "A new putative natural hybrid bromeliad from southernmost Brazil, Tillandsia Xbaptistana Gongalves & Azevedo-Gongalves (Bromeliaceae), is here described. Its habit is very similar to T. mallemontii Glaziou ex Mez, but the floral characteristics are intermediate between the probable parental taxa (T. recurvata (L.) L. and T. mallemontii). A key to identify this hybrid and its parents on the basis of the floral characters is also presented." ... "The species belongingt o subgenusA noplophytuma,s well as Tillandsia usneoides and T. tricholepis, are morphologicallqyu ited ifferentf romT . Xbaptistanaa nd may be promptly excluded as its parents"
	Smith, L.B. and Downs, R.J. 1977. Tillandsioideae (Bromeliaceae). Flora Neotropica 14(2): 663-1401+1403-1411+1413-1473+1475 1492	[No T. usneoides hybrids documented] "In Tillandsia interspecific hybrids are rare except in the advanced subgenus Diaphoranthema. Most of these hybrids are natural and thus without vouchers except as the supposed parents are found in the vicinity."

604	Self-compatible or apomictic	n
	Source(s)	**Notes**
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 19 Feb 2015]	"Any self-pollinated flowers fail to produce seeds."
	Ramírez Morillo, I. M., Chi May, F., Carnevali, G., & May Pat, F. (2009). It takes two to tango: self incompatibility in the bromeliad Tillandsia streptophylla (Bromeliaceae) in Mexico. Revista de Biología Tropical, 57(3), 761-770	[Suggests self-incompatibility in T. usneoides] "Furthermore, the presence of self incompatibility is for the first time reported for the genus. Nevertheless, Garth (1964) reported that in bagged flowers of Tilllandsia usneoides (L.) L. there were no developing pollen tubes on four out of eight flowers examined with self pollen, but fruit developing was very poor."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Standley, P.C. 1944. Flora of Panama. Part II. Fascicle III. Annals of the Missouri Botanical Garden 31(1): 1-157+159-172	"Inflorescence reduced to a single flower. Floral bract shorter than the sepals, ovate, lepidote. Sepals narrowly ovate, acute, to 7 mm. long, thin, nerved, glabrous, equally short-connate. Petals narrow, 9-11 mm. long, pale green or blue. Stamens deeply included, exceeding the pistil. Capsule cylindric, to 25 mm. long."

Qsn #	Question	Answer
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 19 Feb 2015]	"The flowers last about four days and have a pleasant, subtle fragrance, which attracts a variety of insect pollinators."
	Billings, F. H. (1904). A study of Tillandsia usneoides. Botanical Gazette, 38(2): 99-121	"The flowers, which are produced in considerable quantity in May and June, present little of special interest. Each flower has a calyx of three sepals, and a corolla of three green petals. Having a fragrant odor, it is possible that it is visited by insects, though no information has been collected by me on the subject. Thrips, however, inhabit many of the flowers and puncture the style in order to deposit an egg at its base. It is possible, therefore, that they may serve in cross pollination."

606	Reproduction by vegetative fragmentation	y
	Source(s)	**Notes**
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"The plant is propagated simply by breaking off a piece of the stem and attaching it to a support."
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 19 Feb 2015]	"Vegetative reproduction and spread is much more common than propagation by seeds. Small broken plant fragments are scattered by wind, birds and animals and can also float."

607	Minimum generative time (years)	
	Source(s)	**Notes**
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Unknown. May be able to reproduce vegetatively before reaching sexual maturity] "It rarely flowers and seems to be distributed when fragments of the plant are blown by the wind or carried by birds."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	**Notes**
	Floridata. 2012. Tillandsia usneoides. http://www.floridata.com/ref/t/till_usn.cfm. [Accessed 20 Feb 2015]	[No evidence] "Spanish moss produces tiny seeds that sail on the wind and stick fast to tree branches. Birds and the wind carry fragments of the plant to new locations, probably the commonest means of propagation."

702	Propagules dispersed intentionally by people	y
	Source(s)	**Notes**
	Frohlich, D. & Lau, A. 2007. New plant records from O'ahu for 2006. Bishop Museum Occasional Papers 96: 8-13	"A species introduced to Hawai'i around 1920, Spanish moss is cultivated in many home gardens throughout the state."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"It is one of the most ubiquitous bromeliads found in gardens, where it is draped from wires or hanging baskets, attached to tree branches, or grown as shade material over orchid benches."

703	Propagules likely to disperse as a produce contaminant	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Floridata. 2012. Tillandsia usneoides. http://www.floridata.com/ref/t/till_usn.cfm. [Accessed 19 Feb 2015]	"Spanish moss produces tiny seeds that sail on the wind and stick fast to tree branches. Birds and the wind carry fragments of the plant to new locations, probably the commonest means of propagation. " ... "Spanish moss makes a great mulch if you're lucky enough to garden within its range. It is often used in decorative floral arrangements and handicrafts." [Used as packing material, and often attached to other plants]
	USDA NRCS. 2006. Plant Guide - Spanish Moss - Tillandsia usneoides. http://plants.usda.gov/plantguide/pdf/cs_tius.pdf. [Accessed 19 Feb 2015]	[Use in flower arrangements & as packing material could contribute to its inadvertent spread] "Spanish moss is used in flower arrangements and as decorations for handicrafts. It is said to be excellent mulch for the garden. Spanish moss is grown commercially for use as packing material and as a replacement for horsehair in upholstery and mattress stuffing. Campers, because of red bugs and chiggers do not recommend the plants for use as bedding. If you wish to use fresh Spanish moss you may get rid of these pests by boiling small portions of the plant in water or heating them in the microwave."

704	Propagules adapted to wind dispersal	y
	Source(s)	**Notes**
	Garth, R.E. 1964. The ecology of the Spanish moss (Tillandsia usneoides), its growth and distribution. Ecology 45: 470-481	"Seedlings, as well as seeds, may be carried by the wind to new locations by means of a mass of hairs which function like a parachute. These hairs are covered with tiny barbs which aid the seeds and seedlings in attaching to each other, to mature plants, festoons, bark, etc."

705	Propagules water dispersed	y
	Source(s)	**Notes**
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 19 Feb 2015]	"Vegetative reproduction and spread is much more common than propagation by seeds. Small broken plant fragments are scattered by wind, birds and animals and can also float. "

Qsn #	Question	Answer
706	**Propagules bird dispersed**	**y**
	Source(s)	**Notes**
	Kubitzki, K. (ed.). 1998. The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae). Springer-Verlag, Berlin, Heidelberg, New York	"Dispersal in the vegetative state is common in Tillandsia usneoides, as it is used by birds for nest construction."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"It rarely flowers and seems to be distributed when fragments of the plant are blown by the wind or carried by birds." ... "Birds may pull out strands for nest building, which can defoliate a large clump rather quickly."
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 19 Feb 2015]	"Vegetative reproduction and spread is much more common than propagation by seeds. Small broken plant fragments are scattered by wind, birds and animals and can also float."

707	**Propagules dispersed by other animals (externally)**	**y**
	Source(s)	**Notes**
	Floridata. 2012. Tillandsia usneoides. http://www.floridata.com/ref/t/till_usn.cfm. [Accessed 20 Feb 2015]	"Spanish moss produces tiny seeds that sail on the wind and stick fast to tree branches. Birds and the wind carry fragments of the plant to new locations, probably the commonest means of propagation."

708	**Propagules survive passage through the gut**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	Unknown

801	**Prolific seed production (>1000/m2)**	**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 reproductive specimens of this species were located from Puerto Rico or the Virgin Islands."
	Lemke, C. 1999. Cal's Plant of the Week - Tillandsia usneoides - Spanish Moss. http://www.plantoftheweek.org/week056.shtml. [Accessed 20 Feb 2015]	"Spanish moss rarely blooms in cultivation."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Presumably no in the Hawaiian Islands] "It rarely flowers and seems to be distributed when fragments of the plant are blown by the wind or carried by birds."

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Baskin, C.C. & Baskin, J.M. 2014. Seeds Ecology, Biogeography, and Evolution of Dormancy and Germination. Second Edition. Academic Press, San Francisco, CA	"Not much is known about the germination ecophysiology of epiphyte seeds (Benzing, 1990). Madison (1977) says that most epiphytes have ND seeds and that vivipary is found in fleshy fruited species..." ... "At maturity in autumn, seeds of Tillandsia usneoides (Bromeliaceae) germinated readily at room temperatures, but they did not germinate on tree branches in southern Georgia (USA) until late May and early June (Guard and Henry, 1968)."
	Ansari, S. 2003. WRA Specialist. Personal Communication	"Probably not - an epiphyte." [Answer included in 2003 assessment]
	Royal Botanic Gardens Kew. 2008. Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/. [Accessed 20 Feb 2015]	"Storage Behaviour: No data available for species. Of 1 known taxa of genus Tillandsia, 100.00% Orthodox(p/?)"

803	Well controlled by herbicides	y
	Source(s)	**Notes**
	Arny, N.P. 1996. Spanish Moss and Ball Moss. FOR52. University of Florida IFAS Extension, Gainesville, FL http://edis.ifas.ufl.edu. [Accessed 20 Feb 2015]	"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."
	Gowans, M. 2015. How to Safely Control Tillandsia usneoides. http://homeguides.sfgate.com/safely-control-tillandsia-usneoides-76975.html. [Accessed 20 Feb 2015]	"Chemical Control" ... "Pour 1 gallon of water in a clean bucket. Add 6 tablespoons of concentrate liquid copper sulfate; mix thoroughly with a wooden stir stick." ... "Transfer the diluted copper sulfate to a clean garden pump sprayer. Spray the Spanish moss to the point of runoff with the copper sulfate during the tree's dormant season."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	**Notes**
	Kew Royal Botanic Gardens. 2015. Tillandsia usneoides (Spanish moss). http://www.kew.org/science-conservation/plants-fungi/tillandsia-usneoides-spanish-moss. [Accessed 20 Feb 2015]	"Small broken plant fragments are scattered by wind, birds and animals and can also float."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits
• Broad natural distribution, & elevation range exceeds 1000 m, demonstrating environmental versatility
• Thrives in tropical climates
• Naturalized on Oahu, Hawaiian Islands & in Australia
• Described as a pest in pecan orchards
• Other Tillandsia species have become invasive
• Flammable & could increase fire risk when densely covering trees
• Produces seeds (rarely in cultivation)
• Spreads vegetatively by fragments dispersed by wind, birds, water & people
• Seeds dispersed by wind
• Able to regrow after breaking or damage

Low Risk Traits
• Generally regarded as a desirable native or ornamental where grown
• Unarmed (no spines, thorns or burrs)
• Provides fodder for livestock
• Non-toxic
• Limited seed production in cultivation
• Herbicides may provide effective control