

**Florida ziziphus
(*Ziziphus celata*)**

**5-Year Status Review:
Summary and Evaluation**



Drawing by Jean C. Putnam Hancock; flower photograph by Steve Shirah.

**U.S. Fish and Wildlife Service
Southeast Region
Florida Ecological Services Field Office
Vero Beach, Florida**

March 2024

STATUS REVIEW
Florida ziziphus (*Ziziphus celata*)

GENERAL INFORMATION

Current Classification: Endangered

Lead Field Office: Florida Ecological Services Field Office, Vero Beach, David Bender,
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Date of original listing: August 28, 1989 (54 FR 31190; July 27, 1989)

Methodology used to complete the review: In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants ([50 CFR 424.11](#)). The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of Florida ziziphus (*Ziziphus celata*) to inform this status review.

We announced initiation of this review in the Federal Register on April 11, 2019 (84 FR 14669) with a 60-day comment period and received one comment. The primary sources of information used in this analysis were the 1989 final listing rule (54 FR 31190), the 1999 and 2019 recovery plan and amendment (respectively) peer-reviewed reports, agency reports, unpublished survey data and reports, and personal communication with recognized experts. This review was completed by the U.S. Fish and Wildlife Service, Florida Ecological Services Field Office, Vero Beach, Florida and all literature and documents used for this review are on file at the office. All recommendations resulting from this review are the result of thoroughly reviewing the best available information on Florida ziziphus.

FR Notice citation announcing the species is under active review:

April 11, 2019 (84 FR 14669)

Species' Recovery Priority Number at start of 5-year review:

Florida ziziphus is assigned a recovery priority of 5 meaning that it is a species with a high degree of threat and a low recovery potential.

Review History:

A previous 5-year review recommending no change in status was published on August 27, 2009 (Service 2009).

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature

In the previous 5-year review and listing rule, this taxon was listed as *Ziziphys celata* as accepted in the literature, state heritage program, and Integrated Taxonomic Information System (ITIS). Since then, studies have explored the generic breakdown of the Rhamnaceae family. In 2015 a study of the genera that composed *Condaliopsis* (i.e., *Ziziphys* and *Condalia*) concluded that the taxon *Ziziphys celata* should be placed in the genus *Condalia*, giving the species the name *Condalia celata* (Islam and Guralnick 2015). Another study (Hauenschield et al. 2016) reviewed this taxon's genetics and nomenclature and reclassified it from *Ziziphys celata* to *Pseudoziziphys celata*. Details of this taxonomic change are given in Hauenschield et al. (2016). The new nomenclature is currently supported by the Florida Natural Areas Inventory (FNAI; 2023), the Atlas of Florida Plants (2023), and the Flora of the Southeastern United States (Weakley and the Southeastern Flora Team 2022). This nomenclature, however, has not been updated in the ITIS (2023).

These updates do not impact our assessment of the listed entity (e.g., do not change its distribution, biology, life history, or threats), and it is still considered a valid entity by the Service. Until we finalize a technical correction of the name, we will continue to reference the species using the name as it was listed, i.e., *Ziziphys celata*.

Distinct Population Segment (DPS) ([61 FR 4722](#))

The 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 of a DPS to only vertebrate species. Because the species under review is a not a vertebrate, the DPS policy does not apply.

Recovery Criteria

Recovery Plan or Outline

Recovery Plan: South Florida Multi-Species Recovery Plan (MSRP) signed May 18, 1999 (Service 1999)

Recovery Plan Amendment: Lake Wales Ridge Plants Recovery Plan Amendment signed September 27, 2019 (Service 2019)

In 2019, the Service published amended recovery criteria for Florida ziziphys, as follows: Florida ziziphys will be considered for delisting when:

1. *At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.*

As of 2021 there were 16 known populations. While most populations have individuals that produce clonal offshoots annually (vegetative reproduction), only a few have shown sexual reproduction through the formation of fruit, as more genetic variability is required within the population. Fewer yet have shown any new plants arising from seeds.

2. *Populations (as defined in criterion 1) in sand hill habitat are distributed across the known range of the species.*

Some of the populations are in sandhill habitat, while others are in semi-improved pastures. The remaining populations, while few, do largely represent the known range of the species.

3. *Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future.*

Seven of 16 populations are located on public or private conservation lands. These sites are managed for non-native species and may be occasionally treated with prescribed fire. Populations on non-conservation private sites are vulnerable to destruction by landowners or, in some cases, grazing cattle. Privately owned sites are not managed for Florida ziziphus or sandhill habitat.

The Service believes these criteria are appropriate and relevant; however, based on the most recent best available science, they have not yet been met.

Biology and Habitat Summary

Florida ziziphus (Rhamnaceae) is a thorny, clonal shrub found endemic to the Lake Wales Ridge. Only 16 remnant and introduced populations in two central Florida counties (Highlands, Polk) still persist (Figure 1).

One factor contributing to the rarity of Florida ziziphus is its breeding system (Weekley and Race 2001, Weekley et al. 2002), which limits sexual reproduction to plants of different mating types (some genotypes are incompatible). Typically, the plant is hermaphroditic and spreads/reproduces vegetatively via shoots from lateral roots. Most populations are uniclonal, containing multiple genetically identical clones originating from a single individual (Godt et al. 1997, Weekley et al. 2002, Weekley et al. 2007, Gitzendanner et al. 2012). Those uniclonal populations cannot reproduce sexually, because the species requires out-crossing between different compatible genotypes for successful pollination (Weekley and Race 2001). Production of viable fruits has only been confirmed in three wild populations, which indicates successful cross-pollination may be limiting. Those populations that are not sexually reproducing rely on vegetative growth, which can reduce adaptive capacity through limitations in genetic variation.

Due to the vegetative reproduction of the plant, counting individuals is challenging and can be misleading because above ground stems can be connected underground. Other seemingly distinct individuals may have been fragmented and therefore could be genetically identical (i.e., resulted from clonal dispersion which can spread widely (Weekley and Menges 2006)). Nearly all remaining wild populations are uniclonal, consisting of a single fragmented individual of the same genetic type (genotype).

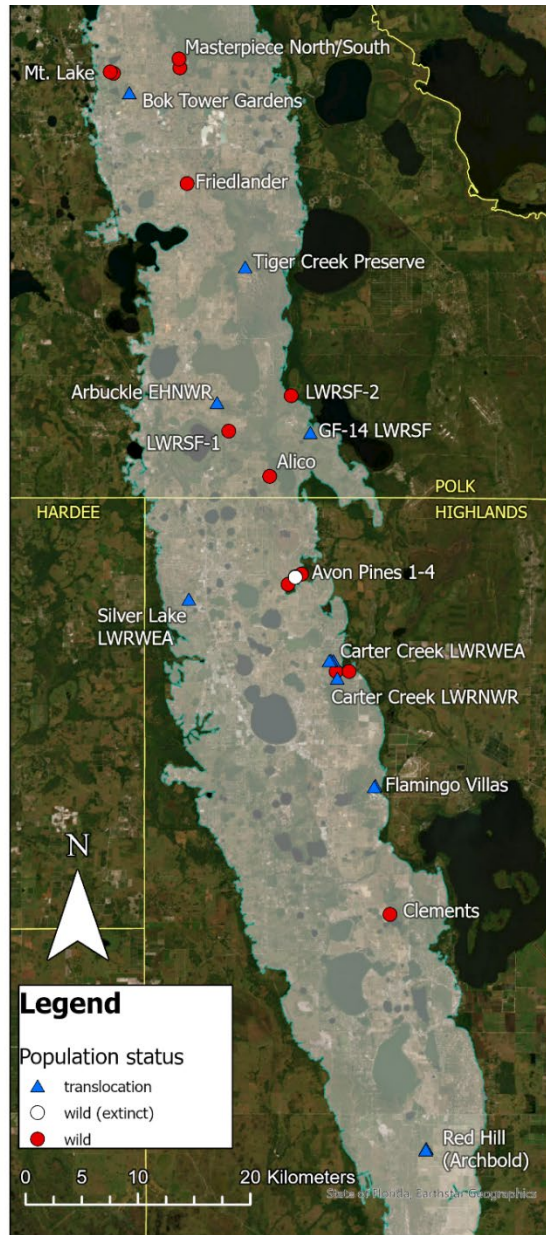


Figure 1. The geographic range of Florida ziziphus as of 2022-2023 (David and Herron 2023). The map includes all translocated / captive (blue triangles) and wild populations (red circles, white if extinct).

In 2009 there were 14 extant populations. Since that review, the monitoring schedule for the plant has been altered to be less frequent than previously, and the most recent survey data are from 2021. As of 2021, there are 13 extant wild populations and 3 introduced populations (Table 1; Heron pers. comm 2024). This is a reduction from the 16 documented wild populations because three of those located on private lands have been extirpated (Herron pers. comm 2024). Several of the extant wild populations also occur on private land and are at risk of loss. These populations are vital to recovery, as plants on public property represent a small fraction of genetic diversity. The Masterpiece site (including the Masterpiece North and South populations), which has a conservation easement, supports over half of known plants and much of the genetic

diversity in this species. Most populations on privately owned sites have declined steadily over the past decade (Smith et al. 2013) and will continue to decline without efforts to promote sexual reproduction (Ellis et al. 2007). The recent transfer of the Gulfstream/Mitigation site to the Service has also aided in the conservation of Florida ziziphus. This parcel is now known as the Arbuckle unit and is part of the Everglades Headwater National Wildlife Refuge.

Several translocations of Florida ziziphus have occurred (Table 2; for details, see David and Herron 2023). Only one plant remains from the initial augmentation at one of the Avon Pines sites, and it is unclear whether the second augmentation has yet resulted in sexually mature and reproducing plants. Two larger augmentations at Arbuckle Everglade Headwaters National Wildlife Refuge in 2003 and 2006 have been successful in flowering, producing fruit, and producing one second generation seedling. However, survival has been relatively low in this disturbed sandhill.

Table 1. Summary of all known wild Florida ziziphus populations, based on the most recent census. “Extant Wild Genotypes” shows the number of unique wild genotypes currently extant at that population with the original number of known genotypes in parentheses. For augmented wild populations, the year of augmentations are shown in parentheses. All censusing was carried out by Archbold Biological Station. (Table adapted from David and Herron 2023).

Population	Property	Habitat	Extant Wild Genotypes (All Known Genotypes)	Year Discovered	Census Total	Census year
Alico	private	disturbed sandhill	1(1)	2012	1	2022
Arbuckle*	federal	disturbed sandhill	0 (1)	1988	65	2022
Avon Pines 1	private	pasture	2 (4)	1988	21	2022
Avon Pines 2*	private	pasture	0 (1)	1988	0	2022
Avon Pines 3*	private	pasture	0 (1)	1988	0	2022
Avon Pines 4	private	pasture	2 (4)	2001	2	2022
Carter Creek 1	state	sandhill	2 (2)	2007	14	2023
Carter Creek 2	state	sandhill	2 (2)	2007	6	2023
Clements	state	sandhill	1 (1)	2017	25	2022
Friedlander	private	pasture	1 (1)	1995	193	2022
Masterpiece North	private	pasture	3 (5)	2007	201	2020
Masterpiece South	private	pasture	18 (21)	2007	438	2020
Mt. Lake Disturbed	private	disturbed sandhill	1 (1)	2001	1	2022
Mt. Lake Sandhill	private	disturbed sandhill	1 (1)	1995	1	2022
Lake Wales Ridge State Forest-1	state	sandhill	1 (1)	1987	11	2022
Lake Wales Ridge State Forest -2	state	sandhill	1 (1)	2007	4	2022

* Populations that are introduced.

Table 2. Summary of all introductions and captive Florida ziziphus sites, based on the most recent census. “Genotypes” shows the current number of extant, unique, confirmed genotypes at each population (for introductions, these are primarily hybrids). Sites with unknown counts still require genotyping for most plants. Some sites have received multiple introductions (indicated under year introduced). Captive populations are listed at the end (separated by thick line), which are managed gardens at Bok Tower Gardens. All introductions were carried out by Archbold Biological Station (ABS) except for those marked with *. Censusing for all sites was conducted by ABS.

Property: BTG = Bok Tower Gardens; LWRSF= Lake Wales Ridge State Forest; LWRNWR= Lake Wales Ridge National Wildlife Refuge; LWRWEA=Lake Wales Ridge Wildlife and Environmental Area; TNC=The Nature Conservancy. Table taken from David and Herron (2023).

Site	Property	Habitat	Genotypes	Years Introduced	Method	Census Total	Census year
Carter Creek	LWRNWR	sandhill	20	2002, 2009, 2016	Transplants, seeds	194	2023
Carter Creek	LWRWEA	sandhill	unknown	2021-2023	Seeds	2	2023
Flamingo Villas	LWRNWR	sandhill	unknown	2021-2023	Seeds	1	2023
GF-14	LWRSF	sandhill	7	2010	Transplants, seeds	98	2022
Mountain Lake*	Mt. Lake Corporation	restored sandhill	unknown	2021	Transplants	25	2023
Pine Ridge Preserve	BTG	sandhill	6	2008, 2010	Transplants	16	2022
Red Hill	ABS	sandhill	13	2023	Transplants	73	2023
Silver Lake	LWRWEA	sandhill	11	2012	Transplants, seeds	132	2023
The Knoll*	BTG	restored sandhill	unknown	2019	Transplants	3	2023
Tiger Creek Preserve	TNC	sandhill	18	2005, 2007	Transplants, seeds	154	2022
Endangered Plant Garden*	BTG	managed garden	4	2002	Transplants	41	2023
National Collection Planting Beds*	BTG	managed garden	21	1990	Transplants	179	2023

Threats (Five-Factor Analysis) Summary

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act, including: Factor A: the present or threatened destruction, modification, or curtailment of its habitat or range; Factor B: overutilization for commercial, recreational, scientific, or educational purposes; Factor C: disease or predation; Factor D: the inadequacy of existing regulatory mechanisms; Factor E: other natural or manmade factors affecting its continued existence. A summary of this assessment is detailed below.

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

Florida ziziphus is endemic to the Lake Wales Ridge in central Florida. The extent of post-Columbian xeric upland habitat loss on the Lake Wales Ridge is estimated to exceed 85 percent (Weekley et al. 2008) and the loss is likely to increase with increasing pressure from population growth. Continued conversion of Florida scrub and sandhill to agriculture, housing, and other developments is affecting the habitat of Florida ziziphus. Although there has been considerable progress in acquiring habitat on the Lake Wales Ridge, only three publicly protected sites (Lake Wales Ridge State Forest, Carter Creek and Clements units of the Lake Wales Ridge Wildlife and Environmental Area) support wild populations of Florida ziziphus. Land acquisition to date has placed nearly half (87.4 square kilometers [sq km] or 48.9 percent) of the remaining 178.7 sq km of scrub and sandhill habitat on the Lake Wales Ridge within protected areas (Turner et al. 2006).

Without assurances or agreements with landowners, the populations on private lands are at risk of habitat damage or plant destruction. The largest and most genetically diverse populations (e.g., Masterpiece North and South) are located on private land at sites that have been converted to pasture. While some of these populations are temporarily safe from imminent destruction due to cooperative landowners, they have no legal protection from destruction by the landowner and a transfer of ownership could result in a loss of the populations. The breeding system of Florida ziziphus amplifies the consequences of habitat fragmentation because the remaining populations are isolated from others that contain compatible mates. While the species can reproduce clonally, it is crucial to persistence of the plant to sexually reproduce to allow for more robust and diverse genetic material across the landscape. Several populations have been fenced to prevent damage by cattle, however those fences can and have been breached by cattle, including in Avon Pines where cattle activity (foraging, trampling) resulted in the extirpation of two populations. Some other privately owned suitable and occupied habitat is used as a yard waste dumpsite and the waste pile is moving closer to the plants.

The discovery of seven populations since 2007 suggests the possibility of additional undiscovered populations. Considering the rapid pace of development in central Florida, it is possible that unknown populations will be destroyed before they are discovered. Florida ziziphus continues to be threatened by habitat loss, modification, and fragmentation.

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

Overutilization for commercial, recreational, scientific, or educational purposes was not identified as a potential threat in the original listing package. Since listing, no evidence of overutilization has been found.

C. Disease or predation: Disease has not been observed as a limiting factor in Florida ziziphus.

Based on seedlings that resulted from introduction efforts, there is limited evidence to suggest that herbivory can impact seedlings. However, browsed seedlings did re-sprout once the plants were protected from browsing (Weekley and Menges 2008). Some evidence of herbivory has also been observed on mature plants (Service 1999), and invasive species like green iguanas (*Iguana iguana*) may be contributing to predation. However, at present there is insufficient data to evaluate the level of predation pressure by herbivores.

D. Inadequacy of existing regulatory mechanisms: Florida ziziphus is listed as endangered by the State of Florida on the Regulated Plant Index (Florida Department of Agriculture and Consumer Services Rule 5B-40). This law regulates the taking, transport, and sale of listed plants. This law does not prohibit private property owners from destroying listed plants nor does it require them to manage habitats to maintain populations.

Existing Federal and State regulations prohibit the removal or destruction of listed plant species on public lands. However, they afford no protection to listed plants on private lands. State regulations are less stringent than Federal regulations on land management practices that may adversely affect populations of listed plants. Therefore, existing regulatory mechanisms are inadequate to protect this species.

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

Fire suppression or lack of adequate fire regime

Fire suppression is a continuing threat to the habitat of Florida ziziphus. In studies of Florida ziziphus introduced to one sandhill site, Menges et al. (2008) found that resprouting oaks encroached with negative effects on plant survival. The number of oaks increases under fire suppressed conditions. Fire return intervals for Florida ziziphus should be in the 5- to 20-year range (Menges et al. 2020), however most private property owners do not apply prescribed fire at this frequency. Fire suppressed conditions will likely continue on most private sites, to the detriment of potential Florida ziziphus habitat. Prescribed fire implementation on some public lands is behind schedule due to insufficient resources coupled with logistical obstacles. Smoke, public safety, and property liability issues, along with public perceptions relating to aesthetics still pose obstacles to implementing prescribed fire.

Invasive plants

Non-native invasive plant species are a threat to Florida ziziphus at sites, especially those that are adjacent to modified landscapes and those that have been converted to pasture. In pastures, the dominant groundcover of pasture grasses may be a factor in the lack of recruitment from seeds in the few reproductive populations, but this has not been investigated. In addition, non-native vines pose a threat and can grow over Florida ziziphus. These vines compete for sunlight, space, water, and nutrients and may cause a decrease in the survival and reproductive success of Florida ziziphus. Invasive plants are managed at the protected sites and are not a significant threat to Florida ziziphus at these sites.

Paucity of recruitment from sexual reproduction

Few fruits and seedlings have been documented in populations. Because populations are fragmented and beyond likely pollination distance, crosses among populations only occur when plants are brought together or manually pollinated. The destruction of unprotected populations on private land could result in additional loss of genotypes critical to conservation and recovery of the species. In particular, if the remaining genetic diversity drops, sexual reproduction may become impossible further threatening the species.

Climate change

Effects of climate change on the habitat of Florida ziziphus are not known. Increases in temperature and changes in precipitation patterns could be important in the future. Forecasts of more severe droughts and higher rainfall between droughts could mean that fires would be more severe and that prescribed fires harder to control. This could harm Florida ziziphus populations. Sea level rise in coastal Florida is already a reality and may lead to an increase in development in interior Florida, thus increasing the vulnerability of Florida ziziphus habitats (Volk et al. 2017).

The National Climate Assessment (Melillo et al., 2014) reports that the average precipitation has decreased in central Florida since 1900; however, heavy downpours are increasing in frequency and intensity since 1970. Future projected precipitation changes in seasonality for central Florida indicate 0 to +10% in winter, 0 to -10% in spring, -10 to -20% in summer, and +10 to +20% in fall will occur. Statewide annual rainfall is projected to increase from 0 to +20% by 2100. In addition to changes in precipitation, Florida has undergone increases in average temperatures since the beginning of the 20th century (Runkle et al. 2022). Warming is expected to increase in the future and will result in declines in soil moisture loss. Consecutive dry days are expected to increase 10 to 20% for most of Florida. Predictions of increased drought frequency, intensity, and duration could result in plant losses due to prolonged drought conditions (Melillo et al., 2014). However, this plant and other xeric species are relatively drought-resistant, but seasonality changes may affect seedling recruitment and general phenology of the species.

Although Florida's coastal areas will likely be influenced by sea level rise, based on our understanding of current sea level rise models and the species occurrences inland on well drained soils (e.g., ancient ridges mainly in central Florida), sea level rise does not currently pose a threat to this species. The Service has no direct evidence that climate changes observed to date have had any adverse impact on the species or its habitat.

Synthesis

Florida ziziphus (Rhamnaceae) is a federally endangered clonal shrub found only in two central Florida counties (Highlands, Polk) on the Lake Wales Ridge, and is represented by only a 16 remnant and introduced populations. The plant's system of reproduction complicates recovery efforts as many populations come from a single individual and sexual reproduction is not possible due to the species' requirement for out-crossing. In addition, conditions for exchange of genetic information between populations are poor due to fragmentation and isolation of occupied habitat. Of the extant populations ten, including the populations with the highest genetic diversity remaining, occur on unprotected lands. The species continues to be threatened by habitat loss and lack of habitat management (especially fire suppression), competition with invasive species, and increased risk because of the limited evidence of sexual reproduction and recruitment. Due to the limited number of individuals, populations, genetic diversity, Florida ziziphus continues to be at risk of extinction and it is recommended to remain listed as endangered.

RECOMMENDED FUTURE ACTIVITIES

Recovery actions outlined in the initial recovery plan (Service 1999) and the amendment to the recovery plan (Service 2019) are mostly ongoing or partially complete. Stakeholders (e.g., state

agency, private conservation groups) are actively working toward the recovery of this plant, including maintaining ex situ collections, monitoring, and protecting existing populations.

Recovery Activities

- Continue to maintain captive populations to use for reintroductions and/or to increase genetic diversity at extant sites.
- Maintain regular fire-return intervals across the inhabited landscape

Monitoring and Research Activities

- Continue regular census of extant populations, determine genetic makeup of populations.
- Search appropriate habitat types in private lands (that have yet to be scouted) for potential additional populations.
- Monitor sites post-fire to understand how long after fire FL ziziphus will recover/re-sprout.
- Maintain collaboration and data sharing agreements with state agencies and the Archbold biological station to ensure that all data on monitoring of extant populations are collated and shared with appropriate parties.

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RESULTS / SIGNATURES

U.S. Fish and Wildlife Service Status Review of Florida ziziphus (*Ziziphus celata*)

Status Recommendation:

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

- Downlist to Threatened
- Uplist to Endangered
- Delist:
 - The species is extinct*
 - The species does not meet the definition of an endangered or threatened species*
 - The listed entity does not meet the statutory definition of a species*
- No change needed

FIELD OFFICE APPROVAL:

Division Manager, Florida Ecological Services Field Office, U.S. Fish and Wildlife Service

Approve _____

** In the Florida Ecological Services Field Office, the Classification and Recovery Division Manager has delegated authority to approve 5-year reviews that do not recommend a status change.*