KISC KAUAI INVASIVE SPECIES COMMITTEE	Kauai Status	KISC Status	HPWRA	Invasive Impacts Score	Feasibility Score	Combined Score
Yucca* cf. *aloifolia (Spanish bayonet)	**NATURALIZED**	**EARLY DETECTION**	**HIGH RISK (14)**	**6.5**	**5.5**	**12**

Initial Prioritization Assessment completed: January 2018
Report updated as of: N/A
Current Recommendation for KISC: Pending Ranking and Committee approval
Knowledge Gaps and Contingencies:

1) Delimiting surveys are necessary to determine a more precise distribution
2) A plan for controlling plants situated next to beaches and the high water mark is necessary.
3) An assessment of outreach effort is need to encourage the public to report plants on private residences.
4) An assessment of crew safety for plant control is necessary
5) Verification of identification is required.

Background

Yucca aloifolia (Asparagaceae), or "Spanish bayonet", is a shrub that is sometimes cultivated in Hawaii. The identification of plants discussed in this report are uncertain and thus, the "cf." qualifier denoting taxonomic uncertainty will be applied when referring to specimens from Kauai. The most likely alternative identification is the very closely related *Y. gloriosa* (Hess and Robbins 2003, Rentsch and Leebens-Mack 2012), which shares many (although variable) morphological characteristics and is also cultivated on Kauai. A voucher of Kauai plants has been collected as part of this project, but further collection of fruits (a diagnostic character) and detailed photographs of floral organs are necessary to verify the identification as *Y. aloifolia*. Kauai plants were determined to more closely resemble *Y. aloifolia* according to Hess and Robbins (2003) using leaf and flower material and observations of growth habit from Kealia Beach (K. Brock, PTBG). If future efforts substantiate that the plants referred to in this report are not *Y. aloifolia*, the potential invasive impact sections (see below) of this report should be rewritten to account for this information. *Y.* cf. *aloifolia* has not been considered for control by KISC in the past, and thus, this prioritization assessment report was written to evaluate whether KISC should attempt to eradicate (i.e. accept "Target" status) this plant from Kauai. This will be informed by scoring this plant relative to other "Early Detection" species known to Kauai (See Table 5 in KISC Plant Early Detection Report for status terminology).

Detection and Distribution

No herbarium records exist for *Y.* cf. *aloifolia* on Kauai, but plants at Kealia beach have been present at least since the 1980's (L. Kaneholani, pers. comm.). Neither *Y. aloifolia* nor the closely related *Y. gloriosa* are considered naturalized on any Hawaiian islands according to the most recent inventory of Hawaiian vascular plants (Imada 2012). However, 2015-2017 surveys indicate that *Y.* cf. *aloifolia* has naturalized in at least four locations on Kauai (Figure C43- 1). The largest populations exist along Kealia beach (Figure C43- 2) and throughout a coastal residential area in Aliomanu (Figure C43- 3). Both of these populations likely include once-cultivated plants and each is distributed over approximately 3 hectares (7.5 acres), with densities ranging from sporadic to 70% cover. Three other patches comprising less than a 1/2 hectare were also detected, including one naturalized infestation at Hanalei Bay, another near Poipu, and a third site that appears to be spreading vegetatively from a resort planting in Wailua Bay. Additionally, four actively cultivated plants were detected. The current distribution of *Y.* cf. *aloifolia* suggests that two methods of dispersal are occurring: short-distance spread vegetatively by horizontal, re-rooting stems and longer distances by seed, which are thought to be dispersed by birds (Rentsch and Leebens-Mack 2014). *Y.* cf. *aloifolia* appears to flower for a short period of time each year on Kauai (L. Kaneholani, pers. comm) and thus, seed dispersal of this plant is likely a discrete event that occurs only once annually. Currently, data shows that *Y.* cf. *aloifolia* is naturalized in three judiciary districts (Hanalei, Kawaihau, Koloa) and three watersheds (Aliomanu, Lumahai, Waikomo) and is cultivated in two judiciary districts (Kawaihau, Koloa) and three watersheds (Wailua, Aakukui, Mahaulepu).

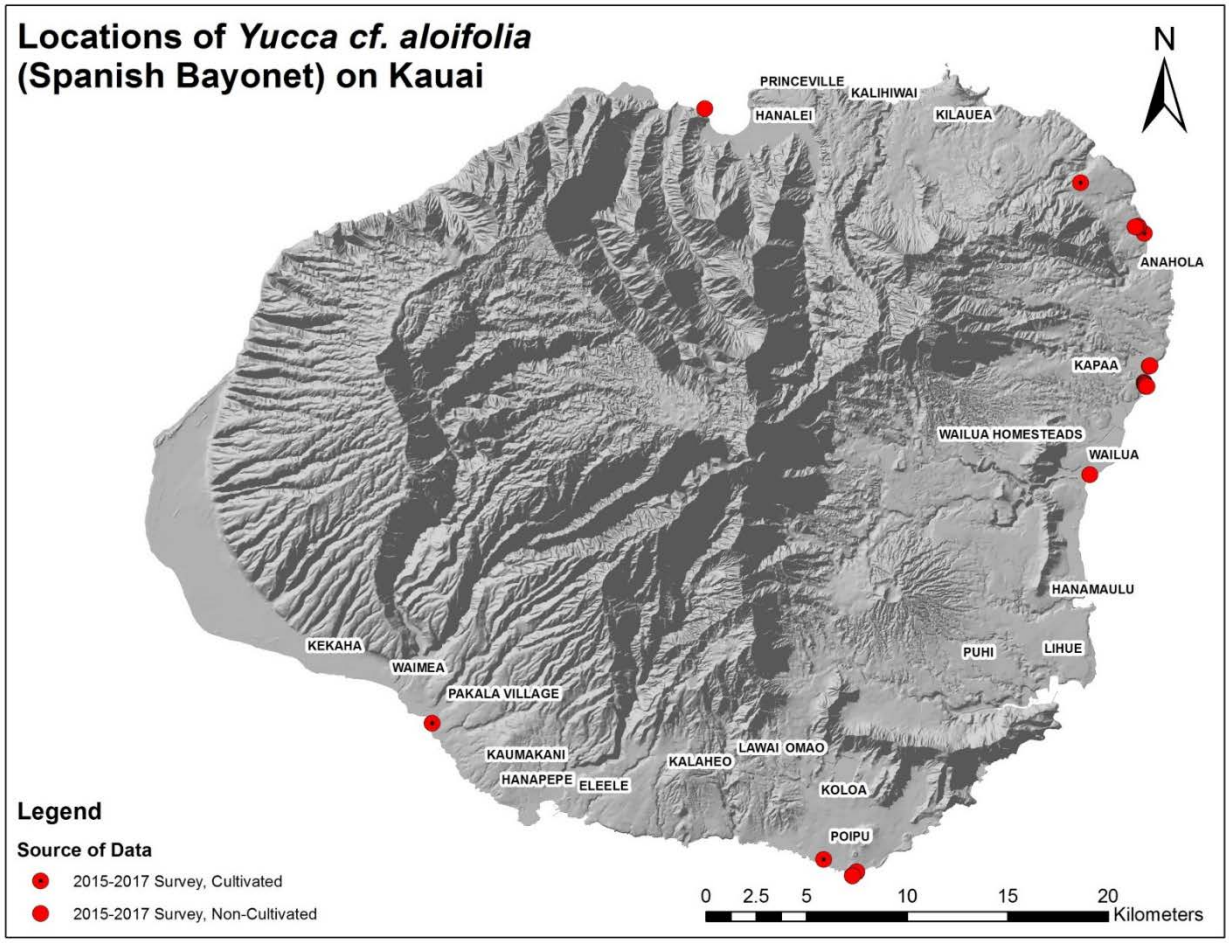

Figure C43- 1. Locations of *Y.* cf. *aloifolia* on Kauai.

Hawaii Pacific Weed Risk Assessment (HPWRA) Score

Y. aloifolia is designated as "High Risk", receiving a score of 14 (Daehler et al. 2004, HPWRA 2013). Although there is some uncertainty involved in using this assessment when the identification of Kauai plants have not been verified, the alternative ID, *Y. gloriosa*, is also designated "High Risk" with a score of 11. The differences in scoring between the two species reflects an intermediate (vs high) climate suitability, specialist pollinator requirement, and absence of thicket formation and bird dispersal in *Y. gloriosa*. Traits contributing to *Y. aloifolia*'s "High Risk" status are listed below according to whether they pertain to the likelihood a plant will invade vs. the consequences of the invasion, according to Daehler and Virtue (2010). Categorization of traits in this manner more accurately informs invasive impact potential scoring and prioritization of species that are already established on Kauai.

Likelihood of Invasion	*Consequences of Invasion*
• Well suited to climates in Hawaii, broad climatic versatility • Naturalized outside of its native range • Produces spines • Unpalatable to grazing animals • Shade tolerant at some point in its life cycle • Produces viable seed • Tolerates a wide range of soil conditions • Self-compatible/apomictic • Reproduces by vegetative fragmentation • Propagules likely to be dispersed both intentionally and unintentionally by people • Propagules dispersed by birds, survives gut passage • Benefits from disturbance	• Garden/Amenity/Disturbance Weed • A congeneric weed, sharing a genus with other known invasive species (i.e. implies inheritance of tendencies to inflict invasive impacts) • Forms dense thickets

Refer to the full Weed Risk Assessment for *Y.* cf. *aloifolia* at https://sites.google.com/site/weedriskassessment/assessments/Download-Assessments.

Figure C43- 2. *Y. aloifolia* at Kealia Beach.

Figure C43- 3. *Y.* cf. aloifolia naturalizing in Aliomanu.

Invasive Impacts Score

The assessment of potential invasive impacts below assumes that plants will be verified as *Y. aloifolia*, and inferences derived from observations outside of Kauai will need to be altered if this assumption doesn't hold true.

1. Impact on natural community structure and/or composition

Score: 2 = Moderate impacts

Y. cf. *aloifolia* was assigned a score of 2 because *Y. aloifolia* is considered a potential environmental weed of coastal areas in Australia and has naturalized in southern Africa, Spain, Taiwan, Lord Howe Island, Puerto Rico, Virgin Islands and New Caledonia (Smith et al. 2012, HPWRA 2013, DEEDI 2016). Although, it is unknown whether *Y. aloifolia* invasions can dominate ecosystems, some dense but small patches have been observed on Kauai (Figure C43- 4, Figure C43- 5). At Kealia beach, a preliminary soil analysis of *Y.* cf. *aloifolia*- infested versus *Scaevola taccada* –dominated sites was performed to determine whether the current *Y.* cf. *aloifolia* distribution can be explained by its inability to tolerate salty soils relative to the native *S. taccada* (Keanini 2017). Surprisingly, *Y.* cf. *aloifolia* occurred in areas with somewhat higher average soil salinity than *S. taccada*, which suggests that *Y.* cf. *aloifolia* population growth in native plant habitats will likely not be impeded by soil salinity –a factor that usually limits alien plant invasions in natural habitats (Zefferman et al. 2015, D'Antonio et al. 2017, Keanini 2017). However, other abiotic factors, including soil texture, must be accounted for to determine whether *Y.* cf. *aloifolia* can out-compete *S. taccada* throughout coastal strand ecosystems, particularly near the high water mark (Keanini 2017). Coastal areas remain one of the last lowland ecosystems in many of the Hawaiian Islands where one can find native-dominated vegetation, as few alien species can tolerate the wind shear and saline conditions of these sites. Thus, the spread of species that are capable of competing with stress tolerant native species in coastal environments should be monitored carefully. In addition to coastal habitats, *Y. aloifolia* exhibits remarkable versatility in which habitats it can colonize (Kanwal et al. 2012). *Y.* cf. *aloifolia* has been observed growing among 1) moist-mesic, native/alien mixed forest on Maui (Figure C43- 6) naturalizing at 750 m near the in-land town of Waimea on Hawaii Island (J. Parker pers. comm.), and 3) growing in mostly shaded roadside ditch habitats on Kauai. *Y. aloifolia* is reportedly able to withstand extreme heat as well as mild frost without any evidence of physical damage (HPWRA 2013). These observations indicate that *Y.* cf. *aloifolia* may naturalize widely throughout Kauai if given sufficient time with preferences for dry habitats, which may include native-dominated or habitats with rare species. However, *Y.* cf. *aloifolia* received a 2 rather than a 3 in this section because seed set/dispersal appears to occur only once annually and plants appear to be somewhat slow growing (HPWRA 2013). Thus, it will likely take longer to establish in all suitable habitats on Kauai relative to other well-known invaders on Kauai.

2. Impacts to Agriculture, Culture and other Human Systems

Score: 2.5 = Moderate - Major impacts

Y. cf. *aloifolia* received a score of 2.5 because the strap-shaped leaves are armed with a sharp, rigid tip that is capable of puncturing skin, even through thick clothing. Y. *aloifolia* can grow up to 6m tall (although stems usually topple before they reach those heights), making it a dangerous plant to handle and maneuver around (HPWRA 2013). It is sometimes densely planted around private properties to form a "living fence" to deter people and animals (Smith et al. 2012). Given *Y.* cf. *aloifolia's* preference for coastal habitats, it is possible that this plant may impede access and injure people and pets visiting Kauai's beaches. Oddly, people appear to be sheltering in dense stands of *Y.* cf. *aloifolia* at Kealia Beach Park for at least some part of the day. It is unknown whether these people are homeless or are using the dense cover of the plants for temporary privacy, but alterations to the plants to form comfortable spaces, as well as household items and human waste were found during soil salinity sampling (T. Keanini pers. comm.) and 2015-2017 Early Detection surveys. Spread of these plants in public beaches may further encourage this behavior, which poses a public health and safety problem and affects the aesthetic quality of Kauai's beaches. However, as the plant is occasionally cultivated as an ornamental, people are unlikely to feel that the plant alone detracts from beach scenery. *Y.* cf. *aloifolia* has also been observed naturalizing along roadsides in Aliomanu among other common roadside weeds such as *Megathyrsus maximus* (Guinea grass) and *Leaucaena leucocephala* (haole koa), and may continue to spread in fallow fields and other disturbed areas. Physical contact with *Y. aloifolia* is known to induce contact urticaria (hives) in some people (Kanerva et al. 2001).

Figure C43- 4. An example of *Y.* cf. *aloifolia* forming a small, locally dense stand in a coastal habitat, likely spreading vegetatively from a former planting site near Wailua Beach.

Figure C43- 5. *Y.* cf. *aloifolia* growing in a ditch near Aliomanu, Kauai.

Figure C43- 6. *Y. aloifolia* exhibiting environmental versatility by growing among moist-mesic alien/native mixed forest near Keanae, Maui (Photo credit K & F Starr).

3. Impacts to biotic and abiotic processes

Score: 2 = Moderate Impacts

Y. cf. *aloifolia* received a score of 2 in this section because although specific effects of *Y. aloifolia* on abiotic factors have not been studied, analysis of stem and leaf tissue indicate that impacts to soil may be possible. The leaves and stems are known to contain saponin and glycoside compounds, which are used for plant defense and can have allelopathic effects on adjacent plants (Bahuguna and Sati 1990, Bahuguna et al. 1991, Zablotowicz et al. 1995). Additionally, release of saponins into the soil during leaf and stem decomposition may ameliorate the stressful effects of salt on seed germination in adjacent species (Yang et al. 2018), which may facilitate the invasion of other less salt-adapted species into coastal habitats. Members of the genus *Yucca* are known for their production of long fibers that resist decomposition (Schaefer et al. 1985, McLaughlin and Schuck 1991). Thus, the invasion of *Y.* cf. *aloifolia* may alter the amount of persistent leaf litter in Kauai soils, and may especially promote soil carbon build-up in coastal environments where native species are adapted to withstand high-draining, sandy soils. It is important to note that none of these effects have been determined from field studies on *Yucca*, but these observations imply that further investigation may discover at least moderate effects to soil from *Y.* cf. *aloifolia*. However, the magnitude of this effect ultimately depends on how widespread and dense *Y.* cf. *aloifolia* is likely to become on Kauai.

TOTAL INVASIVE IMPACTS SCORE: 6.5

Feasibility of Control Score

Feasibility of Control Scoring and rationale for *Y.* cf. *aloifolia* is presented below. Refer to Appendix A for details regarding the Invasive Impact Score.

Delimiting Survey:

Score: 2 = Moderate Effort

Feasibility of a delimiting survey for *Y.* cf. *aloifolia* was given a score of 2 because although several locations have been found on Kauai, the plant is easy to detect and is slow growing. Thus, naturalized populations are not likely to be very large at this point and are likely located in urban and coastal areas where plants are easily observed from the road or easily accessed coastal areas. However, given the history of *Y. aloifolia* in cultivation, outreach efforts are necessary to detect plants that are planted on private residences. Additionally, *Y. aloifolia* is easily confused with *Y. gloriosa*, which emphasizes the need to finalize the identification and provide the crew and public with helpful characters for identification.

Initial control:

Score: 1 = Major Effort

Feasibility of initial control for *Y.* cf. *aloifolia* was given a score of 1 because although herbicide control is likely effective for this species (HPWRA 2013) and populations are not large, field conditions for controlling this plant are dangerous for the KISC crew. Firstly, any handling of the plants is dangerous due to the presence sharp leaf tips and it is unclear whether herbicides may be restricted near beaches. Additionally, as mentioned above (see Impacts to Agriculture, Culture and other Human Systems), trash and human waste have been observed among plants at Kealia Beach, which poses a health and safety hazard to the crew. Lastly, two naturalized populations exist in Poipu and near Hanalei Bay in very steep coastal areas which may require rappelling Figure C43- 9, Figure C43- 10). Although no large, dense infestations were found, the proximity of these plants to ocean and public beaches may pose a problem for chemical control. An assessment by the crew is required to determine a suitable method for control, which may change this scoring.

Monitoring:

Score: 2.5 = Moderate -Minimal Effort

No species-specific information is available to predict the ability *Y.* cf. *aloifolia* seeds to persist in the soil on Kauai, although other Yucca species produce seeds that can go dormant during non-ideal conditions (HPWRA 2013). However, the rare seed set of this plant combined with its slow maturity rate (up to 3 years) indicate that monitoring visits can be well-spaced may consist of few regenerating plants.

FEASIBILTY OF CONTROL SCORE: 5.5

COMBINED SCORE: 6.5 + 5.5 = 12

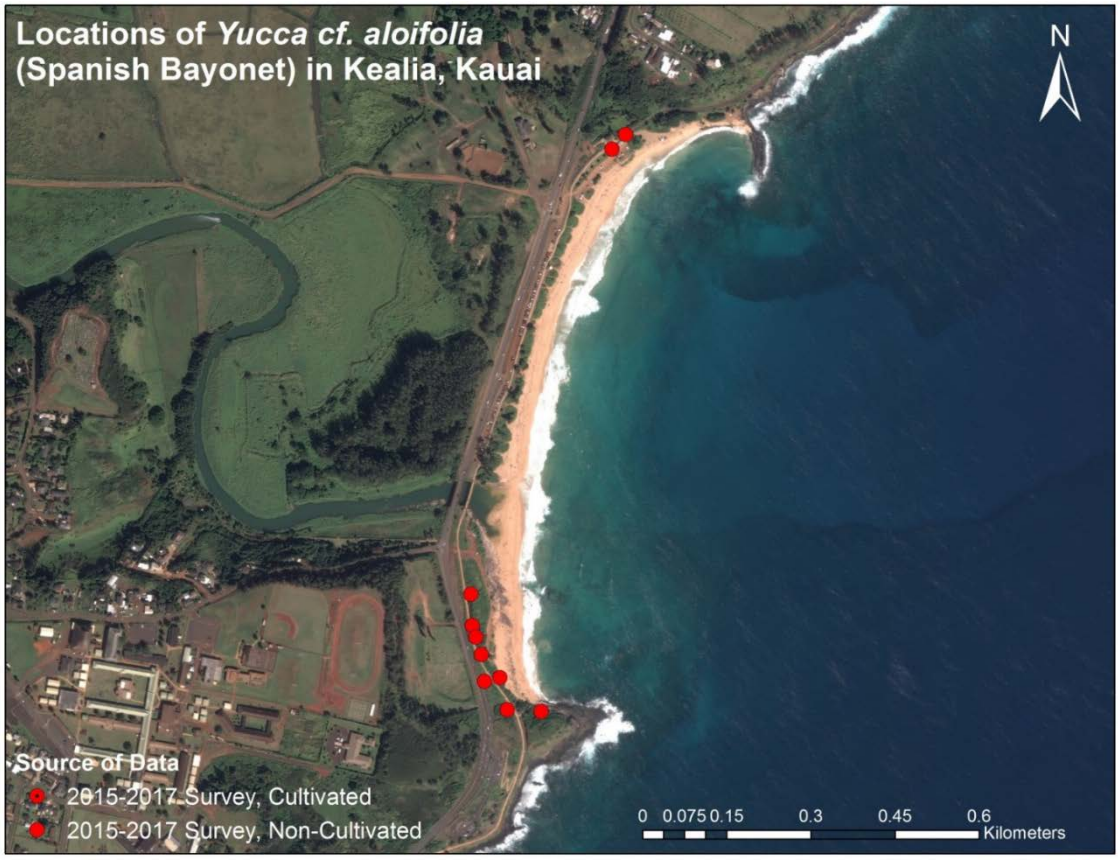

Figure C43- 7. Distribution of naturalizing *Y.* cf. *aloifolia* at Kealia Beach.

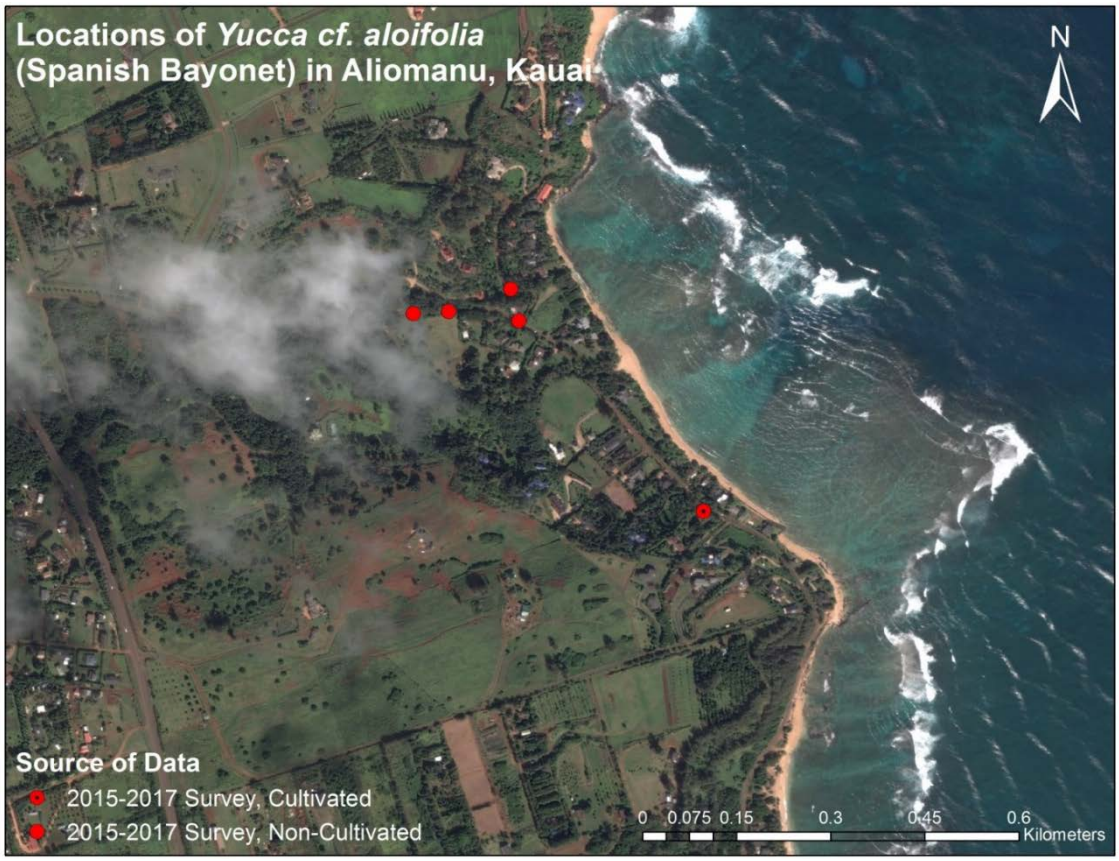

Figure C43- 8. Distribution of naturalizing *Y.* cf. *aloifolia* in Aliomanu.

Figure C43- 9. *Y.* cf. *aloifolia* naturalizing along Hanalei Bay on a dangerous 70-80% slope dropping into the ocean.

Figure C43- 10. *Y.* cf. *aloifolia* naturalizing along the coast in Poipu on a dangerous 50-60% slope dropping into the ocean (the white back-ground is sunlight reflecting off of the ocean).

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