

**BALCONES CANYONLANDS PRESERVE
LAND MANAGEMENT PLAN**

TIER II A

**CHAPTER X
ANIMAL MANAGEMENT**



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1.0 INTRODUCTION

1.1 Background

The negative impacts of exotic, non-native, feral and nuisance species have been well-documented throughout Texas and around the world. In response to potential human health and safety, economic, and environmental impacts, these general guidelines have been created to direct management of these species. The purpose of the Animal Management portion of the Balcones Canyonlands Preserve Land Management Plan is to recognize that threats may be posed by these species, to outline appropriate management strategies, and to direct implementation of measures to minimize these threats.

These guidelines are intended to provide direction to Land Managers throughout the BCP 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 Land Managers.

The Texas Parks and Wildlife Department (TPWD) and the Texas Agricultural Code define exotic animals as grass eating or plant eating, single hoofed or cloven-hoofed mammals (or 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 considered exotic include Aoudad, Axis deer, Blackbuck antelope, Elk, Fallow deer, Nilgai antelope, and Sika deer.

Non-native animals are those 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 English sparrows, European starlings, red-imported fire ants, and rock doves (or pigeons).

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, to BCP property, or to 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, skunks, opossum, and white-tailed deer.

In order to meet the species protection and enhancement goals required under the terms and conditions of the BCCP, Land Managers strive to maintain exotic, non-native, and feral species at zero population levels. Management to control nuisance animals has been directed by the USFWS as a part of the recovery plans for species protected under the permit (USFWS 1991, 1992). Nuisance animal control may also be deemed appropriate if public health and safety threats or habitat damage become evident.

1.2 Implementation and management methods

Land Managers are responsible for implementation of all aspects of animal management within individual preserve units. Land Managers shall ensure that management actions comply with Tier III management plans in place for each tract, and will coordinate any management actions with agencies having jurisdiction in these matters. Wildlife is considered a public resource in the State of Texas, and the Texas Parks and Wildlife Department (TPWD) is the agency charged with management oversight of the public resource throughout the state. Management actions therefore must comply with all TPWD codes and regulations. Land Managers are encouraged to coordinate management actions with TPWD Technical Guidance and District Biologists. Other agencies with jurisdiction may include, but are not limited to, the Texas Animal Health Commission, Texas Commission on Environmental Quality, Travis County Sheriff's Office, City of Austin Police Department, and the U. S. Fish and Wildlife Service.

Effective management of these species will require long-term commitment on the part of BCP Land Managers and may require multiple concurrent management actions. Methods selected will vary based upon laws and regulations, public use, nature/intensity of the threat, existing land management directives/plans, and the particular circumstances of each tract. No single management recommendation can be made that would apply equally to each species in every location. In all cases, animal removal must be discreet and as humane as possible. Any animals taken will be dispatched in a swift, effective and humane manner. No cruelty will be tolerated. The following methods may be selected alone or in combination to achieve management goals.

1. Trapping and removal or relocation by cooperating Agencies. Removal or relocation may be accomplished in cooperation with other Agencies, including, but not limited to the Texas Parks and Wildlife Department, the Travis County Agricultural Extension Service and the U. S. Department of Agriculture Wildlife Services.

2. Contracted services. BCP Land Managers may elect to enter into a contract with an appropriate Agency or individual to provide removal, relocation, or other management services.
3. Recreational hunting opportunities in accordance with the TPWD Code and Agency policies and procedures.
4. Management actions by BCP staff. Control activities will be selected based upon practicality of achieving management goals. These actions may include, but are not limited to, the use of approved firearms by qualified personnel.
 - The first priority in all management actions is to ensure the safety of staff and the public.
 - Land Managers are urged to require that designated harvesters must demonstrate successful completion of a TPWD (or equivalent) Hunter Education and Safety Program. Land Managers shall maintain records verifying successful completion of this training. Firearms must be approved (caliber and type) as appropriate for ranges and species encountered within each preserve unit, and designated harvesters must demonstrate safe and proficient use of these firearms. Site- and event-specific safety protocols will be specified for each management action.
 - Whenever practical, animals that have food value will be maintained in an edible condition and will be donated to charitable organizations to help provide nutritious meals for needy residents of Travis County.
 - Any ill or injured animal will be dispatched as swiftly and humanely as possible, and with every effort to ensure the safety of staff and the public. When and if possible, animals requiring euthanization should be moved to a safe area, out of public view, and dispatched quickly and with every effort to minimize suffering.
 - If an animal has bitten someone, or if an incidence of rabies or other communicable disease is suspected, the Travis County Health Department will be notified and will direct actions for appropriate examination and testing.

2.0 WHITE-TAILED DEER MANAGEMENT

2.1 Purpose

Texas is home to the largest white-tailed deer (*Odocoileus virginianus*, hereafter WTD) populations in North America, and the Edwards Plateau annually produces more WTD than any other ecological region of the state. Numerous authors have documented the significant WTD population increases across the Edwards Plateau from the 1930's to the present (Hahn 1945, Reagan 1992, Van Auken 1993, Van Volkenberg and Nicholson 1943). This large population of free ranging, browsing ungulates can have significant impacts on the habitat of species protected under the BCCP. Preserve Land Managers must continually assess and actively manage populations of WTD to prevent long-term habitat degradation and loss.

2.2 Background

A number of factors have resulted in the current WTD populations observed throughout the Texas Hill Country. As was true throughout most of the U. S., large predators were systematically removed in an effort to increase livestock production from the time of the first settlers. WTD now exist throughout much of the state with a minimal threat from natural predators. Control of the New World Screwworm (*Cochliomyia hominivorax*) in the 1960's and 70's, while proving a boon to ranching and agriculture, also removed a natural WTD population limiting factor.

As western Travis County's native juniper-oak woodlands are increasingly converted to urban and suburban communities, the construction of residential and commercial development, roads and infrastructure corridors fragment wildlife areas and create habitat edge effects. WTD are considered an edge adapted species; that is, they thrive in areas with a diversity of habitat types that contain high proportions of edge. In the absence of natural population limiting factors and with readily available food supplies provided by landscaped lawns, manicured gardens and golf courses, WTD populations continue to increase throughout the area. Examples are common throughout Travis County and include many communities surrounding Lake Travis (Teer 1984).

In many areas of the Hill Country, the revenue provided by WTD hunting provides an economic incentive for landowners to manage to increase WTD production. Range management practices and the use of supplemental feed and water sources can increase WTD populations beyond an area's natural carrying capacity. Individual WTD faced with high population densities and limited food, water or other resources often move in search

of more suitable habitat. Lands thus intensively managed for WTD production may therefore become “sources” which serve to maintain artificially high populations.

Habitat carrying capacity and limited hunting pressure are now the primary population limiting factors throughout much of the state. Periods of climatic stress, such as summer droughts or winter storms, exert some limiting pressure on WTD populations, though these events are typically of short duration and insufficient to maintain populations within the habitat's carrying capacity (Cook 1984).

TPWD trend data indicate a steady increase in WTD populations in the 25 counties that make up the Edwards Plateau Wildlife Management District from 1976 through the present. By 2003 (the most current year for which data are currently available) the estimated population of WTD in this region of the state exceeded 1.6 million animals. TPWD trend data also show an increasing harvest of WTD in this region over the same period. In 2002 (the most current year for which data are currently available) however, the estimated number of WTD harvested in the region totaled approximately 175,000 animals. This harvest level represents less than 11% of the total population (TPWD 2004). Therefore, despite increasing harvest totals by sport hunters, the Edwards Plateau WTD population continues to increase.

Browse and foraging pressure exerted by WTD populations on native vegetation is a primary concern to BCP Land Managers. Adult WTD each consume approximately one half ton of vegetation annually. WTD show distinct preferences for specific plant species and may thus directly impact the composition and structure of vegetation communities (Harlow and Downing 1970, Healey 1997, Marquis 1981, Tierson et al 1966, Tilghman 1989, Trumbull et al 1989). In the mixed woodlands of the BCP, hardwood seedling establishment is especially vulnerable to WTD foraging. Both mast (seeds and fruit) and vegetation of young seedlings are high quality forage available to and eagerly consumed by WTD (Cook 1984).

Long-term changes in vegetation communities may reduce nesting and rearing opportunities for breeding songbirds, including the endangered black-capped vireo (*Vireo atricapilla*) and golden-cheeked warbler (*Dendroica chrysoparia*), by preventing recruitment and survival to sapling and small adult size classes (Alverson and Waller 1997, Inouye et al 1994, Russell et al 2001, Stange and Shea 1998, Tierson et al 1966, Tilghman 1989, Trumbull et al 1989, Healey 1997). WTD populations must therefore be

closely monitored and managed to ensure suitable habitat protections in accordance with the goals of the BCCP (Campbell 1995a, 1995b, USFWS 1996).

Appropriate deer densities for management of plant species of concern have yet to be determined. Observed browse lines on some preserve tracts indicate that WTD populations currently exceed carrying capacity and require management action.

2.3 Monitoring

Any effort to manage wildlife populations must begin with monitoring of population densities. TPWD census and survey techniques recommended for use in the Hill Country include spotlight, mobile, aerial, and walking (Hahn) line methods. Spotlight and mobile techniques are most often employed by BCP Land Managers. These census methods provide an estimate of WTD density that is time and site-specific, and results are therefore not comparable between preserve units. Technical assistance for any of these techniques is available from TPWD.

Spotlight and mobile census methods approximate WTD populations by estimating densities in a subset of plant cover types. Recorded counts are then extrapolated based upon the percentage of each cover type available on the managed area. Spotlight surveys are typically initiated within one hour after dusk. Visibility estimates, recorded perpendicular to the census route, are used to estimate the acreage sampled. All deer within 200 yards of the route are counted and identified by age and sex if possible. The acreage estimate divided by the total number of deer observed yields a density estimate, expressed as acres per deer. The mobile census method is conducted during daylight hours to ensure a reasonable estimate of sex and age data. A minimum of three surveys (usually performed in late summer or early fall) should be averaged to generate a population density estimate.

Preferred browse species such as Texas Oak (*Quercus buckleyi*) are extremely vulnerable to browse pressure and observed recruitment of this species on the BCP is extremely low. At the current rate of depletion by browsing, old age, and Oak Wilt, Texas Oaks may face a long-term decline that may impact the habitat suitability for protected species throughout the preserve. Monitoring preferred browse species such as Texas Oak may further enhance our understanding of WTD population densities on managed lands.

BCP Land Managers evaluate WTD population densities on a tract-by-tract basis for all lands throughout the preserve. Appropriate population densities may vary throughout the

preserve, and will vary annually due to both biotic factors such as mast and forage production and abiotic factors such as rainfall and climactic conditions. For the management of optimal habitat for songbirds that nest one to six feet off the ground, TPWD suggests deer densities of 15-20 acres/deer (Armstrong 1991). Population densities that allow for successful recruitment of hardwoods may require levels as low as 30-40 acres/deer.

2.4 Management Techniques

A number of techniques have been demonstrated to control WTD, and Land Managers may employ multiple concurrent methods to efficiently manage preserve lands. As conditions change, Land Managers continually re-assess and refocus management goals and methods to reflect those changes.

Though lethal removal of species such as white-tailed deer may be somewhat controversial to some members of the public, professional wildlife biologists and Land Managers agree that these means are the most humane and effective methods to control populations that no longer have natural controls. Selective culling or recreational hunting may be employed by Land Managers to achieve population goals. The need to control immigration and emigration of free ranging WTD through fencing is a primary management tool available to BCP Land Managers. Alternative strategies such as trap, transport and release programs and fertility control methods have been investigated and have shown to be cost prohibitive and to yield limited long-term population management at this time (DeNicola et al 2000, Ishmael and Rongstad 1984, Palmer et al 1980). Further research into these techniques will continue to be reviewed by BCP Land Managers. Strategies or techniques not recommended here shall be reviewed by the BCCP Scientific Advisory Committee and receive Coordinating Committee approval before being implemented on the preserve.

2.4.1 Fencing

Effective long term WTD management is only possible if immigration and emigration of free ranging populations is effectively controlled. Typical “deer proof” fencing is a minimum of eight feet in height. Initial costs for this fencing are high (currently starting at about \$10/linear foot), but the effectiveness of management efforts is undermined if WTD movement into and out of the preserve is not controlled. A number of other fencing systems have proven effective under a variety of conditions, and Land Managers are encouraged to investigate the range of potential fence designs best suited to particular

applications (DeNicola et al 2000, Hygnstrom and Craven 1988, Longhurst et al 1962, Palmer et al 1985, Porter 1983, Tierson 1969).

Land Managers responsible for contiguous tracts are encouraged to plan cooperative fencing agreements that meet common needs. Land Managers shall prioritize fencing efforts based upon WTD densities and probability of effectively controlling local populations.

2.4.2 Trap, Transport and Release

Trap, transport and release (TTR) techniques have been used to reduce WTD numbers, and are often popular with the public. Advantages to TTR programs include "observable" removal of animals and acquisition of "brood stock" for reintroduction efforts. Unfortunately, few ranges in the area have excess carrying capacity to support translocated WTD. TPWD requires that receiving lands have been appropriately surveyed and are managed under an approved wildlife management plan before the required permits may be issued. According to TPWD Conservation Scientists, release sites are becoming scarce and the effectiveness of these expensive and highly labor-intensive control methods are minimal.

TPWD permitted various Wildlife Co-ops, under Travis County and Lower Colorado River Authority guidance, to conduct a trap-and-release test program at Travis County's Pace Bend Park beginning in 1996. After 5 years of the program, and transporting almost 400 animals, the TTR method was only able to reduce the WTD population density from an initial 4.9 acres/deer in 1996 to a final 5.6 acres/deer in 2001. Although this method provided some population management, WTD densities at Pace Bend Park continue to exceed healthy and sustainable levels.

Although the public may have a positive perception of trap and release efforts, studies indicate that survivability of translocated deer is often very low (DeNicola et al 2000). A degeneration of muscle tissue characterized by depression, muscle stiffness, lack of coordination, paralysis, and death due solely to the stress of capture and handling, referred to as "capture myopathy", may occur up to 26 days after capture (Beringer et al 1996). Mortality rates due to capture myopathy of greater than 25% have been reported (Bishop et al 1999). Mortality of translocated WTD within one year of release ranges from 49% to greater than 85% (Bishop et al 1999, Cromwell et al 1999, Florida Game and Freshwater Fish Commission 1983, Hawkins and Montgomery 1969, Jones and Witham 1990, McCall et al 1988, McCullough et al 1997). Causes of death in relocated

WTD include malnutrition, predation and vehicle collisions. Relocated deer from overpopulated areas are especially vulnerable due to their often poor physical condition and additional stress stemming from unfamiliarity with their release site (Bishop et al 1999, Ellingwood and Caturano 1988).

Michigan Department of Natural Resources (2000) reported a review of eight published accounts that included cost estimates for operation of TTR efforts. Though capture and transport techniques varied across the studies, and none of the reported costs were adjusted for inflation, an average cost of \$352 per animal (n=1,224) was calculated from reported data. This figure is generally considered low, as many of the studies did not report incidental costs (including state employee's time, vehicle mileage, liability insurance coverage, disease testing, independent contractors, etc.) or operational costs (capture equipment, trap maintenance, bait, etc.).

2.4.3 Trap and Euthanize

Trap and euthanize techniques use baited traps, Clover traps, drop nets or rocket nets to capture WTD, which are then euthanized by a shot to the head with a firearm (Jordan et al 1995) or a captive bolt gun (Schwartz et al 1997). These methods have been shown to result in blood cortisol levels (a measure of animal stress) as much as 10 times greater than non-captured deer killed by rifle shot (Schwartz et al 1997). Trap and kill methods therefore are generally considered less humane than sharpshooting or recreational hunting methods. Costs for implementing trap and euthanize methods have been reported to exceed \$300 per animal (DeNicola et al 2000, McDonald and McKinney 2004).

2.4.4 Fertility Control Measures

Extensive research into fertility control as a method of controlling deer populations has been reported (Walters 1990, Cohn et al 1996, McIvor and Schmidt 1996, Kreger 1997, Curtis and Warren 1998, Warren 2000). While there is significant interest in fertility control as a non-lethal management tool, financial, legal and practical issues have prevented these techniques from being employed in wild free-ranging deer. Though ongoing research may provide viable management options in the future, no fertility control measures have yet been proven effective in managing wild deer populations. The following discussion is provided as a brief overview of the current state of knowledge on this topic.

Fertility control research generally focuses upon treatment of females, as the polygamous breeding behavior of WTD makes population control impractical when treating males.

Fertility control research has generally fallen into four main categories: surgical sterilization, synthetic steroid hormones, immunocontraception and contragestation.

Sterilization approaches require surgical alteration of each female to prevent fertilization. Capture myopathy (see discussion above) and post-surgical stress are drawbacks to this approach. Ovariectomy would prevent fertilization, but also removes the source of steroidal hormones (estrogen and progesterone), resulting in behavioral changes in treated does (Warren 2000). Ligation of the oviduct also prevents fertilization, though this technique results in repeated estrous cycling (Knox et al 1988). Most WTD in the wild undergo one estrous cycle each breeding season, and repeated cycles may result in an extended rut period and associated behavioral and physical stress to both treated does as well as bucks. TPWD does not authorize or permit surgical sterilization methods in free-ranging WTD in the state of Texas.

Synthetic steroid hormones have been demonstrated to prevent fertilization in captive deer populations. Orally administered steroids have been demonstrated to be effective (Roughton 1979), though required daily oral exposure makes these approaches impractical for wild free-ranging populations. Subcutaneous implants have proven effective over short periods but require capturing and surgically administering new implants every other year (Bell and Peterle 1975, Matschke 1977, 1980). Synthetic steroid hormones remain orally effective in the tissues of treated animals, rendering meat from treated animals unfit for human consumption. Non-target organisms ingesting meat from treated does may also incur secondary effects (Warren 2000). The U. S. Food and Drug Administration (FDA) has not approved any synthetic steroid hormones for use in WTD, and TPWD does not authorize or permit the use of these compounds in wild free-ranging deer.

Immuno-contraception (IC) methods stimulate the immune system to generate antibodies that interfere with the reproductive process. Some success has been achieved with remotely administered syringe darts containing various vaccine formulations. These methods require multiple booster injections to remain effective, however, as fertility resumes once antigen levels decline (Kirkpatrick et al 1996, Muller et al 1997, Turner et al 1992). In published field experiments with free-ranging populations, estimates for IC treatment ranged from \$802 to \$1,100 per animal (Peck and Stahl 1997, Rudolph et al 2000, Walter 2000). One study determined that after five years of continual treatment, no decline was observed in the experimental population (Underwood and Verret 1998).

Another researcher determined that the use of IC vaccines was appropriate only in isolated populations containing no more than 100 does (Rudolph et al 2000).

Research into orally delivered IC vaccines has begun, as this delivery method may facilitate administration to free-ranging animals. The long-term effectiveness and health implications of these methods are currently unknown. Concerns related to non-target animal effects may, however, limit uses in wild populations (Warren 2000). The FDA has not approved any IC methods for use in free-ranging deer herds, and currently requires all experimental trials to undergo federal Investigational New Animal Drug authorization and that all treated animals be marked as “Experimental Animal: Do Not Consume” (Kesler 1997). TPWD does not currently permit the use of IC drugs in wild deer populations.

The Contraception in Wildlife Subcommittee of the International Association of Fish and Wildlife Agencies Animal Damage Control Policy Committee concluded after evaluating fertility control options that:

“Currently, no species-specific, orally deliverable immunocontraceptive technology exists. No registration of a wildlife contraceptive vaccine either as a pesticide (U. S. Environmental Protection Agency) or a vaccine (U. S. Department of Agriculture or U. S. Food and Drug Administration) has been applied for or approved. No model for evaluating the population impacts of hypothetical immunocontraceptive systems has been developed. It currently appears that this technology may have application on some limited, isolated or confined populations where hunting is not feasible. However, its eventual use on wild, free-ranging populations appears in question” (IAFWA 1993).

Contraception methods target does likely to be pregnant. Treated animals are injected with prostaglandin F₂₇, which reduces blood progesterone levels, thereby inducing abortion (Lauderdale 1972). Published studies have demonstrated the efficacy of this approach in contained populations (DeNicola et al 1997, Waddell 2000). After two years of experimentation, Jordan et al (2000) were able to demonstrate a 50% pregnancy rate in a free-ranging herd, contrasted with a 100% rate in a control population. While contraception approaches show some promise as a fertility control method, disadvantages include the lack of FDA approval of these compounds for use in wild deer populations and the necessity of annually re-treating each doe (Lauderdale 1972). In addition, some communities may object to the abortion of fetuses that can appear fawn-like (Waddell 2000).

Fertility control methods, by definition, do not reduce current populations. These measures can only impact the breeding success rate of individuals successfully treated. Current deer densities can only be reduced by removing individuals from a population. Reduction of a population solely by means of fertility control would require suppressing reproduction below the natural mortality rate every year while also preventing immigration of individuals from surrounding areas for a period exceeding the expected lifespan of individual deer. Fertility control approaches remain experimental at this time, and have yet to prove effective in wild free-ranging WTD populations.

2.4.5 Recreational Hunting

Recreational hunting may be employed to reduce WTD populations where deemed appropriate by the individual tract Land Manager. Inherent safety and liability concerns, as well as local codes and statutes regarding the use of firearms within various political jurisdictions may limit the use of recreational hunting opportunities within some preserve units. Archery and crossbow equipment is effective at relatively short ranges (maximum effective range varies from 40 to 60 yards) and may therefore pose fewer safety concerns, though these methods are far less efficient at managing populations due to generally low success rates.

Controlled recreational hunting as an effective management tool has been successfully implemented in several locations across the country (DeNicola et al 2000, Sigmund and Bernier 1994, Deblinger et al 1995, Kilpatrick et al 1997, Mitchell et al 1997, McDonald et al 1998, Kilpatrick and Walter 1999). Recreational hunting opportunities on the BCP may facilitate good public relations and also serve to support the management of overpopulated WTD herds when used in conjunction with other WTD control methods.

2.4.6 Selective Culling

BCP Land Managers may implement selective culling to manage WTD populations. TPWD administers permitting options that allow preserve managers to legally manage WTD herds. Anterless and/or Spike Deer Control Permits (ADCP) and Managed Lands Deer Permits (MLDP) provide BCP Land Managers with management flexibility to effectively control WTD populations on the preserve. Management plans defining the need to remove excess deer are annually submitted to the TPWD Wildlife Division for review and approval. Approved Wildlife Management Plans are then issued the appropriate permit by TPWD. Land Managers are encouraged to cooperate with local meat processors and organizations such as Hunters for the Hungry, Caritas of Austin and

the Capital Area Food Bank to distribute venison resulting from these management actions to needy residents of Travis County.

2.5 Conclusion

Public concern about WTD management efforts are best met with education and outreach efforts that focus on BCP Land Managers common goal of protecting and managing populations of all native wildlife on the BCP. For more information about BCP education and outreach efforts, please see Tier II-A, Chapter XIII.

WTD management to maintain populations within the carrying capacity of the habitats of the BCP will always be necessary. The naturally high WTD reproductive success rate, lack of natural controls and the abundance of a variety of preferred forage both within and on tracts adjacent to the BCP have the potential to support deer populations that result in significant ecological damage to the preserve. Failure to effectively address the threat posed by WTD populations may significantly undermine other habitat protection measures on the BCP.

3.0 BROWN-HEADED COWBIRD MANAGEMENT

3.1 Purpose

The black-capped vireo (*Vireo atricapilla*, hereafter BCVI) and the golden-cheeked warbler (*Dendroica chrysoparia*, hereafter GCWA) both suffer nest parasitism by the brown-headed cowbird (*Molothrus ater*, hereafter BHCO). Cowbird trapping is recommended as an important management technique to promote recovery of these species (USFWS 1991, 1992, 1996a, 1996b, 1996c).

The USFWS Black-capped Vireo Population and Habitat Viability Assessment (1996a) lists brood parasitism as the most immediate threat to the BCVI in Travis County. Observed rates of adult and juvenile survival and fecundity estimates obtained in the absence of brood parasitism yield very high probabilities of BCVI extinction without effective BHCO control (USFWS 1996a).

3.2 Background

BHCO are brood parasites that lay their eggs in the nests of other bird species (Erlich et al 1988). BHCO evolved this reproductive strategy as an adaptation to its association with migrating bison herds throughout the Great Plains. By leaving the responsibilities for nest building and rearing of their young to other birds, BHCO were able to travel with

grazing bison that provide the insects and seed food source through their grazing activities.

3.2.1 Range Expansion

Prior to European settlement, BHCO were limited to open grasslands of the central Great Plains. As eastern forests were cleared for agriculture in the early 1800s, BHCO began expanding their range into this newly opened habitat (Mayfield 1965). BHCO increased the number of host species parasitized as range expansion continued. Many forest species, previously unexposed to nest parasitism, were unable to adapt to the reproductive pressures posed by the BHCO. Populations of many of these species consequently declined (Lowther 1993). Further evidence of recent range expansion can be seen in the Sierra Nevada of California, where BHCO have been detected only within the last century (Rothstein et al. 1980).

3.2.2 Reproductive Strategy

The BHCO is known to parasitize 220 species, 144 of which it parasitizes successfully. Many species recognize and reject BHCO eggs. Others species are simply inadequate foster parents. The remaining species will successfully raise BHCO young. Recent studies estimate only 3% of BHCO eggs result in adult birds. The female's laying cycle takes advantage of a continuous supply of host nests for approximately a two-month period. Jackson and Roby (1992) found that female BHCO in captivity will lay almost daily when adequate nutrition is available. The average female lays about 40 eggs per year for two years. With 3% of those 80 eggs reaching adulthood, every female produces an average of 2.4 adult cowbirds, which more than compensates for the high loss of eggs and young in nests of inappropriate hosts (Erlich et al 1988). Adult winter survivorship does not appear to be a significant limiting factor. Arnold and Johnson (1983) determined winter adult survivorship in Texas to be 53% for males and 63% for females.

BHCO females search for nests by perching in shrubs or treetops watching for nest building activity in surrounding open areas, by walking on the ground watching the movements of other birds, or by employing short flights between vegetation, making noisy landings and flapping her wings to flush potential hosts from their nests (Norman and Robertson 1975).

The eggs of more than one female are frequently found in a single host's nest, though individual BHCO generally lay only one egg per nest. Approximately one third of all parasitized nests hold more than one BHCO egg. BHCO eggs typically hatch more

rapidly than host species eggs, and BHCO nestlings are usually larger and grow faster than the host species young (Erlich et al 1988).

3.2.3 Diurnal Movement

Recapture data in Travis County has shown that female BHCO can travel more than 12 km from their capture sites over a period of 61 days (DLS 1989). The average distance from breeding to feeding sites observed at Fort Hood is 4 km. Studies in the Sierra Nevada have shown BHCO females commuting up to 7 km daily between breeding and feeding sites (Rothstein et al 1980, 1984). Few of the study sites, however, were greater than 7 km from a manmade food source indicating 7 km may not represent BHCO maximum capabilities (Rothstein et al 1984). Research at Ft. Hood (Cook et al 1996) and in the Sierra Nevada (Rothstein et al 1980, 1984) using radio telemetry has shown females spend the vast majority of the morning hours in breeding habitat searching for nests or laying eggs. The majority of afternoon hours are spent in habitat more suitable for feeding. During their work to delineate home range size, Cook et al (1996) found female BHCO travel relatively short distances between feeding and breeding areas and significantly greater distances between feeding and roosting areas. During the latter part of July, cowbirds began congregating at roost sites in excess of 20 km from main breeding areas (Cook et al 1996).

3.2.4 Diet

In general, BHCO diet consists of 75% seeds, mostly grasses with a minimal component of crop grains. The remaining 25% consists of animal matter, primarily grasshoppers and beetles (Lowther 1993). During the breeding season, females especially expand the insect component of their diet, and increase calcium intake by ingesting mollusk shell (Ankney and Scott 1980).

3.2.5 Host Species

The impact of BHCO parasitism on host birds depends on the relative distribution and abundance patterns of the two species. The red-winged blackbird (*Agelaius phoeniceus*) is important as a BHCO host simply because it is so numerous, even though the percentage of nests parasitized is low. On the other hand, Kirtland's warbler (*Dendroica kirtlandii*) actually produces very few cowbirds, but its existence is threatened because such a high percentage of its nests are parasitized (Lowther 1993).

Erlich et al (1988) consider the GCWA a frequent cowbird host with resultant parasitism posing severe impact on reproductive success. The GCWA recovery plan (USFWS 1992)

and Population Habitat Viability Analysis (USFWS 1996b) both mention the need for additional research to assess the degree of brood parasitism to the warbler. Likewise, the BCVI is threatened by habitat loss and BHCO parasitism with more than 90% of nests on the Edwards Plateau usually parasitized in the absence of cowbird control (Erlich et al 1988, Grzybowski 1995).

3.3 Management Techniques

Assessing and reducing BHCO parasitism should be a primary concern for BCP Land Managers (USFWS 1996). Successful population management options include physical removal of BHCO or their eggs and land use modification.

3.3.1 Trapping

BHCO trapping to improve the reproductive success of a target species began in 1972 with the Kirtland's Warbler (*Dendroica kirtlandii*) in Michigan. BHCO trapping has been employed as a management tool for other endangered species (e.g. least Bell's vireo, Southwestern willow flycatcher, BCVI and GCWA). The 1990 Comprehensive Report of the Biological Advisory Team (BAT) recommended that trapping should be a primary management tool on the BCCP. The BAT conclusions were based in part on the assertion that the BCP design may not ensure viable BCVI populations without accompanying intense management. BHCO trapping will therefore remain a component of the management activities for the BCP (BAT 1990, USFWS 1991, USFWS 1996a, 1996c).

BHCO trapping utilizes one of several types and sizes of decoy traps: large wood and wire cages stocked with live cowbirds (decoys), seed, and water. The target birds enter through a funnel or slotted entrance to join the decoy birds and are generally unable to exit the trap. The size of the entrance opening plays a critical role in limiting most other species of birds from entering the trap (McClure 1984, Goerring 1997 pers comm.).

Other BHCO management techniques are presented in subsequent sections. Non-breeding season techniques have been proposed as well. However, at least one author considers trapping during the breeding season to be the most effective means of cowbird control: "*Management of wintering blackbird flocks, by habitat alteration to disperse birds from roosts or by large scale killing, would have some impact on brown-headed cowbirds but probably little effect on limiting parasitism at specific locations in the following breeding season. Effective control is essentially limited to trapping at specific breeding areas* (Lowther 1993)."

Traps should be located within 2-3 km of breeding territories for the target species. Research at Fort Hood has shown that traps located in pastures to attract feeding cowbirds may be the most effective in removing cowbirds. “Over 79% of all feeding behavior was recorded within a pasture/grassland area and 76% of feeding activities occurred in association with cattle (Cook et al 1996).” Vehicular accessibility to traps in all weather conditions is important as well.

A strategy for protecting a county-sized area is suggested in the BCVI Population Viability and Habitat Analysis report (USFWS 1996a). This strategy employs the use of a trap-line of portable traps for initial trapping efforts to evaluate the effectiveness of site placement. Large traps then replace the portable traps to increase trapping effectiveness in areas determined to be “hot spots.” An optimal design is to place large traps at proven locations with a smaller group of portable traps used to test potential new sites. This also allows flexibility to respond to variations in cowbird distributions.

Wire mesh panels around the outside of the trap to prevent predator access are preferred to wire floors. An open trap floor facilitates maintenance and eliminates the possibility of birds becoming trapped underneath the floor wire. Traps should be tall enough for easy access and doors should be wide enough to allow entry while carrying supplies or equipment. Traps should provide a shaded area to prevent undue stress to captive birds.

Trapping should commence by mid-March and continue through July, or until capture rate of female BHCO decline or until non-target capture rates begin to increase. BHCO egg laying in Texas generally declines around mid-July, with eggs found in host nests from 29 March to 5 August (Oberholser 1974).

Because BHCO traps are not completely species specific in their capture selectivity, the possibility of capturing non-target species is an important factor to be addressed in all trapping programs. Since the inception of trapping efforts, several trap modifications have been made. Probably the most important modification to trap design has been to reduce the size of the trap opening to exclude bird species larger than the BHCO. It is critical that traps be checked daily (more than once a day if possible) once the breeding season has begun. Captured non-target breeding birds may suffer losses of eggs or nestlings. Juvenile non-target birds are often incapable of surviving more than a few hours of captivity once trapped.

Land Managers operating BHCO traps are responsible for obtaining any required state or federal scientific collection permits. Annual permit reports require a list of all species captured in cowbird traps and numbers of individuals taken and/or released from traps.

To minimize unauthorized bird release or damage to traps through vandalism, it is recommended that all trap doors are locked and signs posted on traps explaining the purpose for the traps, the permits under which the traps are operated, and contact information for trap operators.

3.3.2 Land Use Modification

Radio telemetry data indicate most BHCO movements between breeding and feeding areas range from 2 km to 15 km (Cook et al 1996, Rothstein et al 1980, 1984). Removing livestock within a 2 km radius of BCVI habitat may reduce BHCO impacts on this species. Research in the Sierra Nevada suggests that human influence "...such as at a [horse] pack station or bird feeder, may allow commuting cowbirds to occupy a large area of otherwise natural Sierran habitat" (Rothstein et al 1980). Mobile traps can greatly increase trapping success in conjunction with high-intensity grazing systems.

BHCO generally prefer to feed in shortgrass areas. By restoring areas within a 2 km buffer zone to mid or tall grasses, limiting spilled grain, and limiting livestock concentrations, livestock managers may be able to reduce the desirability of these areas to cowbirds.

Grazing systems: Certain grazing systems can be useful in managing cowbird concentrations:

- Off-season grazing: Because BHCO are migratory and are attracted to grazed areas, absence of livestock during the nesting season (March-September) may reduce incidence of parasitism and overall BHCO numbers. As mentioned above, extensive areas (>2 km radius) must be managed for grazing in order to effectively reduce cowbird density.
- High-intensity grazing system: Continuous grazing is not recommended. The use of multiple pastures where cattle are grazed in a given pasture for a short period of time followed by a long period of rest is recommended. Such systems allow for better control of range conditions, cattle concentrations, herd location, and improved BHCO trapping success.

3.4 Conclusion

BCVI and GCWA monitoring to determine population trends will provide one measure of BHCO trapping success. Monitoring of BCVI and GCWA fecundity can also provide a metric by which trapping success can be measured (USFWS 1996a).

BCVI and GCWA survey data from Fort Hood following several seasons of trapping effort showed low BHCO-to-host ratios. This index may provide a cost-effective technique to measure the effectiveness of a trapping program (Cook et. al. 1996).

Establishment of a banding program could provide information regarding daily, seasonal, and annual movements of BHCO. BHCO banding in the eastern half of Travis County could determine if birds over wintering at stockyards also parasitize songbirds in the western half of the county.

4.0 RED IMPORTED FIRE ANT MANAGEMENT

4.1 Purpose

The Red Imported Fire Ant (*Solenopsis invicta*, hereafter RIFA) is indigenous to a broad floodplain in northern Argentina, Paraguay and southern Brazil (Allen et al 1995). This highly invasive species was introduced into the United States near Mobile Alabama in the 1930's, probably in soil used as ship ballast (APHIS 1999, Vinson 1997). These pests pose a threat to people, small animals, agricultural equipment, and to many of the species listed for protection under the BCCP.

4.2 Background

RIFA spread in the 1940's largely through commerce involving infested sod and nursery rootstock. The inadvertent distribution and rapid colonization was recognized in the 1950's and in 1958 the U.S. Department of Agriculture enacted Federal Quarantine 301.81 regulating movement of hay, sod, soils, soil-moving equipment, potted plants, and plants with attached soil into uninfested areas (Canter 1981, Dowel et al 1997). The species was first recorded in Texas in 1956. By 1985, RIFA had infested approximately 275 million acres (106 million ha) in much of Florida, South Carolina, Georgia, Alabama, Louisiana and Mississippi, and had invaded parts of North Carolina, Tennessee, Arkansas, Oklahoma, southern California, and Texas (Morisawa 2000). RIFA cannot survive long periods of dry or cold conditions and are expected to eventually occupy nearly one quarter of the United States wherever the average minimum annual temperatures are greater than 10 degrees F (Allen et al 1995).

RIFA have been shown to out-compete and eliminate native ant species, in one instance replacing 180 *Solenopsis germinata* (a native Texas fire ant) colonies with 1,100 RIFA mounds over a three-year period. Survey and census data indicate that overall ant diversity is lower where RIFA become established (Porter et al 1988).

RIFA often feed on other arthropods, though they are omnivorous and will feed on almost any animal or plant material. RIFA have been shown to reduce biomass, abundance and diversity of invertebrate fauna in ecosystems where they become established (Allen et al 1995). RIFA compete with other organisms for food resources directly and can alter the abundance of prey species upon which other taxa feed (Allen et al 1995, Porter et al 1988). RIFA have been documented to attack lizards, snakes, turtles, the eggs and young of numerous ground and tree nesting birds including the endangered black-capped vireo and the least tern, and small or young mammals (Morisawa 2000, Stake 2000).

RIFA impact vegetation by feeding directly upon new growth, buds and developing fruits. RIFA have been shown to feed on the seeds of 139 species of grasses and wildflowers and may impact the abundance and distribution of seeds and plant communities (Lockley 2004). RIFA are known to “nurse” numerous homopteran plant pests such as aphids and scale insects, and may thereby further contribute to reduced fitness of native plant assemblages. RIFA predation upon vertebrate and invertebrate pollinators and seed dispersers may also impact plant communities (Morisawa 2000, Vinson 1997).

RIFA are an economically important pest of agricultural crops, and have been found to damage 57 widely cultivated species, including citrus crops, corn, cucumbers, eggplant, okra, potatoes, peanuts, pecans, sorghum, soybeans and sunflowers (Adams 1986, Morisawa 2000). RIFA are known to attack and kill livestock including calves, small pigs and domestic animals (Dowell et al 1997, Morisawa 2000). During hot periods and droughts, RIFA will invade caves and can have significant impacts upon cave fauna. Elliott (1997) confirmed predation on endangered cave fauna.

RIFA are very aggressive and quickly attack anything that disturbs their mounds. RIFA typically grasp the skin of their victim with their jaws and inject venom from poison sacs with each sting. Since each ant can sting many times, an individual may receive multiple stings before the ants can be removed. RIFA venom contains toxins which cause an intense burning and itching which lasts for about one hour. Sting sites then redden and

form a blister that develops into a characteristic white pustule that may leave a scar (Morisawa 2000). Sting sites can become infected and require medical attention. In sensitive individuals, RIFA stings can induce anaphylactic shock and even death (Dowell 1997). Expenses due to medical treatment resulting from RIFA stings are estimated to total \$7.9 million annually (Morisawa 2000).

RIFA are attracted to electrical current and often infest and short circuit equipment including air conditioners, traffic signal boxes, telephone junction boxes, airport runway and landing lights, oil and water well pumps, and even computers and automotive electrical systems (Morisawa 2000, Vinson 1997). Economic impacts due to RIFA damage to livestock, wildlife and public health in Texas alone is estimated at \$300 million per year (Morisawa 2000).

4.2.1 Colony Establishment

RIFA spread primarily by one of four methods:

1. transport of colonies or mated queens in nursery root stock, sod, or in soil used during construction;
2. by mating flights when reproductive queens fly or are blown into new areas;
3. when mated queens land in trucks, train beds or other transport methods and are carried into new areas; and
4. by being flooded from their mounds by heavy rains and being transported by floodwaters to a new location.

Queens establish individual colonies following mating flights. During warm months, mature colonies produce large numbers of winged male and female ants, called alates. A mature colony may produce as many as 10,000 alates annually, with six to eight mating flights occurring between the spring and fall seasons.

Mated queens that land on suitable sites loose their wings and dig small burrows in the soil, usually under leaves, rocks or in small crevices. They excavate a small chamber at the end of the burrow and seal themselves in to protect themselves from predators. It is during and immediately after a mating flight that queens are most vulnerable to predators. In areas not dominated by RIFA, other ants can kill RIFA queens. Mortality of newly-mated queens may be as high as 90 to 99% during the mating flight and the early weeks of colony establishment.

RIFA queens begin laying eggs within one day of their mating flight. Within six months the mounds may contain several thousand ants and are easily observed on the surface. Typical mature colonies contain 200,000 to 300,000 workers (Morisawa 2000).

4.2.2 Structure of the Mound and Colony Behavior

RIFA often construct earthen mounds consisting of conical domes of excavated soil with hardened, rain-resistant crusts. Mounds average 16 inches (0.40 m) in diameter and 10 inches (0.25 m) in height. In areas with heavy soils, mounds may exceed 59 inches (1.5 m) in diameter and 39 inches (1.0 m) in height, though RIFA have been found nesting in logs, in cracks and crevices in stone walls, in walls of buildings, and under sidewalks (Lockley 2004). Mounds may not be maintained during hot dry periods and colonies may be easily overlooked. In rainy or cooler weather, mounds are more active and are easily observed.

Mounds are filled with chambers and tunnels that may extend to a depth of five feet (1.5 m) or more depending on water table depth. Most mounds have no visible entrances or exits except during mating flights. Workers leave and return to the mound in shallow underground tunnels that may extend up to 132 feet (40 m) from the mound. The tunnels often branch and contain openings that lead to the surface from which the ants emerge to forage.

RIFA readily defend their mound from intruders. Any disturbance of the mound results in worker ants rushing out in all directions, usually attacking anything that moves. Worker ants are sensitive to vibrations, which seem to stimulate them to attack. Excited workers release pheromones that incite other workers to attack. Nurse worker ants surround and move the queen to deep parts of the mound during any disturbance. Colonies may survive, therefore, even if thousands of workers and larvae are killed as long as a few workers or pupae survive along with the queen.

RIFA are unable to regulate mound temperature and humidity. Larvae and queens are continually moved to the most suitable locations within the mound. On early summer mornings larvae and queens are usually near the top sunny side of the mound in the warm and humid conditions. As the sun dries out and heats up the mound, larvae and queens are moved deeper into the mound. RIFA may remain deep underground during periods of drought.

If water slowly invades a mound, RIFA will form a “raft” of worker ants with the workers in the middle holding the larvae, eggs and queen safe and dry as the colony floats to a new nest site.

4.2.5 Monogyne vs. Polygyne Colonies

Early RIFA research indicated that a single queen controlled each colony. In 1973 polygyne colonies (colonies with multiple queens) were discovered in Mississippi. Queens in polygyne mounds are tolerant of other queens in the colony, though they compete reproductively. Polygyne mounds lack the territoriality observed in monogyne (single queen) colonies, but occur at much higher densities (Allen et al 1995). Typical monogyne colony densities range from 20 to 49 mounds per acre (50 to 120 mounds/ha), contrasted with typical polygyne densities of 162 to 243 mounds per acre (400 to 600 mounds/ha)(Porter et al 1988).

Fifty percent of the RIFA colonies in Texas are of the polygyne type (Allen et al 1995). Polygyne mounds present additional management challenges, as all of the queens (ranging from 250 to 700 queens per mound) must be killed to eliminate a colony.

4.3 Monitoring

RIFA and other ants of the genus *Solenopsis* are readily identified from native ant species by the presence of 10-segmented antennae with a 2-segmented club. Other identifying characteristics of the genus include the presence of a stinger, a two-segmented pedicel and an unarmed propodeum (Lockley 2004).

Land managers are encouraged to determine the relative density of native ant populations before implementing RIFA treatments. Effective survey techniques include sampling stations. Baited sampling stations typically provide abundance and species data within fifteen minutes.

4.4 Management Techniques

Many methods are available to control RIFA colonies, including mound drenches, surface dusts, injections, fumigants, baits, and biological deterrents.

4.4.1 Chemical Control

Mound drench techniques involve flooding colonies with large volumes of liquid containing contact insecticides (bendiocarb, carbaryl, diazinon, dursban, rotenone, etc.) often in combination with a surfactant. Care must be taken to avoid alerting the mound

before application, as workers often relocate queens in response to any disturbance. Queens moved deep into a mound might not come into contact with the drench solution.

Application of boiling water to individual mounds has proven very effective in some areas. COA Parks and Recreation Department utilizes a fire ant boiler, plus 100' of hose and two 55 gallon barrels, which are transported by truck to the work site. In areas inaccessible to a truck or trailer-mounted boiler, portable high-intensity propane stoves have been used for individual mound treatment, such as near remote karst features containing endangered species (Veni 1998).

Insecticidal surface dusts or granules (acephate, boric acid, pyrethroids, etc.) must come into contact with individual ants to be effective. Watering or stirring these compounds into a mound may increase effectiveness, though direct contact with the queen is uncertain. Insecticidal surface compounds are sometimes used in conjunction with other methods to increase success.

Injection and fumigation techniques (chlorpyrifos, pyrethrin, resmethrin, tetramethrin, etc.) have been developed to effectively control RIFA colonies, though these methods tend to be expensive and require permitting of applicators through the State Pest Control Licensing Board and the use of specialized equipment. Though effective, these methods are generally impractical for preserve use due to the scale of the area to be treated and the expense of application.

Baits are typically formulated with slow-acting poisons that control the mounds within weeks (abamectin, amindinohydrazone, n-ethyl perfluorooctanesulfonamide, spinosad, etc.), or with chemicals that impede successful production of workers thereby starving the colony over a period of months (fenoxycarb, methoprene, pyriproxyfen, etc.). Baits are typically composed of oil and a toxicant formulated on a carrier. The ants find and carry the bait into the mound where they feed the poisoned oil to their queen and nest mates.

Baits are typically distributed by individual mound treatment or broadcast spreaders. Individual mound treatment is labor intensive and requires that each mound be located and treated. Broadcast baits can quickly treat large areas and can control small and unseen mounds. Broadcast of bait is sometimes accomplished with a spreader attachment to a utility ATV or pickup truck or by use of a hand-held crank. Drawbacks to broadcast bait applications include:

- some mounds are well fed and don't accept the bait;

- the bait is not located by some colonies;
- the bait is light sensitive and rapidly photochemically degrades; and
- the baits are not specific to the RIFA, and native ants may collect it and be killed.

This lack of specificity is the biggest disadvantage of broadcasting pesticides.

Though effective at any time of year, fall applications are the most effective for broadcast of the hormone-based bait formulation Logic®. Treated RIFA populations decline throughout the fall and winter, releasing fewer alates in the spring and summer. Logic® (fenoxycarb) has the advantage of “bleeding” over to nearby mounds in areas of polygyne infestation (Drees 1994).

Amdro® applications are best followed with a second application within one month. Newly established colonies are actively foraging after this time. A second application allows new colonies to be exposed to active baits. Without follow up applications, newly established colonies quickly dominate an area in the absence of competition from colonies killed by the first application.

4.4.3 Minimizing Effects of Pesticides on Native Invertebrates

Pesticide impacts on non-target species should be minimized (USFWS 1994). Pollinators and dispersers of plant species of concern are especially important to consider when contemplating pesticide use, and care should be employed to avoid impacts to these critical links in the ecology of native plants. Native ant species are critical to slowing the invasion of RIFA and can assist in RIFA control by killing new queens arriving after nuptial flights.

Native *Pogonomyrmex* harvester ant nests can be protected from pesticide applications by surveying to determine when the ants are least active, and applying enough ice to the mounds to keep the ants inactive for 24 hours after applying pesticide baits.

Food baits are an effective method to confirm and target RIFA near caves or karst features. Food baits should be placed in the morning. Once RIFA presence is confirmed, replace food baits with granular bait pesticide placed in small plastic containers with the lids cut out and replaced with screen mesh. This prevents larger ants and other non-target species from entering and consuming the pesticide. Mark the locations of each container with wire flags. In the evening, collect the flags, containers, and any dirt around the container. RIFA will sometimes remove the bait and store it under the container. This method also prevents wind dispersal and allows easy removal of uneaten bait before

evening cave cricket emergence. In addition, baits should be at least 15m from a cave entrance or sinkhole known to connect to a cave (Veni 1998).

Veni (1998) recommends that Amdro® or Logic® is best distributed on early mornings during dry weather to allow RIFA to consume the bait before cave crickets emerge to forage in the evening. Amdro® should be placed in ant-infested areas rather than broadly distributed, and this pesticide should be avoided near caves or other karst features.

4.4.4 Biological Control

Many insects have a predator or parasite that is species specific. As a non-native species, RIFA have no natural biological control agents in North America. Biocontrol options will likely not eradicate RIFA, but may reduce populations to levels at which native ants may be able to compete successfully. A number of biological control agents are currently being investigated to determine their effectiveness in the U.S. Three promising biocontrol agents include a pathogenic microsporidian protozoan, a parasitic ant also in the genus *Solenopsis*, and parasitic flies of the genus *Pseudacteon*.

The microsporidium *Thelohania solenopsae* is an obligate intracellular pathogen that infects workers and is passed to the queen through the exchange of food items within a colony. Infected queens are unable to maintain body weight and therefore produce fewer eggs. Worker ants also transmit the microsporidium to larval ants, which emerge after pupation as infected adults. Colonies have been eliminated within nine to eighteen months of exposure to *T. solenopsae*. Research indicates that native ants are not affected by this microsporidium, and field trials have begun. Some research has indicated that not all queens in polygyne colonies became infected, allowing them to split from dying mounds to form new colonies. Research into potential applications of this microsporidium is ongoing (Morisawa 2000).

The parasitic ant *Solenopsis dagerrei* seeks out and invades RIFA mounds. This species is unique in that it only produces males and queens, and completely lacks a worker class. Queens of this species attach themselves to RIFA queens and redirect RIFA worker ants to tend their own brood. RIFA egg production in parasitized colonies declines, and colonies eventually die off (Lockley 2004).

The phorid fly *Pseudacteon tricuspidis* lays a single egg inside the body of a live RIFA worker ant. The larva feeds on the host's tissues and emerges in approximately four weeks from the head capsule of the dead ant as an adult fly. Colonies exposed to *P.*

tricuspis adults alter foraging behavior to minimize exposure of worker ants to the parasitic flies. Colonies suffer from reduced energy supplies and weaken as fewer ants venture out of the mound to find food. *P. tricuspis* research has demonstrated a high degree of host specificity as no native ants have been found to be impacted by this parasitic fly. Field-testing is currently underway on this and another related phorid fly species (Morisawa 2000).

4.5 Conclusion

RIFA are a significant threat to the species and ecosystems protected by the BCP and will require significant effort on the part of Land Managers to control colonies without negatively impacting the area's unique native wildlife.

5.0 FERAL ANIMAL MANAGEMENT

5.1 Cats and Dogs

5.1.1 Purpose

With a number of preserve locations adjacent to residential subdivisions and increasing urbanization impacts, feral cats and dogs present an increasing concern for preserve Land Managers.

5.1.2 Background

More than 100 million cats live in the United States (Clarke and Pacin 2002), of which an estimated 10-50 million are unowned, stray or feral (Mahlow and Slater 1996). Feral house cats can significantly impact populations of amphibians, reptiles, birds, and small mammals (Fitzgerald 1988, Slater 2002). Feral cats have been implicated in the declining numbers of ground and tree-nesting birds and several species of small rodents (Gore and Schaefer 1993, Humphrey and Barbour 1981). Researchers have shown that housecats may compete for food resources with native species (Erlinge et. al 1984, George 1974) and may kill significant numbers of wild animals each year (Bradt 1949, Churcher and Lawton 1987, Coleman and Temple 1996, Davis 1957, Eberhard 1954, Liberg 1984).

Feral dogs and cats may also carry and transmit a number of diseases. These agents may range from feline leukemia and feline distemper that may be transmissible to wildlife species as well as pets, to diseases that may be dangerous to people such as rabies and toxoplasmosis (Jessup et al 1993, Roelke et al 1993, Patronek 1998, Warfield and Gay 1986).

Feral dogs often form packs that may pose a threat to preserve staff, visitors, or neighbors. A number of area parks and preserves currently experience a significant animal “dumping” problem as people dispose of unwanted pets.

5.1.3 Monitoring

Land Managers should actively monitor BCP tracts for feral cats and dogs and work to manage populations of these animals as soon as they are observed.

5.1.4 Management Strategies

Land Managers shall direct these animals to be humanely live-trapped and released into the care of the Town Lake Animal Shelter or other appropriate humane care facility.

5.1.4 Conclusion

Education and outreach programs that inform the public about the impacts that free-ranging house cats and dogs can have on native wildlife, as well as the unfortunate reality faced by discarded or unwanted pets left to fend in wild environments, can help minimize the incidence of animal “dumping” and help generate public support for appropriate management of feral populations. Cooperative efforts among BCP Partners in conjunction with regional animal control programs such as the Austin-Travis County Humane Society and the Austin-Travis County Health Department Animal Control Program may effectively reach a wide segment of the public. Education and outreach issues are discussed further in Tier II-A Chapter XIII.

5.2 Feral Hogs

5.2.1 Purpose

Feral hogs (*Sus scrofa*) are members of the family Suidae and include the European wild hog (sometimes referred to as “Russian boar”), escaped domestic hogs, and European-domestic crossbreeds. Feral hogs are found throughout the southeastern United States from Texas to Florida and north to Virginia, and have been reported from 19 states, Puerto Rico and the Virgin Islands (APHIS 1994). Fourteen states currently have a ban or prohibition related to introduction of feral hogs (Miller 1997). There are currently an estimated two million feral hogs in Texas, and they have been reported from 233 of the state’s 254 counties (Mapston 2004). Feral hogs can create significant financial and ecological damage, and management of wild free-ranging populations is a major concern for BCP Land Managers.

5.2.2 Background

The family Suidae is native to Europe and Asia and appears to have been domesticated by about 7000 B. C. (Mapston 2004). Early Texas explorers, including DeSoto, Cortez and LaSalle, brought hogs to Texas, and hogs were an important livestock animal for early Texas settlers. Free-ranging and abandoned domesticated hogs became feral over time (Conner 1971, Fehrenbach 1985). Ranchers and sportsmen imported and released European wild hogs for sport hunting in Texas in the 1930's (Mapston 2004). Escaped or intentionally released European wild hogs began interbreeding with the feral animals already ranging in portions of the state, and a variety of domesticated and wild traits may be observed in feral hogs today.

Mature feral hogs may reach a shoulder height of 36 inches (0.91 m) and weigh from 100 pounds (45.36 kg) to greater than 400 pounds (181.44 kg). They vary in color and coat pattern, and males are generally larger than females. Feral hogs have relatively poor eyesight but have a keen sense of hearing and smell. They may breed at six to ten months of age and have an average gestation period of 115 days with a typical litter size of four to six, though litters of as many as 13 have been documented (APHIS 1994, Mapston 2004). Typically producing two litters a year, hog numbers can expand rapidly if left unmanaged (Texas Wildlife Damage Management Service 1998). Feral hogs generally travel in family groups consisting of two sows and their young. Boars are generally solitary, only joining a herd to breed (Taylor 1991).

Feral hogs typically demonstrate a home range of 320 to 12,160 acres (130 ha. to 4,921 ha.), though ranges of 70,000 acres (28,328 ha.) have been reported (Mapston 2004, Taylor 1991). Natural mortality is greatest among individuals three months or younger and average life expectancy is typically 4 to 5 years. Adult mortality is mainly due to hunting, parasites, disease and tooth deterioration. Predation by coyotes and bobcats is a minor limiting factor (Taylor 1991).

Feral hogs are omnivorous, primarily consuming vegetation, mast, roots and tubers, and a wide range of animal species including invertebrates, reptiles, amphibians, birds, small mammals and carrion (Davis 1994, Everitt and Alaniz 1980, Hellgren 1997, Springer 1977, Taylor 1991). Numerous studies have demonstrated competition with native wildlife for food, water or space (Everitt and Alaniz 1980, Kroll 1985, Springer 1977, Tate 1984).

Feral hogs can have a significant impact on ranching and farming operations. Hogs have been documented to prey upon newly born calves, sheep and goats, feed directly on agricultural crops, and plow up soil and damage plants as they seek roots and invertebrates in the soil (Pavolv et al 1981, Singer 1981, Tisdell 1982). Feral hogs are known to be capable of carrying a number of endemic and exotic diseases and parasites transmissible to domestic livestock and humans (Mapston 2004, Miller 1997, U.S. Department of Agriculture 1992).

Feral hogs often damage or destroy fences by tearing or ripping through woven or welded wire and by weakening wires and fence posts. Large hogs can breach all but the most heavily built fence, requiring frequent and costly repairs (Mapston 2004). These activities are a concern to Land Managers charged with protecting unique native species found throughout the preserve.

Feral hogs prefer riparian areas, bottomlands and dense vegetative cover. During hot weather, hogs seek wet areas to create muddy wallows that are used to cool body temperature and to seek relief from insect infestations. This activity can increase soil erosion and can destabilize wetland areas, springs, creeks and other riparian areas and lead to a localized shift in plant succession (Davis 1994, Mapston 2004). This behavior is of special concern to Land Managers attempting to protect native plant species and populations of the Jollyville Plateau Salamander (*Eurecea tonokawae*) found only in isolated springs and spring runs in the Bull Creek and Cypress Creek Macrosites.

5.2.2 Monitoring

Because feral hogs are largely nocturnal, surveying and providing accurate census information for wild, free-ranging populations is often difficult. Feral hogs may sometimes best be detected by signs such as wallows, rooting, and rubs (tree trunks or fence posts where hogs scratch or rub themselves). Hog tracks are similar to deer tracks, but with somewhat more rounded toes and greater width to length ratio. Scat appears very much like that of a small calf, being dropped in several small piles. These are very distinct from deer pellets or predator cord-like droppings (Taylor 1991).

5.2.3 Research Needs

There is currently insufficient information about many aspects of feral hogs and their management. In addition to the basic information discussed above, the BCP Partners should try to obtain information about the following topics and encourage research proposals and projects to better understand and manage feral hogs on BCP lands, however; this is not an exhaustive list:

Studies on Feral Hog Ecology in Urban/Wildland Interface

- Radio tagging to determine range and foraging ecology.
- Effects of hog rooting on the spread of exotic plants and soil erosion.
- Effects of hog rooting on rare and spring and riparian plant species.
- Methods to attract hogs to traps or harvesting stations.

5.2.4 Management Strategies

The feral hog is classified by the TPWD as an unprotected, non-game animal and may be taken by any legal method at any time of the year with no minimum sizes or bag limits. Parks and Wildlife Code states a resident landowner or the landowner's agent or lessee may take feral hogs causing depredation on the resident landowner's land without having acquired a hunting license. There are currently no toxicants, repellents, fertility control methods or biological control agents registered or approved for use in the U.S. (Mapston 2004).

Mesh wire panel in combination with electric fencing and chain link fencing with a sufficient underground buried “skirt” have been shown to successfully exclude hogs from small areas. Unfortunately, these methods are very expensive to install and maintain for large tracts (Mapston 2004). In addition, many portions of the BCP contain topography or prior land uses that make this type of fencing difficult or impossible to install. Neck or leg snares are sometimes used to manage hogs. Snares are inexpensive, relatively easy to install and require little maintenance. Snares are indiscriminate, however, and will capture a variety of wildlife (Mapston 2004). Land Managers electing to use these methods should clearly sign and post notification of their use, and locate snares in areas to minimize non-target wildlife impacts.

Cage traps and pens may be employed to capture feral hogs. A number of portable and site-constructed designs are available. Trapping is most successful near riparian or feeding areas. Pre-baiting traps for several days by operating traps with disengaged trigger mechanisms increases capture success rates. Common baits include dry or fermented corn or grain, sweet fruit-flavored mixtures such as raspberry jello or kool-aid, livestock pellets or cubes, vegetables, fruit or carrion. Active traps must be checked at least once daily, though excessive disturbance near traps may cause hogs to avoid these areas (Mapston 2004). Hogs quickly become “trap shy” and frequent movement of traps to new locations and changing baits improves trap success. The Texas Animal Health

Commission regulates transport of feral hogs in an effort to control the spread of infectious diseases.

Feral hogs may be hunted with techniques similar to those used for white-tailed deer. Stand hunting and still-hunting can be used effectively, and hogs may be taken incidental to other wildlife management activities. Intensive management efforts often cause feral hogs to shift home ranges or to become more nocturnal in habit (Mapston 2004). TPWD allows landowners to hunt feral hogs at night with the use of spotlights once local Game Wardens are notified.

5.3 Conclusion

Feral hogs are known from all areas of western Travis County and are likely to occur on tracts throughout the preserve. Land Managers are encouraged to actively work to reduce and control feral hog populations to prevent property damage and to minimize impacts to native wildlife and habitat.

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