Highlands Scrub Hypericum
(Hypericum cumulicola)

5-Year Review:
Summary and Evaluation

Photos by Eric Menges

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

5-YEAR REVIEW
Highlands scrub hypericum (*Hypericum cumulicola*)

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 (Service 2008) 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 14669). We received one public comment during the open comment period. We evaluated and incorporated comments as appropriate in this review. We also 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 listing this plant under the Endangered Species Act of 1973, as amended (ESA) (52 FR 2227), the Recovery plan (Service 1999), the 2008 5-year review, peer reviewed scientific publications, and unpublished field observations by Federal, State, and other experienced biologists. The review was contracted to an Archbold Biological Station (ABS) plant ecologist and finalized by the lead recovery biologists for Highlands scrub hypericum in the Florida Ecological Services Office (FESO), Vero Beach. Literature and documents used for this 5-year review are on file at the FESO. All recommendations resulting from this review are a result of thoroughly reviewing the best available information on Highlands scrub hypericum. The completed draft was sent to three peer reviewers for review. Comments were received from two reviewers and evaluated and incorporated into this final document as appropriate (see Appendix A).

B. Reviewers

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

Lead Field Office: FESO, Emily Bauer, (772) 469-4335

C. Background

1. FR Notice citation announcing initiation of this review: April 11, 2019. 84 FR 14669.

2. Listing history:
Original Listing
FR notice: 52 FR 2227
Date listed: January 21, 1987
Entity listed: Species
Classification: Endangered

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

4. Review History: Each year the U.S. Fish and Wildlife Service (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 2008 showed this species as unknown with no change recommended to the species' status due to the probability of continued populations losses at unprotected sites and the lack of adequate fire management at existing protected sites (Service 2008).

Recovery Plan: 1999
Previous 5-year review: 1991 and 2008

5. Species' Recovery Priority Number at start of review (48 FR 43098): 2. A recovery priority number of "2" indicates that this is a species with a high degree of threat and high recovery potential.

6. Recovery Plan:
Name of plan: South Florida Multi-Species Recovery Plan (MSRP) (Service 1999)
Date issued: May 18, 1999
Date of amendment to the original 1999 MSRP Highlands scrub hypericum recovery criteria: September 24, 2019 (Service 2019)
Dates of previous plans: Recovery Plan for nineteen central Florida scrub and high pineland plants (revised). June 20, 1996; Recovery plan for eleven Florida scrub plant species. January 29, 1990.

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 and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

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. **For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5 listing factors are not relevant to this species, please note that here.**

The recovery criteria as presented in the 2019 amendment to the recovery plan is broken down into three parts ([1-3] in bold below) for clarity purposes (Service 2019). These criteria address 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 for commercial, recreational, scientific, or educational purposes) and C (disease or predation) are not relevant to this species.

Highlands scrub hypericum may be delisted when:

[1] at least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes;

There are not sufficient data on 20 populations to classify trends, determine natural recruitment levels, or quantify age classes. To determine age classes directly, individual plants will need to be followed from seedlings onward.

[2] populations (as defined in criterion 1) in rosemary scrub habitats are distributed across the known range of the species;

This criterion has largely been satisfied, with protected populations found throughout the species range on the Lake Wales Ridge (LWR). There is one unprotected population off the LWR.

and [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.

Highlands scrub hypericum is protected at 22 sites, many with large populations, with active fire management programs. However, no population viability analyses have been conducted to determine long-term viability at multiple sites. ABS has had

consistent fire management to support viable populations of Highlands scrub hypericum (P.F. Quintana-Ascencio, University of Central Florida, pers. comm. 2020) and modeling suggests a healthy metapopulation (Quintana-Ascencio et al. 2018; Quintana-Ascencio et al. 2019). A few other populations (e.g. Carter Creek and Gould Road Units of the Lake Wales Ridge Wildlife and Environmental Area [LWRWEA]) are also well managed and populations may be viable there. Highlands scrub hypericum is abundant and well distributed at Lake Wales Ridge State Forest (LWRSF), but recent burning has potentially been too frequent in rosemary scrub, as it is sometimes embedded in flatwoods and other plant communities that are frequently burned (H. Rosner-Katz, Florida Department of Agriculture and Consumer Services, pers. comm. 2020). However, fires are often patchy in rosemary scrub, reducing the frequency at a small spatial scale.

C. Updated Information and Current Species Status

1. Biology and Habitat

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:

Population Sizes – Highlands scrub hypericum is locally abundant at ABS, the properties of the LWRWEA (including Lake Placid, Holmes Avenue, Lake Apthorpe, Gould Road, and Carter Creek), Lake June in Winter Scrub State Park, The Nature Conservancy's (TNCs) Saddle Blanket Lakes Preserve, and the Arbuckle tract of LWRSF. Many other populations of Highlands scrub hypericum are relatively small. Population size estimates for 34 populations showed a median of 539 individuals, most populations were smaller than 1,000 plants, the largest population was estimated to be greater than 300,000 plants, and the 25^{th}-75^{th} percentiles for population size were 130-4,000 plants (data summarized in Table 1 of Menges et al. 2001).

Rosner-Katz (pers. comm. 2020) reported that the LWRSF has 259 GPS points representing 3,034 individuals of Highlands scrub hypericum. Some of these are from 10 or more years ago and may not have been revisited more recently. A map of points with vegetation shows that many patches of rosemary scrub (the most suitable habitat for Highlands scrub hypericum) are occupied by this species, but there are also many patches without it present (or at least not ever observed/documented as being present).

Trends in Population Sizes – Population sizes of Highlands scrub hypericum vary considerably over time in relation to fire. Population trends in roadside populations are more volatile than scrub populations (Quintana-Ascencio et al. 2007). Scrub populations subjected to fires generally show a sharp initial decline, as plants directly affected by fire are killed. However, populations rebound quickly from seeds germinating from a soil seed bank, and population size often peaks in the first

decade after fire (Quintana-Ascencio et al. 2003; Dolan et al. 2008). Higher fecundity, survival, establishment, and population growth rates occur after fire than in unburned populations (Quintana-Ascencio et al. 2003). Fire return intervals less frequent than once every 50 years create substantial extinction risk (Quintana-Ascencio et al. 2003). In most cases, there is a partial or full recovery of population size a few years after fire (Quintana-Ascencio et al. 2007). Thereafter, populations tend to decline, although the declining pattern often flattens out several decades post-fire.

Highlands scrub hypericum at Saddle Blanket Preserve was once monitored using mapping by B. Pace-Aldana of TNC (pers. comm. 2008). The species occurs in approximately 75 percent of scrub patches at this site. This monitoring has been discontinued (Pace-Aldana, pers. comm. 2020). While Highlands scrub hypericum also occurs at several other conservation sites on the LWR, no other data on population trends are available. Due to these data limitations, it is difficult to draw inferences on population trends.

Ecology and Life History – Highlands scrub hypericum is a diminutive, short-lived, perennial herb. It generally is found in rosemary scrub or dry scrubby flatwoods (and along roadsides on similar soils; Quintana-Ascencio et al. 2007). It is a specialist for gaps and for recently burned areas (Quintana-Ascencio et al. 2003; Menges et al. 2017).

There has been as much published research on the ecology and life history of Highlands scrub hypericum as on any other Florida scrub species. The large demographic dataset was used to provide examples of the use of software to conduct integral projection models (Metcalf et al. 2012). The most practical finding from this research is that the long-term absence of fire will result in declining vital rates and population viability (Quintana-Ascencio et al. 2003). Survival, growth, and fecundity were all higher in recently burned sites in a series of field experiments (Quintana-Ascencio and Menges 2000). In addition, Highlands scrub hypericum survival and growth were higher in more open sites and away from Florida rosemary (*Ceratiola ericoides*) (Quintana-Ascencio and Morales-Hernandez 1997; Quintana-Ascencio and Menges 2000). However, mis-timed fire may cause declines in Highlands scrub hypericum. Poor recruitment at one ABS site occurred when a strong drought followed a 1999 burn (P. Quintana-Ascencio, pers. comm. 2008). Although land managers cannot control drought, fires that precede forecasted droughts should be avoided. Other factors that can cause population crashes include flooding in roads (Quintana-Ascencio et al. 2007) and frost damage (Quintana-Ascencio, pers. comm. 2008).

It is clear that Highlands scrub hypericum prefers fire return intervals of less than 50 years; longer intervals without fire may lead to local extinctions (Quintana-Ascencio et al. 2003). Fire managers should manage for heterogeneous landscapes as the optimal fire return interval for this species, 15-40 years, may conflict with co-occurring species (Menges et al. 2019).

Recent modeling of Highlands scrub hypericum has become more sophisticated and has been accomplished at a larger spatial scale. Quintana-Ascencio et al. (2018), using a large dataset of 22 years, 15 populations, and nearly 11,000 plants, considered four landscape drivers (time-since-fire, patch area, patch aggregation, patch elevation) affecting the demography of this species. Population growth was greater and extinction risk was lower with frequent fire, at higher elevations, and in larger and more aggregated patches. The model was successful at predicting patch occupancy but less so in predicting abundance. Large, higher (i.e. drier), aggregated patches supported more stable populations without fire, while smaller, lower lying, isolated patches required more frequent fire to reduce extinction risk (Quintana-Ascencio et al. 2018).

An extension of this approach (Quintana-Ascencio et al. 2019) modeled seed dormancy and seed dispersal in a spatially explicit metapopulation model, finding that a model with limited seed dispersal (mean 0.5 meter) and high dormancy (field estimates * 1.2 percent) was a good predictor of the spatial distribution of occupied patches of Highlands scrub hypericum.

Highlands scrub hypericum also grows on roadsides with similar soils to Florida scrub. These populations differ demographically from scrub populations: they grow faster, have more variable mortality, have shorter lifespans, and subsequently have more variable population dynamics compared to scrub populations (Quintana-Ascencio et al. 2007). These differences are likely to be due to phenotypic plasticity, not genetic divergence, and could represent an ecological and evolutionary trap that could cause scrub populations to be less well adapted to scrub sites (Quintana-Ascencio et al. 2007). However, roadside sites may be demographically important to allow populations to persist through periods of fire suppression.

Highlands scrub hypericum generally has high germination percentages. Field experiments resulted in 20-40 percent germination (Quintana-Ascencio and Menges 2000). In experiments, its germination percentage was above 50 percent for all treatment combinations of smoke and dry heat, neither of which statistically affected its germination (King and Menges 2018). However, another field experiment sowing seeds in gaps of various sizes resulted in no Highlands scrub hypericum germination (Petru and Menges 2003). Navarra et al. (2011) showed that Highlands scrub hypericum forms a persistent seed bank (varying with time-since-fire) that allows for dormancy and delayed germination for up to three years. Other relevant research includes the experiments showing that Highlands scrub hypericum germination is higher with soil crusts present (Hawkes 2004), suggesting that this species may be vulnerable to vehicle disturbance or trampling. In contrast, the presence of ground lichens appears to have a negative effect on recruitment of Highlands scrub hypericum (Hawkes and Menges 2003), although these effects were slight given low rates of germination. Allelopathy from Florida rosemary may limit recruitment of Highlands scrub hypericum as well (Hunter and Menges 2002; Hewitt and Menges 2008), although Highlands scrub hypericum densities in the field were

not affected by the presence of the allelopathic *Calamintha ashei* (Calabrese and Menges 2007). In scrub, Highlands scrub hypericum occurs mainly in gaps (Quintana-Ascencio et al. 2003; Dolan et al. 2008). These results suggest that recently burned, untrampled sites with inter-shrub gaps will provide the best conditions for recruitment in this species. Highlands scrub hypericum seeds were removed more often by invertebrates than vertebrates and in higher frequency in intact than disturbed scrub (Stephens et al. 2012). The species also had higher germination in bare sand than in litter only or under shrubs (Stephens et al. 2012).

Highlands scrub hypericum is dependent on arbuscular mycorrhizal (AM) fungi to help it garner nutrients. In addition, biological soil crusts fix nitrogen from the atmosphere and some of this nitrogen is eventually taken up by nearby plants of several species, including Highlands scrub hypericum (Hawkes 2003).

Highlands scrub hypericum has also been the subject of explorations into the role of microbes on demography. A study combining demographic data, bioassays, and population modeling found that soil microbiomes increased the population growth rate of Highlands scrub hypericum by 13 percent, with greater benefit in low-nutrient, high elevation microhabitats (David et al. 2019).

Small native solitary bees of the genus *Dialictus* (Hymenoptera: Halictidae) were the main flower visitors to Highlands scrub hypericum, making 99 percent of all observed visits (Boyle and Menges 2001). These bees harvested pollen and their movements suggested they are efficient pollinators. Visitation rates increased with flower density and populations that had higher visitation rates had higher average seed set. Since flowering density decreases with time since last fire, long-unburned patches of Highlands scrub hypericum suffer lower fecundity and are likely more susceptible to inbreeding depression (Boyle and Menges 2001). Highlands scrub hypericum is self-compatible, with very similar seed set whether self- or cross-pollinated; however, there is little seed set without insect visitation (Evans et al. 2003).

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding):

Highlands scrub hypericum populations have a low amount of genetic (isozyme) variability but a high degree of genetic differentiation among populations (Dolan et al. 1999; Menges et al. 2001). Genetic variation in Highlands scrub hypericum was not related to population size or past/current landscape structure (Menges et al. 2010). A detailed isozyme analysis at a single site showed that expected heterozygosity increased, and allele presence and allele frequencies showed marked shifts, following a 2001 fire that killed the aboveground population (Dolan et al. 2008). Populations became twice as differentiated after fire. This study demonstrated that seed banks can be genetic reservoirs, that rapid genetic change with disturbance can occur, and that fire can have positive effects on the genetics of Highlands scrub hypericum. Microsatellite markers have also been developed for

Highlands scrub hypericum (Edwards et al. 2007). A large crossing study including 16 populations of Highlands scrub hypericum showed that fitness was significantly lower in smaller than larger populations (Oakley and Winn 2012). Fitness of larger transplanted experimental populations was greater than for smaller populations, and fitness was also higher for roadside than scrub populations (Oakley 2013). Finally, there was little differentiation among 16 wild populations in ecologically important genetic traits, suggesting limited adaptive responses to environmental change (Oakley 2015).

c. Taxonomic classification or changes in nomenclature:

No recent changes. The Integrated Taxonomic Information System (2020) was checked while conducting this review. There are no taxonomic issues with this taxon.

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

Highlands scrub hypericum has a narrow distribution on the southern half of the LWR, primarily in Highlands County (32 Element Occurrence Records [EORs]) but also in Polk County (6 EORs; one EOR spans both counties). As of March 2020, Florida Natural Areas Inventory (FNAI) listed 39 EORs for Highlands scrub hypericum, compared to 66 in April 2008. This change in numbers is due to increasing the area that FNAI uses to define an EOR. In general, its current distribution matches its historic distribution, although individual populations within its range have undoubtedly been lost to development.

Of these 39 EORs, 17 are considered "good" or "excellent" data quality and 7 are "lower" quality. One population cannot be found. The remaining 14 are considered "historical", which indicates a lack of recent field information and possible extirpation. The most recent observations are distributed from the 1980s (19 EORs), to the 1990s (7 EORs), to the 2000s (1 EOR), and to the 2010s (13 EORs). EOR sizes varied widely from 0.02–2,116 acres (ac), skewed toward many small and few large EORs, with a median of 28 ac and a mean of 188 ac.

Schultz et al. (1999, see Table 3) summarized 76 EORs for Highlands scrub hypericum, of which 32 (42 percent) occurred in 10 areas protected or proposed for protection on the LWR. These areas are Sunray (2 EORs), Trout Lake (1 EOR), Avon Park Lakes (1 EOR), Silver Lake (3 EORs), Carter Creek (4 EORs), Lake Apthorpe (4 EORs), Holmes Avenue (1 EOR), Lake June West (2 EORs), Highlands Ridge (5 EORs), and Gould Road (1 EOR) (Schultz et al. 1999, Table 4). FNAI (2020) reported 22 of 39 EORs (approximately 56 percent) on managed properties, with LWRWEAs (8 EORs), LWRSF (2 EORs), and ABS (2 EORs) having multiple EORs. Menges et al. (2019) lists the following 13 (of 19) FWC sites with Highlands

Scrub hypericum: Carter Creek, Clements, Gould Road, Henscratch, Highland Park Estates, Highlands Ridge, Holmes Avenue, Lake Placid Scrub, McJunkin, Royce Ranch, Silver Lake, Sun 'N Lakes (Sebring), and Sunray/Hickory Lake. Similar results can be found in Turner et al. (2006).

Among the 17 FNAI occurrences that are unprotected, two areas are notable. Highlands scrub hypericum at the Hendrie Ranch in southern Highlands County accompanies many listed plants and occurs in superb examples of rosemary scrub. This area is also at the edge of the range for Highlands scrub hypericum. Likewise, the disjunct population at Lizzie Lake is a range edge location for Highlands scrub hypericum. Because range-edge populations may be genetically different from populations in the central part of the range, they should be given consideration for protection.

Continued conversion of Florida scrub and sandhill to agriculture, housing, and other developments is undoubtedly affecting the number and sizes of Highlands scrub hypericum populations. About 78 percent of upland habitats on the LWR were lost by the 1980s (Weekley et al. 2008). By the early part of this century, about 87 percent of upland habitat was gone (Turner et al. 2006). Habitat losses were greatest on yellow sands and in the northern part of the LWR (Weekley et al. 2008). However, there has been considerable habitat loss on the soil types favored by Highlands scrub hypericum (Menges et al. 2007), suggesting that many populations have been extirpated.

An analysis of Florida scrub conservation progress (Turner et al. 2006) includes Highlands scrub hypericum among the 36 rare species of the LWR. Based on small area and limited geographic extent, Turner et al. (2006) listed Highlands scrub hypericum as a species of high conservation concern; in fact, it was included in a list of eight species thought to require translocation or captive propagation. Turner et al. (2006) also recommended that integrated management planning and management protocols be developed for Highlands scrub hypericum and other species of the highest conservation concern.

In the mid-1980s there were only four large conservation sites on the LWR. 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 more than $68 million to acquire nearly 24,710 ac of land on the LWR, with plans to acquire an additional 24,710 ac (Florida Department of Environmental Protection 2008). In 1990, the Service established the first National Wildlife Refuge (NWR) in the country designated primarily for plants, the LWRNWR. Particularly problematic and challenging have been the acquisition projects known as megaparcel sites, which include extensive areas of scrub habitat that were previously subdivided and sold to numerous lot owners. Through 2006, land acquisition placed nearly half (21,596 ac or 48.9 percent) of the remaining 44,157 ac of xeric upland habitat on the LWR within protected areas (Turner et al. 2006).

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

Highlands scrub hypericum is found almost exclusively in upland areas with excessively drained white sand soil (Judd 1980; Menges et al. 2007). It is found primarily in rosemary scrub but also in xeric scrubby flatwoods. These areas have fire return intervals from 5 to 30 years (Menges 2007). The species is not found in all areas of suitable habitat (Quintana-Ascencio et al. 1998), probably because of dispersal limitations. Because of this, Highlands scrub hypericum patch occupancy is more likely in larger and less isolated patches (Quintana-Ascencio and Menges 1996).

Within these types of Florida scrub, Highlands scrub hypericum is a gap specialist (Quintana-Ascencio and Morales-Hernandez 1997) and a poor competitor with shrubs (Quintana-Ascencio and Menges 2000). In rosemary scrub, gap sizes are smallest in areas that have not burned in decades (Menges et al. 2008). Shrinking gaps in long-unburned areas (Menges et al. 2017) may be one explanation for the decline in population viability in Highlands scrub hypericum in the absence of fire (Quintana-Ascencio et al. 2003).

In addition, Highlands scrub hypericum grows in disturbed areas such as sandy roadsides that often occur adjacent to scrub populations. These roadside populations are demographically divergent from scrub populations; they are less stable with more variable life spans, earlier flowering, and higher fecundity (Quintana-Ascencio et al. 2007). These weedier tendencies could represent phenotypic plasticity or have a genetic basis. If the latter is true, then roadside genotypes might be able to invade scrub sites, perhaps to the detriment of adaptation to scrub conditions.

FNAI descriptions are consistent with Highlands scrub hypericum being specialized for well-drained white sands. Of specific scrub types, rosemary scrub was most commonly mentioned (15), followed by scrubby flatwoods/oak scrub (7). Fifteen descriptions were generic scrub or sand pine scrub (often used generically for Florida scrub). One EOR was described on yellow sand and one EOR had no habitat description. Human-caused disturbances were rarely mentioned (2 EORs).

Weekley (et al. 2008) estimated that approximately 85 percent of the xeric upland habitat on the LWR was destroyed by 2006, mainly due to development (commercial and residential) agriculture (largely citrus), and cattle ranching. The few hundred ac of remaining sandhill on the LWR are generally degraded from a history of logging, fragmentation, and fire-suppression (Peroni and Abrahamson 1986). By county, the greatest percent loss of habitat was in Lake County. By soil type, areas of yellow sand suffered the greatest loss because they were favored for citrus production (Weekley et al. 2008).

Fire management may be inadequate even though sites are protected for conservation. However, fire management has become more consistent in many conservation lands, especially those managed by the Florida Fish and Wildlife Conservation Commission (Menges, personal observation). 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.

f. Other: N/A

2. Five-Factor Analysis

a. Present or threatened destruction, modification or curtailment of its habitat or range: Habitat for Highlands scrub hypericum continues to be developed for agriculture, housing, and other uses. This is likely reducing the number and size of populations of this species on unmanaged lands. Despite the acquisition between 1985 and 2005 of over 45,500 ac of undeveloped land on the LWR, primarily through State programs such as Preservation 2000 and its successor Florida Forever, natural areas have continued to be destroyed during the past two decades (Weekley et al. 2008). Turner et al. (2006) estimated that 87 percent of upland habitat had been lost on the LWR by 2006; Weekley et al. (2008) estimated losses of over 85 percent. Areas with yellow sand substrate experienced greater loss (84.9 percent) than white sand areas (46.7 percent), where Highlands scrub hypericum is known to occur (Weekley et al. 2008).

Increasing pressure from population growth is likely to result in further loss of these habitats going forward. Carr and Zwick (2016) analyzed existing land use and landscape patterns to identify areas (including central Florida) most likely for development to accommodate a growing human population. They suggested that Florida's 2070 population will be nearly 15 million persons greater than in 2010, for an estimated total of 33,721,828. Using these figures, they estimated relative losses to agriculture, open space, and conservation to other land uses. If trends continue, they estimate 34 percent of land will be developed by 2070, up from 19 percent in 2010. At the same time, conservation lands will increase less than 1 percent (from 9,269,000 ac in 2010 to 9,525,000 ac by 2070). Overall, loss of habitat to development, primarily on private lands, will likely continue in Central Florida, eliminating populations and reducing the area of suitable habitat for Highlands scrub hypericum. Therefore, habitat on protected lands are critical for the recovery of these scrub plants.

Inappropriate fire regimes, mechanical treatments, and invasive exotic species also threaten the continued existence of Highlands scrub hypericum. Even on protected lands, Highlands scrub hypericum may be threatened by habitat modifications due to lack of fire. The effect of mechanical surrogates or pre-treatments for fire, which are widely used by land managers on the LWR, on Highlands scrub hypericum is not fully known, although one study (Weekley et al. 2007) suggested that fire alone is

most effective in maintaining this species. The main habitat for Highlands scrub hypericum, Florida rosemary scrub, may be threatened by too frequent fires (more than once in 15 years may cause local extirpation of Florida rosemary) or infrequent fires (longer than every 50 years may lead to decline of Florida rosemary). Infrequent fires are probably the greatest threat on both managed and unmanaged sites, although specific data are lacking. Competition from shrubs (Quintana-Ascencio and Morales-Hernandez 1997), the negative effects of ground lichens on recruitment (Hawkes and Menges 2003), and allelopathic inhibition of seed germination from Florida rosemary (Hunter and Menges 2002; Hewitt and Menges 2008) will cause fire-suppressed sites to have declining populations of Highlands scrub hypericum. Mechanical treatments to manage Florida rosemary are not a good alternative because plants do not resprout, and recovery by seedling recruitment following mechanical treatments has not been studied. Exotic species, particularly cogon grass (*Imperata cylindrica*) and feral hogs (*Sus scrofa*), are potential problems on sites that support Highlands scrub hypericum, but negative impacts have not been documented.

b. Overutilization for commercial, recreational, scientific, or educational purposes: We have no evidence of overutilization at this time.

c. Disease or predation: We have no information on disease affecting Highlands scrub hypericum. Herbivory has been reported for this species by Brudvig and Quintana-Ascencio (2003), but there is no indication that it has a strong impact on population dynamics.

d. Inadequacy of existing regulatory mechanisms: The ESA protect plants only when they occur on federally-owned lands or when a federal nexus is involved. Florida's "Preservation of Native Flora of Florida" law (Rule Chapter 5B-40 of the Florida Administrative Code under authority from the Florida Statutes, Chapters 581.185, 581.186, and 581.187) protect plants only when they occur on state-owned lands. This law allows for collection of plants on state-owned lands by permit only and only for scientific and educational purposes.

Highlands scrub hypericum is listed as endangered by the State of Florida on the Regulated Plant Index (Florida Department of Agriculture and Consumer Services Rule [FDACS] 5B-40). This law regulates the taking, transport, and sale of listed plants. However, property owners are not prohibited under this law from destroying populations of listed plants nor are they required to manage habitats to maintain populations.

Existing Federal (ESA) and state regulations (FDACS Rule 5B-40) prohibit the removal or destruction of listed plant species on public lands. However, they afford no protection to listed plants on private lands. In addition, state regulations are less stringent than federal regulations on land management practices that may adversely affect populations of listed plants. In conclusion, there are no existing regulatory measures that reduce or remove the threat of loss of populations or

removal/destruction of plants on private property.

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

Trampling

Damage from off-road vehicles and pedestrian trampling is a threat for Highlands scrub hypericum, especially for unprotected populations. Because Highlands scrub hypericum germination is higher with soil crusts present (Hawkes 2004), vehicle disturbance or trampling could threaten some populations with extirpation.

Few, Small, Isolated Populations in a Limited Geographic Range

The known occurrences of Highlands scrub hypericum occur within a very limited geographic range, primarily within the southern half of the LWR in Highlands and Polk County. The limited geographic range in combination with the loss of habitat has resulted in a highly fragmented landscape where the remaining scrub areas that provide habitat for Highlands scrub hypericum have become more and more isolated from each other, thereby making resiliency, redundancy, and representation more challenging to achieve. Given the limited geographic range of the species, a single catastrophic event could greatly reduce redundancy. In addition, the fragmented landscape may prevent 'rescue' or 'repopulation' from surrounding nearby populations.

Limited Dispersal Capability

Highlands scrub hypericum likely has dispersal limitations as indicated by its absence in some areas of suitable habitat (Quintana-Ascencio et al. 1998). Quintana-Ascencio et al. (2019) modeled seed dormancy and seed dispersal in a spatially explicit metapopulation model and found that a model with limited seed dispersal (mean 0.5 meter) and high dormancy (field estimates * 1.2 percent) was a good predictor of the spatial distribution of occupied patches of Highlands scrub hypericum. Limited seep dispersal means that areas where the species occurs may have large seed banks and should be considered in management plans to prevent scrub encroachment between fire intervals (Coutts et al. 2021).

Climate Change

There is currently no evidence of negative impacts to Highlands scrub hypericum from climate change factors, but this could change in the future. Florida is vulnerable to changes in rainfall and temperatures expected due to climate change. While the strong influence of ocean currents make 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°F (0.8 to 3.1°C) by 2050 and from 2.3 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 for Central Florida fall summer rainfall (wet season) will decrease up to 5 percent by 2050 (Runkle et al. 2017). 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. Scrub species, in general, can tolerate drought conditions, but it is unclear how this anticipated future threat will fully affect species like Highlands scrub hypericum or the ability to implement prescribed fire.

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. Highlands scrub hypericum was not affected by three strong hurricanes in 2004 (Menges et al. 2011); however, its resiliency to potentially stronger storms in the future is unknown.

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 LWR (Volk et al. 2017).

D. Synthesis - Highlands scrub hypericum is protected on 22 sites, often with large population sizes and active fire management. However, remaining unprotected populations are in imminent danger of decline and extirpation. Unprotected habitat continues to be developed for agriculture, housing, and other uses. This is likely reducing the number and size of populations of this species. The most recent estimate of the loss of xeric upland habitat on the LWR is 87 percent (Turner et al. 2006). On managed areas that include the protected occurrences, better land management is needed to ensure that protected populations remain extant. Appropriate management includes avoiding fire suppression, avoiding fires before forecasted droughts, creation of gaps, and avoiding damage by vehicles or pedestrian trampling to plants and to the cryptobiotic soil crust, which may facilitate seedling emergence. Inappropriate fire regimes remain a significant threat. Most scrub sites supporting Highlands scrub hypericum are not burned frequently enough to support viable populations and mechanical pre-treatments or surrogates may not provide the same benefits as fire. Exotic species invasion and herbivory are potential threats but have not been directly implicated as causing population declines. Few, small, isolated populations in a limited geographic range present additional risk for Highlands scrub hypericum. These factors, in conjunction with the species' limited dispersal potential, hinder population resiliency and ultimately recovery. Anticipated climate change factors such as alterations to temperature and precipitation patterns, tropical storm intensity, and sea-level risk will only exacerbate these threats. Due to these ongoing threats mentioned above, 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

- Develop land management plans that address the following threats to Highlands scrub hypericum: avoiding fire suppression, avoiding fires occurring before forecast droughts, creation of gaps, avoiding disturbances from off-road vehicles, and avoid trampling of Highlands scrub hypericum and the cryptobiotic soil crust that may facilitate its seedling emergence.
- Collect data on the response of Highlands scrub hypericum to management activities such as roller chopping, mowing, gyro-tracking, logging, and chain-saw felling and, to the extent that responses are dissimilar to post-fire responses, adjust fire-based population viability models.
- Develop a metapopulation model using information on population dynamics within populations, the number and distribution of populations, and dispersal among populations (for plants, mainly seed dispersal) to determine the number of self-sustaining populations needed to ensure persistence.
- Study seed dispersal among populations of Highlands scrub hypericum for use in a metapopulation model.
- Conduct quantitative level 2 surveys (counting individuals in defined areas) at additional sites outside of ABS and the LWRSF. Surveys should track changes in population sizes over time and in response to management treatments.
- Land purchase or conservation easement of key parcels (e.g., Hendrie Ranch, Lizzie Lakes) to protect important populations.
- Surveys for Highlands scrub hypericum at privately-owned, unprotected sites.
- Targeted collection of Highlands scrub hypericum from unprotected sites for *ex situ* conservation. Highlands scrub hypericum currently has limited protection in Bok Tower Garden's *ex situ* collection, with 32,012 seeds collected from 1988-1990 in cryogenic storage, and two plants from one population in their living collection (P. Gonsiska, Bok Tower Gardens, pers. comm. 2020).

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Highlands scrub hypericum (*Hypericum cumulicola*)

Current Classification: Endangered.

Recommendation resulting from the 5-Year Review:

___ **Downlist to Threatened**
___ **Uplist to Endangered**
___ **Delist**
_X_ **No change needed**

Review Conducted By: Emily Bauer, Florida Ecological Services Office, Vero Beach.

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve ROXANNA HINZMAN Digitally signed by ROXANNA HINZMAN Date: 2021.03.15 15:58:08 -04'00' Date _____

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

ADDENDUM 1, APPENDIX A
Peer Review
Summary of peer review for the 5-Year Review of Highlands scrub hypericum (*Hypericum cumulicola*)

A. Peer Review Method:
Initial draft peer review was requested from three individuals outside the Service who are knowledgeable of Highlands scrub hypericum.

B. Peer Review Charge:
In order to ensure that the best available information was used to conduct this 5-Year Review, we conducted a peer review of the draft document. Carrie Straight, Recovery Coordinator for the Atlanta Regional Office managed the peer review. On February 17, 2021, she emailed a draft copy of the 5-Year Review Addendum to three individuals who do not work for the Service. Specifically, we asked for comments on the validity of the data used, and the identification of any additional new information regarding Highlands scrub hypericum that had not been considered in this review. We specifically mentioned that we were not seeking the opinion on the legal status of this species, but rather that the best available data and analyses were considered in reassessing the status.

As part of the peer review process, we must evaluate the potential for conflicts of interest with the subject species or the action. Therefore, we asked each reviewer to fill out a Conflict of Interest form and return it with their comments.

C. Summary of Peer Review Comments: We received peer review comments from two reviewers. Both reviewers concurred with the information included, recommended future actions, and the results of the review. One reviewer included the citation for a recent scientific article related to the demography of Highlands scrub hypericum that they felt is appropriate for inclusion in the review.

D. Response to Peer Review: We appreciate all comments and suggestion received from peer reviewers. The recommendation for inclusion of the recent article by Coutts et al (2021) was incorporated into the 5-year review.