City of Austin

Staff Report on Bracted Twistflower (*Streptanthus bracteatus*)

Balcones Canyonlands Preserve Annual Report



5.5-tall Bracted Twistflowers blooming under Ashe juniper canopy, Mt. Bonnell (© Mark Sanders)

City of Austin, Austin Water
Wildland Conservation Division
Balcones Canyonlands Preserve
Austin, Texas

January 2022

Summary

This report provides a brief overview of Bracted Twistflower habitat and trends in abundance on the City of Austin's Balcones Canyonlands Preserve (BCP). City of Austin BCP tracts with naturally-occurring populations include Barton Creek Greenbelt and Wilderness Park (Barton Creek), Bull Creek District Park (Valburn), Covert Park at Mt. Bonnell (Mt. Bonnell), and Ullrich Water Treatment Plant (Ullrich). The population at Gus Fruh Park (Gus Fruh) was discovered in 2014 and may not be naturally-occurring; former BCP staff spread seeds downstream of the Barton Creek population in the late 1990s. Transplants were introduced at the Vireo Preserve as part of a research project in 2009, with additional transplants in 2012.

Bracted Twistflower counts from 2012-2021 continue to show high annual variability. Surveys in 2019 yielded the highest counts for sites except at Valburn and the Vireo Preserve. In 2017, canopy trees were removed on the property immediately adjacent to Bull Creek District Park (the entire area was formerly included as the Valburn population), and no plants have been observed in the clearing on subsequent surveys. Following the experimental introduction of plants at the Vireo Preserve in 2009-2012, no plants have been observed at this site since 2018, when only one plant was seen. Barton Creek remains the largest population, with Ullrich being the second largest.

Based on an inspection of aerial photographs from 1940-2019, the naturally-occurring sites on City of Austin properties and at Gus Fruh have had little to no change in canopy cover, and no accounts of fire or fire suppression have been reported. In the area where Bracted Twistflowers were experimentally introduced at the Vireo Preserve, aerial photographs show conversion from forest to grassland following clear-cutting in the 1950s followed by a wildfire in 1961. While the Bracted Twistflower counts vary considerably from year to year, this appears to be influenced largely by the amount of rainfall from the previous December, although Winter Storm Uri appeared to override this effect in 2021. With the exception of the decline at the Valburn site following tree clearing, we have not observed a trend in abundance that is correlated with vegetation changes.

In 2020, Bracted Twistflowers were found on City of Austin property that is part of the Valburn population. The City of Austin acquired the Bright Leaf Preserve in 2021. While no Bracted Twistflowers were observed in spring 2021, Bright Leaf has had Bracted Twistflowers in multiple locations. These sites will be included in future reports.

Introduction

The Bracted Twistflower (*Streptanthus bracteatus*) is a rare, annual plant in the Brassicaceae family. The U.S. Fish and Wildlife Service (USFWS) published a proposed rule to list this species as threatened with critical habitat on November 10, 2021 (USFWS 2021). Its known population is limited to five counties in central Texas (Bexar, Hays, Medina, Travis, and Uvalde Counties; Poole et al. 2007), with a historical range of at least eight counties (Damude and Poole 1990). Of the few remaining populations, many are located in rapidly urbanizing areas where colonies are threatened by development. Other threats include recreational activities (mountain bikes and foot traffic), deer herbivory, and low genetic variation (Zippin 1997, Pepper 2010, USFWS 2013).

Bracted Twistflowers sprout in the fall and winter and develop an acaulescent rosette of waxy blue-green leaves. In spring, the plants begin bolting and display their showy lavender, four-petaled flowers along a stalk with clasping leaves. The fruits, called siliques, are long slender pods that later dehisce to release

their seeds. The plants are commonly eaten by White-tailed Deer (*Odocoileus virginianus*) and other mammalian browsers (such as rabbits and squirrels) as well as by insects such as Falcate Orangetip (*Anthocharis midea*) and Checkered White (*Pontia protodice*) butterfly larvae (Zippin 1997, Leonard 2010). Leonard (2010) suggested that studies should be done on the potential detrimental effects of powdery mildew as this pathogen was noted on most plants in the field.

There are only 16 known colonies of Bracted Twistflower. Of those, eight are within Travis County and five exist entirely within or extend onto City of Austin (COA) property. The COA signed a Memorandum of Agreement (MOA) with the USFWS and other members of the Bracted Twistflower Working Group in 2003 to manage and monitor those populations (USFWS 2004). Naturally-occurring populations that COA manages include Mt. Bonnell, Ullrich, Barton Creek, and Valburn. BCP staff discovered Bracted Twistflowers at Gus Fruh in 2014, however, these plants may have been introduced by seeding efforts in the late 1990s by former BCP staff who spread seeds downstream from the Barton Creek population (M. Sanders, BCP staff, pers. comm.). Transplants were introduced at the Vireo Preserve as part of a research project in 2009 (Fowler 2010, Fowler et al. 2012), and were supplemented with more plants in 2012 (Stewart 2012).

COA staff have worked to protect plants from trampling by humans and browse by deer. Chain link fencing was installed along Loop 360 (Capitol of Texas Highway) and around the upslope and downslope entrances of an unauthorized trail that passed through an area with Bracted Twistflowers. The goal of these fencing efforts was to reduce trampling and erosion from large numbers of people who were parking along Loop 360. In 1998, COA staff also built a fence around a section of plants at Barton Creek, next to a former research plot (Zippin 1997), to exclude deer from foraging on plants (M. Sanders, BCP staff, pers. comm.). At Ullrich, a game fence was built to prevent deer browse of Bracted Twistflowers in 2003. In winter of 2015, iron fencing was installed to reduce damage to plants from social trails along the summit at Mt. Bonnell.

On COA property, Bracted Twistflowers tend to occur on hillsides in canopy openings, near canopy gaps, and in closed canopy typical of Ashe juniper-oak (*Juniperus ashei-Quercus sp.*) woodlands. The most common canopy species that co-occur with Bracted Twistflower include Ashe Juniper, Plateau Live Oak (*Quercus fusiformis*), Shin Oak (*Quercus sinuata*), Texas Red Oak (*Quercus buckleyi*), and Texas Ash (*Fraxinus texensis*). The understory vegetation that commonly co-occurs with Bracted Twistflower includes Texas Mountain Laurel (*Dermatophyllum secundiflorum*), Elbow Bush (*Forestiera pubescens*), Mouse Ears (*Bernardia myricifolia*), Agarita (*Mahonia trifoliata*), Texas Persimmon (*Diospyros texana*), Shrubby Croton (*Croton fruticulosus*), Wafer Ash (*Ptelea trifoliata*), Shrubby Boneset (*Ageratina havanensis*), Silk Tassel (*Garrya ovata*), Texas Sacahuista (*Nolina texensis*), Twist-leaf Yucca (*Yucca rupicola*), Evergreen Sumac (*Rhus virens*), and Yaupon (*Ilex vomitoria*) (Zippin 1997; Fowler 2014; J. Scalise, BCP staff, pers. obs.). Species that we find to be characteristically associated with Bracted Twistflowers, but which are comparatively scarce elsewhere on BCP sites, include Texas fan (*Meximalva filipes*), Mouse Ears (*Bernardia myricifolia*), Peonía (*Acourtia runcinata*), Zigzag Cliffbrake (*Pellaea ovata*), Bluewood Condalia (*Condalia hookeri*), Texas Hogplum (*Colubrina texensis*), and Thicket Threadvine (*Cynanchum barbigerum*). A common characteristic of these species is that they are adapted to rocky environments of hotter and drier parts of the state.

Methods

COA staff organize and conduct annual surveys of Bracted Twistflower at all known populations on BCP lands. Surveys are scheduled during the peak blooming period for Bracted Twistflower, late April to early

May. Survey areas are delineated in the field based on fencing and geographic landmarks, as well as with field maps and GPS coordinates of previous plant locations. At Vireo Preserve, surveys are conducted at all 21 planting sites. To cover the survey areas, observers line up and move across the area while searching for plants, and double back as necessary. When a plant is found, a thorough search is done in the immediate area to locate more plants, and will continue to widen around the first plant observed until no more new plants are found. Each group of plants is assigned a unique ID based on the site name, the search area, and the order in which it was found. Flagging is placed above each group of plants to avoid double counting. A GPS waypoint is recorded from the center of each group, along with the GPS accuracy at the time the point was taken. The distance from the point to the furthest plant in that group is also recorded. Within each group, each plant is counted and recorded as either in the rosette stage, bolting stage, or fruiting stage. Any plant that has only basal rosette leaves and no bloom stalk is counted as a rosette. If a plant has a blooming stalk and no siliques greater than 1 inch long, it is counted as a bolting plant. If a plant has any siliques greater than 1 inch in length, it is counted as a fruiting plant. The total number of siliques greater than 1 inch is counted and recorded for each group.

Since the effects of powdery mildew on Bracted Twistflower are not fully understood, we document how many plants within each group are afflicted with powdery mildew. Herbivory, both insect and deer, are also known to have deleterious effects on individual plant fitness. We record the number of plants within each group that show signs of insect herbivory and deer (or mammalian) herbivory.

During the surveys, several observers are assigned to carry a GPS unit with tracking on, and these observers cover the outer edges of each transect. Their tracks are saved and loaded into ArcGIS along with the locations of each plant group, and a polygon is drawn to delineate the area surveyed and calculate its area in square meters. All field data are entered into Microsoft Excel by study site and search area and used to create a GIS shapefile of the plant locations.

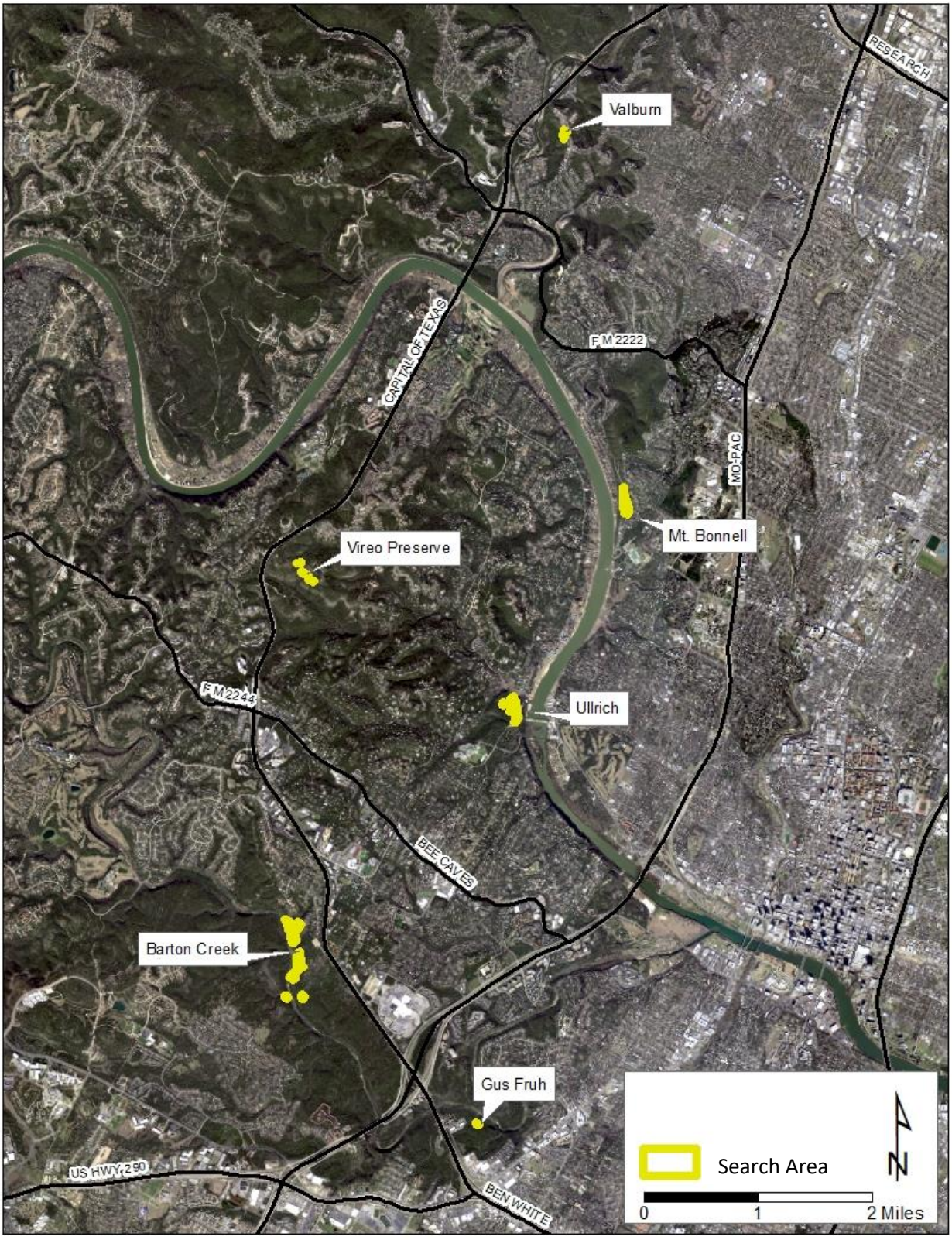
These counts are performed about the same time each year to maintain consistency. Each site is only counted once a year, due to limited staff resources during this time. We recognize that these counts are static snapshots of the plant's status, and do not address the final reproductive output of each population.

For analyses of abundance trends, counts from all plant stages (rosette, bolting, and fruiting) were pooled for each site, and graphed by year. Gus Fruh was treated as a separate population from Barton Creek as it was only discovered in 2014 and was not included in previous years. COA counts at Valburn did not begin until 2015 as it was believed that the population had been destroyed by housing development along Valburn Drive. The survey area at Valburn also varied greatly by year, as surveyors in earlier years were not aware of COA property limits. Plants at the Vireo Preserve were not included in the trend analyses as it was an experimental population. Total plants from Barton Creek, Ullrich, and Mount Bonnell were pooled. We examined trends from 2012-2021, as survey methods prior to 2012 were inconsistent.

We expanded the COA (2018) analyses of the relationship between abundance and rainfall by adding data from 2019-2021. We downloaded monthly weather data from the Camp Mabry weather station (NOAA). We examined rainfall totals by month as well as seasonally. We created graphs to visually compare the relationships between seasonal and monthly rainfall totals and total number of plants. We also examined the correlation coefficients between seasonal and monthly rainfall totals and total number of plants.

To assess changes in canopy cover, we overlayed all known Bracted Twistflower locations in our database for Barton Creek, Gus Fruh, Mt. Bonnell, Ullrich, Valburn, and Vireo Preserve on aerial photographs from 1940-2019. BCP staff also took photographs to illustrate typical habitat around existing colonies. O'Donnell and Nesvacil (2020) evaluated fire history on and near the BCP from 1961-2020.

Figure 1. Bracted Twistflower survey locations on the Balcones Canyonlands Preserve in Travis County, Texas.



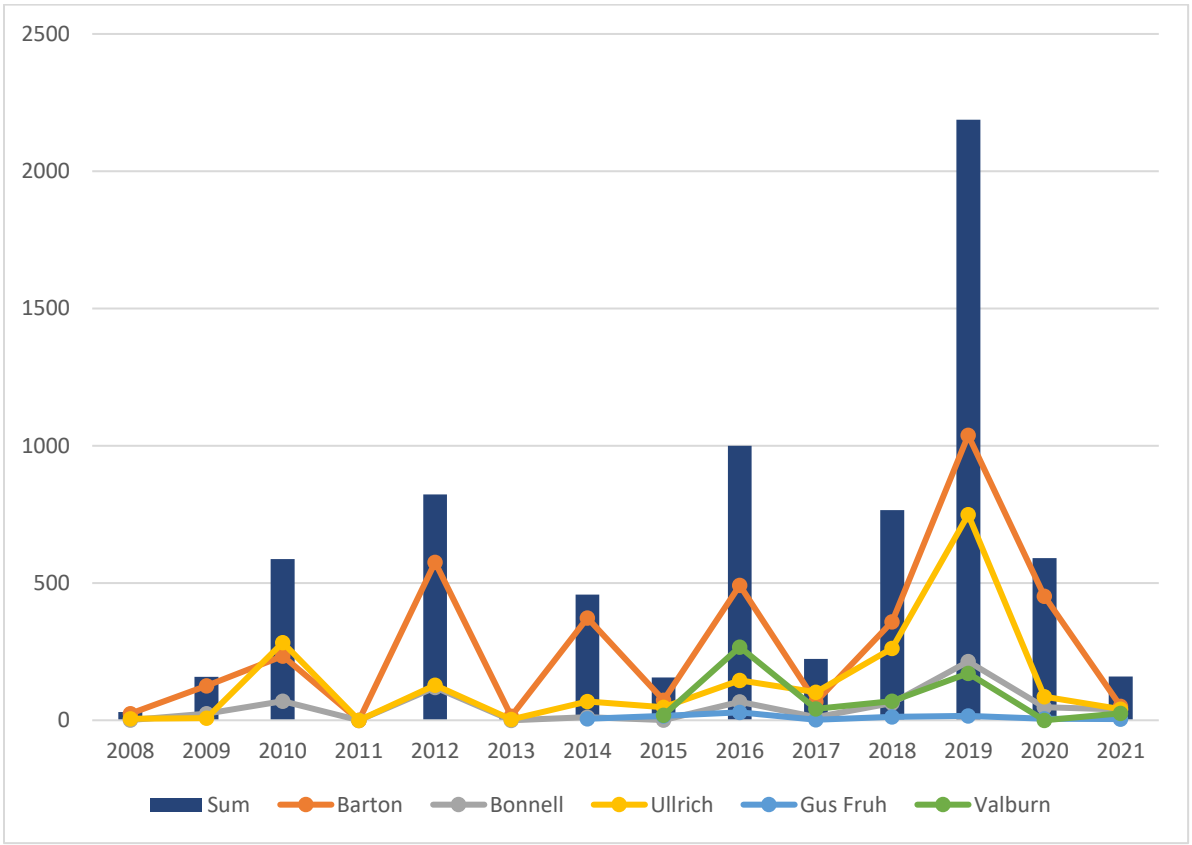
Results

Plant abundance varies greatly by year, with the highest numbers of plants recorded in 2016 and 2019 (Figure 2). Barton Creek, Gus Fruh, Mt. Bonnell, and Ullrich show no apparent increase or decrease in total number of plants over time due to the extreme variability by year. The variation by year was consistent across sites with the exception of a higher than expected count at Ullrich in 2017, and lower count at Valburn.

Based on the analysis of 1940-2019 aerial photographs, all but the Valburn and Vireo Preserve sites have experienced little to no change in canopy cover. A portion of the Valburn site was cleared of woody vegetation in 2017, and no plants have been observed in the clearing during subsequent surveys. The loss of these plants is reflected in the 2019 counts, which were significantly higher at all naturally occurring sites except for Valburn. The site of the experimental introduction at the Vireo Preserve was clear-cut in the 1950s, followed by a wildfire in 1961; no plants have been observed at this site since 2018, when one plant was seen. While many of the naturally-occurring sites are dominated by Ashe juniper, canopy cover of the 21 experimental sites is dominated by Texas red oak and other hardwoods.

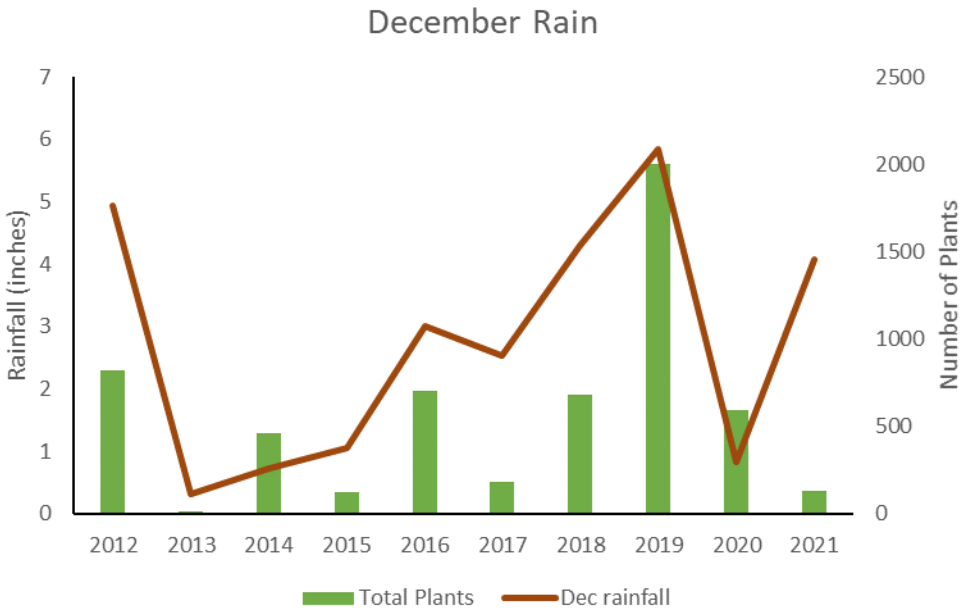
Except for the 1961 fire on what is today the Vireo Preserve, we are unaware of any reports of fire or fire suppression within the COA Bracted Twistflower sites.

Figure 2. Total number of Bracted Twistflower plants on the Balcones Canyonlands Preserve, 2012 – 2021, Travis County, Texas.



The 2012-2020 data continued to show a strong positive correlation (0.79) between December rainfall and plant abundance in the following spring; however, the year 2021 did not follow this pattern (Figure 3). While December 2020 had a high rainfall total (4.07 inches), an extended freeze from 13-17 February 2021 (Winter Storm Uri) likely affected plant survival and overrode effects of the December rain, resulting in a lower correlation coefficient (0.68).

Figure 3. Total December rainfall and corresponding plants per year from 2012 – 2021 in Travis County, Texas.



Discussion and Management Implications

Consistent with our previous analyses (COA 2018), we found that climate conditions account for much of the variability in Bracted Twistflower abundance. In particular, higher rainfall in December is correlated with a higher abundance of plants the following spring, although Winter Storm Uri appeared to override this effect in 2021.

The 1940-2019 aerial photographs show little to no changes in the forested canopy cover of the Bracted Twistflower sites on the COA-owned portions of Barton Creek, Gus Fruh, Mt. Bonnell, Ullrich, and Valburn for more than 80 years. At Valburn, an area adjacent to Bull Creek District Park was cleared in 2017. While Bracted Twistflowers continued to be observed in the woodland, none have been detected in the clearing on subsequent surveys. Our observations suggest that canopy retention benefits the Bracted Twistflower populations on the BCP, perhaps by providing more stable environmental conditions.

Based on fire incident information for known fires on and near the BCP from 1961 to 2020, the frequency and rate of spread of fires in Ashe juniper-oak woodland is very low compared to grassland and shrubland, with less than 10 percent originating from lightning strikes (O'Donnell and Nesvacil 2020). We are unaware of any wildfires or fire suppression efforts in recent history within the COA's bracted twistflower sites, with the exception of the experimental introduction site at the Vireo Preserve. Despite three successive plantings between 2009 and 2012 on this formerly clear-cut and burned site, no Bracted Twistflowers have been observed since 2018, when only one plant was found. These findings suggest that wildfire may not be a beneficial or necessary to sustain Bracted Twistflower populations. Bracted Twistflower habitat on the BCP appears to be stable for long periods of time without human-caused disturbance.

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Appendix A:

Aerial Photography and Habitat Photographs of Bracted Twistflower Sites, Balcones Canyonlands Preserve, Western Travis County, Texas

This appendix shows a series of aerial photographs (1940-2019) overlayed on known Bracted Twistflower sites for four naturally-occurring Bracted Twistflower populations (Barton Creek, Mt. Bonnell, Ullrich, and Valburn), Gus Fruh (believed to have been seeded by BCP staff in the late 1990s), and the experimental introduction at the Vireo Preserve. BCP staff also photographed Bracted Twistflowers at Gus Fruh in spring 2015-2016, habitat at Bracted Twistflower colonies (under pink and orange flagging) at Barton Creek, Mt. Bonnell, and Ullrich in August and September 2018, at the Valburn site in spring 2017 and 2019, and at the Vireo Preserve sites (within welded wire mesh cages) in December 2021.

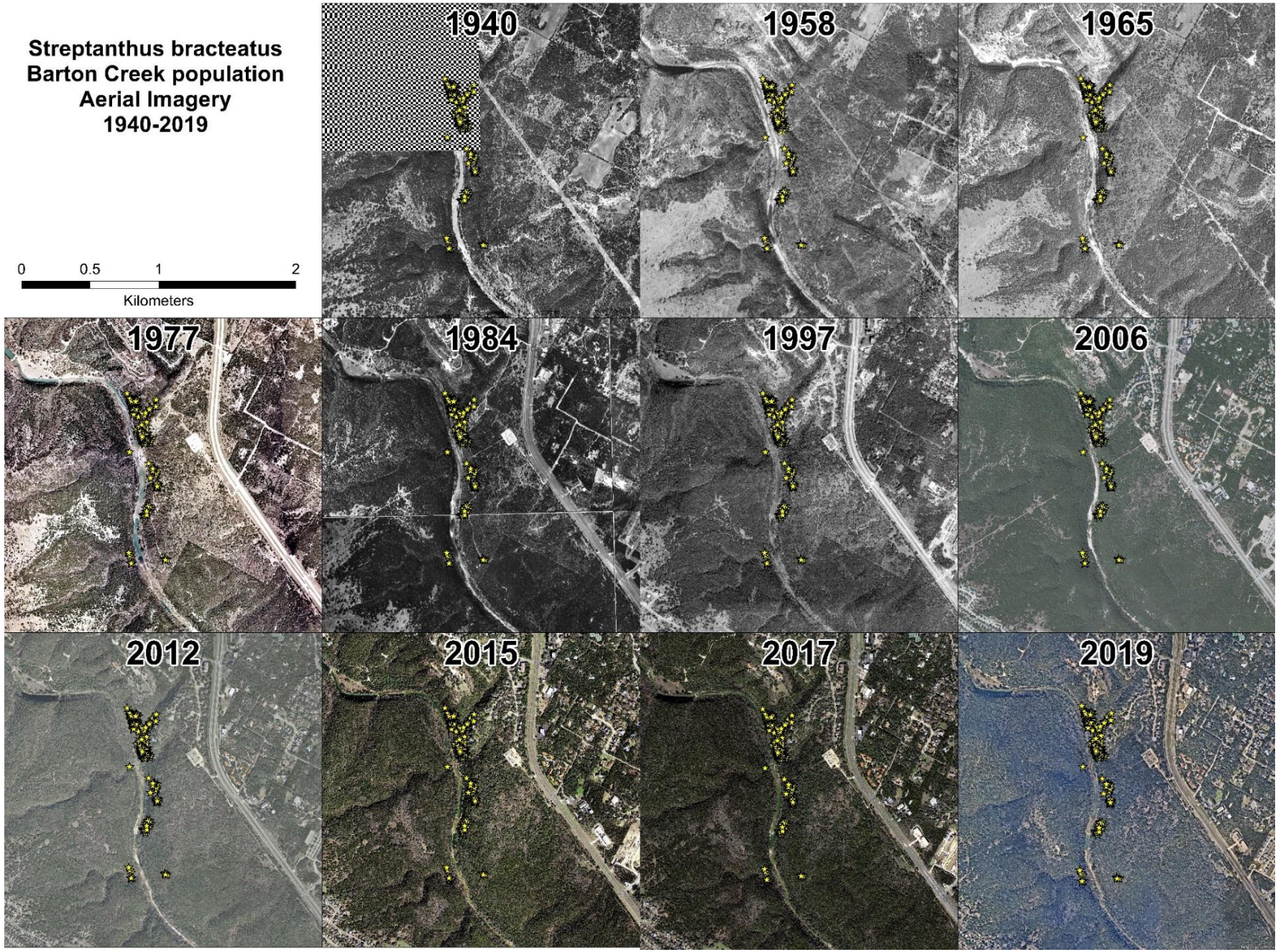
Photographs of Bracted Twistflower Habitat at Barton Creek Greenbelt/Wilderness Park (Barton Creek)










Streptanthus bracteatus
Barton Creek population
Aerial Imagery
1940-2019
0
0.5
1
2
Kilometers
1940
1958
1965
1977
1984
1997
2006
2012
2015
2017
2019

Photographs of Bracted Twistflower Habitat at Gus Fruh Park (Gus Fruh)

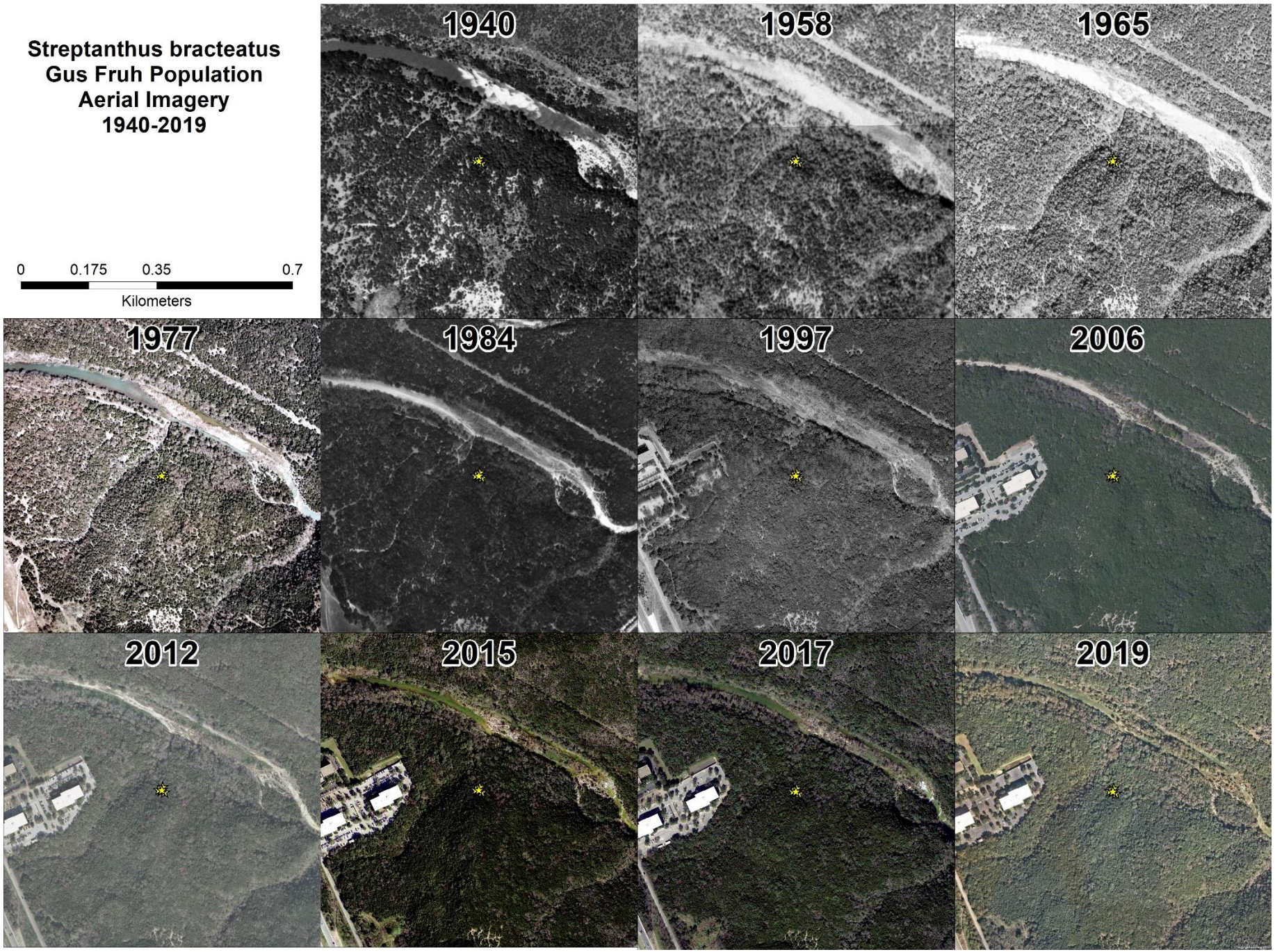








Streptanthus bracteatus
Gus Fruh Population
Aerial Imagery
1940-2019



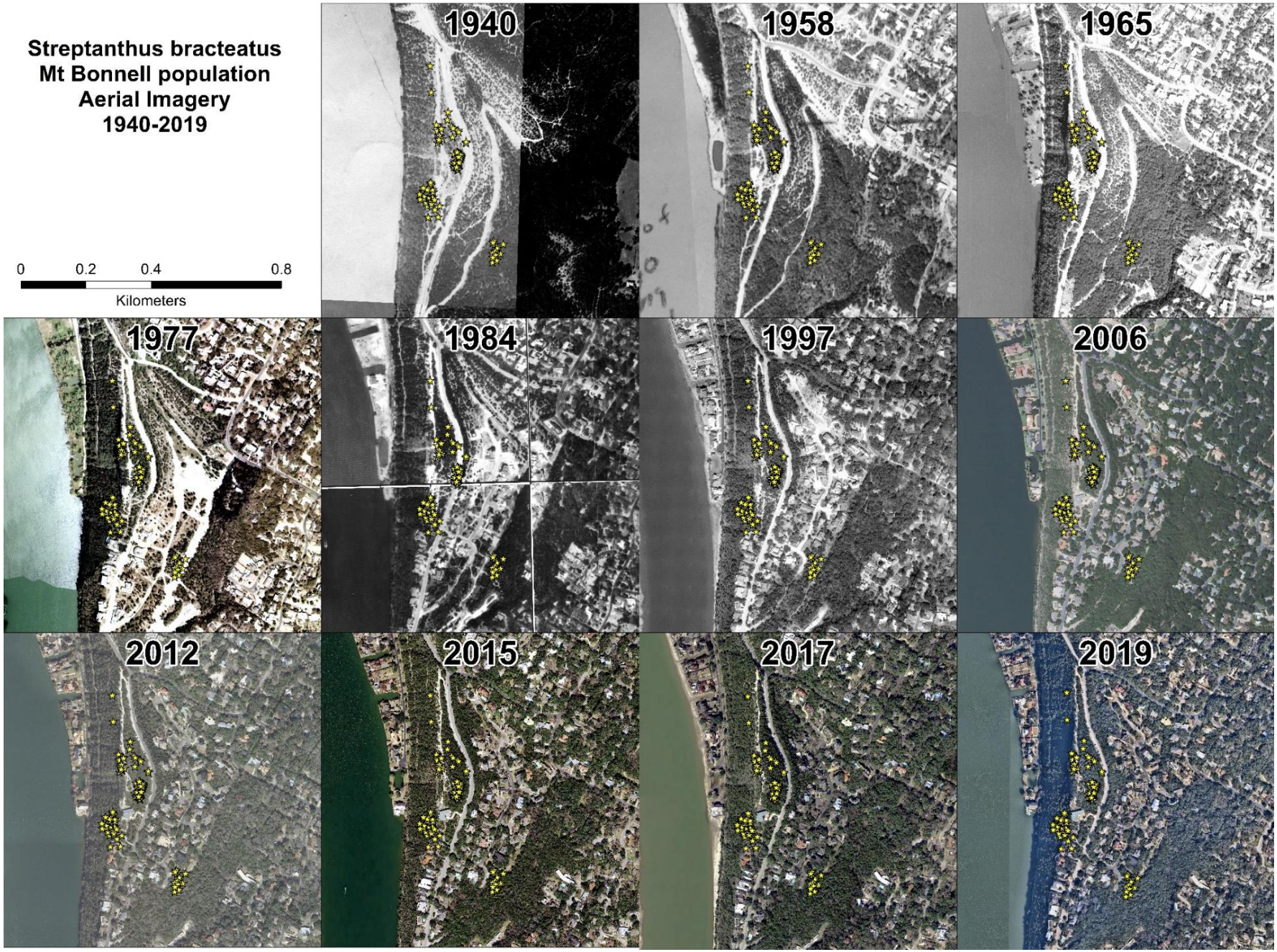
Photographs of Bracted Twistflower Habitat at Covert Park at Mt. Bonnell (Mt. Bonnell)










Streptanthus bracteatus
Mt Bonnell population
Aerial Imagery
1940-2019
0
0.2
0.4
0.8
Kilometers
1940
1958
1965
1977
1984
1997
2006
2012
2015
2017
2019

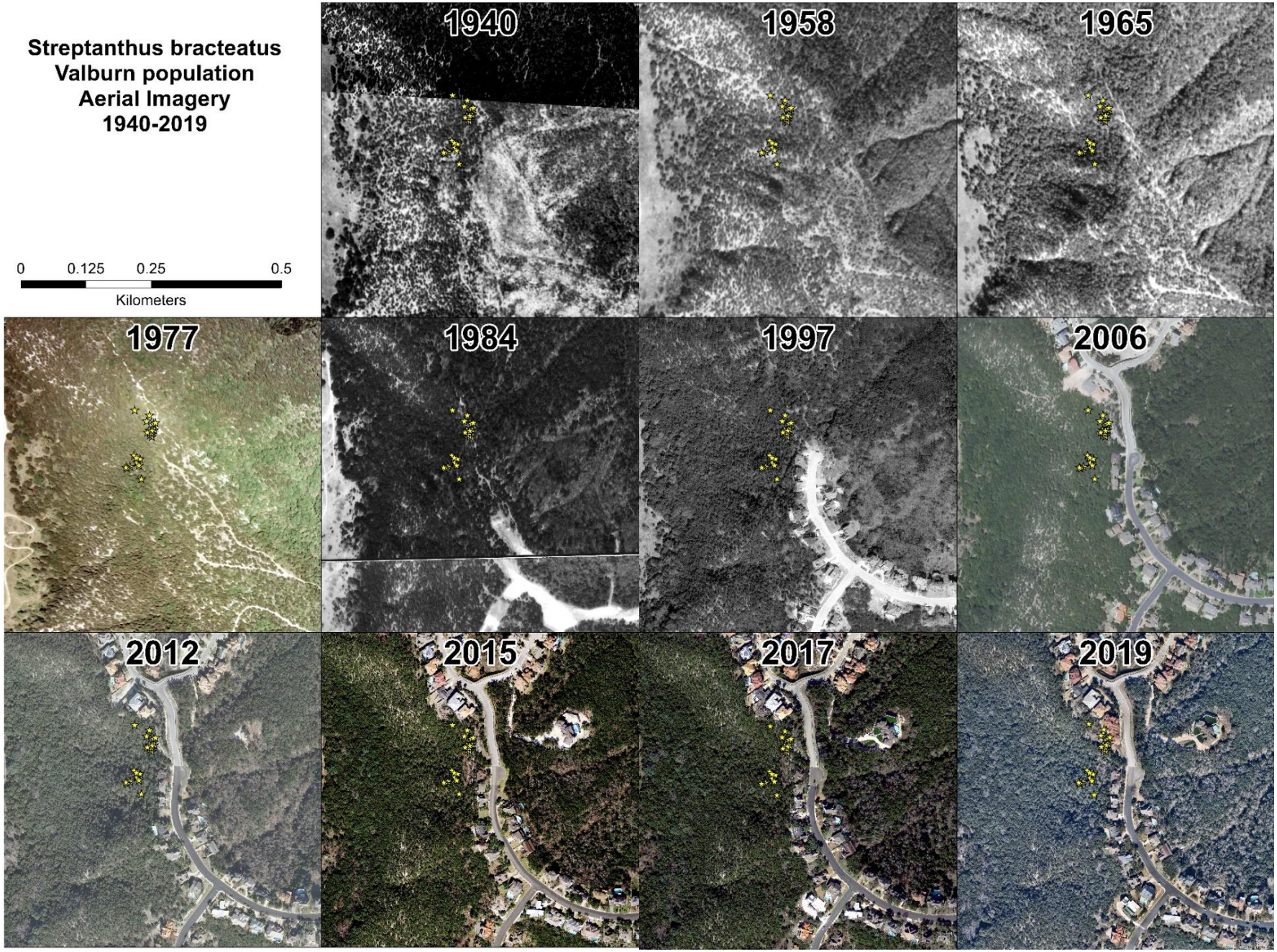
Photographs of Bracted Twistflower Habitat and Adjacent Clearing at Bull Creek District Park (Valburn)



Typical Bracted Twistflower habitat at Valburn



Adjacent site where no Bracted Twistflowers have been observed following removal of canopy trees, primarily Ashe junipers, in 2017


Streptanthus bracteatus
Valburn population
Aerial Imagery
1940-2019
0
0.125
0.25
0.5
Kilometers
1940
1958
1965
1977
1984
1997
2006
2012
2015
2017
2019

Photographs of Bracted Twistflower Habitat at Ullrich Water Treatment Plant (Ullrich)

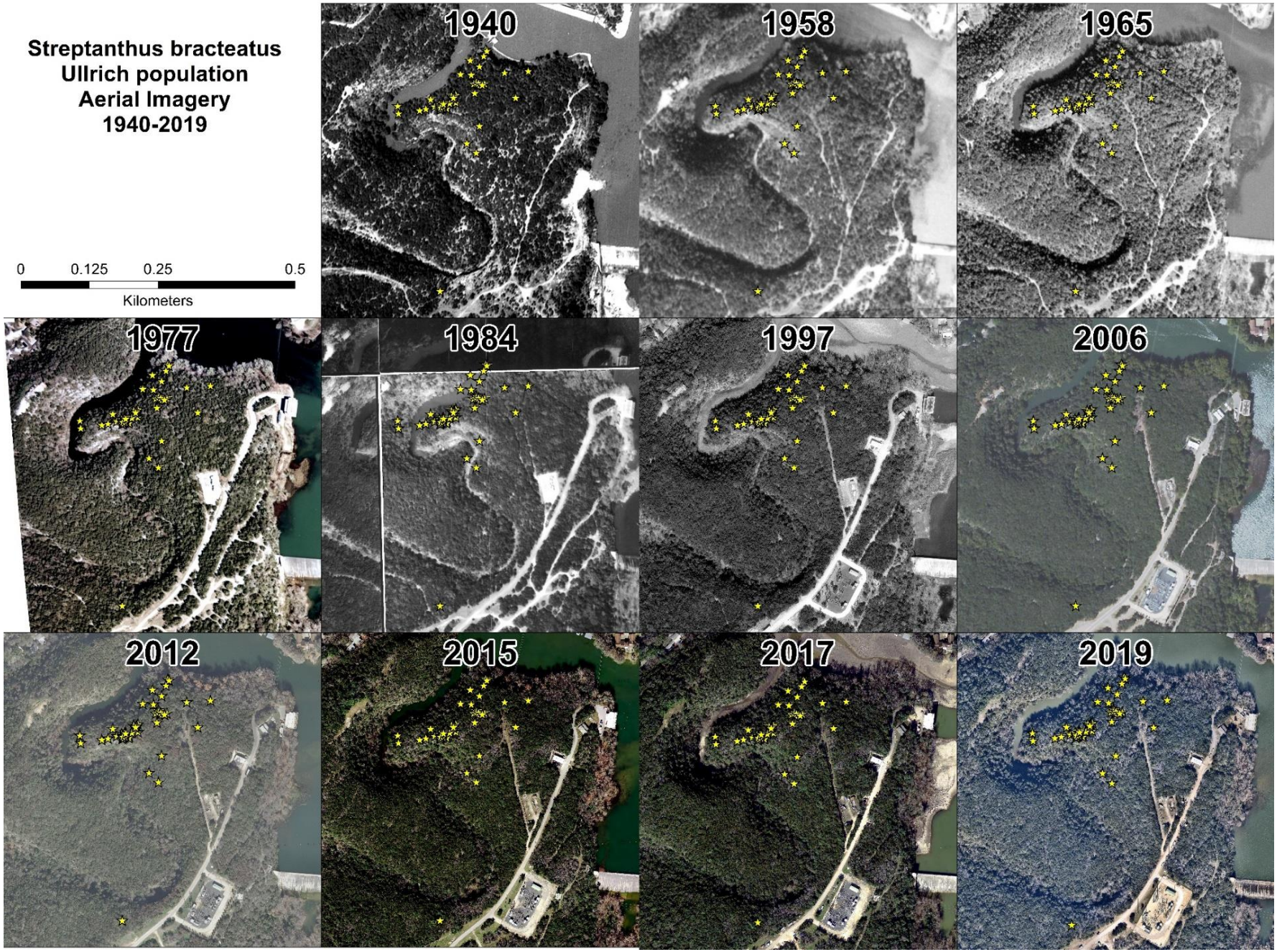








Streptanthus bracteatus
Ullrich population
Aerial Imagery
1940-2019



Photographs of Bracted Twistflower Habitat at Vireo Preserve









Streptanthus bracteatus
Vireo Preserve Study Site
Aerial Imagery
1940-2019

