

**Lewton's polygala  
(*Polygala lewtonii*)**

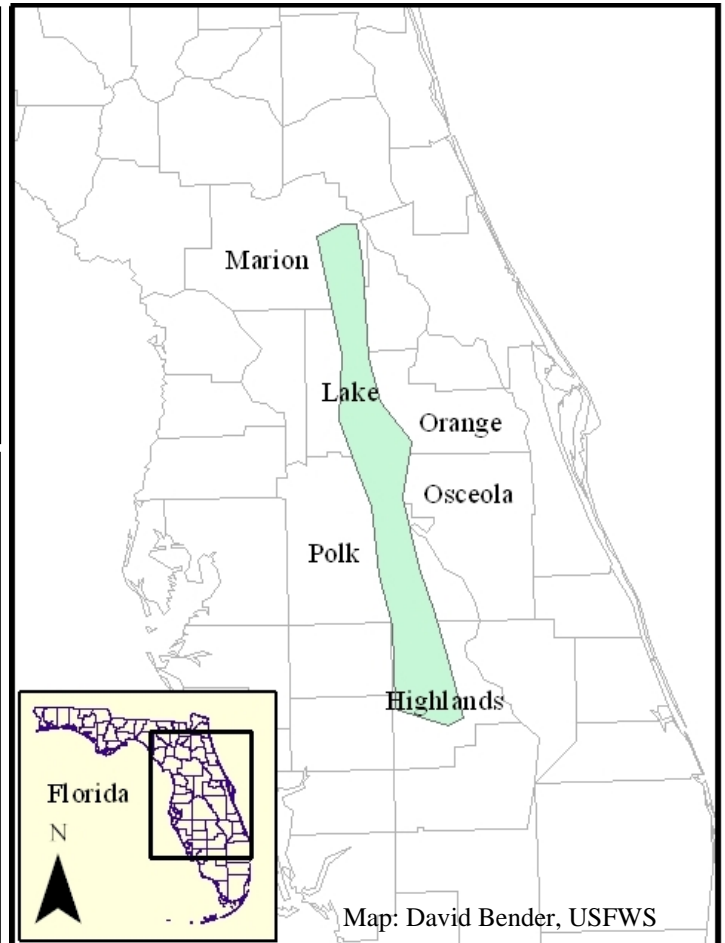
**5-Year Review:  
Summary and Evaluation**



Photo: Laurie Sullivan



Photo: Carl Weekley, Archbold Biological Station



Map: David Bender, USFWS

**U.S. Fish and Wildlife Service  
Southeast Region  
South 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:** This review is based on monitoring reports, surveys, and other scientific information, augmented by conversations and comments from biologists familiar with Lewton's polygala. The review was conducted by the lead recovery biologist for the species in the U.S. Fish and Wildlife Service (Service), South Florida Ecological Services Field Office. Literature and documents used for this review are on file at the South Florida Ecological Services Field Office. All recommendations resulting from this review are a result of thoroughly reviewing the best available scientific information on Lewton's polygala. Public notice of this review was given in the *Federal Register* on April 9, 2009, and a 60-day public comment period was opened (74 FR 16230). No part of the review was contracted to an outside party. Comments received and suggestions from peer reviewers were evaluated and incorporated as appropriate (see Appendix A).

#### **B. Reviewers**

**Lead Region:** Southeast Region, Kelly Bibb, 404-679-7132

**Lead Field Office:** South Florida Ecological Services Field Office, David Bender, 772-562-3909

**Cooperating Field Office:** Jacksonville Ecological Services Field Office, Annie Dziergowski (904) 232-2580

#### **C. Background**

**1. Federal Register Notice citation announcing initiation of this review:** April 9, 2009. 74 FR 16230

**2. Species status:** Uncertain (2009 Recovery Data Call). Florida Natural Areas Inventory (FNAI) and other sources provide 49 extant occurrence records, 32 (65 percent) of which are protected on 13 managed areas. Populations are known to experience wide fluctuations from year to year in response to fire. Fire suppression and habitat loss continue to threaten occurrences on private land, except those lands owned by The Nature Conservancy (TNC). Populations in some protected areas may be threatened due to the inadequate prescribed fire management. Further loss of unprotected populations is likely as development continues on the Lake Wales Ridge. Unprotected habitat continues to be developed for agriculture, housing, and other uses. Trends in threats are continuing at the same level. Rangewide survey data are lacking for 2009; therefore the status of the species is uncertain.

**3. Recovery achieved:** 1 (1 = 0-25 percent of recovery objectives achieved).

**4. Listing history**

Original Listing

FR notice: 58 FR 25746

Date listed: April 27, 1993

Entity listed: Species

Classification: Endangered

**5. Associated rulemakings:** None

**6. Review History**

Recovery Plan for Nineteen Florida Scrub and High Pineland Plant Species (June 20, 1996)

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

Recovery Data Call: 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, and 2009

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

8 (species with a moderate degree of threat coupled with high recovery potential).

**8. Recovery Plan**

Name of plan: South Florida Multi-Species Recovery Plan (MSRP)

Date issued: May 18, 1999

Dates of previous plans: Recovery Plan for Nineteen Florida Scrub and High Pineland Plant Species (June 20, 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 Endangered Species Act (ESA) defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife that interbreeds when mature. This definition limits listing a DPS to only vertebrate species of fish and wildlife. Because the species under review is a plant, the DPS policy does not apply.

**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?** No. The criterion of 20 to 90 percent probability of persistence for 100 years is flawed because it allows for a possible 80 percent chance of extinction at the lower end of the range of probability of persistence. Moreover, population stability is not a useful concept in a species such as Lewton's polygala where healthy populations fluctuate in response to periodic fire. A metapopulation approach should be considered when evaluating the persistence of Lewton's polygala at sites where it occurs.

**b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?** 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 stated Recovery Objective is to reclassify from endangered to threatened. Delisting criteria have not been developed.

Lewton's polygala may be reclassified from endangered to threatened when:

1. Enough demographic data are available to determine the appropriate numbers of self-sustaining populations and sites needed to assure 20 to 90 percent probability of persistence for 100 years.

This criterion has not been met. Detailed demographic data (Level 3 monitoring *sensu* Menges and Gordon 1996) has been collected from multiple populations at several sites (Menges et al. 2009). No population viability analyses (PVAs) have been conducted because sufficient data on seed germination rates are lacking (C. Weekley, Archbold Biological Station, pers. comm. 2010a). The number of populations required by the stated probability of persistence criteria has yet to be established. This criterion addresses listing factor A.

2. When these sites, within the historic range of Lewton's polygala, are adequately protected from further habitat loss, degradation, and fragmentation.

This criterion has not been met. The number of populations required to satisfy this criterion has yet to be established, as described above. Seventeen of 49 extant occurrences (35 percent) are located on private property where they have no protection (FNAI 2009a, TNC 2008, Bok Tower Gardens, unpubl. data, 2009, J. Rolly, Florida Native Plant Society pers. comm. 2008). Unprotected occurrences are susceptible to habitat loss or degradation and are unlikely to be managed with prescribed fire (Turner et al. 2006). Protection of occurrences is inadequate in three northern counties (Lake [2 of 14], Orange [0 of 1], and Osceola [0 of 1]) that

constitute approximately one-fourth of the species range. This criterion addresses factors A and E.

3. When these sites are managed to maintain the seral stages of high pine and xeric oak scrub to support Lewton's polygala.

This criterion has not been met. Prescribed fire management is likely non-existent on the 17 unprotected occurrences located on private lands. On protected lands, 9 of 32 occurrences (29 percent) have not been managed with prescribed fire (TNC 2008, Menges et al. 2009, TNC 2010a). Sites with inadequate fire management become overgrown and less suitable for Lewton's polygala (Menges et al. 2009). Twenty-three of 32 occurrences (74 percent) on protected land are adequately managed, primarily with prescribed fire, to maintain xeric oak scrub and sandhill (TNC 2010a). This criterion addresses factor A.

4. When monitoring programs demonstrate that these sites support the appropriate numbers of self-sustaining populations, and those populations are stable throughout the historic range of the species.

This criterion has not been met. The Service assumes that the 'appropriate numbers of self-sustaining populations' refers to a number that would be arrived at through a PVA. Since no PVA has been conducted, this number is not known. Protected sites represent only a portion of the species' historical range, with a significant lack of protected occurrences in Lake, Orange, and Osceola Counties. Monitoring programs cover occurrences throughout most of the historic range, but these programs are not consistent in methodology or the quality of the data they produce. This criterion addresses factor A and E.

## **C. Updated Information and Current Species Status**

### **1. Biology and Habitat**

Information on the biology and habitat of Lewton's polygala is summarized in the South Florida Multi-Species Recovery Plan (MSRP) (Service 1999). Relevant biology and habitat information is summarized and updated in this review.

#### Plant Description

Lewton's polygala, a member of the milkwort family (Polygalaceae), is an herb reaching a height of 20 centimeters (cm). Each plant produces one to several annual stems, which are spreading, upward curving or erect, and are often branched. The leaves are small, sessile, and tend to overlap along the stem. Three types of flowers are produced – aboveground open-pollinated (chasmogamous) flowers, aboveground self-pollinated flowers that do not open (aboveground cleistogamous), and belowground closed self-pollinated flowers that do not open (belowground cleistogamous) (Weekley 1996). Chasmogamous flowers are in erect, loosely

flowered racemes about 1.5 cm to 3.3 cm long. Each flower is about 0.5 cm long and bright pink to purplish-red. Two of the five sepals are enlarged and wing-like, between which the largest of the three petals forms a keel that ends in a tuft of finger-like projections. This species is closely related to the widespread *P. polygama*, which forms larger clumps and has a longer root, narrower leaves, and differently shaped wing sepals. It also has short branches that hug the ground, bearing inconspicuous cleistogamous flowers (Wunderlin et al. 1981).

### Current Distribution

Lewton's polygala occurs in xeric upland habitats on the Lake Wales Ridge and Mount Dora Ridge in Ocala National Forest (Menges and Weekley 2002). It occurs almost exclusively on yellow sands in sandhill (high pine) and oak-hickory scrub (Menges and Weekley 2003), and transition zones between these two communities. It occurs in Marion, Lake, Osceola, Orange, Polk, and Highlands Counties (FNAI 2009a).

### Life History

Lewton's polygala is a relatively short-lived (5 to 10 years) perennial (TNC 2008, Weekley and Menges, submitted). Lewton's polygala is amphicarpic, producing flowers and fruits above and below ground at different times (Menges and Weekley 2002). It produces three kinds of flowers: aboveground open-pollinated Chasmogamous (CH) flowers, belowground self-pollinated cleistogamous (CL) flowers, and aboveground self-pollinated CL flowers (Menges and Weekley 2003). CH flowers are usually produced in the spring; CL are usually produced in the summer or fall. However, observations suggest that flowering periods for both CH and CL flowers are variable, and that sexual reproduction is not confined to a specific season (Menges et al. 2008).

Belowground sexual reproduction occurs commonly in Lewton's polygala (Menges and Weekley 2005). Plants usually begin to produce below ground flowers once they have reached aboveground sexual maturity, but may produce aboveground or belowground CL flowers at a younger age than CH flowers. CL flowering generally occurs between episodes of CH flowering, but some overlap may occur (Menges et al. 2009). Both types of CL flowers are not always present at the same time, and their order of appearance is variable. Older plants generally seem to produce more belowground than aboveground CL flowers (Menges et al. 2008).

Lewton's polygala is one of only a few dozen amphicarpic angiosperms known worldwide. Amphicarpy is viewed as an adaptation for reproduction in uncertain habitats, for example, producing seeds underground where they have better chances of surviving fire (Cheplick and Quinn 1982) and are protected from herbivory (Menges and Weekley 2003).

While self-fertilization occurs in Lewton's polygala, it appears to be a less-reliable mechanism for seed production than insect pollination. In pollinator-exclusion experiments, Weekley and Brothers (2006) found that exclusion reduces the fruit set of CH flowers. Prominent pollinators include bee-flies (Bombyliidae), flower flies (Syrphidae) and leaf-cutter bees (Megachilidae) (Menges et al. 2006).

Seedling recruitment occurs year-round, but major recruitment events are linked to winter rainfall (Menges and Weekley 2003) and about 75 percent of all seedling recruitment occurs between October and March (Menges et al. 2007).

### Seed Ecology

Underground fruits produced by CL flowers may contribute to the seedbank (Menges and Weekley 2002), but the importance of this feature to the population dynamics of Lewton's polygala is not yet known (Menges et al. 2006). Excavation studies carried out by Menges et al. (2007) suggest that large plants are capable of bearing hundreds of seeds per year from underground flowers, but average plants produce fewer. Seed burial and retrieval experiments suggest that Lewton's polygala seeds can remain intact within the soil and retain viability for at least 2 years (Menges and Weekley 2004). Seeds are capable of surviving short-term heat pulses lethal to living cells, which underground seeds might be subjected to during fire (Menges and Weekley 2004). Evidence suggests that a persistent seed bank is important to post-fire recovery of Lewton's polygala populations (Weekley and Menges, submitted).

Numerous lab and field experiments have yet to reveal a clear understanding of seed germination requirements for Lewton's polygala. Since seeds readily imbibe water, physical dormancy is not an issue (Menges and Weekley 2005). Experimental evidence indicates that seeds have some sort of dormancy mechanism, but standard practices used to promote germination of dormant seeds (scarification, plant hormones) have proven unsuccessful (Menges and Weekley 2005, Menges et al. 2007). Smoke is known to stimulate seed germination in some species adapted to fire-prone habitats (Lindon and Menges 2008). This adaptation may be particularly important for species that require seedling recruitment to recover post-fire, such as Lewton's polygala. Lindon and Menges (2008) found that a 5-minute experimental smoke treatment produced significant positive germination responses. Seeds treated with smoke germinated at a rate of 18 percent versus 2 percent for untreated seeds. However, this effect has yet to be demonstrated in the field (Menges et al. 2006).

Lewton's polygala seeds have a fleshy appendage called an elaiosome which is a protein- and lipid-rich body common among ant-dispersed seeds. The elaiosome attracts ants, which presumably benefit the plant by distributing the seeds to appropriate microsites. At least eight species of ants collect seeds of Lewton's polygala, the most frequent being *Pheidole morrissii* (Menges and Weekley 2002, 2003). Menges and Weekley (2003) showed that some ants (e.g., *Paratrachina arenavaga*, *P. phantasma*) preferentially collected elaiosomes or seeds with elaiosomes, and disregarded seeds in which the elaiosome had been experimentally

removed, indicating that the elaiosome, rather than the seed, is the target. Determining the fate of seeds taken by ants to their nests and documenting dispersal resulting in germination are difficult. When ant nests near fruiting plants were excavated, no evidence of seed caches was found (Menges and Weekley 2005). Menges et al. (2008) found that seedling recruitment was higher near ant nests close to fruiting adults than it is to ant nests near random points. However, this pattern may be due to the proximity of seeds to fruiting plants, rather than to ant dispersal.

**a. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate), or demographic trends:**

Demographic Features

Monitoring of Lewton's polygala has occurred at several sites. Archbold Biological Station (ABS) began a demographic study of populations in two managed areas beginning in 1996 and 2001, respectively. TNC monitored populations at two sites from 1991 to 2008. Cox (2006) monitored populations at Seminole State Forest (SSF) Warea tract. The United States Forest Service (USFS) monitors populations at Ocala National Forest (ONF). Only the ABS monitoring methodology (Level 3 monitoring *sensu* Menges and Gordon 1996) is sufficient to produce demographic models and a population viability analysis (PVA).

Fire is the predominant natural disturbance in Florida and a primary driver in the demography of all Florida scrub and sandhill plants that have been studied (Menges 2007). Plants of Lewton's polygala are consumed by fire and post-fire resprouting is extremely rare (Weekley and Menges 2003). The beneficial effects of fire on Lewton's polygala include removal of litter, competing vegetation, and ground lichens (Menges and Weekley 2004). The chemical compounds in smoke may also cue or improve seed germination (Lindon and Menges 2008). Populations are re-established through germination of seeds from the soil seed bank (Weekley and Menges, submitted). Usually, Lewton's polygala responds to fire with abundant seedling recruitment (Menges and Weekley 2003), which often results in population increases of at least one order of magnitude (Menges and Weekley 2005). For example, Menges and Weekley (2003) documented an 800 percent increase following the 2001 prescribed fire at the Carter Creek unit of the Lake Wales Ridge National Wildlife Refuge (LWRNWR). Weekley and Menges (submitted) determined that occupancy of Lewton's polygala decreased 1.2 percent in unburned sites, while it increased 16.7 percent in those that received fire. Demographic monitoring indicates that: (1) seedling recruitment is markedly higher in burned than unburned areas for the first six months post fire, (2) survival was higher for plants that recruited in burned plots, (3) plants in burned areas reach reproductive age more quickly, (4) burned microsites have greater plant density than unburned ones, and (5) any increase in density-dependent mortality is outweighed by the first three benefits. As a result, plants recruited



into burned sites make a greater contribution to the seedbank, and thus to the long-term viability of the population, than do recruits in unburned sites (Weekley and Menges, submitted). Menges et al. (2006) recommend that fire frequencies for Lewton's polygala be at least every 4 years, due to the rapid decline in population size as time-since-fire increases.

TNC monitored populations of Lewton's polygala at two sites from 1991 to 2008. Plant counts fluctuated widely from year to year. Numbers ranged from 121 plants counted in 6 study populations in 1996 to 694 plants in 21 populations in 2008. Over time, plant density declined to zero for three consecutive years in three study populations, and declined by at least 30 percent in 14 study populations. Five study populations remained stable or increased. At both sites, some study populations disappeared entirely and then reappeared 1 to 3 years after prescribed fire (TNC 2008).

Populations occurring at sites with a long period of fire suppression may retain the potential for dramatic increase. For example, Menges and Weekley (2002) reported a dramatic increase in seedling recruitment following a fire on a sandhill site that had not burned in 60 years. Data from long-unburned populations suggest that even small (fewer than 50 plants) populations can persist without fire through occasional small-scale seedling recruitment events (Menges et al. 2007). The relationship between fire, the seed bank, and seedling recruitment is complex. Data suggest that the beneficial effects of fire on recruitment are short-lived and that fire may temporarily deplete the soil seed bank (Menges and Weekley 2004). The response of Lewton's polygala may vary from one fire to another depending on post-fire precipitation patterns, with lower seedling recruitment when fire occurs during drier seasons (Menges et al. 2009). Higher rates of recruitment are observed in El Niño winters, when rainfall is greater and temperatures are lower than average (Weekley and Menges, submitted).

### Summary of Known Occurrences

FNAI maintains a database of Element Occurrence Records (EORs) for rare plants and animals of Florida. Each EOR identifies a place on the landscape where a rare plant or animal has been observed. FNAI (2009a) has 51 EORs for Lewton's polygala. The occurrence record for Highlands Hammock State Park (EOR 14) (FNAI 2009a) is almost certainly in error. Recent surveys did not record Lewton's polygala, and the area where it was previously recorded is a swamp (C. Weekley pers. comm. 2010a, b). FNAI (2009a) also identifies The Preserve (managed by Highlands County Parks and Recreation Department) and the Silver Lake unit of the Lake Wales Ridge Wildlife and Environmental Area (LWRWEA) with EOR 14. These two areas were included because the polygon mapped for Highlands Hammock State Park was extremely large, extending well outside the Park. The Preserve does not contain appropriate habitat, and Lewton's polygala has never been recorded at

Silver Lake LWRWEA (C. Weekley pers. comm. 2010a). The Service agrees that records for the all three sites associated with EOR 14 are in error and they are not included in our analysis.

Other sources (TNC 2008, Bok Tower Gardens, unpubl. data, 2009, Rolly pers. comm. 2008) provide an additional four occurrence records. The combination of these data sources yields 55 occurrences that were evaluated for this review. All protected occurrences were presumed to be extant, unless data showed otherwise. Six occurrences on private property (EORs 4, 9, 26, 30, 33 and 35) were ranked as likely extirpated because habitat was completely overgrown and no plants were observed in 2009 (FNAI 2009a, Bok Tower Gardens, unpubl. data, 2009). Thus, of 55 occurrences, 6 are presumed extirpated as of this review, while 49 are presumed extant.

Of the 49 extant occurrences, 32 (65 percent) are protected on publicly owned land (23 occurrences) or private conservation land (9 occurrences). Protected occurrences span 13 different managed areas. Seventeen of 49 extant occurrences (35 percent) are located on private property (excluding those on private conservation lands) where they have no protection from development and are threatened by lack of fire and other management. The status of 14 of the 17 unprotected occurrences on private property is uncertain. Three occurrences (EORs 2, 7, and 29) were known to be extant as of 2009 (Bok Tower Gardens, unpubl. data, 2009, Weekley pers. comm. 2010a). Four occurrences (EORs 8, 12, 13, and 23) may be extant based on the presence of suitable habitat where they were previously recorded. The status and trend, as far as it is known for each occurrence, is discussed below and summarized in Tables 1 and 2.

### Protected Occurrences

The Ocala National Forest (ONF) (EORs 1, 62, 63, 64, 65, and 66) is located in central Florida in Marion and Lake Counties and includes portions of the Mount Dora Ridge. The ONF contains the most northerly occurrences of Lewton's polygala. It encompasses approximately 383,000 acres, most of which are managed to produce sand pine pulpwood. Lewton's polygala occurs in sandhill and scrub on the ONF. The largest population occurs on Hughes Island, and smaller populations are scattered at other sandhill and scrub areas (FNAI 2009a). Clear-cutting of sand pine is the predominant technique used to manage scrub in the ONF. Prescribed fire is carried out at 2-3 year rotation at Hughes Island, but other sandhill sites are not being managed with fire (USFS 2009). The USFS monitored Lewton's polygala from 1993-2006, but data presented in available reports are inadequate to infer population trends. In 2007, the USFS revised their endangered plant monitoring methodology with assistance from FNAI, and portions of the ONF were resurveyed (Hughes Island and 18 other sites) for Lewton's polygala (USFS 2008). The USFS monitors for Lewton's polygala at Hughes Island

annually by mapping the perimeter of the population with GPS and assigning rough density estimates. In 2008 (the most recent report available), the USFS reported that the population at Hughes Island remained 'large and vigorous'. The population's extent in 2008 was 190 acres. A 2006 survey estimated the population at 1,690 to 1,802 plants (USFS 2009).

The USFS (2009) reported that populations outside of Hughes Island on the ONF (EORs 62, 63, 64, 65, and 66) seem to be decreasing in size and vigor. Thirty-nine of 51 locations previously supporting Lewton's polygala were surveyed from 2007 to 2008 and the species was present in fewer than half (15 of 39) of these locations (USFS 2008, 2009). All of these occurrences were small, isolated populations, with most consisting of fewer than 25 plants and occurring mostly along firebreaks or sand roads (USFS 2008). According to the USFS, these populations are not 'vigorous'. The USFS speculates that one reason for their decline is the lack of fire treatment in these areas. To restore vitality to these populations, USFS is considering burning the remaining sandhill occurrences on a 3-year rotation and applying prescribed fire following sand pine harvests. They also acknowledge that to make conditions favorable for Lewton's polygala, scrub on the ONF needs to be managed for an earlier successional stage, with applications of fire at more frequent intervals (USFS 2009). The USFS (2009) plans to 'recover Lewton's polygala outside Hughes Island to at least 50 individuals in each of at least 10 locations by 2020.' They have yet to achieve this goal. In 2007 (the most recent survey numbers available), monitored populations outside Hughes Island totaled 136 plants (range 15 to 39) (FNAI 2009a). There are also serious concerns about off-road vehicle (ORV) impacts to Lewton's polygala plants and habitat on the ONF (USFS 1999, Duever 2002, USFS 2007-2009, Paben 2006, L. Duever, Conway Conservation, pers. comm. 2008). This issue is discussed in the Five Factor Analysis section of this review.

The Scrub Point Preserve (EOR 32) in south Lake County, is an 89-acre site on the south shore of John's Lake. The site is managed by the Lake County Water Authority (LWCA). Lewton's polygala was present when the site was surveyed in 1991 (50 plants), 1994 (6 or more plants) (FNAI 2009a), and 2009 (approximately 30 plants) (C. Weekley pers. comm. 2010a). The LWCA has an active prescribed fire program. Lewton's polygala is presumed to be extant due to protection of the site and ongoing fire management.

The Seminole State Forest (SSF) Warea Tract (EOR 37) (aka Flat Lake in Schultz et al. 1999) is located about 5 miles southeast of Clermont in southern Lake County. The SSF is managed by Florida Division of Forestry (FDOF). The SSF is managed under a multiple-use paradigm that includes recreation and timber extraction. Recreation uses on the Warea Tract are currently limited to research and guided tours by permit. The 120-acre tract is primarily sandhill and is somewhat isolated with no public access. Lewton's polygala is distributed throughout the Warea Tract (FDOF 2008a). Cox (2006) monitored populations in three burn units from 2001 to 2006, recording a low of 6 plants

in 2004 and a steady increase to 139 through spring 2006. This was followed by an explosion of seedlings in fall 2006 resulting in a high of 568 plants, most new recruits and the greatest number of plants were recorded in the NW block after it was burned in 2004 (Cox 2006). A 2008 survey reported 193 plants for the Warea Tract (FDOF 2008a). The FDOF 2000 Five-Year Resource Management Plan (RMP) for SSF stated that fire suppression on this tract had resulted in high hardwood density and that growing season burns and hardwood reduction treatments would be implemented immediately to manage habitat for rare species (FDOF 2000). FDOF burned the 40-acre NW block in spring 2004 (Cox 2006), and a second 40-acre block in 2007 (FDOF 2008b). Manual hardwood reduction was completed on 61 acres of the tract in 2007 (FDOF 2008b). Herbicide control of Natal grass (*Rhynchelytrum repens*) and Lantana (*Lantana camara*) was conducted at the Warea Tract in 2008 (FDOF 2008a). Additional hardwood removal and prescribed fire are planned for 2010 (FDOF 2008b).

Allen D. Broussard Memorial Catfish Creek Preserve (ADBP) (no EOR) is located in Haines City, eastern Polk County. The 8,244-acre site is managed by FDEP. TNC monitored several study populations of Lewton's polygala from 1991 to 2000 at ADBP. All study populations declined throughout the 1990s and TNC (2008) described the trend as 'worrisome'. The area was impacted by feral hog disturbance in 1995, and only six plants were observed in 1997. TNC discontinued monitoring after 2000. Prescribed fire was not implemented at ADBP from 1991 to 2000 in the areas where Lewton's polygala occurred (TNC 2008). Prescribed fire has been implemented on about one-third of ADBP since 2001 (TNC 2010a), but it is unclear whether these burns included areas that once supported Lewton's polygala. Plants were observed at ADBP near the fire tower as recently as 2008 (C. Weekley pers. comm. 2010a). Population trend data are unavailable for ADBP from 2000 to 2009.

Horse Creek Scrub (EOR 21) is a 1,325-acre site, located near the north end of the Lake Wales Ridge in the northeast corner of Polk County. Horse Creek Scrub is an island of scrub bounded by Horse Creek to the south and Reedy Creek Swamp to the east. It is part of the Upper Lakes Basin Watershed Management Area. Large portions of the scrub island and surrounding swamp are owned by the South Florida Water Management District (SFWMD) and the Southwest Florida Water Management District (SWFWMD). More scrub and sandhill are in the privately owned sections (Schultz et al. 1999). Horse Creek Scrub consists of about 20 acres divided into three parts by the extension of Horseshoe Creek Road and a power line right-of-way (ROW). The Progress Energy ROW and a five-acre clearing at the east side of the power line contain a population of Lewton's polygala (Schultz et al. 1999). In 1998, more than 500 plants were observed in the clearing adjacent to the ROW (FNAI 2009a). The Service confirmed that Lewton's polygala was extant at this site in 2008, but the population size was not estimated. Bahia grass (*Paspalum notatum*) is a problem at this site, but control efforts are

being implemented by SFWMD (D. Bender, Service, unpubl. notes, 2008). SFWMD has implemented fire management in most of the area under public ownership. The area known to support Lewton's polygala was last burned in 2003 (TNC 2010a).

The Pine Ridge Preserve (no EOR) is a 25-acre sandhill remnant located in Polk County on the property owned by Bok Tower Gardens (Gardens). This occurrence of Lewton's polygala has been monitored since 1996. The population has been dynamic over the past 14 years, ranging from a high of 306 plants in 1996 to just 5 plants in 2006 (Bok Tower Gardens, unpubl. data, 2008). In 2009, 173 plants were observed (Bok Tower Gardens, unpubl. data, 2009). The Preserve is actively managed with prescribed fire and efforts are underway to control invasive Natal grass.

TNC's Tiger Creek Preserve (EORs 11, 16, 17, 18, 19, 20, and 61) is located in eastern Polk County, just south of the City of Lake Wales. Lewton's polygala is scattered throughout the western portion of the 4,718-acre site. TNC has monitored Lewton's polygala at Tiger Creek Preserve from 1991 to 2008. Seventeen populations were surveyed in 2008, totaling 513 plants (range 2 to 152, mean 30, median 18). Thirteen additional populations were also mapped in 2006 and 2007 but count data for these populations was not included in the 2008 monitoring report. From 1991 to 2008, population sizes for all monitored populations ranged from a high of 768 in 2008, to a low of 37 in 1996. All populations have been burned over this period, at intervals ranging from three to 7 years between fires. The long-term trend for populations at Tiger Creek Preserve is that of annual fluctuation, with some patches of Lewton's polygala disappearing and new ones appearing in response to prescribed burns (TNC 2008).

Crooked Lake Sandhill (also known as Longleaf Pine Preserve) (EOR 25) is located near the town of Babson Park in southwestern Polk County. The Preserve is a 25-acre sandhill remnant managed by Polk County Environmental Lands Program. TNC has monitored Lewton's polygala from 1991 to 2008. From 1991 to 2008, total number of plants ranged from a high of 248 in 1994, to a low of 7 in 2002. Two populations were recorded in 2008, one with 132 plants, a second with 49 plants, for a total of 181 plants. Prescribed burns were implemented in areas supporting Lewton's polygala in 1993, 2001, and 2004 (TNC 2008).

The Lake Wales Ridge State Forest (LWRSF) is located in Polk County on the south-central portion of the Lake Wales Ridge. It is the largest tract of Lake Wales Ridge xeric upland habitat in public ownership. The LWRSF, managed by FDOF, is composed of four tracts: Arbuckle (13,531 acres), Walk-In-Water (6,902 acres), Hesperides (1,267 acres), and Prairie (4,863 acres) for a total of 26,563 acres. Approximately 8,859 acres are xeric upland

communities (FDOF 2006). Lewton's polygala occurs on the Walk-In-Water, Arbuckle, and Hesperides tracts (FNAI 2009a).

The FDOF 10-Year Resource Management Plan (RMP) states that "one of the primary management goals for LWRSF is to maintain and enhance ecosystems and organisms that are threatened, endangered, or species of special concern." The RMP includes timber harvest in a list of management activities deemed appropriate for the LWRSF. Recreation is also permitted – including hunting, horseback riding, and camping (FDOF 2006). A prescribed fire program is currently in place on the Arbuckle, Walk-In-Water, and Hesperides tracts. FDOF is using mechanical treatments, prescribed fire, and herbicides to restore sandhill on the LWRSF (FDOF 2006).

The Walk-In-Water tract of the LWRSF (EORs 5, 10, and 15) contains a large expanse of degraded sandhill comprising several square miles (nearly 2,700 acres). Prior to its acquisition, much of the sandhill was roller-chopped and aerially seeded with Bahia grass in the 1990s (FDOF 2006). The condition of sandhill habitat ranges from sandhill with Bahia grass as the dominant groundcover, to areas overgrown with sand pine, to xeric hammock with few longleaf pines. FDOF intends to restore these sandhill sites through a combination of herbicide applications, mechanical treatments, ground cover planting, and prescribed fire (FDOF 2006). Only the eastern portion of the tract (about 20 percent of the total tract acreage), which was not roller-chopped and seeded, has the full complement of sandhill species, including most of the Lewton's polygala (C. Weekley pers. comm. 2010a).

The Arbuckle tract of the LWRSF (EORs 55, 56, 57, 58, 59, and 60) contains small, scattered areas of sandhill totaling nearly 700 acres. The Reedy Creek Management Blocks contain small areas of sandhill that support Lewton's polygala, some of which have been burned over the past decade, but many remain degraded due to decades of fire exclusion (FDOF 2006).

On the Hesperides tract of the LWRSF (EOR 38), sandhill occurs at the south end of State Road 60 and along Walk-In-Water Road (Schultz et al. 1999). FDOF reported mapping 180 plants in the Babson parcel of the Hesperides tract in 2008 near the vicinity of EOR 38 (Clanton 2009).

FNAI EORs for LWRSF are outdated, with last observation dates ranging from 1982 to 1998. The records indicate that 8 of 10 populations had fewer than 20 plants (FNAI 2009a). The ABS study populations are the best source of useful trend data for Lewton's polygala at LWRSF. ABS has been collecting demographic data on four populations of Lewton's polygala since 1996. All four of the ABS study populations declined from 1996 to 2001 (Menges and Weekley 2002). The decline trend continued over the past decade, probably due to lack of fire management (Menges et al. 2009). In 2005, the study populations comprised only 235 live plants (Menges et al.

2006). In 2009, these populations totaled just 77 plants and three of four study populations were smaller than their 14-year average (Menges et al. 2009). A fifth study population which numbered several hundred plants as recently as 2005, had fewer than 30 plants when surveyed in 2009 (Menges et al. 2009). FDOF has implemented a fire management program and burned about two-thirds of the LWRSF over the past 10 years (TNC 2010a), however none of the ABS study populations have been burned in over a decade (Menges et al. 2009). Menges (et al. 2009) suggests that the decline in these populations is due to a lack of fire. While this is probably true, they also note that all four study populations have shown substantial annual fluctuations in size over the years (Menges et al. 2009). For the first time since ABS has monitored populations at LWRSF, they observed a population (at Deerslayer Hill) decline to zero plants in 2009. However, researchers expect that a substantial seedbank persists at this site and predict that the aboveground population may re-appear through seedling recruitment in the next few years (Menges et al. 2009), particularly if prescribed fire is implemented at these sites (C. Weekley pers. comm. 2010a).

Carter Creek (EOR 39) is located at the east edge of the Lake Wales Ridge about 3 miles east of Sebring in north central Highlands County. Sandhill occurs on a series of rolling hills on the north and south sides of Arbuckle Creek Road (Schultz et al. 1999). The Carter Creek unit of the LWRNWR (also known as Carter Creek South [CCS]) is managed by the Service and occupies 628 acres on the south side of Arbuckle Creek Road in Highlands County. About one third of the site is sandhill, but it is degraded from decades of fire suppression. The Service conducted prescribed burns at CCS three times in the last 8 years (2001, 2007, and 2009), and ABS conducted experimental small-scale manual hardwood canopy reduction. ABS has monitored Lewton's polygala at CCS since 2001. From the period 2001 to 2009, the study population has fluctuated from approximately 1,500 plants in 2002 (following a 2001 prescribed fire) to about 250 plants in 2008. In 2009, 414 plants were recorded, an increase of 54 percent from the previous year (Menges et al. 2009).

The Carter Creek unit of the LWRWEA (also known as Carter Creek North [CCN]) is located on the north side of Arbuckle Creek Road. The site is a diverse mosaic of xeric habitats gridded with paved, sand, and clay roads from a planned development. The Florida Fish and Wildlife Conservation Commission (FFWCC) manages the site. They have recently increased their efforts to restore the sandhill habitat through manual reduction of overgrown hardwoods and prescribed fire (C. Weekley pers. comm. 2010a).

#### Unprotected occurrences

Lake County has the highest number of unprotected occurrences (14). Four occurrences (EORs 4, 30, 33, and 35) are presumed to be extirpated. When

last surveyed these sites were overgrown and no plants were observed (FNAI 2009a; Bok Tower Gardens, unpubl. data, 2009). The status of seven other occurrences (EORs 3, 6, 27, 28, 31, 36, 54) is completely unknown as they have not been surveyed in the past 5 years (FNAI 2009a). Two occurrences (EORs 2 and 7) supported populations of Lewton's polygala when surveyed in 2009 (Bok Tower Gardens, unpubl. data, 2009). Another (EOR 29) may still support a population of Lewton's polygala based on existing habitat remaining in the vicinity of these EORs (Bok Tower Gardens, unpubl. data, 2009). All private occurrences are threatened by lack of adequate fire management. Lake County occurrences on private land are discussed below.

Lake County Potential Natural Area (PNA) #175 (EOR 2) is located in Lake County east of Clermont near the intersection of State Highways 50 and 27; this area was surveyed in 2009, with 11 plants reported. The site that supports Lewton's polygala is open sandhill. A second population nearby was not located, and the habitat was overgrown sandhill 'infested with invasive species' (Bok Tower Gardens, unpubl. data, 2009). Parcels are for sale in the area and the occurrence is threatened by development and lack of fire.

Castle Hill (EOR 7) is located about 2.5 miles east of Clermont in southern Lake County, on the south side of State Road 50. Most of the 75-acre site is sandhill. It is surrounded by groves, residential communities, and a sand mine. The State of Florida targeted the site for acquisition under the Florida Forever program. Schultz (et al. 1999) reported that Lewton's polygala was 'numerous and widespread' with more than 40 plants observed in a 1998 survey. In 2009, a survey reported that '100 plus' plants were observed (Bok Tower Gardens, unpubl. data, 2009). This occurrence is threatened by development and lack of fire.

Ferndale Ridge (EOR 3) is located about 5 miles northeast of Clermont in east-central Lake County. The 104-acre site is divided into several small, privately owned tracts. The site was removed from the state's acquisition target list due to residential development. A 1998 survey located 15 plants of Lewton's polygala (Schultz et al. 1999). When the site was surveyed in 2009, the habitat was extremely overgrown and no plants were observed. However, the surveyor noted that plants may have been missed because they were not in flower (Bok Tower Gardens, unpubl. data, 2009). The status of this occurrence is unknown. It is threatened by development and lack of fire.

John's Lake North (EOR 27) is located on private land in Lake County north of John's Lake off State Highway 50. Several hundred plants were observed in a 1991 survey (FNAI 2009a). The site is now oak hammock and impacted by ORVs (Bok Tower Gardens, unpubl. data, 2009). No other information is available and the status of this occurrence is unknown. It may be extant, based on open habitats in the vicinity of EOR. This occurrence is threatened by development, lack of fire, and ORVs.



The Sugarloaf Mountain (EOR 28) sandhill (located near the Lake Apopka Restoration Area in FNAI 2009a) is part of 52-acre site 8 miles north of Clermont in east-central Lake County. The site was described by Schultz (et al. 1999) as 'heavily disturbed by human activities'. Four plants were recorded in 1994, but none were located in 1998 (Schultz et al. 1999). The site is partially acquired and managed by Saint Johns River Water Management District. However, the area with Lewton's polygala has not been acquired. On the northwest shore of Lake Apopka, this property is used as a demonstration site for a marsh flow-way system designed to filter the waters of the lake (FNAI 2009a). No recent survey data are available. The status of the occurrence is unknown.

Schofield Sandhill (EOR 29) is located about 8.0 miles southeast of Clermont in southern Lake County, and about 2.5 miles east of U.S. Highway 27. Only 15 plants were observed in a 1998 survey (Schultz et al. 1999). The 120-acre site is owned by Orange County and managed as part of a wastewater reclamation project that provides water to area citrus growers (Water Conserve 2010). Lewton's polygala was confirmed present in 2009 (more than 30 plants), but the occurrence is threatened by lack of fire (C. Weekley pers. comm. 2010a).

In Orange County, two of three known occurrences (EORs 9 and 26) are presumed extirpated (FNAI 2009a) and destruction of the third (Spyglass Hill landfill site) is imminent, as the site is slated for expansion of a landfill facility (Rolly pers. comm. 2008).

The single occurrence in Osceola County is Lake Davenport (EOR 12), located on private land 6 miles west of Interstate 4 and Disney World. The 500-acre site is located along the east shore of Lake Davenport. The sandhill is degraded from a history of grazing. In 1997, Lewton's polygala was reported as rare to occasional, with more than 35 plants observed (Schultz et al. 1999). No other information is available and the status of this occurrence is unknown. It may be extant, based on existing habitat in the vicinity of EOR, but is threatened by development and lack of fire.

The status of three occurrences on private property in Polk County is unknown. Two occurrences (EORs 8 and 13) were last surveyed in the early 1980s (FNAI 2009a), and the third (Rocky Point Road) in 1992 (Bok Tower Gardens, unpubl. data, 2009). They may be extant, based on existing habitat in the vicinity of EOR, but are threatened by development and lack of fire.

The status of two occurrences (EORs 23 and 24) on private property in Highlands County is unknown. Both were last surveyed in the late 1990s (FNAI 2009a). They may be extant, based on existing habitat in the vicinity of EOR, but are threatened by development and lack of fire.

There are no records for unprotected occurrences in Marion County (FNAI 2009a).

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

ABS initiated a rangewide survey of genetic diversity in Lewton's polygala in 2008. They collected 600 leaf samples from 13 sites between April 2008 and May 2009. The data is being compiled and publication of results is expected in 2010. Preliminary results suggest a low level of genetic diversity (Menges et al. 2009).

**c. Taxonomic classification or changes in nomenclature:**

Lewton's polygala was first collected near Frostproof, Florida by F. L. Lewton in 1894, and was promptly named by J. K. Small in 1898. The taxonomy of Lewton's polygala is reviewed in the MSRP (Service 1999). *Polygala lewtonii* is recognized as a valid taxon by the Integrated Taxonomic Information System (ITIS) (ITIS 2010).

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

Lewton's polygala is endemic to xeric upland ridges of central peninsular Florida. Wunderlin and Hansen (2003) describe the distribution of the species as "Marion County south to Highlands County". Herbarium specimens are primarily from Polk, Lake, and Highlands Counties with a smaller number of collections from Orange, Osceola, and Marion Counties (Schmalzer et al. 2003). The one record for Lewton's polygala in Brevard County was based on a misidentification. No plants of this taxon were encountered during subsequent surveys in scrub on the outer barrier island, Merritt Island, or mainland of Brevard County (Schmalzer et al. 2003). USFWS (1999) and Menges and Weekley (2003) indicate that the primary distribution of the species is yellow sand xeric uplands on the Lake Wales and Mount Dora ridges.

The distribution of Lewton's polygala has decreased over the past 100 years as the central Florida has been transformed by commercial and residential development. Large-scale destruction of upland habitat on the Lake Wales Ridge began in the 1880s. Citrus growers favored yellow sands and many sites potentially supporting Lewton's polygala were converted to citrus production in the early decades of the 20<sup>th</sup> century. Habitat loss has played a large role in the current abundance and distribution of Lewton's polygala. The loss and fragmentation of habitat has resulted in scattered, mostly small, populations.

All known occurrences are protected in the northernmost portion of the species range in Marion County, but a gap in protection exists in Lake, Orange, and Osceola Counties (approximately one-fourth of the range of Lewton's polygala), where only two of 14 occurrences are protected. Protection of occurrences is adequate in Polk and Highlands Counties, which constitutes the southern portion of the species range.

**e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):**

A detailed discussion of the habitat of Lewton's polygala is provided in the MSRP (Service 1999). Important features are summarized below.

Lewton's polygala occurs primarily in sandhill, but also in scrub in areas that probably were former sandhill sites prior to logging and fire suppression (C. Weekley pers. comm. 2010a). Sandhill and scrub are fire-dependent plant communities with differing species composition, structure, and fire regime. Sandhill (also known as high pine) is an open-canopied pine (*Pinus palustris* or *P. elliotii* var. *densa*) savanna with a sparse midstory of mostly deciduous oaks and a dense groundcover of grasses, forbs, and low shrubs. Wiregrass (*Aristida stricta* var. *beyrichiana*) is ecologically important as a fine fuel that facilitates frequent low-intensity fires that carry through the forest floor. The natural fire frequency for sandhill is 1 to 3 years (FNAI 2009b). Scrub is a community composed of evergreen shrubs, especially scrub oaks (*Quercus myrtifolia*, *Q. chapmanii*, and *Q. geminata*), with or without a sand pine (*P. clausa*) canopy. The oaks form a dense cover interspersed with patchy openings that consist of bare sand with a sparse cover of herbs. Oaks and other shrubs are periodically top-killed by fire. The natural fire frequency for scrub depends on the type of scrub; 3 to 20 years for oak scrub, 15 to 30 years for rosemary scrub, and 5 to 40 years for sand pine scrub (FNAI 2009c). Based on these modal fire return intervals for sandhill and scrub, land managers should aim to maintain a diverse mosaic of sites with regard to time-since-fire.

Weekley et al. (2008) estimated that 78 percent of the xeric upland habitat on the Lake Wales Ridge was destroyed by 1990, and greater than 85 percent by 2006, mainly due to agriculture, ranching, and commercial and residential development. 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). Large areas of sandhill have been converted to pine plantations, citrus groves, pastures, and residential or commercial development. The area between Lake Apopka and Clermont in Lake County were once covered with sandhill, but these habitats are nearly gone (Service 1996). The greatest percent loss of habitat was in Lake County, and yellow sands, which support sandhill, were the hardest hit because they were favored for citrus production (Weekley et al. 2008).

## Fire Suppression

Fire suppression started on a regional scale on the Lake Wales Ridge between 70 and 120 years ago. Long-unburned sandhill sites have dense shrub layers and slowly undergo succession to xeric oak hammock. Long-unburned oak scrub sites have dense shrub growth and litter accumulation. In both communities, gap specialists and shade-intolerant endemics, including Lewton's polygala, tend to decline with time-since-fire (Menges 2007). Fire management in some managed areas is inadequate to maintain habitat quality for occurrences of Lewton's polygala, as described above for numerous sites. There is a backlog of long-unburned habitat within conservation areas on the Lake Wales Ridge. For example, 16 of the 63 Lake Wales Ridge conservation sites have not received any fire management since they were acquired. TNC's fire history database showed that in 2008 (the last year for which data analysis was completed) 123,484 acres are within the recommended fire return interval and 38,359 acres are outside the recommended fire return interval (TNC 2010b). The fire management condition of most privately owned parcels is unknown. Fire management is highly unlikely on private properties unless they are designated conservation areas. Undeveloped private sites are likely to be overgrown due to fire suppression.

## Acquisition History

In the mid-1980s there were only four large conservation sites on the Lake Wales Ridge. In 1991, the state launched a \$3 billion land acquisition program, Preservation 2000. Its successor, Florida Forever, was launched 10 years later. Since 1992, the State of Florida has spent over \$68 million to acquire nearly 24,710 acres of land on the Lake Wales Ridge, with plans to acquire an additional 24,710 acres (FDEP 2008). The Service established the first national wildlife refuge in the country designated primarily for plants, the LWRNWR. Particularly problematic and challenging have been the acquisition projects known as megaparcels sites, which include extensive areas of scrub habitat that were previously subdivided and sold to numerous lot owners. To date over 14,000 such lots have been purchased for conservation within the megaparcels sites, in a checkerboard manner, but nearly as many lots have yet to be purchased (Turner et al. 2006).

Land acquisition to date has placed nearly half (21,597 acres, or 48.9 percent) of the remaining 44,157 acres of scrub and sandhill habitat on the Lake Wales Ridge within protected areas. However, many species are likely to remain at great risk of extinction despite ongoing conservation efforts, primarily because even the most optimistic acquisition scenarios will protect only 7.5 percent of the original Lake Wales Ridge habitats, most having already been destroyed (Turner et al. 2006). The protected fragments are surrounded by residential neighborhoods, citrus groves, and other anthropogenic habitats.

A recent analysis of Florida scrub conservation progress based on land acquisition included Lewton's polygala among the 36 rare species of the Lake Wales Ridge. Turner et al. (2006) calculated protection indices for each species based on number of locations, extent of occurrence, and area of occupancy. The overall protection index of 1.5 identified Lewton's polygala as 'endangered' in their ranking system (Turner et al. 2006).

## **2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)**

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

Habitat loss on the Lake Wales Ridge is detailed in the MSRP (Service 1999). Current threats to the habitat of Lewton's polygala include habitat loss from development and habitat modification due to long-term fire suppression and damage from ORVs. On private lands, Lewton's polygala is threatened primarily by habitat loss to development, and secondarily by fire suppression. Seventeen of 49 extant occurrences (35 percent) are located on private properties where they have no protection from development and prescribed fire is unlikely (FNAI 2009a). The status of 14 of these occurrences is unknown. If they are not already extirpated, they could be destroyed at any time. On public lands, Lewton's polygala is protected from development, but is threatened by inadequate fire management (fire too infrequent or non-existent) at some sites. These threats are discussed below.

#### Development

Development is the primary threat to the 17 unprotected occurrences on private land. Several unprotected occurrences (i.e., EORs 8, 9, 23, 24, 26, and Rocky Point Road) are known to have been partially or completely impacted by development. The last remaining extant occurrence of Lewton's polygala in Orange County (Spyglass Hill Road) is slated for development as a landfill in 2010.

Increasing pressure from population growth is likely to result in further loss of Lake Wales Ridge habitats. Zwick and Carr (2006) analyzed existing land use and landscape patterns to identify areas most likely to be developed to accommodate a growing human population (e.g., not a wetland, near major roads, near other development, on the coast and thus desirable) and estimated relative losses to agriculture, open space, and conservation to other land uses. They predicted central Florida will experience "explosive" growth, with continuous urban development from Ocala to Sebring, the area encompassing nearly the entire range of Lewton's polygala. They estimated 2.7 million acres of native habitat and 630,000 acres of land currently under consideration for conservation purchase will be lost. Also of significance, they state that

“more than two million acres within 1 mile of existing conservation lands will be converted to an urban use, complicating management and isolating some conservation holdings in a sea of urbanization” (Zwick and Carr 2006). Overall, loss of habitat to development will likely continue in central Florida, eliminating many unprotected populations, fragmenting remaining habitat and reducing the area of suitable habitat for Lewton’s polygala.

#### Fire suppression and inadequate fire management

As discussed above, fire stimulates regeneration from seed, improves seedling recruitment, increases seed production, and reduces competition, allowing Lewton’s polygala to thrive under conditions of frequent (every 1 to 5 years) fire. Lewton’s polygala has a persistent soil seed bank, but populations that have been extirpated due to fire suppression for decades may not recover even if fire is reintroduced to these sites (Menges et al. 2006).

Due to the extent of residential and agricultural development on the Lake Wales Ridge, fire has all but disappeared from the region as a widespread, natural phenomenon. Because there is little chance of prescribed fire being implemented to maintain habitat suitability in fragments on private land, imperiled species on unprotected sites will almost certainly disappear over time (Turner et al. 2006). In some managed areas, inadequate fire management may threaten occurrences. For example, while TNC monitored study populations at ADBP, they disappeared due to disturbance and lack of prescribed fire (TNC 2008). At LWRSF, while fire management has occurred, it has failed to target sites that support Lewton’s polygala, resulting in declining populations (Menges et al. 2009). On the ONF, fire return intervals applied to scrub are aimed at sand pine production, resulting in longer fire-return intervals than are ideal for Lewton’s polygala (USFS 2008). Data indicate that almost one-third (29 percent) of the occurrences on protected sites have not received prescribed fire (TNC 2010b).

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

Based on the best available information, this factor is not considered a threat to Lewton’s polygala.

#### **c. Disease or predation:**

Vertebrate herbivory has been observed on Lewton’s polygala (Weekley 1997). Rooting by feral hogs has impacted Lewton’s polygala at a few sites (TNC 2008). The overall threat level from predation appears low. No diseases have been observed to affect Lewton’s polygala.

**d. Inadequacy of existing regulatory mechanisms:**

Lewton's polygala 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 on State and Private lands. It does not prohibit private property owners from destroying populations of listed plants on their property nor require landowners to manage habitats to maintain populations. Existing Federal and State regulations prohibit the removal or destruction of listed plant species on public lands. However, such regulations afford no protection to listed plants on private lands. The ESA only protects populations from disturbances on Federal lands or when a 'Federal nexus' is involved for other lands, meaning any action that is authorized (e.g., permitted), funded or carried out by a Federal agency. In addition, State regulations are less stringent than Federal regulations toward land management practices that may adversely affect populations of listed plants on private land. Existing regulatory mechanisms are inadequate to protect Lewton's polygala.

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

Off-road vehicles (ORVs)

ORV impacts have been observed on natural areas on the Lake Wales Ridge (Schultz et al. 1999) and throughout central Florida. At ONF, the problem is acute, and there is a well-documented history of ORV impacts since 1994 (USFS 1999, Duever 2002, USFS 2007-2009, Paben 2006, Duever pers. comm. 2008). The USFS (1999) reported that "the current permissive access policy has resulted in a maze of crisscrossing roads and travel ways. Effects include user conflicts, erosion, compaction, and rutting of soils, sedimentation of streams and lakes, damage or destruction of heritage resource sites and disturbance of sensitive wildlife species." In a 2005 Biological Opinion the Service concluded that "next to the proper application of prescribed fire, the single most important factor affecting the federally listed species in the [ONF] is the increasing numbers of recreational users" (Service 2005). Off-road vehicles crush, uproot and tear plants as they drive over them. Roads have the potential to facilitate and intensify illegal collection of rare plants and serve as corridors for exotic plant invasion. In ONF, breaks created by ORVs in the wiregrass ground cover interfere with sandhill burns. The damaged wiregrass groundcover is unlikely to recover without lengthy and costly ecological restoration (Duever 2002).

Prior to the revision of the Land Management Plan (LMP) for the Forests of Florida in 1999, recreation users were allowed to travel cross-country, off of the roads and trails throughout most of the ONF. Years of lax monitoring and law enforcement had made Florida's national forests an essentially lawless frontier for ORV users, with little enforcement of regulations due to a lack of

law enforcement personnel (Duever 2002). Once the LMP was signed, two significant policy changes took place. All cross-country travel on land with no existing roads or trails was prohibited and restricted areas were established where travel would be limited to designated roads and trails only. Under the 1999 LMP, motorized use would continue on existing routes in the “unrestricted area” (USFS 1999a).

The LMP-mandated ORV route designation process was drawn-out over several years. In 2002, 97 percent of the ONF exceeded the 1 mile per square mile standard scientists recommend for ecological core habitat (Duever 2002). Paben 2006 reported that ORV use is heavy in all parts of the ONF and road densities are extremely high. Of the 3,721 miles of roads in ONF 2,400 miles (64 percent) are unauthorized ORV tracks. Paben 2006 estimated that 120,170 acres of Ocala National Forest had been denuded by ORVs operating off of designated roads and trails. ONF’s problems are compounded by the forest’s popularity as a site for organized ORV rallies and races. These widely advertised events attract large numbers of users from Florida and all over the United States. These events often lack any USFS enforcement presence and there has been little attempt to document site conditions before or after these events (Duever 2002). Duever (pers. comm. 2008) recounts numerous instances of obliterated populations of listed plant species, and comments that “damage to *Polygala lewtonii*...sites has probably had even worse consequences, since the physical structure of those plants would appear to make them more vulnerable to vehicular injury.”

In response to mounting evidence of negative effects of ORVs in national forests, the USFS (2006) published a new Final Rule on motor vehicle access in 2005 that requires each National Forest to designate roads, trails, and areas open to motor vehicle use. The “restricted areas” set up in the 1999 LMP were superseded by the new rule. In effect, the more stringent rules for designating roads, trails, and areas in the restricted areas now apply to the entire ONF (USFS 2006). Starting in 2006, the USFS began implementing measures to enforce the 2005 ORV access policy. All trails have now been marked with usage designation and 45 unauthorized roads and trails were blocked off where they intersected designated ORV routes. However, it was reported that forest users opened up some of the blocked roads with chain saws during hunting season (USFS 2008). USFS uses repeat photography to monitor the recovery of unauthorized trails. USFS (2009) reports that after 3 years of (2006-2008) of implementing their ORV access plan, some of the unauthorized trails are beginning to show signs of closing-in and modest recovery of ground cover. However, USFS (2007-2009) reported that “continuing threats to wilderness character include motorized incursions into wilderness by (ORVs).” The percentage of non-designated roads still being used ranged from 36 percent on the Tobacco Patch Trail to 80 percent on the Wandering Wiregrass Trail (USFS 2009). Unfortunately, ORV monitoring is not yielding useful information such as number and type of ORV violations



recorded and thus no trend data for ORV use or enforcement are available (USFS 2009). Overall, the Service considers ORVs a significant threat to Lewton's polygala, especially in the ONF, but also on unprotected sites on the Lake Wales Ridge.

#### Non-native plant species

Bahia grass, cogon grass (*Imperata cylindrica*), and Natal grass invade scrub and sandhill habitats and have negative effects through direct competition and by altering fire behavior. These species are reported at numerous sites supporting Lewton's polygala.

#### Ex situ measures

Lewton's polygala is lacking two standard *ex situ* conservation measures. First, it is not grown at Bok Tower Gardens, which houses other species in the Center for Plant Conservation National Collection of Endangered Species. Second, seeds have not been provided for storage at the National Center for Genetic Resources Preservation in Fort Collins, Colorado (Bok Tower Gardens unpubl. data, 2009).

### **D. Synthesis**

Lewton's polygala is a perennial herb occurring in sandhill and scrub communities on the Mount Dora Ridge and Lake Wales Ridge in central Florida. It has a complex breeding system involving three different types of flowers, including underground flowers which produce seeds that are already buried and are thus better equipped to withstand the heat during the frequent fires associated with sandhill communities. Lewton's polygala responds favorably to fire, often with explosive population growth. In the absence of fire, populations can persist through recruitment episodes that correlate with periods of high rainfall. At sites managed with prescribed fire, patches of Lewton's polygala disappear and reappear, establishing a mosaic across the landscape.

None of the recovery criteria identified in the MSRP have been achieved to date. Seventeen of the 49 extant occurrences (35 percent) are located on private property where they have no protection. Occurrences on private, unprotected sites are threatened by habitat loss due to development and lack of fire. Lewton's polygala occurs in 13 managed natural areas. Some occurrences on public lands are threatened by inadequate fire management and ORV disturbance. About one-third (29 percent) of the 32 occurrences on protected lands are not adequately managed with fire. Monitoring programs are ongoing at several sites, but no PVA for Lewton's polygala has been produced to date. Protected occurrences are few (2 of 14) in Lake, Orange and Osceola Counties, representing a significant portion of the species range that is not protected. For these reasons, Lewton's polygala continues to meet the definition of endangered under the ESA.

### III. RESULTS

#### A. Recommended Classification:

  X   No change is needed

B. New Recovery Priority Number   N/A  

### IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Acquire private sites with existing populations from willing sellers, particularly in Lake County.
- 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 conserve extant populations.
- Ensure representation of Lewton's polygala at the National Center for Genetic Resources Preservation in Fort Collins, Colorado.
- Continue demographic monitoring at multiple sites and produce a PVA.
- Develop a standard methodology for monitoring Lewton's polygala on conservation lands
- Determine the level of disturbance from ORVs to Lewton's polygala occurrences on the ONF and other sites
- Strengthen *ex situ* conservation measures. The species should be represented at Bok Tower Gardens, which houses other species in the Center for Plant Conservation National Collection of Endangered Species.

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**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW OF LEWTON'S POLYGALA (*Polygala lewtonii*)**

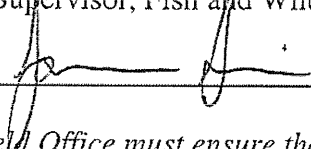
Current Classification Endangered  
Recommendation resulting from the 5-Year Review

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

Review Conducted By David Bender, Botanist

**FIELD OFFICE APPROVAL:**

*for*  
Lead Field Supervisor, Fish and Wildlife Service

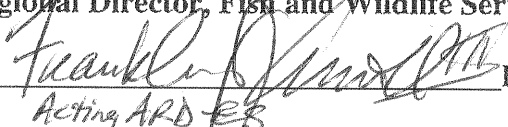
Approve  Date 5/13/10

*The lead Field Office must ensure that other offices within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. The lead field office should document this coordination in the agency record.*

**REGIONAL OFFICE APPROVAL:**

*The Regional Director or the Assistant Regional Director, if authority has been delegated to the Assistant Regional Director, must sign all 5-year reviews.*

**Lead Regional Director, Fish and Wildlife Service**

*for*  
Approve  Date 8/5/2010  
*Acting ARD - ES*

*The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. If a change in classification is recommended, written concurrence from other regions is required.*

**Cooperating Regional Director, Fish and Wildlife Service**

Concur  Do Not Concur

Signature \_\_\_\_\_ Date \_\_\_\_\_

Table 1. Summary of occurrences (Bok Tower Gardens, unpubl. data; FNAI 2009a; Rolly, pers. comm. 2008; TNC 2008, 2009; Weekley, pers. comm. 2010a).

FNAI EOR No.	County	Site Name	Alternate Site Name	Managing Agency	Status	Last Observation Cite	Year	Population Estimate	Comments
<b>Protected Occurrences</b>									
1	Marion	Ocala National Forest	Hughes Island	USFS	extant	FNAI 2009	2006	1690 - 1802	
5	Polk	Walk-In-Water Tract LWRSF		FDOF	extant	FNAI 2009	1982	4	
10	Polk	Walk-In-Water Tract LWRSF		FDOF	extant	FNAI 2009	1983	"one small clump"	
11	Polk	Tiger Creek Preserve	Pfundstein near PF7	TNC	extant	TNC 2008	2008	300	estimates are plots within EOR
14	Highlands	Highlands Hammock State Park		FDEP	record in error	Weekley pers. comm. 2010a	2009	not present	removed from analysis
	Highlands	The Preserve		Highlands Cty. Parks and Rec. Dept.	record in error	Weekley pers. comm. 2010a	2009	not present	removed from analysis
	Highlands	Silver Lake LWRWEA		FWC	record in error	Weekley pers. comm. 2010a	2009	not present	removed from analysis
15	Polk	Walk-In-Water Tract LWRSF		FDOF	extant	FNAI 2009	1998	8	
16	Polk	Tiger Creek Preserve	Central Highlands near CH 7	TNC	extant	TNC 2008	2008	32	estimates are plots within EOR
17	Polk	Tiger Creek Preserve	Central Highlands near CH 2 and 8	TNC	extant	TNC 2008	2008	20	estimates are plots within EOR
18	Polk	Tiger Creek Preserve	Tiger Creek Forest TF3	TNC	extant	TNC 2008	2006	0	no plants in study plots, still extant on
19	Polk	Tiger Creek Preserve	Pfundstein north of PF7	TNC	extant	FNAI 2009	1987	1	unable to match EOR with TNC 2008
20	Polk	Tiger Creek Preserve	Tiger Creek Forest TF1.3	TNC	extant	TNC 2008	2008	0	no plants in study plots, still extant on site
21	Polk	Upper Lakes Basin Watershed	Horse Creek Scrub	SFWMD	extant	unpubl. notes 2008	2008	present	
22	Polk	Tiger Creek Preserve	Wakeford WK1	TNC	extant	TNC 2008	2008	97	estimates are plots within EOR
25	Polk	Longleaf Pine Preserve	Crooked Lake Sandhill	Polk County Env. Lands Prg.	extant	TNC 2008	2008	181	estimates are plots within EOR
32	Lake	Scrub Point Preserve		Lake County Water Authority	extant	Weekley pers. comm. 2010a	2009	> 30	
37	Lake	Warea Tract - Seminole State Forest	Warea tract (or Flat Lake)	FDOF	extant	FNAI 2009	2008	"several hundred"	
38	Polk	Hesperides Tract LWRSF		FDOF	extant	Clanton 2009	2008	180	
39	Highlands	Carter Creek LWRNWR	Carter Creek south	USFWS	extant	Weekley pers. comm. 2010a	2009	present	
	Highlands	Carter Creek LWRWEA	Carter Creek north	FFWC	extant	Weekley pers. comm. 2010a	2009	present	
55	Polk	Arbuckle Tract LWRSF		FDOF	extant	FNAI 2009	1989	< 10	
56	Polk	Arbuckle Tract LWRSF		FDOF	extant	FNAI 2009	1989	20 to 100	
57	Polk	Arbuckle Tract LWRSF		FDOF	extant	FNAI 2009	1989	< 10 plants	
58	Polk	Arbuckle Tract LWRSF		FDOF	extant	FNAI 2009	1989	< 20 plants	



Table 1. (continued)

FNAI EOR No.	County	Site Name	Alternate Site Name	Managing Agency	Status	Last Observation Cite	Year	Population Estimate	Comments
59	Polk	Arbuckle Tract LWRSF		FDOF	extant	FNAI 2009	1989	< 80 plants	
60	Polk	Arbuckle Tract LWRSF		FDOF	extant	FNAI 2009	1989	"common"	
61	Polk	Tiger Creek Preserve	Pfundstein east of PF7	TNC	extant	FNAI 2009	2005	> 1	unable to match EOR with TNC 2008
62	Marion	Ocala National Forest	scrub occurrences	USFS	extant	FNAI 2009	2007	44	
63	Marion	Ocala National Forest	scrub occurrences	USFS	extant	FNAI 2009	2007	15	
64	Marion	Ocala National Forest	scrub occurrences	USFS	extant	FNAI 2009	2007	25	
65	Marion	Ocala National Forest	scrub occurrences	USFS	extant	FNAI 2009	2007	21	
66	Marion	Ocala National Forest	scrub occurrences	USFS	extant	FNAI 2009	2007	36	
none	Polk	Pine Ridge Preserve	Bok Tower Gardens	BTG	extant	BTG unpubl. data 2009	2009	173	
none	Polk	Allen D. Broussard Memorial Catfish Creek Preserve		FDEP	extant	Weekley pers. comm. 2010a	2008	present	no plants in study plots, but still present on site
<b>Unprotected Occurrences</b>									
2	Lake	private property	Lake County PNA #175	n/a	extant	BTG unpubl. data 2009	2009	11	surrounded by development
3	Lake	private property	Ferndale Ridge	n/a	unknown	FNAI 2009	1998	15	overgrown
4	Lake	private property		n/a	likely extirpated	FNAI 2009	2004	0	
6	Lake	private property		n/a	unknown	FNAI 2009	1994	1	
7	Lake	private property	Castle Hill	n/a	extant	BTG unpubl. data 2009	2009	> 100	surrounded by development
8	Polk	private property		n/a	unknown	FNAI 2009	1982	present	
9	Orange	private property		n/a	likely extirpated	FNAI 2009	1999	0	
12	Osceola	private property	Lake Davenport	n/a	unknown	FNAI 2009	1997	> 35	
13	Polk	private property		n/a	unknown	FNAI 2009	1983	< 10	
23	Highlands	private property		n/a	unknown	FNAI 2009	1988	present	
24	Highlands	private property		n/a	unknown	FNAI 2009	1987	present	
26	Orange	private property		n/a	likely extirpated	FNAI 2009	2006	0	
27	Lake	private property	John's Lake north	n/a	unknown	FNAI 2009	1994	"rare"	overgrown to oak hammock, ORVs
28	Lake	private property	Sugarloaf Mountain	n/a	unknown	FNAI 2009	1998	0	
29	Lake	private property	Schofield Sandhill (Water Conserve II site)	n/a	extant	Weekley pers. comm. 2010a	2009	> 30	fenced
30	Lake	private property	Lake County PNA #3	n/a	likely extirpated	BTG unpubl. data 2009	2009	0	overgrown
31	Lake	private property		n/a	unknown	FNAI 2009	1994	"rare"	
33	Lake	private property	Lake County PNA #92	n/a	likely extirpated	BTG unpubl. data 2009	2009	0	overgrown

Table 1. (continued)

FNAI EOR No.	County	Site Name	Alternate Site Name	Managing Agency	Status	Last Observation Cite	Year	Population Estimate	Comments
35	Lake	private property	Lake County PNA #127 (Lost Lake)	n/a	likely extirpated	BTG unpubl. data 2009	2009	0	overgrown
36	Lake	private property		n/a	unknown	FNAI 2009	1994	2	
38	Polk	private property	FFBOT Hesperides (unacquired)	n/a	unknown	FNAI 2009	1998	5	
54	Lake	private property		n/a	unknown	FNAI 2009	1994	48	
none	Orange	private property	Spyglass Hill landfill site	n/a	unknown	Rolly pers. comm. 2008	2008	24	slated for development to landfill in 2009
none	Polk	private property	Rocky Point Road (Phillips Rd)	n/a	unknown	BTG unpubl. data 2009	1992	2	vacant lot in subdivision

Table 2. Occurrences by county (Bok Tower Gardens, unpubl. data; FNAI 2009a; Rolly, pers. comm. 2008; TNC 2008, 2009; Weekley, pers. comm. 2010a).

County	Extant		Extirpated		Total
	Protected	Unprotected	Protected	Unprotected	
Polk	22	3	0	0	25
Lake	2	10	0	4	16
Marion	6	0	0	0	6
Highlands	2	2	0	0	4
Orange	0	1	0	2	3
Osceola	0	1	0	0	1
<b>Total</b>	<b>32</b>	<b>17</b>	<b>0</b>	<b>6</b>	<b>55</b>

**Appendix. Summary of peer review for the 5-year review of Lewton's polygala (*Polygala lewtonii*)**

**A. Peer Review Method:** The Service conducted a peer review for this species 5-year review. Three peer reviewers were selected by the Service. Individual responses were requested and received from each of the peer reviewers.

**B. Peer Review Charge:** See attached guidance.

**C. Summary of Peer Review Comments/Report:** The reviewers found the 5-year review comprehensive and all agreed with the main conclusions of the review.

One peer reviewer suggested more current or better (i.e., peer-reviewed journal versus agency report) citations for particular statements throughout the review. This reviewer was an author of numerous papers on the species and provided clarification of some aspects of the species life history demography. This reviewer took issue with the claim that extirpations had occurred at two protected sites. The reviewer also provided updates for several of the occurrences, and disputed the validity of another.

A second reviewer clarified that monitoring results presented by her organization represented study populations, rather than all occurrences at the sites in question.

A third reviewer corrected a citation for data provided by her organization and had no other comments on the substance of the review.

**D. Response to Peer Review:** The Service agreed with all of the comments and made changes throughout the review to address substantive comments. Citations for aspects of the species' life history, demography, and survey data were updated and corrected. Text was added to clarify statements about the species' seed bank longevity, post-fire survival, and recommended fire return interval. Comments from the second reviewer regarding her study populations, once addressed, served to satisfy the concerns expressed by the first reviewer regarding extirpations at two protected sites (i.e., they were patch extirpations in study plots, as opposed to the disappearance of the species across the entire site). The Service corrected the status of these occurrences to extant. The validity of EOR 14 was found to be erroneous and not supported by data, so this record was removed from the analysis. All figures in the review were recalculated based on these corrections to the number of occurrences and their status.

**Guidance for Peer Reviewers of Five-Year Status Reviews**  
U.S. Fish and Wildlife Service, South Florida Ecological Services Office

March 27, 2009

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with U.S. Fish and Wildlife Service (Service) policy.

Peer reviewers should:

1. Review all materials provided by the Service.
2. Identify, review, and provide other relevant data apparently not used by the Service.
3. Not provide recommendations on the Endangered Species Act classification (e.g., endangered, threatened) of the species.
4. Provide written comments on:
  - Validity of any models, data, or analyses used or relied on in the review.
  - Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.
  - Oversights, omissions, and inconsistencies.
  - Reasonableness of judgments made from the scientific evidence.
  - Scientific uncertainties by ensuring that they are clearly identified and characterized, and that potential implications of uncertainties for the technical conclusions drawn are clear.
  - Strengths and limitation of the overall product.
5. Keep in mind the requirement that the Service must use the best available scientific data in determining the species' status. This does not mean the Service must have statistically significant data on population trends or data from all known populations.

All peer reviews and comments will be public documents and portions may be incorporated verbatim into the Service's final decision document with appropriate credit given to the author of the review.

Questions regarding this guidance, the peer review process, or other aspects of the Service's recovery planning process should be referred to Dana Hartley, Endangered Species Supervisor, South Florida Ecological Services Office, at 772-562-3909, extension 236, email: Dana\_Hartley@fws.gov.