Sandlace
(Polygonella myriophylla)

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
Sandlace/*Polygonella myriophylla*

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 sandlace. The review was conducted by a biologist in the U.S. Fish and Wildlife Service (Service), South Florida Ecological Services Field Office. Revision of the document was contracted to a plant ecologist familiar with the species and relevant research on it. Literature and documents used for this review are on file at the South Florida Ecological Services Field Office. All recommendations resulting from this review are a result of thoroughly reviewing the best available scientific information on sandlace. 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 Region, Kelly Bibb, 404-679-7132

Lead Field Office: Stephen Mortellaro and David Bender, South Florida Ecological Services Field Office, 772-562-3909, Carl W. Weekley (contractor), Archbold Biological Station, 863-465-2571

Cooperating Field Office: Jacksonville Ecological Services Field Office (904-731-3336)

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). There are 113 extant sandlace occurrences, 55 (49 percent) of which are protected on 26 managed areas. Fifty-eight (51 percent) of extant occurrences are located on private property (excluding those on private conservation lands) where they have no protection from development and lack fire and other types of active management. Fire suppression and habitat loss continue to be threats to occurrences on unprotected sites. Inadequate prescribed fire implementation remains a significant threat at many managed sites. Many fire-suppressed, overgrown scrub sites have not been restored using prescribed fire, and mechanical surrogates to fire may not provide the same benefits as fire for gap specialist species. Roadside populations have different demographics and a higher extinction risk than those within scrub. Further loss of unprotected populations is likely as development continues on the Lake Wales Ridge. Unprotected habitat continues to be developed for agriculture, housing, and other uses. Because the status of none of the 113 extant occurrences was reported in 2009, no data are available to infer overall

population trends for the past year. In addition, trends in threats are continuing at the same level. Therefore, the overall species' status is uncertain.

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

4. Listing history
Original Listing
FR notice: 58 FR 25746
Date listed: 04/27/1993
Entity listed: Species
Classification: Endangered

5. Associated rulemakings: None.

6. Review History:

Final Recovery Plan: 1999

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

7. Species' Recovery Priority Number at start of review (48 FR 43098): 8 (a species with a moderate degree of threat and high recovery potential).

8. Recovery Plan
Name of plan: South Florida Multi-Species Recovery Plan (MSRP; Service 1999)
Date issued: May 18, 1999
Dates of previous plans:
Recovery plan for nineteen central Florida scrub and high pineland plants. 1996 (revised; Service 1996).
Recovery plan for nineteen central Florida scrub and high pineland plants. 1990 (original).

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 or 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.

Criterion 1. The criterion of 20 to 90 percent probability of persistence for 100 years is flawed because it allows for a possible 80 percent chance of extinction at the lower end of the range of probability of persistence.

Criterion 3. The criterion identifies only rosemary scrub as the habitat of sandlace. The species also occurs in scrubby flatwoods and oak scrub. These habitats have different fire regimes, species composition, and vegetation structure. These differences are discussed in the review.

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

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

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

Sandlace may be reclassified from endangered to threatened when:

1. Enough demographic data are available to determine the appropriate number 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. The short-term demographic data that have been collected to date (Quintana-Ascencio et al. 2008) are inadequate to determine the number of self-sustaining populations needed to assure the persistence for the species. This criterion addresses factor A.

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

This criterion has been partially met. Federal, state, and county land acquisition programs have succeeded in protecting a considerable number of sites on the Lake Wales Ridge. However, the existing network of protected lands does not adequately represent the historic range of sandlace. Fifty-five occurrences are protected on

public or private conservation lands. Fifty-eight (51 percent) of 113 extant occurrences are located on private property (Florida Natural Areas Inventory [FNAI] 2009; Christman 2006) where they are susceptible to habitat loss or degradation and are unlikely to be managed with prescribed fire (Turner et al. 2006). Only half of the extant occurrences are protected and all of these occur in the southern half (Highlands and southern Polk Counties) of sandlace's historic range. In the northern half of the range in northern Polk, Orange or Osceola Counties there are no protected occurrences. Occurrences by County are summarized in Table 1. This criterion addresses factors A and E.

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

This criterion has not been met. It is based on an incomplete understanding of the full range of habitats that support sandlace. The species also occurs in scrubby flatwoods and oak scrub. The appropriate fire return interval for sandlace has not been determined due to lack of data on its post-fire maturation rates. In addition, land managers often use mechanical treatments as surrogates for fire, and these treatments may not provide the same benefits as fire. Mechanical treatments also exacerbate problems with non-native grasses that colonize the same gaps as sandlace. Mowing and chopping subject populations to different selective pressures than fire, possibly resulting in a shift toward adaptations to these treatments rather than the fires that were part of their evolutionary history (Menges and Gordon 2010). This criterion addresses factor A.

4. Monitoring programs demonstrate that populations of sandlace 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. All protected occurrences are located in the southern half of sandlace's historic range, and acquisition of the few remaining unprotected sites on the northern half of the range is unlikely. A meaningful assessment of persistence probabilities for individual populations and the species as a whole requires population viability analyses based on detailed long-term demographic data drawn from multiple populations across the species range. No such studies are underway or have been completed. This criterion addresses factors A and E.

C. Updated Information and Current Species Status

1. Biology and Habitat:

Information on the biology and habitat of sandlace is summarized in the South Florida Multi-Species Recovery Plan (USFWS 1999). Relevant biology and habitat information is summarized and updated in this review.

Plant Description

Sandlace is 1 of 11 species of North American *Polygonella* and one of 6 species that occur in scrub habitat in south Florida (refer to photo at start of this review). Also known as Small's jointweed or woody wireweed, sandlace is a member of the Polygonaceae (jointweed or buckwheat family). It is a sprawling sub-shrub, 15 to 30 centimeters (cm) tall, that forms patches of prostrate or decumbent stems with many branches zigzagging along the ground, rooting at the nodes, and forming large mats (Wunderlin et al. 1980, Kral 1983, Flora of North America 2010). The lower parts of the creeping branches have bark that cracks and partly separates in long, flat, interlacing strips. Sandlace has the sheathing leaf stipules (ocreae and ocreolae) typical of the jointweed family. The leaves are needle-like and 0.3 to 10.0 millimeters (mm) long. The flowers are bisexual and found on short, lateral branches on terminal racemes; they have white, petal-like sepals up to 3.4 mm long (Kral 1983). Achenes are reddish-brown, 2 to 3 mm in length, and minutely roughened (Flora of North America 2010). Gravity is the primary dispersal agent for sandlace seeds.

Current Distribution and Habitat

Sandlace is endemic to the Lake Wales, Mount Dora, and Winter Haven ridges of central peninsular Florida in Highlands, Polk, Osceola and Orange Counties (Christman 2006). There are also occurrence records from on or near the Lake Henry Ridge in Polk County. Sandlace prefers xeric, white sandy soils in Florida scrub (Flora of North America 2010), but it is also known from other soil types (Menges et al. 2007). Christman (1988) surveyed 216 scrub sites in Highlands, Polk, Orange, and Osceola Counties, and identified 118 that supported sandlace. Christman (2006) resurveyed these sites in 2004 and 2005 and documented the presence of sandlace on 101 of the original 118 sites. Most extant occurrences are located in Highlands and southern Polk Counties, with a few remnant occurrences in Orange or Osceola Counties (FNAI 2009). Table 2 is based on a compilation of the FNAI (2009) and Christman (1988, 2006) records and summarizes the recent search history and status of these records. Sandlace occurs mainly in Florida scrub, including rosemary and oak scrub and scrubby flatwoods (Menges 1999) and on sandy roads and roadsides traversing scrub (Quintana-Ascencio et al. 2008), but it is also recorded from a few, long-unburned sandhill sites.

Life History

Sandlace is a clonal sub-shrub (Wunderlin et al. 1980, Kral 1983, Flora of North America 2010) endemic to open sand gaps within Florida scrub. Plants are slow-growing but long-lived. Sandlace reproduces sexually and vegetatively through the rooting of prostrate branches. Quintana-Ascencio et al. (2008) documented flowering in all months except January and February, but most flowering occurred between

April and September. It is not known if sandlace is self-compatible. The bisexual flowers are visited by a variety of insects from the orders Hymenoptera, Diptera and Lepidoptera, including halictid bees (*Dialectus placidensis*) (M. Deyrup, Archbold Biological Station [ABS], pers. comm. 2010), the shore fly *Allotrichoma abdominalis* (Deyrup and Deyrup 2008), and the hairstreak butterfly *Hemiargus ceraunus* (C. Weekley, ABS, pers. obs.). However, floral visitors are not necessarily pollinators, and there have been no studies of the pollination biology of sandlace. Sandlace produces allelopathic leachates (Weidenhamer and Romeo 1989) that may help to maintain its open habitat.

In a 1-year study, Quintana-Ascencio et al. (2008) found that rates of seed production, seed germination and seedling survival were extremely low. From several hundred flowers collected from a single population at Lake Wales Ridge State Forest (LWRSF), Quintana-Ascencio et al. (2008) recorded only 21 achenes. In a germination study including over 400 seeds, the germination rate was less than 10 percent, with the first germinant recorded after 45 days. No seedlings survived from the seeds that germinated (Quintana-Ascencio et al. 2008). Seedling recruitment in the wild has been documented in both burned and mechanically disturbed microsites (Weekley and Menges 2003, Quintana-Ascencio et al. 2008), but seedling recruitment in undisturbed sites appears to be rare (Quintana-Ascencio et al. 2008).

Fire Ecology

Sandlace is killed by fire and recolonizes burned areas by seedling recruitment or clonal growth (Weekley and Menges 2003, Quintana-Ascencio et al. 2008). Most obligate seeders in Florida scrub and sandhill, including both herbs (e.g. Highlands scrub hypericum [*Hypericum cumulicola*], snakeroot [*Eryngium cuneifolium*], Lewton's polygala [*Polygala lewtonii*]) and sub-shrubs (e.g. several species in the genus *Dicerandra*), recover quickly post-fire via seedling recruitment and often show dramatic aboveground population booms (Menges and Kimmich 1996, Quintana-Ascencio et al. 1998, Weekley and Menges submitted). Like Florida rosemary (*Ceratiola ericoides*), another obligate seeder, sandlace seems to recover slowly (Weekley and Menges 2003, Quintana-Ascencio et al. 2008, Weekley et al. 2008b), with seedling recruitment only after several months (as opposed to a few weeks). Obligate seeders often have persistent seedbanks (Menges 2007), but the longevity of sandlace's seedbank has not been investigated. The congeneric wireweed (*P. basiramia*), which is also endemic to Florida rosemary and oak scrub, lacks a seedbank and relies on dispersal from nearby unburned sites to re-establish its populations post-fire (Hawkes and Menges 1995).

In sandlace's preferred habitats, recommended fire return intervals range from 8 to 16 years for xeric scrubby flatwoods (Woolfenden and Fitzpatrick 1996, Menges 2007) to 15 to 30 years for Florida rosemary scrub (Menges 2007). Sandlace's preference for habitats with relatively long fire return intervals is consistent with its obligate-seeding habit and slow recovery time. Because obligate seeders may require several years to reach sexual maturity and to replenish their seedbanks, their populations may

be extirpated if their habitat is burned too frequently (Menges 2007). On the other hand, obligate seeders may also decline with time-since-fire due to clonal growth of surrounding shrubs and shrinking areas of bare sand (Menges et al. 1993, Menges and Kohfeldt 1995, Menges et al. 2008). However, even in sites that have not been burned for decades, bare areas often persist around sandlace plants, probably due to the allelopathic substances they release (Weidenhamer and Romeo 1989).

Because many remaining scrub sites are embedded in a growing urban or suburban matrix, many land managers have turned to mechanical methods as a pre-treatment or surrogate for fire. In separate studies, Quintana-Ascencio et al. (2008) and Weekley et al. (2008b) investigated the response of sandlace to chopping (with a Gyro Trac) compared to burning. Both studies found that the survival of sandlace plants was higher in sites that were chopped but not burned than in sites that were burned (with or without a chopping pre-treatment). In the Weekley et al. (2008b) study, sandlace re-colonized most burned macroplots within 2 years, presumably by seedling recruitment or clonal spread from plants occurring on the perimeter of the study plot. Working at a finer scale, Quintana-Ascencio et al. (2008) also found that seedlings recruited into burned plots, but that seedling recruitment was greatest in plots that included chopping either as a pre-treatment or as a surrogate for fire. Thus, it may appear that mechanical treatments benefit sandlace more than burning alone. However, these results must be assessed with caution because comparisons based on one or two vital rates cannot predict long-term persistence probabilities. Population viability analyses of populations in scrub vs. roadside habitats make this point clear (see below).

Scrub versus Roadside Populations

Like many other scrub endemics adapted to fire-maintained habitats, sandlace also occurs in sand roads, roadsides, and other mechanically disturbed sites. Roads and similar anthropogenic disturbances alter native habitats, generally with adverse consequences for plant species recruiting into these sites (Andrews 1990, Forman and Alexander 1998, Hourdequin 2000). The demography, autecology and genetics of a species may be negatively impacted by such disturbances (Bradshaw and Hardwick 1989). For example, the vital rates of scrub and roadside populations of Highlands scrub hypericum, a scrub endemic that sometimes co-occurs with sandlace, differ dramatically, with roadside populations displaying weedier characteristics and perhaps reflecting a divergent selective regime (Quintana-Ascencio et al. 2007). Thus, chopped or mowed vegetation, along with roadsides, may be an evolutionary trap (Schaepfer et al. 2002) for gap specialist species, including sandlace.

In a 4-year study of scrub and roadside populations of sandlace, Quintana-Ascencio et al. (2008) found that growth rates and reproductive effort (number of inflorescences) were higher in roadside than in scrub sites. Nonetheless, higher variation in these and other measures of demographic performance increased the extinction probability of roadside compared to scrub populations. In addition, long-unburned scrub also had a substantial risk of extinction. Thus it seems likely that a species that evolved in

pyrogenic habitats and continues to persist in them is best managed with fire despite short-term local extirpations and the apparently slow rate of post-fire recovery. Determination of the appropriate management regime for sandlace requires collection of long-term demographic data from populations with differing management histories.

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:

Abundance

Abundance data are difficult to obtain for a clonal species such as sandlace because without genetic analysis it is extremely difficult to determine what constitutes a genetic individual (genet). In the only demographic study of sandlace conducted to date, Quintana-Ascencio et al. (2008) defined a "plant" as a group of rooted branches (ramets) separated by other such groups by more than 30 cm. Using this definition, Quintana-Ascencio et al. (2008) counted the plants in their study areas. Most previous sandlace surveys (Christman 1988, Schultz et al. 1999, Weekley et al. 2001) recorded presence/absence, although Christman (2006) attempted to make ocular estimates of areal coverage.

Population Trends

Population trends are also difficult to estimate in a clonal species if the goal is to determine changes in the number of genets. Level 2 monitoring (*sensu* Menges and Gordon 1996) is usually based on counts of the number of genets present within a population. Level 2 monitoring has only been conducted at a few sites for sandlace. Currently, ABS's Population Dynamics of Endemic Plants (PDEP) project is tracking changes in sandlace populations in response to management treatments on sites managed by the Service and the Florida Fish and Wildlife Conservation Commission (FWCC). The PDEP protocol relies on measurements of canopy cover of patches at least 25 cm apart to estimate changes in the size of sandlace populations.

Summary of Known Occurrences

A compilation of the FNAI (2009), Christman (2006), and C. Peterson, Bok Tower Gardens, (pers. comm. 2010) datasets provides the sandlace occurrence data used in this review. The compilation resulted in 140 occurrence records, 113 of which are extant. Of these, 55 occurrences (49 percent) are protected by public ownership or private conservation organizations on 26 managed areas.

Twenty-seven (19 percent) of 140 sandlace occurrences are considered extirpated based on available data. Twenty-four of these occurrences were located on unprotected, private lands. Most were eliminated by residential and commercial development, the rest by citrus production. In comparison, three occurrences on protected sites are considered extirpated because surveys failed to locate any sandlace plants in recent years.

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

Protected Sites

All managed areas with protected sandlace occurrences are located in southern Polk and Highlands Counties and most occur on the Lake Wales Ridge. Notable exceptions include large occurrences at Lake Blue and Lake McLeod on the Winter Haven Ridge and one occurrence at Crooked Lake West near the Lake Henry Ridge. The Arbuckle Tract of Lake Wales Ridge State Forest is the site with the largest number of occurrences (nine) of sandlace.

Unprotected Sites

Fifty-eight of 113 extant sandlace occurrences (51 percent) are located on private property where they have no protection from development and are unlikely to be appropriately managed. None of the six presumably extant occurrences on private property in Orange or Osceola Counties are protected in this northern portion of the species' range.

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

In a survey of allozyme diversity in the 11 species of *Polygonella* that are native to North America, Lewis and Crawford (1995) found that sandlace had the second highest average gene diversity in the genus. Given its narrow geographic range, this was a surprising finding (Lewis and Crawford 1995). However, the relatively high level of diversity in sandlace is consistent with its perenniality and its hermaphroditic floral system (Hamrick et al. 1991, Lewis and Crawford 1995).

At the scale of individual sandlace patches that may appear to be separate plants, Quintana-Ascencio and associates have recently found that 20 to 30 percent of the time, patches contain more than one genetic individual (P. Quintana-Ascencio, University of Central Florida, pers. comm. 2010).

Metzger (2010), using microsatellites, described genetic variation of five populations across sandlace's range and confirmed its high level of genetic

diversity. The study also documented the presence of unique alleles in all the study populations and the uniqueness of the northern population.

These researchers are continuing to assess the relative amount of genetic variation within clusters, within populations, and among populations. A full analysis of these data is forthcoming.

c. Taxonomic classification or changes in nomenclature:

There have been no recent changes in nomenclature. Horton (1963) provides a detail review of the status of the genus. *Polygonella myriophylla* is recognized as a valid taxon by the Integrated Taxonomic Information System (ITIS 2010).

d. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors), or historic range:

Extant occurrences of sandlace are concentrated on the Lake Wales Ridge in Highlands and southern Polk Counties. The only FNAI (2009) record of sandlace for Lake County is now believed to have been based on a mis-identification and the record has been expunged. With the exception of protected occurrences at Lake Blue and Lake McLeod on the Winter Haven Ridge and Crooked Lake West near the Lake Henry Ridge, there are no protected occurrences off the Lake Wales Ridge. For example, two of three occurrences known from the Mt. Dora Ridge in Orange County have been lost to development. Two extant occurrences on the Lake Wales Ridge in Orange County and three in Osceola County are unprotected. The loss of these sites would represent a further reduction in sandlace's geographic range and perhaps of its genetic diversity.

The small number of occurrences (six) on the northern half of the Lake Wales Ridge reflects the relative scarcity of white sand scrub in this area as well as the loss of these habitats to development. The pre-Columbian areal extent of white sand habitats in Lake County accounted for less than 1 percent of the white sand habitat on the Lake Wales Ridge, and 99.9 percent of this habitat had been lost by the late 1990s (Weekley et al. 2008a). In contrast, approximately 45 percent of white sand habitat remains in Polk and Highlands Counties (Weekley et al 2008a). Fifty-two presumably extant but unprotected occurrences remain on the Lake Wales Ridge in southern Polk and Highlands Counties.

e. Habitat:

Determining the suitability of remaining sandlace habitat requires data on its management requirements that do not currently exist. Sandlace's preferred scrub habitats have fire return intervals ranging from 8 to 16 years for xeric

scrubby flatwoods (Woolfenden and Fitzpatrick 1996, Menges 2007) to 15 to 30 years for Florida rosemary scrub (Menges 2007). Several studies have demonstrated that the demographic performance (survival, growth, fecundity) of many Florida scrub and sandhill endemics deteriorates with time-since-fire (Menges and Kimmich 1996, Quintana-Ascencio et al. 1998, Weekley and Menges submitted). In addition, Menges and Kohfeldt (1995) characterized a number of scrub plants as "decreasers" because their populations decline with time-since-fire. However, there are few data on the vital rates (survival, growth, fecundity and recruitment) of sandlace in sites varying in fire history. Seedling recruitment has only been documented in post-fire populations (Weekley and Menges 2003, Quintana-Ascencio et al. 2008), but these results are based on short-term studies. There are no data on survival, growth or fecundity rates as a function of time-since-fire. It is not even known how long it takes a seedling to reach sexual maturity or whether fecundity declines with plant age. Assessing the suitability of extant habitat requires a greater knowledge of the biology of sandlace than currently exists.

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 more than $68 million to acquire nearly 24,710 acres of land on the Lake Wales Ridge, with plans to acquire an additional 24,710 acres (FDEP 2008). In 1990, the Service established the first national wildlife refuge in the country designated primarily for plants, the LWRNWR. Particularly problematic and challenging have been the acquisition projects known as megaparcel sites, which include extensive areas of scrub habitat that were previously subdivided and sold to numerous lot owners. To date over 14,000 such lots have been purchased for conservation within the megaparcel sites, in a checkerboard manner, but nearly as many lots have yet to be purchased (Turner et al. 2006).

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

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

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

Development

Habitat loss on the Lake Wales Ridge is detailed in the MSRP (USFWS 1999) and in Turner et al. (2006) and Weekley et al. (2008a).

Sandlace was among 36 imperiled Lake Wales Ridge taxa evaluated by Turner et al. (2006) using protection indices for each taxon and for three time periods (past, current, targeted) based on number of locations, extent of occurrence, and area of occupancy. Based on the number of protected sites known to Turner et al. (2006), sandlace's overall protection index (PI) fell between 1 and 2, corresponding to "endangered" status on the IUCN Red List (IUCN 2001). Although acquisition of five of the seven sites targeted for acquisition by Turner et al. (2006) is encouraging, it does not change the PI for sandlace. In addition, all recent acquisitions occur on the Lake Wales Ridge in Highlands County and therefore do not extend the range of protected occurrences.

Fifty-eight of 113 occurrences (51 percent) are located on private land where they have inadequate protection from development. Twenty-four occurrences on unprotected, private lands have already been extirpated due to habitat loss. 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. For example, a site in Polk County supporting a sandlace occurrence is slated to be developed as a railroad depot in 2011 (Peterson pers. comm. 2010).

Zwick and Carr (2006) analyzed existing land use and landscape patterns to identify the areas most likely to be developed to accommodate a growing human population and estimated relative losses to agriculture, open space, and conservation to other land uses. They predicted central Florida will experience "explosive" growth, with continuous urban development within the known range of sandlace. They estimated 2.7 million acres (ac) of native habitat and 630,000 ac of land currently under consideration for conservation purchase will be lost. Also of significance, 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 (Turner et al. 2006). Losses are greatest on yellow sands at the northern end of the Ridge, and least on white sands near the southern end (Weekley et al. 2008a). Overall, loss of habitat to development will likely continue in central Florida, eliminating occurrences and reducing the area of suitable habitat for sandlace. Most remaining

occurrences are located on small sites embedded in an urban or suburban matrix that poses a significant challenge to effective management.

Inappropriate management

On protected sites, the greatest threat to sandlace is inappropriate management due to lack of prescribed fire or over-reliance on mechanical means as a substitute for fire. Although the appropriate fire return interval has not yet been determined for sandlace, it is endemic to fire-maintained plant communities. Moreover, it appears from the limited data available that seedling recruitment in sandlace requires fire or mechanical disturbance (Weekley and Menges 2003, Quintana-Ascencio et al. 2008, Weekley et al. 2008b). However, mechanical surrogates for fire in Florida scrub do not achieve the community-wide benefits of fire (Weekley et al. 2008, Menges and Gordon 2010). In addition, Quintana-Ascencio et al. (2008) have shown that extinction risks for sandlace populations are greater in roadways and long-unburned scrub, than in recently burned scrub. Selection for roadside existence may reduce a species adaptation to colonizing and persisting in natural scrub gaps. Thus, while roadsides or mechanically treated sites may provide temporary refugia for gap specialists within long-unburned sites, they also fit the model of an evolutionary or ecological trap (*sensu* Schaepfer et al. 2002). Thus, maintenance of recommended fire return intervals (Menges 2007) for sandlace's preferred scrub habitats is likely the best way to promote the persistence of its populations.

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

This factor is not considered a threat to sandlace. It was once considered to have potential as a low-maintenance groundcover in xeric landscaping. However, due to unsuccessful propagation by commercial interests, it apparently is no longer offered by native nurseries (Floridata 2010).

c. Disease or predation:

No diseases or predation have been observed to affect sandlace.

d. Inadequacy of existing regulatory mechanisms:

Sandlace is listed as endangered by the State of Florida on the Regulated Plant Index (Florida Department of Agriculture and Consumer Services Rule 5B-40). This law regulates the taking, transport, and sale of listed plants on State and private lands. It does not prohibit private property owners from destroying populations of listed plants on their property nor require landowners to manage habitats to maintain populations. Existing Federal and State regulations prohibit the removal or destruction of listed plant species on

public lands. However, such regulations afford no protection to listed plants on private lands. The ESA only protects populations from disturbances on Federal lands or when a 'Federal nexus' is involved for other lands, meaning any action that is authorized (e.g. permitted), funded or carried out by a Federal agency. In addition, State regulations are less stringent than Federal regulations toward land management practices that may adversely affect populations of listed plants on private land. Existing regulatory mechanisms are inadequate to protect sandlace.

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

Off-road vehicles (ORVs)

Off-road vehicle (ORV) impacts have been observed on natural areas on the Lake Wales Ridge (Schultz et al. 1999) and throughout central Florida. ORVs crush, uproot and tear plants as they drive over them. Although most managed sites restrict ORV use where sandlace occurs, ORVs are a threat to sandlace on unprotected sites.

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. Efforts to control these species are implemented to varying degrees at some protected sites.

Ex situ conservation measures

Standard *ex situ* conservation measures for sandlace are incomplete. Bok Tower Gardens (BTG) maintains living plants as part of the Center for Plant Conservation National Collection of Endangered Species; plants in the living collection are all from a single wild population. More populations should be represented in order to capture an adequate sample of the genetic diversity of the species. Additionally, seeds are not in storage at BTG, nor have they been provided for storage at the National Center for Genetic Resources Preservation in Fort Collins, Colorado.

D. Synthesis

Sandlace is a low-growing, long-lived sub-shrub endemic to Florida scrub on the Lake Wales Ridge and associated uplands in central peninsular Florida. It reproduces sexually and vegetatively, but seed production and germination rates are low (Quintana-Ascencio et al. 2008). Sandlace is killed by fire and re-establishes populations postfire by seedling recruitment and clonal spread. However, recovery is slow and it may take sandlace several years to reach sexual maturity.

Fifty-eight (51 percent) of 113 extant sandlace occurrences are located on private land, where they are not adequately protected from habitat loss and prescribed fire is unlikely. Our review of available data indicates that 24 occurrences on unprotected, private land have already been extirpated, mostly by development and citrus production. While many may be lost, others may become available for acquisition. In addition, conservation organizations may be able to work with private landowners to conserve some occurrences on private land.

Fifty-five (49 percent) of the 113 extant sandlace occurrences are protected on 26 managed areas, mostly on the Lake Wales Ridge in Highlands and southern Polk Counties. The main threat to protected occurrences is inappropriate site management due to lack of prescribed fire or the use of mechanical treatments such as mowing and chopping as a substitute for fire. Sandlace's preferred scrub habitats have fire return intervals ranging from 8 to16 years for xeric scrubby flatwoods (Woolfenden and Fitzpatrick 1996, Menges 2007) to 15 to 30 years for Florida rosemary scrub (Menges 2007). Given that postfire recovery of sandlace appears to be protracted compared to co-occurring scrub endemics, application of prescribed fire at too frequent intervals could also be a threat. However, over-use of fire is not often a problem on Lake Wales Ridge managed areas.

None of the recovery criteria for sandlace have been fully met. While acquisition efforts have been successful in securing 55 occurrences on 26 managed areas in Polk County and Highlands County, protection is inadequate in the northernmost portion of the specie's range. None of the remaining (3) occurrences in Osceola County are protected, and sandlace is extirpated in Orange County. Sandlace is also one of the least studied listed species on the Lake Wales Ridge. Monitoring programs are needed to determine the stability of populations and the number that need to be conserved to ensure long-term persistence and reduce extinction probabilities. With the exception of Archbold Biological Station's PDEP project, there is apparently little or no ongoing monitoring of sandlace in managed areas. Quintana-Ascencio et al. (2008) provides the only detailed demographic investigation of sandlace, and it is based on only 4 years of data, a short time for a long-lived species. Additional demographic, autecological and genetic studies are needed to advance the recovery program for this poorly understood species. For these reasons, sandlace continues to meet the definition of endangered under the ESA.

III. RESULTS

A. Recommended Classification:

__X__ **No change is needed**

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Acquire private sites with existing occurrences from willing sellers, particularly in northern Polk County and Osceola County.
- Reintroduce the species its historic range within Orange County.

- Work with private landowners to conserve extant occurrences.
- Work with State, Federal, and non-profit partners to ensure adequate fire management at sites that support sandlace.
- Prescribed fire should be the preferred management technique for habitat supporting sandlace. Mechanical treatments should be avoided as much as possible where sandlace occurs.
- Ensure a diverse representation of seed and living material in the Center for Plant Conservation's National Collection at Bok Tower Gardens.
- Ensure representation of sandlace at the National Center for Genetic Resources Preservation in Fort Collins, Colorado.
- Continue Level 2 monitoring at multiple sites to track changes in population sizes in response to management treatments.
- Extend demographic monitoring to additional sites.
- Carry out population viability analyses (PVAs) of sandlace populations at multiple scales to determine the number of protected populations required to ensure a 90 percent probability of persistence over 100 years.
- Conduct additional research on the autecology, reproductive biology, and population genetics of sandlace.

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Table 1. Summary of sandlace occurrences by county (data from FNAI 2009, Christman 2006, Peterson pers. comm. 2010).

County	Extant		Extirpated	Total
	Protected	Unprotected		
Highlands	29	33	16	**78**
Orange	0	3	3	**6**
Osceola	0	3	0	**3**
Polk	26	19	8	**53**
Total	**55**	**58**	**27**	**140**

* Note that the record for Lake county in Table 2 is believed to a misidentification and was not included in this summary.

Table 2. Summary of known sandlace occurrences (data from Christman 2006, FNAI 2009, Peterson pers. comm. 2010).

FNAI EOR No.	County	Site Name	Manager	Last Observation			Status	Comment
				Source	Year	Population Estimate		
Protected Occurrences								
62	Polk	Allen David Broussard Catfish Creek Preserve State Park	FDEP	Christman 2006	2004-2005	3475	Extant	
82	Polk	Allen David Broussard Catfish Creek Preserve State Park	FDEP	Christman 2006	2004-2005	2200	Extant	
144_63	Polk	Allen David Broussard Catfish Creek Preserve State Park	FDEP	Christman 2006	2004-2005	1750	Extant	
25	Polk	Arbuckle LWRSF	FDOF	Christman 2006	2004-2005	0	Extant	"Recently logged" in Christman 2006 explains lack of plants at time of survey, plants likely recolonized site
38	Polk	Arbuckle LWRSF	FDOF	Christman 2006	2004-2005	2000	Extant	
59	Polk	Arbuckle LWRSF	FDOF	Christman 2006	2004-2005	200	Extant	
60	Polk	Arbuckle LWRSF	FDOF	Christman 2006	2004-2005	4000	Extant	
61	Polk	Arbuckle LWRSF	FDOF	Christman 2006	2004-2005	400	Extant	
137	Polk	Arbuckle LWRSF	FDOF	Christman 2006	2004-2005	1	Extant	
138	Polk	Arbuckle LWRSF	FDOF	FNAI 2009	1989	10-50	Extant	
139	Polk	Arbuckle LWRSF	FDOF	FNAI 2009	1989	no estimate	Extant	
140	Polk	Arbuckle LWRSF	FDOF	FNAI 2009	1989	21-100	Extant	
none 5	Polk	Arbuckle LWRSF	FDOF	Christman 2006	2004-2005	1	Extant	
141	Highlands	Archbold Biological Station	ABS	FNAI 2009	2000	1-9	Extant	
none 1	Highlands	Archbold Biological Station	ABS	Christman 2006	2004-2005	no estimate	Extant	
53	Highlands	Carter Creek LWRWEA	FWC	Christman 2006	2004-2005	3800	Extant	
64	Highlands	Flamingo Villas LWRNWR	USFWS	Christman 2006	2004-2005	6000	Extant	
16	Highlands	Gould Road LWRWEA	FWC	Christman 2006	2004-2005	1025	Extant	
77	Highlands	Gould Road LWRWEA	FWC	Christman 2006	2004-2005	30	Extant	
144_143 b	Polk	Hatchineha Ranch	TNC	FNAI 2009	2009	no estimate	Extant	
124	Highlands	Henscratch Road Jack Creek LWRWEA	FWC	FNAI 2009	1998	no estimate	Extant	
125	Highlands	Henscratch Road Jack Creek LWRWEA	FWC	Christman 2006	2004-2005	no estimate	Extant	

Table 2. Continued

FNAI EOR No.	County	Site Name	Manager	Last Observation			Status	Comment
				Source	Year	Population Estimate		
146_11	Highlands	Henscratch Road Jack Creek LWRWEA	FWC	Christman 2006	2004-2005	no estimate	Extant	
55	Polk	Hesperides LWRSF	FDOF	Christman 2006	2004-2005	3800	Extant	
80	Polk	Hesperides LWRSF	FDOF	Christman 2006	2004-2005	no estimate	Extant	
6	Polk	Hickory Lake Scrub County Park	Polk County Env. Lands Prg.	Christman 2006	2004-2005	no estimate	Extant	
102	Highlands	Highland Park Estates LWRWEA	FWC	Christman 2006	2004-2005	0	Extirpated	
104	Highlands	Highland Park Estates LWRWEA	FWC	Christman 2006	2004-2005	4800	Extant	
27	Highlands	Highlands Hammock State Park	FDEP	Christman 2006	2004-2005	no estimate	Extant	
22b	Highlands	Highlands Hammock State Park	FDEP	Christman 2006	2004-2005	no estimate	Extant	
40	Highlands	Highlands Ridge LWRWEA	FWC	Christman 2006	2004-2005	no estimate	Extant	
44	Highlands	Highlands Ridge LWRWEA	FWC	Christman 2006	2004-2005	no estimate	Extant	
97	Highlands	Highlands Ridge LWRWEA	FWC	Christman 2006	2004-2005	no estimate	Extant	
107	Highlands	Highlands Ridge LWRWEA	FWC	Christman 2006	2004-2005	0	Extirpated	
146_12	Highlands	Highlands Ridge LWRWEA	FWC	Christman 2006	2004-2005	no estimate	Extant	
146_45	Highlands	Highlands Ridge LWRWEA	FWC	Christman 2006	2004-2005	no estimate	Extant	
50	Highlands	Holmes Avenue LWRWEA	FWC	Christman 2006	2004-2005	5400	Extant	
136	Highlands	Jack Creek	FWC	Christman 2006	2004-2005	0	Extant	
146_145	Highlands	Jack Creek	FWC	FNAI 2009	2009	100-1050	Extant	
144_143 a	Polk	Kissimmee Chain of Lakes	SFWMD	FNAI 2009	2009	no estimate	Extant	
122	Highlands	Lake Apthorpe LWRWEA	FWC	Christman 2006	2004-2005	0	Extirpated	
49	Polk	Lake Blue LWRWEA	FWC	Christman 2006	2004-2005	110	Extant	

Table 2. Continued

FNAI EOR No.	County	Site Name	Manager	Last Observation			Status	Comment
				Source	Year	Population Estimate		
14	Highlands	Lake June-in-Winter Scrub State Park	FDEP	Christman 2006	2004-2005	97	Extant	
15	Highlands	Lake June-in-Winter Scrub State Park	FDEP	Christman 2006	2004-2005	no estimate	Extant	
146_96	Highlands	Lake June-in-Winter Scrub State Park	FWC	Christman 2006	2004-2005	no estimate	Extant	
121	Polk	Lake McLeod LWRNWR	USFWS	FNAI 2009	1998	no estimate	Extant	
18	Polk	Saddle Blanket Scrub Preserve	TNC	Christman 2006	2004-2005	no estimate	Extant	
30	Highlands	Silver Lake LWRWEA	FWC	Christman 2006	2004-2005	7500	Extant	
56	Highlands	Silver Lake LWRWEA	FWC	Christman 2006	2004-2005	no estimate	Extant	
74	Highlands	Silver Lake LWRWEA	FWC	Christman 2006	2004-2005	2200	Extant	
126	Highlands	Silver Lake LWRWEA	FWC	Christman 2006	2004-2005	no estimate	Extant	
129	Highlands	Silver Lake LWRWEA	FWC	Christman 2006	2004-2005	12000	Extant	
22a	Highlands	Silver Lake LWRWEA	FWC	Christman 2006	2004-2005	2200	Extant	
123	Polk	Sun Ray Scrub	TNC	Christman 2006	2004-2005	no estimate	Extant	
34	Polk	Sunray Hickory Lake LWRWEA	FWC	Christman 2006	2004-2005	5	Extant	
58	Polk	Sunray Hickory Lake LWRWEA	FWC	FNAI 2009	1979	no estimate	Extant	
120	Polk	Sunray Hickory Lake LWRWEA	FWC	Christman 2006	2004-2005	no estimate	Extant	
78	Polk	Upper Lakes Basin Watershed	SFWMD	Christman 2006	2004-2005	no estimate	Extant	
Unprotected Occurrences								
2	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extirpated	'lost' scrub
4	Highlands	private property	n/a	Christman 2006	2004-2005	0	Extirpated	'lost' scrub
7	Highlands	private property	n/a	Christman 2006	2004-2005	170	Extant	
10	Highlands	private property	n/a	Christman 2006	2004-2005	12000	Extant	
17	Highlands	private property	n/a	Christman 2006	2004-2005	600	Extant	
20	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
26	Highlands	private property	n/a	Christman 2006	2004-2005	0	Extirpated	'lost' scrub
28	Highlands	private property	n/a	FNAI 2009	1983	over 500	Extant	
29	Highlands	private property	n/a	Christman 2006	2004-2005	50	Extant	
31	Highlands	private property	n/a	Christman 2006	2004-2005	600	Extant	
32	Highlands	private property	n/a	Christman 2006	2004-2005	850	Extant	
39	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
41	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
42	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	

Table 2. Continued

FNAI EOR No.	County	Site Name	Manager	Last Observation			Status	Comment
				Source	Year	Population Estimate		
43	Highlands	private property	n/a	FNAI 2009	1983	~ 1000	Extant	
51	Highlands	private property	n/a	Christman 2006	2004-2005	400	Extant	
52	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
54	Highlands	private property	n/a	Christman 2006	2004-2005	500	Extant	
69	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
70	Highlands	private property	n/a	Christman 2006	2004-2005	0	Extirpated	
71	Highlands	private property	n/a	Christman 2006	2004-2005	300	Extant	
73	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
79	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
87	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
88	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
89	Highlands	private property	n/a	Christman 2006	2004-2005	400	Extirpated	'lost' scrub
90	Highlands	private property	n/a	Christman 2006	2004-2005	50	Extirpated	'lost' scrub
94	Highlands	private property	n/a	Christman 2006	2004-2005	10	Extirpated	'lost' scrub
95	Highlands	private property	n/a	Christman 2006	2004-2005	50	Extirpated	'lost' scrub
98	Highlands	private property	n/a	Christman 2006	2004-2005	0	Extirpated	
99	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
101	Highlands	private property	n/a	Christman 2006	2004-2005	20	Extant	
103	Highlands	private property	n/a	Christman 2006	2004-2005	2300	Extant	
105	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
106	Highlands	private property	n/a	Christman 2006	2004-2005	120	Extant	
110	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
111	Highlands	private property	n/a	Christman 2006	2004-2005	200	Extant	
112	Highlands	private property	n/a	Christman 2006	2004-2005	120	Extant	
113	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
115	Highlands	private property	n/a	Christman 2006	2004-2005	0	Extirpated	
116	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
118	Highlands	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
none 2	Highlands	private property	n/a	Christman 2006	2004-2005	15	Extant	
none 7	Highlands	private property	n/a	Christman 2006	2004-2005	30	Extirpated	'lost' scrub
none 8	Highlands	private property	n/a	Christman 2006	2004-2005	0	Extirpated	'lost' scrub
none 9	Highlands	private property	n/a	Christman 2006	2004-2005	10	Extirpated	'lost' scrub
1	Lake	private property	n/a	FNAI 2009	1998	n/a	n/a	record based on misidentification and sandlace not found in repeated surveys
57	Orange	private property	n/a	FNAI 2009	2007	no estimate	Extirpated	site developed
84	Orange	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
91	Orange	private property	n/a	Christman 2006	2004-2005	no estimate	Extirpated	'lost' scrub
117	Orange	private property	n/a	Christman 2006	2004-2005	1	Extant	
142	Orange	private property	n/a	FNAI 2009	2007	16	Extant	
none 3	Orange	private property	n/a	Christman 2006	2004-2005	0	Extirpated	
65	Osceola	private property	n/a	FNAI 2009	2008	hundreds	Extant	
85	Osceola	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
86	Osceola	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
3	Polk	private property	n/a	Christman 2006	2004-2005	0	Extirpated	
5	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
8	Polk	private property	n/a	Christman 2006	2004-2005	3300	Extant	
19	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	

Table 2. Continued

FNAI EOR No.	County	Site Name	Manager	Last Observation			Status	Comment
				Source	Year	Population Estimate		
21	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
33	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
35	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
36	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
37	Polk	private property	n/a	FNAI 2009	1983	no estimate	Extant	
66	Polk	private property	n/a	Christman 2006	2004-2005	15	Extant	
67	Polk	private property	n/a	Christman 2006	2004-2005	100	Extant	
68	Polk	private property	n/a	Christman 2006	2004-2005	100	Extant	
75	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
76	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	area only partially surveyed by Christman 2006
81	Polk	private property	n/a	Christman 2006	2004-2005	2400	Extant	
83	Polk	private property	n/a	Christman 2006	2004-2005	60	Extant	
108	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
109	Polk	private property	n/a	Christman 2006	2004-2005	0	Extirpated	
119	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extant	
none 10	Polk	private property	n/a	Christman 2006	2004-2005	1	Extirpated	'lost' scrub
none 11	Polk	private property	n/a	Christman 2006	2004-2005	45	Extirpated	'lost' scrub
none 12	Polk	private property	n/a	Christman 2006	2004-2005	0	Extirpated	'lost' scrub
none 13	Polk	private property	n/a	Christman 2006	2004-2005	11	Extirpated	'lost' scrub
none 14	Polk	private property	n/a	Christman 2006	2004-2005	no estimate	Extirpated	'lost' scrub
none 15	Polk	private property	n/a	Peterson pers. comm. 2010	2010	no estimate	Extirpated	site slated for development in 2011 as CSX terminal, plants removed for salvage
none 4	Polk	private property	n/a	Christman 2006	2004-2005	179	Extant	
none 6	Polk	private property	n/a	Christman 2006	2004-2005	140	Extant	

U.S. FISH AND WILDLIFE SERVICE
5-Year Review of Sandlace (*Polygonella myriophylla*)

Current Classification Endangered

Recommendation resulting from the 5-Year Review

__X__ **No change is needed**

Review Conducted By Carl Weekley, Archbold Biological Station; David Bender and Steve Mortellaro, South Florida Ecological Services Office

FIELD OFFICE APPROVAL:

for

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 7/16/11

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 Aaron L Valdez Date 8-26-10

Appendix. Summary of peer review for the 5-year review of sandlace (*Polygonella myriophylla*)

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 took issue with the statement in the review that suggested that the use of mechanical treatments to restore scrub habitat may have negative consequences. The reviewer stated that he believes mechanical treatments benefit some rare plants, observing that at some long-unburned sites, gap-specialist species only persist in areas that experience mechanical disturbance, such as mowed roadsides or firebreaks.

The Service acknowledges that firebreaks, sand roads, and other anthropogenic disturbances often do serve as refuges for gap-specialists within long-unburned overgrown scrub. However, Quintana-Ascencio et al. (2008) predicted higher extinction rates for roadside than scrub populations, despite higher rates of growth and flowering in roadside plants. Also, while roadsides may have some of the features favorable to sandlace, roads also have novel features that produce different selective pressures than scrub gaps. Selection for roadside existence may reduce a species adaptation to colonizing and persisting in natural scrub gaps. Thus, while roadsides may provide temporary refugia for gap specialists within long-unburned sites, they also fit the model of an evolutionary or ecological trap (*sensu* Schlaepfer et al. 2002).

The same reviewer suggested that hand crews, rather than heavy machinery, should be utilized to reduce fuel loads and restore fire-suppressed habitats. The Service agrees that well-targeted, small scale fuel reduction efforts using hand crews are preferable to vegetation treatments that utilize heavy equipment.

This reviewer also commented that many public lands are not being properly managed for listed plants, especially in regard to prescribed fire and controlling invasive species. He suggested that land managers should be more proactive about updating their knowledge of listed plant occurrences on their sites and more closely tailor management activities to promote and protect these species. The Service agrees with this comment.

A second reviewer provided a reference to an article published (Metzger 2010) in recent months that is pertinent to the review. Metzger (2010) using microsatellites described genetic variation of five populations across the range of sandlace and confirmed its high level of genetic diversity. The study documented the presence of unique alleles in all the study populations and the genetic distinctiveness of the northern populations compared with those in the southern portion of the species' range.

The reviewer stated that he believed the available data was inconclusive as to the effect of mechanical treatments on sandlace. The reviewer also stated that longer-term data are needed to evaluate the stability of sandlace populations.

The Service agrees that the available data is somewhat inconclusive as to the effect of mechanical treatments on sandlace population persistence. In general, mechanical treatments such as mowing or chopping do not consume litter and increase the amount of dead biomass at the soil surface. Since gap-specialists tend to prefer open-sand microsites, these treatments often do not produce favorable conditions for seedling recruitment. Gordon and Menges (2010) recommend that land managers exercise caution in the application of mechanical treatments as a surrogate for fire because there are both known disadvantages (e.g. increase in non-native grasses, retention of litter) and potential negative consequences associated with the long-term substitution of fire with mechanical vegetation treatments. Chopped or mowed vegetation, like roadsides, may be an evolutionary trap (Schlaepfer et al. 2002) for gap specialists species, including sandlace. The Service agrees with the recommendations of Gordon and Menges (2010). The Service agrees that fire should be the preferred tool for managing Florida xeric upland plant communities. If mechanical treatments are used in a restoration context (e.g. reducing shrub heights, or ladder fuels), they should be closely followed by the application of fire. Nevertheless, 'stand-alone' mechanical vegetation treatments (i.e. not followed by fire) will continue to be a reasonable alternative on sites where liability or other circumstances preclude the implementation of prescribed fire.

A third reviewer provided information about a sandlace site in Polk County that is slated for development as a CSX railroad depot on 2011. They also stated that the misidentification of plants collected at Castle Hill in Lake County as sandlace (and the subsequent verification that they are not sandlace) should not be taken as evidence that sandlace no longer occurs at the site.

The Service agrees that the absence of sandlace from Castle Hill is not verified by the fact that plants collected there and believed to be sandlace were actually another similar-looking *Polygonella* species. However, FNAI (2009) also states that the Castle Hill site record (EOR 1) originated with a herbarium specimen that may have been misidentified. Moreover, sandlace was not located at Castle Hill during surveys conducted in 1987, 1994, and 1998 (FNAI 2009). The absence of sandlace from surveys in multiple years, coupled with the suggestion that the original record may have been misidentified, and the misidentification of more recent material collected at the site all support the conclusion that sandlace was never present at Castle Hill.

D. Response to Peer Review:

The Service was in agreement with all comments and concerns received from peer reviewers, except where noted above. 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 Field 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.