

Taxon: <i>Heliconia bihai</i> (L.) L.	Family: Heliconiaceae
Common Name(s): firebird lobster claw macaw flower wild plantain	Synonym(s): <i>Heliconia aurea</i> G.Rodr. <i>Heliconia humilis</i> (Misapplied) <i>Musa bihai</i> L.

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 7 Jun 2021
WRA Score: 6.0	Designation: EVALUATE	Rating: Evaluate

Keywords: Tropical Herb, Naturalized, Self-Compatible, Bird-Pollinated, 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	n
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		
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed		
305	Congeneric weed		
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

Qsn #	Question	Answer Option	Answer
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)	y=1, n=0	n
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	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	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	2
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	n
705	Propagules water dispersed		
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	y
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
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Possible that some cultivars may be less likely to naturalize and/or become invasive] "This species is one of the most taxonomically complex in the genus. Many variations in size and inflorescence coloration exist throughout its native range. Some distinct geographical races, many of which are in cultivation in Hawai'i, may deserve varietal status."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2021). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2021). 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, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Jun 2021]	"Native Southern America CARIBBEAN: Antigua and Barbuda, Dominica, Jamaica, St. Lucia, Montserrat, Martinique NORTHERN SOUTH AMERICA: French Guiana, Guyana, Suriname, Venezuela BRAZIL: Brazil WESTERN SOUTH AMERICA: Colombia"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Jun 2021]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes

Qsn #	Question	Answer
	CABI. (2021). <i>Heliconia bihai</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	" <i>H. bihai</i> grows in areas with high annual precipitation regimes at elevations below 500 metres (Kress, 1990; Andersson, 1998). <i>H. bihai</i> is shade tolerant but can also grow in open areas with full sunlight exposure. It develops best in wet and fertile sandy and loamy soils with pH ranging from 5.5 to 6.5 (Every, 2013)."
	Tropicos.org. (2021). Missouri Botanical Garden. http://www.tropicos.org/ . [Accessed 3 Jun 2021]	Collected from 5-10 m Elevation, 10°32'N Latitude to 1450 - 1600 m Elevation, 10°47'N Latitude. Elevation range exceeds 1000 m at 10° Latitude. Unknown if able to grow at higher elevations in the latitudes of the Hawaiian Islands.

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to the Caribbean and South America; in Hawai'i cultivated as an ornamental, now naturalized along the Hana Highway, Maui. Cultivated on O'ahu as early as 1941 (Neal s.n., BISH)."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Jun 2021]	Native Southern America CARIBBEAN: Antigua and Barbuda, Dominica, Jamaica, St. Lucia, Montserrat, Martinique NORTHERN SOUTH AMERICA: French Guiana, Guyana, Suriname, Venezuela BRAZIL: Brazil WESTERN SOUTH AMERICA: Colombia"

205	Does the species have a history of repeated introductions outside its natural range?	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	"Lobster-claw has been in cultivation for nearly a century and is now cultivated as an ornamental in tropical climates around the world. It has been grown in Hawai'i for many years and is naturalized along the Hana Highway on Maui."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to the Caribbean and South America; in Hawai'i cultivated as an ornamental, now naturalized along the Hana Highway, Maui. Cultivated on O'ahu as early as 1941 (Neal s.n., BISH)."

302	Garden/amenity/disturbance weed	
	Source(s)	Notes

Qsn #	Question	Answer
	CABI. (2021). <i>Heliconia bihai</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Possible disturbance weed, although negative impacts have not been corroborated in the cited references on this website] " <i>H. bihai</i> can behave as a pioneer species. It is able to rapidly invade and colonize open and disturbed areas forming monocultures and avoiding the establishment of other plant species (Kress 1990; Andersson, 1998; Every 2013)." [Although other species of <i>Heliconia</i> are reported to form monocultures in other references, a search of the references listed here found no evidence that <i>Heliconia bihai</i> forms monocultures in disturbed areas]
	Argel, M., Pedro, J., Villegas, C., & Doll, J. D. (1977). Control químico de tacana (<i>Heliconia bihai</i>) en potreros. <i>Revista COMALFI</i> 1: 32-44	<i>Heliconia bihai</i> is subjected to control in paddocks

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	CABI. (2021). <i>Heliconia bihai</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[No impacts to agriculture documented] " <i>H. bihai</i> can behave as a pioneer species. It is able to rapidly invade and colonize open and disturbed areas forming monocultures and avoiding the establishment of other plant species (Kress 1990; Andersson, 1998; Every 2013)." [Although other species of <i>Heliconia</i> are reported to form monocultures in other references, a search of the references listed here found no evidence that <i>Heliconia bihai</i> forms monocultures in disturbed areas]

304	Environmental weed	
	Source(s)	Notes
	CABI. (2021). <i>Heliconia bihai</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	" <i>H. bihai</i> can behave as a pioneer species. It is able to rapidly invade and colonize open and disturbed areas forming monocultures and avoiding the establishment of other plant species (Kress 1990; Andersson, 1998; Every 2013)." [Although other species of <i>Heliconia</i> are reported to form monocultures in other references, a search of the references listed here found no evidence that <i>Heliconia bihai</i> forms monocultures in disturbed areas]
	Kress, W. J. (1984). Systematics of Central American <i>Heliconia</i> (Heliconiaceae) with pendent inflorescences. <i>Journal of the Arnold Arboretum</i> , 65(4), 429-532	"It almost always occurs in dense stands in open swamps or standing water. <i>Heliconia marginata</i> is one of the few truly aquatic species of the genus." [<i>Heliconia marginata</i> is the only species in this publication reported to form dense stands]
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to the Caribbean and South America; in Hawai'i cultivated as an ornamental, now naturalized along the Hana Highway, Maui. Cultivated on O'ahu as early as 1941 (Neal s.n., BISH)." [No environmental impacts documented]

305	Congeneric weed	
	Source(s)	Notes

Qsn #	Question	Answer
	Lau, A. & Frohlich, D. (2015). New plant records for the Hawaiian Islands 2014. Bishop Museum Occasional Papers 116: 35–40	"The 'Dwarf Jamaican' cultivar of this bird-dispersed species was collected in Waimea Valley, where it is a recognized weed of the area, naturalized and scattered throughout the understory of the botanical collection, usually in dense shade." [Heliconia stricta regarded as a weed]
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Several Heliconia species are listed as naturalized or invasive, but evidence of impacts is generally lacking or unspecified.

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[No evidence] "Perennial herbs 2-5 m tall. Longest blade 100-250 cm long, 20-40 cm wide, both surfaces green, petioles 50-115 cm long. Flowers 10-20 per cincinnus, in erect inflorescences up to 60 cm long (exc. peduncle), rachis red, cincinnal bracts reddish orange with green margins and apex, 12-25 cm long, 11-13 cm wide at base, distichous, 5-12 per inflorescence, glabrous, margins straight, middle bract with apex acuminate; perianth white basally to pale green toward apex, 5.5-6.5 cm long, glabrous; ovary white, glabrous. Drupes blue, glabrous. [2n = 24.]"

402	Allelopathic	n
	Source(s)	Notes
	Morikawa, C. I. O., Miyaura, R., Tapia Y Figueroa, M. D. L., Rengifo Salgado, E. L., & Fujii, Y. (2012). Screening of 170 Peruvian plant species for allelopathic activity by using the Sandwich Method. Weed Biology and Management, 12 (1): 1-11	[Extracts of Heliconia bihai inhibit radicle elongation, but the results are not statistically significant] "Peru is one of the 20 botanically extremely diverse countries in the world, with >17 000 flowering plants, of which 30% are endemic. So far, no systematic research has been conducted on the screening of the allelopathic plants. In this study, the allelopathic activity of 170 species from 61 families of Peruvian plants that were collected from the three main regions of Peru – the Costa (Pacific coastline), the Sierra (Andean mountains), and the Selva (Amazonian rainforest)– was evaluated. The allelopathic activity was determined by the Sandwich Method, which can evaluate the activity of leaf leachates. The species that were found to be highly inhibitory in this screening, under the criterion of >90% inhibition of the radicle of lettuce (Lactuca sativa) seedlings, were Aristeguietia ballii and Diplostegium foliosissimum (Asteraceae) and Spondias mombin (Anacardiaceae). All of these species are native plants from Peru. This study gives a strong clue regarding the potential of isolating potent allelochemicals from these plants in the future."

403	Parasitic	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Perennial herbs 2-5 m tall." [Heliconiaceae. No evidence]

Qsn #	Question	Answer
404	Unpalatable to grazing animals	
	Source(s)	Notes
	Southern Living. (2021). Lobster Claw, False Bird-of-Paradise. http://www.southernliving.com/plants/lobster-claw-false-bird-of-paradise . [Accessed 4 Jun 2021]	"Deer don't seem to care for them." [Generic description. Possibly unpalatable]

405	Toxic to animals	n
	Source(s)	Notes
	California Poison Control System. (2021). Non-toxic plants. https://calpoison.org/topics/plant#non-toxic . [Accessed 4 Jun 2021]	[<i>Heliconia bihai</i> non-toxic to animals and people] "The plants in this list are considered to be safe to humans. This list is in two parts. The first list is alphabetical by common name and the second list is alphabetical by Latin or scientific name. Keep in mind that even non-toxic plants can cause vomiting in humans and animals. Also children can choke on a plant piece and have gagging or choking. Some plants that are not a problem to humans can be a problem for animals. The plant names that are listed in bold typeface are known to be dangerous to animals (dogs and cats). Because dogs, especially, will eat large amounts, it is important to keep pets and these plants apart."
	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

Qsn #	Question	Answer
406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Exotic Tropical Plants. (2021). <i>Heliconia</i> Information Page. http://members.iinet.net.au/~meckms/Heliconia%20Information%20Page.html . [Accessed 4 Jun 2021]	"The only significant pests for gardeners are grasshoppers, scale and mealybugs. Diseases are rare but wet feet, especially in winter, can rot the root system. "
	Sewake, K. T., & Uchida, J. Y. (1995). Diseases of <i>Heliconia</i> in Hawaii. Research Extension Series 159. Hawaii Institute of Tropical Agriculture and Human Resources, Honolulu, HI	[Fungal and bacterial pathogens found on multiple hosts, including <i>H. bihai</i>] " <i>Calonectria spathiphylli</i> has been isolated from diseased <i>heliconia</i> throughout the state. This common pathogen attacks <i>Heliconia</i> species and cultivars such as <i>H. angusta</i> cv. Holiday (formerly 'Red Christmas'), <i>H. bihai</i> cv. Kamehameha and cv. Lobster Claw One (formerly <i>H. jacquini</i>)," ... "Species of <i>Cercospora</i> and <i>Pseudocercospora</i> are known to infect almost every plant family. <i>Cercospora</i> and <i>Pseudocercospora</i> species have been isolated from leaf spots of <i>H. psittacorum</i> cv. Andromeda, <i>H. collinsiana</i> , <i>H. jarinosa</i> , <i>H. bihai</i> cv. Lobster Claw Two, and <i>H. wagneriana</i> (Aragaki, Bushe, and Uchida, unpublished)." ... "Disease and symptoms. <i>Rhizoctonia solani</i> -like fungi have been recovered from rotting roots of <i>H. bihai</i> cv. Lobster Claw One and <i>H. caribaea</i> (Uchida, unpublished). Although frequently associated with diseased plants, these fungi are generally considered weak pathogens, and pathogenicity tests are needed to determine the role of these organisms on <i>heliconia</i> . <i>Rhizoctonia solani</i> is one of the most common pathogens occurring throughout the world."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	California Poison Control System. (2021). Non-toxic plants. https://calpoison.org/topics/plant#non-toxic . [Accessed 4 Jun 2021]	[<i>Heliconia bihai</i> non-toxic to animals and people] "The plants in this list are considered to be safe to humans. This list is in two parts. The first list is alphabetical by common name and the second list is alphabetical by Latin or scientific name. Keep in mind that even non-toxic plants can cause vomiting in humans and animals. Also children can choke on a plant piece and have gagging or choking. Some plants that are not a problem to humans can be a problem for animals. The plant names that are listed in bold typeface are known to be dangerous to animals (dogs and cats). Because dogs, especially, will eat large amounts, it is important to keep pets and these plants apart."
	Quattrocchi, U. (2012). <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	No evidence
	Wagstaff, D.J. (2008). <i>International poisonous plants checklist: an evidence-based reference</i> . CRC Press, Boca Raton, FL	No evidence

Qsn #	Question	Answer
408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Smith, R. (1968). A taxonomic revision of the genus <i>Heliconia</i> in middle America. PhD Dissertation. University of Florida, Gainesville, FL	"Common on moist slopes, wet ravines, and wet mountainsides." [No evidence. Unlikely given habitat and habit]

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	CABI. (2021). <i>Heliconia bihai</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Within its native distribution range, <i>H. bihai</i> is a common element in moist or wet forests, as well as in seasonally dry forests. This species grows in shaded moist habitats of primary forests, river banks, and is an aggressive colonizer of open, disturbed sites, pasturelands, and secondary forests (Shenk, 1983; Kress, 1990; Andersson, 1998; Kress and Whittemore, 2000; Acevedo Rodríguez and Strong, 2005; Every, 2013)."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	Notes
	CABI. (2021). <i>Heliconia bihai</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"It develops best in wet and fertile sandy and loamy soils with pH ranging from 5.5 to 6.5 (Every, 2013)."
	Backyard Gardener. (2021). <i>Heliconia bihai</i> . https://www.backyardgardener.com . [Accessed 4 Jun 2021]	"pH Range: 5.5 to 6.5 Soil Range: Some Sand to Loam Water Range: Normal to Moist"

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Perennial herbs 2-5 m tall."

412	Forms dense thickets	
	Source(s)	Notes
	CABI. (2021). <i>Heliconia bihai</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	" <i>H. bihai</i> can behave as a pioneer species. It is able to rapidly invade and colonize open and disturbed areas forming monocultures and avoiding the establishment of other plant species (Kress 1990; Andersson, 1998; Every 2013)." [Although other species of <i>Heliconia</i> are reported to form monocultures, a search of the references listed here found no evidence that <i>Heliconia bihai</i> forms monocultures in disturbed areas]
	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] "Distribution in Puerto Rico: Recorded from Luquillo, Rio Grande, Santa Isabel, Trujillo Alto, and Utuado; this species is very rare in Puerto Rico."

Qsn #	Question	Answer
	Missouri Botanical Garden. (1945). Flora of Panama. Part III. Fascicle I. Annals of the Missouri Botanical Garden, 32 (1): 1-105	[No evidence] "Extremely abundant. This is the showiest of Panamanian Heliconias, and the colorful spikes frequently are cut for house decoration."
	Judd, W. S. (1986). Floristic study of La Visite and Macaya National Parks, Haiti. Prepared for USAID/Haiti under contract Number 521-0169-C-00-3083-00.	[No evidence] "Heliconia bihai L. Terrestrial herb; moist forest on limestone (common), 950-1050 m; Bois Formon."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[No evidence] "in Hawai'i cultivated as an ornamental, now naturalized along the Hana Highway, Maui."

501	Aquatic	n
	Source(s)	Notes
	Rojas-Sandoval, J., & Planas, S. (2008). Self-compatibility of microgametophytes in <i>Heliconia bihai</i> (Heliconiaceae) from St. Lucia. Caribbean Journal of Science, 44(2), 145-149	[Terrestrial] " <i>Heliconia bihai</i> is a large understory herb up to 6m) native to northern South America and the lower islands of the Lesser Antilles (Berry and Kress, 1991)."
	Missouri Botanical Garden. (1945). Flora of Panama. Part III. Fascicle I. Annals of the Missouri Botanical Garden, 32 (1): 1-105	[Terrestrial] "Mexico to Peru and Brazil; Antilles; also introduced and escaped in Oceania. In lowland forests and thickets."

502	Grass	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Jun 2021]	"Family: Heliconiaceae"

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Jun 2021]	"Family: Heliconiaceae"

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Perennial herbs 2-5 m tall."

Qsn #	Question	Answer
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Missouri Botanical Garden. (1945). Flora of Panama. Part III. Fascicle I. Annals of the Missouri Botanical Garden, 32 (1): 1-105	"Extremely abundant. This is the showiest of Panamanian Heliconias, and the colorful spikes frequently are cut for house decoration."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to the Caribbean and South America; in Hawai'i cultivated as an ornamental, now naturalized along the Hana Highway, Maui."
	Smith, R. (1968). A taxonomic revision of the genus <i>Heliconia</i> in middle America. PhD Dissertation. University of Florida, Gainesville, FL	"The scope of this study is restricted to the Caribbean. However, <i>H. bihai</i> is much more widespread. The "Flora of Peru" lists this species, and it is found throughout northern South America. (Map 7.) It was one of the first Heliconias to be brought into cultivation during the latter part of the 18th century."

602	Produces viable seed	y
	Source(s)	Notes
	CABI. (2021). <i>Heliconia bihai</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	" <i>H. bihai</i> spreads sexually by seeds and asexually by rhizomes. Fruits are bright blue, very attractive to birds, and consequently seeds are primarily bird dispersed."
	Backyard Gardener. (2021). <i>Heliconia bihai</i> . https://www.backyardgardener.com . [Accessed 4 Jun 2021]	"Seed Start: easily propagated from seed."
	Skutch, A. (1933). The Aquatic Flowers of a Terrestrial Plant, <i>Heliconia bihai</i> L. American Journal of Botany, 20(8), 535-544	"The flowers are visited by humming-birds; yet at the beginning of anthesis the pollen is shed directly upon the stigma, and seeds are set freely in bagged inflorescences."

603	Hybridizes naturally	y
	Source(s)	Notes
	Isaza, L., Marulanda, M. L., & López, A. M. (2012). Genetic diversity and molecular characterization of several <i>Heliconia</i> species in Colombia. Genetics and Molecular Research 11(4): 4552-4563	"The existence of interspecific hybrids, such as <i>H. caribaea</i> x <i>H. bihai</i> , can be determined by the fact that hummingbirds are the sole pollinators of heliconias in the Americas, influencing the hybridization phenomenon between heliconias."

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

Qsn #	Question	Answer
	Rojas-Sandoval, J., & Planas, S. (2008). Self-compatibility of microgametophytes in <i>Heliconia bihai</i> (Heliconiaceae) from St. Lucia. <i>Caribbean Journal of Science</i> , 44(2), 145-149	"ABSTRACT.—Potential for physiological self-incompatibility in <i>Heliconia bihai</i> as a mechanism to promote outcrossing was studied in St. Lucia. Our results do suggest that <i>H. bihai</i> is self-compatible. However, plants vary in their degree of compatibility from full to partial self-compatibility. We found only traces of physiological incompatibility but conclusive determination of its mechanism would require further testing. In contrast to Central American <i>Heliconia</i> species, we found that more pollen tubes are able to grow inside <i>H. bihai</i> styles following artificial pollinations. Additional studies would be needed to test if other populations of <i>H. bihai</i> share this phenomenon."
	Skutch, A. (1933). The Aquatic Flowers of a Terrestrial Plant, <i>Heliconia bihai</i> L. <i>American Journal of Botany</i> , 20(8), 535-544	"The flowers are visited by humming-birds; yet at the beginning of anthesis the pollen is shed directly upon the stigma, and seeds are set freely in bagged inflorescences."

605	Requires specialist pollinators	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	"New World <i>Heliconia</i> are pollinated by hummingbirds (Linhart 1973; Stiles 1975, 1979; Kress 1985a)."
	Temeles, E. J., Rah, Y. J., Andicoechea, J., Byanova, K. L., Giller, G. S., Stolk, S. B., & Kress, W. J. (2013). Pollinator-mediated selection in a specialized hummingbird– <i>Heliconia</i> system in the Eastern Caribbean. <i>Journal of Evolutionary Biology</i> , 26(2), 347-356	"Unlike the longer specialized flowers of <i>H. bihai</i> , which are only visited by female <i>E. jugularis</i> , the shorter flowers of <i>H. caribaea</i> present a more generalized pollination system which allows visitation by both males and females (Gowda & Kress, 2012)."
	Skutch, A. (1933). The Aquatic Flowers of a Terrestrial Plant, <i>Heliconia bihai</i> L. <i>American Journal of Botany</i> , 20(8), 535-544	[Adapted for hummingbird pollination, but capable of selfing in the absence of pollinators] "The flowers are visited by humming-birds; yet at the beginning of anthesis the pollen is shed directly upon the stigma, and seeds are set freely in bagged inflorescences."

606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Smith, R. (1968). A taxonomic revision of the genus <i>Heliconia</i> in middle America. PhD Dissertation. University of Florida, Gainesville, FL	"All the species studied have a well-developed rhizome, and are perennial. The modes of propagation are by the formation of and dispersal of seeds, and by the formation of new plants from the rhizome."
	CABI. (2021). <i>Heliconia bihai</i> . In: <i>Invasive Species Compendium</i> . Wallingford, UK: CAB International. www.cabi.org/isc	" <i>H. bihai</i> spreads sexually by seeds and asexually by rhizomes. Fruits are bright blue, very attractive to birds, and consequently seeds are primarily bird dispersed. New pseudostems (formed by the leaf sheaths) can emerge from branched underground rhizomes (Kress 1990; Andersson, 1998; Kress and Whittemore, 2000; Acevedo-Rodríguez and Strong, 2005; Every 2013)."

607	Minimum generative time (years)	2
	Source(s)	Notes

Qsn #	Question	Answer
	Exotic Tropical Plants. (2021). Heliconia Information Page. http://members.iinet.net.au/~meckms/Heliconia%20Information%20Page.html . [Accessed 4 Jun 2021]	"Growing speed-heliconias are fairly quick growers if given plenty of good rich soil and fertilizer. Most of the larger species will take 12-24 months to flower when grown from a rhizome." [Time required to flowering after rhizome planting, reproduction by seed must be longer - minimum estimate is given for a rhizomatous perennial herb]

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	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	"Fruit a capsule or drupe-like, separating into 3 cocci or dehiscent, usually blue or black. Seeds stony, grayish, without an aril." [Generic description. No evidence. Fruits & seeds lack means of external attachment]

702	Propagules dispersed intentionally by people	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	"Lobster-claw has been in cultivation for nearly a century and is now cultivated as an ornamental in tropical climates around the world. It has been grown in Hawai'i for many years and is naturalized along the Hana Highway on Maui."

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	WRA Specialist. (2021). Personal Communication	Unlikely. Not a food crop. Commercial propagation in Heliconias is mostly by rhizomes and not seeds; stems used in floral arrangements do not contain seeds and do not root.

704	Propagules adapted to wind dispersal	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	"The fleshy drupes of Heliconia are dispersed by birds in the neotropics and a wide variety of birds have been reported (Stiles 1979) to feed on them."

705	Propagules water dispersed	
	Source(s)	Notes
	CABI. (2021). Heliconia bihai. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Within its native distribution range, H. bihai is a common element in moist or wet forests, as well as in seasonally dry forests. This species grows in shaded moist habitats of primary forests, river banks, and is an aggressive colonizer of open, disturbed sites, pasturelands, and secondary forests" [Although adapted for bird dispersal, rhizome fragments or seeds could potentially be moved by water in riparian habitat]

Qsn #	Question	Answer
706	Propagules bird dispersed	y
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Drapes blue, glabrous."
	CABI. (2021). <i>Heliconia bihai</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"H. bihai spreads sexually by seeds and asexually by rhizomes. Fruits are bright blue, very attractive to birds, and consequently seeds are primarily bird dispersed."
	Skutch, A. (1933). The Aquatic Flowers of a Terrestrial Plant, <i>Heliconia bihai</i> L. American Journal of Botany, 20(8), 535-544	"The bright-blue berries are sought by several kinds of birds, which often inflict great injury to the inflorescence in their eagerness to reach them before they are duly exposed by the elongation of the pedicel."
	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	"The fleshy drupes of <i>Heliconia</i> are dispersed by birds in the neotropics and a wide variety of birds have been reported (Stiles 1979) to feed on them."
	Kress, W. J. (1984). Systematics of Central American <i>Heliconia</i> (Heliconiaceae) with pendent inflorescences. Journal of the Arnold Arboretum, 65(4), 429-532	"The fruits are very attractive to birds that disperse the seeds (Skutch, 1933; Stiles, 1979). Each drupe contains from one to three pyrenes. Each seed is surrounded by an exceptionally hard, roughened endocarpic envelope. Unlike the seeds of many other members of the order, those of <i>Heliconia</i> do not have an aril."

707	Propagules dispersed by other animals (externally)	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	"Fruit a capsule or drupe-like, separating into 3 cocci or dehiscent, usually blue or black. Seeds stony, grayish, without an aril." [Generic description. ca. Inflorescences per plant / year - 35 inflorescences; 3 seeds per fruit]
	Kress, W. J. (1984). Systematics of Central American <i>Heliconia</i> (Heliconiaceae) with pendent inflorescences. Journal of the Arnold Arboretum, 65(4), 429-532	"The fruits are very attractive to birds that disperse the seeds (Skutch, 1933; Stiles, 1979). Each drupe contains from one to three pyrenes. Each seed is surrounded by an exceptionally hard, roughened endocarpic envelope. Unlike the seeds of many other members of the order, those of <i>Heliconia</i> do not have an aril."

708	Propagules survive passage through the gut	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	"The fleshy drupes of <i>Heliconia</i> are dispersed by birds in the neotropics and a wide variety of birds have been reported (Stiles 1979) to feed on them."
	Kress, W. J. (1984). Systematics of Central American <i>Heliconia</i> (Heliconiaceae) with pendent inflorescences. Journal of the Arnold Arboretum, 65(4), 429-532	"The fruits are very attractive to birds that disperse the seeds (Skutch, 1933; Stiles, 1979). Each drupe contains from one to three pyrenes. Each seed is surrounded by an exceptionally hard, roughened endocarpic envelope. Unlike the seeds of many other members of the order, those of <i>Heliconia</i> do not have an aril."

Qsn #	Question	Answer
801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	Temeles, E. J., Rah, Y. J., Andicoechea, J., Byanova, K. L., Giller, G. S., Stolk, S. B., & Kress, W. J. (2013). Pollinator-mediated selection in a specialized hummingbird– <i>Heliconia</i> system in the Eastern Caribbean. <i>Journal of Evolutionary Biology</i> , 26(2), 347-356	"We then dissected each fruit and counted the number of seeds, which range from 1 to 3 in <i>H. bihai</i> and <i>H. caribaea</i> , and from this information determined the mean number of seeds produced per flower for the inflorescences sampled for each plant (seeds/flower)." ... "Table 1 Means ± 1 SE (N) for two floral traits, one fitness measure and visitation rates of plants in two populations of <i>H. bihai</i> in 2008 and 2009." [<i>H. bihai</i> documented to produce from 18.48 ± 4.88 to 96.60 ± 13.90 seeds per plant]
	WRA Specialist. (2021). Personal Communication	Although capable of selfing, <i>H. bihai</i> is pollinated by hummingbirds in its native range. Seed set is therefore predicted to be much lower in the Hawaiian Islands than within its native range where native pollinators are extant]

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	Kricher, J. (2011). <i>Tropical Ecology</i> . Princeton University Press. Princeton, NJ	" <i>Heliconia</i> seeds have a six- to seven-month dormancy period prior to germination, which ensures that the seeds will germinate at the onset of rainy season." [Unknown if seeds persist in soil beyond 12 months]
	Royal Botanic Gardens Kew. (2021) Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/ . [Accessed 4 Jun 2021]	[Generic description] "Storage Behaviour: Uncertain. Storage Conditions: MCS= 65% (Vazquez-Yanes & Toledo, 1989) Comment: Based on MCS, this species may show recalcitrant seed storage behaviour; further work is necessary to determine the storage behaviour of this species."

803	Well controlled by herbicides	y
	Source(s)	Notes
	Sewake, K. T., & Uchida, J. Y. (1995). Diseases of <i>Heliconia</i> in Hawaii. Research Extension Series 159. Hawaii Institute of Tropical Agriculture and Human Resources, Honolulu, HI	"control measures should include immediate roguing of infected plants or killing them with herbicide and keeping that area undisturbed." [Refers to sanitary measures for controlling <i>Heliconia</i> diseases but no specifics of an effective herbicide treatment are given]
	Hyde, K. D., McCulloch, B., Akiew, E., Peterson, R. A., & Diatloff, A. (1992). Strategies used to eradicate bacterial wilt of <i>Heliconia</i> (race 2) in Cairns, Australia, following introduction of the disease from Hawaii. <i>Australasian Plant Pathology</i> , 21(1), 29-31	[Glyphosate injection effective in killing <i>Heliconia</i>] " <i>Heliconia</i> plants in each of these areas were destroyed by injection with glyphosate herbicide."

Qsn #	Question	Answer
	Daintree Living. (2021). Weed Control Factsheet. http://www.livingindaintree.org.au/weeds.html . [Accessed 7 Jun 2021]	[Herbicide recommended to control other Heliconia species would likely be effective if needed] "Glyphosate (e.g. Roundup®) is the commonest (and most grossly over-used) herbicide sold - and comes in a wide variety of liquid mixtures and names. It is generally used for grasses, Heliconia and a very few difficult weeds. Glyphosate is a 'broad spectrum' herbicide, which kills almost everything so 'collateral damage' is a major problem." ... "Heliconia - Heliconia psittacorum family: Heliconiaceae Introduced as a commercial cut flower, this plant thrives in wet ground. It is pollinated and dispersed in Costa Rica by hummingbirds, here by sunbirds. Control: Cut stems at base and apply 10% glyphosate."
	Ferreira, S. A., Trujillo, E. E., & Ogata, D. Y. (1997). Banana bunchy top virus. Plant Disease 12. College of Tropical Agriculture and Human Resources, University of Hawaii, Honolulu	[Methods to control infected bananas would likely be effective on Heliconia] "Aphids on heliconia and flowering ginger in the vicinity of banana plants can be controlled with systemic insecticides approved for such use. No systemic insecticide is approved for use on banana against aphids. Infected banana plants can be killed with the systemic herbicide glyphosate. Roundup Ultra™ (SLN no. HI-960005, EPA reg. no. 524-475) is approved for use in Hawaii on banana; follow label directions."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Moore, S. (2020). Heliconia Growth. Home Guides SF Gate, https://homeguides.sfgate.com/heliconia-growth-80168.html . [Accessed 7 Jun 2021]	"If Heliconia freeze, they will usually die back to the ground, but in warm climates their underground roots will regenerate new shoots and regrow."
	Exotic Tropical Plants. (2021). Heliconia Information Page. http://members.iinet.net.au/~meckms/Heliconia%20Information%20Page.html . [Accessed 7 Jun 2021]	"You should not prune your heliconias, as the 'stem' is actually made up of rolled leaf bases and the flowers emerge from the top of these 'pseudostems'. However, each stem will only flower once, so after flowering you can cut that stem out. This is recommended, to encourage more flowering, to increase airflow in between the stems of your plant, and also to generally tidy it up and improve the appearance." [Tolerates pruning, but not recommended with frequency][

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes

Qsn #	Question	Answer
	<p>Sewake, K. T., & Uchida, J. Y. (1995). Diseases of Heliconia in Hawaii. Research Extension Series 159. Hawaii Institute of Tropical Agriculture and Human Resources, Honolulu, HI</p>	<p>[Bacteria and fungi present. Unknown if these act as limiting factors in Hawaii] "Calonectria spathiphylli has been isolated from diseased heliconia throughout the state. This common pathogen attacks Heliconia species and cultivars such as H. angusta cv. Holiday (formerly 'Red Christmas'), H. bihai cv. Kamehameha and cv. Lobster Claw One (formerly H. jacquinii)," ... "Species of Cercospora and Pseudocercospora are known to infect almost every plant family. Cercospora and Pseudocercospora species have been isolated from leaf spots of H. psittacorum cv. Andromeda, H. collinsiana, H. jarinosa, H. bihai cv. Lobster Claw Two, and H. wagneriana (Aragaki, Bushe, and Uchida, unpublished)." ... "Disease and symptoms. Rhizoctonia solani-like fungi have been recovered from rotting roots of H. bihai cv. Lobster Claw One and H. caribaea (Uchida, unpublished). Although frequently associated with diseased plants, these fungi are generally considered weak pathogens, and pathogenicity tests are needed to determine the role of these organisms on heliconia. Rhizoctonia solani is one of the most common pathogens occurring throughout the world."</p>

Summary of Risk Traits:

High Risk / Undesirable Traits

- Thrives, and can spread, in regions with tropical climates.
- Naturalized on Maui (Hawaiian Islands)
- Reported to rapidly invade and colonize open and disturbed areas (corroboration needed)
- Other species are potentially invasive.
- Shade tolerant
- Reported to form dense monocultures (uncorroborated)
- Reproduces by seeds and rhizomes.
- Self-Compatible
- Able to hybridize with other species.
- Seeds dispersed by birds and intentionally by people.
- Seeds able to be stored for extended periods; May form a persistent seed bank.
- Able to resprout from rhizomes after cutting or pruning.

Low Risk Traits

- Despite naturalization and history of cultivation, negative impacts not documented in the Hawaiian Islands.
- Unarmed (no spines, thorns, or burrs)
- Non-toxic
- Requires specialized pollinators (hummingbirds) which may limit seed set in areas lacking hummingbirds.
- Herbicides may provide effective control.

Second Screening Results for Herbs or Low Stature Shrubby Life Forms

(A) Reported as a weed of cultivated lands? Possibly. Reports of weediness in cultivated lands (paddocks) have not been corroborate.

(B) Unpalatable to grazers or known to form dense stands? Possibly. Unverified reports of monocultures formed by this species.

Outcome = Evaluate further