

Assessment date: 10/3/2023 Prepared by E. Williams

<i>Heliotropium amplexicaule</i> (blue heliotrope)		Answer	Score
1.01	Is the species highly domesticated?	n	0
1.02	Has the species become naturalised where grown?	0	
1.03	Does the species have weedy races?	0	
2.01	Species suited to Florida's USDA climate zones (0-low; 1-intermediate; 2-high) North Zone: suited to Zones 8, 9 Central Zone: suited to Zones 9, 10 South Zone: suited to Zone 10	3	
2.02	Quality of climate match data (0-low; 1-intermediate; 2-high)	3	
2.03	Broad climate suitability (environmental versatility)	y	1
2.04	Native or naturalized in habitats with periodic inundation North Zone: mean annual precipitation 50-70 inches Central Zone: mean annual precipitation 40-60 inches South Zone: mean annual precipitation 40-60 inches	y	1
2.05	Does the species have a history of repeated introductions outside its natural range?	y	
3.01	Naturalized beyond native range	y	2
3.02	Garden/amenity/disturbance weed	?	
3.03	Weed of agriculture	y	4
3.04	Environmental weed	y	4
3.05	Congeneric weed	y	2
4.01	Produces spines, thorns or burrs	n	0
4.02	Allelopathic	?	
4.03	Parasitic	n	0
4.04	Unpalatable to grazing animals	?	
4.05	Toxic to animals	y	1
4.06	Host for recognised pests and pathogens	?	
4.07	Causes allergies or is otherwise toxic to humans	?	
4.08	Creates a fire hazard in natural ecosystems	?	
4.09	Is a shade tolerant plant at some stage of its life cycle	?	
4.10	Grows on infertile soils (oligotrophic, limerock, or excessively draining soils). North & Central Zones: infertile soils; South Zone: shallow limerock or Histisols.	y	1
4.11	Climbing or smothering growth habit	n	0
4.12	Forms dense thickets	?	
5.01	Aquatic	n	0
5.02	Grass	n	0
5.03	Nitrogen fixing woody plant	n	0
5.04	Geophyte	n	0
6.01	Evidence of substantial reproductive failure in native habitat	n	0
6.02	Produces viable seed	y	1

6.03	Hybridizes naturally	?	
6.04	Self-compatible or apomictic	?	
6.05	Requires specialist pollinators	n	0
6.06	Reproduction by vegetative propagation	y	1
6.07	Minimum generative time (years)	1 or fewer	1
7.01	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y	1
7.02	Propagules dispersed intentionally by people	y	1
7.03	Propagules likely to disperse as a produce contaminant	y	1
7.04	Propagules adapted to wind dispersal	n	-1
7.05	Propagules water dispersed	y	1
7.06	Propagules bird dispersed	?	
7.07	Propagules dispersed by other animals (externally)	y	1
7.08	Propagules dispersed by other animals (internally)	y	1
8.01	Prolific seed production	?	
8.02	Evidence that a persistent propagule bank is formed (>1 yr)	?	
8.03	Well controlled by herbicides	?	
8.04	Tolerates, or benefits from, mutilation or cultivation	y	1
8.05	Effective natural enemies present in U.S.	?	
Total Score		25	
Implemented Pacific Second Screening		no	
Risk Assessment Results		reject	

section	# questions answered	satisfy minimum?
A		10 yes
B		5 yes
C		16 yes
total		31 yes

	Evidence	Reference
1.01	1. introduced into Australia in the late 19th century for ornamental purposes, no mention of domestication 2. introduced into Australia from South America as an ornamental plant, no mention of domestication	1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm 2. Cullen, J., Julien, M., & McFadyen, R. (2012). Biological control of weeds in Australia. CSIRO Publishing.
1.02	0	0
1.03	0	0
2.01	1-2. Present in USDA hardiness zones 8b through 9b	1. Heliotropium amplexicaule Vahl. (n.d.). https://www.gbif.org/species/2925790 2. USDA Plant Hardiness Zone Map. (n.d.). https://planthardiness.ars.usda.gov/
2.02	No computer analysis carried out	0
2.03	1-2. Present in Koppen-Geiger zones Aw, Bsh, Bwh, Cfa, Cfb, Csa, Csb	1. Heliotropium amplexicaule Vahl. (n.d.). https://www.gbif.org/species/2925790 2. World Maps of Köppen-Geiger climate classification. (n.d.). https://koeppen-geiger.vu-wien.ac.at/present.htm
2.04	1. "Major infestations occur in areas receiving more than 500 mm of rainfall per years, although it is also established in low rainfall areas" 2. Naturalized in Hawai'i 3. Rainfall in Hawai'i ranges from 8 inches to 404 inches a year	1. Blue heliotrope. (2022, March 17). Weed Identification – Brisbane City Council. https://weeds.brisbane.qld.gov.au/weeds/blue-heliotrope 2. Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/ 3. Rainfall Atlas of Hawaii Rainfall. (n.d.). http://rainfall.geography.hawaii.edu/rainfall.html#:~:text=Hawai%CA%BBi's%20rainfall%20pattern%20is%20spectacularly,windward%20slope%20of%20Haleakal%C4%81%2C%20Maui.
2.05	1. introduced into Australia in the late 19th century 2. introduced into Australia from South America as an ornamental plant	1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm 2. Cullen, J., Julien, M., & McFadyen, R. (2012). Biological control of weeds in Australia. CSIRO Publishing.

3.01	<p>1. widely naturalized throughout Australia 2. naturalized in Mauritius, Mascarene Islands</p>	<p>1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm 2. PYNEE, K., & LORENCE, D. H. (2014). First record and distribution of Heliotropium curassavicum L.(Boraginaceae) in the Mascarene Islands.</p>
3.02	<p>1-2. noted to be a weed of "Footpaths, lawns, parks, gardens"</p>	<p>1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm 2. Blue heliotrope. (2022, March 17). Weed Identification – Brisbane City Council. https://weeds.brisbane.qld.gov.au/weeds/blue-heliotrope</p>
3.03	<p>1. considered to be a major weed of crops and a serious pasture weed as is poisonous to livestock, competes with desirable summer pastures species, and reduces pasture productivity. 2. pasture weed that "competes with desirable summer pasture species and is toxic to stock"</p>	<p>1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm 2. Briese, D. T., & Zapater, M. (2002, September). A strategy for the biological control of blue heliotrope (Heliotropium amplexicaule). In Proceedings of the 13th Australian Weeds Conference (pp. 394-397). Plant Protection Society of Western Australia.</p>
3.04	<p>1. Listed as a priority environmental weed in three parts of Australia. H. amplexicaule outcompetes and displaces native species, and is also considered to be a threat to rangeland biodiversity in Queensland, Australia. H. amplexicaule cannot be sold in New South Wales, Australia and must be controlled through approved management methods. 2. priority environmental weed in Australia; displaces native species</p>	<p>1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm 2. Blue heliotrope. (2022, March 17). Weed Identification – Brisbane City Council. https://weeds.brisbane.qld.gov.au/weeds/blue-heliotrope</p>

3.05	1. Heliotropium europaeum is a weed in Western Australia 2. Heliotropium indicum is a weed in Africa	1. Heliotrope: pest. (n.d.). Agriculture and Food. https://www.agric.wa.gov.au/pest-plants/heliotrope-pest 2. Heliotropium indicum (Indian heliotrope). (2022). [Dataset]. In CABI Compendium. https://doi.org/10.1079/cabicompendium.26899
4.01	1-3. plant description does not mention spines, thorns, or burrs	1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm 2. NSW WeedWise. (n.d.). https://weeds.dpi.nsw.gov.au/weeds/details/19 3. KAMBHAR, S. V., & Kotresha, K. (2015). A RECORD ON DISTRIBUTION OF HELIOTROPIUM AMPLEXICAULE VAHL (BORAGINACEAE) IN DHARWAD, KARNATAKA, INDIA. J. Econ. Taxon. Bot, 39(2).
4.02	Research has been done on the allelopathy of congeners; 1-2. aqueous extracts of H. europaeum had allelopathic effects	1. Abdulghader, K., Nojavan, M., & Naghshbandi, N. (2008). Chemical stress induced by heliotrope (Heliotropium europaeum L.) allelochemicals and increased activity of antioxidant enzymes. Pakistan journal of biological sciences : PJBS, 11(6), 915–919. https://doi.org/10.3923/pjbs.2008.915.919 2. Aliloo, A.A. (2016). Allelopathy of Heliotropium europaeum (Boraginaceae) : Influence on Small Grain Cereals.
4.03	No evidence of parasitism mentioned in literature	0
4.04	1. H. amplexicaule is generally unpalatable to livestock and will be avoided and only eaten if no other food is available. However, "some individuals continue to eat it indiscriminately"	1. NSW WeedWise. (n.d.). https://weeds.dpi.nsw.gov.au/weeds/details/19
4.05	1. Poisonous to livestock, particularly young cattle 2. toxic to livestock	1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm 2. Cullen, J., Julien, M., & McFadyen, R. (2012). Biological control of weeds in Australia. CSIRO Publishing.
4.06	Lack of evidence of species specific pests and pathogens	0

4.07	<p>1. "Humans also are susceptible to poisoning by these hepatotoxic alkaloids, small quantities of which occur in honey obtained from Echium, Heliotropium and Senecio species. " 2. "Humans have ingested toxic levels of pyrrolizidine alkaloids from species in Heliotropium either directly from herbal teas and contaminated wheat, or indirectly from eggs, milk, and meat"</p>	<p>1. Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia as cited in Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/ 2. Edgar, J. A., and L. W. Smith. 1999. Transfer of pyrrolizidine alkaloids into eggs: Food safety implications. Pages 118-128 in A. T. Tu and W. Gaffield, (eds.). Natural and Selected Synthetic Toxins. American Chemical Society, Colorado. as cited in Plant Epidemiology and Risk Analysis Laboratory Center for Plant Health Science and Technology. (2014). Weed Risk Assessment for Heliotropium europaeum L. (Boraginaceae) – European heliotrope. In United States Department of Agriculture. United States Department of Agriculture.</p>
4.08	lack of information	0
4.09	<p>1. Does best in sun or partial shade 2. shade tolerant.</p>	<p>1. Heliotropium amplexicaule (Clasping Heliotrope, Creeping Heliotrope) North Carolina Extension Gardener Plant Toolbox. (n.d.). https://plants.ces.ncsu.edu/plants/heliotropium-amplexicaule/#:~:text=Creeping%20heliotrope%20does%20best%20in,and%20to%20keep%20more%20compact. 2. Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/</p>

4.10	1. prefers sandy soils 2. grows on a wide range of soils 3. prefers sandy soils	1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm 2. Cullen, J., Julien, M., & McFadyen, R. (2012). Biological control of weeds in Australia. CSIRO Publishing. 3. Blue heliotrope. (2022, March 17). Weed Identification – Brisbane City Council. https://weeds.brisbane.qld.gov.au/weeds/blue-heliotrope
4.11	1-2. herbaceous plant that grows to be 15-30 cm tall	1. Blue heliotrope. (2022, March 17). Weed Identification – Brisbane City Council. https://weeds.brisbane.qld.gov.au/weeds/blue-heliotrope 2. NSW WeedWise. (n.d.). https://weeds.dpi.nsw.gov.au/weeds/details/19
4.12	1. generally found in clumps free of other species. Insufficient evidence for 'yes'	1. Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia as cited in Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-am
5.01	not aquatic	0
5.02	1-2. Family: Boraginaceae	1. Wunderlin, R. P., B. F. Hansen, A. R. Franck, and F. B. Essig. 2023. Atlas of Florida Plants (http://florida.plantatlas.usf.edu/). [S. M. Landry and K. N. Campbell (application development), USF Water Institute.] Institute for Systematic Botany, University of South Florida, Tampa. 2. Heliotropium amplexicaule Vahl. (n.d.). https://www.gbif.org/species/2925790

5.03	1-2. Family: Boraginaceae	<p>1. Wunderlin, R. P., B. F. Hansen, A. R. Franck, and F. B. Essig. 2023. Atlas of Florida Plants (http://florida.plantatlas.usf.edu/). [S. M. Landry and K. N. Campbell (application development), USF Water Institute.] Institute for Systematic Botany, University of South Florida, Tampa.</p> <p>2. Heliotropium amplexicaule Vahl. (n.d.). https://www.gbif.org/species/2925790</p> <p>2. Plant Epidemiology and Risk Analysis Laboratory Center for Plant Health Science and Technology. (2014). Weed Risk Assessment for Heliotropium europaeum L. (Boraginaceae) – European heliotrope. In United States Department of Agriculture. United States Department of Agriculture.</p>
5.04	1. strong slender taproot 2. "Perennial herbs 2-5 dm tall, from deep woody taproots, glandular puberulent and hirsute."	<p>1. NSW WeedWise. (n.d.). https://weeds.dpi.nsw.gov.au/weeds/details/19</p> <p>2. 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. As cited in Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/</p>
6.01	No evidence of substantial reproductive failure	0
6.02	1. reproduces mostly by seed 2. reproduces via seed or from root buds	<p>1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm</p> <p>2. Briese, D. T., & Zapater, M. (2002, September). A strategy for the biological control of blue heliotrope (Heliotropium amplexicaule). In Proceedings of the 13th Australian Weeds Conference (pp. 394-397). Plant Protection Society of Western Australia.</p>
6.03	No evidence of hybridization found	0

6.04	1. Heliotropium species listed in California are genetically self-compatible 2. Heliotropium europaeum is self-compatible	1. Moldenke, A. R. 1976. California pollination ecology and vegetation types. <i>Phytologia</i> 34: 305-361.
6.05	1-2. Insect pollination is the main source of pollination for the genus Heliotropium	1. Les, D. H. (2017). <i>Aquatic Dicotyledons of North America: Ecology, Life History, and Systematics</i> . CRC Press, Boca Raton, FL as cited in Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/ 2. Kadereit, J. W. & Bittrich, V. (ed.). 2016. <i>The Families and Genera of Vascular Plants. Vol. XIV. Flowering Plants. Eudicots: Aquifoliales, Boraginales, Bruniales, Dipsacales, Escalloniales, Garryales, Paracryphiales, Solanales (except Convolvulaceae), Icacinaceae, Metteniusaceae, Vahliaceae</i> . Springer, New York as cited in Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/
6.06	1-2. can establish from root fragments or shoots from roots	1. Heliotropium amplexicaule. (n.d.). Fact Sheet Fusion V2. https://keyserver.lucidcentral.org/weeds/data/media/Html/heliotropium_amplexicaule.htm 2. Blue heliotrope. (2022, March 17). Weed Identification – Brisbane City Council. https://weeds.brisbane.qld.gov.au/weeds/blue-heliotrope
6.07	1-2. Perennial plant 3. able to reach maturity in <1 year	1. Briese, D. T., & Zapater, M. (2002, September). A strategy for the biological control of blue heliotrope (<i>Heliotropium amplexicaule</i>). In <i>Proceedings of the 13th Australian Weeds Conference</i> (pp. 394-397). Plant Protection Society of Western Australia. 2. Blue heliotrope. (2022, March 17). Weed Identification – Brisbane City Council. https://weeds.brisbane.qld.gov.au/weeds/blue-heliotrope 3. Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/

7.01	1-2. seeds are commonly spread by farm machinery and other vehicles	<p>1. NSW WeedWise. (n.d.). https://weeds.dpi.nsw.gov.au/weeds/details/19</p> <p>2. Blue heliotrope. (2022, March 17). Weed Identification – Brisbane City Council. https://weeds.brisbane.qld.gov.au/weeds/blue-heliotrope</p>
7.02	1. plant is for sale at Lowes 2. seeds available on Amazon	<p>1. Lowe’s Blue heliotrope in 2.5-Quart pot. (n.d.). https://www.lowes.com/pd/2-5-Quart-Blue-Heliotrope-in-Pot-L9146/4779512</p> <p>2. Amazon.com : QAUZUY GARDEN 50 Premium Common Garden Heliotrope Seeds Cherry Pie, Heliotropium, Marine Blue Flower Seeds - Perennial Showy Garden Cut Flower Arrangements Bouquets : Patio, Lawn & garden. (n.d.). https://www.amazon.com/QAUZUY-GARDEN-Common-Garden-Heliotrope-Heliotropium/dp/B0BNC45QK1/ref=sr_1_6?c=ts&keywords=Flower+Plants+%26+Seeds&qid=1696965682&refinements=p_n_feature_three_browse-bin%3A3749981&s=lawn-garden&sr=1-6&ts_id=3749091</p>
7.03	1. can disperse as a fodder contaminant 2. can disperse as a produce contaminant	<p>1. Blue heliotrope. (2022, March 17). Weed Identification – Brisbane City Council. https://weeds.brisbane.qld.gov.au/weeds/blue-heliotrope</p> <p>2. Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/</p>
7.04	1-2. seeds not adapted to wind dispersal	<p>1. Blue heliotrope. (2022, March 17). Weed Identification – Brisbane City Council. https://weeds.brisbane.qld.gov.au/weeds/blue-heliotrope</p> <p>2. Australia, A. O. L. (n.d.). Heliotropium amplexicaule WEEDS AUSTRALIA profiles. https://profiles.ala.org.au/opus/weeds-australia/profile/Heliotropium%20amplexicaule</p>

7.05	1. commonly spread through water dispersal 2. spread through water dispersal	1. NSW WeedWise. (n.d.). https://weeds.dpi.nsw.gov.au/weeds/details/19 2. Briese, D. T., & Zapater, M. (2002, September). A strategy for the biological control of blue heliotrope (<i>Heliotropium amplexicaule</i>). In Proceedings of the 13th Australian Weeds Conference (pp. 394-397). Plant Protection Society of Western Australia.
7.06	no specific evidence pointing towards bird dispersal	0
7.07	1. seeds are sticky and adhere to animals 2. dispersed via animal movement	1. NSW WeedWise. (n.d.). https://weeds.dpi.nsw.gov.au/weeds/details/19 2. Briese, D. T., & Zapater, M. (2002, September). A strategy for the biological control of blue heliotrope (<i>Heliotropium amplexicaule</i>). In Proceedings of the 13th Australian Weeds Conference (pp. 394-397). Plant Protection Society of Western Australia.
7.08	1-2. seeds can survive passing through the digestive track of animals	1. NSW WeedWise. (n.d.). https://weeds.dpi.nsw.gov.au/weeds/details/19 2. Plant Pono. (2018, December 5). <i>Heliotropium amplexicaule</i> - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/
8.01	1. "Prolific seed production in Australia"	1. Plant Pono. (2018, December 5). <i>Heliotropium amplexicaule</i> - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/
8.02	1. "relatively long-lived seed bank"	1. Briese, D. T., & Zapater, M. (2002, September). A strategy for the biological control of blue heliotrope (<i>Heliotropium amplexicaule</i>). In Proceedings of the 13th Australian Weeds Conference (pp. 394-397). Plant Protection Society of Western Australia.

8.03	<p>1. Heliotropium amplexicaule can be controlled through the use of Dicamba, Fluroxypyr, Tebuthiuron, a combination of Triclopyr and Picloram, a combination of Picloram, Triclopyr, and Aminopyralid, a combination of Amitrole and Ammonium thiocyanate, and a combination of 2,4-D and Picloram</p> <p>2. "Herbicides have had limited success in reducing its impact and have not stopped its spread"</p>	<p>1. NSW WeedWise. (n.d.). https://weeds.dpi.nsw.gov.au/weeds/details/19</p> <p>2. Briese, D. T., & Zapater, M. (2002, September). A strategy for the biological control of blue heliotrope (Heliotropium amplexicaule). In Proceedings of the 13th Australian Weeds Conference (pp. 394-397). Plant Protection Society of Western Australia.</p>
8.04	<p>1. "Blue heliotrope proliferates aggressively because of its abundant seed output and ready regeneration from root buds, especially those on root fragments left after mechanical disturbance."</p> <p>2. tolerates mowing and mechanical damage; will resprout from roots</p>	<p>1. Parsons, W.T. & Cuthbertson, E.G. 2001. Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia as cited in Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/</p> <p>2. Plant Pono. (2018, December 5). Heliotropium amplexicaule - Plant Pono. https://plantpono.org/hpwra/heliotropium-amplexicaule/</p>
8.05	No specific enemies in US known	0