

Key Words: High Risk, Naturalized, Environmental Weed, Toxic Seeds, Edible Fruit

Family: *Annonaceae*

Taxon: *Annona reticulata*

Synonym: *Annona lutescens* Saff.

Common Name: ox-heart
bullock's-heart
custard-apple

Questionnaire :	current 20090513	Assessor:	Patti Clifford	Designation:	H(HPWRA)
Status:	Assessor Approved	Data Entry Person:	Patti Clifford	WRA Score	11
101	Is the species highly domesticated?		y=-3, n=0		n
102	Has the species become naturalized where grown?		y=1, n=-1		
103	Does the species have weedy races?		y=1, n=-1		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"		(0-low; 1-intermediate; 2-high) (See Appendix 2)		High
202	Quality of climate match data		(0-low; 1-intermediate; 2-high) (See Appendix 2)		High
203	Broad climate suitability (environmental versatility)		y=1, n=0		y
204	Native or naturalized in regions with tropical or subtropical climates		y=1, n=0		y
205	Does the species have a history of repeated introductions outside its natural range?		y=-2, ?=-1, n=0		y
301	Naturalized beyond native range		y = 1*multiplier (see Appendix 2), n= question 205		y
302	Garden/amenity/disturbance weed		n=0, y = 1*multiplier (see Appendix 2)		n
303	Agricultural/forestry/horticultural weed		n=0, y = 2*multiplier (see Appendix 2)		n
304	Environmental weed		n=0, y = 2*multiplier (see Appendix 2)		y
305	Congeneric weed		n=0, y = 1*multiplier (see Appendix 2)		y
401	Produces spines, thorns or burrs		y=1, n=0		n
402	Allelopathic		y=1, n=0		
403	Parasitic		y=1, n=0		n
404	Unpalatable to grazing animals		y=1, n=-1		
405	Toxic to animals		y=1, n=0		n
406	Host for recognized pests and pathogens		y=1, n=0		
407	Causes allergies or is otherwise toxic to humans		y=1, n=0		y
408	Creates a fire hazard in natural ecosystems		y=1, n=0		n
409	Is a shade tolerant plant at some stage of its life cycle		y=1, n=0		y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)		y=1, n=0		y

411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	
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	
604	Self-compatible or apomictic	y=1, n=-1	
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
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	
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	
706	Propagules bird dispersed	y=1, n=-1	
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)	y=1, n=-1	
803	Well controlled by herbicides	y=-1, n=1	
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y=-1, n=1	

Designation: H(HPWRA)

WRA Score **11**

Supporting Data:

101	2012. WRA Specialist. Personal Communication.	[Is the species highly domesticated? No] No evidence of domestication that reduces invasive traits.
102	2012. WRA Specialist. Personal Communication.	[Has the species become naturalized where grown? NA]
103	2012. WRA Specialist. Personal Communication.	[Does the species have weedy races? NA]
201	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical? 2- High] "The custard apple is believed to be a native of the West Indies but it was carried in early times through Central America to southern Mexico. It has long been cultivated and naturalized as far south as Peru and Brazil. It is commonly grown in the Bahamas and occasionally in Bermuda and southern Florida
202	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Quality of climate match data? 2-High] "The custard apple is believed to be a native of the West Indies but it was carried in early times through Central America to southern Mexico. It has long been cultivated and naturalized as far south as Peru and Brazil. It is commonly grown in the Bahamas and occasionally in Bermuda and southern Florida."
203	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Broad climate suitability (environmental versatility)? Yes] "The custard apple tree needs a tropical climate but with cooler winters than those of the west coast of Malaya. It flourishes in the coastal lowlands of Ecuador; is rare above 5,000 ft (1,500 m). In Guatemala, it is nearly always found below 4,000 ft (1,220 m). In India, it does well from the plains up to an elevation of 4,000 ft (1,220 m); in Ceylon, it cannot be grown above 3,000 ft (915 m). Around Luzon in the Philippines, it is common below 2,600 ft (800 m). It is too tender for California and trees introduced into Palestine succumbed to the cold. In southern Florida the leaves are shed at the first onset of cold weather and the tree is dormant all winter. Fully grown, it has survived temperatures of 27° to 28°F (-2.78° to 2.22°C) without serious harm."
203	2007. Ecocrop. <i>Annona reticulata</i> . Food and Agriculture Organization of the United Nations, http://ecocrop.fao.org/ecocrop/srv/en/cropView?id=412	[Broad climate suitability (environmental versatility)? Yes] Native of the Caribbean area, and also occur in Central America, northern South America and in South-East Asia at elevations between sea level and 1500 m.
204	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Native or naturalized in regions with tropical or subtropical climates? Yes] "The custard apple is believed to be a native of the West Indies but it was carried in early times through Central America to southern Mexico. It has long been cultivated and naturalized as far south as Peru and Brazil. It is commonly grown in the Bahamas and occasionally in Bermuda and southern Florida."
205	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Does the species have a history of repeated introductions outside its natural range? Yes] "The custard apple is believed to be a native of the West Indies but it was carried in early times through Central America to southern Mexico. It has long been cultivated and naturalized as far south as Peru and Brazil. It is commonly grown in the Bahamas and occasionally in Bermuda and southern Florida. Apparently it was introduced into tropical Africa early in the 17th century and it is grown in South Africa as a dooryard fruit tree. In India the tree is cultivated, especially around Calcutta, and runs wild in many areas. It has become fairly common on the east coast of Malaya, and more or less throughout southeast Asia and the Philippines though nowhere particularly esteemed. Eighty years ago it was reported as thoroughly naturalized in Guam. In Hawaii it is not well known."
205	2005. Staples, G.W./Herbst, D.R.. <i>A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places</i> . Bishop Museum Press, Honolulu, HI	[Does the species have a history of repeated introductions outside its natural range? Yes] Widely cultivated and naturalized throughout the tropics.
301	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Naturalized beyond native range? Yes] "The custard apple is believed to be a native of the West Indies but it was carried in early times through Central America to southern Mexico. It has long been cultivated and naturalized as far south as Peru and Brazil. It is commonly grown in the Bahamas and occasionally in Bermuda and southern Florida."
301	2003. Groves, R.H./Hosking, J.R./Batianoff, G.N. et al.. Weed categories for natural and agricultural ecosystem weed management. Bureau of Rural Sciences, Canberra	[Naturalized beyond native range? Yes] <i>Annona reticulata</i> is naturalized in Queensland, Australia. It is impacting natural ecosystems and a national containment or eradication program is recommended.

302	2003. Groves, R.H./Hosking, J.R./Batianoff, G.N. et al.. Weed categories for natural and agricultural ecosystem weed management. Bureau of Rural Sciences, Canberra	[Garden/amenity/disturbance weed? No] <i>Annona reticulata</i> is naturalized in Queensland, Australia. It is impacting natural ecosystems and a national containment or eradication program is recommended. [scored as an environmental weed]
303	2012. WRA Specialist. Personal Communication.	[Agricultural/forestry/horticultural weed? No] No evidence of <i>Annona reticulata</i> as an agricultural weed that causes productivity losses or costs due to control.
304	2003. Groves, R.H./Hosking, J.R./Batianoff, G.N. et al.. Weed categories for natural and agricultural ecosystem weed management. Bureau of Rural Sciences, Canberra	[Environmental weed? Yes] <i>Annona reticulata</i> is naturalized in Queensland, Australia. It is impacting natural ecosystems and a national containment or eradication program is recommended.
305	2003. CRC. Weed management guide - pond apple <i>Annona glabra</i> . CRC Australian Weed Management, http://www.weeds.gov.au/publications/guidelines/wons/pubs/a-glabra.pdf	[Congeneric weed? Yes] " <i>Annona glabra</i> is a Weed of National Significance. It is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts. Introduced as grafting stock for the closely related custard apple, it is a very hardy tree and an aggressive invader. Over time the dense thickets it forms can gradually replace everything else in the canopy and create an undesirable new habitat."
305	2003. Weber, E.. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Congeneric weed? Yes] <i>Annona glabra</i> is an invasive tree/shrub that forms dense thickets and shades out native shrubs and trees by preventing their establishment and growth. Species richness is reduced in stands of this tree/shrub.
401	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Produces spines, thorns or burrs? No] <i>Annona reticula</i> is an erect tree, with a rounded or spreading crown and trunk 10 to 14 in (25-35 cm) thick. Height ranges from 15 to 35 ft (4.5-10 m). The leaves are deciduous, alternate, oblong or narrow-lanceolate, 4 to 8 in (10-20 cm) long, 3/4 to 2 in (2-5 cm) wide, with conspicuous veins.
402	2012. WRA Specialist. Personal Communication.	[Allelopathic? Unknown]
403	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Parasitic? No] Annonaceae.
404	2012. WRA Specialist. Personal Communication.	[Unpalatable to grazing animals? Unknown]
405	2012. National Center for Biotechnology Information. PubMed. http://www.ncbi.nlm.nih.gov/sites/entrez	[Toxic to animals? No] No evidence of toxicity to animals.
405	2012. Specialized Information Services, U.S. National Library of Medicine. TOXNET toxicology data network [online database]. National Institutes of Health, http://toxnet.nlm.nih.gov/	[Toxic to animals? No] No evidence of toxicity to animals.
406	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Host for recognized pests and pathogens?] " <i>The custard apple is heavily attacked by the chalcid fly. Many if not all of the fruits on a tree may be mummified before maturity. In India, the ripening fruits must be covered with bags or nets to avoid damage from fruit bats. A dry charcoal rot was observed on the fruits in Assam in 1947. In 1957 and 1958 it made its appearance at Saharanpur. The causal fungus was identified as <i>Diplodia annonae</i>. The infection begins at the stem end of the fruit and gradually spreads until it covers the entire fruit.</i> "
407	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Causes allergies or is otherwise toxic to humans?] " <i>In India, the fruit is eaten only by the lower classes, out-of-hand. In Central America, Mexico and the West Indies, the fruit is appreciated by all. When fully ripe it is soft to the touch and the stem and attached core can be easily pulled out.</i> " [food]
407	2007. Ecocrop. <i>Annona reticulata</i> . Food and Agriculture Organization of the United Nations, http://ecocrop.fao.org/ecocrop/srv/en/cropView?id=412	[Causes allergies or is otherwise toxic to humans? Yes] The hard seeds are very toxic and all non-fruit parts are quite toxic.
408	2012. WRA Specialist. Personal Communication.	[Creates a fire hazard in natural ecosystems? No] No evidence of biomass accumulation that results in a fire hazard.
409	2007. Ecocrop. <i>Annona reticulata</i> . Food and Agriculture Organization of the United Nations, http://ecocrop.fao.org/ecocrop/srv/en/cropView?id=412	-[Is a shade tolerant plant at some stage of its life cycle? Yes] Young trees need partial shade.

410	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)? Yes] "The custard apple does best in low-lying, deep, rich soil with ample moisture and good drainage. It grows to full size on oolitic limestone in southern Florida and runs wild in light sand and various other types of soil in the New and Old World tropics."
410	2012. Lim, T.K.. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	[Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)? Yes] <i>Annona reticulata</i> grows on many soil types with pH from 5-8, but thrives best in low-lying, deep, rich soil with ample moisture and good drainage. It is intolerant of water-logging.
411	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Climbing or smothering growth habit? No] Tree.
412	2003. CRC. Weed management guide - pond apple <i>Annona glabra</i> . CRC Australian Weed Management, http://www.weeds.gov.au/publications/guidelines/wons/pubs/a-glabra.pdf	[Forms dense thickets?] <i>Annona glabra</i> , a related species does form dense thickets.
412	2012. WRA Specialist. Personal Communication.	[Forms dense thickets? Unknown]
501	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Aquatic? No] Terrestrial; tree.
502	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Grass? No] Annonaceae; tree.
503	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Nitrogen fixing woody plant? No] Annonaceae.
504	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] Tree; woody.
601	2012. WRA Specialist. Personal Communication.	[Evidence of substantial reproductive failure in native habitat? No] No evidence.
602	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Produces viable seed? Yes] "Seed is the usual means of propagation. Nevertheless, the tree can be multiplied by inarching, or by budding or grafting onto its own seedlings or onto soursop, sugar apple or pond apple rootstocks."
602	1994. Hernando Bermejo, J.E./Leon, J. (eds.). Neglected Crops: 1492 from a Different Perspective. Plant Production and Protection Series No. 26. FAO, Rome http://www.hort.purdue.edu/newcrop/1492/annona_s.html	[Produces viable seed? Yes] <i>Annona reticulata</i> is generally propagated by seed, the germination rate of which ranges from low to medium. Grafting is usually done on stock of the same species.
603	2012. WRA Specialist. Personal Communication.	[Hybridizes naturally? Unknown]
604	2012. WRA Specialist. Personal Communication.	[Self-compatible or apomictic? Unknown]
605	2009. Pena, J.E./Crane, J.H.. Insect/mite management in <i>Annona</i> spp.. U.S. Department of Agriculture, Cooperative Extension Service, University of Florida, IFAS, Florida A. & M. University Cooperative Extension Program, and Boards of County Commissioners C	[Requires specialist pollinators? No] "The majority of Annonaceae are pollinated by beetles, although some are pollinated by thrips." [family-level description]
606	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Reproduction by vegetative fragmentation? No] "Seed is the usual means of propagation. Nevertheless, the tree can be multiplied by inarching, or by budding or grafting onto its own seedlings or onto soursop, sugar apple or pond apple rootstocks."

606	1994. Hernando Bermejo, J.E./Leon, J. (eds.). Neglected Crops: 1492 from a Different Perspective. Plant Production and Protection Series No. 26. FAO, Rome http://www.hort.purdue.edu/newcrop/1492/annona.html	[Reproduction by vegetative fragmentation? No] Annona reticulata is generally propagated by seed, the germination rate of which ranges from low to medium. Grafting is usually done on stock of the same species.
607	2007. Ecocrop. Annona reticulata. Food and Agriculture Organization of the United Nations, http://ecocrop.fao.org/ecocrop/srv/en/cropView?id=412	[Minimum generative time (years)? 3+] "Begin to fruit 3-5 years after sowing."
701	2012. WRA Specialist. Personal Communication.	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? No] No evidence of unintentional dispersal.
702	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Propagules dispersed intentionally by people? Yes] "The custard apple is believed to be a native of the West Indies but it was carried in early times through Central America to southern Mexico. It has long been cultivated and naturalized as far south as Peru and Brazil. It is commonly grown in the Bahamas and occasionally in Bermuda and southern Florida. Apparently it was introduced into tropical Africa early in the 17th century and it is grown in South Africa as a dooryard fruit tree. In India the tree is cultivated, especially around Calcutta, and runs wild in many areas. It has become fairly common on the east coast of Malaya, and more or less throughout southeast Asia and the Philippines though nowhere particularly esteemed. Eighty years ago it was reported as thoroughly naturalized in Guam. In Hawaii it is not well known."
702	1994. Hernando Bermejo, J.E./Leon, J. (eds.). Neglected Crops: 1492 from a Different Perspective. Plant Production and Protection Series No. 26. FAO, Rome http://www.hort.purdue.edu/newcrop/1492/annona.html	[Propagules dispersed intentionally by people? Yes] Introduced to the American tropics and Southeast Asia.
702	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Propagules dispersed intentionally by people? Yes] Widely cultivated and naturalized throughout the tropics.
703	2012. WRA Specialist. Personal Communication.	[Propagules likely to disperse as a produce contaminant? No] No evidence.
704	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Propagules adapted to wind dispersal? No] Heart-shaped fruit 6" long.
705	2012. Lim, T.K.. Edible Medicinal and Non-Medicinal Plants. Volume 1, Fruits. Springer, New York	[Propagules water dispersed?] Intolerant of water-logging. [Unlikely]
705	2012. WRA Specialist. Personal Communication.	[Propagules water dispersed? Unknown].
706	2012. WRA Specialist. Personal Communication.	[Propagules bird dispersed? Unknown]
707	2005. Staples, G.W./Herbst, D.R.. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Propagules dispersed by other animals (externally)? No] Heart-shaped fruit 6" long. [no means of external attachment]
708	2011. Kunz, T.H./Braun de Torrez, E./Bauer, D./Lobova, T./Fleming, T.H.. Ecosystem services provided by bats. Annals of the New York Academy of Sciences. 1223: 1-38.	[Propagules survive passage through the gut? Yes] Annona reticulata seeds are dispersed by bats.
801	1987. Morton, J.F.. Fruits of warm climates. J.F. Morton, Miami, FL http://www.hort.purdue.edu/newcrop/morton/index.html	[Prolific seed production (>1000/m ²)?No] With adequate care, a mature tree will produce 75 to 100 lbs (34-45 kg) of fruits per year. Actual seed counts have been 55, 60 and 76 per fruit.
801	2007. Ecocrop. Annona reticulata. Food and Agriculture Organization of the United Nations, http://ecocrop.fao.org/ecocrop/srv/en/cropView?id=412	[Prolific seed production (>1000/m ²)?No] Trees usually bear about 20-40 fruits per year, each about 300 g in weight but may produce up to 45 kg per year.
802	2012. WRA Specialist. Personal Communication.	[Evidence that a persistent propagule bank is formed (>1 yr)? Unknown]

803	2012. WRA Specialist. Personal Communication.	[Well controlled by herbicides? Unknown]
804	2012. WRA Specialist. Personal Communication.	[Tolerates, or benefits from, mutilation, cultivation, or fire? Unknown]
805	2012. WRA Specialist. Personal Communication.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Unknown]
