

Table of Contents

1.0 Purpose of and Need for Proposed Action	1
1.1 Introduction.....	1
1.2 Location	1
1.3 Background.....	2
1.4 Purpose of Action	3
1.5 Need for Action.....	3
1.6 Decision to be Made	5
1.7 Regulatory Compliance	5
1.8 Scoping/Public Involvement and Issues Identified.....	8
2.0 Alternatives	9
2.1 Alternative A.....	9
2.2 Alternative B (Preferred Alternative)	13
2.3 Alternative C.....	16
2.4 Alternative Considered but Dismissed from Detailed Analysis	19
3.0 Affected Environment.....	19
3.1 Physical Environment	19
3.1.1 Air Quality	20
3.1.2 Soils/Geology.....	20
3.1.3 Water Quality and Quantity	21
3.2 Biological Environment.....	21
3.2.1 Vegetative Communities.....	21
3.2.2 Wildlife	22
3.2.3 Threatened and Endangered Species and Other Special Status Species.....	26
3.3 Human Environment.....	28
3.3.1 Cultural Resources	28
3.3.2 Socioeconomic Resources	28
3.3.3 Public Use/Recreation.....	29
4.0 Environmental Consequences	30
4.1 Effects Common to All Alternatives.....	30
4.1.1 Environmental Justice.....	30
4.1.2 Climate Change.....	31
4.2 Effects by Resource	31
Physical Environment	31
4.2.1 Impacts on Air Quality.....	31
4.2.2 Impacts on Water Quality and Quantity	32
4.2.3 Impacts on Soils.....	33

Biological Environment	33
4.2.4 Impacts on Habitat	33
4.2.5 Impacts on Wildlife.....	35
4.2.6 Impacts on Threatened and Endangered Species and Other Special Status Species	36
Human Environment.....	37
4.2.7 Impacts on Socioeconomics.....	37
4.2.8 Impacts on Visitor Services/Activities.....	39
4.2.9 Impacts to Cultural Resources	40
4.2.10 Humaneness and Animal Welfare Concerns	40
4.2.10 Impacts on Public Health and Safety	41
4.3 Assessment of Cumulative Impacts	42
4.3.1 Anticipated Direct and Indirect Impacts of Proposed Hunt on Wildlife Species ..	42
4.3.1.1 Resident Wildlife	42
4.3.1.2 Migratory Wildlife.....	47
4.3.1.3 Other (Non-hunted) Resident Wildlife	48
4.3.1.4 Endangered Species	49
4.3.2 Anticipated Direct and Indirect Impacts of Proposed Action on Refuge Programs, Facilities, and Cultural Resources.....	49
4.3.3 Anticipated Impacts of Proposed Hunt on Refuge Environment and Community	51
4.3.4 Other Past, Present, Proposed, and Reasonably Foreseeable Hunts and Anticipated Impacts	52
4.3.5 Anticipated Impacts if Individual Hunts are Allowed to Accumulate.....	54
4.4 Indian Trust Assets	55
4.5 Unavoidable Adverse Effects	55
4.6 Irreversible and Irrecoverable Commitment of Resources.....	55
4.7 Summary of Environmental Effects by Alternative.....	56
5.0 Consultation, Coordination, and Document Preparation	57
5.1 Agencies and individuals consulted in the preparation of this document.....	57
5.2 References.....	57
APPENDIX A (Definitions)	63

1.0 PURPOSE OF AND NEED FOR PROPOSED ACTION ALTERNATIVE

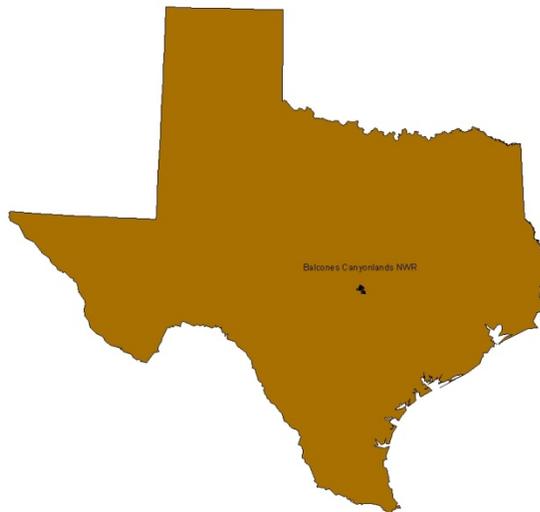
1.1 Introduction

The United States Fish and Wildlife Service (Service) is proposing to expand hunting activities for white-tailed deer (*Odocoileus virginianus*), feral hog (*Sus scrofa*), wild turkey (*Meleagris gallopavo*) and doves [mourning (*Zenaida macroura*), white-winged (*Zenaida asiatica*), Eurasian collared (*Streptopelia decaocto*), and rock (*Columba livia*)] on Balcones Canyonlands National Wildlife Refuge. This Environmental Assessment (EA) is being prepared to evaluate the effects associated with this proposal and complies with the National Environmental Policy Act (NEPA) in accordance with Council on Environmental Quality regulations (40 CFR 1500-1509) and Department of the Interior (516 DM 8) and Service (550 FW 3) policies (see section 1.7 for a list of additional regulations with which this EA complies). NEPA requires examination of the effects of proposed actions on the natural and human environment. In the following chapters, three alternatives are described and environmental consequences of each alternative are analyzed.

1.2 Location

Balcones Canyonlands NWR is located in Travis, Williamson, and Burnet counties, Texas, approximately 35 miles northwest of Austin (Figure 1).

Figure 1. Balcones Canyonlands NWR Vicinity Map



Balcones Canyonlands NWR headquarters is located on Texas Ranch Road 1431, approximately 5 miles west of Lago Vista. The mailing address is 24518 FM 1431, Marble Falls, TX 78654.

1.3 Background

Balcones Canyonlands NWR Balcones Canyonlands National Wildlife Refuge (NWR) was established in February 1992 by the Endangered Species Act (ESA) of 1973, as part of a larger conservation strategy in the Austin, Texas area. The Service initially proposed purchasing 41,000 acres in the Edwards Plateau of central Texas. The Secretary of Interior approved the addition of 5,000 acres in 1996, bringing the total proposed acquisition to 46,000 acres. The objectives of the Refuge are: “to ensure that (1) A sufficient representation of Golden-cheeked Warbler and Black-capped Vireo habitat is included; (2) Watersheds and water quality will be protected; (3) Destroyed or fragmented nesting habitats acquired have high potential for ecological restoration; (4) A protective buffer zone for nesting habitat and nesting populations is in place within the Refuge boundary.” This Refuge is approximately 35 miles from Austin (population 790,390) and within 120 miles of San Antonio (population 1,327,407). Other local towns and cities including Cedar Park, Leander, Georgetown, and Round Rock contribute to a total Austin metropolitan population of over 1.7 million, and an Austin/San Antonio corridor population of about 4 million people (2010 Census).

The Refuge was opened to hunting activities starting in 1997 (for white-tailed deer, turkeys, and feral hogs) and added hunting for doves in 2001. Environmental Assessments (EAs), Hunt Plans, Finding of No Significant Impacts (FONSI), Section 7 Consultations and Compatibility Determinations (CDs) were completed as part of the opening packages. The Fund for Animals/Humane Society lawsuit of 2003 listed Balcones NWR as one of 38 national wildlife refuges which had not provided a cumulative impact analysis when writing the environmental assessments for the waterfowl, big game and upland game hunting program. An updated Environmental Assessment provided a cumulative impact analysis for each of the alternatives. Since the Refuge began the hunting program, 31 additional tracts of land totaling 6,027 acres have been purchased. The total current acreage of the Refuge is approximately 19,842 acres in fee title, and another 4,599 acres under conservation easement protection.

Hunting for feral hogs on the Refuge began in 1997. Big Game hunt participants are encouraged to take hogs, but most choose not to and instead focus on harvesting deer. Feral hogs have been trapped on an intermittent basis since establishment of the Refuge, but little effort was been devoted to trapping before 2011 due to the labor intensive nature of trapping, and the lack of funds to acquire effective traps. In 2011, the Refuge staff made a concerted effort to control feral hogs and were successful in removing 143 hogs through trapping and shooting.

Wild turkeys are not sought out by the majority of the participants in our Big Game Hunt, and as a result, few birds are harvested. Only 9 wild turkeys have been harvested since hunting began on the Refuge in 1997. No more than 1 bird was harvested in any year but 2009, when 2 toms were taken.

One refuge tract (Johnson) was opened to dove hunting in 2001. About 2/3 of this 274-acre tract is dominated by old fields and open grasslands – mostly vegetated in the exotic grass, King

Ranch bluestem (*Bothriochloa ischaemum*). Portions of the tract (currently approximately 13 acres) are tilled and planted in native vegetation to replace the exotic grass and to encourage seed production by annual forbs. Hunting success on the Refuge has fluctuated over the years the hunt has been conducted – with total harvest numbers ranging from 0 (2009) to 137 (2012).

The 2012 Hunt Plan contains a proposal to open 1 additional tract to dove hunting.

1.4 Purpose of Action

The purpose of the Environmental Assessment is to evaluate the addition of several tracts of land to the areas already open to hunting on Balcones Canyonlands NWR. The U.S. Fish and Wildlife Service is proposing this action: (1) to enhance endangered species habitat by reducing or maintaining the white-tailed deer population; (2) to enhance endangered species habitat by reducing the population of invasive feral hogs; and (3) to provide additional, compatible, wildlife-oriented recreation.

1.5 Need for Action

Reducing or maintaining the white-tailed deer population on the Refuge to densities below 1 deer per 20 acres would improve habitat conditions for the two endangered bird species found on Balcones Canyonlands NWR. Because acquisition of lands has been piecemeal – by purchasing land from willing sellers as funding is made available – there are many refuge tracts that contain endangered species that were not included in the original Hunt Plan. By including those tracts, we can more effectively manage the deer herd, to the benefit of the Golden-cheeked Warbler and Black-capped Vireo.

Feral hog rooting and digging is causing disturbance and harm to native wildlife and plants on the Refuge. The expansion of feral hog hunting is being proposed to: (1) help reduce the number of hogs and the destruction caused by their foraging behavior; and (2) provide additional opportunities for priority, wildlife-oriented recreation on the Refuge. A reduction in feral hog numbers would reduce negative impacts caused by feral hogs and help maintain the integrity of Refuge habitats.

Providing additional acreage for the pursuit of turkeys and doves would help meet a growing demand for low-cost public hunting land in Texas. Approximately 94% of the State's lands are held in private ownership. Landowners typically charge hunting access (lease) fees ranging from \$50 per day to over \$3,000 per day. Providing additional land on which to hunt turkeys and doves is being proposed to provide additional opportunities for priority, wildlife-oriented recreation on Balcones Canyonlands NWR and to fulfill the Refuge System hunting goals described below.

The guiding principles of the Refuge System's hunting programs as outlined in the U.S. Fish & Wildlife Manual (605 FW 2) are to:

- Manage wildlife populations consistent with Refuge System-specific management plans approved after 1997 and, to the extent practicable, State fish and wildlife conservation plans;
- Promote visitor understanding of and increase visitor appreciation for America's natural resources;
- Provide opportunities for quality recreational and educational experiences consistent with criteria describing quality found in 605 FW 1.6;
- Encourage participation in this deeply-rooted tradition in America's natural heritage and conservation history.

Proposed additional hunting in part fulfills the Refuge CCP (2001) which contains the following Goals:

Goal 1, Objective 3: Protect existing Golden-cheeked Warbler habitat on Refuge lands and enhance additional areas for Golden-cheeked Warbler where appropriate. (Strategy 3. Maintain white-tailed deer at one per 20 or more acres and attempt to eliminate feral hogs to reduce impacts on recruitment of hardwood trees.)

Goal 2, Objective 2: Within 10 years, design and implement a plan to restore wetlands and riparian corridors. (Strategy 2. Implement a big-game hunt for white-tailed deer and feral hogs to reduce their populations and thereby reduce interference with restoration efforts.)

Goal 2, Objective 5: Reduce the Refuge white-tailed deer herd to achieve and maintain a density of one deer per 20 or more acres within five years to reduce adverse effects on Refuge habitat.

Goal 2, Objective 7: Control feral, exotic and domestic animals that can compete with native wildlife and damage its habitat (e.g. dogs, cats, feral hogs, emu, etc.). Complete hog control plan within three years.

Goal 4, Objective 2: Provide compatible wildlife dependent outdoor recreational opportunities for the public on the Refuge to include wildlife viewing access, while striving for a balance between conflicting user groups. Annually evaluate hunting program to include newly acquired tracts.

1.6 Decision to be Made

This EA is an evaluation of the environmental impacts of the alternatives and provides information to help the Service fully consider these impacts and any proposed mitigation related to opening additional acreage on Balcones Canyonlands National Wildlife Refuge to white-tailed deer, feral hog, turkey, and dove hunting. Using the analysis in this EA, the Service will decide whether or not the environmental consequences of any of the alternatives would be significant and require an EIS, or decide to prepare a Finding of No Significant Impact for the selected alternative.

To initiate or expand hunting programs, the Service must publish in the Federal Register any proposed and final refuge-specific regulations pertaining to that use prior to implementing them. The regulations are only one element of a complete opening package, which is comprised of the following documents: hunting plan; compatibility determination; documentation pursuant to compliance with the National Environmental Policy Act of 1969, as amended (NEPA) and appropriate NEPA decision document; Endangered Species Act section 7 evaluation; copies of letters requesting State involvement and the results of the request; draft news release; outreach plan; and the draft refuge-specific regulations.

1.7 Regulatory Compliance

National wildlife refuges are guided by the mission and goals of the National Wildlife Refuge System (NWRS), the purposes of an individual refuge, Service policy, and laws and international treaties. Relevant guidance includes the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, Refuge Recreation Act of 1962, and selected portions of the Code of Federal Regulations and Fish and Wildlife Service Manual.

The mission of the Refuge System is:

“... to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57).

The goals of the Refuge System are to:

- *conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered;*
- *develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed*

and carefully managed to meet important life history needs of these species across their ranges;

- *conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts;*
- *provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation); and*
- *foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.*

The NWRS Improvement Act of 1997 provides guidelines and directives for the administration and management of all areas in the NWRS. It states that national wildlife refuges must be protected from incompatible or harmful human activities to ensure that Americans can enjoy Refuge System lands and waters. Before activities or uses are allowed on a national wildlife refuge, the uses must be found to be compatible. A compatible use "... will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuges." In addition, "wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety." The act also recognized that wildlife-dependent recreational uses involving hunting, fishing, wildlife observation, photography, environmental education and interpretation, when determined to be compatible with the mission of the System and purposes of the Refuges, are legitimate and appropriate public uses of the NWRS and they shall receive priority consideration in planning and management.

This EA was prepared by the Service and represents compliance with applicable Federal statutes, regulations, Executive Orders, and other compliance documents, including the following:

American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)

Archaeological Resources Protection Act of 1979 (16 U.S.C. 470)

Clean Air Act of 1972, as amended (42 U.S.C. 7401 *et seq.*)

Clean Water Act of 1972, as amended (33 U.S.C. 1251 *et seq.*)

Endangered Species Act of 1973, (ESA) as amended (16 U.S.C. 1531 *et seq.*)

Executive Order 12898, Federal Action Alternatives to Address Environmental Justice in Minority Populations and Low Income Populations, 1994.

Fish and Wildlife Coordination Act of 1958, as amended (16 U.S.C. 661 *et seq.*)

Floodplain Management (Executive Order 11988)

National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 *et seq.*)

Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 *et seq.*)

National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 *et seq.*)

Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 *et seq.*)

Protection and Enhancement of the Cultural Environment (Executive Order 11593)

Protection of Wetlands (Executive Order 11990)

National Pollutant Discharge Elimination System, as amended (33 U.S.C. 1251 *et seq.*)

Executive Order 13112, Invasive Species (issued in February 1999)

Administrative Procedures Act (5 U.S.C. 551-559, 701-706, and 801-808) as amended

Antiquities Act of 1906 (16 U.S.C. 431-433)

Bald Eagle Protection Act (16 U.S.C. 668-668d) as amended

Federal Land Recreation Enhancement Act (REA), 16 U.S.C.6803(c),

Consolidated Appropriations Act (PL 108-447)

Fish and Wildlife Act of 1956 (16 U.S.C. 742a-754j-2)

Fish and Wildlife Conservation Act (16 U.S.C. 2901-2911) as amended

Fish and Wildlife Improvement Act of 1978 (16 U.S.C. 7421)

Migratory Bird Treaty Act (16 U.S.C. 703-712 as amended)

National Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee) as amended

Recreation Hunting Safety and Preservation Act of 1994 (16 U.S.C. 5201-5201)

Refuge Recreation Act (16 U.S.C. 460K-460K-4) as amended

Sikes Act (16 U.S.C. 670a-680o) as amended

Soil and Water Conservation Act of 1977 (16 U.S.C. 2001-2009) as amended

Further, this EA reflects compliance with applicable State of Texas and local regulations, statutes, policies, and standards for conserving the environment and environmental resources such as water and air quality, endangered plants and animals, and cultural resources.

1.8 Scoping/Public Involvement and Issues Identified

On October 31, 2012, the Service announced its intent to prepare an Environmental Assessment of alternatives for opening 10 additional tracts on Balcones Canyonlands National Wildlife Refuge to white-tailed deer, feral hog, and turkey hunting; and opening 1 additional tract to hunting for migratory birds (doves). A 14-day scoping period (November 2-November 15) was established under that notice. The Service provided a news release to the following media outlets:

Newspapers -- Burnet Bulletin, Liberty Hill Independent, Liberty Hill Leader, Highlander News, The Picayune, Round Rock Leader, Hill Country News, Austin American Statesmen, Four Points News, Williamson County News, Daily Texan, Community Impact News

Television -- KEYE, KLRU, KTBC, KVUE, KXAN, YNN

Radio -- KXBT, KUT, KLBJ.

We also posted notification on our web site, and sent a letter to the Texas Parks and Wildlife Department, announcing the initial scoping period for development of this EA. The DRAFT copy of the Hunt Plan was made available for all who inquired.

During the scoping period the Service received 2 public response emails with comments that were considered as part of this analysis. The following concerns were identified:

- There is a concern that other species can be illegally shot during hunts (need for Law Enforcement presence),
- There is a desire to control populations of species that may be out of control.

All alternatives analyzed and considered are discussed below.

A public comment period for the Draft EA will be held from December 1, 2012 to January 1, 2013. Comments will be addressed following the completion of this scoping.

2.0 ALTERNATIVES

This environmental assessment discloses the environmental consequences of opening additional tracts to white-tailed deer, feral hog, turkey and dove hunting alternatives on the Refuge. The Service evaluated consequences of three alternatives for the proposed hunting programs on various Refuge resources: 1) Alternative A – no additional Refuge tracts open to white-tailed deer, feral hog, turkey and dove hunting (Current Management); 2) Alternative B (Preferred Alternative) - open 10 additional Refuge tracts to white-tailed deer, feral hog, and turkey hunting, and open 1 additional Refuge tract to dove hunting in accordance with State and special Refuge regulations; and 3) Alternative C - open 34 additional Refuge tracts to white-tailed deer, feral hog, and turkey, and open 1 additional Refuge tract to dove hunting in accordance with State regulations and Refuge specific regulations. Section 2.4 includes a discussion of other alternatives considered, but not analyzed in detail.

2.1 Alternative A: No additional Refuge tracts open to white-tailed deer, feral hog, turkey and dove hunting – Current Management

Under this alternative, the Refuge would maintain status quo – offering hunting on 12 tracts for white-tailed deer, feral hog, and turkey, and providing dove hunting on 1 Refuge tract. There would be no change to current public use or wildlife management programs on the Refuge under this alternative. The Refuge would continue to allow current hunting opportunities including 1 Youth Big Game and Upland Game Hunt, and 3 General Big Game and Upland Game Hunts (which allow for the harvest of white-tailed deer, feral hog, turkey), and a migratory bird hunt for doves. Figure 2 shows all currently designated Refuge Hunt Units, which include the Simons (Unit 1), Mullen (Unit 2), Eckhardt (Unit 3), Gainer (Unit 4), Nagel (Unit 5), Doeskin (Unit 6), Rodgers (Unit 7), Webster (Unit 8), Old Salem (Unit 9), Beard (Unit 10), Flying X (Unit 11), and Johnson (Unit 12) tracts. Only the Johnson tract is open to migratory bird (dove) hunting at this time (Table 1, Figure 2).

Big Game and Upland Birds: Participants for the white-tailed deer, feral hog, and turkey (Big Game and Upland Game) hunts are selected via a lottery drawing to limit the number of hunters and define hunting dates.

During the 3-day hunts (Friday – Sunday), general public use of areas open to hunting is closed. Hunters attend an orientation session before their hunt to become familiar with Refuge regulations. Each participant is provided maps showing access points/entrances to each unit and is allowed to drive personal vehicles to their respective units. Hunters may drive on designated roads in the units, and in larger areas (Unit 3, 7, 8, and 11) hunters are assigned a designated parking area.

The number of permits issued are adjusted periodically based on acreage and arrangement of the tract, and the white-tailed deer density. Tracts are administratively opened or closed to hunting

by adjusting the number of permits issued annually. Hunting with handguns is not allowed. In some units, safety considerations dictate that participants must hunt from an established elevated blind.

Refuge bag limits on white-tailed deer and turkeys are adjusted as needed to meet management objectives, but are the same as, or more restrictive than, the State limits. Refuge staff monitor the deer and turkey populations, habitat conditions, and hunter success to allow for adaptive management and reduce or increase the number of hunts or permits offered as needed to ensure sound management. Various strategies to incentivize harvesting doe deer and feral hogs may be employed. There are no limits on the number of feral hogs that can be taken by hunt participants. Baiting is not allowed per Service regulations [50 CFR 32.2(h)]. Camping on the Refuge is not allowed.

Refuge Law Enforcement Officers and/or TPWD wildlife officers monitor the hunt and conduct license, bag limit, and access compliance checks. Refuge staff and trained volunteers administer the hunt and check all harvested game.

Refuge staff work with mobility-impaired hunters to arrange appropriate hunting access. Hunters requiring special access contact Refuge officials for additional information or assistance. Examples of special provisions include the use of accessible hunting blinds; the use of an off-road motor vehicle; or assistance by a non-hunting guest who is not otherwise authorized to participate in the hunt. If a hunt participant informs Refuge staff in advance that he/she has special needs or limitations, every reasonable effort is made to address those concerns so the person may fully participate and have an enjoyable experience.

A permit and payment of a fee are required to participate in the General Big Game and Upland Game Hunts. Fees are waived for participants for the Youth Big Game and Upland Game Hunt. The reasons for requiring a permit are to ensure a safe, high-quality hunt by limiting the number of hunters allowed in a unit during any specific hunt; and to generate income to offset the cost of the hunts. Without requiring a permit and limiting the number of participants, the high demand and participation would result in over-crowded and unsafe hunting conditions.

The estimated cost to implement the current hunting program is \$10,000. The baseline cost to conduct the hunts is determined largely by labor costs to conduct administrative activities, biological surveys, Law Enforcement patrols, and staffing check stations – and is not dependent on the numbers of participants or area open to hunting. There is no additional cost to the Refuge under this alternative.

Under current management, Big Game Hunt participants are encouraged to take hogs, but most choose not to and instead focus on harvesting deer. In addition, much of the refuge is not open to hunting under the current plan, and feral hogs are not taken by hunters on those areas. Therefore, this alternative has not been an effective means for managing feral hog numbers.

Under this Alternative, habitat for endangered Golden-cheeked Warblers and Black-capped Vireos is negatively impacted by consumption of acorns, and browsing of oak seedlings and saplings by white-tailed deer. Habitat conditions in un-hunted tracts continue to be negatively impacted by consumption of acorns by deer - and erosion caused by rooting, and degradation of water quality and quantity caused by feral hogs. Other native wildlife species experience competition for resources and predation by invasive, exotic feral hogs.

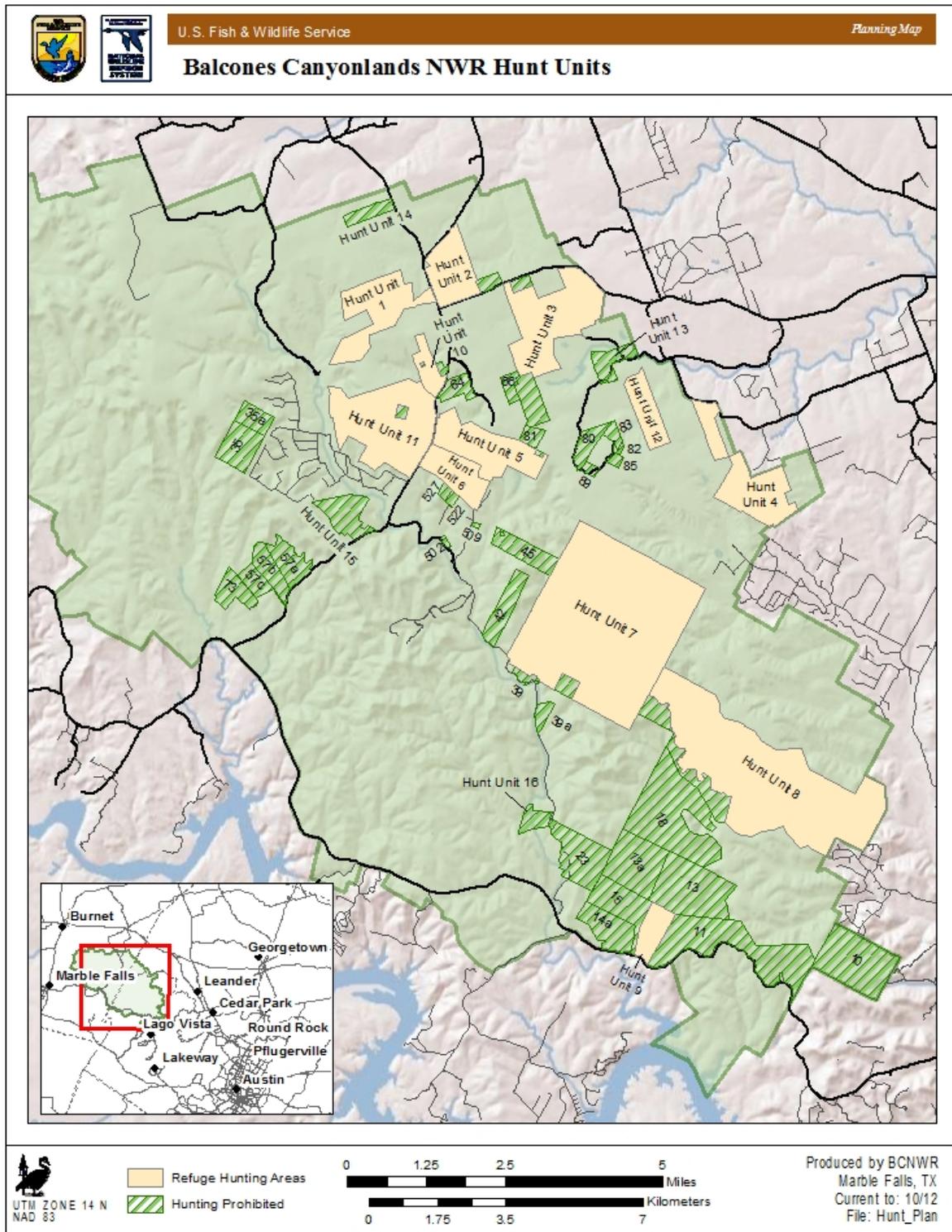
This alternative provides a low-cost compatible recreational experience for the general public; reduces impacts to endangered species habitat by white-tailed deer and feral hogs; reduces environmental and natural resource damage caused by feral hogs; and maintains a healthy, sustainable turkey population on approximately 12,818 acres of the Refuge.

Migratory birds: The Refuge allows hunting for mourning dove, white-winged dove, Eurasian collared dove, and rock dove (feral pigeon) on one 274 acre tract (Johnson). Hunting takes place on the first four days during the State season, from noon until the end of legal shooting hours. Hunting areas are accessible by vehicle, and parking areas are designated. A permit is required to participate in the Migratory Bird hunts. These permits are provided for a fee on a first-come-first-served basis. The reasons for requiring a permit are to offset the cost of habitat and facilities management (roads, signs, parking areas) and staff time (staff hunt check station and provide law enforcement support); and to ensure a safe, high-quality hunt by limiting the number of hunters allowed in the hunt area.

Table 1: Current Hunt Units (Alternative A)

TRACT	Tract #	ACRES	HUNT UNIT #	SPECIES HUNTED	Max. # of PERMITS
Simons	99	631	1	Deer, Feral Hog, Turkey	3
Mullen	97	441	2	Deer, Feral Hog, Turkey	3
Eckhardt	10a	1020	3	Deer, Feral Hog, Turkey	6
Gainer/Kindred	62, 63	707	4	Deer, Feral Hog, Turkey	4
Nagel	58	630	5	Deer, Feral Hog, Turkey	3
Doeskin	54	357	6	Deer, Feral Hog, Turkey	2
Rodgers	40	3703	7	Deer, Feral Hog, Turkey	10
Webster	30	3527	8	Deer, Feral Hog, Turkey	6
Old Salem	14	207	9	Deer, Feral Hog, Turkey	1
Beard	61	164	10	Deer, Feral Hog, Turkey	1
Flying X/Hoyer	60, 70	1157	11	Deer, Feral Hog, Turkey	6
Johnson	120	274	12	Deer, Feral Hog, Turkey, Dove	2 (Big Game)

Figure 2. Current Hunt Units (Alternative A)



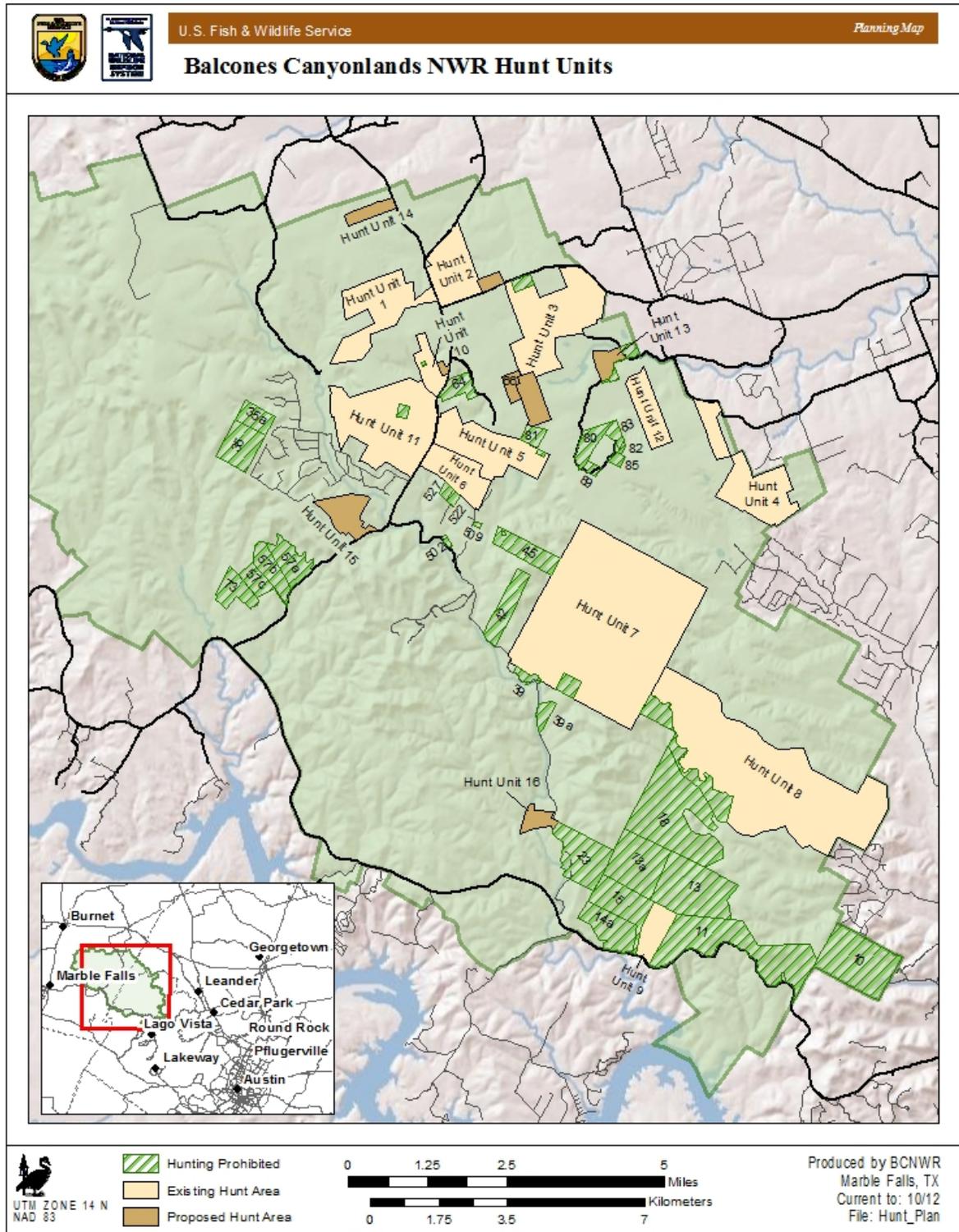
2.2 Alternative B (Proposed Action Alternative):

Open 10 additional Refuge tracts to white-tailed deer, feral hog, turkey hunting and open 1 additional Refuge tract to dove hunting in accordance with State and special Refuge regulations. Under this alternative, 7 additional Refuge tracts would be incorporated into adjacent units and 3 geographically separate units would be opened to hunting for white-tailed deer, feral hog, and turkey (730 acres); and one additional tract of 97 acres would be opened for Migratory Bird (dove) hunting (Table 2, Figure 3).

Table 2: Alternative B (Preferred Alternative) Hunt Units (current units in black, new units in red)

TRACT	Tract #	ACRES	HUNT UNIT #	SPECIES HUNTED	Max. # of PERMITS
Simons	99	631	1	Deer, Feral Hog, Turkey	3
Mullen	97	441	2	Deer, Feral Hog, Turkey	3
D.Damrow	20	34	(2)	Deer, Feral Hog, Turkey	0
D.Damrow	20a	1.5			
N.Damrow	21	2.7			
Wier (combined w/ Mullen)	22	1.7			
Eckhardt	10a	1020	3	Deer, Feral Hog, Turkey	6
Kennedy	92	173	(3)	Deer, Feral Hog, Turkey	2
Heine (combined w/ Eckhardt)	66	60			
Gainer/Kindred	62, 63	707	4	Deer, Feral Hog, Turkey	4
Nagel	58	630	5	Deer, Feral Hog, Turkey	3
Doeskin	54	357	6	Deer, Feral Hog, Turkey	2
Rodgers	40	3703	7	Deer, Feral Hog, Turkey	10
Webster	30	3527	8	Deer, Feral Hog, Turkey	6
Old Salem	14	207	9	Deer, Feral Hog, Turkey	1
Beard	61	164	10	Deer, Feral Hog, Turkey	1
Owens (combined with Beard)	65	18	(10)	Deer, Feral Hog, Turkey	0
Flying X/Hoyer	60, 70	1157	11	Deer, Feral Hog, Turkey	6
Johnson	120	274	12	Deer, Feral Hog, Turkey, Dove	2 (Big Game)
Arnold (SW of road) (NEW Unit)	121	100	13	Deer, Feral Hog, Turkey	1
Russell (NEW Unit)	93	98	14	Deer, Feral Hog, Turkey	1
Tater Hill (NEW Unit)	57	241	15	Deer, Feral Hog, Turkey	1
McKeever (NEW Unit)	23a	97	16	Dove	0 (Big Game)

Figure 3. Alternative B (Preferred Alternative) Proposed Hunt Units



Big Game and Upland Birds: Hunts would continue to be conducted similar to the current system (Alternative A), but with the addition of 10 new hunting tracts.

Various strategies to incentivize harvesting doe deer and feral hogs may be employed. Hunters will be offered the opportunity to “earn” a buck tag by shooting a feral hog. This encouragement should overcome the bias against shooting hogs during the hunts and result in more hogs taken.

Refuge management goals and objectives may require occasional modifications to the hunting program as harvest data, public use pressure, and Refuge programs are developed. Refuge hunting plans will be reviewed annually and updated if necessary.

This alternative would result in better control of the feral hog and white-tailed deer populations on the 730 acres added to the current hunt program (Alternative A), but less than the acreage under Alternative C. It also offers increased opportunities for public hunting and fulfills the Service’s mandate under the National Wildlife Refuge System Improvement Act of 1997.

Migratory birds: Dove hunting would be conducted similar to the current system, but with the addition of a 97 acre tract. The Refuge would allow hunting on four days during the State season, from noon until the end of legal shooting hours. Offering a second hunting location should provide opportunities to a different clientele as the proposed new location is approximately 20 miles from the current dove hunting area. We have observed a drastic reduction in hunter success after the 2nd day of hunting. Opening a second unit will offer the option of holding a 2-day hunt on one unit, and a 2-day hunt on the other. This should improve hunter success, without appreciably increasing costs to the refuge.

The first year estimated cost to implement the Preferred Alternative is \$12,000, with costs likely to be lower in successive years. Even though this Alternative proposes an addition of 731 acres for Big Game and Upland Game hunting and 97 more acres added for dove hunting than Alternative A, there would not be a proportional cost increase. The baseline cost to conduct the hunts is determined largely by labor costs to conduct administrative activities, biological surveys, Law Enforcement patrols, and staffing check stations – and is not dependent on the numbers of participants. Initial maintenance of facilities would account for the first-year increase in cost, and subsequent year costs would be the same as the current system.

This alternative provides a low-cost compatible recreational experience for the general public; reduces impacts to endangered species habitat by white-tailed deer and feral hogs; reduces environmental and natural resource damage caused by feral hogs; and maintains a healthy, sustainable turkey population – on a total of 13,646 acres.

2.3 Alternative C: Open 34 additional Refuge tracts to white-tailed deer, feral hog, turkey and dove hunting in accordance with State regulations and Refuge specific regulations.

Under this alternative, 34 additional Refuge tracts totaling 7,024 acres would be opened to hunting for white-tailed deer, feral hog, and turkey; and 1 of these additional tracts (97 acres) would also be opened for dove hunting (Table 3, Figure 4). These tracts have been purchased over the past 14 years. Due to the acquisition process, many of these tracts are small areas adjacent to other Refuge tracts, which can be aggregated by merely removing a cross fence. Taken by themselves, many of the tracts are not large enough to justify opening to hunting, but when joined with adjacent areas they merely represent an expansion of hunting areas – or addition of a single sizeable parcel.

Big Game and Upland Birds: Hunts would continue to be conducted similar to the current system, except that under this Alternative, we propose to use other legal methods of take (archery, muzzle loader, or shotgun) in some areas to attempt to manage the white-tailed deer and feral hogs, and to provide recreational opportunities for turkey hunters. The means and methods (i.e. firearms, archery only, shotgun only, muzzleloader only, or a combination) would be adjusted as required to insure safety of participants and adjacent landowners.

We anticipate that we will continue to add acreage to the Refuge, and those additions, when joined with current refuge properties, will provide sufficient area and arrangement to eliminate hunter access concerns or safety issues that are present now.

Migratory birds: Dove hunting would be conducted similar to the current system, but with the addition of a 97 acre tract (as in Alternative B). Opening a second unit will offer the option of holding a 2-day hunt on the current dove hunt unit, and a 2-day hunt on the proposed site.

This Alternative results in 7,024 more huntable acres added to the program than the current program (Alternative A), and is 6,196 acres more than Alternative B.

The first year estimated cost to implement Alternative C is \$13,000, with costs likely to be lower in successive years. Initial maintenance of facilities would account for much of the first-year increase in cost, and subsequent year costs would be slightly higher than the current system.

This alternative provides increased low-cost compatible recreational experience for the general public; reduces impacts to endangered species habitat by white-tailed deer and feral hogs on a substantially larger area; reduces environmental and natural resource damage caused by feral hogs on areas currently not hunted; and maintains a healthy, sustainable turkey population.

Figure 4. Proposed Hunt Units (Alternative C)

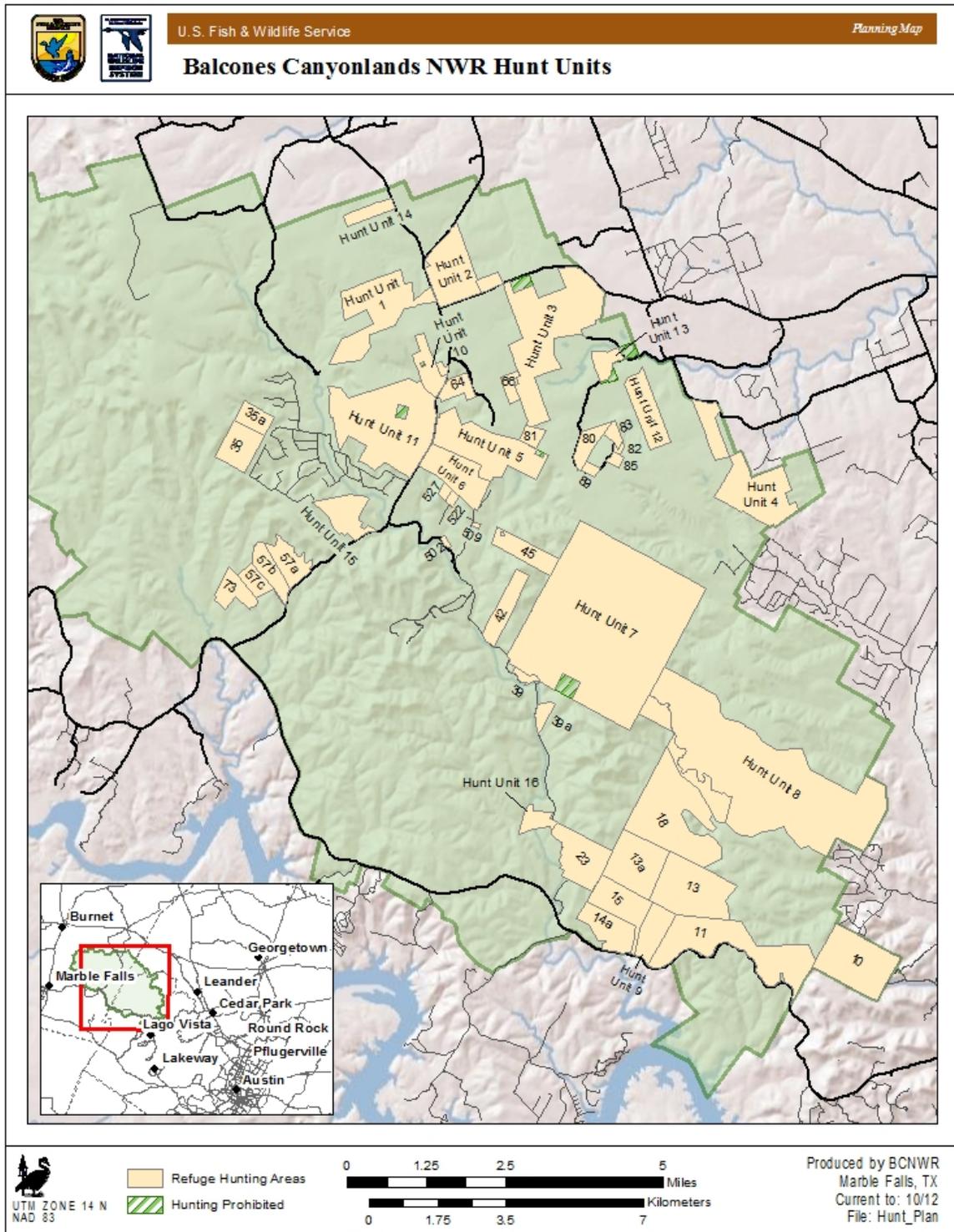


Table 3: Alternative C Proposed Hunt Units (current units in black, new units in red)

TRACT	Tract #	ACRES	UNIT #	SPECIES HUNTED	Max. # of PERMITS
Simons	99	631	1	Deer, Feral Hog, Turkey	3
Mullen	97	441	2	Deer, Feral Hog, Turkey	3
D.Damrow	20	34	(2)	Deer, Feral Hog, Turkey	0
D.Damrow	20a	1.5			
N.Damrow	21	2.7			
Wier	22	1.7	(2)	Deer, Feral Hog, Turkey	0
Eckhardt	10a	1020	3	Deer, Feral Hog, Turkey	6
Kennedy	92	173	(3)	Deer, Feral Hog, Turkey	1
Heine	66	60	(3)	Deer, Feral Hog, Turkey	0
Gainer/Kindred	62, 63	707	4	Deer, Feral Hog, Turkey	4
Nagel	58	630	5	Deer, Feral Hog, Turkey	3
Doeskin	54	357	6	Deer, Feral Hog, Turkey	2
Mountain Creek (Clausius)	522	19	(6)	Deer, Feral Hog, Turkey	0
Mountain Creek (Allied Int.)	527	21	(6)	Deer, Feral Hog, Turkey	0
Rodgers	40	3703	7	Deer, Feral Hog, Turkey	10
Lyda	39, 39a	90	(7)	Deer, Feral Hog, Turkey	0
Starnes	45	195	(7)	Deer, Feral Hog, Turkey	1
Webster	30	3527	8	Deer, Feral Hog, Turkey	6
Old Salem	14	207	9	Deer, Feral Hog, Turkey	1
Beard	61	164	10	Deer, Feral Hog, Turkey	1
Owens	65	18	(10)	Deer, Feral Hog, Turkey	0
Flying X/Hoyer	60, 70	1157	11	Deer, Feral Hog, Turkey	6
Johnson	120	274	12	Deer, Feral Hog, Turkey, Dove	2 (Big Game)
Arnold	121	150	13	Deer, Feral Hog, Turkey	1
Russell	93	98	14	Deer, Feral Hog, Turkey	1
Tater Hill	57	241	15	Deer, Feral Hog, Turkey	1
McKeever	23a	97	16	Deer, Feral Hog, Turkey, Dove	0
McKeever	23	361		Deer, Feral Hog, Turkey	2 (Big Game)
Victoria	10	585		Deer, Feral Hog, Turkey	3
Mouton/TPL	57a,b& c	442		Deer, Feral Hog, Turkey	3
Bye	73	150		Deer, Feral Hog, Turkey	1
Barho	80	112		Deer, Feral Hog, Turkey	0
Williams	82	13		Deer, Feral Hog, Turkey	0
Gregg	83, 83a	40		Deer, Feral Hog, Turkey	0
Payton	85	27		Deer, Feral Hog, Turkey	0
England	89	27		Deer, Feral Hog, Turkey	0
Shaw	42	200		Deer, Feral Hog, Turkey	0
Martin	15	305		Deer, Feral Hog, Turkey	2
Rathgeber	18	906		Deer, Feral Hog, Turkey	3
RPI Penn E & W	13,13a	1030		Deer, Feral Hog, Turkey	4
Rodgers Front Range	11	834		Deer, Feral Hog, Turkey	3
Three Creeks	35,35a	350		Deer, Feral Hog, Turkey	2
New Salem	14a	264		Deer, Feral Hog, Turkey	0
Rust	64	103		Deer, Feral Hog, Turkey	1
Barho House	81	57		Deer, Feral Hog, Turkey	1
Mountain Creek (Shoup)	502	10		Deer, Feral Hog, Turkey	0
Mountain Creek (Connolly)	509	5		Deer, Feral Hog, Turkey	0

2.4 Alternative Considered But Dismissed From Detailed Analysis

All comments and suggestions received during scoping were considered during alternative development. Alternatives that were determined to be infeasible are discussed below.

The Refuge considered opening all or part of the Refuge to feral hog hunting in accordance with State regulations. Since feral hogs are not a game species and there is no closed season, they can be taken by any means at any time. This would result in the Refuge being open to feral hog hunting by all interested hunters at any time from sunrise to sunset daily. This alternative would result in disturbance to nesting endangered bird species during the period of March 15 through August 15 – in violation of provisions of the Endangered Species Act. This would also result in closure of the Refuge to other public uses and curtailment of management activities by Refuge staff due to safety concerns. In addition, funding and staffing levels would not allow for sufficient management that would be required to ensure the safety of hunters and/or the general public with this level of consumptive use.

The Refuge also considered opening all or part of the Refuge to hunting turkeys during the spring season. Impacts, or perceived impacts, to endangered bird species (due to nesting disturbance from hunt participants) could occur in some areas - in violation of provisions of the Endangered Species Act. Further research at a future date may provide the data necessary to make an informed decision, but at the present time, we prefer to err on the side of the birds and forego any additional opportunity for this recreational activity.

3.0 AFFECTED ENVIRONMENT

Balcones Canyonlands NWR supports a variety of wetland and upland vegetation. Management activities focus on preservation and restoration of habitat for two migratory endangered songbird species. A complete description of Refuge resources can be found in the Balcones Canyonlands NWR Comprehensive Conservation Plan (USFWS 2001). The following resources are not discussed in this EA because the proposed changes in hunting activities are not expected to have any impacts on them: physiography, minerals, visual resource, and wilderness.

The current and proposed hunting areas are located across the breadth of the Refuge, and the affected environment includes a variety of topography, geology, vegetation, and wildlife. The resources described below are those that could be impacted (directly or indirectly) by the alternatives discussed in this document.

3.1 Physical Environment

Balcones Canyonlands NWR is located in Travis, Williamson, and Burnet Counties in central Texas. It lies at the eastern side of the Edwards Plateau physiographic area at the edge of the Balcones Fault escarpment in the Balcones Canyonlands subregion, and is characterized by a

deeply dissected topographic relief. This area is characterized by relatively flat plateau tops with steep canyons and broad valleys. The moist, shady canyon bottoms and dry uplands provide a diverse habitat for a variety of plants and animals. Elevation throughout the Refuge varies from 700 feet above mean sea level (msl) on the banks of Cow Creek near the confluence with the Colorado River to above 1400 feet above msl at the Simons tract on the northwestern portion of the Refuge.

The Refuge headquarters is approximately 35 miles northwest of Austin, Texas. At the present time, it consists of 68 individual tracts scattered over a wide area (over 18 miles from southeast to northwest tracts) interspersed with private lands.

3.1.1 Air Quality

Although no air quality monitoring stations are located on the Refuge, the air quality is assumed to be good since the Refuge is located in a relatively rural environment. Future development may contribute to higher concentrations of vehicle and industry air emissions, however the City of Austin generally has emphasized development of high-tech, non-polluting industries so industrial impacts may be limited. None of the proposed Alternatives would likely significantly affect the quality of air beyond temporary minor localized dust from vehicles traveling on unpaved roads.

The Texas Commission on Environmental Quality (TCEQ) monitors air quality. The closest monitor to the Refuge is the Audubon C38 station and can be accessed on TCEQ's website at http://www.tceq.texas.gov/cgi-bin/compliance/monops/daily_summary.pl?cams=38 .

3.1.2 Soils / Geology

Soils in the hunting areas and across the Refuge are diverse because of the variety in topography, including ridge tops, slopes, outcrops, and bottoms. Soils are mostly clays and loams, and are sometimes very shallow with significant amounts of stones or cobbles. Historically, much of the top soil was washed away from ridge-tops and hillsides, leaving rocky outcrops and exposed subsoils (Soil Conservation Service, 1974, 1979 & 1983).

The entire refuge sits atop the Balcones Canyonlands and Escarpment Region. The limestone layers that characterize the geology of this area were formed from compacted marine sediments during a time when the entire area was under a great inland sea. When the region was uplifted across Central Texas, variations in the rate of uplift caused the rocks to buckle, forming a hinge between the emerging continental landmass and subsiding gulf, out of which erosion created the Balcones Escarpment (Rose 1971). The geological uplift left the interior of Central Texas, known as the Edwards Plateau, tilted slightly toward the southeast. Newly formed stream channels cut into the dipping limestone substrate carving canyons that reached far into the

plateau. Beneath the plateau underground streams of naturally mildly acidic water have dissolved the limestone substrate to form a honeycomb network of karst habitat. This karst habitat is home to several rare endemic species.

3.1.3 Water Quality and Quantity

Water Quality sampling was conducted by Sissel and Sarkar (2009) at 14 sites on 5 creeks across the Refuge. Most chemical results corresponded with healthy water conditions. One site on Post Oak Creek near the Refuge Headquarters contained coliform on an initial test, but not on a second test. On both dates, the site appeared to be healthy and contained fish such as largemouth bass, perch, and minnows. Cow Creek crossing number 6 was the only site in which over 80 colonies of *E. coli* were present and recorded as too many to count. About sixty nine percent (9 of 13) of all sampled sites were below the standards set by USEPA for *E. coli* criteria for full body contact recreation water. Sissel and Sarkar (2009) identified possible causes for high *E. coli* as cattle and feral hogs. As identified in Sissel and Sarkar 2009, in 2005 the U.S. Geological Survey, in cooperation with TCEQ, evaluated Cow Creek as part of a broader analysis of nutrient and biological conditions in small streams of the Edwards Plateau. The location of the Cow Creek site for the 2005 survey yielded very close results in corresponding criteria. Cow Creek was designated as one of the five “least disturbed” sites of 15 total sites.

The Refuge has numerous creeks and drainages, most of which drain into Lake Travis (Colorado River). The Colorado River provides drinking water for most Austin area residents. Within the proposed hunting units, there are no significant water quality issues.

3.2 Biological Environment

3.2.1 Vegetative Communities

The current and proposed hunting units are located across the Refuge and encompass a variety of vegetative types. The dominant vegetative types found on the Refuge can be categorized as: (1) oak/juniper woodlands; (2) shin oak mottes (shinnerys); or (3) grassland/savannah – with riparian sites hosting a different community on a very small portion of the area.

The oak/juniper woodlands are characterized by old-growth closed-canopy woodlands dominated by Ashe junipers and hardwoods such as Spanish oak, shin oak, and live oak (*Quercus fusiformis*), Texas ash, cedar elm, and escarpment cherry (*Prunus serotina var. eximia*). The habitat is best developed on steep rocky slopes and canyons but may develop on level upland areas in the absence of long-term disturbance. Vegetation mapping indicates that approximately 16,000 acres of this vegetative type are found on the Refuge.

Shin oaks (*Quercus sinuata var. breviloba*) reach heights of approximately 3 meters tall, and if left unchecked, create dense thickets with a low foliage layer. Estimates indicate from 2,000 to

4,000 acres of this type of habitat is intermingled with other vegetative communities on the refuge (Sexton 2006, unpubl. data).

Grassland areas are found where woody species have been removed, and are maintained by periodic prescribed fire. Savannahs are characterized by scattered clumps of trees interspersed with the grasses of upland areas. These areas are indicative of past human influences (i.e. livestock grazing and mechanical harvest of woody vegetation), and are distributed across the Refuge in flatter topography.

Hunting activity for Big Game and Upland Game occurs on all of the vegetative sites, whereas dove hunting occurs in or adjacent to cultivated fields located in former grassland areas.

For additional information on vegetative communities in the Texas Hill country, please see Ecological Systems Project: Phase 1 Interpretive Booklet prepared for Texas Parks and Wildlife and the Texas Natural Resources Information System for a thorough discussion related to vegetative communities within the Refuge at

<http://www.tpwd.state.tx.us/landwater/land/maps/gis/tescp/index.phtml>.

3.2.2 Wildlife

The Refuge supports a diversity of wildlife native to the Balcones Canyonlands region of Texas. Over 270 species of birds, 56 species of mammals, and 55 species of reptiles and amphibians have been documented. Of special concern for the Refuge are two endangered species, Golden-cheeked Warbler and Black-capped Vireo, the primary purpose for establishment of the Refuge. Additionally, the Refuge provides habitat for extremely rare karst related species. Many karst features are known to occur on the Refuge. Despite this, no endangered karst invertebrates or salamanders have been identified on the Refuge, but further investigation is warranted since only limited surveys have been conducted. The Refuge also provides important habitat for declining grassland bird species, and much of the Refuge is managed for their benefit. For a more in-depth review of wildlife, please review the Refuge Comprehensive Conservation Plan, 2001.

White-tailed Deer

White-tailed deer on Balcones Canyonlands Refuge have been managed to meet the needs of the endangered bird species found here. The Golden-cheeked Warblers and Black-capped Vireos require an oak component in their preferred habitat for a feeding or nesting substrate. Deer consume acorns and browse seedling and sapling oaks, impacting recruitment or replacement of trees necessary for warbler survival - or height structure important for vireo nesting. Our management objective is to maintain deer densities at a rate lower than 1 deer per 20 acres in order to protect oak recruitment and structure. Population densities from annual spotlight counts conducted since 1996 ranged from a high of 1 deer per 3.6 acres in 2001 to a low of 1 deer per

27.5 acres in 2011 (Figure 5). Harvest numbers ranged from a high of 58 deer in 2003 to a low of 18 deer in 2007 and 2011 (Figure 6).

Figure 5. Deer densities (number of deer per 1,000 acres) at Balcones Canyonlands NWR based on spotlight surveys, 1997-2012. The dashed line at 50 deer per 1,000 acres (equivalent to 1 deer per 20 acres) indicates the maximum density for the management goal.

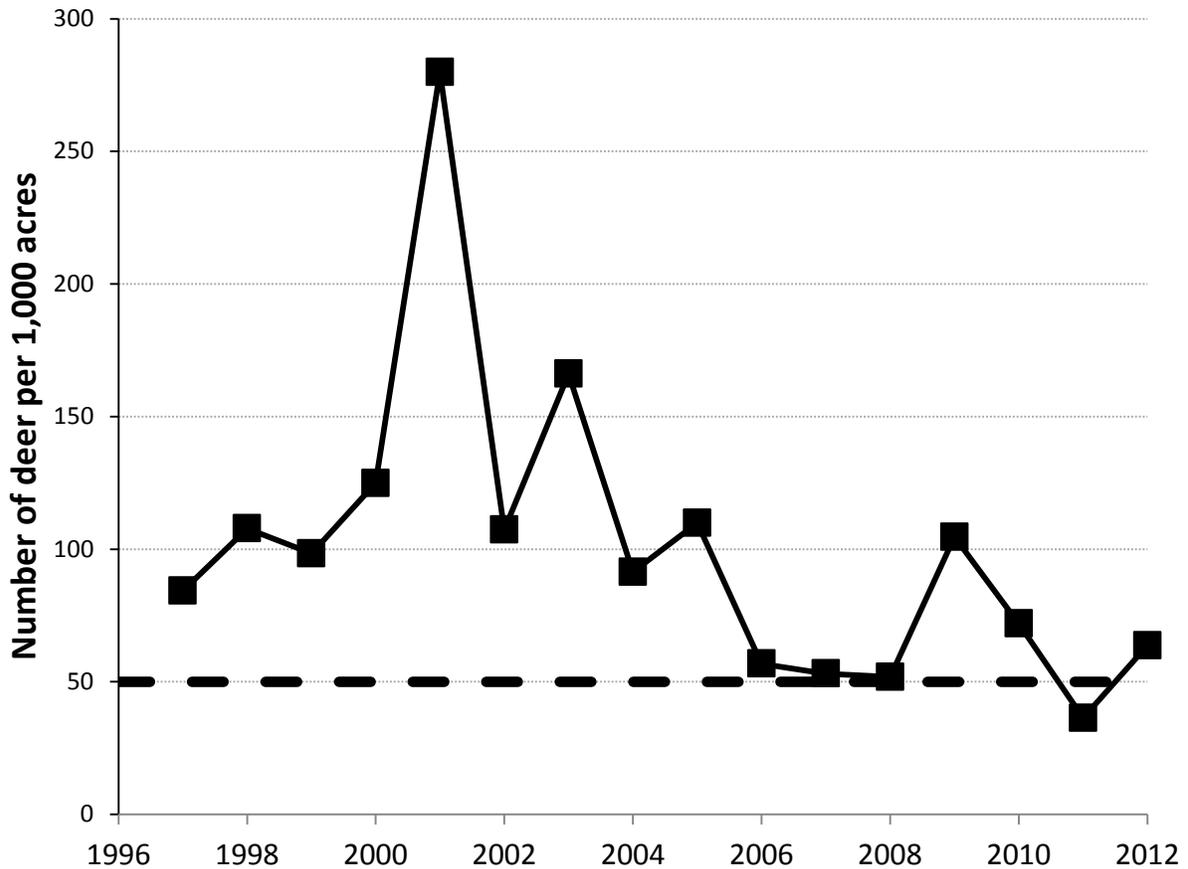
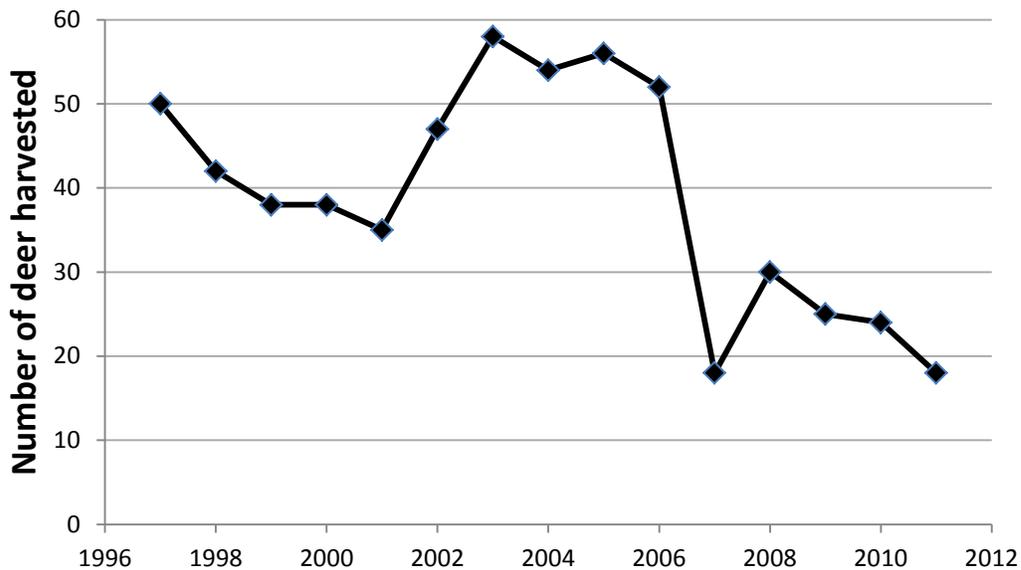


Figure 6. Number of deer harvested at Balcones Canyonlands NWR, 1997-2011. Harvest for 2012 was not available at time of writing.



Feral Hog

The pig family (Suidae) is not indigenous to Texas. Hogs were first introduced into the state and became a feral population through accidental releases and intentional stockings (Mayer and Brisbin 1991). Feral hogs are pervasive throughout much of Texas with the highest populations occurring in the east, south, and central portions of the state (Taylor 1991). Texas has the distinction of being the feral hog capital of the United States, with an estimated population of 2 million hogs. This invasive species has been documented in 225 of the state's 254 counties. Feral hogs are considered free-ranging, exotic animals in Texas and are not considered wildlife by legal definition; however, a hunting license is required to hunt feral hogs anywhere in the state. There is no season or bag limit set by the Texas Parks and Wildlife Department (TPWD), the regulatory agency for wildlife in Texas.

The body of scientific work regarding feral hogs is impressive, particularly in the arenas of natural history, biology, ecology, and environmental impact. Wolf and Conover (2003) and, more recently, Mayer and Shedrow (2007) have compiled excellent bibliographies for individuals wanting an exhaustive review of all the scientific literature pertaining to feral hogs.

Feral hogs are highly adaptable, have high reproductive capabilities, and can be found in a wide range of habitat types. They are opportunistic omnivores and compete with native wildlife (game and non-game) for food, cover, water, and space. Rooting and digging activities negatively impact vegetative communities, soil properties, and plant successional patterns (Stevens 1996). Wood and Roark (1980) found oak mast to be one of the more important

seasonal food items of feral hogs. Tate (1984) found that feral hogs compete with deer, turkey, squirrels, waterfowl and other wildlife species for this food resource. Feral hogs can impact ground-nesting species, particularly quail and turkey, through nest destruction and predation. Beach (1993) also found that feral hogs prey on fawns and ground nesting birds.

Like all wild or domestic animals, feral hogs are susceptible to a wide range of infectious and parasitic diseases (Davis 1993). As hog populations increase and expand, there is a greater chance they may transmit diseases to other wildlife, domestic animals, and humans. Currently, the two most serious diseases found in feral hogs are swine brucellosis and pseudorabies (United States Dept. of Agriculture 1991).

The feral hog population explosion has become a serious problem for Texas. The high reproductive potential, opportunistic feeding habits, adaptability, and mobility of feral hogs have adversely impacted native wildlife species. From 2006-2009, feral hogs caused an estimated \$52 million dollars in damage to Texas agriculture annually. During this same period, landowners spent an estimated \$7 million annually on control and/or correction of damage due to feral hogs (Texas AgriLife Extension Service, 2009). Nationally, the damage estimate is \$1.5 billion annually (Pimental, 2007).

Turkey

By the early 1900s, most wild turkey populations had been wiped out in North America, victims of overharvest. As late as the Great Depression, fewer than 30,000 turkeys remained in the entire United States. Through restoration efforts, turkey populations rebounded dramatically and now more than 7 million wild turkeys roam North America, with huntable populations in every U.S. state but Alaska (National Wild Turkey Foundation 2011).

Texas hosts three subspecies of wild turkey: Merriam's, Eastern, and Rio Grande. The subspecies found on Balcones Canyonlands NWR is the Rio Grande wild turkey which has a population estimated between 600,000 and 1,000,000 birds in Texas. The closest known population of the Eastern subspecies is approximately 130 miles east of the Refuge. Observations made by Refuge staff, volunteers, and visitors indicate the Refuge wild turkey population is generally stable, with seasonal fluctuations due to emigration and immigration across Refuge boundaries. Surveys conducted in 2012 detected wild turkey at 26% of the points sampled (65 of the 250 points). Hunting during the spring season is not allowed on the Refuge due to potential disturbance to nesting Golden-cheeked Warblers and Black-capped Vireos.

Doves

Mourning doves, white-winged doves, rock doves, and Eurasian collared-doves are all legal game during the Refuge hunt. Rock doves (pigeons) and Eurasian collared-doves are introduced species, and are not protected by federal or state law. They are usually found in cities and surrounding farm lands – and few are present on or adjacent to the Refuge. Mourning doves are

migratory birds and are found across much of the United States, and into Canada and Mexico. White-winged doves are also migratory, but their range does not extend much farther north than the refuge and reaches as far south as South America. White-wings are seen regularly through the summer months, but are rarely included in the hunters' bag in September. Mourning doves are highly productive – typically producing several young per year (Baskett et al. 1993).

3.2.3 Threatened and Endangered Species and Other Special Status Species

The Refuge was established in 1992 under the authority of the Endangered Species Act of 1973 as part of a larger conservation strategy in the Austin area to protect and enhance populations of two endangered songbirds, the Golden-cheeked Warbler and the Black-capped Vireo, along with other listed and candidate species (City of Austin and Travis County 1996, USFWS 1991a, 1991b, 1996, and 2000). The first goal listed in the Comprehensive Conservation Plan for the Refuge is to “restor(e) and enhance...threatened and endangered species habitat on Refuge lands” (USFWS 2001).

Of all central Texas threatened and endangered species, only the Black-capped Vireo, Golden-cheeked Warbler, Bald Eagle, and Whooping Crane have been documented as occurring within the Refuge. Only the warbler and vireo regularly occur within the Refuge. There are three sightings of single Bald Eagles over the Refuge in the past 16 years; none has stopped to use any Refuge habitats or resources (Refuge files). Since the first sighting in October 2003, there have been a total of three sightings of small groups of southbound Whooping Cranes migrating over the Refuge in October (M. Klym, TPWD; S. Edler, USFWS; K. Kilfeather; pers. comm.). No suitable foraging, resting, or roosting habitat for either the eagle or the crane occurs in the Refuge and no impacts, either positive or negative, are expected and will not be discussed further.

While the Refuge has a considerable number of caves and karst features, none of the threatened and endangered cave, aquifer, and stream-related species known to occur within the Austin area have been detected within the Refuge (Elliott and Reddell 1989, Reddell 1991, Elliott 1992, USFWS 1994, TPWD 1995b). Several caves in the Refuge area were mapped and explored for biological resources in the late 1980s and early 1990s by local experts. Veni (1991) placed the Refuge in an isolated “Post Oak Ridge” cave faunal region, separate from those occupied by the listed cave species. Reddell (undated) described the occurrence of four aquatic and seven terrestrial troglobitic invertebrates which occur on the Refuge, most of which have very limited ranges and some of which may be restricted to the Post Oak Ridge. While none of the listed *Eurycea* sp. salamanders are expected to occur on the Refuge, suitable habitat for this species group occurs in at least one spring on the Refuge (Mason Hollow, Victoria tract) and *Eurycea* sp. salamanders may yet be documented there; the expected taxon at that location would be the

Jollyville Plateau Salamander (*Eurycea tonkawae*), a species proposed for listing under the Endangered Species Act (City of Austin, Watershed Protection Dept. 1999).

Black-capped Vireo

The Black-capped Vireo occupies secondary successional shrublands on stony plateau tops (Graber 1961, Grzybowski 1991). In the Refuge area, the best habitat (i.e. most densely occupied) consists of shin oak (*Quercus sinuata* var. *breviloba*) thickets approximately 1 to 3 m tall with dense low foliage layer and with canopy cover in the range of 30-70%. Early environmental documents for the Refuge indicated that approximately 8,200 ha (18,000 ac) of potential habitat for the Black-capped Vireo occurred within the original 18,640-ha (41,000-ac) acquisition boundary (e.g. USFWS 1991a, b). Subsequent research has indicated that a much smaller portion of the Refuge--possibly on the order of 900 - 1,800 ha (2,000 – 4,000 ac)--is expected to be suitable for vireo habitat (Sexton 2006, unpubl. data). In 2010 and 2011, 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 100 vireo territories on refuge lands.

Because the migratory Black-capped Vireos are not present during any Refuge hunting season, there are no anticipated impacts to the species resulting from hunting activity. An Intra-Service Section 7 Endangered Species Consultation has been conducted, and resulted in a finding of No Effect.

Golden-cheeked Warbler

The Golden-cheeked Warbler occupies old-growth closed-canopy woodlands dominated by Ashe junipers and hardwoods such as Spanish oak, shin oak, and live oak (*Quercus fusiformis*), Texas ash, cedar elm, and escarpment cherry (*Prunus serotina* var. *eximia*). Canopy cover is usually 70% to 100% with canopy height usually 5 to 8 m (TPWD 1995a, Ladd and Gass 1999, USFWS 1992). Understory and ground cover are often sparse in the heavily shaded woodlands. The habitat is best developed on steep rocky slopes and canyons but may develop on level upland areas in the absence of long-term disturbance. Warblers may occur in more open woodlands (50% to 70% canopy cover) or in tall riparian groves if old-growth junipers occur intermixed with, or adjacent to, the woodland stand.

Early environmental documents for the Refuge indicated that approximately 2,400 ha (5,300 ac) of “actual or potential” warbler habitat were in the original 18,600 ha (41,000 ac) boundary. Based on (a) a review of the satellite classification on which that estimate was based, and (b) maturation of some marginal habitat, a substantially larger area of warbler habitat is probably now in existence in the previous Refuge boundary. A 2009 draft map of “Golden-cheeked Warbler Habitat Management Areas” for the draft Habitat Management Plan shows at least 6,475 ha (16,000 ac) of warbler habitat management area within Refuge lands. Additional acreage of

suitable warbler habitat occurs on many private tracts within the 36,400-ha (80,000 ac) Refuge acquisition boundary (USFWS 2001).

The Golden-cheeked Warbler 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). Preliminary analysis of 2012 surveys estimated that Golden-cheeked Warblers occurred on approximately 48% of the Refuge.

Because the migratory Golden-cheeked Warblers are not present during any Refuge hunting season, there are no anticipated impacts to the species resulting from hunting activity. An Intra-Service Section 7 Endangered Species Consultation has been conducted, and resulted in a finding of No Effect.

3.3 Human Environment

3.3.1 Cultural Resources

A “cultural overview and assessment” of the Refuge was completed in 1998 (Tomka & Leffler, 1998). The cultural history of the region includes four general chronological stages of possible occupation of the region over thousands of years (EH&A, 1990). The three prehistoric stages have been defined on the basis of ecological adaptation and recovered archeological materials. Each stage reflects a change in subsistence as exhibited by material remains and settlement patterns (EH&A, 1990). The historic period reflects the effects of European immigration and the settlement of the region by native populations. The historic stage includes ranching and farming activities and their influence on the present day land use patterns in the region. Many documented sites occur within the Refuge boundary and in the general vicinity, but no known site specific studies have been conducted on the Refuge. Additional information related to cultural resources may be found in the Refuge’s Comprehensive Conservation Plan (2001). Archeological sites on the Refuge are provided full protection under the Archaeological Resources Protection Act. On the Refuge, there have been no known impacts to cultural resources by feral animals to date.

3.3.2 Socioeconomic Resources

The socioeconomic impact of Balcones Canyonlands NWR operations is primarily in the neighboring communities of Marble Falls, Burnet, and Lago Vista, Texas. The Refuge’s annual budget as of 2011 was just over \$2,000,000 and much of this amount is recycled in the local economy through Refuge staff salaries, purchases from local vendors, and service contracts. Additionally, under the Refuge Revenue Sharing Act, refuges contribute money to each county in which they occur. This payment is in lieu of property taxes and is based upon the appraised

value of the refuge property. In 2010 Balcones Canyonlands NWR provided \$155,381 to Burnet, Travis, and Williamson Counties under this program.

Various recreational activities offered by the Refuge attract visitors who participate in wildlife observation, photography, hiking, and hunting. The majority of visitors are from the central Texas area, but the number out of state and out of country persons who visit the Refuge has been increasing. Visitor recreation expenditures for 2006 amounted to \$470,400 for non-consumptive activities and \$29,000 for consumptive expenditures in Burnet, Travis and Williams Counties. Total expenditures were \$500,200 with non-residents accounting for \$385,700 or 77 percent of total expenditures. Expenditures on non-consumptive activities accounted for 94 percent of all expenditures (U.S. Fish and Wildlife Service, 2007).

Gross revenues generated by Refuge hunts amount to about \$9,000 annually. The majority of these funds are put back into the economy through salaries and expenditures on supplies and equipment to support the visitor services program.

The current economy and employment in the Austin area is driven by Government and the high-tech industry with the size of nonagricultural labor at 652,300 (Austin Economy 2012). Unemployment is currently at 7.4% (Austin – Round Rock – San Marcos, Texas Unemployment, 2012).

3.3.3 Public Use/Recreation

Providing recreational opportunities and interpreting the unique natural features of the Refuge for visitors, in compliance with the Refuge Improvement Act of 1997, are important elements of the Visitor Services Program. It has been determined that the following public uses are compatible with the purpose for which the Refuge was established: dove, hog, turkey, and deer hunting; wildlife observation; photography; and hiking.

The Refuge received over 25,000 visitors in 2012. The refuge is open from dusk to dawn 365 days of the year for wildlife watching, and wildlife photography at Warbler Vista trails and observation deck, Shin Oak Observation Deck and Doeskin Ranch hiking trails and served over 15,000 visitors. The Refuge offers environmental education classes from September thru March and last year hosted over 1,000 school children from Bertram, Marble Falls, Liberty Hill, and Pflugerville. Approximately 400 visitors participated in the hunting program.

The Refuge currently allows hunting opportunities including 1 Youth Big Game and Upland Game Hunt, and 3 General Big Game and Upland Game Hunts (which allow for the harvest of white-tailed deer, feral hog, turkey), and a migratory bird hunt for doves.

Friends of Balcones Canyonlands, a not-for profit group organized to support the Refuge, has more than 90 members and hosts a number of free and fee events, including the Songbird

Festival which hosts approximately 500 visitors annually. They also conduct offsite outreach programs and are a strong voice of support in the community. The Friends of Balcones Canyonlands maintain a website at <http://www.friendsofbalcones.org/>.

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter analyzes and discusses the potential environmental effects or consequences that can reasonably be expected by the implementation of the alternatives described in Chapter 2.0 of this EA. An analysis of the effects of management actions has been conducted on the physical environment (air quality, water quality, and soils); biological environment (vegetation, wildlife, and threatened and endangered species); and socioeconomic environment (socioeconomic features including public use/recreation, cultural resources). The direct, indirect, and cumulative impacts of each alternative are considered. Direct effects are the impacts that would be caused by the alternative at the same time and place as the action. Indirect effects are impacts that occur later in time or distance from the triggering action. Cumulative effects are incremental impacts resulting from other past, present, and reasonably foreseeable future actions, including those taken by federal and non-federal agencies, as well as undertaken by private individuals. Cumulative impacts may result from singularly minor, but collectively significant actions taking place over a period of time. Potential impacts on physical, biological, and socioeconomic resources are addressed in the sections below. Potential impacts are described in terms of type, duration, intensity, and context (scale). Please refer to Appendix A for definitions of terms used during analysis.

4.1 Effects Common to All Alternatives

4.1.1. Environmental Justice

Executive Order 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations” was signed by President Bill Clinton on February 11, 1994, to focus federal attention on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The Order directed federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Order is also intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority- and low-income residents access to public information and participation in matters relating to human health or the environment. This EA has not identified any adverse or beneficial effects for any alternative unique to minority or low-income populations in the affected area. Additionally, none of the alternatives will disproportionately place any adverse environmental, economic, social, or health impacts on minority or low-income populations.

4.1.2. Climate Change

Climate change is already affecting fish, wildlife, plants and their habitats around the globe. The Service's Southwest Region has been working with the U.S. Geological Survey (USGS), the academic community, and other natural resource management agencies and interest groups to translate available and emerging science into concrete actions that reduce the impacts of a changing climate on the broadly diverse ecosystems in Arizona, New Mexico, Oklahoma and Texas.

The Refuge believes that its hunt program will have negligible impacts on Climate Change; however, much is unknown about this subject. The Service has recently addressed the subject of Climate Change with the issuance of the publication “*Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change.*” This five-year plan calls for developing long-term processes and protocols for biological planning and conservation at broad, landscape scales. This five-year action plan calls for baseline data to be established. Refuges to date have no information or data regarding their carbon footprint. This subject will be further addressed as future direction is developed and provided on how to step this Strategic Plan down to the field level.

4.2. Effects by Resource

Physical Environment

4.2.1 Impacts on Air Quality

Alternative A: No Action Alternative:

Under Alternative A, no additional impacts to air quality are expected from continuation of current management. Emission and dust from vehicles used by hunters to access the Refuge would continue to produce negligible short-term impacts on local air quality. The current level of public use on the Refuge does not appear to be impacting air quality, as current air quality in the area is considered to be good.

Alternative B: Proposed Action

Impacts to air quality would be slightly more than the No Action alternative and less than the Alternative C. The addition of new hunt areas would result in an estimated maximum of 31 additional vehicles on actual hunt days and a few additional days for scouting. This small increase in the number of hunter visits is considered insignificant; no changes to air quality are anticipated.

Alternative C:

This alternative could result in a slight increase in impacts to air quality over time due to emissions and dust from additional vehicles used by hunters, non-consumptive users, and Law

Enforcement staff to access the Refuge. Combined, all new hunts would result in an estimated maximum of 130 additional vehicles on actual hunt days and a few additional days for scouting. This small increase in the number of hunter visits is considered insignificant; no significant changes to air quality are anticipated.

4.2.2 Impacts on Water Quality and Quantity

Alternative A: No Action Alternative:

The current hunting program has no direct impacts on water quality or quantity. This alternative, however, could result in long-term adverse impacts to water quality in areas where feral hogs are not hunted due to the increasing hog population causing disturbance in creeks, springs, and riparian areas. Feral hog rooting and digging activities along wetlands and waterways may damage wetland vegetative communities and cause erosion along waterways and wetlands. Water quality may also be impacted by an increasing number of hogs entering the water to drink or to lower body temperature which would result in additional turbidity and excrement discharge. The result could cause moderate to significant adverse effects to long-term water quality and could substantially impact resources for spring adapted (dependent) species, such as the yet to be documented *Eurycea* sp. salamanders.

Alternative B - Proposed Action:

Under this alternative, there would likely be indirect beneficial impacts to water quality – especially on the 730 additional acres opened to hunting for feral hogs. Strategies to incentivize taking feral hogs under this proposal could further reduce the hog population. As hunters reduce the number of feral hogs, water quality would be expected to improve. Fewer feral hogs would result in less damage to wetland vegetation, less erosion, less turbidity, and less excrement deposit. Water quality would also be improved due to healthier vegetative communities to filter impurities and could substantially impact resources for spring adapted (dependent) species, as a result of reduced disturbance by feral hogs.

There would be no change to water quantity.

Alternative C:

Under this alternative, there would be indirect beneficial impacts to water quality similar to Alternative B above on the 7,023 additional acres opened to hunting for feral hogs. There would be no change to water quantity.

4.2.3 Impacts on Soils

Alternative A: No Action Alternative:

Under this alternative, minor long-term adverse impacts to soils on Refuge tracts not open to hunting are expected due to continued damage associated with feral hog activity. The rooting and digging activities of feral hogs negatively impact vegetative communities, soil properties and plant successional patterns (Stevens 1996). Damage includes erosion on uplands, slopes and along riparian areas.

In addition, current management would continue to result in disturbance to surface soils due to compaction by foot traffic in hunt areas. This impact is expected to be short-term, negligible, and local, since current hunter densities are low across the Refuge. Vehicles are currently restricted to access roads and parking areas, so soils would not be impacted by off-road vehicle use.

Alternative B- Proposed Action:

Under this alternative, disturbance to surface soils by feral hogs would likely decrease in areas opened to hunting, while a negligible short term increase due to additional vehicles and foot traffic from hunters could result. Typically, vehicles used by hunters and Refuge staff remain on or in close proximity to gravel roads and do not significantly impact soils. The benefits of reducing the feral hog impacts to soils would be realized on 730 additional acres. The expected short term negative impacts would be negligible, while minor long term positive impacts would be likely.

Alternative C:

This alternative could result in a slight increase in short term impacts to soils due to additional vehicles and compaction by foot traffic compared to Alternative A, but these impacts would be more than offset by a reduction in feral hog population and associated rooting and wallowing. Typically, vehicles used by hunters and Refuge staff remain on or in close proximity to gravel roads and do not significantly impact soils. The expected short term negative impacts would be negligible, while minor long term positive impacts would be likely.

Biological Environment

4.2.4 Impacts on Habitat

Alternative A: No Action Alternative:

One of the primary concerns for the Refuge is the long-term sustainability of its endangered species habitat for both the Golden-cheeked Warbler and Black-capped Vireo. As identified in

the proposed Hunt Plan, both deer and feral hogs impact the vegetative composition of Refuge habitat – resulting in lower quality habitat for these endangered bird species. Feral hogs consume mast and other seeds, root up and consume tree seedlings and cause significant disturbance to soils. White-tailed deer consume acorns and browse seedling and sapling oaks, impacting recruitment or replacement of trees necessary for warbler survival - or height structure important for vireo nesting. Such actions over time will likely reduce the probability of the Refuge being able to sustain habitat for the two endangered species the Refuge is charged with protecting. Any increase in invasive species population only increases the likelihood that the habitat will not be sustainable. Feral hogs and other invasive species may induce the spread of exotic plant species because most exotics typically favor disturbed areas and colonize more quickly than many native plants. As disturbed areas increase, the occurrence of exotic plants would also increase. Physical damage, as well as the establishment of exotic plant species, would significantly degrade habitat quality.

Under Alternative A, long-term adverse impacts to Refuge habitats are expected on lands where deer and hogs are not managed by hunting. Competition between feral hogs and native wildlife for food, cover, water, and space would continue and increase. Current and increasing rooting and digging activities would negatively impact vegetative communities, soil properties and plant succession patterns (Stevens 1996). Additional spreading of invasive plants through hog rooting behavior could occur. Erosion along springs and riparian areas and the loss of native plants would increase. Damage to roadsides and trails would continue and increase.

No significant impacts are anticipated due to hunting turkeys or doves.

Alternative B - Proposed Action:

The proposed action would result in minor disturbance to habitat/vegetation due to hunter foot/traffic during hunts and scouting on additional hunting areas. There is a small potential of spreading invasive species by vehicle and hunter foot traffic. These impacts are expected to be minimal due to low hunter density across the Refuge on scouting and hunting days.

Positive impacts to habitat quality and quantity would result from reduced competition with native wildlife for food, cover, water, and space; reduced rooting and digging behavior that negatively impacts soils, water, and vegetation; reduced damage to roadsides and trails; and improved water quality.

Negative impacts to endangered species habitat would be reduced on the tracts opened to hunting - increasing the probability of endangered species habitat being more sustainable over the long-term, and improving the odds for long-term survival of the species.

No significant impacts are anticipated due to hunting turkeys or doves.

Alternative C:

Impacts to habitat quality would be similar to the impacts described under Alternative B, but potential disturbance to habitat/vegetation and potential spread of invasives would be more widespread (7,023 acres vs. 827 acres).

The positive impacts enumerated in Alternative B would also be similar but proportionally reduced in scope.

Negative impacts to endangered species habitat would be reduced on the tracts opened to hunting - increasing the probability of endangered species habitat being more sustainable over the long-term, and improving the odds for long-term survival of the species.

4.2.5 Impacts on Wildlife

Alternative A: No Action Alternative:

Impacts to native wildlife on the Refuge tracts that are not opened to hunting could be negative under this alternative due to the unchecked presence of feral hogs. Feral hogs compete with native wildlife for resources and cause direct wildlife mortality through nest predation and opportunistic consumption of birds, reptiles and amphibians. As discussed in the impacts on soil resources, degradation in water quality can have an adverse effect on aquatic wildlife species as well. Feral hogs also serve as a vector for many diseases that can be contracted by other wildlife species.

Additional mortality of white-tailed deer, feral hogs, turkeys, or doves from hunting would not occur under this alternative. Additional human disturbance to hunted and non-hunted wildlife species would not occur. White-tailed deer, turkey and feral hog populations could increase above the habitat's carrying capacity. The addition of other environmental stressors (i.e. drought) under high population densities could increase the likelihood of starvation and disease among these species.

Alternative B- Proposed Action:

Additional mortality of white-tailed deer, feral hogs, turkeys, or doves from hunting would occur under this alternative.

There would be some short-term negative impacts on small mammals, birds, and other wildlife due to disturbance in areas where human access for hunting activities occurs. This disturbance would occur during September, November and December – outside the time of year when disturbance could result in additional mortality to the young of most species. Refuge regulations to control the number of hunters and number of hunting days would minimize disturbance – resulting in a maximum of 12 days per year (16 in dove hunt areas).

Impacts on other native wildlife would likely be positive under this alternative due to decreasing numbers of feral hogs. Less competition with native wildlife for resources, less direct wildlife mortality from nest predation and consumption of birds, reptiles and amphibians would be expected. Improved water quality from less turbidity from hog activity would benefit aquatic wildlife species, and fewer native species of wildlife would be exposed to diseases vectored by feral hogs.

Alternative C

Impacts on wildlife (both positive and negative) would be similar to the impacts described under Alternative B, but would occur on 7,023 acres instead of 827 acres.

4.2.6 Impacts on Threatened and Endangered Species and Special Status Species

Alternative A: No Action Alternative:

Under the No Action Alternative, the existing habitat conditions would likely be maintained. A Section 7 Evaluation associated with the original opening of hunting on the Refuge determined that the action is not likely to adversely affect any threatened or endangered species. Impacts to Threatened and Endangered Species - from degraded habitats due to foraging activities by deer and feral hogs - in the areas that are currently not opened to hunting would continue.

Alternative B- Proposed Action:

Under this alternative, hunter visits are not likely to negatively impact threatened and endangered species. A Section 7 Evaluation associated with this assessment determined that the proposed alternative is not likely to adversely affect any threatened or endangered species. Restricting hunting to areas and seasons of the year when Threatened and Endangered Species are not present will insure there are no negative impacts.

The Proposed Action would likely result in a reduction of the white-tailed deer and feral hog populations, resulting in an improvement to endangered species habitats.

Alternative C:

Under this alternative, hunter visits are not likely to negatively impact threatened and endangered species. A Section 7 Evaluation associated with this assessment determined that none of the alternatives listed are likely to adversely affect any threatened or endangered species. Restricting hunting to areas and seasons of the year when Threatened and Endangered Species are not present will insure there are no negative impacts.

This Alternative would likely result in a reduction of the white-tailed deer and feral hog populations on the additional tracts, resulting in an improvement to endangered species habitats.

Human Environment:

4.2.7 Impacts on Socioeconomics

Alternative A: No Action Alternative:

Under this alternative, white-tailed deer, turkeys, and feral hog populations would remain stable, or increase on Refuge tracts not opened to hunting. Because of the patchwork arrangement of Refuge lands and privately owned acreage – and the porous nature of boundary fences – there is substantial emigration and immigration between the public/private interface.

Private landowners have expressed concerns that the Refuge is a reservoir for feral hogs, as well as other species that are potentially injurious to their livestock or habitat. An increase in the number of pigs on non-hunted Refuge tracts could increase the needed level of effort by these landowners to control the feral hog population on their lands. The No Action Alternative would not result in a reduction of the feral hog populations on Refuge lands.

Conversely, adjacent landowners have expressed the opinion that the Refuge is a reservoir for more desirable species such as white-tailed deer and turkeys that provide them and their families recreation and/or income. Hunting of deer on some nearby private ranches generates income for these landowners. The No Action Alternative would not reduce deer numbers on non-hunted Refuge tracts address, and would result in no change to adjacent landowner concerns.

Under this alternative the feral hog population on non-hunted tracts would likely increase and the potential for damage to adjacent lands would also increase. The Refuge maintains a close relationship with many adjacent landowners and has been told of (and has seen) the damage caused by feral hogs. Feral hogs cause damage by directly consuming crops, damaging fields by rooting and digging, and trampling crops (Whitehouse 1999). In addition to directly damaging crops, hogs can damage infrastructure such as fences, irrigation ditches, roads, dikes, and other structures. Rooting and wallowing in agricultural fields creates holes that, if unnoticed, can damage farming equipment and pose potential hazards to equipment operators (Nunley 1999). In addition to impacting ecosystems, feral hogs can damage timber, pastures, and, especially, agricultural crops (West 2009). With increasing numbers of feral hogs, vehicle/hog collisions will become more likely.

Under this alternative, there would be no change to revenues or expenses associated with the hunting program, and no positive or negative impacts to the local or regional economy.

Alternative B- Proposed Action:

The Proposed Action would likely have a positive impact on the local economy through an increase in the purchase of fuel, food, lodging and supplies by hunters and non-consumptive users (i.e. hikers and photographers) coming to the community. We do not expect a significant increase in the number of hunters allowed on the Refuge; however, we expect an increase in non-consumptive users (see Public Use section for more details). Adopting this Alternative would

increase opportunities for hunting and wildlife observation and would allow the general public to take part in one or more of the six priority uses identified by the Refuge Improvement Act, therefore helping the Refuge System to meet its goals.

Under this alternative active control of feral hogs by hunters would help reduce the overall damage to habitat, livestock, and infrastructure on neighboring lands. This result would not only minimize the economic loss experienced by adjacent landowners, but would contribute to the relationships between neighboring landowners and Refuge personnel. Good relationships with neighboring landowners would help to establish and maintain cooperative efforts to control feral hogs on lands adjacent to the Refuge.

Hunting deer and turkeys on additional Refuge tracts may reduce the density of those species on adjacent properties, which could be a negative impact on Refuge neighbors. Conversely, deer and turkeys may relocate to adjacent properties during Refuge hunts (rather than serve as a sanctuary area during hunting seasons) – which could have a positive impact on Refuge neighbors.

Alternative C:

This alternative would likely have a positive impact on the local economy through increases in the purchase of fuel, food, lodging and supplies by new hunters as well as non-consumptive users coming to the community. No additional economic benefit attributable to increased staff or expenditures associated with the hunt by the Refuge are anticipated. Adopting this Alternative would increase opportunities for hunting and wildlife observation and would allow the general public to take part in one or more of the six priority uses identified by the Refuge Improvement Act, therefore helping the Refuge System to meet its goals.

Under this alternative, active control of feral hogs by hunters could help reduce the overall damage to habitat, livestock, and infrastructure on neighboring lands. Impacts would be expanded to the 7,023 acres included in the Big Game hunting area included in this alternative. This result would not only minimize the economic loss experienced by adjacent landowners, but would contribute to the relationships between neighboring landowners and Refuge personnel. Good relationships with neighboring landowners would help to establish and maintain cooperative efforts to control feral hogs on lands adjacent to the Refuge.

Hunting deer and turkeys on additional Refuge tracts may reduce the density of those species on adjacent properties, which could be a negative impact on Refuge neighbors. Conversely, deer and turkeys may relocate to adjacent properties during Refuge hunts (rather than serve as a sanctuary area during hunting seasons) – which could have a positive impact on Refuge neighbors.

4.2.8 Impacts on Visitor Services/Activities

Alternative A: No Action Alternative:

There would be no change in existing visitor services and recreational opportunities on the Refuge. The public would not have increased opportunity to harvest a renewable resource, participate in wildlife-oriented recreation that is compatible with the purposes for which the Refuge was established, or have an increased awareness of Balcones Canyonlands NWR and the National Wildlife Refuge System. Non-hunter access would not change, since Public Use is only allowed at 3 sites at the present time, and access is restricted during hunts (12 days total during November and December).

Alternative B-Proposed Action:

This alternative supports the vision and management direction outlined in the Balcones Canyonlands NWR CCP, *Goal 4, Objective 2: Provide compatible wildlife dependent outdoor recreational opportunities for the public on the Refuge to include wildlife viewing access, while striving for a balance between conflicting user groups. Annually evaluate hunting program to include newly acquired tracts.*

Opening additional tracts on Balcones Canyonlands NWR to white-tailed deer, feral hog, turkey and dove hunting would allow more opportunities for the public to harvest a renewable resource. The Refuge would be promoting a wildlife-dependent recreational opportunity that is compatible with the purposes for which the Refuge was established. Public awareness of Balcones Canyonlands NWR and the National Wildlife Refuge System would increase. This alternative would allow the public to enjoy hunting at an affordable rate in a region where public land is limited and private land lease prices are high.

Providing 827 additional hunting acres would allow the Refuge the flexibility to administratively suspend hunting on other areas that are currently open to hunting without significantly reducing hunting opportunity. Two tracts, Doeskin Ranch and North Nagel (totaling 987 acres), are at the present time included in the hunt program, and are currently closed to non-consumptive uses during public hunts. Under this alternative, the Refuge could administratively suspend hunting on these tracts - and activities such as hiking, wildlife observation and photography could remain open on the Doeskin Ranch tract without compromising the safety of Refuge visitors. The Doeskin Ranch and Nagel tracts have produced few deer for hunters in recent years. Administratively removing them from the hunt program would reduce the number of huntable acres, but would not significantly impact hunter success or opportunities. The areas could be administratively re-opened if annual wildlife surveys indicate there is a biological need to harvest animals in those tracts. This alternative would provide an estimated 48 additional Visitor Use Days of Big Game and Upland Game hunting, 45 additional Visitor Use Days of dove hunting, and 45 additional Visitor Use Days of wildlife observation and photography.

Alternative C:

The impacts on Public Use and Recreation under this alternative would be similar to Alternative B, except increased in scope due to additional acreage. This alternative would increase public hunting opportunity for white-tailed deer, feral hog, turkey and doves on 7,023 acres. This alternative would provide an estimated 300 to 360 additional Visitor Use Days of Big Game hunting and an estimated 45 additional Visitor Use Days of dove hunting, and 45 additional Visitor Use Days of wildlife observation and photography. There would be no negative impacts to other visitor services and public use.

4.2.9 Cultural Resources:

Alternative A: No Action Alternative:

Under this alternative, minimal direct or indirect impacts to the cultural environment are possible. However, no ground disturbance beyond light foot traffic is anticipated. Feral hogs could potentially negatively impact cultural resources through their foraging and digging behavior. This alternative would not result in any reductions of hog populations on Refuge tracts not currently open to hunting.

Alternative B- Proposed Action:

Effects under this alternative would be similar to Alternative A. A minor amount of increased disturbance would be expected on the 827 acres included in the tracts added to the hunt program as additional hunters would drive on established roads and parking areas and walk through the units.

Reduced impacts from feral hog rooting and digging behavior is likely. This would result in a decreased likelihood that cultural sites would be damaged by hogs.

Alternative C:

Anticipated impacts are similar to Alternative B but increased in scale (7,023 acres).

4.2.10 Humaneness and Animal Welfare Concerns:

Alternative A: No Action Alternative:

There would be no changes in impacts on humaneness and animal welfare concerns under this alternative. Hunter safety and license requirements would be in accordance with State regulations. All hunters born after September 2, 1971, are required to complete a hunter safety course before they will be issued a hunting license. During this course, established hunter ethics

and responsibilities to help ensure hunters are using good judgment related to humaneness and animal welfare are addressed. Additionally, the Refuge hunting orientation required for participation in the Big Game and Upland Game hunts includes information and admonishments to encourage humaneness and animal welfare. Accurate, clean shots are expected. The quarry should be within the effective range of the firearm and the skills of the hunter; and a humane kill is likely.

Alternative B- Proposed Action:

Under this alternative, additional mortality of white-tailed deer, feral hogs, turkeys, and doves would occur. The same hunter safety and license requirements apply under this Alternative as Alternative A.

Alternative C:

Impacts would be similar to the Preferred Alternative, but a more interactions between hunters and quarry would be expected due to increased numbers of hunters would be participating in hunting activities. The same hunter safety and license requirements apply under this Alternative as Alternative A. The quarry should be within the effective range of the firearm, ammunition, or bow and arrow and the skills of the hunter; and a humane kill is likely.

4.2.11 Impacts on Public Health and Safety

Alternative A— Current Management:

Under this alternative, there would be no change to impacts on public health and safety on the Refuge.

Alternative B— Proposed Action:

Under this alternative there are potential negative impacts on public health and safety, since there would be a minor increase in hunting activity on the Refuge, primarily due to opening an additional dove hunting unit.

There is only a very slight chance of a hunting accident during the Big Game and Upland Game Hunts as Refuge hunter *densities* are strictly limited and all hunters must wear 400 sq. inches of hunter orange, including a cap. This requirement does not apply to Migratory Bird (dove) hunting. There is a chance of a firearms accident involving another hunter or themselves. The risk of an accident on the Refuge would be minimized by limiting the number of hunters through a permit process, limiting the areas open for hunting, and shortening seasons throughout the Refuge. All hunters born after September 2, 1971 must have completed a state-certified hunter education course, and all participants in Refuge Big Game and Upland Game hunts attend an

orientation where safety is stressed. Hunter numbers and season lengths are very restrictive relative to State seasons under this alternative.

Alternative C:

Under this Alternative, impacts to public health and safety would be similar to those discussed under Alternative B, except there would be an increased number of participants in the Big Game and Upland Game hunts. The same mitigating factors apply to this Alternative as discussed in Alternative B.

4.3 Assessment of Cumulative Impacts

A cumulative impact is defined as an impact on the environment that results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time (40 CFR 1508.7).

Cumulative impacts are the overall, net effects on a resource that arise from multiple actions. Impacts can “accumulate” spatially, when different actions affect different areas of the same resource. They can also accumulate over the course of time, from actions in the past, the present, and the future. Occasionally, different actions counterbalance one another, partially cancelling out each other’s effects on a resource. But more typically, multiple effects add up, with each additional action contributing an incremental impact on the resource.

4.3.1 Anticipated Direct and Indirect Impacts of Proposed Hunt on Wildlife Species

4.3.1.1 Resident Wildlife

White-tailed Deer

Regional and Local Analysis

The history of white-tailed deer numbers in Texas is marked with drastic fluctuations. This game animal was an important food source for Native Americans, and has been important for food and sport throughout the more recent history of the state. At the close of the Civil War, deer populations took a dive (ostensibly due to a combination of overgrazing by livestock and overhunting) and populations remained fairly low until early conservation measures were implemented at the turn of the century. Parasitism by screwworms (*Cochliomyia hominivorax*) posed a major obstacle to population growth for years – causing up to 80% mortality in newborn fawns - until the governments of the United States and Mexico implemented a screwworm

eradication program in the 1970's. Following the eradication of screwworm from Florida the deer population more than doubled, and in Texas the deer population increased more than threefold over that of 1960 (Novy 1991). A vigorous predator control program and improved habitat conditions following a major drought in 1957 also provided momentum to the population surge (Rollins 1997). The Texas deer herd quickly grew to an estimated 3 to 4 million animals today.

Hunting white-tailed deer is an important tool for management of the vegetative component of Refuge endangered species habitat. As mentioned previously in this document and throughout the Refuge CCP, the strategy for managing habitat is to maintain the Refuge deer density at or below 1 deer per 20 acres. At the present time, hunting is the only viable alternative available to achieve that goal.

Deer hunting is not considered detrimental to the local, regional or overall white-tailed deer population throughout their range. The harvest of deer on Balcones Canyonlands NWR is insignificant compared to the off-refuge harvest (Table 4).

Table 4. 2010-11 Deer Harvest

Area	# of Participants	# Deer Harvested
Balcones Canyonlands NWR	155	24
Edwards Plateau	177,838*	196,949*
State of Texas	692,142*	647,975*

*(Purvis 2012a)

As a resident game animal, primary management responsibility for white-tailed deer rests with the Texas Parks and Wildlife Department. This state agency's staff includes biologists and technicians who gather data and recommend harvest numbers. A "base-line" recommended carrying capacity figure given by TPWD for the eastern Edwards Plateau area is ten to fifteen acres per deer.

Harvest rates are based on compartment averages derived from survey lines located in the county, and several other surrounding counties. Due to changes in habitat conditions and other factors, recommended harvest rates change annually. TPWD's harvest recommendations from the 2004/2005 season for the eastern Burnet and western Travis County areas include 1 doe per 40 acres and 1 buck per 200 acres. Recommendations for Williamson County were slightly more conservative at 1 doe per 60 acres and 1 buck per 300 acres (TPWD 2004). At a minimum, that would translate to a recommended Refuge harvest of 213 does and 42 bucks annually.

During drought conditions, such as that experienced in 2011, *not* harvesting deer may have a greater negative impact than harvesting deer – as poor range conditions may lower the carrying capacity of habitat. The more deer that survive the hunting season, the more deer there are competing for the available food resources – and greater mortality may result from starvation and disease. This impact is more pronounced in the fawn cohort.

Our strategy for maintaining the deer population density below the carrying capacity of Refuge tracts includes providing an incentive for hunters to preferentially harvest female deer by requiring harvest of a doe (or feral hog) before a permit for a buck is issued.

The Refuge bag limit for white-tailed deer is the same as the State bag limit, except that only 1 branch-antlered buck deer may be taken. Currently, the annual bag limit in Burnet, Williamson, and Travis Counties is 5 deer, no more than 2 bucks.

Feral Hogs

Regional and Local Analysis

The hunting of feral hogs is not considered detrimental to the biological integrity of the Refuge, is not likely to create conflict with other public uses, and is within the wildlife-dependent public uses to be given priority consideration. In fact, the removal of as many of these destructive, exotic, feral animals as possible would positively benefit the Refuge (and neighboring) habitat.

Executive Order 13112, Invasive species, issued in February, 1999 instructs Federal Agencies to: (a) Each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law, (1) identify such actions: (2) subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them.

Feral hogs are an extremely invasive, non-native species and not considered a game species by the State of Texas. There is an estimated population in excess of 1.5 million feral hogs in Texas. This is due in part to intentional releases, improved habitat, increased wildlife management, disease eradication, limited natural predators, and high reproductive potential. There seem to be very few inhibiting factors to curtail this population growth (Taylor, R. 2003). No bag limits or set seasons are established for feral hogs. Hunting of feral hogs provides the Refuge with another management tool in reducing this detrimental species, and at the same time, is widely enjoyed by

hunters. Cumulative effects to an exotic species should not be of concern because the Refuge would like to extirpate this species on Refuge lands. They are a priority species for Refuge management only in terms of their negative impacts on Refuge biota and need for eradication. The public interest would best be served by allowing this activity on all portions of the Refuge that can safely accommodate hunting without negatively impacting other refuge programs. However, even with hunting, feral hogs are likely to always be present because they are prolific breeders. The State of Texas allows for year-round hunting (day and night) of feral hogs.

Under Alternative A (Current Management), impacts would remain the same as previously described. Under Alternative B, negative impacts would be reduced on an additional 730 acres compared to Alternative A, as more feral hogs would be removed which would result in some minor positive impacts on habitat quality. Under the Preferred Alternative C, impacts would be reduced on an additional 7,023 acres compared to Alternative A, as more feral hogs would likely be removed on these tracts.

Rio Grande Turkey

Regional and Local Analysis

Three different subspecies of wild turkeys occur in Texas. The Rio Grande (*Meleagris gallopavo intermedia*) is the most plentiful and occupies a swath from the Oklahoma border to the Gulf coast and Mexico, across the central half of the state from east to west. Only the Rio Grande subspecies occurs in the Edwards Plateau region of Texas. The Eastern subspecies (*Meleagris gallopavo silvestris*) is restricted to the far eastern portion of the state and are far less numerous. The Merriam's (*Meleagris gallopavo merriami*) subspecies occupies a tiny area of its former historic range in the Davis and Guadalupe Mountains in west Texas and are the fewest in number.

Rio Grande turkeys are by far the most numerous in the state. One estimate from 2000 lists the statewide population at approximately 590,000 (Tapley et al 2000). Eastern turkeys are less numerous at approximately 5,012 birds, and Merriams number about 500 (Wild Turkey Zone 2012).

In the late 1970s, conservation efforts nationwide resulted in a surplus of Eastern turkeys, and using funds from a state stamp, TPWD bought 7,361 turkeys from 12 states between 1979 and 2003. The birds were released on 327 sites in 58 counties (Knight 2012). Surveys indicate the population has declined in recent years and the TPWD elected to suspend hunting for this subspecies in 15 counties in 2012 in an attempt to increase the number of birds, and improve reproductive efforts. The closest population of the Eastern subspecies occurs approximately 130 miles from the refuge.

Hunting of turkeys is not considered detrimental to the biological integrity of the Refuge, is not likely to create conflict with other public uses, and is within the wildlife-dependent public uses to be given priority consideration.

Private lands surrounding the Refuge are leased for hunting, but the primary target is white-tailed deer. Due to the interspersed public and private lands, and the substantial area included in the seasonal home range of turkeys, flocks routinely move on and off the refuge lands.

Based on sightings, it is estimated that more than 100 turkeys inhabit Balcones Canyonlands NWR. Flocks of 30-40 birds have been noted on the Johnson tract, and smaller flocks of 5 - 15 birds have been seen in tracts across the refuge. Surveys for turkeys conducted on the Refuge in 2012 by Service employees and researchers detected the birds at 26% of the points sampled (65 of the 250 points).

Because turkeys are hunted concurrently with deer and feral hogs, Refuge hunters are reticent to harvest a turkey and potentially spoil a chance to shoot a deer. Since turkey hunting was first opened on the Refuge (on 12,818 acres) in 1997, only 9 turkeys have been harvested. It is unlikely that even with the increase in the number of huntable acres in the Proposed Alternative, the harvest rate would increase from the current average of .6 turkeys bagged per year to 1 bird per year. Continental data sets suggests the average reproductive output for wild turkey populations is approximately 24%, thus at this rate most populations can withstand an average removal rate of 30% [not gender specific (Vangilder 1992)]. Based on these population statistics the Refuge should not adversely impact its turkey population by providing 12 days of hunting, with an annual harvest of less than 2.

Texas hunting regulations allow hunters to take four turkeys annually in the northern zone of Texas, which includes Burnet, Williamson, and Travis Counties, during the fall season that usually spans November 5 – January 1. According to TPWD’s harvest report, an estimated 70,406 Texas hunters harvested an estimated 34,202 turkeys during the fall season in 2010 (Table 5).

Table 5. 2010 Turkey Harvest (Fall Season only)

Area	# of Participants	# Turkeys Harvested
Balcones Canyonlands NWR	155	1
Edwards Plateau region	20,590*	8,887*
State of Texas	70,406*	34,202*

*(Purvis 2012b)

Turkeys are non-migratory - therefore hunting only impacts the local population. Turkey hunting is limited to a fall hunt with a maximum take of one turkey per hunter. According to state biologists, males or females can be taken during the fall without adversely affecting turkey production.

The cumulative effects of hunting turkeys on Balcones Canyonlands NWR to the turkey population will be increased individual mortality - but the number of turkeys likely to be harvested from the Refuge is, and will remain, small due to limits in the number of permits issued and the average success rate for turkey hunters.

4.3.1.2 Migratory Wildlife

Dove

Regional and Local Analysis

The several dove species included in the State hunting season include mourning doves, white-winged doves, rock doves, and Eurasian collared-doves. Rock doves (pigeons) and Eurasian collared-doves are introduced species, and are not protected by federal or state law. During the time the Refuge hunt is conducted, there are very few white-winged doves present (none have been recorded in hunter bags on the refuge). Mourning doves have comprised 100% of the doves brought to bag on Refuge hunts to date.

Dove hunting is not considered detrimental to the local, regional or overall dove population throughout their range. The harvest of doves on Balcones Canyonlands NWR is insignificant compared to the off-refuge harvest (Table 6).

Dove sightings are common across the refuge during the year. Structured surveys are not conducted, but employees report counts in proximity to the hunt area exceeding 200 birds in the month prior to the hunt, and an equal number in the month after the hunt.

Because doves are a migratory bird, and local numbers can fluctuate widely from one day to the next due to their movements, surveys conducted on the Refuge would provide little data that would be useful in determining how many doves are present during the Refuge hunt. We rely on the information collected and synthesized by the State game agency to determine whether the dove population can sustain hunting mortality. The Balcones Canyonlands biological staff assists in a cooperative effort with the TPWD and the U.S. Fish and Wildlife Service to trap and band doves in a regional, statewide, and national effort to determine populations. TPWD also conducts a variety of other surveys to estimate the state's dove population. Call counts, urban dove surveys, and harvest surveys are also used to collect data. Data from these different sources serve as an index for population trends are used to set the State bag limits. We adopt the State bag limits on the Refuge.

The Refuge harvest of doves is insignificant compared to local, regional, and flyway harvest numbers. The cumulative effects of additional dove hunting on Balcones Canyonlands NWR to the dove population will be increased individual mortality - but the number of doves likely to be harvested from the Refuge is, and will remain, relatively small due to limited number of hunters and the average success rate for dove hunters. Hunting is not likely to impact mourning dove populations as the dove hunting area comprises less than 1.5% of the area of the refuge, and the Refuge's four-day hunt is much more restrictive than the State's seventy-day season.

Table 6. 2010 Dove Harvest

Area	# of Participants	# Doves Harvested
Balcones Canyonlands NWR	21	119
State of Texas	316,178*	7,923,377*

*(Purvis 2012b)

4.3.1.3 Other (Non-hunted) Resident Wildlife

Regional and Local Analysis

Currently, hunting is allowed for white-tailed deer, feral hogs, turkey, and doves. Other resident wildlife species are also present on the Refuge, including songbirds, wading birds, and raptors; small mammals such as voles, moles, mice, shrews, and bats; reptiles and amphibians such as snakes, skinks, turtles, lizards, salamanders, frogs and toads; and invertebrates such as butterflies, moths, other insects and spiders. Most of these species are common and widespread. In general these species are broadly distributed throughout the region and have limited home ranges. Hunting is not expected to affect any wildlife populations regionally. Some wildlife disturbance (increased human presence and sounds of gunshots) will occur locally during the hunting season. These impacts are expected to be minor because collectively, the Refuge will only be open to hunting for a total of 16 days per year.

Dove hunting takes place in a concentrated area and interactions with, or impacts to, other non-hunted resident wildlife may be locally high (within 20 to 30 acres) but will not affect wildlife outside those concentrated areas.

Small mammals, including bats, become less active during winter when Big Game and Upland Game hunting season occurs, and many of these species are nocturnal. Both of these characteristics reduce/eliminate hunter interactions with small mammals. Hibernation or torpor by cold-blooded amphibians and reptiles also limits their activity during the winter months when hunting occurs. Hunters would rarely encounter amphibians and reptiles during most of the

hunting season. Encounters with amphibians and reptiles would be greater during early fall but should not have cumulative negative effects on amphibian and reptile populations. Invertebrates become less active during the fall and winter months and there would be few interactions with hunters during the hunting season.

4.3.1.4 Endangered Species

It is the policy of the Service to protect and preserve all native species of fish, wildlife, and plants, including their habitats, which are designated as threatened or endangered with extinction.

Regional and Local Analysis

A Section 7 Evaluation completed during this assessment determined that the proposed alternative is not likely to adversely affect any threatened or endangered species. Restricting hunts to times of the year when endangered migratory songbirds are not present on the Refuge will preclude impacts to Golden-cheeked Warblers and Black-capped Vireos.

No scenario is envisioned whereby hunting could adversely impact any Threatened or Endangered karst invertebrates or potentially present amphibians.

The proposed action would likely have no impact on federally-listed species.

4.3.2 Anticipated Direct and Indirect Impacts of Proposed Action on Refuge Programs, Facilities, and Cultural Resources

Other Refuge Wildlife-Dependent Recreation

Adopting the Proposed Alternative would likely benefit public use wildlife-dependent opportunities by providing additional hunting area that could be substituted for areas that are currently closed during Refuge hunts. At the present time two tracts, Doeskin Ranch and North Nagel (totaling 987 acres), are included in the hunt program, and are currently closed to non-consumptive uses during public hunts. Under this alternative, the Refuge could administratively suspend hunting on these tracts - and activities such as hiking, wildlife observation and photography could remain open on the Doeskin Ranch tract without compromising the safety of Refuge visitors. The areas could be administratively re-opened if annual wildlife surveys indicate there is a biological need to harvest animals in those tracts.

Due to potential impacts to endangered species, only 3 areas of the Refuge (Doeskin Ranch, Warbler Vista, and the Shin Oak Observation deck) are currently opened to wildlife-dependent recreation at any time. Implementing the Proposed Alternative would not negatively impact opportunities.

By implementing the Proposed Action, the Refuge would meet the demands of the public, as well as, meeting the goals for which the Refuge was established. Implementing this hunt program would also bring a new public hunt opportunity to an area dominated by private lands. This is especially important as nation-wide statistics show a decrease in hunter retention and recruitment (especially youth hunters), in part due to a lack of quality public hunting areas.

Refuge Facilities

The Service defines facilities as: “Real property that serves a particular function(s) such as buildings, roads, utilities, water control structures, raceways, etc.”

Under the proposed action those facilities most utilized by hunters would be: public roads, parking lots, and trails. These facilities are currently used to accommodate Refuge management operations and general public use. The addition of these limited hunts would slightly increase vehicular traffic; however, impacts on these facilities would be minor in the short term and over time. Any negative impacts realized to these facilities would be reduced by appropriate regulation(s).

Minor additional use of roads, trails and parking areas to accommodate the hunt program would occur. Periodic maintenance or improvement of the existing small parking areas, roads, and trails would cause minimal negative impacts as the volume of hunters and the amount of hunter use would be light. With no new roads or parking areas required for the proposed hunts, costs should be minimal relative to total Refuge operations and maintenance costs and would not significantly diminish resources dedicated to other Refuge management programs.

Cultural Resources

Hunting, regardless of method or species targeted, is a consumptive activity that does not pose any threat to historic properties on or near the Refuge. In fact, hunting meets only one of the two criteria used to identify an “undertaking” that triggers a federal agency’s need to comply with Section 106 of the National Historic Preservation Act. These criteria, which are delineated in 36 CFR Part 800, state:

1. An undertaking is any project, activity, or program that can alter the character or use of an archaeological or historic site located within the “area of potential effect;” and
2. The project, activity, or program must also be either funded, sponsored, performed, licenses, or have received assistance from the agency.

Consultation with the pertinent State Historic Preservation Office and federally recognized Tribes is, therefore, not required.

Long term, the reduction of the Refuge feral hog population would likely result in a decreased likelihood that cultural sites would be damaged by hogs. If any new cultural or historical sites

are located on the Refuge, all recreational uses would be reviewed and restricted as necessary to protect those resources.

4.3.3 Anticipated Impacts of Proposed Hunt on Refuge Environment and Community

Negative impacts to the Refuge environment associated with the proposed hunting activities would be minor. It is expected that some minor disturbance to soils and vegetation would occur as a result of people traveling by vehicle or by foot to access hunting areas. Air quality would experience very minor impacts due to increased fossil fuel emissions as people travel to and from hunting areas. Due to nearby traffic, quarry operations, and farming equipment operation, limited areas of solitude are found on Refuge lands. There would be an impact on solitude, but visitors can time their visit to maximize the likelihood of solitude. The biggest conflict with visitors would be firearm noise from hunters. Disturbance from firearm noise would be a minor impact to neighbors. However, hunting conducted since 1997 has not resulted in complaints from neighbors involving gunfire. Comments on the Refuge CCP (2001) and discussions with Refuge visitors and general public suggest there exists both support and opposition to hunting on the Refuge. Water quality should actually improve as the feral hog population decreases and cause less turbidity in water bodies. Hunting of feral hogs should benefit vegetation, as it would reduce damage to all habitat types from hog foraging behavior. Other impacts to vegetation are expected to be minimal and temporary.

The impacts of allowing additional hunting opportunity may include disturbance of non-target species in the hunt areas, trampling of vegetation, and the possible creation of temporary paths by hunters, subsequent erosion, or littering. Refuge staff would control hunter access to minimize any impacts. Hunts would be monitored for impact on Refuge resources and, if any are found, appropriate adjustments would be made to eliminate them. Any future negative cumulative impacts to the Refuge environment would be further reduced by appropriate regulation(s). Collectively, these actions are anticipated to result in minor cumulative effects to the Refuge environment.

Lands adjacent to the Refuge are predominantly agricultural and sparsely populated. Hunting is and has always been a common pastime in the area, so the brief increase in activity on the Refuge would have little effect on the public, visitors, and nearby residents.

Some non-hunting Refuge visitors may be seasonally displaced due to concerns about safety while visiting the Refuge during hunting season. There would be some visitors who would avoid Public Use areas in proximity to hunting activity by altering the days they visit the Refuge. Hunting activity off refuge on private lands likely poses a more significant risk – something we cannot control or mitigate for.

The newly opened hunt areas would result in new public hunting opportunities - positively impacting the general public, nearby residents, and Refuge visitors. Refuge staff expects increased visitation and tourism to bring additional revenues to local communities, but not a significant increase in overall revenue in any area.

4.3.4 Other Past, Present, Proposed, and Reasonably Foreseeable Hunts (and Other Activities) and Anticipated Impacts

Cumulative effects on the environment result from incremental effects of a proposed action when these are added to other past, present, and reasonably foreseeable future actions. While cumulative effects may result from individually minor actions, they may, when viewed as a whole, become significant over time. The Refuge is not aware of any past, present or future planned actions that would result in a significant cumulative impact when added to the Refuge’s proposed action, as outlined in Alternative B.

Past

Although we have no detailed records, it is safe to assume that all lands acquired by the Service that now comprise the Refuge were previously hunted. Other past uses include farming, ranching, commercial harvest of Ashe juniper and other woody vegetation for wood and charcoal production, and quarry operations (caliche pits).

Hunting of white-tailed deer, feral hogs, and turkeys was implemented on the Refuge in 1997. Hunts have been held annually, and have provided a quality recreational experience for hundreds of participants. For the period 1997 - 2011, the average harvest was 39 deer per year with a high of 56 and a low of 18. Hog and turkey harvest has been small in comparison, with an average of 2.8 hogs and .6 turkeys harvested per year (Table 7).

Table 7. Game Harvest records, Balcones Canyonlands NWR

Game	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total	Average
Deer	50	42	38	38	35	47	58	54	56	52	18	30	26	24	18		586	39
Hogs	1	3	0	5	2	7	2	1	2	3	5	1	6	3	2		43	2.8
Turkey	0	1	1	1	0	1	0	0	1	0	0	1	2	1	1		10	0.6
Dove	-	-	-	-	-	-	19	95	1	12	8	6	0	119	117	137	514	51.4

Hunting for migratory birds (doves) was implemented in 2003. Weather conditions and Refuge staff management effort has fluctuated over the past – resulting in varying degrees of success for area hunters. In recent years, hunter success has been good, despite drought conditions, and

participation has increased. For the period 2003 - 2012, the average harvest was 51.4 doves per year with a high of 137 and a low of 0 (Table 7).

Refuge hunts for all species fill an important need for low-cost public hunting recreation in this portion of the country with relatively few public hunting opportunities.

Present

At the present time, the Refuge is open to hunting for white-tailed deer, feral hogs, and turkeys during 4 three-day weekends. These hunts have traditionally occurred on the two weekends before Thanksgiving, and the two weekends after Thanksgiving.

During September, Refuge employees conduct spotlight surveys for deer to estimate the current population. Spotlight survey data from 2011 indicates the Refuge deer population is approximately 700 animals.

Migratory bird (dove) hunting on the Refuge is currently conducted on the Johnson tract. This 274 acre unit contains several fields (12 to 15 acres total) that are planted to native sunflowers and have naturally occurring doveweed that is attractive to feeding doves. Hunting pressure for these species is typically low (average < 20 participants per year) over the 4 day hunt. Hunting hours are from noon until the end of legal shooting time. Hunter success falls off quickly after the opening day as birds are harvested or become wary of the new activity around the fields. Few if any birds are harvested on the last day of the hunt. During the 2012 season, 25 hunters harvested 137 doves.

Negative impacts from past/current hunts have not been noted and none are anticipated in the future due to relatively low pressure from migratory bird hunts and limits on the number of hunters for deer, hogs, and turkeys.

Many past land use practices such as farming or ranching no longer occur on property acquired by the Service . Habitat management activities, including manipulation by mechanical thinning and crushing of vegetation, and prescribed burning have taken their place. Several hundred acres of vegetation is manipulated annually by burning, cutting, or crushing to change species composition, reduce fuel loading, or alter vegetative structure to benefit wildlife species. Other activities that occur round the refuge include residential development and ranching. There are several active quarry sites in proximity to the refuge – one of which moves product to market via an easement through refuge.

Proposed

Under this alternative, additional acreage would be included in the Refuge hunting program for Big Game and Migratory Birds. The number of hunting days would not change from the present.

The addition of new hunting areas is expected to be an effective management tool for feral hogs and white-tailed deer on larger areas of the Refuge. Refuge staff would continue to promote native flora and fauna diversity through active habitat management activities that achieve Refuge wildlife habitat priorities and objectives. No negative impacts are anticipated to turkey and dove populations under the proposed change.

In addition to homes on individual tracts, there are 3 housing subdivisions within acquisition boundary at the present time, and vacant lots are available in each. It is likely that housing construction will continue, and new subdivisions are likely. Several tracts within the acquisition boundary have been surveyed for limestone quarries, and changes in economic conditions for ownership could result in overnight expansion of mining activities.

4.3.5 Anticipated Impacts if Individual Hunts are Allowed to Accumulate

The Service has concluded that cumulative impacts on the Refuge's wildlife populations, either hunted or non-hunted species, would be negligible. The Service has also concluded that the proposed action would not cumulatively impact the Refuge environment or Refuge programs. This determination was based upon a careful analysis of potential environmental impacts of hunting on the Refuge together with other projects and/or actions. Hunting is an appropriate wildlife management tool that can be used to manage wildlife populations. Some wildlife disturbance would occur during the limited hunting seasons.

Hunting for white-tailed deer, feral hogs, and turkeys all occur simultaneously. Rather than having hunts for individual game species at different times and locations, activities are limited to the same space and time. This minimizes the duration of disturbance and impact.

Service staff recognizes that all uses of Refuge lands create some impact to Refuge wildlife and their habitats. These uses, when taken together, have the potential to create accumulating impacts as the number of Refuge uses increases. Because of this potential, Refuge uses are limited to those uses which have been formally determined to be compatible with the purposes for which the Refuge was established and with the mission of the National Wildlife Refuge System. When these formal compatibility determinations are reviewed (every ten to fifteen years) possible accumulating impacts that may have occurred in succeeding years will be considered and addressed as necessary.

Field checks by Refuge law enforcement officers would be planned, conducted, and coordinated with staff and other agencies to maintain compliance with regulations and assess species populations and numbers harvested.

Because of the primary mission of Balcones Canyonlands NWR (protection and enhancement of endangered species and their habitats), expansion of non-consumptive public uses are unlikely to significantly expand across time. Any expansion of these uses has the potential for unanticipated

conflicts among and within user groups that may be present. In the event such unanticipated conflicts occur as a result of implementing this hunt program, the Refuge's visitor service programs would be adjusted as needed to eliminate or minimize each problem to ensure that high quality, wildlife-dependent recreational opportunities continue. Hunting season dates and regulations would be set and regulated to allow all user groups to experience a quality visit. The Refuge would have the flexibility to modify the hunt program in order to meet the needs of all wildlife-dependent recreational user groups.

4.4 Indian Trust Assets

No Indian Trust Assets have been identified within the Balcones Canyonlands NWR boundary and there are no reservations or ceded lands present. Because resources are not believed to be present, no impacts are anticipated to result from implementation of the preferred alternative described in the EA.

4.5 Unavoidable Adverse Effects

Under the Proposed Action (Alternative B), adding additional acreage to the Refuge hunt program could result in some unavoidable adverse impacts. There would be some short-term disturbance to other resident wildlife, but these impacts are expected to be minimal. Opportunities for public viewing and photography of wildlife on the Refuge during hunt days would be limited to areas closed to hunting.

Allowing white-tailed deer and feral hog numbers to grow unchecked on areas of the Refuge not open to hunting, as proposed in Alternative A would result in much greater unavoidable adverse impacts.

4.6 Irreversible and Irretrievable Commitment of Resources

None of the alternatives would result in a large commitment of nonrenewable resources.

A slight increase the irretrievable commitment of fossil fuels (diesel and gasoline), oils, and lubricants used by heavy equipment and vehicles for a short period of time for maintenance of hunt access would be required. However, none of the alternatives would result in a large commitment of nonrenewable resources.

4.7 Table 8. Summary of Environmental Effects by Alternative

Environmental Resource	Alternative A: No Action Alternative	Alternative B: Proposed Action Alternative	Alternative C:
Impacts to Air Quality	No change	Negligible short- and long-term negative impacts likely	Negligible short- and long-term negative impacts likely
Impacts to Water Quality and Quantity	Moderate short- and long-term negative impacts likely	Moderate short- and long-term negative impacts likely	Minor short- and long-term positive impacts likely
Impacts to Soils	Negligible short-term and minor long-term negative impacts likely	Negligible short-term and minor long-term positive impacts likely	Negligible short-term and minor long-term positive impacts likely
Impacts on Habitat	Moderate long-term negative impacts likely	Minor short-term negative impacts and moderate long-term positive impacts likely	Minor short-term negative impacts and moderate long-term positive impacts likely
Impacts on Wildlife	Moderate long-term negative impacts likely	Additional mortality to deer, turkey, feral hogs and doves would occur. Minor disturbance to other wildlife. Long-term positive benefits for native wildlife.	Additional mortality to deer, turkey, feral hogs and doves would occur. Minor disturbance to other wildlife. Long-term positive benefits for native wildlife.
Impacts on Threatened and Endangered Species	Moderate long-term adverse impacts likely	Moderate long-term positive impacts likely	Minor long-term positive impacts likely
Impacts on Socioeconomic Resources	No change	Minor positive short and long-term impacts likely	Minor positive short and long-term impacts likely
Impacts on Cultural Resources	No change	No change or long-term minor positive impacts	No change or long-term minor positive impacts
Impacts on Visitor Services	No change	Moderate short- and long-term positive impacts	Moderate short- and long-term positive impacts

5.0 Consultation, Coordination, and Document Preparation

Document prepared by David Maple and Scott Rowin, Balcones Canyonlands National Wildlife Refuge, U.S. Fish and Wildlife Service, Marble Falls, Texas.

5.1 Agencies and individuals consulted in the preparation of this document include:

Texas Parks and Wildlife Department

Carol Torrez, Region 2, NEPA Coordinator for Refuges

Juli Niemann, Region 2, Division of Visitor Services

5.2 References

Austin Economy. 2012. Available website. <http://www.city-data.com/us-cities/The-South/Austin-Economy.html>

Austin – Round Rock – San Marcos, Texas Unemployment. 2012. Available website. <http://www.deptofnumbers.com/unemployment/texas/austin/> .

Baskett, T.S., R.E. Tomlinson, and R.E. Mirarchi, eds. 1993. Ecology and management of the mourning dove. Stackpole Books, Harrisburg, Pa. 567 pp.

Beach, R. 1993. Depredation problems involving feral hogs. Pages 67-93 in C.W. Hanselka and J.F. Cadenhead, eds. Feral Swine: A compendium for resource managers. Texas Agric. Ext. Service, College Station, Tex.

City of Austin, and Travis County, Texas. 1996. Habitat Conservation Plan and Final Environmental Impact Statement. Austin, Texas.

City of Austin, Watershed Protection Dept. 1999. Jollyville Plateau Water Quality and Salamander Assessment. Executive Summary. Water Quality Report Series COA-ERM 1999-01, October 25, 1999.

Corn, J. L., J. C. Cumbee, B. A. Chandler, D. E. Stallknecht, and J. R. Fischer. 2005. Implications of feral swine expansion: Expansion of feral swine in the United States and potential implications for domestic swine. Pages 295–297 in Proceedings of the 109th Annual Meeting of the United States Animal Health Association, Hershey, Pennsylvania, USA. Accessed online at: <http://www.usaha.org/meetings/proceedings.shtml> .

Davidson, W. R., editor. 2006. Wild swine. Pages 105–134 in Field manual of wildlife diseases in the southeastern United States. Third edition. Southeastern Cooperative Wildlife Disease Study, Athens, Georgia, USA.

Davis, D.S. 1993. Feral hogs and disease: implications for humans and livestock. Pages 84-87 in C.W. Hanselka and J.F. Cadenhead, eds. Feral Swine: A compendium for resource managers. Texas Agric. Ext. Service, College Station, Tex.

- Ditchkoff, S. S., and B. C. West. 2007. Ecology and management of feral hogs. *Human-Wildlife Conflicts* 1:149–151.
- Elliott, W. R., and J. R. Reddell. 1989. The status and range of five endangered arthropods from caves in the Austin, Texas region. A report on a study supported by the TPWD and the Texas Nature Conservancy for the Austin Regional Habitat Conservation Plan.
- Elliott, W. R.. 1992. Endangered and rare karst species in Travis County, Texas: Options for the Balcones Canyonlands Conservation Plan. Prep. for Balcones Canyonlands Conservation Plan, USFWS, TPWD, Texas Nature Conservancy.
- Espey, Huston & Associates. 1990 Environmental Assessment and alternative route analysis for Lytton Springs – Slaughter lane 138-kv transmission line project. EH&A Document No. 890501. Austin, Texas.
- Gaston, W. D. 2008. Feral pig (*Sus scrofa*) survival, home range, and habitat use at Lowndes County Wildlife Management Area, Alabama. Thesis, Auburn University, Auburn, Alabama, USA.
- Graber, J. W. 1961. Distribution, habitat requirements, and life history of the black-capped vireo (*Vireo atricapillus*). *Ecol. Monogr.* 31:313-336.
- Grzybowski, J. 1991. Black-capped Vireo (*Vireo atricapillus*) Recovery Plan. Prep. for USFWS, Albuquerque, NM.
- Haig, S.M. 1992. Piping Plover. In the *Birds of North America*, No. 2 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.
- Hill, R.T. 1901a. *Geography and Geology of the Black and Grand Prairies, Texas* 60 pp.
- Hill, R.T. 1901b. *Geography and Geology of the Black and Grand Prairies, Texas* 66 pp.
- Hubbard, J.P. 1985. Least Tern (*Sterna antillarum*) New Mexico Department of Game and Fish Handbook of Endangered Species. Santa Fe, NM
- Jolley, D. B. 2007. Reproduction and herpetofauna depredation of feral pigs at Fort Benning, Georgia. Thesis, Auburn University, Auburn, Alabama, USA.
- Kaller, M. D., and W. E. Kelso. 2006. Swine activity alters invertebrate and microbial communities in a coastal plain watershed. *American Midland Naturalist* 156:163–177.

- Knight, S., 2012. Eastern Turkey Season Cut To 28 Counties. The Tyler Paper. Available online at: <http://www.tylerpaper.com/article/20120408/SPORTS0202/120409849/-1/SPORTS02>
- Ladd, C., and L. Gass. 1999. Golden-cheeked Warbler (*Dendroica chrysoparia*), In: The Birds of North America, No. 420 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Mayer, J.L. and L. Brisbin Jr. 1991. Wild pigs in the United States: Their history, comparative morphology, and current status. The University of Georgia Press, 314pp.
- Mayer, J. J., and C. B. Shedrow. 2007. Annotated bibliography of the wild pig (*Sus scrofa*). Washington Savannah River Company, Aiken, South Carolina, USA.
- Mayer, J. J., and I. L. Brisbin, Jr. (Editors). 2009. Wild pigs: Biology, damage, control techniques and management. SRNL-RP-2009-00869. Savannah River National Laboratory, Aiken, South Carolina, USA: in press.
- National Wild Turkey Foundation website, October 2011. <http://www.nwtf.org/>
- Tapley, J., Abernethy, R. K., and Kennamer, J. E. 2000. Wild Turkey Status and Range 2000. National Wild Turkey Federation Bulletin No. 21. Available website: www.nwtf.org/conservation/bulletins/bulletin_21.pdf · PDF file
- Novy, J. E. 1991. New World screwworm response to an emergency. World Animal Review, FAO. Available website: <http://www.fao.org/>
- Nunley, G. L. 1999. The cooperative Texas wildlife damage management program and feral swine damage management. Pages 27–30 in Proceedings of the Feral Swine Symposium. Texas Animal Health Commission, June 2–3, 1999, Fort Worth, Texas, USA.
- Patten, D. C. 1974. Feral hogs — boon or burden. Proceedings of the Sixth Vertebrate Pest Conference 6:210–234.
- Pimental, D. 2007. Environmental and Economic Costs of Vertebrate Species Invasions into the United States. College of Agriculture and Life Sciences, Cornell University, Ithaca, New York.
- Purvis, J. 2012a. Big Game Harvest Survey Results 2001-2001 Thru 2010-2011. Austin: Texas Parks and Wildlife Dept. PWD RP W7000 0718b (7/12).
- Purvis, J. 2012b. Small Game Harvest Survey Results 1992-93 Thru 2011-12. Austin: Texas Parks and Wildlife Dept. PWD RP W7000 0719a (7/12).

Reddell, J. 1991. Further study of the status and range of endangered arthropods from caves in the Austin, Texas, region. A report on a study for the USFWS, Austin, TX.

Reddell, J. Undated (ca. 2000). Letter report to Deborah Holle, re: cave species occurrence on Balcones Canyonlands NWR.

Rollins, D. 2001. Wildlife by design. *Livestock Weekly*, Internet Edition. Available website: <http://www.livestockweekly.com/papers/01/04/12/whlrollin.asp>

Rose, P. 1971. "Edwards group, surface and subsurface, Central Texas." Bureau of Economic Geology. Report of Investigations No. 74. University of Texas at Austin.

Sexton, C. W. March 2009. A New Estimate of the Golden-cheeked Warbler Population on Balcones Canyonlands NWR. Prep. for Travis Audubon Society. Unpubl. report.

Singer, F. J., W. T. Swank, and E. E. C. Clebsch. 1984. Effects of wild pig rooting in a deciduous forest. *Journal of Wildlife Management*. 48:464–473.

Sissel, B., Sarkar, S. 2009. Water Quality Tests for the Balcones Canyonlands National Wildlife Refuge, Spring 2009, Technical Note 60 dated September, 10, 2009.

Soil Conservation Service (SCS). 1974. Soil survey of Travis County Texas. In cooperation with the Texas Agricultural Experiment Station. U.S. Department of Agriculture. Washington, D.C.

Soil Conservation Service (SCS). 1979. Soil survey of Blanco and Burnet Counties Texas. In cooperation with the Texas Agricultural Experiment Station. U.S. Department of Agriculture. Washington, D.C.

Soil Conservation Service (SCS). 1983. Soil survey of Williamson County Texas. In cooperation with the Texas Agricultural Experiment Station. U.S. Department of Agriculture. Washington, D.C.

Stevens, R.L. 1996. The feral hog in Oklahoma. Samuel Roberts Noble Foundation, Ardmore, Oklahoma.

Tate, J. 1984. Techniques in controlling wild hogs in Great Smokey Mountains National Park; Proceedings of a workshop National Park Service Research/Resources Manage. Report SER-72, Nov. 1984.

Taylor, R. 1991. The feral hog in Texas. Texas Parks and Wildlife Department. Federal Aid Report Series No. 28. 21pp.

Texas AgriLife Extension Service-Outreach Education Effort Summary-Feral Hogs; Department of WFS-Extension Project Group, 2006-2009

Texas Commission on Environmental Quality. 2010. Accessed October 18, 2011 at http://www.tceq.state.tx.us/nav/eq/mon_sites.html

Texas Parks & Wildlife Department. Undated (1995a). Golden-cheeked Warbler [information pamphlet]; Management guidelines for Golden-cheeked Warbler. TPWD, Austin, TX.

Texas Parks & Wildlife Department. 1995b. Karst Invertebrates [information pamphlet]; Management guidelines for Karst Invertebrates. TPWD, Austin, TX.

Texas Parks & Wildlife Department. 2002a. The Blackland Prairies. Available website. <http://www.tpwd.state.tx.us/nature>

Texas Parks & Wildlife Department. 2002b. Crosstimbers and Prairie Ecological Region. Available website. <http://www.tpwd.state.tx.us>

Texas Parks & Wildlife Department. 2003. Freshwater Fishing. Available website. <http://www.tpwd.state.tx.us/nature>

Texas Parks & Wildlife Department. 2004. The Hill Country Wildlife District. Available website. <http://www.tpwd.state.tx.us>

Tomka, S.A. and J. Leffler. 1998. A Cultural Overview and Assessment of Balcones Canyonlands National Wildlife Refuge. University of Texas at San Antonio, Spec. Rept. No 24.

U.S. Census Bureau. 2010. Accessed October 16, 2011/ at <http://quickfacts.census.gov/qfd/states/48/48291.html>

U. S. Department of Agriculture. 1991. Wild pigs - hidden danger for farmers and hunters. U.S. Dept. of Agric., Animal Plant Health Inspection Serv., Agri. Inform Bull.

U.S. Fish and Wildlife Service. 1991a. Final Environmental Assessment, Proposed Balcones Canyonlands National Wildlife Refuge. USFWS, Albuquerque, NM.

U.S. Fish and Wildlife Service. 1991b. Land Protection Plan, Proposed Balcones Canyonlands National Wildlife Refuge. USFWS, Austin, TX.

U.S. Fish and Wildlife Service. 1992. Golden-cheeked Warbler (*Dendroica chrysoparia*) Recovery Plan. Albuquerque, New Mexico.

U.S. Fish and Wildlife Service. 1994. Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas. Albuquerque, NM.

U.S. Fish and Wildlife Service. 1996. Balcones Canyonlands National Wildlife Refuge Proposed Additions, Final Land Acquisition Compliance Document. Albuquerque, NM.

U.S. Fish and Wildlife Service. 1999. Endangered and threatened wildlife and plants; proposed rule to remove the bald eagle in the lower 48 states from the list of endangered and threatened wildlife. Federal Register 64:46543.

U.S. Fish and Wildlife Service. 2000. Balcones Canyonlands National Wildlife Refuge, Environmental Assessment on Proposed Additions. Albuquerque, NM.

U.S. Fish and Wildlife Service. 2007. Banking on Nature 2006: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation. Washington, D.C.

Vangilder, L.D. 1992. Population dynamics. Pages 144-164 *in* J.G. Dickson, ed. The wild turkey: biology and management. Stackpole Books, Harrisburg, PA.

Veni, George. 1991. Geologic controls on cave development and the distribution of cave fauna in the Austin, Texas, region. George Veni & Assoc., Inc. Prepared for U.S. Fish & Wildlife Service, Fort Worth, Texas.

Whitehouse, D. B. 1999. Impacts of feral hogs on corporate timberlands in the south eastern U.S. Pp. 108-110 *in*: Proc., First National Feral Swine Conf., Ft. Worth, TX, June 2-3. Texas Animal Health Commission, Austin. <http://texnat.tamu.edu/symposia/feral/FeralConf99.pdf>.

West, B. C., A. L. Cooper, and J. B. Armstrong. 2009. Managing wild pigs: A technical guide. Human-Wildlife Interactions Monograph 1: 1-55.

West, B. C. 2009. The human side of invasive species. Human - Wildlife Conflicts 3:6-7.

Wild Turkey Zone, 2012. Available online at:
<http://wildturkeyzone.com/wildturkey/population.htm>

Wolf, T., and M. R. Conover. 2003. Feral pigs and the environment: an annotated bibliography. Berryman Institute Publication 21, Utah State University, Logan, Utah, USA; Mississippi State University, Starkville, Mississippi, USA.

Wood, G.W. and D.N. Roark. 1980. Food habits of feral hogs in Coastal South Carolina. J. Wildl. Manage. 44: 506-511.

Yarrow, G. K., and J. C. Kroll. 1989. Coexistence of white-tailed deer and feral hogs: management implications. Southeast Deer Study Group 12:13-14.

Appendix A DEFINITION OF TERMS

Carrying capacity is the maximum population of a particular organism that a given environment can support without detrimental effects.

Effects

Direct effects are the impacts that would be caused by the alternative at the same time and place as the action.

Indirect effects are impacts that occur later in time or distance from the triggering action.

Cumulative effects are incremental impacts resulting from other past, present, and reasonably foreseeable future actions, including those taken by federal and non-federal agencies, as well as undertaken by private individuals. Cumulative impacts may result from singularly minor but collectively significant actions taking place over a period of time.

Impact Type

Beneficial/positive impacts are those resulting from management actions that maintain or enhance the quality and/or quantity of identified Refuge resources or recreational opportunities.

Adverse/negative impacts are those resulting from management actions that degrade the quality and/or quantity of identified refuge resources or recreational opportunities.

Duration of Impacts

Short-term impacts affect identified refuge resources or recreational opportunities; they occur during implementation of the management action but last no longer.

Medium-term impacts affect identified refuge resources or recreational opportunities that occur during implementation of the management action; they are expected to persist for some time into the future though not throughout the life of the CCP.

Long-term impacts affect identified refuge resources or recreation opportunities; they occur during implementation of the management action and are expected to persist throughout the life of the Plan and possibly longer.

Intensity of Impact

Insignificant/negligible impacts result from management actions that cannot be reasonably expected to affect identified refuge resources or recreational opportunities at the identified scale.

Minor impacts result from a specified management action that can be reasonably expected to have detectable though limited effect on identified refuge resources or recreation opportunities at the identified scale.

Moderate impacts result from a specified management action that can be reasonably expected to have apparent and detectable effects on identified refuge resources or recreation opportunities at the identified scale.

Major impacts result from a specified management action that can be reasonably expected to have readily apparent and substantial effects on identified refuge resources and recreation opportunities at the identified scale.