

Urban Coyotes: Preparing residents of the Greater Washington Metropolitan
Area for potential conflicts

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ABSTRACT

Coyotes, *Canis latrans*, are members of the Family Canidae that have expanded their range and now encompass the entire continental United States. While expanding their distribution, they have adapted to an urban lifestyle. Because of their adaptable behavior and opportunistic diet, they have prospered in many major cities, with real consequences for people and their pets. The most recent urban area coyotes have inhabited is the Greater Washington Metropolitan Area. Preparing residents of this large urban area for how to prevent human-coyote and pet-coyote conflicts will be essential.

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CHAPTER 1 – INTRODUCTION

Species must be adaptable if they are to survive in a changing environment. An example of a species that displays remarkable adaptability is the coyote (*Canis latrans*). Coyotes are members of the Family Canidae that have expanded their historical range and now successfully inhabit many urban areas. Conflicts with humans have arisen as coyotes moved into and occupied urban environments, areas with high densities of humans and their domesticated pets. Residents in many urban areas have been unprepared for certain coyote behaviors, such as attacks on their pets. Most recently, coyotes have entered the Greater Washington Metropolitan Area (GWMA), which includes the District of Columbia and neighboring jurisdictions of Montgomery County, MD; Prince George's County, MD; Fairfax County, VA; Arlington County, VA; and the City of Alexandria, VA.

The coyote's arrival into the GWMA is not without controversy. Although society increasingly has embraced the practice of wildlife viewing, there is concern about health and safety implications from our proximity to wildlife. As a result, there is critical need for sound public education about conflict prevention. While minimizing human and domestic pet conflicts with urban coyotes in the GWMA is the main purpose for writing this paper, I also will present pertinent background information about the coyote to help the public better understand this animal and its behavior in the urban environment.

CHAPTER 2 – REVIEW OF LITERATURE

Species biology

Few studies focus on urban coyotes (Andelt and Mahan 1980, Atkinson and Shakleton 1991, Quinn 1992, Webber 1997, Grinder and Krausman 2001a, Way et al. 2004) and these studies provide conflicting data. One theme derived from these studies is that urban coyotes are very adaptable within differing urban environments. Although our knowledge about urban coyotes is limited, much is known about this species overall. The following biological information about coyotes is crucial to consider before discussing relevant issues and strategies pertaining to preventing human-coyote and pet-coyote conflicts.

Male coyotes typically are longer, taller, and heavier than females. Bekoff (1977) describes a body mass range of 8 to 20 kg (18 to 44 lbs) for males and 7 to 18 kg (15 to 40 lbs) for females. The average body mass for an eastern coyote is between 16 to 18 kg (35 to 40 lbs). The most common pelage pattern of eastern coyotes is a gray-brown body with tan legs, rufous flanks and ears, and a gray chest. Other body colors may be seen, including dark brown, blonde, reddish-blonde, and black (Parker 1995). Bekoff (1977) describes the abdomen and throat as being lighter in color than the rest of the body. A black tip on the tail commonly is seen. The coyote usually keeps its tail down while running (Kays and Wilson 2002).

The typical coyote social unit includes a monogamous pair and their immediate offspring (Harrison 1992). Bekoff and Wells (1980) expanded this description of coyote social organization to include anything from a solitary individual to large stable groups. Very few studies of coyotes in urban environments have discussed social units/packs, but those that do reflect a broad range of findings. Urban social units consisting of 1 to 9 coyotes have been reported (Webber 1997), yet most units were on the lower end of this range (Webber 1997, Way et al. 2004).

The diet of coyotes encompasses a wide variety of flora, fauna, and even non-edible items. Coyotes have been classified as carnivores (Gier 1975), generalists (Bekoff and Wells 1982), and opportunists (Bekoff 1977). Parker (1995) categorized their food into 5 types: 1) hares and rabbits, 2) deer and antelope, 3) rodents, 4) fruits, berries, and vegetation, and 5) domestic animals. Coyotes also will scavenge on carrion (Gier 1975, Bekoff and Wells 1982), based upon the presence of maggots and fly larvae in stomach contents (Kleinman and Brady 1978). The presence of garbage in coyote feces indicates that they also will utilize human-provided resources. The GWMA provides an abundance of many of these food sources.

Understanding the reproductive cycle of coyotes is important because it explains much about their behavior during certain times of the year, and allows wildlife managers to tailor plans accordingly. Coyotes are capable of reproducing

starting with the first breeding season after birth (Parker 1995). Female coyotes are monoestrous, i.e., they come into breeding condition once annually. Mating occurs from late winter into early spring. Coyotes can be vocal during courting and pair formation. Average gestation length is about 63 days (Bekoff 1977). Both the male and female search for den-sites together, hunt together, and sleep near each other (Parker 1995). This can be important to wildlife managers; if you find a coyote during the spring season, there likely will be a mate nearby.

The large variety of sites used by coyotes for dens illustrates the species' adaptability. Parker (1995) describes many types of potential den sites, including brush covered slopes, embankments with or without brush, hollow logs, brush piles, ledges, abandoned dens from other species, areas below outbuildings or other structures, and drainage pipes. Bekoff (1977) found most den sites were located close to timber and brush cover. Urban coyotes may use concrete culverts for dens (Andelt and Mahan 1980). Females often dig multiple dens, in the event the need arises to move the litter to another location in case of disturbance (Parker 1995).

Atkinson and Shakleton (1991) determined the average litter size of urban coyotes was around 5 pups, which is similar to Bekoff's (1977) estimate of 6 pups for coyotes in the wild. The sex ratio in coyotes is 1:1. The pups, born blind and helpless, nurse for 5 to 7 weeks. During this time, the male finds and brings food back to the female. Thus, the male usually will be the only family

member who leaves the den during late spring to early summer. The pup rearing stage (from early summer through fall) is when most conflicts with humans occur (United States Department of Agriculture 2002). Pups disperse when 6 to 9 months old. The average life span of a coyote in the wild is 6 to 8 years (Bekoff 1977). Natural factors that may limit reproductive productivity are climate, parasites, disease, and food (Gier 1975).

Distribution change

The original range of the coyote was centered in North America's heartland, but it has since expanded toward the East (Gier 1975, Bekoff and Wells 1982, Gilbert 1991, Moore and Parker 1992, Parker 1995). Prior to European settlement, coyotes occupied the central United States, northern Mexico, and southwest Canada (Figure 1). Two factors led to the coyote's eastward expansion. The first involved the elimination of large predators in the East by humans. With the extirpation of the gray wolf (*Canis lupus*) and the red wolf (*Canis rufus*), the coyote's main predators, humans inadvertently aided coyotes by reducing interspecific competition (Thurber and Peterson 1991). In addition to the gray and red wolf, Moore and Parker (1992) believe removal of the grizzly bear (*Ursus arctos horribilis*) and mountain lion (*Felis concolor*) also benefited the coyote. Secondly, as humans converted woodlands to open spaces during the early 1900s, coyotes used these newly cleared areas to facilitate their eastward movement (Figure 2; Gilbert 1991).

Although somewhat speculative, another factor attributed with helping this eastward range expansion was human relocation of this species. Schultz (1955) documents coyote releases by fox hunters in Tennessee. The Georgia Game and Fish Commission attributed the presence of coyotes in Georgia to stockings conducted by fox hunters who desired a new animal to chase (Wohlgemuth 1968). Moore and Parker (1992) reported coyote releases occurred south of the Ohio River and contributed to their range expansion into the Mid-Atlantic region (Figure 3). In recent decades, coyotes successfully have filled other vacant niches and have become ubiquitous throughout the continental United States (Figure 4; Gompper 2002). A recent *Washington Post* article reported coyote presence in the counties surrounding the District of Columbia (Cho 2004), and there now are confirmed reports of coyote presence inside the city limits (Cohn 2004; Ken Ferebee, National Park Service, pers. comm.; John Hadidian, Humane Society of the United States, pers. comm.; Earl Hodnett, Fairfax County Police Department, pers. comm.). Regardless of whether they exist inside or outside city limits, their occupation of the GWMA needs to be addressed.

Urban coyotes

As more of the United States is converted to urban land uses, resident wildlife species must either adapt or move. The coyote is an example of a species that has adapted and now thrives in urban areas (Gill 1970). The research conducted to date on urban coyotes reveals some similarities and distinct contradictions. Studies of urban coyotes in Lincoln, NE (Andelt and Mahan 1980), Tucson, AZ

(Grinder and Krausman 2001a), Vancouver, BC (Webber 1997), Lower Fraser Valley, BC (Atkinson and Shackleton 1991), Seattle, WA (Quinn 1992), and Cape Cod, MA (Way et al. 2004) were all conducted over short periods of time. Andelt and Mahan (1980) found that the home range of a young, male, urban coyote (7.4 km²) in Lincoln was much smaller than that of a male rural coyote (14.5 – 67.8 km²). They also provided limited information about the diet of this urban individual, which included dog food, table scraps, and cottontail rabbits (*Sylvilagus floridanus*), but no evidence of domestic/feral cats. Activity was restricted to the periods between 0300 to 0600 hrs and 1730 to 2130 hrs, with only occasional activity elsewhere throughout the day and night. The majority of this animal's time was spent within a "biological center of activity" (Andelt and Mahan 1980).

The home range of urban coyotes inhabiting Tucson averaged 12.6km² and the daily distance traveled averaged 2.8 km for males and 1.2 km for females. These animals displayed a crepuscular activity pattern, as measured by radio telemetry tracking, which peaked at 0500 hrs and again at 2300 hrs. They were most active between 2200 hrs and 0000 hrs, but only occasionally during daytime hours (Grinder and Krausman 2001a).

Studies of urban coyotes studies in Vancouver were based on analysis of cadaver stomach contents and surveys mailed to residents. Stomach content analysis identified domestic pets as a major source of food, along with other

small animals, plants, and garbage. Survey results suggested these coyotes often were active during the day as the majority of sightings by residents occurred during daytime hours, and that group size was variable, from a single coyote to as many as 9 in one group (Webber 1997).

Twenty-six coyotes were studied in an urban area of Lower Fraser Valley (Atkinson and Shackleton 1991). Their diet consisted of plants, passerine birds, mammals (domestic livestock, rabbits, and microtines), and miscellaneous items. Similar to other urban coyotes, these animals were active throughout the night, but did not display distinct activity peaks at dawn or dusk. Their home range averaged 10.8 km², and daily distance traveled was 3.3 km.

Quinn's (1992) 3-year study of 5 urban coyotes in the Greater Seattle Metropolitan Area demonstrated strong crepuscular activity in his study animals. These animals also appeared to avoid heavily urbanized areas and instead preferred forested areas. Based on scat analyses, the diet of these urban coyotes consisted of more house cats, squirrels, plums, and dog food than that of rural coyotes. Urban coyotes also consumed household garbage, wild birds and reptiles, and domestic livestock (Quinn 1992).

Way et al. (2004) conducted a study of 11 urban coyotes on Cape Cod, from June 1998 to August 2001. Similar to reports on other urban coyotes, these animals predominantly were nocturnal. However, 2 females displayed unusually

high levels of daytime activity from April through June. Daily movements averaged 23.5 km. Compared to their western counterparts, these eastern urban coyotes made less use of natural areas, but more use of altered areas, such as power line rights of way, roads, railroad tracks, and golf courses.

Differences in home range size, averaged distance traveled daily, time of peak activity, diet composition, and environmental preferences illustrate the range of adaptability that exists among coyotes in urban environments. Howell (1982) attributes the affinity of coyotes toward urban areas to an abundant, diverse, and conveniently accessible food supply. Readily available and undefended food sources require little energy expenditure. Coyotes have learned that life in these urban environments can be quite profitable.

The coyote's range expansion into urban environments has led to an increase in encounters with humans. Increasing interactions between coyotes and humans can lead to decreased timidity of humans by coyotes (Humane Society of the United States 2003). These interactions, and inappropriate human responses and behaviors, can lead to more serious incidents, such as coyote attacks on people or their pets. These issues will be discussed more thoroughly in Chapter 5.

Attitudes toward wildlife

As land continues to be developed or altered for human uses, public sentiment for protecting natural surroundings becomes more prevalent. Gill and Bonnett (1973:107), when describing positive public attitudes about wildlife, offered the following as an example: “The most significant of the positive reactions toward the coyote was an appreciation for the feeling of remoteness from the city which the coyote evoked when seen or heard.”

Dr. Stephen Kellert, a leader in analyzing public attitudes toward wildlife, performed a national study of the U.S. public's perception toward the wolf and coyote (Kellert 1985). He corroborates other studies that have indicated that many urban residents enjoy seeing coyotes in their daily life. Individuals expressing the strongest positive reaction towards coyotes were people under 35 years of age, who came from a high socioeconomic class, were not involved with livestock production, and classified themselves as wildlife enthusiasts (Kellert 1985). This demographic profile accurately describes a large portion of the human population currently living within the GWMA. It is likely that these residents also possess similar positive feelings toward sharing their environment with coyotes.

Webber (1997) discusses public perceptions regarding coyotes in the urban area of Vancouver. An overwhelming majority of survey respondents (79%)

expressed positive or neutral feelings toward coyotes and were willing to accommodate their lifestyle to enhance wildlife well-being (Webber 1997).

While the attitudes of the many stakeholder groups involved with urban coyotes may not be in complete consensus and may experience evolutionary changes, the above studies illustrate public affinity toward urban coyotes. These positive results from urban residents indicate that a coyote education program should be well-received and implemented in the GWMA.

CHAPTER 3 - METHODS

I searched the extant literature for pertinent information about urban coyotes, especially those within the GWMA, using both existing on-line electronic databases and web-based search engines. To expand that base of information, I also initiated discussions with wildlife professionals who represented local community or county governments within the GWMA, state or federal wildlife management agencies, and private sector natural resource or conservation organizations. Representatives were asked a standardized list of questions (Appendix I) that delved into many aspects of human-coyote interactions and approaches for dealing with conflicts, where and when they have arisen. I also consulted a local veterinarian who has experience with vaccination protocols and treating animal emergencies. I concluded my research by consulting all of the local municipal codes regarding animal laws.

CHAPTER 4 - RESULTS

Based upon the weight of evidence from the literature and my interviews with wildlife professionals, it is clear that coyotes have expanded their range significantly in recent decades. Additionally, given the increasing number of sightings and other physical evidence, coyotes now occupy habitats within much of the GWMA. However, accurate data on abundance, population status, range size, movement patterns, and other aspects of their ecology and behavior within the GWMA currently does not exist.

Urban coyotes display a remarkable adaptability and a variety of behaviors. They also respond to humans and their pets in a variety of ways. As coyotes have expanded their range into the GWMA, jurisdictions within the GWMA have responded to this incursion in differing ways.

To date, 3 counties within the GWMA have disseminated information about coyotes. To educate county executives, the Fairfax County Police Department, Animal Services Division, Wildlife Section (2004) published a chapter about coyotes in Fairfax County. This literature also is available to residents upon request. It discusses the increasing coyote population since the 1980s. Officials in Fairfax County predict that the coyote population will continue to increase, as will the risk to cats and small dogs. However, coyotes are not considered a direct threat to humans despite the fact that a rabid coyote attacked a person in

Virginia (Cho 2004; Earl Hodnett, Fairfax County Police Department, pers. comm.).

Fairfax County Park Authority (2004) recently placed information about urban coyotes on its website. They include information on the potential benefits derived from having these animals present, such as predation on existing rat and resident Canada goose (*Branta canadensis*) populations. It encourages residents to secure garbage can lids, eliminate readily available food sources, and keep pets indoors at night. Contact information is provided for residents who wish to report sightings. At this time, the Fairfax County Park Authority maintains that coyotes present no major concern for citizens.

Montgomery County Animal Control has created a package of literature on coyotes that they mail to residents, upon request. This package includes a copy of "Living With Wildlife: Urban and Suburban Coyotes" (United States Department of Agriculture 2002), which describes coyote distribution, physical appearance, diet, reproduction, and behavior. It also provides suggestions on how to prevent human-coyote conflicts, such as not providing food or water for coyotes, constructing a 6-foot tall fence, supervising children and pets when they are outdoors, and keeping distance from coyotes. A handout from Maryland's Department of Natural Resources (MDDNR) presents an overview of the physical description, distribution, diet, reproduction, and habits of coyotes. The MDDNR attributes most human-coyote conflicts to situations where people have left pets,

livestock, fruits, and berries outside and unprotected

(<http://www.dnr.state.md.us/wildlife/abcoyote.html>). The last piece of literature in the packet is a brochure that discusses damage prevention and control methods relevant mostly to livestock producers (Green et al. 1994).

To educate the residents of Arlington County, officials have provided information on its website dealing with all local wildlife, including coyotes. This source provides a thorough description of the coyote's appearance and identifies many precautions to implement to prevent coyotes from approaching residents' homes. It recommends keeping pet food inside, supervising pets when outside, securing garbage receptacle lids, and fastening pet doors shut. In the event of a coyote encounter, it recommends keeping one's distance while scaring it away with loud noise (Animal Welfare League of Arlington 2004). Arlington County's website also provides a link to the Humane Society of the United States for more information about coyotes in this area.

It appears that many residents of the GWMA currently are unprepared to co-exist with coyotes. Some communities provide no information to their residents about the potential threats coyotes might pose (e.g., the City of Alexandria, VA; Prince George's County, MD; Washington, D.C.). Others provide some information in pamphlet form or on their websites (e.g., Fairfax County and Arlington County, VA; Montgomery County, MD). However, the information provided differs in content and depth and often conflicts with information available elsewhere (Table

1). For example, sightings of coyotes in Maryland should be reported to the United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (APHIS) Maryland, Delaware, and Washington, D.C. office contracted by the MDDNR (Kevin Sullivan, APHIS, pers. comm.). Maryland residents, who call their county's animal control department, will be forwarded to the APHIS hotline. However, sightings of coyotes in Northern Virginia should be reported to their respective county's animal control department. Virginia residents who contact their APHIS Northern Virginia office will be forwarded to their county's animal control department (Dage Blixt, APHIS, pers. comm.). Residents in Washington, D.C., who call the Washington, D.C. Animal Shelter about urban coyotes, are forwarded to the National Park Service's Natural Resource Manager at Rock Creek Park (Jim Monsma, Washington, D.C. Animal Shelter, pers. comm.).

In addition to differences among each jurisdiction's urban coyote management protocol, disparities also exist regarding each jurisdiction's domesticated animal laws (Table 2). Each of these counties' and the District of Columbia's codes are presented below.

Montgomery County, MD – All dogs and cats > 4 months of age are required to receive and maintain a rabies vaccination and possess a valid county license tag (Montgomery County Code Chapter 5 2001). When away from the owner's property, all dogs and unsterilized cats must be restrained. A female dog in heat

must be contained in a building or other enclosure. This code allows dogs and cats to roam the owner's property freely outside (except female dogs in heat), be fed and watered outside, not be sterilized, and not be current on vaccinations other than rabies.

Prince George's County, MD – All dogs, cats, and ferrets > 4 months of age are required to receive and maintain a rabies vaccination, and be licensed by the county. When away from the owner's property, pets must be restrained (Prince George's County Code Section 3-145 1985). This code allows dogs and cats to roam the owner's property freely outside, be fed and watered outside, not be sterilized, and not be current on vaccinations other than rabies.

Fairfax County, VA – Dogs and cats > 4 months of age are required to receive and maintain a rabies vaccination, but only dogs must display a valid county license tag. When away from the owner's property, dogs and cats must be restrained (Fairfax County Code Section 41.1 2004). This code allows dogs and cats to roam their owner's property freely outside, be fed and watered outside, not be sterilized, and not be current on vaccinations other than rabies.

Arlington County, VA – All dogs and cats > 4 months of age are required to receive and maintain a rabies vaccination, but only dogs are required to display a valid county license tag. When away from owner's property, cats and dogs must be restrained (Arlington County Code Section 2 2002). This code allows dogs

and cats to roam their owner's property freely outside, be fed and watered outside, not be sterilized, and not be current on vaccinations other than rabies.

City of Alexandria, VA – All dogs and cats > 4 months of age are required to receive and maintain a rabies vaccination and be licensed by the city (City of Alexandria Code Section 5-7 2004). This code allows dogs and cats to roam the owner's property freely outside, be fed and watered outside, not be sterilized, and not be current on vaccinations other than rabies.

District of Columbia – All dogs > 4 months of age by July 1st or owned > 10 days are required to receive and maintain rabies and distemper vaccinations and possess a valid license tag (DC Code 8-1801 2002). This code allows for dogs and cats to roam freely, be fed and watered outside, not be sterilized, and not be current on vaccinations other than rabies and distemper.

Information available about urban coyotes, along with current domestic animal regulations, demonstrates the conflicting messages presented to GWMA residents. Standardizing this information and regulations is essential for preventing human-coyote and pet-coyote conflicts and is discussed in the following chapter.

CHAPTER 5 – DISCUSSION

The presence of coyotes in an urban area inevitably increases the potential for human-coyote and pet-coyote interactions. The ramifications stemming from these increased interactions can become serious, given that coyotes have the potential to transmit diseases, viruses, and parasites, as well as cause physical harm.

Concern about personal safety

Coyotes can attack humans and the number of attacks by coyotes on humans has increased in recent years (Howell 1982, Baker and Timm 1998, Trout 2001, Timm et al. 2004). Timm et al. (2004) investigated reported attacks by coyotes on humans in southern California over the last 3 decades and found a substantial increase within the last decade (Figure 5). The number of attacks from 2000-2003 (n=38) already has reached the number that occurred during the entire 1990-1999 decade (n=38). Because most attacks on humans involved small children (Timm et al. 2004), it is speculated that coyotes may view them as any other small prey item.

One such attack resulted in the death of a 3-year old girl (Howell 1982, Carbyn 1989, Quinn 1992, Timm et al. 2004). In nearly all incidents, attacks occurred after coyotes had become accustomed to humans as a direct result of having been fed by humans (Trout 2001). Once coyotes become dependent upon

humans for food, they typically lose their natural fear and may become aggressive.

The urban coyote population of California is well-established and has been documented for at least 30 years (Timm et al. 2004). In fact, Timm et al. (2004) identified a series of characteristic behaviors and precipitating events associated with attacks by coyotes on humans in California, including the following:

1. An increase in observing coyotes on streets and yards at night
2. An increase in coyotes approaching adults and/or taking pets at night
3. Early morning and late afternoon daylight observance of coyotes on streets and in parks and yards
4. Daylight observance of coyotes chasing or taking pets
5. Coyotes attacking and taking pets on a leash or in close proximity to their owners; coyotes chasing joggers, bicyclists, and other adults
6. Coyotes seen in and around children's play areas, school grounds, and parks in mid-day
7. Coyotes acting aggressively toward adults during mid-day.

It may be imprudent to assume that similar behavior patterns exist in newly established urban coyote populations, such as those in the GWMA. Although coyotes now have been sighted in the Rock Creek Park area of Washington, D.C. (Cohn 2004; Ken Ferebee, National Park Service, pers. comm.) and in other areas of the GWMA for much longer (Earl Hodnett, Fairfax County Police Department, pers. comm.), there is little information about population size or whether behavior patterns in these animals are comparable to those in urban areas of California.

Timm et al.'s (2004) list is instructive and provides guidance on what residents should be attuned to look for in coyote behavior. Cho (2004) believes coyotes within the GWMA already are at Level 5, whereas, Hodnett (Fairfax County Police Department, pers. comm.) believes coyotes are demonstrating characteristics attributed to Level 6. Regardless of the exact level of behavioral traits exhibited by coyotes at present, residents of the GWMA need to be prepared to deal with the inherent risks before situations arise like those seen in California.

Concern about personal health

In addition to concerns raised about human safety, coyotes also can pose potential threats to human health, most notably the potential for transmission of rabies. Nationwide, confirmed rabies-caused deaths in humans have decreased to only 1 or 2 cases per year (Rupprecht et al. 1995). One of the deaths in 2003 occurred in northern Virginia when a 25-year old man contracted the raccoon rabies virus variant (Center for Disease Control and Prevention 2003). According to the Centers for Disease Control and Prevention (CDC), wildlife serves as the primary vector for rabies (Figure 6; Krebs et al. 2004). Here in the East, raccoons (*Procyon lotor*) are the primary vector species for transmission of the rabies virus (Figure 7).

The Virginia Department of Health records the number of confirmed rabies cases occurring in the Commonwealth of Virginia. The incidence of rabies in Virginia

fluctuates from a low of 428 cases in 1994 to a high of 690 cases in 1997, with no apparent trend for the remaining ten years of data from 1994 to 2003 (Virginia Department of Health 2004). Confirmed rabies cases reported to the CDC for Maryland and Washington, D.C. during recent years also display fluctuations with no distinctive pattern (Krebs et al. 2001, Krebs et al. 2002, Krebs et al. 2003).

Wherever increases in domestic dog and cat populations are concomitant with increasing coyote populations, such as within the GWMA, the likelihood for increased interactions between humans, coyotes, and pets exists. This increases the chance for rabies to spread to human and pet populations.

Few papers openly discuss a relationship between urban coyotes and rabies.

Baker and Timm (1998:299), when examining potential concerns associated with this issue, stated,

“While none of the coyotes involved with these human bite cases was found to have rabies, this disease is endemic to much of the U.S., including California, and has been found in coyotes. If rabies were to become prevalent in coyotes in the urban interface, it could have severe public health and safety consequences because of the high risk of contact between coyotes and people or their pets.”

Clearly the implications of increasing coyote numbers and the potential for transmission of the rabies virus warrants further examination. A recent incident near the GWMA highlights this concern. While mowing his lawn, a man in Virginia was attacked several times by a coyote. Failing to scare it away, he ultimately shot it. The coyote tested positive for rabies (Cho 2004; Earl Hodnett,

Fairfax County Police Department, pers. comm.). This case, along with an increasing urban coyote population, should raise concern especially to wildlife managers and public officials in the GWMA.

Concern about domestic pets

Coyotes may attack domestic animals for 2 reasons: small animals may be viewed as potential food sources whereas larger animals, especially dogs, likely are considered threats or potential competitors (Trout 2001). Nationwide, the number of incidents involving pets and coyotes has been increasing. Timm et al. (2004) reported that pet-coyote encounters in California increased from 17 (1991) to 149 (1997) to 281 (2003), increased 315% from 1985 to 1995 in Vancouver, and increased 4-fold from 1994 to 2003 in Texas. Most attacks in the GWMA occurred while their pet was in the owner's yard or during a walk (Cho 2004), but the common denominator is for a pet being outside. A supervising owner may be able to successfully scare off the offending coyote, but only after the pet has incurred scratches, bites, or more serious injuries needing veterinary care.

Coyotes also may be vectors for external and internal parasites, diseases, and other viruses. Coyotes are known to carry or transmit fleas, ticks, lice, heartworms, roundworms, hookworms, cestodes, whipworms, pinworms, coccidia, leptospirosis, rabies, canine parvovirus, canine distemper virus, infectious canine hepatitis, tularemia, bubonic plague, and Q fever (Bekoff 1977,

Grinder and Krausman 2001b). As previously stated, the best management technique is prevention. However, it is challenging for owners to supervise their pets constantly. Therefore, the next step in responsible pet ownership is following parasite preventive practices and vaccination protocols to avoid the spread of parasites, diseases, and viruses to their pets in case of attack. If pets are attacked, the primary care veterinarian should be contacted to see if treatment is recommended. Because parasites can be transmitted via fecal ingestion or contact to their pets, owners should contact their veterinarian if they notice hair missing, excessive scratching, licking, diarrhea, vomiting, or weight loss, because these can be symptoms of external or internal parasites (Sara Crispell, Emergency Veterinary Clinic, pers. comm.). Because many of these diseases, viruses, and parasites are zoonotic, owners should practice good hygiene to prevent spread to themselves and contact their primary care physician if they experience any of these symptoms.

All companion animal codes in the GWMA have at least minimal requirements regulating rabies vaccinations and some elements of proper restraint, yet none of these codes specifically dissuade the feeding of wildlife. Only Montgomery County's code acknowledges that unsterilized female dogs pose potential problems and should be contained to prevent wild or domesticated animal conflicts, although they are still permitted to be outdoors if in some kind of enclosure. This still will attract wildlife or domesticated animals to the area. Only the District of Columbia's code acknowledges that distemper is contagious and

poses a potential health problem. All of these codes have much room for improvement in preparing residents and their pets for the establishment of a coyote population in this area.

Implications of human activities and behaviors on coyotes

The actions of humans significantly can influence urban coyote behavior and therefore must be examined. Many residents within the GWMA consider themselves to be wildlife enthusiasts. There are many well-meaning individuals that regularly feed wildlife, including birds, squirrels, raccoons, deer, and feral cats and dogs. In addition, a large number of people within the GWMA maintain unsterilized dogs and cats outdoors because they believe it is more natural for them and domesticating them indoors is cruel. Although these individuals have good intentions, some of these behaviors are irresponsible and actually may contribute to creating future problems or cause harm to urban wildlife.

The simple act of distributing birdseed to attract birds also commonly draws in rodents and other small mammals that feed on the dropped seeds. When rodent numbers increase sufficiently or the feeding station remains unkempt, predators like coyotes may be attracted to that prey base of rodents or they may simply visit the feeding station to eat seeds. Providing food to squirrels and raccoons, whether intentional or inadvertent (e.g., leaving pet food dishes outside) will increase their density per unit area and thus this rich prey base ultimately may

attract coyotes. Finally, the presence of unattended pets represents an opportunistic food source for coyotes.

Small mammals comprise a large portion of a coyote's diet, but plant matter and trash also are utilized by urban coyotes. Coyotes may be attracted to the odor of ripening fruits and vegetables, or by the presence of small mammals that make use of these resources. The cover provided by trees, shrubs, and other plants attracts small mammals or other animals, which in turn can attract coyotes.

These are all reasons for residents to become aware of the contribution landscaping has to wildlife and the need to maintain their yards accordingly.

Garbage and compost left out also become more pungent and attract coyotes (Trout 2001). Outdoor garbage cans with loose fitting or absent lids and open compost piles eventually will become frequented resources due to the ease of acquiring food. Using tight-fitting containers for garbage and enclosing compost sites will make it much harder for coyotes to obtain food.

Documentation of the attitude of wildlife, including coyotes, in urban areas demonstrates positive public sentiment (Gill and Bonnett 1973, Kellert 1985, Webber 1997). Since residents in the GWMA demonstrate a remarkable resemblance to the coyote-friendly demographic profile outlined by Kellert (1985), there is a very good chance for their support, cooperation, and ultimately

behavior changes. The behavior changes in the following chapter are simple to follow and should successfully deter coyotes if practiced consistently.

CHAPTER 6 – RECOMMENDATIONS

Public representatives and agencies, including law enforcement officials and local organizations and jurisdictions, should institute changes to help educate and protect residents throughout the GWMA to avoid problems with coyotes. Private citizens also bear responsibility for minimizing potential conflicts with coyotes. Below I offer a number of recommendations to guide needed changes in policies and programs.

Public Officials

Changes to laws – The current statutes regulating domestic or companion animals and situations involving wild animals throughout the GWMA are not adequate. To minimize the potential for future conflicts with coyotes, all localities need to update and revamp existing regulations so that residents do not unwittingly encourage human-coyote or pet-coyote conflicts, as follows:

- a. Require all pets and companion animals that go outdoors to be current on all vaccinations against transmissible diseases/viruses for which reliable vaccines exist.
- b. Restrict cats to the owner's property. Outdoor cats frequently are preyed upon by urban coyotes and have been found to comprise a major component of their diet. Cats also inflict much damage upon wildlife populations, especially songbirds and small mammals. Though likely to prove difficult and unpopular, strict regulations on free-roaming outdoor cats should be adopted.

- c. Keep intact female dogs in estrus indoors because they can attract wildlife, like coyotes, and are capable of breeding with male coyotes. They should be required to stay indoors during the estrus cycle, except during routine walks where the animal is properly restrained or where the animal is confined and inaccessible on the owner's property.
- d. Provide food and water for dogs and cats indoors, or immediately discard unused portion after consumption if given outdoors, to reduce the potential of attracting coyotes and other wildlife.
- e. Strengthen laws that would make yard maintenance necessary given the fact that untrimmed trees and shrubs, fallen logs, fruits, vegetables, other plant material, and tall grass attract rodents, and therefore coyotes.
- f. Require properly sized and fastened lids for garbage/trash receptacles and compost containers because unprotected and available garbage and compost attracts coyotes and other wildlife. Said receptacles should not be placed at the curb until the morning of scheduled pickup. At all other times, said receptacles must be protected to prevent access by animals.
- g. Create civil and criminal penalties for individuals who provide food and water to urban coyotes and other mammalian wildlife because their actions can lead to physical and emotional trauma to others and their property (pets).

Law enforcement

Some elements of these suggested modifications already exist in local code, but, for the most part, are not diligently enforced. If a law or regulation is not enforced, it becomes ineffective and provides little purpose. All of the suggestions above are designed to help prevent human-coyote and pet-coyote conflicts. Since enforcing the recommended regulations will require more resources, extra revenue will need to be generated. Issuing fines on violators will increase revenue needed to pay for these resources and will serve as additional incentive for behavioral changes. These restrictions must be enforced if co-existence with urban coyotes is to occur.

Localities work together

Urban coyotes do not recognize political boundaries and therefore travel through multiple jurisdictions. Each of these jurisdictions enforces a separate set of regulations. If one jurisdiction is lax in implementing and enforcing appropriate regulations then the efforts of a neighboring jurisdiction with strict compliance may be undermined. Therefore, for the purposes of addressing nuisance wildlife issues, and especially to prepare communities to deal with urban coyotes that consistently cross jurisdictions, I recommend that the entire GWMA be reorganized to function as one management region rather than several smaller bodies. For example, The Metropolitan Washington Council of Governments (COG) is an organization composed of the local government that comprise the GWMA along with representatives from the Virginia and Maryland legislature,

U.S. Senate, and U.S. House of Representatives. Because these GWMA representatives regularly discuss issues that impact this entire area, such as the environment (Brian LeCouteur, COG, pers. comm.), I suggest they, in concert with professional wildlife biologists, explore the urban coyote situation and develop a region-wide management plan. The policies developed by COG then would have to be adopted and implemented by each of the respective jurisdictions in this region.

Private citizens

Prevention is the best way to manage conflict. History has shown us that residents of cities that already have experienced conflicts with urban coyotes often were not prepared adequately enough to effectively prevent or resolve these incidents. Educating the residents of the GWMA on how to prevent coyote conflicts is essential. I created a brochure (Appendix II) that stresses the importance of proper and timely preparation as a means to avoid causing panic. However, residents must become familiar with and recognize the threats that coyotes pose, because consequences can arise from a lack of action. My goal in developing this brochure is to encourage changes in behavior among residents of the GWMA that will allow peaceful co-existence with coyotes.

Future studies

More research about urban coyotes is needed. The following is a list of possible studies that would provide valuable new information on urban coyote populations:

- Radio-collar and track movement using GPS locators to learn more about coyote behavior and dispersal within the GWMA (Appendix III).
- Describe and document den sites so proper warning can be provided to residents for avoidance of those areas.
- Conduct scat analysis to determine the composition of the diet and whether any food preference can be identified.
- Conduct a survey of GWMA residents to identify times and locations of coyote sightings and to establish a measure of the willingness of residents to change their behaviors.
- Conduct population estimates to determine coyote abundance within the GWMA. This should be repeated at regular intervals to establish indices of population trend.
- Create a GIS database of wildlife sightings and all reported incidents involving wildlife for the entire region to help identify high-risk areas. Analysis of such data may provide clues that can lead to the development of management plans to prevent future incidents.

CHAPTER 7 - CONCLUSION

Based upon my review of the previous experiences of other cities, I believe coyotes can and will thrive in the GWMA. Although research on urban coyotes has been conducted in some of these cities, it still needs to be conducted in the GWMA. I have identified likely reasons that contribute to their success in urban environments, and have offered suggestions on how to prevent human-coyote and pet-coyote conflicts. To prevent conflicts with coyotes, urban residents in the GWMA must learn how to co-exist peacefully with the highly adaptable coyote.

The recommendations made in this paper are going to be challenging to public officials due to their significant changes from current regulations. These changes will deter coyotes from approaching and acclimating to urban resident lifestyles, therefore preventing needless attacks. If these changes are not made and residents continue their current behaviors, then there is a good chance for repeating the tragic events experienced in other urban areas inhabited by coyotes. The benefits associated with performing research on this area's urban coyotes, along with the other recommendations, are well worth the costs to provide safety to citizens and their pets. Of all the recommendations, stressing the need for preparation is paramount.

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Figure 1-Map of coyote range before Europeans. (Moore and Parker 1992)

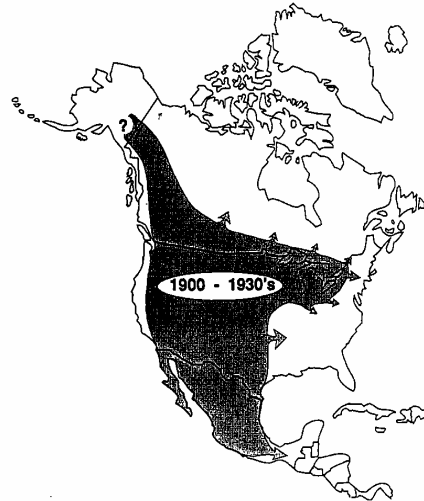


Figure 2-Map of coyote range during early 1900s. (Moore and Parker 1992)

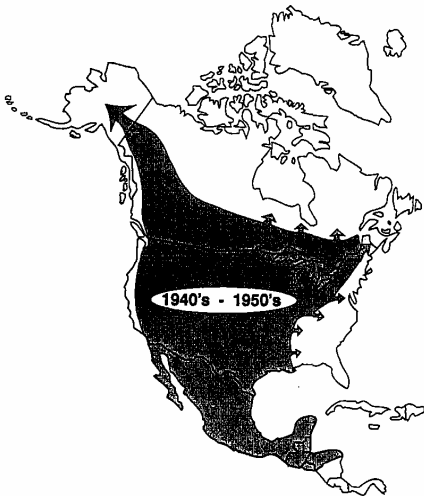


Figure 3-Map of coyote range moving east. (Moore and Parker 1992)

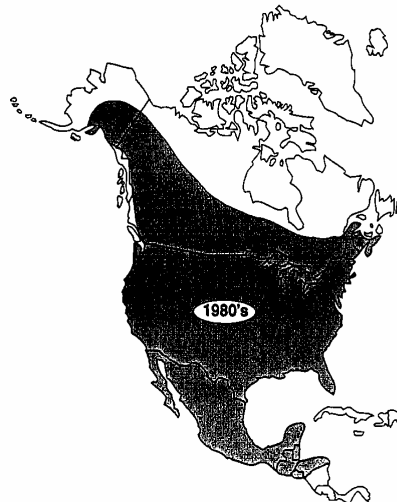


Figure 4-Map of current coyote range. (Moore and Parker 1992)

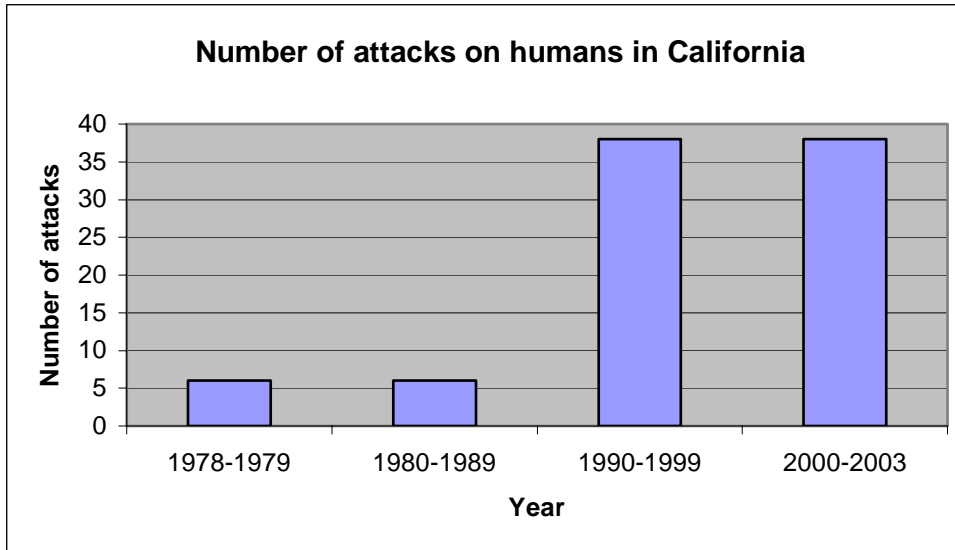


Figure 5-Graph of number of attacks on humans in California. Recording the number of humans attacked by coyotes from 1978-2003. (Data from Timm et al. 2004)

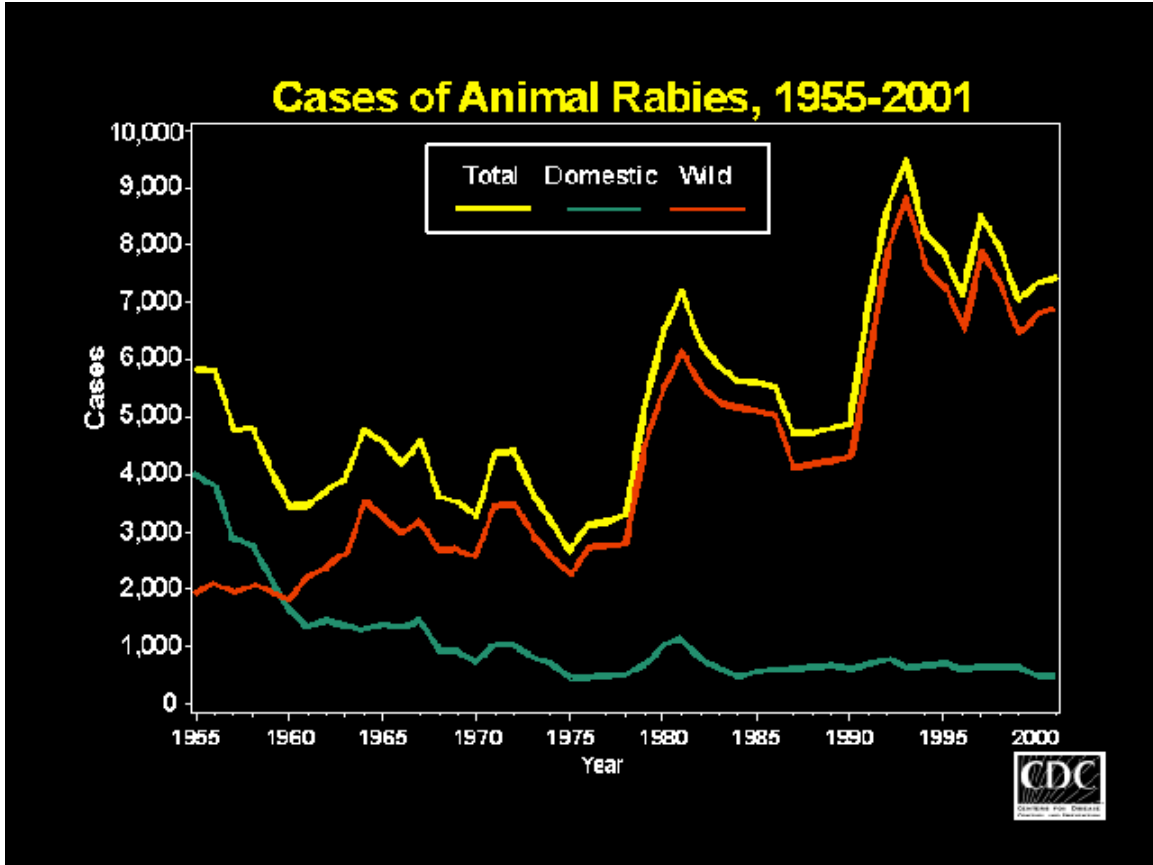


Figure 6-Chart showing progression of rabies from animal sources. (Chart provided by Krebs et al. 2004)

Distribution of Major Terrestrial Reservoirs of Rabies in the United States



Figure 7-Map identifying rabies sources in the United States. (Map provided by Krebs et al. 2004)

Table 1-Local jurisdictions' urban coyote protocol.

	Montgomery County	Prince George's County	Fairfax County	Arlington County	City of Alexandria	District of Columbia	National Park Service
Info available for residents	Yes	No	Yes	Yes	No	No	Yes
Employ wildlife specialists	Yes	No	Yes	No	No	No	Yes
Feeding wildlife legal	Yes	Yes	Yes	Yes	Yes	Yes	No
Maintain log about sightings	Yes-USDA	Yes-USDA	No	No	No	Yes-NPS	Yes-NPS
Contact # for sightings	1-877-463-6947	1-877-463-6947	703-691-2131	703-931-9241X1	703-838-4444	202-895-6221	202-895-6221

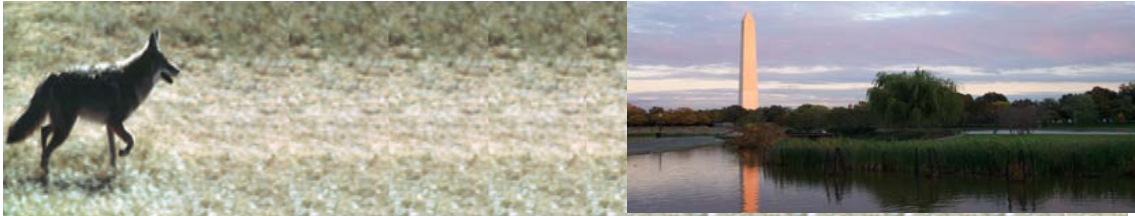
Table 2-Local jurisdictions' domestic animal requirements.

	Montgomery County	Prince George's County	Fairfax County	Arlington County	City of Alexandria	District of Columbia
Sterilization	No	No	No	No	No	No
Restraining Dogs In Heat	Yes	No	No	No	No	No
Rabies Vaccine	Yes	Yes	Yes	Yes	Yes	Yes
Parvovirus Vaccine	No	No	No	No	No	No
Distemper Vaccine	No	No	No	No	No	Yes
Hepatitis Vaccine	No	No	No	No	No	No
Licensing	Yes	Yes	Yes	Yes	Yes	Yes
Allow food/water outdoors	Yes	Yes	Yes	Yes	Yes	Yes
Allow for outdoor pets	Yes	Yes	Yes	Yes	Yes	Yes

Appendix I -Telephone survey

- ◆ Does this jurisdiction provide information about urban coyotes to its residents?
- ◆ Does this jurisdiction's Animal Control department employ wildlife specialists?
- ◆ Is feeding wildlife (especially coyotes) legal in this jurisdiction?
- ◆ Does this jurisdiction maintain a log about coyote sightings?
- ◆ What phone number should residents call if they see a coyote in this jurisdiction?

Appendix II – Public education brochure



Learning to Live with Coyotes in the Greater Washington Metropolitan Area

Photos provided by the National Park Service, Department of the Interior

•COYOTE BACKGROUND

Coyotes, *Canis latrans*, are 35 to 40 pound dog-like mammals that are entering the Greater Washington Metropolitan Area and have a very good chance for survival here. They have thrived in other cities in the United States. Being generalists, they eat plants, animals, and even garbage. Their main diet is rodents, other small mammals, fruits, and vegetables, all of which is available in our area. While **we can** co-exist with coyotes, we need to do so while respecting their wild nature.

•THE THREAT

If coyotes lose their natural fear of people (due to people feeding them), then they have the potential to attack. Numerous small children and adults have been attacked in other cities, after being fed by people. In addition to human safety concerns, we need to consider pet safety as well. Outdoor cats and small dogs serve as potential prey, while larger dogs may also be attacked if viewed as competitors. Coyotes carry many diseases, viruses, and parasites, some of which may be fatal, like rabies.

•THE SOLUTION

Prevention is the best medicine! If everyone **works together** and follows these simple guidelines, we can keep the coyote population down and minimize problems.

1. Keep your pets and their food and water indoors. Supervise your pets if they do go outside.
2. Spay/neuter your dogs to prevent hybridization. Keep pets current on vaccinations.
3. Supervise young children when outdoors. Teach them that it is okay if a coyote is seen in the distance but never go close enough to touch or feed. Children should tell an adult if they ever see one.
4. Take your garbage can to the curb the morning of your scheduled pickup using a tightly secured container.
5. Clean up any fallen birdseed, fruits, or vegetables.
6. Use closed containers for compost rather than open piles.
7. Trim shrubs and trees to their natural shape. Since unkempt yards attract rodents, and therefore coyotes, please maintain your yard.
8. Treat any rodent problem you may have according to the package's label.
9. If you choose to fence your yard, it is helpful to make it at least six feet tall, arching outwards at the top, and buried one to two feet. But, no fence is completely coyote-proof.
10. Take extra precautions near potential den sites (brush piles, hollow logs, embankments, and abandoned structures) during pup-rearing season (May-August) due to the coyote's aggressive parental nature.
11. Most importantly, **DO NOT FEED COYOTES!**

•IF YOU SEE A COYOTE

Don't panic! Simply seeing you may strike enough fear in the coyote to leave immediately. If after seeing you, the coyote does not leave, then try to make loud noise and turn on any nearby lights. If your stubborn coyote still does not leave, you can try throwing rocks at it, eliciting the flight response. If the above techniques do not work, or you are nervous at all, call your local animal control.

This information was provided by Shannon Pederson while working on her Master of Natural Resources for Virginia Tech.

APPENDIX III – Project Proposal

Ecology and behavior of coyotes (*Canis latrans*) in the
Greater Washington Metropolitan Area

Submitted to:
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College of Forest Resources
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Abstract

Coyotes (*Canis latrans*) are now ubiquitous throughout the continental United States. They have altered their ecology and behavior to adapt to urban lifestyles. Coyotes in other urban areas have thrived; however, this has been at the expense of the health and safety of humans and their domestic pets. This study will assess the ecology and behavior of coyotes in the Greater Washington Metropolitan Area (GWMA) to determine their population size, distribution, activity level, home range size, interactions in human-modified environments, den site locations, and pack behavior. This data will prove to be useful in minimizing human-coyote and pet-coyote conflicts.

Problem Statement

In urban areas where coyotes have existed for decades, coyote attacks on humans and pets have increased continually (Howell 1982, Baker and Timm 1998, Trout 2001, Timm et al. 2004). One young girl and countless pet dogs and cats have been killed as a result of coyote attacks (Howell 1982, Carbyn 1989, Quinn 1992, Timm et al. 2004). Even with these serious health and safety threats, very few studies have been conducted on urban coyotes (Andelt and Mahan 1980, Atkinson and Shakleton 1991, Quinn 1992, Webber 1997, Grinder and Krausman 2001a, Way et al. 2004). Of these studies, only one was conducted in the eastern United States (Way et al. 2004).

Research by Timm et al. (2004) identified a sequence of seven events that led to serious human-coyote conflicts in California. Two reliable sources

determine the urban coyotes in the GWMA to be exhibiting behavior at the fifth (Cho 2004) and sixth level (Earl Hodnett, Fairfax County Police Department, pers. commun.) as outlined by Timm et al. (2004). Research is needed to assess the ecology and behavior of coyotes in the GWMA in order to prevent serious human and pet conflicts.

Objectives

The overall objective of this project is to assess the ecology and behavior of coyotes in the GWMA. By tracking their movements in real-time, we will be able to examine pack size, den locations, and interactions within the urban environment. By uploading of all the recorded movement locations at the end of the study, we will be able to learn their daily activity movements, home range size, and usage of different environments within the urban ecosystem. Results of this study will enable us to gain a much clearer picture of urban coyotes in the GWMA and may help us determine new ways of minimizing human-coyote and pet-coyote conflicts.

Material and Methods

The study size for this project is 20 coyotes. Trapping of coyotes in the GWMA will be outsourced to experienced, professional, local trappers using Bridger™ No. 2 squarejaw, offset, laminated traps. This particular trap meets the qualifications designed for improving the welfare of trapped animals and decreasing capture of other animals (International Association of Fish and

Wildlife Agencies 2003). Traps will be checked twice daily to minimize time animals are spent in them. Coyotes will be sedated using Xylazine HCl prior to the GPS collars placement to minimize their stress level and potential conflicts. Xylazine HCl has a wide therapeutic margin for safe sedation and its muscle relaxant property wears off before its sedative effect, thus ensuring a smooth recovery as well as the coyote's ability to stand and walk without risk of falling (Bayer Animal Health 2004). Based on an average 16 kg adult coyote body mass, 9.6 mg will be injected intramuscularly while a noose pole restrains the coyote's head (Plumb 2002). During sedation, approximate age, sex, and body mass will be determined while blood and hair samples will be taken for each individual coyote. Coyotes will be fitted with GPS remote-release collars and ear-tagged. Coyotes will then be allowed to recover from the sedation and released. If a reversal is needed, Yohimbine is the antagonist for Xylazine HCl and will be carried in the field. Based on an average 16kg adult coyote body mass, 4mg will be injected intramuscularly (Plumb 2002).

GPS collars have been chosen for this study due to their advantages of recording coyote fixed locations over large areas under numerous environmental conditions, cost-effectiveness (Rodgers et al. 1996), and location accuracy (Moen et al. 1997). They also minimize intrusiveness by researchers due to programmed transmission extending the life of the transmitter thus retrieving more data with less animal capturing for replacements and remote collar release that prevents additional animal captures (Mech and Barber 2002). The Lotek 4400S GPS collar was chosen because of its relatively light 450 gm weight, high

number of frequent location fixes, advanced differential correction capability, and drop-off capability (Lotek 2004). This collar will allow us to perform occasional real-time tracking during the study so we can locate the coyotes to determine their use of the environment, pack size, and den locations.

The GPS collars will remain on the coyotes for twelve months, at which time they will be remotely released. They will be programmed to record location fixes every two hours because a great frequency, such as this, is optimal for determining activity level (Merrill and Mech 2003). The data will be uploaded and analyzed to determine average daily activity level, average daily distance traveled, and home range size. Seasonal and gender differences will be determined. Combining the GPS data with GIS will allow us to visualize different environments used.

This proposal will be reviewed by the Institutional Animal Care and Use Committee.

Special Provisions

Special care will be taken to minimize stress levels for coyotes and to prevent conflicts. Leg-hold traps that minimally injure coyotes' legs and rarely trigger on other species will be used. All traps will be checked twice daily to minimize time animals are restrained by them. Coyotes will be sedated to prevent injury and allow for data to be taken and for GPS collars to be applied. A relatively lightweight collar will be used so coyotes will be impacted as little as

possible. Investigators will maintain great distance from coyotes during times of occasional tracking and collar release as to minimize disturbance of coyotes.

Permits will be obtained for research on public land throughout the GWMA. In Maryland, the Scientific Collection permit from the Wildlife and Heritage Service of the Department of Natural Resources will be obtained. In Virginia, the Virginia Scientific Collection Permit from the Virginia Department of Game and Inland Fisheries will be obtained. For spaces maintained by the National Park Service, a Scientific Collection permit will be obtained. Personnel working on this project will include the graduate research assistant, faculty member, trappers, and volunteers associated with Virginia Polytechnic Institute and State University.

Study Area

This project will be conducted on public land in the GWMA. These areas include: Washington, D.C.; Montgomery County, MD; Prince George's County, MD; Fairfax County, VA; Arlington County, VA; and the City of Alexandria, VA.

Budget Requirements: 2005-2007

A. Personnel

Faculty Member (5% time)	12,000
Adjunct Faculty (25% time)	36,000
Graduate research assistant	50,000

B. Contract Services

Professional Trappers	3,000
C. Other Direct Costs	
GPS collars (20 units)	102,000
Remote release mechanisms (20 units)	10,200
Download link	910
Differential correction software (N4 Win)	1,500
Radio receiver	2,695
Other equipment – torque wrench	215
Satellite time	33,576
Sedatives & other sedation equipment	300
Ear tags	20
Data Management Software	50
Permit fees	100
Conference Travel	2,500
Journal page charges	2,500
D. Indirect costs – VPI&SU indirect rate is 27.6% for off-site locations (such as the National Capital Region)	
	75,673
E. Fringe Benefits	
Faculty Member	3,750
Adjunct Faculty Member	11,610
Graduate Research Assistant	1,250
Total	349,849

Project Schedule

The field portion of this study will run for 21 consecutive months from January 2005 through September 2006, which includes at least one full reproductive cycle. Data compilation from satellites will occur throughout the field portion of the study, and analysis of final location data as well as individual coyote morphological data will occur in the fall of 2006. Following analysis of all data, manuscript preparation will commence with a targeted completion date of January 2007.

Project Deliverables

- ◆ Biological Conservation – A technical paper on the ecology of coyotes in the GWMA emphasizing habitat relationships and behavioral adaptations to the urban environment.
- ◆ Virginia Cooperative Extension Bulletin – A flyer for public awareness about coyotes in urban areas and a short technical bulletin on Urban Coyote Management.
- ◆ Wildlife Society Bulletin – A technical paper on research methods for studying coyotes in urban areas emphasizing spatial and temporal movement patterns.
- ◆ North American Wildlife and Natural Resources Conference – A paper on policy implications for managing urban coyotes across multiple jurisdictions.
- ◆ The Washington Post – A popular article for the Sunday magazine.

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VITA

Shannon Pederson

Shannon Pederson received a Bachelor's of Science in Animal Science from Texas A&M University in 1999. While attending Texas A&M University, Shannon worked for many years as a student research assistant in the Department of Veterinary Pathobiology. After graduation, she continued working at the veterinary school as a small animal ICU veterinary technician.

Since returning to the Greater Washington Metropolitan Area, she has continued working as an emergency veterinary technician at a private emergency veterinary clinic. She also works as the Public Relations Director for the Center for the Advancement of the Steady State Economy.