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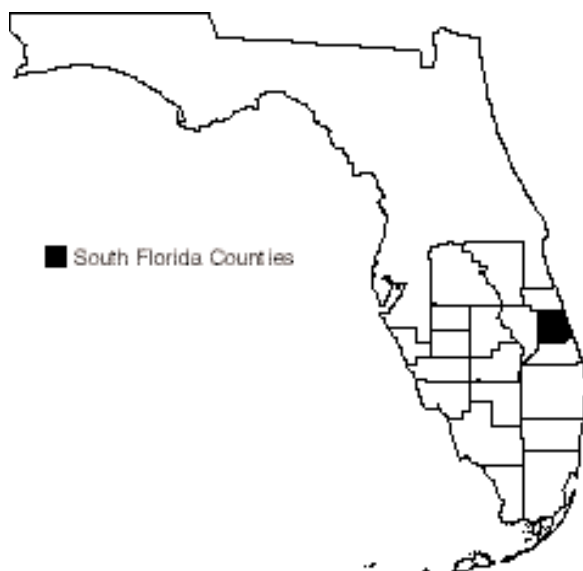
# Fragrant Prickly-apple

*Cereus eriophorus* var. *fragrans* (Small) L. Benson

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<b>Federal Status:</b>	Endangered (Nov. 1, 1985)
<b>Critical Habitat:</b>	None Designated
<b>Florida Status:</b>	Endangered
<b>Recovery Plan Status:</b>	Revision (May 18, 1999)
<b>Geographic Coverage:</b>	Rangewide

Figure 1. County distribution of the fragrant prickly-apple.



*Cereus eriophorus* var. *fragrans* is a rare, slender, columnar cactus restricted to 11 small disjunct sites in eastern St. Lucie County. A 1996 survey documented the presence of 320 plants. Habitat loss and fragmentation remains a serious threat for plants on private lands. On public lands this species is protected from destruction, but in many areas it is experiencing a precipitous decline in abundance.

This account represents a revision of the existing recovery plan for the fragrant prickly-apple (FWS 1988).

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## Description

*Cereus eriophorus* var. *fragrans* is a solitary tree cactus that may have from one to eight, spiny, cane-like, stout, and succulent stems. The columnar stems are 2.5 to 5.0 cm in diameter, and have 10 or 12 ridges alternated with deep, sharp grooves (Benson 1982). Stems may be erect, or for longer stems, the plant may recline over neighboring vegetation. The branching can be extensive, and the roots of this cactus are coarse, fibrous, and shallow (Small 1920). The spine-bearing regions (areoles) are aligned along its ridges about 2 cm apart. Each areole bears 9 to 13 spines, which are mostly grayish and yellowish at the tip, with one spine longer (2 to 4 cm) than the rest.

*Cereus eriophorus* var. *fragrans* has initial flower buds that are 1 cm long, white, and exceedingly hairy. Buds often appear on the plant one to two months prior to flower growth. About 9 days after initiation of flower growth, the flower opens (Rae 1995). The flowers are fragrant, showy, solitary, and open only at night. The buds are 12 to 20 cm long when about to open and 7.5 to 10 cm in diameter when open. The ovary bears many lanceolate scales while the flower tube has only a few scattered scales. A tuft of long white hairs (10 to 15 mm long) protrudes from the axil beneath each scale. The sepals are narrowly linear, with green outer sepals and nearly white inner ones. There are numerous spatulate petals, white or pinkish, with unevenly

toothed margins. The stamens are numerous and are composed of white filaments and yellow anthers. The style is elongate with 9 to 12 stigmas (FWS 1988). The fruits are attached at the narrower end. They average 4 to 6 cm in diameter and are a dull red. The fruit does not split and has long tufts of white hairs that remain persistent with the scale bases (Leon and Alain 1953). The fruits are swollen at the base and finely pitted; each contains approximately 1,500 black seeds that are about 3 mm long (Rae 1995).

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### Taxonomy

*Cereus eriophorus* var. *fragrans* (as well as the two other varieties mentioned below) have recently been placed within the genus *Harrisia*. However, the former classification *C. e.* var. *fragrans*, and its common name, fragrant prickly-apple, was used in the federal regulations to list the species (50 CFR 17.12) and the recent taxonomic change has not yet been adopted in the most recent list of endangered and threatened wildlife and plants (December 1998). To maintain consistency between this recovery plan and 50 CFR 17.11 and 17.12, we have opted to continue using *C. e.* var. *fragrans* (and the *Cereus* genus for other species) until it is officially changed in the Federal regulations.

*Cereus eriophorus* var. *fragrans* has two congeners also found in South Florida: *C. gracilis* var. *simpsonii*, Simpson prickly-apple cactus and *C. gracilis* var. *aboriginum*, aboriginal prickly-apple cactus. *Pilosocereus robinii*, Key tree-cactus, was formerly in the genus *Cereus*. There has been some taxonomic confusion between the fragrant prickly-apple and Simpson's prickly-apple, leading to questions of historical range (Austin 1984). The best character separating these species appears to be spine length. *C. e.* var. *fragrans* has one longer (2 to 4 cm) spine per cluster of shorter spines, whereas *C. g.* var. *simpsonii* has only the shorter spines.

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### Distribution

*Cereus eriophorus* var. *fragrans* occurred from Merritt Island, Brevard County south to the St. Lucie River in St. Lucie County. Today, it is known only from three geographically-isolated populations all on the Atlantic Coastal Ridge of St. Lucie County, Florida (Rae 1994a, 1995, 1996) (Figure 1). These populations have been further subdivided by habitat fragmentation and loss; they now occur on 11 disjunct sites on the coastal ridge. The ridge habitat where this plant occurs is approximately 11 km long by 0.2 km wide.

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### Habitat

*Cereus eriophorus* var. *fragrans* prefers early-successional sand pine scrub habitat (Rae 1994b). The known sites are limited to St. Lucie sand which is excessively well drained (Watts and Stankey 1980), where the water table is normally deeper than 3 m. Water capacity, fertility, and organic matter content are all very low. The most common plant species in this community include *Polygonella fimbriata*, *P. ciliata*, *P. gracilis*, *Quercus geminata*, *Q. myrtifolia*, *Sabal palmetto*, and *Opuntia humifusa*. Much of the Atlantic Coastal Ridge was

**Fragrant prickly-apple.**

Original photograph by John Rae.



cleared in the 1880s for pineapple plantations, but commercial pineapple cultivation was abandoned by 1920. The vegetative community has yet to regain its previous level of diversity or productivity. The vegetative succession has been arrested and the plant community has not succeeded to the climax sand pine habitat type (Rae 1994a, 1995). This cactus prefers partial shade, which is often provided by surrounding plants that shelter it from sun for a portion of the day (Rae 1994b).

**Reproduction**

*Cereus eriophorus* var. *fragrans* reproduces sexually and by regeneration by vegetative reproduction. Plants flower from April to September with two distinct peaks. The first peak is in the spring with flowering starting in April and reaching a peak in May. Some sporadic flowering occurs in the summer. In September and October, another minor peak in flowering occurs. Flowering is uncommon in the late fall, and no flowering occurs from January through March. Fruit set follows flowering with a major peak in May and a minor peak in September. A large standing crop of fruit remains on plants for approximately 8 months of the year.

According to Rae (1995), mature plants are greater than 4.1 dm in length. The smallest plant to flower was 1.45 dm in stem length and the smallest plant to set fruit was 4.1 dm in length. In his study, 63 percent of the mature plants flowered. At two sites in the Savannas State Preserve, in St. Lucie County, 38 and 60 percent of flowers successfully produced fruits and 44 and 61 percent of mature plants successfully set fruit. A positive relationship was observed between total length of the stems and branches of a plant and the total annual production of fruit.

The means of seed dispersal are uncertain, but there is evidence that birds consume the fruit of *C. eriophorus* var. *fragrans*. Additionally, most individuals

of this species are found within the dripline of other plants, suggesting avian seed dispersal. Rodents or gopher tortoises may also distribute the seeds. In addition to sexual reproduction, long stems will occasionally snap off of existing plants. After falling to the ground, stems may reroot at several places creating a small group of genetically identical plants (Rae 1994a).

Vegetative growth of this perennial species is slowest from November to March. Growth accelerates in April and May, with the fastest growth occurring from July through September. The growth rate drops off rapidly after September (Rae 1994a, 1995).

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### Relationship to Other Species

The plant species most commonly associated with *C. e.* var. *fragrans* are *Sabal palmetto*, *Smilax laurifolia*, and *Cassytha filiformis* (Rae 1995). *Schinus terebinthifolius*, an invasive exotic, is often found associated with this species. Surrounding vegetation is often used for support by *C. e.* var. *fragrans* for its long stems. Other plants may serve as “nurse plants” for the seedlings, protecting them from direct sun, but this has not been studied. As the plant grows, the nursery plant may die, leaving the cacti exposed to a greater intensity of sunlight. Overgrowth and shading by sand live oaks (*Quercus geminata*) and other species may cause reproductive failure and premature death. Growth and productivity seems to be greater for plants in areas that are partially shaded.

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### Status and Trends

*Cereus eriophorus* var. *fragrans* was listed as endangered on November 1, 1985, following substantial losses of suitable habitat (50 FR 45621). Historically, this species occurred from Merritt Island south to the St. Lucie River in coastal hammocks (Small 1917, 1918, 1922, 1925, 1932, 1935). All the identified sites were on the Atlantic Coastal Ridge bordering the Indian River or on spoil islands in the Indian River.

More recently, surveys of the historic range of *C. e.* var. *fragrans* resulted in the discovery of a population of five to eight plants north of Sebastian Inlet, Brevard County, and one individual on Turtle Mound, Volusia County (Poppleton 1981). Poppleton also found a population in Indian River County just south of the Brevard County line. Austin (1984), however, believed that cacti found previously on Merritt Island in Brevard County (Small 1927, Norman 1976, Poppleton and Shuey 1977), and Turtle Mound and south of Coronado in Volusia County (Small 1929) were misidentified and that they were *C. g.* var. *simpsonii*. A population of *C. e.* var. *fragrans* from Malabar, Brevard County, was extirpated prior to 1979 (Austin *et al.* 1980). A thorough botanical search of all spoil islands from Brevard to Martin counties by DEP personnel from 1986 to 1988 failed to find any specimens.

The primary threat to *C. e.* var. *fragrans* is the destruction of sand pine scrub habitat as a result of seaside residential, commercial, and sand mine development. In addition to habitat loss, collecting by cactus enthusiasts may have resulted in the loss of additional plants. Many of the *C. e.* var. *fragrans*

individuals are found on or near the right-of-way of the Florida East Coast Railroad. Herbicides used in maintaining railroad rights-of-way may affect cacti near the tracks. Off-road vehicle use in *C. e. var. fragrans* habitat is also known to impact plants. Today, the only protected habitat for this species is in Savannas State Preserve in St. Lucie County.

The ecology of *C. e. var. fragrans* in the Savannas State Preserve is being studied by Rae (Francis Marion University, personal communication 1995). According to Rae (1994a; J. Rae, Francis Marion University, personal communication 1997), the number of individuals of this species on his study plots declined by 41 percent between 1988 and 1993. The reason for such a decline is unknown. A severe unknown stress on the populations has led to high mortality (average, 10.7 percent/year) and general recruitment failure (average, 1.0 percent/year). Most deaths appear to occur during the summer months. Later surveys indicated an additional decline of 40 percent between 1993 to 1996 (Rae 1996). These recent deaths may be partially due to changing vegetation patterns, as observed when adjacent vegetation overgrows and shades the cacti.

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## Management

*Cereus eriophorus* var. *fragrans* has specific micro-habitat requirements. Plants growing in mostly sunny areas between vegetation and open sandy areas are reproductively successful, while plants growing in the shade rarely flower or produce fruit (Rae 1995). To maximize available habitat for this species, both shade and sun are needed. As one or the other increases, it may be necessary to manage vegetation in proximity to individual cacti by pruning or planting nurse plants.

Lacking adequate reproduction in the wild, it may be necessary to germinate seeds and subsequently transplant seedlings. However, efforts to germinate seeds have failed. Germination failure may be due to one of several factors, including low seed viability, inadequate micro-habitat conditions, or pollination failure (J. Rae, Francis Marion University, personal communication 1998).

To protect *C. e. var. fragrans*, land management is critical (Rae 1994b). Management for this species at Savannas State Preserve should include fencing and patrolling to eliminate poaching and damage by off-road vehicles, selective canopy thinning, and control of invasive and exotic plants. Additional research on the effects of land management practices on this species will help guide development of appropriate habitat management strategies for *C. e. var. fragrans*. Annual population censuses, experimental introductions and reintroductions following successful propagation may also be important in the successful management of this species.

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# Recovery for the Fragrant Prickly-apple

*Cereus eriophorus* var. *fragrans* (Small) L. Benson

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**Recovery Objective:** PREVENT extinction, then stabilize.

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## Recovery Criteria

*Cereus eriophorus* var. *fragrans* may never reach a level at which reclassification could be possible. The objective of this recovery plan should be to increase existing populations and prevent extinction. Current research shows a drastic decline over the last few years in all of the sites being monitored. Determining the cause and extent of this decline is crucial. *Cereus eriophorus* var. *fragrans* may be considered stabilized when existing populations, within the historic range, are self-sustaining and are adequately protected from further habitat loss, degradation, exotic plant invasion, and fire suppression. These sites must also be managed to maintain xeric coastal scrub to support *C. e.* var. *fragrans*.

This recovery objective is an interim goal because of the limited data on the biology, ecology, and management needs of this species. The recovery objective will be reassessed annually based on new research, management, and monitoring information. Reclassification criteria may be defined if new information identifies ways of re-establishing populations of this species to expand its current distribution within its historic range.

## Species-level Recovery Actions

- S1. Determine distribution of *C. e.* var. *fragrans*.** Known *C. e.* var. *fragrans* populations occur on well-drained soils indicative of xeric upland plant communities. Much of the xeric upland habitat of Indian River and St. Lucie counties remains botanically unsurveyed and threatened with destruction. Efforts to survey and assess the xeric vegetative communities for *C. e.* var. *fragrans* are needed to ensure the survival of this species.
  - S1.1. Inventory known populations.** Conduct a thorough ground survey to determine the distribution of *C. e.* var. *fragrans*. Collect and archive herbarium voucher specimens for all populations. Locate and tag all individual plants. Record population sizes. Initiate a quarterly monitoring program. Use existing standardized monitoring protocols developed by the FNAI to record baseline data regarding the biology and ecology of this species.
  - S1.2. Search for additional populations.** Resurvey historic locations. Conduct thorough ground surveys to locate unrecorded individuals and populations of *C. e.* var. *fragrans*.
  - S1.3. Map distribution of known populations and suitable habitat.** Map populations, including obtaining GPS coordinates and developing GIS coverages.

- S2. Protect and enhance existing populations.** Of the three populations known, one occurs on private land in residential areas and two occur in Florida's Savannas State Preserve. Additional protection at each of these sites is needed.
- S2.1. Acquire or otherwise protect habitat.** Protect habitat through cooperative agreements, lease agreements, acquisition by conservation organizations or government agencies, or by measures other than simple fee title.
- S2.2. Use local or regional planning to protect habitat.** Utilize available regional and county planning processes to encourage protection of suitable unoccupied and occupied habitat of *C. e. var. fragrans*.
- S2.3. Augment existing populations of *C. e. var. fragrans*.** Even though existing populations may persist and possibly expand without human intervention if habitat is protected and appropriately managed, some sites may require augmentation, especially where natural regeneration is unlikely or has not been documented.
- S2.3.1. Characterize the habitat and identify suitable sites for experimental outplantings.** Experience with garden populations of *C. e. var. fragrans* will provide seedling production methods, and perhaps some insight into how seeds or seedlings would fare in the wild. Based on horticultural information available on this species, seedling production, followed by transplanting onto suitable sites, appears to be the most feasible method for introducing *C. e. var. fragrans* to the wild.
- S2.3.2. Conduct experimental outplantings.** Study the feasibility of restocking and reintroducing *C. e. var. fragrans* into historically appropriate and protected natural habitats.
- S2.3.3. (Re)introduce plants to protected sites.** Following successful implementation of **S2.3.3**, use plants under cultivation to (re)establish plants in suitable habitat. Use protocols established by the conservation community and modify, if needed, based on (re)introduction results.
- S2.3.4. Monitor experimental outplantings.** Monitoring of reintroduced plants is essential for assessing the success of recovery efforts. Growth and survivorship will be measured.
- S2.4. Continue *ex situ* conservation.** *Ex situ* collections can help preserve genetic diversity, prevent loss of the species, and determine ecological characteristics and habitat management needs. These collections will be instrumental in the recovery of *C. e. var. fragrans*.
- S2.4.1. Conserve germ plasm.** Fairchild Tropical Garden maintains an *ex situ* conservation collection of this species. This collection needs to be expanded in order to build a genetically representative conservation collection. Continue to identify germination and cultivation protocols. Identify seed storage potential and methods.
- S2.4.2. Continue propagation and development of successful horticultural methods.** This species is currently cultivated at Bok Tower Gardens and Fairchild Tropical Gardens. Cultivated collections maintain genetic diversity and provide valuable information regarding the reproductive biology of rare species.

- S2.4.3. Maintain *ex situ* collections.** Currently, The Center for Plant Conservation sponsors the establishment of garden populations of endangered plants at member botanical gardens. Fairchild Tropical Gardens continues to work with the genus *Cereus*, including *C. e.* var. *fragrans*. Bok Tower Gardens also cultivates this species. The wild plants bear fruits freely, and each fruit apparently contains at least 700 seeds. Dissemination of seed for propagation for display in other botanical gardens or for commercial propagation would probably not adversely affect the wild populations.
- S2.5. Enforce available protective measures.** Use local, State, and Federal regulations to protect this species from overcollecting and damage from off-road vehicle use. Regulations should also be used to protect xeric vegetative communities where *C. e.* var. *fragrans* occurs.
- S2.5.1. Initiate section 7 consultation when applicable.** Initiate section 7 consultations when Federal activities may affect this species. However, since all known populations occur on either private or State-owned lands, we anticipate few, if any, consultations regarding *C. e.* var. *fragrans*.
- S2.5.2. Enforce take and trade prohibitions.** *C. e.* var. *fragrans* is protected by take provisions of the ESA (including its prohibition against removing and reducing to possession any endangered plant from land owned by the Federal government; maliciously damaging or destroying any such species on any such area; or removing, cutting, or digging up any such species), by the Preservation of Native Flora of Florida Act, and by State regulations regarding removal of plants from State lands. Violation of these State prohibitions (including Florida criminal trespass law) is also a violation of the ESA.
- S3. Conduct research on the biology of *C. e.* var. *fragrans*.** Much of the basic biology and ecology of this species remains poorly understood. If we are to effectively recover the species, more specific biological information will be needed.
- S3.1. Study the reproductive biology of *C. e.* var. *fragrans*.** Evaluate pollination ecology, seed germination, seedling survivorship in varying habitats, seed dispersal, age at sexual maturity, and species-specific diseases. Most of this information is poorly understood and will be essential for the successful recovery of this species.
- S3.2. Study the response of *C. e.* var. *fragrans* to habitat management treatments.** Little is known regarding how *C. e.* var. *fragrans* responds to various land management actions such as vegetative control or use of prescribed fire. Determine if fire, vegetative cutting, or other means will be required to manage vegetative communities at any of the protected sites where *C. e.* var. *fragrans* occurs.
- S3.3. Conduct genetic studies to document genetic variation within and between populations.** Conservation and recovery of *C. e.* var. *fragrans* will require knowledge of genetic diversity. Outplanting will require knowledge of genetic stock to ensure compatibility of donor and recipient populations.
- S4. Monitor *C. e.* var. *fragrans* populations.** Maintain an inventory of naturally reproducing populations to help determine habitat characteristics and natural environmental changes affecting *C. e.* var. *fragrans*.

- S4.1. Initiate quarterly monitoring program.** Use existing monitoring protocol developed by the Florida Natural Areas Inventory to record baseline data regarding the biology and ecology of this species, including existing individuals and individual plants that may be reintroduced in the future.
- S4.2. Collect and archive existing and historical data.** A number of individuals and institutions maintain data for this species. To effectively monitor this species all data must be archived to a central location.
- S5. Provide public information about the fragrant prickly-apple cactus.** It is important, and perhaps crucial, to the recovery of this species that governmental agencies, conservation organizations such as the Florida Native Plant Society, and landowners be appropriately informed about this species. Informing the conservation organizations such as the Cactus and Succulent Society is appropriate, but care is needed to avoid unnecessarily revealing localities and to avoid stimulating demand for the species.
- Efforts must also continue to address the increasing concern that horticultural demand for this and other rare species may not benefit conservation of threatened and endangered species. Public education should identify that commercial production and horticultural uses of endangered species provide little benefit to species, since the recovery of *C. e. var. fragrans* and other rare species requires a self-sustaining, secure, number of natural populations.
- S6. Establish delisting criteria.** Once reclassification is achieved, research and monitoring results may provide data necessary to develop delisting criteria.

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### Habitat-level Recovery Actions

- H1. Protect, manage and enhance habitat.** None of the habitat for *C. e. var. fragrans* on private land is secure at this time. Efforts to protect these sites are essential since many of the remaining plants occur on private land.
- H1.1. Acquire habitat.** Fee title acquisition or less-than-simple-fee title acquisition should be sought for remaining or suitable but unoccupied *C. e. var. fragrans* habitat. Some of these sites are targeted for acquisition and inclusion in the Savannas State Preserve, including portions of three populations already partially protected on State property. Where State acquisition is not possible, pursue protection through conservation easements or other appropriate means.
- H1.2. Develop and implement management plans on public lands.** Manage habitat to maintain cactus populations by preventing damage from off-road vehicle use, and reduce or eliminate threats due to fire (both uncontrolled and controlled), herbicide application, and invasive and exotic vegetation.
- H1.2.1. Control off-road vehicle use.** Eliminate off-road vehicle use through controlled entry and use.
- H1.2.2. Control invasive and exotic plants.** Seedling and young *C. e. var. fragrans* require nurse plants to provide shade to enhance their survival. In some cases, exotic or invasive native species serve this role well. However, if invasive or exotic plants continue to shade cacti, they may outcompete them for light. Selective removal of competing vegetation may be required once *C. e. var. fragrans* no longer require large amounts of shade.

- H1.2.3. Reduce impacts associated with herbicide application.** Negotiate best management practices with railroad to eliminate adverse effects due to herbicide application on their rights-of-way.
- H1.2.4. Define and implement habitat management techniques.** Determine land management techniques most beneficial to *C. e. var. fragrans* and implement these actions.
- H1.2.5. Restore habitat.** Based on soil surveys, identify unoccupied but potentially suitable habitat and manage as in **H1.** above.
- H2. Monitor habitat and ecological processes.** Little is known regarding response of *C. e. var. fragrans* to land management actions used in coastal xeric communities. The effects of fire, vegetative cutting, or other measures must be monitored to determine biological and ecological consequences.
- H3.1. Determine effects of fire.** Determine the effects of fire on adult plants, seedlings, and seeds.
- H3.2. Determine effects of vegetative thinning.** Evaluate the effects of canopy thinning on the survival, growth, and reproduction of this species.
- H3. Continue public information efforts about xeric vegetative communities and their unique biota.** Educational efforts, especially those conducted by private conservation organizations, have been successful in providing important information about xeric plant communities to the public. The State's system of biological preserves depends on funding, and their future success is based on the public's understanding and support. In addition to past and ongoing educational efforts by The Nature Conservancy, Bok Tower Gardens, Fairchild Tropical Garden, and Archbold Biological Station, future efforts by these organizations, the Florida Park Service, Florida Native Plant Society, and local garden clubs will play an important role in the conservation of xeric plant communities and *C. e. var. fragrans*.

