Wireweed
(*Polygonella basiramia*)

5-Year Review:
Summary and Evaluation

Photo: David Bender, USFWS

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

5-YEAR REVIEW
Wireweed / *Polygonella basiramia*

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 the species. The review was initially conducted by a fish and wildlife biologist in the U.S. Fish and Wildlife Service (Service) South Florida Ecological Services Office. Additional review was contracted to an ecologist familiar with the species and relevant research. Literature and documents used for this review are on file at the South Florida Ecological Services Office. All recommendations resulting from this review are a result of thoroughly reviewing the best available scientific information on the wireweed. Public notice of this review was given in the *Federal Register* on April 9, 2009, with a 60-day public comment period (74 FR 16230). Comments received and suggestions from peer reviewers were evaluated and incorporated as appropriate (see Appendix A).

B. Reviewers

Lead Region: Southeast Regional Office, Kelly Bibb, 404-679-7132; Nikki Lamp, 404-679-7118

Lead Field Office: David Bender and Darla Fousek, South Florida Ecological Services Office, 772-562-3909; Eric Menges (contractor), Archbold Biological Station, 863-465-2571

C. Background

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

2. Species status: Uncertain (2009 Recovery Data Call). Wireweed has 153 occurrence records, most of which are known to the Florida Natural Areas Inventory (FNAI). Thirty-four (22 percent) of these occurrences are considered extirpated. Eighty-four (71 percent) of 119 extant occurrences are protected and are distributed across 29 managed areas, many of which have thousands of plants documented (FNAI 2009). Thirty-five (29 percent) of the 119 extant occurrences are located on unprotected, private property, where they are vulnerable to habitat loss. Wireweed has a relatively short life span with fluctuating populations and metapopulation dynamics. Therefore, year-to-year assessments of population stability are not appropriate. Fire suppression and habitat loss continue to be threats to occurrences on private land, except those owned by Archbold Biological Station and The Nature Conservancy (TNC). Inadequate prescribed fire implementation or too frequent fires could be significant threats at many managed sites. It is not known if mechanical surrogates to fire provide the same benefits as fire. Further loss of unprotected occurrences 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 populations over the past year, 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: 52 FR 2234
Date listed: January 21, 1987
Entity listed: Species
Classification: Endangered

5. Associated rulemakings: None

6. Review History : In fiscal year 2002, reclassification of wireweed from endangered to threatened was considered, however upon further analysis and review, the Service determined that insufficient data existed to support reclassification (USFWS 2003).

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):
2 (a species with a high degree of threat coupled with high recovery potential).

8. Recovery Plan or Outline
Name of plan: South Florida Multi-Species Recovery Plan (MSRP)
Date issued: May 18, 1999
Dates of previous revisions: Recovery Plan for Nineteen Florida Scrub and High Pineland Plant Species June 20, 1996 (revised plan). Recovery plan for nineteen central Florida scrub and high pineland plants. January 29, 1990 (original plan).

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 wildlife. This definition limits listing DPS to only vertebrate species of fish and wildlife. Because the species under review is a plant, the DPS policy is not applicable.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective measurable criteria? Yes

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? No. The criterion of 20 to 90 percent probability of persistence over 100 years is too broad. It allows for a possible 80 percent chance of extinction at the lower end of the range of probability of persistence. Population stability is not a useful concept in a species such as wireweed where healthy populations fluctuate in response to periodic fire and where metapopulation dynamics have been demonstrated.

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 is not relevant to this species, please note that here.**

The stated Recovery Objective is to reclassify from endangered to threatened. Delisting criteria have not been developed.

Wireweed 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, although some useful data exist that could be brought to bear on this question. Detailed demographic data on individual populations (Level 3 monitoring, *sensu* Menges and Gordon 1996) was collected by Maliakal-Witt (2004), but has not been applied to questions of individual population persistence. With so many protected populations and with observed metapopulation dynamics, a metapopulation analysis would be more relevant than analyses for individual populations. Archbold Biological Station has collected data that could be used to model metapopulation dynamics at several spatial scales. However, no relevant metapopulation analyses have been conducted. This criterion addresses factor A.

2. These sites, within the historic range of wireweed, are adequately protected from further habitat loss, degradation, and fragmentation.

It is not clear if this criterion has been met. The number of populations required to satisfy this criteria has yet to be established, as described above. However, a high level of protection has been achieved, with 84 occurrences (71 percent) occurring in managed areas, and protection throughout the species' range. Thirty-five of 119 extant occurrences (29 percent) are located on private property where they have no

protection (Christman 2006, FNAI 2009). Unprotected occurrences are susceptible to habitat loss or degradation and are unlikely to be managed with prescribed fire (Turner et al. 2006). There may be a sufficient number of protected populations to support downlisting to Threatened, especially given that many of the populations number in thousands of individuals (some in tens of thousands). However, monitoring has not determined how many of these populations are viable or how many need to be protected to attain the given persistence criterion. This criterion addresses factors A and E.

3. These sites are managed to maintain the rosemary phase of xeric oak scrub communities to support wireweed.

It is not clear if this criterion is met, although it is probably met at some sites. For rosemary scrub, Menges (2007) recommends a fire return interval of 15 to 30 years. Fires at the more frequent end of this range are likely to be patchy in rosemary scrub. This patchiness is important to wireweed's capacity to recolonize burned areas, because wireweed plants are killed by fire and resprouting does not occur (Menges and Kohfeldt 1995). The analysis by Maliakal-Witt (2004) implies that wireweed can survive over a range of moderate fire return intervals, although frequent fire could be a threat. That analysis also does not directly address extreme fire suppression, which could be expected to also threaten wireweed by eliminating the gaps the species requires.

In summary, some prescribed fire management, including either patchy fires or avoiding very frequent fires, would benefit wireweed. Prescribed fire management is unlikely on the 35 unprotected sites located on private land. On managed lands, about a quarter of land area has not been managed with prescribed fire to restore habitat (TNC 2010). Sites with inadequate fire management become overgrown and less suitable to wireweed. Very frequent fires could also be a threat to wireweed but there is no analysis to address this issue. This criterion addresses factor A.

4. Monitoring programs demonstrate that populations of wireweed on 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 'appropriate numbers of self-sustaining populations' is not known. A metapopulation viability analysis is required to address this question. Protected sites represent only a portion of the species range, with a significant gap in protection on lands in private ownership. The criterion of "stable" is inappropriate for wireweed, which typically has wide population fluctuations and observable metapopulation dynamics (i.e., observed local extinction and colonization events; Boyle 2004).

C. Updated Information and Current Species Status

1. Biology and Habitat

Information on the biology and habitat of wireweed 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

Wireweed (*Polygonella basiramia*) is a short-lived, herbaceous perennial endemic to the central ridges of the Florida peninsula. The stems grow to 0.8 meter (m) tall; the narrow leaves are no more than 2 centimeters (cm) long. Branches of the main stems are tipped by short elongate clusters of small white flowers, conspicuous only when in bloom. Lateral spread of root activity in wireweed is substantial relative to aboveground plant sizes. Roots were found at distances of up to 83 cm from plant centers, yet aboveground rosettes are typically less than 5 cm in diameter (Hawkes 2002, Hawkes and Casper 2002). Wireweed does not have associations with mycorrhizal fungi (Hawkes and Casper 2002).

Current Distribution

Wireweed is a narrow endemic, restricted to the Winter Haven, Bombing Range and Lake Wales Ridges in Polk and Highlands Counties, Florida. The northern limit of its range is at Auburndale, Avon Park Air Force Range, and Catfish Creek (about 5 miles (8 km) east of the town of Lake Wales) and ranges southward to Archbold Biological Station (about 8 miles (12.9 km) south of the town of Lake Placid) (Christman 1988). Wireweed is predominately a Lake Wales Ridge species, with 84 percent of occurrences located there (Turner et al. 2006).

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:

Life History, Breeding System, and Seed Production

Wireweed is a short-lived, perennial herb with an average lifespan of 0.31 years (Maliakal-Witt 2004). It is an obligate seeder: no adult plants survive fire, and all post-fire recruits derive from seed. However, because fires in rosemary scrub are patchy, plants may survive in unburned patches and contribute to further recruitment to burned patches after fire.

Wireweed flowering begins in September and achenes (a one-seeded fruit) are produced in late November and December. Because flowering is sequential, beginning at the top of each spike panicle and flowers downward, flowers and achenes are present at the same time in mid-autumn. Flowers are bisexual or functionally unisexual (Mitchell and Dean 1978), and individual plants are either female or hermaphroditic (Hawkes and Menges 1995). Pollinators of

wireweed include small halictid bees, *Perdita polygonellae* (a bee specific to the genus *Polygonella*), Eumenidae wasps, and potentially *Glabellula* spp. (Bombyliidae) (USFWS 1999).

Both females and hermaphrodites produce seeds, but seed production by female plants is higher by nearly seven-fold (Hawkes and Menges 1995). Seed production is higher in more open areas and in denser populations (Hawkes and Menges 1995). Across years, seed production is higher in years with high fall rainfall (Maliakal-Witt 2004). Reproductive output in experiments was higher for plants placed in recently burned sites as compared to long-unburned sites (Quintana-Ascencio and Menges 2000).

Seed Germination and Seedling Ecology

Wireweed seeds are produced in the late fall and early winter. Wireweed seeds are extremely small, averaging 28 microns (µm) long by 7 µm wide. Seed germination can occur immediately after seeds are produced; in fact, seeds sometimes germinate while still held on the plant. Achenes drop readily from the plant and most fall by mid-January. Seed dispersal appears to be passive, and dispersal distances are probably short.

Wireweed has high seed germination percentages. Seeds sent to National Center for Genetic Resources Preservation in Fort Collins, Colorado for seed banking had high germination rates (96, 80, 61, and 43 percent for four accessions collected between 1988 and 1990; Bok Tower Gardens unpubl. data 2010). Germination percentages in various other non-field trials have also been high. Hawkes (2004) summarized a series of germination experiments including 35 percent germination in a pot experiment. Petro and Menges (2004) achieved over 60 percent germination from shallow soil depths in a greenhouse study. Germination rates in the field summarized by Hawkes (2004) were more variable, from 1 to 21 percent among experiments. Nonetheless, wireweed germination percentages were generally higher than co-occurring herbaceous species (Hawkes 2004). Germination in one series of field experiments varied from 26to 60 percent by treatment/site combination (Quintana-Ascencio and Menges 2000). Wireweed was also found to have the highest rate of germination compared to other seeding scrub endemics (Quintana-Ascencio et al. 2009), although rates were less than 4 percent (Quintana-Ascencio et al. 2009). Seed germination can occur rapidly; in one study 95 percent of germination occurred within 4 days of the initiation of the experiment (Quintana-Ascencio and Menges 2000).

Wireweed seed germination is generally unaffected by factors that affect germination of other species. For example, Hunter and Menges (2002) found no significant allelopathic effects of rosemary leachates on wireweed seed germination. Similarly, germination was unaffected by soil crusts in experiments conducted by Hawkes (2002). In this experiment, wireweed seed germination was not influenced by any environmental factors tested (except for a positive response to water), with no significant difference in germination

across post-fire classes, shrub distances and crust treatments. Lindon and Menges (2008) studied effects of smoke on seed germination of 20 species. Results indicated that there was no significant differences in wireweed seed germination percentages among the control, 1, 5 or 10-minute smoke treatments. Wireweed germination was also not affected by proximity to ground lichens, shrubs, and herbs in a field study conducted by Quintana-Ascencio and Menges (2000). However, ground lichens did increase seedling mortality in this study.

Nevertheless, some factors do affect wireweed seedling emergence. Movement of sand by wind or disturbances may cause seeds to be buried at various depths, affecting emergence of wireweed seedlings (Petru and Menges 2004). In this study, significantly more wireweed seedlings emerged from 0.0 to 5.0 millimeter (mm) sand depths compared to 20.0 mm. Seedlings of wireweed were the most frequent and their proportions were significantly greater than proportions of the other two species examined. Lichen removal also caused an increase in wireweed seedling emergence (Hawkes and Menges 2003). Maliakal-Witt (2004) found that seedling recruitment was highest in years with high winter rainfall.

Seed size in Florida endemic scrub perennials affects the seed predation and dispersal mechanisms between undisturbed scrub and disturbed scrub. Vertebrates tended to remove larger seeds than invertebrates in exclusion experiments set up by Quintana-Ascencio et al. (2009). The seeds of wireweed were intermediate in size compared to other species in these experiments, and were depredated more by vertebrates than invertebrates.

Wireweed's high and rapid germination rate implies that it does not store seeds in a persistent soil seed bank. Maliakal-Witt (2004) found that wireweed did have a persistent seedbank, although it was small. After 1 year, 14 percent of seeds were viable; after 2 years 7 percent; and after 3 years only 3 percent. Since there is little persistent seed bank and since plants of this species are killed by fire (Menges and Kohfeldt 1995), wireweed must rely largely on seed dispersal from outside burns or unburned patches to colonize recently burned patches.

Demography

Information on wireweed has included rangewide surveys for wireweed presence and population size, a detailed demographic study, a comparative demographic study, and consideration of its metapopulation dynamics.

Monitoring of wireweed occupancy (and sometimes population size) has been undertaken by Schultz et al. (1999), Christman (2006), Clanton (2008) and FNAI (2009). Range-wide monitoring was performed by Christman (2006) in 2004 and 2005. FNAI conducted ecological surveys of 29 sites on the Lake Wales Ridge that were targeted for conservation (Schultz et al. 1999). Lake Wales Ridge State Forest managers are monitoring wireweed, as well as 15

other federally listed species, using newly written level 2 (*sensu* Menges and Gordon 1996) monitoring protocol (Clanton 2008).

Level 3 monitoring (*sensu* Menges and Gordon 1996) was accomplished by Maliakal-Witt (2004). This study, as is common, sampled a small subset of populations (at Archbold Biological Station) for intense data collection, but did not address the status of other occurrences. This demographic study was part of a study of four species. Six populations of wireweed at sites with varying time-since-fire were monitored for 5 consecutive years. The goal was a comparison of generalist and specialist congeners in two genera (*Polygonella* and *Lechea*), but the results have many implications for conservation of wireweed. Maliakal-Witt (2004) confirmed that wireweed was a short-lived species and a specialist for bare sand. Relative to its congener (*P. robusta*), wireweed had more variable recruitment and survival, but less variable growth. Much of the variation in vital rates was due to rainfall. Growth and seed production was higher in years with high fall rainfall and seedling recruitment was higher in years with high winter rainfall (Maliakal-Witt 2004). Overall, the finite rate of increase (lambda) was higher in years with higher winter rainfall. Stochastic lambda was 0.90, suggesting a declining population based on these 5 years of data. Drought scenarios increased extinction risk in wireweed. In contrast to many listed species that co-occur with it, wireweed extinction risk was higher with more frequent fires (e.g., 11 to 20 years) and lower with no fire (Maliakal-Witt 2004). Based on these results, Maliakal-Witt (2004) cautioned against frequent fire. The study indicated that the small bare sand gaps that wireweed requires may still be present after 25 years without fire, but gaps may largely disappear by 50 years post-fire. Time-since-fire effects interacted with rainfall and were mainly seen during dry years.

Hawkes and Menges (1995) studied multiple wireweed populations across a time-since-fire chronosequence. From this, they were able to infer demographic patterns over a time-since-fire gradient based on comparing sites. Plant densities and time-since-fire were unrelated, suggesting that plant populations could persist for extended periods in rosemary balds without fire. However, both plant density and seedling production were greatest in gaps. Seed production actually increased with wireweed plant density. This suggests that wireweed plants must compete with other species but not with neighboring wireweed plants. The gaps that are wireweed's preferred microhabitat are likely to have lower levels of inter-specific competition.

Wireweed exhibits classic metapopulation dynamics at the gap scale (Boyle 2004). This conclusion is based on repeated sampling of patch occupancy over time and is a unique study among scrub plants to date, and one of few such studies for any plant species. Extinctions were most likely in smaller and more isolated gaps. The probability that vacant gaps are colonized increased with gap area and proximity to other occupied gaps. During the short period of this study, extinction rates exceeded recolonization rates (Boyle et al. 2003). This dynamism implies that individual wireweed patches are transitory

and that population and metapopulation dynamics may be quite variable in space and time.

Habitat Preferences

Wireweed is found in Florida scrub, a xeric shrubland ecosystem found primarily on sand ridges in Florida. These sand ridges support Florida scrub both heterogeneous in structure and distribution due to variable soils, topography and fire (Abrahamson 1984, Menges and Hawkes 1998). Wireweed is only found in a subset of Florida scrub types. It is restricted to moderately-drained white sands (Menges et al. 2007) that generally support rosemary scrub or scrubby flatwoods. Shrubs dominate these sites, including Florida rosemary (*Ceratiola ericoides*), scrub oaks (*Quercus* spp.*)* and palmettos (*Serenoa repens* and *Sabal etonia*). Sand pine (*Pinus clausa*) is sparsely scattered. Wireweed is also found in xeric scrubby flatwoods, again in gaps. Scrubby flatwoods (also known as oak scrub) are dominated by scrub oaks and palmettos.

Wireweed is also often found in disturbed sites on the proper soil type. It may respond positively to certain types of anthropogenic disturbances, although this has not been systematically studied. For example, it increased markedly in areas where sand pines were harvested (logged) but was not affected by roller chopping in a series of landscape level experiments (Weekley et al. 2008b).

Microhabitat Preferences

Within its Florida scrub habitats (primarily rosemary scrub but also scrubby flatwoods, oak scrub, and sand pine scrub), wireweed is a specialist for gaps (Maliakal-Witt 2004, Corogin and Judd 2009) and bare sand microhabitats (Hawkes and Menges 1995). Wireweed is one of the more common species in rosemary scrub gaps, occurring in about 16 percent of randomly selected gaps (Menges et al. 2008). Open gap areas tend to decrease with time-since-fire, as shrubs encroach from the gap edges, decreasing the quality of habitat for gap specialists (Hawkes and Menges 1995, Menges et al. 2008). Densities of obligate seeding or mixed strategy (i.e., seeding and resprouting) herbs increased with the amount of open space in more open, elevated scrub sites (Hawkes and Menges 1996). Wireweed seedlings grew faster in larger gaps (Maliakal-Witt 2004). Scrubby flatwoods have fewer and smaller gaps than rosemary scrub (Menges and Hawkes 1996), which is likely one of the main reasons that wiregrass is less common in scrubby flatwoods than in rosemary scrub.

Beyond being found in gaps, wireweed is a specialist for bare sand microhabitats. Bare sand microsites occur primarily in gaps (vs. the shrub matrix), although some gaps become covered with litter and ground lichens. Wireweed germination is higher in bare sand microsites than other microsites (Quintana-Ascencio et al. 2009). Presence of ground lichens did not affect

seed germination but increased mortality rates of wireweed seedlings (Quintana-Ascencio and Morales-Hernandez 1997). There was no significant effect of neighboring small shrubby and herbaceous species on survival, growth or fecundity.

Soil crusts are another factor that may affect wireweed performance. Biological soil crusts are complexes of cyanobacteria, lichens, fungi, bacteria and mosses that vary spatially, temporally, and with time-since-fire (Hawkes and Flechtner 2002). They are able to photosynthesize and fix atmospheric nitrogen (a limiting nutrient). They can then provide this nitrogen to wireweed and other plants (Hawkes 2002). However, non-mycorrhizal herbs, such as wireweed, appear to be less dependent on soil crusts for nitrogen (Hawkes and Casper 2002). The effects of soil crusts on vital rates of vascular plants in the scrub were complex and varied among species and types of experiments. For example, wireweed was one of only four species that did not have reduced germination with crust elimination in a greenhouse experiment (Hawkes 2004). In field experiments, germination of wireweed was higher than other species and was not sensitive to crust disturbance or other environmental variables (Hawkes 2004).

Fire and Wireweed

Fire is the predominant natural disturbance in Florida and a primary driver in the demography of most Florida scrub species (Menges 1999, Menges 2007). For rosemary scrub, plant population viability analyses suggest more frequent fires (15 to 30 years) than do previous recommendations (20 to 100 years) (Menges 2007). Fires at the more frequent end of this range are likely to be patchy in rosemary scrub. This patchiness is important for wireweed because wireweed plants are killed by fire (resprouting does not occur; Menges and Kohfeldt 1995) and because wireweed has a small persistent seed bank (Maliakal-Witt 2004). Therefore, dispersal from outside burns or from unburned patches in patchy burns is necessary for recolonization of burned areas. In fact, the rate at which wireweed returns to burned sites often lags behind other scrub species that store seeds in a persistent seed bank. At a larger scale, regional persistence of this species is dependent on landscape features and disturbance effects on metapopulation dynamics. Fire may expand or create the open sand gaps within a shrub matrix that support wireweed, but fire also kills established plants. Patchy fires may provide a balance, both creating suitable habitats and providing a fine-grained spatial landscape structure so wireweed can colonize those habitats.

Fire is important to plants in Florida rosemary scrub, but land managers need information on what fire return intervals would be best for wireweed. Some reports have stated that wireweed does better in regularly burned areas, and given its specialization for gaps (see below), this is a reasonable conclusion. However, wireweed abundances did not show a significant relationship with time-since-fire in one broad study in rosemary scrub and scrubby flatwoods (Menges and Kohfeldt 1995) and in one specific study in rosemary scrub

(Hawkes and Menges 1995). As discussed above, the modeling of Maliakal-Witt (2004), based on detailed monitoring of six populations, did not suggest that frequent fires would benefit wireweed. This finding conflicts with research showing that wireweed performance is greater in recently burned areas compared to long unburned areas. It had higher growth in burned areas and in microsites away from oaks and rosemary plants (Quintana-Ascencio and Menges 2000). Although wireweed is a gap specialist, it is found in smaller gaps and nearer gap edges than some other Lake Wales Ridge endemic herbs whose microhabitats occur closer to oaks and rosemary than these other species (Quintana-Ascencio and Menges 2000). It is clear that wireweed is able to persist in smaller gaps than some other, more sensitive gap specialists. Part of the problem is dispersal; wireweed is slow to recolonize burned areas, especially when burns are large and complete. Repeated frequent burns might also have negative effects on wireweed (Maliakal-Witt 2004). If frequent and complete burns can be avoided, it appears that wireweed may be tolerant to a wider range of fire return intervals than other gap specialist species.

Landscape Patterns

Wireweed shows patterns in abundance at the landscape scale as well. Wireweed is more likely to occupy larger and less isolated gaps. Gap area and isolation were significant predictors of wireweed abundance, which increased rapidly with gap area (Boyle 2004). Local populations in small gaps are smaller and more likely to go extinct than those in large gaps. Since gaps presumably shrink with increasing time since last fire due to shrub encroachment, local populations will shrink too, increasing the likelihood of extinction. Average extinction and colonization rates of gap networks at the coarse patch scale was slow, however, turnover at the fine scale was rapid (Boyle et al. 2003, Boyle 2004). This turnover suggests that wireweed occurs as a metapopulation. Metapopulation persistence depends on a balance of colonization and local extinction. During Boyle's (2004) study, gap extinction of wireweed exceeded rates of colonization.

Summary of Known Occurrences

Wireweed is among the more abundant of listed plants of the central Florida ridges. This review of occurrences was based on data from FNAI (2009) and Christman (2006). The combination of the two data sets yields a total of 153 occurrence records for wireweed. Most occurrences are found in the FNAI dataset. Many occurrences updates are from Christman (2006), who in 2004 and 2005 repeated previous surveys of sites originally visited in 1988, updating 132 (86 percent) of FNAI occurrences. Thirty-four of 153 occurrences (22 percent) are considered extirpated as of this review, while 119 occurrences are presumably extant.

Christman (2006) identified 112 wireweed occurrences, of which he had counts on 107 (the other five were considered "lost" and were not counted).

Christman (2006) reported about 556,000 plants in these occurrences. The total number of plants for all sites evaluated is 1,082,433. The distribution is skewed so the median (19,760) is larger than the mean (6,560). The largest occurrence was 32,959 and the smallest consisted of one plant. The large occurrences are consistent with high local densities that often occur. For example, Clanton (2008) reports that the average population density is about 11 plants per m^2 at Lake Wales Ridge State Forest. Of these occurrences, Christman (2006) also found 10 sites with wireweed that did not spatially overlap any FNAI records. Of these 10 sites, we considered 5 that were ranked likely extant, while the other 5 had been developed and were considered likely extirpated.

Most extant wireweed occurrences (84 of 119 occurrences; 71 percent) are protected by public ownership or private conservation organizations. Protected sites appear to be offering true protection for wireweed. Between 1988 and 2005, only one extirpation occurred on these managed lands. The extirpation on public land apparently occurred at Hickory Lake South, where Christman (2006) found no plants. Menges (unpubl. notes, 2002) noted wireweed at this site in December 2002, photographing plants killed by frost that winter. It is not known if the frost mortality caused the extirpation or if some other factor was responsible. An occurrence in Highlands County (EOR 102) was last observed at the XL Ranch Conservation Easement site in 1987 (FNAI 2009). No plants were observed at the site in 2005, and he considered the site a 'lost scrub' (Christman 2006).

The Service analyzed Christman's (2006) results together with current aerial photographs to classify the likely fate of wireweed occurrences. The analysis suggests that wireweed occurrences continued to be extirpated on private lands throughout the 1990s and 2000s. Currently, of 61 occurrences on unprotected, private land, 35 (29 percent) are extant. Twenty-six former occurrences on private lands are considered extirpated.

Christman (2006) calculated that the distribution of wireweed declined from 33,651 acres (ac) to 26,950 ac between 1988 and 2005, a 20 percent decline. The decline in total numbers of plants (556,000 to 451,000) is also about 20 percent. In 2005, he also estimated that 6,815 ac were actually occupied by wireweed. This suggests that about 25 percent of the study area had wireweed present. Although there are not specific data to place this last percentage into context, intuitively this seems like a rather high percentage relative to other species, suggesting that wireweed can be present quite commonly throughout suitable habitat.

Within its range, wireweed occurs on nearly all conservation areas that include appropriate habitat. There are 14 occurrences at Avon Park Air Force Range, which is an interesting range "extension" in contrast to most other plant species largely endemic to the Lake Wales Ridge. Wireweed occurs at nearly all (at least 14) of the units of the Lake Wales Ridge Wildlife and Environmental Areas, at three units of the Lake Wales Ridge State Forest, at

two state parks (Highlands Hammock, Lake June in Winter), at two areas owned by The Nature Conservancy (Saddle Blanket Lakes, Tiger Creek Preserve), at two tracts of the Lake Wales Ridge National Wildlife Refuge, at land owned by the Southwest Florida Water Management District, and at Archbold Biological Station.

Seven government agencies and five private conservation groups manage 58,591 ac of land on the Lake Wales Ridge. The five major land managers are the Florida Division of Forestry (FDOF) (17,255 ac), the Florida Fish and Wildlife Conservation Commission (FWCC) (15,038 ac), the Florida Department of Environmental Protection (FDEP) (8,696 ac), Archbold Biological Station (7,099 ac), TNC (5,439 ac), and the Service (1,730 ac) (Weekley et al. 2008a). Wireweed occurs on land owned by all these entities, and others, as detailed below.

A summary of all wireweed occurrences and their status, as far as it is known, is presented in Table 1. Occurrences by county are summarized in Table 2.

Protected Occurrences

Below, we describe 92 protected occurrences (84 of which are believed to be extant) by site, with sites organized in descending order of number of occurrences for wireweed. This information is based on occurrence and survey data from FNAI (2009) and Christman (2006), along with fire management records from TNC (2010).

Lake Wales Ridge Wildlife and Environmental Area (LWRWEA) is an archipelago of protected areas that supports more wireweed occurrences than any other set of sites. The LWRWEA consists of separate tracts scattered over roughly 75 miles of the Lake Wales Ridge in Highlands and Polk Counties. In total, these areas support 38 extant occurrences in 11 tracts. Tracts with the most occurrences are Highlands Ridge, Royce, and Henscratch. Wireweed occurs in both rosemary scrub and scrubby flatwoods, and is very abundant in many areas. Sixteen of the 38 occurrences have been burned since 2000. Three occurrences are believed extirpated - one at Sunray Hickory Lake and two at Lake Blue (Christman 2006).

Avon Park Air Force Range (APAFR) is another important site for wireweed, supporting 14 occurrences in scrubby flatwoods and oak scrub. Nearly all occurrences have been burned in recent years. Many of these occurrences are located in areas of military activity (USFWS 2005) and could be impacted by ordinance-ignited wildfires. A survey by Stout et al. (2006) identified 141 potential soil polygons that could support wireweed. Of the 108 polygons surveyed, 24 supported wireweed. The species was well distributed across APAFR. These sites supported over 100,000 individual plants (Stout et al. 2006). Military activities at APAFR could benefit wireweed by igniting fires that could maintain gaps. However, fire regimes that include very frequent or

extensive fires could have a negative effect. In addition, disturbance by vehicles would likely have a negative effect.

The Lake Wales Ridge State Forest (LWRSF) supports nine extant wireweed occurrences; seven in the Arbuckle tract, two in the Hesperides tract, and one in the Walk-In-Water tract. Wireweed sites have received prescribed fire at LWRSF in recent years. Six occurrences were burned in 2008, with three others burned from 1998 to 2006. Wireweed is abundant at the LWRSF; Clanton (2006) reported over 16,000 plants. Three occurrences are believed extirpated at LWRSF - two in the Arbuckle tract, and one in the Hesperides tract (Christman 2006).

LWRSF is 26,563 ac 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 ac), Walk-in-the-Water (6,902 ac), Hesperides (1,267 ac), and Prairie (4,863 ac). Approximately 8,859 ac are xeric upland communities (FDOF 2006).

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).

Highlands Hammock State Park supports four extant occurrences for wireweed, two of which have been burned in recent years. This park, managed by FDEP, has increased its emphasis on fire management in recent years.

Archbold Biological Station supports three extant wireweed occurrences; all include areas recently burned. Wireweed is widespread at Archbold, occurring in the majority of the over 100 patches of rosemary scrub and occurring occasionally in xeric scrubby flatwoods. Virtually all the Archbold Biological Station's 5,200-acre main property is in its natural condition (undisturbed by humans), and the Station's original property (1,000-acre Roebling Red Hill estate) has never been logged or impacted by turpentine collection. The Station contains excellent examples of all the original upland habitats of the Lake Wales Ridge, including the rosemary scrub and scrubby flatwoods habitats supporting wireweed.

Fire management planning at Archbold Biological Station attempts to balance diverse goals and provide temporal and spatial heterogeneity across the landscape. The goals are enhancing biological diversity, enhancing threatened

and endangered species, mimicking natural processes, providing a diversity of research and educational opportunities, interacting with other fire management agencies, reducing fire hazards, and conducting safe burns. Recent fire management has increased the number of prescribed burns, shifted most burns to the natural ignition season, and used a range of fire sizes (2.5 to 180 ac).

Lake June in Winter Scrub State Park is 845-acres of predominantly scrub, both oak-dominated and sand pine scrub, located near Lake Placid, Florida. It is managed by the FDEP, and has an active burn program (FDEP 2004). Mapping the distribution of listed plant species and monitoring the distribution and frequency of these species over time, especially in response to prescribed fire and visitor use, is a priority for this park (FDEP 2004). This park supports three occurrences for wireweed, two of which have been burned in recent years.

Allen David Broussard Catfish Creek State Park supports two extant wireweed occurrences. Catfish Creek State Park is an 18,641-acre natural area of high scrub ridges, interspersed with lakes, next to Lake Pierce. The site is managed by FDEP. Scrub occupies a large area on the park's west side, where many of the rare endemic plants occur in open sandy areas. One of the areas supporting wireweed was described as sand pine scrub (FDEP 2004). Two of the three wireweed occurrences have been burned in recent years. One occurrence previously recorded in the Park is extirpated.

Fisheating Creek Preserve supports two extant occurrences of wireweed. This area is just south of the Lake Wales Ridge and few Ridge endemic plants are found here. There are no records of fire at this site. The property is 8,377 ac, located adjacent to FWCC-managed Fisheating Creek Wildlife Management Area. FDEP has management responsibility for this site.

Jack Creek supports two extant occurrences, both of which were burned in 2005. This area is managed by the Southwest Florida Water Management District (SWFWMD) and contains rosemary and oak scrub.

Lake Wales Ridge National Wildlife Refuge (LWRNWR) supports two extant occurrences, one on each of two disjunct tracts (Flamingo Villas and Lake McLeod). The occurrence at Flamingo Villas was burned in 2001. The Lake McLeod occurrence has not been burned since the site was acquired in the mid 1990s, but shrub cover in the area where wireweed occurs remains sparse due to years of off-road vehicle (ORV) damage at this site prior to acquisition.

Other Sites support a single occurrence. Hickory Lake Scrub and Lakeland Highlands, both managed by Polk County, support one occurrence each (Christman 2006). The Saddle Blanket Lakes, Sun Ray Scrub, and Tiger Creek Preserves, owned and managed by TNC, each support a single occurrence. The XL Ranch Conservation Easement is a private site protected

by conservation easement, but wireweed has not been observed there since 1987 (FNAI 2009). Christman (2006) considered the site a 'lost scrub'.

Unprotected occurrences

There previously were 61 unprotected occurrences in Highlands and Polk Counties. Twenty-six of 61 occurrences (51 percent) are considered extirpated as of this review. All private occurrences are threatened by habitat loss or modification, and lack prescribed fire and other types of active management. See Table 1 and 2.

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

Genetic studies of wireweed show moderate levels of genetic diversity. The first genetic study including wireweed compared many species of the genus *Polygonella*, emphasizing that widespread species had unexpectedly lower variation than species with narrower, southern ranges (Lewis and Crawford 1995). In that study, the three wireweed populations that were sampled had intermediate levels for most genetic statistics. Boyle (2004) studied wireweed genetic variation in more detail. He characterized genetic diversity as moderate (this contrasts to low genetic diversity in many rare scrub plants; Menges et al. 2001). Population differentiation was relatively low, again a contrast to other Lake Wales Ridge endemic species such as Highlands scrub hypericum (Menges et al. 2001). This combination implies that gene flow among patches is occurring in wireweed. This may maintain genetic connectivity among patches even as local extinctions, colonization, and metapopulations occur (Boyle 2004). Roadside populations did not differ genetically from scrub populations, again implying a reasonable level of gene flow that may mitigate any potential selective differences between these two habitats.

c. Taxonomic classification or changes in nomenclature:

The taxonomy of wireweed is reviewed in the MSRP (Service 1999). The Integrated Taxonomic Information System (ITIS) was checked while conducting this review. ITIS states that *P. basiramia* is an accepted taxon (ITIS 2010). Originally named *Delopyrum basiramia* by Small, it was later thought to be a variety of *P. ciliata* by Horton (1963). In 1984, Nesom and Bates (1984) recognized wireweed as a separate species, commonly known as tufted or hairy wireweed. *Polygonella basiramia* is most closely related to *P. ciliata* and *P. gracilis* (Lewis and Crawford 1995). Wireweed and *P. ciliata* are believed to have originated from *P. gracilis*, but whether they did so independently or from a single intermediate ancestral species is unknown.

Some uncertainty remains over the identification of this plant (versus *P. ciliata* and *P. gracilis*), although Nesom and Bates (1984) considered them

easy to tell apart. Nesom and Bates (1984) reviewed the systematics of these species, and there is no apparent need for further systematic investigations.

The Service has carefully reviewed the available taxonomic information to reach the conclusion that *P. basiramia* is a valid 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):

At the time of listing in 1987, wireweed was considered endemic to the Lake Wales, Winter Haven, and Bombing Range ridges in central peninsular Florida. Christman and Judd (1990) identified its range as Lake Pierce in Polk County southward to Venus near the southern tip of the Lake Wales Ridge in Highlands County. The distribution and number of wireweed occurrences has almost certainly decreased over the past 100 years as 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. Habitat loss has played a large role in the current abundance and distribution. Losses have been least in Highlands County, high in Polk County, and extreme in Lake, Orange, and Osceola Counties (Weekley et al. 2008a). With loss of habitat comes habitat fragmentation, which isolates remaining fragments, reducing potential connections and the likelihood of immigration of propagules from other populations. Loss of population connectivity will reduce gene flow, which may lead to loss of genetic diversity. It also means that immigrants will be less likely to rescue declining populations.

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

Wireweed occurs in Florida scrub; a xeric shrubland ecosystem found primarily on sand ridges in Florida. These sand ridges support Florida scrub that is both heterogeneous in structure and distribution due to variable soils, topography and fire (Abrahamson 1984, Menges and Hawkes 1998). Wireweed is only found in a subset of Florida scrub types. It is restricted to moderately-drained white sands (Menges et al. 2007) that generally support rosemary scrub or scrubby flatwoods. Rosemary-dominated scrub, which is the primary habitat for wireweed, occurs on well-drained white sand at higher elevations. Shrubs dominate these sites, including Florida rosemary (*Ceratiola ericoides*), scrub oaks (*Quercus sp.)* and palmettos (*Serenoa repens* and *Sabal etonia*). Sand pine (*Pinus clausa*) is sparsely scattered. Wireweed also occurs in xeric scrubby flatwoods. Scrubby flatwoods (also known as oak scrub) is dominated by scrub oaks and palmettos.

Wireweed also occurs in disturbed sites on the same soil types that support occurrences on undisturbed sites. It may respond positively to certain types of anthropogenic disturbances, although this has not been systematically studied.

For example, it increased markedly in logged plots but was not affected by roller chopping in a series of landscape level experiments (Weekley et al. 2008b).

Weekley et al. (2008a) estimated that 78 percent of upland habitat on the Lake Wales Ridge was destroyed by 1990, and upward of 85 percent by 2006, mainly to agriculture, ranching, commercial and residential development. Areas of white sand and gray sand, which support wireweed, have been less affected by habitat loss and fragmentation, than have areas of yellow sand, which were favored for citrus production (Weekley et al. 2008a).

Fire Suppression

Fire suppression started on a regional scale on the Lake Wales Ridge about 70 years ago. Long-unburned scrub sites develop dense shrub growth and litter accumulation; however, this closure process varies depending on the vegetation (e.g., rosemary scrub closes more slowly than oak-dominated scrub). Gap specialists and shade-intolerant endemics generally tend to decline with time-since-fire (Menges 2007), although these patterns are not evident for wireweed. Fire management in some managed areas has been inadequate to maintain habitat quality for occurrences of plants preferring open sites, including (in some areas) wireweed. 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. In 2008, the TNC developed a spatial database for tracking fire history on the Lake Wales Ridge (TNC 2010a, b). The fire database provides a method of documenting how well fire-maintained natural communities are being managed with fire. The TNC fire history database showed that in 2008 (the last year for which data analysis was completed) 123,484 ac were within the recommended fire return interval and 38,359 ac were outside the recommended fire return interval (TNC 2010b). The fire management condition of most privately owned parcels is unknown. Because fire management is unlikely on most private properties, the majority 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 10,000 hectares (ha) of land on the Lake Wales Ridge, with plans to acquire an additional 10,000 ha (FDEP 2008). The Service established the first national wildlife refuge in the country designated primarily for plants in 1993, 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. By about 2006, over 14,000 such lots have

been purchased for conservation within the mega-parcel sites, in a checkerboard manner, but nearly as many lots remain to be purchased (Turner et al. 2006).

Land acquisition to date has placed nearly half (21,597 ac, or 48.9 percent) of the remaining 44,157 ac 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 wireweed 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 identified wireweed 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 wireweed include habitat loss from development and habitat modification due to altered fire regimes and damage from ORVs. Thirty-five of 119 occurrences (29 percent) are located on private property where they have no protection from development and prescribed fire is unlikely (FNAI 2009). On public lands, wireweed is protected from development, but is threatened by inadequate fire management (fire too infrequent or non-existent) at some sites.

Development

Habitat destruction from development continues to occur and development pressure remains high. 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. They estimated relative losses to agriculture, open space, and conservation to other land uses. They predicted central Florida will experience "explosive" growth over the next 50 years, with continuous urban development from Ocala to Sebring, the area encompassing most of wireweed's range. They estimated 2.7 million acres of native habitat and 630,000 ac of land currently under

consideration for conservation purchase will be lost. They state that "more than two million acres within one 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). Areal extent of post-Columbian xeric upland habitat loss on the Lake Wales Ridge is estimated to exceed 85 percent. Losses have been greatest on yellow sands at the northern end of the Ridge, and least on white sands (wireweed's preferred soils) near the southern end (Weekley et al. 2008a). Overall, loss of habitat to development will likely continue in central Florida, eliminating populations and reducing the area of suitable habitat for wireweed.

Fire suppression and inadequate fire management

Fire stimulates regeneration from seed, improves seedling recruitment, increases seed production, and reduces competition, allowing wireweed to thrive under post-fire conditions. Wireweed does not have an extensive persistent soil seed bank, and therefore is not likely to recover populations that have been extirpated for years due to fire suppression. On the other hand, wireweed plants are killed by fire, they have little seed bank to recruit after fire, and they are not strong dispersers. This means they are often slow to recolonize areas after a fire and could be threatened by frequent, large fires.

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. Managed areas with insufficient fire frequencies are noted in FNAI (2009).

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

This factor is not considered a threat to wireweed.

c. Disease or predation:

Vertebrate herbivory (attributed to rodents and birds) has been observed on wireweed (Quintana-Ascencio et al. 2009). Howerver, the overall threat level from predation appears low. No diseases have been observed to affect wireweed.

d. Inadequacy of existing regulatory mechanisms:

Wireweed 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. 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. Therefore, existing regulatory mechanisms are inadequate to protect wireweed.

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. Off-road vehicles crush, uproot and tear plants as they drive over them. Roads facilitate and intensify illegal collection of rare plants and serve as corridors for exotic plant invasion. Although most managed sites restrict ORV use where wireweed occurs, overall, the Service considers ORVs a significant threat to wireweed on unprotected sites on the Lake Wales Ridge. However, no studies have directly considered how detrimental ORVs are to wireweed (or most other listed plants).

Non-native plant species

Bahia grass (*Paspalum notatum*), cogon grass (*Imperata cylindrica*), and natal grass (*Rhynchelytrum repens*) invade scrub habitats and have negative effects through direct competition and by altering fire behavior. These species are reported at numerous sites supporting wireweed. Because of wireweed's small stature and its preference for open conditions, exotic grasses are likely to have a serious negative effect on wireweed where they co-occur. Efforts to control these species are implemented to varying degrees at some protected sites.

Ex situ measures

Wireweed is lacking *ex situ* conservation measures that should be implemented for imperiled and rare plants. Wireweed is not represented at Bok Tower Gardens, which houses other species in the Center for Plant Conservation's National Collection of Endangered Species. However, wireweed may not be an ideal candidate for *ex situ* measures. Its short life span will create problems holding plants in a botanical garden setting. Seeds have been provided for storage at the National Center for Genetic Resources Preservation in Fort Collins, Colorado. Seeds tend to germinate immediately

and may not store well over long periods (although this has not been investigated).

Climate change

Wireweed vital rates are sensitive to winter and spring rainfall (Maliakal-Witt 2004). If climate change reduces rainfall rates, this would likely have negative effects on wireweed. Climate projections for Florida are not very well defined, so the effects of climate change on wireweed are not easy to predict.

D. Synthesis

Wireweed is a short-lived, herbaceous perennial endemic to the central ridges of the Florida peninsula. Wireweed is relatively abundant for a listed plant species. It occurs in hundreds of sites over several ridges, and in most Florida scrub habitats that contain soils known to support wireweed. It has many occurrences, including occurrences in dozens of protected areas, and population sizes numbering tens of thousands are not uncommon. Wireweed's reproductive rates do not suggest it is vulnerable to decline. It flowers, produces seeds, and recruits seedlings at relatively high rates.

However, several factors place this pattern of abundance into context. Individual plants are short-lived and require gaps within a shrub matrix. Such gaps may become scarce with fire suppression, which is a common problem on all unprotected, as well as some protected sites. In addition, wireweed has an unfortunate combination of life history traits; it is killed by fire and lacks a persistent soil seed bank. This means that recovery from fire, other disturbances, and local extinctions due to fire suppression requires dispersal from unburned, undisturbed, or unsuppressed sites, respectively. Since wireweed has no mechanism to promote long-distance dispersal, habitat fragmentation and large contiguous areas of just-burned habitat may limit re-colonization.

Although many authors have speculated that wireweed requires periodic fire, the demographic data analyzed by Maliakal-Witt (2004) contradict this supposition. Wireweed extinction risk was highest with frequent burning and lowest when sites were long-unburned. The inability of this species to quickly colonize post-fire may be part of the explanation for this pattern. Maliakal cautions that her results suggest that wireweed can do well in moderately long-unburned sites (greater than 25 years) but that extreme fire suppression (e.g., 50 years or more) may result in a loss of the gaps that are its preferred microhabitat.

Another factor emphasized by Maliakal-Witt (2004) is the high variability in wireweed demography, especially in recruitment and survival. This variation is tied to fall and winter rainfall. Extinction risk increased in modeled scenarios that included drought. While climate change projections for Florida are not currently well refined, if droughts increase, they could be an additional threat to wireweed.

On private sites, there has been a marked decline in numbers of occurrences. On protected sites, local extinctions and wide variations in population size have been noted. Extinction rates exceed colonization rates, suggesting metapopulation decline. We lack the precise data

needed to determine the ideal fire regime to maintain viable populations. More information on demography and metapopulation dynamics is needed, and recommendations to manage for viable populations and metapopulations are lacking.

None of the recovery criteria identified in the MSRP have been fully achieved to date. The analysis required to determined the number of populations required to minimize extinction is lacking, as is key information on management practices necessary to maintain protected populations. For these reasons, wireweed 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 occurrences from willing sellers.
- Work with State, Federal, and non-profit partners to ensure adequate fire management is achieved at sites that support wireweed.
- Work with private landowners to conserve extant occurrences.
- Continue existing monitoring programs and expand them throughout wireweed's geographic range, including sites across a spectrum of time-since-fire and management regimes.
- Update and expand metapopulation analyses to focus on how many populations are needed for species' survival.
- Determine longevity of stored seed and feasibility of maintaining this species in long-term seed storage and *ex situ* living collections.
- Revise recovery criterion of "20 to 90 percent probability of persistence over 100 years" to 90 percent over 100 years based on a metapopulation analysis.

V. REFERENCES

Abrahamson, W. G. 1984. Species responses to fire on the Florida Lake Wales Ridge. American Journal of Botany 71: 35-43.

Bok Tower Gardens. 2010. *Polygonella basiramia ex situ* holdings at Bok Tower Garden. Unpublished data.

Boyle, O. D. 2004. The metapopulation biology of *Polygonella basiramia*, a federally endangered Florida scrub endemic. Univ. of Wisconsin-Madison. 159 pages.

Boyle, O. D., E. S. Menges, D. M. Waller. 2003. Dances with fire: Tracking metapopulation dynamics of *Polygonella basiramia* in Florida scrub (USA). Folia Geobotanica 38: 255-262.

Christman, S. P. 1988. Endemism and Florida interior sandpine scrub. Unpublished report (GFC-84-010) to the Florida Game and Fresh Water Fish Commission, Tallahassee, FL.

Christman, S. P. 2006. Distribution and status of three endemic Lake Wales Ridge scrub plants. U. S. Fish and Wildlife Service, Atlanta, Georgia.

Christman, S. P. and W. S. Judd. 1990. Notes on plants endemic to Florida scrub. Florida Scientist 53:52-73.

Clanton, K. 2006. Lake Wales Ridge State Forest plant monitoring and management report: 2006 final report from 1/2006 through 12/2006. Florida Plant Conservation Program/Florida Division of Forestry. 26 pages.

Clanton, K. 2008. Lake Wales Ridge State Forest plant monitoring and management report: 2008 final report from 1/2008 through 12/2008. Florida Plant Conservation Program/Florida Division of Forestry. 56 pages.

Corogin, P. T. and W. S. Judd. 2009. Floristic inventory of Tiger Creek Preserve and Saddle Blanket Scrub Preserve, Polk County, Florida. Rhodora 111:448-502.

Florida Department of Environmental Protection. 2004. Lake June in Winter Scrub State Park Unit Management Plan.

Florida Department of Environmental Protection. 2008. The Florida Forever five-year plan, September 2008 report. Board of Trustees of the Internal Improvement Trust Fund of the State of Florida. Tallahassee, Florida.

Florida Division of Forestry. 2006. Ten-year resource management plan for the Lake Wales Ridge State Forest. Florida Department of Agriculture and Consumer Services. Tallahassee, Florida.

Florida Natural Areas Inventory. 2009. Element population records for *Polygonella basiramia*. Florida Natural Areas Inventory. Tallahassee, Florida.

Hawkes, C. V. 2002. Plant-microbe interactions for nitrogen mediated by microbiotic soil crusts and vesicular-arbuscular mycorrhizal fungi in a zeric Florida shrubland. Ecology 84: 1553-1562.

Hawkes, C. V. 2004. Biological soil crusts in a xeric Florida shrubland: composition, abundance, and spatial heterogeneity of crusts with different disturbance histories. Microbial Ecology 43: 1-12.

Hawkes, C. V. 2004. Effects of biological soil crusts on seed germination of four endangered herbs in a xeric Florida shrubland during drought. Plant Ecology 107: 121-134.

Hawkes, C. V. and B. B. Casper. 2002. Lateral root function and root overlap among mycorrhizal and nonmycorrhizal herbs in a Florida shrubland, measured using Rubidium as a nutrient analog. American Journal of Botany 89:1289-1294.

Hawkes, C. V. and V. R. Fletchner. 2002. Biological soil crusts in a xeric Florida shrubland: composition, abundance, and spatial heterogeneity of crusts with different disturbance histories. Microbial Ecology 43:1-12.

Hawkes, C. V. and E. S. Menges. 1995. Density and seed production of a Florida endemic, *Polygonella basiramia*, in relation to time since fire and open sand. American Midland Naturalist 133: 138-148.

Hawkes, C. V. and E. S. Menges. 1996. The relationship between open space and fire for species in a xeric Florida shrubland. Bulletin of the Torrey Botanical Club 123:81-92.

Hawkes, C. V. and E. S. Menges. 2003. Effects of lichens on seedling emergence in a xeric Florida shrubland. Southeastern Naturalist 2:223-234.

Horton, J. H. 1963. A taxonomic revision of *Polygonella*. Brittonia 15: 177-203.

Hunter, M. and E. S. Menges. 2002. Allelopathic effects of root distribution of *Ceratiola ericoidesi* on seven rosemary scrub species. American Journal of Botany. 89:1113-1118.

Integrated Taxonomic Information System. 2010. Retrieved February 1, 2010 from ITIS website: http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=29345&print_version=PRT&source=to_print.

Lewis, P. O. and D. J. Crawford. 1995. Pleistocene refugium endemics exhibit greater allozymic diversity than widespread congeners in the genus *Polygonella* (Polygonaceae). American Journal of Botany 82:141-149.

Lindon, H. L. and E. S. Menges. 2008. Effects of smoke on seed germination of twenty species of fire-prone habitats in Florida. Castanea 73: 106-110.

Main, K. N., and E. S. Menges. 1997. Archbold Biological Station, Station Fire Management Plan. Land Management Publ. 97-1, 95 pages.

Maliakal-Witt, S. 2004. Microhabitat distribution and demography of two Florida scrub endemic plants with comparisons to their habitat-generalist congeners. PhD thesis, Louisiana State University.

Menges, E.S. 1999. Ecology and conservation of Florida scrub. Pages 7-22 in R.C. Anderson, J.S. Fralish, and J. Baskin (editors). The savanna, barren, and rock outcrop communities of North America. Cambridge University Press.

Menges, E. S. 2007. Integrating demography and fire management; an example from Florida scrub. Australian Journal of Botany: 55: 261-271.

Menges, E. S. and D. R. Gordon. 1996. Three levels of monitoring intensity for rare plant species. Natural Areas Journal 16:227-237.

Menges, E. S. and C. V. Hawkes. 1998. Interactive effects of fire and microhabitat on plants of Florida scrub. Ecological Applications 8: 935-946.

Menges, E. S. and N. Kohfeldt. 1995. Life history strategies of Florida scrub plants in relation to fire. Bulletin of the Torrey Botanical Club, Vol. 122: 282-297.

Menges, E. S., R. W. Dolan, R. Yahr, and D. R. Gordon. 2001. Comparative genetics of seven plants endemic to Florida's Lake Wales Ridge. Castanea 66:98-114.

Menges, E. S., C. W. Weekley, S. I. Hamze, and R. L. Pickert. 2007. Soil preferences for federally-listed plants on the Lake Wales Ridge in Highlands County, Florida. Florida Scientist 70:24-39.

Menges, E.S., P. J. McIntyre, M. S. Finer, E. Goss, and R. Yahr. 1999. Microhabitat of the narrow Florida scrub endemic *Dicerandra christmanii*, with comparisons to its congener *D. frutescens*. Journal of the Torrey Botanical Society 126: 24-31.

Menges, E. S., A. Wally, J. Salo, R. Zinthefer, and C. W. Weekley. 2008. Gap ecology in Florida scrub: species occurrence, diversity, and gap properties. Journal of Vegetation Science 19:503-514.

Mitchell, R. S. and J. K. Dean. 1978. Polygonaceae (buckwheat family) of New York State. Contributions to a Flora of New York State I, edited by Richard S. Mitchell. Bulletin 431, 79 pp. + index, illus., maps. New York State Museum, Albany.

Nesom, G. and V. M. Bates. 1984. Reevaluations of infraspecific taxonomy in *Polygonella*. Brittonia 36:7-44.

Petru, M. and E. S. Menges. 2004. Shifting sands in Florida scrub gaps and roadsides: dynamic microsites for herbs. American Midland Naturalist 151: 101-113.

Quintana-Ascencio, P. F. and E. S. Menges. 1996. Inferring metapopulation dynamics from patch-level incidence of Florida scrub plants. Conservation Biology 10:1210-1219.

Quintana-Ascencio, P. F. and E. S. Menges. 2000. Competitive abilities of three narrowly endemic plant species in experimental neighborhoods along a fire gradient. American Journal of Botany. 87: 690-699.

Quintana-Ascencio, P. F. and M. Morales-Hernandez. 1997. Fire-mediated effects of shrubs, lichens and herbs on the demography of *Hypericum cumulicola* in patchy Florida scrub. Oecologia 112: 263-271.

Quintana-Ascencio, P. F., E. Stephens, J. Navarra, M. Beg, H. McArdle, L. M. Castro Morales, M. Camchong, and K. Ferreri. 2009. Seed germination and seedling survival of *Eryngium cuneifolium, Hypericum cumulicola, Liatris ohlingerae, Paronychia chartacea*, and *Polygonella basiramia* in native and disturbed scrub habitats. Final Report to Florida Division of Forestry. 41 pages.

Schultz, G. E., L. G. Chafin, S. T. Krupenevich. 1999. Rare plant species and high quality natural communities of twenty-six CARL sites in the Lake Wales Ridge ecosystem. Florida Natural Areas Inventory, Tallahassee, Florida.

Stout, I. J., M. Lewis, and G. Baez-Munoz. 2006. Monitor rare and endangered plants at Avon Park Air Force Base, Florida. Biennial Report. University of Central Florida, Orlando, Florida.

The Nature Conservancy. 2010a. The Lake Wales Ridge Fire History GIS Database (shapefile LWRFHGD2008_allfire [ESRI shapefile]). The Nature Conservancy, Lake Wales Ridge Program. Babson Park, Florida.

The Nature Conservancy. 2010b. A Decade of Fire: Lake Wales Ridge prescribed fire team. The Nature Conservancy, Lake Wales Ridge Program. Babson Park, Florida.

Turner, W. R., D. S. Wilcove, and H. M. Swain. 2006. State of the scrub: conservation progress, management responsibilities, and land acquisition priorities for imperiled species of Florida's Lake Wales Ridge. Archbold Biological Station. Lake Placid, Florida.

U. S. Fish and Wildlife Service. 1999. South Florida multi-species recovery plan. Atlanta, Georgia: U.S. Fish and Wildlife Service, Southeast Region.

U. S. Fish and Wildlife Service. 2003. Science needs for reclassification of Lake Wales Ridge scrub plants. U. S. Fish and Wildlife Service, Southeast Region.

Ward, D. B., D. F. Austin, and N. C. Coile. 2003. Endangered and threatened plants of Florida, ranked in order of rarity. Castanea 68:160-174.

Weekley, C. W., E. S. Menges, and R. L. Pickert. 2008a. An ecological map of Florida's Lake Wales ridge: a new boundary delineation and an assessment of post-Columbian habitat loss. Florida Scientist 71: 45-64.

Weekley, C. W., E. S. Menges, M. A. Rickey, G. L. Clarke, and S. A. Smith. 2008b. Effects of mechanical treatments and fire on Florida scrub vegetation. Final Report to US Fish and Wildlife Service, Vero Beach Office.

Zwick, P. D. and M. H. Carr. 2006. Florida 2060: A population distribution scenario for the State of Florida. 1000 Friends of Florida. Tallahassee, Florida.

Table 1. Summary of known wireweed occurrences (data from Christman 2006, FNAI 2009, Gandy pers. comm. 2009).

FNAI EOR No.	County	Site Name	Christman Site Name	Managing Agency	Status	Last Observation
Protected Occurrences						
36	Polk	Allen David Broussard Catfish Creek State Park	Catfish Creek	FDEP	Extant	Christman 2006 = present
37	Polk	Allen David Broussard Catfish Creek State Park	Lake Pierce East, Hesperides	FDEP	Extirpated	Christman 2006 = absent
63	Polk	Allen David Broussard Catfish Creek State Park	Tiote East	FDEP	Extant	Christman 2006 = present
99	Highlands	Archbold Biological Station	Archbold South, Archbold Rosemary Scrub	ABS	Extant	Christman 2006 = present
130	Highlands	Archbold Biological Station	Archbold Sand Pine Scrubs, Archbold Rosemary Scrub	ABS	Extant	Christman 2006 = present
12a	Highlands	Archbold Biological Station	Archbold NW, Archbold Oak Scrub, Archbold Rosemary Scrub	ABS	Extant	Christman 2006 = present
68	Polk	Avon Park Air Force Range	West Spur Ridge West Scrub, Clitoria 008 Scrub	USDOD	Extant	Christman 2006 = present
69	Polk	Avon Park Air Force Range	West Spur Ridge West Scrub, Clitoria 008 Scrub	USDOD	Extant	Christman 2006 = present
70	Polk	Avon Park Air Force Range	Old Bravo Road North	USDOD	Extant	Christman 2006 = present
71	Highlands	Avon Park Air Force Range	Avon Ridge North Scrub	USDOD	Extant	Christman 2006 = present
121	Polk	Avon Park Air Force Range	Old Bravo Road North	USDOD	Extant	Christman 2006 = present
122	Polk	Avon Park Air Force Range	Clitoria 008 Scrub	USDOD	Extant	Christman 2006 = present
123	Polk	Avon Park Air Force Range	not surveyed	USDOD	Extant	FNAI 1992 = present
124	Polk	Avon Park Air Force Range	Old Bravo Road North	USDOD	Extant	Christman 2006 = present
125	Highlands	Avon Park Air Force Range	Avon Ridge North Scrub	USDOD	Extant	Christman 2006 = present
126	Highlands	Avon Park Air Force Range	Avon Ridge North Scrub	USDOD	Extant	Christman 2006 = present
127	Polk	Avon Park Air Force Range	Old Bravo Road North	USDOD	Extant	Christman 2006 = present
128	Polk	Avon Park Air Force Range	Old Bravo Road North	USDOD	Extant	Christman 2006 = present
132	Highlands	Avon Park Air Force Range	Avon Ridge North Scrub	USDOD	Extant	Christman 2006 = present
133	Highlands	Avon Park Air Force Range	Avon Ridge North Scrub	USDOD	Extant	Christman 2006 = present

Table 1. Continued

FNAI EOR No.	County	Site Name	Christman Site Name	Managing Agency	Status	Last Observation
98	Highlands	Fisheating Creek/Smoak Groves Conservation Easement	Venus ESE Scrub	FDEP	Extant	Christman 2006 = present
101	Highlands	Fisheating Creek/Smoak Groves Conservation Easement	Venus ENE Scrub	FDEP	Extant	Christman 2006 = present
117	Polk	Hickory Lake Scrub County Park	Hickory Lake South Scrub	Polk Co. Env. Svc. Dept.	Extant	Christman 2006 = present
1	Highlands	Highlands Hammock State Park	Highlands Hammock Scrub	FDEP	Extant	Gandy pers comm. 2009 = present
57	Highlands	Highlands Hammock State Park	Blue Lake South Scrub	FDEP	Extant	Gandy pers comm. 2009 = present
100	Highlands	Highlands Hammock State Park	Sebring Wolf Lake Scrub	FDEP	Extant	Gandy pers comm. 2009 = present
106	Highlands	Highlands Hammock State Park	Sebring Southgate Scrub	FDEP	Extant	Gandy pers comm. 2009 = present
129a	Highlands	Jack Creek	Lake Josephine/Josephina Creek SE	SWFWMD	Extant	Christman 2006 = present
3a	Highlands	Jack Creek	Lake Josephine South Scrub	SWFWMD	Extant	Christman 2006 = present
10	Highlands	Lake June-in-Winter Scrub State Park	Lake June in Winter SW	FDEP	Extant	Christman 2006 = present
11	Highlands	Lake June-in-Winter Scrub State Park	Tomolka Scrub	FDEP	Extant	Christman 2006 = present
9a	Highlands	Lake June-in-Winter Scrub State Park	Crews Lake North, Lake June in Winter NW	FDEP	Extant	Christman 2006 = present
151	Polk	Lakeland Highlands Scrub	Lakeland Highlands Scrub	Polk Co. Env. Svc. Dept.	Extant	Christman 2006 = present
155	Highlands	LWRNWR-Flamingo Villas	Red Beach Lake East	USFWS	Extant	Christman 2006 = present
137	Polk	LWRNWR-Lake Mcleod	not surveyed	USFWS	Extant	FNAI 1998 = present
22	Polk	LWRSF - Hesperides	Flaming Arrow Scrub, Walk-in-the-Water Rd. Scrub	FDOF	Extant	Christman 2006 = present
60	Polk	LWRSF - Hesperides	Lake Aurora SE Scrub	FDOF	Extirpated	Christman 2006 = absent
61	Polk	LWRSF - Hesperides	Walk- in-the-Water Rd. Scrub	FDOF	Extant	Christman 2006 = present
28	Polk	LWRSF-Arbuckle Tract	Bonnet Creek Scrub	FDOF	Extant	Christman 2006 = present
29	Polk	LWRSF-Arbuckle Tract	Livingston Creek Scrub	FDOF	Extirpated	Christman 2006 = absent

Table 1. Continued

FNAI EOR No.	County	Site Name	Christman Site Name	Managing Agency	Status	Last Observation
30	Polk	LWRSF-Arbuckle Tract	Lake Livingston East Scrub	FDOF	Extirpated	Christman 2006 = absent
32	Polk	LWRSF-Arbuckle Tract	Alico Access Road South	FDOF	Extant	Christman 2006 = present
34	Polk	LWRSF-Arbuckle Tract	Alico Access Rd. East, Old Railroad Grade South, Lake Godwin South Scrub	FDOF	Extant	Christman 2006 = present
35	Polk	LWRSF-Arbuckle Tract	Alico Access Road North	FDOF	Extant	Christman 2006 = present
153	Polk	LWRSF-Arbuckle Tract	Lake David North	FDOF	Extant	Christman 2006 = present
154	Polk	LWRSF-Arbuckle Tract	not surveyed	FDOF	Extant	FNAI 1989 = present
27	Polk	LWRSF-Walk-In-Water Tract	Lake Arbuckle SW Scrub, Bonnet Creek North Scrub, Route 64 Railroad	FDOF	Extant	Christman 2006 = present
21	Highlands	LWRWEA - Carter Creek	Carter Creek South Scrub, Grassy Pond NE Scrub, Carter Creek West, Bonnet Lake East	FFWC	Extant	Christman 2006 = present
40	Polk	LWRWEA - Crooked Lake West	Wolfolk Scrub	FFWC	Extant	Christman 2006 = present
42	Polk	LWRWEA - Crooked Lake West	Lake Buffum Scrub, Alturas-Babson Park Cutoff South	FFWC	Extant	Christman 2006 = present
51	Polk	LWRWEA - Crooked Lake West	Crooked Lake Railroad West	FFWC	Extant	Christman 2006 = present
52	Polk	LWRWEA - Crooked Lake West	Crooked Lake Scrub	FFWC	Extant	Christman 2006 = present
13	Highlands	LWRWEA - Gould Road	Horn Road West Scrub, Horn Road Scrub	FFWC	Extant	Christman 2006 = present
2	Highlands	LWRWEA - Henscratch	Josephine Road Scrub, Payne Road - Josephine Scrub	FFWC	Extant	Christman 2006 = present
15	Highlands	LWRWEA - Henscratch	not surveyed	FFWC	Extant	FNAI 1998 = present
81	Highlands	LWRWEA - Henscratch	Henscratch Road East Scrub	FFWC	Extant	Christman 2006 = present
141	Highlands	LWRWEA - Henscratch	Josephine Creek South east US 27	FFWC	Extant	Christman 2006 = present
129b	Highlands	LWRWEA - Henscratch	Lake Josephine/Josephina Creek SE	FFWC	Extant	Christman 2006 = present
3b	Highlands	LWRWEA - Henscratch	Lake Josephine South Scrub	FFWC	Extant	Christman 2006 = present
7a	Highlands	LWRWEA - Henscratch	Lake Hill East Scrub	FFWC	Extant	Christman 2006 = present

Table 1. Continued

FNAI EOR No.	County	Site Name	Christman Site Name	Managing Agency	Status	Last Observation
8	Highlands	LWRWEA - Highlands Ridge	Lake Hill West	FFWC	Extant	Christman 2006 = present
79	Highlands	LWRWEA - Highlands Ridge	Leisure Lakes West Scrub	FFWC	Extant	Christman 2006 = present
84	Highlands	LWRWEA - Highlands Ridge	Lake Hill SW, Henscratch Rd/Miller Ave. Scrub	FFWC	Extant	Christman 2006 = present
146	Highlands	LWRWEA - Highlands Ridge	Leisure Lakes North Scrub	FFWC	Extant	Christman 2006 = present
7b	Highlands	LWRWEA - Highlands Ridge	Lake Hill East Scrub	FFWC	Extant	Christman 2006 = present
9b	Highlands	LWRWEA - Highlands Ridge	Crews Lake North, Lake June in Winter NW	FFWC	Extant	Christman 2006 = present
19	Highlands	LWRWEA - Holmes Avenue	Holmes Avenue East Scrub	FFWC	Extant	Christman 2006 = present
144	Highlands	LWRWEA - Holmes Avenue	Holmes Avenue East Scrub	FFWC	Extant	Christman 2006 = present
156_131	Polk	LWRWEA - Lake Blue	Blue Lake Scrub	FFWC	Extirpated	Christman 2006 = absent
156_138	Polk	LWRWEA - Lake Blue	Blue Lake Scrub	FFWC	Extirpated	Christman 2006 = absent
18	Highlands	LWRWEA - Lake Placid Scrub Preserve	Lake Placid South Shore Scrub	FFWC	Extant	Christman 2006 = present
114	Highlands	LWRWEA - Lake Placid Scrub Preserve	Placid View Road North Scrub, Placid View Road Dicerandra	FFWC	Extant	Christman 2006 = present
none	Highlands	LWRWEA - Lake Placid Scrub Preserve	SR70 Placid View Road Scrub	FFWC	Extant	Christman 2006 = present
12b	Highlands	LWRWEA - McJunkin	Archbold NW, Archbold Oak Scrub, Archbold Rosemary Scrub	FFWC	Extant	Christman 2006 = present
92	Polk	LWRWEA - Mountain Lake Cutoff	Lake Wales NW	FFWC	Extant	Christman 2006 = present
86	Highlands	LWRWEA - Royce, Clements, Apthorpe	Lake Istokpoga West Scrub	FFWC	Extant	Christman 2006 = present
87	Highlands	LWRWEA - Royce, Clements, Apthorpe	Boggy Branch	FFWC	Extant	Christman 2006 = present
88	Highlands	LWRWEA - Royce, Clements, Apthorpe	Grassy Creek East	FFWC	Extant	Christman 2006 = present
91	Highlands	LWRWEA - Royce, Clements, Apthorpe	Lake Apthorpe East	FFWC	Extant	Christman 2006 = present
136	Highlands	LWRWEA - Royce, Clements, Apthorpe	not surveyed	FFWC	Extant	FNAI 1998 = present
148	Highlands	LWRWEA - Royce, Clements, Apthorpe	not surveyed	FFWC	Extant	FNAI 2003 = present
23	Highlands	LWRWEA - Silver Lake	Avon Park Airport Scrub	FFWC	Extant	Christman 2006 = present

Table 1. Continued

FNAI EOR No.	County	Site Name	Christman Site Name	Managing Agency	Status	Last Observation
50	Highlands	LWRWEA - Silver Lake	County Line East	FFWC	Extant	Christman 2006 = present
135	Highlands	LWRWEA - Silver Lake	Sun & Lakes Silver Lake Scrub	FFWC	Extant	Christman 2006 = present
142	Highlands	LWRWEA - Silver Lake	Avon Park Airport Scrub	FFWC	Extant	Christman 2006 = present
145	Highlands	LWRWEA - Silver Lake	Lake Glenada SW	FFWC	Extant	Christman 2006 = present
59	Polk	LWRWEA - Sunray Hickory Lake South	Sun Ray Water Tower Scrub	FFWC	Extirpated	Christman 2006 = absent
118	Polk	LWRWEA - Sunray Hickory Lake South	Lake Streety NE Scrub	FFWC	Extant	Christman 2006 = present
108	Polk	Saddle Blanket Scrub Preserve	Saddle Blanket Lakes	TNC	Extant	Christman 2006 = present
119	Polk	Sun Ray Scrub Preserve	Sun Ray Water Tower Scrub	TNC	Extant	Christman 2006 = present
none	Polk	Tiger Creek Preserve	Tiger Creek Preserve SE	TNC	Extant	Christman 2006 = present
102	Highlands	XL Ranch Conservation Easement	Carlton Ranch South B Scrub	private	Extirpated	Christman 2006 = 'lost scrub'
Unprotected Occurrences						
4	Highlands	Private Property	Lake Josephine / Josephina Creek SE	n/a	Extant	Christman 2006 = present
5	Highlands	Private Property	Jackson Creek - Skipper Road	n/a	Extant	Christman 2006 = present
6	Highlands	Private Property	not surveyed	n/a	Extant	Aerial Imagery 2008 = habitat present
14	Highlands	Private Property	Bear Hollow Scrub	n/a	Extirpated	Christman 2006 = 'lost scrub'
16	Highlands	Private Property	US 27 & Bald Hill Road Scrub	n/a	Extant	Christman 2006 = present
17	Highlands	Private Property	Venus Scrub, Venus North Scrub	n/a	Extant	Christman 2006 = present
20	Highlands	Private Property	Hendrie Ranch North Scrub	n/a	Extant	Christman 2006 = present
24	Highlands	Private Property	Placid View Road North Scrub	n/a	Extant	Christman 2006 = present
38	Polk	Private Property	Surveyor's Scrub	n/a	Extirpated	Christman 2006 = absent
39	Polk	Private Property	Cutoff Road East Scrub	n/a	Extant	Christman 2006 = present
41	Polk	Private Property	Lake Henry North	n/a	Extirpated	Aerial Imagery 2007 = citrus groves

Table 1. Continued

FNAI EOR No.	County	Site Name	Christman Site Name	Managing Agency	Status	Last Observation
43	Polk	Private Property	Lizzie Lake	n/a	Extant	Christman 2006 = present
44	Polk	Private Property	Lizzie Lake	n/a	Extant	Christman 2006 = present
45	Highlands	Private Property	Sun & Lakes Holiday Inn Scrub	n/a	Extant	Christman 2006 = present
46	Highlands	Private Property	Avon Park C Scrub	n/a	Extirpated	Christman 2006 = absent
47	Highlands	Private Property	Hog Lake South, Schumacher Road Scrub	n/a	Extant	Christman 2006 = present
48	Highlands	Private Property	College Scrub	n/a	Extirpated	Christman 2006 = 'lost scrub'
49	Highlands	Private Property	Avon Park Lakes	n/a	Extant	Christman 2006 = present
53	Polk	Private Property	Lake Cinch West South, Lake Clinch West North	n/a	Extant	Aerial Imagery 2007 = habitat present
54	Highlands	Private Property	Grassy Lake SE Scrub, Highlands Ave. Scrub	n/a	Extant	Christman 2006 = present
56	Highlands	Private Property	Golf Hammock Scrub	n/a	Extirpated	Christman 2006 = absent
58	Highlands	Private Property	Lake Chilton	n/a	Extant	Christman 2006 = present
62	Polk	Private Property	Hesperides West	n/a	Extant	Christman 2006 = present
64	Polk	Private Property	Lake Rosalie NW	n/a	Extirpated	Christman 2006 = present
65	Highlands	Private Property	Old Bombing Range Road Scrub	n/a	Extant	Christman 2006 = present
72	Highlands	Private Property	Lake Jackson NW	n/a	Extirpated	Christman 2006 = absent
73	Highlands	Private Property	Lake Sebring South Scrub	n/a	Extirpated	Christman 2006 = 'lost scrub'
76	Highlands	Private Property	Lake Sebring West	n/a	Extirpated	Christman 2006 = absent
77	Highlands	Private Property	Lake Sebring Southwest	n/a	Extirpated	Christman 2006 = 'lost scrub'
78	Highlands	Private Property	Lake Henry South Scrub	n/a	Extirpated	Christman 2006 = 'lost scrub'
80	Highlands	Private Property	Lake Placid North	n/a	Extant	Christman 2006 = present
82	Highlands	Private Property	Jones Gulley SE	n/a	Extirpated	Christman 2006 = 'lost scrub'
83	Highlands	Private Property	Lake June North	n/a	Extirpated	Christman 2006 = 'lost scrub'
85	Highlands	Private Property	Grassy Lake SE Scrub, Grassy Lake East Scrub	n/a	Extant	Christman 2006 = present

Table 1. Continued

FNAI EOR No.	County	Site Name	Christman Site Name	Managing Agency	Status	Last Observation
90	Highlands	Private Property	Highlands Park States, Cavender Hill Scrub	n/a	Extant	Christman 2006 = present
93	Polk	Private Property	Pierpointe Scrub	n/a	Extirpated	Christman 2006 = present
94	Highlands	Private Property	Huckleberry Lake Scrub	n/a	Extant	Christman 2006 = present
95	Highlands	Private Property	Hendrie Ranch West Scrub	n/a	Extant	Christman 2006 = present
96	Highlands	Private Property	U.S. 98 South	n/a	Extant	Christman 2006 = present
97	Highlands	Private Property	College Scrub	n/a	Extirpated	Christman 2006 = 'lost scrub'
104	Highlands	Private Property	Hendrie Ranch Middle Scrub	n/a	Extant	Christman 2006 = present
105	Polk	Private Property	Pittsburg Scrubs	n/a	Extirpated	Christman 2006 = 'lost scrub'
107	Highlands	Private Property	Skipper Road South Scrub	n/a	Extant	Christman 2006 = present
109	Highlands	Private Property	Lake Charlotte East Scrub	n/a	Extant	Christman 2006 = present
110	Highlands	Private Property	Payne Road East Scrub	n/a	Extant	Christman 2006 = present
111	Highlands	Private Property	Lake Jackson West	n/a	Extant	Christman 2006 = present
112	Highlands	Private Property	Sebring Triangle Northeast	n/a	Extirpated	Christman 2006 = absent
113	Highlands	Private Property	Lake Wolf South	n/a	Extant	Christman 2006 = present
115	Highlands	Private Property	not surveyed	n/a	Extirpated	Aerial Imagery 2008 = citrus groves
116	Polk	Private Property	Sun Ray Motel & Restaurant	n/a	Extant	Aerial Imagery 2008 = habitat present
134	Polk	Private Property	Trout Lake North Scrub	n/a	Extirpated	Christman 2006 = absent
140	Polk	Private Property	not surveyed	n/a	Extant	Aerial Imagery 2007 = habitat present
143	Polk	Private Property	Sun Ray East	n/a	Extirpated	Christman 2006 = absent
none	Highlands	Private Property	Josephine Creek SE US27	n/a	Extirpated	Christman 2006 = 'lost scrub'
none	Highlands	Private Property	Hendrie Ranch South	n/a	Extant	Christman 2006 = present
none	Highlands	Private Property	Hendrie Ranch Subcell E8G	n/a	Extant	Christman 2006 = present

Table 1. Continued

FNAI EOR No.	County	Site Name	Christman Site Name	Managing Agency	Status	Last Observation
none	Highlands	Private Property	Oak Street Scrub	n/a	Extirpated	Christman 2006 = 'lost scrub'
none	Highlands	Private Property	Venus NE Two Mile Scrub	n/a	Extant	Christman 2006 = present
none	Highlands	Private Property	Bruce Sherwood Cemetery	n/a	Extirpated	Christman 2006 = 'lost scrub'
none	Polk	Private Property	West Lake Wales Scrub	n/a	Extirpated	Christman 2006 = 'lost scrub'
none	Polk	Private Property	Flagship Development Scrub	n/a	Extirpated	Christman 2006 = 'lost scrub'

ABS	Archbold Biological Station
BTG	Bok Tower Gardens
FDEP	Florida Department of Environmental Protection
FDOF	Florida Division of Forestry
FFWC	Florida Fish and Wildlife Commission
LWRNWR	Lake Wales Ridge National Wildlife Refuge
LWRSF	Lake Wales Ridge State Forest
LWRWEA	Lake Wales Ridge Wildlife and Environmental Area
SWFWMD	Southwest Florida Water Management District
TNC	The Nature Conservancy
USFWS	U.S. Fish and Wildlife Service
none	occurrence was not in FNAI 2009
n/a	not applicable

Table 2. Summary of wireweed occurrences by county (data from Christman 2006, FNAI 2009, Gandy pers. comm. 2009).

County	Extant		Extirpated	Total
	Protected	Unprotected		
Highlands	52	28	18	98
Polk	32	7	16	55
Total	**84**	**35**	**34**	**153**

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Wireweed (*Polygonella basiramia*)

Current Classification Endangered
Recommendation resulting from the 5-Year Review

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist**
__X__ **No change is needed**

Appropriate Listing/Reclassification Priority Number, if applicable N/A

Review Conducted By Eric Menges, Archbold Biological Station; David Bender and Darla Fousek, South Florida Ecological Services Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 7/16/10

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.

Acting
Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 9-7-10

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_____

Appendix A. Summary of peer review for the 5-year review of wireweed (*Polygonella basiramia*)

A. Peer Review Method: The Service conducted peer 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: In general, the reviewers felt the 5-year review was comprehensive, well-written, and that assertions were adequately supported by the cited literature.

One reviewer did not identify any concerns with the review and only commented that there is enough data to evaluate wireweed's major population trends and principal risks, but we need broader scale quantitative surveys to detect regional trends and long-term data to reduce uncertainties and improve our understanding of the population viability of wireweed.

A second review had no concerns with the review and only commented that he is concerned that some public lands are not being managed to sustain rare plants. In particular, many sites have not been managed with fire and are in the same overgrown condition they were upon acquisition.

A third reviewer requested minor points of clarification regarding the discussion of micorrhizal associates, seed dispersal, germination ecology, demography, and response to fire. Some of these comments required the insertion of additional text to provide clarity, but they did not affect the substance of the review or its conclusions.

D. Response to Peer Review: The Service was in agreement with all comments and concerns received from peer reviewers. Comments were incorporated into the 5-year review where appropriate.

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.