Taxon: Orbea variegata

Family: Apocynaceae

Common Name(s): carrion flower
starfish cactus
starfishplant
toad cactus
toadplant

Synonym(s): Stapelia atrata Tod.
Stapelia ciliolulata Tod. ex Rüst
Stapelia clypeata Donn ex Jacq.
Stapelia hanburyana A. Berger & Rüst
Stapelia planiflora Jacq.
Stapelia rugosa Donn ex Jacq.
Stapelia variegata L.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 17 Jun 2015

WRA Score: 8.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Succulent, Environmental Weed, Dense Cover, Vegetative Reproduction, 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	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	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)	n
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic	y=1, n=0	n
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
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	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	y
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	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)		
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	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut	y=1, n=-1	n
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	n
803	Well controlled by herbicides	y=-1, n=1	y
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**
	Bruyns, P. V. (2002). Monograph of Orbea and Ballyanthus American Society of Plant Taxonomists. Systematic Botany Monographs, 63: 1-196	[Assessment of wild type. Variable species. Some selection may have occurred in cultivation] "Over its long history, there has been more unjustified and pointless "splitting" of O. variegata than of any other stapeliad (Leach 1978). Many of the authors of these names have themselves cast doubt on whether they are distinguishable with any certainty from O. variegata, but White and Sloane (1937) still managed to construct a key to many of these "varieties." Yet, they also pointed out the extent of the variability of the species, how many of these variants had been found cohabiting within an area of a few square meters, and that the same plant even produces rather different flowers on occasion."

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

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	NA

201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**High**
	Source(s)	**Notes**
	USDA, ARS, National Genetic Resources Program. 2015. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/. [Accessed 16 Jun 2015]	"Native: AFRICA Southern Africa: South Africa - Cape Province"

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	USDA, ARS, National Genetic Resources Program. 2015. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/. [Accessed]	

203	**Broad climate suitability (environmental versatility)**	**n**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Honan. I. 2006. A succulent escape in the arid lands of southern Australia – carrion flower (Orbea variegata). Pp. 188-190 in C. Preston, J.H. Watts & N.D. Crossman (eds.). 15th Australian Weeds Conference proceedings: managing weeds in a changing climate. Weed Management Society of SA	"Carrion flower (Orbea variegata (L.) Haw.) has been seen as a pest plant on the Upper Eyre Peninsula for over 30 years. The plant fits into the 'no care' ornamental category and was said to be grown in the harsh arid climate of Upper Eyre Peninsula both for its flowers and its ability to attract flies."
	Learn 2 Grow. 2015. Orbea variegate. www.learn2grow.com/plants/orbea-variegata/	"Carrion flowers can be very difficult to grow even in dry climates similar to that of their homeland. They are quite prone to rotting off at the soil line if not perfectly drained. Even under the best conditions they may inexplicably die out or rot away. Unlike other succulent cuttings that are planted in sand to encourage rooting, these plants prefer to lie on top of the ground, rooting where they fall without planting. Planting cuttings makes them far more prone to rot. "

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	**Notes**
	Queensland Government. 2011. Weeds of Australia. Carion flower. Orbea variegate. http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Orbea_variegata.htm. [Accessed 16 Jun 2015]	[Naturalized at latitudes of approximately 27° S. Marginally subtropical] "This species is mainly naturalised on the Eyre Peninsula in the southern parts of South Australia. It has also been recorded from the southern Lofty Mountains region in south-eastern South Australia, from near Kalgoorlie in inland Western Australia, and from the Darling Downs in the inland parts of south-eastern Queensland."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	**Notes**
	South African National Biodiversity Institute. 2006. Orbea. http://www.plantzafrica.com/plantnop/orbea.htm. [Accessed 16 Jun 2015]	"O. variegata (L.) Haw. is probably the most well known of all the species, having been in cultivation the longest. As it was one of the first South African stapeliads to be cultivated in Europe "
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	"Orbea variegata (L.) Haw (Asclepiadaceae) is a recent introduction to some arid zones of South Australia. It is believed to have been introduced to the region as an easy-care garden perennial, and it was first collected from the field near the BHP nursery in Whyalla (32829 S, 1378329 E) in 1967 (Poyner, 1995)."

301	Naturalized beyond native range	y
	Source(s)	**Notes**
	Hamilton, M. A., Turner, P. J., & Wurst, D. (2013). Carrion flower, a novel invasive species in NSW. Pp.33-136 In: Proceedings of the 17th NSW Weeds Conference. Corowa, New South Wales, 9-12 September 2013	"Carrion flower (Orbea variegata (L.) Haw.) is a stem-succulent, perennial herb in the Apocynaceae family. Native to South Africa and widely cultivated as a hardy, 'low-care' ornamental plant; it has naturalised in semi-arid and arid parts of Western Australia, South Australia, and Queensland."

Qsn #	Question	Answer
	Queensland Government. 2011. Weeds of Australia. Carion flower. Orbea variegate. http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Orbea_variegata.htm. [Accessed 16 Jun 2015]	"This species is mainly naturalised on the Eyre Peninsula in the southern parts of South Australia. It has also been recorded from the southern Lofty Mountains region in south-eastern South Australia, from near Kalgoorlie in inland Western Australia, and from the Darling Downs in the inland parts of south-eastern Queensland."

302	Garden/amenity/disturbance weed	n
	Source(s)	**Notes**
	Queensland Government. 2011. Weeds of Australia. Carion flower. Orbea variegate. http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Orbea_variegata.htm. [Accessed 16 Jun 2015]	[A garden escape with negative environmental impacts] "Carion flower (Orbea variegata) is regarded as an environmental weed in South Australia and is listed as a priority environmental weed in at least one Natural Resource Management region. This species has escaped cultivation and is becoming a serious garden escape in the arid lands of South Australia. It is also listed as an invasive garden plant in the Greater Adelaide Region."

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

304	Environmental weed	y
	Source(s)	**Notes**
	Honan. I. 2006. A succulent escape in the arid lands of southern Australia – carrion flower (Orbea variegata). Pp. 188-190 in C. Preston, J.H. Watts & N.D. Crossman (eds.). 15th Australian Weeds Conference proceedings: managing weeds in a changing climate. Weed Management Society of SA	"Carrion flower is having a significant impact on native vegetation in and around Whyalla. While the plant has been noted to behave as an aggressive pest on the rocky hills in Whyalla (Hudson, 1985), it appears it has been equally destructive on the pastoral saltbush/bluebush where it is well established (Dunbar 1996, Lenz 1999)."
	Hamilton, M. A., Turner, P. J., & Wurst, D. (2013). Carrion flower, a novel invasive species in NSW. Pp.33-136 In: Proceedings of the 17th NSW Weeds Conference. Corowa, New South Wales, 9-12 September 2013	"Upon discovering the infestation, a NSW Weed Risk Assessment was performed to ascertain potential risk. This assessment confirmed that carrion flower is a 'very high risk' weed. The NSW National Parks and Wildlife Service (NPWS) immediately treated the weed to prevent further spread."

Qsn #	Question	Answer
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	[Orbea has a severe detrimental effect on the native vegetation] "This study measured the impact of an introduced plant species, Orbea variegata (African carrion flower), upon the dominant shrub Atriplex vesicaria (bladder saltbush) and the annual plant community in chenopod shrublands of South Australia. Shrubs with Orbea growing underneath were likely to be less healthy than shrubs without Orbea. Pre-dawn water potential and growth of saltbush decreased in the presence of Orbea. Orbea appears to limit water availability to saltbush either by direct competition, a decrease in rainfall penetration through the soil, or a combination of both. Orbea also reduced both the germinable soil seed bank and the biomass of annual plants. Our data suggest that Orbea has a severe detrimental effect on the native vegetation. We speculate that Orbea has the potential to spread further into the chenopod shrublands during years of particularly high summer rainfall."

305	Congeneric weed	n
	Source(s)	**Notes**
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence [Only includes entry for Orbea variegate]

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Learn 2 Grow. 2015. Orbea variegate. www.learn2grow.com/plants/orbea-variegata/	"Carrion flowers feature a clump of four sided, angled blue green stems bearing distinguished tubercles along the edges that feature a hardened tip. These are not thorns nor are they spines."
	Bruyns, P. V. (2002). Monograph of Orbea and Ballyanthus American Society of Plant Taxonomists. Systematic Botany Monographs, 63: 1-196	"Small succulent forming clumps 5-20 cm (-1 m) in diameter, not rhizomatous. Stems 2.5-10 cm long, 0.5-1 cm in diameter (excluding teeth), (shortly) decumbent, green mot tled with purple-brown; tubercles 3-9 mm long, arranged loosely into 4 obtuse rows along stem with a groove between rows, tapering to a spreading to ascending conical acute tooth, often with a minute denticle on either side near apex."
	South African National Biodiversity Institute. 2006. Orbea. http://www.plantzafrica.com/plantnop/orbea.htm. [Accessed 16 Jun 2015]	"The four-angled stems are usually prominently sharp-toothed, with a soft tip."

402	Allelopathic	n
	Source(s)	**Notes**
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	"Orbea also had a detrimental effect on the plant annual community by reducing the number of seedlings emerging from the soil seed bank and the biomass of ephemerals growing under dense Orbea mats. Because the removal of Orbea resulted in similar ephemeral biomass as in areas without Orbea it can be assumed that there is no persistent accumulation of allelopathic compounds."

403	Parasitic	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Bruyns, P. V. (2002). Monograph of Orbea and Ballyanthus American Society of Plant Taxonomists. Systematic Botany Monographs, 63: 1-196	"Small succulent forming clumps 5-20 cm (-1 m) in diameter, not rhizomatous." [No evidence. Apocynaceae]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Lenz, T. I., & Facelli, J. M. (2003). Shade facilitates an invasive stem succulent in a chenopod shrubland in South Australia. Austral Ecology, 28(5), 480-490	"Both invertebrate herbivory and fungal infections have been observed in O. variegate (Hudson 1986; T. Lenz, pers. obs.,1998–1999), but their impacts on the population appear minimal."

405	Toxic to animals	n
	Source(s)	**Notes**
	ASPCA. 2015. Toad Spotted Cactus. https://www.aspca.org/pet-care/animal-poison-control/toxic-and-non-toxic-plants/toad-spotted-cactus. [Accessed 16 Jun 2015]	"Toxicity: Non-Toxic to Dogs, Non-Toxic to Cats"
	Lenz, T. I., & Facelli, J. M. (2003). Shade facilitates an invasive stem succulent in a chenopod shrubland in South Australia. Austral Ecology, 28(5), 480-490	[No evidence] "Both invertebrate herbivory and fungal infections have been observed in O. variegate (Hudson 1986; T. Lenz, pers. obs. 1998–1999), but their impacts on the population appear minimal."

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**
	Learn 2 Grow. 2015. Orbea variegate. www.learn2grow.com/plants/orbea-variegata/	"Adult plants may suffer from mealy bugs in the roots as well."
	Rau, E. 2015. President, Sustainable Bioresources, LLC. Personal Communication. 17 June	"Not affected by false spider mites or anthracnose even when surrounded by heavily infested plants (Hoodia spp.)." ... " Seldom affected by soft rot in well draining soil. Lesions tend to be localized on the plant and walled off. Rotted off/severed pieces can reroot in cinder based soil media."
	South African National Biodiversity Institute. 2006. Orbea. http://www.plantzafrica.com/plantnop/orbea.htm. [Accessed 17 Jun 2015]	"The most common pests include scale (Figure 8) on the stems and mealy bugs on the roots. The latter can cause fungal infections that may devastate plants within days."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence
	Specialized Information Services, U.S. National Library of Medicine. 2015. TOXNET toxicology data network [online database]. http://toxnet.nlm.nih.gov/. [Accessed 17 Jun 2015]	No evidence

408	Creates a fire hazard in natural ecosystems	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	[Not listed among adverse impacts]
	Bruyns, P. V. (2002). Monograph of Orbea and Ballyanthus American Society of Plant Taxonomists. Systematic Botany Monographs, 63: 1-196	[Succulent habit & sparsely vegetated habitat may minimize fire risk] "Small succulent forming clumps 5-20 cm (-1 m) in diameter, not rhizomatous." ... "Orbea variegata generally grows on gentle (rarely steep), stony slopes, sometimes under bushes but also more or less fully exposed on rock slabs or ledges."

409	**Is a shade tolerant plant at some stage of its life cycle**	**y**
	Source(s)	**Notes**
	Rau, E. 2015. President, Sustainable Bioresources, LLC. Personal Communication. 17 June	"Does best in partial shade. In full sun specimens fail to thrive, have purple color suggestive of stress. In nature these may grow under other plants."
	Lenz, T. I., & Facelli, J. M. (2003). Shade facilitates an invasive stem succulent in a chenopod shrubland in South Australia. Austral Ecology, 28(5), 480-490	"In the field O. variegate performed considerably better under Atriplex vesicaria Heward ex Benth. (Chenopodiaceae) or under 75–80% shade cloth than in full light. Monthly irrigation of 20 mm did not reduce this positive effect of the A. vesicaria canopy on O. variegate , suggesting that O. variegate is inhibited by high light intensities or temperatures, independent of water availability. In conclusion, whereas shrub canopies do not seem to be required for the establishment or survival of O. variegate , shrubs improve adult growth and can improve establishment. The possibility of exotic plants being facilitated by other plants has to be taken into account when assessing the probability and rate of invasion." ... "The shade of canopies increased the growth of O. variegata and quite likely assisted with, or at least had no negative effect on, germination and seedling establishment at water availability levels likely to be found in the field. However, the response of O. variegata to shade in the field was highly variable and patches in full light were still able to survive, grow and reproduce. Thus, although the presence of shrubs may have increased the growth of individual O. variegata patches, their presence did not appear to be obligatory."

410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**y**
	Source(s)	**Notes**
	Learn 2 Grow. 2015. Orbea variegate. www.learn2grow.com/plants/orbea-variegata/	"Soil pH: Neutral, Alkaline Soil Drainage: Well Drained Soil type: Loam, Sand"

Qsn #	Question	Answer
411	**Climbing or smothering growth habit**	**n**
	Source(s)	**Notes**
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	"The succulent stems of Orbea variegate (hencefore called Orbea) grow upright and close together forming dense mats that spread via asexual reproduction (Albers & Meve, 1991)."

412	**Forms dense thickets**	**y**
	Source(s)	**Notes**
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	"The succulent stems of Orbea variegate (hencefore called Orbea) grow upright and close together forming dense mats that spread via asexual reproduction (Albers & Meve, 1991)." ... "Orbea also had a detrimental effect on the plant annual community by reducing the number of seedlings emerging from the soil seed bank and the biomass of ephemerals growing under dense Orbea mats."

501	**Aquatic**	**n**
	Source(s)	**Notes**
	Bruyns, P. V. (2002). Monograph of Orbea and Ballyanthus American Society of Plant Taxonomists. Systematic Botany Monographs, 63: 1-196	[Terrestrial] "Orbea variegata generally grows on gentle (rarely steep), stony slopes, sometimes under bushes but also more or less fully exposed on rock slabs or ledges."

502	**Grass**	**n**
	Source(s)	**Notes**
	USDA, ARS, National Genetic Resources Program. 2015. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/. [Accessed 15 Jun 2015]	"Family: Apocynaceae subfamily: Asclepiadoideae tribe: Ceropegieae subtribe: Stapeliinae. Also placed in: Asclepiadaceae "

503	**Nitrogen fixing woody plant**	**n**
	Source(s)	**Notes**
	Bruyns, P. V. (2002). Monograph of Orbea and Ballyanthus American Society of Plant Taxonomists. Systematic Botany Monographs, 63: 1-196	"Small succulent forming clumps 5-20 cm (-1 m) in diameter, not rhizomatous" [Apocynaceae]

504	**Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)**	**n**
	Source(s)	**Notes**
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	"The roots of Orbea are very dense and concentrated in the upper 10 cm of soil,"

Qsn #	Question	Answer
601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	Bruyns, P. V. (2002). Monograph of Orbea and Ballyanthus American Society of Plant Taxonomists. Systematic Botany Monographs, 63: 1-196	[No evidence] "Orbea variegata is widespread in the southwestern Cape, with its northernmost stations around Lambert's Bay and Clanwilliam, so that it remains somewhat south of Na maqualand, where increasing aridity is obviously a limiting factor. From here it is found southwards to the hills around Cape Town and along the Cape Peninsula to near its southern tip; it is the only stapeliad to occur on the peninsula. Further eastwards it grows on the coastal plain south of the Langeberg to Riversdale, Mosselbay, Humansdorp, and near Hankey. There are also scattered records from the Karoo around Worcester and on the southern parts of the Great Karoo, e.g., Matjiesfontein (White & Sloane 1937: Fig. 673) and specimens from Willowmore and Steytlerville (Leach 1978). Some of these might well represent escapes from local gardens in which it is frequently cultivated, rather than records of naturally occurring populations."

602	**Produces viable seed**	**y**
	Source(s)	**Notes**
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	"Each flower produces a bilobed fruit approximately 20 cm long (Poyner, 1995) containing many seeds each attached to a hairy pappus that aids wind dispersal. In a preliminary study we found that only about 6% of seeds of Orbea at the current study site were fully developed, but of these, 100% successfully germinated independent of light and water level."
	Rau, E. 2015. President, Sustainable Bioresources, LLC. Personal Communication. 17 June	[Seeds not observed in Hawaii thus far] "Blooms frequently (below photo) but has never set seeds here even with multiple seedlings in bloom. "

603	**Hybridizes naturally**	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Barad, G.S. (1990). Pollination of Stapeliads. Cactus and Succulent Journal 62: 130-140	"Although field hybridization is known to occur. it is relatively infrequent. There are several factors which appear to be responsible for this. It has been observed that pollinators are quite specific in limiting themselves to a single stapeliad species in areas where several are found in the same region. Mechanical differences are also limiting factors in the field. A key of excessive size will not fit into a smaller lock. Duvalias tend to have a large lock and key. Although Duvalia and Piaranthus may be found in the same habitat, they rarely hvbridize. Insertion of the large Duvalia key is prevented by the small Piaranthus lock and the reverse cross is unlikely because the small Piaranthus key slips through the large Duvalia lock. In the laboratory, mechanical manipulations make it possible to place pollinia and produce hybrids that would not occur in nature. There are habitats where mechanically compatible species are present. Huernia vereckeri and Huernia longituba ssp. cashelensis grow side by side in Zimbabwe and numerous intermediate hvbrids are seen in the region. The production of a great many intergeneric hybrids by artificial pollination suggests that there are limited genetic incompatibilities in the group. The limitation of field hybridization seems primarily a factor of geographic isolation, pollinator specificity, and mechanical barriers."
	South African National Biodiversity Institute. 2006. Orbea. http://www.plantzafrica.com/plantnop/orbea.htm. [Accessed 16 Jun 2015]	"O. variegata (L.) Haw. is probably the most well known of all the species, having been in cultivation the longest. As it was one of the first South African stapeliads to be cultivated in Europe , many hybrids have been grown, most of them described as distinct species at some stage. Many of these hybrids are still in cultivation world-wide."
	Bruyns, P. V. (2002). Monograph of Orbea and Ballyanthus American Society of Plant Taxonomists. Systematic Botany Monographs, 63: 1-196	[Possible natural hybrid] "The peculiar distribution of this species, in the area where O. variegata and O. verrucosa overlap, suggests that it might be a hybrid. Pollination experiments have shown that progeny of direct crosses of O. variegata and O. verrucosa all had much larger an nuli and were far more coarsely mottled than in O. pulchella; additional crossing studies are necessary to investigate the possibility of hybrid origin. The structure of the corona of O. pulchella is intermediate between O. variegata and O. verrucosa; however, around Port Elizabeth one generally only finds O. pulchella, which suggests that, if it were of hybrid origin, it has become as a viable, breeding species independent of the parent taxa."

Qsn #	Question	Answer
604	**Self-compatible or apomictic**	**y**
	Source(s)	**Notes**
	Barad, G.S. (1990). Pollination of Stapeliads. Cactus and Succulent Journal 62: 130-140	"It can be seen that there is a wide variation in the degree of self fertility in the different genera. Duvalia, Orbea and Stapelianthus have shown the greatest degree of self fertility."
	Manders, W. (1980). Pollination of Stapeliads. Asklepios, 20: 32-36	[Self-fertile] "Orbea: 20 flowers of O. variegata were self-pollinated and only two pedicels have aborted. Five months later some follicles have started to grow. The fi rst follicles to grow, however were those of a crosspollinated fl ower. Once follicles start to appear they grow amazingly fast." ... "Initial results indicate self-fertility in C. hesperidum, H. keniensis, H. macrocarpa v. penzigii, H. plllansii, H. zebrina, O. variegata, S. englerana, S. grandifl ora and S. mutabilis."

605	**Requires specialist pollinators**	**n**
	Source(s)	**Notes**
	Rau, E. 2015. President, Sustainable Bioresources, LLC. Personal Communication. 17 June	"Flowers are malodorous but flies do not seem to be attracted to the blooms (unlike Hoodia gordonii). Suspect that higher air temperatures are needed to volatilize the odor."
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	"Flowers are star shaped, approximately 5-8 cm across and produce an odour similar to that of rotting meat. This smell, along with the rough flesh-like texture and purple and cream colouring of the flowers attract flies which constitute the main pollinators (Meve & Liede, 1994)."
	Bruyns, P. V. (2002). Monograph of Orbea and Ballyanthus American Society of Plant Taxonomists. Systematic Botany Monographs, 63: 1-196	"It is now fairly well established that flies pollinate the flowers in the stapeliads (Bruyns 2000a), and the species of Orbea are not exceptional in this respect, although rel atively few observations of pollinators have been reported. It has been noted (often on cul tivated plants) that many species are visited by larger flies, such as blow-flies of the genus Lucilia {O. sprengen subsp. foetida; Gilbert 1978), blue-bottle flies of the genus Calliphora {O. gemugofana; Gilbert 1978), or the common house-fly Musca domestica and carrion-flies of the genus Sarcophaga (for O. variegata around Cape Town, O. namaquensis in Namaqualand; pers. obs.)." ... "To attract these insects, the flowers of species of Orbea emit a wide range of odors. Many of these odors are foul and excrement-like, and such evil odors generally attract the larger flies."

606	**Reproduction by vegetative fragmentation**	**y**
	Source(s)	**Notes**
	Hamilton, M. A., Turner, P. J., & Wurst, D. (2013). Carrion flower, a novel invasive species in NSW. Pp.33-136 In: Proceedings of the 17th NSW Weeds Conference. Corowa, New South Wales, 9-12 September 2013	"The plant forms dense mats with stems that root at the nodes and spread vegetatively (Albers and Meve 1991, M. Hamilton, pers. obs., 2012-2013)."
	Learn 2 Grow. 2015. Orbea variegate. www.learn2grow.com/plants/orbea-variegata/	"The plants creep along, spreading into large patches where conditions are ideal. These plants tend to break into segments when they are old and heavy, with pieces falling away to root where they land."

Qsn #	Question	Answer
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	"The succulent stems of Orbea variegate (hencefore called Orbea) grow upright and close together forming dense mats that spread via asexual reproduction (Albers & Meve, 1991)."

607	Minimum generative time (years)	2
	Source(s)	**Notes**
	South African National Biodiversity Institute. 2006. Orbea. http://www.plantzafrica.com/plantnop/orbea.htm. [Accessed 16 Jun 2015]	"Orbeas are easily propagated by stem cuttings, which should be taken during the active growing stage to ensure good rooting, before the plants enter their dormant phase. Cuttings can flower in their first year, depending on the size of the cutting. Seed also germinate easily-be sure to use fresh seed and treat seedlings for damping off. Generally plants grow fast and most will flower within two to three years when grown from seed."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	**Notes**
	PlantNET. 2015. New South Wales Flora Online - Orbea variegata (L.) Haw. National Herbarium of NSW, Royal Botanic Garden, Sydney, Australia. http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Orbea~variegata. [Accessed 17 Jun 2015]	[No evidence, but coma hairs may aid in external attachment] "Follicles narrow, fusiform, 6–12 cm long. Seeds numerous, coma long and silky."

702	Propagules dispersed intentionally by people	y
	Source(s)	**Notes**
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	"Orbea variegata (L.) Haw (Asclepiadaceae) is a recent introduction to some arid zones of South Australia. It is believed to have been introduced to the region as an easy-care garden perennial, and it was first collected from the field near the BHP nursery in Whyalla (32829 S, 1378329 E) in 1967 (Poyner, 1995).
	Cactus Art Nursery. 2015. Orbea variegate (Syn. Stapelia variegata). http://www.cactus-art.biz/schede/ORBEA/Orbea_variegata/Orbea_variegata/Orbea_variegata.htm. [Accessed 15 Jun 2015]	"Orbea variegata is almost certainly the most common Asclepiad in cultivation, even if it is still often seen under its earlier name of Stapelia variegata. (name given by Linnaeus) nowadays it is possible to find plants with both names in collections. And for the reason of the variability of the species, many could believe they have two different genera represented. It is the first Stapelia that has reached Europe,"
	Lenz, T. I., & Facelli, J. M. (2003). Shade facilitates an invasive stem succulent in a chenopod shrubland in South Australia. Austral Ecology, 28(5), 480-490	"Orbea variegate is a popular ornamental and has been grown in Whyalla gardens for at least 40 years."

Qsn #	Question	Answer
703	**Propagules likely to disperse as a produce contaminant**	**n**
	Source(s)	**Notes**
	WRA Specialist. 2015. Personal Communication	No evidence of produce contamination found. An ornamental plant, but seeds possess conspicuous hairs, which should make them conspicuous and unlikely to contaminate other potted plants.

704	Propagules adapted to wind dispersal	y
	Source(s)	**Notes**
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	"Each flower produces a bilobed fruit approximately 20 cm long (Poyner, 1995) containing many seeds each attached to a hairy pappus that aids wind dispersal."

705	Propagules water dispersed	
	Source(s)	**Notes**
	PlantNET. 2015. New South Wales Flora Online - Orbea variegata (L.) Haw. National Herbarium of NSW, Royal Botanic Garden, Sydney, Australia. http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Orbea~variegata. [Accessed 17 Jun 2015]	[Adapted for wind-dispersal. Buoyancy of seeds and hairs unknown] "Follicles narrow, fusiform, 6–12 cm long. Seeds numerous, coma long and silky."

706	Propagules bird dispersed	n
	Source(s)	**Notes**
	Honan. I. 2006. A succulent escape in the arid lands of southern Australia – carrion flower (Orbea variegata). Pp. 188-190 in C. Preston, J.H. Watts & N.D. Crossman (eds.). 15th Australian Weeds Conference proceedings: managing weeds in a changing climate. Weed Management Society of SA	[Adapted for wind dispersal] "Seed pods are a consistent banana shape, but will vary from 1–2 cm thick and 8–16 cm long. The seeds are 4–5 mm long and are attached to a long silky pappus (2–6 cm) which can wrap itself around a shade-providing plant."

707	Propagules dispersed by other animals (externally)	
	Source(s)	**Notes**
	Honan. I. 2006. A succulent escape in the arid lands of southern Australia – carrion flower (Orbea variegata). Pp. 188-190 in C. Preston, J.H. Watts & N.D. Crossman (eds.). 15th Australian Weeds Conference proceedings: managing weeds in a changing climate. Weed Management Society of SA	[No evidence, but the pappus may aid in attachment] "The seeds are 4–5 mm long and are attached to a long silky pappus (2–6 cm) which can wrap itself around a shade-providing plant."

708	Propagules survive passage through the gut	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Gordon, D. R., Mitterdorfer, B., Pheloung, P. C., Ansari, S., Buddenhagen, C., Chimera, C., ... & Williams, P. A. 2010). Guidance for addressing the Australian Weed Risk Assessment questions. Plant Protection Quarterly, 25(2): 56-74	[No evidence that follicles or seeds would be consumed] "Answer 'no' where the taxon is unlikely to be eaten by animals or if seeds are not viable following passage through the gut."

801	Prolific seed production (>1000/m2)	n
	Source(s)	**Notes**
	Rau, E. 2015. President, Sustainable Bioresources, LLC. Personal Communication. 17 June	"Blooms frequently ... but has never set seeds here even with multiple seedlings in bloom."
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	[In this study, only 6% of seed develop] "Each flower produces a bilobed fruit approximately 20 cm long (Poyner, 1995) containing many seeds each attached to a hairy pappus that aids wind dispersal. In a preliminary study we found that only about 6% of seeds of Orbea at the current study site were fully developed, but of these, 100% successfully germinated independent of light and water level."

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	**Notes**
	Lenz, T. I., & Facelli, J. M. (2003). Shade facilitates an invasive stem succulent in a chenopod shrubland in South Australia. Austral Ecology, 28(5), 480-490	"Dunbar and Facelli 1999) found that seed viability in an average rainfall year was low (~ 6%) and that seeds did not appear to have a dormancy period, germinating with the first available water." ... "Orbea variegata seeds do not appear to have dormancy periods (K. R. Dunbar, unpubl. data, 1996) and facilitation of germination underneath shrubs after summer rainfall may contribute to population growth in this species in the study area."

803	Well controlled by herbicides	y
	Source(s)	**Notes**
	Hamilton, M. A., Turner, P. J., & Wurst, D. (2013). Carrion flower, a novel invasive species in NSW. Pp.33-136 In: Proceedings of the 17th NSW Weeds Conference. Corowa, New South Wales, 9-12 September 2013	"The NSW National Parks and Wildlife Service (NPWS) immediately treated the weed to prevent further spread. This initial herbicide treatment was mostly ineffective. Subsequently, foliar application of four herbicide formulations was trialled in situ to determine: i) efficacy of carrion flower control; and 2) any non-target damage to native plant species. Monitoring plots were established and sampled before and after herbicide application. Interim results showed that Garlon 600 and Starane® Advanced achieved 100 and 98% mortality of the plant respectively."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	**Notes**
	Dunbar, K. R., & Facelli, J. M. (1999). The impact of a novel invasive species, Orbea variegata (African carrion flower), on the chenopod shrublands of South Australia. Journal of Arid Environments, 41(1), 37-48	[Unknown. Damage may result in propagation of fragments] "The succulent stems of Orbea variegate (hencefore called Orbea) grow upright and close together forming dense mats that spread via asexual reproduction (Albers & Meve, 1991)."

Qsn #	Question	Answer
	Learn 2 Grow. 2015. Orbea variegate. www.learn2grow.com/plants/orbea-variegata/	[Unknown. Possible that damage to plant may result in asexual propagation of fragments] "The plants creep along, spreading into large patches where conditions are ideal. These plants tend to break into segments when they are old and heavy, with pieces falling away to root where they land."

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

Summary of Risk Traits:

High Risk / Undesirable Traits
• Naturalized in Australia, from Mediterranean to subtropical climates
• An environmental weed in Australia, suppressing native plant recruitment
• Shade tolerant (able to establish other under plants)
• Forms dense mats that can suppress other vegetation
• Reproduces by seeds and vegetatively
• Plants are self-fertile
• Able to reach reproductive maturity in 2+ years
• Seeds dispersed by wind, & possibly other vectors
• Plants dispersed intentionally by people (as an ornamental)

Low Risk Traits
• Non-toxic
• Ornamental
• Limited production of viable seeds
• Seeds lack dormancy & should not form a persistent seed bank
• Certain herbicides may provide effective control