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BAD DOGS: WHY DO COYOTES AND OTHER CANIDS BECOME UNRULY?

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Abstract: We summarize the behavior of several species of canids (coyotes, dingoes, and gray wolves) in relation to their habituation to humans and to human food sources. Striking parallels exist between coyotes and other wild canids in terms of the inclination of individual animals to act aggressively toward humans and even attack, once they have come to associate humans with food. We describe the stages of coyotes' behavioral adaptation to suburban ecosystems, listing 7 steps toward increasing habituation, which can be used as action thresholds for invoking active coyote management or removal efforts. We consider the hypothesis that coyotes may regard small children as potential prey, as demonstrated by stalking and attack behaviors. We discuss the difficulty in extinguishing aggressive coyote behavior with hazing or other less than lethal practices, once it has become established. We note that in educational materials developed to reduce the incidence of dog bite and injury to children, the recommendations made are the opposite of those made when encountering an aggressive coyote. We note that there are additional questions that must be answered in order for us to have a better understanding of why some canids become dangerous following habituation.

Key words: behavior, canids, *Canis latrans*, coyote, coyote attacks, dingoes, dogs, human safety, pets, wolves

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INTRODUCTION

The interest in organizing this first 'Urban Coyote Symposium' stems from what many people perceive is an increasing incidence of coyote (*Canis latrans*) attacks on people and pets in recent years. This is a serious issue, and people suffer the negative effects of this human-wildlife interaction when it occurs.

Throughout history, and particularly during the era when the North American continent was being settled with pioneers, humans interacted with some of the large mammalian native species, such as wolves (*Canis lupus*), bears (*Ursus* spp.), and mountain lions (*Puma concolor*). Much of

the concern that led to extirpation or reduced populations of several of these species from much of what became the 48 contiguous states related to depredation on livestock, and most of our management techniques were developed to reduce this depredation.

But today, we are dealing with something a bit different: coyote attacks on people and their pets in urban and suburban environments. Problem behaviors of coyotes in suburban and urban settings apparently began to be noted in southern California as early as the late 1930s or early 1940s (see Gill 1965, Timm and Baker 2007). Such conflicts included attacks on pets and "backyard" hobby animals by

coyotes that had become comfortable and somewhat bold in close proximity to people. By the early 1970s, there were reports of incidents of coyote aggression toward humans, and the first known incidents of non-rabid coyotes biting both children and adults occurred in this region during the late 1970s (Howell 1982, Baker and Timm 1998, Timm et al. 2004).

By the 1990s, such attacks were being reported in a number of other states, primarily in the West, but more recently in suburban and urban areas of the East Coast. Just within the past couple days, we have heard news reports of a coyote attack on a child in New Jersey, perhaps one of the first attacks of its kind on record from that locality. A 20-month-old boy was grabbed on the neck by a coyote that tried to drag him away, and was saved from more serious injury by his 11-year-old uncle who was nearby (Sucato 2007).

A simple question that is asked by the public, by news media representatives, and also by many wildlife professionals is, "Why is this happening?" While any answer is likely not simplistic, any more than coyotes' behavior is simple or predictable, our ability to understand all the factors that have led to the emergence of a new "urban coyote" will assist in finding management solutions that will prevent or reduce these occurrences.

AGGRESSION VERSUS PREDATION

Recent summaries of coyote attack incidents on humans in California (see Baker and Timm 1998, Timm et al. 2004), strongly suggest that in suburban and urban areas, coyote predation on pets such as house cats (*Felis catus*) and small dogs (*Canis familiaris*) is a precursor to eventual attacks on humans. However, the behavioral literature draws a clear distinction between canid aggression and canid predatory behavior.

Fox (1971) noted that in the twentieth century there had been considerable discussion and disagreement as to whether the behavior of a predator toward prey could be "considered within the framework of aggression". He further noted that aggression "has to be considered in relation to time and place, and in relation to the social context be it intraspecific, intrasexual or interspecific". As an example, he observed that a coyote, both in intraspecific aggression and when attacking prey, will stab with its forepaws and bite, "it therefore appears superficially that the predator is being aggressive in the same way toward both prey and conspecific. We must, however, consider the temporal patterning of these actions, their frequency, duration, intensity and orientation. Intraspecific aggression in canids is always preceded by some warning or threat display. Such reactions toward prey are invariably absent...". Fox further noted that in the case of intraspecific aggression, "...there is frequent antagonistic vocalization. Vocalization toward or with prey was rarely observed, and was then invariably associated with defence of prey from a conspecific..." (Fox 1971:134-135). He concluded, "Prey-catching behaviour cannot therefore be considered within the motivational framework of aggression, although comparable action patterns (biting, forepaw stabbing) are seen during intraspecific aggression and in prey killing" (Fox 1971:135).

The question remains: why have coyotes, after adapting to suburban environments where they might be expected to have a natural inclination to regard domestic cats and small dogs as potential prey (as well as feeding on rodents, small birds, and lagomorphs), sometimes aggressively attack humans, including adults? Recent evidence that such behavioral shifts have also occurred in other

canids may provide some insight. They also reveal some interesting parallels in society's changing attitudes toward predators, and how difficult predator management can be in the suburban arena.

PARALLELS WITH OTHER WILD MAMMALIAN PREDATORS

Dingoes

During the past 5 years, several towns and cities in coastal Queensland, Australia, have seen a sharp increase in reports of large packs of wild dogs, and dingoes (*Canis lupus dingo*) in particular, roaming their suburbs. Impacts have been reported in several cities, where studies have shown their prey to include allied rock wallaby (*Petrogale assimilis*) and other native macropods, piglets, rabbits, and cats. The plentiful presence of wildlife in landscaped suburbs, coupled with such attractants as domestic rubbish, compost, and pet foods, was regarded a major factor attracting the dogs into this environment. In one city, Townsville, an initial decision by a task force to initiate a toxic baiting program was reversed after a public backlash. Ineffective attempts to trap the dogs, and subsequently to bait them to sites where they could be tranquilized by means of a dart gun, followed. Only after a 2-year-old girl was attacked while playing in her backyard, did the community support stronger action to control the dogs. Most communities are relying on programs that involve trapping, shooting, and environmental changes to make the suburban habitat less attractive to dogs (Rural Management Partners 2003).

Fraser Island, a 395,370-acre (160,000-ha) reserve off the coast of Queensland, Australia, and 160 miles (257 km) north of Brisbane, supports a population of approximately 160 dingoes. Considered the purest strain of dingoes in Australia because of their geographic isolation from

the mainland's domestic and feral dogs, this species is protected by law on Fraser Island, which is a UNESCO World Heritage Site. The island receives visits from some 300,000 tourists annually, including campers and hikers. While the dingoes at this location were described as "timid and afraid of humans" in the early 1980s, the number of incidents involving dingoes and humans "has started to increase alarmingly" (Anonymous 2001a). Various media reports detail dingo attacks on humans from 1995 to 2001 involving 20 victims, including a March 1998 attack on two British tourists, an April 1998 attack on a 13-month-old toddler who was dragged 6 feet (2 m) by two dingoes before being released, another April 1998 attack in which a 3-year-old Norwegian girl was bitten and scratched, and a February 1999 incident in which a German tourist was bitten on the shoulder and legs by 2 dingoes (Anonymous 2001a, Roberts 2001). This culminated in an incident on April 30, 2001, when a 9-year-old boy near a campground was killed by a pair of dingoes and his 7-year old brother was attacked, suffering multiple bites to the arms, legs, and body.

News interviews with various residents and authorities suggested that the behavior of Fraser Island's dingoes had been altered as a result of "constant feeding by tourists." A local resident identified one of the animals involved in the fatal attack as one of several that had been fed by a tourism operator to make it easier for visitors to photograph the animals. The resident continued, "We repeatedly warned National Parks officers that something very serious would happen because this dog was particularly aggressive and it had lost all fear of people" (Anonymous 2001a, Roberts 2001). The same animal was implicated in at least 7 incidents during a 6-week period in which people were bitten or harassed (Roberts 2001).

Some authorities contend that the Fraser Island dingo population is so large that it can only be sustained by scavenging and taking food from tourists. They state that the additional food resource provided by tourists has allowed more of the younger animals, which would not normally survive, to thrive (Anonymous 2001b). Since 1995, more than 50 people had been cited for illegally feeding dingoes. Additionally, authorities on Fraser Island had reportedly culled approximately 40 dingoes over the decade preceding the fatal attack for “showing dangerous habits” (Anonymous 2001c, Roberts 2001).

Immediately after the April 2001 fatality, authorities were able to identify and kill the 2 dingoes responsible, and they planned to cull 20 or more dingoes to reduce further risks to people. The incident ignited a debate about whether dingoes on the island should be exterminated, with one faction blaming the tourists for providing food to the animals simply because they “want to take their little photo close-up. This tragedy is not the fault of the dingo.” Others contended, “Anywhere else in Australia, landholders are told to get rid of them because they are vermin. Here, they are being preserved as some kind of precious native wildlife species when they are not.” Those favoring extirpation of dingoes from Fraser Island noted that dingoes were introduced to Australia by humans about 10,000 years ago (Roberts 2001).

Wolves

Several authors have written that wolf attacks on humans are common in Eurasia but rare in North America (Young and Goldman 1944, Jamsheed 1976, Kumar 2003). For example, Cagnolaro et al. (1996) looked at reports of wolf attacks from the fifteenth to nineteenth centuries in northern Italy and found some 440 instances of humans being killed by non-rabid wolves;

most victims were children under the age of 12. He noted reports of 67 persons, including 58 “youths”, being killed by wolves in the Po Valley of Northern Italy between 1801 and 1825 (Fritts et al. 2003). More recently, Jhala and Sharma (1997) investigated both fatal and nonfatal attacks by wolves on 76 children, aged 4 months to 9 years, in rural villages of Uttar Pradesh, India (Fritts et al. 2003).

While there exist reports of wolf attacks on humans in North America, most United States and Canadian biologists have been skeptical of these reports and have downplayed any danger posed by wolves to humans (Fritts et al. 2003). Canadian biologist Douglas Pimlott wrote in 1967, “... in spite of one of the highest wolf populations in the world... thousands of children canoe and camp in the wilderness section of Algonquin Park each year and there are no reports of any one of them having been attacked or even threatened by wolves” (Pimlott 1967). David Mech spoke for many wildlife biologists when he stated, “...there is no basis for the belief that healthy, wild wolves in North America are of any danger to human beings. On the contrary they are extremely shy of man and usually try to avoid him as much as possible” (Mech 1970).

In Algonquin Provincial Park (in Ontario, Canada), 5 attacks on humans by 4 wolves occurred between 1987 and 2000. According to park officials, all the wolves involved were healthy adult animals that had hung around park campgrounds for weeks or months before the attacks occurred. Park rangers dismissed the first few attacks as oddities, and they even thought it was a positive experience for visitors when wolves made themselves visible. They came to refer to these wolves as “fearless wolves,” that is, wolves habituated to people. Park policy since 2000 has been to kill any wolves that show signs of fearlessness, and

no further attacks on humans have been reported at this location (Medred and Manning 2000).

In April 2000, a wolf came out of the woods at a logging camp at Ice Bay, north of Yakutat, Alaska and approached 2 young boys, ages 6 and 9. The boys ran and the wolf attacked, biting the 6-year-old on the back and buttocks, requiring stitches to close the wounds. The attacking wolf, described as healthy, had attacked without provocation or warning, perhaps because the boys ran. It is unknown whether this wolf had previous experiences around humans.

In July 2000, a wolf attacked a 23-year-old university student who was in a sleeping bag on a beach on Vargas Island, British Columbia. Friends came to his aid and scared the wolf away, but not until after the student had sustained bites to the hand and the back of the head, the latter wound requiring 50 stitches (Anonymous 2000). Ministry of Environment officials speculated that wolves in the area had been occasionally fed by humans, which might have been a factor in the attack (Mader 2000).

Skinner (1926) may have been the first to offer an explanation for the difference in wolf behavior toward humans in Europe versus in North America, stating that in Europe, wolves "...are dangerous because they do not fear man, since they are seldom hunted except by the lords of the manor. In America, the wolves are the same kind, but they have found to their bitter cost that practically every man and boy carries a rifle..." Mader (2000) extended this reasoning to the situation in Asia, noting that where wolf attacks occurred on that continent, people generally had no firearms or other effective means of predator control. The necropsy report of the wolf that attacked the boy at Ice Bay showed the wolf to be in excellent condition, and suggested the animal probably had not come to rely on

food sources provided by humans. This prompted the editor of *Livestock Weekly*, a Texas newspaper, to state, "It's past time to... quit looking for alibis; wolves are large and capable predators, and they will attack people any time they think they can get away with it" (Livestock Weekly 2000). Alaska Board of Game member and native village council chief Mike Fleagle noted, "The people of old Alaska were always taught to be careful of wolves when we were growing up. It's a rarity that they attack, but they do, regardless of the prey situation. Wolves will kill for the sake of killing. They're not these super-duper fluffy little house pets" (Medred and Manning 2000).

In their review of wolf behavior toward humans, Fritts et al. (2003:300) stated "How wolves react to humans depends on their experience with people. Wolves with little negative experience with people, or wolves that are positively conditioned by feeding... may exhibit little fear of humans." As to why there appeared to be more historical records of wolf attacks on humans, they speculated, "Wolves may have learned that modern humans are especially dangerous and changed their behavior accordingly" (Fritts et al. 2003:304).

Domestic Dogs

Dog bites in the United States were responsible for more than 300 fatalities from 1979 through 1996, or an average of approximately 17 deaths annually (Centers for Disease Control and Prevention 1997). Pit bull-types and Rottweiler breeds were responsible for more than half of the fatalities for which data are available (Sacks et al. 2000). In 1986, nonfatal dog bites resulted in an estimated 585,000 injuries requiring medical treatment or restricted activity; in 1994, approximately 800,000 persons sought medical care for dog bites (Centers for Disease Control and Prevention

1997), and 6,000 were hospitalized (Centers for Disease Control and Prevention 2003).

In 2001, an estimated 68 million canines were kept as pets in the United States (Centers for Disease Control and Prevention 2003). Although the number of dogs in the United States increased by only 2% between 1986 and 1996, the number of dog bite injuries requiring medical treatment rose by 37% (Weiss et al. 1998). This rising incidence of dog bites has fostered efforts to prevent such injuries; strategies to reduce this problem include educational programs on canine behavior, especially directed at children; laws for regulating dangerous or vicious dogs; enhanced animal control programs; and educational programs on responsible dog ownership and training (Sacks et al. 1996).

Timm et al. (2004) noted that incidents of coyote attack were more common during the coyote's pup-rearing seasons (May through August), suggesting that this might lend support to the idea that attacks, particularly on small children, were predatory in nature. Some such attacks, occurring during the season when adult coyotes are defending pups and their dens, may be a result of territorial defense, particularly when den sites or pups are approached by humans accompanied by pet dogs. On the other hand, data regarding domestic dog bites to humans also indicates increases during the warmer seasons of the year: for dog bites, the number of cases increased slightly during the period April through September, with a peak in July (Centers for Disease Control and Prevention 2003). Thus, this seasonal variation may simply be caused by increased human outdoor activity during spring and summer; however, the mild climate of southern California lends itself to outdoor activity essentially year-round.

CATEGORIZING ATTACKS

Linnell et al. (2002), in their review of wolf attacks on humans, categorized attacks into these categories: 1) rabid, 2) defensive / investigative, and 3) predatory. In this paper, we are dealing with attacks by non-rabid coyotes, so the first category does not apply. The second and third categories may be provide a framework for understanding coyote attacks on people. Linnell et al. (2002:16) defined defensive / investigative attacks as follows. Defensive attacks occur when a scared or cornered animal is confronted, usually consist of a single bite, and the animal does not press the attack, but simply escapes when possible. Investigative attacks, according to Linnell and colleagues, are described as cases where it is suspected "...the wolves are 'testing' or investigating the person as potential prey, which can result in close approach, being knocked over, or bites. In other cases, it appears that the wolf has been trying to seize an object" (e.g., a lunch bag or purse, or a sleeping bag) "and panics with the victim wakes up or surprises the wolf. This panic is often expressed as a bite or series of quick bites. As in defensive attacks, the wolf does not press the attack, and is easily scared away" (Linnell et al. 2002:16). In contrast, we believe that true predatory attacks involve the animal intending to exploit the human victim as prey, and are usually directed around the neck and face in a sustained manner, with the victim often dragged away.

Coyote attacks on humans listed in Timm et al. (2004), from the brief descriptions given, in many cases can be categorized as "defensive", "investigative", or "predatory". Among these incidents, there were 4 cases in which coyotes attempted to drag away small children (aged 13 months to 3 years), and this also occurred in the case of the one known fatality, a 3-year-old girl (Boghossian 2004). Carbyn

(1989), in analyzing 10 coyote attacks on humans, primarily occurring in national parks, noted that of the 4 most serious attacks, all were on children and 3 occurred during the season when pups were whelped or were being fed. He regarded these particular attacks as being predatory in nature, and speculated that the coyotes' boldness was related to food stress. Coyotes easily capture and kill lagomorphs and small ungulates, as well as cats, small dogs, sheep, and goats. Small children simply are not immune to attack as prey, and attacks have been summarized in Timm and Baker (2007). Young children are attracted to "dogs", and both a child's size and his or her jerky-jerky movements may make a hungry coyote investigate. In addition, small children may have food or food scraps nearby, again serving as an attractant.

Carbyn (1989) also noted the occurrence of additional aggressive responses to humans, at various seasons, that did not fit this pattern (e.g., chasing cars and biting at tires, slashing tents, and nipping at campers in sleeping bags), concluding that there may not have been a common basis for these additional aberrant behaviors.

We suggest that coyote attacks on house cats are usually predatory; consumed remains of house cats are commonly found at coyote den sites and in other areas of coyote activity throughout residential neighborhoods. However, attacks on dogs may be either predatory or defensive, depending on the size and aggressiveness of the dog and the demeanor and experience of the coyotes.

Regardless of how coyote attacks might be categorized, all attacks represent human-coyote conflicts in which people are often traumatized, sometimes injured and must undergo post-exposure rabies treatments, and often are frustrated that agencies or governmental entities do not provide better responses or solutions to these

problems. From a practical standpoint, wildlife managers need to more specifically understand the causes of these "new" coyote behaviors in order to implement appropriate management solutions.

POSSIBLE FACTORS CONTRIBUTING TO "BAD" BEHAVIORS

Changes in Human Behavior

It is possible that certain changes in human behavior have contributed to the rise of "bad coyotes" in suburban areas. Coyotes, as well as dingoes (as noted above), find that human modifications to the residential environment create an acceptable, even inviting, resource-rich habitat for those coyotes that venture into suburbia from adjacent wildlands. This factor has been noted by those who have reported on the development of coyote conflicts in suburbia, including Howell (1982) and Baker and Timm (1998). The establishment of irrigated landscaping around homes and businesses provides both shelter and a water source to coyotes, and many plants used in southern California landscapes (as well as in similar climatic zones) bear fruits and seeds that coyotes utilize as food sources (Timm et al. 2007). This lush vegetation also attracts and supports populations of rodents and lagomorphs that provide a prey base for coyotes. Always the opportunists, coyotes also use household garbage, items in compost piles, pet food, and pets as food items when they are readily available.

As a society, we have re-designed residential habitats to be more environmentally friendly with open space, wildlife corridors, parks, greenbelts, and other habitat features that attract and support a variety of desirable wildlife. We tolerate wildlife's presence in closer proximity to us. And as a result, many kinds of wildlife, including coyotes, have become healthy,

successful suburban residents that at times are larger and more numerous than their wildland counterparts.

The way we interact with wild coyotes when we encounter them is important. Protection of predators, rather than their extermination or control, has become the prevailing attitude in our society, particularly in urban and suburban areas. Thus, agency predator control programs have ceased to exist or, in some localities, may respond only to human safety incidents (and not to predator attacks on pets). Concurrently, sporting uses of firearms have declined in and around the periphery of urban areas, so coyotes are not receiving any negative consequences of being in close proximity to humans.

Finally, it is obvious that a significant number of people believe that any conflict between coyotes and people are solely the fault of people. Thus, as one portion of a neighborhood works to manage nuisance coyotes, another portion feeds and protects them. This protectionist attitude certainly is a more recent phenomenon.

Intentional Feeding

Anecdotes about the development of problem behaviors in human-adapted coyotes following intentional feeding are scattered throughout the coyote literature. For example, Young and Jackson (1951:69) noted “two tourist-habituated coyotes” in Yellowstone National Park, in 1947, were stopping traffic and begging for handouts. Several publications that discuss coyote attacks on humans suggest that intentional or unintentional feeding of coyotes may be a contributing factor (and sometimes, the most important factor) in creating coyote aggression: see Howell (1982), Carbyn (1989), Parker (1995:167-169), Baker and Timm (1998), Timm et al. (2004), and Fox and Papouchis (2005:34).

Carbyn’s (1989) report summarized several coyote attacks on children, which had occurred primarily in national parks in western Canada. While he noted that “availability of garbage in campgrounds ... likely contributes to the habituation process of coyotes to humans” (Carbyn 1989), it is not difficult to imagine that in such park situations tourists are all too inclined to get a closer look at wildlife by enticing them with food items from their backpacks or camp kitchens. Bounds and Shaw (1994) established a correlation between intentional feeding of coyotes and coyote aggression toward humans. In a survey of United States national parks, they found that in parks reporting aggressive coyotes, intentional feeding of coyotes by tourists was more commonplace than in those parks that did not report aggressive coyotes.

Changes in Coyote Behavior

The coyote that saunters down a suburban residential street in broad daylight, ignoring the presence of humans, exhibits strikingly different behavior from a coyote that lives in the wild or a rural ranching community and survives because it has successfully avoided other predators, traps, snares, and gunshots. Coyotes are considered among the most adaptable mammals in North America, as witnessed by their ability to expand their range from its historical limits to the entire 48 contiguous states, into Canada and Alaska, and southward through Mexico into Central America (Parker 1995). A large part of this adaptability is behavioral, as coyotes within populated areas habituate to the presence of humans.

“Habituation” of wildlife has recently been described as “animals’ decreased responsiveness to humans due to repeated contact” by Geist (2007), who noted that this phenomenon “...has ushered in a host of new wildlife management

challenges.” Geist cautions, “Unfortunately, habituated animals, those who have developed a psychological patience with our presence, are potentially much more dangerous than non-habituated, or “wild” animals, because habituation is a state of unconsummated interest on the part of the animal, expressing itself as tolerance of and even an attraction to humans” (Geist 2007).

We know from studies of coyotes in natural settings that their social structure is very adaptable. In the presence of abundant food, such as at the National Elk Refuge in Wyoming, coyotes were observed to function within packs, whereas in environments where food is scarce, they successfully survive as solitary individuals or as mated pairs (Camenzind 1978, Bekoff and Wells 1986, Gese et al. 1988). Suburban coyotes in the Los Angeles area were found to reach some of the highest densities and have the smallest home ranges ever reported (see Shargo 1988).

Aside from their social behavior, it is presumed that their use of space and territory also are highly adaptable. To date, there are few good studies of coyote behavior in urban and suburban settings, especially in areas where aggressive, habituated coyotes have been noted (but see Gerht 2007). Such studies may be challenging in these habitats; for example, coyotes in the San Jose, California region have been seen to frequently use storm sewers as underground “subways” for their travel (M. Phillips, Santa Clara County Vector Control District, personal communication).

While we have relatively little data about urban coyotes’ foraging patterns, movements, territoriality, diet, and habitat use, it is clear to most observers that they have adapted remarkably well to certain suburban habitats, successfully denning and rearing pups in suburban neighborhoods in the presence of people, pets, and traffic

(Gerht 2007). Coyotes seem to have become “at home” in suburban areas, and do not associate humans as enemies. Baron (2004) suggested that the same behavioral adaptations have occurred with mountain lions in some suburban localities.

Are coyotes naturally wary of humans, or is this a learned behavior that results from multiple negative interactions with humans? There is little doubt among predator control professionals that most coyotes “wise up” when pursued with traps, guns, and aircraft (the “trap-shy” animal syndrome is well known among trappers). While Geist (2007) mentions “wildlife’s innate fear of humans”, Hastings, an early explorer of southern California, observed 3 kinds of “wolves” in California: “... black, gray,” and the “... prairie wolves; the latter of which are very small, but they are much the most numerous and troublesome ... In traveling through the valleys of this section, you will pass many hundreds of them during the day, which appear to evince no timidity, but with heads and tails down, in their natural crouching manner, they pass within a very few rods of you.” This early account of coyotes’ behavior suggests that, at least in the localities where Hastings observed them, they exhibited little fear of humans.

Regardless of whether coyotes’ innate fear of humans is being overridden, or their learned avoidance of humans is being extinguished, there is a recognition that the behavior of coyotes in suburbia can change in a predictable manner over time. Rex Baker first outlined the stages of increasingly troublesome coyote behavior in Baker and Timm (1998); these behavioral stages, in their usual order of occurrence are as follows:

1. An increase in observing coyotes on streets and in 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 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"

This progression of behaviors has been adopted for use in evaluating problem coyote complaints and deciding thresholds for management actions in Texas (see Farrar 2007), New York, and elsewhere. Typically, most management entities consider taking some sort of action to remove the offending coyote(s) or otherwise reduce the risk to human safety once stages 4 or 5 are reached.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

In the absence of formal studies of the ways in which coyotes habituate to suburban and urban environments, and subsequently some coyotes become aggressive toward humans, we can only speculate that the important factors leading to these conflicts include:

1. An attractive, resource-rich suburban environment.
2. Human acceptance or indifference to coyote presence.
3. Lack of understanding of coyote ecology and behavior.
4. Intentional feeding.
5. Reduction or cessation of predator management programs.

We believe there are practical strategies for reducing the risks associated with these factors. These strategies include:

A Resource-Rich Environment

Reducing sources of food, shelter, and water that attract coyotes into the suburban environment can be effective. Pruning overgrown landscape plantings to give coyotes and their prey less cover is a good start. Choosing landscape plants that do not produce edible fruits or seeds is advised; a list of common landscape plants that are attractive to coyotes in Southern California are listed in Timm et al. (2007) and should be avoided. Recognize that spillage from bird feeders can attract both birds and rodents that serve as prey and in turn attract coyotes.

Management of pets and pet food can be a critical factor. Uneaten pet food left outside can be an attraction to coyotes or to their prey. Some coyotes apparently kill and consume many small dogs and house cats, and thus in some neighborhoods, such pets are at risk whenever they are out-of-doors, even during daytime hours. The most egregious problem in some neighborhoods is the existence of feral cat colonies. In some such situations, coyotes regularly prey on the cats as well as consume the cat food that humans provide in copious amounts (Baker and Timm 1998). However, rodents and lagomorphs typically found in rights-of-ways, trails, parks, cemeteries, and undeveloped lots fall outside any homeowner's management authority, and can maintain a coyote population. Reducing risk, not eliminating it, is probably the best way of looking at habitat manipulation to reduce coyote encounters with people.

Human Acceptance or Indifference

Perhaps it is typical of human nature to take a "live and let live" attitude toward wild animals, even with coyotes in one's

own neighborhood. And it is also typical to regard coyote conflicts as someone else's problem. A homeowner may have no strong opinion about coyotes until his or her own pet is attacked and injured or killed, or until a person in the immediate neighborhood is bitten. Early preventive action might be effective if an entire residential area or community were more alert to coyotes' presence when these animals first become visible in the community. If the majority of residents would undertake hazing efforts, such as making threatening movements toward coyotes that come too near residences, squirting them with a garden hose, or throwing rocks or sticks at them, it is possible that some degree of wariness toward humans could be maintained. We recognize that coyotes will habituate to these non-injurious actions, so monitoring the quantity and intensity of coyote-human interactions is important in any neighborhood.

Lack of Understanding

When coyotes first come into a neighborhood, most people probably regard them as an interesting novelty. Some may even welcome their presence, having a desire to see them up-close (see Kellert 1980). Most people probably do not recognize that coyotes are very numerous, and that they have spread their range tremendously during the past century and thus the attitude that the conflict "is not the coyotes' fault, because they were here first" is often inaccurate. While coyote behavior is highly individualistic and situation-dependent, we have enough knowledge of urban coyote behavior to predict that when coyotes settle into a neighborhood and find rich food resources, some of the individuals may become increasingly bold to the point of preying on pets, if not also becoming aggressive toward humans. This is no longer an exception or a very rare event in

such environments. Communities need to recognize that when coyote habituation progresses to a certain point, remedial action may be required. Geist (2007) notes, "An animal that that has become accustomed to humans can turn from indifferent to aggressive at the drop of a hat." But, because coyotes are very individualistic in their behavior, it is likely that only a very small percentage of the coyote population will develop aggressive behavior toward humans. It is this small percentage, however, that requires aggressive management action.

Organizations and people opposed to any lethal control of coyotes often recommend hazing or scaring tactics, in conjunction with habitat modification, as the solution to urban and suburban coyote conflicts (see Fox and Papouchis 2005). In discussing the process of habituation of wild animals, Geist (2007) notes that "Habituation need not progress to taming; deliberate negative conditioning is best if the aim is to instill fear of humans in the animals. Negatively conditioned animals are usually not very dangerous, as they tend to keep their distance from humans and flee when approached." Geist further suggests one approach is "to consider more vigorously employing the psychological conditioning of fear, in its best manifestations. We must work to systematically link human presence with stimuli to which predators cannot possibly habituate; in doing so, we push them away and thus protect them" (Geist 2007).

While we agree that negative conditioning would be a desirable technique to use, the difficulty comes in practically applying negative stimuli in an actual suburban setting. Timm et al. (2004) stated, "Once coyotes have begun acting boldly or aggressively around humans, it is unlikely that any attempts at hazing can be applied

with sufficient consistency or intensity to reverse the coyotes' habituation."

Geist's summary conclusion, stated in regard to all wildlife, applies well to the suburban coyote situation: "Wildlife habituation is, quite certainly, a problem of the times ... Homeowners as well as wildlife professionals need to know how to respond to the many and varied signs of warning from habituated and tamed animals that share our highways and towns. The reality is that habituated animals can and do become troublesome or dangerous and lack of understanding about wildlife behavior is a major contributing factor" (Geist 2007). Educational brochures, produced by states and other entities, describing how to respond if approached by a coyote, mountain lion, or black bear (*Ursus americanus*), have proliferated in recent years, particularly in states and regions where attacks and other human safety incidents have occurred. Their recommendations upon encountering a coyote include such tips as "If you see a coyote, be aggressive in your behavior, make loud noises, wave your arms, throw sticks and stones" (NY DEC 2007); "Be as big, mean and loud as possible, make yourself appear larger, shout in a deep, loud and aggressive voice". However, recommendations in parallel educational materials aimed at instructing children how to avoid bites or attacks by domestic dogs have a different message: "If a dog approaches to sniff you, stay still ... If you are threatened by a dog, remain calm, do not scream. If a dog approaches to sniff you, stay still" (American Veterinarian Medical Associatio 2007). So for dogs, which are the much larger risk to children, we are training our children to behave in one way, and for coyotes, we are recommending almost the exact opposite set of behaviors. How is a 3- or 4-year old child supposed to decide whether the approaching canid is a

dog or a coyote, and remember which set of recommendations to follow?

Intentional Feeding

It is difficult to know in how many cases of coyotes attacking humans intentional feeding of these specific coyotes was a factor. However, many of the coyote bite incidents reported outside of urban and suburban areas have occurred in parks and campgrounds, where human interactions with coyotes undoubtedly involve intentional feeding on many occasions. Some have speculated that intentional feeding may be the most significant reason that some coyotes begin to exhibit aggression toward humans.

Geist describes the process of habituation progressing into "taming" as follows: Habituation "...begins when a creature tolerates humans at a distance. Over time, a process launching from the first few critical minutes and often then stretching into days, an animal may allow closer and closer approaches by humans, learning that the observer does not pose an apparent or immediate threat. The difference between habituation and taming, however, can be revealed quite dramatically when an animal suddenly turns the tables and closes the distance to explore the observer. With the distance closed, and if the setting allows, the human can proceed gingerly into the realm of taming, conditioning an animal through positive reinforcement such as food or salt. Thus habituation progresses to taming via the animal's own initiative as it consummates its curiosity about the observer and accepts the strategic bribery of positive feedback in foodstuffs or other pleasures..." (Geist 2007).

While it is often suggested that cities or counties enact anti-feeding ordinances to cover coyotes and other wild mammals, the reality is that enforcement of such

regulations is always going to be a low priority for law enforcement personnel. More effective is neighborhood peer pressure. Neighbors generally know who within the neighborhood might be intentionally feeding coyotes or other wildlife, and when the residential community comes to understand that such actions put everyone's pets and everyone's children at risk, their one-on-one communication can effectively stop such practices. In addition, feeding that is unintentional may be just as effective as intentional feeding at habituating coyotes to human presence.

This raises the question of "cheaters": in a neighborhood or a community, where there are strict rules, ordinances, or peer pressure against feeding coyotes or other nuisance wildlife, how many "cheaters" does it take to change a coyote's behavior? Is it 1 resident in 100 who, if they intentionally feed coyotes, will maintain the coyotes in the neighborhood and cause them to increasingly habituate to humans and human food resources? We can only speculate, but it's probably not very many. It is a challenge whenever you have to work with 100% of the residents in a community.

Predator Management Programs

We believe that there are some problem coyotes whose habituated and/or aggressive behavior cannot be reversed with any feasible or practical methods. Those problem animals that are aggressive toward humans will therefore need to be removed from the population in order to prevent further attacks. Predator management professionals have demonstrated the ability to selectively remove such problem animals. Given permission from city authorities, it is often possible for professionals to remove them by use of firearms or traps. This is predator damage control, not "predator

control"; no attempt is made to exterminate the entire population of coyotes. Complete elimination is not practical nor is it necessary to solve the problem. Many coyotes in a neighborhood may be invisible to residents, living on rodents and lagomorphs and avoiding people during the day. It is the problem animals that require targeting.

Baker and Timm (1998) suggested that selective removal of a few bold individuals from a suburban coyote population will restore the fear of humans into the entire group of coyotes in the area, causing them to act with increased wariness toward humans, or sometimes to even leave the area. This effect is most strongly seen when problem coyotes are removed with foothold traps, but it also occurs to some extent when coyotes are removed by shooting. This effect may persist for months or even years, when neighborhoods also concurrently take actions to reduce the habitat factors that attract coyotes into the area (R. O. Baker, personal communication). We have also talked to predator control professionals who have heard coyotes caught in foothold traps make unusual vocalizations, which potentially are a way of communicating fear and danger to conspecifics. More needs to be known about such communications, as this could explain why trapping is a more effective method for reversing coyote habituation than are other methods.

It has been reported that the City of Glendale, California, developed an effective coyote damage control program in the 1980s, relying on a combination of neighborhood education that was supplemented by the removal of individual problem coyotes when deemed necessary. Over time, the number of coyotes that had to be removed declined (Baker and Timm 1998). Unfortunately, decision-makers at the city and county level are often the targets

of political pressures organized by animal activist groups that have a philosophical opposition to any lethal control of coyotes (see Boghossian 2004). For a community to maintain an effective coyote damage control program, the public has to be willing to support not only preventive, but also corrective actions, in a timely manner.

UNANSWERED QUESTIONS

We believe that our present understanding of urban and suburban coyotes and their behavior permits us to recommend a combination of management measures that, when enacted, form an effective strategy to prevent, or at least substantially reduce, coyote attacks on humans. Yet, there are many unknowns about coyotes and coyote behavior that prevent us from providing a detailed answer to “Why do (some) coyotes become unruly?”

For example, the following are pertinent and interesting questions to which we have incomplete answers:

- Why do some individual coyotes become aggressive and bite people, while others, although well habituated, do not?
- What is different about southern California, causing documented suburban coyote problems to develop at an earlier time, and in greater numbers, than in other regions of the country?
- A related question, perhaps, is why are the number of reported coyote attacks on pets similar in both Texas and California (see Timm et al. 2004), but coyotes attack very few humans in Texas?
- Why have the number of coyote attacks on humans in California apparently dropped significantly from 2005 through 2007, as compared to the previous 5 years?

- How important is intentional feeding as the root cause of coyote aggression toward humans?

These are important questions that need to be researched, discussed, and the answers or conclusions shared with various audiences.

While coyote attacks on humans have made the largest headlines in recent years, from a public policy perspective, it is probably attacks by coyotes on pets that drives the system. This is a topic we know far less about, at least in terms of scientific studies and publications. With coyotes being the opportunists that they are, it would be difficult to imagine that coyotes might be conditioned to avoid domestic dogs and cats as prey items; most likely, they would not discriminate between domestic and wild animals as general categories. And we will hear more about this aspect of suburban coyote conflicts in other presentations in this symposium.

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