Taxon: Livistona chinensis (Jacq.) R. Br. ex Mart. **Family:** Arecaceae

Common Name(s): Chinese fan palm
Chinese fountain palm

Synonym(s): Latania chinensis Jacq.
Livistona oliviformis (Hassk.) Mart.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 10 Dec 2020

WRA Score: 13.0 **Designation:** H(Hawai'i) **Rating:** High Risk

Keywords: Naturalized Palm, Spiny Petioles, Dense Stands, Autogamous, 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	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)	y
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		
401	Produces spines, thorns or burrs	y=1, n=0	y
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	y=1, n=0	y
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
408	Creates a fire hazard in natural ecosystems		
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	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	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	n
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)		
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	y=1, n=-1	n
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**
	Henderson, A. 2009. Palms of Southern Asia. Princeton University Press, Princeton, NJ	[No evidence of domestication] "Range and habitat. China (Guangdong, Hainan), Japan (Ryukyu Islands and southern Japanese islands of Aoshima, Kyushu, Shikoku, and Tsukishima), and Taiwan (Chishan Island); coastal forests, often on sandy soils, at low elevations. Uses. Widely planted as an ornamental throughout tropical and subtropical areas of the world."

Qsn #	Question	Answer
102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. (2020). Personal Communication	NA

Qsn #	Question	Answer
103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. (2020). Personal Communication	NA

Qsn #	Question	Answer
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**
	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 Ryukyu Islands, Bonin Islands, Volcano Islands, and islands off Kyushu, Japan, now widely cultivated in tropical areas worldwide; in Hawai'i cultivated as an ornamental, persisting after cultivation, and sparingly naturalized in areas where previously cultivated, at least in Moanalua Valley, O'ahu, but perhaps elsewhere."
	CABI. (2020). Livistona chinensis (Chinese fan palm). In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	Af - Tropical rainforest climate Am - Tropical monsoon climate As - Tropical savanna climate with dry summer Aw - Tropical wet and dry savanna climate

Qsn #	Question	Answer
202	**Quality of climate match data**	**High**
	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.	

Qsn #	Question	Answer
203	**Broad climate suitability (environmental versatility)**	**y**
	Source(s)	**Notes**

Qsn #	Question	Answer
	CABI. (2020). Livistona chinensis (Chinese fan palm). In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Af - Tropical rainforest climate Preferred > 60mm precipitation per month Am - Tropical monsoon climate Preferred Tropical monsoon climate (< 60mm precipitation driest month but > (100 - [total annual precipitation(mm}/25])) As - Tropical savanna climate with dry summer Preferred < 60mm precipitation driest month (in summer) and < (100 - [total annual precipitation{mm}/25]) Aw - Tropical wet and dry savanna climate Preferred < 60mm precipitation driest month (in winter) and < (100 - [total annual precipitation{mm}/25])"
	Ellison, D. & Ellison, A. 2001. Cultivated Palms of the World. UNSW Press, Sydney, Australia	"Once established, it is adaptable and grows in mild-temperate to tropical climates, tolerating sunny to shady sites and dry conditions."

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 Ryukyu Islands, Bonin Islands, Volcano Islands, and islands off Kyushu, Japan, now widely cultivated in tropical areas worldwide; in Hawai'i cultivated as an ornamental, persisting after cultivation, and sparingly naturalized in areas where previously cultivated, at least in Moanalua Valley, O'ahu, but perhaps elsewhere."
	Meyer, J. Y., Lavergne, C., & Hodel, D. R. 2008. Time bombs in gardens: invasive ornamental palms in tropical islands, with emphasis on French Polynesia (Pacific Ocean) and the Mascarenes (Indian Ocean). Palms, 52(2): 71-83	"The Chinese fan palm or fountain palm (Livistona chinensis) is considered invasive in Bermuda (Kairo et al. 2003) and in Mauritius and La Réunion Islands (Moore & Guého 1984, Strahm 1993, 1999). It is naturalized in Florida (www.fleppc.org/list/05List.htm), in Hawaii (Wagner et al. 1990, 1999) where it spreads in ditches, stream beds, wet gulches and shady understory of disturbed secondary forests (Starr et al. 2003a) and on the east coast of New Caledonia in riparian forest (MacKey 1985)."
	Oppenheimer, H. (2011). New Hawaiian plant records for 2009. Bishop Museum Occasional Papers 110: 5-10	"Widely cultivated, and in Hawai'i persisting and sparingly naturalized where previously cultivated on O'ahu and West Maui but perhaps elsewhere (Wagner et al. 1999: 1364; Oppenheimer 2003: 5 ; Daehler & Baker 2006: 12). these observations are consistent with its occurrence on Kaua'i, where all size classes were observed, including large plants, on nearly vertical gulch walls. Material examined. KAUA'I: Hanalei Distr, Kīlauea str., 79 m, 12 Nov 2008, Oppenheimer H110819."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	**Notes**
	Ellison, D. & Ellison, A. 2001. Cultivated Palms of the World. UNSW Press, Sydney, Australia	"Common in cultivation, this popular species is native to Japan, Taiwan, and the Japanese Bonin Islands and Ryukyu Islands."
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"This species is widely planted as an ornamental throughout tropical and subtropical areas of the world."

301	Naturalized beyond native range	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Daehler, C. C. & Baker, R. F. 2006. New Records of Naturalized and Naturalizing Plants Around Lyon Arboretum, Mänoa Valley, Oʻahu. Bishop Museum Occasional Papers 87: 3-18	"Livistona chinensis (Jacq.) R. Br. A large, single-trunked fan palm with glossy green leaves, drooping at the tips; petioles with sharp teeth; and olive-sized and shaped, greenish blue fruit. This species was reported by Wagner et al. (1999) as escaping in Moanalua Valley, Oʻahu. At the Arboretum, this species is found around the original plantings, with some naturalized individuals >200 m from original plantings. Groves have also been observed on the Nuʻuanu side of Konahuanui. The particular naturalized variety of L. chinensis came from plantings in Moanalua Gardens in 1927. It appears to be a taller, faster-growing variety than that found in landscaping around Honolulu. Material examined: OʻAHU: Immature, 3 m tall plant established at the edge of Aroid Valley, near Hawaiian Section, no planted specimens seen within 100 m, Lyon Arboretum, 22 Jun 2005, C. Daehler 1306 (HLA)."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Livistona chinensis (Jacq.) R.Br. ex Mart. Arecaceae Total N° of Refs: 34 Global Risk Score: 1.44 Rating: Low Habit: Tree Preferred Climate/s: Mediterranean, Subtropical, Tropical Origin: E Asia Major Pathway/s: Herbal, Ornamental Dispersed by: Humans References: United States of America-N- 101, United States of America-EW-179, United States of America-N-301, United States of America-N-839, India-N-976, Brazil-I-984, Africa-W-990, Philippines nC- 1099, United States of America-N- 1114, South Africa-U-1247, Caribbean-NI- 1201, Bermuda-N-1267, United States of America-N-1292, La Reunion-I-1321, Brazil-I-1328, Global-N-1338, Global-W- 1376, South Africa-N-1002, Global-I-1404, Argentina, Brazil and Uruguay-I-1476, New Caledonia-I-1507, United States of America-W-1719, India-N-1370, United States of America-E-1736, Brazil-I-1876, - I-, South Africa-N-1991, Mascarene islands-N-2049, Brazil-W-1977, Fiji-W-1977, Kiribati-W-1977, Marshall Islands-W-1977, Mauritius-W-1977, Micronesia (Federated States of)-W-1977, Nauru-W-1977."
	Oppenheimer, H. (2011). New Hawaiian plant records for 2009. Bishop Museum Occasional Papers 110: 5-10	"Livistona chinensis (Jacq.) r.Br. ex mart. New island record Widely cultivated, and in Hawaiʻi persisting and sparingly naturalized where previously cultivated on Oʻahu and West Maui but perhaps elsewhere (Wagner et al. 1999: 1364; Oppenheimer 2003: 5 ; Daehler & Baker 2006: 12). these observations are consistent with its occurrence on Kauaʻi, where all size classes were observed, including large plants, on nearly vertical gulch walls. Material examined. KAUAʻI: Hanalei Distr, Kīlauea str., 79 m, 12 Nov 2008, Oppenheimer H110819."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawaiʻi Press and Bishop Museum Press, Honolulu, HI.	"Native to Ryukyu Islands, Bonin Islands, Volcano Islands, and islands off Kyushu, Japan, now widely cultivated in tropical areas worldwide; in Hawai'i cultivated as an ornamental, persisting after cultivation, and sparingly naturalized in areas where previously cultivated, at least in Moanalua Valley, O'ahu, but perhaps elsewhere. Mentioned by Rock (l917a) as common in Honolulu, and thus probably introduced to Hawai'i in the 1800s"

Qsn #	Question	Answer
	Meyer, J. Y., Lavergne, C., & Hodel, D. R. 2008. Time bombs in gardens: invasive ornamental palms in tropical islands, with emphasis on French Polynesia (Pacific Ocean) and the Mascarenes (Indian Ocean). Palms, 52(2): 71-83	"The Chinese fan palm or fountain palm (Livistona chinensis) is considered invasive in Bermuda (Kairo et al. 2003) and in Mauritius and La Réunion Islands (Moore & Guého 1984, Strahm 1993, 1999). It is naturalized in Florida (www.fleppc.org/list/05List.htm), in Hawaii (Wagner et al. 1990, 1999) where it spreads in ditches, stream beds, wet gulches and shady understory of disturbed secondary forests (Starr et al. 2003a) and on the east coast of New Caledonia in riparian forest (MacKey 1985)."
	Oppenheimer, Hank L. 2003. New plant records from Maui and Hawai'i Counties. Bishop Museum Occasional Papers. 73: 3-30	[West Maui] "Livistona chinensis (Jacq.) R. Br. ex Mart. New island record Reported to be sparingly naturalized where previously cultivated, at least in Moanalua Valley, Oʻahu but perhaps elsewhere (Wagner et al., 1990: 1364). This is consistent with small populations on West Maui, where it appears to be spreading from trees that apparently were formerly cultivated. Different size classes were noted in the collection locality, with many seedlings. It has also been observed to be sparingly naturalized in the Honolua Bay area, and in Hāna District on East Maui. Material examined: MAUI: West Maui, Wailuku Dist, ʻĪao Valley, above road near Kepaniwai Park, 244 m, 27 Jan 2001, Oppenheimer H10139."

302	Garden/amenity/disturbance weed	y
	Source(s)	**Notes**
	CABI. (2020). Livistona chinensis (Chinese fan palm). In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Livistona chinensis is a palm tree that has been widely introduced into tropical and warm temperate regions of the world to be used as ornamental. It has escaped from cultivation and become naturalized in disturbed sites, but also in undisturbed natural areas. L. chinensis produces a large amount of fruits and has high germination rates. It grows by forming dense thickets that can crowd out and overshadow native species. Currently, it is listed as invasive in Hawaii, Florida, Bermuda, Mauritius, Reunion and New Caledonia. In Florida, L. chinensis is listed as a category II invasive plant, a category designed for species with the potential to disrupt native plant communities."
	Meyer, J. Y., Lavergne, C., & Hodel, D. R. 2008. Time bombs in gardens: invasive ornamental palms in tropical islands, with emphasis on French Polynesia (Pacific Ocean) and the Mascarenes (Indian Ocean). Palms, 52(2): 71-83	"The Chinese fan palm or fountain palm (Livistona chinensis) is considered invasive in Bermuda (Kairo et al. 2003) and in Mauritius and La Réunion Islands (Moore & Guého 1984, Strahm 1993, 1999). It is naturalized in Florida (www.fleppc.org/list/05List.htm), in Hawaii (Wagner et al. 1990, 1999) where it spreads in ditches, stream beds, wet gulches and shady understory of disturbed secondary forests (Starr et al. 2003a) and on the east coast of New Caledonia in riparian forest (MacKey 1985)."
	Adams, J. (2020). Lyon Arboretum Botanist. Pers. Comm. 04 Dec	[Management issue in Lyon Arboretum, Oahu, Hawaii] "It is definitely naturalizing at the Arboretum and next to Pinanga coronata is a serious control issue for us." … "It is a control issue because it is so prolific and widespread throughout the entirety of the Arboretum. They tend to form dense clusters and shade everything out. In wet areas it creates a paradise for the pigs and shade loving weeds."

303	Agricultural/forestry/horticultural weed	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

304	Environmental weed	y
	Source(s)	**Notes**
	Pettit, D. (2016). An Illustrated Guide for Bermuda's Indigenous and Invasive Plants. Department of Environment and Natural Resources, Flatts, Bermuda	"A very aggressive and fast growing palm that has naturalised throughout many of Bermuda's habitats. It can form dense, mono-specific stands. The Chinese Fan Palm should not be encouraged due to its fast growth, prolific seeding, drought resistance and attractiveness for rats. It has become a weed in many tropical and subtropical ecosystems and is designated as a Category II invasive by the Florida Exotic Pest Plant Council. It is one of Bermuda's most aggressive invasive plants. It should not actively be planted or transplanted and should be removed at every opportunity, unless in a heavily maintained area. Caution. It should not be mistaken for the Bermuda Palmetto, which is also a superb substitute for the Fan Palm in every situation."
	CABI. (2020). Livistona chinensis (Chinese fan palm). In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"L. chinensis produces a large number of fruits and has high germination rates. Fallen berries germinate at the base of the parent tree, forming dense thickets that smother and outcompete native vegetation (Bermuda DENR, 2016). In Mauritius, it has become invasive and is threatening the critically endangered endemic palm Acanthophoenix rubra (Maunder et al., 2001)."

305	Congeneric weed	
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Potentially. Livistona australis, Livistona rotundifolia, and Livistona saribus are listed as naturalized and/or weeds, but impacts are ambiguous or anecdotal

401	Produces spines, thorns or burrs	y
	Source(s)	**Notes**
	Neal, M.C. 1965. In Gardens of Hawaii. Bishop Museum Press, Honolulu, HI	"The leaf stem is as long as the blade an d in the lower half bears stout, brown spines to 0.25 inch long; or teeth in old plants"
	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.	"Trunk up to 15 m or more tall. Leaves numerous, pale green, up to 1.5 m long, with a prominent undivided central area and numerous deeply bifid segments, their tips pendulous, petioles armed with stout prickles."

402	Allelopathic	
	Source(s)	**Notes**
	WRA Specialist. (2020). Personal Communication	Unknown. No evidence found

403	Parasitic	n

Qsn #	Question	Answer
	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.	"Trunk up to 15 m or more tall." [Arecaceae (alt. Palmae). No evidence]

404	Unpalatable to grazing animals	
	Source(s)	**Notes**
	Genini, J., Galetti, M., & Morellato, L. P. C. (2009). Fruiting phenology of palms and trees in an Atlantic rainforest land-bridge island. Flora, 204(2), 131-145	[Fruit consumed. Palatability of older vegetation or seedlings unknown] "L. chinensis also has solitary stems of 5–15m height and dark green fruits, which are dispersed mainly by birds, but also eaten by foxes, tapirs, deers and rodents (Galetti et al., 1999)."

405	Toxic to animals	n
	Source(s)	**Notes**
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"(Astringent, stomachic.)" [No evidence. Limited medicinal uses]
	Filmer, A. K., & Dodge, L. (2012). Safe and poisonous garden plants. University of California, Davis, CA. https://ucanr.edu/. [Accessed 10 Dec 2020]	"Safe Plants (by common name) A note on "safe" plants: The plants on this list are generally believed to be safe. However, if you suspect that a child (or adult) has eaten quantities of any of these plants (or any of their parts), or if you notice symptoms such as illness or dermatitis after handling these plants, call your Poison Control Center for additional information" [Includes Livistona chinensis]
	Shoot Gardening. (2020). Livistona chinensis (Chinese fan palm). https://www.shootgardening.co.uk/plant/livistona-chinensis. [Accessed 10 Dec 2020]	"Toxicity - Though not toxic, sharply-toothed leaf stalks may cause injury."
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	y
	Source(s)	**Notes**
	Odak, S. C., & Dhamdhere, S. V. (1970). Record of a new alternate host plant of Parnara mathias Fabricius. Indian Journal of Entomology, 32(4): 397	"At Gwalior, Madhya Pradesh, in October-November 1969, larvae of Pelopidas (Parnara) mathias (F.) were found for the first time on the garden fan palm (Livistona chinensis). This is a newly recorded alternative food-plant to rice, of which the Hesperiid is a pest ."
	Gilman, E.F. & Watson, D.G. (1993). Livistona chinensis. Chinese Fan Palm. Fact Sheet ST-365. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu. [Accessed 10 Dec 2020]	"Pests Scales. Diseases It is moderately susceptible to lethal yellowing disease."

Qsn #	Question	Answer
	Harrison, N. A., Bourne, C. M., Cox, R. L., Tsai, J. H., & Richardson, P. A. (1992). DNA probes for detection of mycoplasmalike organisms associated with lethal yellowing disease of palms in Florida. Phytopathology, 82 (2), 216-224	[Lethal yellowing is a recognized disease attacking economically important species within plam family] "AB: Five Eco RI restriction fragments consisting of chromosomal DNA of the mycoplasma-like organism (MLO) associated with lethal yellowing (LY) disease of Manila palm (Veitchia merrillii) in Florida were cloned and identified. In addition to Manila palms, probes detected the presence of LY MLO DNA in DNA samples extracted from heart tissues of LY-diseased true date (Phoenix dactylifera), clif date (P. rupicola), Chinese fan (Livistona chinensis), and5 coconut (Cocos nucifera) palm cultivars. Probes also hybridized to DNA from symptomatic Caryota rumphiana and L. rotundifolia, 2 palm species previously not known to be affected by LY disease."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"(Astringent, stomachic.)" [No evidence. Limited medicinal uses]
	Shoot Gardening. (2020). Livistona chinensis (Chinese fan palm). https://www.shootgardening.co.uk/plant/livistona-chinensis. [Accessed 10 Dec 2020]	"Though not toxic, sharply-toothed leaf stalks may cause injury."
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	
	Source(s)	**Notes**
	Ehara, H., Dowe, J. L., Nagatomo, R. & Kawasaki, A. (2002) Livistona chinensis var. subglobosa on Aoshima, Japan. Palms, 46(2): 62-67	"a small area of the eastern zone where the soil surface was covered with dead palm leaves." [Flammable leaves could accumulate on the ground and increase fire risk]
	CABI. (2020). Livistona chinensis (Chinese fan palm). In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"It grows by forming dense thickets that can crowd out and overshadow native species." [Could potentially increase fire risk, but not listed among impacts]

Qsn #	Question	Answer
409	**Is a shade tolerant plant at some stage of its life cycle**	**y**
	Source(s)	**Notes**
	Gilman, E.F. & Watson, D.G. (1993). Livistona chinensis. Chinese Fan Palm. Fact Sheet ST-365. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu. [Accessed 10 Dec 2020]	"Light requirement: tree grows in part shade/part sun; tree grows in full sun"
	Meyer, J. Y., Lavergne, C., & Hodel, D. R. 2008. Time bombs in gardens: invasive ornamental palms in tropical islands, with emphasis on French Polynesia (Pacific Ocean) and the Mascarenes (Indian Ocean). Palms, 52(2): 71-83	"The Chinese fan palm or fountain palm (Livistona chinensis) is considered invasive in Bermuda (Kairo et al. 2003) and in Mauritius and La Réunion Islands (Moore & Guého 1984, Strahm 1993, 1999). It is naturalized in Florida (www.fleppc.org/list/05List.htm), in Hawaii (Wagner et al. 1990, 1999) where it spreads in ditches, stream beds, wet gulches and shady understory of disturbed secondary forests (Starr et al. 2003a) and on the east coast of New Caledonia in riparian forest (MacKey 1985)."

410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**y**
	Source(s)	**Notes**
	Palmpedia. (2020). Livistona chinensis. http://palmpedia.net/palmsforcal/Livistona_chinensis. [Accessed 10 Dec 2020]	"Soil Preference: extremely adaptable to nearly any soil type"
	Gilman, E.F. & Watson, D.G. (1993). Livistona chinensis. Chinese Fan Palm. Fact Sheet ST-365. University of Florida, IFAS, Gainesville, FL. http://edis.ifas.ufl.edu. [Accessed 10 Dec 2020]	"Soil tolerances: clay; loam; sand; acidic; alkaline; well-drained"
	Shoot Gardening. (2020). Livistona chinensis (Chinese fan palm). https://www.shootgardening.co.uk/plant/livistona-chinensis. [Accessed 10 Dec 2020]	"Soil type - Chalky, Loamy, Sandy Soil drainage - Moist but well-drained, Well-drained Soil pH - Acid, Alkaline, Neutral"

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.	"Trunk up to 15 m or more tall."

412	**Forms dense thickets**	**y**
	Source(s)	**Notes**
	Pettit, D. (2016). An Illustrated Guide for Bermuda's Indigenous and Invasive Plants. Department of Environment and Natural Resources, Flatts, Bermuda	"A very aggressive and fast growing palm that has naturalised throughout many of Bermuda's habitats. It can form dense, mono-specific stands."
	Department of Environment and Natural Resources. (2020). Chinese Fan Palm (Livistona chinensis). Government of Bermuda. https://environment.bm. [Accessed 9 Dec 2020]	"Fallen berries germinate at the base of the parent tree, eventually forming thickets of palms of various sizes. These thickets can be seen along the road side, where other plants have been overshadowed and crowded out by Fan Palms."
	CABI. (2020). Livistona chinensis (Chinese fan palm). In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"It grows by forming dense thickets that can crowd out and overshadow native species."

Qsn #	Question	Answer
	Adams, J. (2020). Lyon Arboretum Botanist. Pers. Comm. 04 Dec	"They tend to form dense clusters and shade everything out. In wet areas it creates a paradise for the pigs and shade loving weeds." [Lyon Arboretum, Oahu, Hawaii]

501	Aquatic	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.	[Terrestrial] "Trunk up to 15 m or more tall."

502	Grass	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 9 Dec 2020]	Family: Arecaceae (alt. Palmae) Subfamily: Coryphoideae Tribe: Trachycarpeae Subtribe: Livistoninae

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 9 Dec 2020]	Family: Arecaceae Subfamily: Coryphoideae Tribe: Trachycarpeae Subtribe: Livistoninae

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.	"Trunk up to 15 m or more tall. Leaves numerous, pale green, up to 1.5 m long, with a prominent undivided central area and numerous deeply bifid segments, their tips pendulous, petioles armed with stout prickles."

Qsn #	Question	Answer
601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Coastal forests, often on sandy soils. Guangdong, Hainan, Taiwan [S Japan]. This species is widely planted as an ornamental throughout tropical and subtropical areas of the world."
	Ehara, H., Dowe, J. L., Nagatomo, R. & Kawasaki, A. (2002) Livistona chinensis var. subglobosa on Aoshima, Japan. Palms, 46(2): 62-67	[Regenerate and dominant in natural habitat] "This paper describes the habitat, distribution, dispersal, and aerial branching of Livistona chinensis var. subglubosa which occurs in subtropical woodlands and littoral forests and is a dominant species of the flora of Aoshima, Japan, the northern limit of the range of natural regeneration."

602	**Produces viable seed**	**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	"Germination takes one to two months"
	Ehara, H., Dowe, J. L., Nagatomo, R. & Kawasaki, A. (2002) Livistona chinensis var. subglobosa on Aoshima, Japan. Palms, 46(2): 62-67	"It have been observed that flowering and fruiting has not occurred for several years on any part of the islet. Regeneration was observed on most part of the islet, although young plants and seedlings were completely absent from a small area of the eastern zone where the soil surface was covered with dead palm leaves."
	Ellison, D. & Ellison, A. 2001. Cultivated Palms of the World. UNSW Press, Sydney, Australia	"Mature fruit is blue to green and seed germinates readily in 2 to 3 months."
	Chatty, Y., & Tissaoui, T. (1999) Effect of temperature on germination of ornamental palm trees in Tunisia. Acta Horticulturae 486: 165-167	"Ornamental palms are widely spread throughout the coastal regions of North Africa. In Tunisia, the cultivated species belong to genera acclimatised to Mediterranean regions, with the exception of the two local species, Chamaerops humilis (Doum) and Phoenix dactylifera (Date Palm). Among of the 21 species recorded in a survey done in 1993, only 9 are cultivated in some extent. The remaining species exist exclusively in collections dedicated to preserving rare and threatened species. Germination is difficult in many palms, which imposes a serious market restriction for these species. The present trial was set up to study germination, under controlled conditions at different temperatures (5, 15, 25, 35,45°C). This report was focused on ten species of palms, one local species and nine of exotic origin. Of the latter, two are widely cultivated as street trees, four are moderately cultivated, and three are rare. According to their germinating capacity, the species are grouped into 3 categories: species with rapid germination, intermediate germination, and species showing germination difficulties. The germination temperature vary considerably according to the area of origin and the ecology of each species, with most optimums falling between 15 and 35°C."

Qsn #	Question	Answer
	Wen, B. (2009). Storage of recalcitrant seeds: a case study of the Chinese fan palm, Livistona chinensis. Seed Science and Technology, 37(1), 167-179	"Various seed storage techniques were applied to the recalcitrant seeds of the Chinese fan palm (Livistona chinensis [Jacq.] R. Br.). Fully hydrated seeds were stored in perlite at 5 moisture levels at 15 C, and partially dried seeds were stored at 6 moisture levels at 4 temperatures. Cryopreservation was attempted with both intact seeds and isolated embryos. It was found that L. chinensis seeds can not survive sub-zero temperature storage for even one week, but short-term storage at above-zero temperature is feasible. Moist storage of fully hydrated seeds did not impair seed viability, but led inevitably to germination and fungal growth after one month. Partially dried seeds began to lose viability after 3 months storage. Intact seeds can not survive cryo-exposure at any moisture content. By contrast, embryos were successfully stored at liquid nitrogen temperature after desiccation to below 20% moisture content, and no significant viability loss was found after 2-year cryostorage. The advantages and disadvantages of these storage methods are evaluated."

603	Hybridizes naturally	
	Source(s)	**Notes**
	Rodd, A. N. (1998). Revision of Livistona (Arecaceae) in Australia. National Herbarium of New South Wales, Royal Botanic Gardens. Telopea 8(1): 49-153	[Unknown. Putative hybrids suspected in genus] "Burret (1941) tentatively identified a palm collected by him in 1937 in the botanical garden at Rio de Janeiro as a hybrid between L. australis and L. chinensis var. subglobosa, but the evidence he presents for this conclusion is rather slender." … "White (1988) illustrates an instance of inferred hybridism between L. humilis and L. inermis, though makes no mention of this in his text. The two are sympatric over most of the range of L. inermis, though generally ecologically segregated. I have found a few vegetative specimens difficult to assign to one species or the other, and so believe such hybrids may well exist. Again, further investigation is needed."

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Dowe, J. L. (2001). Studies in the genus Livistona (Coryphoideae: Arecaceae). PhD Dissertation. James Cook University, Townsville, Australia	[Capable of autogamy, or self-fertilization] "The data presented indicate that L. chinensis is predominantly autogamous, which is directly related to the hermaphroditism of that species, although geitonogamy and xenogamy may also be involved. Livistona decora and L. muelleri may exhibit autogamy (i. e., within-flower selfing), geitonogamy and xenogamy."… "It is predicted that there is a trend from autogamy/geitonogamy in L. chinensis, and to autogamy/geitonogamy/ xenogamy in L. decora, L. lanuginosa and L. muelleri."
	Wu, Z. Y., P. H. Raven & D. Y. Hong, (eds.). (2010). Flora of China. Vol. 23 (Acoraceae through Cyperaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Flowers hermaphroditic] "Inflorescences 1–1.2 m, branched to 3 orders, with 6 or 7 partial inflorescences; rachillae 10–18 cm; flowers hermaphroditic, borne in clusters of 4–7, white or yellow, 2–2.5 mm."

605	Requires specialist pollinators	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Dowe, J. L. (2001). Studies in the genus Livistona (Coryphoideae: Arecaceae). PhD Dissertation. James Cook University, Townsville, Australia	"Livistona flowers have no clear adaptations for insect or animal pollination, and may be relatively less efficient if entomophilous pollination is involved (Neale et al., 1998). The flowers of Livistona provide only poor or ill adapted landing platforms, there are no apparent guiding mechanisms, and most species are usually dull coloured and with no perceptible odour."
	Abe, T. (2006). Threatened pollination systems in native flora of the Ogasawara (Bonin) Islands. Annals of Botany, 98(2), 317-334	"Table A.1" [Livistona chinensis var. boninensis. Pollination = I, insect - Eb,Be,F,(bat)*. Eb, endemic small bees; Be, other bees; F, flies; , (bat)*]

606	Reproduction by vegetative fragmentation	n
	Source(s)	**Notes**
	Ellison, D. & Ellison, A. 2001. Cultivated Palms of the World. UNSW Press, Sydney, Australia	"A medium to tall, solitary-stemmed palm"
	Department of Environment and Natural Resources. (2020). Chinese Fan Palm (Livistona chinensis). Government of Bermuda. https://environment.bm. [Accessed 9 Dec 2020]	[No evidence] "Fallen berries germinate at the base of the parent tree, eventually forming thickets of palms of various sizes. These thickets can be seen along the road side, where other plants have been overshadowed and crowded out by Fan Palms." … "Removal: Removing a Fan Palm of any size requires gloves to protect against their thorns. Seedlings can be pulled by hand. Larger saplings are more difficult to pull as there is no trunk to get hold of. They can be dug out with a fork, but will re-grow if you break them."

607	Minimum generative time (years)	>3
	Source(s)	**Notes**
	Shoot Gardening. (2020). Livistona chinensis (Chinese fan palm). https://www.shootgardening.co.uk/plant/livistona-chinensis. [Accessed 10 Dec 2020]	"10-20 years To maturity" [May be referring to height rather than reproductive age]
	Palm Doctor. (2001). Palm of the Month Award-Winner! Livistona chinensis Chinese Fan Palm. http://palmdoctor.com. [Accessed 10 Dec 2020]	"The fruit, which is bluish-green, sets mostly bisexually, so one trees fruits are probably all fertile, and sprout very readily! This is a nice "bonus" as your Chinese Fan Palm reaches the age of about 5-7 years"

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	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.	"Fruit bluish green to bright green, darker with age, ellipsoid to subglobose or pyriform, 1.5-2.6 cm long, 0.9-1.8 cm in diameter." [No evidence. Relatively large fruit and seeds that lack means of external attachment]
	Genini, J., Galetti, M., & Morellato, L. P. C. (2009). Fruiting phenology of palms and trees in an Atlantic rainforest land-bridge island. Flora, 204(2), 131-145	"L. chinensis also has solitary stems of 5–15m height and dark green fruits, which are dispersed mainly by birds, but also eaten by foxes, tapirs, deers and rodents (Galetti et al., 1999)."

702	Propagules dispersed intentionally by people	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Ellison, D. & Ellison, A. 2001. Cultivated Palms of the World. UNSW Press, Sydney, Australia	"Common in cultivation, this popular species is native to Japan, Taiwan, and the Japanese Bonin Islands and Ryukyu Islands."

703	Propagules likely to disperse as a produce contaminant	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.	"Fruit bluish green to bright green, darker with age, ellipsoid to subglobose or pyriform, 1.5-2.6 cm long, 0.9-1.8 cm in diameter." [No evidence and unlikely,. Relatively large, single-seeded fruit]

704	Propagules adapted to wind dispersal	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.	[Fleshy-fruited] "Fruit bluish green to bright green, darker with age, ellipsoid to subglobose or pyriform, 1.5-2.6 cm long, 0.9-1.8 cm in diameter."

705	Propagules water dispersed	y
	Source(s)	**Notes**
	Ehara, H., Dowe, J. L., Nagatomo, R. & Kawasaki, A. (2002) Livistona chinensis var. subglobosa on Aoshima, Japan. Palms, 46(2): 62-67	"a primary experiment on seed germination in L. chinensis, and found that seed germinated even after having been soaked in seawater for 60 days. Although detailed data of the germination experiment are not available, their preliminary result support Honda's hypothesis of a southern origin of assisted by northward tidal current." [a coastal plant able to germinate after soaking in sea water]
	CABI. (2020). Livistona chinensis (Chinese fan palm). In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"In Hawaii, it is possible that plants are also spread in water, as seedlings are often observed germinating along ditches (Starr et al., 2003). Dispersal by sea currents has been suggested for the northerly spread of L. chinensis (as var. subglobosa) from the Ryukyu Archipelago to Shikoku, Japan (Yoshida et al., 2000)."

706	Propagules bird dispersed	y
	Source(s)	**Notes**
	Department of Environment and Natural Resources. (2020). Chinese Fan Palm (Livistona chinensis). Government of Bermuda. https://environment.bm. [Accessed 10 Dec 2020]	"How it spreads: Fruit fall to the ground and sprout below the parent tree. Some fruit are spread by birds. Trees are also moved about by people."
	Genini, J., Galetti, M., & Morellato, L. P. C. (2009). Fruiting phenology of palms and trees in an Atlantic rainforest land-bridge island. Flora, 204(2), 131-145	"L. chinensis also has solitary stems of 5–15m height and dark green fruits, which are dispersed mainly by birds, but also eaten by foxes, tapirs, deers and rodents (Galetti et al., 1999)." … "Table A1. List of palms and tree species observed on Anchieta Island" [Livistona chinensis - Syndrome = Birds]

Qsn #	Question	Answer
	Corlett, R. T. (2005). Interactions between birds, fruit bats and exotic plants in urban Hong Kong, South China. Urban Ecosystems, 8(3-4), 275-283	"The greatest diversities of fruit-eating birds were attracted by Cinnamomum camphora (11 bird species), Livistona chinensis (7 spp.), Pyracantha crenulata (6 spp.) and Ficus religiosa (6 spp.), which have a wide range of fruit characters but all fruit in winter."… "All fruits smaller than their 13 mm maximum gape width were swallowed whole by bulbuls, while larger fruits were either eaten piecemeal (Morus alba and Passiflora foetida) or flesh was pecked from the seed (Livistona chinensis and Syzygium cumini)." … "Common koels (Eudynamis scolopacea) and, occasionally, magpies (Pica pica and Urocissa erythrorhyncha), ate mostly large fruits, particularly those of Livistona chinensis, which they swallowed whole."
	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.	[Fleshy-fruited] "Fruit bluish green to bright green, darker with age, ellipsoid to subglobose or pyriform, 1.5-2.6 cm long, 0.9-1.8 cm in diameter."

707	Propagules dispersed by other animals (externally)	
	Source(s)	**Notes**
	Genini, J., Galetti, M., & Morellato, L. P. C. (2009). Fruiting phenology of palms and trees in an Atlantic rainforest land-bridge island. Flora, 204(2), 131-145	"L. chinensis also has solitary stems of 5–15m height and dark green fruits, which are dispersed mainly by birds, but also eaten by foxes, tapirs, deers and rodents (Galetti et al., 1999)." [No means of attachment, but could potentially be cached by rodents]

708	Propagules survive passage through the gut	y
	Source(s)	**Notes**
	Corlett, R. T. (2017). Frugivory and seed dispersal by vertebrates in tropical and subtropical Asia: an update. Global Ecology and Conservation, 11, 1-22	"Although generally a summer, breeding visitor in the north of its Asian range, Hong Kong has a winter-resident population apparently maintained by the fruits of urban palms, particularly the winter-fruiting Livistona chinensis (personal observations). Koels appear to regurgitate not only large seeds, as many other bird species do, but also hundreds of figs seeds in a single pellet (Shanahan et al., 2001). Such regurgitation of seeds, coupled with the koels' tendency to remain in fruiting trees for long periods (>1 h; personal observations) may limit their effectiveness as dispersal agents."
	Genini, J. (2006). Reproductive Phenology and Fruit Production on a Land Bridge Island in the Brazilian Atlantic Forest. MSc Thesis, Sao Paulo State University,	"Among introduced species are the well dispersed Chinese palms Livinstona chinensis and Cocos nucifera, which are restricted to the settlement areas (Guillaumon et al., 1989)." … "The other two species of palms on the island, Euterpe edulis and Livisntona chinensis, are mainly dispersed by birds."
	Corlett, R. T. (2005). Interactions between birds, fruit bats and exotic plants in urban Hong Kong, South China. Urban Ecosystems, 8(3-4), 275-283	"Common koels (Eudynamis scolopacea) and, occasionally, magpies (Pica pica and Urocissa erythrorhyncha), ate mostly large fruits, particularly those of Livistona chinensis, which they swallowed whole."
	Genini, J., Galetti, M., & Morellato, L. P. C. (2009). Fruiting phenology of palms and trees in an Atlantic rainforest land-bridge island. Flora, 204(2), 131-145	"L. chinensis also has solitary stems of 5–15m height and dark green fruits, which are dispersed mainly by birds, but also eaten by foxes, tapirs, deers and rodents (Galetti et al., 1999)."

801	Prolific seed production (>1000/m2)	

Qsn #	Question	Answer
	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.	"Fruit bluish green to bright green, darker with age, ellipsoid to subglobose or pyriform, 1.5-2.6 cm long, 0.9-1.8 cm in diameter." [With relatively large, single-seeded fruit, but photos suggest seed fruit production and seed densities could be approaching 1000/m2]
	Department of Environment and Natural Resources. (2020). Chinese Fan Palm (Livistona chinensis). Government of Bermuda. https://environment.bm. [Accessed 10 Dec 2020]	"How it spreads: Fruit fall to the ground and sprout below the parent tree. Some fruit are spread by birds. Trees are also moved about by people." [Densities unspecified]

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	**n**
	Source(s)	**Notes**
	Chatty, Y., & Tissaoui, T. (1999) Effect of temperature on germination of ornamental palm trees in Tunisia. Acta Horticulturae 486: 165-167	"According to their germination capacity, the species were grouped into 3 categories: species with rapid germination (Washingtonia filifera , Livistona chinensis , Phoenix canariensis and C. humilis), intermediate germination (Trachycarpus fortunei and Sabal sp.), and species showing germination difficulties (Sabal minor , Syagrus romanzoffiana [Arecastrum romanzoffianum], Erythea armata and E. edulis [Brahea edulis])."
	Wen, B. (2009). Storage of recalcitrant seeds: a case study of the Chinese fan palm, Livistona chinensis. Seed Science and Technology, 37(1), 167-179	[Recalcitrant seeds that lose viability in <1 year unless placed in cryostorage] "Various seed storage techniques were applied to the recalcitrant seeds of the Chinese fan palm (Livistona chinensis [Jacq.] R. Br.). Fully hydrated seeds were stored in perlite at 5 moisture levels at 15 C, and partially dried seeds were stored at 6 moisture levels at 4 temperatures. Cryopreservation was attempted with both intact seeds and isolated embryos. It was found that L. chinensis seeds can not survive sub-zero temperature storage for even one week, but short-term storage at above-zero temperature is feasible. Moist storage of fully hydrated seeds did not impair seed viability, but led inevitably to germination and fungal growth after one month. Partially dried seeds began to lose viability after 3 months storage. Intact seeds can not survive cryo-exposure at any moisture content. By contrast, embryos were successfully stored at liquid nitrogen temperature after desiccation to below 20% moisture content, and no significant viability loss was found after 2-year cryostorage. The advantages and disadvantages of these storage methods are evaluated."

803	**Well controlled by herbicides**	**y**
	Source(s)	**Notes**
	Department of Environment and Natural Resources. (2020). Chinese Fan Palm (Livistona chinensis). Government of Bermuda. https://environment.bm. [Accessed 10 Dec 2020]	"'Roundup' herbicide can also be brushed onto the stump to prevent re-growth."

Qsn #	Question	Answer
	Lazzaro, L. G., de Barros, A. D. S., Esteves, R., de Souza, S. C. P. M., & Ivanauskas, N. M. (2019). Techniques for chemical control of invasive palm trees in protected areas in the São Paulo metropolitan region. Biotemas, 32(2), 55-70	"Abstract : Invasive alien species harm native plant communities by directly eliminating native species or inhibiting their regeneration. There is evidence that the exotic palm trees Livistona chinensis and Archontophoenix cunninghamiana, which colonize Atlantic Forest remnants, threaten the successional processes of native vegetation and, therefore, must be controlled. In this study we assessed the efficacy of glyphosate at chemically controlling invasive populations. The herbicide Roundup Transorb R (30%) was injected into the stem of 30 individuals of each species and the dose was adjusted according to the size of the palm. Senescence symptoms were monitored weekly until all individuals had died, which happened after 18 weeks for L. chinensis and 29 weeks for A. cunninghamiana. Glyphosate proved to be an effective herbicide for both species. Priority should be given to using glyphosate to eliminate large adult palm trees first, since they are responsible for producing the most propagules."
	Langeland, K.A.& Stocker, R.K. 2001. Control of Non-native Plants in Natural Areas of Florida. SP 242. Institute of Food & Agricultural Sciences, University of Florida, Gainesville, FL	"Livistona chinensis Chinese fan palm Treatment: Hand pull seedlings; cut young specimens at ground level or spray Garlon 4 into the apical bud."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	n
	Source(s)	**Notes**
	Department of Environment and Natural Resources. (2020). Chinese Fan Palm (Livistona chinensis). Government of Bermuda. https://environment.bm. [Accessed 10 Dec 2020]	[May regrow if cut, but chopping up stump prevents regeneration] "Mature Fan Palms can be cut back to ground level using a machete and bow saw. Fan Palms are fibrous so if using a chainsaw it will need to be unclogged regularly. Palms grow from a central heart, so using a machete or saw to chop up the centre of the stump should prevent the tree from re-sprouting. 'Roundup' herbicide can also be brushed onto the stump to prevent re-growth."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	**Notes**
	Oppenheimer, H. (2011). New Hawaiian plant records for 2009. Bishop Museum Occasional Papers 110: 5-10	"Livistona chinensis (Jacq.) r.Br. ex mart. New island record Widely cultivated, and in Hawai'i persisting and sparingly naturalized where previously cultivated on O'ahu and West Maui but perhaps elsewhere (Wagner et al. 1999: 1364; Oppenheimer 2003: 5 ; Daehler & Baker 2006: 12). these observations are consistent with its occurrence on Kaua'i, where all size classes were observed, including large plants, on nearly vertical gulch walls. Material examined. KAUA'I: Hanalei Distr, Kīlauea str., 79 m, 12 Nov 2008, Oppenheimer H110819." [Probably no. Naturalized on several islands]

Summary of Risk Traits:

High Risk / Undesirable Traits
• Broad climate suitability
• Grows, and capable of spreading in regions with tropical climates
• Naturalized on Kauai, Oahu, and Maui (Hawaiian Islands) and elsewhere
• An aggressive, weedy tree in Lyon Arboretum, Oahu, Hawaiian Islands
• An environmental weed in Bermuda, and potentially elsewhere
• Other Livistona species have naturalized and may be invasive
• Petioles armed with spines
• Host of lethal yellowing disease
• Shade tolerant
• Tolerates many soil types
• Capable of forming dense thickets
• Reproduces by seeds
• Capable of autogamy, or self-fertilization
• Seeds dispersed by birds, other frugivorous animals, water, and intentionally by people

Low Risk Traits
• Non-toxic
• Not reported to spread vegetatively
• Reaches maturity in 5-7 years, or longer
• Relatively large fruit and seeds, and size of frugivorous birds in the Hawaiian Islands, may limit long distance dispersal
• Recalcitrant seeds will not form a persistent, long-lived seed bank
• Mechanical and chemical control methods may be effective