U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Streptanthus bracteatus

Common Name:

Bracted twistflower

Lead region:

Region 2 (Southwest Region)

Information current as of:

05/26/2011

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

_X_ New Candidate

___ Continuing Candidate

___ Candidate Removal

___ Taxon is more abundant or widespread than previously believed or not subject

___ Taxon not subject to the degree of threats sufficient to warrant issuance of

___ Range is no longer a U.S. territory

___ Insufficient information exists on biological vulnerability and threats to s

___ Taxon mistakenly included in past notice of review

___ Taxon does not meet the definition of "species"

___ Taxon believed to be extinct

___ Conservation efforts have removed or reduced threats

Petition Information

_X_ Non-Petitioned

___ Petitioned

90-Day Positive:

12 Month Positive:

Did the Petition request a reclassification?

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below)

To Date, has publication of the proposal to list been precluded by other higher priority listing?

Explanation of why precluded:

We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions (including candidate species with lower LPNs). During the past 12 months, the majority our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements; meeting statutory deadlines for petition findings or listing determinations; emergency listing evaluations and determinations; and essential litigation-related administrative and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of Progress on Revising the Lists, in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov/).

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Texas
- **US Counties**:County information not available
- **Countries**:Country information not available

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Texas
- **US Counties**: Bexar, TX, Hays, TX, Medina, TX, Travis, TX, Uvalde, TX
- **Countries**:Country information not available

Land Ownership:

Bracted twistflower has been documented at 32 sites since 1989. The owners of these sites are summarized in Table 1.

Table 1. Land ownership of bracted twistflower populations.

Owners	No. of Sites	Percent of Sites
Individual Private Landowners	16	50.0
City of Austin, TX	4	12.5
Medina County, TX	4	12.5
City of San Antonio, TX	2	6.3
Texas Department of Transportation	2	6.3
Texas Parks and Wildlife Department	2	6.3
U.S. Department of Defense	1	3.1
Austin Community Foundation	1	3.1

Lead Region Contact:

Lead Field Office Contact:

Biological Information

Species Description:

Species Description is adapted from McNeal 1989, p. 14 and Poole, et al. 2007, pp. 470 to 471.

Bracted twistflower is a herbaceous annual plant of the Mustard Family (Brassicaceae) known from eight counties of south-central Texas. The seeds germinate in response to fall and winter rainfall, forming basal rosettes (clusters of leaves that radiate from the root crown); the young plants resemble radish seedlings. The waxy bluish-green basal leaves, up to 15 centimeters (cm) (5.9 inches (in)) long, have broadly lobed margins. Flower stalks emerge the following spring bearing showy lavender-purple flowers; often these stalks are un-branched and 46 to 61 cm (18 to 24 in) tall, but may reach 137 cm (54 in) in height, and have several long branches. The lower stem leaves have an elongated heart shape and the upper leaves are progressively shorter, ultimately reduced to very short, triangular bracts (modified leaves) at the base of each flower stem. Thin seed pods, known as “siliques,” are up to 12 cm (4.7 in) long and 4 millimeters (mm) (0.15 in) wide; they mature and dry during the summer, finally splitting open to release flattened seeds with narrow wings. The foliage withers as the fruits mature, and the plants die during the blazing heat of summer.

Taxonomy:

About 100 species of Streptanthus have been described, although many of these have more recently been placed in Caulanthus, Boechera, Thelypodium, or other genera (Tropicos 2011a, pp. 1 to 2). The Flora of North America treatment recognizes about 35 species from the central and western U.S. and northern Mexico (Al-Shehbaz 2011, p. 700). Gray (1848, p. 146) described Streptanthus bracteatus as a new species, based on specimens collected by Ferdinand Lindheimer near New Braunfels, Texas, in 1846. Kuntze (1891, p. 933,

cited in Tropicos 2011c, p. 1) classified this taxon as Erysimum bracteatum (A. Gray) Kuntz. Nevertheless, the Flora of North America (Al-Shehbaz 2011, p. 706), Tropicos (2011b, p. 1), the Integrated Taxonomic Information Service (2011, p. 1), the International Plant Names Index (2011, p. 1), and the Plants Database (Natural Resources Conservation Service 2011, p. 1) treat this taxon as a valid species with the name Streptanthus bracteatus. Pepper (2010, p. 14) concluded that S. bracteatus is a morphologically and evolutionarily distinct species; its closest extant relative is the broadpod jewelflower, S. platycarpus, a west Texas endemic. Poole et al. (2007, p. 470) list "bracted twistflower" and "bracted jewelflower" as common names for this species. While the latter is also used by the Plants Database, the botanists and conservation organizations who work with this species primarily use the former name.

The Flora of North America treatment (Al-Shehbaz 2011, p. 700 to 723) distinguishes S. bracteatus from most other members of the genus on the basis of its sessile cauline leaves (leaves of the flower stalk that lack stems) and completely bracteate racemes (all flower stems have a small modified leaf at their bases). Streptanthus bracteatus is most similar to S. platycarpus, a species of west Texas and the Mexican state of Coahuila, and is distinguished from it by the following characters: petal length, stamens, capsule size, number of ovules, and length of style. Therefore, we concur that Streptanthus bracteatus is a distinct, valid species.

Table 2. Characters distinguishing *Streptanthus bracteatus* and *S. platycarpus*.

Characters	*S. bracteatus*	*S. platycarpa*
Petal length	14-19 mm (0.55-0.74 in)	16-27 mm (0.63-1.06 in)
Stamens (pollen-bearing flower part)	Tetradynamous (four long and two short stamens)	Two long, two medium, and two short stamens
Capsule size	8-14.5 cm (3.1-5.7 in) long by 2.5-4 mm (0.1-0.16 in) wide	4-9.5 cm (1.6-3.7 in) long by 0.18-0.24 in) wide.
Number of ovules (female sex cells in ovary of flower)	48-80 per ovary	26-42 per ovary
Length of style (stalk connecting ovary and stigmas)	1-3.5 mm (0.04-0.14 in)	0.5-2 mm (0.02-0.08 in)

Habitat/Life History:

McNeal (1989, pp. 14 -16) described 5 Travis County S. bracteatus populations that occurred mostly at or near the tops of ridges in thin clay soils overlying limestone formations. Dense populations occupied very small areas, often in narrow bands perpendicular to the slope, where winter soil moisture was greater than in surrounding areas. However, groups of plants appeared in different portions of the same habitat from one year to the next, up to 450 feet (ft) (137 meters (m)) away from the previous year's location. Tree canopy cover ranged from 25 to 100 percent, and the shrub understory was often dense, but there was very little herbaceous ground cover. Streptanthus bracteatus plants were heavily browsed by deer unless protected by dense shrubs; however, in sites protected from deer, some plants grew in more open vegetation.

McNeal (1989, p 15) observed that most Travis County populations occur very near the Balcones fault line. Zippin (1997, p. 223) found the species over limestone of the Glen Rose, Walnut, and Edwards formations; one site, however, occurred on Quaternary alluvium. Carr (2001a, p. 1) observed that S. bracteatus may occur most often in canyons where the Edwards or similar limestone formation occurs as a thin caprock stratum overlying the Upper Glen Rose limestone formation. Pepper (2010, p. 5) describes the species as a geologic or edaphic endemic, since "all known populations occur within 1 kilometer (km) of the Balcones Fault Zone, and are perched above a thick impermeable layer of limestone or dolomite". Both limestone and dolomite are sedimentary carbonate rocks; while the former is composed of calcite and/or aragonite, which are crystalline forms of calcium carbonate ($CaCO_3$), the latter is composed of calcium magnesium carbonate ($CaMg(CO_3)_2$) (Wikipedia 2011a, p. 1; 2011b, p.1). The Bracted Twistflower Working Group (2010, pp. 2 to 3) is seeking analyses of soil samples to determine if the species is associated with dolomite.

We received descriptions of plant species associated with S. bracteatus populations from 11 independent sources (see Appendix 1 for sources). Of the 89 species reported, S. bracteatus occurs most often under a tree canopy of Juniperus ashei (Ashe juniper) and Quercus fusiformis (Texas live oak) or other oak species, and is frequently found within a dense understory of small trees and shrubs, including Diospyros texana (Texas persimmon), Sophora secundiflora (Texas mountain laurel), Rhus virens (evergreen sumac), Mahonia trifoliolata (agarita), Garrya ovata ssp lindheimeri (silk-tassel), and Bernardia myricifolia (oreja de ratón). Nevertheless, in sites protected from white-tailed deer, the most robust S. bracteatus plants occur where woody plant cover is less dense (Damude and Poole 1989, pp. 29 to 30; Poole et al. 2007, p. 470). Therefore, the dense shrub thickets where the species is often found may serve as refugia from herbivory, but may not be its optimal habitat.

Zippin (1997) investigated the herbivory and population biology of S. bracteatus. In 1994 and 1995, survival rates of flowering S. bracteatus plants at several sites ranged from 40 to 98 percent (Zippin 1997, p. 57). Deer-exclusion cages significantly increased the probability of survival, reproduction, above-ground biomass, and seed set, compared to un-caged plants, at a S. bracteatus population near Mesa Drive in Austin where the deer population was very high (Zippin 1997, p. 60). Deer reduced survival by 40 percent, and selectively browsed the largest S. bracteatus plants (Zippin 1997, p. 65). Nevertheless, the rosettes (prior to flowering) were very resistant to herbivory, and plants flowered even after all rosette leaves had been eaten (Zippin 1997, pp. 62 - 63). The most common insect herbivore was the falcate orange-tip (Anthocharis midea, Pieridae), a Brassicaceae specialist, which fed primarily on flowering S. bracteatus plants in late April and May (Zippin 1997, p. 61). Other potential insect herbivores included flea beetles (Psylliodes, Chrysomelidae) (Zippin 1997, pp. 61 - 62). Deer herbivory reduced growth more than insects (Zippin 1997, p. 64). Seeds were able to germinate 1 to 2 months after dispersal, and germinated best when placed just below the soil surface (Zippin 1997, p. 187). Large numbers of plants emerged from the soil seed bank of one site following two years in which 95 percent of seeds were removed (Zippin 1997, p. 226). However, no seed bank, regardless of size, will persist if not replenished for 15 (or probably fewer) years (Zippin 1997, p. 191).

The light requirements of S. bracteatus are centrally important to the management of its habitat. Ramsey (2010, pp. 1 - 35) conducted controlled laboratory and outdoor experiments to compare the species' growth and reproduction under different light regimes. Although survival rates were not significantly different under varying light regimes, the growth rates, biomass, and reproductive output of mature plants was significantly greater when exposed to direct sunlight for all or part of a day versus plants grown under a shade cloth that reduced sunlight intensity to 42 percent of non-shaded levels (pp. 10 to 13). Ramsey stated that the highly shaded environments where the species is often found are probably not ideal, and recommended that reintroduction sites have exposure to full sun for at least 60% of the day length (p. 20). Lower light levels may also induce higher incidences of an Ascomycete fungus parasite (family Erysiphaceae), commonly known as a "powdery mildew," that frequently attacks the plants and may kill them (p. 21) (see figure 1, photograph 3).

Leonard (2010a, pp. 1 - 86) also compared the response of S. bracteatus to varying levels of light intensity, as well as nutrients, soil moisture, soil depth, and herbivory. Potted plants grown in wire cages with varying

grades of shade cloth were exposed to 1,353 ± 10 micro-moles per square meter per second (µMm-2s-1), 919 ± 10 µMm-2s-1, 530 ± 25 µMm-2s-1, and 286 ± 10 µMm-2s-1 (Leonard 2010a, pp. 17 - 19). Shoot height, bas diameter, and above- and below-ground biomass all increased with increasing light levels, and above-ground, below-ground, and total biomass were significantly greater at the highest compared to the two lowest light levels (but not the second highest light level) (Leonard 2010a, pp. 30- 32). Similarly, potted plants were grown in a natural setting with and without deer exclosures under full sun (1,229 ± 10 µMm-2s-1) and beneath a live oak canopy (397 ± 45 µMm-2s-1). The caged plants in full sun had significantly greater biomass than un-caged full-sun plants. Interestingly, the caged full-sun plants had greater biomass than caged shaded plants, but conversely, the unprotected plants in the shade had greater biomass than unprotected plants in full sun. This difference is probably attributable to increased herbivory of sun- versus shade-grown plants; the wild population at this site (Rancho Diana natural area) is heavily browsed by deer (Leonard 2010a, pp. 58 and 61). Leonard also observed herbivory by the checkered white butterfly (Pontia protodice) at the Eisenhower Park natural population (p. 61). Seed germination trials indicated that seeds germinate better at 21° to 32° Celsius (C) (70° to 90° Fahrenheit (F)) than at 10° C (50° F); exposure to sunlight and florescent lights also improved germination (p. 17). Recommended management of bracted twistflower populations includes excluding herbivores and thinning tree and shrub canopies; however, if deer cannot be excluded, only the tree canopy should be thinned, leaving the shrubs to protect herbaceous plants from deer (Leonard 2010a, p. 63).

Fowler (2010, pp. 1 - 18) investigated the response of S. bracteatus seedlings transplanted into a naturally-vegetated site with varying degrees of canopy cover. Although the experimental plots were protected from deer, severe herbivory, apparently from squirrels, continued until the plants were individually protected with wire cages (p. 7). Where there was less cover and greater light availability, the plants had higher fecundity (seed production), which is the most relevant measure to predict future population size for annual plants (Fowler 2010, p. 9). The optimal conditions at this site would have been 50 percent cover or less, which would be expected if S. bracteatus were a fire-following species (p. 10). Prior to the 20th century, frequent wildfires probably occurred in or near S. bracteatus habitats, and are now very infrequent (Bray 1904, pp. 14 – 15, 23 – 24; see discussion below). However, the fire ecology of S. bracteatus has not been investigated. Fowler's results (2010, p. 11) do support a recommendation to manage vegetative cover at existing populations so that it does not exceed 50 percent.

The reported population sizes of S. bracteatus , like many annual plants, fluctuate greatly from year to year (McNeal 1989, p. 15; Zippin 1997, p. 222). Anecdotal reports from surveyors indicate that S. bracteatus populations increase following seasons of above-average fall and winter precipitation (Zippin 1997, p. 225). However, Fowler (2011a, p.1; 2011b, pp. 1 – 9) compared Barton Creek population sizes and Camp Mabry precipitations from 1993 to 2005 (Camp Mabry is 9.7 km (6.0 miles (mi)) northeast of the Barton Creek population). Using Spearman's rank correlation coefficient, no significant correlations existed between annual population sizes and the corresponding precipitation totals from the preceding October to December, preceding January to March, or concurrent April to June (see table 3). Similarly, Fowler found no significant correlations between the annual average reported size of six S. bracteatus populations with the corresponding seasonal precipitation averages from Austin, San Marcos, and San Antonio, Texas. Nevertheless, the failure to detect correlations between precipitation and population size may be due to different surveyors using different methods, or to other factors such as disturbance, competition, and herbivory. Of particular interest is whether S. bracteatus germination is stimulated by wildfire, disturbance to vegetation or soil, or other factors in addition to rainfall.

The above information, in synthesis, support the hypotheses that S. bracteatus is best adapted to sites with less than 50 percent cover of woody plants, and that severe herbivory by very dense populations of white-tailed deer has largely extirpated the plant from its optimal habitats. It may persist for a time in the protection of dense thickets, or it may gradually decline. In addition, the germination of seeds and reproduction of S. bracteatus in the wild appears to respond to as-yet unknown triggers. This compels us to consider how historic vegetation changes may have affected S. bracteatus populations. Bray (1904, pp. 14, 22) described a very apparent, ongoing transition of Edwards Plateau uplands from grassland to woodland at

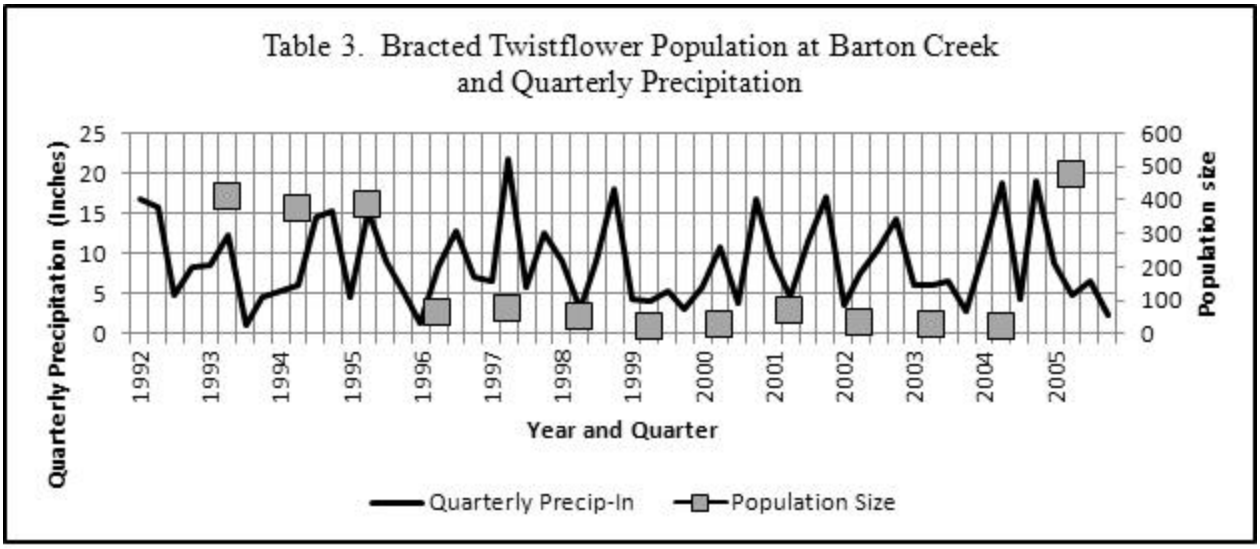
the beginning of the twentieth century. At that time, the well-watered canyons supported dense forests with trees over 500 years old; stunted but continuous forest covered hills and bluffs; sparse trees were found on loose, stony slopes in the eastern Edwards Plateau (precisely where S. bracteatus populations currently occur); and trees were then invading the open prairies on the level plateau divides (uplands), which previously were free of woody vegetation (Bray 1904, pp. 14 - 15). He attributed this change to overgrazing and the consequent depletion of grasses, erosion, and cessation of wildfires, and stated that open prairies had been converted to dense oak scrub in a span of 25 years (Bray 1904, pp. 14 - 15, 22 - 23). These historic descriptions support a hypothesis that S. bracteatus is a relict of a woodland-grassland ecotone (transition zone) that occurred at or near the confluence of loose, stony slopes and prairie uplands. This savanna, in the broad sense of the term, would have been influenced periodically by wildfires of varying intensity and frequency. Some Streptanthus species, such as S. heterophyllus (San Diego wild cabbage), germinate following wildfires (Moreno and Oechel 1991, pp. 1999 - 2000), thus, fire may also be a trigger of S. bracteatus emergence.

We received 59 reports of S. bracteatus phenology from surveyors (listed in Appendix 1). Rosettes have been reported in October, November, and March, and presumably can be seen throughout the winter months. The relatively few rosette observations (five) reflects the difficulty of positive species identification at this life stage; prior to flowering, S. bracteatus is easily confused with another member of the mustard family, rock cress (Arabis petiolaris) (Damude and Poole 1990, p. 6). From 79 to 90 percent of seed germination occurs during October and November (Zippin 1997, p. 222). Flowering peaks in April and may continue into May and June. Fruits have been observed from April through June. Mature seeds have been collected most often in June, but occasionally as late as August.

Dieringer (1991, pp. 341 to 343) investigated the pollination ecology of one population of S. bracteatus. He determined that it is primarily an outcrossing species, although 6.3 percent of self-pollinated flowers set fruit. A locally common species of leafcutter bee, Megachile comata (family Megachilidae), was an effective pollinator. About 29 percent of un-manipulated flowers set fruit, 12 percent of fruiting plants were eaten by deer, and 11 percent of fruit capsules were damaged by seed-eating insects.

Pepper (2010, pp. 9 -10) assessed the genetic status of 14 S. bracteatus populations in Travis, Bexar, Medina, and Uvalde Counties. This investigation examined DNA from leaf samples of 318 individuals, using microsatellite DNA markers from Caulanthus amplexicaulis var. barbarae; these markers are useful for studying genetic relationships in the Streptanthoid complex (Burrell and Pepper 2006, p. 3). Wright's Fst and Nei's genetic distance showed that the species has substantial genetic differentiation (Pepper 2010, p. 11). Much of the species' genetic differentiation is between rather than within populations and most populations are genetically distinct and are not undergoing appreciable inter-population gene flow (Pepper 2010, p. 11). Deviations from the expected Hardy-Weinberg values indicated the extent of inbreeding, genetic drift, gene flow, and natural selection. The Barton Creek and Cat Mountain populations are the most genetically diverse and are core reservoirs of the species diversity (Pepper 2010, p. 12). The privately owned CR 2700 and PR 2632 populations in Medina County are also genetically diverse (Pepper 2010, pp. 12 - 13). Geographically isolated populations are more distinct, due to genetic drift, founder effects, isolation, or lineage sorting of alleles (Pepper 2010, p. 11). The populations at Garner State Park (SP), Bright Leaf Preserve, Camp Bullis, Fall Trail, and Eisenhower Park had exceedingly low levels of genetic diversity; Mt. Bonnell also had relatively low genetic diversity. Inbreeding is most prevalent in the smaller, more isolated populations, such as Eisenhower Park (Pepper 2010, p. 15). The Cat Mountain, Barton Creek, and Mt. Bonnell populations had unexpectedly high levels of inbreeding, despite the genetic diversity of the first two mentioned; this may be due to subdivision within these larger populations (Pepper 2010, p. 14). The Ulrich population is genetically distinct from other Austin populations and may represent a remnant of the species original genetic diversity (Pepper 2010, p. 17).

Source of precipitation data: National Climate Data Center 2011.



Historical Range/Distribution:

For practical purposes, we distinguish the historic locations of S. bracteatus populations, which were not accurately mapped or described, from the accurately described and mapped locations of recent reports (1989 to the present). The geographic and survey data of S. bracteatus populations have been compiled in the Texas Natural Diversity Database (TXNDD), managed by Texas Parks and Wildlife Department (TPWD). The geographic sites, termed “Element Occurrences” (EOs), are defined as “areas of land and/or water in which a species or natural community is, or was, present” (NatureServe 2002, p. 1). EOs are displayed as points and polygons buffered by their estimated geographic precision. Historic reports that lack precise geographic coordinates are represented by relatively large polygons; more recent survey data collected with global positioning systems (GPS) are represented by smaller polygons. The reported populations occur or occurred within, but not necessarily throughout, the polygons in the range map (Figure 2). In addition to data from the TXNDD, which was provided to us on April 19, 2007 (Texas Natural Diversity Database 2007, pp. 7,972 – 8,025), individual surveyors (listed in Appendix 1) have provided us more recent population data. We summarize both the historic and recent population data from all sources in tables 4 and 5, respectively.

The herbarium label from Ferdinand Lindheimer’s original collection states only “15. Streptanthus. New Braunfels. May 1846.” However, like many field botanists of that era, Lindheimer listed the location of his base of operations rather than the specific collection site (Texas Natural Diversity Database 2007, p. 7,972); the site is unknown but is assumed to have been in Comal County. Similarly, most of the historic collections listed in table 4 cannot be ascribed to specific locations. These historic collections are represented on the range map (Figure 2) as circles rather than points; the radius of the circles indicates their estimated geographic precision.

Table 4. Historic collections of *S. bracteatus* listed in the Texas Natural Diversity Database (2007, pp. 7,972 – 8,025).

Collector and Specimen Number	Date	Location	County	TXNDD Element Occurrence Record and Page No.
F.J. Lindheimer 15	May, 1846	New Braunfels	Comal	EO 1, p. 7,972
F.J. Lindheimer 676	April, 1849	Comanche Spring	Bexar	EO 30, p. 8,024
J. Reverchon s.n.[1]	June, 1884	Bandera Pass	Bandera or Kerr	EO 27, p. 8,018
M.S. Young s.n.	May 8, 1911	Cat Mountain, Austin	Travis	EO 2, p. 7,974
E.J. Palmer 10155	June 9, 1916	Leakey	Real	EO 28, p. 8,020
E.J. Palmer 12254	June 14, 1917	Medina Lake	Medina	EO 29, p. 8,022
B.H. Tharp s.n.	April 28, 1940	Austin	Travis	EO 3, p. 7,977
B.H. Warnock 204	April 28, 1940	Austin	Travis	EO 3, p. 7,976
B.C. Tharp 44158	May 10, 1944	Austin	Travis	EO 3, p. 7,976
W.L. McCart 6662	May 8, 1957	"Bee Creek City Preserve"	Travis	EO 7, p. 7,978

1. s.n. indicates that the collector did not assign a specimen number.

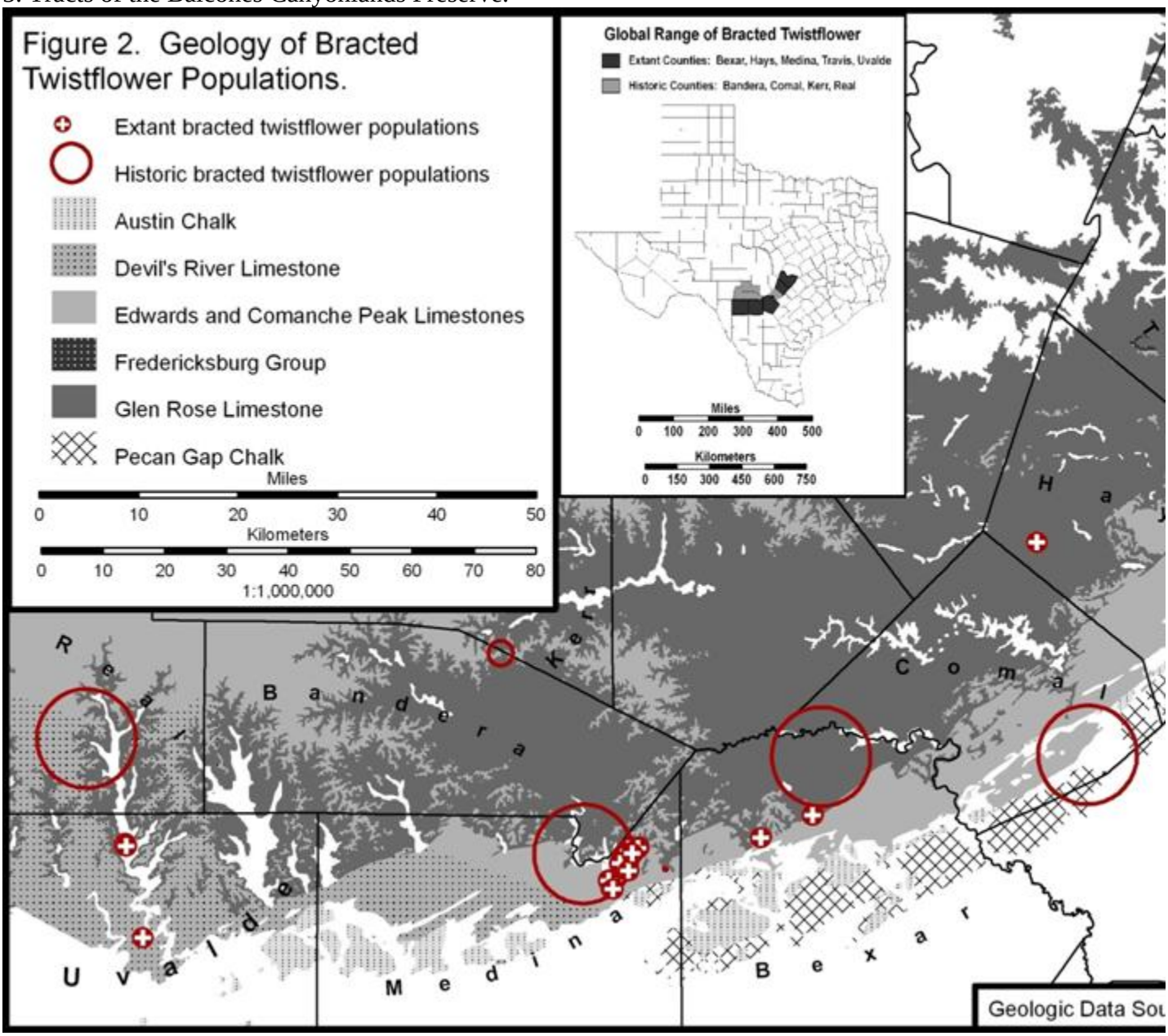
Current Range Distribution:

Table 5. *S. bracteatus* Element Occurrences and maximum population sizes observed from 1989 to 2010 (recent EOs).

EO_ Num[1] / Page	EO_ ID[1]	County	Site Name	Owner	Maximum Population	Most Recent Observation	Conservation Status	Habitat Condition
002 / 7964	6457	Travis	Cat Mountain	Private	115	2007	Not protected	Intact
007 / 7978	5603	Travis	Bee Creek Nature Preserve/Ulrich Water Treatment Plant[4]	City of Austin	165	2002	Protected Natural Area	Intact
008 / 7980	625	Medina	RM 1283 near Mico Rd	TxDOT	1000	2002	Not protected	Mowed ROW
009 / 7982	8016	Travis	Mt. Bonnell[2,3]	City of Austin	330	1997	Protected Natural Area	Intact
009 / 7982	8016	Travis	Mt. Bonnell Terrace[2] (Surveys combined with Mt. Bonnell Park)	Private	(330)	1997	Presumed Extirpated	Developed
009 / 7982	8016	Travis	Mt. Bonnell Augmentation[3]	City of Austin	185	1997	Protected Natural Area	Intact
010 / 7984	8017	Uvalde	Garner State Park[3]	TPWD	133	2001	Protected Natural Area	Intact
010 / 7984	8017	Uvalde	Garner State Park[3]	TPWD	420	2001	Protected Natural Area	Intact
011 / 7986	2111	Travis	Bull Creek-Lakewood (North Cat Mountain)	Private	86	1989	Presumed Extirpated	Developed
012 / 7988	774	Travis	Bull Creek-Valburn (North Cat Mountain)	Private	590	1989	Presumed Extirpated	Developed
013 / 7990	5961	Travis	Bull Creek-Valburn (North Cat Mountain)	Private	3	1989	Presumed Extirpated	Developed
014 / 7992	227	Medina	CR274 W of RM1283	County	88	2001	Not protected	Mowed ROW
015 / 7994	4145	Medina	CR2700	County/ Private	290	2002	Not protected	Mowed ROW
016 / 7996	2316	Travis	Cat Mountain	Private	10	1989	Not protected	Intact
017 / 7998	6843	Travis	Barton Creek Greenbelt[3]	City of Austin	477	2002	Protected Natural Area	Intact
018 / 8000	4641	Medina	CR2615	County	200	2002	Not protected	Mowed ROW
019 / 8002	3462	Medina	RM1283/CR2700	TxDOT	212	2002	Not protected	Mowed ROW
020 / 8004	3463	Medina	CR2700/Dripping Spring Creek	County	124	2002	Not protected	Mowed ROW
021 / 8006	6928	Travis	Mt. Bonnel/Small Drive	Private	90	1992	Presumed Extirpated	Developed
022 / 8008	1878	Travis	Cat Mountain Villas	Private	30	1992	Not protected	Partially Developed
023 / 8010	7551	Bexar	Eisenhower Park[4]	San Antonio City Park	129	2002	Protected Natural Area	Intact

1. EO_Num (Element Occurrence Number) and EO_ID (Element Occurrence Identity) designated in the Texas Natural Diversity Database (2007). Sites that have not yet been assigned identification numbers are listed as A through G.
2. Due to an unmarked property line, early surveys at Mt. Bonnell included private land that was later developed. A significant but unknown portion of the population was lost; for practicality, we assume 50% of the maximum population of 330 was extirpated.
3. A separate sub-population was discovered at Garner SP in 2001, but is considered part of the same Element Occurrence.
4. A single population straddles the boundary between Eisenhower Park and Camp Bullis; these portions

have been surveyed separately.
5. Tracts of the Balcones Canyonlands Preserve.



Population Estimates/Status:

It is difficult to interpret the size and trends of S. bracteatus populations due to the wide annual fluctuation in the numbers of plants growing at each site. Like other annual plants, the species persists through its “soil seed bank” (the quantity of viable, dormant seeds that are present in the soil). We do not know how many viable seeds reside in the soil seed banks, how long the seeds remain viable in the soil, or what factors stimulate their germination. However, one useful parameter to judge the potential population size of each Element Occurrence is the maximum number of plants observed there in any single year; Table 5 includes these maximum population sizes.

It is also difficult to ascertain the area occupied by these populations. Within a specific site and year, the plants are often found in areas ranging from less than 0.4 ha (1 ac) to 10 ha (25 ac); in subsequent years, the plants may appear in another small portion of the same site (Damude and Poole 1990, p. 30). The plants tend to cluster in narrow horizontal bands where winter soil moisture persists longer (McNeil 1989, p. 14), suggesting that they are dependent on seepage of perched groundwater through the fissures between

limestone strata. The density and type of vegetative cover upslope influences the proportion of rainfall that infiltrates into the soil and is stored as groundwater. Compared to native vegetation, impermeable surfaces impede the infiltration of rainwater and the recharge of perched groundwater, and consequently may reduce the habitat suitability for this species. Therefore, it appears that S. bracteatus is restricted to very small portions of a larger habitat mosaic, and the actual habitat required to support its populations is likely to be much larger than the finite areas the species occupies in any single year.

An obvious indication of the status of S. bracteatus populations is the condition of their habitats, including the soil structure, rock strata, and associated vegetation. It is reasonable to assume that an entire population is lost if its habitat is completely converted to pavement, structures, nonnative vegetation, or other artificial surfaces. Where habitat is completely intact, the population may or may not persist, depending on other factors. It is likely that partial destruction or degradation of habitat results in at least partial loss or decline of a population. Therefore, a practical measure of this annual plant's overall status is the number of populations with intact habitat, together with their potential (maximum observed) population sizes. Another important consideration is whether the intact sites are on some form of protected or managed natural area; intact sites on private land are likely to be lost at the rate that the local economy drives development. Table 6 summarizes the maximum populations, conservation statuses, and habitat conditions of the reported populations. In summary, of 32 populations reported since 1989, 15 remain with intact habitat, 9 have degraded or partially destroyed habitat, and 8 are presumed extirpated. Only 9 of the intact sites are on protected natural areas. This corresponds to a loss of 18.8 percent of the potential population since 1989; 31.2 percent of the potential population is intact and present in protected natural areas. (Note that some of the reported populations that surveyors previously tracked separately may now be combined into individual EOs in the TXNDD, in accordance with EO standards established by NatureServe (2002, p. 1).

Table 6. Summary of *S. bracteatus* populations and maximum population sizes observed from 1989 – 2010 (recent populations).

Population[1] Status	Number of Pops.	Percent of Pops.	Total of Maximum Populations	Percent of Maximum Populations Total
Populations observed 1989 – 2010 (recent)	32	100.0	8558	100.0
Recent populations intact	15	46.9	4881	57.0
Recent intact populations protected	9	28.1	2671	31.2
Recent intact populations not protected	6	18.8	2210	25.8
Recent populations presumed extirpated	8	25.0	1613	18.8
Recent intact populations in disturbed habitat	9	28.1	2064	24.1

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

The greatest threat to S. bracteatus is habitat loss due to urban and residential land development (McNeal 1989, p. 17; Damude and Poole 1990, p. 51; Zippin 1997, p. 229; Fowler 2010, p. 2; Pepper 2010, p. 5). Our analysis of populations reported since 1989 indicates that 25 percent have been extirpated, 28 percent have been disturbed or partially developed, 19 percent are intact but vulnerable to development, and only 28 percent are intact and protected from development. The Cat Mountain population, which is a core reservoir of the species' genetic diversity (Pepper 2010, p. 12), is located on private land that is currently (April 2011) for sale and may soon be developed (Bracted Twistflower Working Group 2010, pp. 3 - 4). Fortunately, Holder (2003a, pp. 1-3) collected seeds from this and several other populations (with landowner approval) for the seed bank managed by the Lady Bird Johnson Wildflower Center. Therefore, habitat loss is an imminent threat throughout the species range to the populations not on protected natural areas, and is likely to continue.

In addition, changes in vegetation structure and composition, specifically the increased density of woody plant cover, appear to be detrimental to S. bracteatus (Pepper 2010, p. 5). Laboratory and field experiments conducted by Fowler (2010, pp. 10 - 11), Leonard (2010a, p. 63), and Ramsey (2010, p. 20) demonstrated that the species benefits from higher light intensity and duration than it receives in many of the extant populations; its persistence in dense thickets may be due to increased herbivory of the plants growing in more open vegetation (Leonard 2010a, p. 63; Ramsey 2010, p. 22). Some Streptanthus species, such as S. heterophyllus, germinate in response to wildfire (Moreno and Oechel 1991, pp. 1999 to 2000). The positive reproductive response of S. bracteatus to higher light levels is consistent with the hypothesis that it may also be a fire-adapted species (Fowler 2010, pp. 3, 10). Bray (1904, pp. 14-15, 23-24) documented the rapid transition of grasslands to woodlands in the Edwards Plateau occurring more than a century ago; he attributed this change to over-grazing, the depletion of grasses, and the cessation of wildfires. We conclude that S. bracteatus habitats were probably influenced by frequent wildfires and that the frequency of wildfires has decreased greatly since pre-settlement times; therefore, S. bracteatus may be a fire-adapted species, and the lack of wildfire may have contributed to its decline. The increase in density of woody plant cover has occurred incrementally over a span of decades, but affects most S. bracteatus populations, including those on protected natural areas, and may also have caused a gradual decline in population sizes.

Both permitted and unauthorized recreation threatens the species' survival at several protected natural areas, as well as on private lands. Hiking and mountain bike trails have led to trampling of the herbaceous vegetation and severe soil erosion where trails cut directly through occupied habitats (McNeal 1989, p. 19; Fowler 2010, p. 2; Bracted Twistflower Working Group 2010, p. 3; Pepper 2010, pp. 5, 15, 17). These trails have impacted the entire population at Mt. Bonnell City Park and large proportions of the populations at Barton Creek Preserve and Garner SP. Illicit mountain bike trails have also impacted populations on private lands, including most of the Bull Creek/Valburn population and a small proportion of the Cat Mountain population (Bracted Twistflower Working Group 2010, p. 3; Holder 2011a, p.1, 2011b, p. 1).

Therefore, based on our evaluation, we conclude that S. bracteatus is threatened by the present and threatened destruction, modification, or curtailment of its habitat and range, now and in the foreseeable future.

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

We are not aware of any direct use or overuse of S. bracteatus plants.

C. Disease or predation:

Severe herbivory by white-tailed deer is a major threat to S. bracteatus (McNeal 1989, p. 17; Damude and Poole 1990, pp. 52 -53; Dieringer 1991, p. 341; Zippin 1997, pp. 39 -197, 227; Leonard 2010a, pp. 36 - 43) and is exacerbated by the extremely high deer densities in the Edwards Plateau of Texas (Zippin 1997, p. 227). The foliage of S. bracteatus is very palatable to many browsing animals, including squirrels (Fowler 2010, p. 7), and even humans (Kral 1990 cited in Damude and Poole 1990, p. 51). Exotic ungulate species

such as aoudad (Ammotragus lervia), which have been widely introduced on game ranches in central Texas, present an additional potential threat (Damude and Poole 1990, pp. 52 - 53). It is also likely that S. bracteatus populations were impacted during historic periods of poor rangeland management in central Texas, particularly by herds of goats and sheep. White-tailed deer herbivory may cause the decline of local populations (Zippin 1997, p. 67) and is an imminent threat throughout the species' range, except where populations are protected from deer by fencing or intensive herd management (hunting). Deer fencing protects nearly all of the Eisenhower Park population in Bexar County, as well as a privately-owned site near Mico in Medina County. Individual exclosures protect about 10 percent of the populations at both Cat Mountain and Barton Creek Greenbelt. The remaining populations are not protected from ungulate herbivory.

Streptanthus. bracteatus is highly susceptible to attack from a powdery mildew fungus (Ascomycota, family Erysiphaceae) which may be more severe when plants grow in dense, shaded thickets (Ramsey 2010, p. 21; Leonard 2010a, p. 53). The fungus species has not yet been identified; it may be an introduced pathogen to which S. bracteatus has no resistance (Bracted Twistflower Working Group 2010, p. 2). This powdery mildew infestation has been observed in most or all wild populations as well as Streptanthus bracteatus plants propagated under controlled conditions far from the natural populations, which suggests that the pathogen is ubiquitous. The pathogen is evident on most plants, and appears to kill some plants outright before they reproduce; other plants reproduce effectively despite infection. Therefore, we believe that powdery mildew infestation is clearly a significant threat to the species' survival, but do not yet know the extent of its impact.

A number of insect herbivores have been documented on S. bracteatus (Dieringer 1991, pp. 341 - 342; Zippin 1997, pp. 39 to 70; Leonard 2010a, pp. 53; Ramsey 2010, pp. 15, 21); however, the dispersed pattern of insect herbivory may be less harmful than the focused herbivory of deer and other ungulate browsers (Zippin 1997, pp. 70 - 71; Leonard 2010a, pp. 59 - 60). Consequently, insect herbivory appears to be a relatively low-magnitude threat.

Based on our evaluation, we conclude that S. bracteatus is threatened by disease and predation now and in the forseeable future.

D. The inadequacy of existing regulatory mechanisms:

Streptanthus bracteatus is not currently protected by existing state or federal laws, except where it occurs at Garner SP (Section 59.134 of the Texas Parks and Wildlife Code states "It is an offense for any person to willfully mutilate, injure, destroy, pick, cut, remove, or introduce any plant life except by permit issued by the director (Texas Secretary of State 2011)). Nevertheless, over 300,000 people visit Garner SP each year, and the S. bracteatus population there has declined in part due to the very heavy recreational use of its habitat (Pepper 2010, p. 5).

Streptanthus bracteatus is not specifically protected by the Balcones Canyonlands Habitat Conservation Plan (BCCP). However, a voluntary Memorandum of Agreement between and among U.S. Fish and Wildlife Service, TPWD, City of Austin, Travis County, Lower Colorado River Authority, and Lady Bird Johnson Wildflower Center sought to protect S. bracteatus and its habitats on Balcones Canyonlands Preserve tracts (Service et al. 2004). These tracts include Covert Park at Mt. Bonnell, Ulrich Water Treatment Plant, and Barton Creek Greenbelt. The agreement provides for monitoring and restoration of existing populations, surveys for new populations, reintroduction, protections from deer, and public education about the need to conserve the species. While the scope of this agreement does not protect the species throughout its range, the implementation of these responsibilities will contribute to the species' conservation and recovery.

Based on our evaluation, we conclude that the inadequacy of existing regulations threatens S. bracteatus.

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

Due to the small size and isolation of S. bracteatus populations, several may already suffer from genetic bottlenecks, genetic drift, inbreeding, and loss of allelic diversity; consequently, these populations may be less able to survive and to adapt to other ongoing threats, including urbanization, increased herbivory, pathogens, vegetation change, and climate change (Pepper 2010, p. 6). Furthermore, such small populations are more vulnerable to catastrophic losses from chance events. Currently, the species as a whole still possesses sufficient genetic diversity to assure its survival, but many of the remaining populations have very little genetic diversity and relatively high levels of inbreeding (Pepper 2010, pp. 12 – 15). Furthermore, several of the core reservoirs of the species' genetic diversity occur on private lands and may be lost to development (Pepper 2010, pp. 18 – 19). These core populations are critical to the long-term genetic viability of the species (Pepper 2010, p. 4), and their loss would threaten the species' survival. Therefore, we conclude that the loss of genetic resources is a significant threat in the foreseeable future.

Several of the extant S. bracteatus populations occur on conservation lands managed as nesting habitat for the golden-cheeked warbler, a federally listed endangered species. However, the nesting habitat of the golden-cheeked warbler consists of dense, mature stands of Ashe juniper, various oak species and other broadleaf trees (U.S. Fish and Wildlife Service 2011). If the optimal habitat management for S. bracteatus and the golden-cheeked warbler are determined to be incompatible, it is likely that the reserves would be managed strictly for the latter species, since they were created primarily for that purpose; S. bracteatus would probably continue to decline at those sites. Therefore, incompatible habitat requirements may be a potential future threat to S. bracteatus.

The Intergovernmental Panel on Climate Change (IPCC) (2007, p. 8) predicts that the southwestern U.S. may experience the greatest temperature increase of any area in the lower 48 States, and that many semi-arid areas like the western United States will suffer a decrease in water resources, due to climate change. Milly et al. (2005, p. 347) project a 10 to 30 percent decrease in precipitation in mid-latitude western North America by the year 2050 based on an ensemble of 12 climate models. It is more difficult to predict how climate will change at the finite geographic scale of S. bracteatus populations. Furthermore, climate changes may have vastly complex, unpredictable synecological effects; for example, reduced rainfall may be relatively more detrimental to an invasive competitor, and therefore benefit rare plant species of concern. Consequently, we cannot currently attribute any threats to climate change. Nevertheless, future potential threats may arise due to the rapid pace of projected climate change and the proliferation of man-made barriers to migration.

We conclude that S. bracteatus is potentially threatened by other natural or manmade factors, including the small size and isolation of populations, the limited genetic diversity within some populations, the potential incompatibility with habitat management for the golden-cheeked warbler, and the potential effects of climate change.

Conservation Measures Planned or Implemented :

Nine extant populations of S. bracteatus occur on seven protected natural areas. Deer exclosures have been installed at the Barton Creek Greenbelt site and the privately-owned Cat Mountain site (currently for sale). A Memorandum of Agreement (U.S. Fish and Wildlife Service et al. 2004) provides for the conservation and recovery of the species on tracts of the Balcones Canyonlands Preserve in Travis County.

The recovery of S. bracteatus will require the reintroduction and augmentation of stable, healthy populations in protected sites (Pepper 2010, p. 6). The Bracted Twistflower Working Group (2006, pp. 1 to 30) has prepared a draft reintroduction plan, and the species has been successfully propagated (p. 25). However, at least ten attempts to restore populations in appropriate sites have all failed, indicating that the species' requirements are not fully understood (Bracted Twistflower Working Group 2006, p. 18; Pepper 2010, p 6.).

Summary of Threats :

The continued survival of S. bracteatus is imminently threatened by habitat destruction from urban development, severe herbivory from very dense herds of white-tailed deer, and the increased density of woody plant cover. Additional ongoing threats include erosion and trampling from foot and mountain bike trails, a pathogenic fungus of unknown origin, and insufficient protection by existing regulations. Furthermore, due to the small size and isolation of remaining populations and lack of gene flow between them, several populations are now inbred and may have insufficient genetic diversity for long-term survival. The consistent failure of pilot reintroduction efforts has so far prevented the augmentation and reintroduction of populations in protected, managed sites. Optimal vegetation management of S. bracteatus populations may be incompatible with the management of golden-cheeked warbler nesting habitat. The species is potentially threatened by as-yet unknown impacts of climate change.

We find that S. bracteatus is warranted for listing throughout all of its range, and therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

• Continue to search for new populations on public conservation land as well as private lands (with landowner permission).
• Provide technical guidance and material support to private landowners who voluntarily wish to conserve the species on their land.
• Manage the existing populations on protected natural areas more rigorously, including installation of deer exclosures, closing illicit foot and mountain bike trails, enforcing applicable regulations that protect the habitats on public property, and conducting public outreach.
• To the extent allowed under the existing habitat management plans or applicable regulations, maintain less than 50 percent cover of woody plants at occupied habitats.
• Protect multiple populations within each area of the species' genetic diversity in Medina and Travis counties (Pepper 2010, p. 15).
• Continue to investigate the species' ecology and optimal habitat requirements, particularly the fire ecology, geology, and associated vegetation structure.
• Conduct pilot reintroductions to determine effective methods of population reintroduction and augmentation.
• Continue to collect seeds from extant populations for seed bank storage and propagation, in accordance with USFWS policy on controlled propagation of endangered species (FR 65: 56916). Propagate plants from the representative genetic ecotypes and produce seed for experimental and reintroduction efforts (to prevent excessive collection from wild sources and depletion of the soil seed bank at extant populations).
• Reintroduction and augmentation must use seeds from ecotypes adapted to the sites. Avoid translocating propagules of an ecotype into sites that support a genetically distinct ecotype (Pepper 2010, p. 17).

Priority Table

Magnitude	Immediacy	Taxonmomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	**Imminent**	Monotypic genus	7
		Species	**8**
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Magnitude:

The principle threats to S. bracteatus are habitat loss, severe herbivory by white-tailed deer, increased density of woody plant cover, and habitat degradation from harmful recreational uses. Habitat loss affects S. bracteatus populations on private land throughout the species' range; 25 percent of the populations documented since 1989 are presumed extirpated, 28 percent have been disturbed or partially extirpated, and 19 percent are intact but vulnerable to development. Nevertheless, 28 percent of the documented populations occur on seven protected natural areas in Travis and Bexar counties. Significant new populations were discovered as recently as 2010 at Garner SP in Uvalde County, Rancho Diana City Park in Bexar County, and private land in Hays County, and it is reasonable to assume that more populations exist and may be discovered in the future. White-tailed deer herbivory potentially affects all populations but can be alleviated with exclusion fencing or intensive deer herd management. Woody plant cover is too dense at many of the populations, including those on protected natural areas, and may be causing a gradual decline in populations. However, this threat can be alleviated through improved vegetation management of populations on protected natural areas and through voluntary agreements with private landowners. Illicit mountain bike and foot trails have impacted some populations, but can be prevented by enforcing existing laws and regulations, including state trespass laws. Therefore, the magnitude of these threats is currently moderate.

Imminence :

Habitat loss, white-tailed deer herbivory, increased woody plant cover, and illicit recreational use are all imminent, ongoing threats to S. bracteatus. Potential threats include depletion of genetic diversity, the pathogenicity of a powdery mildew fungus, incompatibility with gold-cheeked warbler habitat management, inability to reintroduce or augment populations in protected sites, and possible impacts of climate change.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

Description of Monitoring:

Botanists and trained volunteers from TPWD, The Nature Conservancy, the Lady Bird Johnson Wildflower Center, the Cities of Austin and San Antonio, the Balcones Canyonlands Preserve, and academic institutions, as well as private individuals, have conducted surveys for S. bracteatus and monitoring of known populations consistently since 1989. Under the terms of the Memorandum of Agreement described above (U.S. Fish and Wildlife Service et al. 2004), the Lady Bird Johnson Wildflower Center has coordinated the efforts of the organizations and individuals concerned with the conservation of this rare plant. This consortium was initially called the Streptanthus Conservation Corps but has more recently adopted the name "Bracted Twistflower Working Group" (Bracted Twistflower Working Group 2010). Appendix 1 (below) lists the sources of monitoring data that were provided to us by various members of the Bracted Twistflower Working Group that were used and cited in the current review. The members of this group intend to continue annual surveys and monitoring of this species, and have made frequent recommendations on its conservation, research needs, and recovery.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Texas

Indicate which State(s) did not provide any information or comment:

none

State Coordination:

The Texas Parks and Wildlife Department compiled and provided Element Occurrence data from the Department's Natural Diversity Database. We also consulted with Dana Price and Jackie Poole of the Department's Wildlife Diversity Program.

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Appendix

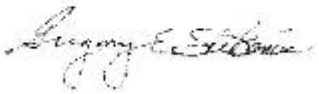
Appendix 1. Sources of population surveys, geographic data, phenology, and associated vegetation.

Citation	Year	Page	Population Surveys	Geographic Data	Phenology	Associated Vegetation
Carr	2001b	1-2	X	X	X	X
Damude and Poole	1990	8-12, 27-29, 31-41	X	X	X	X
Dieringer	1989	1-3	X		X	X
Fowler	2011c	1-3		X		
Holder	2003a	1-3	X	X	X	X
Holder	2003b	1-3	X		X	X
Holder	2004	1-2	X	X	X	
Holder	2010	1-8	X	X	X	
Leonard	2008	1	X			
Leonard	2009	1-3	X		X	
Leonard	2010b	1-3	X	X		X
Leonard	2011a	1	X		X	
Leonard	2011b	1-6	X		X	
Marr	2010	1-2	X	X	X	
Marr and Ito	2007a	1-2	X	X	X	
Marr and Ito	2007b	1-2	X	X	X	
Marr and Ito	2007c	1-2	X	X	X	
Marr and Ito	2007d	1-2				
McNeal	1989	14-15, 24-25, 27-28	X	X	X	X
Merritt and Bahr	2005	1-6	X	X	X	
Neal and Merritt	2006	1-2	X	X		
Poole et al.	2007	470-471			X	X
Price	2005	1				X
Price et al.	2007	1-3	X	X	X	X
Texas Natural Diversity Database	2007	7,972-8,025	X	X	X	
Zippin	1993	1-5	X	X	X	
Zippin	1997	221-225			X	X

Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  06/01/2011
Date

Concur:  10/07/2011
Date

Did not concur: _____ _____
Date

Director's Remarks: