South Texas Ambrosia
(*Ambrosia cheiranthifolia*)

5-year Review:
Summary and Evaluation

Photograph by Chris Best

U.S. Fish and Wildlife Service
Corpus Christi Ecological Services Field Office
Corpus Christi, Texas

5-Year Review
South Texas ambrosia (*Ambrosia cheiranthifolia*)

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office: Southwest Regional Office, Region 2
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1.2 Methodology used to complete the review:

This review was conducted through public review notification and a comprehensive review of all documents regarding South Texas ambrosia (*Ambrosia cheiranthifolia),* that were available in the U.S. Fish and Wildlife Services' (Service) Corpus Christi Ecological Services Field Office (CCESFO). The *Federal Register* notice announcing this review was published on March 20, 2008, and solicited new information from Federal and State agencies, non-governmental organizations, academia, and the general public. Information used in the preparation of this review includes scientific information from Service files, section 7 consultations, the Texas Natural Diversity Database (formerly known as the Biological Conservation Database), unpublished reports, monitoring reports, conversations with and comments from botanists familiar with the species, and information available on the internet. This document was drafted by staff in the CCESFO with assistance from the Services' Texas State botanist, and no part was contracted to an outside party. Dr. Alice Hempel, a Texas A and M University-Kingsville (TAMUK) botanist familiar with this species, reviewed drafts of the life history, status, and threats sections of this five-year review and provided clarifications and new information produced by her field research.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

73 R 14995; March 20, 2008.

1.3.2 Listing History

Original Listing

FR Notice: 58 FR 41696
Date Listed: August 5, 1993
Entity Listed: *Ambrosia cheiranthifolia*
Classification: Endangered (no critical habitat designated)

1.3.3 Associated Rulemakings: None.

1.3.4 Review History:

The Service first listed *A. cheiranthifolia* as a Category 2 candidate species on December 15, 1980 (45 FR 82479; USFWS 1980). Following receipt of B.L. Turner's status report (1983), we classified this plant as a Category 1 species in the *Federal Register* on September 27, 1985 (50 FR 39626), and February 21, 1990 (55 FR 6184). The species was listed as endangered without critical habitat on August 24, 1994 (59 FR 43648). We initiated this 5-year review of *A. cheiranthifolia* on March 20, 2008 (73 FR 14995) in a notice that included 27 other southwestern species.

1.3.5 Species' Recovery Priority Number at start of 5-year review: 8

Species are assigned priority numbers ranging from 1 – 18 based upon degree of threats, recovery potential, and taxonomic distinctiveness (48 FR 43098). *Ambrosia cheiranthifolia*'s Recovery Priority Number is 8, indicating that it is a full species with a moderate level of threat and a high potential for recovery.

1.3.6 Recovery Plan or Outline

Name of Plan: None. A recovery plan is currently being drafted.

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

No, the species is a plant; therefore, the DPS policy does not apply.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan?

No. The recovery plan is under development.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat:

Ambrosia cheiranthifolia is a perennial, herbaceous plant in the Asteraceae (sunflower) family that grows to be 10 to 30 centimeters (cm) (4 to 12 inches [in]) height. The species' simple leaves are a grayish-green, and the inflorescences (clustered, branched flowers) support two or more small, radial flowers (same-sized petals arranged equally from the center forming a round shaped, composite flower) that can be green, pink, or cream in color. Female and male flowers are separate but found on the same plant and bloom in late summer and fall (Texas Parks and Wildlife Department [TPWD] webpage 2010). The inflorescence and floral structure of the Asteraceae family are suited for anemophily (wind pollination); however, entomophily (insect pollination) may occur (Stebbins 1970). Although the mode of pollination is unknown for *A. cheiranthifolia* (see section 2.3.2.5), Hempel (pers. comm. 2010) believes the plant is likely wind pollinated, similar to many other species in this genus. Due to the species' rhizomatous growth, producing underground stems, clones are formed vegetatively and a single plant may be represented by hundreds of clonal stems (USFWS 1994). The plant grows at low elevations, typically on well-drained, heavy soils associated with subtropical woodland communities in openings of coastal prairies and savannas (USFWS 1994). Much of the native habitat of *A. cheiranthifolia* has undergone land use change for urban development, agricultural fields, and improved pastures. These cleared areas tend to support non-native grasses, which eventually outcompete native vegetation, or become invaded by thorny scrub as a result of overgrazing and fire suppression (USFWS 1994).

Historically, the species occurred in Cameron, Jim Wells, Kleberg, and Nueces counties in South Texas, and the state of Tamaulipas in Mexico. At present, there are six verifiable sites that still contain extant *A. cheiranthifolia* plants, and these are found in scattered, fragmented areas of remaining habitat located in Nueces and Kleberg counties in the Coastal Bend region of Texas; the status in Mexico is unknown (Table 1).

2.3.1.1 New Information on the species' biology and life history:

This 5-year review summarizes all information that has become available concerning *A. cheiranthifolia* since the final rule to list the species was published in 1994. Projects undertaken to gather new information on the biology and ecology of *A. cheiranthifolia* include preliminary reproductive biological investigations and efforts to propagate and introduce the species. There is also new information related to the species' management needs, including responses to fire and mowing.

Propagation

Ambrosia cheiranthifolia was successfully propagated from root cuttings by the San Antonio Botanical Garden (SABG) (Price 2007). Plants propagated by the SABG served as donor materials for a 2006 experimental introduction of *A. cheiranthifolia* into a Nueces County park in Robstown, Texas, (Robstown County Park) and provided TAMUK and TPWD with potted plants for research (Dr. Alice Hempel, pers. comm. 2010). Hempel, Price, Service biologists, students from TAMUK and Robstown High School, and other volunteers planted

200 individual *A. cheiranthifolia* plants into a prepared and secured area within Robstown County Park in the fall of 2006. These 200 plants increased to 300 by 2007. The results of Hempel's data analysis after one year at this introduction site showed that watering of seedlings was essential to successful establishment of *A. cheiranthifolia*. Additionally, Hempel determined that tall grasses and other non-native vegetation negatively impacted *A. cheiranthifolia*'s establishment and noted the species' rapid growth in both individual size and stem counts when invasive vegetation was removed from the site. Use of weed block fabric at the time of transplanting into the site had mixed effects, probably helping with early establishment of transplants by reducing soil water losses and competition, but after immediate establishment of the transplants, the weed block fabric had negative effects on the clonal growth and increase of *A. cheiranthifolia* at the site. For future efforts, removal of weed block fabric or other non-organic exclusionary covers is recommended once transplants are solidly established (A. Hempel, pers. comm. 2010). When tall grass and forb cover was eliminated in the Robstown experimental plot, *A. cheiranthifolia* produced abundant fruit (burs) and also began expanding rapidly by clonal growth.

Preliminary Reproductive Biological Investigations

The SABG produced the plants used in the Robstown County Park demonstration site using root cuttings/division. The SABG relied on vegetative propagation because production of *A. cheiranthifolia* from seed had not been successfully accomplished, although it had been attempted by multiple parties (A. Hempel pers. comm. 2010). In 2007 and 2008, Hempel and students used Robstown County Park demonstration site plants to perform some preliminary reproductive biology investigations in order to gain an understanding of possible reasons for the failure to successfully germinate *A. cheiranthifolia* from seed (A. Hempel, pers. comm. 2010). Hempel (pers. comm. 2010) provided the following details of her methods and results from this investigation:

> *Ambrosia cheiranthifolia*'s primary reproductive period occurs in late summer/fall, dependent on rainfall, and lasts until the lack of water or cold temperatures curtails growth. At the Robstown site, most stems produced a terminal inflorescence of staminate (male) heads that released abundant wind-dispersed pollen. Below that, in the leaf axils of the upper 1/3rd to 2/3rds of the vegetative portion of the stem, a series of small, sessile pistillate (female) heads was normally produced throughout the reproductive season. It was noted that some stems produced only or predominately pistillate or staminate heads, but most stems produced both types of heads. A single achene was produced per pistillate head. The phyllaries (bracts surrounding the flower head on a composite plant) hardened around the single fruit as it matured, producing a somewhat star-shaped, bur with the "seed" embedded inside. Multiple female heads were produced in each axil throughout the reproductive period, so burs of varying maturity sometimes occurred at the same node simultaneously. Burs darkened, hardened, and most easily dehisced (dried,

opened, and detached) at maturity, with most falling to the base of the plant. A number of burs remained on the stems as the leaves senesced and persisted for several weeks into the winter time. Plants at Robstown County Park produced a consistent average of 2.98 mature burs/cm (7.57 burs/in) the pistillate reproductive region of the stem.

At the Robstown County Park site, 80 percent of the pistillate heads, monitored across various controls and pollination treatments in fall 2007, produced mature burs. Most of these burs appeared "good" to the eye at maturity, but a substantial number turned out to be empty with no achene (a dry, one-seeded fruit), only partially filled, or had insect-damaged achenes. Burs were collected at two points in the season from both control and manipulated stems/plants. The November (fall) collection represented burs produced during the peak of the reproductive season and these were collected at maturity in early November. Maturity was defined as indurate burs that dehisced naturally with little or no assistance beyond gentle brushing of burs by fingers drawn along the stem. Burs were dissected and the enclosed achene sliced open and the degree of fill by the embryo and cotyledons of the achene was judged under magnification. The November collection had between 0 and 60 percent fill rate (overall mean of 41 percent fill). Burs persisted on the stems for several weeks into the winter (December) as the vegetative leaves senesced and reproduction ceased appeared sound, but dissection revealed only empty burs or unfilled achenes, resulting in 0 percent fill. Most December burs had frass (insect-produced debris or excrement) or actual insect larvae inside; suggesting insect herbivory of seeds may proceed rapidly at maturity. Due to this insect predation, immediate collection of matured *A. cheiranthifolia* seeds was required to have any viable seeds in hand.

Burs and bare seeds (dissected from enclosing burs) from the November 2007 collection (41 percent fill) were planted in February 2008 in trays of soil that were maintained in a greenhouse and watered as needed to maintain soil moisture. Only 1 of 213 seeds germinated (at 19 days) and although the trays were monitored for three months, no further germination occurred. A tetrazolium (TZ) staining technique was applied to 30 burs and 30 bare seeds approximately 6 months post collection to distinguish live seeds from filled, but dead, seeds. During staining, two additional seeds germinated. The percent viable filled seeds (bare seeds) was 14.3, 16.7, and 25 from the 3 individuals sampled (for each of the 3, n=10), based on TZ staining.

Although the SABG had reported successful germination of freshly collected seeds from plants growing at their gardens in December 2007, they did not furnish details as to the number of seeds planted, percent germination, seed fill, or details of methods beyond "standard nursery growing techniques" (A. Hempel, pers. comm. 2009).

Management-related Information

Mowing

Bush et al. (1994) studied the varying effect of mowing regimes on sub-populations of *A. cheiranthifolia* at the Naval Air Station Kingsville (NASK) in 1993. Eighty total test plots, divided among four treatments that included weekly mowing, monthly mowing, mowing two to three times/year, and a control (no mowing), were assessed for effects to *A. cheiranthifolia*. Garvon (2005) indicated that in order to quantify the number of populations on NASK, yearly monitoring and base-wide searches for new locations every 3-6 years may prevent accidental destruction and may indicate where *A. cheiranthifolia* is expanding on the base. As of 2005, the Navy was not following any scheduled mowing regime; mowing was performed on a need only basis. Bush et al. (1994) and Garvon (2005) found that mowing at certain heights, and under regimes that allowed the plant to flower, benefitted *A. cheiranthifolia* by reducing competitive pressures from invading non-native grasses. Carol Bush, botanist from Corpus Christi Botanical Garden (CCBG), and associates observed that *A. cheiranthifolia* plants in the NASK's monthly mowing treatment were the hardiest and suggested that areas mowed weekly would benefit from less frequent mowing, especially under the hot, dry conditions of the summer months (Bush et al. 1994). The Service (in Grahl 1994) noted that regular mowing regimes might aid rhizomatous growth and result in an increased density of clonal stands.

Fire

Fire is a major influence in the ecology of prairie ecosystems; however the effects of fire on *A. cheiranthifolia* have never been formally investigated. The results of two fires, in 2008 and 2009, did provide some illumination on this topic. A subpopulation of *A. cheiranthifolia* along the right-of-way (ROW) on the west side of U.S. Highway 77 burned to ground level in a grass fire on June 30, 2008 (Hempel 2008a). For several months following this roadside burn, Hempel gathered global positioning system (GPS) points for *A. cheiranthifolia* and other associated grasses at the site. Plants were again monitored in mid-October (10/13/2008) and *A. cheiranthifolia* had recovered significantly (Hempel 2008a). Prior to the roadside fire, the dominant grass was Kleberg bluestem (*Dichanthium annulatum*) and subsequent monitoring at the site post-burn showed that this aggressive, invasive grass had overgrown the native vegetation; however, it did not appear to change the dynamic between the native and exotic vegetation. Long-term monitoring has not been undertaken to determine the full response and effects of this fire on *A. cheiranthifolia*. In 2009, a prescribed burn, carried out on the NASK, affected some *A. cheiranthifolia*. The species survived and responded by producing new growth (Richard Riddle, Navy Natural Resource Manager, pers. comm. 2009). Results of these two events indicate that fire, whether prescribed or natural, does not appear to kill *A. cheiranthifolia* plants but may act to stimulate new growth.

2.3.1.2 Abundance, population trends, demographic features, or demographic trends:

Ambrosia cheiranthifolia is currently found across its known range in Nueces and Kleberg counties in a patchy, scattered pattern of distribution, in part due to the extensive fragmentation of native prairie habitat. Turner (1983) found that *A. cheiranthifolia* is rhizomatous in nature, making counting of individual plants difficult because one plant may have hundreds of stems. Most *A. cheiranthifolia* survey data collected to date has been reported as stem counts as opposed to number of individual plants. Although it appears that *A. cheiranthifolia* can reproduce sexually, it is unclear whether this mode of reproduction constitutes the major source of new growth. Hempel (2008b) documented the vegetative reproduction of the species. Genetic analysis of the species to date is lacking, creating uncertainty about whether plants in many of the *A. cheiranthifolia* sites are clones of each other and what the relatedness is between sites. Unanswered genetic questions regarding relatedness between sites add to the confusion about what constitutes a population versus a discrete site (or subpopulation) for this species.

For purposes of this review, we describe a "site" (or subpopulation) as a discrete location where one or more plants have been located and where there is a clear separation from any other group of plants. A plant population is a spatially discrete group of conspecific individuals (Ellstrand 1992) that sustains gene flow between individuals through seed dispersal and pollen transfer. Some occurrences of *A. cheiranthifolia* consist of scattered sites or subpopulations that are located in relatively close proximity to one another, as is true on the Naval Air Station in Kingsville, Texas (NASK), which may constitute a single meta-population in which the collection of sites occurs in relatively close proximity to one another (separated by a distance of less than one kilometer) (NatureServe 2009). Distance influences gene flow between meta-populations. Ideally, populations should be sufficiently distributed across available habitat to minimize loss from catastrophic events (NatureServe 2009). Expanses of unsuitable habitat, including cropland and urban areas, may serve as barriers to continued gene flow for a species (NatureServe 2009). This is relevant to *A. cheiranthifolia* because much of the suitable habitat across its range has been destroyed by land cover conversion to row crops, improved pasture, or residential/commercial development.

Much of the occurrence and/or abundance data available for *A. cheiranthifolia* are tracked in Texas' Natural Diversity Database (TNDD). The TNDD is managed by TPWD and compiles data on target plant and animal species that is submitted by a vast consortium of Federal, State, academic, non-governmental organizations (NGOs), private researchers, and consultants. The TNDD tracks 232 rare, threatened, and endangered plant species in Texas, including all 33 federally-listed plants (23 endangered, 6 threatened, and 3 candidate species, and 1 endangered plant proposed for delisting at this time). The geographic, population, and other relevant data for each species are tracked as Element Occurrences. "An

Element Occurrence (EO) is an area of land and/or water in which a species or natural community is, or was, present" (NatureServe 2009). EOs may consist of one or many sites as reported by surveyors. In the geographic information system (GIS) component of the TNDD, EOs are displayed as points and polygons buffered by their estimated geographic precision. For this reason, historic reports that do not contain precise geographic coordinates are shown as relatively large polygons, while more recent survey data collected with global positioning system (GPS) instruments are represented by smaller polygons. Therefore, it must be understood that the tracked species occur within but not necessarily throughout the polygons displayed in the GIS. The TNDD is an essential tool for the long-term conservation and management of species at risk. Documented EOs in Figure 1 do not account for all the known extant sites of *A. cheiranthifolia* on NASK; the TNDD does not record EOs that occur in Mexico. The Service makes frequent use of the TNDD in listing actions, for planning and tracking recovery of listed species, for section 7 consultations, and for Habitat Conservation Plans.

The TNDD has 26 element occurrence records (EORs) for *A. cheiranthifolia*, but some of these EORs are for subpopulations as opposed to populations, or in some cases the EORs describe historic, extirpated sites so there may be multiple EORs for a single EO (Table 1). Fourteen total sites can be considered separate populations based on documented reports. The Service believes that 6 of these sites still contain extant *A. cheiranthifolia* populations (some consisting of multiple sub-populations) with all six located in Nueces and Kleberg counties in the Coastal Bend region of Texas (Table 1). Of 7 Texas populations verified within the last 25 years, 1 that formerly occurred on private land adjacent to Texas Department of Transportation (TXDOT) ROW has not been seen since 1992; while the remaining 6 are accounted for by a population on another TXDOT ROW, 1 on Federal land (NASK), 2 on city and county parkland (town of Bishop's municipal park and Nueces County's Robstown Park), and 2 on private land in Bishop and to the east of Kingsville on a large ranch in Kleberg County (Figure 1). Five of the six extant sites are known to be viable as of 2009, but the status of the ranch population is unknown due to lack of access since 1994. Three sites were historically documented by one record each (including herbarium vouchers) in Cameron and Jim Wells counties, Texas, and in Tamaulipas, Mexico, but these have never been relocated. We do not have a herbarium voucher or identification verification of a recent (2003) Tamaulipas, Mexico, *A. cheiranthifolia* record, however GPS coordinates from the collection site are available (Alberto Contreras 2005).

Kleberg County: *Naval Air Station Kingsville Sites – Federal land*
Population Number 7 (Table 1)

The NASK supports the largest number of *A. cheiranthifolia* sites documented to date (Table 1; EOs: 7, 9, 10, 11, 12, 13, 14, 15, 17, and 20). Philip Clayton, Service botanist, first reported *A. cheiranthifolia* on the NASK in 1991. In 1993, William Carr, Texas Nature Conservancy (TNC) botanist, identified several new sites on NASK that consisted of thousands of stems. In 2005, Shannon Garvon,

Service biologist under contract to the Navy, produced a management plan for *A. cheiranthifolia* on the NASK (Garvon 2005). She located subpopulations, used a Trimble Global Positioning System (GPS) unit to record their perimeters, and estimated plant numbers using transects, quadrats, and stem counts. Garvon's total count was 25 sites ranging in size between four and 288 stems. In 2005, Service and Navy biologists began annual monitoring of *A. cheiranthifolia* distribution and abundance on NASK using Garvon's 2005 management plan as their baseline. The fall monitoring protocol includes visits to all known sites, as well as surveys for previously undiscovered sites. This effort also entails GPS delineation of the perimeter of each site to check for spread of existing sites, and sampling of stem counts. In 2006, two new sites were documented, however an October 2008 survey resulted in a count of 24 sites on the NASK, a reduction of two (R. Riddle, Navy Environmental Manager, pers. comm., 2009). The reason for the changing numbers of *A. cheiranthifolia* sites found on the NASK is not clear; however it appears that the plant may be capable of spreading into new areas, while disappearing from others over the same period of time. The disappearance may be primarily due to habitat degradation from invading grasses, as *A. cheiranthifolia* plants at several former sites on NASK can no longer be located and the areas are now covered by tall, dense stands of non-native grasses. New, formerly undetected patches of *A. cheiranthifolia* have been located in the past few years.

Kleberg County: *King Ranch Training Area Site-NASK*
Population Number 10 (Table 1)

Carr (1993) found seven discrete areas of *A. cheiranthifolia* in 1993 on the King Ranch Training Area (a tract of land adjacent to NASK, leased from the King Ranch by the National Guard for training in the early 1990s). These seven sites may constitute one large meta-population, based on their close proximity, but genetic data is lacking to clarify relatedness of the plants in the individual sites (Table 1; EOs 19, 21, 22, 23, 24, 25, and 27). According to Carr, most of these sites (five of seven) contained hundreds of stems. One site (EO 19) had the highest numbers found on the King Ranch Training Area with "thousands, maybe even tens of thousands" of stems, while another population was comprised of thousands of stems (TNDD 2007).

Nueces County: *Texas Department of Transportation - Right-of-way Site*
Population Number 9 (Table 1)

Several of these are located between the town of Bishop and U.S. Highway 77, including a population (or two subpopulations) that grows in the right-of-way (ROW) of State Highway 77 at the Nueces/Kleberg county line and extends onto private land; the status of the private land population is unknown due to restricted access (Table 1, EO 18). Lee Elliott (Service) and Ruth O'Brien (contract botanist) found *A. cheiranthifolia* plants growing in these ROW sites in 1993 and counted 1,737 stems on the northwest side of the highway, where *A. cheiranthifolia* occurs immediately south of Carreta Creek. In the years 1994, 2000, and 2002, surveyors found 4,201 (Poole and Janssen 1994), 30 (TNDD

2007), and 592 stems, respectively, at this site. This constituted an overall 86 percent decrease in stem abundance between 1994 and 2002 (Clary et al. 2002).

In 2008, *A. cheiranthifolia* plants were located at the site but were shorter than the average heights of 10 – 40 cm and less abundant than was found during a 2006 survey (Cobb 2008). Blanton and Associates, a consulting firm, made a preliminary stem count of approximately 850 stems on the west side of Hwy 77 in 2008 (Hempel 2008a). Later in 2008, R. Cobb described *A. cheiranthifolia* plants in the ROW on the east side of Hwy 77 as "chlorotic looking", appearing yellowish in color. This was determined to be the result of herbicide drift from an adjacent crop field, however these plants did not die as a result of this exposure. In 2009, Blanton and Associates consulted with the Service on a project to upgrade Highway 77 between Driscoll (Nueces County) and Riviera (Kleberg County). They conducted presence/absence surveys between May 2008 and April 2009 in the proposed ROW and found populations of *A. cheiranthifolia* in the project area along Highway 77. Some areas were not surveyed due to denied entry (TXDOT 2009).

Nueces County: *St. James Cemetery Site*

Population Number 6 (Table 1)

In 1987, O'Brien found an *A. cheiranthifolia* site along a road and within the adjacent privately-owned St. James Cemetery on the south side of Bishop (Figure 1; Table 1, EO 6). The size of this population has never been systematically ascertained (TNDD 2007). Observations documented in the species' file generally indicate the condition of the cemetery population as noted during a series of visits by different individuals. For example, in March of 2005, tens of thousands of stems were observed in this population, most of which were in good vegetative condition, and clumped in varying densities (TNDD 2007).

Nueces County: *Town of Bishop, Carreta Creek Site*

Population Number 9 (Table 1)

Another population (or potentially a sub-population) exists directly upstream of the cemetery population on the northeast side of Carreta Creek, in the town of Bishop's city park (Table 1, EO 16). Although Bush and O'Brien (1992) counted hundreds of stems at this site, the numbers and condition of *A. cheiranthifolia* in this park have not been evaluated since their work there in the early 1990s (TNDD 2007). In 2009, Hempel searched for *A. cheiranthifolia* at this site but was unable to locate any plants; documented locality information for this EO was insufficient and may be a factor in her difficulty in relocating these plants. The status of this population is unknown.

Nueces County: *Petronila Creek Site*

Population Number 1 (Table 1)

A population, geographically separated from the previously described Nueces and Kleberg County populations, previously occurred along the banks of Petronila Creek near the ROW of State Highway 70 (Table 1, EO 1). This population

existed in close proximity to a population of the endangered slender rush-pea (*Hoffmannseggia tenella*). The slender rush-pea remains extant in the TXDOT ROW at this location, but the *A. cheiranthifolia* occurrence was on adjacent privately-owned land. According to David Potter, former TXDOT biologist, the last documented observations of this *A. cheiranthifolia* population in TXDOT files were from 1992 and he never personally saw this population after he started work with the agency in 1994 (A. Hempel, pers. comm. 2010).

Nueces County: *West of Violet Site*

Population Number 4 (Table 1)

The remaining documented populations are found in the north-central part of Nueces County. One of these populations, located just west of the town of Violet, on the north side of State Highway 44, was reported in 1969 by Ruth O'Brien (Table 1, EO 4). This population was relocated in 1991 and stem numbers were estimated at 100-1,000 (TNDD 2007). In 2000, Jackie Poole, TPWD botanist, found only 30-40 stems at this location and noted that many of these stems suffered from severe beetle damage (TNDD 2007). Hempel was unable to locate *A. cheiranthifolia* at this site in 2008 and 2009 and referred to the presence of "lots of invasives" in the area although she noted uncertainty about whether she was in the exact location where the *A. cheiranthifolia* formerly grew (A. Hempel, pers. comm. 2010).

Nueces County: *Robstown Cemetery/Railroad Track Site*

Population Number 11 (Table 1)

In Robstown, Nueces County, *A. cheiranthifolia* was located on the edge of a cemetery alongside a railroad track (Table 1, EO 26). In 1993, this population was described as occurring in small patches and contained only 50 stems (TNDD 2007). Recent (2006-2010) searches at to this site have failed to relocate any plants (A. Hempel, pers. comm. 2010).

Nueces County: *Robstown County Park*

Population Number 12 (Table 1)

Also in Robstown, a very small number of individual plants were found on a field belonging to the Nueces County Park (Table 1, population 12). This population became the donor site of cuttings for propagation by the SABG. The progeny were planted into a "created" sanctuary site on a different part of the park in 2006. No *A. cheiranthifolia* plants have been located in the field at the park, now used for sports, as of 2004 (A. Hempel, pers. comm. 2010). However, Price found the population again in 2006 but subsequent searches in 2007 and 2008 were not successful in finding any plants. In May 2009, two formerly undiscovered patches of *A. cheiranthifolia* were found growing along the mowed roadside on the (eastern) boundary of this park (A. Hempel pers. comm. 2009).

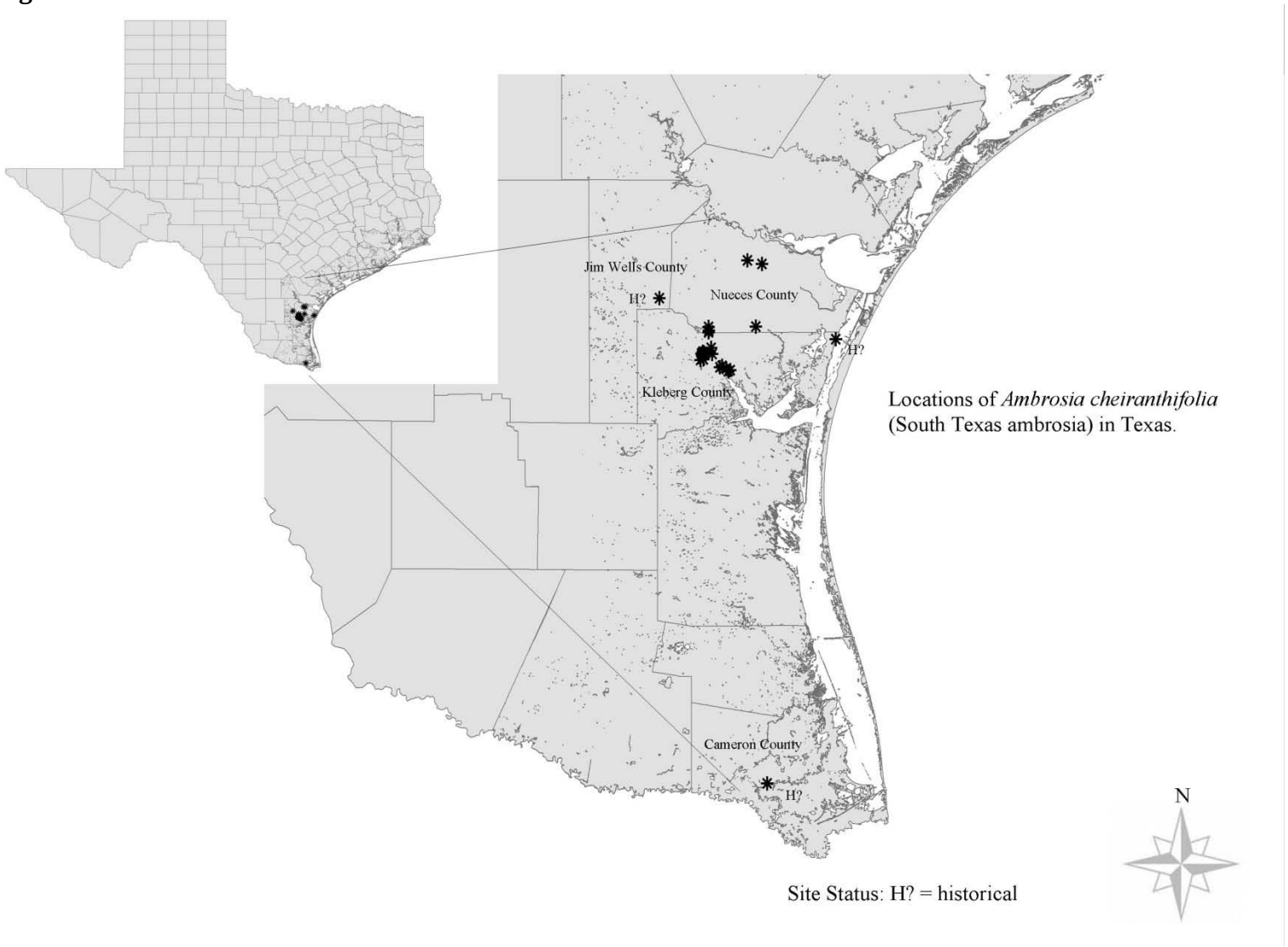
Table 1. Populations of South Texas Ambrosia
Element Occurrences (EO#s) listed in the Texas Natural Diversity Database (2007).

Pop #'s	EO #	First Obs.	Observer/s	Last Obs.	County	Site Description	Voucher*	Population Size and Observations	Status**
1	1	1968	J. Poole	1979	Nueces	Bank of Petronila Creek, HWY 70 crosses over bridge		In 1979, found 100 plants.	H
2	2	1932	Robert Runyon	1938, 1941	Cameron	Near Barreda	TEX-LL (1932), TEX (1938), U.S. Nat'l Herbarium (1941)	Unknown, may be historical site.	H
3	3	1942		1942	Kleberg	Coast near Kingsville	TEX	Historic but unable to relocate due to inadequate location information.	H
4	4	1969	Ruth O'Brien, Jackie Poole, Alice Hempel	2000, 2009	Nueces	North side of Route 44, east of junction with St.Rt.24, west of Violet	TEX (three), CCM (1986)	Found 100-1000 stems in 1991 and 30-40 stems in 2000. Two site visits in 2008 and 2009 were unsuccessful in finding stems.	U
5	5				Jim Wells	Uncertain – location information vague		Record published in Flora of Texas Coastal Bend (Jones 1977). Locality information too vague to relocate.	H
6	6	1987	Ruth O'Brien, Robyn Cobb, Alice Hempel	2009	Nueces	St. James Cemetery	CCM (1988)	In 2005, found 1,000s of stems. A 2009 survey showed an average of 10 stems/m². This is the largest population known in Nueces County.	E
7	7, 9, 10, 11, 12,13, 14,15, 17,20	1991, 1992, 1993	Philip Clayton, William Carr, Carol Bush, Alice Hempel, Shannon Garvon	2008	Kleberg	NASK (Naval Air Station Kingsville)		Clayton made first observation of *Ambrosia* ***cheiranthifolia*** on NASK in 1991. Bush conducted mowing study in 1992. Carr found additional populations in 1993. Riddle, Garvon, and others began systematic monitoring of subpopulations in 2005.	E
8	16	1992	William Carr, Carol Bush, Ruth O'Brien, Robyn Cobb	2008	Nueces	Bishop City Park on northeast side of Carreta Creek; both sides of drainage ditch		Hundreds of stems in earliest surveys. No counts since 1992, but site has been visited as recently as 2008.	U
9	18	1993	Lee Elliott, Ruth O'Brien, Alice Hempel	2008	Nueces, Kleberg	West side of U.S. HWY. 77, southwest of Carreta Creek and east side of U.S. Hwy 77 south of Nueces/Kleberg line		1,737 stems (1993). 4,201 stems (1994). 30 stems (2000). 592 stems (2002). Fire destroyed vegetation in 2008, however, this population recovered. Site visits in 2009 showed herbicide damage and disturbance with what appears to be a decline in populations on both the east and west side of the ROW.	E
10	19	1993	William Carr	1993	Kleberg	King Ranch Training area (KRTA)		Most recent survey found thousands or tens of thousands of stems. Populations entirely on privately-owned lands.	E-Uv.
10a	21	1993	William Carr	1993	Kleberg	KRTA		Most recent survey found hundreds, but not thousands of stems.	E-Uv.
10b	22	1993	William Carr	1994	Kleberg	KRTA; Pinto pasture		In 1993, found hundreds, but not thousands of stems and tens of thousands of stems in 1994.	E-Uv.
10c	23	1993	William Carr	1994	Kleberg	KRTA; road to Pinto Creek		In the most recent survey, found hundreds of stems.	E-Uv.
10d	24	1993	William Carr	1995	Kleberg	KRTA; south towards Ramos Well		Several thousands of stems.	E-Uv.
10e	25	1993	William Carr	1993	Kleberg	KRTA; southwest of Bordo Nuevo Windmill		Hundreds, but not thousands of stems.	E-Uv.
10f	27	1993	William Carr	1994	Kleberg	KRTA; road through Pinto pasture		Hundreds of stems.	E-Uv.
11	26	1993	Alice Hempel	2009	Nueces	North of RT.44 in Robstown, edge of cemetery at foot off Railroad tracks		In 1993, found 50 stems. No remaining stems found between 2000 and 2009 surveys.	H
12		200?	C. Sahadi, Alice Hempel	2009	Nueces	Nueces County Park in Robstown		Sahadi initially located small number of plants in one park field; in 2006 a pilot introduction effort was started in another area of park; 2 new subpopulations found in 2009.	E
13		1835	Luis Berlandier	?	Mexico	Near San Fernando, Tamaulipas		First specimens of *Ambrosia cheiranthifolia* collected.	U
14		2005	A. Contreras	2005	Mexico	Tamaulipas		Specimen taken to university in Nuevo Leon, but identification not confirmed.	U

*HERBARIUM VOUCHERS: CCM - Corpus Christi Museum of Science and History
LL - Lundell Herbarium
TEX - University of Texas at Austin Herbarium

**STATUS: E - Extant
E - Uv - Population is extant but unverifiable
H - Historic
U - Unknown

Figure 1



Locations of *Ambrosia cheiranthifolia* (South Texas ambrosia) in Texas.

Site Status: H? = historical

2.3.1.3 Genetics, genetic variation, or trends in genetic variation:

Performing a genetic analysis of *A. cheiranthifolia* is a pressing need. To date, a microsatellite-enriched library (DNA fragments) has been created by researchers at Texas A and M University-College Station (TAMU) (Alan Pepper, Professor, pers. comm. 2005). Plant material for this analysis was collected from the St. James Cemetery population. A research project that includes collection and analysis of genetic data from all extant sites, as well as investigation of other basic ecology and reproductive biology, was funded in late 2008, with results anticipated in 2010.

Keeping in mind the discussion of *A. cheiranthifolia*'s reproductive strategy (see section 2.3.1.2), the level of genetic diversity that currently exists for the entire species is undetermined and there is reason to suspect that many stems in a site (subpopulation) are clones of a single individual plant (A. Hempel, pers. comm. 2010). Most extant *A. cheiranthifolia* populations and subpopulations are small in aerial extent with low numbers of plants. Additionally, *A. cheiranthifolia* populations are scattered over a heavily fragmented landscape making the species vulnerable to loss of genetic diversity and increasing its potential for extinction from natural and catastrophic events (see section 2.3.2.5). Loss of genetic variability may make *A. cheiranthifolia* more subject to extirpation than would be true for the same size populations with higher genetic diversity (A. Hempel, pers. comm. 2010).

2.3.1.4 Taxonomic classification or changes in nomenclature:

Ambrosia cheiranthifolia is 1 of 10 species of *Ambrosia* (ragweeds) in the family Asteraceae in Texas (Flora of North America 2009). Luis Berlandier collected the first specimens of *A. cheiranthifolia* in 1835 near San Fernando, Tamaulipas, Mexico (59 FR 43648). *Ambrosia cheiranthifolia* was not described as a species until 1859 when it was recognized by Asa Gray (Payne 1964). Voucher specimens from Texas were first obtained in 1932 when Robert Runyon made the initial U.S. collection of *A. cheiranthifolia* in a grassland near Barreda, Cameron County (Turner 1983). Taxonomic classification of *A. cheiranthifolia* has not changed since the final listing of the species in 1994.

2.3.1.5 Spatial distribution, trends in spatial distribution, or historic range:

Although *A. cheiranthifolia*'s historic range extends from Nueces County on the north as far south as San Fernando in Tamaulipas, a distance of approximately 322 kilometers (200 miles), the vast majority of documented sites are in the northern part of the range, within an area that extends from north central Nueces County to south central Kleberg County (Figure 1). Of the two occurrences in Tamaulipas, one has not been seen since 1835 (historic) and the other is based on a specimen that lacks a confirmation of identification. The historic reports from Cameron and Jim Wells counties consisted of only one record each, so no pattern

of distribution in the southern part of the range is apparent. In Cameron County, *A. cheiranthifolia* was found in open, llano (plains) in clayey soils with drought-resistant vegetation, adapted to the irregular rainfall and droughts common to the area (Turner 1983, Jahrsdoerfer and Leslie 1988, TNDD 2007). In general, Tamaulipas has native Texas ebony (*Ebenoposis ebano*), retama (*Parkinsonia aculeate*), granjeno (*Celtis ehrenbergiana*), huisache (*Acacia farnesiana*), pricklypear (*Opuntia* species), and mesquite (*Prosopis glandulosa*) growing in alluvial soils (Blair 1950). No habitat descriptions exist for the historic Jim Wells County population. Loss of native habitats in Cameron County, including coastal prairie, has been extensive with approximately 95 percent of the Lower Rio Grande Valley's (LRGV) original native brushland habitat converted for agricultural or urban use since the 1920s (USFWS 1980; Parvin 1988a, b). Approximately 98 percent of the Rio Grande delta region native plant cover was cleared in both the United States and Mexico (USFWS 1980, Collins 1984).

Contreras-Arquieta (2005) reported *A. cheiranthifolia* near Matamoros, Tamaulipas, but did not collect a herbarium voucher specimen. This site has not been independently confirmed.

Most *A. cheiranthifolia* occurrences in Nueces and Kleberg counties are located in a clumped pattern with numerous sites (subpopulations) in close proximity to one another, with larger geographic separation between the groupings. In Nueces County, *A. cheiranthifolia*'s characteristic habitat primarily remains in strips of native prairie that have been left untilled and undeveloped within, or on the periphery of, towns and along highway ROWs. These remnant strips of habitat occur, for the most part, near drainage features such as Petronila Creek and Caretta Creek, and in Tamaulipas, near old river channels/resacas (oxbows).

In Kleberg County, a higher percentage of the grassland ecosystem containing *A. cheiranthifolia* remains intact than in Nueces County, therefore a higher potential for undiscovered populations exists in portions of this county. Within the range of *A. cheiranthifolia* in Kleberg County, at least one large ranch has maintained a vast area of rangeland that is used for grazing and is managed, at least in part, by prescribed burns. Clayton (1991) attributed the persistence of *A. cheiranthifolia* on the NASK to its Federal ownership and the associated regular mowing and maintenance activities which may have abated the threats to the plant from invasive grasses. At the same time, grazing and root-plowing activities on the NASK site have contributed to losses in species diversity and cover of woody herbaceous vegetation, thereby allowing invasive grasses to become even more pervasive in areas lacking regular maintenance.

2.3.1.6 Habitat or ecosystem conditions:

Ambrosia cheiranthifolia grows in the Gulf coastal grasslands of southern Texas at low elevations 26 to 66 feet above sea level (8 to 20 meters above sea level). The plant is found in grassland and mesquite shrubland habitat on various soils,

both heavy clays to lighter-textured sandy loams, mostly of the Beaumont and Victoria Clay series (Turner 1983, Poole et al. 2007). Extant populations and sites are found in habitats where native short-grass prairie species have persisted, perhaps due to regular mowing that may have impeded takeover by introduced invasive grasses. Poole et al. (2007) also noted that *A. cheiranthifolia* sites occur on unplowed, but mowed, railroad and highway ROWs, cemeteries, mowed park fields, and erosional areas along creeks. Although this species does not appear to persist under intense soil disturbance (such as plowing or disking), recent evidence indicates light to moderate vegetation disturbance levels (e.g. mowing) may benefit *A. cheiranthifolia* by reducing competition from non-natives.

In its native habitat, associated prairie species include Texas grama (*Bouteloua rigidiseta*), buffalograss (*Buchloe dactyloides*), curly-mesquite (*Hilaria belangeri*), Texas wintergrass (*Nassella leucotricha*), littlehead gumweed (*Grindelia microcephala*), cuman ragweed (*Ambrosia psilostachya*), violet wild petunia (*Ruellia nudiflora*), coastal indigo (*Indigofera miniata*), Dakota mock vervain (*Glandularia bipinnatifida*), painted tongue (*Bouchetia erecta*), threelobe false mallow (*Malvastrum coromandelianum*), Santa Maria feverfew (*Parthenium hysterophorus*), streambed bristlegrass (*Setaria leucopila*), Drummond's clematis (*Clematis drummondii*), pyramidflower (*Melochia pyramidata*), and Texas crownbeard (*Verbesina microptera*). The Federally endangered slender rush-pea co-occurs with *A. cheiranthifolia* at three sites (Poole et al. 2007). Native woody plants found within or adjacent to *A. cheiranthifolia* plants include honey mesquite, huisache, huisachillo (*Acacia schaffneri*), brasil (*Condalia hookeri*), granjeno, and lotebush (*Ziziphus obtusifolia*) (USFWS 1994).

Across its range and at all extant sites, non-native invasive grasses have become a large component of the vegetative community that surrounds *A. cheiranthifolia* plants. These non-native grasses invade native ecosystems and in *A. cheiranthifolia*'s environment the exotic species assemblage includes buffelgrass (*Pennisetum ciliare*), Kleberg bluestem (*Dichanthium annulatum*), Guineagrass (*Urochloa maxima)* King Ranch bluestem (*Bothriochloa ischaemum* var. *songarica*), bermuda grass (*Cynodon dactylon*), St. Augustine grass (*Stenotaphrum secundatum*), silky bluestem (*Dichanthium sericeum*), and yellow bluestem (*Bothriochloa ischaemum*) (USFWS 1994, Poole et al. 2007, Hempel 2008a).

2.3.2 Five-Factor Analysis

2.3.2.1 Present or threatened destruction, modification, or curtailment of its habitat or range – Factor A:

The primary threat to *A. cheiranthifolia* throughout its range at the time of listing was habitat loss. Invasion of short-grass prairie by non-native grasses, conversion of native prairie to row crops and improved pasture, development in urban and rural areas, and restricted geographic distribution and abundance are historic, as

well as ongoing, habitat-related threats affecting *A. cheiranthifolia* (USFWS 1994). Plowing, paving, and other construction can completely eliminate this species. Beaumont and Victoria clay soils support agricultural production and most of the land overlying these soils has been plowed and planted to sorghum, cotton, and corn (Franki et al. 1965), particularly in Nueces County, where 60 to 70 percent of the land is now in row crop production (The Handbook of Texas Online, HTO, 2008b). Habitat alterations in Kleberg County include conversion to improved pasture and row crop agriculture (HTO 2008a). The historic Cameron County population (Population 2, Table 1) was located in an area where the vast majority of formerly existing, native vegetation was removed to accommodate residential, commercial, municipal, and industrial development, or was converted to agriculture and improved pasture (Jahrsdoerfer and Leslie 1988).

Ambrosia cheiranthifolia is associated with numerous native grass, forb, and woody species (see section 2.3.1.6); however, exotic grasses have invaded extant population sites and potential habitat throughout the current and historical range (see species list above in 2.3.1.6). These non-native grasses originated in regions of Africa, India, and other parts of Asia, and were introduced for livestock forage, roadside stabilization (Correll and Johnston 1979), and/or for lawns and parks (Gould 1978). The exotic grass species found in south Texas thrive on disturbed, subsaline soils and have spread throughout much of south Texas and the Rio Grande plains (Correll and Johnston 1979). Several of the predominant invasive grass species in south Texas appear to be positively fire adapted, creating a possible scenario of increased competition from invasive grasses under intensified fire frequency in response to changes in climate (Mahler 1982, D'Antonio et al. 1998, Kuvlesky et al. 2002). In addition to spread of these exotic grasses as a result of deliberate plantings, they can also proliferate on highway ROWs, oil and gas pipelines, and drilling areas where their invasiveness may be linked to the soil disturbance associated with human construction activities and transport of seeds via equipment and vehicles. Most exotic species planted on highway ROWs are used for erosion control and maintenance (Gould 1978, Invasive Species Specialist Group 2009).

In northern Tamaulipas, where *A. cheiranthifolia* was historically recorded, habitat conversion for agricultural uses continues, however, we lack specific information about the historic location and cannot determine the extent of this threat to *A. cheiranthifolia* in Mexico.

In summary, habitat loss and degradation continue to pose a tremendous threat to the continued existence of *A. cheiranthifolia*. Historical conversion of native coastal prairie habitat to agricultural and residential development uses, including the native short-grass prairie community of which *A. cheiranthifolia* is a component, has likely eliminated some *A. cheiranthifolia* populations. This habitat loss has certainly restricted and fragmented the species within its current distribution. Currently however, the most pervasive and widespread habitat-

related threat for *A. cheiranthifolia* is the degradation, and potentially the loss of habitat associated with the invasion of short-grass prairie by non-native, invasive species of grasses including Old World bluestems, guineagrass, buffelgrass, and others.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes – Factor B:

At the time of listing in 1994, no known threats were associated with the commercial trade or the excessive scientific and/or recreational use of the species (USFWS 1994). Turner (1983) postulated that *A. cheiranthifolia* may contain compounds possessing anti-tumor agents with potential to be manufactured for future use. To the best of our knowledge, no further assessment of the species' potential for this type of production has taken place. Excessive recreational or scientific use is not known or anticipated for the species, and overuse is not anticipated to constitute a significant threat to the species.

2.3.2.3 Disease and predation – Factor C:

No threats for disease or predation were known in 1994, however, damage to stems and rhizomes could be possible in situations of heavy trampling or grazing (USFWS 1994). Poole in 2000 and 2001 observed extensive beetle damage on the Violet population (TNDD 2007). Hempel (2008a) noted that insects would quickly damage seeds of *A. cheiranthifolia*, making seed reintroduction difficult. It is unknown whether this is true at other population sites, however high rates of seed predation are common in Asteraceae, and Hempel indicated that this is not an unexpected situation. Although this may not constitute a significant threat to the species, it would be an important consideration if seed was collected for purposes of banking because many seeds may not be viable (A. Hempel, pers. comm. 2010). Other than the insect damage discussed above, existing information does not indicate that *A. cheiranthifolia* is negatively affected by predation and/or disease. Information available at the time of listing *A. cheiranthifolia* did postulate that damage to stems and rhizomes was possible in situations where grazing animals may forage on or trample the plant. However at the NASK, one *A. cheiranthifolia* stand continues to persist within a horse pasture where it appears that the horses graze surrounding plants but leave *A. cheiranthifolia* uneaten, suggesting the plant may be unpalatable to horses. There is no reason to believe that disease and predation are increasing and they are not considered threats to the viability of the species.

2.3.2.4 Inadequacy of existing regulatory mechanisms – Factor D:

The endangered status of *A. cheiranthifolia* under the Endangered Species Act (ESA) furnishes protections that can also help to recover the species. The NASK is the only Federally-owned land supporting *A. cheiranthifolia*, under management of the U.S. Department of Defense. The Sikes Act Improvement

Act of 1997 (SAIA) requires implementation of an Integrated Natural Resource Management Plan (INRMP) to provide for the conservation and rehabilitation of fish and wildlife resources on military installations. The INRMP is to provide "integrated fish and wildlife management, land and forest management, wetland enhancement and protection, public access and sustainable use of natural resources, and enforcement of natural resource laws and regulations without interfering with the military readiness or mission." Section 7 consultations require other Federal agencies to consult with the Service on projects that they fund, authorize, or permit that may disturb suitable native habitat for *A. cheiranthifolia* and possibly reduce the numbers of the plant and other listed species. Under section 7 consultation, suggestions to avoid or minimize impacts or to carry out reasonable and prudent measures can help to produce additional benefits to the species by increasing the interest level and coordination between other state, local, and Federal agencies and the Service. The management plan developed for NASK by Garvon in 2005 was a result of the Navy's desire to work with the Service on its INRMP to develop measures that would help it to avoid potential future land use restrictions.

Regarding protection afforded *A. cheiranthifolia* by State regulations, under Chapter 88 of the Texas Parks and Wildlife Code, any Texas plant that is placed on the Federal list as endangered is also required to be listed by the State; and *A. cheiranthifolia* was given endangered status by TPWD in 1997. The State prohibits taking and/or possessing listed plants for commercial sale, or sale of all or any part of an endangered, threatened, or protected plant from public (state-owned) land. Scientific permits are required for purposes of collection of endangered plants or plant parts from public lands for scientific or education purposes. One population of *A. cheiranthifolia* is found on the TXDOT-controlled ROW of Highway 77. A second population was known from private land adjoining the State Highway 70 ROW where it crossed Petronila Creek. The presence of plants at the Petronila Creek site has not been reconfirmed in over 18 years.

Activities (including herbicide applications) that might affect populations in State highway ROWs require prior coordination between TXDOT and TPWD and potentially may require TPWD-issued permits. The TXDOT and TPWD currently cooperate under a Memorandum of Understanding (MOU), originally signed in 1992, revised in 1998 and up for renewal in 2010, that governs management actions targeting conservation of listed species on State highway ROWs. However, even with these protections in place for listed plants on state-owned land, accidents or activities not coordinated with TPWD or TXDOT have occurred, at least at the Highway 77 ROW population site. This was the case in 2008 when *A. cheiranthifolia* plants in the ROW on the west side of Highway 77 burned in a vehicle-related fire (accident). In the same year, *A. cheiranthifolia* plants on the east side of this highway were exposed to overspray drift of herbicide from the adjacent farm field. Furthermore, in 2009, *A. cheiranthifolia* and SRP on the east side of Highway 77 were affected by brush clearing and

blading associated with fence replacement at the edge of the ROW. None of these actions was coordinated with or permitted by TXDOT or TPWD.

Several populations occur on privately-owned land and include the one in St. James cemetery, as well as sites on a private ranch to the east/southeast of the NASK. Scientific and commercial permits must be obtained from TPWD to collect endangered plants from private land only if the collector intends to sell the plants or plant material. Private landowners are not required to manage for or protect *A. cheiranthifolia* unless they receive federal funding or federal permits, therefore these populations are largely unprotected. To the best of our knowledge, the ranch is perhaps not aware of the population at the training area or of managing the continued existence of *A. cheiranthifolia* at this site.

Landowners are aware of the Highway 77 population after the herbicidal drift incident in 2008. Current land use in the pertinent area of the ranch appears to be livestock grazing which is not believed to be incompatible with the continued existence of *A. cheiranthifolia*. The St. James Cemetery belongs to the Corpus Christi Catholic Diocese. The portion of the cemetery supporting *A. cheiranthifolia* and the slender rush-pea does not currently have burial plots and none are planned for these sections within the next 25-50 years (R. Cobb, pers. comm. 2008). The primary activity taking place in this area of the cemetery is mowing that is controlled by the priest at Bishop's St. James Church. The Service has met with the priest and a member of the church's Cemetery Committee and these church officials have been amenable to management suggestions from the Service and TPWD. They have also invited the agencies to make a presentation to the remainder of the Cemetery Committee regarding long-term management needs of the endangered plants.

Section 6 funding can be used for research studies and on-the-ground actions on land owned by the State, local governments, and/or private entities. These actions can be carried out by non-governmental organizations, other Federal and State agencies, and academics, and can include searches for new populations, biological and ecological research, establishment of seed banks, and reintroduction into the wild. A section 6-funded research project for *A. cheiranthifolia* was initiated in 2009, with results expected in 2010. This project will help to clarify the genetic variation within the species, some aspects of the species ecology and biology, and will produce a reintroduction plan for *A. cheiranthifolia*.

2.3.2.5 Other natural or manmade factors affecting its continued existence – Factor E:

Limited Genetic Diversity

The current limited geographic distribution of *A. cheiranthifolia* may be expected to result in lower genetic diversity due to a lack of gene exchange through pollen, seed, or ramets between different sub-populations and populations (Poole et al.

2007). The existence of the species in fragmented, unconnected habitat patches can lead to restrictions in genetic variability, reducing the species' ability to overcome environmental stresses, especially during stochastic events or in response to climate change, and thereby render the populations vulnerable to extirpation and extinction. Habitat changes in the wild and certain management scenarios that encourage the plant to rely on vegetative spread as opposed to sexual reproduction, may potentially also result in a lowered genetic diversity. Competition from invasive grasses that are pervasive throughout the range of *A. cheiranthifolia*, in conjunction with the general lack of active management of populations and sites, may further isolate these occurrences and thereby also contribute to loss of genetic diversity.

City improvements

Since most of the plants are located near or along drainage corridors (see section 2.3.1.5) and in close proximity to one another, improvements or diversion of water could perhaps impact the species. These improvements could cause an increase/decrease in water amounts reaching natural drainages, cause a channelizing of natural drainage routes, and cause habitat fragmentation to an existing population or otherwise potential sites of *A. cheiranthifolia*.

Climate change

Projected climate changes across the South Texas plains and the southern coastal region include higher temperatures, more frequent and prolonged droughts, and intensified rainfall events (Intergovernmental Panel on Climate Change 2007). These climatic conditions can cause or exacerbate direct stress to vegetation communities and individual plant species by decreasing water availability, altering temperature regimes to which the species has adapted, and subjecting the plants to flooding and potentially increased erosion from more severe storms. Less frequent freezes can enhance grass growth, a situation likely to benefit the introduced, invasive pasture grasses across the range of *A. cheiranthifolia*, thereby facilitating further invasion of *A. cheiranthifolia* populations by these non-natives (see section 2.3.2.1).

Encroachment by non-native grasses has already been noted at both the Nueces and Kleberg county sites where plantings of invasive grasses for erosion control and/or for improving rangeland were cited in the listing package as potentially threatening situations for the continued existence of that population (see section 2.3.2.1). Many control methods that are employed currently for invasive grasses could also have deleterious effects on *A. cheiranthifolia*. Sustained tilling, plowing, and broad-spectrum herbicide treatments, for instance, would be counter-indicated, while the application of grass-specific herbicide would likely have positive effects on *A. cheiranthifolia* by reducing invasive grass competition (A. Hempel, pers. comm. 2010). Alterations in grazing, burning, or stocking rates

to control invasive grasses could have positive or negative effects, depending on a particular location, timing, and frequency.
Ambrosia cheiranthifolia's restriction to small, isolated remnants of suitable habitat will likely limit dispersal opportunities for the species to areas with preferred climatic conditions (Opdam and Wascher 2004). For *A. cheiranthifolia*, development and agriculture continue to fragment habitat. This habitat alteration could result in the reduction in the number of individual plants, with geographic barriers inhibiting the exchange of genetic material by limiting pollen exchange. *Ambrosia cheiranthifolia* individuals occur in small, isolated populations within a short-grass coastal prairie habitat that is very limited in both extent and geographic distribution within an area undergoing rapid urban development with both past and present extensive agriculture conversion. Such a limited geographic and ecological range increases *A. cheiranthifolia*'s vulnerability to localized catastrophic events such as droughts or flooding. Broader climate changes also could decrease suitable habitat by making conditions more conducive to exotic grass invasion or by altering pollinator phenology. If *A. cheiranthifolia* is indeed insect pollinated, environmental changes in moisture and temperature related to climate change could alter the phenology such that the current blooming and fruiting patterns of *A. cheiranthifolia* could be different than the pollinators that visit these plants; therefore pollination would not occur (Sherry et al. 2007). However, while it appears reasonable to assume that *A. cheiranthifolia* may be affected, we lack sufficient certainty to know specifically how or if climate change will affect the species with the projected climate change models.

Some of the projected effects of a changing climate, such as more frequent and extended periods of drought across South Texas, also play a role in fire ecology by increasing the frequency, and potentially severity, of fires. *Ambrosia cheiranthifolia* may be adapted to naturally occurring fire cycles, as is true for many prairie species. Several of the predominant invasive grass species in south Texas also appear to be positively fire adapted, so consequences of increasing droughts may include increasing competitiveness of these non-natives (Kuvlesky et al. 2002). Intensified, routine fire cycles can allow exotic grasses to form dense monocultures where few short-grass native species are able to persist (Mahler 1982, D'Antonio et al. 1998). The large amount of biomass and understory produced by these non-native grasses may intensify fire in terms of heat and duration, thereby altering the effects of fire on native prairie vegetation. An extreme lack of precipitation, combined with a lack of management actions that curb continued growth of tall, exotic prairie grass species, would allow even greater encroachment into native habitat, adding to fuel levels. Invasion of an ecosystem by non-native plants can thereby change fuel properties, affecting fire regime characteristics including frequency, intensity, extent, type, and seasonality of fires (Brooks and Pyke 2001). Additionally, because all ecosystem components and the interactions among these components are affected by a changed fire scenario, restoration of habitat becomes more difficult (Brooks and Pyke 2001).

Effects of Pesticide (Herbicide and Insecticide) Drift

Remaining areas of the native coastal prairie habitat of *A. cheiranthifolia* populations are surrounded by agricultural fields, pastures, and urban development, from which aerial drift of pesticides has potential to harm or kill individuals of the species. Herbicide drift incidents have occurred in *A. cheiranthifolia* habitats (see section 2.3.1.2). The Texas Department of Agriculture (TDA) has recommended special protective measures to be taken when *A. cheiranthifolia* occurs within 18 to 91 meters (20 to 100 yards) of any area being treated with agricultural chemicals including 2,4 - D, Atrazine, Clopyralid, Dicamba, Dichlorprop, Hexazinone, MCPA, Metribuzin, Paraquat, Picloram, Sulfometuron Methyl, and Tebuthiuron (list provided by the U.S. Environmental Protection Agency) (TDA 1995). However, the existence of *A. cheiranthifolia* in neighboring areas may be unknown to applicators, and thus protective measures may not be deployed when needed, as in the case of the Highway 77 ROW population in 2008 (see section 2.3.2.4). The clonal nature of *A. cheiranthifolia* may potentially enhance mortality by translocation of the chemical. The close proximity of many of the subpopulations to one another may mean that a given aerial spraying event could impact a whole population or a large number of individuals. Herbicide drift, in conjunction with other extreme climatic and anthropogenic activities, may threaten the survival of *A. cheiranthifolia* in areas subjected to aerial applications.

Insecticides, as another form of pesticides, could be considered a potential threat because they can directly or indirectly kill pollinators of *A. cheiranthifolia*, if indeed the plant relies on entomophilous (insects as pollinators) pollination. Although the pollination system (wind or insect) and pollinators of *A. cheiranthifolia* remain unknown, pesticides sprayed in adjacent areas, upwind, or up-watershed of the plant could harm insect pollinators in the adult, larval, or egg stage. Pesticides, particularly insecticides, are linked to bee declines (Kearns et al 1998, Kremen et al. 2002, National Academy of Sciences 2007). Also, the abundance and diversity of wild bee communities is negatively correlated with increasingly intensive chemical applications of pesticides (Tuell and Isaacs 2010). Although the toxicity of pesticides to pollinators is difficult to quantify in a field setting and varies depending on the chemistry, quantity applied, degree of contact, area treated, and seasonal timing (Mineau et al. 2008, Tuell and Isaacs 2010), some pesticides cause immediate mortality to bees if applied upon crops while bees are actively foraging (Johansen 1977). Both wild and honey bee (*Apis mellifera*) declines have been found in areas adjacent to sprayed fields, suggesting a wider spatial impact to the pollinator community than just a targeted area (Kevan 1975, Kevan et al. 1990). Pesticide and insecticide effects on insects, if investigated at all, have mainly been researched in relation to bees, making our knowledge of effects to other insects, other than impacts of *Bacillus thuringiensis* subsp. *kurstaki* (Btk) to some Lepidoptera (butterflies, skippers, and moths), virtually non-existent. Furthermore, depending on the seasonal timing of pesticide application, effects to pollinator communities may be chronic and

cumulative, yet difficult to assess due to the different phenologies and nesting situations of pollinator species (Desneaux et al. 2007, Tuell and Isaacs 2010). Therefore, as with herbicide drift, pesticide or insecticide drift may threaten the survival of *A. cheiranthifolia* in areas subjected to applications, by harming pollinator communities.

2.4 Synthesis

Within its current range, *A. cheiranthifolia* can be found in six extant populations (some with multiple subpopulations) in scattered locations across Nueces and Kleberg counties. The largest and most stable populations occur on the NASK, Kleberg County, and in Bishop's St. James Cemetery, Nueces County. Six of 14 historically reported populations are no longer extant; 3 sites have been overgrown by invasive grasses (all in Nueces County), and the fate of the southernmost U.S. site (Cameron County) is uncertain since the population could never be relocated. The location descriptions of two other populations (one each in Kleberg and Jim Wells counties) are so vague that they are untraceable in the field. In addition to the unverified status of these historical sites, the current status of the metapopulation documented from the King Ranch training areas in Kleberg County is unknown, with no site visits since 1994 due to lack of access to this privately owned land. The total number of individual plants has never been ascertained for the species and all counts to date consist of stem counts as opposed to individual plant counts due to the clonal nature of the species.

All populations in Nueces County exist on remnant strips of land, generally near a land feature like a natural drainage that protected the native habitat by virtue of being more difficult to plow. The eastern mainland of Kleberg County, north of Baffin Bay, contains the largest remaining area of habitat suitable for *A. cheiranthifolia*, and is privately owned. The status of short-grass prairie and of *A. cheiranthifolia* within this area is unknown due to lack of access to survey.

Historically the greatest threat to the continued existence of *Ambrosia cheiranthifolia* was outright loss and fragmentation of coastal prairie habitat as it was converted to row crop agriculture, improved pasture, and residential development. In more recent years, the highest level of threat to *A. cheiranthifolia*'s habitat is the ongoing and widespread invasion of native prairie by introduced, aggressive pasture grasses. New threats associated with projected climate changes include anticipated increases in temperatures, decreases in the amount and frequency of precipitation, and potentially more intense and frequent storm events. Climate change may further enhance the invasive properties of exotic vegetation at existing *A. cheiranthifolia* population sites and in areas of potential habitat. Pollinator species are unknown and data on their interactions with *A. cheiranthifolia* plants is lacking. Pollination ecology of *A. cheiranthifolia* has not been studied, therefore the effects of changing climate conditions or nearby insecticide spraying on pollinators are unknown. Herbicidal drift has also been documented as a threat to the species.

Because most of *A. cheiranthifolia* populations and subpopulations are small in aerial extent with low numbers of plants, and are scattered across a heavily fragmented landscape, the species is very vulnerable to loss of genetic diversity. Genetic information for the species is lacking, and most observations of *A. cheiranthifolia* in the wild indicate that much of the reproduction may be

vegetative, a scenario that can also restrict the amount of genetic variability. Because the degree of vegetative reproduction is not understood for this species, it is unclear how many distinct, individual plants are represented by the estimated stem counts at different localities. Limited genetic variability and small population sizes may make *A. cheiranthifolia* more subject to extirpation than would be true for a species with these same size populations but with higher genetic diversity.

The ease with which *A. cheiranthifolia* can be propagated offers great hope for future restoration of historic population sites, supplementation of extant populations, or potential introduction into new, suitable habitat. However, the species remains endangered throughout its range due to the extensive loss of habitat from land cover conversions and the ongoing alteration of remaining native short-grass prairie by invading, introduced grasses. Because these non-native grasses are so widespread throughout the range of *A. cheiranthifolia*, it is not certain that the plant can persist in wild habitats without active management such as mowing. Due to these high remaining levels of threat to *A. cheiranthifolia*'s habitat, the few extant populations and low numbers of individual plants, and the uncertainty of the species genetic composition and inherent ability to survive stochastic events, we recommend that the species' classification remain as endangered.

3.0 RESULTS

3.1 Recommended Classification:

_____ Downlist to Threatened
_____ Uplist to Endangered
_____ Delist
__x__ No change is needed

3.2 New Recovery Priority Number: No change; remain as 8.

Brief Rationale: Based on this review, *A. cheiranthifolia* remains a full species with a moderate degree of threat and a high recovery potential. Threats from extensive loss of habitat from land cover conversions that have produced small, fragmented patches of the plant, and the ongoing alteration of remaining native short-grass prairie by introduced, aggressively invasive grasses continue to endanger *A. cheiranthifolia.* The recovery potential remains high given the success of propagation and the potential for restoration of previously inhabited sites.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The continued loss of habitat from invasive grasses exceeds impacts from all other currently known threats to *A. cheiranthifolia* in the extant populations in Nueces and Kleberg Counties. Evaluation of best management practices, including prescribed burns, grazing, and mowing, that will favor *A. cheiranthifolia* in these existing population sites is among the highest of priorities. Determining the best methods of controlling invasive plants, particularly introduced grasses, within *A. cheiranthifolia* populations is a critical need.

Further investigation of reproductive biology in wild populations is needed to ascertain if *A. cheiranthifolia* is reproducing sexually as well as vegetatively. Research is needed to describe pollination ecology and pollinator species of the plant. A thorough genetic analysis of *A. cheiranthifolia,* including a determination of the relatedness of subpopulations and populations, is needed to clarify the genetic diversity that exists within the species. New information collected on the genetics, pollinators, and dispersal of the species may help in understanding maximum or minimum distances between populations that would allow for transfer of genetic material.

Additional surveys for new populations of *A. cheiranthifolia* are needed in potential habitat areas in both counties, where permission to access land can be attained. Building good relationships with private landowners is a prerequisite to conducting these surveys. The Service, TPWD, and other partners should develop presentations and materials to share with landowners and their representatives that provide reassurance that threatened and endangered plants will not restrict land uses.

Soil analyses should be conducted at all known population sites. Soil analysis will help to elucidate the substrate that supports shortgrass prairie in the Texas Coastal Bend region. This would aid in focusing *A. cheiranthifolia* surveys as well as providing information needed to more fully understand habitat requirements for the shortgrass prairie species, including *A. cheiranthifolia*. A reintroduction plan for *A. cheiranthifolia* should be developed that identifies potential sites for both restoration and pilot introduction efforts.

Annual monitoring of existing populations should be undertaken to monitor status and trends and to evaluate condition of the plants and the habitat.

These and other site specific recommendations and actions should be addressed within the recovery plan currently undergoing development by the South Texas Plant Recovery Team. Identification of these actions, as well as objective and measurable criteria for downlisting and delisting will greatly benefit the conservation of this species.

5.0 REFERENCES

Blair, W.F. 1950. The biotic provinces of Texas. Texas Journal of Science 2 (1): 93-117.

Brooks, M.L. and D.A. Pyke. 2001. Invasive Plants and Fire in the Deserts of North America. Pages 1-14 *in* K.E.M. Galley and T.P. Wilson (eds.). Proceedings of the Invasive Species Workshop: the Role of Fire in the Control and Spread of Invasive Species. Fire Conference 2000; the First National Congress on Fire Ecology, Prevention, and Management. Miscellaneous Publication No. 11, Tall Timbers Research Station, Tallahassee, FL.

Bush, C, N. Elliott, and R. O'Brien. 1994. Final Report: Management Study of South Texas Ambrosia, NAS Kingsville, Texas. August 15, 1994.

Carr, W. 1993. Letter from Texas Natural Heritage Program to Angela Brooks, USFWS. April 30, 1993.

Clary, K., S. Ghosh-Dastidar, and J. Barker. 2002. Texas Department of Transportation Survey Report for Listed and Category Plants on US Highway 77, Kleberg County, Texas; Listed plant, South Texas Ambrosia. June 21, 2002.

Clayton, P. 1991. Field notes for South Texas ambrosia on Naval Air Station Kingsville in Kleberg County, Texas. February 7, 1991.

Cobb, R.A. 2008. Note to File – Field Trip to St. James Cemetery, Bishop, and the Highway 77 ROW, Nueces/Kleberg Counties, Texas. March 7, 2008.

Collins, K. 1984. Status and management of south Texas brushlands. U.S. Fish and Wildlife Service, Corpus Christi, TX. In: Jahrsdoerfer, S.E., and D.M. Leslie, Jr. 1988. Tamaulipan Brushland of the Lower Rio Grande Valley of South Texas: Description, Human Impacts, and Management Options. Biological Report, 88 (36).

Contreras-Arquieta, A. 2005. Final Report: Status, Distribution and Conservation of Three Species of Rare Plants of the Lower Rio Grande in Mexico. Section 6 grant. Pronatura Noreste. Monterrey, Nuevo León.

Correll, D.S., and M.C. Johnston. 1979. Manual of the Vascular Plants of Texas. University of Texas at Dallas, Vol. 6.

D'Antonio, C.M., R.F. Hughes, M. Mack, D. Hitchcock, and P.M. Vitousek. 1998. The response of native species to removal of invasive exotic grasses in a seasonally dry Hawaiian woodland. Journal of Vegetation Science 9:699-712.

Desneux, N., A. Decourtye, and J.M. Delpuech. 2007. The sublethal effects of pesticides on beneficial arthropods. Annual Review of Entomology 52:81-106.

Ellstrand, N.C. 1992. Gene Flow by Pollen: Implications for plant conservation genetics. Oikos 63 (1): 77-86.

Flora of North America. 2009. *Ambrosia cheiranthifolia*. Website at http://www.eFloras.org. (Accessed on March 11, 2009).

Franki, G., R.N. Garcia, B.F. Hajek, D. Arriaga, and J.C. Roberts. 1965. Soil survey of Nueces County. U.S. Department of Agriculture.

Garvon, S. 2005. Management Plan for the Endangered South Texas Ambrosia (*Ambrosia cheiranthifolia*) on Naval Air Station Kingsville, Texas. June 2005.

Gould, F.W. 1978. Common Texas Grasses: an illustrated Guide. Texas A&M University Press. College Station and London.

Grahl, T.E. 1994. Letter to Captain Maxey, Department of the Navy on NASK. September 12, 1994.

The Handbook of Texas Online (HTO). 2008a. Kleberg County. HTO website at http://tshaonline.org/handbook/online/articles/KK/hck10.html.

The Handbook of Texas Online (HTO). 2008b. Nueces County. HTO website at http://tshaonline.org/handbook/online/articles/NN/hcn5.html.

Hempel, A. 2008a. History: Slender Rush Pea and (some Ambrosia Notes) recovery work 2008. October 2008.

Hempel, A. 2008b. Reproductive Biology, Genetics and Ecology of South Texas Ambrosia: Implications for the Management, Recovery and Reintroduction. Traditional Section 6 Grant.

Invasive Species Specialist Group (ISSG). 2009. *Pennisetum ciliare*. Global Invasive Species Database at http://www.issg.org/database/welcome/.

Intergovernmental Panel on Climate Change. 2007. Fourth Assessment Report on Climate Change 2007: Synthesis Report Summary for Policymakers. Released on 17 November 2007. Available at: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

Jahrsdoerfer, S.E., and D.M. Leslie, Jr. 1988. Tamaulipan Brushland of the Lower Rio Grande Valley of South Texas: Description, Human Impacts, and Management Options. Biological Report, 88 (36).

Johansen, C.A. 1977. Pesticides and pollinators. Annual Review of Entomology 22:177-192.

Jones, F.B. 1977. Flora of the Texas Coastal Bend. Rob and Bessie Wilder Wildlife Foundation, Sinton, Texas.

Kearns, C.A., D.W. Inouye, and N.M. Waser. 1998. Endangered mutualisms: the conservation of plant-pollinator interactions. Annual Review of Ecology and Systematics 29:83-112.

Kevan, P.G. 1975. Forest application of the insecticide fenitrothion and its effect on wild bee pollinators (Hymenoptera: Apoindea) of lowbush blueberries (*Vaccinium* spp.) in southern New Brunswick, Canada. Biological Conservation 7:301-309.

Kevan, P.G., E.A. Clark, and V.G. Thomas. 1990. Insect pollinators and sustainable agriculture. American Journal of Alternative Agriculture 5:12-22.

Kremen, C., N.M. Willimans, and R.W. Thorp. 2002. Crop pollination from wild bees at risk from agricultural intensification. Proceedings from the National Academy of Sciences 99:16812-16816.

Kuvlesky, W.P., Jr., T. Fulbright, and R. Engel-Wilson. 2002. The impact of invasive exotic grasses on quail in the southwestern United States. Pages 118-128 in S. J. DeMaso, W. P. Kuvlesky, Jr., F. Hernandez, and M. E. Berger, eds. Quail V: The Fifth National Quail Symposium. Texas Parks and Wildlife Department, Austin, TX.

Mahler, W. 1982. Status Report of *Hoffmannseggia tenella*.

Mineau, P., K.M. Harding, M. Whiteside, M.R. Fletcher, D. Garthwaite, and L.D. Knopper. 2008. Using reports of bee mortality in the field to calibrate laboratory-derived pesticide risk indices. Environmental Entomology 37:546-554.

National Academy of Sciences. 2007. Status of pollinators in North America. The National Academies Press, Washington, D.C.

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: May 6, 2002).

Opdam, P. and D. Wascher. 2004. Climate change meets habitat fragmentation: linking landscape and biogeographical scale levels in research and conservation. Biological Conservation 117:285-297.

Parvin, B. 1988a. Valley under Seige. Defenders, 63: 18 – 29. In: Jahrsdoerfer, S.E., and D.M. Leslie, Jr. 1988. Tamaulipan Brushland of the Lower Rio Grande Valley of South Texas: Description, Human Impacts, and Management Options. Biological Report, 88 (36).

Parvin, B. 1988b. The Disappearing Wild Lands of the Rio Grande Valley. Texas Parks and Wildlife, 46: 2 – 15. In: Jahrsdoerfer, S.E., and D.M. Leslie, Jr. 1988. Tamaulipan Brushland of the Lower Rio Grande Valley of South Texas: Description, Human Impacts, and Management Options. Biological Report, 88 (36).

Payne, W.W. 1964. A Reevaluation of the Genus *Ambrosia* (Compositae). J. Arnold Arboretum. 45: 501 – 430. Rydberg, PA 1922. Ambrosiacceae. In North American Flora 33: 3 – 44.

Poole, J.M. and G.K. Janssen. 1994. Performance Report. Project No. 35: Assessment and Management Plan Development for Listed and Category Plants on Texas Department of Highways and Public Transportation Rights-of-Way. As required by the Endangered Species Act, Section 6, Texas Grant No: E-1-6. Texas Parks and Wildlife Department, Austin, TX. In: Clary et al. 2002. TX DOT Survey Report for Listed and Category Plants on US Highway 77, Kleberg Co., TX

Poole, J.M., W.R. Carr, and J.R. Singhurst. 2007. Rare Plants of Texas. Texas A&M University Press, College Station, Texas.

Price, D. 2007. History of North Nueces County Park South Texas Ambrosia project.

Sherry, R.A., X. Zhou, S. Gu, J.A. Arnone III, D.S. Schimel, P.S. Verburg, L.L. Wallace, and Y. Luo. 2007. Divergence of reproductive phenology under climate warming. P.N.A.S. 104 (1): 198 – 202.

Stebbins, G.L. 1970. Adaptive radiation of reproductive characteristics in Angiosperms, I: Pollination Mechanisms. Annual Rev. Ecol. Syst. 1: 307 – 326.

Texas Department of Agriculture. 1995. Nueces County Endangered Plant Species Information Program, Corpus Christi A&M Center Auditorium. August 25, 1995.

Texas Department of Transportation. 2009. Technical Report on Federally Listed Threatened and Endangered Species: US 77 Upgrade IH 37 to US 83 Nueces, Kleberg, Kenedy, Willacy, and Cameron Counties, Texas. 21410-2010-TA-0119.

Texas Natural Diversity Database. 2007. Element of Occurrence Printouts for South Texas Ambrosia Records #'s 4, 6, 16, 18, 19, & 26. Wildlife Diversity Program of TPWD.

TPWD - Texas Parks and Wildlife Department. 2010. Website of South Texas Ambrosia species description: http://www.tpwd.state.tx.us/huntwild/wild/species/ambrosia/.

Tuell, J.K. and R. Isaacs. 2010. Community and species-specific responses of wild bees to insect pest control programs applied to a pollinator-dependent crop. Journal of Economic Entomology 103(3):668-675.

Turner, B.L. 1983. Status Report of *Ambrosia cheiranthifolia*.

U.S. Fish and Wildlife Service. 1980. Department of the Interior Habitat Preservation Plan-preservation of areas of important fish and wildlife habitat: Cameron, Hidalgo, Starr, and Willacy counties, Texas. Region 2, Albuquerque, NM. 92 pp. In: Jahrsdoerfer, S.E., and D.M. Leslie, Jr. 1988. Tamaulipan Brushland of the Lower Rio Grande Valley of South Texas: Description, Human Impacts, and Management Options. Biological Report, 88 (36).

U.S. Fish and Wildlife Service. 1983. Endangered and Threatened Species Listing and Recovery Priority Guidelines. 1983 Federal Register, Vol. 48, No. 184, 43098-43105.

U.S. Fish and Wildlife Service. 1993. Endangered and Threatened Wildlife and Plants; Proposed Rule to List the Plants *Ayenia limitaris* (Texas Ayenia) and *Ambrosia cheiranthifolia* (South Texas Ambrosia) as Endangered. 1993 Federal Register, Vol. 58, No. 149, 41696-41700.

U.S. Fish and Wildlife Service. 1994. Endangered and Threatened Wildlife and Plants; Final Rule Listing *Ambrosia cheiranthifolia* as an Endangered Species. 1994 Federal Register, Vol. 59, No. 163, 436480-43652.

U.S. Fish and Wildlife Service. 2008. Initiation of 5-year reviews for 28 Southwestern species. Federal Register 73 FR: 14995 – 14997.

PERSONAL COMMUNICATIONS

Cobb, Robyn. 2008. Visit to St. James Cemetery. March 7, 2008, note to file: unpublished data.

Hempel, A. 2009. Notes written by Amber Miller from Alice Hempel, TAMU-Kingsville (July 15, 2009).

Hempel, A. 2010. Comments to draft of South Texas Ambrosia Five Year review to Amber Miller and Robyn Cobb (January 13, 2010).

Pepper, A. 2005. Electronic mail correspondence from Dr. Alan Pepper to Robyn Cobb, with cc to James Manhart, TAMU-Kingsville, and Steven Travis, USGS, (July 9, 2005).

Riddle, R. 2009. Electronic mail correspondence from Richard R. Riddle, PWD for NASK to Amber Miller, with cc to Pat Clements, USFWS, (March 10, 2009).

PHOTO CREDIT

Chris Best, Botanist - USFWS, from Bishop Cemetery in Nueces County, Texas, November 7, 2006.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW
South Texas Ambrosia (*Ambrosia cheiranthifolia*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist
__x__No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: Not applicable.

Review Conducted By: Amber Miller and Robyn Cobb, U.S. Fish and Wildlife Service, Corpus Christi Ecological Services Office, Texas

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve E. Dawn Whitehead Date 11/9/10

REGIONAL OFFICE APPROVAL:

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Approve Steven M. Chambers Date 12/30/10