

Coyote Attacks on Humans, 1970-2015

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ABSTRACT: Beginning with the developing pattern of urban and suburban coyotes attacking humans in southern California in the late 1970s, we have gathered information on such incidents in an effort to better understand the causes of such changes in coyote behavior, as well as to develop strategies that can reduce the incidence of such attacks. Here, we update information from our knowledge of conflicts between humans and coyotes occurring largely in urban and suburban environments in the United States and Canada during the past 30 years. This problem emerged in states beyond California and in Canadian provinces in the 1990s, and it appears to be growing. We have documented 367 attacks on humans by coyotes from 1977 through 2015, of which 165 occurred in California. Of 348 total victims of coyote attack, 209 (60%) were adults, and 139 (40%) were children (age ≤ 10 years). Children (especially toddlers) are at greater risk of serious injury. Attacks demonstrate a seasonal pattern, with more occurring during the coyote breeding and pup-rearing season (March through August) than September through February. We reiterate management recommendations that, when enacted, have been demonstrated to effectively reduce risk of coyote attack in urban and suburban environments, and we note limitations of non-injurious hazing programs. We note an apparent growing incidence of coyote attack on pets, an issue that we believe will drive coyote management policy at the local and state levels.

KEY WORDS: canid behavior, *Canis latrans*, coyote-human attacks, habituation, history, human safety, pets, predator management,

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INTRODUCTION

Beginning with the developing pattern of urban and suburban coyotes (*Canis latrans*) attacking humans in southern California in the late 1970s, we have gathered information on such incidents in an effort to better understand the causes of such changes in coyote behavior. The senior author (ROB) served as a consulting biologist and was directly involved in many of the case histories documented in Baker and Timm (1998) and Baker (2007). Coyote management strategies have been developed, in conjunction with municipalities, counties, and with state and federal agencies, that have been shown to be effective in reducing the occurrence of conflicts with coyotes in suburban and urban environments.

Our objectives have been to: 1) compile records that contain information related to human-coyote incidents, including season and time of day of their occurrence, age and gender of victims, behaviors of coyote(s) and person(s) involved, and contributing factors such as presence of pets, evidence of intentional feeding, and other relevant information; and 2) better understand reasons for this change in coyote behavior. We have worked with local, state, and federal agencies, land managers, homeowners' associations, and others in an effort to develop, adapt, and utilize adaptive management programs that will successfully reduce or prevent human-coyote conflicts that occur in suburban and urban environments. We have obtained information on a sufficient number of incidents so as to begin to determine patterns and trends related to such attacks. We continue our efforts to collect such information, in order to refine practical management recommendations that will allow agencies to deal effectively with this growing problem.

Urban Coyote Conflicts - A Brief History

Perhaps the first report of human-habituated coyotes was that from Yellowstone National Park in 1947, as cited by Young and Jackson (1951:69): "Two tourist-habituated coyotes, repeatedly observed begging for food and posing for pictures, causing tourist traffic jams along the main park highway..." Ryden (1975:110) described a habituated female coyote in Yellowstone: in her haste to photograph the animal, she left her car door open. The coyote leaped in, in search of food items, and refused to exit. Ryden observed this same coyote's interaction with another tourist's car, in which the coyote snapped at a child's hand when the child reached out to pet the coyote, concluding "...it was only a matter of time before this brash animal would bite someone." Howell (1982) reported on a developing situation in Los Angeles County, CA, when from 1978 through 1981 at least 7 persons had been attacked by coyotes; one attack resulted in the death of a 3-year-old girl in Glendale, CA (Gottschalk 1981, Howell 1982). Howell (1982) also noted many attacks on pets, and coyote aggression toward children in protection of a den within a suburban yard, recorded in the Los Angeles region "for at least the past twelve years" (Howell 1982:21).

Subsequently, Carbyn (1989) summarized information on several coyote attacks on children that had occurred in North America, primarily in national parks in western Canada, mostly during the 1980s. Of the 14 reported attacks, 4 resulted in "major injuries."

Alexander and Quinn (2012) noted that in recent years, coyotes have become an increasing management concern because their significant behavioral plasticity allows them to live in cities. By the late 1990s, Baker and Timm (1998) had compiled coyote-caused human safety incidents

within California involving 53 persons in 16 locations, from 1988 through 1997, in which 21 people suffered coyote bites. We provided detailed case histories on 13 incidents or clusters of incidents, noting that more than 32 other people experienced human safety incidents due to habituated or aggressive coyotes during this same period. Six years later, Timm et al. (2004) had documented a total of 89 coyote-caused human safety incidents in California from 1978 to 2003, of which 48 had occurred from 1998 to 2003, suggesting an increasing problem. By May 2007, we had compiled 111 coyote attacks in California, including injuries to 136 individuals (87 adults, and 49 children ≤ 10 years of age). We had also become aware of at least 76 coyote attacks that had occurred in states other than California, as well as 17 reported attacks from 4 Canadian provinces (Timm and Baker 2007).

White and Gehrt (2009) tabulated 142 reported coyote attack incidents occurring in the U.S. and Canada (14 states and 4 provinces) during the period 1960 through 2006, resulting in 159 bite victims. However, in 10 of these attacks, the coyote was found to be rabid, affecting 15 victims. Alexander and Quinn (2011) found 26 reports of coyote attacks on people, involving 26 victims, in Canada during the period 1995 through 2010.

Defining a Coyote “Attack”

In response to the concern expressed by White and Gehrt (2009) that our use of the term “attack” was too broad and included incidents in which coyotes aggressively threatened humans, stalked children, or otherwise caused concerns for human health or safety without a bite occurring, we define a coyote “attack” on a human to be when physical contact between one or more non-rabid coyotes and one or more people occurred at a single location at a point in time, when contact was not initiated by the person(s). This follows our definition of “attack” as stated in Timm and Baker (2007). For example, if a coyote bit two or more people at a single location at a specific time of day, we categorize this as one attack. However, if persons at two different locations were bitten by a coyote within a short time interval, we categorize this as two separate attacks.

In addition to “coyote attacks,” we have compiled numerous “human safety incidents” within California where no physical contact was made between a coyote and a human (or physical contact was not mentioned in the incident report). These incidents are not included in the analyses of attacks discussed here. However, they are noted as potential indicators of emboldened (habituated) coyote behavior; we believe such events should be called to the attention of public health and safety personnel. For example, by 2004 we recorded 77 incidents when coyotes stalked children, chased individuals, or aggressively threatened adults (Timm et al. 2004). In some incidents where coyotes stalked or approached children, we believe there was the possibility of serious injury to the child, had not an adult been present to intervene.

METHODS

The senior author (ROB) initiated a survey of non-rabid coyote attacks to humans in 1997, by querying representatives of various federal, state, county, and city

agencies as well as private wildlife control companies about incidents occurring in California since the 1970s. In Baker and Timm (1998), the incidents listed included only those documented by more than one reputable source, and preferably by a city, county, or state agency, or for which the authors had personal knowledge. In the absence of any statewide repository of coyote-human safety incidents, we have been aided by incident information shared with us by the USDA Wildlife Services California state office. By 2004, we used Internet capabilities to search media databases, yielding newspaper reports of coyote incidents gleaned from NewsBank and LexisNexis from throughout the U.S. and Canada. In recent years, we have also obtained media reports of human-coyote conflicts via a Google News Alert using the search phrase “coyote attack.” Efforts by the authors to document such incidents have continued to the present.

RESULTS

To date, we have compiled 165 coyote attacks on humans in California from calendar years 1977 through 2015. An injury to one or more victims was reported in 121 (73%) of these attacks, resulting in injuries to 78 adults and 64 children (age ≤ 10). Of these 165 attacks, 17% were associated with presence of dogs (e.g., persons walking dogs or in close proximity to dogs within their yard). Timm et al. (2004) noted that of those attacks occurring in 5 counties in southern California, the number of attacks was correlated with the human population in those counties. We also have compiled reports of a total of 141 coyote attacks in 25 additional states, and 61 attacks in 7 Canadian provinces. These attacks outside California resulted in injuries to 131 adults and 75 children.

Of the 367 total coyote attacks on humans within the U.S. and Canada, only 2 resulted in fatalities: a 3-year-old girl Kelly Keen was killed in Glendale, CA, in August 1981 (Howell 1982); and a 19-year-old woman (Taylor Mitchell, *nee* Taylor Josephine Stephanie Luciw), was killed on a hiking trail in Cape Breton Highlands National Park, Nova Scotia, in late October 2009 (Aulakh 2009).

The attacks we have compiled are shown in Figure 1 according to calendar year in which they occurred, beginning in 1977. Reports of attacks from other states within the U.S. began to appear in the early 1990s (see Timm and Baker 2007, White and Gehrt 2009) and began to be reported in Canada in 2000 (Alexander and Quinn 2011).

Of 348 total victims of coyote attacks in the U.S. and Canada from 1977 to 2015 where the victims’ age was noted, 209 (60%) were adults, and 139 (40%) were children age ≤ 10 years, indicating adults are somewhat more likely to be victims of coyote attack. This is significantly different from a 50:50 ratio (Pearson’s Chi-Square; $p = 0.008$). However, children (especially toddlers) are at greater risk of serious injury resulting from an attack. In at least 60 instances in California where a child was attacked by a coyote, the victim would presumably have been more seriously injured or killed had not an adult intervened to interrupt the attack.

Attack reports in California are seasonal, with 75 of 113 (66%) of attacks occurring during the coyote breeding and pup-rearing season (March - August), versus the other periods. This seasonal pattern also is apparent when looking

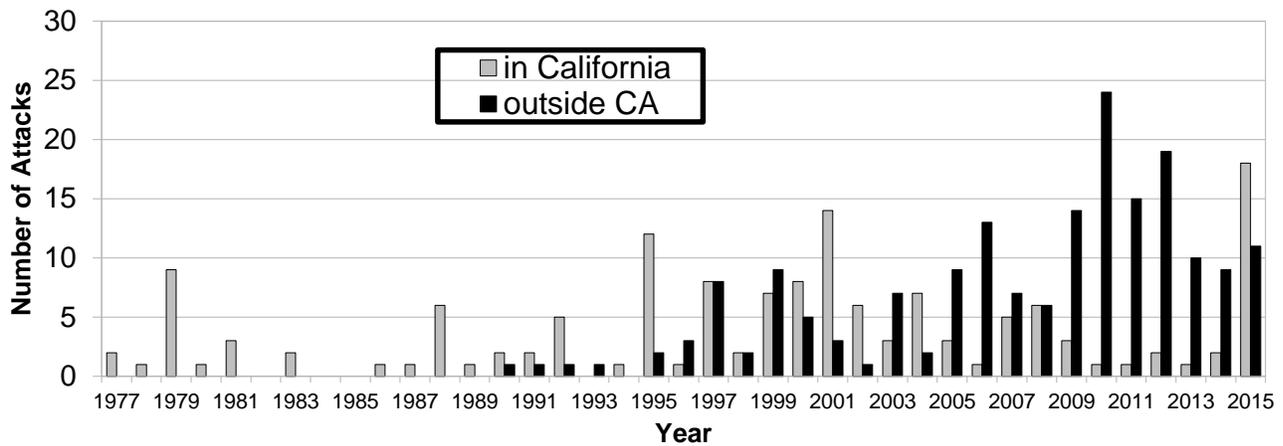


Figure 1. Number of coyote attacks on humans by year, 1977-2015, within California and in other areas of the U.S. and Canada.

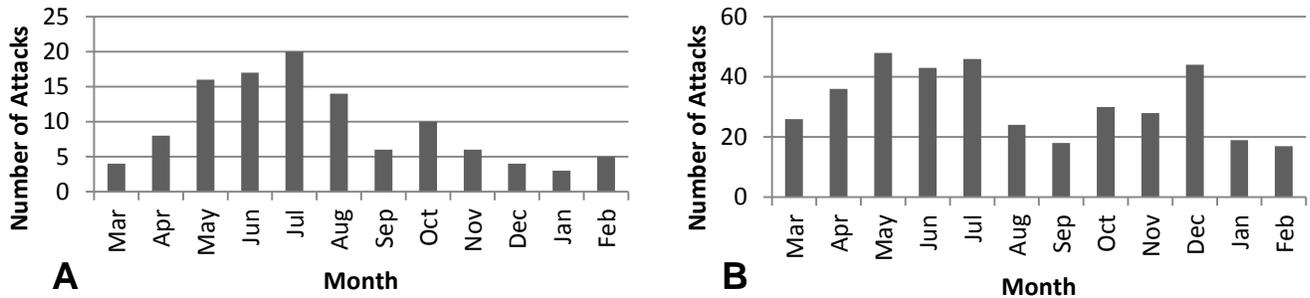


Figure 2. Seasonality of coyote attacks on humans
 A - Within California; B - Within the U.S. and Canada, excluding California

at attacks throughout the U.S. and Canada (excluding California), except for a relatively higher number of December attacks (Figure 2 A&B).

DISCUSSION

We have long recognized that our data set of incidents is incomplete. Baker reported that numerous animal regulation organizations and city authorities declined to cooperate in gathering these data, in order to avoid adverse publicity towards their management of wildlife or the specific cities. Park rangers also reported a reluctance of some citizens to file reports after being attacked by coyotes (see Baker and Timm 1998). Baker also found that some agencies or entities that received such reports would not share this information with researchers or others, and some reports were said to have been discarded after a few years or were not maintained in a manner that was easily accessible (Timm et al. 2004).

Some years ago, we learned from agency personnel of 32 separate coyote attacks that occurred within a national park in California in 4 separate years (D. Simms, Sr., USDA Wildlife Services, pers. commun.), none of which had ever been reported in the news media. These alone represented a 38% increase in known coyote attacks. Similarly, at least 13 persons were bitten by coyotes in one

geographic area within Los Angeles, CA, during 10 separate attacks that occurred over 24 weeks in late 2015 (N. Quinn, Univ. of Calif. Cooperative Extension, pers. commun.). Only one of these attacks is known to have been reported in the news media.

These experiences differ from Alexander and Quinn (2011:356) who stated "...there is sufficient anecdotal evidence to argue that human bites always (or nearly always) get reported to the media, but do not always get reported to agencies." We hypothesize that the number of coyote attacks on humans is significantly greater than has been documented in either media or agency reports.

This raises questions about whether the number of coyote-caused human safety incidents reported by media sources or received by agencies represents trends accurately, or whether the number of such reports may vary due to factors unrelated to incident frequency. For example, the coyote-caused fatality in Nova Scotia in late 2009 resulted in a 375% increase in the number of "primary articles addressing coyotes" in Canadian media during the 14-month period following that attack (Alexander and Quinn 2011). We suspect that coyote attacks on pets in some suburban areas are so common that they are no longer considered news.

If indeed the frequency of coyote attacks is increasing

in some suburban and urban areas, among potential reasons for such an increase are a range expansion by coyotes into certain suburban and urban environments, an increase in coyote densities, an increase in human population densities, and changes in coyote behavior.

After following this issue for the past 30 years, it is our conclusion that urban and suburban coyote conflicts are continuing to increase as coyotes increasingly adapt to living in close proximity to humans. Based on the reported coyote attacks in California, attacks increased from 31 during the period 1990-1997 to 50 during 1998-2005. Complaints received by USDA Wildlife Services in southern California related to human health and safety totaled 834 during the period FY1991-FY1998, and increased to 1,899 during the period FY1999-FY2006, with the human population increasing only 13% (Orthmeyer et al. 2007). A representative of the California Fish & Game Commission stated several years ago that in California “coyote attacks on humans are now routine” (WAFWA 2009). Based on coyote attacks outside California we have compiled, attacks increased from 43 during the period 1990-2003 to 139 during 2004-2015. This apparent increase in coyote-human attacks and other conflicts in urban and suburban environments has led us to seek to better understand the circumstances and reasons responsible for this relatively recent change. Unfortunately, there is a lack of field research concerning this topic, perhaps because researching predators such as coyotes in urban and suburban settings can be challenging. Better knowledge about coyote (and human) behavior could allow wildlife managers to develop adaptive management strategies that will reduce the occurrence of such conflicts.

Factors Related to Habituation and Changing Coyote Behavior

Understanding “habituation” by coyotes to human-occupied environments is helpful to our understanding of how to prevent, or perhaps reverse, increasingly bold coyote behavior. Geist (2007b) defined habituation as “animals’ decreased responsiveness to humans due to repeated contact.” He explained: “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 2007b:35).

Froman (1961:111-112) stated “. . . I was able to find no record or even unsubstantiated report of any Los Angeles coyote that had ever attacked a man, woman or child.” We are not aware of any attacks on humans by non-rabid coyotes in suburban environments in California prior to 1977, and only a few such bite incidents occurred in California in the 1960s and early 1970s, primarily in campgrounds at state or national parks. Howell (1982), reporting the emergence of aggressive coyote behavior and attacks on humans in suburban Los Angeles County, surmised that lack of human harassment coupled with a resource-rich environment that encouraged coyotes to associate food with humans could result in coyotes losing their “normal” wariness of humans, producing “abnormal numbers of bold coyotes.” He noted it was not unusual for

joggers, newspaper delivery persons, and other early risers to see 1 to 6 coyotes daily in such residential areas.

Carbyn’s (1989) account of coyote attacks on children in national parks supports the notion that a food-rich environment that places coyotes in proximity to humans leads to attacks. He noted, “Coyotes appeared to have lost fear of humans and regarded the children as prey,” stating that a Jasper National Park representative observed, “Loss of fear of humans has been widespread in national parks and urban areas where this predator associates humans with food at campgrounds” (Carbyn 1989:445). A habituated coyote near a campground during the late 1990s in Joshua Tree National Monument, CA, was observed to fake a limp when in the presence of tourists, in order to successfully obtain greater food handouts (L. Clapp, National Park Service (retired), pers. commun.). Humans unintentionally provide food to wildlife: campgrounds or public use areas in parks often provide opportunities for animals to obtain human food items, either from careless storage of foods or from garbage containers that are not animal-proof or are full to overflowing. Baker and Timm (1998) noted intentional and unintentional feeding as a factor in multiple case studies of urban and suburban coyote conflicts, and also described a situation in which a feral cat (*Felis catus*) colony served as an attractive food source for urban coyotes: the coyotes eventually killed most of the cats and continued to feed on the cat food placed daily by well-meaning citizens.

Intentional feeding of coyotes by park visitors often is the cause of the predators losing their fear of humans, resulting in their approaching humans at close distances where the risk of negative interactions is highly likely. Bounds and Shaw (1994), in a survey of United States national parks, 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. Elliott et al. (2016) found via a survey that about 25% of Los Angeles County residents report they leave food outside for pets, wildlife, and stray animals. White and Gehrt (2009) attributed intentional or unintentional feeding of coyotes as a factor in 30% of the attacks they investigated; however, they suspected that the number of cases in which coyotes were being fed was higher than reflected in the reports they analyzed. Fedriani et al. (2001) found human-related foods in as much as 25% of coyote diets in areas of high human population densities, while Alexander and Quinn (2011) found food conditioning to be directly or indirectly identified in 100% of the coyote attacks occurring in urban areas in Canada. Schmidt and Timm (2007) speculated that it may not require many residents within a neighborhood providing food to coyotes to defeat efforts to keep urban coyotes from becoming habituated to humans.

Schmidt and Timm (2007) discussed a number of factors that may have led to behavioral changes in coyotes in southern California, beginning in the late 1970s, and which resulted in coyote attacks on humans. Among the factors they listed as likely contributing to changes in coyote behavior were:

- An attractive, resource-rich suburban environment,
- Human acceptance of, or indifference to coyote presence,

- Lack of understanding of coyote ecology and behavior,
- Intentional feeding, and
- Reduction or cessation of predator management programs.

Our experience in evaluating such factors has been similar to that of White and Gehrt (2009), who noted that lack of standardized record-taking following attack incidents makes it difficult to analyze all factors that may contribute to attack.

Evaluating Habituation

Baker (2007) first outlined, from personal experience dealing with managing habituated coyotes in southern California, a progression of increasingly bold coyote behaviors in relation to humans (Table 1). This “Behavioral Progression of Increasing Coyote Habituation” has been used by agencies at local and state levels to evaluate observed changes in behavior of urban and suburban coyotes, as well as to specify “action levels” in deciding when to remove problem coyotes from a population (e.g., see Farrar 2007, 2016). Generally, we believe that when behaviors such as chasing or taking pets in daylight, attacking pets on leash or near owners, or chasing joggers or cyclists occur, it is prudent to preemptively remove several coyotes from the population before a human safety incident occurs. Experience has shown that such action can change the behavior of remaining coyotes in the local population, reducing the likelihood that habituation will progress to the extent that some coyotes may attack adults or children. When accompanied by environmental measures to make the local habitat less inviting and less attractive to coyotes, it is possible to reduce or prevent aggressive coyote behavior from reoccurring for months or even years (Baker 2007, Farrar 2007).

Parallels exist between coyotes and other wild canids (e.g., gray wolves *Canis lupus*, dingoes *C. lupus dingo*) in terms of the inclination of some individuals to act aggressively toward humans and even attack, once they have come to associate humans with food or view humans as prey (Schmidt and Timm 2007). Dingoes have, in recent years, become habituated to certain suburban areas of coastal cities in Queensland, Australia, where numerous tourists have been attacked and injured, including one fatality (Burns and Howard 2003). In the past century, 41 wolf-human attacks (two of them fatal) were reported in North America (McNay 2002, 2007; Geist 2008, Butler et al. 2011). After witnessing behavior of a wolf pack on Vancouver Island, BC, Canada, Geist (2005, 2007a) created an “Escalation Model” (Table 2) describing habituation of wolves to humans, unaware of Baker’s (2007) similar observations regarding habituated urban coyotes (Geist 2016). These two scales can serve as guidelines to assist observers or agencies in better understanding when management action may be necessary in order to prevent increasingly severe conflicts with humans.

Characteristics of Attacks

Early on, Carbyn (1989) speculated that the coyote attacks on children he reported might be “related to food stress”, as 3 of the 4 “most serious” attacks occurred when coyotes were either about to have pups or were feeding

pups. Timm et al. (2004) noted that of human safety incidents occurring in California up to that point in time, 63% (and 72% of incidents involving children) occurred during March through August, when adult coyotes would most likely be provisioning pups or experiencing increased food demands because of the female’s gestation. For our current data set, 66% of attacks in California have occurred during March through August, and a similar pattern exists for combined data from the other states plus Canadian provinces (Figures 2A &B). As most coyote pups are born in early spring, we note that attacks are highest during the months that parents would be provisioning pups (May,

Table 1. Sequence of increasingly aggressive coyote behaviors (from Baker and Timm 1998).

A Behavioral Progression of Increasing Coyote Habituation to Suburban Environments	
1.	Increase in coyotes on streets and in yards at night
2.	Increase in coyotes <i>non-aggressively*</i> approaching adults and/or taking pets at night
3.	Coyotes on streets, and in parks and yards, in early morning / late afternoon
4.	Coyotes chasing or taking pets in daytime
5.	Coyotes attacking and taking pets on leash or near owners; chasing joggers, bicyclists, 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 in mid-day

*clarification added by Baker, 2008

Table 2. Sequence of increasingly aggressive wolf behaviors (from Geist 2007a).

“Escalation Model” of Increasing Wolf Habituation to Humans	
a)	Severe depletion of natural prey.
b)	Followed by wolves searching for alternative food sources among human habitations.
c)	The brazen behavior of wolves was due to the wolves being undeterred by and habituated to inefficiently armed humans (or ineffectual use of weapons or outright protection of wolves),
d)	Wolves shifted to preying on pets and livestock, especially on dogs. (In our neighborhood one or several wolves attacked dogs despite the physical intervention by their owners which the wolves more or less ignored).
e)	Wolves tested and killed livestock; the tests resulted in docked tails and ears of cattle.
f)	The wolves commenced deliberate, drawn-out exploration of humans be such on foot or on horseback, (this is not merely visual and olfactory, but included – weeks before these wolves attacked a human – the licking, nipping and tearing of clothing (Beatty 2000).
g)	This was followed by wolves confronting humans.
h)	Wolves attack humans.

June, and July), although these data sets are too small to show statistical significance. Increased attacks during this period could also be associated with territoriality, reproduction, and defense of den sites and/or pups.

In Lukasik and Alexander's (2011) analysis of coyote incidents collected in Calgary, Alberta, Canada that occurred between January 2005 and August 2008, they found that incidents involving physical contact with humans or pets most commonly occurred during the May-August "pup-rearing season" (as defined by Morey et al. 2007). This finding is similar to our data from attacks within California.

Alexander and Quinn (2011) found that in 16 of 67 (23.9%) "direct encounters" between humans and coyotes, dogs (*Canis lupus familiaris*) were present, but only in 4 cases were people bitten when they tried to intervene and protect their dogs. White and Gehrt (2009) reported the presence of a pet (dog, cat, or other not specified) in 8 of 142 attacks (6%). Dogs were noted as being present in 28 of 165 (17%) of our recorded coyote attacks on humans. In defining a "coyote attack," we have attempted to exclude instances in which a human was only incidentally scratched or bitten in the act of initiating contact with the attacking coyote to rescue a pet; however, when the coyote was described to intentionally turn its attention to, and injure the person, we have regarded this as an "attack."

Classification of Coyote Attacks and Attack Victims

In regard to whether coyote attacks are more likely to occur to children (age ≤ 10 years) or adults, we found significantly more adults than children were victims (209 vs. 139). This differed from the findings of Alexander and Quinn (2011), whose evaluation of coyote attacks in Canada found 13 adults and 13 children were victims. White and Gehrt (2009), evaluating 159 victims in 142 attack incidents, found a slightly greater number of coyote attacks on children (75) than on adults (67), noting that in attacks they classified as "predatory" the majority of victims were children (47 children vs 10 adults) (White and Gehrt 2009:425). Their definition of "predatory" attacks included those "... in which a coyote directly and aggressively pursued and bit a victim, causing multiple or serious injuries (often to the head and/or neck) ... typified by coyotes running straight to the victim and continuing to attack even after being discovered by the victim." They noted, "In predatory attacks, injuries were usually more severe than other cases and victims and/or bystanders had to exert considerable effort to stop the attack" (White and Gehrt 2009:422).

Management and Education Strategies and Recommendations

One of the challenges in dealing with urban coyote management is an absence of common understanding of the problems and of potential solutions, not only among suburban residents, but among decision-makers. "Educating the public" is a need often expressed by agencies and individuals attempting to solve such conflicts. However, in today's society, reaching consensus on how to manage suburban wildlife involves not only effective biological solutions, but sociological, attitudinal, economic, and political challenges (Schmidt 2007). Specific urban coyote

management recommendations (see Timm et al. 2007) include:

- Reduce resources attractive to coyotes in the suburban habitat (food, water),
- Reduce dense landscape habitat (prune & thin),
- Exclude coyotes where possible,
- Maintain coyotes' "natural" wariness of humans,
- Inform the public about ways to discourage predators,
- Educate responsible agency personnel concerning appropriate prevention and control strategies, and
- Remove individual bold / aggressive coyotes when necessary.

Additionally, Baker and Timm (1998) expressed the need for centralized record-keeping of coyote-caused human safety incidents, so that cities, counties, and states could track this problem and have some objective means of measuring success of implemented management efforts. White and Gehrt (2009) and Lukasik and Alexander (2011) noted a similar need for comprehensive reporting of coyote-human incidents. Localities that keep records of coyote conflicts can better pinpoint and respond to developing problems in specific neighborhoods. Consequently, they can concentrate timely efforts in education and coyote management in ways that are more likely to reduce or prevent attacks on pets and humans, as did officials in Glendale, CA (Baker 2007) and Austin, TX (Farrar 2007, 2016).

Here, we list components of strategies that should be initiated to prevent coyotes from becoming habituated to humans, and to correct problem behavior when coyotes have become bold and pose potential human safety risks. The methods have been tested and proven over the last 25 years, and they are listed here in order of importance:

I - Programs to Prevent Coyotes from Losing Fear of Humans

- 1.1 Public education to inform citizens about wildlife, what habitat components attract animals, and effective hazing methods
- 1.2 Development of statutes to prohibit feeding wildlife and regulate refuse handling
- 1.3 Develop coyote behavior monitoring regarding daytime activity, boldness to humans, pet losses, and human conflicts
- 1.4 Initiate coyote population reduction when needed

II - Programs to Address Existing Bold Coyote Problems

- 2.1 Public education to warn about safety for humans and pets
- 2.2 Initiate coyote behavior monitoring to pinpoint and evaluate potential problems and specific target areas
- 2.3 If necessary, and when feasible, start trapping or shooting in specific target areas
- 2.4 Continue to monitor behavior, as trapping of one or two coyotes may reintroduce fear into the target coyote family group
- 2.5 Public education to eliminate components of attractive habitats, such as food, water, shelter, and friendly humans (Baker 2007)

Effectiveness of Non-Injurious Hazing

When coyotes first venture into a suburban area, they likely have some degree of wariness toward humans. In this situation, certain hazing techniques may, when combined with modifications to make the environment less attractive, reduce the chance that coyotes will lose their wariness of humans. Suburban residents who see a coyote in their neighborhood should attempt to frighten it away by shouting, throwing rocks, squirting it with a water hose, blowing portable air horns, or otherwise acting aggressively to reinforce its fear of people. Motion-sensitive lights on houses or outbuildings may deter coyotes from approaching.

Baker (2007:389-390) stated, "In observed coyote behavior at stages 1 and 2 [see Table 1], a fair level of success was often obtained by use of various hazing or aversive conditioning methods, when practiced consistently every time coyotes were observed in close proximity to humans. The effect could last for several months or even years. However, in stages 3 and beyond, any changes in coyote behavior due to hazing was usually temporary, only lasting a few weeks or months (depending on the methods used), unless one or more coyotes was trapped or shot."

Without any real threat, many coyotes quickly adapt or habituate to sounds and to human activity. Recent research in suburban environments in the Greater Denver, CO area has concluded that hazing at times can be a useful tool for short-term relief from a coyote encounter, but in other circumstances non-injurious hazing may have little effect on coyote behavior, especially if the coyote has already become somewhat habituated to human presence (Bonnell and Breck 2016, Breck et al. 2016). Breck et al. (2016: 109) noted, "Unfortunately, because of the nature of urban coyote conflict, managers and the public often tend to ignore coyotes until an individual begins to show extreme forms of aggressive behavior. It is only after a problem individual develops that these techniques are implemented, and we believe this is a grave mistake that dooms the effectiveness of non-lethal methods."

Politics of Managing Urban Coyotes

An ongoing dilemma for wildlife managers and local decision-makers is the degree to which urban coyote problems quickly become politicized. As Alexander and Quinn (2011:346) noted, "Highly charged discourse concerning urban coyotes often plays out in the media, especially after a public report of a negative encounter." This has certainly occurred in southern California (Timm and Baker 2007), and people typically have a wide range of opinions about presence of urban coyotes or need for their management (Schmidt 2007). In urban and suburban populations, some segment of the citizenry will oppose active coyote management, especially if it includes lethal removal of coyotes. Some animal welfare and animal rights groups gain a large following (and presumably substantial financial support) from inflaming the issue of coyote control (Oleyar 2010). In California, an important tool for selectively removing problem coyotes from suburban environments was lost with passage of "Proposition 4," an initiative measure approved by voters in November 1998 (Animal Legal & Historical Center 2006). Promoted by proponents primarily as an anti-fur trapping measure, the regulatory measure

banned use of foot-hold traps, except in declared human safety emergencies. This had the effect of limiting the ability of local, state, or federal agencies to remove coyotes unless a person had been attacked and/or bitten by a coyote; attacks on pets are generally not considered "human safety emergencies." Thus, preventive removal of increasingly bold coyotes, to reduce risk of coyote attacks on people, became more difficult to accomplish.

Failure to Take Timely Action

Our investigation of the substantial number of coyote attacks on humans has revealed that failure to remove the responsible problem coyote(s) in a timely manner can lead to multiple attacks, presumably by the same coyote or family group of coyotes. This situation can occur in municipalities that do not wish to undertake lethal removal of coyotes because of philosophical reasons or political pressures. It can also occur in parks and other such public use areas, when managers may not wish to incur negative publicity in regard to their park or facility.

Carillo et al. (2007) reported on a series of coyote attacks on humans in November 2006, when coyotes attacked and injured 8 people during 13-day period in a retirement community in Green Valley, AZ. In this instance, multiple problem coyotes, and the difficult logistics involved in safely and selectively removing coyotes from the suburban environment, likely contributed to the number of persons attacked. In 2004, we learned that 32 attacks had occurred (in 1975, 1976, 2000, and 2001) in which coyotes had bitten visitors in a specific national park within California (D. Simms, Sr., USDA Wildlife Services, pers. commun.). In the series of attacks in mid-summer 2001, at least 14 individuals were bitten before successful action was taken to remove the responsible coyote(s).

Similarly, during 2015, there were at least 13 people bitten by coyotes within Los Angeles, CA, only one of which was reported in the news media (N. Quinn, Univ. of Calif. Cooperative Extension, pers. commun.); no corrective action was begun until approximately 3 months following the first bite incident. Absent these accounts, there were only 6 other coyote bites to humans within California during that calendar year. In this series of incidents, local Los Angeles, CA authorities failed to share information on these attacks with other agencies and did not initiate effective management actions for a prolonged period. Failure to actively manage the mounting problem of habituated coyotes can result in additional local loss of pets and the potential for increased attacks on people. Local decision-makers need policies in place that will allow for a range of responses that are appropriate to the situation. They must weigh sometimes unpopular actions, such as lethal removal of coyotes, against the risk of delay or taking ineffective actions, which could lead to human safety incidents and resulting liability.

Implications of Coyote Attacks on Pets

Attacks by coyotes on pets are an issue that is closely related to human safety events. Alexander and Quinn (2011) noted that several news articles from Canada described coyote attacks on dogs and cats, as well as pet disappearance, prior to the first attacks by coyotes on children in specific localities. Baker and Timm's (1998)

scale of “Behavioral Progression” for coyote attacks and Geist’s (2007a) “Escalation Model” of wolf habituation to humans note the occurrence of pet attacks as an indicator that may precede attacks on people. Yet, information on distribution, number, and severity of coyote attacks on pets is largely lacking.

It is our perception that the number of news articles about coyote attacks on pets in southern California has increased in recent years. Whether this is a result of an increasing number of coyotes, an increase in suburban coyotes’ level of habituation, or has simply become a more newsworthy story (or some combination of these factors) is difficult to determine. However, some measures of the coyote-pet problem suggest that the number of such incidents has been increasing. The USDA Wildlife Services program in California received 362 complaints of coyote attacks on pets/hobby animals with estimated damage totaling \$78,232 during FY1991-FY1998, and 1,079 such complaints with estimated damage of \$402,540 during FY1999-FY2006 (Orthmeyer et al. 2007). The police department of Huntington Beach, CA recorded that the number of suspected coyote attacks on pets increased from 37 in 2014, to 80 in 2015, and again increased to 107 in 2016 (Mellen 2015; K. Miller, pers. commun.).

By the early 1980s in Glendale (Los Angeles County), coyote attacks on pets were “very common,” (Baker and Timm 1998) and stomach contents of Glendale coyotes were found to contain “chiefly garbage” and included a measurable quantity of domestic cat remains (Wirtz et al. 1982). Following the fatal coyote attack on a child in Glendale in August 1981, an intensive program of coyote removal was initiated as described by Howell (1982), followed by an urban coyote management program administered by the Glendale Police Department that included an intensive public education effort accompanied by selective removal of problem coyotes when necessary. This strategy was credited with reinstating in coyotes a fear of humans. The program managers reported that during 1993-1997, a low incidence of pet attacks were reported (averaging slightly more than 4 cats and 1 dog lost per year), compared to “much smaller communities” that report 20 to 50 pet losses per year (Baker and Timm 1998). Farrar (2007) provided a report from Austin, TX that suggests an urban coyote management program targeting removal of aggressive coyotes, based on standardized behavioral observations, was effective in reducing safety risks to pets (as well as to humans).

Alexander and Quinn (2008) were among the first to report specifically on coyote attacks on pets in suburban environments. They subsequently found that trauma was reported in 6.2% of cases where a human watched their pet be killed by coyotes, noting “Humans now view pets as family members and thereby the loss of the animal has the significance of a loss of a child to some individuals. As a result, response by agencies should reflect a level of concern for these losses and address the issue with appropriate regard” (Alexander and Quinn 2012:18).

While the risk of human safety incidents, especially attacks on children such as those that have occurred in southern California and elsewhere, is often the most likely factor to generate headlines, we believe that coyote attacks on pets, because of their sheer numbers, is likely to be a

principal factor driving public policy toward urban coyote management in the foreseeable future. Persons whose pets become victims may change their attitude toward urban coyotes. Alexander and Quinn (2008) found that in 13% of news articles regarding coyote attacks on pets, there was a request for authorities to take lethal action against coyotes, noting “lack of response by authorities may be a key issue that exacerbates contempt for coyotes.” Decker et al. (2002:12) have reported, “People are more likely to want a population decrease if they believe a high probability of negative impacts exists or if they personally have experienced such impacts. Similarly, people concerned about such impacts are more willing to accept lethal and invasive management actions.”

We believe that coyote attacks on humans in suburban areas are preventable (Baker and Timm 1998). However, unless policies permit agencies, or homeowner groups and their agents, to proactively remove problem coyotes once pet attacks begin to occur, the risk of coyote attack to children and adults in suburban areas, parks, and other such environments will likely continue to increase.

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