Agave eggersiana
(No common name)

5-Year Review: Summary and Evaluation

Photo by James Yrigoyen (USFWS)

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U.S. Fish and Wildlife Service
South Atlantic-Gulf and Mississippi Basin Regions
Caribbean Ecological Services Field Office
Boquerón, Puerto Rico

5-YEAR REVIEW
***Agave eggersiana* (No common name)**

I. GENERAL INFORMATION

A. Methodology used to complete the review:

The U.S. Fish and Wildlife Service (Service) accomplished this review using information obtained from the final rule listing and designation of critical habitat under the Endangered Species Act (Act), the recovery outline, peer-reviewed scientific publications, several unpublished research projects, unpublished field observations by the Service, State agencies, and other experienced biologists, and personal communications. The Service's lead Recovery biologist for this species prepared this following review.

On June 20, 2019, the Service published a notice in the Federal Register (84 FR 28850) announcing the initiation of the 5-year review for 53 southeastern species including *Agave eggersiana*. At that time, the Service opened a 60-day comment period and requested new information concerning the biology and status of the species. No information was received from the public during the comment period. We also obtained information on the status of this species from the species' final listing rule (79 FR 53303), peer-reviewed scientific literature, unpublished field observations by Federal, State, and other experienced biologists; unpublished studies and survey reports; and notes and communications from other qualified individuals. The Service sought peer review from four individuals familiar with this species and its habitat (see Appendix A). Comments were incorporated into the final document and are summarized in Appendix A.

B. Reviewers

Lead Region: Carrie Straight, Recovery Coordinator, Southeast Atlantic-Gulf and Mississippi-Basin Regions, Atlanta, Georgia.

Lead Field Office: Jaime Yrigoyen, Omar Monsegur, and Jose Cruz-Burgos, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico.

C. Background

1. FR Notice citation announcing initiation of this review

June 20, 2019; 84 FR 28850.

2. Listing History

Original Listing
FR notice: 79 FR 53303
Date listed: September 9, 2014
Entity listed: Species
Classification: Endangered

3. Associated Rulemaking(s)

Critical Habitat
FR notice: 79 FR 53315
Date: September 9, 2014

4. Review History

The final listing rule and designation of critical habitat published on September 9, 2014, are the most recent comprehensive analyses of the status of this species. These documents were used as reference point documents for this 5-year review.

5. Species' Recovery Priority Number at start of review (48 FR 43098): 8

At the time of listing, *Agave eggersiana* was recognized as a species with a moderate degree of threat and a high recovery potential.

6. Recovery Plan

Currently there is no final recovery plan approved for the species.

II. Review Analysis

A. Application of the 1996 Distinct Population Segment (DPS) policy

1. Is the species under review listed as a DPS?

The Endangered Species Act (Act) defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPSs to only vertebrate species of fish and wildlife. Because the species under review is a plant, the DPS policy is not applicable.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? No.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Species' abundance, population trends (e.g. increasing, decreasing, stable), demographic features, or demographic trends

Before 2010, *Agave eggersiana* was thought to be extinct in the wild (Acevedo-Rodríguez and Strong 2005; DPNR 1996, pers. comm.). In 2010, Virgin Islands Department of Planning and Natural Resources (DPNR) reported several populations of the species on St. Croix (DPNR 2010, pers. comm.). At the time of listing, the Service categorized some populations as remnant of 'wild' or

'natural' populations. However, we did acknowledge that those individuals' origin could be from cultivation or escaped from landscaping. The Service considered those 'natural' populations as remnant of 'wild' populations because, at the time of listing, the populations had characteristics which differentiate them from introduced individuals (growing mixed with native vegetation, evidence of natural recruitment, and the presence of different size classes) (75 FR 57720). Therefore, for the purpose of this 5-year status review, and to be consistent we will refer to them as wild populations.

Table 1. Summary of known *Agave eggersiana* populations and individuals.

	2010 Wild	**2010 Introduced**	**2013 Wild**	**2013 Introduced**	**2018 Wild**	**2018 Introduced**	**2020 Wild**	**2020 Introduced**
Populations	6	4	7	4	6	7	5*	8**
Individuals	261	189	587	328	651	436	886	615
Total Individuals	**450**		**915**		**1,087**		**1,501**	

***West Vagthus Point Population presumed extirpated**
**** Ruth Cay Population presumed extirpated**

Populations in 2010. Before listing, available information on *Agave eggersiana* was published in a 12 month finding (75 FR 57720). That data included 10 populations (6 wild and 4 introduced) with a total of 450 individuals (Table 1; 75 FR 57720.).

Populations at the time of listing (2014). The data available at the time of listing is based on surveys conducted by the Service in 2013 (Table 1; USFWS 2013a). At that time, approximately 915 *Agave eggersiana* individuals (587 wild and 328 introduced individuals) were known from 11 populations (Table 1: USFWS 2013a and b). Seven populations were identified as wild populations (Manchenil Bay, West Vagthus Point, Gallows Bay, Protestant Cay, Great Pond, South Shore, and Cane Garden Bay), and four were identified as introduced populations (Ruth Cay, Salt River Bay National Park and Ecological Preserve (SARI), Buck Island National Monument and Altona Lagoon) (USFWS 2013b).

Populations in 2018. The Service signed a Cooperative Agreement with St. Croix Environmental Association in 2018 to conduct comprehensive assessments of the *Agave eggersiana* wild populations. These surveys resulted in 1,087 individuals (651 wild and 436 introduced) in 13 populations (6 wild and 7 introduced). Those surveys did not include *A. eggersiana* populations found on U.S. National Park Service (NPS) lands, or introduced ornamental individuals (SEA 2018). At that time, there were no access to NPS lands due to Hurricane Maria.

Populations in 2020. In 2020, 1,501 individuals contributing to the recovery of the species (886 wild and 615 introduced), were described as occurring in 13 extant populations (5 wild and 8 introduced) (Table 1). Reproduction (presence

of bulbils or inflorescence) has been documented in the 5 extant wild populations, and in 3 of the introduced populations known by the time of listing. As of 2020, the populations' structure of *Agave egersiana* was 489 (33%) mature adults, 644 (43%) young adults, and 368 (28%) juveniles (Table 2). It should be noted that in 2020, populations at West Vagthus Point and Ruth Island Cay, described as wild and introduced populations, respectively, and each had single individuals in 2010 and 2013, that are now presumed extirpated (USFWS 2021). As expected, the populations known since 2010 and 2013 have more adult individuals than the newer introduced populations. As of the date of this review, 886 (59%) of the total known wild individuals (1,501) are located in 5 of the 6 wild populations described in 2013 (West Vagthus Point is now presumed as extirpated; Table 2). Although the data indicates an increase in the overall number of individuals from 450 in 2010 to 1,510 in 2020, approximately 75% of these individuals are currently located within unprotected areas (Tables 1 and 2).

Introduced Populations. Since the time of listing, the number of known populations, individuals, and planting efforts have increased. Prior to listing, a total of 328 *Agave eggersiana* individuals had been introduced in five locations (Table 1). One of these populations (i.e., Ruth Cay) is presumed extirpated (SEA 2018). Since the species was listed in 2014, the Service and its partners have successfully established 4 new populations for the recovery of the species, at Sandy Point National Wildlife Refuge, South Horseshoe Bay (East End The Nature Conservancy (TNC) lands), Goat Hill (East End TNC lands), and Southgate Coastal Reserve. As of this report, 307 individuals or 20% of the 1,501 individuals contributing to the species' recovery occur within the 4 extant populations introduced after the listing (Tables 1 and 2). Recently established, these populations consist of younger plants, and none of these populations has shown evidence of reproduction. All of the populations introduced after listing are located within protected lands (designated for conservation). Based on the currently available information, of the populations introduced before listing, three have exhibited evidence of reproduction (i.e., Salt River Bay National Historical Park and Ecological Preserve (SARI) west-Visitor Center, Buck Island Reef National Monument, and Altona Lagoon), and one has not (i.e., SARI east). Introduced populations will be monitored for evidence of natural recruitment and their long-term viability in light of on-going threats.

We have not included ornamental plantings as part of the recovery of this species, as the areas where these are located are actively landscaped and do not provide the conditions for the establishment of self-sustainable populations (Appendix B). Although *Agave eggersiana* ornamental material may serve as a source of bulbils for cultivation, for the preservation of genetic variation, it would be best to utilize populations deemed wild. The propagation of ornamental material for recovery purposes should be avoided to reduce the likelihood of further genetic depression. Thus, this material could be used as last source in the event of a major loss to wild

Table 2. Status of the known populations contributing for the recovery of *Agave eggersiana* in the U.S. Virgin Islands from 2018-2020 (Valiulis 2020, pers. comm.; USFWS 2020; SEA 2018).

Population	Number of juveniles (< 25 cm)	Number of young adults (0.26-1m)	Number of mature (over 1m)	Total	Reproductive Populations	Private/ Public	Protected Populations
Wild Populations							
Manchenil Bay (Ha'Penny Beach)	1	13	2	16	Yes	Private	Yes
Great Pond (EEMP Office)	46	160	91	297	Yes	Private	No
Gallows Bay	0	1	2	3	Yes	Private	No
Protestant Cay	101	75	97	273	Yes	USVI	No
South Shore/Cane Garden Bay	76	89	132	297	Yes	Private	No
West Vagthus Point *	0	0	0	0	n/a	Private	No
Sub-Total	**224**	**338**	**324**	**886**	**-**	**-**	**-**
Introduced Populations by the Time of Listing							
Altona Lagoon (Near Entrance + In Park)	35	72	154	261	Yes	USVI	No
SARI (West-Visitor Center)	0	5	1	6	Yes	Federal - NPS	Yes
Salt River Bay (SARI East-Lower Level/Upper & Lower Level)	0	2	3	5	No	Federal - NPS	Yes
Buck Island Reef National Monument	6	28	2	36	Yes	Federal - NPS	Yes
Ruth Cay*	0	0	0	0	n/a	USVI	No
Sub-Total	**41**	**107**	**160**	**308**	**-**	**-**	**-**
Introduced Populations after Listing that Contribute to the Recovery of the Species							
Sandy Point NWR (North of Road/Near Pond/Further west)	34	20	0	54	No	Federal - Service	Yes
South Horseshoe Bay (East End TNC Isaac Bay)	54	9	0	63	No	Private (TNC)	Yes
Goat Hill (East End TNC)	15	65	5	85	No	Private (TNC)	Yes
Southgate Coastal Reserve		105	0	105	No	Private (St. Croix Environmental Association)	Yes
Sub-Total	**103**	**199**	**5**	**307**			**-**
Total Individuals as of 2020	**368**	**644**	**489**	**1,501**	**-**	**-**	**-**

* Populations presumed extirpated in 2020

populations. Additional information about ornamental plantings are addressed in section C.1.f.

Population summary. In summary, there were approximately 450 known *Agave eggersiana* individuals distributed among 10 populations (75 FR 57720) described during rapid assessments in 2010. Recent comprehensive surveys from 2018 to 2020 documented 1,501 individuals in 13 extant populations with 2 previously described populations now presumed to be extirpated (i.e., West Vagthus Point and Ruth Cay). This increase in the number of *A. eggersiana* individuals and populations since the time of listing is primarily due to an increase in monitoring efforts and ongoing introductions.

Table 3. Extant Populations in Protected vs Unprotected Areas.

Area Protection	Number of Populations	Number of Individuals	Number of Reproductive Populations
Protected	8	370 (25%)	3
Not Protected	5	1,131 (75%)	5
Total	**13**	**1,501**	**8**

Note: Protected individuals are located in conservation areas.

b. Genetics, genetic variation, or trends in genetic variation

There is no new information on genetics, genetic variation, or trends in genetic variation of *Agave eggersiana*.

c. Taxonomic classification or changes in nomenclature

There is no new information on taxonomic classification of *Agave eggersiana.*

A common name for this species is the Eggers' Century Plant. It is recognized as a common name for this species by Integrated Taxonomic Information System (ITIS), but has not been formally recognized by the Service.

d. Spatial distribution, trends in spatial distribution, or historic range (e.g. corrections to the historical range, change in distribution of the species within its historic range, etc.)

Agave eggersiana is endemic to St. Croix in the U.S. Virgin Islands. In the early 1900s, the species was reported from hillsides and plains in the dry eastern districts of St. Croix. When the species was federally listed in 2014 (79 FR 53303), 10 populations were identified by surveys conducted in 2010 by Service and DPNR biologists. At present, there are 13 extant populations of *A. eggersiana* located on the north and south coasts of St. Croix, USVI (Figure 1).

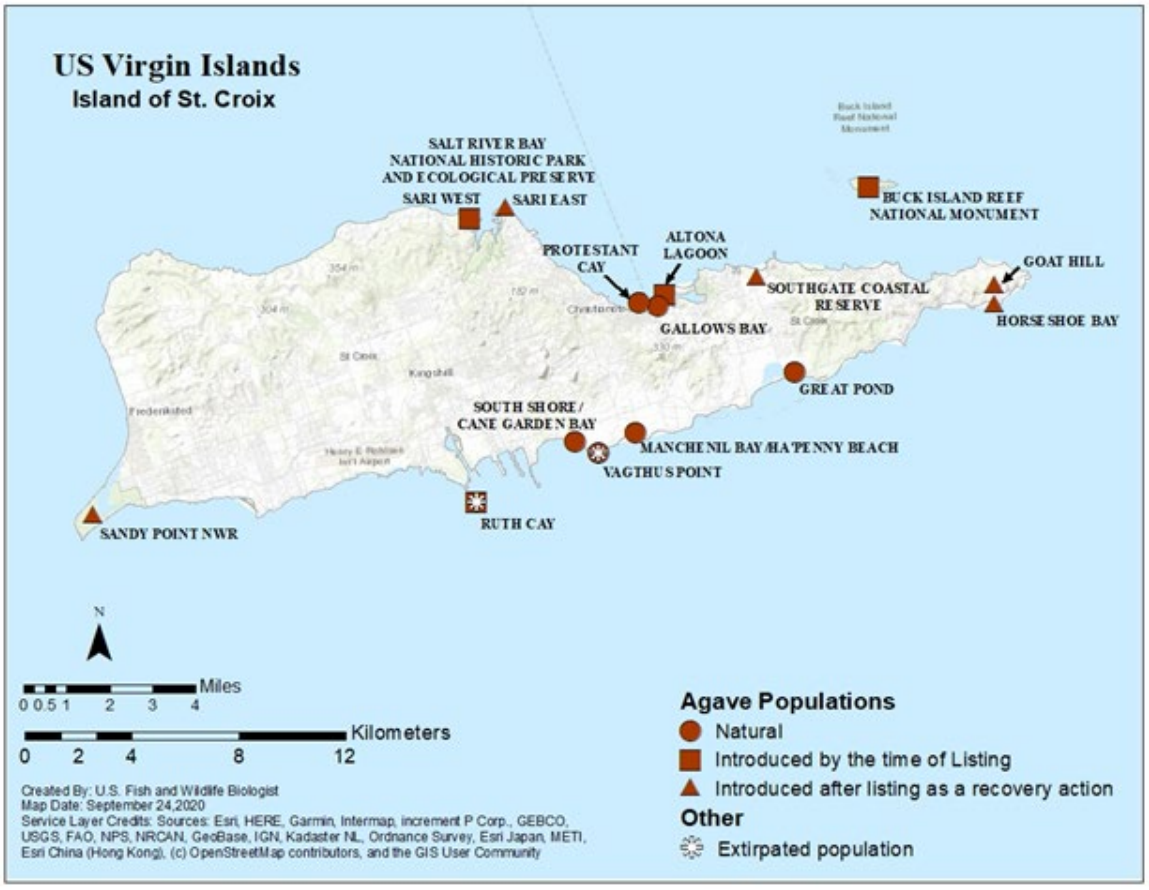

Figure1. Map showing the general distribution of *Agave eggersiana*.

e. Habitat or ecosystem condition

Although reported from the hillsides and plains of the eastern portion of St. Croix in the 1900s, *Agave eggersiana* is currently limited to coastal cliffs with sparse vegetation and dry coastal shrubland vegetation communities within the subtropical dry forest life zone of St. Croix, USVI (Virgin Islands Department of Agriculture [VIDA] 2010).

Plant species associated to the currently known localities of *Agave eggersiana* include: *Sesuvium portulacastrum* (sea purslane), *Laguncularia racemosa* (white mangrove), *Bucida buceras* (black olive), *Hippomane mancinella* (manchineel), *Jacquinia arborea* (barbasco), *Opuntia stricta* (prickly pear, *Pilosocereus royenii* (Royen's tree, *Suriana maritima* (bay cedar), *Bursera simaruba* (gumbo limbo, *Canavalia rosea* (seaside bean), *Caesalpinia bonduc* (gray nicker), *Capparis flexuosa* (falseteeth), *Scaevola plumieri* (ink berry), *Oplonia spinosa* (prickly bush), *Capparis indica* (linguam), *Adelia ricinella* (wild lime), *Crossopetalum rhacoma* (maidenberry, *Heteropterys purpurea* (bull withe), *Pisonia subcordata*

(mampoo), *Exostema caribaeum* (Caribbean princewood), *Cordia dentata* (white manjack), and *Coccoloba uvifera* (seagrape) (USFWS 2013a).

St. Croix contains two life zones; subtropical moist and subtropical dry forests. Subtropical dry forests make up 72% of the island, while the other 28% is subtropical moist forest (VIDA 2010). Forest characteristics are diverse from site to site due to the history of land use. Dominant forest types on St. Croix are deciduous, evergreen mixed forest, shrubland with succulents, drought-deciduous young forest/scrub and, semi-deciduous forest/scrub. Young forests and scrubs, indicative of recent disturbance, are dominated by the non-native tan-tan (*Leucaena leucocephala*) and casha (*Acacia macracantha*) (VIDA 2010).

On September 9, 2014, the Service published the final rule designating critical habitat for *Agave eggersiana* (Figure 2), and identified the primary constituent elements of the critical habitat for the species (79 FR 53315).

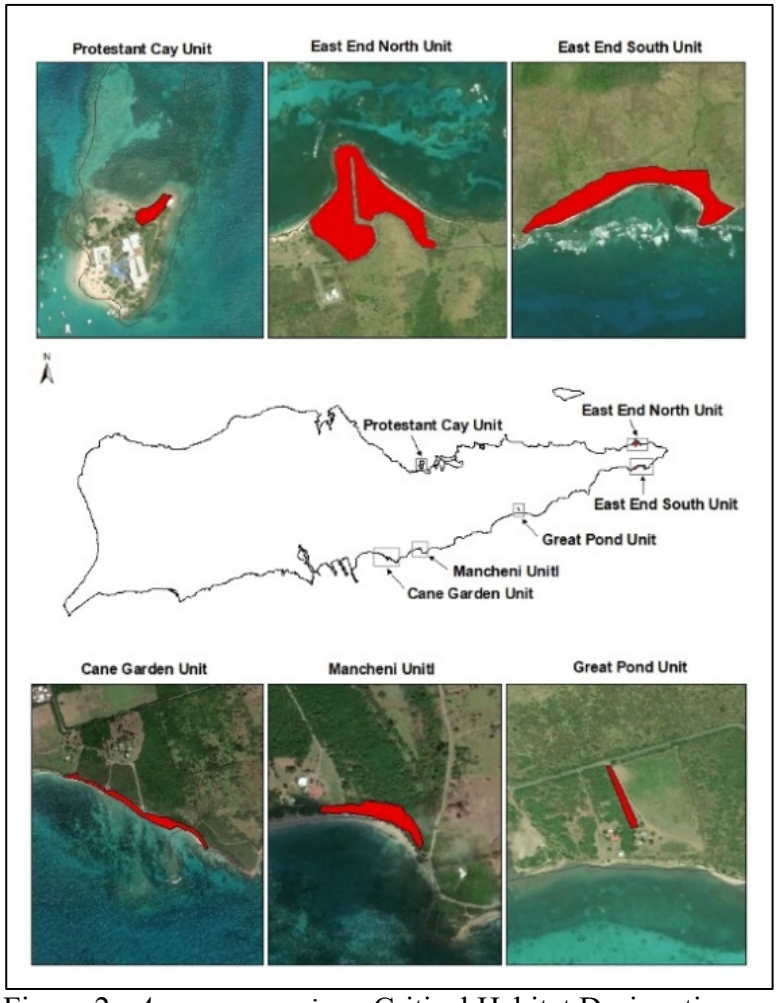

Figure 2. *Agave eggersiana* Critical Habitat Designation (79 FR 53315).

f. Other relevant information

Agave eggersiana is not known to produce fruit containing viable seeds, and like other Agave species, it is monocarpic, meaning the plant dies after producing the flowering spike or inflorescence. After flowering, the panicles (inflorescence) produce numerous small vegetative bulbs (bulbils), which fall off to produce new individual plants (75 FR 57720). Furthermore, based on observations of cultivated plants, *A. eggersiana* requires at least 10 to 15 years to develop as a mature individual and produce an inflorescence (75 FR 57720) but may take longer under drought conditions.

When the species was listed in 2014, it was described as being reliant on asexual reproduction (79 FR 53303). In 2019, Jen Valiulis from the St. Croix Environmental Association observed an unknown structure that had the appearance of a seedpod on an individual *Agave eggersiana* (USFWS 2021). This observation suggests that sexual reproduction mechanisms may be present; however, studies to confirm or deny the suggestion of sexual reproduction in this species have not been conducted.

In addition, during 2018-2020 surveys, 11 locations were identified with 1,314 ornamental individuals of this species and additional 215-potted plants of the species that had been propagated by the Botanical Garden of the US Virgin Islands (Appendix B). Aside from the extant 5 wild populations, the 4 extant populations introduced before the listing and the 4 introduced after the listing of the species, the 11 ornamental populations, where the species was identified under cultivation, are located in areas that do not contribute to the recovery of the species. Most of these areas are located on private properties or on land owned by the USVI government where unsustainable landscaping practices (i.e., cutting of spikes after flowering, not allowing development of bulbils, bulbils considered rubbish, populations adjacent to roadways or on private properties subject to impacts from mowing) prevent the natural development of self-sustaining populations.

In the 1990s, Margaret Hayes, a local horticulturalist on St. Croix, sent bulbils to the Fairchild Tropical Botanical Garden in Coral Gables, Florida. This institution has since propagated individuals from these plants, of which some were sold to the garden's members, and also sent to 14 botanical gardens around United States (Possley 2020, pers. comm.). The Service is developing a database of repository institutions that maintain the species.

2. Five Factor Analysis

The purpose of a 5-Year Review is to recommend whether a listed taxon continues to warrant protection under the ESA and, if so, whether it should be reclassified (from threatened to endangered or from endangered to threatened). This task requires that the analysis of the threats to the species be performed while assuming that the species

is not receiving the regulatory protections, funding, recognition, and other benefits of ESA listing. Summaries of ongoing applications of ESA protections may shed light on some future activities that constitute threats to the species. However, the analysis under Factor D (Inadequacy of Existing Regulatory Mechanisms) focuses on the adequacy of existing alternative (i.e., non-ESA) mechanisms to address the continuing and foreseeable threats.

a. Present or threatened destruction, modification or curtailment of its habitat or range

Development, Unsustainable Landscaping, and Unregulated Land Clearing
As stated when listed (79 CFR 53305), considering the monocarpic growth form of *Agave eggersiana* and its apparent dependence on asexual reproduction, the populations' proximity to urban areas subject to habitat destruction and modification represents a threat to the species. Currently, 5 of the 13 extant populations are located on unprotected lands subject to unsustainable landscaping practices, potential development, and unregulated land clearing that reduce the opportunities for natural recruitment. For example, at Altona Lagoon (an ornamental population), an adult *A. eggersiana* individual was documented with a large spike cut off at the tip, and no bulbils were observed in the area (Yrigoyen 2020a, pers. obs.). Being a monocarpic plant, this individual will now die after producing the spike and no new individuals will be recruited from this plant. In addition, bulbils, along with the remnants of adults, which have flowered, are known to have been completely removed for disposal in areas where a large density of new individuals is not desired, such as gardens and residential areas (Yrigoyen 2020a, pers. obs.). These actions preclude natural recruitment and the establishment of a healthy population structure.

Of the currently known individuals, approximately 75% of *Agave eggersiana* individuals (1,131 of 1,501) occur within unprotected privately owned lands growing in areas subject to habitat modification in developed areas, currently managed as tourism and residential projects (Table 1 and Table 2). Habitat modification practices such as unsustainable landscape and vegetation clearing negatively affect the recruitment and possible expansion of these populations. During field assessments, we have documented that little or no room for population expansion and unsustainable landscaping practices such as: trimming, removing bulbils considered rubbish, mowing of populations adjacent to roadways or on private properties are all a threat to the species on private lands (SEA 2018).

The proximity of the known populations to urban areas makes them vulnerable to the maintenance of utility lines. For example, in January 2018, the Service recorded direct impacts (cutting, crushing) on at least 17 *A. eggersiana* individuals at the East End Marine Park in St. Croix associated with the reconstruction of power lines following Hurricanes Irma and Maria (Pott 2018, pers. comm.). Moreover, in the Altona Lagoon and Protestant Cay populations, which are located

in areas owned by the USVI government, threats such as unsustainable landscaping practices, dumping of debris on individuals, trimming of the species, clearing of fallen bulbils, and the lack of management for individuals located along the roadway, parking lots and recreational areas have been documented (SEA 2018). For example, in December 2011, while *A. eggersiana* was still a candidate for listing, staff from DPNR documented impacts to at least 5 individuals of the species due to excavation work conducted at Protestant Cay (DPNR 2012, pers. comm.).

The development of tourist and residential projects in coastal areas harboring suitable habitat for the species can also threaten *Agave eggersiana* and may result in the extirpation of some populations or, at the least, will reduce the chances of the populations to expand or to colonize other areas (SEA 2018).

The area of the island of St. Croix is less than 85 square miles. Throughout St. Croix, indigenous forests were mostly cleared for agriculture from 1733 to 1917 (VIDA 2010). By the time the US Virgin Islands were acquired from Denmark by the United States in 1917, it is estimated that 90% of St. Croix had been cleared for agriculture and logging (Brandeis and Charkroff 2010). From 1994 to 2010, the Virgin Islands Forest Inventory and Analysis program reported a loss of 8% of St. Croix forests due to development (VIDA 2010). St. Croix's urban footprint almost tripled in the last thirty years, with St. Croix having the most significant loss of its forest and scrub that adds up to more than 4000 hectares of lost vegetation in 33 years (Vega 2019). Once human activities alter landscapes for agricultural purposes, these lands are typically accompanied by non-native species introductions such as invasive plants, animals, and pest insects (Allerton and Van Bloem 2018). Once cleared lands have been abandoned, forest regeneration is dominated by non-native, invasive, tree species such as tan-tan (*Leucaena leucocephala*) (Allerton and Van Bloem 2018) and multiple species of grasses. St. Croix's dry tropical forests are dominated by these non-native forests. Native forest succession is adapted for natural disturbances such as hurricanes; however, habitat disturbance associated to development and agricultural practices leads to root systems removal and soil degradation, which does not allow for native vegetation regeneration and sprout back following the abandonment fields effectively (Allerton and Van Bloem 2018).

Because most individuals (1,131 of 1,501) presently occur within non-protected lands subjected to the threats mentioned above, the Service has recently entered into collaborative agreements with local partners to monitor and enhance wild and introduced populations, and to establish new *Agave eggersiana* within private lands that ensure the protection of the species in St. Croix. These recovery actions are implemented through Service's Cooperative Landowner Agreements.

Based on the above information, the Service believes that destruction and modification of habitat continues to threaten the *Agave eggersiana* populations

located on both private and some protected properties. The Service's recent efforts to enhance and protect populations within private lands are intended to minimize and decrease threats the species is facing within those lands. However, these efforts' benefits are not measurable yet and may be tangible in a near future.

b. Overutilization for commercial, recreational, scientific, or educational purposes:

Historically and currently, most *A. eggersiana* found on St. Croix are occurring on private lands and in landscaped areas are ornamental plantings (79 FR 53303, Appendix B). At the time of listing, this species continued to be grown and locally distributed by the St. George Village Botanical Garden of the Virgin Islands and Cruzan Garden (local nursery) to residents for private landscaping purposes (79 FR 53303), as well as shared amongst residents. Most cultivated (ornamental) individuals are landscaped, and the residents do not allow the old inflorescence to develop bulbils, thus, not allowing the natural recruitment of those ornamental plants. Collection from wild populations is likely to occur. However, the Service has no evidence that illegal collection from wild populations is currently occurring.

Since *Agave eggersiana* has a long history of cultivation, the Service does not consider collection to be a threat to the species but does acknowledge that the collection and redistribution of the species on St. Croix may be a vector of transmission for the Agave snout weevil to the few remaining wild populations.

c. Disease or predation:

When the species was listed in 2014, there was no evidence of Agave snout weevil (*Scyphophorus acupunctatus*) on St. Croix. Chamorro et al. (2016) confirmed the presence of the Agave snout weevil at St. Croix later from samples collected in 2013 on the road leading up to SARI. A wide range of ornamental species of the family Asparagaceae (e.g., *Agave* spp and S*ansevieria spp*.) has been recorded as a host plant for the Agave snout weevil (Malumphy 2017). At present, exotic *Sansevieria* spp. has established and become invasive on St. Croix providing a host for the weevil range expansion and eventual infestation of *Agave eggersiana* populations. The Agave snout weevil is native to Mexico and likely introduced to St. Croix by dispersing from neighboring Puerto Rico, or by traveling with a non-native agave plant or cargo to the island (Chamorro et al. 2016). The species is thought to have become introduce to the U.S. Virgin Islands via St. Thomas in the late 1980's, and from there it was transported to St. John and eventually St. Croix (Lindsey et al. 2015). The larvae of this weevil feed on the starchy base of *A. eggersiana's* leaves, increasing the risk of infestation by pathogens such as a virus or fungus, later resulting in the death of the plant (Vaurie 1971). Current available information indicates the Agave snout weevil is affecting all size classes of *A. eggersiana*, including young bulbils (not just adults) (Valiulis 2020, pers. comm.).

In January 2020, NPS staff at SARI conducted a comprehensive survey of *Agave eggersiana* at three localities on the east side of Salt River (NPS 2020) and informed the Service that the agave snout weevil had infested all three sites (Hillis-Starr 2020, pers. comm.). Only 5 (9%) of 55 individuals in these three localities were healthy, and 49 individuals were dead or infested by the agave snout weevil. In fact, Zandy Hillis-Starr (NPS) mentioned that one of the three localities appeared to have been extirpated due to this pest.

Agave snout weevils are one of the most damaging pests to cultivated agave, where it has been known to destroy up to 70% of commercial crops (Chamorro et al. 2016). The Agave snout weevil was detected at the Botanical Garden of the Virgin Islands in 2019 when an *Agave eggersina* was found dead on the property. In March 2020, another *A. eggersiana* was described as collapsed and suspected of agave snout weevil infection (Oliver 2020, pers. comm.). Staff from the Botanical Garden plan systematic root treatments for all of their *A. eggersiana* first and then begin treatments for other agave species (Oliver 2020, pers. comm.). The agave snout weevil is now recorded all across the Virgin Islands (including British VI) and is attacking other regionally endemic species (*A. missionum*) (Malumphy et al. 2019; Malumphy 2017). Currently, horticulturalists and farmers still import agaves of different species to the USVI, so the vector for introduction is still present (Valiulis 2020, pers. comm.). Due to the asexual reproduction of *A. eggersiana*, the species is not able to develop a seed bank, reducing the possibility of recovery after the weevil impacts a core population. Moreover, the clustered distribution of individuals makes entire *A. eggersiana* populations vulnerable to weevil infestation as evidenced by the extirpated localities at SARI, highlighting the magnitude of this threat.

In addition to threats from agave snout weevils, several populations have individuals with what appears as 'bite' marks or scars on the leaves. These scars are suspected of being caused by grasshopper depredation (species unknown) (USFWS 2021).

Based on the above discussion, we believe that the Agave snout weevil is a current significant threat to *Agave eggersiana*, affecting the species across its range and may compromise its viability into the future.

d. Inadequacy of existing regulatory mechanisms:
The Territory of the U.S. Virgin Islands currently considers *Agave eggersiana* as endangered under the Virgin Islands Indigenous and Endangered Species Act (Law No. 5665) (V.I. Code, Title 12, Chapter 2). This law, signed in 1990, amended an existing regulation (Bill No. 18–0403) to provide for the protection of endangered and threatened wildlife and plants by prohibiting the take, injury, or possession of indigenous plants. As we mentioned above, *A. eggersiana* is currently being planted in private landscapes on St. Croix, and we do not have

information about the sources of those individuals. However, the removal of individuals from wild populations for landscaping raises concerns.

Although provisions of the Virgin Islands Indigenous and Endangered Species Act protect *Agave eggersiana* throughout its range, the unregulated/unpermitted land clearing, the large number of individuals planted in private gardens, and the implementation of landscape practices that affect *A. eggersiana*, suggest the enforcement of such legal mechanisms is challenging or not properly implemented (see discussion under Factor A, above). For example, accidental or intentional damage (cutting, pruning, mowing, or land clearing for development) of *A. eggersiana* stills occur on landscape material in St. Croix, however we have not identified such impacts on the wild populations (see discussion under Factor B, above). Currently, the USVI does not have a Comprehensive Land and Water Use Plan to regulate land development in the territory, instead, the Department of Planning and Natural Resources utilizes an antiquated USVI Zoning Code, adopted into law in 1972, to govern land-use development, policies and procedures (Moore 2020).

e. Other natural or manmade factors affecting its continued existence:

Changes in environmental conditions and climate-related stressors. Climate-related changes to habitats or conditions that exceed the physiological tolerances of a species, occurring individually or in combination, may affect species' status. Vulnerability to climate change impacts is a function of sensitivity, exposure, and adaptive capacity of species (Glick et al. 2011; IPCC 2018). For example, the predicted loss of coastal areas (IPCC 2007) may reduce the *Agave eggersiana* populations and result in the irreversible extirpation of habitat for the species. The Caribbean is one of the regions considered threatened by drought, flooding, and sea level rise (USGCRP 2018). Moreover, additive climate change stressors projected by the mid-21st century include increased number and intensity of storms, increased temperatures, and shifts in the timing and amounts of seasonal precipitation patterns will lead to more flooding events in the US Virgin Islands (Khalyani et al. 2016). Recent work on climate change models predicts that Puerto Rico will be subject to a decrease in rainfall, along with increasing drought intensity (Khalyani et al. 2016). Considering the proximity of Puerto Rico to the U.S. Virgin Islands, we believe these model predictions could also extend to the USVI, including St. Croix. The increase in projected stressors are expected to reduce the rate of natural recruitment and lengthen the time needed for individuals to reach sexual maturity. In addition, these stressors may exacerbate competition with drought resistant invasive plants and increase the threat of fire at some populations.

Most likely due to early land clearing in the island of St. Croix for agriculture, primarily sugar cane (Soelberg et al. 2016), remnant populations of *Agave eggersiana* still occur in proximity to beach areas and on or near coastal areas of

relatively low elevation that are susceptible to coastal erosion, storm surge, and landslides. For example, the *A. eggersiana* population at Cane Garden is located on coastal cliffs above/adjacent to the beach and bulbils have been known to fall off the cliffs onto the beach where they are washed out into salt water (Yrigoyen 2020b, pers. obs.). In fact, this population has little suitable habitat to expand, making the individuals vulnerable to coastal erosion.

Hurricanes

The islands of the Caribbean are frequently affected by hurricanes. Seven major hurricanes have hit the U.S. Virgin Islands for example, in recent years (i.e., Hurricane Hugo in 1989, Luis and Marilyn in 1995, Lenny in 1999, Omar in 2008, and Irma and Maria in 2017. Visible effects of hurricanes on the ecosystem include massive defoliation, snapped and wind-thrown trees, large debris accumulations, landslides, debris flows, altered stream channels, and transformed beaches (Lugo 2008). Hurricanes can also produce sudden and massive tree mortality, which is variable among species (Lugo 2000).

As an endemic to the Caribbean, *Agave eggersiana* would be expected to be well adapted to tropical storms and the prevailing environmental conditions in this geographical area. However, rare and endangered native species' resilience may be limited or constricted by the reduced number of populations and individuals, making them vulnerable to stochastic events (78 FR 62560).

The reduced number and small size of *Agave eggersiana* populations make this species susceptible to hurricane impacts (e.g., extirpation of individuals by storm surges). Such impacts can be exacerbated by the species' reproductive biology (i.e., long time to reproduce, plants dying after flowering, and limited dispersal of bulbils). Hurricanes also may directly affect *A. eggersiana* by snapping developing spikes, compromising natural recruitment, particularly in small populations. As previously indicated, storm surge produced by hurricanes can also directly affect individuals and cause coastal erosion on the species habitat (Cane Garden). Utilizing NOAA global sea level rise projections (Lindsey 2018), and the National Oceanic and Atmospheric Administration's (NOAA) National Storm Surge Hazard Maps (2020), we identified populations threatened by hurricane-induced and projected storm surges. Currently, 10 of the 13 extant populations contributing to species' recovery are located at low elevations near (below 6 ft) or at sea level on coastal zones close to the beach, making them susceptible to these threats. Populations at Ha'Penny beach, Sandy Point National Wildlife Refuge and Cane Garden sustained damage due to storm surge associated with Hurricanes Irma and Maria in 2017 (USFWS 2021) were also inundated with storm surge. For example, the *A. eggersiana* population at Cane Garden was also heavily impacted by the Category 5 force winds during Hurricane Maria in 2017 (SEA 2018). In addition, some individuals were completely covered with debris at Sandy Point NWR (USFWS 2021). All populations were observed to have injuries sustained by hurricane winds.

Invasive Plants
Most of the *Agave eggersiana* populations throughout St. Croix are surrounded by landscaping or by dense stands of invasive species such as *Leucaena leucocephala* (tan-tan), *Sansevieria* (snake plant or mother in law's tongue), or *Megathyrsus maximus* (guinea grass). Moreover, *Sansevieria spp*. has been recorded as a host plant for the Agave snout weevil, providing a host for the weevil range expansion and eventual infestation of *A. eggersiana* populations. These invasive species are currently constraining some *A. eggersiana* populations (e.g., Goat Hill, Sandy Point, Great Pond), restricting their expansion (Yrigoyen 2020c, pers. obs.).

As the climate changes, there is also a potential for highly adaptive invasive species to get established in new areas and outcompete *Agave eggersiana*, or in some cases, when pest species move into areas which become climatically suitable, they may become invasive or harmful to the system (IPCC 2018). Species such as the exotic guinea grass (*Megathyrsus maximus*) are naturalized within the Caribbean and has become very effective colonizing dry forest areas and promoting habitat conditions favorable for human-induced fires that certainly alter the habitat of *A. eggersiana*. For example, invasive grasses also serve as fuel for fires, which exacerbate the threat they pose on *A. eggersiana*, which is not adapted to fires.

Human-induced fires
Fires are not natural events in subtropical dry forests in the Caribbean; hence the native vegetation in these islands is not adapted to this type of disturbance (Brandeis and Woodall 2008; Santiago-García et al. 2008). *Agave eggersiana* occurs on the driest regions of St. Croix, where fires are sometimes ignited accidentally or deliberately, particularly during the dry season. Human-induced fires may lead to the destruction of the native vegetation and may create conditions favorable for the establishment of nonnative plant species adapted to fires (e.g., *Leucaena leucocephala* and invasive grasses and vines) that can outcompete *A. eggersiana*. Exotic plant species, particularly grasses, also may promote frequent fire regimes. For example, there have been a series of fires every year during the past three years in the agricultural fields immediately East of the Ha'Penny Beach populations that if not contained by the VI Fire Department, may have spread into areas containing listed species such as the endangered *A. eggersiana* and *Catesbaea melanocarpa*, which are present in the fields adjacent to Ha'Penny road (Yrigoyen 2018, pers. obs.). Hence, some local farms have constructed firebreaks along the south shore of St. Croix.

Fire can result in death of *Agave eggersiana* individuals by damaging the meristematic tissue, thus precluding the development of new growth or the inflorescence. Fire damage to meristematic tissues is likely similar to damage by insect pests, which leads to a loss in fitness and a higher mortality rate for those

plants affected (Adhikari and Russell 2014). Thus, damage by fire would most likely have the same effects. Also, plants die in fires ultimately due to dehydration (Midgley et al. 2011), but fire damage may also lead to lower plant fitness, which may promote the growth of fungi and bacteria that may detrimental to the individuals. Drought conditions may promote a higher frequency of fires.

Based on the above information, the Service believes that *Agave eggersiana* is threatened by other natural or human made factors that affect its continued existence. Factors associated to climate change such as increased droughts, increased intensity of hurricanes and associated storm surge could affect *A. eggersiana*, particularly when 86% of all known individuals contributing for the recovery of the species are currently located in low lying areas or flood zone close to the sea. Other threats include colonization of *A. eggersiana* habitat by invasive plant species and human-induced fires.

D. Synthesis

When *Agave eggersiana* was federally listed in 2014 (79 FR 53303) there were 10 populations with 450 individuals. As of this review, there are 13 extant populations with 1,501 individuals currently contributing to the recovery of the species (Table 1 and 2). This increase is related to a combination of factors such as an increase in survey efforts, recruitment in both wild and introduced populations, an increase in conservation awareness, and the implementation of recovery efforts in public and protected lands. Additionally, with populations introduced since the species listing, the species has less risk of a single catastrophic event damaging or extirpating a majority of the species populations. Even though there have been some increases, two populations known at the time of listing are currently presumed extirpated.

The distribution of *Agave eggersiana* to the public in the past may have led to the present-day circumstance of large number of individuals occurring as ornamental plants on private properties, which in combination with the *Sanseviera* plants that are also cultivated in gardens and escaped into the wild, can facilitate the expansion of the Agave snout weevil across St. Croix populations. Although the majority of the currently known populations (61.5%) occur on protected land managed for conservation, these protected populations account only for 25% of the individuals. The majority of *A. eggersiana* individuals (75%) are threatened by urban development and unsustainable landscaping practices on private properties and or unmanaged VI government land. Therefore, the implementation of additional sound conservation measures is needed to recover this species.

The threats identified to affect *Agave eggersiana* include habitat destruction and modification, urban development, and unsustainable landscape practices. The species is also threatened by the recent introduction of the invasive Agave snout weevil, and other natural or manmade factors such as hurricanes, invasive species, human-induced fires, and factors that might be exacerbated to climate change. Consequently, *A. eggersiana* continues to meet the definition of an endangered species.

III. RESULTS

A. Recommended Classification:

___ **Downlist to Threatened**
___ **Uplist to Endangered**
___ **Delist**
_X_ **No change needed**

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Complete the Recovery Plan for the species.
- Continue promoting conservation, restoration, and recovery within conservation and private lands through a mechanism like landowner agreements.
    - Propagation and Reintroduction. Continue the ongoing ex-situ propagation and planting program to establish at least 10 self-sustainable populations on protected land.
    - Reintroductions should continue on federally protected lands at Sandy Point National Wildlife Refuge, Buck Island Reef National Monument, and Salt River Bay Historical Park and Ecological Preserve.
    - Reintroductions should continue on privately-owned protected areas, Southgate Coastal Reserve (owned by SEA) and East End lands (owned by TNC).
    - Reintroductions should continue on private properties along the south shore of St. Croix to create corridors for the species along the south coast.
- Work with DPNR (as applicable: Permits, Coastal Zone Management) to minimize impacts to the largest populations of *Agave eggersiana* in advance of development or changes in and surrounding these areas.
- A genetic study to determine the levels and distribution of genetic diversity within and among populations of *Agave eggersiana* should be conducted. The study will help distinguish between wild and introduced populations, provide insight into the reproductive process of the species, and support decisions as part of a captive propagation program.
- Continue ongoing population surveys to monitor the spread of the Agave snout weevil and develop a biosecurity program to allow for the early detection of the agave snout weevil and alternatives to control of the invasive species.
- Implement trial control programs for Agave snout weevil using pheromone traps and systemic insecticides using cultivated plants to develop a protocol for pest control before the weevil begins to decimate wild populations as has been seen for other regional endemic Agave species.
- Assess *Agave eggersiana* demographic responses (reproduction, recruitment, mortality) to stochastic events such as hurricanes.
- Given the widespread use of the species for landscaping, public education about the species should be provided. Landowners with the species on their property should be provided with useful guidance about what to do with bulbils rather than disposing of them with other brush or household garbage.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW of *Agave eggersiana* (No common name)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

___ Downlist to Threatened
___ Uplist to Endangered
___ Delist
_X_ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Jaime Yrigoyen, Caribbean Ecological Services Field Office.

FIELD OFFICE APPROVAL:

Field Supervisor, Caribbean Ecological Services Field Office Fish and Wildlife Service

Approve EDWIN MUNIZ Digitally signed by EDWIN MUNIZ Date: 2021.08.20 10:55:58 -04'00' Date _____

LEAD REGIONAL OFFICE APPROVAL:

Assistant Regional Director-Ecological Services, Fish and Wildlife Service

Approve JOHN TIRPAK Digitally signed by JOHN TIRPAK Date: 2021.08.20 12:29:18 -05'00' Date _____

APPENDIX A: Summary of peer review for the 5-year review of *Agave eggersiana*

A. Peer Review Method:

The Service requested peer review of this 5-year status review from four independent reviewers outside the Service who are knowledgeable about *Agave eggersiana*. The request was sent via electronic mail and a 30-day review period was provided to all reviewers.

B. Peer Review Charge:

In the instructions to the peer reviewers, we asked them to evaluate the science in the 5-year status review based on their knowledge of the species, and specifically asked that comments address the following questions:

- Have we assembled the best available scientific and commercial information?
- Is our analysis of this information correct and properly applied? and,
- Can you identify any additional new information on *Agave eggersiana* that has not been considered in this review?

We did not request the reviewer's opinion of the legal status of the species. Also, as part of the peer review process, we must evaluate the potential for conflicts of interest with the subject species or the action. Therefore, we asked each reviewer to fill out a Conflict of Interest form and return it with their comments.

C. Summary of Peer Review Comments/Report:

We received comments from two of the four requests for peer review that were sent out. None of the two reviewers recommended significant changes to the 5-Year Status Review document. Both suggested some grammatical edits and provided general information to help improve the document. Only one of the reviewers provided new information about the abundance of one introduce population, while the other provided a new future action for the recovery of the species. One peer reviewer suggested to give a higher priority to the magnitude of the Agave snout weevil threat to *Agave eggersiana.*

D. Response to Peer Review:

The Service agreed with all recommendations and edits provided by the peer reviewers. We addressed all suggested edits and additional information directly into the 5-year status review as appropriate and added the recommended future action. Also, we strengthened the discussion about the Agave snout weevil, and included the additional number of Agave *eggersiana* individuals provided by a reviewer into the document.

APPENDIX B: Population Estimates for Ornamental Individuals of *Agave eggersiana*

Ornamental *Agave eggersiana* locations in the U.S. Virgin Islands that do not attribute to the recovery of the species from 2018-2020 data (USFWS 2020, unpubl. data; SEA 2018).

Individuals Location	**Number of juveniles (< 25 cm)**	**Number of y adults (0.26-**	**Number of r (over 1 m)**	**Total**	**Reproductiv Populations**	**Private/Publ**	**Protected Populations**
Manchenil B (Ha'Penny B Hotel)	334	307	236	877	Yes	Private	No
Eliza's Retre	6	10	5	21	Yes	Private	No
Teague Bay	50	12	3	65	Yes	Private	No
Grapetree	51	49	64	164	Yes	Private	No
Botanical Ga of the USVI (Potted)*	0 (188)	17 (27)	0 (0)	17 (215)	Yes	Private	No
Sprat Hall	0	12	8	20	Yes	Private	No
Judith's Fanc	12	50	9	71	Yes	Private	No
Hope and Ca Hill	10	30	13	53	Yes	Private	No
Estate Glynn	0	5	0	5	Unk	Private	No
Mon Bijou	0	0	1	1	Unk	Private	No
Shoy's	Unk	Unk	Unk	20 (add belov	Yes	Private	No
Total	**463 (188)**	**492 (27)**	**339 (0)**	**1314 (215)***	**-**	**-**	**-**

***Note: Individuals potted were not counted towards totals for this report.**