City of Austin
P.O. Box 1088. Austin, TX 78767-1088

Public Comments Processing
Attn: FWS–R2–ES–2021–0013, U.S. Fish and Wildlife Service
MS: PRB/3W, 5275
Leesburg Pike, Falls Church, VA 22041–3803

RE: **Comments from the City of Austin regarding Docket No. FWS–R2–ES–2021–0013; FF09E21000 FXES1111090FEDR 223; RIN 1018–BE44 - Proposed Rule: Endangered and Threatened Wildlife and Plants; Threatened Species Status With a Section 4(d) Rule for Bracted Twistflower and Designation of Critical Habitat**

City of Austin staff have reviewed the rule proposed by the U.S. Department of the Interior, Fish and Wildlife Service, to list the bracted twistflower (*Streptanthus bracteatus*) as threatened with critical habitat. This rule was published in the Federal Register on November 10, 2021, in Volume 86, Number 215 (pages 62668 through 62705). Threats to bracted twistflower populations from urban development, human recreation activities, browsing from overpopulated white-tailed deer, and climate change are well-supported. As a co-permit holder for the Endangered Species Act 10(a)(1)(B) permit establishing the Balcones Canyonlands Preserve and as a signatory to the 2004 Memorandum of Agreement to conserve the bracted twistflower and its habitat, the City of Austin remains committed to protecting this plant species. However, we have the following requests, comments and concerns.

Infrastructure Exclusions from Critical Habitat Designation (Travis County, Subunit 1d, page 62699)

The City of Austin requests modifications to the proposed critical habitat at the site of the Ullrich Water Treatment Plant (WTP), as designated in the map for Travis County Subunit 1d (page 62699 of the proposed rule) and the City of Austin map included herein as Attachment A. The Ullrich WTP is one of only three drinking water plants serving over one million Austin Water customers. The critical habitat in the proposed rule includes the sites for an existing Austin Water raw water intake, pump station and an Austin Energy electrical substation that are integral to Ullrich WTP operations. These key facilities require daily access and the surrounding land is dedicated to critical infrastructure operations. A City of Austin capital improvement project is currently under construction to improve the resiliency of these facilities. We are not aware of any records for bracted twistflowers in this location and the data from the Texas Natural Diversity Database(TXNDD) do not show any plants in the project area.

The proposed critical habitat in Travis County Subunit 1d also borders a key road (Redbud Trail) and one of a limited number of bridges that cross the Colorado River in the Austin area. This road and bridge connect the City of West Lake Hills residents to Austin and is an important evacuation

route in an emergency. They comprise the only approved trucking route stipulated in an Interlocal Agreement between West Lake Hills and Austin for Ullrich WTP vehicles. The City of Austin is in the design and environmental review stages to replace the bridge in 2023 as the bridge is nearing the end of its operational life. This project also includes roadway realignment along the southwest boundary of the proposed critical habitat to improve traffic safety. Austin Water will need staging areas for pipeline relocations related to these projects.

For these reasons, we are requesting the exclusion of the portions of the proposed critical habitat in Subunit 1d beyond the existing Balcones Canyonlands Preserve (BCP), as noted in the City of Austin map in Attachment A. We are also recommending including the entire BCP tract in the critical habitat area to compensate for some of the removal of the other areas. We believe this preserve offers the best habitat for the bracted twistflower in Subunit 1d. This change will enable City of Austin biologists to provide more focused habitat restoration and management. Limiting the critical habitat to the BCP portions of Subunit 1d will enable both conservation of the bracted twistflower and the unimpeded maintenance and management of critical transportation and drinking water infrastructure now and in the future.

Habitat Management Regarding Ashe Junipers and Prescribed Burns

The City of Austin respectfully disagrees with statements made in the proposed rule regarding Ashe juniper encroachment and competition. Attachment B included herein provides the basis for why these claims are not supported. Based on the information we have compiled for bracted twistflower populations and its ecosystems on City of Austin properties, and consistent with the proposed rule's acknowledgement that "native, old-growth juniper-oak woodlands and shrublands" are an essential feature of critical habitat, we believe removal of Ashe juniper trees and prescribed burns would be detrimental. Where our perspectives on management strategies differ, we recommend continued collaboration with the U.S. Fish and Wildlife Service and partners to conduct research to promote a mutual understanding of conservation measures needed to protect bracted twistflower populations.

Request to Assist with Recovery Planning and Implementation

Other designated critical habitat includes Bull Creek District Park, Mt. Bonnell Park, and Barton Creek Greenbelt/Wilderness which are managed by both Austin's Parks and Recreation Department and Austin Water's Wildland Conservation Division. This is an important acknowledgement that should be included in any future documents and collaborative efforts pertaining to the bracted twistflower. Also, bracted twistflowers were found on another portion of Bull Creek District Park in 2020, and Austin Water recently acquired the Bright Leaf Preserve that will be managed as part of the City's Balcones Canyonlands Preserve system. Given the significant amount of habitat acreage we manage, our long- term commitments and ongoing monitoring efforts, the City of Austin would appreciate the opportunity to appoint a representative(s) to assist with recovery planning and implementation.

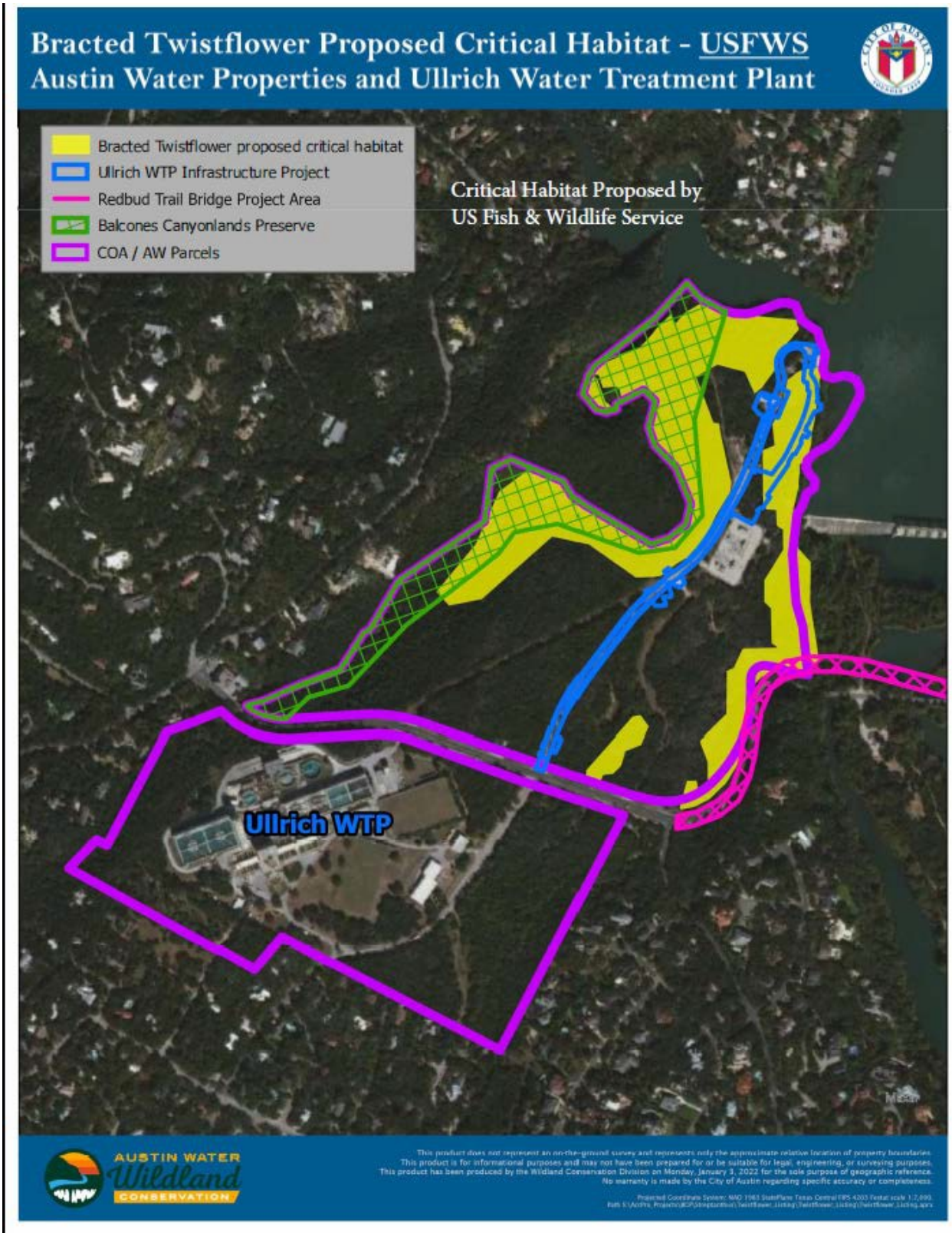
Attachments:

Attachment A: Maps of Proposed Critical Habitat Adjustments for Travis County Subunit 1d

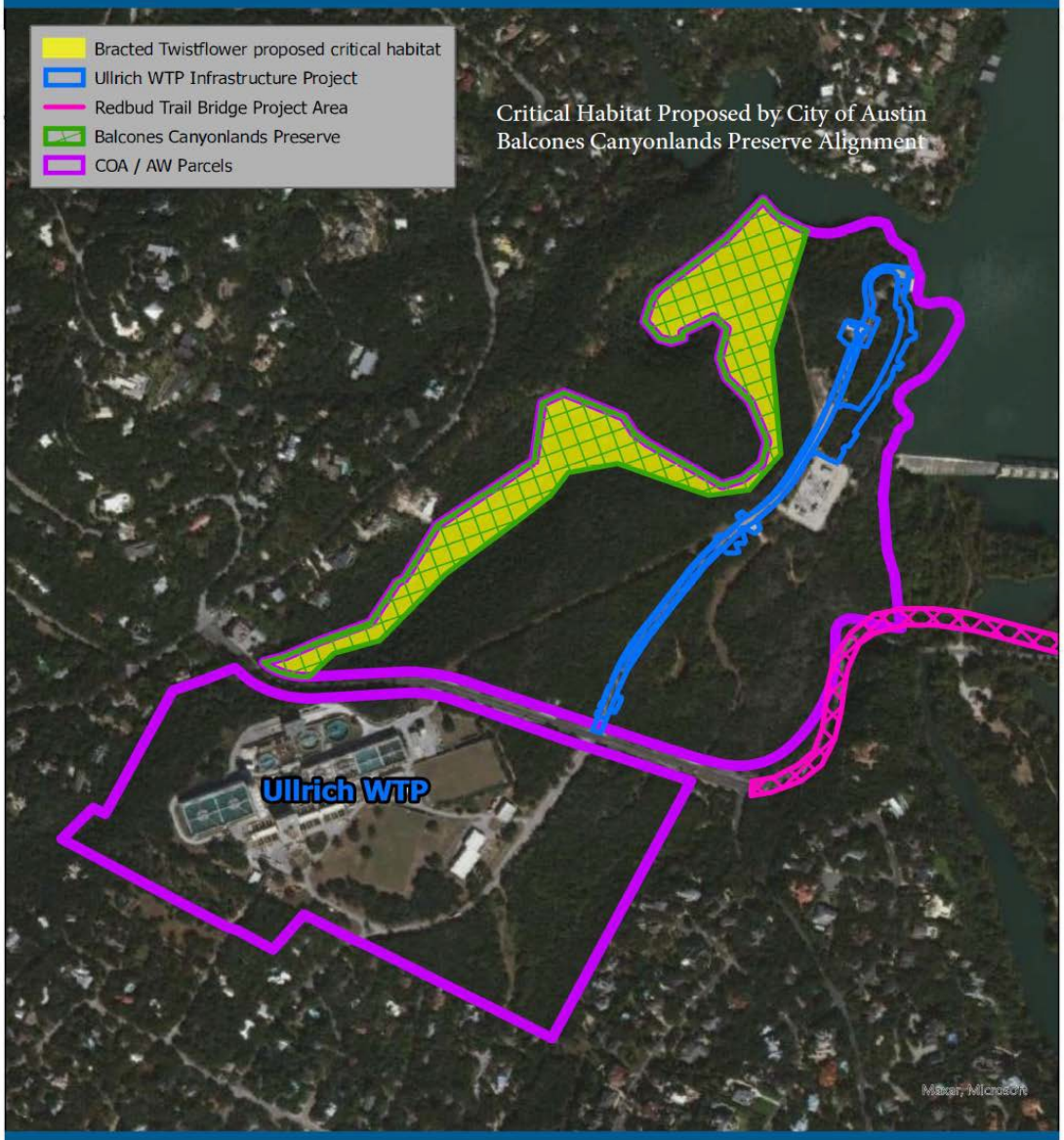
Attachment B: Austin Water BCP Staff Comments on Proposed Listing

Attachment A

City of Austin Maps – Bracted Twistflower Critical Habit – Travis County Subunit 1d



Bracted Twistflower Proposed Critical Habitat - COA
Austin Water Properties and Ullrich Water Treatment Plant



AUSTIN WATER Wildland CONSERVATION

Projected Coordinate System: NAD 1983 StatePlane Texas Central FIPS 4203 Feetat scale 1:7,000.
Path: S:\ArcPro_Projects\BCP\Streptanthus\Twistflower_Listing\Twistflower_Listing\Twistflower_Listing.aprx

Attachment B

City of Austin, Balcones Canyonlands Preserve Comments:
Proposed Rule to List Bracted Twistflower as Threatened with Critical Habitat January 2022

City of Austin staff have reviewed the proposed rule to list the bracted twistflower (*Streptanthus bracteatus*) as threatened with critical habitat. Threats to bracted twistflower populations from urban development, human recreation activities, browse from overpopulated white-tailed deer (*Odocoileus virginianus*), and climate change are well-supported. As a co-permit holder for the Endangered Species Act 10(a)(1)(B) permit establishing the Balcones Canyonlands Preserve and as a signatory to the 2004 Memorandum of Agreement (USFWS 2004), the City of Austin remains committed to conserving the bracted twistflower and its habitat. However, we disagree with statements made in the proposed rule regarding Ashe juniper encroachment and competition, and focus most of our comments on why these claims are not supported. Where our perspectives on management strategies differ, we recommend continued collaboration with the U.S. Fish and Wildlife Service and partners to conduct research to promote a mutual understanding of conservation measures needed to protect bracted twistflower populations. Given the significant amount of habitat acreage we manage, our long-term commitments, and monitoring efforts, the City of Austin would appreciate the opportunity to appoint a representative(s) to assist with recovery planning and implementation for this species.

Much of the proposed rule presents sound science and conclusions, and we concur that old-growth Ashe juniper (*Juniperus ashei*) and oak (*Quercus* spp.) woodlands and shrublands are "physical or biological features essential to the conservation" of the bracted twistflower. For City of Austin properties, this is evidenced by a series of decadal aerial photographs from 1940 to present, which show no changes in the forested canopy cover for more than 80 years. However, identifying Ashe juniper and fire suppression as threats contradicts this essential habitat requirement. The recommendation to remove Ashe juniper trees and promote prescribed burns also unnecessarily conflicts with habitat requirements of other endangered and rare species that depend on Ashe juniper-oak woodlands, including the Golden-cheeked Warbler (*Setophaga chrysoparia*), karst invertebrates, aquatic salamanders (*Eurycea* spp.), canyon mock-orange (*Philadelphus ernestii*), Heller's marbleseed (*Onosmodium helleri*), and Buckley's tridens (*Tridens buckleyanus*). We previously provided comments and documentation related to these concerns on the draft Species Status Assessment (SSA), which are attached again here for consideration. We provide further elaboration below.

Please note that Bull Creek District Park (Valburn), Mt. Bonnell Park, and Barton Creek Greenbelt/Wilderness are managed by both Austin's Parks and Recreation Department and Austin Water's Wildland Conservation Division. This is an important acknowledgement that should be included in any future documents and collaborative efforts pertaining to the bracted twistflower. Also, bracted twistflowers were found on another portion of Valburn/Bull Creek District Park in 2020, and Austin Water recently acquired the Bright Leaf Preserve that will be managed as part of the City's Balcones Canyonlands Preserve system. Table 1 should be updated to: 26-Bright Leaf Preserve; City of Austin; NE.

Benefits of Ashe Juniper to Bracted Twistflower Conservation

As an essential biological feature of bracted twistflower habitat, Ashe juniper provides many ecological benefits, including:

Soil Building - As a pioneer and climax species, decomposition of the needles dropped by Ashe juniper builds soils. Based on data we have collected on the Balcones Canyonlands Preserve, organic matter is higher in soils under Ashe juniper-oak canopies than in adjacent deforested sites and increases with increasing stand age (for example, Figure 1). Organic matter increases soil fertility and water holding capacity (Bray 1904, Bot and Benites 2005).

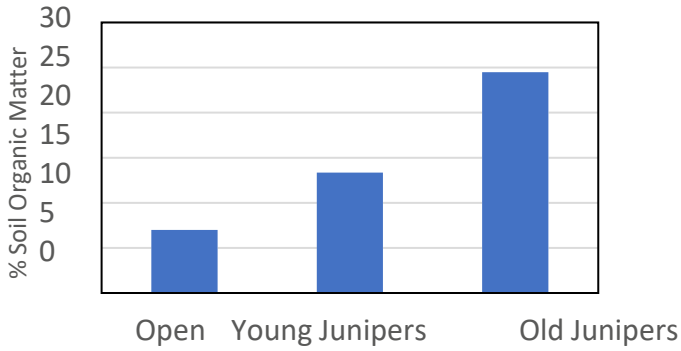


Figure 1. Soil organic matter increases with stand age in Ashe juniper-oak forest, Balcones Canyonlands Preserve

Soil Retention - Soil erosion has been severe and episodic in the Texas Hill Country since the latter part of the 1800s following successive waves of juniper clearing, burning, and overgrazing (Bray 1904, Marsh and Marsh 1992). The force of unobstructed rain on bare soil can be extremely destructive, rapidly eroding soil away. The foliage of Ashe juniper is particularly effective at breaking the momentum of raindrops. When juniper needles fall to the ground, they also prevent erosion, absorbing sediment-bearing water as it moves over the surface. The deposited sediment then forms small berms that further retard the flow of water downhill (Marsh and Marsh 1992). The importance of the Edwards Plateau forests for "checking floods, collecting soil, preventing erosion, promoting the entrance of water into the earth, and maintaining a longer and more constant flow of springs and streams…." was documented as far back as 1904 (Bray 1904).

Water Infiltration - Ashe juniper plays a key role in the maintenance of groundwater by reducing evaporation during drought (Shukla and Mintz 1982, Hauwert and Sharp 2014) and increasing infiltration (Slaughter 1997, Lindley 2005, Dasgupta et al. 2006).

Water Retention - Shade from forest canopies shields the ground from the sun and drying winds, reducing the air and soil temperatures and reducing evaporation from the soil beneath the trees (Nagra et al. 2016).

Reduced Flooding - Central Texas is in one of the most flash-flood prone areas in North America, and has become known as "flash flood alley" (https://twri.tamu.edu/publications/txh2o/2016/fall-2016/do-you-live-in-flash-flood-alley/). Both the evergreen canopy of Ashe juniper and its leaf litter reduce the volume and velocity of rainfall events (Bray 1904, Marsh and Marsh 1992, Owens et al. 2006, Owens 2008). This rainfall interception provides both erosion and flood control, which plays an essential role in reducing runoff and soil loss, particularly on steep slopes where many bracted twistflower populations occur.

Nurse Trees – As acknowledged in the proposed rule, Ashe junipers can serve as "nurse trees" by protecting bracted twistflowers from browsing deer. They can also protect from trampling by humans. Maintaining contiguous Ashe juniper woodlands/forests tends to reduce the invasion and proliferation of native and non-native forbs and grasses that thrive in open, sunny, and/or disturbed areas, such as erect dayflower (*Commelina erecta*) and King Ranch bluestem (*Bothriochloa ischaemum*), that would likely outcompete bracted twistflowers (BCP staff, pers. observation, Gabbard and Fowler 2007).

Climate Mitigation - Evergreen Ashe junipers capture and hold large amounts of carbon dioxide (Bendevis et al. 2010) year-round, and the soils store high levels of organic carbon (for example, Figure 1). Shading and evapotranspiration provide stable temperatures and moisture under forest canopies (https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat- islands, Nowak et al. 2016, Brandt et al. 2020). Forests also play a role in cloud formation and increased albedo (Cerasoli et al. 2021).

Documentation Countering Juniper Encroachment and Fire Suppression Claims

Many historic accounts show that Ashe juniper has long been common in Central Texas and is not "encroaching". We note several examples below:

Buckley (1874) – In addition to the historical reports cited in the proposed rule and discussed below, Buckley (1874) documents clearing of Ashe juniper during the latter part of the 1800s. For example: "There are two species of cedar in Texas—the common red cedar, (*Juniperus virginiana*), and the mountain cedar, common on the hills north of Austin. This last is much used for fencing purposes, for posts and rails, and also for railroad ties. The timber of both these species is very durable. In no other country have I seen such tall cedars as in Texas…I have seen some tall cedars in Central and Eastern Texas. ..These big, tall cedars are too valuable for lumber and for fencing to be permitted to live, and it is to be feared that in a few years more, few, if any, of them will be left"(p. 93-94).

Bray (1904) - The proposed rule cites pages 14-15 of Bray (1904) as evidence that fire suppression impacts bracted twistflower habitat. However, we note that these two pages of Bray (1904) cover a broad area of central and west Texas, from the edge of the Balcones Escarpment to the High Plains. Bray mentions forests and "trees upward of 500 years old" in the canyons and hills, with the timber giving way to prairie on the level portion of the Edwards Plateau. Thus, he is referring to the western edge of the Edwards Plateau when discussing woody encroachment and fire suppression. The "deeply eroded" portion of the Edwards Plateau, where bracted twistflower populations occur, "is a timbered region".

The proposed rule also cites pages 22-23 of Bray (1904). We note here that Bray discusses *recolonization* following tree clearing. For example, "Some hillsides near Austin from which the timber was cut five years ago are now fairly covered with young growth. On numerous clearings in the same neighborhood seedling cedar occurs in thickets." He mentions a forested tract on Dry Creek (near present-day Bright Leaf Preserve) that was cleared "twenty-five years ago" that was being cut again. He includes a photo of this 25-year old "cedar brake," and notes the slow diameter growth of this species: "Of course there was very little, if any, tie or post timber in this, and no clear heart cedar."

We point out other key sections of the report that document forested areas along the eastern edge of the Edwards Plateau:

- Pages 18-19. "The writer knows of no region in which any species of cedar is so uniformly abundant and dominant as is the mountain cedar in the limestone country of Texas…It is, in fact, one of the most valuable assets of the region, as well as the most characteristic feature of the hill timber…Reasonably clear poles 20 to 30 feet in length and with a base diameter of from 1½ to 2 feet were formerly common…The typical cedar brake is an almost impenetrable growth…the intense light of this climate is little checked by cedar foliage, and so the undermost branches are not starved as they would be with a shadier foliage or in a climate of greater humidity and less intense illumination…In general, cedar timber occurs upon all of the hilly or rough parts of the limestone region of Texas from the Palo Pinto country to the Colorado, and thence westward over all of the drainage breaks

and the escarpment nearly to the eastern forks of the Devils River. The most extensive bodies of cedar known to the writer are those of the Colorado River breaks from Austin to the San Saba country."

- Pages 26-29. Bray uses the Westbank Peninsula in Austin (near what is today Wild Basin and Vireo Preserve tracts of the Balcones Canyonlands Preserve) to illustrate the benefits of forest cover and impacts of deforestation on soils and runoff. Plate V. Fig. 1 and Fig. 2 provide photographs of the forested and deforested sites.

- Pages 29-30. Bray expresses concern about overgrazing and "hills denuded by unwise cutting," and advocates maintaining a forest cover under the "ownership and management by the State".

Paige (1912) – In the Llano Uplift area, Paige also notes the extensive removal of Ashe juniper and subsequent erosion. For example: "The cutting of cedar, which abounds on the slopes and tops of ridges in the areas underlain by Paleozoic limestone, has been carried on for years (p. 2)… The beds of these (streams) are filled with an increasing load of sand…Among the factors which bring about this overloaded condition of the pre-Cambrian streams are the occasional torrential rains, the stripping of vegetation from the granite areas by overstocking of ranches, and the rapid disintegration of the bare rocks, a result of alternating hot days and cool nights." (p. 16)"
Fonteyn et al. (1988) - The proposed rule cites pages 80 of this report. However, this page cites secondary sources of information (Bray 1904, Foster 1917) rather than primary data or research to support the claim that the Edwards Plateau was "a relatively open savanna" prior to 1850.

Fowler et al. (2012) - The proposed rule cites pages 1518-1521 of this publication. We note that this is a publication of Fowler (2010) and includes results of a greenhouse study. We provide comments on Fowler (2010) below.

O'Donnell (2019) – As stated in our draft comments on the SSA, this report provides historical eyewitness accounts and photographs from the eastern Edwards Plateau. It documents extensive forested areas, as well as deforestation and fires beginning in the latter part of the 1800s.

O'Donnell and Nesvacil (2020) - To better understand more recent fire occurrence on the Balcones Canyonlands Preserve, we compiled fire incident information for known fires from 1961 to 2020. We

found that the frequency and rate of spread of fires in Ashe juniper-oak woodland is very low compared to grassland and shrubland, and over 90 percent of the fires were human-caused. We are unaware of any naturally occurring fires or fire suppression efforts within the City of Austin's bracted twistflower sites.

Documentation Countering Ashe Juniper Trees as a Threat

Fowler (2010) - The proposed rule cites Fowler (2010) as one of the studies justifying the need to remove Ashe juniper trees. However, in addition to our comments on the draft SSA, we note the following:

- Unlike the old-growth woodlands on the naturally-occurring bracted twistflower sites on City of Austin properties, much of the Vireo Preserve was clear-cut during the 1950s, followed by a wildfire in 1961 (for details, see "Westbank Peninsula Fire, April 1961" in Appendix A of O'Donnell and Nesvacil 2020).
- Study plots were primarily under Texas red oak (*Quercus buckleyi*). Canopy cover was estimated in early March prior to full leaf-out, as evidenced by the comparison with higher June canopy estimates.
- Understory hardwoods were selectively pruned, not canopy trees or Ashe junipers (this was one of the conditions of the research permit that we issued for this project).
- Given the study plot locations and design, the conclusion that Ashe juniper trees need to be removed is not supported by this study.
- 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.

Other Literature- We also note the following literature that counters the assertion that bracted twistflowers require canopy thinning:

- Fowler (2014, p. 20) acknowledges that bracted twistflowers are more reproductively fit further under canopy. Fowler (2014) found no evidence from the vegetation surveys that Ashe juniper is higher in unoccupied versus occupied sites. For example, "…overall the species composition of the two types of plots seemed similar" (p. 15), and "In no instance was the site x plot type (occupied or unoccupied by *S. bracteatus*) significant and it was dropped from the models. Plot type itself was never significant in these reduced models, and it also was dropped. Region was not significant in the analyses of herbaceous species (a category that included succulents) nor in the analysis of woody understory species, and was dropped from those models. While region was significant in the analysis of woody overstory species and was therefore retained in that analysis, the region x plot type term was not and was dropped" (p. 14 and 15).
- Zippin (1997, p. 132) compared experimental populations in a grassland and woodland at Emma Long Metropolitan Park and suggested "*Streptanthus bracteatus* is a true woodland species".

- Leonard and Van Auken (2014) found higher germination rates of bracted twistflowers seeds in low light (30/66; 45%), compared to high light environments (13/66; 20%).

Removal of Woody Vegetation on Rancho Diana and Valburn Sites - The proposed rule cites the removal of woody vegetation from an enclosure at Rancho Diana in 2017 as justification to remove Ashe juniper trees from known bracted twistflower sites. However, the proposed rule removal also occurred at the Valburn site in 2017, with opposite results: while bracted twistflower plants were abundant in the adjacent woodlands, none were detected in the clearing in 2018, 2019, or 2021 (no surveys were conducted at this site in 2020). The loss of these plants is reflected in our 2019 counts, which were significantly higher at all naturally occurring sites except for Valburn (see "*Streptanthus bracteatus* plant counts on COA properties" figure in our comments on the draft SSA).

Bracted Twistflower Counts on Barton Creek Greenbelt/Wilderness Park - The number of bracted twistflowers observed on Barton Creek, where active thinning did not occur, are very similar to those at Rancho Diana from 2015-2021, with the exception of 2016, when counts were higher on Barton Creek.

Other Observations on Balcones Canyonlands Preserve - As stated in our comments on the draft SSA, we have observed plants greater than 5 feet tall, and with numerous siliques, under closed canopy. While our bracted twistflower counts vary considerably from year to year, this appears to be due to rainfall patterns (City of Austin 2018). With the exception of the decline at the Valburn site following tree clearing, we have not observed a trend that is correlated with vegetation changes.

Threats from Removing Ashe Juniper Trees

Given the ecological benefits of Ashe juniper, and lack of evidence that encroachment and infrequent wildfire are threats, we recommend that these be removed from the critical habitat designations. We believe that promoting tree removal would threaten bracted twistflower populations and adversely modify critical habitat, including one or more of the following ways (we recommend adding these to the "Application of the 'Destruction or Adverse Modification' Standard"):

- Increasing exposure to deer herbivory and human traffic
- Increasing soil erosion on steep slopes (and loss of seed bank)
- Increasing growth of grasses, forbs, and shrubs that could compete with bracted twistflowers
- Decreasing water infiltration, water retention, and carbon sequestration
- Increasing air and soil temperatures

Ashe juniper diameter growth rates are slow, with independent estimates on the Balcones

Canyonlands National Wildlife Refuge (http://biodiversityworks.org/wp-content/uploads/2016/02/Hatfield-Link.pdf) and Balcones Canyonlands Preserve (O'Donnell 2019) averaging 0.6 to 1 inch per decade. Thus, if a 10- inch Ashe juniper tree is removed unnecessarily, restoration could take over 100 years. We recommend manipulating habitat only if better scientific data support this need.

Recommended Research

An alternative recommendation to removing canopy and thinning Ashe Juniper where bracted twistflower plants already occur could be to seed locations where canopy gaps have been created naturally, or are required for other purposes, such as boundary fencing, shaded fuel breaks, infrastructure corridors, or removal of non-native trees and shrubs. We look forward to researching the viability of these options as stated in our comments on the draft SSA:

> We recommend collaborating on experiments to elucidate ideal conditions for this species. For example, we are experiencing increasing tree mortality and blow-downs with climate change, creating opportunistic canopy gaps where we can spread *S. bracteatus* seed without intentional canopy thinning. Removal of invasive shrubs and trees creates additional canopy gaps. We have a variety of micro-climates within the BCP where we can experiment to determine optimum *S. bracteatus* habitat under natural (i.e., no supplemental water) conditions. We can also assist with seed bank experiments. We are committed and eager to work with you to further the conservation of this imperiled species.

Walso recommend research to better understand habitat requirements of the leafcutter bee (*Megachile comata*) and other pollinators, as well as methods to enhance pollinator habitat. In addition, recent studies have demonstrated some plants in the mustard family may derive benefits from arbuscular mycorrhizae (Halim 2016, Güneş 2019); we recommend investigating whether bracted twistflower associates with mycorrhizal fungi.

Summary

Overall, we believe the basis for the proposed listing of bracted twistflower as threatened with critical habitat is well supported. We will continue to work with the U.S. Fish and Wildlife Service and other partners to address threats from urban development, human recreation activities, browse from overpopulated white-tailed deer, and climate change. However, based on the information we have for bracted twistflower populations and their ecosystems on City of Austin properties, and consistent with the proposed rule's acknowledgement that "native, old-growth juniper-oak woodlands and shrublands" are an essential feature of critical habitat, we believe removal of Ashe juniper trees and use of prescribed burns would be detrimental. To avoid potentially irreparable damage, we recommend careful research to identify management

strategies needed to promote the long-term survival and recovery of these populations. Given our long-term commitments and monitoring efforts, the City of Austin would also appreciate the opportunity to appoint a representative(s) to assist with recovery planning and implementation.

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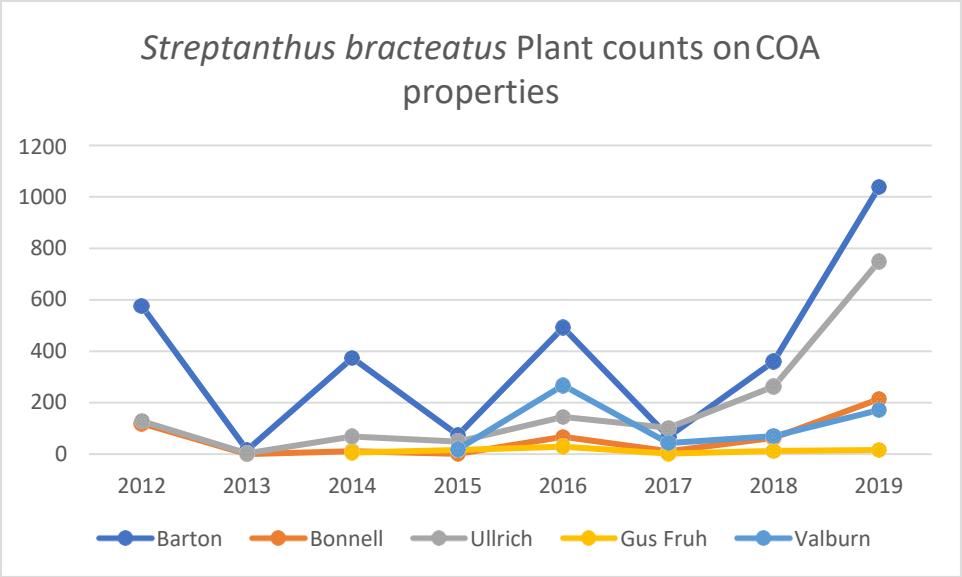
Comments on draft SSA for *Streptanthus bracteatus* [submitted to U.S. Fish and Wildlife Service on 9 August 2019]

City of Austin biologists familiar with populations of Bracted Twistflower (*Streptanthus bracteatus*) growing within Austin's Balcones Canyonlands Preserve (BCP) reviewed the draft species status assessment (SSA) for the species, and had the following comments and corrections:

1) We have attached a report that provides historical eyewitness accounts and photographs from the eastern Edwards Plateau, which we submitted as part of our annual BCCP report (O'Donnell 2019; https://www.traviscountytx.gov/images/tnr/Docs/bccp/2018/appendix-s9.pdf). Note that the cover page has a photograph of a forested area from Bray (1904) that was taken on the Westbank Peninsula near the Ullrich *S. bracteatus* population. This is an example of why we believe the draft SSA mischaracterizes information regarding the extent of Ashe juniper-oak woodlands, including Bray (1904). In contrast to what is stated in the draft SSA, Bray described juniper encroachment in the interior of the Edwards Plateau, but described the canyonlands of the escarpment (eastern and southern edges of the plateau, where *S. bracteatus* populations are extant) to be densely wooded. We are willing to provide a more in-depth assessment of the Bray (1904) accounts referenced in the draft SSA if that would be helpful.
2) The draft SSA repeatedly states or implies that Ashe juniper encroachment has eradicated or diminished populations of *S. bracteatus*, but no evidence is cited. Contrary evidence, that *S. bracteatus* is thriving in some forested environments, is ignored in this report. For example, populations at Barton Creek and Ullrich are thriving and have been forested for more than 80 years.
    a. A series of aerial photographs dating back to 1940 shows that both the Barton Creek site and the Ullrich site have been continuously forested (see attached).
    b. The draft SSA singles out the Barton Creek population as being one of the largest in the species' range. That a forested population is among the largest, and therefore most viable, appears to contradict the premise that shade is detrimental to the species.
    c. The draft SSA singles out the Ullrich population as being perhaps the most genetically robust in the species' range. Again, this appears to contradict the premise that shaded populations are declining. It also appears to contradict the categorization of this population as too small to be viable.
    d. We have no evidence that either of these populations is declining. Preliminary tallies of 2019 survey data show record numbers of plants at all populations but Valburn (which had a reduced survey area) and Gus Fruh. City of Austin (2018) data, paired with results from 2019, suggest an upward trend in plant numbers (see figure below).



e. If juniper encroachment, and the shade resulting from it, is truly as detrimental to the species as the assessment repeatedly declares, we wonder why the species did not disappear from these sites long ago.

f. Contrary to the draft SSA assertions that shade constitutes sub-optimal habitat, populations of *S. bracteatus* in these shaded environments appear to be thriving. The more shaded habitat may reduce water loss. Thinning, therefore, might reduce water availability for individual plants due to increased transpiration and could negatively affect plant population viability.

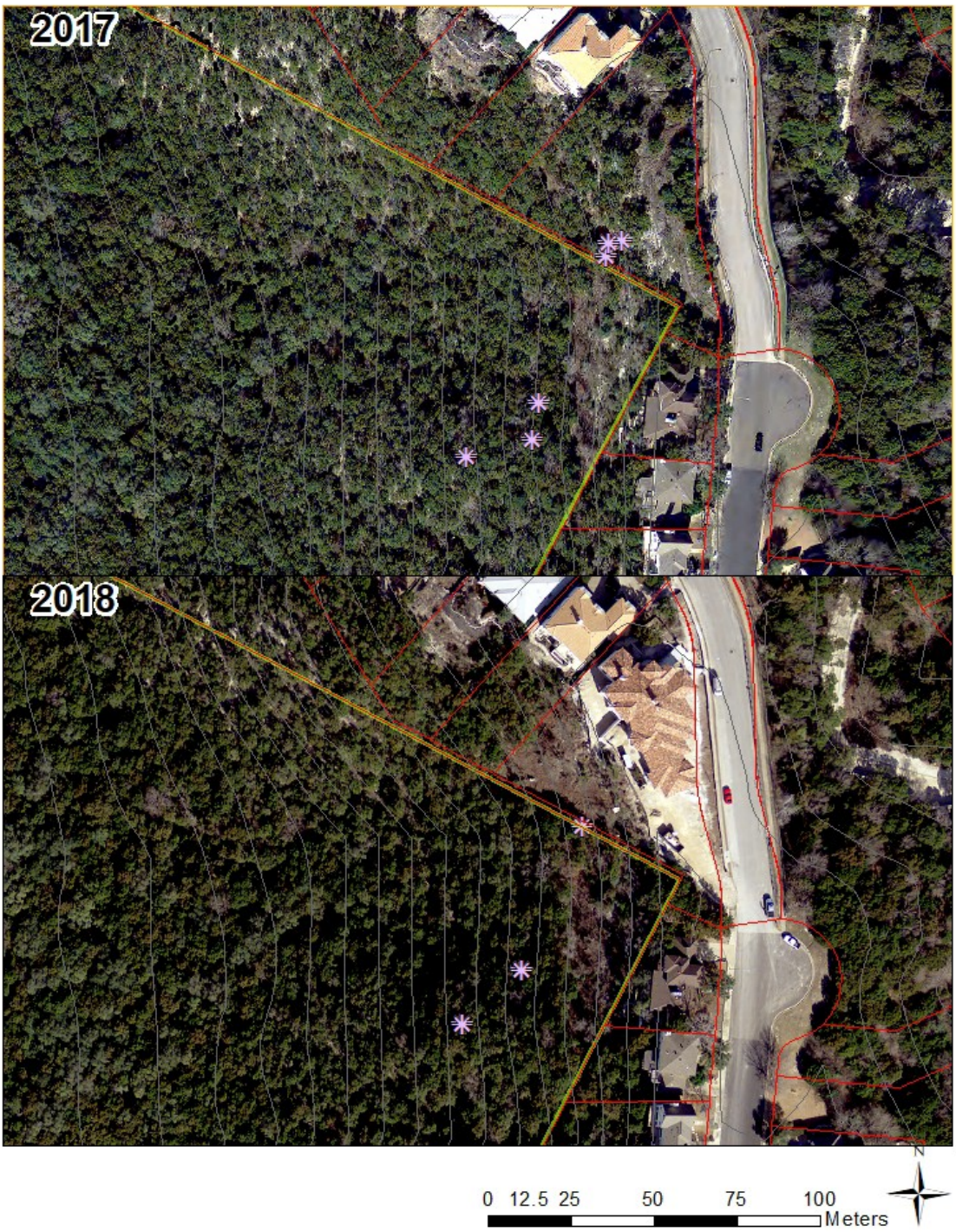
3) A clearing within a portion of the Valburn population appears to have had a negative impact on plant numbers.

a. In 2017 a house was built on the vacant lot on Valburn Drive, immediately adjacent to the COA Valburn colony. The homeowners removed most of the canopy trees, primarily all junipers, leaving a few Texas Red oaks and Live Oaks, on the wooded slope behind their home that had previously been surveyed as part of the Valburn colony.

b. In 2018 and 2019, plants were abundant on the wooded City of Austin property, adjacent to the clearing, yet, no plants were detected adjacent to the City of Austin property, in the clearing, where they had been before.

c. The clearing appears to be mostly dominated now by plateau goldeneye (*Viguiera dentata*,see photo; tree line on right side of photo represents boundary with city property).

Valburn Drive Bracted Twistflowers



4) The draft SSA suggests that plant height is an indication of optimal habitat. We were unaware of this metric and so have not been including plant height as part of our monitoring protocols. However, the photo below shows 5.5-ft. tall *S. bracteatus* under juniper canopy at Mt. Bonnell from May, 1997 (Photo by Mark Sanders).

5) We believe the studies that the draft SSA cites as evidence that *S. bracteatus* is more robust with less shade are critically flawed. We also believe that the recommendations to reduce canopy cover are not warranted by the study results.
   a. Fowler et al. (2012) concluded that plants with more light produced more seed, but the correlation (as depicted in graphs within the report) is very weak.
   b. Several studies (Fowler et al. 2012; Leonard and Van Auken 2013) relied upon supplemental watering to ensure the survival of seedlings.
      i. An unlimited water supply rarely occurs in natural conditions. With unlimited access to such an essential resource as water, nearly any plant will maximize photosynthetic opportunity.
      ii. If study plants were provided with supplemental water, a study cannot assess the resilience of the plants to the intermittent rainfall that is typical here in the growing season.
      iii. Plants growing in the open transpire more water, are more susceptible to desiccation during dry spells, and more likely to wilt before producing seed.
      iv. Plants growing in shaded environments transpire less water, and would

also be sustained by moisture held within the thick layer of duff beneath the shading trees. They may, then, more likely survive periodic dry spells in the growing season, and produce more consistent crops (while still showing "pulses" in production), even if, on average, each plant produces fewer seeds than it would if it successfully produced seeds in the open.

c. For these reasons, the assumption that more light is always beneficial to *S. bracteatus* should be considered unproven, and management actions based upon that assumption should be, at best, experimental.
d. In addition, Leonard and Van Auken (2014) should be cited as a reference. That study found higher germination rates of *S. bracteatus* seeds in low light (30/66; 45%), compared to high light environments (13/66; 20%).

6) The method proposed in the draft SSA for assessing seed production is therefore biased toward plants growing in open areas. If only the maximum seed production is used to assess a population's seed bank, then populations that produce a steadier, less variable, crop will be under-valued.
7) The draft SSA claims that *S. bracteatus* is a "fire follower" without considering other possibilities. An alternative hypothesis is that *S. bracteatus* is a microhabitat specialist, adapted to rocky, xeric, west- and south-facing slopes in a juniper/oak woodland matrix, where soils are too shallow to support a dense growth of trees. An investigation of plants that frequently associate with *S. bracteatus* on the BCP illuminates this hypothesis.
    a. The plant list (Table 2) in the draft SSA is of marginal value as an investigation into associated plants. It is simply a tabulation of how many studies of *S. bracteatus* mention each plant species, with no differentiation between species widespread in the landscape and species found narrowly – or more frequently – in association with *S. bracteatus*.
    b. Most species on the list are pervasive in dry juniper/oak woodlands of the escarpment, so, of course, they are also present near *S. bracteatus*.
    c. Of more interest is this list of species we find to be characteristically associated with *S. bracteatus* (characterization of shrub habitat below from Everitt et al., 2002), but comparatively scarce elsewhere on BCP sites:
        i. *Meximalva filipes*, Texasfan, almost never seen away from twistflower sites; a south Texas shrub of rocky slopes, at the northern edge of its range in Travis County.
        ii. *Bernardia myricifolia*, Oreja de ratón or Mouse Ears, very rarely found away from twistflower sites; a south Texas shrub of rocky slopes, at the NE edge of its range in Travis County.
        iii. *Acourtia runcinata*, Stemless Perezia or Peonía, occasional in dry juniper/oak woods, but always found in numbers near twistflower populations; a forb of western and southern Texas, at the NE extreme of its range in Travis County.

iv. *Pellaea ovata*, Zigzag Cliffbrake, fairly common in Barton Creek valley, but scarce elsewhere on the BCP; a west Texas fern at the eastern edge of its range.

v. *Condalia hookeri*, Bluewood Condalia, rare elsewhere on the BCP, though found in other areas of the county; a major component of south Texas brushlands; near the eastern edge of its range in Travis County.

vi. *Colubrina texensis*, Texas Hogplum, uncommon elsewhere on the BCP, most often in riparian areas; a shrub of gravelly or rocky slopes, and washes and arroyos, in west and south Texas, near the NE edge of its range in Travis County..

vii. *Cynanchum barbigerum*, Bearded Swallow-wort or Thicket Threadvine, sporadic elsewhere on the BCP, but always present in association with twistflowers; a vine of south Texas and parts of the Edwards Plateau, at the eastern edge of its range in Travis County.

viii. In addition, these species, though more widespread across the BCP, are particularly abundant in association with *S. bracteatus*: *Dermatophyllum secundiflorum*, *Nolina texana*, *Phacelia congesta* (appears to be a competitor), *Commelina erecta* (appears to be a competitor), *Pinaropappus roseus*.

d. A common characteristic of these species is that they are adapted to rocky environments of hotter and drier parts of the state – and none appear to be prairie plants.
e. The list of associates may vary across the range of *S. bracteatus*. To the west, associated species adapted to moister environments might be the anomaly. For example, in Medina or Uvalde County, *Tinantia anomala* or *Forestiera pubsecens* may be one of the species that is generally uncommon, but frequent in association with *S. bracteatus*. Or there could be associates that do not range to Travis County.
f. A positive response of *S. bracteatus* to fire residues is cited as proof that the species is dependent upon fire, but that is not incontrovertible evidence, and the conjecture that S. *bracteatus* is a fire follower because it responds to smoke is spurious.
    i. Many plants that show a positive response to fire residues are not fire followers. Increased germination rates have been shown across taxa in over 37 families (Adkins and Peters, 2001). Indeed, many investigations have focused upon species in fire-prone areas, like California chaparral (Keeley and Fotheringham, 1998). However, smoke has been shown to stimulate germination in lettuce, celery, red rice, wild oats, and even some rainforest species (Adkins and Peters, 2001). Applications of

karrikinolide have extended to studies of agricultural weeds, crops, and horticultural plants (Dixon et al., 2009).

8) Phylogenetic inference does not support that *S. bracteatus* is a fire follower based on the biogeography of the genus and its close relative *Caulanthus*. Of the 35 *Streptanthus* species listed on BONAP (Biota of North America Program), 23 are in desert or seasonally arid habitats (5 are serpentine endemics). Most species are associated with habitats that are not fire-prone, and those that are fire-followers, like *S. heterophyllus,* are separated from *S. bracteatus* by long distance and many intermittent species in between. Phylogenetic inference does support that *S. bracteatus* has annual plant, arid-adapted characteristics, such as long-term seed banks.
9) Several other species of *Streptanthus* found in Texas are tied to rocky habitats (talus slopes, cliffs, gravelly streambeds). Though we are not familiar with these, none appear to be prairie species. (Habitat descriptions from Correll & Johnston, 1970.)
    a. *S. hyacinthoides*: Sand hills and sandy areas in oak woods, Texas and Oklahoma.
    b. *S. maculatus*: Most lands in woods, northeast Texas, eastern Oklahoma, western Arkansas.
    c. *S. platycarpus*: Cliff ledges, canyon-walls, talus slopes and rocky inclines. West Texas, mostly west of the Pecos; endemic.
    d. *S. sparsiflorus*: Shady places in gravel and among boulders. Guadalupe Mtns. In the Trans-Pecos; endemic.
    e. *S. carinatus*: Cliff bases, gravelly slopes, canyons and dry creek beds in the Trans-Pecos; endemic.
    f. *S. Cutleri*: Talus slopes, rocky hillsides and gravelly dry streambeds, Big Bend area of west Texas; endemic.

Given the familial propensity for rocky microhabitats, it seems reasonable at least to consider that *S. bracteatus* has also adapted to this specific microhabitat, especially since that is where it seems to be found on the BCP.

10) In short, if *S. bracteatus* is truly an ecotone species, it seems less adapted to prairie/woodland edges and more suited for the boundary between woodlands and open, rocky sites, which require little if any interference by human managers.
    a. These environments appear to be stable for long periods of time without disturbance.
        i. Extreme exposure to solar radiation in the summer, and minimal water storage potential in the shallow soils, taxes the survival of many potentially competing perennial and woody plants.
        ii. With little encroachment, these sites may be suitable habitat for decades.
    b. The habitat may also be "restored" through natural processes aside from fire.
        i. Periodic droughts may kill off encroaching woody plants, restoring the habitat.
        ii. Shallow soils also provide little support for tree roots, increasing the likelihood of blow-downs in windstorms, particularly after freezing rain events.

Given our differing viewpoints on *S. bracteatus'* habitat requirements, we recommend

collaborating on experiments to elucidate ideal conditions for this species. For example, we are experiencing increasing tree mortality and blow-downs with climate change, creating opportunistic canopy gaps where we can spread *S. bracteatus* seed without intentional canopy thinning. Removal of invasive shrubs and trees creates additional canopy gaps. We have a variety of micro-climates within the BCP where we can experiment to determine optimum *S. bracteatus* habitat under natural (i.e., no supplemental water) conditions. We can also assist with seed bank experiments. We are committed and eager to work with you to further the conservation of this imperiled species. Thank you again for the opportunity to comment on the draft SSA, please let us know if you have any questions or need additional information.

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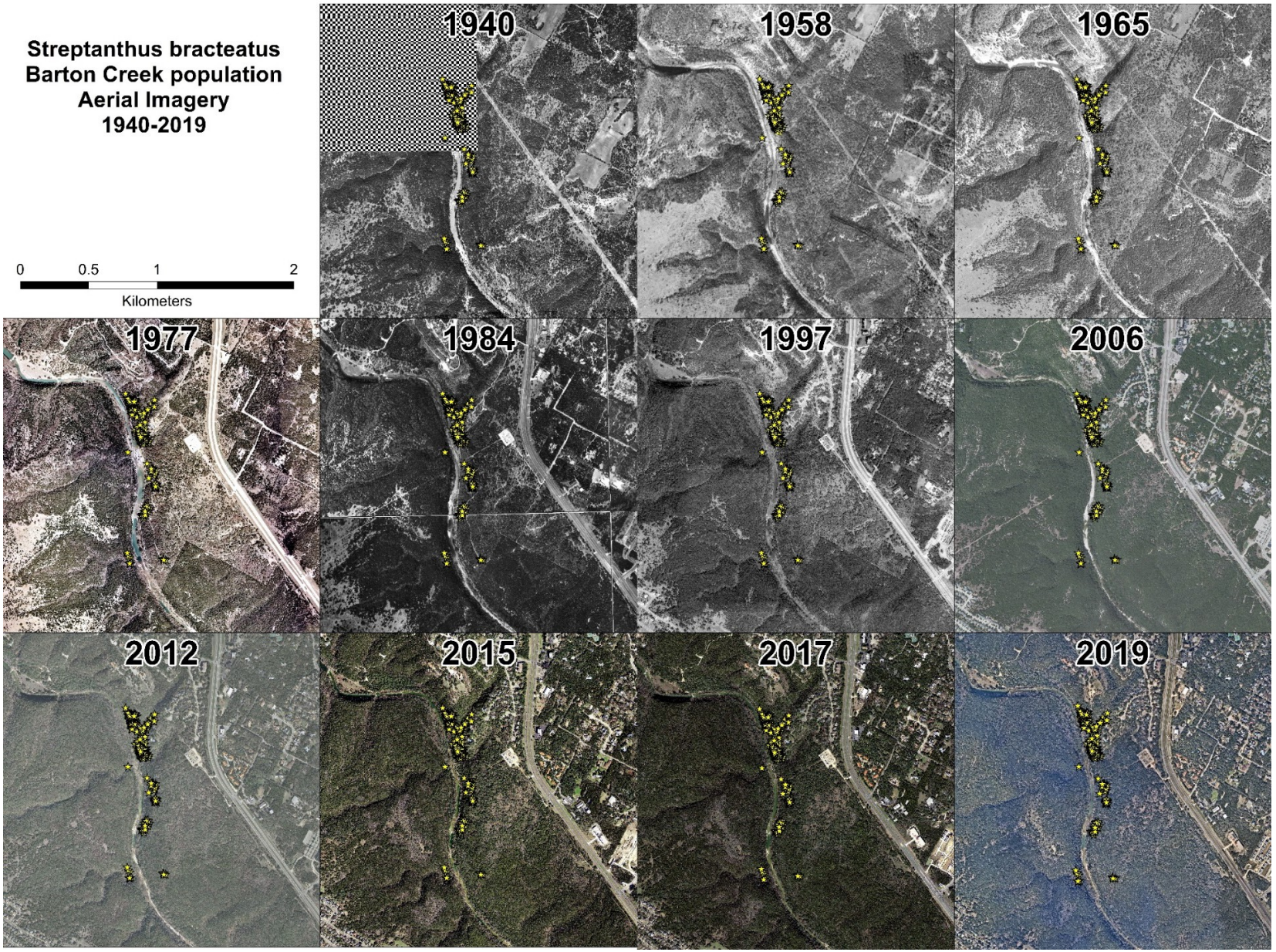
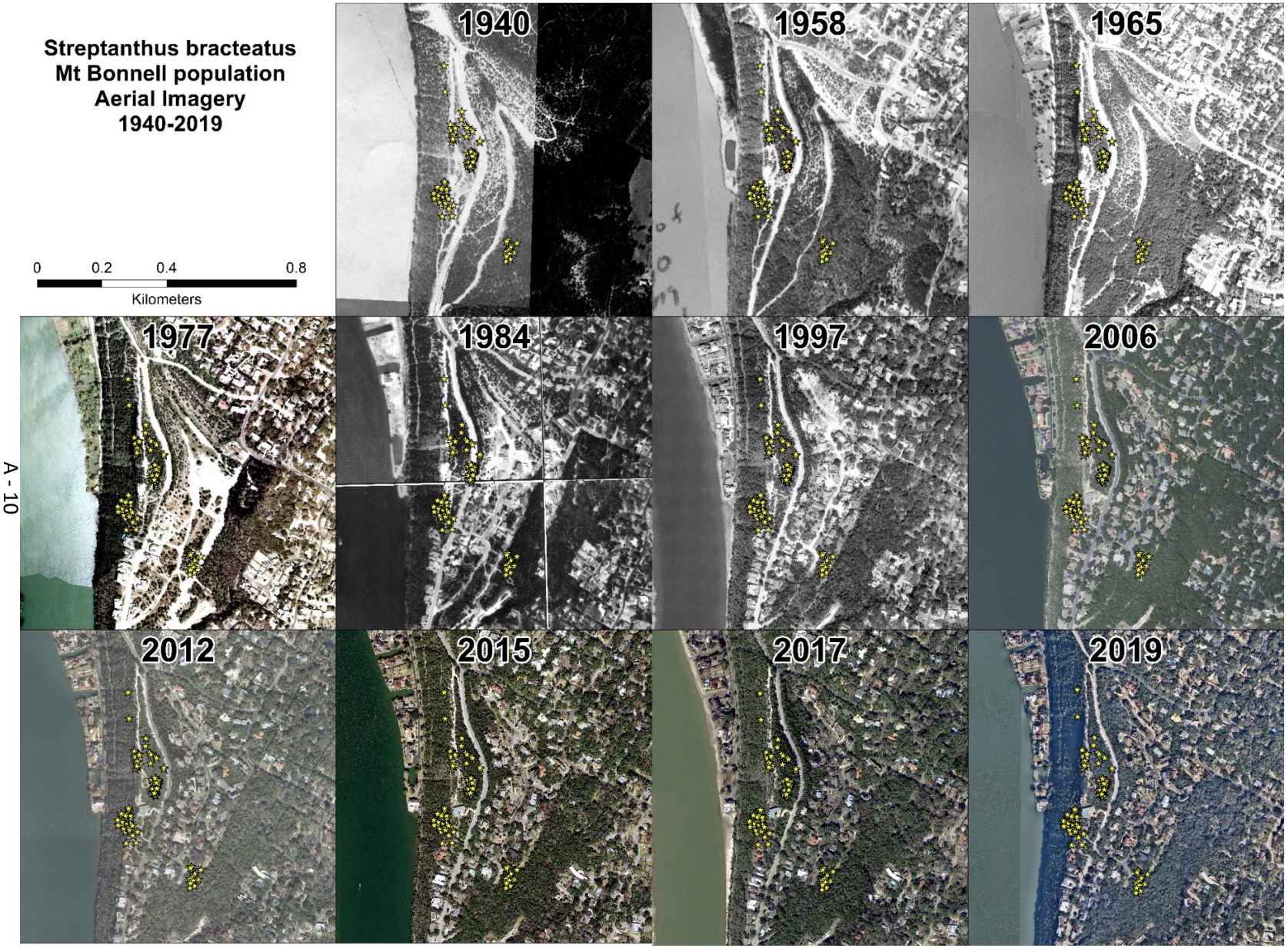
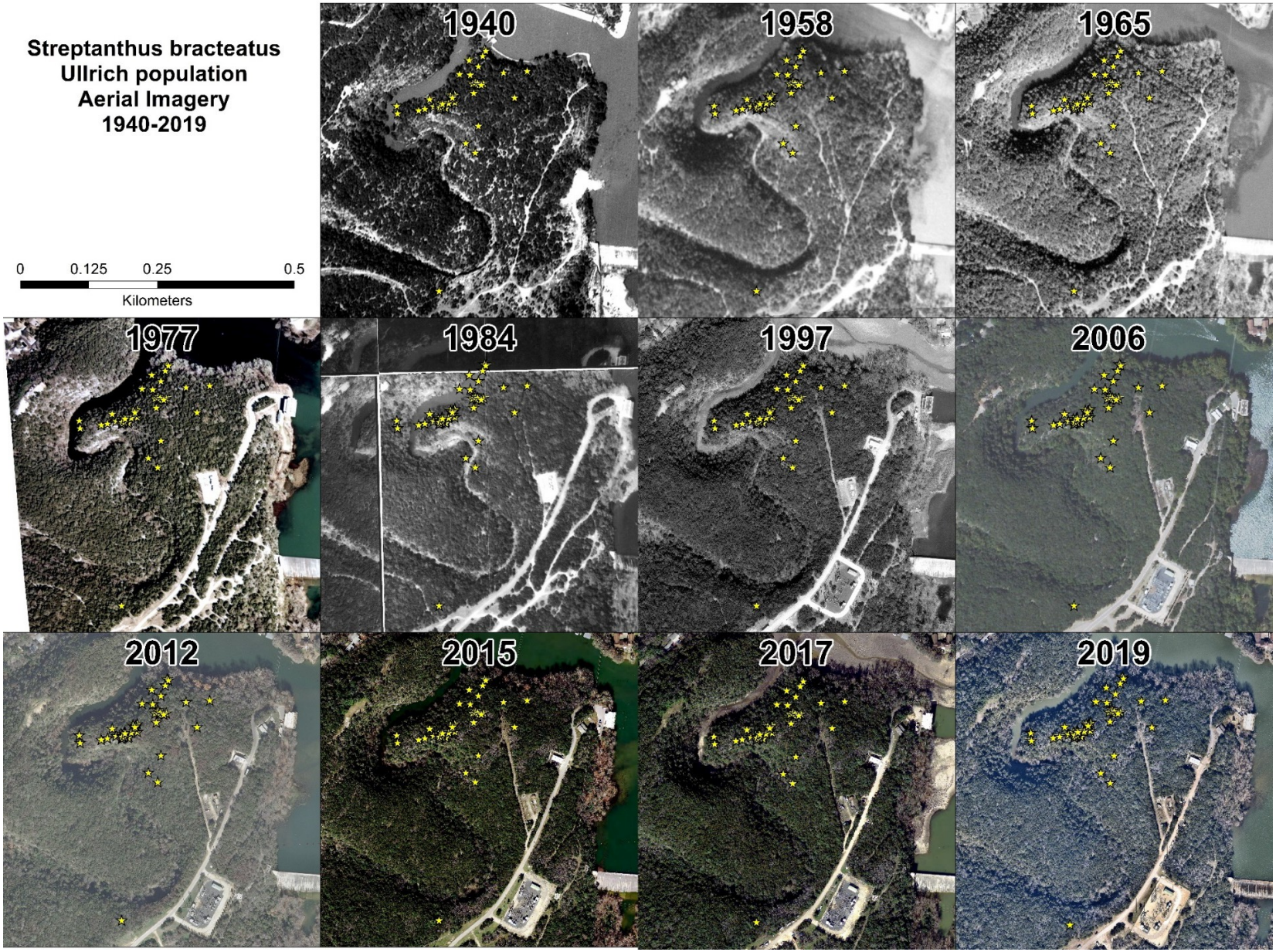
Streptanthus bracteatus
Barton Creek population
Aerial Imagery
1940-2019



Streptanthus bracteatus
Mt Bonnell population
Aerial Imagery
1940-2019



Streptanthus bracteatus
Ullrich population
Aerial Imagery
1940-2019



Streptanthus bracteatus
Valburn population
Aerial Imagery
1940-2019