BALCONES CANYONLANDS PRESERVE
LAND MANAGEMENT PLAN

TIER II-A

CHAPTER II
PLANT MANAGEMENT FOR SPECIES OF CONCERN

August 2007

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1.0 BACKGROUND INFORMATION

The regional section 10(a)l(B) permit, the Balcones Canyonlands Conservation Plan (BCCP), issued in 1996 to the City of Austin (COA) and Travis County (TC) by the U.S. Fish and Wildlife Service (USFWS), required the creation of the Balcones Canyonlands Preserve (BCP). This preserve is designed to secure habitat and protect populations of eight endangered species and 27 species of concern. The Permit Holders, COA and TC, are joined by a Managing Partner, the Lower Colorado River Authority (LCRA), and other cooperating entities (including private landowners, The Nature Conservancy of Texas, Travis Audubon Society and others) in owning and managing designated properties within the BCP. These entities are collectively referred to as the BCP Partners. Figure one on the following page illustrates the BCCP permit area and the targeted preserve areas within each of the macrosites as defined in the BCCP.

Two plants, canyon mock-orange *(Philadelphus ernestii)* and Texabama croton *(Croton alabamensis* var. *texensis),* are among the species listed for protection under the BCCP. The bracted twistflower *(Streptanthus bracteatus),* though not specifically listed in the permit, does occur and is protected within the preserve. The USFWS considers protection of this species to be a primary conservation priority. This document provides guidelines for the monitoring and management of rare plants known to occur on the BCP. The primary goal of this management plan is to protect and increase populations of these rare plants where they occur on BCP properties.

In addition to species listed for protection, species of concern, and rare species, the BCP Partners manage for numerous uncommon plants occurring throughout the BCP. Coral-root *(Hexalectris nitida)* is an uncommon flowering saprophytic species occurring in widely scattered small colonies in central and west Texas. Buckley tridens *(Tridens buckleyanu*s) and Heller's marbleseed *(Onosmodium helleri)* were not considered federal species of concern at the time of permit issuance, and were therefore not included as primary conservation targets in the BCCP (USFWS 1996). Though not specifically identified for protection, the BCP Partners strive to apply conservation practices to benefit these uncommon species throughout the preserve system.

The following biological overview lists known occurrences of canyon mock-orange, Texabama croton, and bracted twistflower in the BCP. However, there may be other locations of these plants in the preserve not yet discovered and as newly acquired BCP properties are added to the preserve continuing surveys are necessary to better assess abundance and distribution of these species. Land Managers are responsible for the

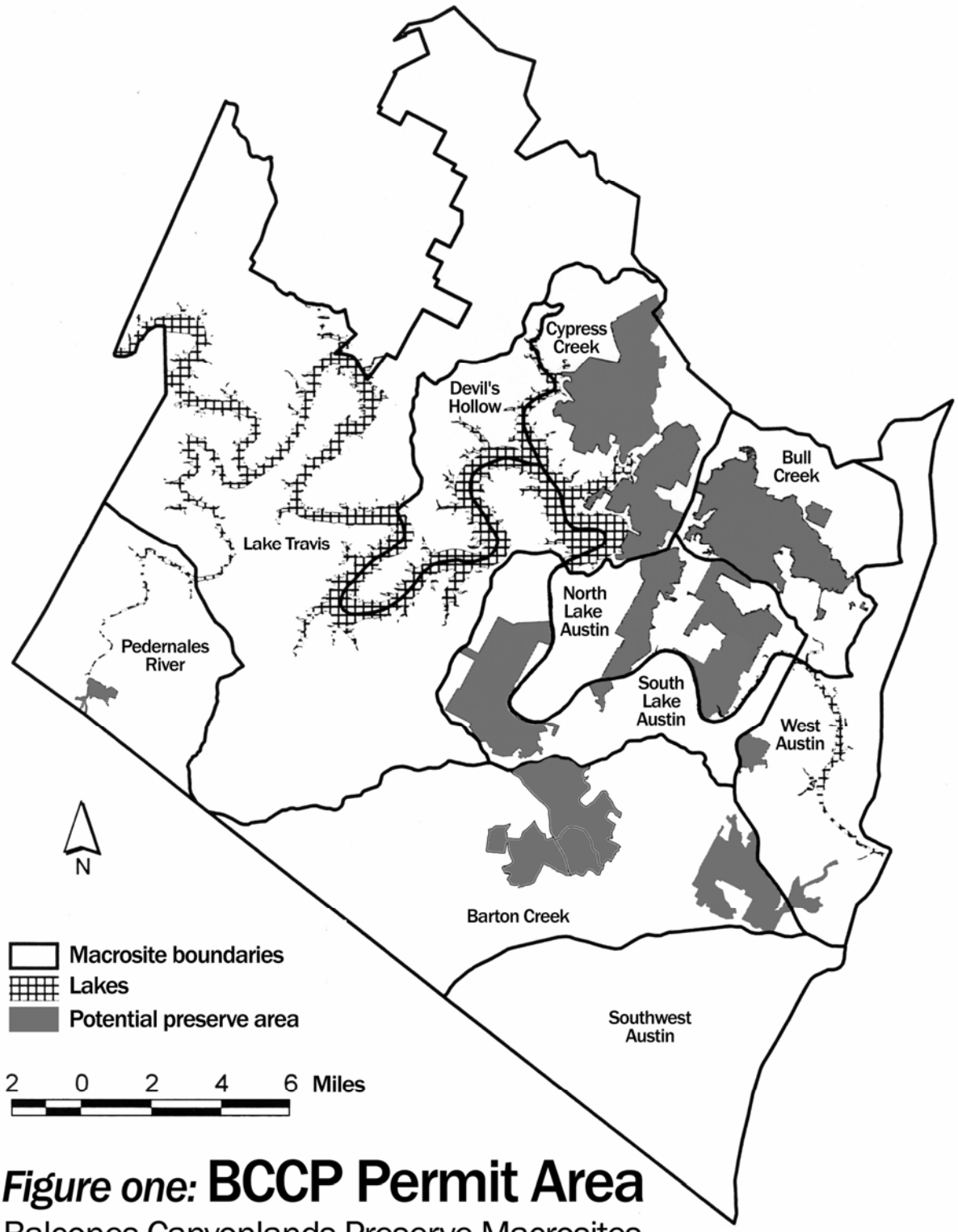

***Figure one:* BCCP Permit Area**
Balcones Canyonlands Preserve Macrosites

protection and management of those known occurrences on BCP lands. Additionally, it is in the species' best interests for the BCP and the USFWS to educate landowners about appropriate management of plant species of concern also occurring on private property. Locations of known populations are discussed in the following biological overview by macrosite (see Figure One). More information about the specific plant populations and their management is provided in Tier III individual tract land management plans.

2.0 BIOLOGICAL OVERVIEW

2.1 Canyon Mock-orange

2.1.1 Description:

The following description of canyon mock-orange *(Philadelphus ernestii)* is taken from the 1990 Biological Advisory Team (BAT) report:

> Canyon mock-orange is a deciduous shrub reaching 0.3 to 2 m in height, with arching branches. The leaves are small (0.6 to 2.8 cm long by 0.3 to 1.3 cm wide), oval to elliptic in shape, dark green on the upper surface, entire and prominently three-veined. The fragrant flowers are borne singly, have four whitish petals arranged like a cross, and are approximately 1.5 to 2.5 cm in diameter, occurring on the first year's wood.

2.1.2 Habitat:

This plant can be found growing on Edwards Limestone and a few strata of Glen Rose Limestone. These two formations both contain holes and solution cavities, which often give the rock a “honeycombed” appearance. Canyon mock-orange can be found in both xeric and mesic juniper woodland and typically grows in full shade to full sun along cliffs in humid canyons. It is found in association with the following plants: elbowbush (*Forestiera pubescens*), shrubby boneset (Eupatorium havanense), shin oak *(Quercus sinuata),* fragrant sumac *(Rhus aromatica)* Lindheimer's silktassel *(Garrya ovata* ssp. *lindheimeri),* Texas mulberry *(Morus microphylla),* Ashe juniper *(Juniperus ashei),* and yaupon holly *(Ilex vomitoria)* (BAT 1990).

2.1.3 Distribution:

The COA manages canyon mock-orange in the Bull Creek Macrosite on the Bull Creek Unit and in the South Austin Macrosite. Approximately 50% of the plants in the Bull Creek Macrosite population are located on the BCP with the remainder located on adjacent private land. The steep slopes on which this population is located may provide some degree of protection. There is concern that recent increased clearing of brush and vegetation on these steep slopes being performed as a fire safety precaution may impact these plant populations

(Sanders pers com 2004). The South Lake Austin Macrosite population of canyon mock-orange (Espey, Huston & Associates, Inc. 1989) is located on COA BCP land (Sanders pers com 2004).

Canyon mock-orange is also found in the Pedernales River Macrosite. A population is managed at Travis County's Hamilton Pool Preserve (Balcones Canyonlands Preserve 2002). Additionally, there is one known canyon mock-orange plant at LCRA's Westcave Preserve (Ahrns pers com 2004).

2.1.4 Threats

The primary threat to canyon mock-orange outside the preserve is habitat loss. The West Bull Creek population in particular is threatened by nearby development. Also, the increase in deer numbers has already caused browse damage to some plants (BAT 1990). Other potential threats include soil erosion, herbicides, pesticides (which may harm the plants' pollinators), disruption of water flow regimes and reduction of water quality. These known populations may also be threatened by the encroachment of exotic and invasive ornamental plants from nearby residences. Nearby developments or public access also increase the potential for harm by preserve visitors or illegal trespassers (BAT 1990).

The canyon mock-orange population at Hamilton Pool Preserve could be threatened by public access pressures, visitors are urged to stay on designated trails to reduce these potential impacts.

2.2 Texabama Croton

2.2.1 Description

Texabama Croton *(Croton alabamensis* var. *texensis)* is described in the BCCP pre-application draft (1992) in the following manner:

> *Croton alabamensis* var. *texensis* is a shrub reaching six feet or more in height. It sometimes spreads by the rooting of lower branches. The stems have thin gray bark and are leafy only near their tips. Leaves are spirally arranged, 2 to 3.5 inches long, with entire margins, dark green above and copper-colored from a covering of shiny scales below. Flowers form at the tips of the branches. A flowering stalk may bear female flowers at the base and male flowers above or all flowers may be of the same sex. A higher percentage of female flowers are produced later in the blooming period. Female as well as male flowers have both petals and sepals. All other U.S. crotons lack petals in the female flowers. The five sepals and five petals of the flowers of both sexes are scaly on the outer surface. Five orange glands are found just inside the

sepals. The male flowers have yellowish petals and usually 14-18 stamens. Female flowers have three down-curved yellow-furrowed (turning reddish brown with age) style branches from the top of a squat, scale-covered ovary. The style branches may fork once or twice near the tips. The light-brown seed capsules are one fourth to one third inch high. The seeds are chestnut-brown with white blotches and streaks.

2.2.2 Habitat

Texabama Croton occurs as an understory shrub in Texas oak series mesic limestone canyon forest. Depending on the site, dominant trees may include plateau live oak *(Quercus fusiformis),* Texas oak *(Quercus buckleyi),* and/or Texas ash *(Fraxinus texana).* Lindheimer's silktassel and yaupon may be important understory shrubs. Some plants also grow in partial or full sun on adjacent drier slopes and plateaus in Ashe juniper-oak woodland/grassland.

2.2.3 Distribution

Though not within the BCP targeted area for protection and preserve acquisition, Texabama Croton has been found in Travis County's Pace Bend Park in the Lake Travis Macrosite. These populations are being managed and protected by Travis County in accordance with BCCP Land Management Guidelines.

2.2.4 Threats

With the exception of habitat destruction and accidental damage to the known populations at Pace Bend Park, there are few known threats to the Travis County populations of Texabama croton. For example, local flooding in 1997-1998 caused Lake Travis to rise and inundate some of the populations at Pace Bend Park, killing some of the plants (Carr pers com 1998).

Additionally, published reports indicate that Texabama Croton is fire tolerant and hypothesized that fire might be a limiting factor in the distribution of the species (Farmer 1962, Hayden et al 2001). Recent anecdotal evidence seems to indicate that this species is not only fire tolerant, but that plants exposed to fire have resprouted vigorously (J. Cornelius, L. Sanchez, C. Sexton, pers com 2005). This topic would seem to merit additional investigation and/or research.

2.3 Bracted Twistflower

2.3.1 Description:

The following description of bracted twistflower *(Streptanthus bracteatus)* is from the 1990 BAT report:

Bracted twistflower is an erect, herbaceous, somewhat succulent annual ranging in height from 0.25 to 1.5m. The leaves form a clump at the base of the stems. The lower leaves are spoon-shaped and lobed. The upper leaves are arrow-shaped and clasp the stem. The leaves are glossy and light to dark green. The violet-purple flowers are scattered at the top of the stem, and arise from prominent green triangular bracts. The flowers are approximately 1 to 2.5 cm in width, and are comprised of four spoon-shaped petals. The fruit is a long, thin pod 7.5 to 20 cm long and 0.5 cm in diameter curved and brown. The fruit contains many seeds.

2.3.2 Habitat:

Bracted twistflower occurs on thin clay soils blanketing limestone. All known Travis County populations occur in oak-juniper woodland with a canopy cover of 25-100%, and most known sites are in areas that contain thick brush which appears to provide protection from deer. Plants that occur in association with bracted twistflower include evergreen sumac *(Rhus virens)*, Lindheimer's silktassel, shin oak, elbowbush, and myrtlecroton *(Bernardia myricifolia)* (BAT 1990). Other plants often associated include cedar sage (*Salvia Roemeriana)*, blue curls (*Phacelia congesta,)*, peonia (*Perezia runcinata*) and/or silver-puff (*Chaptalia nutans*) (Holder pers com 2004).

2.3.2 Distribution:

There are currently no known populations in the North Lake Austin Macrosite. In the early 1990s, University of Texas Graduate Student David Zippin initiated an experimental population of bracted twistflower at Emma Long Metropolitan Park. In the late 1990s, the COA Parks and Recreation Department had initiated preliminary reintroduction work for restoration purposes under the advisement of Dr. Norma Fowler, a botany professor at the University of Texas at Austin. Seeds were selectively removed from the Bee Creek (Ullrich Water Treatment Plant) population and approximately one-tenth of the seeds were planted at Zilker Preserve each year (Stone pers com 1999). Surveys in 2000 through 2004 have shown no survivors from these efforts (Sanders pers com 2004).

The Barton Creek Macrosite contains several bracted twistflower populations on COA land. COA and Texas Parks and Wildlife Department (TPWD) researchers and volunteers have continued monitoring the original plots located by Zippin in this area in the early 1990s. The numbers of plants in Zippin's original study plots has continued to decline dramatically over the years due to trail erosion, effects of creek flooding, effects of trampling by trail users, and possible effects of succession of overstory vegetation. Researchers monitoring locations outside of Zippin's original survey plots believe that the population area is larger than

originally described. Monitoring the study plots alone does not show the extent of the population in this area since environmental conditions and seed dispersal has continued to change their locations (Linam pers com 2004). Additionally, COA has installed new fencing along a utility easement to reroute human foot traffic and constructed deer exclosures to protect these populations from herbivory impacts (Sanders pers com 2004).

The West Austin Macrosite contains two populations of bracted twistflower on BCP properties: one in Bee Creek (Ullrich Water Treatment Plant) and one in Mt. Bonnell Park (USFWS 1996). A population located on private land adjacent to Mt. Bonnell Park was lost in 2004 due to development (Holder pers com 2004).

A population also exists on the Brightleaf Preserve. Until 2005, Brightleaf was a State Natural Area managed by TPWD, and is currently owned by the Austin Community Foundation. Travis County has been approached and is interested in negotiating for possible future partnership and/or management of Brightleaf Preserve.

2.3.4 Memorandum of Agreement

Although the Permit describes the bracted twistflower as a "primary species of concern," this species does not have any federal protected status. USFWS did not wish to allow any "take" and did not feel that the mitigation approach outlined by the Permit could guarantee protection for this very rare plant. As a 10(a) permit, inclusion in the BCCP would have "allowed" loss of this species outside of preserve areas. Therefore, this plant was not listed as one of the species for which "take" could be mitigated through the BCCP. USFWS recommended protection for the species wherever it was found, and the BCP Partners have worked to identify and protect populations within the preserve. Recognizing the imperiled status of this non-listed species, the BCCP Partners entered into a Memorandum of Agreement with other concerned groups in 2004 with the goal of increased cooperation to protect and manage for this plant (MOA 2004).

The Bracted Twistflower Memorandum of Agreement (BTMOA) was signed by COA, Lady Bird Johnson Wildflower Center, LCRA, TPWD, Travis County and the USFWS (MOA 2004). This agreement outlined several monitoring, protection and enhancement strategies to promote cooperative efforts to conserve the bracted twistflower. From 2002 through 2005, the BTMOA partners conducted bracted twistflower training sessions for staff and volunteers; coordinated monitoring and search efforts; constructed deer exclosures; provided educational information to survey volunteers, agency staff, homeowners and the general

public; encouraged additional genetic research; maintained a seed bank and propagated plants; and identified habitat for potential future restoration projects.

2.3.5 Threats

Loss of habitat poses the greatest threat to remaining populations of bracted twistflower. Populations have been lost to development (Holder pers com 2004). Browsing by deer is another significant threat, as many plants show damage caused by deer (Zippin 1997). As wildlands surrounding the BCP are developed, deer populations and therefore browsing pressure are likely to increase, potentially further threatening bracted twistflower populations (Kennedy pers com 1998). Other threats include "decreases in suitability of the remaining habitat due to changes in the vegetation, changes in water flow and purity, erosion, brush clearing, trash dumping, (and) foot and vehicular traffic" (McNeal 1989).

3.0 MANAGEMENT PROGRAM

In the next 5 years, the Managing Partners will develop a specific management and monitoring/research plan for each of the plant species of concern - canyon mock-orange, Texabama croton, and also for bracted twistflower. Until developed, known populations of these plants will be managed and monitored under the following general guidelines by the appropriate BCP Partner. Known populations for these species are shown below in Table 1 by managing agency.

Table 1: Plant Species of Concern Known Locations by Managing Agency

	canyon mock-orange	**Texabama croton**	**bracted twistflower**
City of Austin	Bull Creek Unit, South Lake Austin Macrosite		Mt. Bonnell Park, Barton Creek Wilderness Preserve, Ullrich Water Treatment Plant
Travis County	Hamilton Pool Preserve	Pace Bend Park	
LCRA	Westcave Preserve		

3.1 Management Goals and Objectives

The primary goal of this management plan is to protect and increase populations of these rare plants where they occur on BCP properties. The management goals are to protect, maintain, monitor, and, where appropriate, actively manage the populations. Once comprehensive distribution and abundance information is available for populations within the BCP, an added goal may be to expand and/or establish new populations in suitable locations.

Management objectives for canyon mock-orange, Texabama croton, and bracted twistflower include:

- monitor known populations of canyon mock-orange and Texabama croton at least every 3 years and populations of bracted twistflower at least once a year.
- continue to survey for new populations of all 3 plant species of concern;
- continue with basic research on plant ecology and habitat for all three species;
- protect plants from physical harm by constructing exclosures and brush piles to protect populations from deer and hog herbivory, hog damage and human trampling; use educational signage when these exclosures are located along trails open to the public;
- conduct animal management activities to control white-tailed deer herbivory on rare plants and oak regeneration and feral hog management to control damage to plants and the overall habitat;
- monitor and protect, where possible, species from upslope erosion and debris caused by storm water runoff, construction activities, etc.;
- maintain or improve existing habitat through vegetation management (e.g., prescription fire, mechanical, hand and/or chemical control where appropriate);
- until the results of management are well-documented, continued collection of pre-management baseline data and post-management monitoring for any on-going management activities that might impact the plants is essential;
- maintain records of removal of non-native species including the species name, number of individuals (or measurement), date, person/effort, and site of removal.
- train and better coordinate efforts between park management staff and BCP staff;
- increase public education and outreach efforts concerning these species;
- survey newly acquired BCP tracts for the presence of these or any other unique plant species; and
- continue to collect baseline data on unique endemic plant species. Unusual species previously unrecorded will be assessed for degree of rarity and protected as appropriate.

3.2 Issues

Little is known about the basic biology and ecology of these plant species of concern, and more information is needed in order to determine appropriate management practices. Searches for suitable habitat areas for these species should be identified as BCP tracts are acquired, and surveys should be conducted to identify new populations.

Regular monitoring will uncover important life history and habitat characteristics of the plants biology and ecology, and will aid in refining management practices. Research for each

species should be evaluated cooperatively by BCP Partners, the BCP Scientific Advisory Committee (SAC), and the USFWS.

Public access must be compatible with conservation of the species. Routing trails or access routes to avoid close proximity to these species may be desirable. Deer browsing may require active management to reduce impacts. Increased education and outreach especially to landowners adjacent to BCP tracts to encourage management practices beneficial to these species (limited brush clearing and herbicide applications, control of deer access, etc) should be encouraged. For detailed information on public access see Tier II-A, Chapter XII.

3.3 Specific Management Strategies

Active management of the habitats of the plant species of concern involves a variety of strategies. Appropriate land management includes the control of aggressive non-native plants near or in their habitats, as well as the limitation of browse impacts and protection of plant species of concern from physical harm by human activities. In some cases, it may be necessary to control canopy closure and/or other competition from nearby plant species. Regular monitoring of the known populations may reveal additional problems that should be addressed. Any activity involving direct manipulation of the species (e.g., seed harvesting, propagating, seed dispersal, planting) should be undertaken in a quantitative experimental context using best conservation practices, and directed by a written plan reviewed by the SAC and the USFWS. Specific recommendations relating to appropriate land management strategies are discussed below.

3.3.1 Mechanical or Hand Control

BCP Land Managers may anticipate situations when mechanical controls may be beneficial in the management of a particular species of concern. Land Managers may, for example determine through observation and monitoring that another plant species is harming a population of plant species of concern. Such harm may be displacing individuals within the population or causing some observable stress, such as lack of flowering or seed set. Mechanical or hand control is often the easiest, most selective and most reliable management method available to a manager under these circumstances.

"Weedwrenches™ " or other easily carried and manipulated tools allow the user to physically pull up small diameter woody plants (four inches or less in diameter) by their roots with minimal disturbance to the surrounding plants.

Land Managers should record the methods employed as well as measures of effectiveness for various treatments for the land history record and for use by other BCP Land Managers.

3.3.2 Prescribed Burning

The frequency of wildfires has decreased dramatically since Europeans settled in America. While some species benefit from prescribed burning, non-tolerant species may be harmed by fire. A thorough literature search should be made by any BCP Partner who chooses to explore this management strategy regarding known impacts or benefits of fire on the plant species of concern. The BCP Partner should also communicate directly with published researchers or other managers with direct experience managing fire in areas with the species in question.

Initial attempts to use prescription burning to stimulate any of these species should be approached with caution and be used on only a small percentage of the population. A prescription detailing habitat management burn objectives for areas with plant species of concern must be reviewed and approved by fire managers, the SAC and the USFWS. See Tier II-A Chapter VI for more information.

Recent research reveals that that fire is actually shown to be beneficial for Texabama croton based on the effects of a fire at Fort Hood (Romero, Halward and Shaw, 1996) and also the response to prescribed fires at the Balcones Canyonlands National Wildlife Refuge (Sexton pers com 2005).

3.3.3 Chemical Control

Any use of chemical controls around plant species of concern must be described in the approved site management plan and should not occur within 100 feet of plant species of concern without consultation with the SAC and the USFWS.

Land managers using any chemicals, including pesticides and fertilizers, near populations of plant species of concern must proceed with caution (See Tier II-A Chapter IV). Such chemicals can drift and affect plants some distance away. Some chemicals travel easily through the soil and can impact nearby plants.

Guidelines for applications of herbicides for specific purposes, such as control of stands of exotic, invasive, or nuisance plants, and vegetation management at human access points, are discussed in the Tier II-A Chapter IV. All applications of chemical herbicides must be performed under the supervision of a state-licensed applicator and be in compliance with all

local, state, and federal regulations. Documentation must be kept on file by the Land Manager and conveyed in annual reports per Tier II-A Chapter IV.

3.3.4 Animal Management Procedures

Managers may wish to control invertebrate herbivory during growth stages prior to and after flowering. Caution should be used to avoid negatively affecting pollinators or other species. Land Managers considering controlling invertebrate populations shall consult with conservation botanists including TPWD and the USFWS to determine the safest and most effective approach (Kennedy pers com 1998). Any control measures must be evaluated in terms of potential impacts to the overall habitat and other listed species and species of concern.

Plant species of concern are also vulnerable to deer browse and may be impacted by feral hog activity. Boundary fencing with deer fences, or deer and hog exclosures should be constructed to protect selected plant populations from these disturbances. See Tier II-A Chapter X for guidelines on controlling these and other species that can pose problems for the plant species of concern.

3.3.5 Visitor Management

The preserve system offers public access and recreational opportunities at selected sites. Public access will be discouraged where and when such access directly or indirectly threatens the welfare of the plant species of concern protected under the regional permit. Additionally, public access may be denied due to risks of degradation or loss of soil, vegetation, or water resources. See the Tier II-A Chapter XII for guidelines**.**

Efforts should be made to increase public and adjacent landowner awareness of these plant species of concern. Land Managers may choose to limit information concerning locations of specific species or populations. Increased education and outreach concerning the impacts of deer browse and the harmful effects of inappropriate brush clearing, pesticide and fertilizer use are particularly important. This may be accomplished through the use of programs, brochures, exhibits and signs at trailheads. These may describe the natural history, ecological requirements, and threats to these species and should specifically state that disturbing or removing any plants from the preserve is illegal and strictly prohibited. See Tier II-A Chapter XIII for more information on public education and outreach efforts.

If new trails are constructed, they should be located to avoid impacting these plant populations. Fencing that excludes people or fencing to route human foot traffic away from plant populations will also be used to reduce impacts.

3.3.6 Coordination of Management

Land Managers should report techniques employed and results of management efforts in the BCP Annual Reports. BCP Partners will coordinate on surveys and monitoring efforts when feasible, and evaluate outcomes and need for management adjustments based on new findings.

Since some locations for these plants are in city or county parks managed by other departments, Travis County and the COA BCP staff will continue to train and coordinate plant protection efforts with park staff to help ensure that these plants are protected.

4.0 INVENTORY, MONITORING, AND RESEARCH

Systematic searches for plant species of concern, in both new and current BCP tracts, will be conducted in suitable seasons and habitats. Monitoring known populations will provide valuable life history and ecological information that can be used in management activities. Research is needed about the basic biology and ecology of these plant species of concern. Land Managers should encourage research topics facilitating long-term recovery of the species such as reproductive biology, habitat characterization, reintroduction strategies, pollinator identification and ecology, etc.

It is important that managing entities standardize monitoring methodologies to ensure statistical validity of data recorded across the preserve. In conjunction with the guidelines set forth in this chapter, the managing entities will summarize annual research activities and describe management practices and results in the BCP annual report for review by the SAC and the USFWS.

4.1 Inventory

Systematic searches for plant species of concern should be conducted during the proper season in suitable habitat across the BCP. Search areas should be mapped, and both positive and negative results recorded to best direct future efforts. Survey methods and personnel should also be recorded. Annual surveys (until all suitable habitats have been thoroughly surveyed) will not only increase our knowledge of the distribution and habitat of these species, but also aid in land management planning.

4.2 Monitoring

Monitoring for the plant species of concern will determine their responses to protection and management practices by assessing their population area and size, survivorship, productivity, threats, long-term population trends, and biotic and abiotic habitat characteristics. Site-specific monitoring plans should be developed for each species. Such plans should follow generally accepted monitoring practices, such as those developed by TPWD, Lesica (1987) for woody plants (canyon mock-orange and Texabama croton), and/or photo monitoring. Large-scale monitoring methods such as the Land Condition Trend Analysis developed by the U.S. Army are probably not applicable to the smaller scale changes in community dynamics that would need to be measured for the species of concern (Poole pers com 1999).

The plans should be reviewed by the SAC and the USFWS. All data should be compiled and reviewed regularly by all managers and researchers involved in monitoring and/or managing the plant species of concern. The data should also be made available to the SAC, TPWD and the USFWS.

In general many different methodologies may need to be tried before the best one is selected. An annual species such as the bracted twistflower will need to de monitored more frequently, probably several times a year, to determine demographic and life history features. Woody perennials such as the Texabama croton and the canyon mock-orange may not need to be monitored as often, depending on what criteria are being monitored.

4.3 Research

Research on the plant species of concern is an essential element along with inventory, monitoring, and management in assuring the long-term survival of the plant species of concern. Research would be conducted in a manner that would provide scientifically valid information to benefit management of the species and may include such things as species' habitat requirements, population health and viability, potential dispersal and genetic problems, etc. Additionally, research proposals and projects aimed at specific life history aspects (phenology, pollination, etc.), habitat characteristics (edaphic or micro-climatic requirements, etc.), or management responses (to prescribed fire or vegetation removal, etc.) are encouraged and will help in the protection, management, and recovery of these species. More research is clearly needed, and all manipulation of these species should be undertaken in a quantitative experimental context using best conservation practices and directed by a well thought out written and approved plan (approved by: USFWS, BCCP SAC and BCCP Coordinating Committee).

Reintroduction or augmentation of rare plant populations is a controversial topic, and has yielded only very limited success to date. For a general overview of the subject, see *Restoring Diversity, Strategies for Reintroducing Endangered Plants* (Falk et al. 1996). BCP Partners can consider a proposal on reintroduction of bracted twistflower, canyon mock-orange, and Texabama croton on preserve tracts. Reintroduction plans should be reviewed by BCP Partners and receive approval by the SAC and the Coordinating Committee Secretary. BCP Partners should also consult with TPWD and USFWS on reintroduction proposals.

All research projects, whether conducted by BCP Partners or outside researchers, should adhere to the goals of the management plans and guidelines (i.e., the research shall not result in the "take" of a species of concern or other species covered by this plan, or in any way degrade the habitat of such a species). All research plans including reintroduction or augmentation approved by the BCP Partner should be reviewed by the SAC and the USFWS. All research shall abide by the BCP management plans and preserve rules. Research findings, management recommendations, annual and final reports shall be supplied to the BCP Partners, the SAC, and the USFWS.

4.3.1 Research Needs

Research needs include the following however, this is not an exhaustive list:

- Life history of BCCP plant species of concern (phenology, pollination, habitat characteristics, ecology, etc.)
- Management responses to fire, vegetation removal, deer exclosures, etc.
- Reintroduction or augmentation of rare plant populations
- Survey for new locations of rare plants
- Best management practices for each species

4.4 Guidelines for Biological Research by Non Balcones Canyonlands Preserve Staff

BCP land managers may receive requests from individuals, groups or organizations seeking permission to carry out research within the preserve. Such research must comply with the goals of management plans and guidelines as defined by the HCP and the USFWS permit (i.e. no research shall be permitted to "take" endangered species or in any way degrade protected habitat). Each BCP Partner is responsible for all research underway on tracts that they own or manage. Researchers must obtain approval from the land manager responsible for each tract within the research area. If proposed research may impact endangered species, the researcher shall be responsible for obtaining and providing current copies of the appropriate permits from USFWS and TPWD to the land manager before any research

authorization may be provided. Researchers are required to abide by all BCP management plan guidelines and preserve rules. An annual report documenting all research occurring on the preserve must be submitted to the USFWS, and any publication resulting from such research must recognize the participation of the BCP partners. Individual BCP Partners may have additional requirements of researchers that are not listed here.

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