



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

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### Memorandum

To: David Maple, Acting Refuge Manager, Balcones Canyonlands National Wildlife Refuge

From: Adam Zerrenner, Field Supervisor, Austin Ecological Services Field Office

Subject: Draft Programmatic Biological Opinion for the Balcones Canyonlands National Wildlife Refuge's proposed 15-year Habitat Management Plan (TAILS# 02ETAU00-2016-F-0001).

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) on the proposed Habitat Management Plan (HMP) for the Balcones Canyonlands National Wildlife Refuge (BCNWR or Refuge), located near Lago Vista, in portions of Travis, Williamson, and Burnett counties, Texas, and the effects on the federally listed golden-cheeked warbler (*Setophaga chrysoparia*) (GCWA) and black-capped vireo (*Vireo atricapilla*) (BCVI). This BO addresses habitat management activities that are proposed to occur within the 80,000 acre acquisition boundary for BCNWR over the next 15 years, at a programmatic level. BCNWR's letter requesting intra-Service formal consultation was submitted on June 4, 2015.

This BO has been prepared in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C 1531 et seq.). It is based on information in BCNWR's Biological Evaluation (BE), which was included with the formal consultation request, the draft HMP, information provided by BCNWR staff, Service files and other sources of information. A complete administrative record of this consultation is on file at the Service's Austin Ecological Services Field Office (AUESFO).

The current list of federally threatened and endangered species that are known to occur, or have been documented in the vicinity of BCNWR is presented in **Table 1**.

Common Name	Scientific Name	Status
black-capped vireo	<i>Vireo atricapilla</i>	Endangered
golden-cheeked warbler	<i>Setophaga chrysoparia</i>	Endangered
whooping crane	<i>Grus americana</i>	Endangered

Two federally listed endangered species are known to occur on BCNWR property and are likely to be adversely affected by the implementation of the proposed HMP, the BCVI and GCWA.

Whooping cranes are rare migrants in the area of BCNWR, with only three documented sightings of whooping cranes flying over the refuge during their migration. There is no nesting, foraging, or roosting habitat within the boundaries of BCNWR, therefore, the whooping crane would not be affected by the proposed HMP actions and are not considered further in this BO. In the event that this species is observed on the refuge, all habitat management activities would be suspended in proximity to whooping cranes until they have departed the area.

BCNWR contains habitat for several other listed species found in Travis and Williamson counties. BCNWR contains a considerable number of caves and karst features within the refuge and acquisition boundaries. These karst features may provide suitable habitat for listed karst invertebrate species. Several caves in the Refuge area were mapped and explored for biological resources by local experts in the late 1980s and early 1990s, and a few as recently as March 2015. None of the protected karst species have been detected within BCNWR (Elliott and Reddell 1989, Reddell 1991, Elliott 1992, USFWS 1994, TPWD 1995).

Currently, BCNWR is negotiating with the Texas Speological Survey to conduct long-term biological surveys, karst feature mapping, and management actions on all of the known, and yet to be discovered, karst features on the refuge. It is possible through this effort new species locations will be identified, which may include federally-listed species. The HMP however proposes to manage the surface areas as native ecosystems and would manage the actual karst features consistent with the AUESFO's Karst Preserve Management and Monitoring Recommendations (Service 2014a). As such, no adverse impacts are anticipated, no incidental take coverage is requested, and karst species will not be considered further in this BO.

While none of the listed *Eurycea* salamander species are known to occur on BCNWR, suitable habitat for these species may occur in at least one spring (Mason Hollow) on the Refuge. The spring-fed stream at that location appears similar to the known habitat of the species about 5.5 miles to the southeast, on the Balcones Canyonlands Preserve (BCP). Brief searches of the Mason Hollow spring in the mid-1990s and in 2012 failed to find any salamanders, but further field investigations are warranted. *Eurycea* salamanders may yet be documented in this location or elsewhere in springs on the refuge. Should any salamanders be documented from Refuge springs, their specific identity would need to be verified through genetic testing due to the small geographic scale of genetic differentiation in this group of salamander populations (Chippindale 2000). As with listed karst species, no adverse impacts from the proposed management actions are anticipated to listed *Eurycea* salamanders, and no incidental take coverage is requested. These species will not be considered further in the BO.

On December 29, 2014, the Service announced it would be conducting a status review of the monarch butterfly (*Danaus plexippus*) under the Act. The Service determined that a petition to list a subspecies of the monarch submitted by the Center for Biological Diversity, the Center for Food Safety, and the Xerces Society for Invertebrate Conservation and Dr. Lincoln Brower, presented substantial information, indicating that listing may be warranted. BCNWR is located within the north/south migratory corridor for the monarch and they are known to rest, feed, and breed on the refuge in the spring and fall. BCNWR requested incidental take coverage for HMP actions that may alter monarch migratory habitat; however, the monarch does not have any federal regulatory protection at this time and the Service is unable to evaluate the HMP's effects

to the monarch in this BO. If the Service determines that federal protection is warranted and the species is listed, the Service would reinitiate consultation to determine if the HMP's management actions would result in jeopardy to the species and determine the amount of incidental take that is warranted.

### **Consultation History**

- June 4, 2015: BCNWR provided the AUESFO with a draft HMP, BE, and request for formal intra-Service section 7 consultation.
- June 5, 2015: Meeting between Refuge biologist and AUESFO staff to discuss the information in the Refuges BE initiating formal section 7 intra-Service consultation on the HMP.
- September 28, 2015: The AUESFO initiated formal section 7 consultation on the proposed HMP.
- January 8, 2016: Meeting between AUESFO and Refuge biologists to discuss the HMP and draft BO.
- January 19, 2016: The AUESFO provided a draft BO (21450-2016-F-0) to BCNWR.
- February 9, 2016: BCNWR provided comments on the draft BO to the AUESFO.
- February 12, 2016: AUESFO finalized the biological opinion and issued it to BCNWR.

### **BIOLOGICAL OPINION**

#### **Description of Proposed Action**

For specific information regarding the BCNWR's long-term habitat management actions and objectives, please refer to the Refuge's BE and HMP.

The BCNWR HMP is a step down plan from the Comprehensive Conservation Plan (CCP) approved in 2001. The CCP offers a broad overview or framework for management of existing and future lands and a multitude of aspects related to refuge management (i.e. education, outreach, physical infrastructure, archeological resources, etc.). The Resource Management Goals in the CCP are (USFWS 2001):

1. restoration and enhancement of threatened & endangered species habitat on Refuge lands;
2. protection and enhancement of habitat for a diversity of wildlife, including migratory birds;
3. restoration of watershed health to minimize sheet-flow runoff and siltation, enhance seasonal stream flow, and maximize ground & surface-water recharge;

4. development of interpretive programs that enable the public to (a) enjoy fish & wildlife resources inhabiting the Refuge, (b) understand these resources and issues related to them, and, (c) act to promote fish & wildlife conservation;
5. protection of habitat within approved Refuge boundaries by fee acquisition or conservation easement;
6. accurate, up-to-date data on roads, other physical infrastructure, habitats and wildlife, and plant species;
7. compliance with historical and archeological resource protection laws and regulations; and,
8. efficient administration that supports Refuge objective accomplishments.

The HMP builds upon this by providing more specific information related to habitat management. The HMP provides long-term goals and strategies specific to the management of refuge habitats and will help guide the refuge manager in maintaining and restoring the biological integrity, diversity, and environmental health of the Refuge through an adaptive management process. Each National Wildlife Refuge (NWR) is required by Service Policy (620 FW 1) to have a HMP. Specific project and/or treatment plans would be developed annually based upon the guidance provided in the HMP. Maps of the habitat management boundaries are included in Appendix B of the HMP.

The HMP is a long-term, dynamic document that provides specific guidance on management strategies. These strategies are based on information gained from management and research to date. However, adaptive management (a process that uses feedback from research and monitoring and evaluation of management actions) would be necessary to support goals and objectives throughout the duration of the HMP. The HMP would be in effect for 15 years from the date of approval, and undergo a review every five years; however, revisions to the HMP can occur as necessary. Additional section 7 consultation would be needed if the revisions change the magnitude of the anticipated effects to the GCWA or BCVI, the amount of incidental take expected, or if another species or critical habitat (CH) is designated before the 15 year duration of the HMP has expired.

In accordance with the paragraph above, the Refuge has attempted to identify all known reasonable management actions contemplated to occur over the 15-year term of the HMP, and has identified all currently owned lands and lands likely to be acquired in the near future. However, with new technology, knowledge, and landownership come new management techniques and opportunities. It is likely these management actions and opportunities, currently not identified in the HMP, may be deemed beneficial to the GCWA or BCVI. If the Refuge identifies beneficial management actions or opportunities not identified in the HMP or evaluated in this BO that are within the Refuge's acquisition boundaries (action area), the refuge will contact the AUESFO to determine if the actions are consistent with the purposes of the HMP. If the actions are found to be consistent and would not result in an increase in the amount or types of incidental take authorized in the BO, the AUESFO may authorize the Refuge to proceed without a formal amendment to the BO; however, if the new techniques are not consistent with the HMP or if amount of incidental take authorized in the BO would be exceeded, the Refuge would need to reinitiate formal section 7 consultation before the new techniques are implemented.

## **HMP Goals, Objectives, and Habitat Management Strategies**

The goals of the HMP over the 15 year life of the plan are to:

- Goal 1: Manage woodland habitats to provide high quality breeding habitat for the recovery and long-term sustainability of the GCWA;
- Goal 2: Manage mixed shrublands to provide high quality breeding habitat for the recovery and long-term sustainability of the BCVI;
- Goal 3 - Protect and manage karst and spring habitats to maintain existing levels of species richness throughout the refuge; and,
- Goal 4 – Restore and manage native biodiversity within the prairie grasslands, oak savannahs, and riparian woodlands throughout the refuge.

### Goal 1 Objectives (GCWA Habitat Management)

1. Improve the quality and quantity of GCWA breeding habitat by increasing the amount of juniper-oak woodlands with canopy cover greater than 60% on a minimum of 612 acres. Based on canopy cover estimates in 2012, this addition would represent a 10% increase in the amount of habitat with greater than 60% canopy cover. To be consistent with Objective 2 for high quality GCWA habitat, these new areas of greater than 60% canopy cover should not exceed 90% juniper composition.
2. Increase woody species diversity by converting a minimum of 133 acres of existing juniper-oak woodlands with canopy cover greater than 60% and juniper composition greater than 90% to 50% - 90% juniper composition, while maintaining canopy cover greater than 60%. As currently measured at a 75 meter (246 feet) radius focal mean scale and within GCWA management areas that have greater than 60% canopy cover, there are approximately 2,669 acres of juniper dominated (greater than 90% juniper) woodlands. This objective represents a 5% shift of the juniper dominated woodlands into more diverse woodlands and also recognizes the importance of maintaining areas that are currently diverse.
3. Reduce the amount of edge along blocks of GCWA habitat with greater than 60% canopy cover by 10%. There are currently about 50,208,300 square meters (12,406.74 acres) of GCWA habitat that contain greater than 60% canopy cover and 3,309,640 linear meters (2056.5 miles) of edge. This objective recognizes an increase of acres of habitat greater than 60% canopy cover, consistent with Objective 1, and this addition should contribute to reducing the linear amount of edge by 10%, thereby reducing the overall habitat fragmentation within high quality GCWA habitat.

### *Woodlands Management for GCWA Habitat*

All 19,079 acres of GCWA management area within the Refuge would be managed for the benefit of the GCWA. Within these areas management actions would strive to achieve the definition of high quality GCWA habitat. Historically, most management for the GCWA has been relatively passive, simply letting succession take place and allowing juniper-oak woodlands to mature. This method remains valid and would be considered in many areas of the Refuge, as

GCWA are an old growth woodland species. This is true for much of the Refuge, as very little evidence of old-growth woodlands exists and cut stumps from past land clearing activities are common (Scott Rowin, BCNWR, pers. comm.). White et al. (2010) determined that only 18% of the Refuge was "older growth" ( $\geq 70$  year old) woodlands. More recently, concern has been expressed over the long-term sustainability of GCWA habitat, specifically with respect to replacement of oaks and other hardwoods within the canopy, and the increasing threat of a stand replacement fire. The strategies in the HMP relate to promoting ideal habitat conditions that are sustainable over the long-term, reducing the probability/severity of a stand replacement fire, and promoting hardwood recruitment.

Management Strategy 1: Promote the establishment of additional habitat within the Refuge, addressing habitat loss as identified in the GCWA Recovery Plan.

The most significant action BCNWR can take with respect to GCWA recovery is the creation of additional occupied habitat (i.e. addressing habitat loss). BCNWR's management actions would promote and ensure sustainable high-quality GCWA habitat by benefiting factors that increase GCWA abundance, pairing success, and fledgling success. This includes: increasing hardwood recruitment, facilitating co-dominance of oak/hardwood and Ashe juniper in all sapling and tree size classes, promoting or maintaining proper canopy structure and diversity which includes canopy cover, canopy height, species composition and minimal habitat fragmentation, and promoting large (no upper limit on size) contiguous blocks of habitat with minimal woodland to non-woodland edge-to-area ratio.

Throughout the Refuge there are a number of areas where prior disturbances have created open juniper-oak woodlands, or high density immature juniper woodlands. Where the juniper component is younger (i.e. small diameter) and at high-densities, there is the possibility of accomplishing hands-on thinning of juniper stands, akin to pine stand manipulation of commercial forests in the southeastern U.S., to promote growth and canopy closure. This method may be more appropriate where there is a sufficient density of overstory and understory oaks and other hardwoods. Within these areas at least 500 acres of marginal woodlands would be managed towards developing higher quality GCWA habitat over the next 15 years. The focus of this management action should be to maintain/promote woodland diversity, overstory tree growth, canopy closure, and recruitment of seedling/sapling hardwoods into the canopy.

Management Strategy 2: Promote higher quality habitat by reducing habitat fragmentation.

The GCWA is an interior woodland species and does best under conditions with minimal habitat fragmentation. Specific strategies related to reducing habitat fragmentation include: 1) elimination and rehabilitation of unnecessary roads throughout the Refuge; 2) promoting habitat connectivity through reassignment of management priorities (i.e. managing for closed canopy juniper-oak woodlands versus other habitat types); and, 3) promoting maturation of second-growth juniper-oak woodlands into mature juniper-oak woodlands.

There are a number of roads throughout the Refuge that are no longer needed for adequate access, but are still used on occasion. By closing down and restoring these roads the refuge can substantially reduce the amount of existing habitat fragmentation.

As suggested in Peak and Thompson (2013), connection of GCWA habitat patches to reduce habitat fragmentation and edge-to-area ratio should be encouraged. Throughout BCNWR there are a number of areas that have been cleared and are currently managed as grassland/savannah habitat. While the HMP does not attempt to substantially change such management, as it is still a priority, it does identify a management strategy of reassigning management priorities in strategic locations. This would occur within areas that would substantially reduce the woodland edge-to-area ratio and improve the connectivity of GCWA habitat while not substantially reducing the amount of grassland/savannah habitat. Future management under the HMP would allow these areas to regrow into closed-canopy woodlands. Such action reduces the edge-to-area ratio and promotes habitat connectivity between two relatively small habitat patches to produce one larger patch. Fire and other forms of disturbance would be excluded from these areas. The areas would simply be allowed to transition from a grassland state, possibly into a shrubland state that may become suitable BCVI habitat, and then eventually into a juniper dominated woodland connecting two patches of currently occupied habitat.

*Management Strategy 3:* Promote higher quality habitat by increasing oak and other hardwood regeneration and recruitment.

Regeneration and recruitment of oaks and other hardwoods has been identified as an area of possible concern for long-term sustainability of GCWA habitat (Russell and Fowler 1999, 2002, 2004). Without recruitment and regeneration, areas that currently sustain good quality habitat may transition into juniper dominated woodlands. Such transition would be detrimental to the GCWA since it requires a combination of oaks, other hardwoods species, and junipers for feeding and nesting. Three strategies have been identified to promote oak and other hardwood regeneration and recruitment within identified GCWA management areas. The three strategies are:

1. **White-tailed Deer Control:** To allow for the long-term replacement of the canopy of old-growth juniper-oak woodlands, particularly the hardwood component, it is important to promote hardwood regeneration (Van Auken et al. 1981). In general, germination of hardwood seedlings is abundant, but survival of seedlings is very limited (Russell and Fowler 1999, 2002). The primary factor causing seedling mortality is herbivory by white-tailed deer (Russell and Fowler 2004, Andruk and Fowler 2013). Protection of hardwood seedling growth may be accomplished by using deer exclosures, which is prohibitively difficult at larger scales, or deer herd control.

For suitable regeneration of hardwoods, the Texas Parks and Wildlife Department (TPWD) recommends maintaining deer herd densities of 20 acres or more per deer. The BCP identified 40 acres per deer as the maximum density necessary for hardwood recruitment (BCP 2007). Aside from natural cycles of population density, deer herd control can be aided by public hunts and targeted depredation control efforts. Culling of deer through public hunts has shown an uncertain, but probably limited, effect on deer numbers. Obtaining depredation permits from TPWD involves a long lead time and a substantial commitment of staff resources. The latter strategy may only be applicable for selected areas where restoration of hardwoods is being hindered by excessive deer herd

populations (e.g., BCP 2007). For the purposes of the HMP, Refuge staff would maintain deer herd densities across the Refuge at levels no greater than one deer per 20 acres, and should strive for densities around one deer per 40 acres or greater.

2. **Oak Wilt Control:** Since oak wilt can destroy large areas of oak-dominated woodlands and is known to adversely affect the GCWA (Stewart et al, 2014), it has the potential to cause significant losses of GCWA habitat or degrade the quality of existing stands. It is unlikely that the oak wilt fungus can be eliminated from the habitat. Therefore, practical mitigation strategies include: (a) oak wilt monitoring, (b) oak wilt prevention, suppression and control, (c) education and information dissemination, and (d) recruitment of new oaks into the ecosystem. Oak wilt monitoring should occur within woodland stands throughout the Refuge, but requires field training in the biology and symptoms of the disease as well as specialized skills and investment in GPS-GIS technology. Appropriate timing and limitations on cutting and damage to oak limbs, coupled with prompt treatment of exposed wounds on oaks with tree wound sealant, are important for preventing new infections. The latter effort requires constant vigilance and staff education, but is the most effective strategy for prevention. While there may be little that can be done to limit damage from severe weather events (ice, wind, floods), attention during recovery and clean-up efforts should incorporate sound oak wilt suppression and prevention methods.

Oak wilt treatment can involve (1) removal of infected trees (particularly of Spanish oaks in suitable GCWA habitat), (2) constraint of oak wilt movement by trenching and preventative oak removal (primarily for infected stands of plateau live oak), and (3) treatment of specimen trees with fungicides in high value stands. Due to the excessive cost, no suppression tasks are proposed under the HMP. However, should funds become available Refuge staff would consider treatment options and focus those efforts within high quality GCWA habitat.

3. **Altered Fire Regime:** Because of the lack of data, the HMP does not attempt to define what the average fire return interval within GCWA habitat is, but does recognize wildfires played some role in habitat maintenance and attempts to incorporate it when appropriate. Low intensity prescribed fire may be a cost effective tool that mimics historic wildfires, helps to maintain good quality habitat, and may improve habitat conditions within marginal habitat. It is believed prescribed fires can thin (kill) smaller understory Ashe juniper, promote hardwood recruitment and regeneration, and return necessary nutrients to the soil, while still maintaining the canopy. The Refuge is currently evaluating this technique on select areas of the Refuge and if it is determined to be beneficial, other areas would be considered for treatment. Treatment protocols should follow the Service's (2013a) guidance or as otherwise revised. However, where juniper is a minor component of the woodland, either mature or immature, fire intensities should be low enough to ensure survival and ultimately help fill in canopy gaps to promote the HMP objectives.

Since this is such a new technique, no specific locations have been identified in the HMP, but may be used throughout the Refuge. Should such techniques be used in the future a

specific plan that identifies the time, location, intensity, etc. would be developed. Refuge staff would proceed with caution, and adjust fire intensities to achieve desirable objectives identified in the HMP. Regardless, all prescribed fire within GCWA habitat would be low enough intensity to avoid excessive disturbance to the overstory and would not be conducted during the breeding season (March 1 to August 1). It is possible naturally occurring wildfires that are achieving desirable results during the breeding season may be allowed to burn as a managed wildfire. Careful consideration for both environmental and human consideration would need to occur if Refuge staff decided to utilize such management action.

*Management Strategy 4:* Promote the old growth age structure within GCWA management areas by reducing the probability and/or severity of a stand replacement fire.

Stand replacement fires are probably part of the long-term fire regime in the Texas Hill Country, at least locally and periodically. Ignition of crown fires was explored in the past for its potential in “controlling mature Ashe juniper” (Bryant et al. 1983), but with more recent concern for endangered species management this can no longer be considered practical or desirable in most situations. Crown fires can cause large-scale losses of GCWA habitat and degradation of remaining habitat blocks (Bryant et al. 1983, Baccus et al. 2007, Reemts and Hansen 2008). Examples of which occurred at Fort Hood in 1995, and more recently throughout central Texas during the drought of 2011. Significant fuel reduction (i.e. juniper clearing) within existing closed canopy stands of juniper-oak woodland is likewise not desirable due to the specialized habitat preferences of the GCWA, nor would it help achieve the desired objectives of the HMP.

To protect large blocks of juniper-oak woodlands and promote canopy closure, lengthening of the return frequency of stand replacement fires is desirable and can be addressed by (a) removal of ladder fuels at woodland edges to prevent or deter crown fires, (b) hazardous fuel reduction throughout the Refuge, (c) fire prevention planning and education, and (d) contingency planning for major incidents. The last two strategies are beyond the scope of the HMP.

- **Removal of Ladder Fuels:** A BE of Shaded Fuel Breaks on the Refuge (Sexton and Schwoppe 2006) discusses the advantages and justification for removal of ladder fuels at important woodland-open habitat or woodland-urban interfaces, and is incorporated in the HMP by reference. Limiting the fuel reduction on edges to the zone below 1.5 meters (5 feet) in height will retain most of the profile of the habitat utilized by the GCWA for foraging and nesting (Pulich 1976, Sexton 1987, Beardmore 1994). It is also important to limit the height of such fuel reduction to accomplish the desired goal of allowing the remnant woodland canopy to suppress (shade out) fine fuels and undergrowth. However, the placement of shaded fuel breaks will frequently create harder edges to woodland blocks and have the potential to fragment or isolate patches of suitable GCWA habitat. Because of this, such actions must be well thought out prior to implementation. Currently, most areas on the Refuge adjacent to higher density urbanization and areas that transition from grasslands to woodlands have been treated with shaded fuel breaks or other similar management action. Should additional areas be identified that need to be treated, all treatment should follow the Service’s Hazard Fuel Reduction Best Management Practices.

- **Fuel Reduction:** Scattered throughout much of the GCWA management areas are evidence (slash and cut stumps) of past logging and agricultural activities. These activities have left an abundance of slash that represents a potential wildfire hazard. Additionally, since much of the Refuge has been cleared in the past there is an abundance of second-growth, high density, small diameter Ashe juniper. These areas represent possible ladder fuels and often transition into ideal GCWA habitat. Fuel reduction, in the form of selective removal of second-growth juniper by cutting and burning, or removal of the newly created and existing slash, can reduce the fuel loading in certain areas and may promote quicker canopy closure with the remaining trees. Such action may protect higher quality habitat and allow for better access and emergency response options for fire suppression in the event of a wildfire.

Since this is such a new technique no specific locations have been identified in the HMP. Should such techniques be used in the future a specific plan that identifies the time, location, intensity, etc. would be developed. Refuge staff should proceed with caution, and adjust fire intensities to achieve desirable objectives identified in the HMP. Regardless, all prescribed fire within GCWA habitat should be low enough intensity to avoid excessive disturbance to the overstory, and should not be conducted during breeding season.

*Management Strategy 5:* Promote higher quality habitat by managing all habitat management areas as native ecosystems.

The Refuge plant list contains over 725 species and includes at least 80 species (about 11%) which are not native to North America. Not all of these are invasive. A non-native plant species can be considered invasive when it (a) outcompetes and replaces substantial areas of native cover, (b) introduces poisonous, noxious, or other potentially deleterious effects into native habitats, and/or (c) directly harms, damages, or alters the biology of any of the primary species of concern. King Ranch bluestem, Johnsongrass, and bermudagrass are not native to the Refuge, but are important in the context of grassland restoration. Other plants which are invasive on the Refuge and are having at least local impacts on species or habitats of concern include chinaberry, tree-of-heaven, Chinese tallow, Malta starthistle, and yellow rocket (also known as wild turnip or bastard cabbage). The most invasive non-native animals on the Refuge are feral hogs and imported red fire ant. To a lesser degree, feral cats can become a local problem species. With the exception of imported red fire ants, management of these non-native animals is addressed in the 2013 Invasive and Feral Animal Management Plan for the Refuge (USFWS 2013b).

Several exotic species are of concern for BCVI management areas, these include: chinaberry, King Ranch bluestem, Johnson grass, Malta starthistle, and feral hogs. Exotic species of concern in GCWA management areas are chinaberry, tree of heaven, and feral hogs. In order to meet the habitat objectives for prairie grasslands, oak savannahs, and (to a lesser extent) riparian woodlands, control of exotic species will be needed. On a larger scale prescribed fire is the most cost effective tool available to the Refuge for controlling exotic vegetation and is likely the primary tool to be used within areas where restoration seeding or over-seeding are not appropriate.

Chinaberry is known to occur in all habitat types throughout the Refuge, whereas, tree of heaven is only known to occur within three juniper-oak woodland canyons. Infestations of these two species are extensive, but controllable enough that each can be targeted with local hand-clearing and directed herbicide application. An eradication program was initiated in 2012. Follow up monitoring and control will occur in years 2, 3, 5 and 10. Additional details of this eradication project can be found in the Refuge files.

Most grassland areas, especially those that had seen tillage and/or terracing, are dominated by the invasive non-native King Ranch bluestem. King Ranch bluestem grows in dense rank stands and is a strong competitor with all native prairie components. Moreover, the thick King Ranch bluestem stands provide very poor habitat for wildlife and constitute, in the vernacular, "wastelands" which can be nearly devoid of grassland invertebrates, birds, and mammals. King Ranch bluestem is well adapted to grazing and cool season fire regimes and has ecological tolerances, not unlike native little bluestem. This makes control of King Ranch bluestem problematic. Timing of burns in the early growing season or warm season is currently being investigated for its potential to accelerate the changeover to native bunch grasses. In selected areas, especially former tilled or terraced fields, the near-complete dominance of King Ranch bluestem necessitates a more aggressive restoration effort involving herbiciding, disking, and reseeding with natives. These are cost- and labor-intensive manipulations and must be balanced against available staff and resources.

Johnsongrass is probably the next most prevalent non-native grass which invades native grasslands. It is particularly well-adapted to disturbed areas and is probably a poor competitor in a healthy prairie matrix (Grace et al. 2001). However, it is also fire-adapted and responds positively to periodic mowing. Newman (1993) reported on research that suggests that a late April fire in Texas caused a substantial reduction in Johnsongrass while promoting the growth of little bluestem. However, further research on the potential use and timing of prescribed burning as a management tool is needed.

Very small stands (i.e. single plant) of Johnsongrass can be effectively eliminated by hand clearing, but this method is impractical for extensive grasslands. Currently, most Johnsongrass stands are relatively small (< 1 acre), but many individual stands may be present on a particular tract. It may be possible to control/eliminate these areas by utilizing select timing of prescribed burning in concert with spot treatment with herbicide (Mia McCraw pers. comm. 2013). After a prescribed burn most grasses have been reduced to ground level. Once green-up is initiated, Johnson grass grows quickly and becomes readily apparent due to its greater height than other native grasses. It can also be easily identified based upon the white vein down the center of each leaf. Select timing of herbicide treatments should be effective in controlling Johnsongrass and should be targeted at controlling only Johnsongrass. Treated areas may need to be reseeded with native grasses after control.

Malta starthistle is a noxious annual or biennial forb which colonizes disturbed calcareous soils and open habitats. Control of Malta starthistle can be accomplished by (a) hand pulling of local infestations, (b) local herbicide application, and (c) targeted burning with a propane torch. Malta starthistle is particularly adapted to rapid colonization of open, disturbed ground. Re-establishment of Malta starthistle can occur when ground is repeatedly disturbed, such as by

mowing or vehicle travel around the Refuge's operations center and along roadsides. Maintenance of healthy native ground cover can limit the density and areal coverage of Malta starthistle to some degree. Late winter or early spring burning may be effective at killing basal rosettes. However in at least one instance, a hot summer (August) burn of a plateau grassland in the Central Post Oak Ridge Unit (Flying X) caused a major expansion of Malta starthistle, at least temporarily. Where infestations cannot be completely eliminated (as along roadways), mowing can help reduce the seed set and minimize the conveyance and spread of the species by vehicles. Mowing generally does not control the species and should only be considered along roads to minimize the movement of seed to other Refuge tracts. Additionally, Refuge staff should avoid driving vehicles through stands of Malta starthistle to minimize its spread. Application of herbicide should be targeted towards those areas most accessible and susceptible to secondary spread (e.g. roadsides and parking areas).

Most stands of Malta starthistle occur alongside Refuge roads. After each winter burn in grassland and oak savannah habitats, a propane torch can be used to burn the basal rosettes the following late winter/early spring alongside any roadway that is infested with this plant. Extreme temperatures are effective at killing the plants and in theory would control the majority of these plants, and have a low probability of causing a wildfire (due to minimal fuel levels as a result of the winter burn). Utilizing the anticipated burn schedule in the HMP, it is likely all roads within grassland and oak savannah habitat would be treated.

Feral hogs are so adaptable to different environments, so adept at survival, and have such a high reproductive rate, that their population has exploded in Texas. This has made them significant pests in much of the state (Mapston 2004). They are now widespread and increasing in most habitats on the Refuge. The most conspicuous habitat damage that they cause has been (a) to localized springs and wetlands, and (b) to the ground cover throughout the Refuge including both the shinnery habitat of BCVIs and the juniper-oak woodlands of GCWAs. Hog rooting and wallowing results in the destruction of herbaceous ground cover, exposure of soil surfaces to increase potential for erosion and expansion of exotic plant species, loss of reproduction of hardwoods (e.g., acorn consumption), and loss of other vegetation and fauna that is consumed by the hogs. Feral hogs also carry a variety of infectious and parasitic diseases which can be spread to other wildlife or humans (see Mapston 2004 for a longer discussion). Theoretically, feral hogs can be controlled with exclusion, snares, live traps, shooting and aerial hunting (Mapston 2004). In practice on BCNWR, trapping and shooting are the primary tools available to Refuge staff. Trapping of feral hogs is time and labor intensive.

#### Goal 2 Objectives (BCVI Habitat Management)

1. Increase and/or maintain the area with 30% - 70% shrub cover (the range of suitable shrub cover for BCVI) to 75% of the total area managed for BCVI. This measurement would be done using a 75 meter radius focal mean scale, the approximate average BCVI territory size.
2. Within BCVI management areas, maintain average shrub height of between one and two meters (3 - 6 feet) with foliage extending to the ground and no more than 10% emergent trees.

3. Within BCVI management areas, increase/maintain a mosaic of woody cover with a high vegetative edge-to-area ratio with open areas dominated by native grasses and forbs.

#### *Black-capped Vireo Habitat - Mixed Shrublands*

In the past it was thought manipulation/management for BCVI habitat should occur at the point in which the species begins to abandon a site. This approach can be problematic as it limits the options available for less severe manipulation and the species may find it difficult to reoccupy a site that has been left unoccupied for an extended period of time. The strategies in the HMP attempt to provide proactive management that also maximizes the suitability of the BCVI habitat on the Refuge over the long-term.

Management Strategy 1: Manage plant species composition and structure to promote utilization of BCVI management areas by the BCVI.

Unfortunately very little information exists with respect to necessary management intervals in order to maximize the duration and utilization of BCVI habitat, and how vireos respond to such treatments (Mathewson et al. 2013, TPWD 2003). As such, making management strategies for this species is very difficult and is based largely upon professional opinion. Ultimately, management for the BCVI would need to follow an adaptive management approach. Within BCVI habitat areas, prescribed fire is the preferred method of managing the habitat. However, other forms of habitat management (mechanical, herbicide, etc.) would also likely be necessary over the next 15 years.

To maximize the availability of BCVI habitat, management of currently or historically occupied habitat would occur when vegetation monitoring indicates a need to address one or more of the factors identified below. However, a number of management circumstances would also need to be taken into consideration, including how successional processes affect fine fuel loading that is needed to effectively carry a fire. Through an adaptive management process the Refuge should continue to evaluate the effectiveness of managing habitat primarily with prescribed fire. In the interim and unless found more beneficial otherwise, the Refuge should initiate management actions on existing or historically occupied habitat when monitoring of the habitat shows it has exceeded either of the following two tolerances; when shrub cover (not including overstory trees) exceeds 70%, and/or, when the average maximum shrub height is greater than two meters, not including overstory trees and areas lacking shrub cover.

Because of the habitat management triggers and multiple variables that influence how long habitat will be suitable, no set management return interval or location is provided in the HMP. Instead, the prescribed management actions would target the specific habitat characteristic that needs to be manipulated. For example, if percent cover has been exceeded but the average shrub height has not, the management action taken should focus on reducing percent cover, not shrub height. Under this example, utilization of herbicide and/or mechanical thinning to reduce shrub cover may be the most appropriate course of action. When making management prescriptions, Refuge staff would utilize Mathewson et al. (2012) as a resource, as it describes the effects of past vegetation manipulations on the Refuge.

With respect to the 114 acres that would be managed for both the GCWA and BCVI, these areas include existing linear corridors (i.e. roads and fence lines), patches of second growth juniper-oak woodlands that are relatively isolated from other patches of GCWA habitat, or were historically occupied by BCVI, but now contain suitable GCWA habitat (i.e., the Gainer tract). All of these areas are in close proximity to other blocks of GCWA habitat and are likely occupied by GCWAs. These areas currently have appropriate vegetation composition for BCVI habitat, but lack appropriate vegetative structure. Since these areas are known to be occupied by GCWAs and are in close proximity to larger patches of GCWA habitat, management efforts would promote high canopy cover to assure these areas continue to be occupied by GCWAs. Within these areas the understory would be manipulated to promote habitat structure more suitable for BCVIs while the over story will substantially remain intact thereby providing habitat resources for the GCWA.

*Management Strategy 2:* Utilize a variety of habitat management tools to assure a mosaic of habitat conditions thereby assuring a greater level of success in creating/managing habitat.

Historically wildfires likely were the most significant factor that created BCVI habitat. Because of this, prescribed burns should over time be the primary tool for managing BCVI habitat and should be utilized to replicate historical conditions as much as reasonably possible. Unfortunately, the timing and frequency of prescribed burns that are needed to maintain BCVI habitat is unknown, but almost certainly needs to be dealt with on a case-by-case basis (Mathewson et. al 2013).

Past observations have shown that it may take four or more years for BCVI to begin utilizing an area after significant habitat modification (i.e. dozer and burn). Whereas other areas with less intense management (i.e. cool season prescribed burns) continue to be occupied at similar levels the following breeding season (BCNWR files). The fire return interval and intensity anticipated under the HMP would vary greatly depending on the factors identified above and the management purpose. Therefore, an adaptive management approach is critical and each site would need to be dealt with on a case-by-case basis, as it is not appropriate to have a set schedule for burning these areas. As a general rule though, the type and intensity of management action should be dictated by vegetation monitoring results. To achieve the desired results, fire intensities may occasionally need to be increased. Fire intensities for management purposes are categorized as follows:

- Recovery (high intensity) fires: High intensity fires generate BCVI habitat by returning the habitat to a much earlier successional stage by substantially top-killing a high percentage of the above ground vegetation. Most woody species (not Ashe juniper) are fire adapted and readily resprout creating the necessary configuration of BCVI habitat after approximately four years. Recovery fires, however, can substantially reduce the abundance of Ashe juniper. Therefore, caution should be used in areas where Ashe juniper is an important component.

Due to the increased intensity (heightened risk) of a recovery burn not all BCVI habitat locations can be considered for recovery burns, however where feasible, recovery burns

should be considered. It is expected that Recovery burns would be less frequent than maintenance burns (described below), maybe on the order of every 20 years. Due to the infrequent nature of Recovery burns, a much more liberal burn window is provided. Recovery burns should avoid the primary nesting season for the BCVI (March 15 to July 15). Such window avoids the time of year when BCVIs are establishing/defending territories, and also provides sufficient time for fledglings to be mobile and avoid the fire, but provide an additional 1.5 months for the burn window due to the infrequent nature of these fires.

- Maintenance (low/moderate intensity) fires: This type of burn helps maintain the current configuration of habitat and results in a mosaic of intensities and increased heterogeneity of habitat. Maintenance burns may be used to delay the need for a recovery burn, but ultimately all BCVI habitat areas are likely to eventually grow to a successional stage that does not allow for maintenance burns due to a lack of fine fuels and increased woody vegetation height and cover. Recovery fire, mechanical treatment, or some other form of greater disturbance will be needed at that point. Maintenance burns typically allow for some level of utilization by the BCVI the following season. Maintenance burns should be conducted outside of the breeding season (March 15 to August 31), but may on occasion follow the dates identified under recovery burns. The intent of burns conducted outside the established breeding season dates and the conditions under which it occurs would still be for the purposes of maintenance. It is estimated maintenance burns would be conducted every 3 - 8 years, but would vary given the need to meet biological objectives and adaptive management.

For over-mature shrublands it may be necessary to mechanically manipulate the habitat. Examples include: hand cutting; mechanically crushing; or, masticating portions of the management unit. Mechanical habitat manipulation, coupled with prescribed burns to eliminate slash, can return the stand to suitable structure and successional stage. Over-mature shrublands can reach a stage at which GCWAs may occupy the stands and thus have become "GCWA habitat". The 2006 BE (Sexton 2007) takes this aspect into consideration and describes constraints and conservation measures to minimize the impacts on the GCWA. The primary constraint on such actions is to ensure that GCWA habitat is not unnecessarily removed, converted, fragmented, or damaged in such efforts. These constraints have been taken into consideration and only those GCWA habitat blocks within the identified BCVI habitat management areas would be subject to significant alteration.

One of the concerns with active habitat manipulation is the increased number of stems from re-sprouting woody species after each subsequent disturbance. Such an increase may result in shrub cover of certain areas filling in too quickly, and as a result the percent cover may exceed the desired threshold, but the vegetation height may still be desirable. Under these circumstances herbicides can be effectively utilized to control overabundant shin oak, Ashe Juniper, and other woody species. Herbicide application can open up habitat areas, but based upon past experience the entire plant needs to be sprayed with high enough concentrations to be effective.

In theory, shin oaks and other species can be planted in sufficient quantities to create, or re-establish shrublands on sites where the species is presumed to have occurred in the past or may

be a desirable component in the future. However, establishing woody species can be difficult and result in large mortality in the first few growing seasons (Coffman 1997, Refuge files). Refuge efforts to date have met with limited success, but the achievement of target acreage goals for occupied BCVI habitat management may require such re-establishment/creation.

Shin oak stock can be obtained from acorns collected in late September and early October. Germination of shin oak acorns on natural substrates from hand planting is typically poor, but the acorns germinate readily in cultivation. Seedling stock can be grown in tubes or pots. Transplantation of one- or two-year old seedlings into the rocky terrain is exceedingly difficult and seedling survivorship can be poor in the wild due to desiccation and browse damage unless supplemental watering and physical protection are provided. Competition with extant prairie grasses may also contribute to seedling mortality or limitation on growth. Protection of seedlings with caging is possible but also labor- and material-intensive. Temporary fencing of larger replanted areas may be practical. Areas replanted with seedlings must be deferred from prescribed burning and other forms of disturbance for at least five years to ensure shrub establishment (Refuge files). Supplies of shin oak acorns and other seeds vary widely between years, with some years having poor production or with substantial portions of the acorn crop infested with acorn weevils. Thus collection of acorns and other seeds for planting is not guaranteed every year and collection must take advantage of good crops when available.

Based upon previous efforts (1999), seedling density for shin oak should initially be a minimum of 50 stems per acre with a target configuration described in the objective above. As much as reasonably possible, all forms of disturbance should be limited within these areas until surviving saplings are well established and able to withstand a disturbance. Based upon previous efforts this will likely be greater than five years after planting.

The Refuge would promote the creation of additional habitat areas by lengthening the fire return interval, likely causing an increase in woody vegetation in untreated areas. Based upon Refuge files, it appears there is a close correlation with BCVI habitat and Low Stony Hill ecological sites. In an effort to increase the availability of BCVI habitat, Refuge staff should continually evaluate Low Stony Hill sites for its potential to be managed to become occupied BCVI habitat. Within these areas it may be appropriate to discontinue prescribed fire for a period of time to allow the encroachment of woody vegetation, including species, such as Ashe juniper, that are very intolerant of fire.

Management Strategy 3: Control excessive browsing to ensure a dense foliage layer to ground level.

Deer browse may be a major constraint on regrowth of shin oak saplings or manipulated shin oak shrublands. Optimal deer herd densities are similar to those mentioned for hardwood regeneration in GCWA habitat (above), but in practice, re-establishment of shin oak and other woody species may require complete deer exclosure for a period of time.

Livestock have yet to be utilized as a management tool on the Refuge. It is not known if or when this tool would be used, but nothing in the HMP precludes that option. However, livestock would only be utilized as a management tool to help meet desired habitat objectives. Should

livestock be used, a Special Use Permit would need to be issued and stocking rates and effects on habitat would need to be closely monitored. Livestock would need to be removed well in advance of the BCVI's breeding season so that any associated cowbirds have had a chance to disperse. Cowbird trapping results would be monitored, and if an increase in cowbird numbers is noted, further evaluation should be conducted on the advantages and disadvantages of using this tool.

Management Strategy 4: Promote higher quality habitat by managing all habitat management areas as native ecosystems.

See Management Strategy 5 for Woodlands (above).

### Goal 3 Objectives (Karst Habitat)

1. Control red-imported fire ants by minimizing surface habitat disturbance and other means to ensure they are not a threat to karst invertebrates or their nutrient sources (e.g., cave crickets).
2. Protect the karst and spring habitats from damage or harm that could be caused by activities such as vandalism, contamination, and rooting by feral hogs.
3. Maintain the essential internal habitat in the caves, including a stable and mild temperature, high relative humidity, and appropriate water input.
4. Maintain appropriate nutrient input to caves and associated karst habitat, including cave crickets, plant detritus, root masses, and feces, eggs, and/or dead bodies of animals foraging on the surface and bringing nutrients into the cave.
5. Maintain or improve the conditions and viability of the surface native plant community to support nutrient input and to protect subsurface from contamination or changes in temperature and humidity.

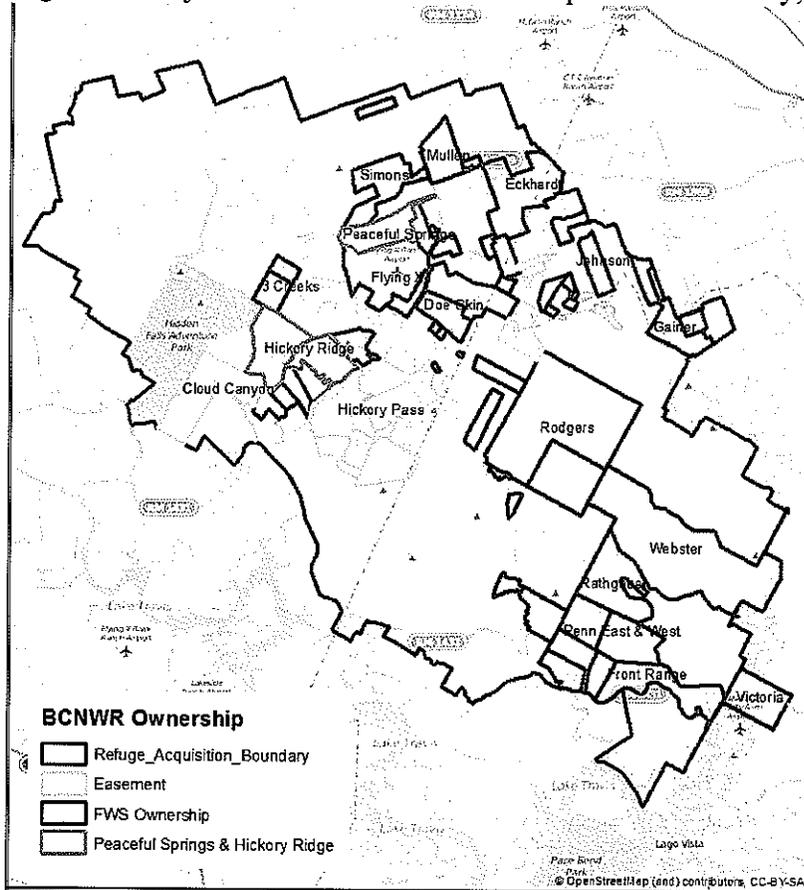
### Goal 4 Objective (Native Biodiversity)

1. Protect and manage 4,700 acres of habitat as native dominated prairie grassland, oak savannah, and riparian woodlands, such that at least 80% of the vegetation is native grasses, forbs and woody vegetation. This objective also stresses the importance of increasing/maintaining monarch butterfly habitat, particularly promoting various species of milkweed and nectar producing plants.

### **Action Area**

The action area of the HMP and this BO is limited to the acquisition boundaries of BCNWR, totaling about 80,000 acres (**Figure 1**). All management actions would be limited to Refuge property; therefore, all direct and indirect effects would also be limited to within the Refuge boundaries. The Service agrees the proposed action area is appropriate for this consultation.

Figure 1. Project action area. BCNWR acquisition boundary, with individual tract names.



## Status of the Species

### *Golden-cheeked Warbler*

For more specific information regarding the GCWA, please refer to the Golden-cheeked warbler Recovery Plan (Service 1992) and Golden-cheeked warbler 5-year Review: Summary and Evaluation (Service 2014b).

### Species Description and Life History

The GCWA was emergency listed as endangered on May 4, 1990 (55 FR 18844). The final rule listing the species was published on December 27, 1990 (55 FR 53160). No critical habitat is designated for this species.

The GCWA is a small, insectivorous songbird, 4.5 to 5 inches long, with a wingspan of approximately eight inches (Pulich 1965 and 1976, Oberholser 1974). The GCWA breeds exclusively in the mixed Ashe juniper/deciduous woodlands of the central Texas Hill Country west and north of the Balcones Fault (Pulich 1976). The GCWA requires the shredding bark produced by mature Ashe junipers for nest material. Typical deciduous woody species include Texas oak (*Quercus buckleyi*), Lacey oak (*Q. glaucoides*), live oak (*Q. fusiformis*), Texas ash

(*Frazinus texensis*), cedar elm (*Ulmus crassifolia*), hackberry (*Celtis occidentalis*), bigtooth maple (*Acer grandidentatum*), sycamore (*Platanus occidentalis*), Arizona walnut (*Juglans major*), and pecan (*Carya illinoensis*) (Pulich 1976, Ladd 1985, Wahl et al. 1990). Breeding and nesting GCWA feed primarily on insects, spiders, and other arthropods found in Ashe junipers and associated deciduous tree species (Pulich 1976).

Male GCWA arrive in central Texas in early March and begin to establish breeding territories, which they defend against other males by singing from visible perches within their territories. Females arrive a few days later, but are more difficult to detect in the dense woodland habitat (Pulich 1976). Three to five eggs are generally incubated in April, and unless there additional nesting attempts, nestlings fledge in May to early June (Pulich 1976). If there is a second nesting attempt, it is typically in mid-May with nestlings fledging in late June to early July (Pulich 1976). By late July, GCWAs begin their migration south (Chapman 1907, Simmons 1924). The GCWA winters in the highland pine-oak woodlands of southern Mexico and northern Central America (Kroll 1980).

#### Historical and Current Distribution

The GCWA's entire breeding range occurs on the Edwards Plateau and Lampasas Cut Plain of central Texas. The GCWA has been confirmed in 39 counties: Bandera, Bell, Bexar, Blanco, Bosque, Burnet, Comal, Coryell, Dallas, Eastland, Edwards, Erath, Gillespie, Hamilton, Hays, Hill, Hood, Jack, Johnson, Kendall, Kerr, Kimble, Kinney, Lampasas, Llano, Mason, McLennan, Medina, Menard, Palo Pinto, Real, San Saba, Somervell, Stephens, Tom Green, Travis, Uvalde, Williamson, and Young. However, many of the counties where it is known to occur, now or in the past, have only small amounts of suitable habitat (Pulich 1976, Service 1996, Lasley et al. 1997). Diamond (2007) estimated that the amount of suitable GCWA habitat across the species' range was approximately 4.2 million acres, much of this habitat occurring on private lands. As a result, the population status for the GCWA on private lands remains undocumented throughout major portions of the breeding range.

#### Reasons for Decline and Threats to Survival

Before 1990, the primary reason for GCWA habitat loss was juniper clearing to improve conditions for livestock grazing. Since then, habitat loss has occurred as suburban developments spread into prime GCWA habitat. Groce et al. (2010) summarized the rates of expected human population growth within the range of the GCWA and found by 2030 the growth rate ranges from 17% around the Dallas-Fort Worth area to over 164% around San Antonio. As the human population continues to increase, so do associated roads, single and multi-family residences, and infrastructure, resulting in continued habitat destruction, fragmentation, and increased edge effects (Groce et al. 2010).

Fragmentation is the reduction of large blocks of habitat into several smaller patches. While GCWAs have been found to be reproductively successful in small patches of habitat (less than 50 acres), there is an increased likelihood of occupancy and abundance as patch size increases (Coldren 1998, Butcher et al. 2010, DeBoer and Diamond 2006). Increases in pairing and territory success are also correlated with increasing patch size (Arnold et al. 1996, Coldren 1998,

Butcher et al. 2010). In addition, while some studies have suggested that small patches that occur close to larger patches are likely to be occupied by GCWAs, the long-term survival and recovery of the GCWA is dependent on maintaining the larger patches (Coldren 1998, Peterson 2001, The Nature Conservancy [TNC] 2002).

As GCWA habitat fragmentation increases the amount of GCWA habitat edge, where two or more different vegetation types meet, also increases. For the GCWA, edge is where woodland becomes shrubland, grassland, a subdivision, etc., and depending on the type of edge, it can act as a barrier for dispersal; act as a territory boundary; favor certain predators; increase nest predation; and reduce reproductive output (Johnston 2006, Arnold et al. 1996). Canopy breaks (the distance from the top of one tree to another) as little as 36 feet have been shown to be barriers to GCWA movement (Coldren 1998). Territory boundaries have not only been shown to stop at edges, but GCWAs are more often further away from habitat edges (Beardmore 1994, DeBoer and Diamond 2006, Sperry 2007).

Other threats to GCWA include the clearing of deciduous oaks upon which they forage, oak wilt infection in trees, nest parasitism by brown headed cowbirds (Engels and Sexton 1994), drought, fire, stress associated with migration, competition with other avian species, and particularly, loss of habitat from urbanization (Ladd and Gass 1999). Human activities have eliminated GCWA habitat throughout their range, particularly areas associated with the I-35 corridor between the Austin and San Antonio metropolitan areas.

#### Range-wide Survival and Recovery Needs

The recovery strategy outlined in the Golden-cheeked Warbler Recovery Plan (Service 1992), which is being revised, divides the breeding range of the GCWA into eight regions, or units, and calls for the protection of sufficient habitat to support at least one self-sustaining population in each unit. These recovery units were delineated based primarily on watershed, vegetation, and geologic boundaries (Service 1992).

Based on the Golden-cheeked Warbler Recovery Plan (Service 1992), and the GCWA's 5-year Review (Service 2014b), protection and management of occupied habitat and minimization of degradation, development, or environmental modification of unoccupied habitat necessary for buffering nesting habitat are necessary to provide for the survival of the species. Habitat protection must include elements of both breeding and non-breeding habitat (i.e., associated uplands and migration corridors). Current and future efforts to create new and protect existing habitat will enhance the GCWA's ability to expand in distribution and numbers. Efforts, such as land acquisition and conservation easements, to protect existing viable populations is critical to the survival and recovery of this species, particularly when rapidly expanding urbanization continues to result in the loss of prime breeding habitat.

Several state and federally owned lands occur within the breeding range of the GCWA, but the overriding majority of the species' breeding range occurs on private lands that have been either occasionally or never surveyed. Currently there are five large GCWA populations receiving some degree of protection: those at the BCP and BCNWR in Travis County; Camp Bullis Military Installation and TPWD's Government Canyon State Natural Area in Bexar County; and

at Fort Hood in Bell and Coryell Counties. There are also several conservation banks (CB) whose goal is to protect GCWA habitat: Hickory Pass CB (3,003 acres) and Hickory Ridge CB (1,255 acres) in Burnet County, Bandera Corridor CB (6,946 acres) in Bandera and Real counties, Clearwater CB (21,305 acres) in Burnet County, and Festina Lente CB (1,147 acres) in Bandera County (acreages represent the total if the entire bank of credits are sold).

### *Black-capped Vireo*

For more specific information regarding the BCVI, please refer to the Black-capped Vireo Recovery Plan (Service 1991a) and Black-capped Vireo 5-year Review: Summary and Evaluation (Service 2007).

### Species Description and Life History

The BCVI was federally listed as endangered on October 6, 1987 (52 FR 37420-37423). No critical habitat is designated for this species. The BCVI is a 4.5-inch long, insectivorous songbird. Mature males are olive green above and white below with faint greenish-yellow flanks. The crown and upper half of the head are black with a conspicuous white eye-ring. The iris is brownish-red and the bill is black. Mature females are generally duller in color than males, and have a dark slate gray head (Service 1991a).

Although BCVI habitat throughout Texas is quite variable with respect to plant species, soils, and rainfall, habitat types generally have a similar overall appearance. The BCVI typically inhabits patchy shrublands and open woodlands with a distinctive patchy structure. The shrub vegetation generally extends from the ground to about six feet above ground and covers about 30 to 60 percent of the total area. In the Edwards Plateau, common plants in BCVI habitat include Texas oak (*Quercus texana*), shin oak (*Q. sinuata*), live oak (*Q. virginiana* & *Q. fusiformis*), mountain laurel (*Sophora secundiflora*), sumac (*Rhus*. sp), redbud (*Cercis canadensis* var. *texana*), Texas persimmon (*Diospyros texana*), mesquite (*Prosopis glandulosa*), and agarita (*Mahonia trifoliata*). In the Edwards Plateau, suitable habitat for the BCVI is early successional scrub/shrub created by fire or woodland clearing. BCVI are opportunistic foragers; however, they prefer insect larvae and seeds (Grzybowski 1995).

Male BCVI arrive in central Texas in late March and begin to establish breeding territories, which they defend against other males by singing. Females arrive a few days later, but are more difficult to detect in the dense brushy habitat. Three to four eggs are generally incubated in April, and unless there is a second nesting attempt, nestlings fledge in May to early June. By mid-September, BCVIs have generally migrated south, beginning with females and young and followed by adult males (Graber 1957, Oberholser 1974). The BCVI breeds from Oklahoma south through central Texas to the Edwards Plateau, then south and west to central Coahuila, Nuevo Leon, and southwestern Tamaulipas, Mexico and they winter on the Pacific slope of Mexico.

### Historical and Current Distribution

The historical breeding distribution of the BCVI included an area stretching from Kansas southward through central Oklahoma and through west-central Texas, with a southern limit in central Coahuila, Mexico. In 1987, the known breeding population was distributed across 21 counties in Texas, four counties in Oklahoma and in Coahuila, Mexico. Survey efforts since 2005 have confirmed that there are occupied breeding habitats in 35 counties in Texas and three counties in Oklahoma (Service, unpublished). Current information from Mexico is lacking. Since listing, cumulatively, breeding populations have been documented in 49 Texas counties, six Oklahoma counties, and three Mexican states. According to surveys, approximately 62% of the known population in the breeding range is found on four well-surveyed areas: Fort Hood Military Reservation (Texas), Kerr Wildlife Management Area (Texas), Wichita Mountains Wildlife Refuge (Oklahoma), and Fort Sill Military Reservation (Oklahoma) (Service, unpublished). Together, these facilities cover approximately 400,000 acres, an area representing only one percent of the total area of rangeland in the Texas/Oklahoma range of the species (Wilkins et al. 2006).

The current BCVI breeding range no longer appears to extend northward past central Oklahoma, and the species has not been documented in Kansas since the 1950s. The current range for the BCVI includes eight counties in Oklahoma and 67 counties in Texas. The discovery of breeding populations of the BCVI in southern Coahuila, Nuevo Leon, and Tamaulipas significantly extends their breeding range farther south than was known at the time of listing.

#### Reasons for Decline and Threats to Survival

At the time of listing, the identified major threats to the BCVI included habitat loss through land use conversion, grazing and browsing by domestic and wild herbivores, and brood parasitism by brown-headed cowbirds. The threat of vegetative succession, originally considered minor, appears to have been underestimated at the time of listing, although the extent of the effects on the BCVI is not known. Historically, naturally occurring wildfires probably maintained a mosaic of suitable habitat throughout the BCVI's range. The threat of predation, also originally considered minor, appears to be of more importance than originally anticipated. Depredation rates of monitored nests at Fort Hood rose steadily between 1997 and 2005 then stabilized slightly above 50% afterward (Cimprich and Comolli 2009). At Fort Hood, brown-headed cowbird removal shows a strong negative correlation with overall parasitism rate. In 2010, Fort Hood had an overall parasitism rate of approximately 12%, up from a low of two percent in 2003 (Cimprich and Comolli 2010). Following the cessation of cowbird trapping on the west range of Fort Hood in 2006, parasitism has increased by more than four times the original rate (Cimprich and Comolli 2009), but then decreased to less than three times the original rate in 2010 (Cimprich and Comolli 2010). During this same time, parasitism on the east range, where trapping still occurs, has remained stable. On average, cattle densities throughout the BCVI's Texas range have shown moderate decreases since 1997, while several areas currently supporting large bird populations, such as Coryell, Edwards, and Mason Counties, show moderate increases in cattle densities (Wilkins et al. 2006, U.S. Department of Agriculture [USDA] 2007). On average, goat densities throughout the BCVI's Texas range have been steadily decreasing since the BCVI was listed in 1987 (Wilkins et al. 2006, USDA 2007). While the relative importance of individual threats appears to have changed since listing, these remain the primary threats to the species.

## Range-wide Survival and Recovery Needs

The Black-capped Vireo Recovery Plan (Service 1991a) provides preliminary criteria that would meet the interim objective of downlisting the species to threatened status. One of these criteria requires at least one viable BCVI population in each of four Texas regions and one each in Oklahoma and Mexico (Service 1991a, Service 2013c). The Service's 5-year status review of the BCVI found the Recovery Plan to be in need of revision and recommended the species be downlisted to threatened status (Service 2007).

Protection and management of occupied habitat and minimization of further degradation, development, or environmental modification of unoccupied habitat are necessary to provide for the survival of the species. Habitat protection must include elements of both breeding and non-breeding habitat (i.e., associated uplands and migration corridors). As habitat is created through silviculture practices and military use, and existing habitat is protected, the BCVI's ability to expand its distribution and numbers will enhance. Efforts to increase numbers of existing viable populations are critical to the survival and recovery of this species, particularly when rapidly expanding urbanization continues to result in the loss of prime breeding habitat. Due to the nature of early successional shrub growth preferred by the BCVI, fire should be used to manage, enhance, and create BCVI breeding habitat, as appropriate. Continued efforts to control cowbirds are necessary in areas where parasitism rates are shown to be excessive (greater than 30%) (Smith et al. 2013).

## **Environmental Baseline**

According to our consultations tracking database, there have been at least 63 formal section 7 consultations for the GCWA. Almost 98,000 acres of GCWA habitat were authorized to be impacted by those consultations. Several large consultations make up a majority of this acreage: 1) over 37,900 acres were associated with a consultation for Fort Hood military activities; 2) over 52,000 acres were associated with brush control projects throughout the GCWA's 35 county range; and, 3) 5,000 acres were for activities on Camp Bullis, less than 15% of which was considered occupied habitat. The conservation resulting from these consultations is over 61,300 acres of GCWA habitat maintained on Department of Defense (DOD) land and over 22,000 acres of private land preserved and/or maintained for GCWA conservation.

Additionally, we have issued 135 individual section 10(a)(1)(B) Incidental Take Permits (ITPs), along with their associated formal section 7 consultations. Over 57,000 acres of GCWA habitat has been authorized to be impacted. This total includes: over 21,000 acres were part of the Travis County and City of Austin HCP; 9,000 acres for the Hays County Regional HCP; 6,000 acres for the Williamson County Regional HCP; over 5,000 acres for the Southern Edwards Plateau HCP; 5,200 acres for the Comal County Regional HCP; 3,000 acres for the Oncor programmatic HCP; and, 1,100 acres for the LCRA's CREZ HCP. The HCPs, when fully implemented, would result in the conservation of over 77,700 acres of GCWA habitat and almost \$1.3 million for the preservation and/or maintenance of land for the benefit of the GCWA.

According to our consultations tracking database, there have been at least 31 formal section 7 consultations for the BCVI. Over 272,000 acres of BCVI habitat were authorized to be impacted by those consultations. Of the total acreage, impacts to 256,196 acres were associated with brush management and prescribed fire consultations. An additional 15,612 acres were associated with activities on Fort Hood. These consultations also resulted in over 27,000 acres of habitat management and maintenance specifically for the BCVI, with an expectation of an additional net benefit in BCVI habitat creation from the brush management and prescribed fire consultations.

One of the formal section 7 consultations was with the Refuge for the implementation of Hazard Fuel Best Management Practices. This consultation covered the alteration of about 900 acres of GCWA habitat, with the potential to affect 45-90 pairs (Groce et al 2010). The habitat impacts were not within the Refuge boundary of acquisition area. It should be noted that the managed habitat remained intact and was only modified by the proposed action to reduce the potential for catastrophic wildfire.

Additionally, we have issued 10 individual section 10(a)(1)(B) ITPs, along with their associated formal section 7 consultations. These 10 permits authorized over 19,300 acres of effects to BCVI habitat. If all authorized take were to occur, the ITPs would also result in over 16,800 acres of habitat preserved and over \$1.5 million given to the Texas Parks and Wildlife Foundation for perpetual management of 4,500 acres of BCVI habitat on Parrie Haynes Ranch.

#### Description of the action area

BCNWR is situated at the southern end of the Great Plains within the region known as the Texas Hill Country (Riskind and Diamond 1986, Amos and Gehlbach 1988). The Refuge straddles a boundary commonly drawn between the true Edwards Plateau to the south and west and the Limestone Cut Plains to the north (also known as the "Lampasas Cut Plain"; Tharp 1939, Riskind and Diamond 1988). This transition is manifested in the more gently sloping terrain of the north third of the Refuge and the heavily dissected canyonlands making up the southern two-thirds. The latter areas are commonly mapped in the Balcones Canyonlands Ecological Subregion (Lyndon B. Johnson School of Public Affairs 1978), from which the Refuge takes its name.

BCNWR is located in Travis, Burnet, and Williamson counties centered not far from the common corner of these three counties. The Refuge headquarters is located 5 miles west of the community of Lago Vista, Texas, in the southern part of the Refuge's 80,000-acre Acquisition Area boundary. This location is about 30 miles northwest of downtown Austin, Texas, the nearest sizeable metropolitan area to the Refuge. Other nearby communities includes Marble Falls, Burnet, Bertram, Liberty Hill, Leander, and Cedar Park.

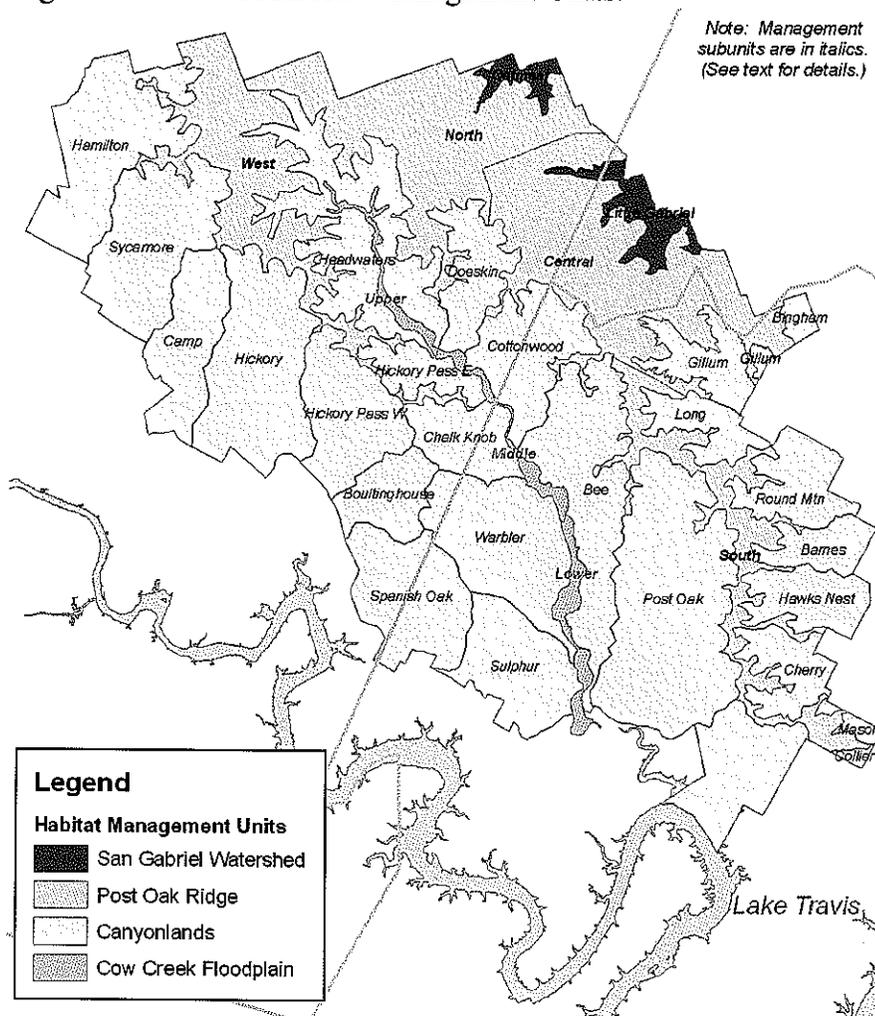
BCNWR lies within a humid, subtropical climate with hot summers and mild winters and is subject to periodic droughts. The Edwards Plateau, including the Balcones Canyonlands ecosystem, is known for extremes in wet and dry years, severe thunderstorms in the summer, and frequent cold fronts of short duration in the fall and winter. Lightning is relatively uncommon in the region in comparison to other areas of the country. Prevailing winds are predominantly from

the southeast, except during seasonal cold fronts when winds switch and come from the north for a few days.

The 80,000-acre acquisition area extends about 18.6 miles in a northwest to southeast direction and about half that distance on its northeast to southwest axis, broadly centered on geographical features known as the Post Oak Ridge and the adjacent Cow Creek watershed. The Refuge's southern edge is located at the north shore of Lake Travis, one of the "Highland Lakes" created on the Colorado River of Texas. The majority of the Refuge is in the Colorado River watershed, but a portion is in the Brazos River watershed (San Gabriel River sub-basin).

BCNWR is divided up into four basic geographic units (**Figure 2**); the Post Oak Ridge, the Canyonlands, the Cow Creek Floodplain, and the San Gabriel Watershed, each of which has several subunits. The lands within each of these units occupy distinctive topographic settings. Within each unit there are broadly shared geologic underpinnings and hydrologic regimes. Although habitats overlap somewhat among the units, each unit has certain characteristic communities that are derived from historical vegetation patterns and variation in historical land use patterns.

Figure 2. BCNWR Habitat Management Units.



The Refuge encompasses a complex mosaic of habitats which have as their basis large-scale geologic, hydrologic, and climatic processes acting over long time frames (Blakey 2005) and more recent changes which are primarily the result of human alteration and manipulation of the landscape (Smeins 1980, Amos and Gehlbach 1988, Baccus et al. 2007). Almost the entirety of the Refuge is underlain by Cretaceous limestone rocks of the Edwards, Walnut, and Glen Rose formations (Sellards et al., 1932; Moore 1964; Garner and Young 1976; Collins 2005). Variations in carbonate rock composition, compactness, micro-constituents, fracturing, weathering, and soil depth combine with elevation, slope, and aspect to create different microhabitats or "site types" in this layer-cake terrain (USDA-SCS 1974, 1979, 1983; Vauter 1994, Diamond et al. 1995), yielding recognizable correlations of geologic strata and vegetation dominants (Hill 1890, Tharp 1939, Amos and Gehlbach 1988, Lyday 1989, Sexton 1993). These correlations can be beneficially employed in prescriptions of habitat management. Overlaid on this are the myriad human influences such as ranching, farming, timber cutting, brush clearing, fencing, road building, fire, fire suppression, urbanization, and introduction of exotic species which have modified the potential natural vegetation of the land (Kuchler 1964, Schmid 1969, White et al. 2010).

#### Status of the species within the action area

There has been one formal section 7 consultation within the action area since 2012. The consultation was with the Refuge for "Management Activities and Research within GCWA Habitat" and provided incidental take of no more than 54 GCWA (27 pairs) to be harmed as a result of implementing the proposed action. The consultation did not evaluate effects to, or provide incidental take of, the BCVI.

#### *Golden-cheeked warbler*

Early environmental documents for the Refuge indicated that approximately 5,300 acres of "actual or potential" warbler habitat occurred within the original 41,000 acre boundary. Based on a review of the satellite classification on which that estimate was based, and maturation of some marginal habitat, a substantially larger area of warbler habitat is probably now in existence in the previous Refuge boundary. The 2015 map of GCWA Habitat Management Areas for the HMP shows approximately 19,079 acres of warbler habitat management areas within the Refuge, not all of which are occupied. Additional acreage of suitable warbler habitat occurs on many private tracts within the 80,000 acre Refuge acquisition boundary (USFWS 2001).

Warblers occur almost throughout the Refuge. It is a fairly common and characteristic species in juniper-oak woodlands on all sizable Refuge tracts. In 2009, Sexton updated the estimate on Refuge tracts and indicated that a minimum of 810 warbler territories were present on about 16,000 acres of the Refuge managed for the warbler (Sexton 2009). In 2012, Mueller et al. estimated occupancy across the Refuge utilizing surveys at 250 random points and determined that approximately 43% of the Refuge is occupied by territorial male warblers. The 250 random points included all habitat types found throughout the Refuge and therefore were not exclusive to typically defined GCWA habitat. This data has been used more recently to estimate the abundance of GCWA across the Refuge. Sesnie et al. (2015 in draft) estimated a Refuge-wide population at 884 GCWA males.

### *Black-capped vireo*

Early environmental documents for the Refuge indicated that approximately 18,000 acres of potential habitat for the BCVI occurred within the original 41,000 acre acquisition boundary (e.g. USFWS 1991a, b). However, a more recent evaluation of potential habitat suggests a much smaller amount of habitat is likely available. Within the proposed management areas for the HMP, approximately 2,200 acres is expected to be suitable and/or is proposed for management for the vireo.

From 2010 to 2014 vireo research efforts headed by Texas A&M University, Washington State University and Refuge staff have provided the best information of vireo distribution and numbers. This effort identified approximately 140 vireo territories in 2014 on Refuge lands. Preliminary results of a Refuge-wide point count survey in 2015, substantially based upon protocols used by Fort Hood, suggests a Refuge-wide population of 145 male BCVIs (Refuge files).

Within the BCNWR there are approximately 2,086 acres identified as black-capped vireo habitat areas, not all of which are occupied by the species. An additional 114 acres are also identified to be managed for both the warbler and vireo, but for calculation purposes are considered a subset of vireo habitat. Doing so brings the total number of acres that would be managed to benefit the vireo to 2,200 acres. Approximately 30% of the 2,086 acres and about 50% of the 114 acres are currently not occupied by the vireo and will require active manipulation to promote utilization.

It should be noted that there are a few small, single territory, BCVI locations on the Refuge that are currently occupied but are not being proposed for vireo management. These areas may contain occupied GCWA habitat and may over time grow out of suitability for the vireo. Additionally, there are a couple areas that have been identified as areas to be managed as grassland/savannah habitat that in the past have also contained one or two BCVI territories. No special vireo management provisions have been identified for these areas. However, it is quite possible vireos will continue to occupy these areas, as current management practices have facilitated their occupancy.

#### Factors affecting the species within the action area

The primary reason why BCNWR was established was for the protection and management of the GCWA and BCVI (Service 1992, Service 2001). Because of this, these two species should always receive the highest priority for management on the Refuge. On-going habitat management actions on the Refuge, such as controlled fire, are the only factors currently affecting these species within the action area.

Significant thought and consideration was placed on prioritizing management actions on the Refuge for the purposes of the HMP. The proposed management actions must consider what benefit the Refuge can contribute towards species recovery at the landscape/population scale. Doing so identified the GCWA as the priority species, over the BCVI, for the following reasons:

- The Refuge is located within the center of the warbler's breeding range. Whereas, the Refuge is at the far eastern extent of the vireo's breeding range.
- The warbler has a much more limited breeding range (39 counties in Texas). Whereas, the range of the vireo extends throughout 75 counties in Texas, southern Oklahoma, and northern Mexico (<http://ecos.fws.gov/ecos/indexPublic>).
- The 5 year status review for the vireo suggests a number of the threats to the species have been reduced since listing and makes a recommendation to down-list the species to threatened (USFWS 2007). In response to this the Service issued a 90-day finding on the petition to downlist the vireo and recommends it be downlisted (USFWS 2013d). Whereas, the draft 5-year status review for the warbler recommends no change to the status to the warbler, and the Service is currently not considering any changes to its status (Groce et al., 2010, Scott Rowin BCNWR pers. com.).
- Urbanization and habitat fragmentation are listed as threats to both species in their respective Recovery Plans (USFWS 1991a, 1992). It is however likely there are greater threats range-wide for the warbler, as much of its core breeding habitat is located within close proximity to major metropolitan corridors (Austin, San Antonio, I-35, etc.). Whereas, the vireo's range extends throughout much of rural Texas, Oklahoma, and Mexico. Additionally, it is likely the vireo has fewer threats from agricultural clearing than the warbler, as vireo habitat is more conducive to livestock grazing and game species (i.e. white-tailed deer, quail, etc.) management than warbler habitat.
- The Refuge has a greater chance of significantly contributing towards recovery of the warbler. The current estimated population for the warbler on the Refuge is approximately 864 individual males, versus 140 territories for the vireo. Additionally, far greater amounts of available and potential habitat occur for the warbler (19,079 acres) than the vireo (2,200 acres) on the Refuge.
- The average patch size of vireo habitat on the Refuge is 85 acres and only two meet the minimum 250-acre target for BCVI population sustainability (USFWS 2013c), and regardless of management efforts, the remaining sites will likely never reach this minimum acreage. Whereas, the majority of GCWA habitat on the Refuge meets the minimum 500-acre of contiguous habitat for population sustainability (USFWS 2013c).
- The time lag for habitat development is substantially greater for the warbler than the vireo. Habitat for the warbler that has been destroyed will take a minimum of 40 years to become suitable again versus approximately 4 years for the vireo.
- The Environmental Protection Agency ([EPA] 2009) identified the GCWA as a species that is critically vulnerable to climate change. This was due in part to an expected increase in temperature, drought, and fire events. Based upon recent observations (2011-2013) on and near the Refuge, and observations during the drought of the early 1950s throughout central Texas (Diamond et al., 1995), it appears as though warbler habitat is more susceptible to severe drought effects where large numbers of Ashe juniper have been observed dead as a result of the drought. Climate change therefore appears to have a greater potential adverse effect on the warbler than the vireo.
- Using available range-wide GIS data and Landsat imagery, the most recent habitat change models for the GCWA suggest a 29% reduction in breeding habitat from 1999/2001 to 2010/2011 (Duarte et al, 2013). While no range-wide habitat change model exists for the vireo, the 5-year status review identifies a substantial increase in known breeding habitat since the species was listed (USFWS 2007).

## **Effects of the Proposed Action**

### Factors to be considered

#### *Proximity of the action*

The Refuge is located in the center of the GCWA range and on the edge of the BCVI range. All management actions proposed in the HMP could alter habitat for either the GCWA or BCVI. Only small portions of habitat would be altered during any single management event and most actions would occur when the birds are not present in the habitat. The proposed management actions may result in temporary disturbance to any birds utilizing the managed areas, however, as the habitat quality increases, so should the populations of the listed birds.

#### *Distribution*

The GCWA and BCVI both currently occupy portions of the Refuge where suitable habitat exists. The HMP would result in management actions on habitat that is of low to moderate quality to improve the habitat quality to high. In addition, management actions would be conducted on areas with existing good quality habitat to maintain the habitat quality in the area. HMP management actions would occur in multiple areas of varying size, depending on site specific management needs, throughout the 15 year term of the HMP.

#### *Timing*

The HMP management actions could occur at any time of year, including during the breeding season (March 1–August 1) when the GCWA or BCVI are present. Prescribed burns would generally be restricted to outside of the breeding season (see discussion in the Project Description above). Annual work plans would be developed and would strive to time management actions to outside of the breeding season, to the maximum extent practicable, in order to avoid or minimize harm and/or harassment of the species during the breeding season.

#### *Nature of the effect*

Management actions that occur during the breeding season could affect any stage of the GCWA and/or BCVI life cycle. Actions undertaken outside of the breeding season would only affect birds if the habitat has not recovered by the following breeding season. In this case, the actions would mostly affect adult male birds seeking to establish territories, but those effects would be short term. Conversion of low/moderate quality habitat into higher quality habitat may result in some initial reduction in the local population, but the overall population should increase over time as the habitat quality increases.

#### *Duration*

Most of the actions in the HMP would occur over a short duration, from a few days to a few weeks each time the action is implemented. Most of the actions related to mechanical vegetation

management would probably only occur once or twice in any given habitat area during the 15 year term of the HMP. Chemical treatment with herbicides or prescribed burns may occur slightly more often, but on a rotation schedule of 3-5 years during the term of the HMP. Adaptive management based on an evaluation of the effectiveness of previous treatments would dictate the frequency of repeated management actions at any particular location.

#### *Disturbance frequency, intensity, severity*

The disturbance frequency for GCWA habitat would be relatively low since the management goal is for near climax woodland habitat. Many management actions for GCWA habitat would only occur once in any given location during the 15 year term of the plan. These results could be accomplished passively, but active management will help speed up the process. Disturbance intensity would be greater with active management than with passive management, but the species response would also be increased. The disturbance severity for GCWA habitat would be low and should result in an increase in the GCWA population by the end of the HMP management period.

The disturbance frequency for BCVI habitat would be higher than for GCWA habitat, as management for the BCVI is for early/mid successional stage shrublands. This type of management would also be more intense and may affect any GCWA that are currently using overgrown BCVI habitat, particularly in the 114 acres that would be managed for both species. The habitat recovery rate when setting back succession is very short, therefore the disturbance severity would be very low and would also result in relatively rapid development of high quality habitat and a greater potential increase in the BCVI population by the end of the HMP management period.

#### Analysis for effects of the action

##### *Beneficial effects*

Implementation of the HMP would result in beneficial effects to GCWA and BCVI by manipulating low to medium quality habitat into high quality habitat. Ultimately, the Refuge is proposing to increase the number of acres that are currently occupied, and maximize the density of warblers and vireos within their identified habitats. It is anticipated the Refuge-wide population of each species would continue to increase over the 15 year duration of the HMP. However, small year-to-year variations in abundance at a particular management site are expected due to the proposed management activities and other natural variations outside the control of the Refuge.

HMP Goal #1, management of woodland habitats for the GCWA, would result in: a minimum increase of 612 acres (10% increase) in juniper-oak woodlands with a canopy cover greater than 60%; a minimum increase of 133 acres (5% increase) increase in woody species diversity by reducing the percent of juniper composition from greater than 90% to between 50 and 90%, while maintaining greater than 60% canopy cover; and, reduce the amount of edge along GCWA habitat blocks by 10% by connecting habitat blocks, thereby reducing habitat fragmentation.

HMP Goal #2, management of mixed shrublands for the BCVI, would result in: an increase in the amount of BCVI habitat with suitable (30% - 70%) shrub cover to 75% of the total managed areas; maintain an average shrub height of between 3 and 6 feet, with foliage extending to the ground and no more than 10% emergent trees; and, maintain a mosaic of woody cover with a high vegetative edge-to-area ratio, with open areas dominated by native grasses and forbs.

### *Direct and Indirect Effects*

Direct and indirect effects are likely to occur to both the GCWA and BCVI as a result of the proposed HMP activities, primarily due to the alteration of each species habitat outside of the breeding season. The Refuge proposes to manage a minimum of 19,079 acres for the benefit of the GCWA and a minimum of 2,086 acres for the benefit of the BCVI. An additional 114 acres are also identified to be managed for both the BCVI and GCWA. The 114 acres are considered a subset of BCVI habitat, as the management actions proposed are expected to benefit the vireo, but would have minimal positive, and possibly negative, impacts to the warbler. Active management of these areas and natural population variations are expected to result in small year-to-year changes in abundance for both of these species. However, the net result over the 15-year term of the HMP is expected to result in an increase in abundance across the Refuge.

There are six GCWA territories that may be displaced due to management actions proposed under the HMP. Management actions that may occur within these areas could result in a reduction of canopy cover such that the site(s) may no longer be desirable for the warbler. It is possible other unknown or transient territories exist on the Refuge and may also be displaced as a result of managing a particular site for the BCVI and/or other species.

There is one BCVI territory that may be displaced due to management actions proposed under the HMP. The territory is located within an area proposed to be managed for the GCWA. Because of GCWA management actions it is likely this site will continue to transition into a mature juniper-oak woodland and would no longer be suitable for the BCVI. It is possible other unknown or transient territories exist on the Refuge which may also be displaced as a result of managing that particular site for the GCWA and/or other species.

Approximately 33% of the identified GCWA management areas have less than 60% canopy cover and as such are occupied at substantially lower rates than high quality warbler habitat. Within these areas, and other areas with an over-abundance of juniper and/or a lack of other species, the Refuge proposes to utilize all available and reasonable management techniques to maximize the benefit to this species. Approximately 30% of the 2,086 acres of BCVI habitat and 50% of the 114 acres to be managed for both BCVI and GCWA are not occupied by the vireo at the present time and would require active management. Management actions within these unoccupied areas, or areas that are occupied at substantially lower rates than expected, may result in minimal adverse effects to the species lasting for a short duration, but should also result in substantial beneficial effects over the 15-year term of the HMP.

Of all the management actions proposed, prescribed fire may have the greatest potential for temporary impacts to the GCWA (Reidy et al. 2014). It is important to recognize historically wildfires likely went through these woodlands on an occasional basis. Over the past several

years the Refuge has begun to evaluate the effectiveness of selective thinning and prescribed fire to sustain ideal GCWA habitat, promote hardwood recruitment and the maturation of suboptimal habitat, and simultaneously reduce the possible threat of a stand replacement fire within warbler habitat. The HMP takes what we have learned so far and proposes the Refuge continue to refine the effectiveness of these techniques.

Since 2010 the Refuge has collected very good data on the distribution and abundance of BCVIs on the Refuge and has noticed a modest but persistent increase each year in the abundance of BCVIs on the Refuge. Additionally, the Refuge has monitored the effects of its management actions on these populations. Typically cool season prescribed burns and other similar low impact actions result in no statistically significant reduction in abundance or productivity from one year to the next (Refuge files). Very few impacts are expected from one year to the next with these less intensive management actions and as such no acreage limitations on management actions are proposed. However, many sites are likely to eventually grow out of suitability and/or past the point in which cool season burns and other less intensive management actions are effective. Within these sites more intensive management actions such as significant mechanical clearing and/or high intensity fires that significantly change the vegetative structure (height and percent cover) of the site are proposed. These actions are likely to temporarily reduce the abundance of the vireo at that particular site. To minimize impacts of these more intensive management actions, the Refuge proposes to treat no more than 20% (440 acres) of the BCVI habitat in any given year. This limitation only pertains to more intensive management actions and would only be conducted when other less intensive management actions are not expected to achieve the desired result. Within the BCVI management areas the Refuge proposes to utilize all available and reasonable management techniques to maximize the benefit to this species.

In order to complete these management actions temporary impacts may occur, but are very difficult, if not impossible, to quantify. Except for the six GCWA and one BCVI territories mentioned above, no management action is expected to result in the permanent loss of a territory. Even then, these territories are likely to only be displaced, as an abundance of habitat exists throughout the Refuge. From a population standpoint, no management action is expected to result in a statistically measurable reduction in the GCWA or BCVI populations on the Refuge.

#### Species' response to the proposed action

The Refuge and the Service believe both the GCWA and the BCVI would respond positively to the habitat management actions proposed in the HMP. These actions are ultimately meant to improve the habitat quality on the Refuge for these two species, thus increasing their populations. Given sufficient time for the habitat management actions to increase habitat quality, and absent any outside negative factors, implementation of the HMP would result in an increase in the habitat and population of the GCWA and BCVI on the Refuge and contribute to the species recovery.

#### **Cumulative Effects**

There are no cumulative effects (future State, local, or private actions) to consider in this biological opinion. All future actions within the action area would occur within the boundaries

of BCNWR and would be considered Federal actions that would require separate consultation pursuant to section 7 of the Act.

### **Conclusion**

After reviewing the current status of the GCWA and BCVI, the environmental baseline for the action area, the effects of the proposed HCP, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of these species. A majority of the management actions in the HMP would be beneficial to the GCWA or BCVI through habitat improvements over the 15 year term of the plan.

Critical habitat has not been designated for the GCWA or BCVI; therefore, none would be affected.

### **INCIDENTAL TAKE STATEMENT**

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined by the Service as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is further defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding and sheltering (50 CFR §17.3). Harm is also further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns, including breeding, feeding, and sheltering. Incidental take is defined by the Service as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary and must be implemented by BCNWR so that they become binding conditions of any authorization issued to implement a project covered by this biological opinion, as appropriate, in order for the exemption in section 7(o)(2) to apply. BCNWR has a continuing duty to regulate the activity covered by this incidental take statement. If BCNWR (1) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the authorizations, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, BCNWR must report the progress of the action and its impact on the species to the AUESFO as specified in the incidental take statement. [50 CFR 402.14(i)(3)].

### **Amount or Extent of Take**

The Service anticipates incidental take of GCWA and BCVI would occur as a result of the proposed implementation of the HMP. Individuals of these species are difficult to detect unless they are observed, undisturbed, in their environment. The Service anticipates the following amount of incidental take:

1. No more than six existing GCWA territories would be disturbed as a result of actions authorized under this biological opinion.
2. No more than one existing BCVI territory would be disturbed as a result of actions authorized under this biological opinion.
3. Harm or harassment of the GCWA or BCVI may occur due to temporary displacement of individuals or territories in all areas prescribed for management under the HMP. Since the total amount of acreage that would be actively managed, at any one time or over the 15 year term of the HMP, is not known, there is no way to numerically describe the amount of potential take. However, the species harm/harassment is expected to be temporary and these species will benefit from the habitat management actions proposed in the HMP over the long-term.

### **Effect of the Take**

In the accompanying biological opinion, the Service has determined that this level of anticipated take is not likely to result in jeopardy of the GCWA or BCVI due to the short-term and limited effects associated with the proposed action. The Refuge's implementation of the HMP is anticipated to benefit these species in the long-term.

Critical habitat has not been designated for these species; therefore, none would be affected.

### **Reasonable and Prudent Measures**

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize incidental take of the GCWA and BCVI:

1. Monitoring of the GCWA and BCVI during management activities associated with implementation of the HMP, described in this biological opinion, and annual reporting.

### **Terms and Conditions**

In order to be exempt from the prohibitions of section 9 of the Act, the Refuge must comply with the following terms and conditions that implement the reasonable and prudent measure described above and outlined reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Where temporary or permanent adverse effects occur, an annual report describing habitat management actions implemented during the previous 12 month period and management actions proposed in the Annual Work plan for the following 12 month period must be submitted to the AUESFO. The annual report must detail: (1) the types of habitat management activities implemented during the previous 12 months, including the dates

the activities occurred; (2) information on the success of the habitat manipulation; (3) an explanation of any unexpected consequences of the management actions; (4) known project effects on the GCWA or BCVI; (5) the Annual Work Plan for the next 12 months; and, (6) any other pertinent information. In addition, the AUESFO must be notified within three working days of the finding of any dead or injured listed species or any unanticipated take of the GCWA or BCVI not addressed in this BO. The AUESFO contact person is Adam Zerrenner, at (512) 490-0057.

In the accompanying BO, the Service determined that no more than 6 GCWA and 1 BCVI territories would be displaced as a result of HMP implementation. In addition, management actions may result in temporary harm or harassment of all GCWA and BCVI within the active habitat management areas on the Refuge during the 15 year term of the HMP. If, during the course of the authorized activities, this level of incidental take is exceeded prior to the annual review, such incidental take represents new information requiring review of the reasonable and prudent measure provided. BCNWR must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measure.

### **Conservation Recommendations**

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service has no conservation recommendations for BCNWR at this time.

### **Reinitiation Notice**

This concludes formal intra-Service consultation on BCNWR's proposed HMP. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) the HMP is proposed to be extended beyond the 15-year term evaluated in this BO; (3) new information reveals the HMP may affect listed species or critical habitat in a manner, or to an extent, not considered in this opinion; (4) the HMP is subsequently modified in a manner that causes an effect to the listed species or CH not considered in this opinion; or (5) a new species is listed or CH is designated that may be affected by the action.

If you have any questions regarding this biological opinion, please contact Tanya Sommer at (512) 490-0057, extension 222.

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