

Taxon: <i>Werauhia sanguinolenta</i> (Linden ex Cogn. & Marchal) J.R.Grant	Family: Bromeliaceae
Common Name(s): green bat bromeliad sanguinolenta vriesea	Synonym(s): <i>Tillandsia ingens</i> Mez <i>Tillandsia sanguinolenta</i> Baker <i>Vriesea sanguinolenta</i> Cogn. & Marchal <i>Vriesea urbaniana</i> Harms

Assessor: Chuck Chimera	Status: Approved	End Date: 7 Dec 2023
WRA Score: 7.0	Designation: H(HPWRA)	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	?
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	n
303	Agricultural/forestry/horticultural weed	y = 2*multiplier (see Appendix 2), n = 0	n
304	Environmental weed		
305	Congeneric weed	y = 1*multiplier (see Appendix 2), n = 0	n
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		

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y = 1, n = 0	y
411	Climbing or smothering growth habit	y = 1, n = 0	n
412	Forms dense thickets		
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	y
605	Requires specialist pollinators		
606	Reproduction by vegetative fragmentation	y = 1, n = -1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	>3
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		
706	Propagules bird dispersed		
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut	y = 1, n = -1	n
801	Prolific seed production (>1000/m ²)		
802	Evidence that a persistent propagule bank is formed (>1 yr)	y = 1, n = -1	y
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 of domestication] "DISTRIBUTION. Epiphytic in forest, from near sea level to 1200 m alt, Costa Rica to Ecuador, Greater Antilles"

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 in forest, from near sea level to 1200 m alt, Costa Rica to Ecuador, Greater Antilles"

202	Quality of climate match data	High
	Source(s)	Notes
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). Flora Neotropica, 14(2), 663-1492	"Distribution. Epiphytic in forest, from near sea level to 1200 m alt, Costa Rica to Ecuador, Greater Antilles"

203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	LLIFLE. (2023). <i>Werauhia sanguinolenta</i> . http://www.llifle.com/Encyclopedia/BROMELIADS/Family/Bromeliaceae/28816/Werauhia_sanguinolenta . [Accessed 4 Dec 2023]	"Temperature: They prefer warm temperature which it is good to keep over the 12°C, best 20-24°C or above year-round, but can withstand short periods of colder temps. USDA Hardiness Zone 10a, 10b, 11"
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). Flora Neotropica, 14(2), 663-1492	[Elevation range in tropics >1000 m] "Distribution. Epiphytic in forest, from near sea level to 1200 m alt, Costa Rica to Ecuador, Greater Antilles"

Qsn #	Question	Answer
204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). <i>Flora Neotropica</i> , 14(2), 663-1492	"Distribution. Epiphytic in forest, from near sea level to 1200 m alt, Costa Rica to Ecuador, Greater Antilles"
	Gallaher, T.J., Brock, K., Kennedy, B.H., Imada, C.T., Imada, K., & Walvoord, N. (2023). <i>Plants of Hawai'i</i> . http://www.plantsofhawaii.org.. [Accessed 4 Dec 2023]	"Island Status O'ahu Naturalized"

205	Does the species have a history of repeated introductions outside its natural range?	?
	Source(s)	Notes
	LLIFLE. (2023). <i>Werauhia sanguinolenta</i> . http://www.llifle.com/Encyclopedia/BROMELIADS/Family/Bromeliaceae/28816/Werauhia_sanguinolenta . [Accessed 4 Dec 2023]	"Uses: In tropical areas it is favored as a landscape plant but it is also popular for interiorscapes. The dramatic leaf colours make this plant a strong focal point even when it is not in bloom. Because of its width, it is a good plant to display on a raised platform, with ferns or other low-light plants beneath it." [Cultivated as an ornamental, but unclear how widespread it has been introduced outside its native range]
	Lau, A. and Frohlich, D. (2012). New plant records from O'ahu for 2009. <i>Bishop Museum Occasional Papers</i> 113: 7-26	[Oahu] "Material examined. O'AHU: Ka'alaea Valley, left side. Mesic streamside. Primary vegetation: Citharexylum caudatum and Hibiscus tiliaceus. epiphytic bromeliad growing on Citharexylum caudatum about 5 ft from ground level. Rosette about 1.5 m across and tall. Blades burgundy red, becoming greenish at ligulate base. Apex apiculate, the tip curling to form a "spine." Single individual in this area, among a dense Citharexylum caudatum thicket, several hundred m from nearest house. This species was also seen reproducing/spreading (2-5 matures, 6-10 immatures) in a yard at the end of Kamakoi Road, where it may have been originally planted, 17 Jul 2009, OED s.n. (BiSH 741558)."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Lau, A. and Frohlich, D. (2012). New plant records from O'ahu for 2009. <i>Bishop Museum Occasional Papers</i> 113: 7-26	[Oahu] "Werauhia sanguinolenta (a name which is sometimes considered to be a synonym of <i>Vriesea sanguinolenta</i> Cogn. & Marchal) grows from around sea level to 1200 m in its native range, which extends from Costa Rica to Ecuador and the Greater Antilles. one individual of this epiphytic species, which has never been collected (either naturalized or cultivated) in the state, was found growing in a <i>Citharexylum caudatum</i> thicket several hundred meters from the nearest home site. in addition, several individuals (2-5 matures, and 6-10 immature) were found apparently reproducing and spreading in a yard down the road from the naturalization site." ... "Material examined. O'AHU: Ka'alaea Valley, left side. Mesic streamside. Primary vegetation: <i>Citharexylum caudatum</i> and <i>Hibiscus tiliaceus</i> . epiphytic bromeliad growing on <i>Citharexylum caudatum</i> about 5 ft from ground level. Rosette about 1.5 m across and tall. Blades burgundy red, becoming greenish at ligulate base. Apex apiculate, the tip curling to form a "spine." Single individual in this area, among a dense <i>Citharexylum caudatum</i> thicket, several hundred m from nearest house. This species was also seen reproducing/spreading (2-5 matures, 6-10 immatures) in a yard at the end of Kamakoi Road, where it may have been originally planted, 17 Jul 2009, OED s.n. (BiSH 741558)."

302	Garden/amenity/disturbance weed	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Lau, A. and Frohlich, D. (2012). New plant records from O'ahu for 2009. Bishop Museum Occasional Papers 113: 7-26	[No evidence or description of impacts] "Material examined. O'AHU: Ka'ala'ea Valley, left side. Mesic streamside. Primary vegetation: Citharexylum caudatum and Hibiscus tiliaceus. epiphytic bromeliad growing on Citharexylum caudatum about 5 ft from ground level. Rosette about 1.5 m across and tall. Blades burgundy red, becoming greenish at ligulate base. Apex apiculate, the tip curling to form a "spine." Single individual in this area, among a dense Citharexylum caudatum thicket, several hundred m from nearest house. This species was also seen reproducing/spreading (2-5 matures, 6-10 immatures) in a yard at the end of Kamakoi Road, where it may have been originally planted, 17 Jul 2009, OED s.n. (BiSH 741558)."

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
	CABI. (2023). CABI Compendium Invasive Species. https://www.cabidigitallibrary.org/product/qi . [Accessed 4 Dec 2023]	No evidence to date.

304	Environmental weed	
	Source(s)	Notes
	Lau, A. and Frohlich, D. (2012). New plant records from O'ahu for 2009. Bishop Museum Occasional Papers 113: 7-26	[No negative impacts reported at time of publication] "Material examined. O'AHU: Ka'ala'ea Valley, left side. Mesic streamside. Primary vegetation: Citharexylum caudatum and Hibiscus tiliaceus. epiphytic bromeliad growing on Citharexylum caudatum about 5 ft from ground level. Rosette about 1.5 m across and tall. Blades burgundy red, becoming greenish at ligulate base. Apex apiculate, the tip curling to form a "spine." Single individual in this area, among a dense Citharexylum caudatum thicket, several hundred m from nearest house. This species was also seen reproducing/spreading (2-5 matures, 6-10 immatures) in a yard at the end of Kamakoi Road, where it may have been originally planted, 17 Jul 2009, OED s.n. (BiSH 741558)."
	WRA Specialist. (2023). Personal Communication	Currently reported from non-native forest. As an epiphyte, it could establish in native forests and potentially compete with native epiphytes, or otherwise impact native plant communities.

305	Congeneric weed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence
	CABI. (2023). CABI Compendium Invasive Species. https://www.cabidigitallibrary.org/product/qi . [Accessed 4 Dec 2023]	No evidence

401	Produces spines, thorns or burrs	n
	Source(s)	Notes

Qsn #	Question	Answer
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). <i>Flora Neotropica</i> , 14(2), 663-1492	"Plant flowering 1-2 m high. Leaves about 10 in a dense rosette, suberect, 6-7 dm long, green, usually with large irregular spots of deep red especially near the base, obscurely punctulate-lepidote; sheaths ovate-elliptic, the same color as the blades but slightly broader; blades ligulate, acute or subrounded with a long apiculus, 8-10 cm wide. Scape erect, greatly exceeding the leaves, well over 1 cm in diameter at the summit, glabrous; scape-bracts erect, imbricate, very broadly ovate, acute or the lower ones triangular-laminate, glabrous, even, thick, coriaceous. Inflorescence simple or few-branched, to 4 dm long; primary bracts suberect, like the upper scape-bracts, covering only the sterile bases of the branches; branches suberect, secundly 11-15-flowered, the lateral ones 25 cm long with 1 or 2 sterile bracts at the base, the terminal one nearly 4 dm long with a sterile base as long as the fertile part and appearing like a continuation of the scape; rhachis to 10 mm in diameter, flexuous, strongly 4-angled, glabrous, dark, its internodes narrowly obconical. Floral bracts becoming secund with the flowers, broadly elliptic to suborbicular, abruptly acute, to 5 cm long, some and usually all more than twice as long as the internodes, glabrous, even, rigid, coriaceous, green, drying to light brown, incurved and carinate toward apex; flowers spreading and downwardly secund; pedicels very stout, to 12 mm long. Sepals very broadly elliptic or ovate, obtuse or broadly acute, 30-45 mm long, rigid, coriaceous, even and glabrous outside, striate and punctulate-lepidote within; petals white, slightly exceeding the stamens, bearing 2 scales at base."

402	Allelopathic	
	Source(s)	Notes
	WRA Specialist. (2023). Personal Communication	Unknown. No evidence found.

403	Parasitic	n
	Source(s)	Notes
	Croat, T.B. (1978). <i>Flora of Barro Colorado Island</i> . Stanford University Press, Stanford, CA	"Epiphyte, variable in size, to ca 1 m tall." [Bromeliaceae]

404	Unpalatable to grazing animals	
	Source(s)	Notes
	Winkler, M., Hülber, K., Mehlreter, K., Franco, J. G., & Hietz, P. (2005). Herbivory in epiphytic bromeliads, orchids and ferns in a Mexican montane forest. <i>Journal of Tropical Ecology</i> , 21(2), 147-154	"Although herbivory in ground-rooted <i>ora</i> is well documented, current knowledge of the herbivore pressure on vascular epiphytes remains mostly anecdotal. Here, we present the results of a 3-year study on the herbivory in a population of the epiphytic bromeliad <i>Vriesea sanguinolenta</i> . In different years, 26± 61% of all epiphytes showed traces of herbivore attack, while up to 4.4% of the entire leaf area of the epiphyte population was consumed annually. The recorded levels of damage to photosynthetic tissue, mostly caused by the larvae of <i>Napaea eucharilla</i> (Riodinidae, Lepidoptera), indicate that vascular epiphytes may be regularly and sometimes even lethally attacked by insect herbivores. The level of damage is comparable to ground-rooted tropical <i>ora</i> , which certainly does not support the prevalent notion of low and negligible levels of herbivory in vascular epiphytes."
	WRA Specialist. (2023). Personal Communication	Palatability to browsing mammals unknown, but as an epiphyte, would likely be out of reach of most terrestrial herbivorous mammals present in Hawaii and other Pacific islands.

405	Toxic to animals	n
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Qsn #	Question	Answer
	Source(s)	Notes
	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 in genus

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	LLIFLE. (2023). <i>Werauhia sanguinolenta</i> . http://www.llifle.com/Encyclopedia/BROMELIADS/Family/Bromeliaceae/28816/Werauhia_sanguinolenta . [Accessed 5 Dec 2023]	"Pests & diseases: Leaf spots (as a result of drying out), bacterial soft rot, scales and mealybugs but usually pesticides are not required. Rot may develop if soil is kept too moist."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Sprout Home. (2023). <i>Werauhia sanguinolenta</i> . https://sprouhome.com/products/werauhia-sanguinolenta-6 . [Accessed 5 Dec 2023]	"Toxicity: Reported to be non-toxic but not considered edible."
	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 in genus
	Wagstaff, D.J. (2008). International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence in genus

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Zotz, G., Laube, S., & Schmidt, G. (2005). Long-term population dynamics of the epiphytic bromeliad, <i>Werauhia sanguinolenta</i> . <i>Ecography</i> , 28(6), 806-814	[No evidence. An epiphyte of wet forests] " <i>Werauhia sanguinolenta</i> (syn. <i>Vriesea sanguinolenta</i> ; see Grant 1995) is found from Costa Rica to Colombia and on various Caribbean islands in lowland to lower montane wet forests (Croat 1978)."

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	Notes
	Araflora. (2023). Bromeliad <i>Vriesea sanguinolenta</i> . https://www.araflora.com/p2331/bromeliad_vriesea_sanguinolenta . [Accessed 5 Dec 2023]	"Light: Semi sun"
	Croat, T.B. (1978). Flora of Barro Colorado Island. Stanford University Press, Stanford, CA	[An epiphyte of trees along water bodies, and in upper tree branches, suggesting preference for higher light levels] "Uncommon, but locally abundant in some areas along the shore, usually in trees fairly low over the water; probably also occurring in upper branches of canopy trees."
	LLIFLE. (2023). <i>Werauhia sanguinolenta</i> . http://www.llifle.com/Encyclopedia/BROMELIADS/Family/Bromeliaceae/28816/Werauhia_sanguinolenta . [Accessed 5 Dec 2023]	[Partial shade] "Light: Bright indirect light to half shade, with some direct sun in the winter. The foliage forms will develop better colour with slightly brighter light. Too much shade will cause leaves to look thin and leggy."

Qsn #	Question	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	LLIFLE. (2023). <i>Werauhia sanguinolenta</i> . http://www.llifle.com/Encyclopedia/BROMELIADS/Family/Bromeliaceae/28816/Werauhia_sanguinolenta . [Accessed 5 Dec 2023]	"Soil: This plant is epiphytic and can be grown attached to slabs or bark, but can be potted in a perfectly drained bromeliad mix or orchid potting soil. Minimum pH: 6.1 Maximum pH: 7.5 "
	Schmidt, G., & Zotz, G. (2000). Herbivory in the epiphyte, <i>Vriesea sanguinolenta</i> Cogn. & Marchal (Bromeliaceae). <i>Journal of Tropical Ecology</i> , 16(6), 829-839	[As an epiphyte, the host tree is the substrate on which this species establishes] " <i>Vriesea sanguinolenta</i> colonizes many different host trees, but is particularly abundant on <i>A. glabra</i> (Zotz et al. 1999)."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Croat, T.B. (1978). <i>Flora of Barro Colorado Island</i> . Stanford University Press, Stanford, CA	[<i>Vriesea sanguinolenta</i>] "Epiphyte, to ca 1 m tall." ... "Uncommon, but locally abundant in some areas along the shore, usually in trees fairly low over the water; probably also occurring in upper branches of canopy trees." [Epiphytic, but no evidence that this plant smothers supporting trees]

412	Forms dense thickets	
	Source(s)	Notes
	Zotz, G., Laube, S., & Schmidt, G. (2005). Long-term population dynamics of the epiphytic bromeliad, <i>Werauhia sanguinolenta</i> . <i>Ecography</i> , 28(6), 806-814	[Possibly. High densities may lead to intraspecific competition and could presumably lead to interspecific competition with native epiphytes] "The density of <i>Werauhia sanguinolenta</i> on the studied branch sections (plots) varied from 4 to 1442 plants m ⁻² bark surface for small atmospheric (A1), from 0 to 505 plants m ⁻² bark surface for large atmospheric (A2), while maximum densities of large plants (T5) reached up to 17 plants m ⁻² bark surface." ... "Plant densities may be high enough for intraspecific competition or facilitation to play a role in demographic processes. We show, e.g. that dense clusters of juveniles can have a positive impact on plant performance. Plants in the centre of such a cluster are probably slightly buffered against rapid water loss by their neighbours, allowing longer periods of photosynthetic activity, which in turn explains increased growth rates. But increased growth in the centre of dense clusters is bound to lead to asymmetric competition later, unless mortality related to other factors decreases plant densities. Clearly, the importance of positive and negative intraspecific interactions relative to other factors merits a more rigorous, experimental analysis."

501	Aquatic	n
	Source(s)	Notes
	Croat, T.B. (1978). <i>Flora of Barro Colorado Island</i> . Stanford University Press, Stanford, CA	[Epiphytic] "Uncommon, but locally abundant in some areas along the shore, usually in trees fairly low over the water; probably also occurring in upper branches of canopy trees."

502	Grass	n
	Source(s)	Notes
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). <i>Flora Neotropica</i> , 14(2), 663-1492	Tillandsioideae (Bromeliaceae)

Qsn #	Question	Answer
503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). <i>Flora Neotropica</i> , 14(2), 663-1492	Tillandsioideae (Bromeliaceae)
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Croat, T.B. (1978). <i>Flora of Barro Colorado Island</i> . Stanford University Press, Stanford, CA	"Epiphyte, to ca 1 m tall. Leaves ligulate, mostly gradually acuminate, sometimes rounded and long-apiculate, to 1 m or more long, (4.5)8-10 cm wide, obscurely punctate-lepidote."
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Croat, T.B. (1978). <i>Flora of Barro Colorado Island</i> . Stanford University Press, Stanford, CA	"Costa Rica, Panama, Colombia; Cuba and Jamaica. In Panama, common along the Atlantic slope in tropical moist and tropical wet forests, but also abundant at higher elevations in lower montane wet forest in Chiriqui."
	Zotz, G., Laube, S., & Schmidt, G. (2005). Long-term population dynamics of the epiphytic bromeliad, <i>Werauhia sanguinolenta</i> . <i>Ecography</i> , 28(6), 806-814	"Recruitment following sexual reproduction, on the other hand, yielded a large number of seedlings in all years, and the two atmospheric size classes were numerically dominating the population structure"
602	Produces viable seed	y
	Source(s)	Notes
	Zotz, G., Laube, S., & Schmidt, G. (2005). Long-term population dynamics of the epiphytic bromeliad, <i>Werauhia sanguinolenta</i> . <i>Ecography</i> , 28(6), 806-814	"Flowering occurs in the rainy season and seeds are released in the late dry season." ... "Recruitment following sexual reproduction, on the other hand, yielded a large number of seedlings in all years, and the two atmospheric size classes were numerically dominating the population structure (Fig. 1)."
	LLIFLE. (2023). <i>Werauhia sanguinolenta</i> . http://www.llifle.com/Encyclopedia/BROMELIADS/Family/Bromeliaceae/28816/Werauhia_sanguinolenta . [Accessed 5 Dec 2023]	"It may also be raised from deeds, it likes to germinate on coconut fibre. Then, as a seedling, it prefers organic compost based on coir with a bit of fine bark before being transplanted onto bark as a fully-grown plant."
603	Hybridizes naturally	
	Source(s)	Notes
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). <i>Flora Neotropica</i> , 14(2), 663-1492	[Unknown, but artificial interspecific hybrids are readily produced] "In <i>Vriesea</i> artificial hybrids are numerous because of the ease of crossing and the frequent beauty of the offspring. However, there are very few good vouchers for the parents either in specimens or illustrations. No. 207 V. x <i>morreniana</i> hortus ex E. Morren (Belg. Hort. S2: 289. 1882) is an excellent exception to this situation. The parent species in the following list are cited in alphabetical order. Unfortunately there is considerable variance in the present International Code of Nomenclature of Cultivated Plants (1969) in regard to distinctions between collective names and cultivars. No attempt has been made to clarify the problems here. The following names and their probable progenitors have appeared in the literature as given."

Qsn #	Question	Answer
604	Self-compatible or apomictic	y
	Source(s)	Notes
	Zotz, G., Laube, S., & Schmidt, G. (2005). Long-term population dynamics of the epiphytic bromeliad, <i>Werauhia sanguinolenta</i> . <i>Ecography</i> , 28(6), 806-814	"Flowering occurs in the rainy season and seeds are released in the late dry season. Observations in the greenhouse in Wiirzburg, Germany, suggested that the species is at least facultatively autogamous (Zotz and Schmidt unpubl.)."
	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	"Vriesea and <i>Werauhia</i> species are capable of inbreeding and numerous <i>Guzmania</i> species are self-pollinated."

605	Requires specialist pollinators	
	Source(s)	Notes
	LLIFLE. (2023). <i>Werauhia sanguinolenta</i> . http://www.llifle.com/Encyclopedia/BROMELIADS/Family/Bromeliaceae/28816/Werauhia_sanguinolenta . [Accessed 6 Dec 2023]	"Ecology: Flowering occurs in the rainy season and are pollinated mainly by glossophagine bats, fruits mature during the following dry season, and seeds are released in the second half of the dry season. "
	Zotz, G., Laube, S., & Schmidt, G. (2005). Long-term population dynamics of the epiphytic bromeliad, <i>Werauhia sanguinolenta</i> . <i>Ecography</i> , 28(6), 806-814	"Observations in the greenhouse in Wiirzburg, Germany, suggested that the species is at least facultatively autogamous (Zotz and Schmidt unpubl.)."
	Brändel, S. D., Hiller, T., Halczok, T. K., Kerth, G., Page, R. A., & Tschapka, M. (2020). Consequences of fragmentation for Neotropical bats: The importance of the matrix. <i>Biological Conservation</i> , 252, 108792	Islands of Gatún Lake harboured locally high numbers of bat-pollinated bromeliads (e.g., <i>Werauhia sanguinolenta</i>), which off"ectar resources during the late rainy season (Zotz et al., 2005)."
	WRA Specialist. (2023). Personal Communication	May be adapted for specialized pollination by bats, but autogamous reproduction may allow for seed set in the absence of preferred pollinators.

606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Zotz, G., Laube, S., & Schmidt, G. (2005). Long-term population dynamics of the epiphytic bromeliad, <i>Werauhia sanguinolenta</i> . <i>Ecography</i> , 28(6), 806-814	"Different from many other bromeliads (Benzing 2000), vegetative reproduction plays no important role in the life cycle of <i>Werauhia sanguinolenta</i> : the production of offshoots was rare and only observed in a few smaller tank individuals and is thus not considered further in this paper."
	LLIFLE. (2023). <i>Werauhia sanguinolenta</i> . http://www.llifle.com/Encyclopedia/BROMELIADS/Family/Bromeliaceae/28816/Werauhia_sanguinolenta . [Accessed 4 Dec 2023]	"Propagation: Like all bromeliads, it are propagated by separating offsets from the mother plant. However <i>Vriesea sanguinolenta</i> send its pups from the base of the flower stalk near the center of the plant, as opposed to the more common side shoot. This makes collecting the offset harder, so let it stay on, replanting the offset only when it is at least 20 cm tall and the old rosette falls apart and discarding the parent plant. Usually this species produces only one new rosette of leaves."
	WRA Specialist. (2023). Personal Communication	Rare, but possible

607	Minimum generative time (years)	>3
	Source(s)	Notes

Qsn #	Question	Answer
	Zotz, G., Laube, S., & Schmidt, G. (2005). Long-term population dynamics of the epiphytic bromeliad, <i>Werauhia sanguinolenta</i> . <i>Ecography</i> , 28(6), 806-814	[Potentially 5+ years] "Seven stage classes were defined on the basis of developmental states (atmospherics vs. tank form, nonreproductive vs. reproductive) and plant size: atmospheric <2 cm LL (in part first year seedlings), larger atmospheric, tanks with a LL of <5, 5-10, 10-20, 20- 40, and >40 cm (the latter group including all potentially reproductive individuals, Schmidt and Zotz 2002). Individual plots did frequently not contain all of these size classes. Therefore, the combined demographic data of all plots were used to construct stage transition matrices. Average fecundity (transition T5-A1) was estimated by dividing the number of new seedlings in year t by the number of all potentially reproductive adults (T5) in year t -1."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Croat, T.B. (1978). <i>Flora of Barro Colorado Island</i> . Stanford University Press, Stanford, CA	[Comose seeds an adaptation for wind dispersal] "seeds 2-2.5 cm long, comose, the seminiferous area ca 4 mm long, brown, the coma white, fused midway and refolded, the distal end free to spread."
	WRA Specialist. (2023). Personal Communication	Although it can be cultivated as a terrestrial plant, in the wild it occurs as an epiphyte and it's wind-dispersed seeds are unlikely to be accidentally dispersed by human activity. Intentional cultivation and seed dispersal by wind appear to be the primary vectors.

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	LLIFLE. (2023). <i>Werauhia sanguinolenta</i> . http://www.llifle.com/Encyclopedia/BROMELIADS/Family/Bromeliaceae/28816/Werauhia_sanguinolenta . [Accessed 4 Dec 2023]	"Uses: In tropical areas it is favored as a landscape plant but it is also popular for interiorscapes. The dramatic leaf colours make this plant a strong focal point even when it is not in bloom. Because of its width, it is a good plant to display on a raised platform, with ferns or other low-light plants beneath it."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	WRA Specialist. (2023). Personal Communication	No evidence and unlikely. Although it can be cultivated as a terrestrial plant, in the wild it occurs as an epiphyte and it's wind-dispersed seeds are unlikely to become a contaminant of other plants.

704	Propagules adapted to wind dispersal	y
	Source(s)	Notes
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). <i>Flora Neotropica</i> , 14(2), 663-1492	"Fruit capsular. Seeds fusiform with a long straight basal coma."
	Kubitzki, K. (ed.). (1998). <i>The Families and genera of vascular plants. Volume IV. Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae)</i> . Springer-Verlag, Berlin, Heidelberg, New York	"Wind-borne seeds prevail in Pitcairnioideae and are obligatory for Tillandsioideae, both with capsular fruits. Seeds of Pitcairnioideae are less adapted to anemochory and are bicaudate or winged at most. The transport of the naked seeds of members of this subfamily, e.g., <i>Navia</i> , is unknown; perhaps rain serves as an agent. In Tillandsioideae an elaborate and very effective flight apparatus (pseudopappus) allows dispersal over long distances."
	Croat, T.B. (1978). <i>Flora of Barro Colorado Island</i> . Stanford University Press, Stanford, CA	[Comose seeds an adaptation for wind dispersal] "seeds 2-2.5 cm long, comose, the seminiferous area ca 4 mm long, brown, the coma white, fused midway and refolded, the distal end free to spread."

Qsn #	Question	Answer
	Paggi, G. M., et al. (2010). Seed dispersal and population structure in <i>Vriesea gigantea</i> , a bromeliad from the Brazilian Atlantic Rainforest. <i>Botanical Journal of the Linnean Society</i> , 164(3), 317-325	[Description of <i>Vriesea gigantea</i> , a related species] " <i>Vriesea gigantea</i> seeds are wind dispersed, as in the majority of vascular epiphytes, including Tillandsioideae (Madison, 1977; Benzing, 1990). In <i>Vriesea</i> , the numerous hairs of the coma extend from the base of the seed, providing additional buoyancy (Benzing, 2000), so that seeds can be classified as floaters (or plumed), which disperse by rapidly floating downwards in a vertical line (Augsburger, 1986; Matlack, 1987)."

705	Propagules water dispersed	
	Source(s)	Notes
	Croat, T.B. (1978). <i>Flora of Barro Colorado Island</i> . Stanford University Press, Stanford, CA	[Possibly. It may be possible that the wind dispersed seeds or vegetative propagules could be dispersed along riparian habitats, although this would probably be a rare event] "Uncommon, but locally abundant in some areas along the shore, usually in trees fairly low over the water; probably also occurring in upper branches of canopy trees."

706	Propagules bird dispersed	
	Source(s)	Notes
	Croat, T.B. (1978). <i>Flora of Barro Colorado Island</i> . Stanford University Press, Stanford, CA	[Comose seeds are an adaptation for wind dispersal, but they could possibly be dispersed into trees attached to the legs or feathers of birds] "seeds 2-2.5 cm long, comose, the seminiferous area ca 4 mm long, brown, the coma white, fused midway and refolded, the distal end free to spread."

707	Propagules dispersed by other animals (externally)	
	Source(s)	Notes
	Croat, T.B. (1978). <i>Flora of Barro Colorado Island</i> . Stanford University Press, Stanford, CA	[Comose seeds are an adaptation for wind dispersal, but they could possibly be dispersed into trees attached to the legs or feathers of birds] "seeds 2-2.5 cm long, comose, the seminiferous area ca 4 mm long, brown, the coma white, fused midway and refolded, the distal end free to spread."
	Paggi, G. M., et al. (2010). Seed dispersal and population structure in <i>Vriesea gigantea</i> , a bromeliad from the Brazilian Atlantic Rainforest. <i>Botanical Journal of the Linnean Society</i> , 164(3), 317-325	[Description of <i>Vriesea gigantea</i> may be applicable to related species] "Fruits are dehiscent and seeds are small with a plumose coma on one side, which enables them to stay in the air longer and promotes adhesion to bark-like structures (Smith & Downs, 1977; Reitz, 1983; Benzing, 2000)."

708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Smith, L. B., & Downs, R. J. (1977). Tillandsioideae (Bromeliaceae). <i>Flora Neotropica</i> , 14(2), 663-1492	"Fruit capsular. Seeds fusiform with a long straight basal coma." [Not fleshy-fruited, and seeds are adapted for wind dispersal]

801	Prolific seed production (>1000/m2)	
	Source(s)	Notes
	Zotz, G., Laube, S., & Schmidt, G. (2005). Long-term population dynamics of the epiphytic bromeliad, <i>Werauhia sanguinolenta</i> . <i>Ecography</i> , 28(6), 806-814	[Seed density unknown] "Recruitment following sexual reproduction, on the other hand, yielded a large number of seedlings in all years, and the two atmospheric size classes were numerically dominating the population structure (Fig. 1)."

Qsn #	Question	Answer
802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	Notes
	Zotz, G. (2013). A Longer Story Than Expected: Seeds Of Several Species (Tillandsioideae) Remain Viable For Up To Two Years. <i>Journal of the Bromeliad Society</i> , 63(1), 83-87	[Seeds may remain viable for >1 year under ambient conditions] "The majority of the seven species showed no reduction in germination response after one year of storage (Fig. 1). Even in <i>V. sanguinolenta</i> , the species showing the greatest decline in germination rate after storage, an estimated 50% of all seeds successfully germinated after one year. After 26 months few seeds remained viable, although in <i>V. viridifolia</i> and <i>T. fasciculata</i> germination success was still, respectively, $25 \pm 7\%$ and $14 \pm 12\%$. In contrast, seeds that had been kept at -20°C had lost hardly any viability. Their average germination success after 26 months was 93% (range: from 74% in <i>V. gladioliflora</i> to 100% in <i>V. viridifolia</i>). We estimated the time it took seeds from each species to lose 50% viability by noting where the curve drawn through the observed mean germination rates over time for that species crossed the dashed horizontal line in Fig 1 representing 50%, yielding values between 12 and 22 months (Table 1). Lack of seed material did not allow us to study germination success of <i>T. flexuosa</i> after 26 months, but after 20 months it was still $89 \pm 6\%$."

803	Well controlled by herbicides	
	Source(s)	Notes
	WRA Specialist. (2023). Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species.

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes
	Zotz, G., Laube, S., & Schmidt, G. (2005). Long-term population dynamics of the epiphytic bromeliad, <i>Werauhia sanguinolenta</i> . <i>Ecography</i> , 28(6), 806-814	[Unknown] "Different from many other bromeliads (Benzing 2000), vegetative reproduction plays no important role in the life cycle of <i>Werauhia sanguinolenta</i> : the production of offshoots was rare and only observed in a few smaller tank individuals and is thus not considered further in this paper."

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

Summary of Risk Traits:

Werauhia sanguinolenta, previously known as *Vriesea sanguinolenta*, is a colorful tank-forming epiphytic bromeliad that can grow up to 2 meters high when flowering. It is native to tropical areas of the Americas, including Costa Rica, Colombia, and various Caribbean islands. The plant has a rosette of about 10 suberect leaves that are glossy, smooth, and green to purple in color. The plant is pollinated mainly by glossophagine bats but is also facultatively autogamous and capable of producing wind-dispersed seeds when pollinators are scarce or absent. It has been cultivated as an ornamental and has become naturalized on the island of Oahu in non-native forest. Although no negative impacts have been documented to date, it may be able to compete with and exclude native epiphytes if it becomes established in native forest communities.

High Risk / Undesirable Traits

- Thrives and can spread in regions with tropical climates
- Broad elevation range within tropical climates
- Naturalized on Oahu, Hawaiian Islands.
- Able to colonize many different host trees.
- Establishes at high densities. Could compete with native epiphytes in native forest communities.
- Reproduces by seeds, and rarely by vegetative offsets.
- Facultatively autogamous (capable of self-fertilization when pollinators are scarce or absent).
- Seeds dispersed by wind and through intentional cultivation by people.
- Viable seeds may persist for >1 year in the environment.

Low Risk Traits

- No documented evidence of negative impacts has been reported to date.
- Currently only naturalized in non-native forest in the Hawaiian Islands (although ability to establish on many host trees suggests this may be a result of early stages of naturalization).
- Unarmed (no spines, thorns, or burrs)
- Non-toxic
- Grows best in high light environments (dense shade may inhibit spread)
- Reaches maturity in >3+ years.