Lewton's polygala
(*Polygala lewtonii*)

5-Year Review:
Summary and Evaluation

Photo: David Bender, U.S. Fish and Wildlife Service

Photo: Carl Weekley, Archbold Biological Station

September 2021

U.S. Fish and Wildlife Service
South Atlantic-Gulf Region
Florida Ecological Services Field Office
Vero Beach, Florida

5-YEAR REVIEW
Lewton's polygala (*Polygala lewtonii*)

I. GENERAL INFORMATION

A. Methodology used to complete the review: In conducting this 5-year review, we relied on the best available information pertaining to historical and contemporary distributions, life histories, genetics, habitats, and threats of this species. This review includes information from the previous 5-year review (U.S. Fish and Wildlife Service [Service] 2010) that is still applicable to the species, with updated or new information incorporated, as appropriate. We announced initiation of this review and requested information in a published *Federal Register* notice with a 60-day comment period in 2019 (84 FR 28850). We received no public comments during the open comment period. We used a variety of information resources, including monitoring reports, surveys, and other scientific and management information, augmented by conversations and comments from biologists familiar with the species. Specific sources included the final rule (58 FR 25746; Service 1993) listing Lewton's polygala under the Endangered Species Act of 1973, as amended (ESA), the Recovery Plan (Service 1999), the last 5-year review (Service 2010), the recovery plan amendment (Service 2019), peer reviewed scientific publications, and unpublished field observations by Federal, State, and other experienced biologists. This review was contracted to an Archbold Biological Station plant ecologist and finalized by the lead recovery biologist for Lewton's polygala in the Florida Ecological Services Field Office (FESFO), Vero Beach. Literature and documents used for this review are on file at the FESFO. All recommendations resulting from this review are a result of thoroughly reviewing the best available scientific information on Lewton's polygala. The Service did not seek additional peer review for this updated 5-year review.

B. Reviewers

Lead Region: South Atlantic-Gulf Region, Carrie Straight, (404) 679-7226

Lead Field Office: FESFO, Vero Beach, Heather Hitt, Heather_Hitt@fws.gov, (772) 469-4267

Cooperating Field Office(s): FESFO, Jacksonville, Todd Mecklenborg, (904) 731-3336

C. Background

1. **Federal Register Notice citation announcing initiation of this review:** June 20, 2019, 84 FR 28850

2. **Listing history**
   Original Listing
   Federal Register Notice: 58 FR 25746
   Federal Register Notice date: April 27, 1993
   Effective listing date: May 27, 1993

Entity listed: Species
Classification: Endangered

3. **Associated rulemakings:** There are no associated rulemakings for this species.

4. **Review History:** Each year, the Service reviews and updates listed species information to benefit the required Recovery Report to Congress. Through 2013, we performed a yearly recovery data call. The last review conducted in 2010 showed this species' status as uncertain with no change recommended to the species' status due to the potential loss of unprotected populations and an ongoing high level of threats.

   Recovery Plan: 1999
   Recovery Plan Amendment: 2019
   Previous Five-Year Reviews: 2010. This review recommended no change in status for the species.

5. **Species' Recovery Priority Number at start of review: 8**
   Degree of Threat: Moderate
   Recovery Potential: High
   Taxonomy: Species

6. **Recovery Plan or Outline**
   Name of plan: South Florida Multi-Species Recovery Plan (MSRP) (Service 1999)
   Date issued: May 18, 1999
   Date of recovery plan amendment: September 24, 2019 (Service 1999)
   Date of previous plan: June 20, 1996 (Recovery Plan for Nineteen Florida Scrub and High Pineland Plant Species) (Service 1996)

II. REVIEW ANALYSIS

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

1. **Is the species under review listed as a DPS?** No. The ESA 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 DPS 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?** Yes

2. **Adequacy of recovery criteria.**

a. **Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?** Yes

b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?** Yes

3. **List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.** The recovery criteria as presented in the 2019 amendment to the 1999 recovery plan are broken down into three criteria ([1-3] in bold below). These criteria address listing factors A) the present or threatened destruction, modification, or curtailment of its habitat or range; D) inadequacy of existing regulatory mechanisms; and E) other natural or manmade factors affecting its survival. Factors B (overutilization) and C (disease and predation) are not relevant to this species.

   Lewton's polygala 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.
   This criterion has not been met. There are an estimated 32 extant populations of Lewton's polygala and 19 known or possibly extirpated populations (Table 1; Florida Natural Areas Inventory [FNAI] 2009, 2021; Service 2010; Rosner-Katz 2020; Menges et al. 2021; Noland 2021). Limited long-term demographic data on population sizes, structure, and recruitment exist, so trends cannot be determined for most populations. Only 6 populations are monitored with level 2 (size/condition) or level 3 (demographic) monitoring (*sensu* Menges and Gordon 1996), and these populations fluctuate in response to fire; only 1 is stable to increasing, 4 are stable, and 1 is declining (Table 1; Rosner-Katz 2020; Menges et al. 2021; Noland 2021). For other populations, only intermittent population estimates are available from FNAI, and it is not certain if the entire population was surveyed. Based on the FNAI 2009 and 2021 Element Occurrence reports for Lewton's polygala, 2 other populations may be stable, and 1 additional one may be declining. The remaining 23 extant populations have an unknown status due to lack of recent survey data, and 19 are known or possibly extirpated based on the most recent plant counts of zero and/or no remaining habitat in the area (Table 1).

Table 1. Summary of the extant and extirpated Lewton's polygala populations. Abundance data are difficult to compare to previous years due to incomplete/opportunistic surveys and gaps in survey years, therefore only the most recent population estimate is included in this table and the status reflects the best estimates based on intermittent survey data and information from land managers and researchers familiar with the populations. Population estimates and status are derived from Florida Natural Areas Inventory (FNAI) 2021 data unless otherwise indicated. EO = Element Occurrence, FNAI Rank = Estimated viability ranked by FNAI (only listed for populations ranked within the last 5 years), LWRSF = Lake Wales Ridge State Forest, LWRWEA = Lake Wales Ridge Wildlife and Environmental Area, LWRNWR = Lake Wales Ridge National Wildlife Refuge

EO Number	Managed Area	Ownership	County	Last Observation	Most Recent Population Estimate	Status (FNAI Rank)	Notes
71	Ocala National Forest	Federal	Marion	2016	10	Declining	Status based on >700 in 2012
1	Ocala National Forest	Federal	Marion	2017	>1,000	Stable (A)	Status based on 1,690-1,802 in 2006[a]
65	Ocala National Forest	Federal	Marion	2012	Present	Unknown	
77	Ocala National Forest	Federal	Marion	2012	5	Unknown	
72	Ocala National Forest	Federal	Marion	2016	Present	Unknown (AB)	
73	Ocala National Forest	Federal	Marion	2014	1	Unknown (C)	
4	None	Private	Lake	1969	Present	Possibly Extirpated (H)	2011 aerial photography shows habitat still available if restored
54	None	Private	Lake	1994	48	Possibly Extirpated	2017 aerial photography shows limited remaining habitat
28	None (Sugarloaf Mountain Florida Forever Project)	Private	Lake	1998	0	Possibly Extirpated	2017 aerial photography shows habitat remains intact
3	None	Private	Lake	2009	0	Possibly Extirpated (C)	2017 aerial photography shows limited habitat available
6	None	Private	Lake	1994	1	Possibly Extirpated (CD)	2017 aerial photography shows limited remaining habitat
2	None	Private	Lake	2009	11	Unknown	
7	None	Private	Lake	2009	>100	Unknown	
35	None	Private	Lake	2009	0	Possibly Extirpated (D)	2017 aerial photography shows habitat still available if restored
27	None	Private	Lake	1994	Present, Rare	Unknown	2017 aerial photography shows habitat remains intact
32	Scrub Point Preserve	County	Lake	2013	>100	Unknown (AC)	

EO Number	Managed Area	Ownership	County	Last Observation	Most Recent Population Estimate	Status (FNAI Rank)	Notes
30	None	Private	Lake	2009	0	Known Extirpated (X)	2017 aerial photography shows no remaining suitable habitat
37	Seminole State Forest	State	Lake	2012	Present, Abundant	Unknown	
29	Schofield Tract	County	Lake	2012	<20	Unknown	
26	None	Private	Orange	1991	40	Known Extirpated (X)	2017 aerial photography shows no remaining suitable habitat
9	None	Private	Orange	1982	Present	Known Extirpated (X)	1999 and 2017 aerial photography shows no remaining suitable habitat
12	None (Lake Davenport Florida Forever Project)	Private	Osceola	1997	>35[b]	Unknown (BC)	2017 aerial photography shows limited remaining habitat
8	None	Private	Polk	1981	Present	Known Extirpated (X)	2017 aerial photography shows no remaining suitable habitat
13	None	Private	Polk	1983	<10[b]	Unknown (D)	2017 aerial photography shows limited remaining habitat
21	Upper Lakes Basin Watershed	State	Polk	2012	>500	Unknown	
69	Serenoa Preserve	Private Conservation	Polk	2012	0	Possibly Extirpated	
70	Allen David Broussard Catfish Creek Preserve State Park	State	Polk	2012	17	Unknown	
67	Allen David Broussard Catfish Creek Preserve State Park	State	Polk	2012	>12	Unknown	
76	Bok Tower Gardens Pine Ridge Preserve	Private Conservation	Polk	2021	1,935[c]	Stable (AB)	Population usually around 200 plants, 2021 census reported 100 adults and 1,835 seedlings 1-year post-fire[c]
25	Crooked Lake Sandhill	County	Polk	2014	4	Unknown	
38	LWRSF Babson	State	Polk	2020	>555[d]	Stable to Increasing (AB)	Plant numbers reported from 11 level 2 monitoring plots in units Bab2, Bab3, and Bab6 only[d]

EO Number	Managed Area	Ownership	County	Last Observation	Most Recent Population Estimate	Status (FNAI Rank)	Notes
5	LWRSF Walk-in-Water, Tiger Creek Preserve	State, Private Conservation	Polk	2020	>24[d]	Stable (AB)	Plant numbers reported from 5 level 2 monitoring plots in units NH8 and NSH4 only[d]
19	Tiger Creek Preserve	Private Conservation	Polk	2012	0	Possibly Extirpated	
61	Tiger Creek Preserve	Private Conservation	Polk	2006	>1	Unknown	
11	Tiger Creek Preserve	Private Conservation	Polk	2008	300[b]	Unknown (C)	
80	LWRSF Walk-in-Water	State	Polk	2013	3	Unknown	
81	LWRSF Walk-in-Water	State	Polk	2011	7-8	Unknown	
79	LWRSF Walk-in-Water	State	Polk	2011	2	Unknown	
15	LWRSF Walk-in-Water, FX Bar Ranch Easements	State, Private Conservation	Polk	2020	>1[e]	Declining (B)	Plant numbers reported from 2 level 3 monitoring plots in unit E5 (Deerslayer Hill and Indigo Ridge) only[d]
78	LWRSF Walk-in-Water	State	Polk	2020	>128[d,e]	Stable (B)	Plant numbers reported from 1 level 3 monitoring plot in unit E6 (Polygala Hill) and 2 level 2 monitoring plots in unit SC1S only[d]
59	LWRSF Arbuckle	State	Polk	2012	0	Possibly Extirpated (B)	
60	LWRSF Arbuckle	State	Polk	2020	>361[d,e]	Stable (AB)	Plant numbers reported from 2 level 3 monitoring plots in unit RC06 (RC06 road and RC06 trail) and 6 level 2 monitoring plots in units RC03, RC05, and RC06 only[d]
55	LWRSF Arbuckle	State	Polk	2012	0	Possibly Extirpated (BC)	
82	LWRSF Arbuckle	State	Polk	2006	22	Unknown	
57	LWRSF Arbuckle	State	Polk	2012	0	Possibly Extirpated	
56	LWRSF Arbuckle	State	Polk	2012	0	Possibly Extirpated	

EO Number	Managed Area	Ownership	County	Last Observation	Most Recent Population Estimate	Status (FNAI Rank)	Notes
83	None	Private	Polk	2006	1	Possibly Extirpated	2017 aerial photography shows no suitable habitat[f]
39	Carter Creek (LWRWEA-North and LWRNWR-South)	State, Federal	Highlands	2021	>750[e]	Stable	Plant numbers from 220 monitoring plots in LWRNWR only[e]
24	None	Private	Highlands	2007	0	Known Extirpated (X)	2017 aerial photography shows no remaining suitable habitat
14	Highlands Hammock State Park, Sandy Gully Conservation Easement	State, Private Conservation	Hardee, Highlands	2012	0	Error	Occurrence likely reported in error as EOR consists of wetland habitat and plants have not been found[b]
N/A	LWRWEA Holmes Ave*	State	Highlands	2015-2018	Present[g]	Unknown	New occurrence documented between 2015 and 2018[g]
23	None	Private	Highlands	1988	Present	Possibly Extirpated (H)	2017 aerial photography shows limited remaining habitat

[a] FNAI 2009, [b] Service 2010, [c] Noland 2021, [d] Rosner-Katz 2020, [e] Menges et al. 2021, [f] Service biologist observation, [g] Menges et al. 2019
N/A indicates occurrence was not in FNAI EO data
* indicates new population recorded since previous status review (Service 2010)
FNAI ranks, following NatureServe 2002 criteria:
AB = excellent to good estimated viability
B = good estimated viability
BC = good or fair estimated viability
C = fair estimated viability
CD = fair or poor estimated viability
D = poor estimated viability
X = extirpated
H = historical

[2] Populations (as defined in criterion 1) in yellow sand scrub or sandhill habitats are distributed across the known range of the species.
This criterion has been partially met. The 32 extant populations are distributed widely throughout the species' range on the Lake Wales and Mount Dora Ridges (Marion, Lake, Orange, Osceola, Polk, and Highlands counties) in scrub and sandhill habitat. However, most populations occur in Polk County, on the Lake Wales Ridge State Forest (LWRSF), and many acres of suitable habitat exist between populations which are either unoccupied by the species or haven't been surveyed to confirm presence.

[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.
This criterion has been partially met. Approximately 26 of the known 32 extant populations occur on public or private conservation lands (Tables 1 and 2). However, Lewton's polygala needs frequent fire (every 4-8 years) to maintain populations (Menges et al. 2006, 2019), and fire management on some conservation managed areas may not be aggressive enough to assure the species' persistence. The remaining 6 extant populations are not protected or managed and suffer from habitat loss, fragmentation, and degradation due to development, conversion to agriculture, overgrowth of invasive and native plants, and lack of prescribed fire (Service 2010; FNAI 2021).

Table 2. Summary of protection status of extant and extirpated Lewton's polygala populations by county.

County	Extant		Known or Possibly Extirpated		Total
	Protected	Unprotected	Protected	Unprotected	
Marion	6	0	0	0	6
Lake	2	4	0	7	13
Orange	0	0	0	2	2
Osceola	0	1	0	0	1
Polk	16	1	6	2	25
Highlands	2	0	0	2	4
Total	**26**	**6**	**6**	**13**	**51**

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Summary of new information on the species' biology and life history:
General information on the biology and life history of Lewton's polygala, a relatively short-lived (5-10 years) perennial herb of the milkwort family (Polygalaceae), is summarized in the final listing rule (58 FR 25746; Service 1993), the MSRP (Service 1999), the previous status review (Service 2010), and the recovery plan amendment (Service 2019). New information pertinent to this review is presented below.

Lewton's polygala is one of the few species exhibiting amphicarpy (mixed reproduction strategy) via three types of flowers: aboveground open-pollinated (chasmogamous) flowers, aboveground self-pollinated closed (aboveground cleistogamous) flowers, and belowground self-pollinated closed (belowground cleistogamous) flowers. This complex mating system results in flowering and fruiting at various times during the year and over the plant's lifetime. Floral morphs are seasonally separated and chasmogamous flowering also occurs earlier in a plant's life and is more abundant compared to aboveground cleistogamous flowering (Koontz et al. 2017). However, fine scale genetic patterns suggest most seedling recruits are the result of selfing (cleistogamy; Swift et al. 2016), even though reproductive effort is dominated by cross-pollination (chasmogamy; Koontz et al. 2017). This does not follow the typical pattern seen in other amphicarpic plants and raises questions about why so much effort is put into chasmogamy if cleistogamy results in higher fitness and survival and what factors limit successful chasmogamous reproduction (Koontz et al. 2017).

Swift et al. (2016) also noted that dispersal distances of both seed types are not very far, with belowground seeds found only as far as the belowground flower is spaced from the parent plant along the rhizome (probably only 1 to 2 meters [3 to 6 feet]). Aboveground seeds are primarily dispersed by ants only 3 to 4 meters (10 to 13 feet), and pollination seems to only be within 15 to 550 meters (50 feet to 0.3 miles) (Swift et al. 2016). A study by Weekley and Brothers (2006) showed low pollinator visitation rates to the chasmogamous flowers despite the large number available, which could be contributing to the low outcrossing rates. Swift et al. (2016) hypothesized that low pollinator visitation could be due to a range shift, declines, or extinction of one or more of the primary pollinators: bee-flies (Bombyliidae), flower flies (Syrphidae), and leaf-cutter bees (Megachilidae) (Menges et al. 2006). Both the higher degree of cleistogamy and the low dispersal distances are contributing to genetic inbreeding (see section II.C.1.c. below).

In a long-term (6-year) recruitment study Lewton's polygala seedling recruitment occurred year-round, but most recruitment occurred in the winter and spring months, especially in years with higher winter rainfall (Weekley and Menges 2012). Additionally, most seedling recruitment occurred within a few months after a prescribed fire in August, presumably from a long-lived, persistent soil seed bank (Weekley and Menges 2012). Benefits from the prescribed fire included higher seedling recruitment, higher survival to reproduction, and earlier flowering indicating that plants recruiting into burned areas make a greater contribution to the seed bank, and thus to the long-term viability of the population, than do recruits in unburned areas (Weekley and Menges 2012). Seed dormancy and germination experiments also showed that dormancy in Lewton's polygala seeds is reduced following warm stratification of summer months, and germination is triggered by cooler winter months and increases with smoke exposure (Koontz et al. in preparation).

b. Abundance, population trends, demography:

Lewton's polygala is currently estimated to occur in 32 extant populations on the Lake Wales and Mount Dora Ridges of central Florida (FNAI 2021). Nineteen (19) populations are known or likely extirpated (Table 1). At the time of the previous status review there was an estimated 49 extant and 6 extirpated populations (Service 2010). This decrease can mostly be attributed to FNAI's Element Occurrence Records (EOR) being combined due to updated definitions of EORs that use NatureServe's (2020) 1.0-kilometer (0.62-mile distance) to differentiate EORs (also considered populations for this review) or new individuals found between populations that connect previously separated populations into larger populations (Rosner-Katz 2020). Some populations may also have been extirpated since the last review, though it is difficult to determine when extirpations have occurred due to limited survey data and the species' persistent soil seed bank (Weekley and Menges 2012). Only populations with the last observation reporting no plants and/or no available habitat remaining according to FNAI's analysis of aerial photography were considered known extirpated (Table 1). If the last observation reported no plants but there was some available habitat left, or if the last observation reported presence over 10 years ago and there was limited remaining habitat, the population was considered possibly extirpated (Table 1).

Limited detailed information is available regarding Lewton's polygala abundance, population trends, and demography because there is not an established monitoring program at most populations. Abundance data are difficult to compare to previous years due to incomplete/opportunistic surveys, gaps in survey years (especially at populations occurring on private lands), and variances in how boundaries were drawn between populations by different surveyors.

The following is a summary of the best available information regarding the abundance and status of Lewton's polygala populations across its range. Of the 32 extant populations, 1 is stable to increasing, 6 are estimated to be stable, 2 are estimated to be declining, and 23 have an unknown status due to lack of recent surveys (Table 1). Population sizes for Lewton's polygala are generally small (usually under 50 plants), with only ten reported as having over 100 plants (Table 1). The largest populations occur at Ocala National Forest (ONF), Lake Wales Ridge National Wildlife Refuge (LWRNWR), LWRSF, Bok Tower Gardens Pine Ridge Preserve, Scrub Point Preserve, Tiger Creek Preserve, and Upper Lakes Basin Watershed. One new occurrence was found between 2015 and 2018 in the Lake Wales Ridge Wildlife and Environmental Area Holmes Avenue area (Menges et al. 2019), but it was not included in the FNAI 2021 data and its status is unknown (Table 1).

Detailed level 3 (demographic) monitoring of Lewton's polygala has taken place for the LWRNWR Carter Creek population (EO39) since 1996 and a LWRSF Arbuckle population (EO60) and two Walk-in-Water populations (EO15 and EO78) since 2001. Past monitoring has occurred at several other populations on

managed lands, but monitoring did not continue and/or data were inadequate to infer trends (Service 2010). At LWRNWR Carter Creek decades of monitoring showed that quadrat occupancy and abundance were both positively affected by previous and initial occupancy, but negatively associated with time-since-fire (Menges et al. 2021). Abundance was also positively affected by the number of fires. Population size has increased rapidly following prescribed fires in March 2019 and January 2020 and has remained high (>500 plants) for the last two years (Menges et al. 2021). Both annual survival (44 percent on average) and seedling recruitment (273 average annual recruits) have remained relatively stable over the years, which can also be attributed to frequent fires (Menges et al. 2021). These results continue to show that frequent fires promote population persistence.

Level 1 (distribution), 2 (size/condition), and 3 (demographic) monitoring of Lewton's polygala at the LWRSF has been ongoing for several years (Rosner-Katz 2020). The number of plants within the level 3 Arbuckle (EO60) and Walk-in-Water (EO78) monitoring plots have been stable while the Walk-in-Water (EO15) plant numbers have been declining (Rosner-Katz 2020). Annual survival is relatively high at the LWRSF, with an average of 57 percent between 2018 and 2021 (Menges et al. 2021). Level 2 monitoring at Babson, Walk-in-Water, and Arbuckle populations since 2014 shows increasing plant numbers at Babson (EO38), stable plant numbers at Arbuckle (EO60) and Walk-in-Water (EO78), and decreasing plant numbers at Walk-in-Water (EO15) plots (Rosner-Katz 2020). In 2020, 61 individuals were added to the LWRSF dataset, which now estimates approximately 2,348 individuals throughout the forest (Rosner-Katz 2020). The LWRSF has an active burn program, though some areas have not been burned in over 10 years, and the assessment of the former LWRSF biologist is that Lewton's polygala is not completely secure at the forest because it occurs in moderate to high numbers only in a few locations (Rosner-Katz 2021).

The other two populations considered stable are one of the ONF populations and the Bok Tower Gardens Pine Ridge Preserve (Table 1). The largest population of Lewton's polygala occurs at on the ONF with over 1,000 individuals spread out over approximately 200 acres (Table 1). Some other smaller populations occur on the ONF, but one seems to be declining and the others have not been surveyed recently (Table 1). The Bok Tower Gardens Pine Ridge Preserve population was discovered in 1995 and has been monitored by Bok Tower Gardens staff annually since discovery. This population has remained stable, hovering around 200 plants (including seedlings) due to frequent fires applied approximately every 4 years (Noland 2021). The most recent prescribed fire was conducted in March of 2020, and the following census in February of 2021 reported 1,935 plants, 1,835 of which were seedlings (Noland 2021).

Several other populations of Lewton's polygala occur on public or private conservation lands throughout the range, though the status of these populations is unknown or possibly extirpated since no survey data have been reported in the last 5 years (FNAI 2021). The populations on unmanaged private lands (19) have

also not been recently surveyed and the majority are either known or possibly extirpated (13) based on aerial photography that show little to no suitable habitat remains (Tables 1 and 2).

c. Genetics:

A study of genetic diversity in Lewton's polygala showed spatial clustering that was the result of inbreeding, probably mainly due to recruitment from belowground flowers or to ant dispersal from aboveground cleistogamous flowers (Swift et al. 2016). The authors concluded that because genetic variation was structured at a fine spatial scale, protecting many populations would be necessary to fully conserve the genetic variation. More recently, a study of genetic variation before and after a fire showed inbreeding and genetic structure increased and spatial mixing decreased, suggesting that the belowground selfed seeds (with limited dispersal ability) increased their contribution to the population after fire and that fire potentially reduces the viability of aboveground outcrossed seeds (Meyer at al. in revision). However, new alleles emerged after fire, demonstrating that the soil seed bank can act as a reservoir of genetic variation and suggesting that amphicarpy is a powerful adaptation to preserve genetic variation and maintain adaptive potential (Meyer et al. in revision).

d. Taxonomic classification or changes in nomenclature:

None. The Integrated Taxonomic Information System (2021) and Atlas of Florida Vascular Plants (Wunderlin et al. 2021) were checked while conducting this review, and both indicate *Polygala lewtonii* is the accepted name for Lewton's polygala and that it is a distinct taxon.

e. Distribution and trends in spatial distribution:

Lewton's polygala occurs in xeric upland habitats on the Lake Wales and Mount Dora Ridges in Marion, Lake, Orange, Osceola, Polk, and Highlands counties (Figure 1). It occurs almost exclusively on yellow sands in sandhill (high pine) and oak-hickory scrub (Menges et al. 2007), and transition zones between these two communities. About one-third of known Lewton's polygala populations, scattered throughout the species' range, are likely to have been extirpated (Table 1). Despite many acres of suitable habitat, there are few populations known between its two strongholds (Ocala National Forest in Marion County and a few managed areas in Polk County). Lewton's polygala occurs in Highlands County but does not extend to suitable habitats in the southern half of the county along the Lake Wales Ridge.

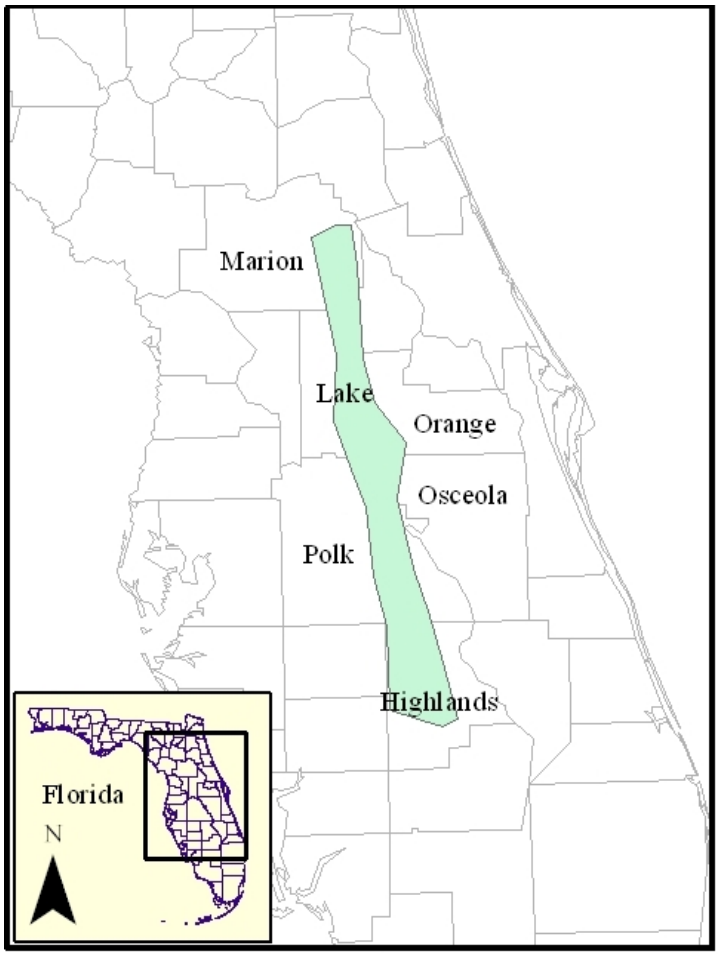

Figure 1: Map of Lewton's polygala range. Map by David Bender, U.S. Fish and Wildlife Service.

f. Habitat or ecosystem conditions:

The distribution of habitat (sandhill and scrub) within the Lewton's polygala range remains fragmented. Sandhill is ranked by FNAI as rare globally and imperiled statewide while scrub is ranked as imperiled globally and statewide (FNAI 2010). Extensive land clearing for human population growth, development, and agriculture has altered, degraded, or destroyed millions of acres of these once abundant ecosystems. By 2006, an estimated 85 percent of upland habitat on the Lake Wales Ridge had been destroyed and about 11 percent had been protected as conservation lands (Weekley et al. 2008). Since listing, the amount of habitat occupied by the Lewton's polygala has decreased by about 50 percent. The few hundred acres of remaining sandhill on the Lake Wales Ridge are generally degraded from a history of logging, fragmentation, and fire-suppression (Peroni and Abrahamson 1986). According to the FNAI 2021 data, Lewton's polygala occupied approximately 1,100 acres around the time of listing (1993), but the total area currently supporting extant populations is approximately 500 acres. The decline in occupied habitat can be attributed to loss from development and agriculture and degradation from lack of management.

Sandhill and scrub habitats require periodic fires to maintain vegetative structure, but increased development makes applying prescribed fire to remaining habitat difficult. As detailed in the previous status review (Service 2010), Lewton's polygala plants are generally killed by fire, with post-fire resprouting being uncommon (Weekley and Menges 2003). However, abundant germination from a persistent seed bank, perhaps stimulated by smoke (Lindon and Menges 2008), allows rapid re-establishment of populations after fire (Weekley and Menges 2012). Benefits from prescribed fire included higher seedling recruitment, higher survival to reproduction, and earlier flowering (Weekley and Menges 2012). Monitoring conducted by Archbold Biological Station at the LWRNWR, showed a huge spike in plant numbers the first 1-3 years after a fire, with numbers declining but remaining above pre-fire levels for 4-5 years (Menges et al. 2021). Menges et al. (2006) recommend that fire frequencies for Lewton's polygala in sandhill be at least every 4 years, due to the rapid decline in population size as time-since-fire increases, and Menges et al. (2019) recommends an overall range of fire return intervals of 4-8 years. Many managed areas (and nearly all privately owned areas) are not managed with fires that are this frequent, resulting in habitat changes (e.g., increased shrub and litter cover) that are likely detrimental for Lewton's polygala. In 2008, The Nature Conservancy reported an estimated 38,359 acres on the Lake Wales Ridge as being out of appropriate fire return interval (The Nature Conservancy 2010), though an updated report was not available for this review.

2. **Five-Factor Analysis (threats, conservation measures, regulatory mechanisms):** 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:**
   Continued habitat loss, fragmentation, and changes in land use threaten the existence of Lewton's polygala. In some instances, where the species or suitable habitat occurred on private or unprotected sites, development has led to both direct destruction of plants and habitat because of land clearing and indirect extirpation and habitat degradation from lack of management. For example, an estimated 23 populations have been extirpated, with the primary cause being habitat alteration, destruction, and degradation on private lands (Tables 1 and 2). Threats from development and habitat degradation on private sites are expected to continue and increase. Within the counties with extant populations (Marion, Lake,

Osceola, Polk, and Highlands), the human population is predicted to grow an average of 52 percent from 2010 levels by 2070 (Carr and Zwick 2016). If trends continue, an estimated 48 percent of land in central Florida will be developed by 2070, up from 25 percent in 2010, while the amount conservation lands will increase less than 1 percent (from 17.3 to 17.9 percent; Carr and Zwick 2016). Lewton's polygala populations on public and private conservation lands are protected from development, but those that occur on private lands are vulnerable to habitat loss from development. As natural habitats become increasingly fragmented and isolated by development, recovery of small, isolated populations may be more unlikely since larger breaks in suitable habitat exist making natural dispersal and gene flow more difficult.

Even though the populations of Lewton's polygala on public and private conservation lands are not at risk of being developed, the plants on these sites may still be vulnerable to lack of or improper habitat management. One of the primary threats to sandhill and scrub is habitat modification and degradation through inadequate fire management, which includes both the lack of prescribed fire and suppression of natural fires. Although the majority of Lewton's polygala populations occur on public and private conservation lands with active habitat management programs, the ability to apply prescribed fire, especially within the recommended 4 to 8-year return interval (Menges et al. 2019), is limited by surrounding development, weather, and staffing. This species has a persistent seed bank (Weekley and Menges 2012), which may allow it to recover from short periods of fire suppression, although its upper limit for fire return intervals is not fully known. Populations that have been extirpated due to fire suppression for decades may not recover even if fire is reintroduced to these sites.

In managed areas, prescribed fire is the preferred tool to manage sandhill and scrub habitats and restore suitable conditions for endemic plants. However, land managers also use mechanical treatments such as mowing, roller-chopping, and logging to manage scrub habitats when fire is not possible or to prepare long-unburned areas for fire (Menges and Gordon 2010). Mechanical treatments cause soil compaction, soil disturbance, and may increase invasion by non-native plant species, such as Bahia grass (*Paspalum notatum*), cogon grass (*Imperata cylindrica*), and natal grass (*Melinus repens*) that compete for space and alter fire behavior (Lippincott 2000). The specific effects of mechanical treatments on Lewton's polygala are not known. Menges and Gordon (2010) recommend that mechanical treatments be used when it is difficult to burn (e.g., when prescribed fire is precluded because of a site's proximity to the urban interface or in the initial phases of restoring severely overgrown sites to a condition in which fire can be applied safely). Vegetation restoration and management programs are costly, and the availability of funding is never assured; therefore, habitat modification from inadequate management even on protected lands remains an imminent, though moderate, threat.

b. Overutilization for commercial, recreational, scientific, or educational purposes:
This was not identified as a potential threat in the original listing rule (Service 1993), the recovery plan (Service 1999, 2019), or the previous 5-year review (Service 2010) and is not known to be a current threat.

c. Disease or predation:
Disease or predation was not considered a threat to Lewton's polygala at the time of listing. The previous status review (Service 2010) mentioned that the species is affected by vertebrate herbivory and feral hog (*Sus scrofa*) damage, though these are not considered current threats to this species.

d. Inadequacy of existing regulatory mechanisms:
The ESA prohibits the removal of federally listed threatened and endangered plants or the malicious damage of such plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of state law or regulations or in the course of any violation of a state criminal trespass law. The ESA does not provide protection for plants on non-federal lands unless it is in violation of state law.

Lewton's polygala is also listed by the Florida Department of Agriculture and Consumer Services (FDACS) as State-endangered (5B-40.0055 Regulated Plant Index). Listing by the State is not reliant on ESA protections, but the State listing does not provide any direct habitat protection. State regulations require both written permission from the owner or legal representative and a permit issued by FDACS to collect or remove plants listed as endangered on the Florida Regulated Plant Index from any property. Additionally, Title 62D-2.013 of the Florida Administrative Code prohibits the removal, destruction, or damage of plants from Florida Department of Environmental Protection, Division of Recreation and Park properties. This regulation provides protection for the populations that occur on state park lands but does rely on public adherence to the Code since monitoring is limited. County-level protection where Lewton's polygala occurs is limited to surveys for listed plants and coordination with the appropriate agencies for any required permits or consultation.

Existing regulatory mechanisms do not adequately prevent the development of sites, as several properties with Lewton's polygala on private lands have been developed. Rescue efforts can only take place if the Service or another qualified organization is made aware of impending development. Because this species occurs in upland habitat on the Lake Wales and Mount Dora Ridges, which is desirable for development and other uses due to its elevation, it remains vulnerable to development pressures where it occurs on private property. Where the species occurs on public land, there is protection from development but not necessarily from habitat degradation. In conclusion, there are no existing regulatory measures that reduce or remove the threat or loss of populations or removal/destruction of plants on private property, and it has only limited

protections if the species was not protected under the auspices of the ESA; therefore, existing regulatory mechanisms are inadequate to protect this species.

e. Other natural or manmade factors affecting its continued existence: Lewton's polygala continues to be threatened by numerous natural and anthropogenic factors, including intrinsic factors (pollinator-limited dispersal, small, isolated populations, low recruitment, and restricted range), stochastic events (hurricanes, droughts, wildfires), climate change, and human disturbances. The previous status review describes how off-road vehicle (ORV) impacts occur on both public conservation and private lands and can damage or kill plants if driven directly over them, alter fire behavior, and increase exotic plant invasion (Service 2010). Impacts from ORVs were documented at several populations, especially at the ONF (Service 2010), and is still considered a threat to Lewton's polygala.

There is currently no evidence of negative impacts to Lewton's polygala from climate change factors, but this could change in the future as Florida is vulnerable to changes in rainfall and temperatures expected due to climate change. While the strong influence of ocean currents makes projecting regional climate in Florida difficult (Kirtman et al. 2017), estimates project that Florida's average annual temperatures will increase approximately 1.5 to 5.5 degrees Fahrenheit (˚F) (0.8 to 3.1 degrees Celsius [˚C]) by 2050 and from 2.0 to 11.5°F (1.1 to 6.4°C) by 2100 depending on the greenhouse gas emission rates and the region in Florida (Runkle et al. 2017). In addition, it is predicted that Florida will experience drier wet seasons (summer) and wetter dry seasons (winter) (Sun et al. 2015). Higher temperatures and changes in precipitation patterns could alter relative humidity levels and evapotranspiration rates, leading to the potential for more frequent and intense droughts and wildfire events. Changes in precipitation patterns, temperature, and relative humidity can also cause increased difficulty in conducting prescribed fires (Kupfer et al. 2020), which are important for maintaining Lewton's polygala populations. However, the predicted wetter dry seasons (winter) may benefit populations as some have been reported to have the highest recruitment following winters with higher average rainfall (Weekley and Menges 2012).

In addition to changes in precipitation and temperatures patterns, there are also anticipated changes to the severity of tropical storms and hurricanes. Sweet et al. (2017) predicted a 20 percent increase in both rainfall rates and wind speeds near the center of storms due, in part, to higher sea surface temperatures. Lewton's polygala, however, is probably not strongly affected by hurricanes (Menges et al. 2011). It is possible that treefall and limbfall could damage or kill plants, or that a buildup of downed tree debris could cause higher intensity fires, which may negatively impact Lewton's polygala soil seed bank (Koontz et al. in preparation).

Sea-level rise is another anticipated consequence of climate change in Florida. The central Florida ridges will be spared from the direct impacts of sea level rise

that are anticipated for coastal and low elevation areas. However, as sea level rises in coastal regions, development is likely to move inland, further increasing the threat of development in the higher elevation areas, such as the central Florida ridges (Volk et al. 2017).

D. Synthesis

Lewton's polygala is a perennial herb occurring in sandhill and scrub communities on the Lake Wales and Mount Dora Ridges in central Florida. Currently, there are an estimated 32 extant populations, though most are of unknown status due to lack of recent surveys, and 19 known or possibly extirpated populations (Table 1). Of the 32 extant populations, only 1 is stable to increasing, 6 are stable, 2 are declining, and 23 have an unknown status (Table 1). Although demographic and abundance data have been collected at 6 populations for approximately 20 years (Rosner-Katz 2020; Menges et al. 2021; Noland 2021), information on natural recruitment and age distribution is lacking for almost all populations, and trends cannot be determined.

Habitat loss, fragmentation, and changes in land use continue, and conversion of sandhill and scrub habitat to urban use in central Florida is projected to continue over the next 50 years. At least 85 percent of the available upland habitat on the Lake Wales Ridge has already been developed (Weekly et al. 2008) and the amount of habitat occupied by Lewton's polygala has decreased by almost 50 percent since the early 1990s (FNAI 2021). Where habitat remains intact, Lewton's polygala depends upon frequent prescribed fires to persist. Twenty-six (26) of the 32 extant populations occur on protected lands, but not many areas are able to be burned as frequently as recommended, every 4-8 years (Menges et al. 2019). Existing regulatory mechanisms are inadequate to protect the species on private lands. The species' intrinsic factors (pollinator-limited dispersal; small, isolated populations; low recruitment; and restricted range) render it vulnerable to human disturbances, stochastic events, and climate change. Due to the above ongoing threats and mostly unknown population status and trends (due to lack of recent surveys and limited demographic monitoring), this species continues to meet the definition of endangered under the ESA.

III. RESULTS

A. Recommended Classification:

_X_ No change is needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

A detailed discussion of recovery actions and criteria are presented in the Recovery Plan and amendment (Service 1999 and 2019, respectively). During this status review new and/or targeted potential recovery activities were identified and are included below.

Recovery Activities

- Conduct habitat restoration efforts at possibly extirpated sites on managed lands since Lewton's polygala has a persistent soil seed bank and can reappear after fire/restoration.

- Work with State, Federal, and non-profit partners to ensure adequate fire management is achieved at sites that support Lewton's polygala.
- Work with private landowners to acquire or conserve extant populations and restore sandhill and scrub habitat on these sites.
- Strengthen *ex situ* conservation measures, including ensuring representation of Lewton's polygala at the National Center for Genetic Resources Preservation in Fort Collins, Colorado.

Monitoring/Research Activities

- Determine the condition of populations on private land whose status is currently unknown.
- Expand level 3 (demographic) monitoring to more populations, such as ONF, Tiger Creek Preserve, and Bok Tower Gardens Pine Ridge Preserve, (as recommended by Menges et al. 2019) to determine trends and produce a population viability analysis.
- Develop a standard methodology for monitoring Lewton's polygala on conservation lands.
- Initiate large-scale level 1 (distribution) and 2 (population size/condition) monitoring of Lewton's polygala throughout the geographic range, including sites across a spectrum of time-since-fire and management regimes.
- Compare germination rates of aboveground to belowground seeds and investigate the limitations to germination of aboveground seeds.
- Determine the status of pollinator populations.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Lewton's polygala (*Polygala lewtonii*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

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

Review Conducted By: Heather Hitt, Florida Ecological Services Field Office, Vero Beach

FIELD OFFICE APPROVAL:

Division Manager, Classification and Recovery, Florida Ecological Services Field Office, Fish and Wildlife Service

Approve: LOURDES MENA Digitally signed by LOURDES MENA Date: 2021.09.27 14:23:41 -04'00' Date: 9/27/21

* In 2021, the Classification and Recovery Division Manager in the Florida Ecological Services Field Office was delegated authority to approve 5-year reviews that do not recommend a status change.