FY 2016 Summary of

Wildlife and Plant Management Activities on

Travis County's Balcones Canyonlands Preserve and Select Parks



Large group of feral hogs that were trapped at the Kotrla Unit

Travis County
Department of Transportation and Natural Resources
Natural Resources and Environmental Quality Division

1 October 2015 – 30 September 2016

TABLE OF CONTENTS

Introduction 3

Brown-headed cowbirds 5

Feral hogs 9

White-tailed deer 11

Plant species of concern monitoring 15

Non-native plant management 17

Literature Cited 21

List of Tables

Table 1. FY16 Cowbird trap locations, trapping period dates, and initial cowbird stocking numbers 6

Table 2. Non-target species found in Travis County operated traps in FY16 7

Table 3. Results of the FY16 Travis County cowbird trapping season 7

Table 4. White-tailed deer population trends at Pace Bend Park FY97 through FY16 .. 13

Table 5. White-tailed deer population trends on the BCP Jollyville Unit FY03 through FY16 ..... .14

Table 6. Deer Harvested on Travis County Properties by Orion Research and Management Services, Inc. during FY16 15

Table 7. Non-native plant species targeted for removal on Travis County Balcones Canyon Lands Tracts 20

Table 8. Summary of invasive plant control efforts by Travis County Natural Resources from FY09 to FY16 20

List of Figures

Figure 1. Texabama croton survey FY16 – Kotrla Unit 24

INTRODUCTION

On May 2, 1996, the City of Austin and Travis County were jointly issued a U.S. Fish and Wildlife Service (USFWS) regional permit (the Permit) referred to as the Balcones Canyonlands Conservation Plan (BCCP) that allows incidental "take" of eight locally occurring endangered species under Section 10(a)1(b) of the Endangered Species Act (U. S. Fish and Wildlife Service 1996a). The thirty-year permit covers Travis County outside of proposed Preserve boundaries identified in the Habitat Conservation Plan and Final Environmental Impact Statement (HCP/FEIS) (U. S. Fish and Wildlife Service, 1996b). The permit also covers incidental take of 27 species of concern should any become listed as threatened or endangered during the life of the Permit. The City of Austin and Travis County (the Permit Holders) are required by the terms of the Permit to assemble and manage a minimum of 30,428 acres of suitable habitat for the benefit of these species. This series of protected lands is known as the Balcones Canyonlands Preserve (BCP).

The City of Austin and Travis County also agreed to protect and manage populations of unique or endemic plant species of concern found within preserve boundaries, as well as on other city- and county-managed properties. Plant species of concern listed in the permit include canyon mock-orange *(Philadelphus ernestii)* and Texabama croton (*Croton alabamensis var. texensis*).

The negative impacts of non-native, nuisance and invasive species have been well documented throughout Texas and around the world. The 2007 BCP Land Management Plan, approved by the USFWS, directs management of the BCP, including control of non-native, nuisance and invasive species.

Beginning in 2002 and updated annually, a *Travis County Parks and Preserves Wildlife Management Permit* is drafted which serves as a general guideline for Travis County staff to direct management of these species in response to the potential human health and safety, economic, and environmental impacts. The purpose of this permit is to recognize that threats may be posed by these species, outline appropriate management strategies, and provide management authority to implement measures to minimize these threats. The guidelines in this permit are intended to provide direction to managers for lands throughout the County system and are anticipated to represent a continually updated and flexible set of directives that are able to meet the needs of a changing environment. As new species or conditions are discovered, this information will be incorporated to provide current status of the conditions and challenges faced by County Park and Preserve land managers.

The Texas Parks and Wildlife Department (TPWD) define exotic animals as herbivorous single-hoofed or cloven-hoofed mammals (ungulates) that are not indigenous or native to Texas, including animals from the deer and antelope families. Ranch and game managers throughout Texas have introduced such animals for various reasons. Animals found on Travis County-managed portions of the BCP meeting the definition of exotic include Russian boars, which freely interbreed with feral hogs.

Non-native animals are species not indigenous to Texas, but which fall outside of the TPWD definition of "exotic". Examples of non-native animal species in Travis County include house sparrows (*Passer domesticus*), European starlings (*Sturnus vulgaris*), red-imported fire ants (*Solenopsis invicta*), tawny crazy ants (*Nylanderia fulva*), and rock doves (*Columba livia*).

Feral animals are wild populations of otherwise domesticated species that have through release or escape reverted to a wild condition. Feral species found in Travis County include house cats, dogs, goats, and hogs.

Nuisance animals are native species that present threats to human health and safety, County property, or other natural resources due to population densities, by providing a disease reservoir or other threat. Nuisance animals may include species such as brown-headed cowbirds (*Molothrus ater*), coyotes (*Canis latrans*), opossum (*Didelphis marsupialis*), and white-tailed deer (*Odocoileus virginianus*).

The BCP Land Management Plan (2007) defines non-native plants as species that were introduced where they did not evolve and do not naturally occur. These introduced species often thrive in the absence of their natural predators, diseases, competitors, and parasites. Non-native plant species can be detrimental to BCP properties by overcrowding and outcompeting native species that are important components to endangered species habitat, as well as reducing overall plant diversity in infested areas.

In Fiscal Year 2016 (FY16, Oct. 1-Sept. 30), wildlife management activities on Travis County-managed portions of the BCP focused on five species: brown-headed cowbirds (*Molothrus ater*), feral hogs (*Sus scrofa*), white-tailed deer (*Odocoileus virginianus*), tawny crazy ant (*Nylanderia fulva),* and red imported fire ants (*Solenopsis invicta*). Monitoring and control of cowbirds, hogs, and deer are described in their respective sections in this report. Fire ant control and Tawny crazy ant monitoring efforts are described in *Appendix H: Balcones Canyonlands Preserve Karst Monitoring and Management FY2016 Annual Report* of the FY2016 BCCP Annual Report.

In FY16, plant management activities focused on survey and control of ten species of non-native plants, which are described in the *Non-Native Plant Management* section of this report, as well as Texabama croton surveys which are described in Plant Species of Concern Monitoring section.

BROWN-HEADED COWBIRDS

Introduction

In addition to many other avian hosts, brown-headed cowbirds (cowbird) parasitize the nests of two Central Texas endangered avian species; the black-capped vireo (*Vireo atricapilla*) and golden-cheeked warbler (*Setophaga chrysoparia*). Cowbird trapping has been the subject of considerable research and management effort and is believed to be an important technique for the conservation of both species. At Fort Hood, cowbird trapping has been credited for drastically reducing parasitism rates of black-capped vireos from 91% before cowbird management to below 20% after a cowbird management program was implemented. Fort Hood currently meets local and regional recovery goals for the black-capped vireo and attributes this success to cowbird management (Kostecke et al. 2005).

This report summarizes the results of the FY16 Travis County cowbird trapping program. Six traps were operated within, or near, Travis County's BCP properties: the Hamilton Pool Preserve (HP), the Nootsie tract, and on private land adjacent to the Toops, Vireo Ridge, and Kotrla tracts. A sixth trap was operated at Travis County's Milton Reimers Ranch County Park.

Background

Cowbird trapping was previously conducted in western Travis County by Espey Huston and Associates and DLS Associates in 1989 and Texas Animal and Damage Control from 1990-1996. In 1997, Travis County Natural Resources Department initiated its own cowbird trapping program. This program was co-managed with the City of Austin until 2001, at which time the City of Austin began operating a program independently. Since 1997, trap locations have been added or removed according to trap success or failure and access availability. Trapping did not occur in 1998 due to staff shortage.

Methods

Cowbird trapping in FY16 was conducted exclusively in the western half of the county. Travis County operated two mega traps (16'x16') and four metal hybrid traps (6'x 8'),

two of which were on loan from TPWD. The mega traps are located at HP and on private property adjacent to the Vireo Ridge tract on FM 2769 (hereafter, FM 2769 trap). The three hybrid traps were operated at Milton Reimers Ranch County Park (hereafter, Reimers trap), within the Nootsie tract (hereafter, Nootsie trap), on private property adjacent to the Toops tract (hereafter, Toops trap), and on private property adjacent to the Kotrla Unit (hereafter, Kotrla trap).

A group of decoy birds (13 males, 5 females) were acquired from a private landowner in the middle of March which allowed the Nootsie trap to open on March 25, 2016. Birds captured in the Nootsie trap were relocated to open other traps on March 28th (Toops) and March 30th (Kotrla). The 2769 trap was opened on April 4th with birds that were relocated from the Kotrla trap. A second (4 males, 9 females) and third (3 males, 4 females) group of decoy birds were acquired from the same private landowner to open the HP trap on April 1, 2016 and Reimers Ranch on April 8, 2016. Table 1 summarizes the FY 16 cowbird trapping schedule and initial stocking numbers of decoy birds.

Table 1. FY16 Cowbird trap locations, trapping period dates, and initial cowbird stocking numbers.

Trap	Date Opened	Date Closed	Initial Stocking Numbers
Nootsie	March 25	June 1	13 Males, 5 Females
Toops	March 28	June 1	3 Males, 2 Females
FM 2769	April 4	June 1	5 Males, 4 Females
Kotrla	March 30	June 1	5 Males, 2 Females
Reimers	April 8	June 2	3 Males, 4 Females
HP	April 1	June 2	4 Males, 9 Females

Traps were inspected and maintained every day of the week throughout the season. If no one was available to check for non-target species on the weekend, the trap was shut down by placing a board over the opening. Water and feed (whole millet seed) were refreshed three times a week. To offset the impact of rising air temperatures on bird health and survivability, plastic water baths and shade cloth were added to the traps. Some traps were reinforced with poultry fencing along the outer base edges to prevent digging by predators attempting to gain access. Non-target species found in traps were removed unharmed unless otherwise noted (Table 2). Cowbirds were euthanized by placing them in a container with carbon dioxide gas following TPWD protocol (TPWD No Date).

Table 2. FY16 Non-target species found in Travis County operated traps.

Common Name	Species Name	Trap(s)	Comments
Bronzed Cowbird	*Moluthrus aeneus*	KO, HP	3 released (2 males and 1 female)
Northern Cardinal	*Cardinalis cardinalis*	2769	3 released (all males)
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	KO	3 released (all females)
Red-winged Blackbird	*Agelaius phoeniceus*	2769	1 released (male)
Rufous-crowned Sparrow	*Aimophila ruficeps*	NT	1 released
Carolina Wren	*Thryothorus ludovicianus*	RR	1 released

RR = Reimers HP = Hamilton Pool Preserve NT = Nootsie TP = Toops 2769 = FM 2769 KO = Kotrla

Results and Discussion

In FY16, a total of 232 male and 195 female cowbirds were captured. The total of 427 cowbirds captured this year was significantly higher than the previous year when 158 cowbirds were trapped. Table 3 summarizes cowbird captures at each trap by class (male, female, and juvenile), month, and trap efficiency (or capture rate) during the 2016 trapping season. Trap success is calculated by dividing the number of females captured by the number of days in operation (x 100). Five of the six traps were operated in the same location as they were since the 2007 trapping season. The trap that was added on the Vireo Ridge tract in FY12 was moved to private property adjacent to the Kotrla Unit in FY16.

Table 3. Results of the FY15 Travis County cowbird trapping season.

Trap	Month	Days in Operation	Males captured	Females captured	Juveniles Captured	Total Captured	Trap Efficiency %
FM 2769	April	27	5	3	0	8	11.11
	May	31	4	1	0	5	3.23
	June	1	0	2	0	2	200.00
	Total	**59**	**9**	**6**	**0**	**15**	**10.17**
Hamilton Pool	April	30	3	11	0	14	36.67
	May	31	8	5	0	13	16.13
	June	2	0	0	0	0	0.00
	Total	**63**	**11**	**16**	**0**	**27**	**25.40**
Nootsie	March	7	4	1	0	5	14.29
	April	30	12	3	0	15	10.00
	May	31	1	1	0	2	3.23
	June	1	0	0	0	0	0.00

	Total	**69**	**17**	**5**	**0**	**22**	**7.25**
Reimers	April	23	5	11	0	16	47.83
	May	31	2	0	0	2	0.00
	June	2	0	1	0	1	50.00
	Total	**51**	**7**	**12**	**0**	**19**	**23.53**
Toops	March	4	3	0	0	3	0.00
	April	30	3	2	0	5	6.67
	May	31	23	32	0	55	103.23
	June	1	0	0	0	0	0.00
	Total	**66**	**29**	**34**	**0**	**63**	**51.52**
Kotrla	March	2	0	0	0	0	0.00
	April	30	134	94	0	228	313.33
	May	31	23	28	0	51	90.32
	June	1	2	0	0	2	0.00
	Total	**64**	**159**	**122**	**0**	**281**	**190.63**
	Grand Totals	**372**	**232**	**195**	**0**	**427**	**52.42**

Travis County Natural Resources maintains a minimum goal of 20% trap efficiency for the program. Trapping efforts fell short of this goal from 2012-2015, but it has been achieved all other years. The average efficiency rate from 2001-2015 was 35.1%. In FY16, overall trapping efficiency was at 52.4%, which is the second highest since the inception of this program. FY16 was the first year trapping was conducted near the Kotrla Unit, which proved to be a very productive location. Areas adjacent to the tracts are still considered rural with some being utilized as cattle ranches. The total amount of cowbirds removed (n=427) was far higher than the average over the last fifteen years (n=304). All the traps exceeded the 20% efficiency threshold except the Nootsie (efficiency of 7.3%) and FM 2769 (efficiency of 10.2%) traps.

In general, Travis County-managed preserve lands have few optimal trapping locations, particularly those adjacent to livestock or agricultural areas that serve as feeding and congregation sites for cowbirds. As the conversion of farms and ranches into subdivisions and other suburban development continues in much of western Travis County, easily accessible off-preserve areas that may concentrate cowbird numbers are becoming uncommon. With this change in land use, cowbird numbers generally have

diminished on parts of the BCP, which has been seen over the past five years. It is worth noting that no instances of parasitism were noted on any avian species during the field seasons from 2014-2016, but further monitoring for the presence of cowbirds in endangered avian species habitat will continue each season and trap placements will be adjusted as necessary.

FERAL HOGS

Introduction

The BCP Land Management Plan (2007) directs land managers to control populations of feral hogs in order to minimize negative impacts to the native wildlife protected within the preserve system. Feral hogs degrade wildlife habitat and compete directly with native wildlife for food. Hogs are omnivorous, primarily consuming vegetation, mast, roots and tubers, and to a lesser degree a wide range of animal species including invertebrates, reptiles, amphibians, small mammals and birds (Davis 1994, Hellgren 1997). Their rooting habits create severely disturbed areas, which may lead to a localized shift in plant succession and increase the potential for soil erosion (Davis 1994). Feral hogs also destabilize wetland areas, springs, creeks and other riparian areas through excessive rooting and wallowing. Their threat to humans and livestock through the spread of disease has also been documented (Miller 1997, U.S. Department of Agriculture 1992). Producing two litters a year, with an average litter size of four to eight piglets, hog numbers can expand rapidly if left unmanaged (Texas Wildlife Damage Management Service 1998).

Background

Travis County Natural Resources is responsible for the management of non-native wildlife on County-owned and managed portions of the BCP. Staff uses the discovery of wallows, rooted areas, rubs, well-worn trails, tracks, and first-hand encounters in the field to identify where hog populations occur within the BCP. Travis County BCP tracts that often show signs of significant feral hog populations include Canyon Vista, Sam Hamilton, Ribelin, Concordia, the Kotrla Unit, and several tracts within the Jollyville Unit. In 2008, feral hogs were also documented within Hamilton Pool Preserve for the first time since the property has been owned and managed by Travis County (since 1985), and have since caused considerable damage to habitat. Most tracts within the Bull Creek Macrosite still see a significant amount of hog traffic and damage.

In FY16, Travis County coordinated efforts with surrounding landowners and the City of Austin to implement management actions on and adjacent to Travis County BCP tracts. In 2008, an Interlocal Cooperation Agreement was entered into between Travis County and Texas AgriLife Extension Service (AgriLife) to conduct an operational wildlife damage management program for the protection of property from damage caused by

wildlife and for the protection of human health and safety from wildlife-related diseases in Travis County. Covering all the unincorporated areas of Travis County, this agreement provides a way of addressing the occasional nuisance wildlife complaints (most commonly feral hogs and coyotes) from preserve neighbors. In FY16, AgriLife continued to address nuisance wildlife complaints but was not actively managing hogs on Travis County properties.

A hog trapping protocol was developed in December 2008 to guide the activities of both County staff and contracted hog trappers in Travis County operated feral hog trapping efforts. The protocol is updated regularly and addresses trapping guidelines as well as trapped animal management. The only contracted entity that performed management activities on the preserve in FY16 was Orion Research and Wildlife Management Services (Orion). In addition to this contracted entity, two Volunteer Hog Trapper Agreements were approved by Commissioners Court on March 22nd, 2016. Under these agreements, hog trappers are allowed to trap on Travis County BCP and Parks lands. They provide their service at no cost and are allowed to keep the meat.

Methods

Travis County Natural Resources staff baited areas of high hog activity on the Karnik, Canyon Vista, Kotrla, Sam Hamilton, and Woody Hollow tracts. Stock panel traps were operated intermittently at these locations throughout the year, with the exception of March-May where staff time is allocated to other field activities. Travis County Parks staff operated one stock panel trap at Milton Reimers Ranch County Park (Reimers).

Standard operation for Travis County staff included setting and baiting stock panel traps with dry or soured corn and occasionally rotten fruit and vegetables. Traps were routinely baited and monitored with the aid of motion-sensing cameras. Utilizing cameras enabled managers to set the trap at the most beneficial time to maximize success. Trapped hogs were humanely dispatched and carcasses were taken to be composted. The traps were operated until signs of hog activity in the area subsided.

Results and Discussion

During FY16, Travis County staff and contractors successfully dispatched 58 total hogs on the BCP. Forty-nine of these were trapped and nine were shot opportunistically (two by Orion and seven by Travis County staff). Hogs removed included 31 adults (11 males and 20 females) and 18 juveniles (11 males and 7 females). An overall increase in trapping effort led to an increase in success from FY15 (43 hogs) to FY16. FY17 will see the addition of wireless cameras and remote door triggers to some County-operated traps. This technology is more advanced and should further increase efficiency and success.

WHITE-TAILED DEER

Introduction

The BCP Land Management Plan (2007) directs that white-tailed deer populations be monitored and maintained at a level that allows for successful recruitment of plant species which make up habitat supporting the species listed in the permit (e.g. the golden-cheeked warbler and the black-capped vireo). Central Texas currently has the highest population density of white-tailed deer in the United States (Richards 2000). Recent research indicating that little or no regeneration of vital habitat components occurred on some preserve tracts (Russell and Fowler, 1999; Russell and Fowler 2002; Russell et. al. 2001) has generated an effort to design and implement a white-tailed deer population monitoring and control program for Travis County BCP properties.

Travis County staff operated a deer management program utilizing lethal harvest from the FY03 through the FY08 hunting seasons on the Jollyville Unit of the BCP. Beginning in FY09 and continuing through FY16, Travis County contracted the services of Orion to manage the population by lethal harvest on the Jollyville Unit and several other BCP tracts.

Under the terms and conditions of the BCCP, Travis County is also charged with managing populations of golden-cheeked warblers and Texabama croton (*Croton alabamensis var. texensis*) that occur at Pace Bend Park. Texabama croton is a rare plant that is usually not over-browsed, but is commonly subject to physical damage from rubbing by deer. In 2002, and continuing through the present, Travis County has utilized lethal harvest to manage deer at Pace Bend Park.

Methods

Travis County staff and volunteers conducted nighttime spotlight deer surveys during the fall of FY16 on the Kotrla Unit of the BCP, Hamilton Pool Preserve/Reimers Park/ Pogue Springs Preserve, and Pace Bend Park. In addition to nighttime spotlight surveys, Travis County staff implemented a new camera survey technique. This method provides a more accurate population estimation of white-tailed deer in areas where there is a lack of infrastructure needed to preform nighttime spotlight surveys (Roberts *et al.* 2006). This technique was only conducted on the Jollyville Unit, and will be repeated in FY 2017.

Due to limitations in conducting reliable censuses on other less accessible BCP tracts, Travis County biologists also utilized data collected by neighboring partner agencies on their properties (City of Austin and LCRA) for other County tracts (Volente, Lucas, Ribelin) if they were targeted for harvests. Travis County staff analyzed the survey data to determine deer population estimates and make harvest recommendations.

TPWD currently recommends population levels in the Texas Hill Country of one deer to 15-20 acres for effective songbird habitat management, and some research indicates

population targets of one deer per 30 to 40 acres for successful hardwood forest regeneration. The goal on the BCP is to have a deer density of about one deer to 15-30 acres. At Pace Bend Park, the deer population goal is set at one deer to 12-15 acres in order to balance the needs of protecting habitat with the desire of the public to observe white-tailed deer in a park setting.

During FY16, deer management was supplied through the contracted services of Orion. This season marked the seventh year that Orion was contracted to harvest deer for Travis County. Orion operates under a TPWD Scientific Permit, and harvested deer on the BCP, Pace Bend Park, and Reimers Ranch.

Animals taken during deer harvests were dispatched in a swift, effective, and humane manner. The safety of the public and staff was Travis County's top priority as efforts focused on effective management of the deer population. Through the Hunters for the Hungry Program, all venison from Travis County's harvest program was donated to Caritas of Austin. This donation provided nutritious meals for needy citizens within the county.

Results and Discussion

Survey data gathered in September and October 2015 were used to estimate deer densities and determine harvest recommendations for the FY16 harvest season (October 2015 to February 2016). Census results for Pace Bend Park estimated a deer density of one deer per 12.0 acres (Table 4). This represents a return to the ideal population density (12-15 acres/deer) that has been established for the park, after a slight increase in FY15. Census results for the Jollyville Unit, which estimated one deer per 33.3 acres is slightly lower than the ideal density established for the BCP, and are probably more realistic when compared to FY15. Very few deer were seen during the survey in FY15 and probably underestimated the population (Table 5). At Hamilton Pool Preserve/Reimers Ranch/Pogue Springs Preserve the deer density was 15.9 acres per deer. This marked the first year that a deer survey was conducted in the Kotrla Unit. This tract was a private ranch that was hunted for deer before Travis County purchased it in FY14 and FY15. Deer density was determined to be 19 acres/deer, which is average for hardwood regeneration on BCP lands.

Orion removed 31 deer from Pace Bend Park (Table 4) and 34 deer from Reimers Ranch Park (Table 6). Twenty-two deer were removed by Orion from the BCP Jollyville Unit and an additional 58 deer were removed from other preserve tracts, including Hamilton Pool (Table 5 and Table 6). Since implementing the lethal cull strategy on these tracts in FY03, the total population on the Jollyville Unit has been steadily declining and the number of acres per deer has increased (Table 5). Although the deer harvest has impacted the Jollyville Unit deer population, it should be noted that the current prolonged drought and increased habitat fragmentation are likely also playing a role in the population decline.

Overall population trends at Pace Bend Park and on the BCP are still reflecting the harvest management strategies implemented by Travis County. The population trend data indicate that the lethal cull strategy has successfully increased the total acreage available per deer and is an effective management option to control deer populations.

In addition to successfully managing the overpopulation of deer, this program has also generated significant public support for County management efforts. This support is largely due to the donation of processed ground venison to Caritas of Austin. In FY16, approximately 4,250 pounds of venison was given to Caritas which provided meals of high quality, low fat protein to needy local residents. This brings the total that Travis County has donated over the years to approximately 20.3 tons (40,730lbs.) of meat.

Travis County staff will continue to monitor deer populations on Travis County-managed land and work to implement TPWD recommendations concerning appropriate management strategies and harvest levels. Annual censuses allow managers to evaluate the effectiveness of management strategies, determine whether desired deer densities have been attained, and calculate future harvest recommendations. As long as census data indicate that deer herds exceed the carrying capacity of County preserve or parklands, deer management should continue on select Travis County Parks and the tracts of the BCP.

Table 4. White-tailed deer population trends at Pace Bend Park FY97 through FY16.

Year	Acres/Deer	Estimated Composition (Buck/Doe/Fawn)	Estimated Population	Total Removed
FY1997	4.9	70/117/57	244	85
FY1998	3.7	40/167/63	270	80
FY1999	3.8	53/156/55	264	111
FY2000	4.5	61/119/45	225	92
FY2001	5.7	29/97/28	326	19
FY2002	3.6	61/86/43	519	0
FY2003	2.7	29/139/30	464	18
FY2004	3.6	110/232/83	425	74
FY2005	2.5	154/329/133	616	91
FY2006	3.4	183/181/79	443	96
FY2007	6.2	86/134/25	245	59
FY2008	8.9	61/91/20	172	34
FY2009	6.1	48/135/67	250	41
FY2010	5.0	56/188/65	307	61

FY2011	6.9	56/108/55	219	89
FY2012	6.6	44/150/37	231	65
FY2013	9.6	N/A	N/A	43
FY2014	13.9	23/74/12	109	32
FY2015	19.4	13/53/12	78	18
FY2016	12.0	25/76/25	127	31

Table 5. White-tailed deer population trends on the BCP Jollyville Unit FY03 through FY16.

Year	Acres/Deer	Estimated Composition (Buck/Doe/Fawn)	Estimated Population	Total Removed
FY03	5.6	46/162/82	290	9
FY04	5.5	61/158/78	297	12
FY05	7.2	35/127/63	225	22
FY06	9.6	33/103/33	169	20
FY07	10.0	44/142/55	241	12
FY08	9.1	29/122/46	197	26
FY09	10.9	37/111/37	185	20
FY10	18.8	20/60/20	100	35
FY11	21.9	22/43/22	86	9[a]
FY12	27.3	31/36/33	90	22[b]
FY13	38.1	26/29/10	65	10[c]
FY14	36.4	27/30/10	67	12[d]
FY15	71.3[*]	7/21/7	35	11[e]
FY16	33.3	10/22/1	33	22[f]

[a] An additional 13 deer were removed from the Volente tract and one deer from the Lucas tract.

[b] An additional 13 deer were removed from the Cypress Creek Unit and four deer from the Lucas tract in the Lake Travis Unit.

[c] An additional 8 deer were removed from the Cypress Creek Unit and 21 from the North Lake Austin Unit (Webb Tract).

[d] An additional 10 deer were removed from the Cypress Creek Unit and 22 from the North Lake Austin Unit (Webb Tract)

[e] An additional deer was removed from the Lake Travis Unit (Lake Perspectives), 18 from the Cypress Creek Unit (Volente, New Life, and Spezia), and 5 from the Lake Austin Unit (Webb).

[f] An additional 11 deer were removed from the Cypress Creek Unit (Volente and New Life), 2 from the Lake Travis Unit (Lake Perspectives), 2 from the North Lake Austin Unit (Webb), and 37 from the South Lake Austin Unit (Medway).

[*] Two surveys were conducted in FY15 with very low deer sightings. This provided an inaccurate acres/deer once extrapolated over the Jollyville Unit.

Table 6. Deer Harvested on Travis County Properties by Orion Research and Management Services, Inc. during FY16.

Location	Bucks	Does	Fawns	Total
BCP Jollyville Unit	14	5	3	**22**
BCP Volente Tract	3	6	0	**9**
BCP Lake Perspectives	0	1	1	**2**
BCP Webb Tract	1	1	0	**2**
BCP New Life Tract	2	0	0	**2**
BCP Medway Tract	19	13	5	**37**
Hamilton Pool Preserve	1	2	3	**6**
Reimers Park	10	17	7	**34**
Pace Bend Park	17	10	4	**31**
Total	**67**	**55**	**23**	**145**

PLANT SPECIES OF CONCERN MONITORING

Up until 2013, Travis County monitored rare plants listed as species of concern in the BCCP Permit, at two locations: Canyon mock-orange at Hamilton Pool Preserve and Texabama croton at Pace Bend Park. These plant surveys generally occurred on three-year rotations.

Texabama croton (hereafter, croton) at Pace Bend was to be monitored in FY15; however the discovery of a new, extensive croton population in 2013 on a potential two-parcel acquisition for the BCP altered the survey schedule. A delay on the purchase of the second parcel shifted the survey of this new population to 2016. The Pace Bend colony is now formally scheduled for 2017 although it is worth mentioning that several of the colonies have been loosely monitored with the reintroduction of a Travis County Parks burn-management program in 2015 and 2016.

Texabama Croton

Texabama croton is a thicket-forming woody species typically occurring as an understory shrub in mesic limestone canyon woodlands associated with live oak (*Quercus fusiformis*) mottes. It can grow 2-3 m tall, often with a multiple-branched base. Although this shrub is neither federally nor state listed, it is considered imperiled due to its rarity and restricted range and was, at one point a category 2 candidate for Federal listing (Hayden et al. 2001). This species was discovered in Alabama over 90 years prior to its discovery in Texas in 1989 on Ft. Hood (Van Ee *et al.* 2006). In 1994 the species was first observed at Pace Bend Park (Travis County Transportation and Natural Resources Department, 1996).

Recent genetic studies indicate that this species of croton has a highly diverged lineage from other *Croton* and that the closest relative is a species endemic to Cuba or other species found in Mexico, Central America, South America or the Caribbean (Van Ee *et al.* 2006). Although not strongly conclusive, the data suggests that the Texas population may be the progenitor of the Alabama population. Regardless, the two American populations are genetically well separated and mutually distinct from one another (Van Ee *et al*. 2006).

In June, 2013 a previously unknown, extensive colony was discovered while Travis County field personnel were conducting a site visit on what would become the Kotrla Unit in 2014-15. The Kotrla Unit is comprised of two bordering properties: the Scott and White tract (450 acres) and the Kotrla tract (500 acres). The Kotrla Unit is located in northwestern Travis County, bounded on the west and north by Nameless Road (FM2243) and on the east by County Road 290. The property is occupied by both golden-cheeked warblers and black-capped vireos. Upland areas contain substantial Ashe juniper (*Juniperus asheii*) as well as areas of concentrated shin oak (*Quercus sinuata* var. *breviloba*) growing in shrub form. Other species include live oak, cedar elm (*Ulmus crassifolia*), Texas ash (*Fraxinus albicans*) and Texas oak (*Quercus buckleyi*). Large areas of uplands, particularly on the Kotrla tract have had much of the woody vegetation removed, by former landowners, to improve livestock range and can be classified as savannah. The upland areas are relatively flat and are underlain by the hard gray limestone of the Edwards formation. A long, deep canyon generally separates the two tracts along a northwest to southeast divide.

The largest croton colonies on the Unit are in the riparian corridor of this canyon where it forms dense, understory thickets. However, rather large colonies and scattered individuals are found throughout the uplands as well. The population is likely one of the largest in Travis County and could rival those colonies on the Balcones Canyonlands National Wildlife Refuge and on Ft. Hood. The Kotrla Unit croton population numbers in the thousands.

For this initial survey, all known locations were mapped either as individual(s) (points) or a colony (polygon). A colony is a unique location of two or more plants, generally covering a broad area. Points may actually be numerous plants in a very small area. For identification, an individual plant or a colony is given a unique numerical identifier. Colonies that are clustered in the uplands near each other received a similar number.

For example, adjacent colonies are subdivided into subgroups or sub-individuals (e.g., 1A, 1B, 1C). The crotons located in the canyon are essentially one large colony – however, for mapping purposes these plants were subdivided when a noticeable gap separated groups.

Croton surveys on the Kotrla Unit were conducted throughout FY16. All known individuals or colonies of croton were mapped using a Global Positioning System (GPS) (**Figure 1**). For this initial survey, croton was mapped but measurements or exact counts (particularly with the colonies) were not attempted. No other biological data were collected. Search efforts in FY16 located 52 colonies (approximately 6.3 acres) and 173 locations of croton on the Kotrla Unit. However, there are several known locations that were identified that have yet to be formally mapped. A final, corrected map will be produced in 2017.

NON-NATIVE PLANT MANAGEMENT

Introduction

Travis County Natural Resources manages non-native plant species in accordance with the BCP Land Management Plan (2007).

Non-native plants outside their home range can become invasive (Keane and Crawley 2002) as a result of reduced competition and the absence of their natural herbivores (Mitchell 2003). In addition, many invaders experience higher productivity in a new location (Thébaud and Simberloff 2001). Some non-native invasive plants use chemical interference (allelopathy) to out-perform native plants (Callaway and Ridenour 2004). Some native systems are less resistant to invasion and provide the opportunity for the non-natives to dominate (Hobbs and Huenneke 1992, Levine and D'Antonio 1999). Given these advantages, native systems are susceptible to usurpation.

A key driver of change in ecosystems is invasion by an alien species. Invasive, non-native plants reduce local plant species diversity of the invaded community (Vilà 2011). Also, exotic plants can alter soil nutrient dynamics (Ehrenfeld 2003). Loss of native biodiversity decreases the quality of food, cover, and breeding sites for wildlife (Cheater 1992, MacDonald 1985, Simberloff 1996). For example, non-native trees can compete with native oaks, impacting a major component of both golden-cheeked warbler and black-capped vireo habitat.

Invasive species control is an increasingly important component of the conservation and management of natural ecosystems, especially in urban areas like the BCP. Successful control can be achieved with large short-term investments and routine monitoring (Zavaleta et al. 2001). Invasive species control combined with broader ecosystem restoration goals gives native biodiversity the best chance to recover (Hobbs 1999).

In order to maintain the integrity of natural ecosystems on the BCP and prevent a negative impact on endangered species habitats, non-native plants found on the BCP are targeted for removal.

Methods

In FY16, Travis County BCP properties were inventoried for the presence of non-native plant species by surveying tracts and documenting locations. When located, these species were assessed for potential impacts to native plant and wildlife populations. Non-native plant species constituting a threat were prioritized for management action based on invasiveness of species, amount of infestation, and threats to sensitive habitats.

Control methods employed to manage non-native species include manual removal (mechanical control) and application of site-appropriate herbicide by staff licensed by the Texas Department of Agriculture (chemical control). Mechanical control of non-natives without the use of herbicides is preferred when practical, since this method has no risk of impact on surrounding vegetation. Hand-pulling is especially effective on young seedlings and saplings of many woody plants, such as Heavenly Bamboo (*Nandina domestica*), Chinaberry (*Melia azedarach*), Japanese Privet (*Ligustrum lucidum*), and Tree of Heaven (*Ailanthus altissima*), as well as ground-running plants such as Periwinkle (*Vinca sp*.). Larger woody plants are removed through use of Weedwrenchs™ or equivalent plant removal tools, which ensure the removal of the entire root and eliminate the potential for re-sprouting. Whenever practicable, fruits and seeds are removed from the site for disposal in the landfill.

Chemical control techniques are used to remove non-native plants that cannot be managed mechanically. The “cut & treat” method is employed with the use of hand tools such as chainsaws, handsaws, or loppers to stump cut the plant. The cut stems are immediately treated with herbicide. The “hack & squirt” method is used on larger trees where felling is impractical. These target plants are girdled around the circumference of the trunk at breast height using a hatchet or hand saw. The appropriate herbicide is

then immediately applied to the wounds. The E-Z-Ject Lance provides another treatment method for large diameter trees. The gravity-fed, spring-loaded lance delivers a capsule of viscous poison under the bark of the tree for slow release. This method is particularly useful in riparian areas and where felling is labor-intensive and/or dangerous. As with mechanical methods, fruits and seeds are removed from the site for disposal in the landfill when possible.

Preferred herbicide mixes for cut & treat and hack & squirt methods on woody plants include a 30% Arsenal AC/surfactant mix (imazapyr) or 50% Garlon 3A/surfactant mix (triclopyr). Liquid chemicals are applied using a medicine dropper style applicator for precise application to minimize non-target impacts. The E-Z-Ject cartridges contain a viscous liquid with imazapyr or glyphosate. While no larger scale spraying of herbicide was conducted in FY 2016, such applications would only be considered under appropriate weather conditions with no rain forecasted for at least 24 hours and winds less than 10 mph.

Strategies

Given the vast areas of land, staff worked to prioritize treatment efforts to maximize the control effects. Non-native plants tend to proliferate in riparian areas due to moisture availability. The waterways act as vectors to distribute non-native seeds downstream. Staff targeted non-native plants of seed bearing age at the headwaters of Bull Creek and along other minor drainages. In addition, Travis County has been installing shaded fuel breaks along wildland urban interfaces to reduce wildfire risks. The treatment areas are prone to infestation by non-native plants due to the proximity to urbanized areas. With the potential for more sunlight to reach the forest floor, it was considered imperative to remove non-natives to prevent further colonization in the disturbed areas.

Results and Discussion

Staff treated or pulled more than 15 species of non-native plants on BCP tracts during FY16 (Table 7). Management activities occurred at the following BCP tracts: 35 Acres, Bunten, Canyon Vista, Collins, Concordia, Cuevas, Grandview Hills, Greenshores, Karnick, Kotrla Unit, Lake Perspectives, Lime Creek Ranch, Lucas, Nootsie, Ribelin, Sam Hamilton, Snowden, Stark's Mine, Steiner Ranch, Trails End, Vireo Ridge, Vista Point Wild Basin and Woody Hollow.

Table 7. Non-native plant species targeted for removal on Travis County Balcones Canyonlands Preserve tracts in FY16.

Species	Common Name	# stems treated
Ligustrum sp.	Ligustrum	2700
Melia azedarach	Chinaberry	1335
Nandina domestica	Heavenly Bamboo	1038
Broussonetia papyrifera	Paper Mulberry	286
Ailanthus altissima	Tree of Heaven	252
Photinia sp.	Photinia	53
Vitex agnus-castus	Vitex	50
Triadica sebifera	Chinese Tallow	29
Lagerstroemia	Crepe Myrtle	21
Pyrocantha	Firethorn	20
	Various others	89

In FY16, approximately 164 hours of staff time and 142 hours of volunteer time were devoted to non-native plant removal (Table 8). Approximately 94 of the volunteer hours were contributed by the Snowden Restoration Garden Club, headed by Yates Barreda. Yates and her team hand pulled or dug up hundreds of plants from 34 different species in their efforts to restore the grounds to a more natural state.

Table 8. Summary of invasive plant control efforts by Travis County Natural Resources from FY09 to FY16.

FY	Staff Hours	Volunteer Hours	Number of Species	Locations	# Stems
2009	25	0	11	5	422
2010	158	3495	12	12	2862
2011	91	96	10	13	5883
2012	103	92	7	15	3510
2013	45	35	9	11	1954
2014	89	87	5	13	2491
2015	36	95	8	13	3217
2016	164	142	49	25	5830

Future plans include prioritizing the headwaters of riparian zones, search and destroy in shaded fuel break treatment areas and “Dead Zones” (areas affected by the 2011 drought), and targeting plants of fruit-bearing age on all current and newly acquired Travis County BCP properties. Natural Resources staff will continue coordinating volunteer projects with staff and students at both Concordia University and Saint Edwards University – Wild Basin Creative Research Center to identify and control invasive plants within the respective preserve tracts.

LITERATURE CITED

Balcones Canyonlands Preserve Land Management Plan. 2007. Unpublished document. Travis County, Texas, USA.

Callaway R. M., W. M. Ridenour. 2004. Novel weapons: Invasive success and the evolution of increased competitive ability. Front Ecol Environ 2: 436–443.

Cheater, M. 1992. Alien Invasion. Nature Conservancy. September/October.

Davis, W. B., and D. B. Schmidley. 1994. The mammals of Texas. Texas Parks and Wildlife Press, Austin, Texas, USA.

Ehrenfeld, Joan G. 2003. Soil and nutrient processes. Ecosystems 6:503-523.

Hayden, T. J., J. D. Cornelius, H. J. Weinberg, L. L. Jette, and R. H. Melton. 2001. Endangered Species Management Plan for Ft. Hood, Texas; FY01-05.

Hellgren, E. C., 1997. Biology of feral hogs (*Sus scofra*) in Texas. Proceedings of feral swine symposium.

Hobbs, R. J. 1999. Restoration of disturbed ecosystems. In Restoration of Disturbed Ecosystems (Walker, L., ed), pp 673-687, Elsevier Science.

Hobbs R. J., L. F. Huenneke. 1992. Disturbance, diversity, and invasion: Implications for conservations. Conserv Biol 6: 324–337.

Keane R. M., M. J. Crawley. 2002. Exotic plant invasions and the enemy release hypothesis. Trends Ecol Evol 17: 164–170.

Kostecke, R. M, S. G. Summers, G.H. Eckrich and D.A. Cimprich. 2005. Effects of Brown-Headed Cowbird (*Molothrus ater*) removal on Black-capped Vireo (*Vireo atricapilla*) nest success and population growth at Fort Hood, Texas. Ornithological Monographs 57:28-37.

Levine J. M., C. M. D'Antonio. 1999. Elton revisited: A review of evidence linking diversity and invasibility. Oikos 87: 15–26.

MacDonald, C. 1985. Trouble in Paradise: Weeds in Nature Preserves. J. of Pesticide Reform, Fall 1985.

Miller, J. E., 1997. A national perspective on feral swine. Proceedings of feral swine symposium.

Mitchell C. E., A. G. Power. 2003. Release of invasive plants from viral and fungal pathogens. Nature 421: 625–627.

Richards, B. 2000. The deer dilemma: to fence or not to fence? Conference sponsored by Texas Parks and Wildlife Department. Reicher Ranch. June 15, 2001.

Roberts, C.W., B.L. Pierce, A.W. Braden, R.R. Lopez, N.J. Silvy, P.A. Frank, D. Random, JR., A. Jara. 2006.Comparison of Camera and Road Survey Estimates for White-Tailed Deer. Journal of Wildlife Management 70: 263-267.

Russell, F. Leland and Norma L. Fowler, 1999. Rarity of Oak Saplings in Savannas and Woodlands of the Eastern Edwards Plateau, Texas. The Southwestern Naturalist. 44(1): 31-41.

Russell, F. Leland and Norma L. Fowler, 2002. Failure of Adult Recruitment in *Quercus buckleyi* Populations on the Eastern Edwards Plateau, Texas. American Midland Naturalist. 148: 201-217.

Russell, F. Leland, David B. Zippen and Norma L. Fowler, 2001. Effects of White-tailed Deer (*Odocoileus virginianus*) on Plants, Plant Populations and Communities: A Review. American Midland Naturalist. 146: 1-26.

Simberloff, D. 1996. Impacts of Introduced Species in the United States. Internet: http://cgrio.ciesin.org/CONSEQUENCES/vol2no2/article2.html

Travis County Transportation and Natural Resources. 1996. Undocumented.

Texas Parks and Wildlife Department. No Date. Trapping brown-headed cowbirds to control songbird nest parasitism. www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_1148.pdf

Texas Wildlife Damage Management Service. 1998. Controlling feral hog damage. Pamphlet No. L-1925. TX. Wildlife Damage Mgmt. Serv., San Antonio, TX.

Thébaud C, D. Simberloff. 2001. Are plants really larger in their introduced ranges? Am Nat 157: 231–236.

U.S. Department of Agriculture. 1992. Wild pigs, hidden dangers for farmers and hunters. Agriculture Information Bulletin No. 620. U.S. Dept. of Agriculture. Hyattsville, MD.

U. S. Fish and Wildlife Service. 1996a. Federal Fish and Wildlife Permit No. PRT-788841.

U. S. Fish and Wildlife Service. 1996b. Final Environmental Impact Statement/Habitat

Conservation Plan for Proposed Issuance of a Permit to Allow Incidental Take of the Golden-cheeked Warbler, Black-capped Vireo, and six karst invertebrates in Travis County, Texas.

Van Ee, B., N. Jelinski, P.E. Berry, and A.L. Hipps. 2006. Phylogeny and biogeography of *Croton alabamensis* (Euphorbiaceae), a rare shrub from Texas and Alabama, using DNA sequence and AFLP data. Molecular Ecology. 15: 2735-2751.

Vilà, M., Espinar, J. L., Hejda, M., Hulme, P. E., Jarošík, V., Maron, J. L., Pergl, J., Schaffner, U., Sun, Y. and Pyšek, P. (2011), Ecological impacts of invasive alien plants: a meta-analysis of their effects on species, communities and ecosystems. Ecology Letters, 14: 702–708. doi: 10.1111/j.1461-0248.2011.01628.x

Zavaleta, E. S., R. J. Hobbs, H. A. Mooney. 2001. Viewing invasive species removal in a whole-ecosystem context. Trends in Ecology and Evolution. 16(8):454-459.

Figure 1. Texabama Croton Survey FY16

Kotrla Unit - Travis County Balcones Canyonlands Preserve

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China





