# Weed Risk Assessment for *Dolichandra unguis-cati* (L.) L. G. Lohmann (Bignoniaceae) – Cat's-claw


United States Department of Agriculture

Animal and Plant Health Inspection Service


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Version 1

Left: Tree infested with *D. unguis-cati* (Source: University of Florida/IFAS Center for Aquatic and Invasive Plants; Bogatescu, 2013). Upper right: Individual vines climbing up a tree (Source: University of Florida/IFAS Center for Aquatic and Invasive Plants; Bogatescu, 2013). Bottom right: Fruit pods of a vine growing on trellis (Source: C. Lewis, Weedbusters, NZ; Lewis, 2013).

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**Introduction** Plant Protection and Quarantine (PPQ) regulates noxious weeds under the authority of the Plant Protection Act (7 U.S.C. § 7701-7786, 2000) and the Federal Seed Act (7 U.S.C. § 1581-1610, 1939). A noxious weed is defined as "any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment" (7 U.S.C. § 7701-7786, 2000). We use weed risk assessment (WRA)—specifically, the PPQ WRA model (Koop et al., 2012)—to evaluate the risk potential of plants, including those newly detected in the United States, those proposed for import, and those emerging as weeds elsewhere in the world.

Because the PPQ WRA model is geographically and climatically neutral, it can be used to evaluate the baseline invasive/weed potential of any plant species for the entire United States or for any area within it. As part of this analysis, we use a stochastic simulation to evaluate how much the uncertainty associated with the analysis affects the model outcomes. We also use GIS overlays to evaluate those areas of the United States that may be suitable for the establishment of the plant. For more information on the PPQ WRA process, please refer to the document, *Background information on the PPQ Weed Risk Assessment*, which is available upon request.

***Dolichandra unguis-cati*** **(L.) L. G. Lohmann. – Cat's-claw**

**Species Information**

Family: Bignoniaceae

Synonyms: *Bignonia tweediana* Lindl. (NGRP, 2013); *B. unguis-cati* L. [NGRP, 2013]; *Doxantha unguis-cati* (L.) Miers (NGRP, 2013); *D. unguis-cati* (L.) Rehd. (Wagner et al., 1999); *Macfadyena unguis-cati* (L.) A. H. Gentry (NGRP, 2013; The Plant List, 2013)

Initiation: In April 2012, the Australian Weeds Committee added this species and others to their list of Weeds of National Significance (AWC, 2013). On May 2, 2012, Al Tasker (PPQ Federal Noxious Weed Program Manager) requested we review those (Tasker, 2012).

Foreign distribution: This plant is native to Mexico and much of the Caribbean, south through the Neotropics into southern South America (Acevedo-Rodríguez and Strong, 2012; NGRP, 2013). It has been sold as an ornamental in many countries with tropical or subtropical climates (Downey and Turnbull, 2007). Consequently, it has become naturalized in Australia, Bermuda, Cape Verde, Kenya, Mauritius, Micronesia, New Caledonia, New Zealand, Niue, Portugal, Réunion, Seychelles, South Africa, Swaziland, Tanzania, Uganda, and Vanuatu (Downey and Turnbull, 2007; Kairo et al., 2003; NGRP, 2013). It is considered a weed or a casual alien in China (Weber et al., 2008), Cuba (Acevedo-Rodríguez and Strong, 2012), India (Holm et al., 1991), and Portugal (DAISIE, 2013).

U.S. distribution and status: This species is native to Puerto Rico and the U.S.

Virgin Islands (NGRP, 2013). It is currently naturalized in the United States, primarily in Florida, but also in Texas, Louisiana, Georgia, Hawaii, and South Carolina (Kartesz, 2013; Wagner et al., 1999). It was cultivated in Hawaii as early as 1928 (Wagner et al., 1999), and probably introduced into the continental United States sometime after 1930 since it is not listed in Hortus (Bailey and Bailey, 1930) but is in Hortus Third (Bailey and Bailey, 1976). The plant was first recorded in the wild in Florida in 1947 (Kaufman and Kaufman, 2007). This species is cultivated in the United States by Monrovia, a large plant wholesale and distribution business (Anonymous, 2013). Australians worried about the resurgence of horticultural interest in this plant noted that it is being promoted in the United States for desert and saline environments (Downey and Turnbull, 2007), which we verified (University of Arizona Master Gardeners Program; Anonymous, 2006). The weed and invasive potential of this species is recognized by many U.S. gardeners, some of whom wonder why it is allowed to be sold (Dave's Garden, 2013). State and county park managers in Florida are trying to eradicate *D. unguis-cati* where possible (Bard, 2013; Maguire, 2013).

WRA area[1]: Entire United States, including territories.

<u>1. *Dolichandra unguis-cati* analysis</u>

**Establishment/Spread Potential**

*Dolichandra unguis-cati* is an invasive species, readily capable of establishing, naturalizing, and spreading. It is a woody vine that attaches to and climbs up its host using claw-like hooks and adventitious roots (Gentry, 1980; Wagner et al., 1999). Although it thrives in the sun, it is shade-adapted (Downey and Turnbull, 2007; Vivian-Smith and Panetta, 2004). This species is self-compatible and reproduces vegetatively and through seed production (Vivian-Smith and Panetta, 2004). Seeds are both wind- and water-dispersed (Grice and Setter, 2003; Vivian-Smith and Panetta, 2004; Wright, 2009). However, *D. unguis-cati* has a relatively long seedling and juvenile stage (Downey and Turnbull, 2007) and does not produce a long-term seed bank (Vivian-Smith and Panetta, 2004). It can root along its nodes, producing tubers along the way, so it forms dense mats on the ground (Csurhes and Edwards, 1998; WMC, 2013). Because both tubers and stem pieces can resprout, the species is very resilient to physical and other control efforts (Dhileepan et al., 2013). We had low uncertainty in this risk element.

Risk score = 12 Uncertainty index = 0.07

**Impact Potential**

Like other large invasive vines, *Dolichandra unguis-cati* poses a threat to entire natural ecosystems, and can damage production systems. In natural systems it smothers vegetation, prevents recruitment of native species, and kills large trees through shading and physical damage from the weight of the vines

[1] "WRA area" is the area in relation to which the weed risk assessment is conducted [definition modified from that for "PRA area" (IPPC, 2012).

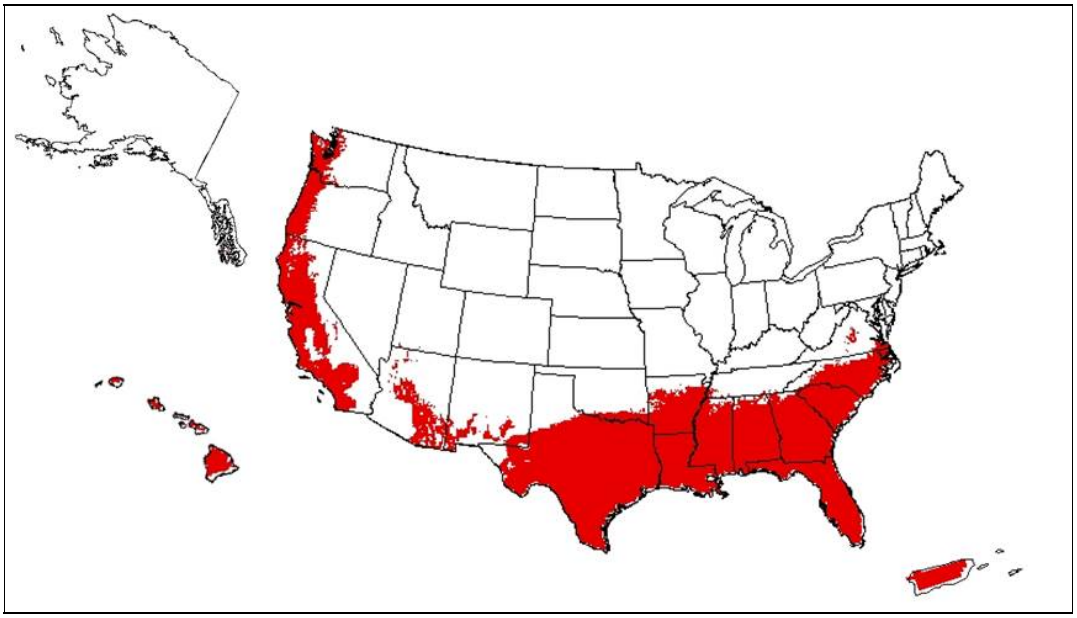
(Downey and Turnbull, 2007; King et al., 2011; Mulvaney, 1991; WMC, 2013). Over time this can cause the entire canopy to collapse, leaving only dead trunks (Grice and Setter, 2003). In urban environments, this species has similar impacts as above on ornamental trees and shrubs, and because it climbs using recurved hooks, it can attach to and damage walls, roofs, and other structures (Dave's Garden, 2013). Numerous gardeners have commented on this species' negative impacts and how difficult it is to control. Those who rate it positively note that it needs to be planted away from other plants, and should be contained through both regular pruning and root barriers (Dave's Garden, 2013). *Dolichandra unguis-cati* is also considered an agricultural weed (Groves et al., 2005; Randall, 2007) and a "significant invader" of plantations and orchards (King et al., 2011). Although this species is very likely to similarly affect both natural areas and orchards/forest plantations, we found little evidence that it has done so. A variety of control strategies are used to manage this species, including biocontrol agents. *Dolichandra unguis-cati* is regulated in Australia (Downey and Turnbull, 2007), New Zealand (MPI, 2012), and South Africa (McNeely, 2001; Nel et al., 2004). Because of the uncertainty of impacts and control activities in production systems, we had above-average uncertainty for this element.
Risk score = 3.4 Uncertainty index = 0.24

**Geographic Potential** Based on three climatic variables, we estimate that about 21 percent of the United States is suitable for the establishment of *Dolichandra unguis-cati* (Fig. 1). This predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. The map for *D. unguis-cati* represents the joint distribution of Plant Hardiness Zones 8-13, areas with 10-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, humid subtropical, Mediterranean, marine west coast, and steppe. We were uncertain if this species could establish in desert environments and in areas with less than 10 inches of annual precipitation, unless it is a protected microhabitat.

The area estimated likely represents a conservative estimate as it uses only three climatic variables. Other environmental variables, such as soil and habitat type, may further limit the areas in which this species is likely to establish. Furthermore, we assumed *D. unguis-cati* could occur in plant hardiness zone 8 based on occurrence records (GBIF, 2013), and cultivation reports from this zone (Dave's Garden, 2013), but it may only establish in the warmer portions of this zone, thereby reducing the northern edge of its predicted distribution. *Dolichandra unguis-cati* is normally associated with forest and riparian habitats (King et al., 2011) but recently it has spread into sclerophyll forests in Australia (Downey and Turnbull, 2007). In other countries it grows in savannas and secondary forests (Downey and Turnbull, 2007).

**Entry Potential** We did not assess *D. unguis-cati*'s entry potential because this species is already present in the United States (Kartesz, 2013; Wagner et al., 1999).

**Figure 1**. Predicted distribution of *D. unguis-cati* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.



<u>2. Results and Conclusion</u>

Model Probabilities: P(Major Invader) = 67.7%
P(Minor Invader) = 30.9%
P(Non-Invader) = 1.4%

Risk Result = High Risk

Secondary Screening = Not Applicable

**Figure 2**. *Dolichandra unguis-cati* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

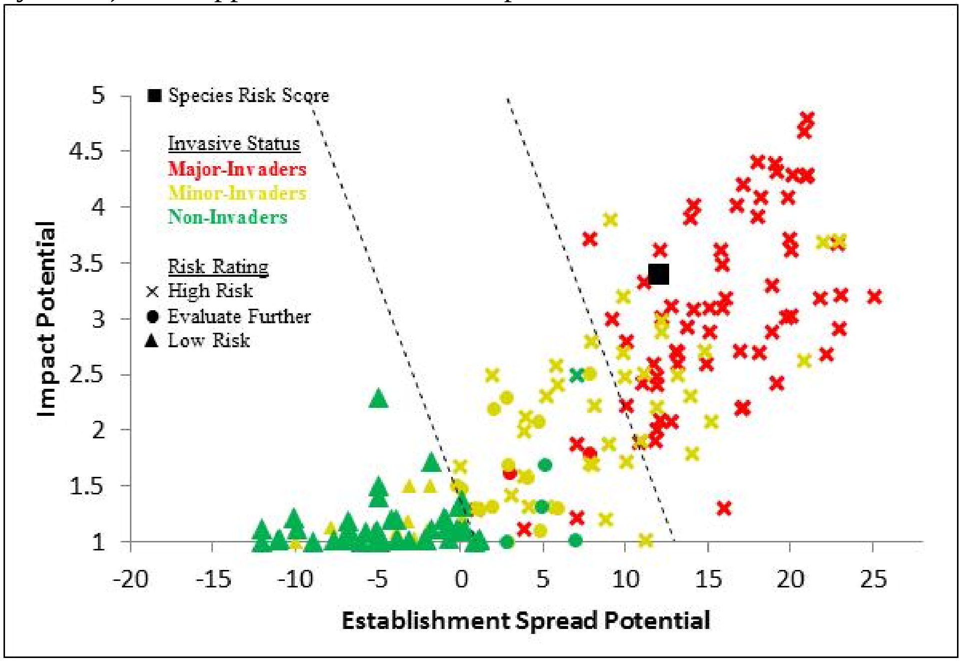
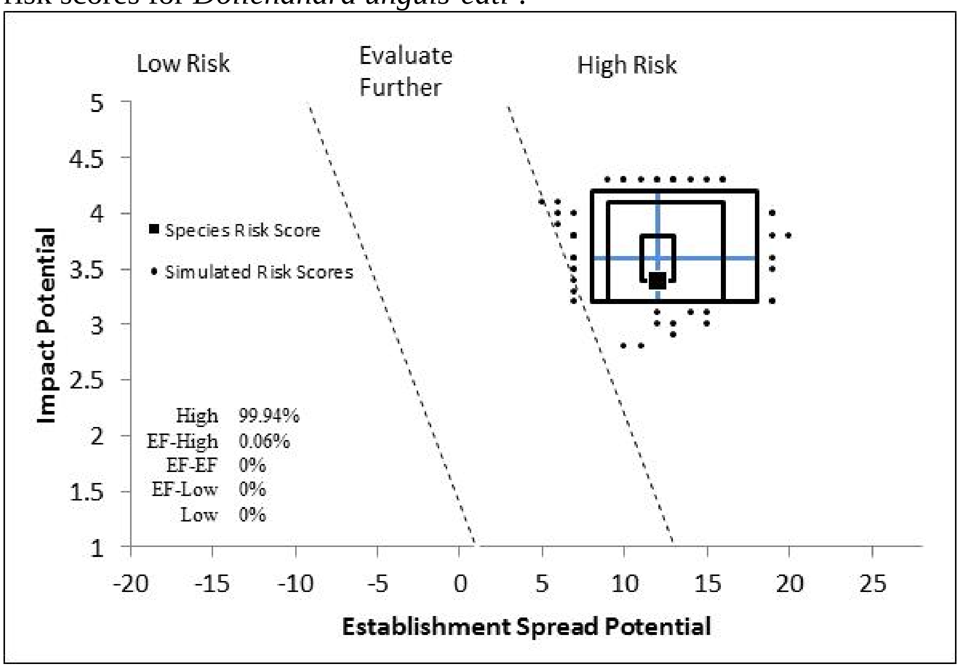



**Figure 3**. Monte Carlo simulation results (N=5,000) for uncertainty around the risk scores for *Dolichandra unguis-cati*[a].




[a] The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

## 3. Discussion

The result of the weed risk assessment for *Dolichandra unguis-cati* is High Risk (Fig. 2). Despite the uncertainty associated with our assessment, we are confident in our result because all but one of the simulated risk scores resulted in a conclusion of High Risk (Fig. 3). Furthermore, our result is consistent with that of another weed risk assessment (Univ. of Hawaii, 2013), and with this species' behavior where it has been introduced (Downey and Turnbull, 2007). *Dolichandra unguis-cati* represents a significant threat to ecosystems because of its ability to smother vegetation and collapse plant canopies (Downey and Turnbull, 2007; Grice and Setter, 2003; Vivian-Smith and Panetta, 2004). Out of 340 invasive environmental weeds in New South Wales, Australia, *D. unguis-cati* ranked 11$^{th}$ for its threat to biodiversity and is recommended for control (Downey et al., 2010). This species is not recommended for planting in central Florida and should be planted with caution in southern and northern Florida (IFAS, 2011).

Given that *D. unguis-cati* is a large, woody vine, its impacts are not surprising. This species' ability to root from cuttings and resprout from underground tubers makes it particularly difficult to manage (Csurhes and Edwards, 1998; King et al., 2011). In dense infestations, tuber density may be as high as 938 per m$^2$ (Downey and Turnbull, 2007). There are two varieties of this plant, a long-pod and short-pod variety. The long-pod variety appears to allocate slightly more biomass to aboveground structures. This variety may be or may become a better invader (Taylor and Dhileepan, 2012). Some individuals or populations of the species are polyploid (i.e., having more than two sets of chromosomes) at 2N = 80 (Gentry, 1980). Polyploidy has been associated with invasiveness in plants (Schmidt et al., 2012).

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**Appendix A**. Weed risk assessment for *Dolichandra unguis-cati* (L.) L. G. Lohmann. (Bignoniaceae). (Hydrocharitaceae). The following information came from the original risk assessment, which is available upon request (full responses and all guidance). We modified the information to fit on the page.

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| **ESTABLISHMENT/SPREAD POTENTIAL** | | | |
| ES-1 (Status/invasiveness outside its native range) | f - negl | 5 | Native from Mexico and much of the Caribbean, south through the Neotropics into southern South America (Acevedo-Rodríguez and Strong, 2012; NGRP, 2013). Present in China (Weber et al., 2008). Established in Madeira Island of Portugal (DAISIE, 2013). Exotic and invasive in Cuba (Acevedo-Rodríguez and Strong, 2012). Naturalized in Bermuda (Kairo et al., 2003) and eastern Zimbabwe (Maroyi, 2012). Naturalized and spreading in South Africa (King et al., 2011). Naturalized and invasive in the Bahamas (Kairo et al., 2003). Invasive in New Caledonia (Soubeyran, 2008). Now common in the Australian Flora (Mulvaney, 1991). Categorized in Australia as an invasive species (category "5A"), which are species that spread rapidly (Randall, 2007). A invasive plant in India (Bhatt et al., 2012). Casual (Howell and Sawyer, 2006) and/or naturalized in Napier, New Zealand (Landcare Research, 2013), and may become more widespread in the future (MPI, 2012). It is naturalized in Florida, Texas, Louisiana, Georgia, Hawaii, and South Carolina (Kartesz, 2013; Wagner et al., 1999; Weakley, 2010). Sparingly naturalized in Hawaii (Wagner et al., 1999), but others (Staples et al., 2000) report it as invasive. A cultivation escape in Florida that is spreading in natural areas (Langeland and Burks, 1998). Alternate answers for the Monte Carlo simulation are both "e." |
| ES-2 (Is the species highly domesticated) | n - low | 0 | Species is cultivated (Bailey and Bailey, 1976; Neal, 1965; Wagner et al., 1999), but there is no evidence that it has been bred for traits associated with reduced weed risk. |
| ES-3 (Weedy congeners) | n - low | 0 | The genus contains about nine species native to the Neotropics (Wagner et al., 1999), but no other species has been reported as a significant weed. |
| ES-4 (Shade tolerant at some stage of its life cycle) | y - low | 1 | Prefers and thrives in full sun to part shade (Kaufman and Kaufman, 2007; Langeland and Burks, 1998), but is also capable of growing in shady environments (Downey and Turnbull, 2007; Vivian-Smith and Panetta, 2004). |
| ES-5 (Climbing or smothering growth form) | y - negl | 1 | A tropical liana up to 15 meters or more in length (Wagner et al., 1999). Aggressive vine (Space and Flynn, 2002). Liana that adheres to trees with recurved hooks and adventitious roots (Weber, 2003). |
| ES-6 (Forms dense thickets) | y - negl | 2 | Forms mats on the ground (Space and Flynn, 2002; Weber, 2003). Forms dense mats (Csurhes and Edwards, 1998). Often roots at nodes (Wagner et al., 1999). Prostrate vines root along nodes, which produce tubers, and from which grow more stems, leading to denser ground mats (WMC, 2013). Reproduces from pieces and cuttings (Space and Flynn, 2002). Dense infestations in Australia (Vivian-Smith and Panetta, 2004). |
| ES-7 (Aquatic) | n - negl | 0 | Plant is not an aquatic; it is a liana (Wagner et al., 1999; Weber, 2003) |
| ES-8 (Grass) | n - negl | 0 | Plant is not a grass; it is in the Bignoniaceae family (Wagner et al., 1999). |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| ES-9 (Nitrogen-fixing woody plant) | n - negl | 0 | No evidence. The Bignoniaceae is not one of the plant families known to contain nitrogen-fixing species (Martin and Dowd, 1990). |
| ES-10 (Does it produce viable seeds or spores) | y - negl | 1 | Reproduces by seed (Osunkoya et al., 2009; Vivian-Smith and Panetta, 2004; Weber, 2003; WMC, 2013). |
| ES-11 (Self-compatible or apomictic) | y - low | 1 | An experimental study that germinated seeds found that some seeds produced multiple embryos (polyembryony), which is a type of apomixis (Vivian-Smith and Panetta, 2004). Multiple seedlings from a single seed suggests it is facultatively apomictic (Downey and Turnbull, 2007). "Plants are self-fertile, unlike most bignoniaceous lianes in N.Z. [New Zealand], so the sp. is more likely to occur wild" (Landcare Research, 2013). The congener *Dolichandra cynanchoides* has a mixed mating system, where some seeds are selfed progeny (Bianchi et al., 2005). |
| ES-12 (Requires special pollinators) | n - mod | 0 | No evidence. Pollinated by anthophorid bees in Costa Rica (Downey and Turnbull, 2007). If plants are self-fertile through apomixis (Landcare Research, 2013), they will not require specialized pollinators. |
| ES-13 (Minimum generation time) | d - high | -1 | There is little direct evidence to fully address this question. However, several observations suggest an answer of "d." "Stays at seedling stage for some time, while enlarging roots into tuberlike storage organs; then rapidly elongates stems, forming long runners when no erect substrate is within reach" (Langeland and Burks, 1998). May not begin flowering until vine is well established (Downey and Turnbull, 2007). It has a prolonged seedling stage (Downey and Turnbull, 2007). Produces tubers from which grow individual climbing runners (WMC, 2013). For seed-produced individuals, this evidence suggests a minimum generation time of four years or more, choice "d." Although the plant can root along nodes (Wagner et al., 1999), and tubers and stem fragments can give rise to new individuals (Dhileepan et al., 2013; King et al., 2011), these are probably acting more like one super plant rather than individual plants. One study concluded that reproduction from seeds is more important (Osunkoya et al., 2009). Consequently answering "d" with high uncertainty. Alternate answers for the Monte Carlo simulation are "c" and "b." |
| ES-14 (Prolific reproduction) | n - mod | -1 | Inflorescences are primarily axillary with typically 1-3 flowers, though up to 15 have been recorded (Downey and Turnbull, 2007). Pods contain on average 90 winged seeds (King et al., 2011). Capsules can contain 106-212 seeds (Downey and Turnbull, 2007). Capsules contain up to 200 seeds (Osunkoya et al., 2009). High seed production (King et al., 2011; Langeland and Burks, 1998; WMC, 2013). An image from New Zealand's Weed Busters website shows a vine on a trellis with dozens of long seed pods within a small area of about a square meter (WMC, 2013). Germination ranges between 31 percent and 69 percent in one study (Vivian-Smith and Panetta, 2004). But one field study that obtained seeds from soil cores along a riparian zone concluded that seed bank densities are low compared to another invasive vine (Vivian-Smith and Panetta, 2004). A seed deposition study estimated rates of 167 seeds per square meter per year directly underneath plant canopies (Downey and Turnbull, 2007). Based on this last piece of evidence, which is direct, answering no, but with moderate uncertainty. |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| ES-15 (Propagules likely to be dispersed unintentionally by people) | y - mod | 1 | Because this species is cultivated (Bailey and Bailey, 1976; Neal, 1965; Wagner et al., 1999), and because it can root from nodes, cuttings, and tubers (Dhileepan et al., 2013; King et al., 2011; Space and Flynn, 2002), it is likely to be spread unintentionally by people in yard waste. From GBIF herbarium locality records, one sample was collected from a ruderal area around an old dumpsite at the edge of an orange grove (GBIF, 2013). |
| ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers) | n - mod | -1 | No evidence. |
| ES-17 (Number of natural dispersal vectors) | 2 | 0 | Description of fruit and seed for questions ES17a-ES17e: Fruit of the genus is a "narrow, linear, compressed capsule, the valves parallel to the septum, smooth externally. Seeds with 2 wings…" (Wagner et al., 1999). For the species: capsules are 26-95 cm long, 1-2 cm in diameter (Wagner et al., 1999). Seeds are 1-1.8 cm long, 4.2-5.8 cm wide, the wings membranous (Wagner et al., 1999). Seeds numerous, 1-3.5 cm long, with two membranaceous wings (Acevedo-Rodriguez, 2005). *Dolichandra unguis-cati* has been placed in several different genera, one is typified as being primarily wind-dispersed (*Doxanthus*), and another being primarily water-dispersed (*Macfadyena*) (Gentry, 1973). Gentry (1980) also reports that there have been several adaptive shifts in the Bignoniaceae from wind to water dispersal (Gentry, 1980). |
| ES-17a (Wind dispersal) | y - negl | | This species has been reported to be wind-dispersed (Csurhes and Edwards, 1998; Kaufman and Kaufman, 2007; Staples et al., 2000; Weber, 2003; WMC, 2013; Wright, 2009). |
| ES-17b (Water dispersal) | y - negl | | This species has been reported to be water-dispersed (Kaufman and Kaufman, 2007; Weber, 2003; Wright, 2009). Given the dispersal ecology of the family, the reports for both dispersal types (i.e., wind and water) in the literature, and the fact that this species grows along riparian corridors in Australian rainforests (Downey and Turnbull, 2007; Grice and Setter, 2003; Vivian-Smith and Panetta, 2004), we are assuming that its light, winged-seeds are dispersed by both wind and water. Seeds can float in water for up to 54 days, with 50 percent still floating after 36 days (Downey and Turnbull, 2007). Germination is not affected by immersion in water (Downey and Turnbull, 2007). |
| ES-17c (Bird dispersal) | n - low | | No evidence. Does not seem likely given fruit and seed morphology. |
| ES-17d (Animal external dispersal) | n - mod | | No evidence. |
| ES-17e (Animal internal dispersal) | n - low | | No evidence. Does not seem likely given fruit and seed morphology don't offer any obvious rewards for frugivores. |
| ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed) | n - low | -1 | An experimental study aimed at determining this characteristic found very little viability of seeds buried for a year, and no germination of seeds in their second season; they concluded there was no long-term seed bank (Vivian-Smith and Panetta, 2004). |
| ES-19 (Tolerates/benefits from mutilation, cultivation or fire) | y - negl | 1 | This species tolerates mutilation. It often roots at nodes (Wagner et al., 1999). Control is difficult because it has tuberous roots and reproduces from pieces and cuttings (Kaufman and Kaufman, 2007; King et al., 2011; Space and Flynn, 2002). Has underground tubers that are 20-40 cm in length (Weber, 2003). Difficult to |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
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| | | | control because it can resprout for a long time from underground tubers (Dhileepan et al., 2013). Forms belowground tuber networks (Vivian-Smith and Panetta, 2004). Resprouts after fire (Downey and Turnbull, 2007). |
| ES-20 (Is resistant to some herbicides or has the potential to become resistant) | n - negl | 0 | Not listed in Heap (2013). A detailed review of control strategies, including several different herbicide formulations and strategies, did not note any herbicide resistance (Downey and Turnbull, 2007). |
| ES-21 (Number of cold hardiness zones suitable for its survival) | 6 | 0 | |
| ES-22 (Number of climate types suitable for its survival) | 6 | 2 | |
| ES-23 (Number of precipitation bands suitable for its survival) | 10 | 1 | |
| **IMPACT POTENTIAL** | | | |
| **General Impacts** | | | |
| Imp-G1 (Allelopathic) | n - low | 0 | No evidence, and plant relatively well studied, particularly in Australia (e.g., Downey and Turnbull, 2007). |
| Imp-G2 (Parasitic) | n - negl | 0 | No evidence. The Bignoniaceae is not a plant family known to contain parasitic plant species (Heide-Jorgensen, 2008; Nickrent, 2009). |
| **Impacts to Natural Systems** | | | |
| Imp-N1 (Change ecosystem processes and parameters that affect other species) | y - negl | 0.4 | The weight and shading of the vines can eventually kill canopy trees (Kaufman and Kaufman, 2007). "Thickets of cats claw creeper (*Macfadyena unguis-cati*) have smothered the canopy of several remnant patches of Northern New South Wales rainforest, severely disrupting photosynthesis and productivity of this ecosystem" (Mulvaney, 1991); the author listed this impact under changing ecosystem processes. "The vines reduced healthy rainforests to a stand of vine-draped poles within one to two decades" (Grice and Setter, 2003)." It can cause the death of large canopy trees through a combination of weight and shading. It can cover standing vegetation, including large trees and shrubs, and eventually cause canopy collapse (Vivian-Smith and Panetta, 2004). *Dolichandra unguis-cati* is also reported to affect stream health and water quality in highly invaded areas (Downey and Turnbull, 2007), but this hasn't been verified. In mature infestations, tuber density can be as high as 1000 per square meter, to within 30 cm of the soil surface, but they have been found as deep as 1 meter (Downey and Turnbull, 2007; Osunkoya et al., 2009). Destabilizes banks in riverine systems (Downey and Turnbull, 2007). May improve soil fertility and change nutrient cycling (Perrett et al., 2012). |
| Imp-N2 (Change community structure) | y - negl | 0.2 | Dense mats prevent the recruitment of native species (Downey and Turnbull, 2007). "Vines such as madiera vine, cat's claw creeper and thunbergia were the most destructive due to their extremely efficient reproductive systems, very rapid growth, height above-ground biomass and capacity to smother all layers of a rainforest from the canopy to the forest floor" (Grice and Setter, 2003). |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
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| | | | Because the plant can root and form tubers along the stem nodes when it is prostrate along the ground, it can form mats which carpet the forest floor (Csurhes and Edwards, 1998). Forms a ground cover in open forests (Kaufman and Kaufman, 2007). Has become dominant ground cover in undisturbed hardwood forests by Lake George in Florida (Langeland and Burks, 1998). As a Category "5A" species, by definition, it creates monocultures (Randall, 2007). All of this evidence indicates this species changes multiple layers of a community. |
| Imp-N3 (Change community composition) | y - negl | 0.2 | Climbs vegetation and can smother native trees and shrubs (Csurhes and Edwards, 1998; Downey and Turnbull, 2007). A smothering vine (MPI, 2012). Outcompetes forest understories and may kill "host" trees because of its weight and shading effect (Weber, 2003). Forms dense ground cover that precludes germination and recruitment of native understory species (King et al., 2011; WMC, 2013). |
| Imp-N4 (Is it likely to affect federal Threatened and Endangered species) | y - negl | 0.1 | This vine is threatening two species (one plant and one animal) listed as Threatened under the New South Wales Threatened Species Conservation Act of 1995 (Coutts-Smith and Downey, 2006). In Australia it is also damaging roosts of threatened flying foxes (Downey and Turnbull, 2007), but these types of animals don't occur in the United States. Given the other impacts listed above, it is likely to affect Threatened and Endangered species in the United States. |
| Imp-N5 (Is it likely to affect any globally outstanding ecoregions) | y - negl | 0.1 | Threatens riparian and rainforest communities in subtropical and tropical habitats in Australia (Csurhes and Edwards, 1998; Downey and Turnbull, 2007), including lowland rainforest communities which are endangered in New South Wales (Downey and Turnbull, 2007). Can dominate entire landscapes in Australia (Osunkoya et al., 2009). Given its ability to affect entire communities, this species is likely to affect several globally outstanding ecoregions in the United States, particularly those in the southeastern and western United States (Ricketts et al., 1999). |
| Imp-N6 (Weed status in natural systems) | c - negl | 0.6 | Weed in Florida in hardwood forest islands (Kaufman and Kaufman, 2007). Considered to be one of the most destructive weeds of rainforests in Australia (Grice and Setter, 2003). Weed of the native flora on Reunion (Tassin et al., 2006). Environmental weed that is considered to be a major problem in at least four locations in Australia (Groves et al., 2005). Declared weed in South Africa that invades forest margins and woodlands (Henderson, 2001). Recommended for eradication or control of spread on the Cook Islands (Space and Flynn, 2002). Seedlings and small plants can be dug out, but the roots must be removed carefully (Weber, 2003; WMC, 2013). Five biological control agents have been released in South Africa (King et al., 2011). Listed as a Category 1 weed under the Conservation of Agricultural Resources Act of South Africa and must be controlled under all situations (i.e., systems) (Nel et al., 2004). Detailed control strategies are described elsewhere (Downey and Turnbull, 2007). Alternate answers for the Monte Carlo simulation are both "b." |
| **Impact to Anthropogenic Systems (cities, suburbs, roadways)** | | | |
| Imp-A1 (Impacts human | y - negl | 0.1 | Leaves have claw-tipped tendril that allows it to climb, including |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
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| property, processes, civilization, or safety) | | | on walls and buildings (King et al., 2011; Neal, 1965; Weber, 2003). "The ability of cat's claw creeper to grow over most surfaces can cause serious damage in urban settings, as the tendrils and aerial roots which anchor the plant are also capable of lifting roof tiles and cladding. In addition, the weight of vines can crack walls and break fences. Consequently, the removal of cat's claw creepers can also damage such surfaces since the tendrils and aerial roots bind tightly to them" (Downey and Turnbull, 2007). In addition, it is "a problem to power companies and railways; it often grows up power and other poles, where it can cause localized power interruptions due to the weight of vines bringing down either the pole and/or powerlines" (Downey and Turnbull, 2007). "It will smother almost anything and made holes in my roof by rooting through the shingles. It climbs up underneath the siding and comes out into the eaves and even into the attic" (Dave's Garden, 2013). Another post on Dave's Garden says it damages stucco (Dave's Garden, 2013). |
| Imp-A2 (Changes or limits recreational use of an area) | n - mod | 0 | No evidence. |
| Imp-A3 (Outcompetes, replaces, or otherwise affects desirable plants and vegetation) | y - negl | 0.1 | There are numerous negative comments from Dave's Garden; here are a few: Will smother previously lush lawns (Dave's Garden, 2013). "Swamps small trees and shrubs" (Dave's Garden, 2013). Smothers valuable plants, and destroyed a 70-year-old heirloom garden (Dave's Garden, 2013). Even the comments that are classified as positive urge caution (Dave's Garden, 2013). |
| Imp-A4 (Weed status in anthropogenic systems) | c - negl | 0.4 | Declared weed in South Africa that invades urban spaces and roadsides (Henderson, 2001). Weed of abandoned urban areas (Williams cited in King et al., 2011). Listed as a Category 1 weed under the Conservation of Agricultural Resources Act of South Africa and must be controlled under all situations (i.e., systems) (Nel et al., 2004). Ornamental plantings sometimes lead to infestations that must be controlled (Ward, 2005). There are numerous negative comments on Dave's Garden website about this species (Dave's Garden, 2013). People have had to remove it because of damage to structures and other plants. One person had to dig up their ligustrum hedge in order to remove the tubers of this vine (Dave's Garden, 2013). Alternate answers for the Monte Carlo simulation are both "b." |
| **Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)** | | | |
| Imp-P1 (Reduces crop/product yield) | ? - max | | One study reports that it poses a serious risk for forestry operations as it can stress and kill trees (Downey and Turnbull, 2007). Although Imp-P6 documents some evidence that it is present in plantations and orchards, we found no evidence that it reduces yield in production systems. Consequently, answering unknown. |
| Imp-P2 (Lowers commodity value) | ? - max | | One study reports that it poses a serious risk for forestry operations because it is difficult to control (Downey and Turnbull, 2007). Although Imp-P6 documents some evidence that it is present in plantations and orchards, we did not find any evidence that it lowers the value of agricultural or forest products. Consequently, answering unknown. |
| Imp-P3 (Is it likely to impact trade) | n - mod | 0 | Listed under the National Pest Plant Accord of New Zealand, and thus is banned from sale, distribution, and propagation throughout New Zealand (MPI, 2012). Prohibited in South Africa (McNeely, |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
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| | | | 2001). Regulated and banned from sale and movement in Queensland and Western Australia (Downey and Turnbull, 2007). However, because there is no evidence it is likely to contaminate trade, answering no. |
| Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water) | n - low | 0 | No evidence. |
| Imp-P5 (Toxic to animals, including livestock/range animals and poultry) | n - low | 0 | Palatable to cattle (Downey and Turnbull, 2007).No known toxicity to goats, but not known to be eaten by them (Simmonds et al., 2000). |
| Imp-P6 (Weed status in production systems) | b - high | 0.2 | Weed of agriculture in Australia (Randall, 2007). A grazing weed in Australia (Groves et al., 2005). "Significant invader" of plantations and orchards (King et al., 2011). Declared weed in South Africa that invades plantations (Henderson, 2001). But another author says it is mainly an environmental weed in Australia (Downey and Turnbull, 2007). Listed as a Category 1 weed under the Conservation of Agricultural Resources Act of South Africa and must be controlled under all situations (i.e., systems) (Nel et al., 2004). The herbicide silvex has been used to control this perennial vine in Florida citrus (Ryan, 1969). Other than these references, we did not find any additional information on impacts or control in production systems. Because in general the evidence is weak and anecdotal, and because one source said it is primarily a natural areas weed, we are answering "b" but with high uncertainty. Alternate answers for the Monte Carlo simulation are "c" and "a." |
| **GEOGRAPHIC POTENTIAL** | | | Unless otherwise noted, all evidence below represents point-occurrences obtained from GBIF (2013). |
| **Plant cold hardiness zones** | | | |
| Geo-Z1 (Zone 1) | n - negl | N/A | No evidence. |
| Geo-Z2 (Zone 2) | n - negl | N/A | No evidence. |
| Geo-Z3 (Zone 3) | n - negl | N/A | No evidence. |
| Geo-Z4 (Zone 4) | n - negl | N/A | No evidence. |
| Geo-Z5 (Zone 5) | n - negl | N/A | No evidence. |
| Geo-Z6 (Zone 6) | n - negl | N/A | No evidence. |
| Geo-Z7 (Zone 7) | n - high | N/A | No evidence. |
| Geo-Z8 (Zone 8) | y - high | N/A | One point on edge near zone 9 in Alabama. Two points near zone 9 edge in Mexico. Dave's Garden reports it is hardy to this zone (Dave's Garden, 2013). Someone from New Bern, North Carolina said it grows there where temperatures go below 10 °F and they are having trouble getting rid of it (Dave's Garden, 2013), but coastal North Carolina is classified as hardiness zone 8 (Magarey et al., 2008). |
| Geo-Z9 (Zone 9) | y - negl | N/A | South Africa, Argentina. Recommended for this zone (Page and Olds, 2001). Survives to 20 °F (Anonymous, 2006). |
| Geo-Z10 (Zone 10) | y - negl | N/A | Australia and New Zealand. Withstands a few degrees of frost (Bailey and Bailey, 1976). Withstands heavy frost (King et al., 2011). Recommended for this zone (Page and Olds, 2001). |
| Geo-Z11 (Zone 11) | y - negl | N/A | Australia, South Africa, Mexico. |
| Geo-Z12 (Zone 12) | y - negl | N/A | Brazil, Bolivia, and Mexico. |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
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| Geo-Z13 (Zone 13) | y - negl | N/A | French Guiana, Peru, and Brazil. |
| **Köppen-Geiger climate classes** | | | |
| Geo-C1 (Tropical rainforest) | y - negl | N/A | Peru, Brazil, and Bolivia. |
| Geo-C2 (Tropical savanna) | y - negl | N/A | Brazil, Bolivia, and Venezuela. |
| Geo-C3 (Steppe) | y - low | N/A | One to a few points in each of the following countries: Australia, South Africa, Brazil, and Mexico. |
| Geo-C4 (Desert) | n - high | N/A | Drought tolerant and capable of growing in desert-like conditions (Downey and Turnbull, 2007). Answering no with high uncertainty because we did not consider this sufficient evidence, particularly when there is no evidence of xerophytic adaptations. |
| Geo-C5 (Mediterranean) | y - low | N/A | One to two points in each of the following countries: South Africa, Ecuador, Colombia, Spain. |
| Geo-C6 (Humid subtropical) | y - negl | N/A | Australia, South Africa, Paraguay, and Brazil. |
| Geo-C7 (Marine west coast) | y - negl | N/A | Australia, South Africa, and one point in New Zealand. |
| Geo-C8 (Humid cont. warm sum.) | n - mod | N/A | No evidence. |
| Geo-C9 (Humid cont. cool sum.) | n - negl | N/A | No evidence. |
| Geo-C10 (Subarctic) | n - negl | N/A | No evidence. |
| Geo-C11 (Tundra) | n - negl | N/A | No evidence. |
| Geo-C12 (Icecap) | n - negl | N/A | No evidence. |
| **10-inch precipitation bands** | | | |
| Geo-R1 (0-10 inches; 0-25 cm) | n - high | N/A | Species occurs at the very tip of Baja California (GBIF, 2013), which is intermixed with 10-20 inches of annual precipitation. Based on the general biology and morphology of this species (Downey and Turnbull, 2007), and potential mapping issues (i.e., resolution, interpolation) for such a small region, we did not think it likely to survive in such extreme conditions. |
| Geo-R2 (10-20 inches; 25-51 cm) | y - low | N/A | Two points in Australia, and tip of Baja California. |
| Geo-R3 (20-30 inches; 51-76 cm) | y - negl | N/A | Australia and South Africa. |
| Geo-R4 (30-40 inches; 76-102 cm) | y - negl | N/A | Australia, South Africa, and Bolivia. Grows from 75-240 cm mean annual precipitation in its native range (Downey and Turnbull, 2007). |
| Geo-R5 (40-50 inches; 102-127 cm) | y - negl | N/A | Australia and Brazil. |
| Geo-R6 (50-60 inches; 127-152 cm) | y - negl | N/A | Brazil and Paraguay. |
| Geo-R7 (60-70 inches; 152-178 cm) | y - negl | N/A | Argentina and Brazil. |
| Geo-R8 (70-80 inches; 178-203 cm) | y - negl | N/A | Brazil. Grows from 75-240 cm mean annual precipitation in its native range (Downey and Turnbull, 2007). |
| Geo-R9 (80-90 inches; 203-229 cm) | y - negl | N/A | Peru. Grows from 75-240 cm mean annual precipitation in its native range (Downey and Turnbull, 2007). |
| Geo-R10 (90-100 inches; 229-254 cm) | y - negl | N/A | French Guiana and Peru. |
| Geo-R11 (100+ inches; 254+ cm)) | y - negl | N/A | French Guiana and Peru. |

| **Question ID** | **Answer - Uncertainty** | **Score** | **Notes (and references)** |
|---|---|---|---|
| **ENTRY POTENTIAL** | | | |
| Ent-1 (Plant already here) | y - negl | 1 | Plant is already present and naturalized in the United States (Kartesz, 2013). |
| Ent-2 (Plant proposed for entry, or entry is imminent ) | - | N/A | |
| Ent-3 (Human value & cultivation/trade status) | d - negl | N/A | Species is cultivated (Page and Olds, 2001). Introduced to Australia as an ornamental (Auld and Medd, 1987) as early as 1865 (Downey and Turnbull, 2007). One of the ten most serious invasive species currently for sale in Australia (Groves et al., 2005). Has been imported illegally into New Zealand (Williams et al., 2001). |
| Ent-4 (Entry as a contaminant) | | | |
| Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China ) | - | N/A | |
| Ent-4b (Contaminant of plant propagative material (except seeds)) | - | N/A | |
| Ent-4c (Contaminant of seeds for planting) | - | N/A | |
| Ent-4d (Contaminant of ballast water) | - | N/A | |
| Ent-4e (Contaminant of aquarium plants or other aquarium products) | - | N/A | |
| Ent-4f (Contaminant of landscape products) | - | N/A | |
| Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances) | - | N/A | |
| Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing) | - | N/A | |
| Ent-4i (Contaminant of some other pathway) | - | N/A | |
| Ent-5 (Likely to enter through natural dispersal) | - | N/A | |