Chamaecrista glandulosa var. *mirabilis* (no common name)

5-Year Status Review:
Summary and Evaluation

Chamaecrista glandulosa var. *mirabilis* with flowers.
Right photo: bee visiting the flowers
Photos by José Gilberto Martínez (Service)

August 2022

U.S. Fish and Wildlife Service
Atlanta Regional Office
Caribbean Ecological Services Field Office
Boquerón, Puerto Rico

5-Year Status Review
***Chamaecrista glandulosa* var. *mirabilis* (no common name)**

I. GENERAL INFORMATION

A. 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. On June 23, 2021, the U.S. Fish and Wildlife Service (Service) published a notice in the Federal Register (86 FR 32965) announcing the 5-year status review and opening a 60-day public comment period for *Chamaecrista glandulosa* var. *mirabilis*. The notice requested new information and comments concerning the species' biology and status. No comments were received from the public. The primary sources of information used in this analysis were unpublished reports and personal communication with recognized species expert.

B. Reviewers

Lead Region: Carrie Straight, South Atlantic-Gulf and Mississippi Basin Region, Atlanta, GA (404) 679-7226.

Lead Field Office: José G. Martínez, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. Email: jose_martinez@fws.gov

C. Background

1. Federal Register Notice Citation Announcing Initiation of this Review

June 23, 2021, 86 FR 32965

2. Listing history

Original Listing
Federal Register Notice: 55 FR 12788
Effective listing date: April 5, 1990
Entity listed: Species
Classification: Endangered

3. Review History

Each year, the Service reviews and updates listed species information for inclusion in the required Recovery Report to Congress. The previous evaluation of *C. glandulosa* var. *mirabilis* was the 2015 5-year status review, which recommended that the species continued to be classified as endangered.

4. Species' Recovery Priority Number at start of review

Chamaecrista glandulosa var. *mirabilis* has a Recovery Priority Number of 5. The species has a high degree of threat and a low recovery potential.

5. **Recovery Plan:**
   Name of plan: *Chamaecrista glandulosa* var. *mirabilis* Recovery Plan
   Date issued: May 12, 1994

II. REVIEW ANALYSIS

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

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 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

The recovery criteria as presented in the 1994 recovery plan specifies that *C. glandulosa* var. *mirabilis* could be considered for delisting when:

1. The known populations are placed under protective status; and

2. At least three new populations capable of self-perpetuation have been established within protected areas.

Further information is provided about the criteria in the Recovery Plan. These should be minimum requirements and could be expanded upon if the regenerative or propagative potential of natural and *ex situ* populations proves to be insufficient. On the other hand, if new populations of the species are discovered, it may be preferable to place greater emphasis on protection, rather than on propagation, in order to achieve a minimum number of plants.

Criterion 1 has been partially met. The Tortuguero Lagoon Natural Reserve (TLNR) is a protected area managed by the Puerto Rico Department of Natural and Environmental Resources (PRDNER) and encompasses at least two of the known natural populations of the species. However, some historical localities lie on private lands subject to urban development and do not have protected status.

Criterion 2 has been initiated. Currently, the researchers from the University of Puerto Rico, Río Piedras Campus (UPR-RP) are developing a seed propagation and reintroduction protocols for *C. glandulosa* var. *mirabilis*. Currently, no new population of the species has been yet established.

C. Update information and current species status

1. Biology and Habitat

a. Summary of new information of species biology and life history

Chamaecrista glandulosa var. *mirabilis* (no common name) is a small shrub endemic to white silica sands in the northern coast of Puerto Rico at elevations

near sea level (Service 1994, Axelrod 2011). *Chamaecrista glandulosa* var. *mirabilis* is an erect shrub that may reach up to 1 meter (m) (3 feet (ft)) in height. Its branches are slender, straight, and wire-like. Leaves are alternate, evenly one-pinnate, 1 to 3 centimeters long, 0.5 to 1 centimeter wide, with some scattered whitish hairs. The flowers are solitary, with a pedicel about as long as the leaves. The corolla is yellow, about 2 centimeters in diameter, with one petal much larger than the others. Mature fruits (legumes) are glabrous, linear, 2.5 to 4 centimeters long, 3 to 4 millimeters wide, flat, elastically dehiscent, and 12 to 15 seeded (Vivaldi and Woodbury 1980).

b. Abundance, population trends, demography

In 1994, the species' Recovery Plan reported approximately 150 *C. glandulosa var. mirabilis* individuals from the TLNR and an additional population was reported in private land in the nearby municipality of Dorado (Service 1994). The Dorado population was estimated between 20 to 50 individuals (Service 1994), but that area is currently occupied by urban developments, and the Service did not find any new information regarding the current status of the species within this locality.

In the 2015 5-year status review, we reported a rapid assessment was conducted in TLNR by Service biologists to determine the overall status of that population. At that time, the biologists confirmed the presence of *C. glandulosa* var. *mirabilis* in the reserve but were not able to obtain an accurate estimate of the number of individuals during the rapid assessment.

From 2019 to 2021, López-Colón conducted a comprehensive survey of the *C. glandulosa* var. *mirabilis* population within TLNR. He reported a total 628 individuals in two locations: 434 individuals in Location 1, and 194 individuals in Location 2 (López-Colón 2021 pers. comm.). Both locations are about 1 mile (mi) (1.6 kilometer (km)) from each other (Figure 1). However, López-Colón (2021, pers. comm.) mentioned that in 2019 a fire burned more than 80 individuals in Location 1. In 2022, López-Colón estimated that the whole population at TLNR is currently between 500-600 individuals (López-Colón 2022 b, pers. comm.).

At the time of this review, the Service considers a population with two locations in TLNR to be extant with one (Location 2) being approximately half the size of the other (Location1). The second known population in Dorado discussed in the Recovery Plan is likely extirpated or if still present may be a remnant population in the matrix of surrounding developed land uses and a golf course with limited habitat for the species remaining in the area.

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

We found no new information on genetics of *C. glandulosa var. mirabilis*.

d. Taxonomic classification or changes in nomenclature

No new information regarding the taxonomic classification or changes in

nomenclature for *C. glandulosa var. mirabilis* was found during this review. The variety is still accepted as a valid taxon as shown on the Integrated Taxonomic Information System (ITIS) Report for the species (ITIS 2022).

e. Spatial distribution, trends in spatial distribution, or historic range

With the presumed extirpation of the Dorado population, *C. glandulosa* var. *mirabilis* is considered to be limited to two small areas in TLNR (Figure 1).

f. Habitat or ecosystem conditions

Chamaecrista glandulosa var. *mirabilis* occurs in the north central coastal plain within the subtropical moist forest life zone, where rainfall ranges from 1,100 to 2,200 mm (44-88 in) per year (Ewel and Whitmore 1973). As a coastal species, it is found in the lower rainfall range of this life zone in well-drained substrate. The population of TLNR is divided in two localities showing different habitat types (López-Colón 2017). Location 1 is on the southeast of the Tortuguero lagoon in an open area without canopy, about 15 meters (m) (49 feet (ft)) from the edge of the lagoon (López-Colón 2017). The main vegetation in that area is composed by *Anacardium occidentale* (Pajuil), *Chrysabalanus icaco* (Icaco), *Clusia rosea* (Cupey), *Hymenaea courbaril* (Algarobo), *Palicourea guianensis* (no common name), *Aiphanes acanthophylla* (Palma coyor), *Cassytha filiformis* (no common name) and *Megathyrsus maximus* (Guinea grass). Location 2 is part of the secondary forest of the TLNR, with a more closed canopy, and a vegetation composition represented by *Chrysabalanus icaco* (Icaco), *Terminalia catappa* (Almendro), *Clusia rosea* (Cupey), *Ananas comosus* (Piña), *Miconia pycnoneura* (Camasey), *Miconia mirabilis* (Camasey blanco), *Miconnia racemosa* (Camasey felpa), and *Nepsera aquatica* (Aleta) (López-Colón (2017).

Figure 1. *Chamaecrista glandulosa var. mirabilis* locations (yellow squares) at Tortuguero Lagoon Natural Reserve. Location 1 (A) and Location 2 (B).

g. Other relevant information

López-Colón (2017) conducted a study on the phenology, pollination, and reproductive success of the population of *C. glandulosa* var. *mirabilis* in TLNR. He reported that phenology is influenced by abiotic factors (e.g., temperature and relative humidity) and that the peaks of buds, flowers and fruits production are more abundant between December and February, following a pattern of rain and colder temperature. Also, the fruit production study showed that *C. glandulosa* var. *mirabilis* has little capacity for self-pollination and requires a specific insect for pollination to achieve reproductive success (López-Colón 2017). During the study, five hymenopteran insect species (i.e., *Xylocopa mordax*, *Centris lanipes*, *Centris haemorrhoidalis*, *Centris decolorata* and *Apis mellifera*) were identified as flowers visitors (López-Colón, 2017). After 56 hours of observation, he concluded that from all potential generalist pollinators, 75% of the visits to the plants were conducted by *X. mordax*, compared to *C. lanipes, C. haemorrhoidalis*, *C. decolorata*, and *A. mellifera*, which had 15, 6, 3 and 1 % visits, respectively. Nonetheless, these native insects likely contribute to the reproductive success through their pollination of flowers. These insects generate vibrations (floral buzzes) that facilitate fertilization within the flowers, that likely benefits the reproductive success of the species (López-Colón 2017).

In December 2019, the PRDNER entered into an agreement with the UPR-RP to develop a protocol for the seed propagation and reintroduction of *C. glandulosa* var. *mirabilis* in suitable habitat within the range of the species. The preliminary seed germination study found a higher germination percentage in the seeds with greater weight (Vilá-Terrada and López-Colón 2022, unpublished data). Also, under laboratory conditions, seed germination started two days after being planted, and most of the seeds germinated during the first 3 weeks after planted (Vilá-Terrada and López 2022, unpublished data). In addition, field observations over a five-month period found no seed germination under natural conditions (Vilá-Terrada and López-Colón 2022, unpublished data). These preliminary results showed that the germination of *C. glandulosa* var. *mirabilis* from seeds is possible in laboratory conditions; but there appeared to be some obstacle to or suppression of germination in nature. More studies are necessary to evaluate *ex situ* propagation and to develop a reintroduction protocol for the species.

2. Five-Factor Analysis

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act. A summary of this assessment is detailed below. The threats to *C. glandulosa* var. *mirabilis* described in the 2015 5-year status review continue to impact the species (Service 2015). However, during this review we identified disease and predation (Factor C) as a new threat to the species.

a. Present or threatened destruction, modification or curtailment of its habitat or range (Factor A)

The limited distribution of *C. glandulosa var. mirabilis* and the specific habitat of siliceous sands where the species occurs makes it vulnerable to habitat destruction

and modification. Although the TLNR is a natural reserve managed for conservation by PRDNER, the species' main localities are near or adjacent to public road and trails. Location 1 is near State Road PR-687 (Figure 1), an area that is periodically affected by human induced fires. Furthermore, some individuals at Location 2 are found very closed to a trail border. This trail is frequently used by TLNR visitors, which can cause physical damage to the species through trampling with ATVs, bicycles and horses, which have been documented in the trails of this reserve (López-Colón 2017, López-Colón 2022b, pers. comm.). Currently, the UPR-RP is working in an outreach project in the communities adjacent to the TLNR to educate the public on the importance of the protection of *C. glandulosa* var. *mirabilis*.

Habitat modification and destruction have had direct impacts on *C. glandulosa* var. *mirabilis* individuals and have contributed to the reduction of its suitable habitat even within the TLNR. Therefore, we consider that Factor A continues to be threat to the species.

b. Overutilization for commercial, recreational (Factor B)

We have no information indicating that overutilization for commercial, recreational, scientific, or educational purposes is occurring. Thus, we continue to consider this factor is not a threat to *C. glandulosa* var. *mirabilis*.

c. Disease and predation (Factor C)

In the 2015 5-year status review, this factor was not identified as a threat to the *C. glandulosa* var. *mirabilis*. The information below is considered new in this threat analysis.

From 2016 to 2017, López-Colón (2017) observed that seed predation activity by a larva of a micro-lepidopteran (unidentified) was about 35% in Location 1, whereas it was not detected in Location 2. López-Colón (2017) believed that predation may occur only in Location 1 because the species in this area is more exposed to insects due to the open canopy caused by frequent habitat disturbance (e.g., fires), and the presence of exotics grasses, contrary to Location 2, which has a secondary forested structure mostly dominated by native vegetation. Nonetheless, in December 2021, López-Colón (2022b, pers. comm.) conducted a rapid assessment of the population and did not observe any larval seed predation activity in neither of the locations. Currently, we don't know the implications of these observations and whether this represents a normal periodic predation event, but given the limited distribution and number of plants any significant impact on reproduction could have lasting effects to the species' viability.

Recently, López-Colón and Santiago-Rosario (2022, unpublished data) observed herbivory activity directly on the reproductive structures (flowers and buds) of *C. glandulosa* var. *mirabilis* by a butterfly (*Phoebis sennae*) that in its larval stage uses plants of the genus *Chamaecrista* as hosts (Hall et al. 2019). This may represent a new threat and risk to *C. glandulosa var. mirabilis* because herbivory

activity in flowers may cause less attractiveness to pollinators, reducing the frequency of pollinator visits, low fruit production, hence, a negative impact on the reproductive success of the species (Ferreira and Torezan-Silingardi 2013).

Based on the above, we consider disease and predation as current threats to *C. glandulosa* var. *mirabilis*, which can be exacerbated by its small number of populations and individuals. Further studies are needed to determine the spatial extent, frequency of predation and herbivory, and long-term effects on reproduction and the survival of the species.

d. Inadequacy of existing regulatory mechanisms (Factor D)

As discussed in the 2015 5-year status review (Service 2015), *C. glandulosa* var. *mirabilis* is legally protected under Commonwealth's Law No. 241 in 1999, known as Nueva Ley de Vida Silvestre de Puerto Rico (New Wildlife Law of Puerto Rico). This law has provisions to protect habitat for all wildlife species, including plants. In addition, this species is protected by PRDNER's Regulation 6766, which prohibits under Article 2.06 collecting, cutting, and removing, among other activities, listed plant individuals within the jurisdiction of Puerto Rico.

Based on the existence of Commonwealth and Federal laws and regulations protecting listed species, we believe the inadequacy of existing regulatory mechanisms is not a threat to the species. However, as previously mentioned, most of the *C. glandulosa* var. *mirabilis* individuals are found near human access locations (e.g., State Road PR-687 and trails) where impacts directly on plants and their habitat have occurred from human-induced fires, and recreational activities within TLNR. Lack of enforcement of these regulatory mechanisms within the reserve could affect the population of *C. glandulosa* var. *mirabilis*. Thus, enforcement of laws and regulations on TLNR and private lands continues to be a challenge, as accidental damage or extirpation of individuals may occur due to lack of knowledge of endangered species in the area.

e. Other natural or manmade factors affecting its continued existence (Factor E)

The natural stressors to the species continue to be the same as described in the 2015 5-year review for *C. glandulosa* var. *mirabilis* (Service 2015), including climate change, invasive species, and human-induced fires, which are briefly described with updated information below.

<u>*Climate change impacts.*</u> *Chamaecrista glandulosa* var. *mirabilis* is limited to coastal habitats adjacent to wetland areas and climate change is predicted to lead to a gradual rise in sea level. Sea level rise may eventually make most coast wetlands inhospitable for any plant species and is expected to alter the coastal habitats (e.g., salinization or reduction in land cover of freshwater coastal wetlands) and can exacerbate the effects of other threats on the species (Intergovernmental Panel Climate Change (IPCC) 2022). In TLNR, about 70

percent of the *C. glandulosa* var. *mirabilis* individuals are found in approximately 70 feet (20 meter) from the lagoons' edge. Furthermore, temperatures are expected to rise during the 21st century, as well as the intensity, frequency, and duration of climatic events, such as rainfall and drought (González et al., 2021). Also, the Intergovernmental Panel Climate Change (2021) estimates that during this century, temperature rises worldwide will result in mismatches between the emergence time of pollinators and the blooming period of plants, as well as in the distribution of plants and pollinators (Feehan et al., 2009, González et al., 2021). This consequence could disrupt beneficial, mutualistic relationships between plants and insects (e.g., pollination) such as the case of *C. glandulosa* var. *mirabilis* (González et al., 2021). In addition, climate change is expected to result in extended periods of drought, changes in mean temperature and rainfall which may result in changes in vegetation composition and structure that may allow invasive species to establish (Deb et al. 2018). Thus, microclimate conditions and vegetation composition surrounding C. glandulosa var. mirabilis populations can also change.

Invasive Plant Species. The presence of invasive species such grasses like *Megathyrsus maximus* or vines like *Cassytha filiformis* (parasitic plant) may spread and colonize *C. glandulosa var. mirabilis* habitat. Invasive species could spread and alter the microclimate and nutrient cycling of the habitat that this species depends on (Nelson 2008, López-Colón 2017). The invasive species *C. filiformis* has been observed to heavily suppress *C. glandulosa* var. *mirabilis* at TLNR (López-Colón 2022 a, pers. comm.). This parasitic plant has structures known as haustoria (sucker) that perforate the stems of their hosts through the vascular system acquiring nutrients (e.g., water, sugars) (Nelson 2008, López-Colón 2022 a, pers. comm.). In Hawaii, this aggressive parasitic species has been reported as a risk for coastal endemic plant species due to its intense competition for resources and creating a hostile environment for endemic species (Nelson 2008). Establishment of these invasive species at locations hosting *C. glandulosa* var. *mirabilis* can put the entire population at risk of decline and depending on density of the invasive plants could eventually result in local extirpation.

Human-induced fires. Fire is not a natural event in subtropical dry or moist forests in Puerto Rico. The vegetation in the Caribbean is not adapted to fires, because this disturbance does not naturally occur on these islands (Brandeis and Woodall 2008, Santiago-García et al. 2008). Native plants and endemic species with limited distribution are particularly susceptible to human-induced fires. Restoring native plant communities is challenging where invasive plants have altered fire regimes and ecosystem properties (Brooks et al. 2004). In 2019, a fire at Location 1 within TLNR burned about 80 individuals of *C. glandulosa* var. *mirabilis* (López-Colón 2021, pers. comm.). This location is near State Road PR-687, making it more accessible to people that can ignite fires intentionally or accidentally. Because this area has the largest concentration of *C. glandulosa* var. *mirabilis* individuals, human-induced fires can have a profound effect on the species.

Although the number of *C. glandulosa* var. *mirabilis* individuals has increased, the species still occurs in limited areas susceptible to human-induced fires, and in areas that receive impacts from human trampling and vehicles like ATVs and bicycles. Furthermore, exotic grasses and parasitic plants are affecting the species by suppressing native vegetation and changing the habitat conditions. Impacts from climate change could also alter habitat conditions for the species. Thus, we consider Factor E is still a threat to *C. glandulosa* var. *mirabilis*.

D. Synthesis

Chamaecrista glandulosa var. *mirabilis* is a small shrub native to the white silica sands in the northern coastal regions of Puerto Rico. It is known to occur in Tortuguero Lagoon Natural Reserve and there is one historical population on private lands in the municipality of Dorado which is likely extirpated. According to available information, this historical location has been suppressed by urban development for the past two decades. The two locations at TLNR are currently estimated at approximately 600 individuals which is an increase compared to the 200 individuals reported in 2015.

Based on a review of the best available information, *C. glandulosa* var. *mirabilis* is still threatened by the presence of destruction, modification, or curtailment of its habitat or range (Factor A). Also, recent field observations indicate that predation of seeds by a micro-lepidopteran, and predation of flowers by a butterfly in its larval stage, are a new threat to this species (Factor C), but the extent this threat on the survival and long-term persistence of *C. glandulosa* var. *mirabilis* is unknown at this time. Although the two main locations occur on protected lands, existing regulatory mechanisms (Factor D) are inadequate to protect it from human-induced fires and trampling from human activities in its habitat. Although a higher number of *C. glandulosa* var. *mirabilis* individuals have been documented since the 2015-5 years status review, *C. glandulosa* var. *mirabilis* is stills isolated in two locations and continues threatened by physical damage caused by human trampling, ATVs, horses, human-induced fires, competition from the exotic grass (e.g., Guinea grass) and the parasitic plant *C. filiformis*, as well as climate change effects can affect the species into the future (Factor E). Thus, the Service considers that *C. glandulosa* var. *mirabilis* stills meet the definition of an endangered species.

III. RESULTS

Recommended Classification:

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist** (*Indicate reasons for delisting per 50 CFR 424.11):*
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
_X___ **No change is needed**

IV. RECOMMENDATIONS FOR FUTURE ACTIVITIES

Recommendations included in the 2015 5-years status review still apply. In addition, an

assessment of the effects of seeds and flowers depredation would help inform the extent of impacts to the species viability.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Chamaecrista glandulosa* var. *mirabilis* (no common name)

Current Classification: Endangered.

Recommendation resulting from the 5-Year Review:

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*
__X_ No change needed

Review Conducted By: José G. Martínez, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico.

VI. APPROVALS

FIELD OFFICE APPROVAL FY 2022*

Field Supervisor, Caribbean Ecological Services Field Office, U.S. Fish and Wildlife Service

Approve EDWIN MUNIZ Digitally signed by EDWIN MUNIZ Date: 2022.08.17 16:23:13 -04'00'

*In 2014, Southeast Region Field Supervisors have been delegated authority to approve 5-year reviews that do not recommend a status change.